EARTHQUAKE DISASTER PREVENTION OF CULTURAL HERITAGES
- EXPERIENCE AND DEVELOPMENT IN JAPAN -

August, 2023

ICOMOS Japan

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* This report is based on the information available at the time of writing (approximately October 2022).

* Unless otherwise noted, reference materials listed are available exclusively in Japanese. Translations of titles are not official and are just for the convenience of non-Japanese readers.

* In this report, the earthquake names referred to are based on the names found in the Cabinet Office of Japan's White Paper on Disaster Management in Japan (2022 English edition). However, please be aware that the official titles are in Japanese, so there may be alternative interpretations of the names.

Acknowledgement

We extend our gratitude to the Taisei Corporation Nature and Historic Environment Fund for their support in publishing this report. We would also like to express our appreciation to the owners of the damaged cultural properties, their management, local governments, the Agency for Cultural Affairs, and the authors of this report for their invaluable support and cooperation, which made the completion of this report possible.

Notes on Terminology

The term "reconstruction" or "restoration" refers to the process of restoring buildings to their former state. In general, both "reconstruction" and "restoration" are synonymous, but in this report, "restoration" refers to the reproduction of lost cultural property buildings based on rigorous investigations, in accordance with the Japanese practice of conservation and repair of buildings that retain the cultural and historical property value. The reconstruction of a lost structure on an archaeological site is distinguished as "reconstruction."

In this report, the terms "recovery" and "rehabilitation" are used to describe the act of restoring the value and functions of damaged buildings and towns. The term 'rehabilitation' encompasses the comprehensive process of rebuilding the lives of individuals impacted by disasters, revitalizing local communities, enhancing resilience through safer villages and urban areas, improving community infrastructure and cultural assets, and fostering sustainable development.

Types, Designation, Selection, and Registration of Cultural Properties in Japan

In the following, information from the Agency for Cultural Affairs website (https://www.bunka.go.jp/english/policy/cultural_properties/introduction/overview/) will be quoted to describe cultural properties in Japan.

The Law for the Protection of Cultural Properties defines cultural properties as "Tangible Cultural Properties," "Intangible Cultural Properties," "Folk Cultural Properties," "Monuments," "Cultural Landscapes," and "Groups of Traditional Buildings." The national government designates, selects, and registers cultural properties of higher importance to prioritize them for more focused protection. The designation, selection, and registration of cultural properties are carried out by the Minister of Education, Culture, Sports, Science and Technology on the basis of reports submitted by the Council for Cultural Affairs in response to a ministerial inquiry (see Diagram 1).

Intangible Cultural Properties and Intangible Folk Cultural Properties that require measures in addition to designation, such as making records, are selected by the Commissioner for Cultural Affairs to ensure the work is recorded.

Other cultural properties include Buried Cultural Properties that lie underground, and Conservation Techniques for Cultural Properties, or traditional techniques and skills required to preserve and repair cultural properties. They are also protected.

While the national government imposes restrictions on the alteration of the existing state of cultural properties, to ensure the preservation and utilization of cultural properties the National Treasury provides support for repair work and various other measures.

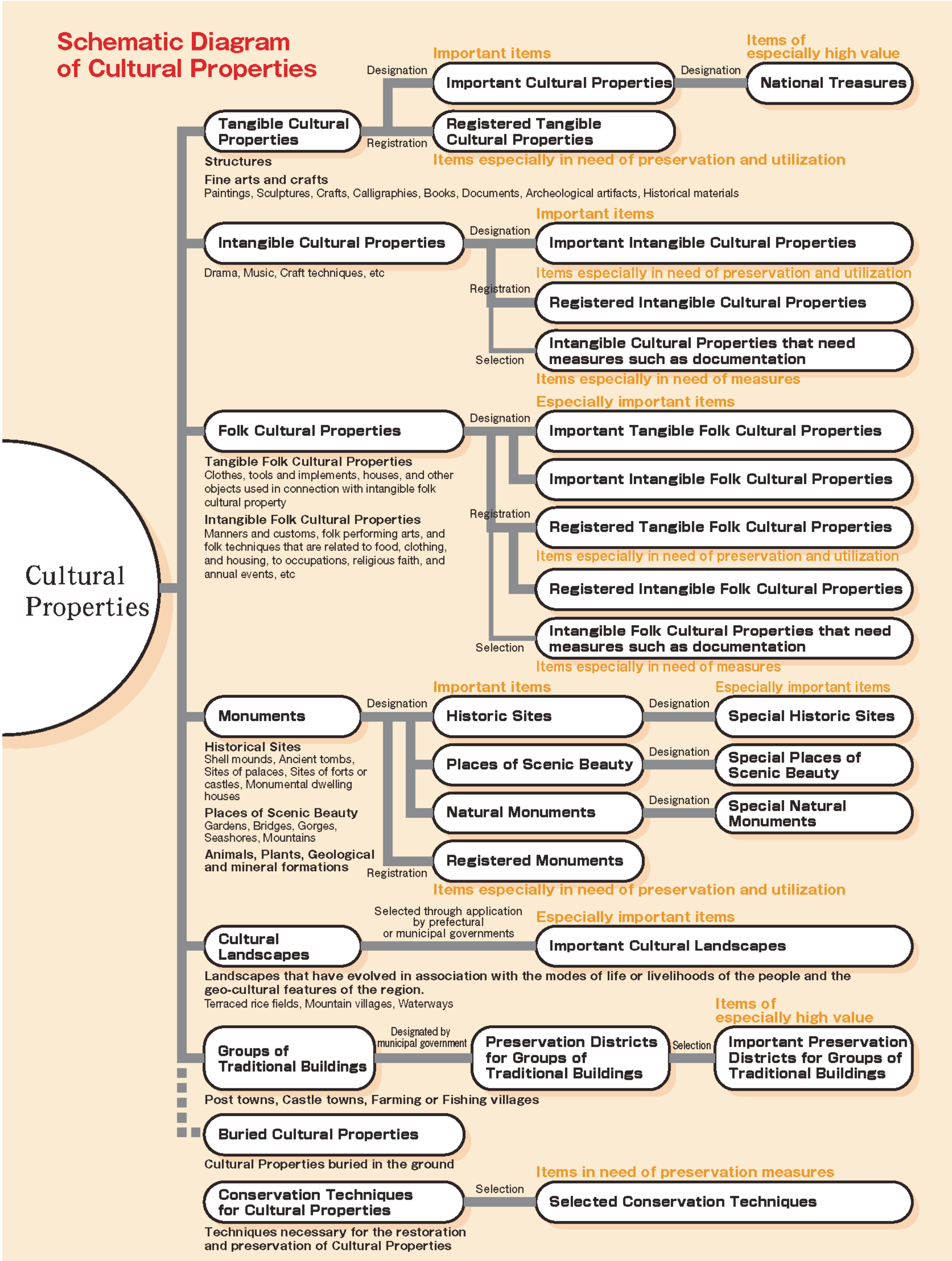

Diagram 1 **Schematic Diagram of Cultural Properties**
(Excerpt from the pamphlet of the Agency for Cultural Affairs, "Cultural Properties for Future Generations.")

Preface
~ Background and Purpose of this Report ~

There is a saying overseas: "Disaster is the mother of disaster prevention." It means that disaster experiences lead to disaster prevention. Disaster prevention techniques and systems have been developed through disaster experiences.

While Japan is a place where vast and diverse cultural heritage has been cultivated through a long history, it is also a country prone to natural disasters. There is a growing social interest in protecting cultural heritage from natural disasters, and in recent years not only major earthquakes, but also large-scale typhoons and local torrential rainfalls have caused major wind and flood damage to cultural heritage, as has often been reported in the media. Under these socially relevant circumstances, ICOMOS Japan published preliminary reports in English and Japanese on the damage, recovery, and subsequent progress of cultural heritage affected by the Great East Japan Earthquake in 2011 and the Kumamoto Earthquake in 2016. Now, 12 years after the Great East Japan Earthquake and 7 years after the Kumamoto Earthquake, the disaster recovery of cultural heritage is wrapping up, with some exceptions. This is the final report on the earthquake damage and subsequent recovery of this cultural heritage.

From an international point of view, in the 1980s, many seismic studies on historic buildings were being conducted in Western Europe, and international conferences on the structural field were held every other year. However, in Japan the catalyst was the Great Hanshin-Awaji Earthquake in 1995, which struck the metropolis, damaging many designated and undesignated cultural property buildings. This tragic event triggered many researchers and practitioners to develop seismic studies and seismic resistance measures for cultural heritage. Currently, these studies are progressing while countermeasures are being developed.

Seismic resistance measures for cultural heritage have been widely discussed at various levels, from national and local governments to researchers and practitioners of seismic design and construction. Pre-disaster measures started with the establishment of seismic resistance assessment guidelines and the creation of a system called the heritage manager system, intended to expand the number of people involved with historic buildings. Post-disaster measures included the establishment of the Cultural Property Doctor Dispatch Program, which was created to help assess damage conditions and provide technical support for recovery. Additionally, various reconstruction and rehabilitation subsidy systems were established. These measures have helped lead the way internationally in disaster management.

Under these circumstances, we experienced the Great East Japan Earthquake, and subsequently the Kumamoto Earthquake. A quarter of a century after the Great Hanshin-Awaji Earthquake, we would like to review how the developed earthquake disaster management measures for cultural properties were used in preparation and response to these earthquakes while identifying remaining issues. In addition, we will introduce the results of the rapid development of earthquake-resistant technology for cultural property buildings in Japan.

(Toshikazu Hanazato)

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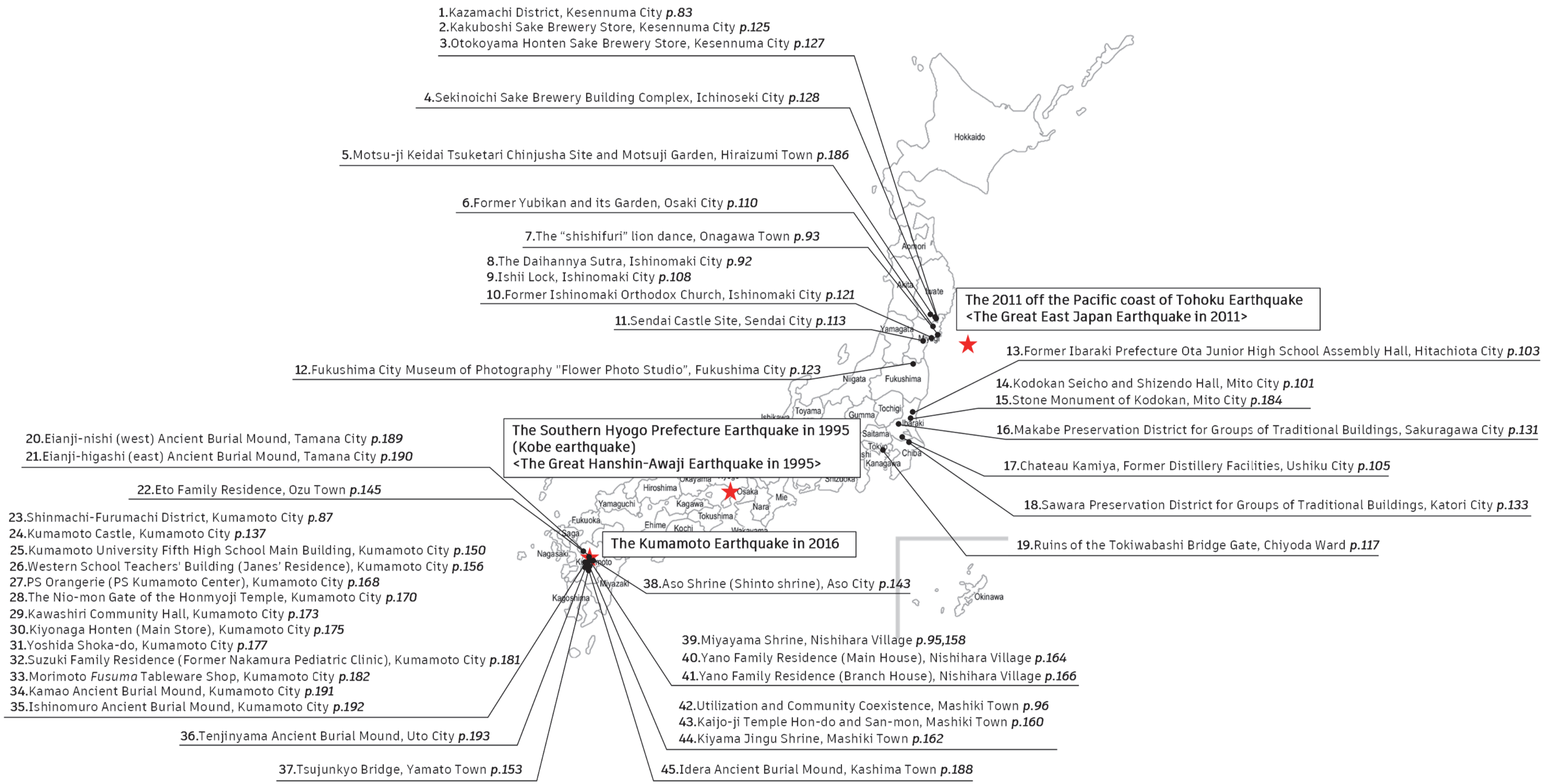
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1. Introduction

1.1 Natural Disasters and Changing Building Standards in the Modern Era

Japan is one of the most seismically active regions in the world. Also, in Japan, rainstorms and typhoons cause landfalls each year, heavy snowfall areas cover half of the land, and active volcanoes abound. Japan is a country rich in natural resources, but it is also prone to natural disasters. Unsurprisingly, buildings have been affected by these natural disasters. As described below, the Building Standards Act currently requires building designs to be safe against seismic forces, heavy wind loads, and snow accumulation. The current structural code of the Building Standards Act is not the product of ancient times; the code has been revised and updated in response to the natural disasters of the modern era. In Japan, buildings that are 50 years old can now be registered as cultural properties, so when diagnosing the seismic and wind resistance of modern cultural property buildings, it is necessary to know what building standards were valid at the time of their design.

Table 1.1.1 shows chronological record of significant disasters, accompaned by the enactment of laws, regulations, guidelines and other measures aimed at mitigations the impact of disasters. Until the middle of the 19th century, Japanese buildings were constructed based on experience, and safety was also judged based on experience. In the middle of the 19th century, along with brick masonry constructions, the braced construction method was introduced from the West as an effective earthquake-resistant element for wooden construction. The Seismological Society of Japan (SSJ) was founded in 1880 after the 1880 Yokohama Earthquake (M=5.5-6.0). This society was the first academic society specific to earthquake in the world. In 1891, the inland crustal type Nobi Earthquake (M=8.4) struck, and a damage survey was conducted by the Imperial Earthquake Investigation Committee, which was established in 1895. The earthquake caused severe damage to many unreinforced brickwork buildings that had been constructed since the early Meiji period (1868-1912). This damage led to skepticism about the seismic reinforcement of brickwork constructions and showed the structural details of the brickwork buildings. The Guidelines for the Structure of Wooden Seismic-Resistant Houses were announced. Circa 1910, architectural technologies were introduced for reinforced concrete constructions, and much of Japan's existing modern architecture was built at that time. 1919 saw the promulgation of the Urban Building Act, which addressed wooden constructions in metropolises. The structural specifications for brickwork, stone, and wooden house constructions of the Urban Building Act were strengthened in response to the damage caused by the Great Kanto Earthquake in 1923. Structural bylaws for reinforced concrete constructions were also introduced. The former Marunouchi Building in front of Tokyo Station was designed using structural technologies imported from the U.S., but it was damaged by the Great Kanto Earthquake before its completion. This event led to the introduction of earthquake-resistant walls in reinforced concrete constructions, a Japanese invention. The detailed structural regulations of the Revised Urban Building Act were the basis for the seismic code of the Building Standards Act, enacted in 1950. In particular, the method presented in the Revised Urban Building Act to calculate the seismic coefficient for design at a 0.1 seismic force (a horizontal force of 0.1 times the weight of the building), was the first seismic design method in the world. Although not a law, the Architectural Institute of Japan issued the Standard for the Structural Calculation of Reinforced Concrete Structures in 1933 and the Design Standard for Steel Structures in 1941. The storms of the 1934 Muroto Typhoon caused extensive damage to wooden constructions, and in 1939 a system was introduced for issuing wooden building construction permits.

As described above, during the period of modernization up to World War II, the disasters experienced through the Nobi Earthquake in 1891 and the Great Kanto Earthquake in 1923 had a significant impact on the kind of standards aimed at improving the seismic resistance of buildings in Japan. The Fukui Earthquake in 1948 was the next great earthquake to have a major impact. In 1950, the Building Standards Act was established, and building on the experience of that earthquake, the seismic code was revised to be consistent with the Revised Urban Building Act. The seismic coefficient for design was set at 0.2, but this value was used for short-term load allowable stress calculations. The 0.1 seismic coefficient for the design of the Urban Building Act was established for long-term load allowable stress calculations and is practically continuous. The seismic calculation method based on wall amount was also presented in this code as a seismic calculation method for wooden houses, and it became popular as a simple approach. Afterwards, the wall amount code for wooden houses in the Building Standards Act was strengthened in response to the damage to wooden structures caused by the Ise Bay Typhoon of 1959. As great fires broke out in various parts of Japan between 1946 and 1952, the fire resistance of wooden structures became a social issue, leading to an increase in the use of reinforced concrete buildings. However, the Earthquake off the coast of Tokachi in 1968 and the Earthquake off the coast of Miyagi Prefecture in 1978 caused significant damage to reinforced concrete buildings designed under the allowable stress design method (Building Standards Act), which had insufficient ductility. In 1981, the seismic design systems were revised considering ductility within safety limits. The base shear factor of the allowable stress design method for the short-term load was 0.2, but the base shear factor corresponding to the safety limit to protect human lives was determined to be 1.0, which corresponds to a moderate earthquake. The Building Standards Act also established a zone coefficient for seismic load based on seismic risk, classified at 0.7 to 1.0. The seismic force determined by the Urban Building Act has been kept along subsequent revisions of the Building Standards Act, meaning that seismic codes are determined in relation to society. 1981 saw the revision of the seismic code of Building Standards Act, which, in addition to the previous seismic codes, included a new "ductility" component to evaluate structural performance up to the point of destruction. The Great Hanshin-Awaji Earthquake in 1995 (the Southern Hyogo Prefecture Earthquake in 1995) caused tremendous damage to cultural heritage and triggered earthquake disaster countermeasures for cultural heritage in Japan. The buildings that collapsed due to this megaquake and posed life-threatening damage were designed before the 1981 revision of the seismic code of Building Standards Act, indicating that the revisions were justified. Buildings designed before the 1981 revision of the seismic code of the Building Standards Act that do not meet the revised seismic performance requirements are referred to as existing non-compliant buildings, and in 1995 a law was enacted to promote seismic retrofitting. In relation to cultural heritage, in 1996, the year after the great Hanshin-Awaji Earthquake disaster, the Agency for Cultural Affairs issued guidelines to ensure the safety of architectural cultural heritage, and in 1999, the Agency issued the Guidelines for Assessing Seismic Resistance of Important Cultural Properties (buildings), which provided specific methods. Their provisions prioritize the protection of human life from earthquakes and basically follow the approach of the Building Standards Act, which was revised in 1981. In addition, in 2017 and 2020, guides on seismic resistance measures were issued for important cultural properties (buildings) and groups of traditional buildings, respectively. In 2018, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) issued guidelines for preparing ordinances for the rehabilitation of historic buildings. In 2004, along with the above-mentioned, government-related standards and guidelines, the Seismic Evaluation Standard Guidelines for Wooden Buildings (Japan Building Disaster Prevention Association), were revised, which apply to traditional wooden constructions. Indeed, since the Great Hanshin-Awaji Earthquake, Japan has developed standards and guidelines for the seismic resistance of cultural heritage. In the measures against the Nankai Trough Earthquake and the framework for measures against the Tokyo Inland Earthquake, a section for cultural heritage is included. Additionally, local government measures and manuals have also been presented to support the protection of cultural heritage from earthquakes.

(Toshikazu Hanazato)

Table 1.1.1 **Summary of significant disasters and related enactments of laws, regulations, guidlines, etc.**

Disasters	Codes, Laws, Regulations, Guidelines, Societies (Note : Formal Legal Title Omitted)
1880 Yokohama Earthquake	1881 Establishment of Society of Earthquake
1891 Nobi Earthquake 1894 Shonai Earthquake	1895 Establishment of Committee for Earthquake Disaster Prevention Rules of Seismic Resistance of Wooden Houses Rules of Seismic Resistance of Brick Masonry Constructions
	1897 Law of Conservation of Historic Temples and Shrines
	1919 Urban Building Regulation
1923 Great Kanto Earthquake	1924 Revision of Urban Building Regulation Introduction of Seismic Design (Shear Coefficient = 0.1 for long term allowable unit stress calculation) Regulation of brace for wooden house Limitation of height and wall thickness of brick masonry constructions
1934 Muroto Typhoon	1939 Permit System of Wooden Constructions
1948 Fukui Earthquake	1950 Building Standards Act (Seismic Shear coefficient = 0.2 for short term allowable unit stress calculation) Regulation of wall's amount of wooden houses
1946 -1952 Conflagration at various places	1952 Act on Promotion of Fire Resistant Constructions
1959 Ise-Bay Typhoon	1959 Revision of wall amount regulation of wooden ho uses
1968 Earthquake Off the Coast of Tokachi 1978 Earthquake Off the Coast of Miyagi Prefecture	1981 Revision of Standard Act of Seismic Design Code Introduction of Ultimate Lateral Strength (Assessing dynamic concept of both structure and ground motion)
1995 Great Hanshin-Awaji Earthquake 2011 Great East Japan Earthquake 2016 Kumamoto Earthquake	1995 Act on Promotion of Seismic Retrofitting of Existing Buildings 1996 Guidelines for Ensuring Safety of Cultural Properties (Buildings) During Earthquakes 1999 Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings) 2004 Revision of Seismic Assessment of existing wooden houses 2017 Manual for Assessing Seismic Resistance and Seismic Reinforcement of Important Cultural Properties (Buildings) 2020 Manual for Seismic Resistant Countermeasure of District of Groups of Traditional Buildings

* In this report, the earthquake names referred to are based on the names found in the Cabinet Office of Japan's White Paper on Disaster Management in Japan (2022 English edition). However, please be aware that the official titles are in Japanese, so there may be alternative interpretations of the names.

1.2 The History of Disaster Management in the Protection of Modern Era Cultural Properties

In Japan, where natural disasters occur frequently, the Act on the Protection of Cultural Properties, which currently defines the basic matters for the protection of cultural heritage, was born out of a heightened awareness of disaster management for cultural properties. After World War II, fires broke out in rapid succession in cultural properties representing Japan, including at the Horyu-ji Temple in January 1949 and the Kinkaku-ji Temple in July 1950. In May 1950, the Act on the Protection of Cultural Properties was enacted. Subsequently, fire control measures to protect cultural properties in Japan were rapidly implemented through the establishment of firefighting systems and the installation of fire prevention equipment. Regarding earthquake measures, aside from some individual examples, no major developments were seen until the Southern Hyogo Prefecture Earthquake in 1995.

The Southern Hyogo Prefecture Earthquake (Kobe earthquake), which occurred in January 1995, damaged 116 important cultural properties, one important preservation district for groups of traditional buildings, and many other cultural heritage structures, including historic buildings that had not yet been designated as cultural properties. The earthquake's damage to cultural property buildings highlighted pre-earthquake issues that needed to be addressed (including the need for seismic resistance measures and seismic reinforcement), as well as post-earthquake issues such as disaster damage surveys and recovery support for cultural properties. In particular, for undesignated historic buildings, it was difficult to assess damage conditions and provide recovery support due to a lack of human resources and information, and many constructions were demolished after being damaged. In 1996, the Agency for Cultural Affairs revised the Act on the Protection of Cultural Properties (1950) to establish a registered cultural property system under which more cultural properties could be listed on a ledger that could be handed down to the next generation with less stringent protection measures. In addition, efforts to train the heritage managers for the conservation and utilization of local cultural property buildings began in Hyogo Prefecture in 2001 and spread throughout the country.

At the time of the Southern Hyogo Prefecture Earthquake, the lack of guidelines and inadequate knowledge and technology concerning the methods for earthquake preparedness posed a major issue. As there was a significant challenge regarding the seismic measures for cultural property buildings, particularly traditional wooden structures. Therefore, in January 1996, the Agency for Cultural Affairs issued a "Notice on Ensuring Safety of Cultural Property Buildings During Earthquakes." This notice introduced "Guidelines for Ensuring Safety of Cultural Properties (Buildings) During Earthquakes" and emphasized the importance of securing the safety of cultural property buildings during seismic events. The guidelines emphasized the simultaneous implementation of seismic reinforcement and soft measures, ensuring that reinforcement efforts do not compromise the cultural value of the buildings.

If ensuring safety is difficult with reinforcement alone, human access should be restricted and visitors should be informed about the construction's unsafe conditions. In April 1999, the "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" were established to provide standard methods and considerations for the seismic assessment of cultural properties. Additionally, based on these guidelines, the "Implementation Guidelines for Owner's Seismic Assessment of Important Cultural Properties (Buildings)" were established to provide preliminary seismic assessment methods to the owners of cultural properties so they can obtain basic information on their own. Building on the owner's guidelines, in April 2001, the "Implementation Guidance for Basic Seismic Assessment of Important Cultural Properties (Buildings)" were also formulated, which provide specific procedures based on the expert seismic assessments performed by repair technicians, structural technicians, and other specialists. In addition, from 1996 to 1998, the committee conducted a contract research project called "Experimental Study on the Improvement of the Seismic Resistance Performance of Cultural Property Buildings." In March 2000, the committee compiled the results of the study into the "Reference Materials for the Guidelines for Assessing Seismic Resistance of Important

Cultural Properties (Buildings)" to provide information on how to calculate the mass of each part of a cultural property building —a step necessary for seismic assessments— as well as experimental data on the mechanical properties of each seismic element, and examples of the seismic assessment and reinforcement of important cultural properties.

In FY2007, the Agency for Cultural Affairs established the Earthquake Countermeasures Division and appointed a research officer specializing in seismic resistance measures. In the same year, the Agency established the "Research and Study Committee for the Promotion of Measures for the Seismic Assessment of Important Cultural Properties (Buildings)" and in FY2008-2012, it established the "Council of Collaborators on the Promotion of Seismic Assessments of Important Cultural Properties (Buildings)" to discuss seismic resistance measures for cultural property buildings, bringing experts in the field together. During this period, in February 2008, an expert panel of the National Disaster Management Council pointed out the risk of disaster damage to a large number of cultural heritage sites in the Chubu and Kinki regions, where cultural heritage sites are concentrated, due to collapse caused by inland earthquakes and damage caused by earthquake fires. In response, in FY2008 the Cabinet Office, the MLIT, the Fire and Disaster Management Agency (FDMA), and the Agency for Cultural Affairs established the "Study Committee on Comprehensive Disaster Mitigation Measures for Important Cultural Property Buildings" to discuss disaster prevention measures for cultural properties.

Based on these results, the Agency for Cultural Affairs is enhancing its subsidy programs for seismic resistance measures for important cultural properties (Buildings). In FY2005, the Agency launched seismic assessment projects, which had previously been subsidized as part of greater repair projects. These seismic assessment projects are now subsidized when carried out independently. In FY2009, the Emergency Disaster Prevention Performance Enhancement Project was launched, which also provided subsidies for independent seismic reinforcement work. Although the names of the projects were later changed and integrated, seismic assessment and reinforcement continue to be subsidized to this day. However, the budget and the number of subsidies for seismic resistance measures were limited at that time. From FY2008 to FY2014, the government dispatched experts in response to the assessments by owner, which were supposed to be conducted by owners themselves. The experts conducted a comprehensive survey of seismic resistance measures for important cultural properties (buildings) across the country. The assessment by owner is based on information related to the seismic resistance, which is classified into three levels: (a), (b), and (c). The buildings placed under Category (c) are likely to have seismic problems and need an expert seismic assessment as soon as possible. About 60% of the important cultural properties fell under the (c) category.

In March 2011, the 2011 off the Pacific coast of Tohoku Earthquake (the Great East Japan Earthquake in 2011) occurred. As the largest earthquake observed in Japan's history, it caused extensive damage over a wide area. An unprecedented amount of damage occurred to cultural property buildings, including 143 important cultural properties, 6 important preservation districts for groups of traditional buildings, and 438 nationally registered tangible cultural properties. Immediately after the earthquake, it was anticipated that assessing the damage to cultural property buildings under the existing system would be difficult, so the Agency for Cultural Affairs launched the Cultural Property Doctor Dispatch Program in collaboration with architectural expert organizations and the government in order to survey the damage.

Regarding the recovery of damaged cultural property buildings, seismic resistance measures were taken as much as possible to prevent similar earthquake damage from reoccurring. At the same time, the need to advance seismic resistance measures outside the disaster-stricken area was strongly re-recognized, in order to prevent cultural property buildings from suffering unrecoverable damage or posing unsafe conditions for human lives. In the year following the earthquake, the Agency for Cultural Affairs' budget for subsidies for seismic resistance measures increased to approximately tenfold from that of the previous year, and although there has been a subsequent decline in the budget, the number of projects continues to increase gradually.

On the other hand, in order to properly promote seismic resistance measures for cultural property buildings, it is necessary to make the cultural property owners and the local government officials fully aware of the need for such measures. Furthermore, providing the necessary information to the experts involved is necessary so that measures can be properly implemented. Based on the discussions of the "Council of Collaborators on the Promotion of Seismic Assessments of Important Cultural Properties (Buildings)," which ran until 2012, the Agency for Cultural Affairs reviewed the "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" along with other instruments that have been established for over 10 years. Revisions were made based on the measures taken and on the study results that accumulated during this period, and the concept of "transitional reinforcement" was included as a form of earthquake damage mitigation that can be implemented until full-scale reinforcement is undertaken. In June 2012, along with the revisions, a communiqué was issued to local government officials and owners of cultural properties, stating that seismic resistance measures, which had previously been implemented in conjunction with major repairs, should be implemented during small-scale repairs as well, such as partial reroofing. Additionally, the communiqué stated that constructions with a high need for seismic resistance measures, such as buildings of high volume of public traffic, should implement seismic resistance measures as soon as possible. It added that appropriate measures needed to be taken against earthquake damage to nonstructural elements, such as ceiling materials prone to fall. In June 2013, a pamphlet entitled "Let's Protect Cultural Property Buildings from Earthquakes! Q&A" was published for owners of cultural properties to introduce the necessity and flow of seismic resistance measures in an easy-to-understand manner. In addition, as a result of the aforementioned council meeting, a "Manual for Assessing Seismic Resistance and Seismic Reinforcement of Important Cultural Properties (Buildings)" was developed for experts involved in seismic resistance measures, which explains methods and points to keep in mind when conducting seismic assessment and reinforcement, and introduces examples of seismic measures that have been implemented to date.

From FY2014 to FY2016, the "Collaborators' Meeting on Seismic Resistance Measures for Cultural Property Buildings" was established to discuss seismic measures for brickwork and reinforced concrete constructions, which had become a new issue. Measures for nonstructural elements, such as ceiling materials, were also discussed. Based on these discussions, the "Manual for Assessing Seismic Resistance and Seismic Reinforcement of Important Cultural Properties (Buildings)" was revised in March 2017 and expanded to include a significant number of examples of seismic resistance measures. In addition, the "Collaborators' Meeting on Seismic Resistance Measures for Cultural Property Buildings" was re-established in FY2017-2019 to share information on structural test data of cultural property buildings and to discuss seismic resistance measures for groups of traditional buildings. Building on the results of these discussions, a "Manual for Seismic Resistant Countermeasure of District of Groups of Traditional Buildings" was formulated in January 2020, and the "Collection of Structural Test Data of Cultural Property Buildings" was published in February of the same year.

During this period, the Kumamoto Earthquake in 2016 (with a foreshock on April 14 and the main shock occurring on April 16) caused damage to 39 important cultural properties (buildings), 3 important preservation districts for groups of traditional buildings, and 74 registered tangible cultural property buildings, among other cultural property buildings. Damage to the stone walls of the Kumamoto Castle was particularly severe, highlighting the need for stone wall seismic resistance measures. Accompanying the recovery of the damaged stone walls of Kumamoto Castle, there has been a series of discussions on how seismic resistance measures for stone walls should be implemented, and guidelines for assessing the seismic resistance of stone walls are currently being formulated. In FY2017-2018, the Board of Audit of Japan conducted the on-site "Seismic Measures for Cultural Property Buildings" inspection, which was openly presented to a large number of people. The inspection found that despite the need for seismic resistance measures identified in Preliminary Seismic Assessments, measures were not yet properly implemented in cultural property buildings. In order to address this issue, the Agency for Cultural Affairs issued an administrative communiqué to local government officials and owners of cultural properties in August 2018, which recommended that buildings in need of seismic resistance measures should consider conducting seismic assessments and implementing seismic reinforcement as soon as possible. The communiqué also provided instructions to create an earthquake response policy that summarized the prospects for countermeasure implementation, immediate improvement, and evacuation guidance in the event of an earthquake. The Agency also published the "Guideline for Preparing Earthquake Protection Policy of Important Cultural Properties (Buildings)," the leaflet entitled "To Protect Cultural Properties (Buildings) and Lives from Earthquakes!" and held explanatory meetings. These efforts have deepened the understanding of cultural property owners and other stakeholders on the need for seismic resistance measures; the number of implemented seismic resistance measures has increased significantly.

The April 2019 fire at Notre Dame Cathedral, the October 2019 fire at the Shuri-jo Site, both of which are World Heritage Sites, have further raised awareness of the need for cultural property disaster prevention management. From FY2021-2025, disaster prevention measures for world heritage sites and national treasures were strengthened as part of the national resilience measures, and the Agency for Cultural Affairs expanded the budget for subsidized disaster prevention projects, including seismic resistance measures.

Since September 2019, the Agency for Cultural Affairs has been continuously surveying the current status of seismic resistance measures for important cultural property buildings throughout Japan. As of May 2021, of the 4218 buildings subject to seismic resistance measures, 4061 (96%) have established earthquake measures to ensure safety, and of these, 2713 (64%) have completed seismic reinforcement, amongst other measures.

In order to continue protecting cultural property buildings, Japan will further promote seismic resistance measures, properly deal with damage recovery following future earthquakes, and solve various newly emerging issues. We believe that the experience that Japan accumulates in this way will be useful for the protection of cultural properties around the world, especially in other earthquake-prone countries.

(**Eisuke Nishikawa**)

1.3 Disaster Response Activities by ICOMOS Japan

Dissemination of the Great East Japan Earthquake Disaster by ICOMOS Japan

The Great East Japan Earthquake disaster occurred on March 11, 2011, and caused unprecedented damage to the national cultural properties were also severely affected by the earthquake and tsunami.

For this reason, on March 12 of that year, Prof. Yukio Nishimura, the chairman of the ICOMOS Japan at that time issued an emergency message. On March 22, he issued a preliminary report on the earthquake off the Pacific coast of Tohoku (the official name of the earthquake had not been determined at that time), and on March 29, he sent a report to ICOMOS and to the National Committees of the various countries on the damage conditions to cultural property buildings, historic sites, and places of scenic beauty, high artistic, or historic value.

In July, damage conditions were reported in the International ICOMOS Headquarters newsletter, and in November an English-language report on the damaged cultural properties (The Great East Japan Earthquake -Report on the Damage to the

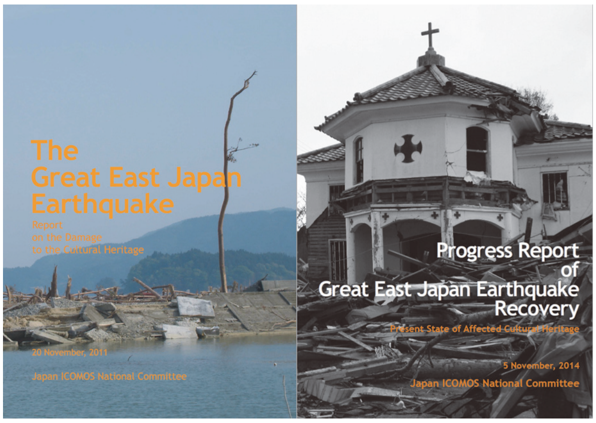

Photo 1.3.1 **Reports issued in 2011 and 2014**

Cultural Heritage) was published and distributed to foreign experts at the 17th ICOMOS General Assembly.

Three years later, in November 2014, an English-language report (Progress Report of Great East Japan Earthquake Recovery) on the state of recovery of cultural properties was published and distributed to experts from other countries at the 18th ICOMOS General Assembly.

ICOMOS Japan's preservation support activities for cultural properties damaged by the Kumamoto Earthquake

The Kumamoto Earthquake in 2016, with a foreshock on April 14 and its main shock on April 16 caused extensive damage to cultural properties, including designated, registered, and undesignated cultural properties. ICOMOS Japan decided to establish the "Special Committee for Supporting Cultural Properties Damaged by the Kumamoto Earthquake" to carry out support activities. Funds were provided by donations from individuals (Shoji Matsuura [selected preservation expert, deceased]), organizations (Japan Cultural Heritage Consultancy, Japan Chapter of the International Interior Design Association), and the Nippon Foundation.

Field Survey

The day after the April 16 main shock, the author (a native of Nishihara Village, Kumamoto Prefecture) arrived at the site and contacted ICOMOS Japan members who lived in Kumamoto to confirm the extent of the damage to historic buildings and other structures. Although the cultural property damage field survey should start when the relief efforts are in full swing and victims have had a chance to catch their breath, if it comes too late, timely and appropriate advice cannot be given to the owners of damaged cultural properties.

Therefore, ICOMOS Japan organized a joint survey team with the Architectural Institute of Japan and the World Monuments Fund (WMF) to conduct a field survey on May 3, 4, 5, and partly on May 6. A total of 19 experts from ICOMOS Japan and the Architectural Institute of Japan participated in the survey.

On May 3, the Eto Family Residence, a national important cultural property in Ozu Town; the Kataoka Family Residence, an undesignated cultural property located in the same area as the Futa district village, directly above a fault in Nishihara Village, which was severely damaged; the Yano Family Residence (Main and Branch Houses), a national registered tangible cultural property in the Monde district; and the Hachio-sha Shrine, an undesignated cultural property located in the Miyayama district were inspected. On May 4, inspections were carried out for the Kumamoto Castle located in Kumamoto City, the national registered tangible cultural property of the PS Orangerie (the former Daiichi Bank Kumamoto Branch) in the Furumachi and Shinmachi towns; the Suzuki Family Residence (former Nakamura Pediatric Clinic) structure of scenic importance, and the Nio-mon Gate of the Honmyoji Temple, a registered tangible cultural property. On May 5, inspections were carried out for the Janes' Residence, a prefectural cultural property, Yasemeganebashi, a prefectural cultural property in Mifune Town, and Suisen-ji Jojuen, the places of scenic beauty and the Mashiki Town. On May 6 the national important cultural property of the Kumamoto University Fifth High School Memorial Hall was inspected.

It was found that the Kumamoto Castle suffered tremendous damage, as stone walls fell apart and turrets and other buildings collapsed. From now on, conducting safe conservation repairs will be necessary, as well as creating a long-term project plan to face the difficult issue of tourism, and a different maintenance system for repairs.

The damage to cultural properties such as registered tangible cultural properties and undesignated important historic buildings was also widespread. While conservation repairs for nationally designated properties such as the Kumamoto Castle will be completed although they might take time, many important historical buildings, including registered tangible cultural properties and undesignated cultural properties, will be demolished unless there is a mechanism to assist with repair construction costs in the event of disasters such as this. The Furumachi and Shinmachi towns in Kumamoto City are old towns that were scorched to the ground in the Seinan War (civil war, 1877). These towns have been partially rehabilitated and have the appearance of a castle town, but many of their *machiya* (townhouses) were in danger of extinction. In this sense, the castle remained, but the castle town was on the brink of disappearing.

Publication of the Report and Urgency Appeal

On April 28, prior to the May field survey, an emergency report (A flash report on the Kumamoto Earthquakes) was submitted in English to the ICOMOS Headquarters for global dissemination.

On May 12, the "Urgent Appeal for Protection of the Cultural Properties Damaged by the Kumamoto Earthquake" (in Japanese and English) was compiled and sent to relevant organizations. The Urgent Appeal includes proposed measures of: "Creating cultural heritage rehabilitation funds comprising donations from private funds," "Constructing an organic public-private cooperation system and promoting rehabilitation measures in the framework of historic community renovation policies," "Building nation-wide strategies for promoting registration of historic buildings," and "Promoting the training of technical experts, and their certification so that they can engage cultural property registration and preservation as part-time conservation architects."

On June 11, based on the field survey conducted in May, "The 2016 Kumamoto Earthquake ICOMOS Japan Committee Report - Damage Situation of Cultural Property Buildings and Prospects for Recovery" was compiled and published.

On July 30, ICOMOS Japan hosted the "Forum on the Conservation of Historic Buildings Damaged by the Kumamoto Earthquake" at Kumamoto Gakuen University. The forum was attended by 180 people, including owners of cultural properties, government officials in charge of cultural properties and landscapes, the heritage managers, experts in repairing cultural properties, university researchers and students, local Diet members, city council members, the general public, and the media. The forum began with a summary report on the disaster by Mr. Yuga Kariya (Vice Chair of ICOMOS Japan), followed by a lecture by Mr. Yasumichi Murakami (Counselor, Hyogo prefectural board of education) on "Experiences from the Great Hanshin-Awaji Earthquake in 1995," in which he reported on the support for damaged historic buildings, including those not yet designated. Mr. Kazuhiro Fujikawa, Executive Director of the Kumamoto Machinami Trust, community driven preservation organization, reported on post-disaster activities in the Shinmachi and Furumachi towns of Kumamoto, his hometown, and Professor Juko Ito of Kumamoto University introduced the recommendations of the Cultural Property Doctors' developed by the Agency for Cultural Affairs through its dispatch program "Interim Report Meeting."

Advancements in Support

In July, the "Committee for Supporting the Rehabilitation of the Kumamoto Castle, Aso Shrine, and other Damaged Cultural Properties" was established and began raising funds to support damaged cultural properties. In response, Kumamoto Prefecture, Kumamoto City, and other local governments have been engaged in the preservation of undesignated historic buildings. Meanwhile, the Cultural Property Doctors who are supported by the Agency for Cultural Affairs, conducted the first survey, and a debriefing session was held at Kumamoto University on September 22, with the participation of Professor Osamu Goto of Kogakuin University, amongst others. In October, a second survey began. The "Rehabilitation Fund for Cultural Properties Damaged by the 2016 Kumamoto Earthquake" was established in Kumamoto Prefecture, and support methods began to be discussed.

On November 2 and 3, the World Monuments Fund (WMF) and Freeman Foundation officials went to Nishihara Village, Mashiki Town, and the Shinmachi and Furumachi towns in Kumamoto City to explore the possibility of these Foundations' support.

In November, the owners of damaged cultural properties in Kumamoto City formed the "Liaison Council of Owners of Damaged Cultural Heritage" to make requests to the government. In cooperation with various parties, ICOMOS Japan has been providing advice to the owners of historic buildings that need be preserved.

In 2017, publicly funded demolitions began, and old, damaged houses were on the brink of disappearing. For this reason, in February 2017, a "Request for Urgent Support for Damaged Cultural Properties" was presented to the Diet members elected from Kumamoto Prefecture. The request asked for collaboration in "supporting the recovery of cultural properties by drawing from the rehabilitation funds" and in "enacting a law to support the damaged registered cultural properties in the regions designated as serious disaster areas".

On February 9, 2017, ICOMOS Japan and the Liaison Council of Owners of Damaged Cultural Heritage co-hosted an exchange meeting in Kumamoto City with ICOMOS Japan and oriental cultural researcher Alex Kerr, bringing 70 people together, including cultural property owners, government officials, university members, and cultural property experts. Alex Kerr gave a lecture on examples of the rehabilitation of historic buildings and the preservation of historic landscapes. Following his lecture, there was a lively exchange of views on the plight of owners and their future prospects.

On February 15, it was announced that the Kumamoto Prefectural Government's Cultural Affairs Division would utilize the "Fund for the Recovery and Rehabilitation of Damaged Cultural Properties (hereafter the rehabilitation fund)" Regarding the design and supervision of the national registered tangible cultural properties, the national and prefectural government will provide 90% of the funding, while historic buildings that have been registered or agreed to be registered will receive 2/3 of the restoration cost, and those that have been recognized for their value as cultural properties will receive 1/2 of the cost. The goal of the rehabilitation fund was to aid 150 cultural properties; at that point it was still unclear how much support would extend beyond Kumamoto Castle and the Aso Shrine.

Start of the Recovery and Rehabilitation of Cultural Properties

One year has passed since the Kumamoto Earthquake, and although there is a sense that things have calmed down somewhat in the area, full-scale recovery and rehabilitation is yet to begin.

Conservation work has begun on cultural properties damaged by the Kumamoto Earthquake, including the Eto Family Residence and the Aso Shrine, which are national important cultural properties, and Kumamoto Castle, which is a special historic site. In addition to these designated properties, regarding the recovery and rehabilitation support for registered and undesignated cultural properties, the "Group Subsidy" from the Small and Medium Enterprise Agency was quick to provide support, and the "Fund for the Recovery and Rehabilitation of Damaged Cultural Properties" has finally officially started to operate. In addition, the rehabilitation fund will provide 1/2 of up to 10 million yen for shrine halls in each village as community facilities.

Although the requests of ICOMOS Japan, the Architectural Institute of Japan, and the Japan Federation of Architects & Building Engineers Associations have had some success, some owners have been forced to choose publicly funded demolition when the construction cost exceeds 50 million yen and the cost for the individual owner is several tens of millions of yen. Indeed, the reality is that it is quite burdensome to spend more than 10 million yen in this aging society. At the end of May, the "Morimoto *Machiya*" (Morimoto Fusuma Tableware Shop) and the "Suzuki Family Residence" (a Western-style building), both of which are said to preserve their original form the best in Kumamoto City, were demolished at public expense.

The "Hachio-sha Shrine" in Nishihara Village, for example, requires an investment of at least 50 million yen for its conservation, and support from the rehabilitation fund, which is limited to 10 million yen (subsidized by 5 million yen), may not be enough for the shrine's members, who were also affected by the disaster. Unless the shrine hall, with its excellent Edo Period design, became a cultural property designated by the village and another form of support was found, the shrine hall would have to be dismantled. The village was able to receive a 2/3 subsidy from the "Fund for the Recovery and Rehabilitation of Damaged Cultural Properties" on the condition that the shrine becomes a designated cultural property, thus enabling its conservation.

Photo 1.3.2 Symposium on "Community Planning Utilizing History" (Sept. 24, 2017)

The Nippon Foundation has decided to provide funding (8.15 million yen) to support ICOMOS Japan's rehabilitation activities for cultural properties damaged by the Kumamoto Earthquake, including technical support for repairs of high technical difficulty, cooperation with unregistered cultural property candidates and cultural properties designated by local governments, symposiums, cooperation with Kumamoto City in the Plan for the Maintenance and Improvement of Traditional Scenery, and English-language report publications on the Kumamoto earthquake.

On September 24, ICOMOS Japan, co-sponsored by Kumamoto City and supported by the Agency for Cultural Affairs and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), held a symposium entitled "Community Planning Utilizing History: Rehabilitation from the Kumamoto Earthquake." In the symposium, it was decided that, under the joint jurisdictions of the Agency for Cultural Affairs, the MLIT, and the Ministry of Agriculture, Forestry, and Fisheries, recovery and rehabilitation support were going to be provided for damaged cultural properties utilizing Law on the Maintenance and Improvement of Historic Landscape in a Community. The symposium featured lectures by Yukio Nishimura (Professor at the University of Tokyo and ICOMOS Japan Chairperson), Osamu Goto (Professor at the Kogakuin University and ICOMOS Japan member), Toshiaki Funabiki (Professor at the University of Miyagi and ICOMOS Japan member), and Kazufumi Onishi (Mayor of Kumamoto City), and was chaired by Kazuyuki Yano (Director General, ICOMOS Japan), with approximately 200 people attending.

Reporting about the Kumamoto Earthquake at the 2017 ICOMOS General Assembly in Delhi

In the context of frequent earthquakes happening around the world with examples in Nepal, the Perugia region of Italy, and South Korea, earthquake damage and rehabilitation in Japan has been the focus of much attention. For this reason, an English-language report was compiled and distributed at the December 2017 ICOMOS General Assembly in Delhi, India. The report was titled "The Kumamoto Earthquake ~Report on the Damage to the Cultural Heritage~" and consisted of 95 pages. A total of 200 printed copies and 600 USB memory sticks were provided to the participants. The activities of ICOMOS Japan were highly evaluated in this report that followed the interim report on the Great East Japan Earthquake disaster.

Technical Guidance by ICOMOS Japan Experts

The followings are the main registered cultural properties and undesignated cultural property buildings that posed technical and planning difficulties, for which ICOMOS Japan experts provided guidance and advice.

The PS Orangerie (former Daiichi Bank Kumamoto Branch) national registered cultural property, Nio-mon Gate of the Honmyoji Temple national registered cultural property, the Yano Family Residence (Main and Branch Houses) national registered cultural property, Yoshida Shoka-do, the Kimura Family Residence, the Kiyonaga Honten (Main Store), the Zuiyo Sake Brewery, the Miyayama Shrine, the Hachio-sha Shrine, and others.

The Kumamoto Earthquake -Damaged Cultural Property Rehabilitation Archives

With the support of the Nippon Foundation, ICOMOS Japan has organized symposiums, published reports in English, provided support for the registration and designation of historic buildings, and provided technical support for the repair of registered and undesignated cultural properties. In the future, it will be necessary to examine what happened after Kumamoto Earthquake struck, from the perspective of rescuing cultural properties, both designated and undesignated. It is said that there is a 72-hour limit for saving human lives, and that salvage activities in the early stages can mean the difference between life and death.

After the Kumamoto Earthquake, the first monetary rehabilitation support came from the group subsidy (*see p.40 for more detail about the subsidy) provided by the Small and Medium Enterprise Agency, followed by the rehabilitation fund. In terms of surveys, the ICOMOS Japan damage conditions survey was launched two weeks after the earthquake, followed by the Agency for Cultural Affairs' Cultural Property Doctor Dispatch program two months later, and the activities of the heritage managers. Needless to say, it is important to have a list of undesignated cultural properties as a base to carry these activities out promptly.

To this end, the Special Committee on Support for Cultural Properties Damaged by the Kumamoto Earthquake targeted areas in Kumamoto Prefecture (including the Shinmachi-Furumachi district, the Kawashiri district, and other districts), the Mashiki Town, Nishihara Village, Ozu Town, and Uki City. The committee collected basic data from the government, conducted interviews with relevant parties, held roundtable discussions (group interviews), and distributed a questionnaire for people who opted for publicly funded demolition (the questionnaire included questions on the trajectory of the property up to the demolition, reasons for opting for demolition, and post-dismantling use of the land) to gain an understanding of the situation at the time and to summarize how post-disaster support should be provided.

The "Kumamoto Earthquake Damaged Cultural Properties Rehabilitation Archives" were established by the members and volunteers of ICOMOS Japan to compile documents related to the damaged cultural properties and their rehabilitation.

The “2016 Kumamoto Earthquake ICOMOS Japan Report on the Cultural Property Conditions and Recommendations for Recovery and Rehabilitation" was published in March 2019, with recommendations for the recovery and rehabilitation of damaged cultural properties to be considered in the case of future disasters in Japan. In this report, drawing from the insights and challenges uncovered during three years of surveys and support initiatives following the Kumamoto Earthquake, we have compiled the following recommendations titled "Proposals for the Restoration and Recovery of Damaged Cultural Properties and the Sound Development of Their Conservation and Utilization in the Future.” For more information, please visit the ICOMOS Japan website.

1. Emergency measures and support for damaged cultural properties.
2. When to start surveying damaged cultural properties and how to provide support for restoration.
3. Issues of post-earthquake risk assessment, publicly funded demolition, and institutional issues related to repair with complete dismantlement and reassembly of original structures.
4. Roles and challenges of each organization related to support for recovery of cultural properties.
5. Support for recovery and rehabilitation of cultural properties and rehabilitation funds for damaged cultural properties.
6. Measures for future disaster prevention (formulation of comprehensive disaster prevention/mitigation plans for earthquake resistance and various types of disasters, proactive positioning of cultural properties in tourism promotion plans, etc.)
7. Comprehensive plans for the recovery and rehabilitation of cultural properties and their appropriate subsequent conservation and utilization
8. Enhancement of human resources and support systems related to cultural properties in local governments.

Future Prospects

From now on, in the event of a disaster, it will be necessary to establish a system to rescue historic buildings that can be preserved (e.g., by establishing a fund and building an organic partnership between the public and private sectors), and to provide long-term rehabilitation support. This will help maintain the dignity of the city and region as well as revitalize the region through cultural tourism. In the case of the recent Kumamoto earthquake, an opportunity can be taken to consider the important historical and cultural aspects of the earthquake as a base to practice Build Back Better (BBB). The "Special Committee for Supporting Cultural Properties Damaged by the Kumamoto Earthquake" decided to change its name to "Special Committee for Supporting Damaged Cultural Properties" so that it can continue its activities beyond the Kumamoto Earthquake.

ICOMOS Japan plans to continue collaborating with the Agency for Cultural Affairs, the MLIT, Kumamoto Prefecture, Kumamoto City, the municipalities, the Japan Federation of Architects & Building Engineers Associations, the Architectural Institute of Japan, which is in charge of Cultural Property Doctor program, and more organizations.

(Kazuyuki Yano)

2. Developing a System of Disaster Measures for Cultural Heritage

2.1 The Great Hanshin-Awaji Earthquake in 1995 Experience

At the time of the Great Hanshin-Awaji Earthquake, Kariya, one of the authors was an officer of Kyoto City, and while the bookshelves, cupboards, and other items in my home were damaged, the losses were fortunately not serious. Thus, it was possible to engage in volunteer activities in the disaster-stricken area of Kobe, for example by distributing food to evacuated residents. I was horrified, not only by the collapsed buildings but also by how they caused death by crushing and by burning due to the large fires caused by the earthquake. In April 1995, I was transferred to the Agency for Cultural Affairs as the Chief Investigator in charge of preservation districts for groups of traditional buildings, (hereafter referred to as "preservation district"), and one of my major tasks was to develop the repair and rehabilitation project of the Kitano Yamamoto-dori Preservation District in Kobe City. In parallel with earthquake disaster rehabilitation projects for designated buildings and preservation district buildings, I supported technical studies to improve their seismic performance. As many historical buildings damaged by the Great Hanshin-Awaji Earthquake in 1995 were rapidly disappearing without any consideration of their cultural value or whether or not they could be rehabilitated, the Agency for Cultural Affairs launched a major effort to establish a Registered Cultural Property system to ensure that cultural properties were being recognized by society. As a member of this effort, I joined the swirl of revisions of the Act on the Protection of Cultural Properties.

In considering the development of seismic resistance measures for cultural properties in Japan, which has been steadily advancing, reflections of this article on the disaster recovery and rehabilitation lessons learned from the Great Hanshin-Awaji Earthquake should raise awareness on the necessity of such measures through records 1) - 10).

Earthquake Overview

At 5:46 a.m. on January 17, 1995, in the north of Awaji Island, an earthquake of magnitude 7.3 (on April 23, 2001, the magnitude, previously thought to be 7.2, was corrected using the results from the Japan Meteorological Agency Magnitude Study Committee) occurred with a hypocenter at 34 ° 36' N latitude, 135° 02' E longitude, and 16 km depth.

The Japan Meteorological Agency (JMA) named this earthquake the "Southern Hyogo Prefecture Earthquake (Kobe earthquake)." In addition, at a Cabinet meeting, the government approved the naming of the disaster as "The Great Hanshin-Awaji Earthquake disaster" because of the particularly large scale of the earthquake damage and the need for a unified name when promoting post-earthquake measures for recovery and rehabilitation.

The Kobe Marine Observatory (now JMA Kobe, located in Nakayamate of the Chuo Ward of Kobe City at the time) and the Sumoto meteorological station (located in Orodani, Sumoto City) recorded a seismic intensity of 6* from the tremors caused by the earthquake. After the earthquake, the JMA's field survey recorded a seismic intensity of 7 for the first time in the Hanshin area (Kobe City, Ashiya City, Nishinomiya City, and Takarazuka City in the southeastern part of Hyogo Prefecture), and parts of Awaji Island (Tsuna Town, Hokudan Town, and Ichinomiya Town). These numbers positioned them as very disastrous earthquakes. Seismic intensities of 1 or higher were felt over a wide area throughout Japan, from Fukushima Prefecture in the east to Nagasaki Prefecture in the west, and from Niigata Prefecture in the north to Kagoshima Prefecture in the south.

The Kobe Marine Observatory recorded a seismic motion with a maximum acceleration of 818 Gal (North-South direction), and similar acceleration records were observed at other locations. The seismic motion component included a killer pulse with a period of 1-2 seconds, which is considered to have caused significant damage to buildings.

The Southern Hyogo Prefecture Earthquake (Kobe earthquake) caused the largest earthquake damage after World War II (since 1945), far exceeding the damage caused by the Nankai Earthquake in 1946 and the Fukui Earthquake in 1948.

Damage Overview

Photo 2.1.1 **Situation of Damage**
(Photo provided by Kobe City)

The Great Hanshin-Awaji Earthquake was the first inland earthquake in Japan to strike a city directly where a high degree of socioeconomic functions concentrated. It caused tremendous human losses, exceeding 6,400 deaths and 43,700 injuries. In addition, the disaster damaged the central functions of administrative agencies and other organizations that were responsible for quick and precise emergency and recovery activities, as well as infrastructure facilities such as transportation routes, port facilities, and lifeline-related infrastructure such as water supply facilities, telecommunications, and electricity.

In the urban area of Kobe City near the hypocenter, in mere seconds, the earthquake halted the urban functions of the city's population of 1.5 million. The earthquake inflicted direct and extensive damage to the lives of its citizens by claiming many lives and causing extensive damage to the city's infrastructure and buildings. Nearly 130,000 buildings were damaged in Kobe City, and 99% of the fatalities occurred there, which gives some idea of the enormity of the damage caused there.

Photo 2.1.2 **An example of a chimney that fell indoors (Former Hunter Residence)**
(Photo provided by Agency for Cultural Affairs)

Damage to Historic Buildings

The area near the epicenter of the earthquake was surrounded by beautiful landscapes and pleasant cultural environments, with an accumulation of outstanding architectural heritage, including western-style houses, *sake* breweries, and quiet residential neighborhoods. The earthquake damaged many of these historic buildings and environments.

In the six prefectures that make up the Kinki region, damage reports to the Agency for Cultural Affairs were drafted for 116 (out of 973) nationally designated buildings and one of the eight important preservation districts for groups of traditional buildings (composed of 34 buildings). The extent of the damage (including minor damage)

Photo 2.1.3 **Damage to a church**
(Photo provided by Kobe City)

reached as far as Aichi Prefecture in the east and Tokushima Prefecture in the west. Because this major earthquake occurred in the Kinki region, where many designated cultural property buildings accumulated, it was one of the largest cultural property disasters in terms of both the number and the extent since the modern cultural properties protection system was established.

Major damage concentrated in the designated buildings located in the southern urban area of Hyogo Prefecture, near the epicenter. A total of 13 structures sustained extensive damage, including two completely destroyed houses: the former Kobe Settlement 15th Building (Chuo Ward, Kobe City) and the main hall at the Hachiman Shrine (Nakasuji, Takarazuka City). Many of these buildings were in or near the area where the very disastrous earthquake recorded a seismic intensity of 7.

As with nationally designated cultural properties, a large number of prefectural designated cultural properties were damaged by the disaster. Of the 570 prefectural designated cultural property buildings in the six prefectures of the Kinki region, 79 (14%) were damaged.

A group from the Kinki Chapter of the Architectural Institute of Japan conducted a damage survey of 1,260 listed historic buildings, which included 1,039 undesignated cultural properties, in 16 cities and towns of the heavily damaged areas in the Hyogo, Osaka, and Kyoto prefectures.

Overall, 75% of the surveyed 1260 historic buildings suffered some kind of earthquake damage, which included 163 completely destroyed houses. In terms of the degree of devastation by building type, *sake* breweries suffered the most, followed by farmhouses, *machiya* (townhouses), and modern houses. Damage to temples, shrines, and modern architecture was relatively low, while residential buildings were affected the most. Looking at the degree of damage by building structures, brickwork constructions were the most affected, with 62% of them being completely or partially destroyed. Wooden constructions were the second structure type most severely damaged, while 12 reinforced concrete constructions in Kobe City were completely destroyed.

Photo 2.1.4 **Damage to sake breweries (Photo provided by Kobe City)**

Photo 2.1.5 **Collapse of the main building of Yasaka Shrine (Photo provided by Agency for Cultural Affairs)**

The Damage Survey Implementation System

Immediately after the earthquake, a historic buildings damage survey was conducted by a three-party team consisting of Agency for Cultural Affairs officials, persons in charge of cultural property buildings and repair technicians from the six Kinki region prefectures, and a team of volunteers who were members of the Architectural Institute of Japan. Under this tripartite structure, an exhaustive survey of the listed historic buildings was almost completed, and a ledger was prepared, compiling and listing the survey results. Then, the damage tendencies were statistically analyzed according to the region, building structure, and building type. The data could be used to develop various subsequent countermeasures.

Regarding movable cultural properties such as arts and crafts, the Agency for Cultural Affairs, local government professionals, and private sector volunteers implemented the "Cultural Heritage

Rescue Program" by organizing a "Committee for the Rescue of Cultural Properties Damaged by the Great Hanshin-Awaji Earthquake." With regard to buried cultural properties, in order to facilitate recovery and rehabilitation work, exceptional measures were taken to relax certain protective regulations. Additionally, specialists were dispatched from all over the country in order to support the prompt and difficult excavations necessary in the wake of the earthquake disaster.

Subsidized Support for Recovery

In addition to the extra subsidies for the disaster recovery of designated cultural properties, subsidies from the "Great Hanshin-Awaji Earthquake Recovery Fund" established by Hyogo Prefecture and Kobe City, supported the recovery of historic buildings. Additionally, private support funding such as the Motor Boat Revenues Fund was put in motion under the jurisdiction of the Ministry of Transport (now the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)). The "Great Hanshin-Awaji Earthquake Subsidy Project for Historic Buildings" of the Great Hanshin-Awaji Earthquake disaster rehabilitation fund provided subsidies for the recovery and rehabilitation of undesignated historic buildings surveyed by the Architectural Institute of Japan and other organizations, with a subsidy rate of 50% or up to 5 million yen. This is the first case in Japan's cultural properties protection administration where full-scale measures were taken for the protection of undesignated local historic property buildings. However, fewer people than expected took advantage of this system. The reason for this attrition was thought to be the fact that the system was launched after the publicly funded demolitions reached their peak, 6 months after the earthquake. Additionally, it was pointed out that architectural design firms in the region were unable to adequately handle the design supervision of the recovery projects.

The Establishment of a Registered Cultural Property System

Before the earthquake, discussions had been led on the need to protect a wide range of buildings from the late modern and post-modern periods. If the historic and cultural significance and value of these buildings remained unrecognized, they were under threat of destruction. The thought was that a protection system that only designates carefully selected important buildings was insufficient to prevent the destruction of late modern and post-modern buildings. Following that line of thought, the need for a broader net of protection and more lenient protective regulations was discussed.

The former Kobe Settlement 15th Building (a national important cultural property) and the main hall of the Rokko Yahata Shrine (a Hyogo Prefecture-designated cultural property), which were completely destroyed, were to be reconstructed. However, since lifesaving efforts took precedence over reconstruction, some of the completely destroyed prefectural designated cultural properties were unavoidably de-designated because of the poor condition of their remains. Additionally, town-designated cultural properties that were partially destroyed were de-designated and dismantled in cases where the owner of the cultural property was troubled by the financial burden and did not understand the need for preservation and recovery. While even the preservation of designated cultural properties was difficult, there was no public support funding system for the conservation of undesignated historic buildings, and their restoration was unavoidably left to the will of the owners. In cities that had no own cultural property ordinance, valuable historic buildings comparable to designated cultural properties disappeared without adequate examination or preservation measures. Even with partial public support funding, the burden on the owners of completely destroyed or partially destroyed houses was too great, and in some cases, the path to recovery was closed. In addition, there were many cases where the owners were concerned about the safety of their historic buildings. These owners were planning to rebuild their properties before the earthquake but decided to take the opportunity of the disaster to demolish them.

In response to this situation, from the perspective of providing public support measures and a human support system after an extraordinary disaster such as an earthquake, it came to be recognized that, at a minimum, an official inventory of historic buildings and a system that casts a wide net of preservation was essential and strongly desired. Thus, the need was recognized for a loosely defined cultural property protection system that could be continuously used and that was different from the designated cultural property system. In 1996, the amendment to the Act on the Protection of Cultural Properties (1950) was introduced with the introduction of the registered tangible cultural properties system. The number of registered tangible cultural properties has been steadily increasing, and as of August 2022, there are more than 13,400 registered tangible cultural properties in Japan, which have become an established part of Japanese society.

Developing Human Resources to Lead the Conservation and Utilization of Local Cultural Properties

Conservation technicians for cultural property buildings involved in the conservation and repair of national designated cultural properties have been working to improve their professional techniques by attending the "Training Course for Chief Engineers of Cultural Property Building Conservation Projects," hosted by the Agency for Cultural Affairs. However, for routine maintenance of cultural properties including registered cultural properties, it was necessary for each community to have personnel who care for and make the most of their own cultural properties. In FY2001, the Prefectural Board of Education and the Architects & Building Engineers Associations collaborated to launch the "Hyogo Prefecture Heritage Managers Training Course." By FY2022, 16 courses will be held, totaling over 500 participants. As of July 2022, the number of registered cultural properties in Hyogo Prefecture reached 747. That number is comparable to that of Osaka Prefecture, which has the largest number of registered cultural properties. Many registered cultural properties in Hyogo Prefecture involve heritage managers (58% of the buildings registered by 2016 were surveyed and documented by heritage managers), and their presence has become indispensable for the conservation and utilization of cultural properties in the region.

This trend of training personnel has spread throughout Japan, and as of FY2021, training sessions have been held in 45 prefectures, resulting in the creation of more than 5,000 heritage managers. Thus, a support system to respond in the event of a regional disaster has been established across prefectural boundaries. This support system has been developed and eventually become t fully functional.

The Seismic Reinforcement of Cultural Property Buildings

Regarding the structural reinforcement of cultural property buildings, it is necessary to harmonize the value of cultural properties and their safety, but no clear evaluation method had been established at the time of the earthquake to address this balance. It is thought that the safety of cultural property buildings in quake-prone countries has

Photo 2.1.6 **Damage situation of the former Kobe Settlement 15th Building < National Important Cultural Property>**
(Building ownership: Nozawa Corporation, Photo provided by Kobe City Museum)

Photo 2.1.7 **The former Kobe Settlement 15th Building recovered with base-isolation retrofit**

come to be considered through the several international conferences that are held after the earthquake. In Japan, the Disaster Management Operation Plan of the Agency for Cultural Affairs (based on the Basic Act on Disaster Management, this disaster management plan was prepared by designated administrative organs) was revised in May 1996, and it states clearly that "Regarding the recovery of designated cultural property buildings, especially when they are open to the public, construction work shall be conducted to improve their strength in order to ensure the safety of human life." This statement revealed that an accurate assessment of damage conditions and seismic reinforcement considerations are essential for the future preservation of cultural property buildings.

Under these considerations, among the national and prefectural designated cultural property building repair projects in Hyogo Prefecture, for large-scale restoration work that required complicated seismic resistance measures, a seismic resistance countermeasures committee was organized, composed of experts such as architectural historians, structural engineering researchers, and repair technicians. The committee examined the repair policies of each project. The majority of the 32 repair projects used conventional construction methods, but there were two cases in which the original structural system was modified by introducing base-isolated devices. The first case of a base-isolated device system introduction for a designated building was the former Kobe Settlement 15th Building. Although it was introduced simultaneously with a recovery to the original state, it marked the beginning of the so-called "retrofit projects" in Japan.

After the earthquake, the need arose to accumulate model examples of safety enhancement measures implemented through the repair of cultural property buildings. Due to the growing social demand to solve the seismic issues experienced in various general structures, the world's largest seismic test table facility was established as a national institution in Miki City, Hyogo Prefecture. Seismic resistance tests were conducted there by shaking full-scale buildings using observed seismic waves. Coupled with the rapid development of computerized structural analysis technologies, research institutes accumulated highly accurate data through experimental and analytical performance verification.

Immediately after the earthquake, the Agency for Cultural Affairs set up the "Cooperative Conference for the Research and Study Supporting the Seismic Performance Improvement of Cultural Property Buildings," and began advancing the research and study based on scientific evidence that supported the creation of comprehensive guidelines and guides regarding the seismic resistance of cultural property buildings. Then, on January 17, 1996, exactly one year after the earthquake, the "Guidelines for Ensuring Safety of Cultural Properties (Buildings) During Earthquakes" were formulated, followed three years later by the April 2000 "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" and the "Owner's Guidelines for Assessing the Seismic Resistance of Cultural Properties (Buildings)" (currently, the "Guidelines for the Preliminary Seismic Assessment"). These were some of the basic guidelines and procedures for earthquake resistance measures developed at that time.

New Developments in the Cultural Property Protection System

After the earthquake, it was recognized that in order to protect the historic buildings that abound in the area expressing characteristic regional features, it is necessary not only to use the conventional preservation methods for designated cultural properties but also to implement a protection system that allows the use of these historical and cultural properties in the present society. In 2002, Hyogo Prefecture compiled the "Utilization Plan of Historic and Cultural Heritage." In response to the growing public awareness of cultural properties and changing lifestyles, the national government introduced a registered cultural property system for buildings in 1996, and in 2004 it created a new category of cultural property named Cultural Landscape, and expanded the registered cultural property system to include areas beyond buildings. In 2007, the Agency for Cultural Affairs drafted the "Basic Scheme for Historic and Cultural Properties" and encouraged municipalities to decide on them.

In 2008, the Law on the Maintenance and Improvement of Historic Landscape in a Community (Historic Community Planning Law) was enacted, and both the Scheme and the Law were steadily disseminated and spread throughout the nation. 2012 saw the compilation of the "Technical Guidelines for the Formulation of the Basic Scheme for Historic and Cultural Properties" Furthermore, the 2019 revision of the Act on the Protection of Cultural Properties introduced the "Regional Plans for the Protection and Utilization of Cultural Properties" to address the loss and dispersal of cultural properties due to social changes such as depopulation, the declining birthrate, and the aging population. Social changes such as rising expectations for cultural properties in the context of tourism and community planning also triggered community efforts to promote the systematic preservation and utilization of cultural properties, including those that had not been designated.

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* The Japan Meteorological Agency (JMA) seismic intensity scale is used to indicate the degree of shaking at a given point. The seismic intensity scale is expressed in 10 levels, from 0 to 7 (5 and 6 include lower and upper sub-scales). Currently, all seismic intensity levels are automatically observed and reported by seismographs, but at the time of the Southern Hyogo Prefecture Earthquake, the JMA field survey team conducted a study that determined the seismic intensity level of 7 based on the field survey of an area with an intensity of 6, as well as on the ratio of collapsed buildings.

(Hajime Yokouchi, Yuga Kariya)

2.2 Understanding Cultural Heritage and Disaster Recovery Response in the Public Administration

Introduction

In order to rehabilitate cultural heritage that has been hit by a megaquake, damage conditions need to be assessed and rehabilitation needs to be planned, and for these actions to take place it is necessary to identify in advance what cultural heritage is.

This may sound paradoxical.

Repeating that statement, in order to protect cultural heritage from megaquakes, the cultural heritage must be identified in advance. This is because undesignated immovable cultural heritage properties can be treated as ordinary properties, and damaged buildings are subject to demolition by the government at public expense. There is no point in lamenting after they have been removed and saying, "That was an important cultural heritage." This is an administrative rule.

Therefore, when there is a cultural heritage in need of protection that constitutes a rich historical and cultural environment, it is first necessary to identify it as broadly as possible. Additionally, we must bear in mind that even if only one part of the cultural heritage is missing, the rich environment will be lost forever.

The Great Hanshin-Awaji Earthquake and Registered Cultural Properties

The Great Hanshin-Awaji Earthquake was the catalyst. The earthquake damaged numerous cultural heritage sites, both designated and undesignated. Many undesignated cultural heritage sites that nevertheless constitute valuable everyday life landscapes were also severely damaged. However, since they were not subject to protection as cultural properties, many disappeared in the rubble. While the sense of loss felt by the people was immeasurable, cultural property protection measures simply lacked adequate means at the time.

This is where the registered cultural property system comes in. The Registered Cultural Property category for cultural properties was newly introduced following the Great Hanshin-Awaji Earthquake.

The Act on the Protection of Cultural Properties is the law that protects Japan's cultural properties, and it was enacted in 1950. Japan's designation system was strictly selective, with a small number of outstanding works being designated and protected as national treasures or important cultural properties. As part of this system, the government was required to bear much of the costs to repair these few, selected properties.

However, the unexpected loss of cultural heritage due to the Great Hanshin-Awaji Earthquake was a great shock. Additionally, Japan was in the final stages of its development as part of the bubble economy at the time, and valuable cultural heritage, which lacked social recognition, was rapidly disappearing. A system with some protection measures was urgently needed for the conservation and utilization of a wide variety and a large amount of cultural heritage. Thus, the registered cultural property system was introduced in 1996.

In principle, the criteria for registered cultural properties are that they cannot be important cultural properties or cultural properties designated by local governments and that at least 50 years have passed since their construction. In addition, buildings that meet the following three conditions are eligible for registration:

(1) Those that contribute to the historic landscape of the land
(2) Those that have become exemplary models
(3) Those that are not easy to reproduce

While a notification must be made when registered buildings undergo major exterior changes or relocation, they offer a high degree of freedom in retrofitting and renovation, and a wide range of possible rehabilitation options is available. For example, a building constructed as a warehouse or factory can easily be converted into a restaurant or museum. the use of registered cultural properties as tourist facilities or as centers for local communities has also become popular.

Some results have been achieved. In the 190 years since the Japanese designation system began in 1897 through enacting the Act on the Preservation of Ancient Shrines and Temples, 2,540 buildings have become designated important cultural properties. In the 25 years since the start of the registered cultural property system, 13,537 buildings (as of December 1, 2022) have been registered. At the municipal level, 995 of the 1,718 cities, towns, and villages in Japan hold registered cultural properties. This means that approximately 60% of the municipalities in Japan count with cultural heritage.

The Great East Japan Earthquake, the Kumamoto Earthquake, and the Cultural Property Doctors

Thus, the registered cultural properties become the smallest unit of cultural heritage in the event of a major earthquake for damage assessments, rescue, and recovery.

When the Great East Japan Earthquake disaster struck in 2011, the cultural property departments of local governments suffered destruction and exhaustion, making it difficult to conduct cultural property damage surveys at the administrative level. In response, the Cultural Property Doctor Dispatch Program was launched.

Traditionally, at the time of a disaster, the damage sustained by cultural property buildings (mainly by designated cultural property buildings) would have been reported to the Agency for Cultural Affairs by the municipalities where the buildings are located, using the respective prefectural boards of education. However, the Great East Japan Earthquake caused such extensive and tremendous damage, that concerns arose about the difficulties at the administrative level to quickly and holistically conduct damage assessments of the cultural properties, especially of registered cultural properties, which are numerous and scattered throughout the region.

Therefore, a new project plan was launched to survey the damage conditions of cultural property buildings by dispatching university architectural historians and private historical building specialists to the disaster-stricken area. Specifically, the Agency for Cultural Affairs requested the cooperation of architecture experts associated with the Architectural Institute of Japan, the Japan Institute of Architects, the Japan Federation of Architects & Building Engineers Associations, and other related organizations. These experts were to conduct an organized survey in cooperation with the public and private sectors to quickly determine the damage extent that cultural property buildings had sustained and to provide technical recovery support. An especially urgent task was confirming the safety of the registered cultural properties.

The Great East Japan Earthquake caused tragic damage to many cultural heritage properties, which collapsed and were washed away by the tsunami that followed. However, through technical support from the Cultural Property Doctor Dispatch Program and financial assistance from overseas, remarkable results were achieved, including the miraculous rehabilitation of registered cultural properties that were washed away by the tsunami. Indeed, we were able to reaffirm that preserving cultural heritage for future generations helps ease the minds of those affected by a disaster and helps pass on their memories, a feat that is irreplaceable.

https://www.wmf.org/project/kesennuma-historic-cityscape

https://www.wmf.org/project/east-japan-earthquake-heritage-sites

The post-megaquake dispatch of Cultural Property Doctors was also implemented after the Kumamoto Earthquake in 2016. Remarkably in this case, the Kumamoto Prefecture reused its rehabilitation funds to support the recovery of cultural properties, even of undesignated cultural properties, under the assumption that they would become registered cultural properties in the future.

Photo 2.2.1 **The Kakuboshi Sake Brewery Store registered cultural property after the Great East Japan Earthquake and tsunami (above) and after rehabilitation (below)**
(Photo courtesy of Shigeki Sekiguchi)

Conclusion – The Regional Plans for the Protection and Utilization of Cultural Properties Lastly, here are some recent cultural heritage policies concerning the understanding and management of cultural properties.

Essentially, when considering the preservation of a rich historic and cultural environment, it is necessary to view cultural heritage, both tangible and intangible, as a collective entity, and to evaluate and preserve it as a whole. In this sense, registered and designated cultural properties are institutionally limited as respective "dots" of a preservation system net.

Therefore, the Regional Plans for the Protection and Utilization of Cultural Properties were introduced in the 2019 amendment to the Act on Protection of Cultural Properties. These are action plans for the conservation and utilization of cultural properties in a municipality.

Here, cultural heritage is not considered a stand-alone entity, but a "surface area," meaning that the area itself is important, and the group of cultural heritage in the area is thus considered a treasure for the community. By connecting cultural heritage to an area, the entire historical and cultural environment can be understood under a single theme or story. Thus, residents and visitors alike can better savor that story, understanding the historic environment and, by extension, the city as a whole.

Furthermore, this regional plan is also a framework for promoting the conservation and utilization of cultural properties based on a comprehensive regional survey of the various cultural properties, designated and undesignated. Through the preparation of this regional plan, the diverse cultural heritage of the region is revealed, leading to the protection of newly found or recognized cultural heritage. The list of cultural heritage sites will be compiled into a database that serves as a resource for future conservation and utilization, connecting it to the disaster prevention of cultural heritage.

In other words, this database will be the first document referred to for the regional planning of disaster prevention measures during normal times and for assessing the damage to cultural properties at the time of a disaster. In the Cultural Property Doctor Dispatch Program mentioned above, it is assumed that after a large-scale disaster, this list would be used to survey the damage and support the recovery of cultural properties.

In order to protect important historic environments from natural disasters such as large-scale earthquakes, local communities must identify their cultural heritage, whether designated or not, and need to specify what would be recovered in their disaster prevention plans.

Cultural heritage resilience to natural disasters begins with the identification and understanding of the many cultural heritage sites.

(Sadahiko Tanaka)

2.3 Developing Human Resources and a Collaboration System

Heritage Managers and Cultural Property Doctor Projects

Heritage Managers

The Great Hanshin-Awaji Earthquake in 1995 caused such a shortage of people supporting the recovery of cultural property buildings, that even the chief engineers assigned by the national government for the important preservation districts for groups of traditional buildings were insufficient to provide the necessary support. Thus, engineers who had studied at the Japan Architecture Seminar were asked to support these endeavors. This reality led to a strong recognition of the need for regional specialists, so in 2001 the first training course for heritage managers was inaugurated in Hyogo Prefecture. Currently, these activities are spreading throughout the country.

The term "heritage managers" refers to individuals who have the ability to discover, preserve and utilize the community’s historical and cultural heritage for community planning. More than 20 years have passed since Hyogo Prefecture began training heritage managers, and as of 2021, 46 prefectural Architects & Building Engineers Associations, as well as NPOs in two ordinance-designated cities, offer training. Meanwhile, the Japan Institute of Architects offers a course called "School for the Conservation of Cultural Properties," which has now spread nationwide. In 2012, the "Guidelines for the Training and Activation of Specialists in the Conservation and Rehabilitation of Historic Buildings (Heritage Managers)" were approved, and the National Heritage Managers Network Council was established, creating a system of mutual cooperation across prefectural boundaries. The significance of their existence has been recognized in various regions. For example, in 2015, a committee for historic buildings was established within the Okayama Society of Architects & Building Engineers, and in 2020, Yuasa Town in Wakayama Prefecture designated the Wakayama Association of Architects & Building Engineers as a support group for the protection and utilization of cultural properties, as stated in Article 192-2 of the Act on Protection of Cultural Properties. In Yuasa Town, *machiya* (townhouses), mud-walled storehouses, and other traditional buildings related to the soy-sauce brewing industry remain well preserved in the urban area, and there is an important preservation district for groups of traditional buildings. The designation of a support group to carry out work in this district makes the firm commitment to post-disaster recovery support for the historic buildings in that preservation district well-known.

The Cultural Property Doctor Dispatch Program

Together with the heritage manager training, the Agency for Cultural Affairs launched the Cultural Property Doctor Dispatch Program in response to the Great East Japan Earthquake. As explained in section 2.2, the Great East Japan Earthquake in 2011 caused such extensive and tremendous damage that concerns arose about the difficulties at the administrative level to quickly conduct a complete damage assessment of the cultural properties. A new project plan was launched to survey the damage conditions of cultural property buildings by dispatching university architectural historians and private historical building specialists to the disaster-stricken area. Specifically, experts associated with the Architectural Institute of Japan, the Japan Institute of Architects (JIA), the Japan Federation of Architects & Building Engineers Associations, and other related organizations formed the "Support Committee for the Recovery of Cultural Property Buildings." The Agency for Cultural Affairs requested the cooperation of the committee, and together with the public and private sectors they conducted systematic surveys to understand the extent of the damage at an early stage while providing technical support for recovery.

In this way, it was possible to respond to the earthquake damage. In the case of the Great East Japan Earthquake, the Architectural Institute of Japan and the JIA served as the secretariat for the "Cultural Property Doctor Dispatch Program" commissioned by the Agency for Cultural Affairs. However, as the Great East Japan Earthquake disaster occurred in March 2011, the Great East Japan Earthquake Recovery Support Committee was launched in May, and the Cultural Property Doctor Dispatch Program started in September so it took about six months until the program could be implemented.

Like the Great East Japan Earthquake, the Kumamoto Earthquake caused extensive damage, and a disaster damage survey and expert technical support were deemed necessary. On April 20, six days after the earthquake, officials from the Architectural Institute of Japan, the Japan Federation of Architects & Building Engineers Associations, the JIA, and the Japan Society of Civil Engineers (JSCE) gathered at the Agency for Cultural Affairs to discuss their response. They established the Support Committee for the Recovery of Cultural Property Buildings, which decided to launch the Cultural Property Doctor Dispatch Program holding the Japan Federation of Architects & Building Engineers Associations as secretariat. On May 19, the Agency for Cultural Affairs formulated the implementation guidelines for the project, and on June 1, a contract was signed with the Japan Federation of Architects & Building Engineers Associations to begin the project. For this project, damage surveys mainly focused on nationally registered tangible cultural properties, municipally designated cultural properties, structures of scenic importance, and undesignated historic buildings. The Support Committee for the Recovery of Cultural Property Buildings was set up immediately after the disaster, and the Cultural Property Doctor Dispatch Program was launched two months later, resulting in a quicker initial response than that of the Great East Japan

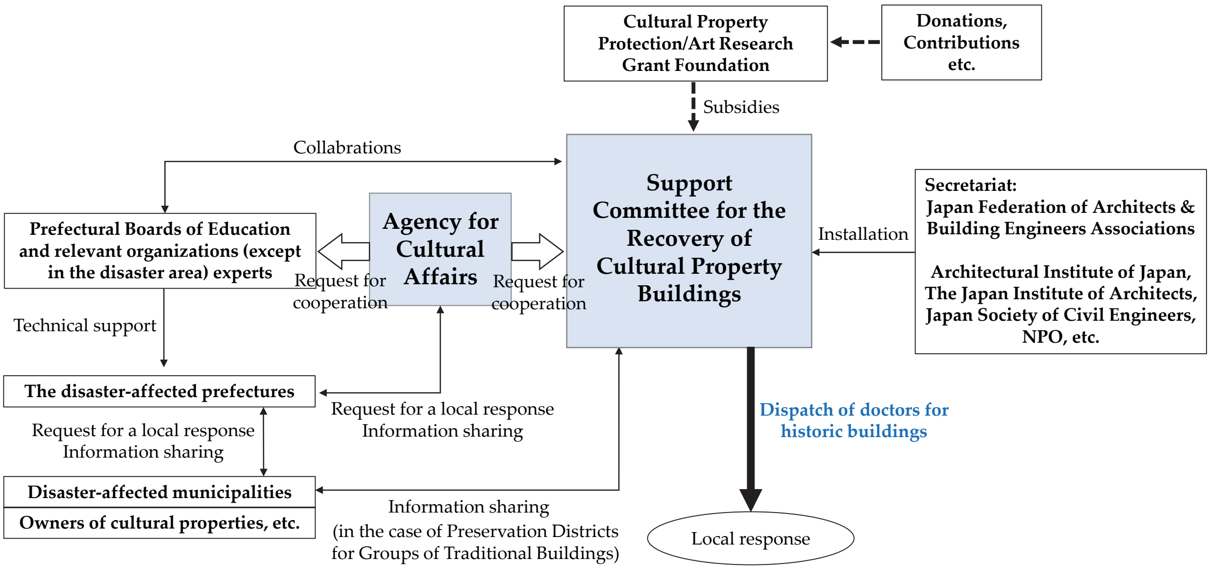

Figure 2.3.1 **Cultural Property Doctor Dispatch Program System in the Kumamoto Earthquake**

Earthquake. (Figure 2.3.1)

In addition, the survey focused on buildings of historical value, whether designated or undesignated. The Architectural Institute of Japan prepared a database of historic buildings in various places (called the Historic Building Inventory Database) based on various survey reports. The Japan Federation of Architects & Building Engineers Associations and the JIA had entered an agreement for the joint use of that database, hoping that it would be used effectively in the event of a disaster. This was the first time the database was put to use.

Coordinating Heritage Managers in the Event of a Disaster

The significance of the heritage managers network was quickly recognized when heritage managers, shortly after their training began, supported local recovery activities from the severe damage that a typhoon caused in Toyooka City, Hyogo Prefecture, in October 2004.

However, at the time of the Great East Japan Earthquake disaster, the heritage manager training had not yet advanced nationwide, and the heritage managers who could respond then were mainly engineers from the Shizuoka and Kanagawa prefectures, with a few participants from the disaster-stricken Tohoku region and a small number of JIA members.

The response to the Kumamoto Earthquake was characterized by the fact that the heritage managers from all over Kyushu carried the practical work out. It was also characterized by holding the location of the secretariat in Fukuoka Prefecture and not in Kumamoto Prefecture, which was the epicenter of the earthquake. This is typical for wide-area disasters, where local engineers are affected by themselves, which drives the surrounding areas to provide support. In the region of Kyushu, which includes Kumamoto, disaster trainings were conducted before the earthquake struck. Additionally, the Kyushu Block of the Architects & Building Engineers Associations reached an agreement before the earthquake to allow for mutual support in the disaster damage surveys of damaged historic buildings. The agreement stipulated that in the event of a disaster in the northern part of Kumamoto Prefecture, the secretariat would be located in Fukuoka Prefecture, and this was carried out accordingly. In addition, a system was established to provide knowledge of Kumamoto's historic buildings to engineers from the Kyushu block who were not from the Kumamoto Prefecture so that they could design and supervise the full-scale recovery in the area. In preparation for this, the Japan Federation of Architects & Building Engineers Associations prepared a "Manual for the Survey and Recovery of Disaster Damaged Historic Buildings" in 2014 at the request of the Kyushu block. Each prefecture is also using this resource as a textbook to step up the heritage managers' training.

By sharing these experiences and achievements among heritage managers in Japan, recovery support activities across the region functioned well in the wake of the Tottori Earthquake in October 2016 and the torrential rainfalls in Kyushu that have been occurring frequently since 2017.

The Cultural Heritage Rescue Program and the Cultural Heritage Disaster Risk Management Center

The Cultural Heritage Rescue Program

The Cultural Heritage Rescue Program was established to provide immediate protection for damaged movable cultural properties and to prevent them from being disposed of, scattered, or stolen. This is a rescue program led by the Agency for Cultural Affairs with the cooperation of a wide range of specialists, groups, and organizations related to cultural properties, museums, and art museums, and it was first undertaken after the Great Hanshin-Awaji Earthquake struck.

Immediately after the Great East Japan Earthquake in March 2011, the Agency for Cultural Affairs launched the "Project for the Rescue of Cultural Properties Damaged by the 2011 off the Pacific coast of Tohoku Earthquake" (the so-called "Cultural Heritage Rescue Program"). With the National Institutes for Cultural Heritage as its secretariat, the program ran for two years until the end of FY2012. The program provided temporary evacuation and emergency treatments for damaged cultural properties regardless of designation or registration status, and beyond arts and crafts, it supported a wide range of fine art objects, natural history documents, archives, and books. After the Fukushima Daiichi Nuclear Power Station accident, many cultural properties remained in areas of Fukushima Prefecture that were inaccessible, including the formerly restricted areas. The National Institutes for Cultural Heritage took the initiative in implementing the "Project for Rescuing Damaged Cultural Properties in Fukushima Prefecture (Fukushima Cultural Properties Rescue Project)" to support Fukushima Prefecture.

The rescue activities that followed the Kumamoto Earthquake in 2016 were voluntarily undertaken by the "Kumamoto Damaged Historical Documents Rescue Network," which was established by university faculty and museum curators from Kumamoto Prefecture, the Kumamoto Prefectural Museum of Art, the Municipal Kumamoto Museum, and the Kumamoto Museum Network Center (an institution that supports museums and art museums in Kumamoto Prefecture). As an example of the activities carried out, in the case of the Kumamoto Prefectural Museum of Art, immediately after the main shock, on April 18, the museum removed a Buddha statue, a national important cultural property, from a temple in the city. Also, on April 27 a work by the painter Tsuguharu Fujita that belonged to the collection of an elementary school attached to Kumamoto University was removed. The "Cultural Heritage Rescue Program" was launched in July at the beckoning of the Agency for Cultural Affairs, and organizations that had already been carrying out rescue operations joined in. The project proceeded in the same manner as in previous Cultural Heritage Rescue Programs: the owners of damaged cultural properties would make a request, upon which the need for rescue would be determined. Following that assessment, the properties in need of rescue were transported to a safe place and given emergency treatments such as mold and dust removal, drying, and fumigation. The objects were then temporarily stored until their owners returned. Requests were made to museums and research facilities in Kyushu and Yamaguchi to dispatch the experts necessary for the work. (Figure 2.3.2)

In the case of the Kumamoto Earthquake, the Kumamoto Prefectural Board of Education had compiled a list of municipal designated and undesignated cultural properties by 1998 for the purpose of identifying designated cultural property candidates. However, the damage was so extensive and the aftershocks were so prolonged, that operationalizing became difficult, and regrettably, it took three months from the time of the earthquake until the rescue project was launched. About 20 years had passed since the survey was conducted, and the list had not been updated. Thus, in some cases, the ownership of a piece of cultural property was unknown because of owner changes, and in other cases, cultural properties that were not on the list were rescued. Other issue examples can be given,

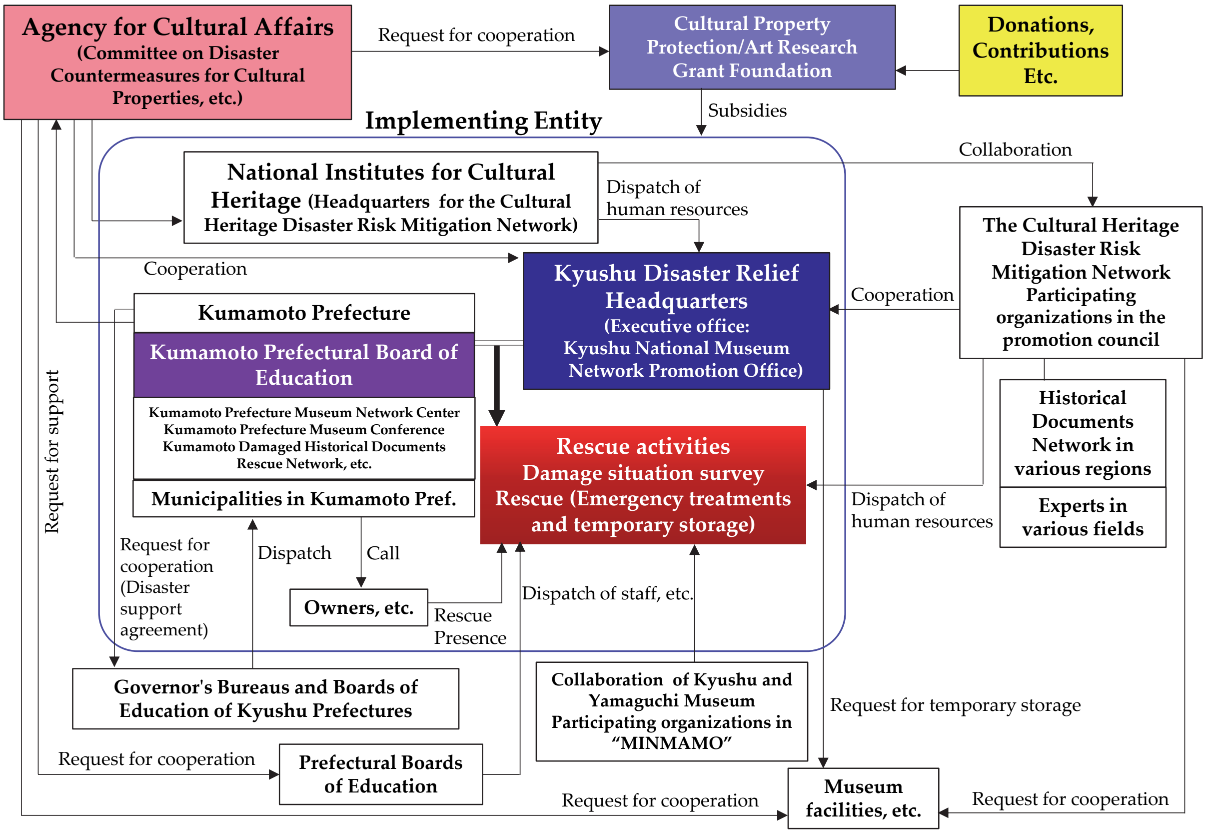

Figure 2.3.2 Cultural Heritage Rescue Program System in the Kumamoto Earthquake

such as securing a work site for emergency treatments and storage of cultural properties. Similar problems were faced during the Great East Japan Earthquake when it was difficult to find a place to store cultural properties because priority was given to the evacuated residents.

The Cultural Properties Disaster Management Network and the Cultural Heritage Disaster Risk Management Center

Based on experiences such as these cultural property rescue examples, the National Institutes for Cultural Heritage recognized the urgent need to establish a system of cultural property disaster prevention and salvage activities for damaged cultural properties in the event of large-scale disasters such as the Nankai Trough Earthquake and the Tokyo Inland Earthquake, which are expected to occur in the future. In July 2014 the "Cultural Properties Disaster Prevention Network Headquarters" were established to build a network for disaster prevention of cultural properties in the event of a disaster. At the same time, with the support of the Agency for Cultural Affairs, the "Cultural Properties Disaster Prevention Network Project" was launched. In October 2020, the Cultural Heritage Disaster Risk Management Center was established as the headquarters of the National Institutes for Cultural Heritage to provide prompt and effective relief and support at the time of a disaster in cooperation with many organizations and experts. The center is also expected to serve as a hub for information sharing and cooperation with related organizations in the event of a disaster.

(Hajime Yokouchi, Osamu Goto)

The Establishment of the Cultural Heritage Disaster Risk Management Center and the Development of a Collaborative System for Cultural Property Disaster Prevention

Establishment of the Cultural Heritage Disaster Risk Management Center

As mentioned above, the Cultural Heritage Disaster Risk Management Center was established in October 2020 as the headquarters facility of the National Institutes for Cultural Heritage after a six-year project to promote a cultural property disaster prevention network. The Cultural Heritage Disaster Risk Management Center has the following three missions and operates under five principles to achieve these missions.

Three Missions ;

1. Create disaster mitigation efforts to minimize damage to cultural properties
2. Establish a system and develop technologies to rescue damaged cultural properties as quickly as possible
3. Support relief activities for cultural properties at the time of a disaster

Five Activity Principles ;

1. Establishing a local disaster prevention management system
2. Maintaining guidelines for the event of a disaster
3. Developing technologies for the rescue, collection, and exhibition of artifacts
4. Raising public awareness
5. Collecting and using information on cultural property disaster prevention

Of these, "establishing a local disaster management system" supports and promotes network-building related to cultural property disaster management, while under "raising public awareness" trainings, symposiums, lectures, and more are provided to foster human resources.

The 2018 revision of the Act on the Protection of Cultural Properties saw the formulation of a framework for the prefectural protection and utilization of cultural properties and the institutionalized recognition by the Director-General of the Agency for Cultural Affairs of regional plans prepared by municipalities that support the protection and utilization of cultural properties. The framework for the protection and utilization of cultural properties (or "the Framework") includes a section entitled "Disaster Prevention and Response," which describes " relevant efforts, including preparing for disasters by building a rescue network in normal times, collecting information related to the damage, and carrying out emergency rescue activities." In addition, the Regional Plans for the Protection and Utilization of Cultural Properties (or the "Regional Plans") are to include "measures for protection and utilization of cultural properties," such as "disaster and crime prevention measures, and measures for disaster response." In terms of disaster and crime prevention measures, countermeasures that can be taken when there is no disaster, include improving seismic resistance, installing fire and crime prevention equipment, improving the surrounding environment, and implementing patrols run by cultural property protection advisory committee members." It is also effective to establish an emergency disaster rescue system in advance, a technical expert guidance system to provide advice on damage condition surveys and repair methods[1)]. The establishment of the Cultural Heritage Disaster Risk Management Center as a permanent organization is highly significant, given that local governments are becoming more interested in cultural property disaster management through the formulation of the Framework and the Regional Plans, which is coupled with an awareness of the frequent occurrence and extreme severity of natural disasters.

The Cultural Heritage Disaster Risk Management Center's Efforts ~Building a Local Disaster Prevention Management System~

The Cultural Heritage Disaster Risk Management Center's efforts are not limited to disaster-related cultural property rescue. The Center also focuses on disaster mitigation: how to prevent cultural property damage, what to do to minimize it, and what to do in normal times to achieve this. This is because while it is impossible to control natural phenomena such as typhoons and earthquakes, it is possible to mitigate the damage they cause (disaster mitigation). One of the efforts to achieve this

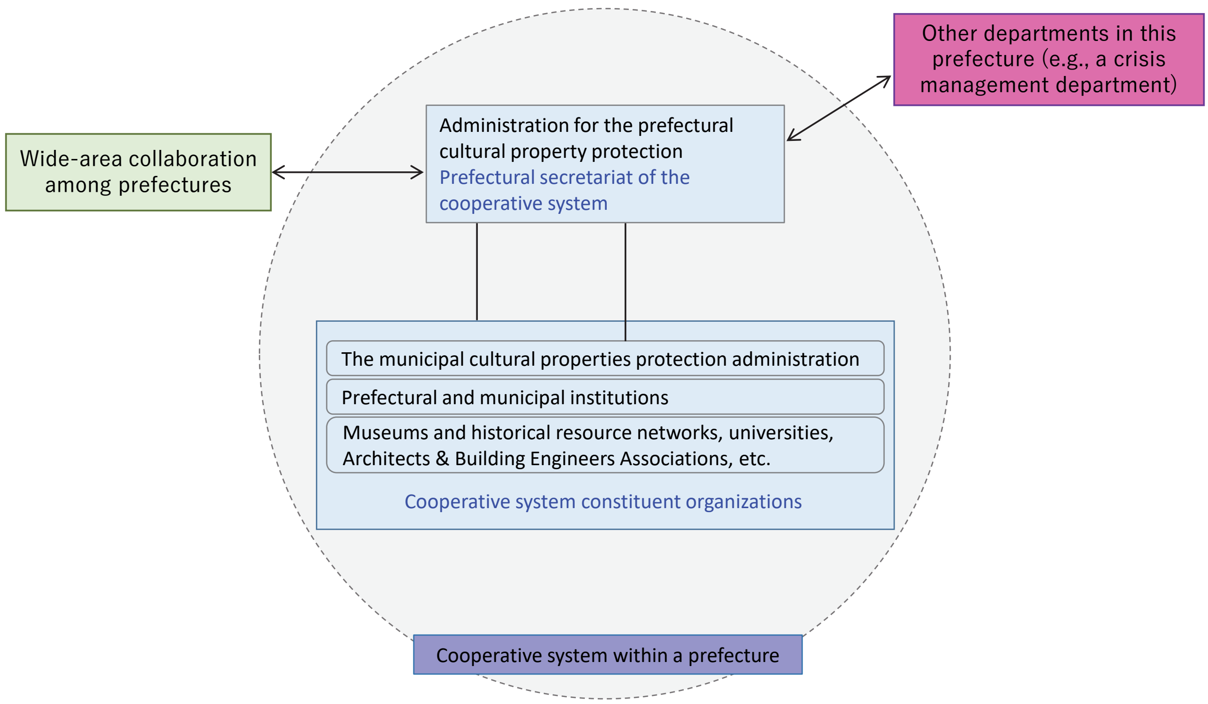

Figure 2.3.3 **Image diagram of intra-prefectural and inter-prefectural cooperation networks**

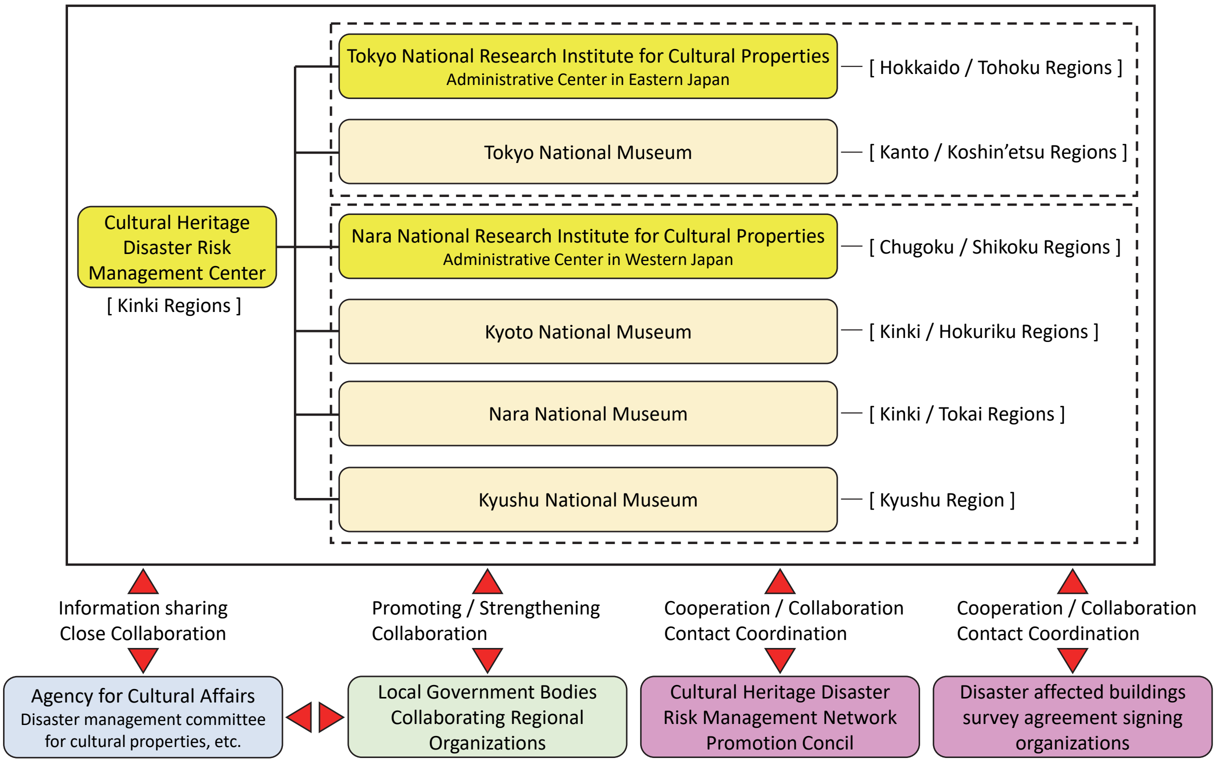

Figure 2.3.4 **Related organizations for cultural heritage disaster risk management**

goal is the establishment of the Local Disaster Prevention Management System. As mentioned earlier, the "Establishing a Local Disaster Prevention Management System" project supports and promotes the establishment of networks related to cultural property disaster management. Specifically, the project supports the protection of cultural properties in different regions as well as the regular sharing of information. Additionally, in order to conduct disaster rescue activities, the project supports the establishment of a cooperative system within prefectures, as well as a mutual inter-prefectural support system through wide-area collaboration. Thus, the prefectural cultural properties protection administration and the Cultural Heritage Disaster Risk Management Center are deepening their cooperation system. It is important to cooperate during normal times and also when responding to disasters. (Figure 2.3.3)

The term "disaster prevention" is defined in the Basic Act on Disaster Management[2)] as "the prevention of disasters, the prevention of disaster damage spreading, and disaster recovery." Additionally, based on the Basic Act on Disaster Management, the Basic Disaster Management Plan[3)] prepared by the National Disaster Management Council under Article 34, Paragraph 1 states, "Disaster prevention consists of three stages over time: disaster management, disaster-related emergency measures, and disaster recovery and rehabilitation. Taking the best possible measures at each stage will lead to the reduction of damage." When considering the disaster prevention management of cultural properties, it is necessary to consider the measures to be taken in each of these three phases. Furthermore, a local disaster management system must be established to create a local network capable of carrying out the series of efforts related to cultural property disaster prevention. Cultural property disaster management is only possible through the collaboration of a variety of regional organizations and people involved with cultural properties. In order to protect cultural properties from disaster, it is important to establish such systems and to actually make them work, and the Cultural Properties Disaster Risk Management Center provides support for such efforts. (Figure 2.3.4)

Cooperation with Various Specialized Organizations

In order to promote disaster prevention for a variety of cultural properties, it is essential to cooperate with various specialized organizations related

Figure 2.3.5 **Building Disaster Risk Management Systems for Japan's cultural heritage through effective use of related networks**

to cultural properties. The Cultural Heritage Disaster Risk Management Center also serves as a hub to connect these specialized organizations with each other as well as with local governments. Regarding movable cultural properties, these specialized organizations, which collaborate in normal times with the Center for Cultural Property Disaster Risk Management, are participating in the "Cultural Heritage Disaster Prevention Network Promotion Conference". For immovable cultural properties (mainly buildings), there is the Cultural Property Doctor Dispatch Program Team (an organization that contracted the "Agreement on Collaborative Damage Assessments and Technical Support for Historic and Cultural Property Buildings at the Time of a Disaster"). (Figure 2.3.5)

The Council for the Promotion of the Cultural Property Disaster Prevention Network was formed when the Cultural Property Disaster Management Network Promotion Project began. The Council called for the participation of related organizations, including member organizations of the Committee for the Relief of Cultural Properties Damaged by the 2011 off the Pacific coast of Tohoku Earthquake. The number of participating organizations has increased over the six years that span the Cultural Property Disaster Management Network Promotion Project. Furthermore, since the Cultural Heritage Disaster Risk Management Center was established, participating organizations have increased, reaching 26 as of October 2022. This network is designed to share information in normal times, to protect cultural properties from disasters through preparations made in advance, and to promptly carry out disaster-related rescue and support activities for cultural properties. In addition, the Network formulated the "Guidelines for the Activities of the Council for the Promotion of the Cultural Property Disaster Prevention Network in the Event of a Disaster," which describe basic policies for the participating organizations to share information and cooperate with each other when a request for assistance is issued after a disaster.

The Cultural Heritage Disaster Risk Management Center aims to promote a more comprehensive approach to cultural property disaster management by expanding the scope of the Cultural Property Disaster Management Network Promotion Project, which mainly targets movable cultural properties, to include buildings, historic sites, places of high artistic or scenic beauty, and natural monuments. The Cultural Property Doctor Dispatch Program was launched in the wake of the Great East Japan Earthquake and was also implemented at the time of the Kumamoto Earthquake. Its purpose was to protect historic buildings by surveying the disaster damage they sustained and to provide technical support for the emergency treatment and recovery of cultural properties. Along with the above-mentioned activities carried out by the established Cultural Heritage Disaster Risk Management Center, in March 2022, together with the Architectural Institute of Japan, the Japan Federation of Architects & Building Engineers Associations, the JIA, and the Japan Society of Civil Engineers, it signed the "Agreement on Collaborative Damage Assessments and Technical Support for Historic and Cultural Property Buildings at the Time of a Disaster". The Center believes that this agreement will enable it to conduct prompt and systematic damage condition surveys and provide technical support even in the event of a disaster that is not categorized as being extremely severe. Currently, the Center is working on the formulation of guidelines that will define specific matters related to its activities.

We would like to continue deepening our efforts in cultural property disaster prevention management by strengthening the cooperation and collaboration with a variety of specialized organizations involved with cultural properties.

References

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2) Basic Act on Disaster Management https://elaws.e-gov.go.jp/document?lawid=336AC0000000223 (see 2022.10.31)
3) Basic Disaster Management Plan https://www.bousai.go.jp/taisaku/keikaku/pdf/kihon_basicplan.pdf (see 2022.10.31)

(Shiho Nakashima, Yohsei Kohdzuma)

2.4 Presentation of Guidelines for Ensuring the Seismic Safety of Historic Buildings

Background

The seismic resistance guidelines for historic buildings often follow the Guidelines for National Treasures and Important Cultural Properties established by the Agency for Cultural Affairs. As for registered tangible cultural properties, groups of traditional buildings, and other historic buildings that are not designated or registered, the Building Standards Act is the instrument that applies. The Act requires taking seismic resistance measures considering the value of the historic building.

The Agency for Cultural Affairs' guidelines mainly describe full-fledged seismic resistance measures, but after a disaster, it is essential to quickly assess the level of damage, establish a system, and a create roadmap for emergency response and permanent recovery in order to preserve the damaged historic buildings. Preparing a manual for this purpose is also important.

This section first explains the history and content of the Agency for Cultural Affairs' guidelines for seismic resistance measures and then introduces the Japan Federation of Architects & Building Engineers Associations' "Manual for Survey and Recovery of Disaster Damaged Historic Buildings," which provides specific measures for damaged cultural properties.

Since most cultural property buildings are made of wood, disaster prevention in Japan focused exclusively on fire prevention, so with few exceptions seismic resistance measures had been neglected. Since the enactment of the Ancient Shrines and Temples Preservation Law in 1897, which marked the official beginning of cultural property preservation, the first significant earthquake damage to cultural properties occurred during the Great Kanto Earthquake in September 1, 1923, during the 12th year of the Taisho era.

The earthquake caused damage mainly in Tokyo and Kanagawa, causing the collapse of Engakuji Temple's relic hall and Kenchoji Temple's Buddhist hall and *karamon* (cusped-gable gate). However, as recovery was possible, little importance was given to seismic resistance measures.

It was not until the Great Hanshin-Awaji Earthquake in January 17, 1995, that serious earthquake measures began to be taken for cultural property buildings. The earthquake damaged a large number of cultural properties, including 116 important cultural properties and one important preservation district for groups of traditional buildings. In particular, the former Kobe Settlement 15th Building, which was normally used as a restaurant, completely collapsed, and the need for cultural property building seismic resistance measures was recognized. Immediately after the earthquake, the Agency for Cultural Affairs set up the "Cooperative Research Conference for Improving the Seismic Performance of Cultural Property Buildings," and began preparing comprehensive guidelines to establish seismic resistance measures for cultural property buildings.

Then, on January 17, 1996, exactly one year after the earthquake, the "Guidelines for Ensuring Safety of Cultural Properties (Buildings) During Earthquakes" were formulated. Three years later, in April 1999, the "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" and the "Implementation Guidelines for Owner's Seismic Assessment of Important Cultural Properties (Buildings)" (now called the Preliminary Seismic Assessment) were established. Two years later, in April 2001, the "Implementation Guidance for Basic Seismic Assessment of Important Cultural Properties (Buildings)" were formulated, presenting a basic diagnosis method for seismic measures.

In June 2012, in light of the earthquake damage caused by the Great East Japan Earthquake (The 2011 off the Pacific coast of Tohoku Earthquake), the "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)," which were established over 10 years earlier, were revised. Along with content corrections that reflected past measure examples and accumulated research results, a description of "transitional reinforcement" was added as a transitional measure to mitigate earthquake damage before full-fledged reinforcement can be applied. Major revisions also include changing the names of "owner assessment," "basic assessment," and "expert assessments" to that of "preliminary seismic assessment," "basic seismic assessment," and "expert seismic assessment" respectively. Regarding the basic assessment, the evaluation for moderate earthquakes is treated as a reference value; and the standard performance target for possible restoration was set to half of that for large earthquakes.

In parallel, in 2013, a pamphlet to explain the necessity of seismic measures to cultural property owners was prepared and distributed. The pamphlet was called "Let's Protect Cultural Property Buildings from Earthquakes! Q&A," and it included a guide of seismic resistance measures for engineers, the "Manual for Assessing Seismic Resistance and Seismic Reinforcement of Important Cultural Properties (Buildings)." The booklet was distributed and posted on the website. (Figure 2.4.1)

Subsequently, in 2017, the "Guide" was revised to include seismic resistance measures for brickwork and reinforced concrete constructions, deterioration measures for structures, seismic resistance measures for ceilings and other nonstructural elements (which were an issue in the Great East Japan Earthquake disaster) and an increased number of case studies of 48 from the previous 27.

In August 2018, the "Guideline for Preparing Earthquake Protection Policy of Important Cultural Properties (Buildings)" were formulated to define safety and other soft measures, and the promotion of these efforts was disseminated through administrative communications and leaflets.

As described above, various guidelines have been prepared for national treasures and important cultural properties. The generous aid from the state has helped advance seismic assessments, repairs, and the implementation of seismic measures. Some success has been reached, but many of the houses in the traditional building preservation district are privately owned, so promoting seismic resistance measures has become a difficult task due to issues related to financing and human resources.

Therefore, from FY2017 to FY2019, the Agency for Cultural Affairs opened discussions on seismic resistance measures for groups of traditional buildings at the "Collaborators' Meeting on Seismic Resistance Measures for Groups of Traditional Buildings." The Agency compiled these measures by collecting the opinions of the National Council for the Preservation Districts of Groups of Traditional Buildings and the persons in charge of each local preservation district. The measures were published in January 2020 as the "Manual for Seismic Resistant Countermeasure of District of Groups of Traditional Buildings."

Figure 2.4.1 **The pamphlet "Let's Protect Cultural Property Buildings from Earthquakes! Q&A"**

All of these guidelines and guides are available on the Agency for Cultural Affairs' website.

Agency for Cultural Affairs: Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)

The Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings) are"

(1) "Guidelines for Ensuring Safety of Cultural Properties (Buildings) During Earthquakes" (January 1996)
(2) "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" (April 1999, revised June 2012)
(3) "Implementation Guidelines for Preliminary Seismic Assessment of Important Cultural

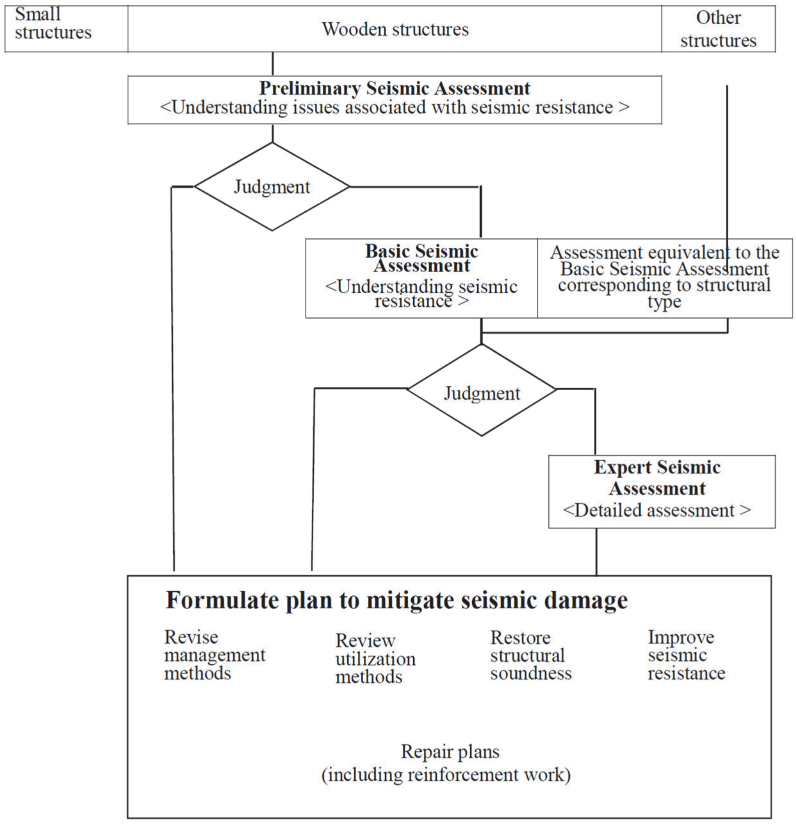

Figure 2.4.2 **Flow chart of seismic assessment and formulation plan for Important Cultural Properties (buildings)**

Properties (Buildings)" (April 1999, revised June 2012)

(4) "Implementation Guidance for Basic Seismic Assessment of Important Cultural Properties (Buildings)" (April 2001, revised June 2012)

In addition, safety and other soft measures are defined in:

(5) "Guideline for Preparing Earthquake Protection Policy of Important Cultural Properties (Buildings)" (August 2018)

(1) The "Guidelines for Ensuring Safety of Cultural Properties (Buildings) During Earthquakes" present a basic approach to cultural property earthquake damage assumptions and the policies for dealing with such damage. Basic concepts presented in the guidelines are that cultural property buildings need to be safe during earthquakes, that reinforcement should be carried out to the extent that the building's value is not lost, that reinforcement should be carried out in conjunction with soft seismic measures, and that in unavoidable cases, if such reinforcement work causes the loss of value, an entry should be restricted to ensure safety. The guidelines also indicate that the responsibility for seismic resistance measures lies with the cultural properties' owners, a chief administrator, or management organizations.

(2) The "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" provide standard methods and matters to be noted for the assessment of the seismic damage to cultural properties and for the development of relevant policies. Specifically, the Guidelines provide the following information: (Figure 2.4.2)

- The target of seismic assessments is buildings, excluding small-scale structures (structures with a total area of 10 m^2 or less, such as *torii* gates, stone monuments or pagodas, fences, etc.). Because the seismic assessment method is intended for wooden structures, appropriate seismic methods for masonry, steel, concrete, and civil engineering structures should respect the seismic diagnosis purpose and take structural characteristics into consideration.

- There are three types of assessment: the “preliminary seismic assessment,” the “basic seismic assessment,” and the “expert seismic assessment.” The “preliminary seismic assessment" is a simple method of noting the location, structural characteristics, and preservation status of a building to determine its seismic issues and decide whether or not to proceed to the next stage, the basic seismic assessment. The “basic seismic assessment” is a specialized diagnosis of the building based on information obtained mainly from visual inspection and the exterior. The "expert seismic assessment" is a specialized diagnosis based on detailed information obtained if and when repair, complete dismantlement, and reassembly works are carried out for the original structures. The basic and expert seismic assessments are carried out under the assumption that the building's structure can be repaired and that it is in sound condition for the diagnosis to take place.

- There are three necessary levels of seismic resistance, depending on the use and characteristics of the building. The "standard for maintaining functionality" is the strictest standard, and it requires the building to be able to maintain its functions even in the event of a major earthquake. This standard applies to infrastructure and facilities used as disaster prevention centers. The "standard for maintaining safety" requires that buildings do not collapse during a major earthquake, and it applies to buildings that people use. The performance is generally equivalent to that of general buildings. The “standard for possible restoration” applies to rar ely visited buildings that are unsafe or at risk of collapsing during a major earthquake but that can be restored as cultural properties, such as *minka* (traditional folk houses), barns, and the main halls of shrines.

-Categorization is based on whether the building can maintain its functions during a major earthquake, whether it will collapse, and whether it is in danger of collapsing.

-Points to note on the improvement of seismic performance measures include methods and procedures to avoid damaging cultural properties, the concept of "transitional reinforcement" to mitigate the damage as much as possible, and recommendations for the creation and publication of process records related to reinforcement plans and public recommendations.

The specific methods of the preliminary seismic assessment and the basic seismic assessment are shown in the following implementation guidelines.

(3) The “Implementation Guidelines for Preliminary Seismic Assessment of Important Cultural Properties (Buildings)” provide specific methods for conducting preliminary seismic assessments. Although the assumption was that the assessment would be carried out by the building’s owner, in reality, it is conducted with the cooperation of experts such as repair technicians and architects. This method is applicable to wooden constructions, and it involves making observations and simple on-site measurements to fill a questionnaire out. Questionnaire items related to the local environment, structural characteristics such as scale and shape, framework and roof structure, and conservation status, are calculated by tallying the scores. Results are categorized into the “OK” rating for 60 or higher total points (judgment A), that of "need for repair" identified through conservation items (judgment B), or that of “NG” (judgment C), which indicates the need to conduct a basic seismic assessment as soon as possible.

This questionnaire is designed to give points if the ground is appropriate, there is no history of earthquakes, the plan shape is regular, the columns are thick, many walls are set up, there is a good balance of column and wall placement, and if the roof is not overgrown.

(4) The “Implementation Guidance for Basic Seismic Assessment of Important Cultural Properties (Buildings)” provide specific basic seismic assessment methods, which are structural analyses carried out by a structural design firm or other experts. The guidelines state that an appropriate method should be selected according to structural characteristics. Assuming a wooden building, the “Method Using the Energy Conservation Law " and the "Equivalent Linearization Method" are given as examples.

The basic seismic assessment is based mainly on visual information obtained from the exterior, while the expert seismic assessment is based on aspects such as wooden member joinery and hidden structures that are revealed on the occasion of repair or dismantlement. When the Guidelines were formulated, it was assumed that the accuracy and complexity of these diagnosis forms would differ greatly. In recent years, in order to examine cultural property buildings in more detail and reduce the need for reinforcement, the Basic Seismic Assessment was generally conducted with more detailed information. Non-destructive inspection methods have been used such as infrared camera observation or the removal of some parts of the building. Thus, the difference between the Basic Seismic Assessment and the Expert Seismic Assessment is becoming smaller. In the Guidelines, in the case of wooden constructions, the equivalent linearization method, or so-called "calculation of response and limit strength," is often used for diagnosis. For multi-level structures such as towers and donjons, or buildings with complex planes, time history response analysis may be used, in which the earthquake waveforms are fed directly to a structural model to examine the response.

(5) The "Guideline for Preparing Earthquake Protection Policy of Important Cultural Properties (Buildings)" compile measures to mitigate damages as much as possible in cases where a "preliminary seismic assessment," a "basic seismic assessment," or an "expert seismic assessment" indicates that a higher level of diagnosis or seismic reinforcement is necessary but following measures cannot be taken. The document outlines soft measures for ensuring safety in the building, such as prohibiting entry, restricting the number of people inside, and clearly indicating evacuation methods and routes to be shared and communicated.

Agency for Cultural Affairs: Manual for Assessing Seismic Resistance and Seismic Reinforcement of Important Cultural Properties (Buildings)

The Manual for Assessing Seismic Resistance and Seismic Reinforcement of Important Cultural Properties (Buildings) (September 2013, revised March 2017) is a guide of seismic resistance measures, mainly intended to explain the "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)." It was prepared in conjunction with the revision of the Guidelines and is intended to inform owners, government officials, cultural property repair technicians, architectural technicians, building structure specialists who are engaged in the practice of the purpose and content of the revision, and other people involved in the seismic assessment. In addition to disseminating the purpose and content of the revision, the Guide provides explanations of the Guidelines' content to deepen the understanding of the philosophy and concept behind each implementation procedure as well as its handling. The basic contents of the revision are explanations of the "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" and the "Implementation Guidance for Basic Seismic Assessment of Important Cultural Properties (Buildings)," focusing on the positioning, concept, and application of each procedure. The 2017 revision included seismic resistance measures for brickwork and reinforced concrete constructions (which were not thoroughly explained in the Guidelines), deterioration counter-

Figure 2.4.3 **Case studies shown in The Manual for Assessing Seismic Resistance and Seismic Reinforcement of Important Cultural Properties (Buildings)**

measures for structures, and seismic countermeasures for nonstructural elements such as ceilings, which were an issue in the Great East Japan Earthquake disaster.

In the Guide, the approach to seismic reinforcement is based on the premise of respecting the value of cultural properties and the following five principles: (1) Do not compromise the design, (2) do not cause damage to the components, (3) be reversible, (4) be distinguishable, and (5) use minimal reinforcement. The most difficult part is to sort out the subjective and conflicting conditions that have the least impact on the cultural properties, such as where to place the cultural property's value, which design and materials must be protected, and how to provide reinforcement details that will cause as little damage as possible.

The guide also includes a separate volume with 48 revised case studies. It covers traditional wooden structures (shrine and temple buildings), residential buildings, castles, Western-style wooden structures, other wooden buildings, timber framed brick masonry buildings, brick buildings, reinforced concrete and steel reinforced concrete buildings, civil constructions, and many different types of buildings and reinforcement methods as possible. (Figure 2.4.3)

Agency for Cultural Affairs: Manual for Seismic Resistant Countermeasure of District of Groups of Traditional Buildings

The "Manual for Seismic Resistant Countermeasure of District of Groups of Traditional Buildings" (January 2020) is a guide for promoting seismic resistance measures for groups of traditional buildings. Traditional groups of cultural property buildings have different characteristics and social backgrounds than important cultural properties, so this Guide is characterized by the fact that it presents the concepts and measure procedures divided into policies to be taken by the administrative side and individual measures taken, for example, by the owners of cultural properties.

The policy measures include the formulation of seismic resistance measures for disaster management plans and the preparation of manuals for those seismic resistance measures. Also included are ideas and the establishment of a system for supportive measures, notes on post-earthquake emergency measures, and the creation of an earthquake preparation system. Regarding the formulation of seismic resistance measures, there are many similar types and forms of traditional/historic buildings in a preservation district. Since the organization of the necessary information and the presentation of a countermeasures model can help promote efficient measures, the items that needed to be investigated were sorted out. In addition, examples of various seismic manuals and support systems from around the country are included to serve as a reference for measure planning.

The individual measures include seismic resistance diagnosis and seismic reinforcement measures. Considering the circumstances of the preservation districts for groups of traditional buildings, compared to important cultural properties, the need is described for repairs and transitional measures to reduce the damage as much as possible in a simple and efficient manner in terms of cost and procedure. For example, the report notes that efficiently adding walls to the interior of a building (something that would dubiously be adopted for Important Cultural Properties), is possible if the main purpose is to preserve the exterior, and that reinforcement that is not based on a seismic assessment is also possible if done well. (Photo 2.4.1)

Photo 2.4.1 **Earthquake damage to groups of traditional buildings**

Japan Federation of Architects & Building Engineers Associations: Manual for Survey and Recovery of Disaster Damaged Historic Buildings

The Japan Federation of Architects & Building Engineers Associations conducts trainings for professionals to appropriately create lists of cultural properties and provide support for the recovery of damaged cultural properties. Those who complete the trainings are called heritage managers, and they are trained, organized, and engaged in activities that are useful for recovery support in the event of a disaster.

In March 2014, the Japan Federation of Architects & Building Engineers Associations published the "Manual for Survey and Recovery of Disaster Damaged Historic Buildings" as a teaching material and index for these professionals to provide recovery support in the event of a disaster. It is a revised version of the one compiled by the Kumamoto Architects & Building Engineers Associations with the cooperation of the Architectural Institute of Japan (Committee on Architectural History and Design, Subcommittee on Cultural Heritage Disaster Countermeasures).

The manual describes responses in three chapters: "1: Emergency," "2: Post-disaster," and "3: Permanent Recovery." The "1: Emergency" section covers the time from the disaster occurrence to the survey, mainly describing the establishment of a post-disaster survey support system, survey, and information collection methods, how to fill out survey forms, post-earthquake temporary risk evaluation, and administrative support. The second section, "Post-disaster," describes how to view the damage to historic buildings and how to provide emergency treatment and maintenance methods. Emergency measures are described for special construction methods of historic buildings and parts that are particularly susceptible to damage in an earthquake, such as traditional wooden structures (post-and-beam construction), masonry constructions, earthen walls (mud walls), lime plaster, and roof tiles. "3: Restoration" describes full-scale reinforcement and retrofit measures for the features described in the second section.

At the time of the Kumamoto Earthquake in 2016, the heritage managers conducted mutual cooperation activities in the prefectures of Kyushu, in accordance with the manual. It is also recommended as training material for heritage managers throughout Japan to improve their skills.

(**Satoshi Nishioka)**

2.5 Enhancement of the Financial Recovery Support Menu for Damaged Historic Buildings

Normally, the owner of a cultural property is responsible for its management and maintenance. However, cultural properties are also objects of public value, and their maintenance and repair can be very expensive, so financial assistance is provided to the owners through national and local government subsidies. After the Great Hanshin-Awaji Earthquake damaged many cultural property buildings, earthquake countermeasures gained importance in Japan's cultural property disaster management. Nationally designated cultural properties underwent seismic retrofitting at the time that conservation repair was carried out. In this context, seismic resistance measures for cultural property buildings have been promoted through the provision of separate subsidies for seismic assessment projects and reinforcement work.

In cultural property disaster recovery, there are high expectations of financial support for the owners of cultural properties, considering the protection of their public value. However, while national treasures, important cultural properties, and traditional buildings in preservation districts for groups of traditional buildings, which are designated or selected by the national government, receive relatively generous subsidies from the national government in times of extreme severity, the reality is that financial support is either unavailable

Table 2.5.1 **Financial assistance by type of cultural properties at the time of the Great Hanshin-Awaji Earthquake in 1995**

	Designated cultural properties					Undesignated cultural properties	
	National designation	Preservation District for Groups of Traditional Buildings	Prefectural Designation	Municipal designation	Kobe City's landscape ordinance buildings	Buildings forming a landscape	Buildings subject to disaster damage survey
National government subsidy	70～85%	63%					
Prefecture subsidy	5～10%	13.5%	33.3%				
Municipal subsidy	5～10%	13.5%	33.3%	50%	50% (Maximum 5 million yen)	Less than 3 million yen	
Owners	2.5～5%	5%	16.7%	25%	50%	50%	50%
Rehabilitation fund	2.5～5%	5%	16.7%	25%	25% (Maximum 2.5 million yen)	50% (Maximum 5 million yen)	50% (Maximum 5 million yen)
Motorboat collection campaigns					Less than 2.5 million yen in principle		
Foundation for the Promotion of Cultural Property Protection		*	*	*		*	*
Others			Local Cultural Properties Preservation Projects	Local Cultural Properties Preservation Projects		Less than 3 million yen from prefectural funds	

* Partially eligible

or difficult to obtain for other types of cultural properties. Even with partial public funding, a great number of historic buildings had been unavoidably dismantled because the financial burden on the owners of completely or partially destroyed houses was too great.

When the Great Hanshin-Awaji Earthquake of 1995 occurred, the national government first provided economic support to local governments. Specifically, state aid increased and a special local grant tax was established to cover the costs incurred by local governments for the disaster recovery of damaged national treasures, important cultural properties, and prefectural and municipal designated cultural properties. Next, Hyogo Prefecture and Kobe City established the Great Hanshin-Awaji Earthquake Rehabilitation Fund to provide subsidies to the owners of cultural properties. Private funding was provided through motorboat collection campaigns, and by the Foundation for the Promotion of Cultural Property Protection. Table 2.5.1 summarizes these financial assistance measures by the type of cultural properties.

Rehabilitation Fund

In addition to increasing state aid and establishing special local allocation taxes to subsidize prefectural and municipal projects, local governments continue to effectively create and support reconstruction funding. Thus, funding methods have also been used in Niigata Prefecture after the Great Hanshin-Awaji Earthquake disaster and the Mid Niigata Prefecture Earthquake in 2004, in Ishikawa Prefecture after the Noto Peninsula Earthquake in 2007, in the Ibaraki and Miyagi Prefecture after the 2011 Great East Japan Earthquake, and in Kumamoto Prefecture after the Kumamoto Earthquake in 2016.

In the central part of Sakuragawa City, Ibaraki Prefecture, the *zaigomachi*, which is the town that once prospered as a regional hub, remains, and the area was selected as an important preservation district for groups of traditional buildings. Many historic buildings also exist outskirts of the preservation district, and the city has received recognition for its Plan for the Maintenance and Improvement of Traditional Scenery, which is based on the law to maintain and improve historic landscapes (the Historic Community Planning Law). The Great East Japan Earthquake caused extensive damage to the entire town, affecting most of the historic buildings. The owners were devastated since the overwhelming destruction happened only shortly after the preservation district selection, leading to a loss of hope and increased uncertainty regarding the restoration process. For context, the city and the national government bore 90% of the earthquake recovery costs for the traditional buildings of the preservation district, and the prefectural government subsidized 3/4 of the owner's remaining share from a fund it had established, considerably lowering the burden on the owners. Meanwhile, damaged historic buildings that were not part of the preservation district were included in the list of structures of historic and scenic beauty. This list is a part of the Plan for the Maintenance and Improvement of Traditional Scenery, and the addition allowed the restoration of these buildings as part of the street environment improvement project that was subsidized by the Ministry of Land and Infrastructure. Additionally, as was the case with traditional buildings, a framework in which the prefectural fund covered 3/4 of the owner's costs was activated in order to relieve their financial burden and thus promote disaster recovery.

Other examples of successful disaster recovery support through the introduction of Preservation Districts and the Law of Historic Landscapes in a Community include the Kuroshima District in Wajima City following the Noto Peninsula Earthquake in 2007, Murata Town in Miyagi Prefecture after the Great East Japan Earthquake, Shirakawa City in Fukushima Prefecture, and Kumamoto City in Kumamoto Prefecture. Regarding Shirakawa City in Fukushima Prefecture, its Plan for the Maintenance and Improvement of Traditional Scenery had been recognized before the earthquake, but the plan was changed immediately after the earthquake by adding damaged historic buildings to the list of structures of historic and scenic beauty in order to save them. Regarding the Kumamoto Earthquake example, the town and village designated the shrine and temple that formed the local community center as cultural properties, allowing their recovery while maintaining their value.

Until around the time of the Great East Japan Earthquake disaster, support had been sought not only for national designated cultural properties, but also for historic buildings designated and registered by the Cultural Properties Administration and the Landscape Administration. At the time of the Kumamoto Earthquake, a subsidy system was established for the rehabilitation of national, prefectural, and municipal designated cultural properties, undesignated historic buildings, and private owners of movable cultural properties, using the "Kumamoto Earthquake Disaster Relief and Rehabilitation Fund." Kumamoto City also established a rehabilitation fund-based subsidy system for traditional townhouses in the Shinmachi-Furumachi district and the Kawashiri district. Using these rehabilitation funds, a streamlined support system was established for cultural heritage that ranged from national, prefectural, and municipal designated cultural properties to undesignated buildings of historic value and movable cultural properties. Below are some examples of projects supported by the rehabilitation fund in the aftermath of the Kumamoto Earthquake.

Local Community Reconstruction Support Projects

The Kumamoto Earthquake damaged facilities that had been used by the local region and village communities for many years. These facilities are exclusively used, maintained, and managed by the local communities to hold festivals, events, and other activities. A program was established by the municipal government to subsidize up to half of the 10-million-yen cost of recovery of these facilities, as long as they satisfy conditions such as being continuously in use now and in the future.

Shrines and temples operated by religious corporations are not eligible for public support due to the separation of politics and religion, but there have been cases where this system supported shrines that are protected and handed down by local residents.

Kumamoto City Town Recovery and Preservation Support Project

The Kumamoto City Town Recovery and Preservation Support Project, financed by the regional allocation of the Rehabilitation Fund, began accepting applications on January 22, 2018. The program is intended to subsidize the cost of restoration of traditional-style buildings such as *machiya* (wooden constructions built before 1950 with traditional construction methods) that were damaged by the Kumamoto Earthquake in the Shinmachi-Furumachi district and the Kawashiri district. The program aims to provide relief to the buildings that did not receive the subsidies or the group subsidies (see below for more detail) provided to damaged cultural properties. The subsidy covers half of the total cost of recovery up to 15 million yen, and if other subsidies are used for the construction work, that amount will be deducted from the grant. After recovery, the building needs to maintain an appearance that meets the town's guidelines for preserving historical towns.

Subsidy for the Recovery and Rehabilitation of Cultural Properties Damaged by the Kumamoto Earthquake

*This explanation focuses on the support for undesignated cultural properties

In order to support the steady recovery of designated cultural properties and of undesignated cultural properties with historical value, Kumamoto Prefecture established the new "2016 Fund fort the Recovery and Rehabilitation of Cultural Properties Damaged by the Kumamoto Earthquake," financed through private sector donations and the government’s Rehabilitation Fund.

Specifically, the subsidy covers 1/2 of the share that owners need to provide for the recovery of designated cultural properties or for the design and supervision of registered tangible cultural properties that are part of a public support funding system. Additionally, 2/3 of the construction costs are provided to registered tangible cultural properties and to undesignated cultural properties (historic buildings and movable cultural properties) if owners agree that they will register them as cultural properties in the future. For other undesignated cultural properties, 1/2 of the construction cost is subsidized.

The Group Subsidies

In addition to the rehabilitation fund, there are quite a few cultural property buildings that have been saved with the support of so-called the group subsidies of small and medium enterprises. The group subsidy, or officially called “Subsidy Project for the Recovery and Installation of Facilities for Groups of Small and Medium-sized Enterprises (SMEs),” is a system under which the national and prefectural governments cover up to 3/4 of the recovery costs for the facilities and equipment of SMEs that were affected by the Great East Japan Earthquake disaster. The group subsidies were also introduced at the time of the Kumamoto Earthquake. In Japan, it is extremely rare that government subsidies are provided for private property.

In the case of the Kumamoto Earthquake support program, a group must be formed first, characterized by a common feature such as a particular industry, region, supply chain, etc. If evidence shows that the group's recovery will contribute to a positive cycle of the local economy, then the individual businesses move on to the grant application process, the second stage after receiving group recognition. The group subsidies are intended to help SME businesses that have been affected by the disaster to continue their operations, and generally, few of them have been used for cultural heritage. The subsidy is strictly limited to business facilities, and it covers 75% of the estimated recovery costs. Therefore, non-business areas such as residential zones are not eligible, so they need to apply for other subsidy programs. Although the amount of the group subsidies was declared, there was no foreseeable prospect for residential recovery. So, during the waiting period for the cultural property support system to be set up (at the end of 2017, the first year after the earthquake), people found themselves in a state of uncertainty, torn between conservation/restoration and the possibility of publicly funded demolition. The group subsidy program for SMEs is also being implemented to support the recovery of facilities and equipment damaged by February 13, 2021, and the March 16, 2022 earthquakes, both occurring off the coast of Fukushima Prefecture. Since the main purpose of this program is to ensure the continuity of SME business operations, residential areas are not eligible for subsidies, and it is difficult to match the program to the restoration project of cultural properties. Even so, the program has been found to be useful for the recovery of cultural heritage in recent disasters.

Private Fund Support

Many cultural properties have been saved through recovery support from private funds and funds from other sources, even though they alone cannot cover all recovery costs. The "2016 Fund for the Recovery and Rehabilitation of Cultural Properties Damaged by the Kumamoto Earthquake " mentioned earlier was established with donations from companies and individuals associated with the disaster-stricken area. At the time of the Great East Japan Earthquake, the National Trust of Japan launched the "Great East Japan Earthquake Natural and Cultural Heritage Recovery and Rehabilitation Support Project," and the Public Interest Foundation for Cultural Heritage Protection and Art Research, collaborated with the World Monuments Foundation (WMF) and others to provide support through the "Great East Japan Earthquake Recovery Support Project for Cultural Property Buildings."

The WMF has a long history of supporting historic and cultural heritage damaged by natural disasters since it was founded in 1965 when Venice was affected by floods. Since then, the WMF has been involved in emergency response and long-term full-scale recovery support activities around the world. In the aftermath of the Great East Japan Earthquake in 2011, the WMF provided significant support for repair and restoration activities for important preservation districts for groups of traditional buildings in Sawara, Katori City, Chiba Prefecture. It also supported the national registered cultural properties located in the Kazamachi district of Kesennuma City, Miyagi Prefecture. In addition, the WMF provided recovery support for the restoration of the Kannondo Hall of the Tenyuji temple in Ishinomaki City, Miyagi Prefecture.

The WMF has entered a partnership with the Kumamoto Machinami Trust, an NPO whose purpose is to restore damaged groups of historic buildings in the Shinmachi and Furumachi towns, which were damaged by the Kumamoto Earthquake, and to preserve their historic townscape. Under this partnership, the WMF, in cooperation with the Freeman Foundation (U.S.A.), will support restoration activities of the Kumamoto Castle Town through public-private cooperation involving the national, prefectural, and municipal governments. This support includes the conservation of five historic buildings in Kumamoto Machinami Trust's "Kumamoto Castle Town Historic Landscape Preservation and Rehabilitation Project," as well as the production of castle town recovery records and community activities.

Summary

Based on lessons learned from earthquake damage, as shown in Table 2.5.2, for the Kumamoto Earthquake

auxiliary “menus” were used according to the circumstances of each building, and restoration work was carried out by combining various auxiliary menus. Taking Kumamoto City as an example, restoration work is generally carried out in the proportions shown in Figures 2.5.1 through 3. Figure 2.5.1 shows the percentage of Kumamoto City's share of the cost to repair national, prefectural, and municipal cultural properties. Figure 2.5.2 shows the percentage of the construction cost for undesignated cultural properties (buildings subject to the Cultural Property Doctor Dispatch Program). Figure 2.5.3 shows the construction cost ratio of business undesignated cultural properties that are supported by group subsidies. Please note that some subsidy menus have not only a percentage of the cost burden but also a maximum subsidy amount.

In city parks, some damaged cultural properties have been saved by facility recovery support. The megaquake has taught us the public value of local cultural properties, whether they are nationally designated or undesignated. We have accumulated know-how on how to reduce the burden of their huge repair costs.

This track record of seamless support can be useful for future disaster management. However, the rehabilitation fund was basically established through private donations, and although in the case of the Kumamoto Earthquake success was achieved due to large donations to Kumamoto Castle, this may not be the case in the future. Furthermore, seamless support has been voluntarily provided by some local governments. The response differs from one local government to another, and preparing with stakeholders during normal times is important. These preparations should include specific project plans, and funding systems to support cultural properties that can be activated promptly, and they should be made even in areas with few disasters or where cultural property protection measures are not progressing as well as expected.

(Hajime Yokouchi)

Table 2.5.2 **Combination of Economic Assistance in the Kumamoto Earthquake in 2016**

	National designated cultural properties	Local government designated cultural properties	National Registered Cultural Properties		Undesignated cultural properties			
			Design work	Construction work	General	Store (Excluding residential portion)	Traditional buildings in Shinmachi and Furumachi town district and Kawashiri district, Kumamoto City	shrines and temples, community hall ,etc.
National government subsidy	○		○					
Local government subsidy	○ Prefecture	○	○					
Subsidy for the Recovery and Rehabilitation of Cultural Properties Damaged by the Kumamoto Earthquake	○	○	○	○	○			
Subsidy Project for the Recovery and Installation of Facilities for Groups of SMEs (Group subsidies)						○		
Kumamoto City Town Recovery and Preservation Support Project							○	
Local Community Reconstruction Support Projects								○
Private Fund Support (WMF, etc.)					○	○	○	○
Support Grants for Reconstructing Livelihoods of Disaster Victims	1,125,000～2,000,000 yen (Applicable to all general housing)							
Emergency Repair System for Damaged Houses	576,000 yen (Applicable to all general housing)							

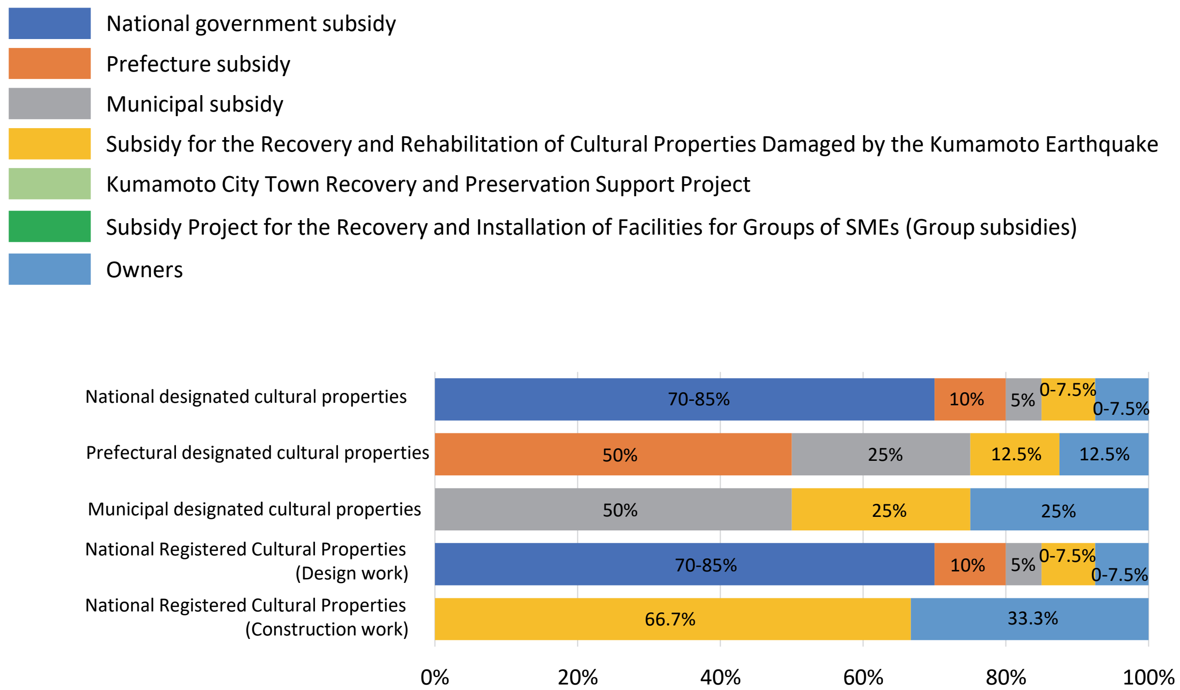

Figure 2.5.1 **Funding for recovery of national, prefectural, and municipal cultural properties**

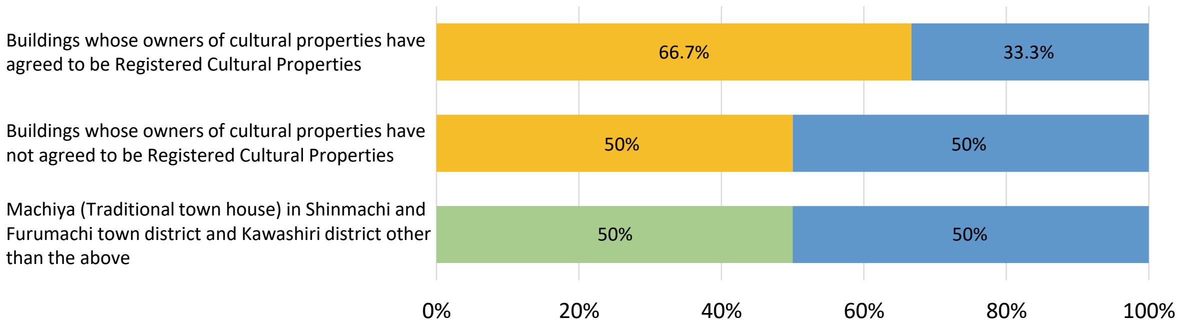

Figure 2.5.2 **Funds for recovery of undesignated cultural properties (construction costs)**
Buildings subject to the Dispatch Conservators for Historic Buildings program

Figure 2.5.3 **Undesignated cultural properties (construction cost) when relying on group subsidies (Assuming 50% each of the area ratio of the store and residential sections)**

3. Overview of the Damage Caused to Cultural Heritage Caused by the Great East Japan Earthquake and the Kumamoto Earthquake

3.1 Characteristics of the Earthquakes

Introduction

Earthquakes are caused by the displacement of the underground bedrock, that is, the rupture of a fault. The wave motion generated by the fault rupture propagates through the ground and reaches the surface, entering the buildings. The seismic motion that enters a building varies according to the size and direction of the fault and the soil structure of the propagation route. Many factors affect the earthquake characteristics that influence the building's seismic resistance, such as the maximum value (strength), strength variations over time, duration, and frequency characteristics. Japan is an earthquake-prone country where the ground motion characteristics are different for earthquakes caused by inland active faults and those caused by oceanic trench plate faults. The Great Hanshin-Awaji Earthquake in January 17, 1995 (magnitude MJ=7.3) occurred along the inland active faults that exist from Awaji Island to Kobe City. Buildings that lay close to the fault, from Awaji Island over Kobe City to Takarazuka City, were severely damaged. These inland-type earthquakes (or inland earthquakes) follow the same occurrence mechanisms as the Kumamoto Earthquake in 2016. The motion of inland active fault-type earthquakes is characterized by a short duration, less repetitive waveforms, and a relatively short-period ground motion. If the hypocenter is shallow, the distance from the fault is small, resulting in large amplitude seismic motion. The source of this inland earthquake lies in plate movements. Plate boundaries surround and cross over Japan. When plate boundaries in the ocean become active, ocean trench earthquakes occur. The characteristic feature of these earthquakes is that they are extremely large in magnitude. In general, if there is a distance from an ocean plate boundary, the duration of the earthquake motion will be long, with many waveform repetitions and dominant periods that are longer than those of the active fault type earthquakes. The Great East Japan Earthquake in 2011 was an ocean trench earthquake. It caused a huge tsunami along the eastern coast of Japan because it was caused by a long-distance submarine fault.

To understand earthquake damage, and with it the damage to cultural heritage, it is extremely important to know what characteristics earthquakes have, especially seismic motion characteristics. Below is an overview of the Great East Japan Earthquake disaster (the 2011 off the Pacific coast of Tohoku Earthquake), the Kumamoto Earthquake, and their seismic motion characteristics, but first, a brief explanation of the differences between how Japan and other countries determine magnitude (which indicates the size of an earthquake), and a seismic intensity scale (which indicates the shaking magnitude).

In Japan, the magnitude of an earthquake is defined by the Japan Meteorological Agency (JMA) as the M_J magnitude. Other countries use the M_L local magnitude or the M_S surface magnitude, which was created by the United States Geological Survey (USGS). Due to the characteristics of the seismometers used for each of these magnitudes, accuracy becomes difficult when measurements exceed 7.5 to 8.0, so the moment magnitude M_W, which is defined by the energy of the earthquake, is used. The magnitude of the Great East Japan Earthquake disaster was 9.0 on that moment magnitude scale. With regard to the seismic intensity scale, which measures how seismic motion occurs, is divided by the Japan Meteorological Agency (JMA) into seven seismic intensity scales. Originally, shaking felt by people indicated a small seismic intensity scale, shaking seen in 'things' indicated a medium intensity scale, and damage to buildings indicated a large intensity scale. Currently, mechanically measured seismic intensities are used to match observed seismic intensities. In most countries other than Japan, a 12-step modified Mercalli intensity scale is used. A comparison of the JMA seismic intensity scale and the modified Mercalli intensity scale is shown in Table 3.1.1.

Table 3.1.1 **Comparison of the JMA seismic intensity scale and the modified Mercalli intensity scale**

Acceleration level (Gal)	JMA seismic intensity scale	MM seismic intensity scale
0-0.8	0	0
0.8-2.4	I	II～III
2.4-8.0	II	III～IV
8.0-24	III	IV～VI
24-80	IV	VI～VII
80-250	V	VII～IX
250-	VI	IX～X
	VII	XI～XII

The Great East Japan Earthquake Disaster in 2011

The area off the Pacific Coast in the Tohoku and Kanto regions of Japan holds the Japan Trench and is a zone where the Pacific plate subducts into the North American plate, causing many major earthquakes throughout history, as described below. The subduction rate of the plates is about 10 cm per year, and the displacement rate of the land on the west side is estimated to be 3 to 7 cm per year. The sudden release of this accumulation of differences is what generates earthquakes. On March 11, 2011, a megaquake with a moment magnitude (M_W) of 9.0 occurred in the area that spans from the Tohoku region to the Kanto region off the Pacific Coast. This 2011 off the Pacific coast of Tohoku Earthquake was the largest earthquake ever recorded in Japan. From a global perspective, earthquakes with a magnitude of 9 or greater have occurred in the past 60 years since seismic observations began to be conducted, although their numbers and affected areas are limited. They include the Kamchatka Earthquake in 1952 (M_W =9.0), the Chile Earthquake and Tsunami in 1960 (M_W =9.5), the Great Alaskan Earthquake in 1964 (M_W =9.2), and the Sumatra-Andaman Earthquake in 2004 (M_W =9.3). The fault that caused the main shock of the 2011 off the Pacific coast of Tohoku Earthquake is a low-angle reverse fault as shown in Figure 3.1.1, and is estimated to be about 450 km long and 200 km wide with a maximum slip of 20 to 30 m (JMA)[1]. The main rupture areas are divided into three, with a focal depth (off the coast of Miyagi Prefecture) of 24 km and an estimated rupture duration of approximately 3 minutes (JMA)[1]. The number of aftershocks is also large, and they occurred over a wide area, reaching as far as the Chubu region, hundreds of kilometers away, with more than 500 aftershocks of magnitudes of 5 or greater[2].

Since 1996, the JMA has been conducting mechanical observations of seismic intensities and has published the measured seismic intensities. Based on this, areas where the seismic intensity of the main shock was of X or above in the modified Mercalli seismic intensity scale (6 or more on the JMA seismic intensity scale) are widely distributed along the Pacific coast from Iwate Prefecture to the

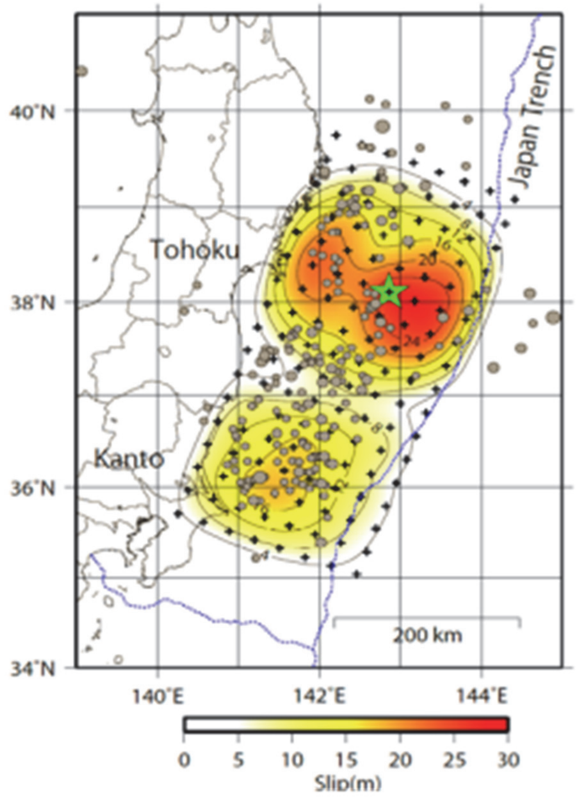

Figure 3.1.1 **The fault that caused the main shock of the 2011 off the Pacific coast of Tohoku Earthquake[1]**

northern part of Ibaraki Prefecture. The National Research Institute for Earth Science and Disaster Resilience (NIED) established a nationwide network of strong-motion seismic observations, and national research institutes and universities have also installed strong-motion seismographs in the Pacific side of the Tohoku region, where the seismic activity is high. According to the earthquake records from these strong-motion seismographs, there were about 20 locations where the peak acceleration exceeded 1.0 G. However, these records were only for short-period earthquakes, with major frequencies of over 5 Hz[2].

As an example, the records of the aforementioned network in Kesennuma City, Miyagi Prefecture (NIED) are shown in Figure 3.1.2. The seismic intensity according to JMA's seismic intensity scale is of a lower 6, and there was little damage to the buildings in the surrounding area. According to the acceleration response spectrum of this earthquake record (Figure 3.1.3), the predominant period is in the short-period range of 0.3 to 0.5 seconds, with a predominant 3-4 second component in the long-period range. This combination of short-period and long-period earthquake ground motion is a common feature at other observation stations, and it has been pointed out that this earthquake motion was caused by the generation of huge long-period slips along the trench and a strong short-period ground motion in the coastal area[2]. As will be described later, the motion of this earthquake is characterized by the relatively little structural damage it caused, even though the peak acceleration of the earthquake motion is very large[2]. The Great Hanshin-Awaji Earthquake in 1995 (the Southern Hyogo Prefecture Earthquake, M_J=7.3), caused extensive damage to common residential wooden constructions, but their casualties were relatively light.[2] Damage to conventional wooden houses, which were severely destroyed by the Great Hanshin-Awaji Earthquake in January 17, 1995 (M_J=7.3), was also slight. This is due to the small seismic motion component of a 1-2 second period, which is what causes damage to wooden houses and other common structures. For traditional wooden structures, seismic motion characteristics are thought to rarely cause progressive failure. The component of seismic motion with a 1-2 second period is reported to be a fraction compared to the seismic motion of the Great Hanshin-Awaji Earthquake[3]. On the other hand, long-period seismic motions of several seconds or longer propagated to the distant metropolis as surface waves, causing large tremors with amplitudes reaching several dozens of centimeters in skyscrapers in Tokyo and Osaka. As an example, the tip of Tokyo Tower (1958, 333 m high), which is listed as a modernization heritage site, was bent from the motion. On the other hand, the impact of these seismic motion characteristics on traditional wooden structures was minimal, but it caused extensive damage to short-pe-

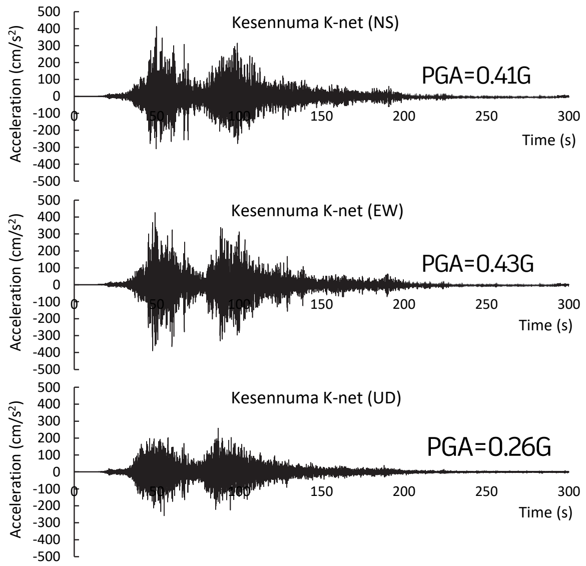

Figure 3.1.2 **The records of the aforementioned network in Kesennuma City, Miyagi Prefecture (NIED K-net Kesennuma)**

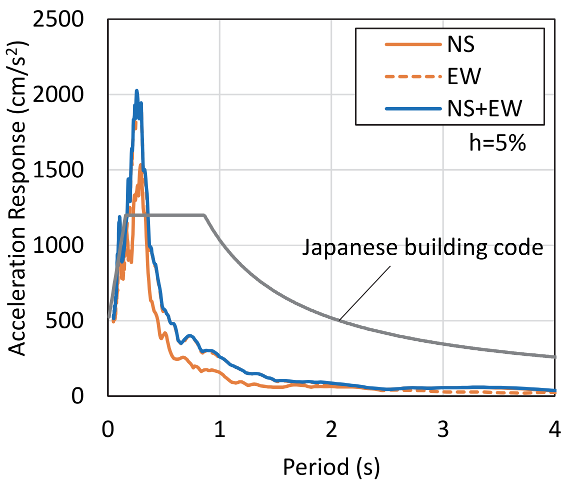

Figure 3.1.3 **The acceleration response spectrum of the aforementioned network in Kesennuma City, Miyagi Prefecture**

riod masonry constructions, mud-walled warehouses, and stone walls over a wide area that ranged from the Tohoku to the Kanto region. In addition, seismic motions with a duration of over 3 minutes caused liquefaction due to repeated shear deformation of the loose saturated sandy soil, which damaged historic buildings and important preservation districts for groups of traditional buildings.

The main cause of the disaster caused by the earthquake was the tsunami, as explained below. Tsunami heights were reported to average 8 to 9 meters along the coast, from Miyako City in Iwate Prefecture to Soma City in Fukushima Prefecture. Tsunami heights were not uniform, exceeding 10 meters south of Kuji City, Iwate Prefecture, and measuring 10 to 15 meters along the Sanriku Coast, reaching as far as the Oshika Peninsula, Miyagi Prefecture. Reports state heights as low as about 5 m in the scenic Matsushima Bay, and about 10 m from Sendai Bay to Soma. A survey by the Japan Society of Civil Engineers (JSCE) reported that the tsunami rose as high as 39.7 m on land in Miyako City. This height is a new record in Japan. The total area flooded by the tsunami was 560 km^2, and 60% of it was in Miyagi Prefecture.

The inland Great Hanshin-Awaji Earthquake (the Kobe earthquake) concentrated the damage in the metropolis, and the disaster caused damage over an extremely wide area of Great East Japan.

As of September 16, the Great East Japan Earthquake disaster has left 15,790 dead, 4,056 missing, and 5,500 injured. According to the Preliminary Report on Disaster Investigation by the Architectural Institute of Japan[2)], about 105,000 residential houses were completely destroyed and 107,000 were partially destroyed. Most of the damage caused to humans and residences was caused by the tsunami. Since most of the damage was caused by the tsunami, the number of injured people was much smaller than the number of fatalities. About 31,000 cases of non-residential damage have been reported[2)]. As was the case with the Southern Hyogo Prefecture Earthquake in 1995, reinforced concrete buildings that were constructed before the 1981 reform to the Building Standards Act suffered damage. Lifelines were also severely affected, and due to the wide area that the earthquake covered, approximately 8.6 million households sustained power losses, 2 million had no gas, and 2.3 million had no water. More than 5,000 bullet trains and conventional rail lines were damaged, and on the coastal rail lines, 23 train stations and approximately 60 km of rail track were washed away or buried by the tsunami. Among civil engineering facilities, 190 of the 300 km of the coastal embankment was completely or partially destroyed by the tsunami. Agricultural lands (23,000 hectares, or about 5% of the total arable land area) were flooded by the tsunami. The total damage is estimated at approximately 17 trillion yen (US$170 billion). The Fukushima Nuclear Power Station accident, caused by the 2011 off the Pacific coast of Tohoku Earthquake, has also become an extremely serious social issue, as its rehabilitation is expected to take a decade or more.

Most areas that sustained heavy earthquake damage are in locations with seismic activity. Their buildings have already sustained damage caused by 7-class magnitude earthquakes over the past 30 years. These earthquakes include the Earthquake off the coast of Miyagi Prefecture in 1978 (M_J=7.4), the Earthquake off the eastern coast of Chiba Prefecture in 1987 (M_J=6.7), and the Earthquake inland of Iwate and Miyagi Prefectures in 2008 (M_J=7.2). One of the reasons why the damage was relatively small even when the strong seismic motion exceeded X (high 6 on the JMA seismic intensity scale) on the modified Mercalli scale, is, as the seismic motion characteristics in Figure 3.1.3 shows, the periodicity, which is the most significant factor. However, another explanation is the fact that since the area was hit by large earthquakes in recent years, buildings with low earthquake resistance were eliminated, and earthquake-resistant buildings remained safe to some extent.

The area has also historically been subject to major tsunami damage, the main being the Jogan-Sanriku Earthquake in 869 (M_J=8.3), the Keicho-Sanriku Earthquake in 1611 (M_J=8.1), the Meiji Sanriku Earthquake in 1896 (M_J=8.25), the Showa Sanriku Earthquake in 1933 (M_J=8.1), the Earthquake off the coast of Tokachi in 1952 (M_J=8.2), and the Chile Earthquake and Tsunami in 1960 (M_J=9.5)[2)]. The Jogan-Sanriku Earthquake in 869 was of the same magnitude as the Great East Japan Earthquake, the area its tsunami flooded might also be similar, and its traces are still being studied. The tsunami that followed the Meiji Sanriku Earthquake in 1896 also caused enormous damage, leaving over 20,000 victims. One of the reasons why there are relatively few historic buildings along the coast from the Iwate to the Fukushima prefectures may be the fact that the area has been frequently hit by major tsunamis. An old town located in the depths of Kesennuma Bay forms a cityscape with nationally registered cultural property buildings of the early 20th century, but most of them were washed away or severely damaged by the tsunami. The Showa Sanriku Earthquake in 1933 did not cause any significant tsunami damage, indicating that the Great East Japan Earthquake tsunami was one of the largest in history. However, it did not affect the Zuigan-ji main temple building (1604) or the Godaido Temple (1605), which faces Matsushima Bay east of Sendai City, and there are no historic records of any tsunami damage to these buildings. It is possible that the topographical effects of Matsushima Bay and its islands reduced the height of the tsunami.

The Kumamoto Earthquake in 2016

The Kumamoto Earthquake in 2016 was a series of earthquakes that caused significant damage in the Kumamoto region, consisting of a foreshock that occurred around 21:45 on April 14, a main shock that occurred around 01:25 on April 16, and over 1000 aftershocks with a seismic motion intensity of 1 or higher.

Both the foreshock on April 14 and the main shock on April 16 registered a seismic intensity of 7. This was the third earthquake with a seismic intensity of 7 since 1996 when instrumental seismic intensity observation began in Japan ahead of the rest of the world (the previous two earthquakes were The Mid Niigata Prefecture Earthquake in 2004 and the 2011 off the Pacific coast of Tohoku Earthquake). An active fault zone extends from the western end of the geological fault line, crossing central Kyushu from roughly northeast to southwest. The recent earthquake was an inland earthquake caused by that active fault zone. The foreshock on April 14 was caused by the Hinagu fault, and the main shock on April 16 was caused by the Futagawa fault. Both faults are right-lateral faults. The focal depths of the hypocenters were about 11 and 12 km, respectively (see Figure 3.1.4).

In the past 400 years since the 17th century, in Kumamoto Prefecture and its surrounding areas, there have been five inland earthquakes of magnitude greater than 5, the largest being of M 6.5. Therefore, it is not considered a highly seismically active area, and the zone coefficient for seismic load specified by the Order for Enforcement of the Building Standards Act in Japan is 0.8, the lowest value except for Okinawa (it is 1.0 for Tokyo, Osaka City, and Kyoto City). The earthquake occurred under these seismic conditions.

The response spectrum is commonly used as a measure to evaluate the seismic response of a

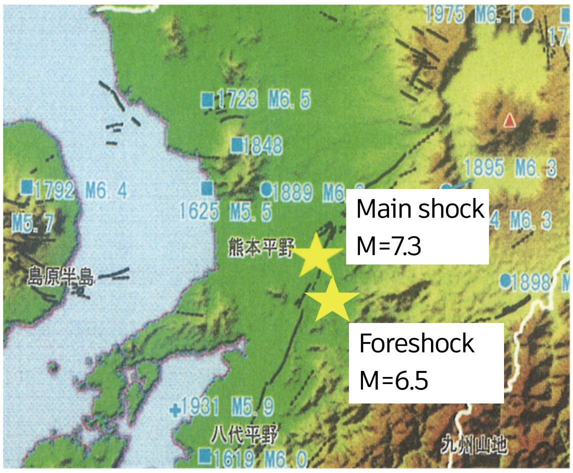

Figure 3.1.4 **Epicenter of the Kumamoto Earthquake and historical earthquakes and active faults**

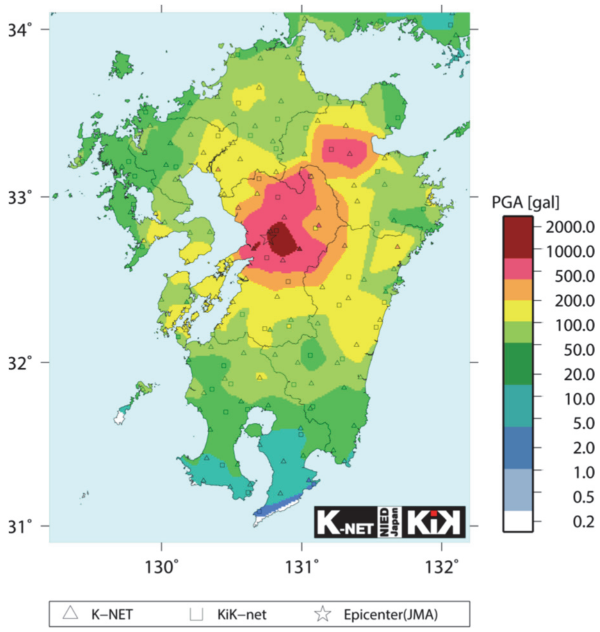

Figure 3.1.5 **Peak acceleration distribution of the main shock [4)]**

building. It takes both the seismic motion characteristics and the dynamic characteristics of the building into account. This report presents the seismic motion characteristics of KiK-net Mashiki (KMMH16) and Nishihara Village Hall, where a seismic intensity of 7 was observed. The seismic motion observed at this time was larger in amplitude in the East-West direction than in the North-South direction. The peak acceleration was 1.15 G in the EW direction and 0.65 G in the NS direction at KiK-net Mashiki, 0.77 G in the EW direction, and 0.72 G in the NS direction at the Komori station of Nishihara Village.

The peak acceleration (three-component composite) of the main shock in the area with the cultural property buildings is shown in Table 3.1.2.

Table 3.1.2 **Instrumental seismic intensity and peak acceleration of the regions with a damaged cultural property indicated in this report (main shock, the National Research Institute for Earth Science and Disaster Resilience K-Net, KiK-Net)**

Measurement station	Instrumental seismic intensity (JMA Scale)	Peak acceleration (cm/s^2)	Measurement station's distance from epicenter (km)
Nishihara Village Komori	6.6	904	15.8
Aso City Ichinomiya	5.5	403	35.5
Kumamoto City Chuo Ward	6.0	657	6.3
Kumamoto City Higashi Ward	6.0	843	4.2
Kumamoto City Nishi Ward	6.0	678	7.5
Kumamoto City Minami Ward	5.9	595	9.0
Kumamoto City Kita Ward	5.8	1027	9.0
Ozu Town Hikigi	5.7	669	17.1
Mifune Town	5.7	499	6.2

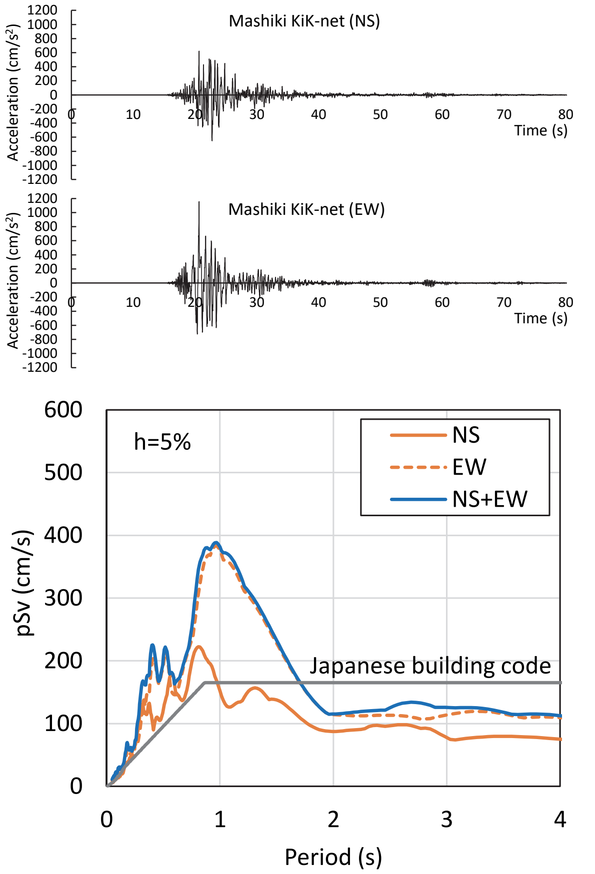

Figure 3.1.6 **Seismic motion waveform and velocity response spectrum observed at KiK-net in Mashiki Town**

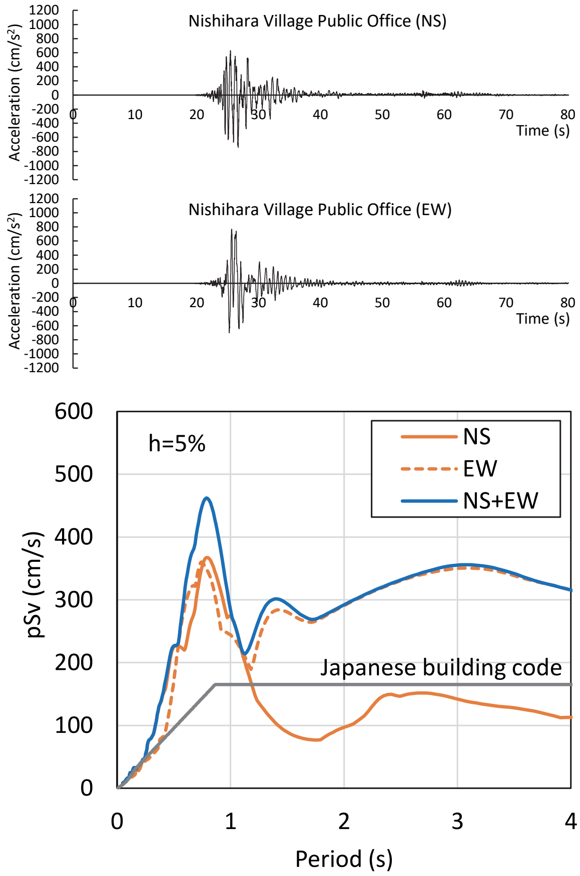

Figure 3.1.7 **Seismic motion waveform and velocity response spectrum observed at Nishihara Village Public Office**

For these seismic motion records, acceleration waveforms and velocity response spectrums (h=5%) in the East-West and North-South directions and composite waveforms in two directions are shown in Figures 3.1.6 and 3.1.7. The response spectrum diagrams also show the spectra for type 2 ground according to the Order for Enforcement of the Building Standards Act.

As Figures 3.1.6 and 3.1.7 show, there is a large difference in response spectrum characteristics between the seismic motion records of Mashiki Town and those of Nishihara Village, even though both experienced an observed seismic intensity of 7. In the Mashiki Town record, the response spectrum value of the town hall is about twice that of the KiK-net record. The response spectrum of the Nishihara village office has a peak at a short period of less than 1 second and a peak at a slightly longer period of 2 to 3 seconds. The slightly longer period of 2 to 3 seconds exceeds 300 cm/s, which may indicate the movement of a fault. The hypocenter depth of the earthquake was shallow, indicating that the seismic motion characteristics of the source region varied greatly depending on the location. Furthermore, the amplitude in the East-West direction is larger than that in the North-South direction. In the source region of inland earthquakes, the orthogonal component to the fault is known to be predominant from theoretical and observational records, but in the case of the Kumamoto Earthquake, the parallel component to the fault is noted to be large. This is particular to the seismic motion characteristics of the Kumamoto Earthquake.

According to the KNET seismic motion record of Kumamoto City, the short-period component with a predominant period of 0.3-0.5 seconds (see Figure 3.1.8) was remarkable. The seismic motion record from the Nishihara Village Office also shows a large short-period component (see Figure 3.1.7). This short periodic range has a significant effect on masonry constructions, which are short-period structures. The stone walls of Kumamoto Castle suffered extensive damage, which can be attributed to the response of the stone wall structure due to the predominant short periodic component. The damage tendency was similar to that of the Great East Japan Earthquake, which caused great damage to masonry constructions. PS Orangerie, Nio-mon Gate of the Honmyoji Temple, and

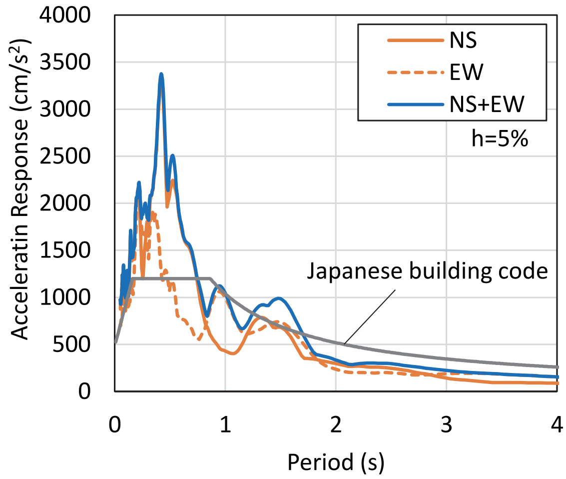

Figure 3.1.8 **Acceleration response spectrum of K-net Kumamoto (KMM006) observation record**

Yasemeganebashi Bridge, which are cultural property buildings shown in this survey report, are also short-period buildings. The characteristics of this earthquake are that seismic motion characteristics differed greatly from point to point in and near the hypocenter region, that a short-period component affecting masonry buildings predominated in the area where many historic buildings are still standing (Kumamoto City), and that a long-period component due to fault slip was observed in the vicinity of the fault.

This section concludes with damage statistics from the Cabinet Office: as of May 31, 2016, 49 people were killed and 1663 people were seriously or slightly injured; for buildings, 6090 houses were completely destroyed, 20219 houses were partially destroyed, 85635 houses sustained partial damage, 1042 non-residential buildings were damaged, and 16 fires were reported. In addition, there were 57 cases of debris flows, 10 cases of landslides, and 115 cases of cliff slides.

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(Toshikazu Hanazato)

3.2 Overview of Damage to Cultural Properties Caused by the Great East Japan Earthquake

Figures 3.2.1 and 3.2.2 show the amount of damage to nationally designated or registered cultural properties as of August 3, 2011, categorized by prefecture and type, respectively (according to Agency for Cultural Affairs). The damage extends to Kochi Prefecture, with more than 700 cases, which is located more than 1,000 km from the epicenter. The list does not include cultural properties designated by the prefectural and municipal governments. If prefecturally and municipally designated properties were included, the number would exceed 1,000. According to detailed survey data from Miyagi Prefecture, one of the hardest hit prefectures, the damage includes 51 prefecturally designated cultural properties (including 33 buildings and 9 art objects) and 179 municipally designated cultural properties (including 62 buildings and 50 art objects). The statistical survey conducted on the number of damaged cultural properties did not differentiate between damage caused by seismic motion and damage caused by a tsunami, and the percentage of tsunami-related damage remained unclear. Furthermore, no damage report was generated regarding cultural properties that were affected by fires caused by seismic motion. The Architectural Institute of Japan conducted a survey to

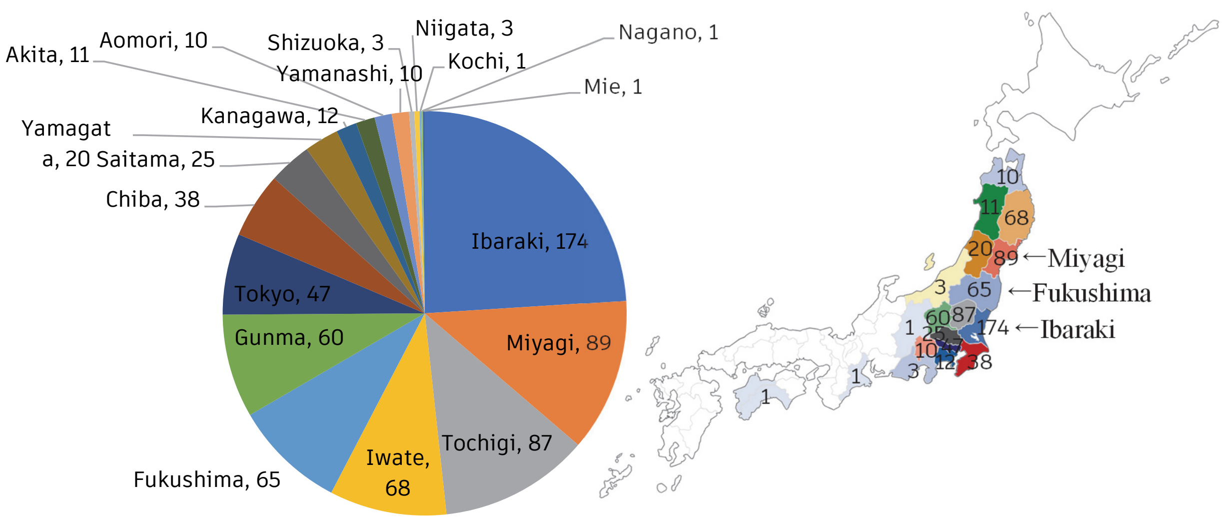

Figure 3.2.1 **Statistics of damage in each prefecture**

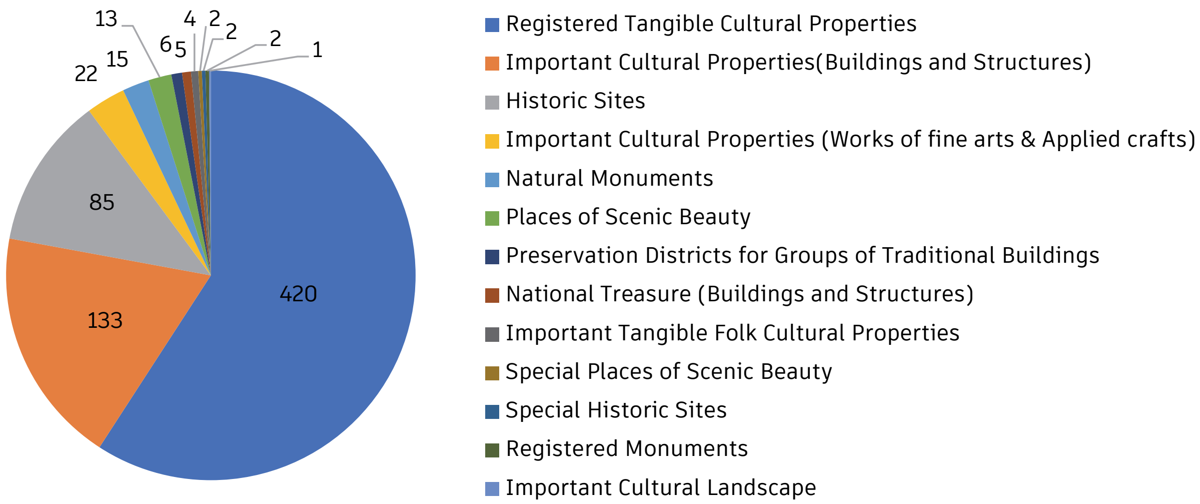

Figure 3.2.2 **Statistics of damage to categorize into type of cultural properties**

Table 3.2.1 **Number of damaged cultural properties in Miyagi Prefecture**

		Designation			Registration		Total
		National	Prefectural	Municipal	National	Municipal	
Tangible Cultural Properties	Structures	19	33	62	36	22	172
	Fine arts and Applied crafts	9	9	50	0	7	75
Folk Cultural Properties	Intangible	2	1	14			17
	Tangible		0	1			1
Monuments	Special Historic Sites and Historic Sites	17	5	44			66
	Historic Sites and Places of Scenic Beauty	1					1
	Special Places of Scenic Beauty and Places of Scenic Beauty	2	0	4			6
	Natural Monuments	5	3	4			12
Total		55	51	179	285	29	599

assess the damage incurred by undesignated cultural property buildings, which are not officially designated by the national, prefectural, or municipal governments, nor registered as cultural properties. Although the breakdown by designation and degree of damage is not available, more than 4,000 buildings were surveyed in the heavily damaged Tohoku and Kanto regions, and 52% of these structures were found to have some type of damage.

As shown in Figure 3.2.1, the amount of damage to nationally designated and registered cultural properties is higher in the Kanto region (Tokyo, Kanagawa, Saitama, Chiba, Ibaraki, Tochigi, Gunma, Yamanashi) than in the Tohoku region (Aomori, Iwate, Miyagi, Fukushima, Yamagata, Akita) where the human suffering from the tsunami was more severe. This is because the Kanto region has more cultural properties than the Tohoku region. Similarly, Figure 3.2.2 shows the remarkably higher amount of damage to registered tangible cultural properties. This is also due to the larger number of such assets in the Kanto region.

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(Hajime Yokouchi)

3.3 Overview of Cultural Property Damage Caused by the Kumamoto Earthquake

This section provides an overview of the damage to cultural properties and other assets caused by the series of earthquakes that hit the Kumamoto

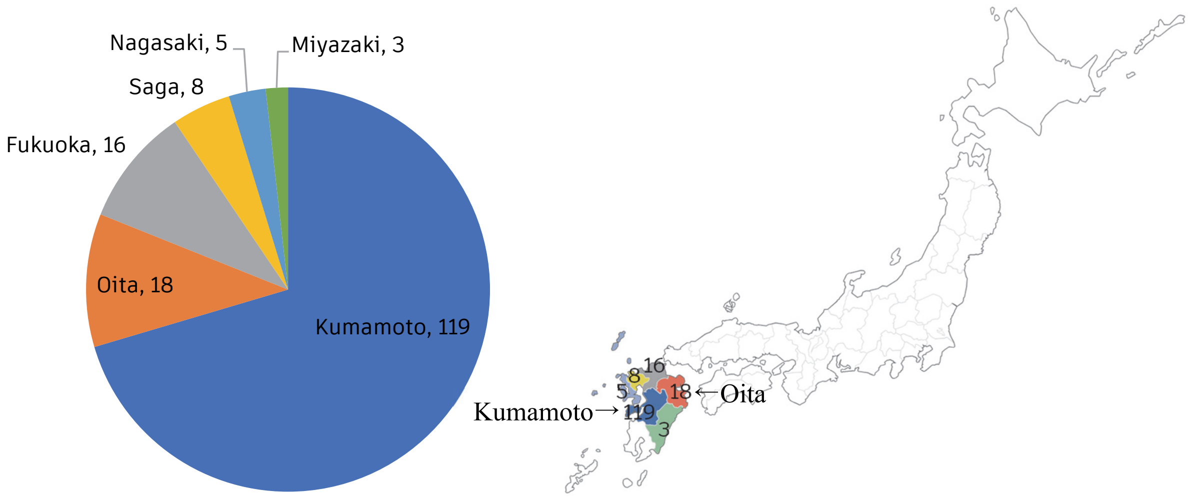

Figure 3.3.1 **Statistics of damage in each prefecture**

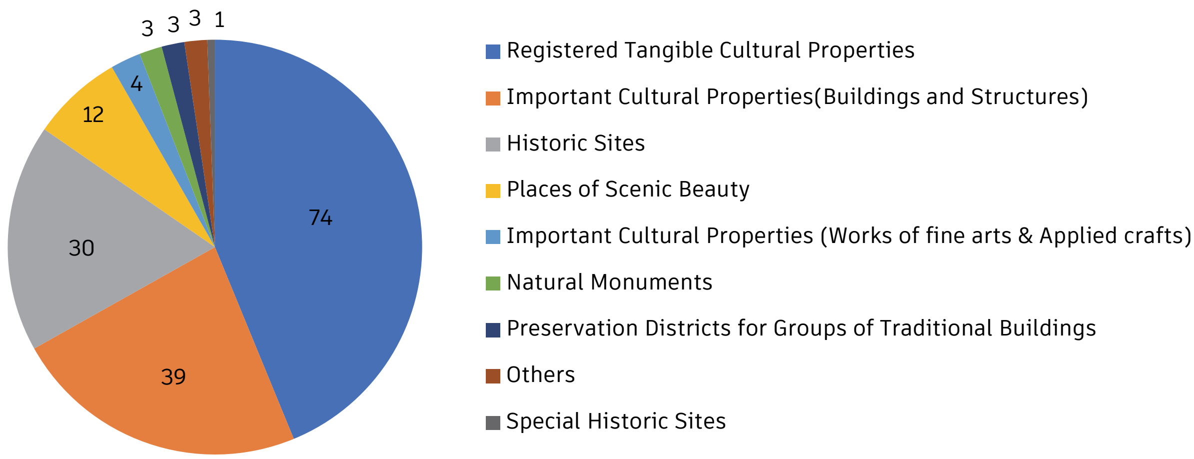

Figure 3.3.2 **Statistics of damage to categorize into type of cultural properties**

region of Kumamoto Prefecture in the 2016 Earthquake. Figures 3.3.1 and 3.3.2 show the amount of damage to nationally designated or registered cultural properties as of October 15, 2018, categorized by prefecture and type, respectively. Damaged buildings of registered tangible cultural properties comprise the largest number (74), followed by damaged buildings of nationally designated important cultural properties (Buildings and Structures) (39), together accounting for about 2/3 of the total cultural property damages. When historic sites and places of scenic beauty are added, the total number of damaged buildings exceeds 90%.

Looking at the number of damages by prefecture, damage to cultural properties in Kumamoto Prefecture accounts for about 70% of the total, followed by Oita and Fukuoka Prefectures, with these three prefectures accounting for 90% of the total.

According to detailed survey data from Kumamoto Prefecture, most of the hardest hit prefectures, the damage includes 148 National designated cultural properties, 383 prefectural designated cultural properties, 2,352 municipal designated cultural properties and 156 registered properties. In Kumamoto Prefecture, Nishihara Village and Mashiki Town recorded a seismic intensity of 7 twice, Kumamoto City recorded a seismic intensity 6. Historic buildings along the fault line were severely damaged, especially brick and stone masonry structures. Most of the buildings in the affected area are of wooden frame construction, and although some Shinto shrines, modern Western-style buildings, and old residential structures "collapsed," it is important to note that they only "partially collapsed" and were deformed.

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(Hajime Yokouchi)

4. Recovery Process by the Type of Cultural Property

4.1 Buildings and Structures

The timeline for the recovery of cultural property buildings and structures varies depending on the scale of the disaster, the type of damaged cultural property, and the level of damage, but the basic process flow is shown in Figure 4.1.1. In this section, we would like to give an overview of the timing and implementation details of each of these processes.

Information Gathering and On-site Inspections to Assess the Damage Levels

Immediately after confirming the post-disaster safety of the victims, information is collected and on-site inspections are conducted to get an overall picture of the damage. The main purpose of this process is not to examine in detail how each individual building is affected, but to have an overview of the damage, which is then used to formulate recovery policies and request recovery budgets.

In the case of nationally designated cultural properties, the prefectural government will intervene immediately after the disaster by communicating with the national government. Local government officials confirm the damage conditions and the Agency for Cultural Affairs conducts on-site inspections. In Miyagi Prefecture, where the Great East Japan Earthquake in 2011 damaged the greatest number of cultural properties, the tsunami and the earthquakes' seismic intensity were so great that cultural properties were expected to be affected throughout the prefecture. For about two days, it was impossible to know if the cultural properties were safe, let alone if the municipal officials were safe, because of the power outages and the

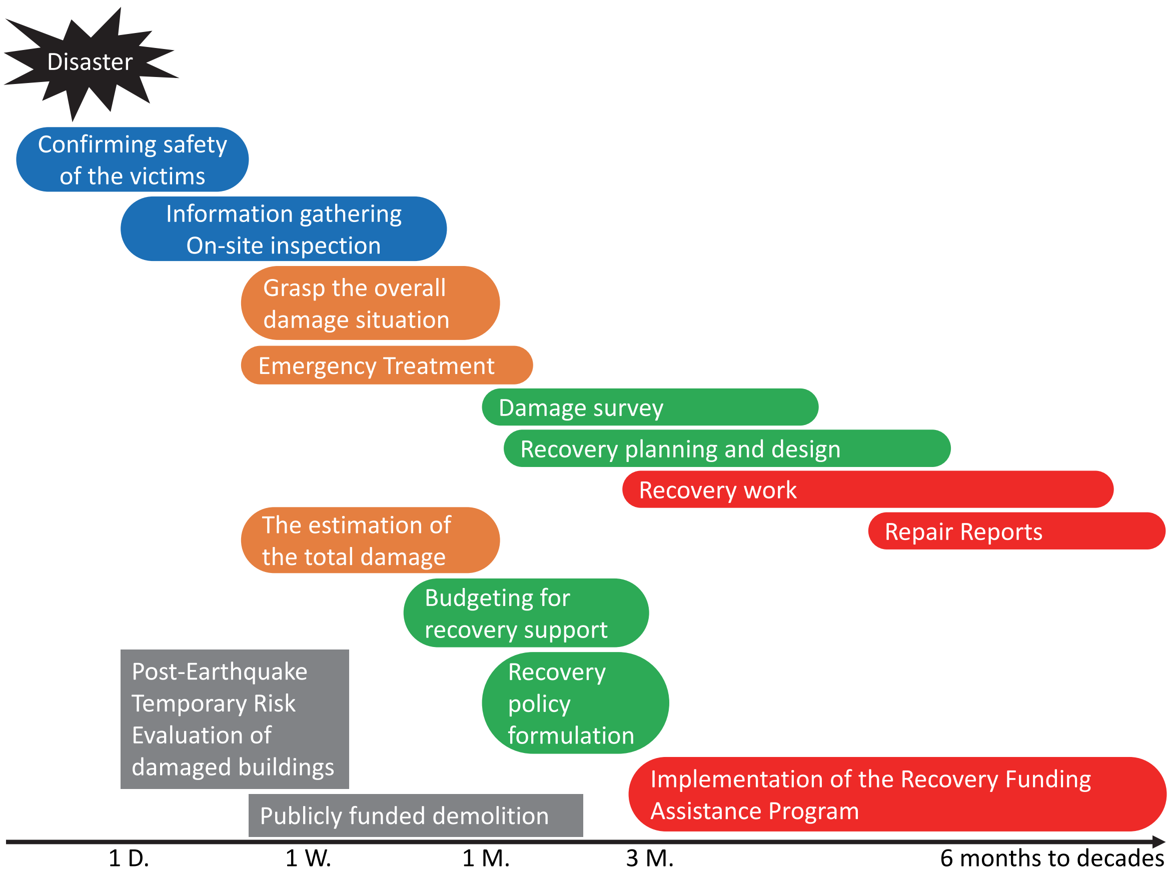

Figure 4.1.1 **Conceptual diagram of recovery timeline**

damage to telephone lines and other means of communication. Under the assumption that most employees of the municipalities affected by the disaster were engaged in disaster response work, prefectural government employees conducted on-site damage surveys of the national and prefectural designated cultural properties in each municipality. Two weeks after the main shock, municipalities settled somewhat in their disaster response, and on March 25 (14 days after the main shock), the prefectural government asked each municipal board of education to submit a damage report on the designated and registered cultural properties. The request was made in an effort to obtain a prefecture-wide understanding of the damage conditions. As communication with the municipalities was gradually restored, the prefectural government also surveyed the damage to municipally designated cultural properties, registered cultural properties, and others, upon request from the municipalities. Thus, the prefectural government grasped the extent of the damage to national and prefectural designated cultural properties in June, and the damage to municipal designated cultural properties in September. The same was true for the Kumamoto Earthquake in 2016.

Reports on the damage to nationally designated cultural properties were quickly sent to the Agency for Cultural Affairs through the prefectural government, and Agency officials were on-site to confirm the damage and respond to this situation. On April 15, Kumamoto Prefecture asked each municipal section in charge of cultural properties to e-mail information on the damaged cultural properties. Subsequently, on April 19, the prefecture requested municipalities to submit a cost estimate for the restoration of the damaged cultural properties. In heavily affected municipalities, damage inspections were difficult because the workload focused on the evacuees, so prefectural curators, as well as curators and faculty members from other organizations were dispatched to the municipalities.

For other types of cultural property, local communities and community planning organizations active in the area carried out the damage inspections while accompanying the concerned residents.

Emergency Treatment

For nationally designated cultural properties, the chief engineers of cultural property building conservation (hereafter referred to as "chief engineers") of specialized organizations (the Japanese Association for the Conservation of Architectural Monuments (JACAM), the Japan Cultural Heritage Consultancy, and others) are brought in to carry out everything from emergency treatments to recovery work in a planned manner.

For other cultural properties, the situation is slightly different. They differ depending on the type of cultural property, as they can be municipal or national registered cultural properties, traditional buildings in a preservation district for groups of traditional buildings, structures of scenic importance, or undesignated cultural properties. Generally, the main difference from nationally designated cultural properties is that they are often still used as places where people live and work. In areas where many such cultural properties remain, recovery support for cultural properties should be integrated with the recovery of people's lives. However, in the immediate aftermath of a disaster, public recovery efforts tend to target people's health and livelihoods, and currently, support for historical and cultural properties is not integrated, as there is no coordination with the disaster measure departments. Thus, problems that arise after a disaster include the anxiety caused to the owners regarding the post-earthquake temporary risk evaluation, the concerns on deciding between preservation and publicly funded demolition, and delays in determining the recovery support of cultural properties.

Post-Earthquake Temporary Risk Evaluation of damaged buildings is intended to prevent secondary disasters that may affect human lives. The evaluation is carried out by surveying buildings damaged by major earthquakes to determine the risk of collapse, shattering of exterior walls or window glasses, and falling of attached features due to subsequent aftershocks. This is conducted within a few days after a disaster occurs. The results are coded in three levels displayed on colored paper that is placed in a visible area of the building: *Inspected* (blue tag), *Caution* (yellow tag), and *Unsafe* (red tag). This is intended to provide information on the safety of the building not only to residents but also to pedestrians passing by the area. The assessment is also said to help comfort victims who are anxious about the damaged buildings since experts directly inspect each construction. While the purpose of these assessments is not to determine whether or not a damaged building can be permanently used, it has been repeatedly pointed out in past earthquakes that the *Caution* or *Unsafe* ratings contribute to the anxiety of the owners, leading them to dismantle the damaged historic buildings in cases where the survey results are posted with no careful explanation for the local residents. Considering this situation, at the time of the Great East Japan Earthquake, Katori City in Chiba Prefecture adopted a policy of not posting the inspection results in the Preservation District for Groups of Traditional Buildings and surrounding landscape areas. The owners were made aware of the dangerous areas only after a careful explanation to them and after the city put a rope up at dangerous places. In addition, on April 7, approximately one month after the main shock, the Agency for Cultural Affairs explained the purpose of the Post-Earthquake Temporary Risk Evaluation mentioned above to each prefectural board of education. In order to prevent valuable cultural properties from being demolished without considering their possible recovery, the Agency for Cultural Affairs issued a notice for property owners with references to expert opinions and safety considerations. A similar notice was issued to prefectural education boards about two weeks after the Kumamoto Earthquake (April 28, 2011).

The dismantlement of damaged houses is essentially that of private property and, in principle, dealt with under the responsibility of the owner. However, in the case of disaster rehabilitation, the affected local government can reimburse dismantlement costs of completely destroyed houses through subsidies. This is called *publicly funded demolition*, and since the Great Hanshin-Awaji Earthquake in 1995, this system has become common. It has led to the publicly funded demolition of historic buildings in many areas. Normally, support is provided for "completely destroyed" houses, but in the case of the Kumamoto Earthquake, partially destroyed houses were also eligible. While support policies for registered cultural properties and undesignated cultural properties were not finalized, the deadline for reservation applications of publicly funded demolitions was extended several times until the end of August (approximately four months after the earthquake), and, until the very last minute, some cultural property owners struggled to decide between publicly funded demolition and preservation.

In order to prevent historic buildings from being dismantled under the disaster recovery support system for housing described above, it is important for experts to go to the disaster-stricken area as soon as possible to advise the owners. Because the earthquake causes damage over a wide area, local experts become victims themselves or are tied up restoring their lives, so expert support from the surrounding area, rather than the local area, is necessary. However, the Cultural Property Doctors (discussed below) were not able to enter the area until two months after the Kumamoto Earthquake, even though discussions with the Agency for Cultural Affairs and related agencies were initiated immediately after the disaster struck. Even if a public finance and human resource support system could be set up at an early stage, the work could not begin immediately because of craftspeople shortages, difficulties in procuring materials, and rising construction costs. However, if appropriate measures are not taken promptly, the damage progresses, placing a heavy financial burden on the owners, and at the same time, discouraging them from pursuing recovery. Therefore, quick and appropriate emergency treatments immediately after a disaster are important, and it is necessary to secure the people in charge of these emergency treatments.

In this process, volunteers and community planning organizations are important stakeholders to support the initial damage assessments and emergency treatments. During the initial period, it is also extremely important to have community planning organizations (such as NPOs), who are present in normal times, accompany anxious residents while assessing the damage in the area and encouraging preservation. The activities of such organizations are also described in the case study of the Preservation District for Groups of Traditional Buildings in Chapters 6 and 7 of this report.

Damage Survey and Recovery Support

The Cultural Property Doctor Dispatch Program was initiated in the wake of the Great East Japan Earthquake disaster. The program begins with a cooperation request from the Agency for Cultural Affairs to related organizations with specialists. The public and private sectors then cooperate to conduct systematic surveys and provide technical support for the early identification of damaged cultural properties and for recovery. In the case of the Great East Japan Earthquake disaster, the Architectural Institute of Japan, the Japan Federation of Architects & Building Engineers Associations, the Japan Institute of Architects (JIA), and the Japan Society of Civil Engineers (JSCE) established a recovery support committee, and the Agency for Cultural Affairs commissioned them to carry these activities out. However, it took about six months to start the project, as the support committee for recovery was launched in May, two months after the disaster, and the Cultural Property Doctor Dispatch Program was launched in September.

The Kumamoto earthquake, like the Great East Japan Earthquake, caused enormous damage, and it was thought that damage surveys and technical support by experts would be necessary. The Architectural Institute of Japan, the Japan Federation of Architects & Building Engineers Associations, the JIA, and the JSCE gathered at the Agency for Cultural Affairs on April 20, six days after the earthquake, to discuss how to respond. They formed the Support Committee for the Recovery of Cultural Property Buildings, which consisted of representatives from each organization. The Japan Federation of Architects & Building Engineers Associations served as the secretariat and the Kumamoto Earthquake Cultural Property Doctor Dispatch Program was launched. On May 19, the Agency for Cultural Affairs drew up the implementation guidelines for the project, and on June 1, a consignment contract was signed with the Japan Federation of Architects & Building Engineers Associations, marking the beginning of the project. The project focused on conducting damage surveys mainly for national registered tangible cultural properties, municipal designated cultural properties, structures of scenic importance, and undesignated historic buildings. The Support Committee for the Recovery of Cultural Property Buildings was set up immediately after the disaster, and the Cultural Property Doctor Dispatch Program was launched two months after the earthquake, which enabled a more rapid initial response than was possible after the Great East Japan Earthquake. In addition to the damage surveys, on April 2017, approximately one year after the earthquake, a preparatory meeting was held for the historic building preservation project, and in May of the following month, individual visits were made to owners to request cooperation for the preservation and provide technical support (providing construction methods and estimates).

After the earthquake, undesignated damaged cultural properties needed to be assessed as soon as possible. Since the Kumamoto Earthquake occurred while the Agency for Cultural Affairs-subsidized "Comprehensive Survey of Modern Japanese-style Architecture" (an exhaustive survey of all houses, public buildings, and religious buildings built after the Meiji period that were made using traditional techniques and designs) was carried out, a list of *machiya* and old houses had been prepared to a certain extent. This list was a powerful tool for understanding the extent of the damage. However, since the survey was still in progress, it was incomplete. The Survey of Early Modern Shrine and Temple Architecture was not fully complete either, because the last iteration was conducted about 40 years ago. Therefore, it is necessary that, under the leadership of the prefectural government, each municipality creates a list of historic buildings like the system of provisionally registered cultural properties, which is currently being promoted by Kyoto Prefecture.

Financial Assistance

Repairing and restoring damaged cultural properties may be costly, and in some cases, cultural properties are not restored promptly and adequately due to the financial burden on cultural property owners and local governments that provide assistance. In Miyagi Prefecture, where the Great East Japan Earthquake damaged the greatest number of cultural properties, one month after the disaster on April 8, the national government announced a plan to increase the rate of state aid, expand the projects eligible, and provide special local grant taxes for projects subsidized by the prefecture and municipalities, in order to reduce the financial burden on the owners of cultural properties, the prefecture, and the municipalities. Additionally, while prefectures can provide subsidies for national and prefectural designated cultural properties within the framework of existing subsidy projects, municipal designated cultural properties and national registered cultural properties, which have sustained extensive damage, may not be subject to this aid. Thus, on July 1, 2012, more than one year after the earthquake, the Miyagi Prefecture Earthquake Reconstruction Fund for Cultural Properties was established. The Fund provides subsidies for up to a quarter of the cost to individuals and corporations who own designated cultural properties or national registered cultural properties, and is retroactive to March 11, 2011.

Other prefectures have considered support measures along the same lines. In Makabe, Sakuragawa City, Ibaraki Prefecture, within three months, a recovery plan was prepared and the government budget for the initial response was allocated. In Sawara, Katori City, Chiba Prefecture, liquefaction severely damaged a new urban area built by reclaiming the Tone River. Since the same government department handled liquefaction issues and historical district issues, there was a period when it was impossible to focus on recovery support for historic buildings. However, about two months after the disaster, the Act on Support for Reconstructing Livelihoods of Disaster Victims was revised and criteria for liquefaction damage were added. Three months after the disaster, applications for disaster recovery grants were accepted, and the grant decisions were made in July.

Public support efforts were underway in the aftermath of the Kumamoto Earthquake. As part of those efforts, people became aware of the need to support the recovery of cultural properties, as the damage to Kumamoto Castle, Aso Shrine, and other cultural properties was widely reported immediately after the disaster. Furthermore, shortly after the disaster, individuals, organizations, and companies began to work together to raise funds to support the recovery of cultural properties damaged by the disaster. As of May 2016, business communities and individuals had made numerous donations since the disaster. In July, the “Committee for Supporting the Rehabilitation of the Kumamoto Castle, Aso Shrine, and other Damaged Cultural Properties” was established, and full-scale fundraising activities began. In October, the collected donations were used to establish the “Rehabilitation Fund for Cultural Properties Damaged by the 2016 Kumamoto Earthquake”. The Fund's allocation policy and other details were decided at a Fund Allocation Committee meeting held in February 2017. At the Fund Allocation Committee meeting of October 2017, a decision was made to establish a prefectural subsidy system for undesignated movable cultural properties. As a result, a seamless system to support cultural properties, from designated to undesignated, has been institutionalized. This helps advance the recovery and rehabilitation of damaged cultural properties. After the funds are allocated, the rehabilitation of undesignated cultural properties will be discussed by a rehabilitation committee composed of experts.

Repair Work

While it will take a considerable amount of time to repair damaged cultural properties such as Kumamoto Castle, whose stone walls need to be restored due to the extensive damage they sustained, other cultural properties designated by the national and local governments are being steadily repaired. However, the construction period and repair process vary for each cultural property, depending on the level of damage and the repair policies. To give some examples, the entire process for the Aso Shrine (a national important cultural property) spanned from FY2016 to FY2018, and consisted of dismantling and investigating the tower gate while repairing the other parts of the gate. Assembly work for the tower gate began in 2019 and is still ongoing, with completion scheduled for 2023. At the Eto Family Residence, which is also an important cultural property, repairing the main building with partial dismantlement and reassembly (the earthen floor area was repaired with complete dismantlement) took about 4 years, from 2017 to 2020. Construction of the storehouse and stable, which underwent repairs with complete dismantlement and reassembly of the original structures, began in 2020 and was completed in 2021. Currently, recovery work is underway for the *nagayamon* gate , the attached shed, and the back gate, and it is scheduled to be completed in FY2022. As for the Kumamoto University's masonry constructions (national important cultural properties), emergency response work to remove chimneys and temporary reinforcement was conducted from 2016 to 2018. The main restoration work began after this, completing the repairs to the main building and the chemical laboratory in 2021 and the mechanical laboratory in 2022.

In Makabe, Sakuragawa City, the disaster recovery project took 10 years to complete for the preservation district for groups of traditional buildings and about three years for the structures of historic scenic beauty. this difference in recovery time can be attributed to different repair policies, which require more time for traditional repairs (especially for mud-walled storehouses), the different number of repairs between the preservation district and its surrounding areas, and the fact that many traditional buildings were damaged at a brewery in the preservation district, so repairs were carried out there in turn. On the other hand, in Sawara, Katori City, the initially scheduled repairs were almost completed in two years by allowing the use of modern materials and construction methods in the foundation, for example. These methods would not damage the landscape, and the work was carried out under the assumption that the traditional buildings would be repaired using traditional construction methods in future major repairs.

Repair Report

After restoration construction works are completed, it is natural that we only see the repaired parts that are visible on the exterior. While it is possible to understand the structure and techniques of a building to some extent by going into the attic space and under the floor, it is almost impossible to see how it was constructed and how the components were handled during the repair process. This information can be important when establishing repair policies. Knowledge obtained during repairs should not be limited to those involved in the repair process. It should be made available to the general public to promote a better understanding of the buildings themselves and their repair evaluation. Records should be made public and passed on to future generations. In the case of important cultural properties, the "conservation repair construction reports" compile and publish the repair process from beginning to completion at the end of the project. These reports serve as reference materials for other repairs and are also valuable academic materials. This is an excellent tradition of the repair projects of cultural property buildings in Japan. In the case of repairs of so-called municipal designated cultural properties, record-keeping was not always well understood, but in recent years the need for construction reports has risen, and most of the reports have been published. Similar reports have also been prepared for disaster recovery work. For example, the repair of Chateau Kamiya Former Distillery Facilities after the Great East Japan Earthquake disaster has been helpful for the recovery of Kumamoto University's masonry constructions, hit by the Kumamoto Earthquake.

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(Hajime Yokouchi)

4.2 Intangible Cultural Heritage

In the Act on the Protection of Cultural Properties, it is understood that intangible cultural properties, intangible folk cultural properties, and selected preservation techniques correspond to intangible cultural heritage under the 2003 UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage.

Among this intangible cultural heritage, craft arts and similar techniques, or so-called artisanal techniques, have an industrial aspect, and the process of their recovery, conservation, and rehabilitation, is presented here, including a framework for so-called small and medium-sized enterprises. Performing arts, another form of heritage, are not income-generating, with the exception of a few professional performing arts, and support for them in the event of a disaster should be considered. With this in mind, this section introduces the process of recovery and rehabilitation of intangible cultural heritage focusing on the performing arts.

How should we think of intangible damage? The author believes that damage to intangible cultural heritage must be considered in four phases.

(1) Persons affected
(2) Damage to objects
(3) Damage to the location
(4) Opportunity damage

First of all, "(1) Persons affected " means that from the viewpoint of the skills that intangible cultural properties are intended to preserve, there is an intention to preserve the people themselves. Therefore, the disaster-related loss of a person who possesses a technique means the loss of the cultural heritage itself. However, people can always die, and this is a point that needs to be taken into consideration beyond disasters. The “(2) Damage to objects” is the loss of tools used in the performing arts. This type of damage is easy to imagine, and if the objects themselves are rescued, they will be dealt with in the same way as fine arts and applied crafts are dealt with. However, intangible cultural property tools are not necessarily subject to protection as cultural properties, so the choice may be made to replace the tools with new ones. An exception is the case of the Gion Festival in Kyoto, where the festival itself is an Important Intangible Folk Cultural Property, and the *Yamahoko*, the main tool, is designated as an Important Tangible Folk Cultural Property. The next "(3) Damage to the location" refers to the loss of the place where the performing arts were carried out. When a village is washed away by a tsunami, as with the Great East Japan Earthquake disaster, it becomes difficult to maintain the folk performing arts that were held there. In other words, the shrines and assembly halls where the performances were held are lost, and the people of the community who served as the audience are also lost. And with the "damage to the location," there is also (4) “Opportunity damage.” The term "disaster" is used for the sake of consistency, but the meaning can be slightly different. When an area is damaged, the place where performances were held is lost, but performing arts do not need to be held at the original place. However, there is no certainty as to what opportunities are available to perform outside the venue. Some groups are actively invited to participate in rehabilitation events and can perform every week, while others do not have such opportunities and are unable to find the chance to resume their activities. With the loss of their original location, opportunity availability becomes an important factor in post-disaster response. These four elements combine in different proportions for each intangible cultural heritage. In terms of recovery and reopening, it is necessary to find the right balance between these four elements.

Although this refers to damaged intangible cultural heritage, items (1) and (3) should be handled within the context of general disaster response rather than cultural property response. On the other hand, (2) and (4) can be handled within the framework of the cultural property protection administration. However, as mentioned earlier, the four elements do not exist in isolation but are interrelated. In this context, it is necessary to think about how things can be recovered and how opportunities can be created. The most important factor in object restoration is the will of the bearers. Tools for the performing arts are not cultural properties themselves. Many of them were purchased at specialty stores. Some of them include hand-carved gifted masks and kimonos, as well as tools made by the bearers themselves. All of these items can be purchased, but each has its own history and value as a cultural property. When these items are lost in a disaster, it is not simply a matter of re-purchasing them. It is necessary to understand the history of each item and consider how to acquire it in order to resume the performing arts. Self-made objects need to be crafted again, and objects that can only be purchased should be recovered this way.

In this context, care must be taken when handling masks and similar objects. It is difficult to craft them because it requires a certain level of skill. On the other hand, objects like these are not acquired all at once. Rather, they are handed down to the present day through donations and the repeated replacement of broken items, and a set of masks becomes the identity of the performing arts group. Therefore, care must be taken when commissioning the production of such masks. In the Great East Japan Earthquake disaster, when *kagura* masks and *shishi*-heads were to be replaced, the performing groups asked us to produce masks and heads that looked like those damaged in the disaster. At that time, private foundations and other organizations were providing substantial support for performing arts and festivals, and with their assistance, performers' requests were fulfilled to the greatest extent possible. The specific work involved carving a temporary head based on photographs and other materials, and then having the bearers confirm the appearance and feel of the head in their hands before carving the final version. Naturally, this was a very time-consuming process, and sometimes the temporary carving would need to be re-done because it was completely different from the original. Despite the time-consuming nature of this work, the bearers had an opportunity to reconsider the nature of their performing art, as they had lost something they had taken for granted and needed to restore it from memory. The same is true for the re-creation of tools. It is a good opportunity for the performers to share the history of how these tools were made and who made them. In the Great East Japan Earthquake disaster-stricken area, this often led to an increased willingness to pass traditions on.

Securing opportunities would simply mean holding supportive events that many groups can attend to. Such events encourage performing arts groups that are unable to continue or resume activities in the area that has been handed down. These events are an easy way for outsiders to provide support to the disaster-stricken area. Inviting performers to the supporter's local communities helps inform supporters about the disaster and the damage it caused, expanding the circle of direct and indirect support. Similarly, the performers on stage are enthusiastic about the opportunity to express their gratitude to their supporters through their performance, and they are willing to accept invitations". They felt that they were thanking their supporters on behalf of their community. It would be no exaggeration to say that popular groups would be on stage in various parts of the country every week during the event season. One group that had been sought after in many places realized that "we are performing for the benefit of the local community." This point is very important. From the perspective of opportunity, and in terms of continuing the performing arts during the period of recovery and rehabilitation, it is important to provide temporary opportunities such as events. Having such opportunities performers continue their work when they are not able to perform in the disaster-stricken area. This is important in terms of opportunities.

From this perspective, it would be a good idea to create a stage in the disaster-stricken area and plan events inviting the evacuees, but also the people from outside to inform them about the disaster area. In any case, events involving people in the disaster-stricken area and opportunities to perform in these events will empower the performing arts to come back to the local communities after rehabilitation.

As we have seen, the revitalization and rehabilitation of the intangible cultural heritage affected by the disaster cannot be achieved simply by providing the tools needed. It is necessary to find a balance between how the elements that make up intangible cultural heritage (objects, people, places, and opportunities) were before the disaster and how they will be in the new society after rehabilitation. At the same time, outside supporters need to be aware of the mechanisms created to involve them in their support. Performing arts and other intangible cultural heritage forms that have been handed down to local communities in disaster-stricken areas are often not recognized as cultural heritage, but they are closely related to local lifestyles. Therefore, there is often a strong desire to resume performing arts and festivals. Excessive support, however, can sometimes lead to a decrease in willingness to continue. It is important to provide support while keeping an eye on the needs of the local community and how they are changing.

(Ryusuke Kodani)

4.3 Damage and Recovery of the *Kofun* Tombs Caused by the Kumamoto Earthquake

Background

The Kumamoto Earthquake in 2016 caused damage to many *kofun* tombs (ancient Japanese burial mounds) mainly in Kumamoto Prefecture municipalities near the epicenter and fault zones, but also in Fukuoka and Oita prefectures. The *kofun* suffered cracks in the mounds, damage to stone chambers and to the protection facilities. Regarding the damage assessments by public organizations, in addition to the reports compiled by the Agency for Cultural Affairs and the Kumamoto Prefectural Board of Education, the reports for the fiscal years 2009 and 2018 prepared by the Working Group on *Kofun* With Decorated Chamber Walls, a special study group established by the Agency for Cultural Affairs. The Japanese Archaeological Association (JAA) established a special committee for the Kumamoto Earthquake measures and published a report. In June 2017, the 20th Kyushu Conference on Keyhole-shaped Mounded Tumuli was held under the title "Current Status and Issues of the *Kofun* Tombs Damaged by the Kumamoto Earthquake and Proposals for the Future," which has been published.

According to a report by the Agency for Cultural Affairs and the Kumamoto Prefectural Education Agency, 35 ancient *kofun* that were designated cultural properties at the national, prefectural, and municipal levels were damaged (Agency for Cultural Affairs and Kumamoto Prefectural Education Agency, 2017). According to Takeshi Sugii, 48 *kofun* designated and undesignated were listed (Takeshi Sugii 2021). The number of *kofun* themselves is said to exceed 1,300 in Kumamoto Prefecture alone. Therefore, it is likely that there are much more that have not yet been fully identified. In addition, there are cases where the damage was not observed immediately after the disaster but became apparent later due to rainwater entering the stone chambers during heavy rainfalls and other events.

The following is an overview of the main damaged *kofun* by damage conditions.

Damage Conditions

(1) Damaged stone chambers and stone coffins in the main body.

Kofun tombs decorated inside with line engravings, reliefs, or pigments on the stone coffin or chamber walls, are called decorated *kofun*. Of the approximately 660 decorated *kofun* in Japan, 30% are located in Kumamoto Prefecture. Many of the tombs decorated with pigments are difficult to handle because of measures related to the management of temperature, humidity, mold, and other factors. This makes the protection and recovery of damaged decorated kofun more difficult. Among the 35 disaster-afflicted *kofun* half (17) are decorated *kofun*. This is partly due to the fact that decorated *kofun* are more likely to be designated than undecorated ones.

In the case of the Idera *kofun*, a national historic site decorated with pigments and located in Kashima Town, the stone chamber is close to collapsing, so entering it is difficult. The same is true of the Imajo-Otsuka *kofun* in Mifune Town. Therefore, even surveying the damage conditions was a difficult task. At the Eianji-higashi kofun in Tamana City, a national historic site, the decorated tuff stones have broken and fallen.

The undesignated Nikengoya *kofun* in Kumamoto City did not appear in any official reports, as pointed out by Mr. Sugii, who actually visited the site. The collapsed part of the mound has been refilled, which is problematic even if it was done with good intentions.

One example of a damaged stone coffin is the Ishinomuro *kofun* of the Tsukawara *kofun* complex, which is a national historic site located in Kumamoto City. It is a combination-style house-shaped stone coffin with a side entrance. Originally, the earth exerted pressure on the lid, but during maintenance work, a protection facility was built over the exposed stone coffin so that it could be seen. The lid flew up and fell, likely increasing the damage. Similar phenomena also occurred at the Etafunayama *kofun* in the town of Nagomi and the Kyodzuka *kofun* in Tamana City, which were left excavated. In the case of the Kyodzuka *kofun*, the brittle parts that had been damaged by salt weathering were damaged by the impact.

(2) Damaged Mounds and others

The Tenjinyama *kofun*, a historic site designated by Uto City, is a 107-meter-long keyhole-shaped mounded tomb. Even before the earthquake, the mound had been scraped for earth removal and other purposes, resulting in a steep cliff. The front part collapsed during the earthquake, and the rear part collapsed due to subsequent heavy rain. In addition, the aforementioned Itera and Imajo-Otsuka *kofun* also collapsed, not only the main body but the entire mound that held it.

At the Omura Yokoana-Gun complex, a national historic site in Hitoyoshi City, the side entrance itself was not damaged, but the cliff face collapsed. At the Ishinuki-Nagino Yokoana complex, a national historic site in Tamana City, no damage was observed immediately after the earthquake, but the surface collapsed due to rain at a later time, which is thought to have been a consequence of the earthquake.

(3) Damaged embankment and visitor facilities for protection and management

The Kamao *kofun*, a national historic site in Kumamoto City, is no longer accessible due to the collapse and burial of its protective embankment. At the Tsukahara *kofun* complex, which is also a national historic site, *kofun* including the Sandanzuka, Kunugizuka, and Biwazuka *kofun* are damaged by cracks and sinking. In addition, the mound of the Tsukabozu *kofun*, a national historic site located in the town of Nagomi, was damaged, causing water to leak into the stone chamber. All of these mounds were filled in during maintenance. The mound of the Matsuhashi-Otsuka *kofun* in Uki City also collapsed, but it is believed to have been filled in later periods.

At Eianji-nishi *kofun* in Tamana City, maintenance was carried out covering the entire mound with a dome, but cracks developed in the roof and foundation of the dome. Since the maintenance of the mound had been difficult even before the earthquake, a maintenance review is being considered.

(4) Others

In many places, excavation surveys are being conducted to record and preserve buried cultural properties that are difficult to preserve in situ due to the earthquake rehabilitation constructions. At the Kosaka-Otsuka *kofun* in Mifune town, a large circular-shaped mounded tomb was discovered during the excavations for earthquake recovery at a support facility for people with disabilities. Despite the fact that it was part of the earthquake recovery work, a local briefing session was held for the general public.

Toward Recovery

Despite the damage described above, relatively early recovery is being carried out for damaged observation facilities and national historic sites such as the Tsukahara *kofun* complex by filling and protecting during maintenance. In addition, the restoration of the Kyodzuka *kofun* in Tamana City, where the stone coffin was damaged, has been completed along with immediate measures against salt weathering.

At the Ohnoiwaya *kofun*, a national historic site in Hikawa Town, which has one of the largest stone chambers with a ceiling height of 6.5 m, the stone material cracked and fell, and the embankment filling fell through the gaps, creating voids. Responding to this situation, the mound was filled with urethane resin for consolidation.

However, for the Itera and Eianji-higashi decorated *kofun* that had damaged chamber walls, caution is necessary when deciding on the recovery policies based on the damage conditions survey.

When restoring a stone chamber, work must be carried out even if the mound has been preserved in its original form. For the preservation of decorated chamber walls, in addition to considering environmental factors such as temperature and humidity, the materials used for recovery must not affect the original pigments used for decoration. In the Eianji-higashi decorated *kofun*, a national historic site, adhesives were avoided to protect the decorations, and the peeled stones were preserved as they were, with no reconstruction.

A committee of experts in archeology, conservation sciences, civil engineering, and other fields was established to study these issues, focusing on *kofun* which are national historic sites and are currently undergoing recovery efforts. There are many difficulties, and it is necessary to continue examinations over time. Then, based on the results of the examinations and after taking measures for the time being, further progress can be made toward a future full-scale recovery. The recovery process, new technologies such as 3D measurements, and construction methods that have been studied will accumulate to be used in the future.

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(Atsushi Takeda)

5. Seismic Resistance Measures for the Earthquake Recovery of Cultural Property Buildings

5.1 Basic Approach to Improving Seismic Resistance

Seismic resistance and recovery measures of damaged cultural property buildings (with the exception of emergency measures) are planned based on the same approach as that used for preventive seismic resistance measures. Avoiding any damage to the historical and cultural value of the cultural properties is important, but the safety of human life is a priority when a large number of persons use the building, even if it is a cultural property. Seismic reinforcement should be as minimal and reversible as possible. When implementing seismic resistance measures for earthquake recovery, it is also important to take a scientific approach, and to work with the owner and government officials in an interdisciplinary team that includes experts in architectural history and structural engineering.

Many cultural property buildings were not designed to be earthquake-resistant at the time of construction, or they were designed before the 1981 reform of the Building Standards Act, making them non-conforming buildings, and many of them are vulnerable to earthquakes. It is said that "earthquakes strike at weak points." Structural damage to cultural property buildings can be considered to be the manifestation of weak points. In developing a recovery plan for damaged cultural property buildings, it is essential to first find the cause of the damage and conduct proper surveys and diagnoses in order to use the earthquake experience to improve the seismic assessment. It should be noted that input seismic motion characteristics are also a factor, and that even at the same input level, some buildings may or may not be damaged, depending on the frequency characteristics and duration. In addition, aftershock countermeasures are also essential for magnitudes of 6 and above. It is desirable to formulate a plan that covers everything from emergency measures to permanent measures. It is known that, after the Great Hanshin-Awaji Earthquake in 1995 struck, about 70% of the collapsed buildings had unbalanced structures. The "weak points" need to be reinforced and a reinforcement plan needs to be developed to create a well-balanced structure.

Conversely, there are cases where no structural damage occurs, even if the building is subjected to a motion equivalent to the maximum seismic motion level of the Building Standards Act. Such a building probably has intrinsic and considerable seismic performance. It is desirable to plan seismic resistance measures taking advantage of this performance in order to improve earthquake resistance.

In the case of earthquake recovery, when a building is used by a large number of persons, the target safety performance is determined in accordance with the Building Standards Act, by ensuring that the structure will not be damaged by a medium-sized earthquake, and that it will ensure the safety of human lives in the case of one of the largest earthquakes. However, cultural property buildings often require large-scale reinforcement, and for important cultural properties, according to the guide, "transitional reinforcement" is one way that may be considered to ensure the safety for the time being. However, even transitional reinforcement that does not comply with the current Building Standards Act must be accompanied by engineering considerations and, in the near future, it will be necessary to ensure safety that conforms to the Building Standards Act.

Many damaged cultural property buildings had structural performance problems before the earthquake, such as deteriorated structural materials, loose joints, and deformed or tilted frameworks. If these structures had been sound, they may have escaped serious damage. In recovery, restoring the originally possessed structural and material performance also leads to minimum reinforcement, which is the principle of structural reinforcement.

(Toshikazu Hanazato)

5.2 Wooden Constructions

General characteristics

Japanese wooden constructions are characterized by their framework structure, which consists of posts and beams, foundations, penetrating tie beams called *nuki*, and *magusa* or lintels. Unlike masonry constructions, which consist of solid walls, openings can be made more freely, allowing them to create open spaces. (Figure 5.2.1)

Figure 5.2.1 **An example of wooden constructions: Byodoin Phoenix Hall**

The components that resist horizontal seismic forces in a building include the joints between posts and penetrating beams, the mortise-and-tenon joints between posts and horizontal members (such as beams and lintels), wall elements such as mud walls or wooden board walls, and in the case of large-diameter posts, the post's own resistance to rocking.

Buildings with sufficiently thick posts and penetrating tie beams are known to be resilient to collapse even if they become largely inclined and can resist deformation angles of up to 1/15 radians.

Conversely, some buildings, like residences and *shoin* style traditional residential buildings feature open layouts with few or unevenly placed walls, which could result in the sudden collapse of the structure if a load-bearing post breaks.

The roof weight also contributes significantly to seismic performance. Plant-based shingles such as Japanese cypress bark or other wooden shingled roofs and thatched roofs are light but pose a risk of fire, while tiled roofing, which has high fire resistance and durability, is heavy, and in many cases made heavier by a layer of soil below the tiles.

Kura or thick mud-walled storehouses are relatively resistant to earthquakes and less likely to collapse. However, their earthen walls may crack and peel when shaken by earthquakes. Even minor shakings can cause partial cracking of mud walls and falling of ceramic tile wall coverings, resulting in significant repair costs.

Repair of damaged parts

The seismic performance of a building can vary significantly based on the condition and age of its materials. In particular, wooden constructions can become weak due to loosening of the frame, insect damage, decay, and wear-and-tear on mud walls caused by age and previous earthquakes and typhoons. Sill beams and post bases are susceptible to decay and termite damage, while pine beams are particularly prone to termite infestation. Aging mud walls are susceptible to cracks, gaps, and lifting from the substrate and the painted surface, leading to decreasing bearing capacity and making them prone to scaling. The adhesive strength of the mud itself also deteriorates, increasing the likelihood of top coats and wall surfaces of ceramic tiles separating. Roof tiles, which are nonstructural elements, may also loosen and become dislodged due to age.

As such, the basic premise of seismic resistance measures for wooden constructions is to ensure that the structure is maintained in a sound

Figure 5.2.2 **An example of repair of damaged parts: replacement and maintenance of damaged beams in *minka* (folk houses)**

condition through appropriate repairs. Therefore, seismic assessments of National Treasures and Important Cultural Properties are conducted under the assumption that the buildings are in stable condition and undergoing proper repairs. (Figure 5.2.2)

Seismic reinforcement

Seismic reinforcement of wooden structures involves adding elements to resist horizontal forces, reinforcing the horizontal structural plane, reducing the weight of the roof, reinforcing joints, and strengthening weak points.

Additional horizontal resistance elements may involve adding earthquake-resistant walls and fixtures or replacing existing ones with earthquake-resistant materials. This can include replacing board sliding doors with earthquake-resistant walls or fittings (Figure 5.2.3). Reinforcement materials can include plywood (Figure 5.2.4), wood lattices (Figure 5.2.5), drywall panels, wood bracings, steel rod bracings (Figure 5.2.6), plate walls, and, in rare cases, steel framing, steel plate seismic rein-

Figure 5.2.3 **Seismic fixtures and fittings**

Figure 5.2.4 **Structural plywood wall used for reinforcement**

Figure 5.2.5 **Lattice wall on the ground floor**

Figure 5.2.6 **Steel bar braces**

Figure 5.2.7 **Steel frame reinforcement**

forcement, and glass seis mic reinforcement. Increasing the thickness of mud walls may also contribute to reinforcement. If it is difficult to add walls or fittings, steel frames may be used for reinforcement. (Figure 5.2.7 and 5.2.8)

Shikuchi dampers (dampers made of viscous materials) (Figure 5.2.9) are sometimes applied at the joints between posts, purlins, and/or beams, serving as both reinforcement and a vibration-control measure.

Reinforcements of horizontal structural planes are applied on floors of the second level or ceiling area of the first level, or inside of roof trusses. This is particularly necessary for buildings with external walls only at the perimeter, or for buildings with unevenly distributed walls. Examples of reinforcements include adding structural plywood sheets on the second floor and/or roof, bracing with steel rods (Figure 5.2.10), and installing wooden diagonal bracing on beams and girders (Figure 5.2.11). Carbon fiber rods may also be used.

To reduce the weight on the roof, it is recommended to reduce the amount of soil during reroofing. It is possible to introduce a wooden foundation instead of soil and lay tiles to make dry-roofing. For some large temples and shrines, when roof tiles are too thick, the reverse side of the tiles were shaved off to make them lighter.

Reinforcement of the joints includes preventing dislodging of both the joints between posts and beams, as well as the penetrating tie beams. Metal cleats or other reinforcement hardware are used.

Reinforcement of weak areas is expected to include the following:

When posts are just laid on foundation stones, their bases are not fixed and may move independently during an earthquake. To prevent such undesirable movement, footing reinforcement may be used to tie the post bases together (Figure 5.2.12).

If there is a risk that a post may break, there are several measures to prevent stress from concentrating on the post, such as installing a supporting column where there is a risk of breakage, rein-

Figure 5.2.8 **Steel frame reinforcement**

Figure 5.2.9 **Seismic reinforcement ring made of resin**

Figure 5.2.10 **Horizontal structure reinforcement with steel bar braces**

Figure 5.2.11 **Reinforcement to horizontal structure with wooden braces**

forcing the post with steel plates, or adding supporting walls.

If the bottom of a post is repaired using a *kanawatsugi* (a tapered table scarf joint with tenons) the joint area may become a weak point. In such cases, metal bands (Figure 5.2.13) or carbon fiber sheet wrapping could be used as reinforcement bracing.

Porch roofs, canopies, eaves, and lower roofs may shake and fall off during an earthquake. The inner structure of porch roofs can be reinforced horizontally after joints are tightened. Eaves and lower roofs are often weak because their connection to the main body of the building is only through the rafters, which are attached with nails. They can be reinforced by increasing the number of nails, binding them with metal fasteners, and strengthening their horizontal structure if necessary.

Seismic reinforcement plan

Efficient seismic reinforcement plans should be developed to reinforce weak points after proper diagnosis.

To preserve the value of historic buildings, reinforcement works should be as discrete and unobtrusive as possible. The interventions made to the members should be minimal and distinguishable.

In the case of wooden constructions, reinforcement should be done in a manner that fully utilizes deformation performance. If seismic reinforcement elements such as earthquake-resistant walls are necessary, the addition or replacement of elements should be installed at existing wall locations or inconspicuous locations. When reinforcements are absolutely necessary for open spaces, design ingenuity, such as emulating existing fixtures and fittings, may be required. If it is difficult to add walls to an open space, earthquake-resistant walls can be installed under the floor, and the partial walls can be added as an earthquake-resistant measure (Figure 5.2.14). Although under-floor reinforcement can reduce the risk of post-breakage under the *kokabe*, it must be noted that reinforcing the *kokabe* themselves may actually increase this risk. Reinforcement of the horizontal structural plane should be done inside the hidden roof structure to make it invisible, and thin members such as steel bar braces should be used to make them less visible if there is no ceiling.

Replacing mud walls with structural plywood, and removing the soil layer under the tiles are common measures to reduce roof weight. However, when considering the preservation of historic buildings and their traditional building techniques,

Figure 5.2.12 **Under the floor reinforcement**

Figure 5.2.13 **Metal plate bands reinforcement placed around a post**

Figure 5.2.14 **An example of reinforcement under the floor**

these measures should be chosen with great care and caution.

Post-earthquake Recovery

When wooden constructions are subjected to earthquakes, they tilt significantly, joints loosen or fall out, and mud walls crack. Posts may break at weak points. When these problems become pronounced, collapse occurs.

Emergency response for wooden constructions immediately after a disaster must be carried out after confirming their safety. If roof tiles fall or mud walls come off, the first step is to cure the roof against leaks, dismantle roof tiles and mud walls that are likely to come off, and protect them from rain by using boards, sheets, etc. If the building is inclined, emergency measures such as installing braces (Figure 5.2.15) or supports made of logs should be taken.

In the event of a collapse, it is necessary to store the fallen components to avoid further deterioration due to rainwater. First, the components should be protected with sheets (Figure 5.2.16), etc., and when ready, they should be stored while recording their original positions as much as possible, in preparation for reconstruction.

With slight damage and inclinations, partial repairs can be done by rectifying core posts and beams, tightening back penetrating tie beams, and touching up damaged mud walls and roofs. However, if a building collapses or the inclination degree is significant, a partial or a complete dismantlement and reassembly becomes necessary.

When an earthquake damages a member causing posts or beams to break, repairs basically target broken parts or the replacement of broken components. These repairs are primarily carried out using traditional methods. However, if major components such as posts are damaged and replacing them would diminish their value, or if similar materials are difficult to obtain, efforts may be made to reuse damaged materials using modern construction methods or state-of-the-art technology. An example of this is the Aso Shrine gate, which suffered substantial damage due to the Kumamoto Earthquake in 2016. To raise the rate of reused original materials, inorganic materials such as aramid rods and epoxy resins were employed to secure broken parts of the components (Figure 5.2.17).

Figure 5.2.15 **An example of emergency measures: installation of braces**

Figure 5.2.16 **How the collapsed members are protected by plastic sheets**

Figure 5.2.17 **An example of earthquake resistant measure using in organic material (Aramid rods). Only the upper part is a new material that is jointed to the original post. (Aso Shrine)**

If a building collapses, its members will be severely damaged, so it is important to make repairs and seismic resistance measures in advance to mitigate any damage.

(Satoshi Nishioka)

5.3 Masonry Constructions

Masonry constructions are buildings made of blocks of stone, bricks, or other earthen material, often joined using a bonding material. Because these blocks can come apart, they are generally considered to be vulnerable to seismic force without reinforcement. In particular, out-of-plane loads on the walls are prone to cause collapse, and must be taken into consideration for the earthquake safety of masonry constructions. Until the mid-Meiji period (1868-1912), lime mortar was used as bonding material, but since the late Meiji period, when Portland cement technology was introduced to Japan, cement mortars with greater strength characteristics became more commonly used. Non-destructive and micro-destructive tests are especially important for buildings with historical and cultural importance because, except for dry masonry, it is difficult to carry out structural testing dismantling the original structures. Even in masonry constructions, roof trusses and floor structures are basically wooden structures, as is the case in Western Europe. Additionally, in Japan, from the early Meiji period to the early Taisho period, hybrid constructions with traditional wooden frameworks on the interior and masonry walls on the exterior were built. During the Taisho period (1912-1926), when reinforced concrete architectural technologies were introduced, brickwork constructions with reinforced concrete walls were also built (i.e., PS Orangerie, a national registered tangible cultural property). From the seismic engineering standpoint, masonry buildings are short-period structures, and they suffered more damage than wooden historic buildings did following the Great East Japan Earthquake in 2011 and the Kumamoto Earthquake in 2016. These earthquakes recorded predominantly short-period seismic motions. Examples of such damage and recovery are shown in Chapter 7.

Japan's architectural culture originally focused on wood, but after the Meiji Restoration in the mid-19th century, western design and technologies were introduced to the field of architecture and civil engineering, and among them, masonry constructions became popular. The Nobi Earthquake in 1891, however, caused many unreinforced masonry constructions to collapse, leading to skepticism about the seismic performance of masonry buildings, which was taken into account in the structural design. The Great Kanto Earthquake in 1923 caused significant damage to brickwork constructions again, and the structural regulations were further tightened. However, along with these stricter regulations, reinforced concrete technologies came from the U.S. at the end of the Meiji period (1868-1912). By the Taisho period (1912-1926), brickwork constructions were gradually disappearing in Japan. The Great Hanshin-Awaji Earthquake in 1995 also caused severe damage to the historic buildings located in the area where seismic forces were particularly strong. For example, the wood-framed brickwork of the former Kobe Settlement 15th Building (1880, a national important cultural property) was regrettably destroyed. It was afterwards reconstructed using a base-isolation seismic resistance system; the first time this technology was employed for earthquake-damaged cultural property buildings.

In Japan, the seismic assessment of historic masonry constructions has in most cases been performed in accordance with the "Seismic Evaluation Standard and Retrofit Guidelines for RC (reinforced concrete) Buildings (Japan Building Disaster Prevention Association JBDPA)"or the "Standard for Seismic Assessment of Brickwork Buildings (Hokkaido Building Engineering Association)", both of which are publicly available. However, the criteria for the seismic index of structure (I_S value) used is that used in the diagnosis of reinforced concrete constructions. This methodology has not been , and it is difficult to claim that a reasonable assessment has been made. The seismic reinforcement design of PS Orangerie (a brickwork construction with wooden frames that was damaged by the Kumamoto Earthquake) is described in Chapter 7. This reinforcement design also follows the above criteria, but the toughness index for seismic force is relaxed in consideration of the deformation performance of brickwork constructions, which is now known from recent studies. The "Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" of the Agency for Cultural Affairs are based on seismic assessment methods for wooden structures and do not provide specific methods for non-wooden structures, including masonry constructions. It would be a challenge to develop a seismic assessment method that takes the deformation performance of masonry constructions into account, including the out-of-plane seismic evaluation. The basic principle of seismic reinforcement for cultural property buildings is to ensure minimal intervention to preserve their historical and cultural value. Thus, it is necessary to develop an evaluation method that takes into account the characteristics of masonry constructions. There are examples of transitional reinforcement of damaged cultural property buildings based on the current status of seismic assessment methods for historic masonry constructions (PS Orangerie, damaged by the Kumamoto Earthquake). One of the principles of seismic reinforcement of cultural property buildings is reversibility. Reversible reinforcement is relatively easy for wooden constructions that can be repaired by dismantling and reassembling original structures. However, this type of reinforcement is generally difficult for masonry constructions, except for dry masonry. Reversible construction methods should be employed whenever possible. Post-construction anchors are used to connect steel constructions and reinforced concrete constructions to the reinforcement components. The evaluation of the bearing capacity of the joints in reinforcement design is based on test construction, but a bearing capacity formula has also been proposed.

When considering seismic resistance measures in terms of seismic reinforcement, they can be divided into (1) methods applicable to buildings damaged by the earthquake, (2) methods primarily used for pre-earthquake measures, and (3) methods applicable to both pre-, and post-earthquake measures. If a building has suffered structural damage from an earthquake, seismic reinforcement should prepare it for future earthquakes, along with conservation measures. Even for transitional reinforcement, engineering considerations are essential.

The following is a summary of the characteristics, advantages, and challenges of typical seismic reinforcement methods for historic masonry constructions.

1) Reduction and control of earthquake loads

Base-isolation system

Seismic isolation devices are installed on the foundation to reduce input seismic motion. Generally, the superstructure also requires seismic reinforcement, but this can be kept to a minimum. Changes to the superstructure should be minimized, as these are cultural properties. The building can remain functional even after a major earthquake. On the other hand, the foundation needs reinforcement, which may affect cultural property buried underground. Additionally, the cost for such work is high. A recent representative example is Tokyo Station, an Important Cultural Property building constructed with steel-framed brickwork. A seismic retrofit project was conducted while the building was still in use as a station. (Figure 5.3.1)

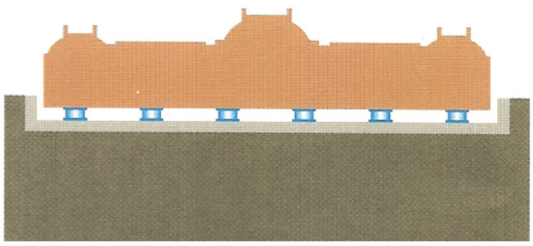

Figure 5.3.1 **Schematic of base-isolation system**

2) Improvement of structural performance

Increasing concrete mass on existing walls

A reinforced concrete wall is installed inside the existing walls to increase their in-plane shear capacity. This is a relatively simple method and is effective when the wall volume is insufficient. It is also low-cost, reliable, and effective against out-of-plane deformation. However, while the exterior can be preserved, it involves a radical intervention on the interior spaces and is irreversible, so in recent years it has only been used when it is absolutely necessary. (Figure 5.3.2)

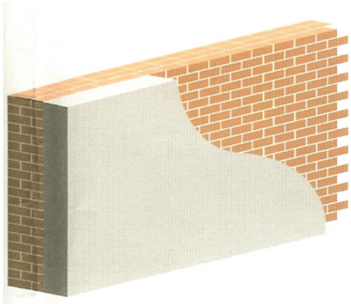

Figure 5.3.2 **Schematic of increasing concrete mass on existing walls**

Attachment of steel plates

Steel plate panels are anchored or bolted to both sides of the wall to prevent out-of-plane deformation and in-plane shear. This is used to reinforce a portion of the wall, rather than the entire wall. Sometimes steel plates are used in strips. This is a relatively easy method that can be applied as an emergency measure and is also reversible. However, the interior and exterior appearance might be compromised. (Figure 5.3.3)

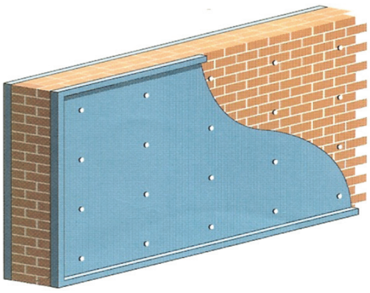

Figure 5.3.3 **Schematic of attachment of steel plates**

Reinforcement with steel frames

A steel frame structure is installed inside the building, and the steel frame structure bears the in-plane and out-of-plane seismic forces. This is a relatively simple reinforcement method. The exterior appearance is preserved, and reinforcement components can be removed. However, the method requires reinforcement of the foundation and the installation of a ring beam on top of the walls. In the case study presented in Chapter 7, this method was used in the earthquake recovery of the Chateau Kamiya Winery, an Important Cultural Property. (Figure 5.3.4)

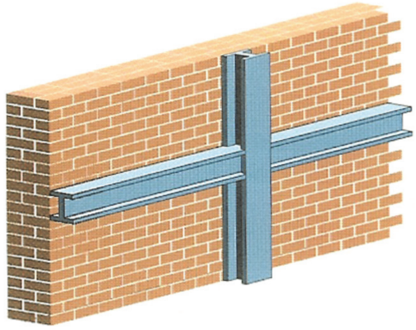

Figure 5.3.4 **Schematic of reinforcement with steel frames**

Inserting steel bars

After drilling vertical or diagonal holes in masonry constructions, steel rods are inserted, and mortar or resin is injected into the holes to bond them to the wall. The interior and exterior appearance of masonry constructions can be preserved and reinforced without any alteration to the design. The bending strength of the wall is improved. The method of anchorage needs to be considered and is used in the case study discussed in Chapter 7, PS Orangerie, a national registered tangible cultural property. (Figure 5.3.5)

A method of driving short stainless-steel pins diagonally into the out-of-plane direction of thick masonry construction walls is also used.

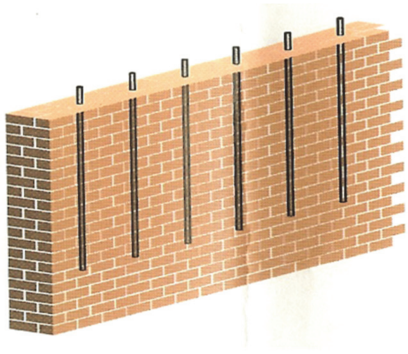

Figure 5.3.5 **Schematic of inserting steel bars**

Prestressing method using high strength steel bars

To reduce tensile stress, which is a weakness in masonry constructions, and to improve the shear capacity of the walls, high strength steel bars are inserted after drilling into the walls to increase prestressing strength. The interior and exterior appearance is preserved. Anchors will need to be devised. In addition, maintenance and management of the prestressing force are also necessary. In the case study shown in Chapter 7, this method was used for the reinforcement of the Fukushima City Museum of Photography, which is a stone masonry, Fukushima City Designated Cultural Property. (Figure 5.3.6)

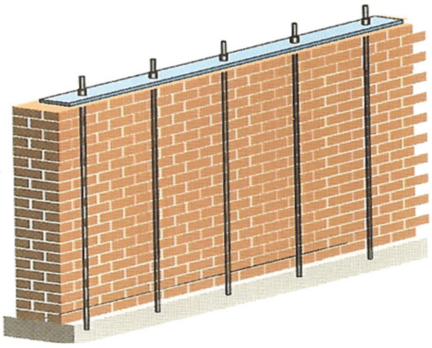

Figure 5.3.6 **Schematic of prestressing method using high strength steel bars**

Epoxy resin injection

To increase the strength performance of the wall, the wall is drilled at intervals of several tens of centimeters (in a grid pattern) and injected with epoxy resin. This is a simple method. Depending on the environment, the durability of the epoxy resin may be problematic, and discoloration may spoil the appearance. (Figure 5.3.7)

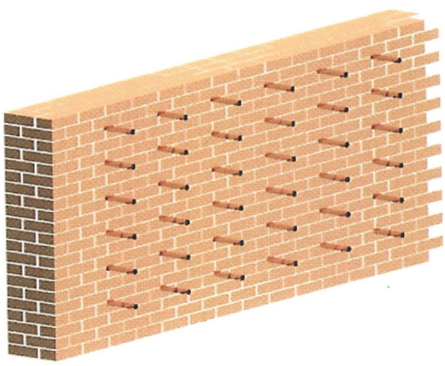

Figure 5.3.7 **Schematic of epoxy resin injection**

Joint Replacement Method

Aramid fibers and other materials are embedded in the joints, enabling reinforcement without damaging the interior or exterior appearance. In the case study in Chapter 7, this method was used in the earthquake recovery of Chateau Kamiya Winery, a national important cultural property.

Attaching buttresses

Steel or reinforced concrete buttresses are attached to the exterior of the building. Historically, masonry buttresses were often attached to historic buildings in Western Europe. The interior space can be preserved. It is also possible to restore the building to its current condition by removing the reinforcement. The case study in Chapter 7 shows the use of this method in the earthquake recovery of Chateau Kamiya Winery, a national important cultural property. (Figure 5.3.8)

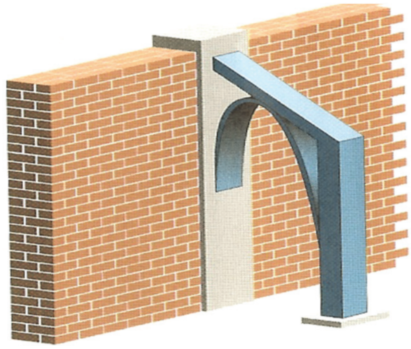

Figure 5.3.8 **Schematic of attaching buttresses**

Installing ring beams on top of the walls

Masonry constructions are integrated three-dimensionally to reduce out-of-plane deformation and improve seismic performance, connecting the walls at the top. Installing ring beams on top of the walls is one of the basic seismic reinforcement methods for masonry constructions. To ensure horizontal structural rigidity, diagonal braces are sometimes used together with the ring beams. Reinforced concrete ring beams or steel ring beams are used.

3) Other basic reinforcement

Reinforcing openings

Reinforcing openings, which are weak points in masonry constructions. (Figure 5.3.9)

Ensuring the rigidity of horizontal structural planes such as floors and roof structures

In wooden constructions, floor and roof structures may have inadequate horizontal plane rigidity.

Reinforcing horizontal structural planes is important to ensure that seismic forces are transmitted to bearing walls. (Figure 5.3.10)

Figure 5.3.9 **Schematic of reinforcing openings**

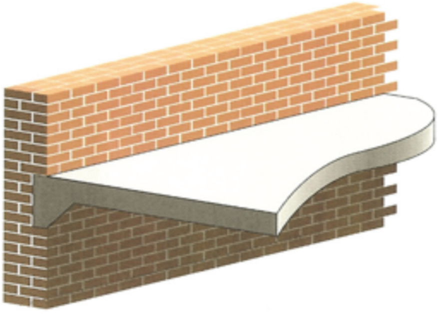

Figure 5.3.10 **Schematic of ensuring the rigidity of horizontal structural planes such as floors and roof structures**

Reinforcing the foundation

This is a basic reinforcement to ensure the structural performance of the wall and to prevent uneven settlement due to the soil-structure displacement caused by earthquakes. (Figure 5.3.11)

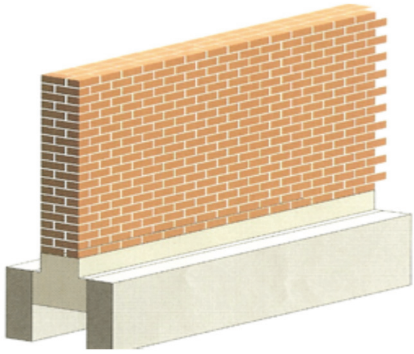

Figure 5.3.11 **Schematic of reinforcing the foundation**

The reinforcement methods described above are rarely used alone but are generally used in combination.

(Toshikazu Hanazato)

5.4 Reinforced Concrete Constructions

Reinforced concrete construction is a structural form in which reinforcing bars are inserted into concrete, exhibits brittle behavior, being strong in compression but weak in tension. Building members such as columns, beams, floors, walls, and foundations as well as their joining parts are formed together to construct buildings with the necessary strength, rigidity, and toughness. Concrete is in a liquid state when it is first mixed, but as time passes, it sets and hardens, enabling the construction of buildings of any shape. In addition, the reinforcing bars are covered with concrete to ensure fire resistance and corrosion resistance, and to prevent buckling, which is likely to occur if the reinforcing bars are exposed. Furthermore, since the linear expansion coefficients of concrete and steel are close in value, repeated daily temperature fluctuations are unlikely to adversely affect the adhesion performance of the rebar and concrete, which also contributes to ensuring the durability of the reinforced concrete structure.

It is said that reinforced concrete constructions were first used for buildings and civil constructions in Europe and the United States in the late 1800s. In Japan, reinforced concrete buildings gradually began to be built around 1905 to 1910. Later, the Great Kanto Earthquake in 1923, which caused 128,000 houses to collapse and 447,000 houses to burn, further emphasized the need for earthquake- and fire-resistant construction.[1] Since reinforced concrete constructions have superior fire resistance and, as discussed in section 5.3, are more earthquake resistant than masonry constructions, which became popular after the Meiji Restoration in the late 1800s, many reinforced concrete buildings were built after The Great Kanto Earthquake, replacing masonry constructions.

In light of the situation described above, the oldest historical reinforced concrete buildings existing in Japan are only about 100 to 120 years old, which make them newer than wooden and other historical structures. However, when the first reinforced concrete structures built in Japan are registered as cultural properties and damaged by earthquakes, restoration and seismic countermeasures are not easy for several reasons, which are listed below.

First, when such reinforced concrete cultural properties were built, reinforced concrete construction was still in its infancy, and structural design and construction methods were not yet as mature as they are today. In Japan, reinforced concrete structures, in particular, have undergone structural design and reinforcement method reviews every time they have been hit by major earthquakes over the past 100 years, and the results of these efforts are reflected in the current structural codes. The principle of seismic reinforcement of cultural property buildings is considered to be the minimum reinforcement that does not damage the historical and cultural value of the building. However, it requires a great deal of effort to collect information and to make appropriate judgments in order to evaluate the building's resistance and to carry out the minimum necessary reinforcement, taking into account what strength, rigidity, and toughness can be expected with the original specifications, and the state of deterioration.

The ICOMOS Japan report mentions Nio-mon Gate of Honmyo-ji Temple as an example of reinforced concrete buildings damaged in the Kumamoto Earthquake in 2016. In addition, other damages from the Kumamoto Earthquake, including the main building of Aso Volcanological Laboratory, Kyoto University, Tokai University Aso Campus Building No. 1, and Kumamoto University Faculty of Engineering Building No. 1, are mentioned in the Japan Concrete Institute (JCI) 's "Special Committee on Kumamoto Earthquake" report (listed at 2)), which could be a valuable resource for gathering details regarding construction dates, specifications, and damage information.

Secondly, it is said that concrete undergoes neutralization over time, and when neutralization progresses to the location of the rebar inside the structural component, the rebar rusts and expands, causing cracks and flaking in the covering concrete. Although recent high-strength concrete is said to be densely packed and slow in the progression of neutralization, many of Japan's early reinforced concrete structures were already suffering from neutralization, as was the case with the Nio-mon Gate of Honmyou-ji Temple mentioned above. The maintenance of neutralization is extremely costly, and while the methods to control the progress of further neutralization by coating the surface of the member are used, it is questionable how long the integrity of the reinforcing bars can be guaranteed. In addition to neutralization, cracks often occur in concrete due to drying shrinkage, and other causes. If cracks are not repaired promptly, they can induce rusting of the rebar much faster than the progress of neutralization, so daily attention and appropriate maintenance are necessary.

Third, one of the principles of seismic reinforcement of cultural property buildings is reversibility. Seismic reinforcement is often performed with materials that are different from the original cultural property building so that the original cultural property building can be visually recognized, but this is particularly difficult for reinforced concrete constructions. For example, in the case of conventional steel frame construction utilizing high-strength bolts for frictional joints, various stresses are transmitted without problems even if clearance is provided in the bolt holes as long as friction joints are made with high-strength bolts. However, in cases where historical reinforced concrete buildings are reinforced with steel frame structures, additional issues arise. Concrete is a structural element that develops cracks with minute deformations as seen in the Figure 5.4.1[3)], and historical reinforced concrete structures and reinforcing steel frames cannot be frictionally connected because concrete can break or anchor bolts for connecting them can become dislodged when the bolts are tightened strongly. In such cases, not only relatively large elastic deformations of reinforcing steel frames, but also slippage deformations would occur between historical reinforced concrete structures and reinforcing steel frames. Therefore, the steel frames used for reinforcement tend to exhibit

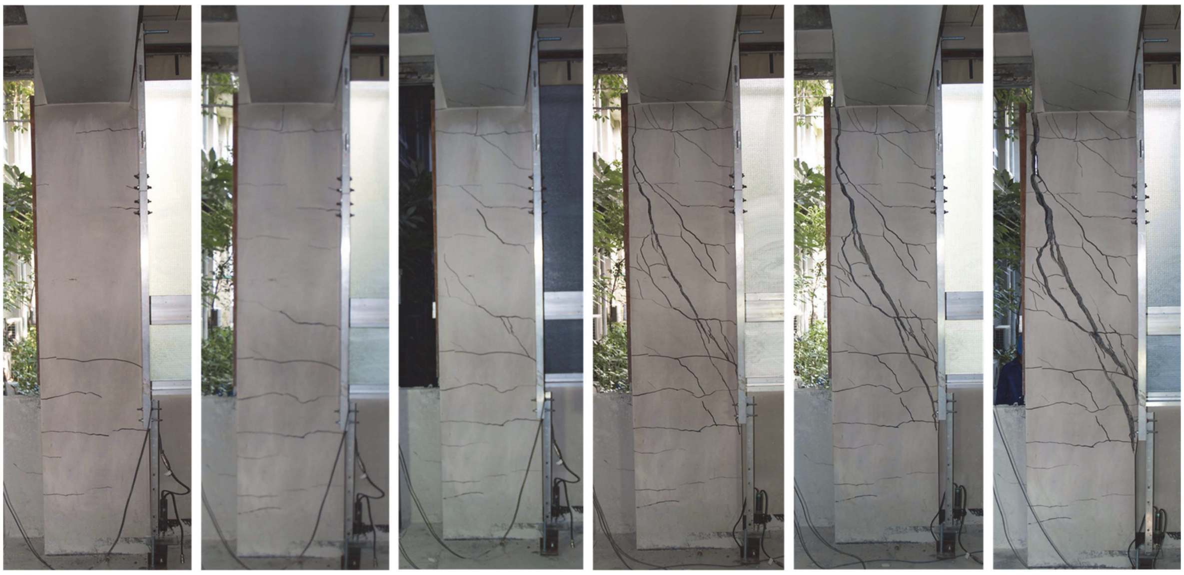

Figure 5.4.1 **The progression of the inter-story drift angle (R) and the transition of the destructive behavior for a column in the 1st story of an existing 3-story reinforced concrete building under horizontal loading experiment: (From left to right: R = 0.2, 0.4, 0.67, 1.0, 1.5, 2.0 x 10^{-2} radians.)[3]**

their effect after the main structure (historical reinforced concrete) has deformed (i.e., cracked). As a result, the reinforcement effect in such cases is very low. In contrast, effective reinforcing methods of reinforced concrete buildings from the small deformation stage are achieved by adding reinforcing walls and/or utilizing bonding type reinforcements. However, this could be incompatible with the said principle of seismic reinforcement of cultural property buildings. Given the anticipated increase in aged reinforced concrete structures with cultural and historic value, it is essential to carefully consider how to address this issue and conduct thorough deliberations.

Currently, in Japan, most seismic evaluations and retrofits for reinforced concrete buildings are based on the Seismic Evaluation Standard and Retrofit Guidelines for RC Buildings[4] of the Japan Building Disaster Prevention Association (JBDPA), and there are a great many cases of seismic reinforcement assessed and evaluated. The aforementioned reference 2) also lists more than two dozen cases of damage situations caused by the 2016 Kumamoto Earthquake in general reinforced concrete buildings to which various types of seismic reinforcement technologies were applied, which can be used as a reference for seismic reinforcement of cultural property buildings made of reinforced concrete. However, it is necessary to consider how to address the three issues mentioned above while implementing seismic countermeasures.

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(Kentaro Yamaguchi)

5.5 Stone Retaining Wall

After the forces of Yamato (ancient Japan) were defeated by the combined forces of the Tang dynasty (ancient China) and Silla (ancient Korean kingdom; 618-907 CE) in the battle of Baekgang in 663, stone retaining walls were built in ancient mountain castles (Korean style mountain castles or *kogoishi*) distributed from northern Kyushu to the Seto Inland Sea coast in preparation for a possible invasion by the Tang dynasty. From the end of the eighth century of the peaceful period to the middle of 14th century, stone walls were not built for castles (except those built to defend against the Mongol invasions). Still, they became popular again at the end of the 15th century when the Warring States era started, as seen in the Azuchi Castle built in 1576, where high stone retaining walls over 10 meters high were constructed. Some walls reaching 20 to 30 meters in height appeared in the early 17th century. The Japanese stone retaining wall construction technique, dry masonry, does not use bonding materials, and is quite unique worldwide. In the 16th century, stone walls were built upright, but later they developed a unique curved slope called *kanekobai*. The unique Japanese castle design consists of multiple concentric layers of such walls. In some cases, these stone retaining walls have collapsed due to earthquakes or heavy rains and had to be restored, but many of the original stone walls from the 16th and 17th centuries remain, and many of them have remained stable for more than 400 years.

Stone retaining walls are military engineering structures consisting of a foundation, stone blocks (including filler stones on the outside and inside of the wall), backfill, and background soil. Some stone walls have stone blocks on both sides, while others have backfill stones on the inside). Natural stones, split stones, and cut stones are used as stone blocks. These three types of blocks are stacked using techniques known as *nozurazumi* or natural-face masonry, *uchikomihagi* or split and inserted masonry, and *kirikomihagi* or cut and inserted masonry, respectively.

Stone walls can sometimes partially collapse due to their age or natural disasters such as earthquakes and heavy rain, and can also become loose or bulged. When they are restored after collapse, their original shape and construction methods are followed. However, the Kumamoto Earthquake in 2016 caused about 10% of the Kumamoto Castle stone walls to collapse and about 30% to become deformed, including bulging. Some Important Cultural Property buildings standing on top of the collapsed stone walls were also affected. Although no human casualties occurred inside the castle because the earthquake happened at night, it was a major cause for concern about the safety of stone retaining walls. Stone retaining walls are a historic military engineering heritage, and their conservation has always required the use of traditional construction methods to ensure their authenticity as a historic cultural property. However, the Kumamoto Earthquake reminded us of the strong necessity for safety compliance.

To ensure safety, one must consider not only the original structural and construction methods but also the use of modern technologies. The proof of safety must be provided by structural engineering analyses. However, it is not easy to calculate the stability of dry masonry composed of natural, split, and cut stones. At present, various attempts have been made. The methods used for the calculations include the force-displacement method, FEM (finite element method), DEM (discrete element method), DDA (discontinuous deformation method), and other analysis methods. Investigations prior to the analyses must also be conducted to determine the height, inclination degree, and deformation condition of the stone wall, the depth of the stone blocks, and the shape, thickness, and composition of the backfill stones. The properties of the foundation and the soil behind are obtained mainly through non-destructive testing such as 3D survey, ground penetrating radar survey, fiberscope survey, boring survey, and elastic wave survey. Vibration tests were also conducted on full-scale and scaled models of the stone walls, and the effectiveness of several types of reinforcement was analyzed, including no reinforcement, reinforcement with geotextiles, and reinforcement with pressing stones on the backs of the stones.

Although the line-of-force analytical method takes into account the properties of the ground, backfill, and back soil, it has a flaw, since it is determined almost exclusively by the incline factor and does not reflect the stone wall's characteristic elements such as shape, material, or stacking method. The FEM and DEM analyses have their own characteristics, but they are not conclusive, and further research is needed. Currently, the Agency for Cultural Affairs is formulating guidelines for assessing the seismic resistance of stone walls.

For the structural reinforcement of stone retaining walls that have either collapsed or require repair with full-scale dismantlement and reassembly, the reinforcement policy must emphasize following the original techniques while providing the necessary reinforcement. Reinforcement methods can be divided into those that rely solely on traditional techniques and those that combine them with modern techniques.

Traditional techniques may include the reinforcement of stone blocks, filler stones, and backfill stones. The stone blocks should have a certain depth, and if they are significantly short, they may need to be replaced. Some of the filler stones may be missing and need to be added back. When stabilizing stones between stone blocks and the backfill stones behind them are insufficient, an appropriate supplement is necessary. If the backfill stones are not tight but loose, it is necessary to reconfigure them so that they fit tightly together, and if necessary, to add gravel to reduce voids.

In addition to this traditional method of reinforcement, there are other methods of reinforcement such as the use of geogrids in the backfill stones. The geogrid (a lattice of high-strength polyester core covered with polypropylene) installed at the time of the previous repair works of Sendai Castle (1998-2004) proved to be effective to a certain extent during the 2022 earthquake, but some parts of the wall were found to be deformed or bulged. In a part of the stone wall under the donjon of Kumamoto Castle, a new type of geogrid (a grid made of a mixture of stainless-steel rods and conventional plastic) was used for reinforcement after confirming its effectiveness in vibration tests, with emphasis on safety.

In addition, methods to stabilize stone walls without full-scale dismantlement and reassembly of the original structures are beginning to be explored, and several experiments are being conducted. These methods include inserting reinforcing steel bars, backfilling with urethane foam for stability, or adding anti-slip structural materials to the front of the base. These methods are all still in the experimental stage and have not yet been established.

(Kazuyuki Yano)

5.6 Structural Monitoring

Many historic masonry constructions have suffered damage due to the aging of structural material characteristics, long-term deformation, uneven foundation settlement, and cracks caused by external forces such as earthquakes or war damage. Structural monitoring of historic buildings, which have withstood their weight and various external forces over their long history, may be an effective method of ascertaining their current structural safety and resistance to seismic forces and wind performance while considering the alterations they underwent and their conservation history. Structural monitoring of historic buildings can be classified into the following three categories: (1) evaluating the structural safety of buildings damaged by earthquakes and other disasters, (2) understanding the actual behavior during earthquakes and strong winds through long-term observation, which may also serve to verify analytical models, and (3) confirming the effectiveness of the structural reinforcement. In a broader sense, it may also include monitoring aimed at investigating the structure itself, such as particle surveying. Structural monitoring is a technique to record and analyze the long-term behavior of structures and is described in the ICOMOS guidelines (International Guidelines for the Structural Restoration, Conservation, and Analysis of Architectural Heritage) as a technique to detect progressive phenomena related to structural behavior, phenomena that may be precursors to destruction, and for understanding actual behavior at each stage of a structural restoration project. In addition, dynamic monitoring such as seismic monitoring is also effective in seismic-prone areas. Especially for buildings of cultural and historical value, the principle is non-destructive testing. Monitoring is an extremely useful structural testing method.

Structural monitoring in earthquake recovery, among the above three categories, falls under (1) evaluating the structural safety of buildings damaged by earthquakes and other disasters. In other words, it functions like a health check-up to examine the soundness of buildings damaged by earthquakes and/or other disasters. Many historic masonry constructions in Western Europe have undergone long-term monitoring of crack displacement to confirm post-earthquake structural stability. A recent example is the displacement monitoring of damaged stone constructions in the Spanish citadel damaged by the 2009 L'Aquila Earthquake in Italy (see Photo 5.6.1). In Italy, the Note Cathedral in Sicily collapsed in 1996, and the Pavia Cathedral collapsed suddenly in 1989. Historical records of Hagia Sophia in Turkey show that the dome collapsed six months or several years after the major earthquake, not during the actual shaking (possibly due to repeated aftershocks). Thus, in historic masonry constructions, long-term stability during the recovery phase after damage from an earthquake may also need to be taken into account. In the PS Orangerie (Chapter 7), a Registered Tangible Cultural Property building damaged by the Kumamoto Earthquake in 2016, cracks appeared in the brick walls, and the crack openings were monitored during the period leading up to the restoration. In such crack displacement monitoring, temperature is generally recorded at the same time, since the displacement of the structure is affected by temperature.

As for post-disaster monitoring, seismic monitoring is conducted for the historic buildings damaged by the Great East Japan Earthquake disaster in 2011 and the Kumamoto Earthquake in 2016. Microtremor measurements have also been recorded as a type of vibration monitoring. For example, microtremor measurements and seismic monitoring have been conducted at the Fukushima City Museum of Photography (see Chapter 7), a Fukushima City Designated Cultural Property damaged by the Great East Japan Earthquake, and at the PS Orangerie (see Chapter 7), a national registered tangible cultural property damaged by the Kumamoto Earthquake. In both cases, conservation projects involving reinforcement were conducted, microtremor measurements were taken before and after structural reinforcement, and the effects of the reinforcement were confirmed through vibration monitoring. Such monitoring corresponds to the aforementioned objective (3) confirming the effectiveness of reinforcement. The Fukushima Museum of Photography, which is a stone masonry building, uses the prestressing method for seismic reinforcement; monitoring of the steel bar tension is being conducted simultaneously with temperature measurement in order to check the variation of the amount of prestressing applied as structural reinforcement over time. Microtremors are measured on wooden designated cultural property buildings damaged by the Great East Japan Earthquake in 2011. In the Kaiseikan, a Fukushima Prefecture Important Cultural Property that was damaged by the February 13, 2021, and March 16, 2022, the Earthquakes off the coast of Fukushima Prefecture, the effects of the extended damage were analyzed from microtremor measurement records. Thus, vibration monitoring tests during the recovery phase have also been conducted.

Figure 5.6.1 **Crack displacement monitoring at the Spanish castle damaged by the L'Aquila Earthquake**

(Toshikazu Hanazato)

6. Cultural Heritage Recovery and Community

6.1 Local Resident Activities for the Town Rehabilitation

Kazamachi District, Kesennuma City [Index Map no.1]

Kazamachi District, "where people wait for the wind to blow before setting sail"

Kazamachi district is located in the deepest part of Kesennuma Port, which is in the middle of the Sanriku Rias coastline. It is called "Kazamachi" (in Japanese literally "wind-wait") because, in the ship-sailing era, people waited for the *narai* wind (northwest wind), which was suitable for ship departure. In 1915 and 1929, great fires burned most of the area to the ground. However, backed by the abundant economic power of the developing fishery industry at the time, along with other industries, a variety of colorful buildings were built, in the Japanese, modern Japanese-Western, and other styles.

These buildings stand against a backdrop of rolling mountains, creating a three-dimensional, compact landscape that is unique to the Kazamachi district.

Photo 6.1.1 Landscape of the Kazamachi District

The Kesennuma Kazamachi Cityscape Preservation Association for Community Recovery is established after the Earthquake

Before the earthquake, local architects and engineers took the lead in the Kazamachi district. The "Kazamachi Research Group" studied the historic buildings and disseminated their charms. Additionally, several buildings became national registered tangible cultural properties (hereinafter referred to as "registered cultural properties").

The Kazamachi district was severely damaged by the tsunami following the Great East Japan Earthquake in 2011, and the Kazamachi Research Group suspended its activities. However, a desire rose to restore the buildings and livelihoods that existed before the earthquake to recall the lively days of the Kazamachi district and convey that scenery to the future. Thus, in May 2012, one year and two months after the earthquake, volunteers from the Research Group, cultural property owners, and experts from all over the country who support Kazamachi District formed the "General incorporated association Kesennuma Kazamachi Cityscape Preservation Association for Community Recovery," one year and two months after the earthquake.

The Revitalization of Cultural Property Buildings and Livelihoods Begins

The six registered cultural properties damaged by the tsunami remained in a dire state as the months passed: some properties were flooded up to the second floor, others barely stood, supported by the buildings on either side and yet others washed away on the ground floor, colliding with neighboring structures. Furthermore, the owners faced the decision between the publicly funded demolition and the preservation of the buildings. The owners hesitated to keep them, saying that they would be a nuisance to neighboring buildings and that they would be an obstacle to rehabilitation. Under such circumstances, experts and the city board of education tenaciously persuaded the building owners that the rehabilitation of the buildings and livelihoods would become a spark in the regional revitalization and a symbol of reconstruction. Owners were also fortunate to receive recovery support from the established SOC Fund (Save Our Culture: the Great East Japan Earthquake Recovery Project for Cultural Heritage).

Waiting for Infrastructure Development While Making Emergency Repairs

Meanwhile, the land readjustment project and seawall issues overlapped, so buildings had to wait until these policies were established. In the mean-time, emergency repairs, such as moving and restoring houses, were undertaken as much as possible to ensure that the buildings would be able to withstand the full-scale conservation work.

In addition, the project held relay events in cooperation with Miyagi Prefecture and the Agency for Cultural Affairs. The project also held monitoring tours where visitors could see the buildings undergoing emergency repairs and the owners explained the conditions and charms of Kazamachi. Furthermore, the project also raised funds, which had been in short supply, by holding fundraising events with original goods as thank-you gifts, and by taking on the challenge of crowdfunding. In each of the restored buildings, the owners displayed original goods along with a donation box, matching the atmosphere of the building and supporting the ongoing conservation work.

Photo 6.1.2 **Monitoring tour where the owners explain the history and conditions of the building and its business (Kakuboshi Sake Brewery)**

Photo 6.1.3 **Original Kazamachi goods were placed in each building along with a donation box, showing appreciation (Takeyama Rice Shop)**

Revitalization of the Buildings and Livelihoods Over a Period of About 10 years

In 2021, 10 years after the earthquake, the restoration of six cultural properties was completed. The owners are rehabilitating these buildings with their own ingenuity by displaying tools related to their livelihoods, holding plays and screening movies in the space of the historic building, selling wood crafts, and opening cafes. The “Machinaka Art Museum," held every November, is a project that allows visitors to tour the Kazamachi district while talking with store owners about the origin and history of the items and treasures displayed in these long-established businesses.

The "Hiking from the Station" program by the East Japan Railway Company has become popular. The program allows visitors to stroll along the road from the JR Kesennuma Station to the Kazamachi district with a map of Kazamachi in hand.

In February 2022, 120 bottles of Kakuboshi local sake, whose brewery was also restored, were aged for one year in an old fireproof safe kept in the Onoken Fish Wholesaler mud-walled warehouse. The owner of the warehouse plans to donate a portion of the proceeds to Kazamachi. The revitalization of the cultural property buildings created a cycle that has led to their increased conservation and utilization in the Kazamachi district. In addition, the sake brewery and the guest room at the Otokoyama Honten Sake Brewery became registered cultural properties.

In this way, we feel that, as not only the buildings but also the people's livelihoods and lives were revitalized in unison, the owners and also the local residents felt invigorated, which led to the creation of a new town.

Photo 6.1.4 **"Machinaka Art Museum" where the store owners plan and exhibit (folding screens displayed at Sanji-do Sasaki Ceramic Shop)**

Photo 6.1.5 **Onoken Fish Wholesaler mud-walled warehouse project, in which the Onoken Fish Wholesaler and Kakuboshi Sake Brewery sold ownership rights to store local sake in a fireproof safe for one year (Onoken Fish Wholesaler mud-walled warehouse)**

Kazamachi from now on

The locals say "Not only the buildings but also the streets have completely changed, and even though I have lived in this place for a long time, sometimes I cannot remember the scenery from even 10 years ago."

Hopefully, the six restored cultural properties serve as a reminder of the nostalgic Kazamachi district scenery, which will continue to be familiar to the community and passed on in the future.

(Hiroko Wada, The Kesennuma Kazamachi Cityscape Preservation Association for Community Recovery)

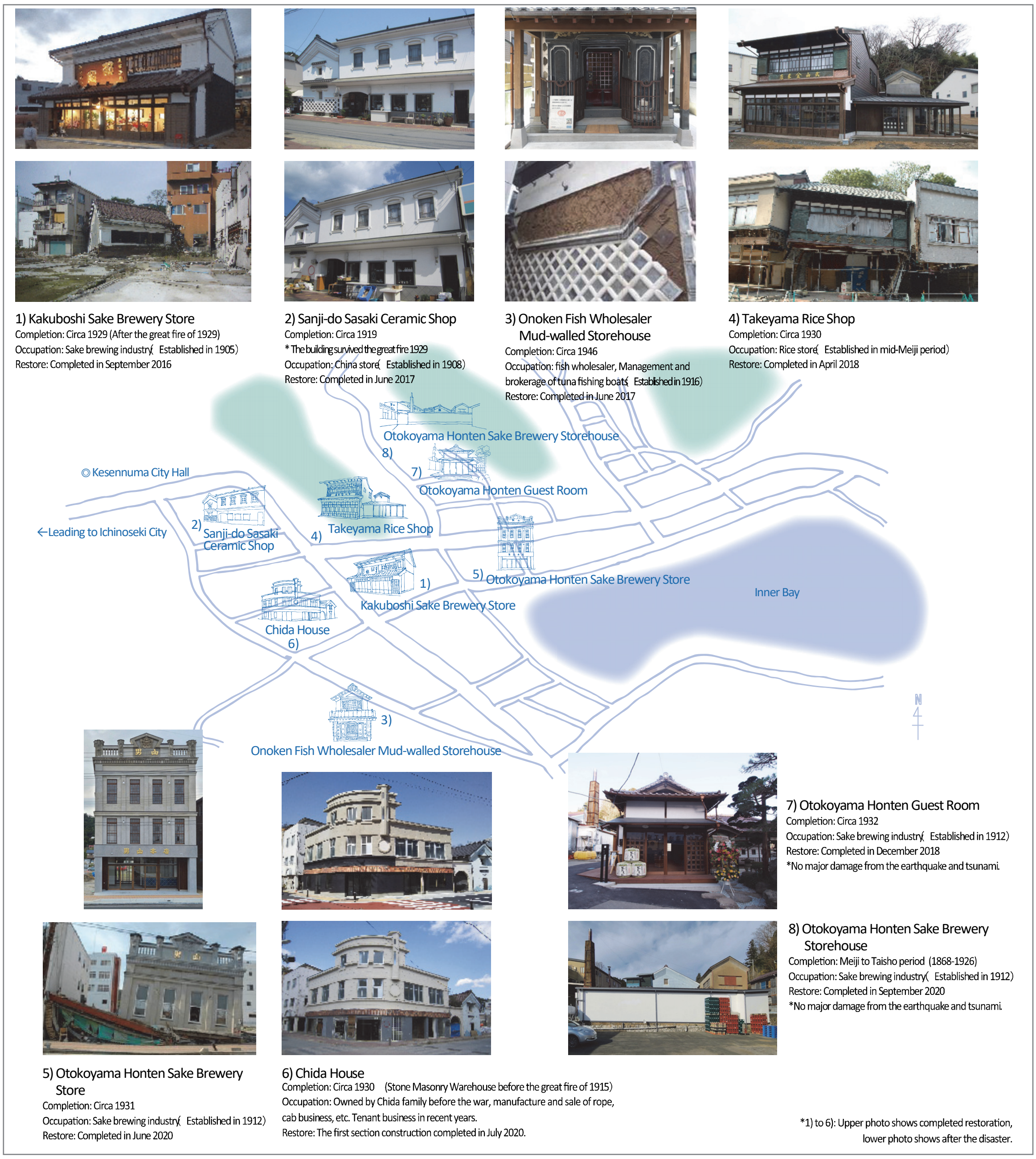


Figure 6.1.1 **Cultural properties building in Kazamachi district**

Table 6.1.1 Kazamachi Dstrict's Ten-Year History

	'02	'03	'05	'06	'11	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
						5, 9, 10, 12, 3	6, 9, 10	4, 6, 10, 11, 12, 3	4, 5, 11, 12	8, 9, 10, 11, 1,2	5, 6, 7, 9, 11, 12	4,5, 6, 8, 12, 3	5, 6, 8, 10, 12	6, 8, 9,10, 12, 2
Activities in Kazamachi	★ Inauguration of the Kazamachi Research Society				Great East Japan Earthquake	★ (5) Inaguration of the Kesennuma Kazamachi Cityscape Preservation Association for Community Recovery; ★ (9) Incorporation; ○ ○ (10, 12) Continuous Monitoring Tour; ○ (3) Citizens' Debriefing and Presentation Ceremony of Foundation	○ (9) Monitoring Tour	● ○ (10, 11) Watch Day Events; ○ (3)	Participated in the UN World Conference on Disaster Reduction; ● (11)	● (9) Ceremony to Present a Letter of Appreciation from the Commissioner of the Agency for Cultural Affairs; ○ (1,2)	○ (7) Film Screening at Kakuboshi; ○ ○ (9, 12) Heritage Walk	○ (4,5) Stamp Rally; ○ (8) Cooperation in Workshops for Officials of Repair, etc.; ○ (12) Crowdfunding; ● (3)	○ (5) Conferral Ceremony of Future Heritage; ○ (8) Heritage Events; ○ (10) Film Screening at Kakuboshi	○ (9,10) Held the Machinaka Art Museum (3rd Year)
1. Kakuboshi Sake Brewery		◎					○ (6) A) House moving; B) Store on site ⟷ (from 9)	B) Store on site ⟷ (to 3); C) Dismantle and Store building member ⟷ (from 3)	C) Dismantle and Store building member ⟷ (to 4); Reconstruction ⟷ (from 5)	Reconstruction ⟷ (to 9)				
2. Sanji-do Sasaki Ceramic Shop				◎						Reconstruction ⟷ (from 1,2)	Reconstruction ⟷ (to 6)			
3. Onoken Fish Wholesaler Mud-Walled Warehouse				◎				D) House moving and jack up ⟷		Reconstruction ⟷ (from 1,2)	Reconstruction ⟷ (to 7)			
4. Takeyama Rice Shop			◎							C) Dismantle and preserve ⟷ (8 to 1,2); Store building member ⟷ (from 1,2)	Store building member ⟷ (to 9); Reconstruction ⟷ (from 9)	Reconstruction ⟷ (to 4,5)		
5. Otokoyama Honten Sake Brewery Store		◎				○ (9) A) House Moving; B) Store on site ⟷ (from 10)	B) Store on site ⟷	B) Store on site ⟷	B) Store on site ⟷	B) Store on site ⟷ (to 1,2); D) Dismantle and preserve ⟷ (1,2 to 5)	Store building member ⟷ (from 5)	Store building member ⟷	Store building member ⟷ (to 5); Reconstruction ⟷ (from 5)	Reconstruction ⟷ (to 8)
6. Chida House								◎ (4)					Reconstruction ⟷ (from 12)	Reconstruction ⟷ (to 2)
7. Otokoyama Honten Guest Room												◎ (4,5); Reconstruction ⟷		
8. Otokoyama Honten Sake Brewery														Reconstruction ⟷ (8 to 9,10)

◎ : Registered as a National Registered Tangible Cultural Properties (Otokoyama Headquarters Sake Brewery is scheduled to be registered in 2021) ●Visits to support groups, etc.

Shinmachi-Furumachi District, Kumamoto City [Index Map no.23]

Names of the Castle Towns Places

During the Edo period, the Castle Town in Higo Province was roughly divided into ten or more place names, one of which was "Shinmachi" area and "Furumachi" area.

Shinmachi-Furumachi District in the Meiji, Taisho, and Early Showa Periods

A saying goes "The Higo Restoration came in the third year of the Meiji period," and indeed the Hosokawa clan governor took office in the third year of the Meiji period, introducing feudal administration reforms and establishing a Western-style school and a medical school in the Third Compound of Kumamoto Castle, adjacent to Shinmachi. This was followed by the installation of a telegraph office, a chamber of commerce, markets, banks, schools, hospitals, and other modern facilities constructed in Shinmachi-Furumachi district. Shinmachi-Furumachi was the main commercial district (merchant quarters) of the castle town, but it was burnt to ashes during the Seinan War (civil war) of 1878. After the war, modernized facilities emerged in the restored townscape of traditional *machiya* (townhouses) while preserving the town layout.

From the Taisho period (1912-1926) to the early Showa period (1926-1989), the Shinmachi-Furumachi district composed the city's busiest downtown area. Financial institutions and various wholesale stores concentrated in Tojinmachi, forming the main street of Furumachi.

Revitalization of the City Center and the Shinmachi-Furumachi District

Kumamoto City was one of the first cities to work on a basic plan for the revitalization of its central area: the first phase began in 2007, the second phase in 2012, the third phase in 2017, and now the city is preparing the fourth phase of the plan, which began in 2023. The Shinmachi-Furumachi district have been included in the plan from the beginning as part of the four districts that make up the city center. However, since the former central city revitalization plan was introduced, based on the former act and the commercial modernization regional plan from the 1960s, the district had already been hollowed out due to the aging population and declining urban functions.

The Shinmachi-Furumachi District as an Area for Advanced Community Planning

In the late 1970s, the PTAs of the Shinmachi Town district's elementary school and Furumachi town's elementary school, feeling a sense of dread over the declining conditions of their communities, took the lead in reviving traditional local festivals, holding town walking symposiums, and other activities.

The community planning activities of both school districts sparked a chain reaction in the local people of the historic and traditional regions who had a strong sense of community. Both districts became model districts when Kumamoto City enacted the "Resident Autonomy Basic Ordinance" in 2009, and self-government councils for each district were set up to promote community development.

A Turning Point in Community Development Activities

A turning point in subsequent community planning activities came around the time of the Great East Japan Earthquake in 2011. At that time, the children of the first generation of community and neighborhood enhancement supporters (who were over 60 years old) and the second generation of community planners (in their 30s) became more active, collaborating with the artists and creators of their generation who had moved to the area after the earthquake to hold events, carry out *machiya* renovations, hold cultural activities, etc. Through a

Photo 6.1.6 **Velotaxi operation, 2006**

series of advancements, the renovation of the Kawaramachi textile wholesale district (Furumachi district) became a hot topic nationwide as an example of advanced and creative activities carried out by young people.

The Kumamoto Earthquake in 2016

The Kumamoto Earthquake in 2016 caused the most severe damage in Mashiki Town and Nishihara Village near the epicenter, but Kumamoto Castle and the castle town including Shinmachi-Furumachi district, both in Kumamoto City, also caught the nation's attention with shocking images of collapsed stone walls and turrets.

Two Early Advancements

Two organizations, the "Shinmachi-Furumachi Rehabilitation Project" and the "Kumamoto Machinami Trust" engaged in the Shinmachi-Furumachi district by advancing the preservation of cultural properties during the initial period of earthquake recovery and rehabilitation. The "Shinmachi-Furumachi Rehabilitation Project" began its activities on the day of the main shock by providing a soup kitchen at an elementary school. After that, activities with mutual assistance from residents followed, including the disposal of rubble, the removal of cultural properties and household goods, and covering roofs with plastic sheets to prevent leaks. This section details the activities of another group, the "Kumamoto Machinami Trust."

The Kumamoto Machinami Trust Citizen Group

The Kumamoto Machinami Trust, a citizen group with its office in Furumachi area, was established in 1997 to preserve the former Daiichi Kumamoto Bank branch office building. Subsequent conservation activity targets included the former Kangyo Bank branch (built in 1933 and dismantled in 1999), the Goto Store (built in 1919 and burned down in 2018), the former Meiji period Kumamoto Red Brick Spinning Factory (built in 1894 and dismantled in 2002, partially preserved), the renovation of a textile wholesale district built on the ruins of a postwar black market (Kawaramachi Project), the operation of velotaxis (supporting university students in NPO activities), and the conservation and utilization of the former Kamikumamoto Station building (built in 1913 dismantled in 2006, partially preserved). In 2007, the Kumamoto Machinami Trust began research on *machiya* in the Shinmachi-Furumachi district.

Joint Research with ICOMOS Japan

In April 2016, the Kumamoto region was hit by two major earthquakes of a seismic intensity of 7 (the Kumamoto Earthquake in 2016). The regular meeting of the Kumamoto Machinami Trust was scheduled for April 20, four days after the disaster. There, it was decided that activities would be carried out to confirm the damage conditions of the existing historic buildings in Kumamoto City, and to begin their recovery and rehabilitation while accompanying the owners. At the end of April, together with ICOMOS Japan, the Trust started preparing a survey, and from May 2 to 3, it accompanied the survey team mainly in the Shinmachi-Furumachi district. While conducting close meetings with the ICOMOS Japan secretariat regarding the damage surveys and preservation of historic buildings, a strong sense of crisis: "Even if Kumamoto Castle survives, the castle town may disappear!" was shared.

Confirmation of Damage Conditions

The damage levels were investigated for 23 buildings in the Shinmachi-Furumachi district, including 13 "structures forming a landscape," 4 "national registered tangible cultural properties," and undesignated cultural properties. Findings also showed that the 448 *machiya* in the Shinmachi-Furumachi district identified in the 2005 Kumamoto Machinami Trust survey had been reduced by about 100 over the past 10 years to about 350 and that 76 of them had been dismantled immediately after the earthquake.

Strategies for the Preservation of Historic Buildings

ICOMOS Japan and the Kumamoto Machinami Trust agreed to the following three points: (1) focusing on undesignated cultural properties among the historic buildings in the district and exploring measures for their preservation; (2) continuing to accompany historic building owners as the Kumamoto Machinami Trust has long been involved in district community planning; and (3) encouraging administrative efforts for community planning that make use of the history of the district.

Liaison Council of Owners of Disaster-affected Cultural Heritage

In order to accompany the owners of damaged cultural property buildings and induce "mutual aid" to save them from damage and dismantling, 25 owners and managers of undesignated cultural properties in the Shinmachi-Furumachi districts established an organization, with the Kumamoto Machinami Trust as its secretariat.

The activities of the council led to the establishment of a subsidy system for undesignated cultural properties, and the prefectural government's "Subsidy for the Recovery and Rehabilitation of Cultural Properties Damaged by the Kumamoto Earthquake." The subsidy allowed for 2/3 of the costs to be covered if there is an intention to register the property as a national registered cultural property after the recovery work finishes. This subsidy is ongoing as of 2022, five years after the earthquake.

Photo 6.1.7 **General Association Assembly, April 2018**

Aid from the World Monuments Fund

Under a proposal from the World Monuments Fund (WMF), which joined the ICOMOS Japan survey project immediately after the 2016 earthquake, the Kumamoto Machinami Trust signed a "Partnership Agreement" with the WMF in July 2017. Over the next three years until 2019, the Trust provided subsidies for the recovery of five disaster-damaged buildings in Nishitojimachi in Furumachi area. The project was successfully introduced.

In June, two months after the disaster, the Kumamoto Machinami Trust was allowed to use a *machiya* that had stopped operations due to the disaster free of charge, and Trust members were stationed there every day except Mondays. The *machiya* were frequently used to receive visitors and provide advice to local residents, and the presence of a full-time resident accelerated consultations on repair and group subsidy applications.

Regional Advancements

In the Shinmachi-Furumachi district, the damage differed from building to building, so recovery was based on individualized efforts (self-help). The local "Shinmachi-Furumachi Rehabilitation Project" organization and the "Kumamoto Machinami Trust" citizen group provided collaborative support.

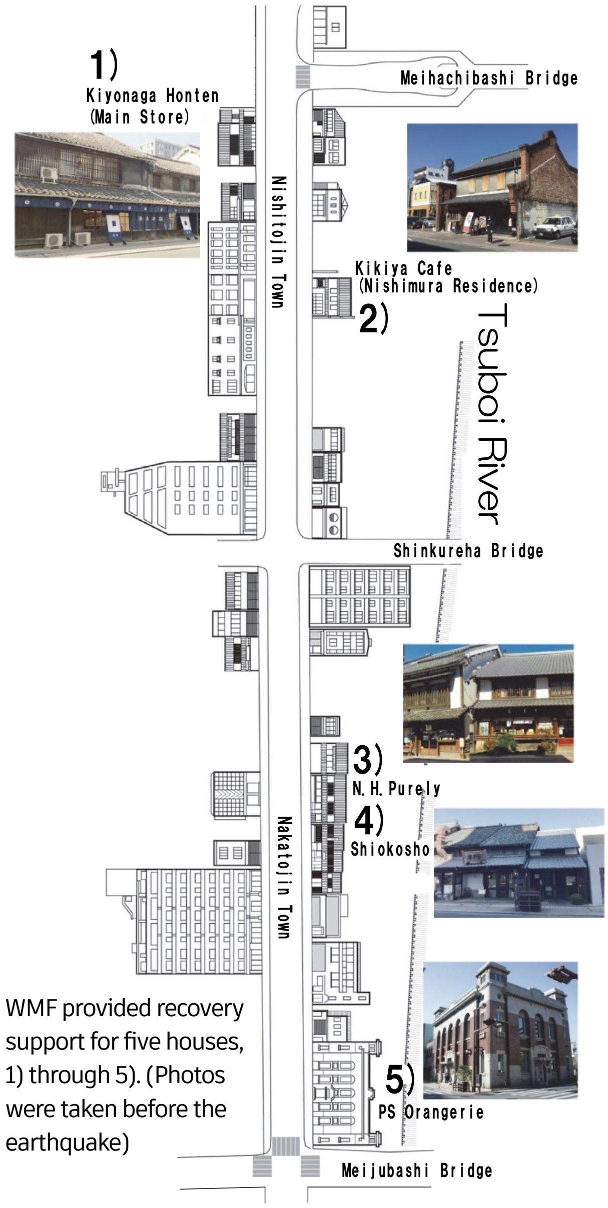


Figure 6.1.2 **Historic buildings in Nishi-Tojinmachi that received WMF's aid**

In addition to routine recovery and rehabilitation support, rehabilitation events were held to foster the desire for future community planning.

Photo 6.1.8 **Rehabilitation Concert, February 11, 2017, Organized by the Shinmachi-Furumachi Rehabilitation Project**

Photo 6.1.9 **Meihachibashi Exchange Meeting, January 27, 2018, Organized by the Kumamoto Machinami Trust**

Administrative action
~Applying the Historic Community Planning Law

In September 2017, one year after the earthquake, a symposium on "Community Planning with History" was held under the auspices of ICOMOS Japan, co-sponsored by Kumamoto City, and supported by 11 organizations including the Agency for Cultural Affairs. The mayor of Kumamoto, who attended the symposium, promised to apply the "Historic Community Planning Law" as it represented the creative rehabilitation of the city from the Kumamoto Earthquake. The Kumamoto Machinami Trust joined the supporting organizations and assisted the organizers as the local secretariat.

Kumamoto City formulated the Kumamoto Historic Community Plan (Plan for the Maintenance and Improvement of Traditional Scenery), which was recognized by the national government in June 2020. Projects such as matching vacant houses began in FY2021.

Summary
~The Preservation of Cultural Heritage and the Sustainability of Cities and Districts

This report has seen how pre-earthquake community planning activities in the Shinmachi-Furumachi district prompted the post-earthquake "creative recovery" and rehabilitation. However, the "Cultural Property Doctor Dispatch Program," which supports recovery and rehabilitation activities for damaged cultural properties throughout the prefecture, should not be overlooked. One of the factors that made it possible for the Cultural Property Doctors to quickly initiate cultural property recovery support activities was the fact that, before the Kumamoto Earthquake, the Kumamoto Prefecture Architects & Building Engineers Associations and the heritage managers had conducted a "survey of current conditions of modern Japanese-style architecture," which compiled a list of undesignated cultural properties in the prefecture.

The PS Corporation, which had purchased the former Daiichi Bank Kumamoto branch office building in Furumachi area, rehabilitated it as its own sales office and laboratory. This place, called the "PS Orangerie," raised a sign with the slogan "for 100 years more" high on a temporary fence at a recovery work site that was severely damaged by the Kumamoto Earthquake. This happened exactly 100 years after the former Daiichi Bank Kumamoto branch office building was constructed (2019).

Historic buildings built as banks, hospitals, shops, schools, and public facilities from the Meiji, Taisho, and early Showa periods have been repurposed and continue to be used. By sharing the experience of utilizing these historically significant spaces, the memories of cities and regions are passed on, enhancing the sustainability of urban and regional continuity within history. To promote the sustainability of cities and regions, it is essential to broaden the scope of cultural properties, comprehensively survey historic buildings including those not officially designated, and ensure regular collaboration with experts.

(Kazuhiro Fujikawa)

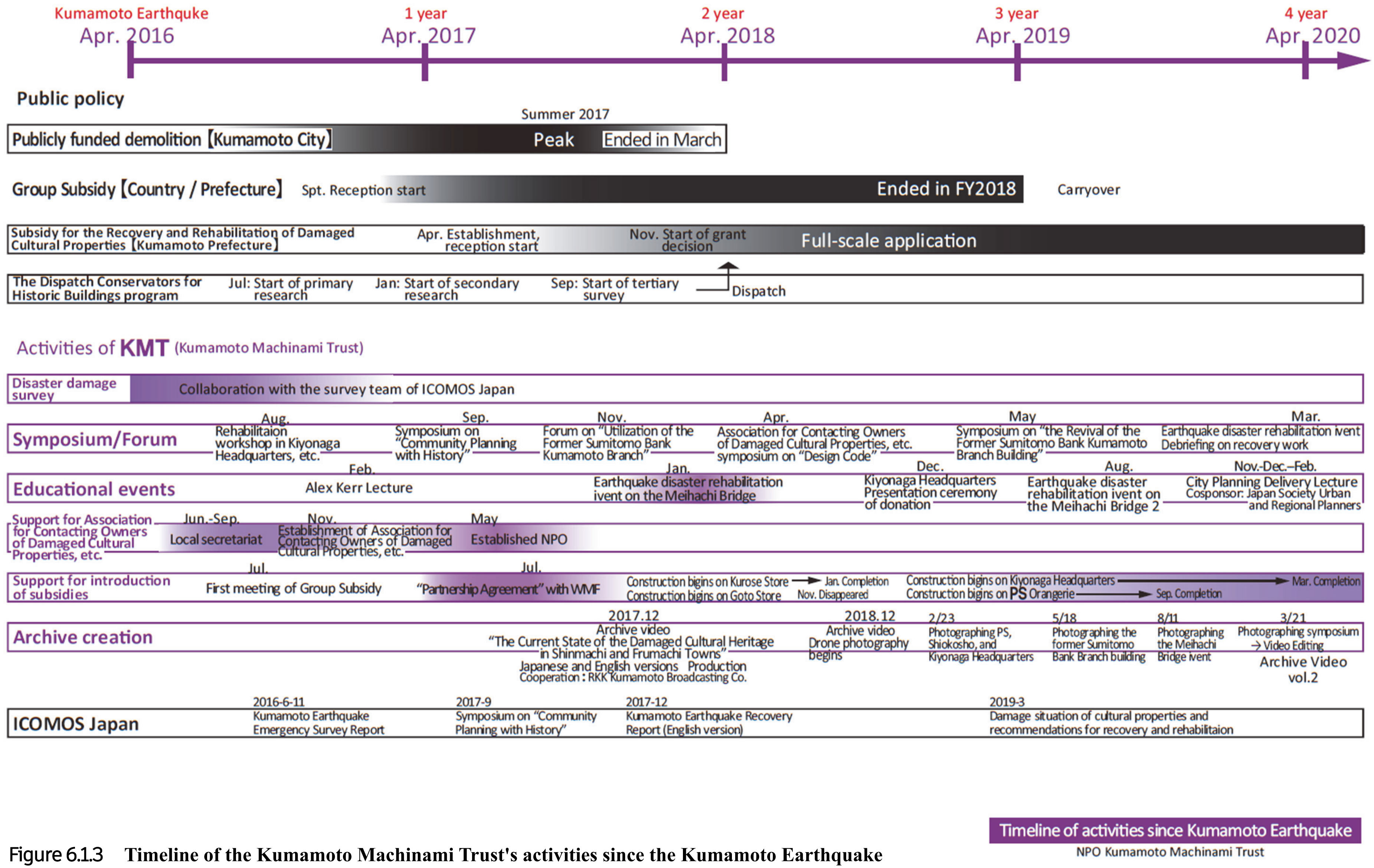


Figure 6.1.3 **Timeline of the Kumamoto Machinami Trust's activities since the Kumamoto Earthquake**

6.2 Relationship Between Communities and Cultural Heritage in Local Rehabilitation

An Example of How a Beloved Craft Became a Force for Rehabilitation [Index Map no.8]

The Kamaya area of Ishinomaki City in Miyagi Prefecture lies a few kilometers inland from the mouth of the Kitakami River, and is a village equally composed of farmers and merchants who prospered through boat transportation on the river. The village, with its rural landscape, is home to the Kamaya Daihannya Kyo pilgrimage, a New Year's event in which the 600 scrolls of the Daihannya Sutra are stored in chests of 100 scrolls each, which are carried around the village on a parade.

The tsunami from the Great East Japan Earthquake in 2011 engulfed the Kamaya area. All houses were completely destroyed by the tsunami, and many people lost their lives. It is particularly well known that the children of Okawa Elementary School in the district were among the victims. Because of the tragedy at the Okawa Elementary School, the area was closed off to onlookers, and even residents were not allowed to enter the area to search for remains. The ban was lifted during the consecutive holidays in May. Since many houses in the area are parishioners of Kannon-ji Temple and it was necessary to search for past records and other items, parishioners were asked to enter the Kamaya area. At the site of the temple, where everything had been swept away, numerous Daihanya sutras were scattered about. The chief priest and his group went around collecting as many of the Daihanya sutras as they could, as they belonged to the temple. When they later counted them, they found about 400 scrolls of the Daihanya Sutra, including some that had been left in fragments. The sutra scrolls had been damaged by the tsunami two months earlier and were still wet. The priest and his group went to the nearby temple, where the main temple was temporarily housed, and unrolled the sutra scrolls to dry. Some of the scrolls were moldy, but the mold settled down and stopped spreading because the scrolls could be immediately dried.

Subsequently, the Daihanya sutras were included in the Cultural Heritage Rescue Program. In addition to dry cleaning and other methods, an investigation of the rescued sutra scrolls was conducted. As a result, it was found that less than 200 scrolls were complete, and the remainder were in fragments. After receiving support, repairs began, but due to budget constraints, it was decided that the 200 scrolls with complete sutras would be desalinated and re-shaped. However, there was no bandwidth to adhere the paper of the fragments that had fallen off, so each sutra scroll was held together with a band seal.

Let us now turn our attention to Kamaya. As mentioned earlier, all houses in Kamaya were completely destroyed by the tsunami. The area where the tsunami hit received an "Unsafe Area" designation, and residents were not allowed to rebuild their homes there. Kamaya had to be relocated. In the Great East Japan Earthquake disaster-stricken area, there was a movement to create so-called "hillside relocation sites" by cutting through steep mountains that approach the sea in the Sanriku area. Even in the villages where upland relocation sites were built, all houses that were needed could not be accommodated. As a result, the residents of Kamaya had to relocate to Futago Danchi, about 15 km inland. In addition to the residents of the Kawakita district, to which Kamaya belongs, residents of the Ogatsu and Kitakami districts also moved into this housing complex, the largest disaster prevention collective relocation project in Ishinomaki City. This was the beginning of a new place where people from several villages could gather.

However, the disaster prevention collective

Photo 6.2.1 **Rescue activities**

relocation project after the Great East Japan Earthquake did not cover religious facilities. This is why the Kannon-ji Temple is still operating using a temporary main building on the safe mountainside of the Kamaya area. The graves are also being reconstructed at their original location. The former residents return to Kamaya when they visit graves, hold Buddhist services or shrine festivals, but it is no longer a place they go to on a daily basis.

Under these circumstances, a project to make the Daihanya Sutra accessible to the public is underway. The project aims to join the above-mentioned fragmented sutras that could not be attached. Of course, there are ways to outsource this kind of work, but the emphasis here was on having the community members repair the Daihanya Sutra, which is their own cultural property, with their own hands. Repair technicians were invited as instructors and held workshops to teach how to join the sutras. Then, participants repaired about 200 scrolls that had been previously treated. The former residents gathered twice a month at Kannon-ji Temple to do this. The conservation techniques gradually improved, and it took about one year to complete the restoration. Originally, the Daihanya Sutras were kept in chests and never seen by the residents. They were regarded as something to be feared. Because of this, they were thrilled to be able to hold them in their hands and be able to repair and restore them.

Since the repairs were completed, a tradition has developed of gathering at Kannon-ji Temple on January 3 every year to check on the condition of the sutra scrolls and perform a lion dance, which was an integral part of the pilgrimage. Although this event is completely different in character from the pilgrimage in which the village gunmen used to gather, it has become an important opportunity for preserving Kamaya for future generations as the Kamaya area has become lost.

(Ryusuke Kodani)

An Example of Local Festivals as a Force for Rehabilitation [Index Map no.7]

In Onagawa Town, Miyagi Prefecture, the “*shishifuri*” lion dance has been handed down from generation to generation in each village. The dance is performed on the occasion of the spring prayer events held in each village of Onagawa Town around January 3 in the New Year. During the spring prayer event, the dancers go house to house to ward off evil house spirits. A *shishi* lion is used to lead the procession. The villagers welcome the *shishifuri* and the other members of the spring prayer group, and the *shishi* lions follow them around the village all day long, especially the children. This is the scene that unfolds in Onagawa.

Since many villages hold their spring prayers on the same day, this event only happens within the village. At the same time, residents are aware that other villages also perform the *shishifuri* dance with a similar artistic style. However, these villagers believe that their lion head is the most splendid and their lion dance is the most exciting. In this sense, the community considers this dance to be a symbol of their identity. Noticing this modest rivalry, the Onagawa Minato Festival, organized by the Onagawa Town Chamber of Commerce and Industry, featured a "maritime *shishifuri*" event, in which each community decorated a fishing boat and paraded it around the bay with *shishi* lions and musicians. The highlight of the event happens when the

Photo 6.2.2 **Onagawa Minato Festival**

boats come ashore and perform a simultaneous *shishifuri* dance on the wharf, with each village performing its own lion dance for a period of about 10 minutes. The lion dance is then surrounded by many people associated with the village as well as tourists. This event, which hints at a village rivalry, is not based on tradition but is a symbolic "tradition" of Onagawa as a municipality.

In March 2011, the Great East Japan Earthquake disaster brought devastating damage to Onagawa Town. Because of its location on the Sanriku Coast, some villages had been built on higher ground, but there was no village facing the Pacific Ocean that was left unharmed. In fact, many villages suffered damage to almost all of their houses. Naturally, the heads and drums of the *shishifuri* lion dance were also lost. After the Great East Japan Earthquake, private foundations and the Agency for Cultural Affairs provided generous support to those whose festivals and performing arts were damaged. Onagawa joined this opportunity, and in the summer of 2011 the entire town launched the "Onagawa Shishifuri Rehabilitation Council." The Council aimed at resuming the lion dance performance and began a town-wide effort to restore the lost tools. At the same time, the council set a goal for all villages to participate in the resumed "Onagawa Minato Festival" maritime *shishifuri* event.

Tools have been successfully reproduced and purchased, and some villages will be able to resume spring prayers by New Year's 2012. Many of the villages were damaged by the tsunami and received "Unsafe Area" designations, and only a few people can currently live in their former villages. For this reason, the *shishifuri* lion dance was performed at a temporary housing complex built in the village. Onagawa, which stretches along the Rias coast, has few flat and high areas, and there is little land on which to build temporary housing. Thus, the largest temporary residential housing complex was built in the neighboring city of Ishinomaki. Many residents had to return from their temporary houses outside the village to the temporary housing that would serve as the venue. However, this provided an opportunity to return to the village, so the spring prayers during this period allowed the villagers to meet each other once a year. In other words, these events connected the post-recovery society. Even in villages where temporary housing had not been built, as the spring prayer was a shrine event, people went to the shrine and returned to their original villages. In Takenoura, one of these villages, the spring prayer was held at a prefabricated meeting place, commonly called "Hamagoya," which had received support to resume the fishing industry. Although the event lost the element of touring around the village, Takenoura still holds a procession around the place where the houses used to be.

Spring prayers continued this way, and from 2016, the elevated relocation sites were gradually completed. People began to return their residences in the villages, and by 2019, the elevated relocation projects were completed in almost all villages. However, the recovery projects for the Onagawa Port and the site of the Onagawa Minato Festival, which were heavily damaged, encountered considerable obstacles. The Onagawa Shishifuri Rehabilitation Council had decided to dissolve the group once the equipment was in place and a maritime lion dance could be held. However, as recovery would take several years, a simultaneous lion dance was held in 2013 as a showcase event for the groups that had re-acquired their equipment. In 2015, the large-scale presentation was held at the plaza in front of JR Onagawa Station, which had been recovered and rehabilitated as a central urban area that was part of the town's reconstruction project. The dance continued to be held annually for several years at the same location. In 2020, the port was finally restored, and the "maritime *shishifuri*" event was going to be held, but it had to be postponed due to the new Coronavirus epidemic. On July 24, 2022, the "Onagawa Minato Festival" was finally held and the lion dance was performed. Ten years later, the rehabilitation of Onagawa's lion dance is finally on track.

As described here, Onagawa's *shishifuri* dance was linked to the reconstruction of the village and connected the residents and community during the period of rehabilitation. Furthermore, the lion dance performances and resumed" maritime *shishifur*" events also related to the reconstruction of the town itself, which was severely damaged by the disaster. In a multilayered manner, performing arts and events have been involved in the rehabilitation of both the municipalities and the communities. This involvement was widely seen in the Great East Japan Earthquake disaster-stricken area, which proves that performing arts and events have taken root in the lives of the local people.

(Ryusuke Kodani)

Recovery of a Shrine as the Stronghold of a Local Community [Index Map no.39]

The Kumamoto Earthquake in 2016 caused severe damage to a small village at the foot of Mt. Aso outer rim. The Miyayama Shrine is located in the Miyayama area of Nishihara Village, Aso County in the Kumamoto Prefecture the Shrine encompasses the Hachio-sha Shrine and the Amamiya Shrine and is located at the end of a cedar-lined path. The earthquake completely destroyed the worship and offering halls at Hachio-sha Shrine, partially destroyed its main shrine, and partially damaged the Amamiya Shrine, located just to the south. The parishioners of the Miyayama and Futa areas, who were also affected by the earthquake, were unable to repair the buildings on their own, and the buildings were on the verge of being demolished.

The Miyayama Shrine was one of the buildings included in the Kumamoto Earthquake disaster damage survey conducted by ICOMOS Japan. In addition to this shrine, many undesignated historic buildings were damaged by the Kumamoto Earthquake. For this reason, ICOMOS Japan submitted a written request to the Agency for Cultural Affairs and other relevant organizations asking for public assistance for the conservation and repair of undesignated cultural properties.

However, it is difficult to obtain public support funding for undesignated cultural properties such as temples, shrines, and other religious buildings due to constitutional restrictions, and in order to obtain such funding, the cultural properties must be registered or designated. Designating Miyayama Shrine as a tangible cultural property of Nishihara Village should make it possible to obtain public support funding. So, following the advice of ICOMOS Japan, the Nishihara Village Board of Education sought the opinion of Professor Ryuichi Ito of Kumamoto University and hastily designated the shrine as a tangible cultural property.

Miyayama Shrine is unique in that its parishioners consist of residents not only from the Miyayama region, where the shrine is located but also from two districts of the Futa area. This characteristic is owed to the fact that the Hachio-sha Shrine was relocated from the Futa area to the Miyayama Shrine due to flood damage in 1735.

The shrine parishioners have held an annual festival without fail, and every 50 years, they hold a festival to return to the site of the old shrine. The 250th-anniversary festival occurred in 1982. Even after the earthquake, a temporary stage was built in front of the damaged shrine building to hold the

Photo 6.2.3 **Damage survey by ICOMOS Japan conducted im-mediately after the earthquake**

Photo 6.2.4 **Children's Sumo Tournament to be held during recovery**

annual festival, where local people dedicated a *kagura* (demon shrine) performance and held community activities such as children's sumo tournaments. During the annual festival, the shrine was crowded with food stalls made by the local people, and one could sense that they were strongly committed to rehabilitation.

Photo 6.2.5 **Dedication of *kagura* (demon shrine) performance by local people**

Therefore, a committee for the reconstruction of Miyayama Shrine was established jointly by the Futa and Miyayama areas, and activities toward the conservation of the shrine were enthusiastically undertaken. The Hachio-sha Shrine's main hall, worship hall, and offering hall were repaired by completely dismantling and reassembling the original structures, while the Amamiya Shrine was partially repaired. These repair projects began in August 2019 and were completed in May 2021. As they were accomplished almost entirely with financial support from the village and prefectural governments as well as private donations, this is a hopeful example that can pave the way for future repairs of undesignated cultural properties in other regions.

Hit by a great famine in 1732 and a flood in 1733, the people of the area struggled just to survive. When one considers that Hachio-sha Shrine was reconstructed at its current location in the hopes of bringing peace to the community, one can only imagine what great efforts were made at that time.

Now, nearly 300 years later, an unprecedented natural disaster has occurred, and we must once again confront the situation of rehabilitating the shrine while rebuilding our lives. The fact that this time the shrine could achieve such a splendid rehabilitation as well is indeed miraculous. The efforts of the people of this community should be greatly praised. This is an example of the importance of the will of local communities for the preservation of cultural properties.

(Kazuyuki Yano)

Utilization and Community Coexistence [Index Map no.42]

About Mashiki Town

Mashiki Town, with a population of over 30,000, is adjacent to the east of Kumamoto City and is close to the Kumamoto Prefectural Government and the Self-Defense Force Kengun Camp. Mashiki has developed as a residential town for Kumamoto City and also functions as a transportation hub with the Kyushu Expressway IC and the Aso Kumamoto Airport. A prefectural road leading from Kumamoto City to Takamori in Minami Aso runs east-west through the town center, and more towns have emerged along the road. However, the Kumamoto Earthquake in 2016 caused major traffic congestion on this prefectural road, as it was a route for transporting relief supplies. A plan to convert the road to a four-lane road has been formulated and is currently under construction.

To the south of the town, four connected mountains spread across the countryside, forming what is known as the Mashiki Plain. For centuries, people have made their living through forestry and agriculture activities there, and old mansions dot the landscape along the mountains. However, Mashiki was hit with a seismic intensity of 7 twice by the Kumamoto Earthquake, and the town suffered tremendous damage, so there are few buildings left.

Post-Earthquake Initiatives

One month after the earthquake, the town's cultural property protection committee members and four or five members of the history study group

Photo 6.2.6 **Putting protection tape on a roadside jizo**

Photo 6.2.7 **Protection of collapsed statues of gods and Buddha**

who had suffered relatively little damage began activities to protect the roadside stone constructions, the village Buddha statues, and the village god figures from being discarded along with the debris. Although these activities happened while they were organizing and repairing their homes, more items could be preserved because of the relatively early start.

It is impossible to make loud declarations for the preservation of cultural property immediately after a disaster, so in January 2017, when temporary housing was in place and all evacuation centers were closed, the "Association for the Protection of Mashiki's Historical Heritage" was launched with people who had been engaged in preservation activities, and full-scale efforts in cultural property rescue began. Upon requests to rescue old *minka* (traditional folk houses), we talked to the building owners about what to do and found that many of them were conflicted because they wanted to protect the buildings left by their ancestors, but they also did not want to cause financial trouble to their children by keeping them. The author is also a member of the town's cultural property protection committee, and in the capacity as a heritage manager, I wondered if the buildings that the owners wanted to keep (if there was funding available) could be included in the Cultural Property Doctor's list of properties. So, I surveyed eight old private homes and approached the prefecture through the town office.

In September 2017, Kumamoto Prefecture issued a policy to subsidize undesignated historic buildings for the first time in disaster-stricken areas, and eight buildings in Mashiki Town are now eligible. While historic buildings are being dismantled one after another under the publicly funded demolition system, we would like to pay tribute to the owners who have decided to keep them.

Establishment of the “Owner’s Association”

In order to preserve the old *minka*, which would require maintenance costs even after surviving the recent disaster and undergoing restoration work, it was necessary for the buildings themselves

Photo 6.2.8 **Example of publicly funded demolition (200-year-old main building and *nagaya-mon* gate)**

to generate revenues to cover maintenance and management costs, and discussions were held with the owners. Fortunately, the eight old *minka* owners wanted to rehabilitate the buildings after their conservation and have them be central to the community revitalization, so they established the "Owners' Association." With the advice of architectural experts from all over Japan who supported Mashiki after the earthquake, the owners decided to consult with the Japan Tourism Agency's "Community Planning Utilizing Historical Assets" program, and promoted tours of old private homes, restaurants, and *minka*, for finding appropriate utilization plans according to each situation.

The "Owners' Association" held a social gathering attended not only by the elderly owners but also by their successors to help them understand the significance of preserving the old *minka*. The Association also requested the town's cooperation. As a result, the town office negotiated with the urban planning division of Kumamoto Prefecture to add an item to the development ordinance regarding the urbanization control zone, which was a major problem when promoting rehabilitation.

Photo 6.2.9 **Owner's Association meeting**

Utilization Plan

Although the conservation work progressed smoothly and the early works were completed in FY2019, the rehabilitation plan was delayed due to the unexpected spread of the Coronavirus. The long-lasting covid-19 pandemic increased the time spent at home and changed social lives, giving the owners an opportunity to reconsider their original plans.

(1) Shiromoto Family House

Shiromoto Family House is located at the entrance of the ruins of a medieval castle at the crater of the Akai Volcano, which is said to have exploded about 140,000 years ago. The kitchen, living room, and other private areas are not eligible for subsidies and were retrofitted during the plan review period, with guidance from a design office manager familiar with old *minka*. Although the unfamiliar work was tiring, the owners were pleased with the joy of building and, most importantly, the fact that their children, now independent, have been actively helping them, becoming more attached to the house.

The owners, a couple in their 70s, are planning to offer homestay accommodations where guests can experience harvesting and cooking organic vegetables. They are also preparing to open a hiking course with local residents, taking advantage of

View from the earthen floor to the Japanese-style room

Exterior view of the building

Photo 6.2.10 **Shiromoto Family House**

the area's historical assets. The house will be offered for events, and plans are being prepared to make it a bustling base in FY2022.

(2) Furusho Family House

Furusho Family House, located on the western edge of the town, suffered the most severe damage of the eight houses, and conservation work was completed in March 2022. The restoration work was carried out mainly by a young couple on behalf of the owner, who is in his 80s. During the restoration, the used craftsmanship was introduced on Facebook. The young couple had been involved in local revitalization efforts, such as the reenactment of festivals and youth group activities, and wanted to use the house for community gatherings and events after the conservation work finished. To support these efforts, the couple opened a boutique and cafe in this house in April 2022. The Japanese-style room is lined with stylish women's clothing and accessories, and young people find it refreshing to sit in the adjoining Japanese room, enjoying homemade scones, western sweets, coffee, and tea while gazing at the tatami and the sunken hearth in the earthen floor. For the elderly, it is a nostalgic scene from the past. The space is off to a good start, and there are hopes to expand how it is used in the future while monitoring how it is doing.

(3) Hayashi Family House

Located on the eastern edge of the town near Aso Kumamoto Airport, Hayashi Family House is the only remaining samurai house in the town, and only the main building remains after the house was moved due to the widening of the prefectural road. In March 2022, it was the first building in Mashiki to become a national registered tangible cultural property, as it is a highly regarded building that retains the characteristics of a middle-class samurai residence. It is also the house where Kajiko Yajima, who contributed to the improvement of women's

Rehabilitation portion (boutique)

Exterior view of the building

Photo 6.2.11 **Furusho Family House**

Entrance (old earthen floor) atrium

Exterior view of the building

Photo 6.2.12 **Hayashi Family House**

rights in the Meiji period, spent 10 years of her married life, and it is still visited today.

It will mainly be used as a rental gallery, and will also be available for overnight stays and as a rental venue. It is also being prepared to play an active part in the community's revitalization by holding social gatherings for local children and members of the senior citizens' association. Taking advantage of the cultural property registration, it is planned to establish a "protection society" centered on the people of the district, as a system to protect the house as a local asset.

(4) Other Examples

In addition to the above-mentioned three houses, two restaurants and lodging facilities, and two private accommodations are in the planning stage, each of which will be completed while overviewing developing circumstances and social conditions.

Closing Words

Through this initiative, the author feels that it is important to be aware of historic buildings on a daily basis. In Mashiki Town, historic building owners were identified at an early stage after the disaster. Personal experience as a heritage manager who surveyed approximately 150 buildings in the "survey of current conditions of modern Japanese architecture" commissioned by the Kumamoto Prefecture Culture Division eight months before the earthquake, allowed for this opportunity. The owners who received prefectural assistance for the conservation of their buildings understood the historical value of their properties and kept them, but repurposing and using them for the future simultaneously gave them more incentive to keep their houses, In the future, other than Hayashi Family House will submit applications to become national registered tangible cultural property. Plans to expand rehabilitation from a single entity to a wider area by organizing tours of old *minka* and events that connect each old *minka*.

Promotions for the rehabilitation of historic privately-owned buildings are not borne just by the owners but throughout the local community as their local treasures. People can establish a system to utilize and preserve these buildings to pass on to future generations.

(Yoko Matsuno)

7. Case Studies of Recovery of Damaged Cultural Properties

7.1 Buildings and Structures

7.1.1 The Great East Japan Earthquake in 2011

Kodokan Seicho and Shizendo Hall [Index Map no.14]

Mito City, Ibaraki Prefecture

National Important Cultural Property

The three regional clan school buildings of the main gate, the main office building called Seicho, and the main hall called Shizendo form a nationally designated important cultural property, and the site is also a designated national historic site. The Seicho and Shizendo buildings are connected by a corridor, and both are one-story wooden constructions with small rooms such as bathrooms and toilets protruding from the plan. A carriage porch also protrudes from the front of the Seicho. Most of the perimeter and room boundaries have fittings such as sliding doors and shoji paper screens, so most of the walls are hanging walls. The walls are finished either with lime plaster or paper.

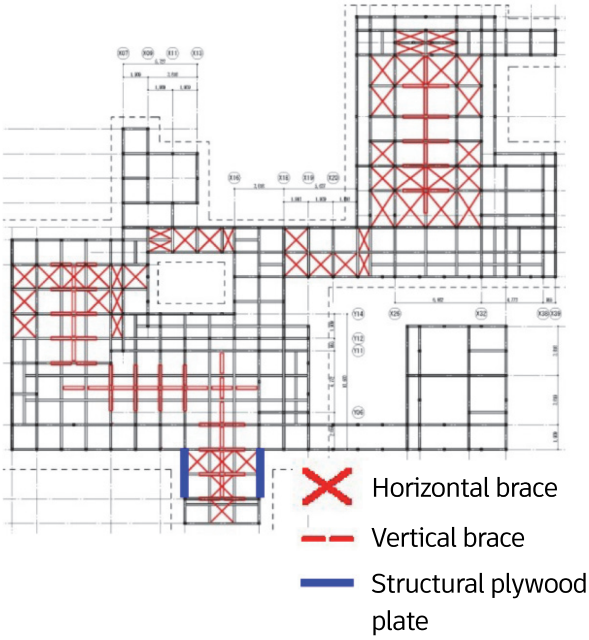
Exterior view after the earthquake

The Seicho and Shizendo suffered post inclinations, wall peeling and cracking, shaft displacement, and damage to fittings as a result of the Great East Japan Earthquake disaster. The protruding parts of the building seemed greatly shaken by the earthquake, and the rate of inclination differed from that of the main buildings. The front porch area was particularly damaged, as the lime plaster finish wall collapsed and the *ramma* or decorative transom was damaged. At the time of the earthquake, there were 40 to 50 people inside the building, but they were able to evacuate safely to an empty lot on the premises after the building staff provided evacuation guidance by making a radio announcement inside the building. Although the roof tiles shifted slightly, they did not fall and did not harm the evacuees. In addition, the main gate shook so much that the posts on the front side of the gate seemed to lift up, creating a gap between the posts and the foundation. Furthermore, the bell tower and a stone monument that conveys the founding spirit of Kodokan collapsed.

Damage of plaster walls in the carriage porch

There is a record that the Kodokan building was once damaged by the Great Kanto Earthquake

Exterior view after the restoration



Seismic reinforcement plan

Diagonal bracing reinforcement under the floor

Retrofit with structural plywood plates in the carriage porch

in 1923, but the damage was only slight, with cracks and partial flaking of the walls, and the building was turned into a facility to receive evacuees after the earthquake.

The walls were repaired only in the damaged areas, minimizing interventions as much as possible. A complete re-roofing was carried out, and the amount of roofing clay was reduced by using a strip clay roofing technique to reduce the roof weight. Seismic assessment and reinforcement were conducted in conjunction with the repairs. The seismic assessment showed that the building lacked seismic performance, so wooden braces were installed under the floor, and horizontal steel bar braces were installed at key points in the attic space functioning as seismic reinforcements. The front porch, which was severely damaged by the Great East Japan Earthquake, was reinforced by replacing the sublayer of both wing walls with structural plywood plates, and horizontal steel bar braces were installed in the attic space to integrate them with the main part of the building. In consideration of the historic and cultural value of the building, the reinforcement measures were mostly placed in the hidden parts of the building so that they did not affect the appearance. They are also reversible so that the braces can be removed in the future.

The Agency for Cultural Affairs was the project sponsor for the restoration work, as it is a national property, and the entire cost was borne by the government.

Considering seismic reinforcements, the initial plan was to reinforce the hanging walls with structural plywood plates and the subfloor with bracings. However, the hanging walls were decorated with a paper finish, and there were concerns that replacing the substrate of the hanging walls with structural plywood would have a significant impact on cultural property value. After conducting further studies, it was determined that if only the subfloor bracing was reinforced, the deformation angle during a major earthquake would exceed the initially set allowable deformation angle of 1/30 radian and could deform to 1/25 radian, but since the posts would not break, no risk of collapse was determined. Therefore, it was decided not to reinforce the hanging walls.

(Eisuke Nishikawa)

Former Ibaraki Prefecture Ota Junior High School Assembly Hall [Index Map no.13]

Hitachiota City, Ibaraki Prefecture
National Important Cultural Property

The former Ibaraki Prefecture Ota Junior High School Assembly Hall was built in 1904 and is a tall, one-story wooden construction. The gable roof has pantile roofing and the roof trusses are in the Western style. A portico is attached on the south side, and there are entrances in the center of both sides. The foundation is made with ashlar masonry (brick core inside), and the exterior walls are boarded with tall double-hung windows. The interior is divided into an entrance hall and an auditorium. The interior walls and ceiling have a lime plaster finish. At the time of construction of the auditorium, Japan was promoting the seismic resistance of wooden buildings due to the severe damage caused by the Nobi Earthquake in 1891 and the damage caused during the Meiji period. That was why this auditorium is considered an earthquake-resistant building equipped with diagonal braces at the top, middle, and lower levels of the walls. The auditorium is an important cultural property, representing the architecture of many Western-style school historic auditoriums architectures built in Japan in the modern era.

Exterior view after the disaster

Diagonal braces inside the wall

For the Great East Japan Earthquake, a maximum acceleration of 1,312 Gal (cm/s^2) and a seismic intensity of upper 6 were recorded at Hitachiomiya City, an observation point near the main auditorium. Due to the main shock and subsequent aftershocks, the roof tiles of the auditorium dislodged, uncovering the roofing soil, and the ridge rippled, causing leaks. Inside, the walls and ceiling were cracked, and some of the lime plaster had fallen off, revealing the foundation of the building. In addition, several window panes were broken.

The roof tiles were dismantled and replaced along with the roofing soil. Interior walls and ceilings that suffered peelings and cracks were partially replastered, depending on the degree of damage. Broken window panes were newly replaced. In addition, the seismic assessment confirmed that the building lacked the desirable seismic performance, so seismic reinforcement was performed.

The recovery work was financed through subsidies from the national government and Ibaraki Prefecture as a disaster recovery project for national important cultural property buildings.

Considering the reinforcement methods, we initially compared wall reinforcement with structural plywood plates (plan A) and frame reinforcement with six steel columns (plan B). Considering the limited time for the construction due to the disaster recovery work, the soundness of the wall substrate, and the fact that no large-scale conservation work or detailed investigation had yet been conducted, we decided to minimize how much of the original structures were going to be dismantled. Therefore, we adopted plan B, which exposes the reinforcement material inside the auditorium but requires only a small amount of dismantling for reinforcement.

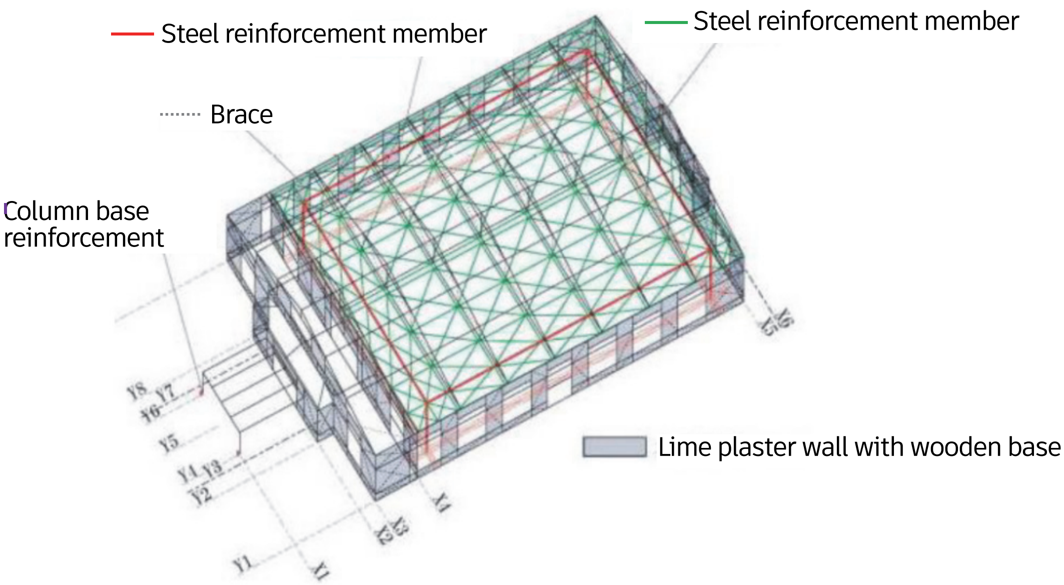
In order to minimize the impact on the design, additional consideration was given to using thick steel columns, and finally, four steel columns (200 square mm, 16mm thick) were placed at the four corners of the auditorium. Ideally, the joints of the steel columns, which are prominent in the design, would not be located inside the rooms, so, a detailed construction plan was made. Additionally, single-steel columns were manually brought into the auditorium and erected and then joined to steel beams both in the attic and subfloor, hidden from view.

Horizontal braces were also installed on the steel beams behind the ceiling to strengthen the horizontal structural plane. Unsafe columns that could break during earthquakes were reinforced with braces.

(Eisuke Nishikawa)

Subfloor steel beam

Interior view after completion (steel columns are painted in the back corners)



Reinforcement plan (Plan B)

Chateau Kamiya, Former Distillery Facilities [Index Map no.17]

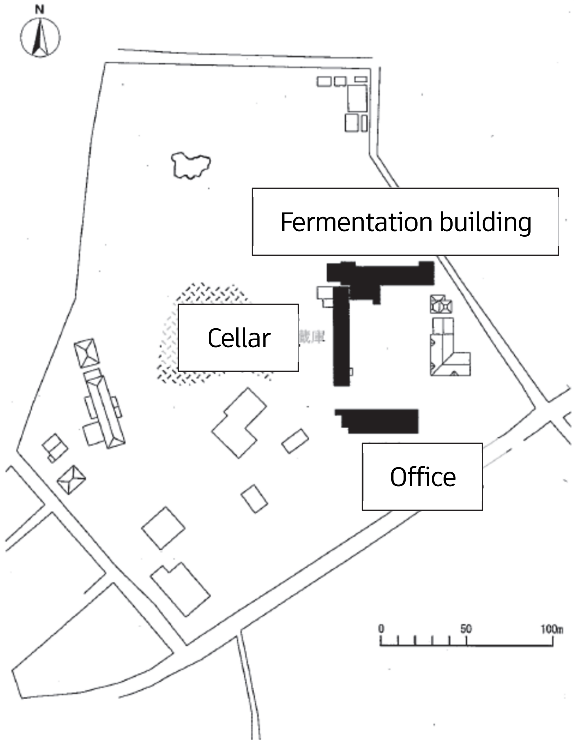
Ushiku City, Ibaraki Prefecture

National Important Cultural Property

This winemaking facility was completed in 1903 and consists of three buildings: an office, a fermentation building, and a cellar. The office is a two-story brickwork construction with many openings, a clock tower, and chimneys rising above the roof. The fermentation building is a two-story brick masonry construction with a basement cellar. A one-story nursery rising from the basement level is attached to the west side of the building, and a one-story brick washing house with a raised roof for ventilation is attached to the west side of the south end on the first floor level. The cellar is a brickwork construction. The complex is a nationally designated important cultural property that represents the production system in the early days of the introduction of winemaking in Japan, and the brickwork design and construction in its developmental period.

The brickwork constructions of the facility seemed to have been damaged in 1921 and 1983 by inland earthquakes whose epicenters were in an adjacent area. A disaster damage survey conducted in conjunction with the recovery work after the Great East Japan Earthquake revealed that the office building had been repaired with resin injections and steel rod reinforcements for the cracks. The interior corners of the walls were reinforced with L-shaped strip steel plates. The investigation also revealed that the chimney top had been removed and reinforced with steel bars, and the floor was reinforced with structural plywood plates. All of these works were done at different times and in different ways. These maintenance and previous reinforcement works were somewhat effective in protecting from the Great East Japan Earthquake.

During the Great East Japan Earthquake disaster, Ushiku City was hit by a seismic intensity of upper 5. Damage to the brickwork constructions of this facility was mainly caused by cracks in the framework. The strength of the bricks used here was notably weak, resulting in cracks that penetrated through the bricks themselves, even though the lime mortar used for the joints was even weaker than the bricks. The office suffered more damage



Plan

Office Building exterior view after the earthquake

Wall cracks in the Office Building

than the other buildings because of its many openings and the presence of the clock tower. Cracks were usually found at the top of the openings, at the corners, and at the interior corners where the walls met perpendicularly. The clock tower was cracked horizontally at the second-floor level and bent into a "1:25 clock hands" shape. Four of the five chimneys were tilted, and two of these collapsed at the base. In the fermentation building, there were cracks around the openings, and the ground subsided unevenly in the basement of the nursery attached to the fermentation building. The pediment of the washing house was tilted out of the plane and was close to collapsing. In addition to the cracks around the openings, horizontal cracks along the brick joints were found on the side walls of the storage building.

It was also observed that the aftershocks caused more severe damage to the bricks, widening the crack openings.

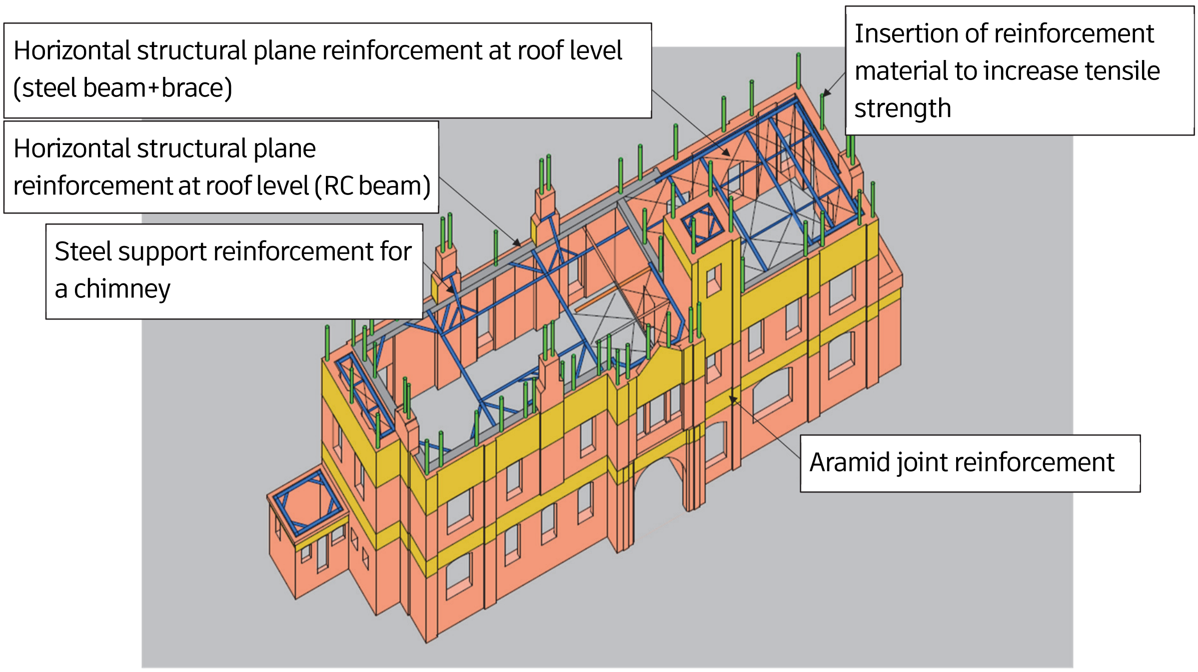
Based on the damage conditions, it was decided that the office and fermentation buildings (including the underground nursery and washing house) would be reroofed and partially repaired. The storage building would be partially repaired, and in conjunction with this work, all building structures would be reinforced.

First, fully covered temporary enclosures were erected above the office and fermentation buildings, and eave-level scaffolding was erected on the storage building. The roofs of the office and fermentation buildings and of the cellar were dismantled, focusing on the damaged areas and the places that would interfere with the structural reinforcement work. The decorative elements of the interior and exterior of each building were also dismantled to examine the damage to the brick walls.

Repair and reinforcement plans were formulated based on the results of the damage and seismic assessment of each building. An advisory committee of experts was formed to carefully examine the plans, which were discussed repeatedly. The national council also discussed the items that would have a significant impact on the cultural value of the property. Based on these decisions, the brick walls were repaired and reinforced where cracks or deformation had occurred, and seismic reinforcement was carried out in each building.

In addition to funds from the building owner, subsidies from the national government, Ibaraki prefecture, and Ushiku City were used to finance the recovery work as a disaster recovery project for national important cultural properties.

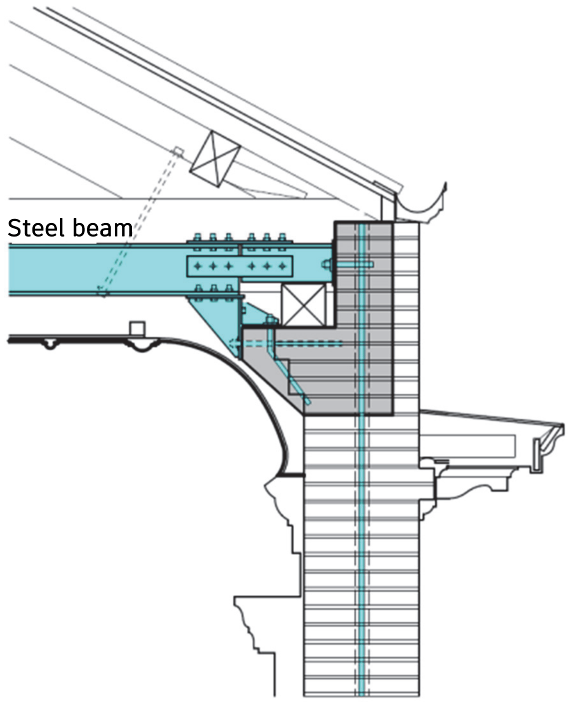
The following are some of the distinctive features of the recovery efforts:



Schematic reinforcement plan

Examining the methods for wall repair and reinforcement

Since so many areas on the brick walls were damaged, appropriate maintenance and reinforcement standards needed to be selected in order to proceed with the recovery quickly. For this purpose, criteria were discussed to enable judgment on which method should be applied depending on the width of the cracks and other conditions of the damaged bricks. The criteria are (1) no maintenance required, (2) grout material injection, (3) aramid joint reinforcement, (4) insertion of stainless-steel rods, and (5) restacking decorative bricks. In addition, the grouting was tested to determine the grouting method and material selection depending on the width of the cracks. These study processes and criteria were explained in an easy-to-understand manner in the repair work report and were also utilized in the recovery work at Kumamoto University following the Kumamoto Earthquake in 2016.



Detailed reinforcement diagram

Examination of structural reinforcement

In the seismic resistance assessment, a three-dimensional analytical model was created to examine the in-plane and out-of-plane directions of the walls. The stress distribution during earthquakes was confirmed, and structural weaknesses were identified by comparing the results with the actual earthquake damage. Unsafe conditions were identified in all the buildings, and reinforcement methods were studied considering the use of buildings with cultural property value. After several reinforcement plans were developed and compared in terms of impact on design, preservation of materials, reversibility, and potential construction problems, an appropriate method was selected from a comprehensive perspective.

For the office building, we placed special emphasis on the exterior and interior design and considered methods that would have as little impact on the design as possible. Reinforcement methods included: (1) Inserting vertical steel rods into the brick walls and stabilizing them with grout, (2) placing steel framing on a section of the first floor, (3) adding reinforced concrete beams, steel beams, and wooden truss to reinforce the horizontal structural plane at roof height, (4) installing structural plywood plates to reinforce the horizontal structural plane at the height of the second floor, and (5) inserting stainless steel rods and a steel brace to reinforce the chimney. The necessity of installing reinforced concrete beams at the roof level was discussed carefully since removing a portion of the top

Reinforcement of the joints, Office Building

Installation of reinforced concrete (RC) beams of the brick wall at this point would have a significant impact on the value of the cultural property.

The fermentation building had bacteria growing on the walls of the underground cellar, so in order to maintain its original function and atmosphere, the reinforcement construction works needed to have minimal impact on the underground space. For this reason, the following methods of reinforcement came up as works that did not require installing a foundation inside the building: (6) placing buttresses on the rear side of the building, and (7) installing steel beams and diagonal braces to reinforce the horizontal structural plane at the height of the roof and under the second-floor flooring. The buttress reinforcement on the back of the building is exposed to the exterior, and even though it is on the rear side, the design of the buttresses was examined carefully. For the basement nursery, (8) reinforcing with an RC foundation to prevent uneven settlement, and (9) reinforcing the horizontal structure of the roof were considered. For the washing house (10) placing steel framing inside the building was identified. All the buildings applied method (1) above, inserting steel rods into the brick walls.

Since the interior of the storage building is not a designated cultural property because the loss of the original fabric in the interior was substantial, we examined methods to reinforce the interior of the building. The methods include: (11) installing additional steel posts and underground beams in the restaurant area, (12) installing additional steel beams to reinforce the horizontal structure at the roof level in the kitchen area, and (13) installing additional steel beams to reinforce the horizontal structure at the roof level. In addition, stainless steel bars were inserted in the brick walls of this building as well as in the office building.

(Eisuke Nishikawa)

Ishii Lock [Index Map no.9]

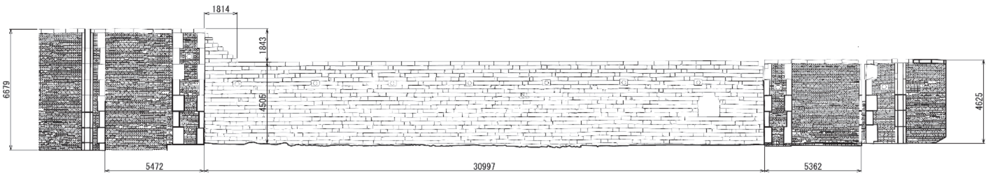
Ishinomaki City, Miyagi Prefecture
National Important Cultural Property

Ishii Lock, which connects the old Kitakami River to the Kitakami Canal, was completed in 1880 and was Japan's first Western-style modern lock gate. It was nationally designated as an important cultural property in 2002 for its significant historical value. Cornelis Johannes van Doorn, a Dutch engineer, was involved in its design and construction which was commissioned by the Ministry of the Interior. The wooden gate was replaced by a steel gate in 1966, but no other major restoration work had been made to the lock since then, and it still retains the appearance it had when it was built. It is the oldest lock gate in Japan that continues to function as a passageway for ships.

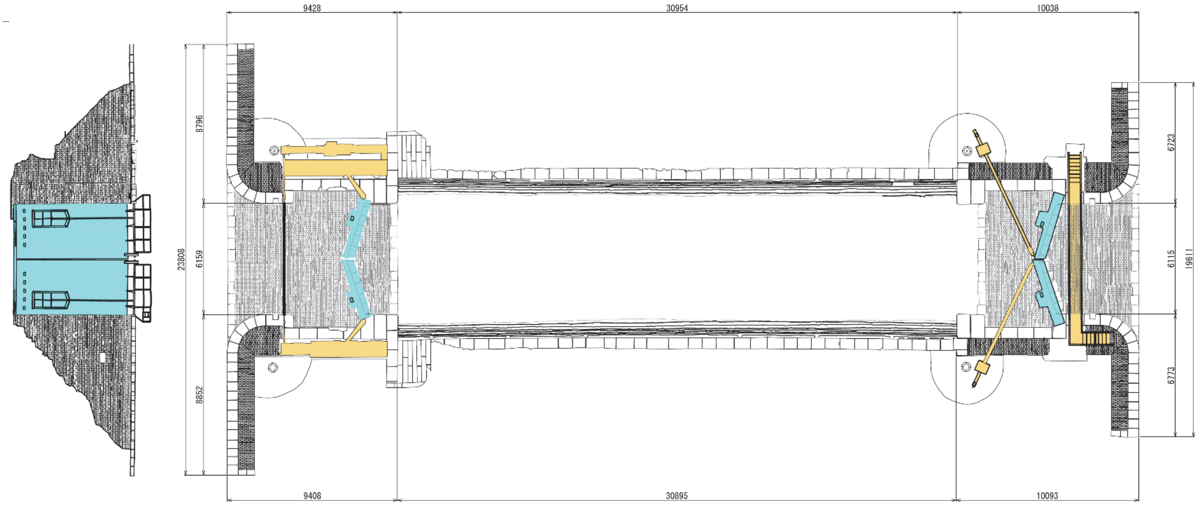
Ishii Lock consists of a lock chamber that controls the water level and a lock head and a lock tail that hold the miter gate (called Gassho-door). The gate is divided into the head and tail sections, with a total length of approximately 50 meters, a width of about 20 to 24 meters, and a depth of about 5 meters for the lock chamber. The lock chamber is of dry masonry made of inai stone produced in Ishinomaki City. The head and tail sections are said to be bricks from Kosuge, Tokyo, and are stacked with English cross bond.

The earthquake of a seismic intensity of upper 6 and the tsunami caused damage, but the main frame of Ishii Lock was not severely damaged.

Damage conditions of the lock chamber and lock tail after the tsunami



Elevation (left bank side of a river)



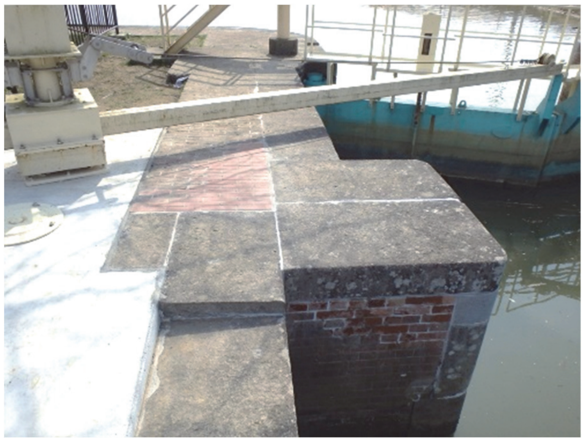
(River side)

(Canal side)

Plan

Elevations and Plans

Damage conditions of the gate posts at the lock tail (left bank) after the switch gate was replaced



Restoration work on the gate posts at the lock tail (left bank)

However, the tsunami that came in from the canal pushed the closed miter gate open, which severely damaged the gate operator that was replaced in 1966, deforming the surrounding stone and brick masonry. In addition, the land subsided in a wide area, causing the entire Ishii Lock to sink about 60 cm and lose its flood control function as a levee that responded to the flooding of the old Kitakami River.

The restoration policies were determined as follows: (1) Preservation at the original location, (2)

Inscriptions (2013) were made to newly added materials to distinguish them from the original materials

Securing the function of the locks as a river management facility, (3) Based on the new levee plan, no repairs would be made to the current Ishii Lock to add a flood control function, (4) Based on the results of the stability assessment, no intervention such as reinforcement of the structure itself would be made, (5) Since the building still retained its original appearance, the scope of repairs and building rehabilitation would be minimized as much as possible by reusing parts, similar materials, and methods used at the time of construction. The Committee for the Study of Conservation Measures for the Ishii Lock Important Cultural Property (hereafter the Committee) was established. Under the guidance of the Committee, a soundness survey, a design for the repairs, and repair work were carried out (from August 2012 to March 2014). The work included the installation of a new damaged switchgear, the reinstallation or replacement of the capping inai stone masonry, and the replacement and re-stacking of the deformed brick masonry. The flood control function was ensured by installing a new sluice gate in front of the old Kitakami River end.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) bore the entire cost of the recovery work, as the management of the river facility is under the jurisdiction of the MLIT.

Temporary closure work was carried out on the old Kitakami River and canal sides, and the inside of the lock was left dry for a period of time to conduct the soundness survey and for maintenance work. Since constant dry conditions inside the lock would cause a difference with the surrounding groundwater level resulting in water and sand eruption, the water level inside the lock was adjusted according to the survey and maintenance work construction status. In addition, floating scaffolds were installed to secure the construction scaffolds so as not to damage the structure.

130 years had passed since the Ishii Lock was completed, and no restoration was carried out on the masonry and brickwork that make up the frame, there were concerns about the aging of the frame. However, the soundness survey revealed that the masonry and brickwork were solid with a reserve width of about 3m, and the results of compressive strength tests of the brickwork indicated that there was no need for immediate repairs. In addition, the investigation revealed that the capping stones had remnants of hardware dowel holes to prevent displacement.

Stones and bricks that were broken and could not be reused were newly procured (for bricks, they were custom-made to the size used in the original construction), and the year of manufacture, "made in 2013," was stamped on them to indicate the replaced materials.

(Koki Goto, Hiroshi Inou)

Former Yubikan and its Garden [Index Map no.6]

Osaki City, Miyagi Prefecture

National Historic Sites and Places of Scenic Beauty

This stroll-style garden is composed of a pond and buildings including the main building, annex buildings, a tea ceremony house, and the main gate. It is believed that the main building was a retirement villa built in 1677 by Munetoshi of the second generation of the Date family in Iwadeyama, and was used as a residence after Munetoshi's death. In the middle of the 19th century, the school was established to educate the children of vassals, and is thought to have been called "Gogaku Yubikan". The connecting annexes and corridors are thought to have been built at different times, and the garden was developed in the early 18th century. After the Meiji period, it was used as the residence of the head of the Date family of Iwadeyama until 1970, when it was transferred to the local government.

The main building is a single-story building with 15.281m girders and 7.64m beams. The annex building is 13.37m girders and 5.73m beams, with hipped thatched roofs.

The buildings were damaged by the Earthquake inland of Iwate and Miyagi Prefectures in June 14, 2008, and were scheduled for drastic preservation repairs that included structural reinforcement because of the many openings and lack of seismic elements inside the building. When the design for the basic seismic reinforcement and conservation repair work was completed, the Great East Japan Earthquake in March 11, 2011, caused the main building to collapse, damaging the annex building, the main gate, and part of the garden. The main building collapsed toward the southeast, with almost all columns broken and walls collapsed so that the eaves of the roof trusses touched the ground. The building was closed to the public following the results of the seismic assessment, so no human casualties were sustained in the collapse.

Other buildings (the annex buildings, corridor, tea ceremony house, and main gate) had distorted shafts and partially collapsed walls but did not collapse. In the garden, the ground subsided behind the pond embankment, and damage and cracks were observed in the garden paths.

In the recovery process, the main building was repaired with full-scale dismantlement, and the annex and corridors were repaired with partial dismantlement. The dismantled materials were temporarily stored in the preservation shed, and not only the original structures but also the replacement materials were repaired and used if possible. The tree species of the new replacement materials were identified, and species matching the original materials were used as much as possible. If they were difficult to obtain, the material was substituted.

The cause for the collapse of the main building was investigated, and the following three seismic reinforcement methods were carried out:

(1) Addition of reinforcement hardware and reinforcing iron braces to increase horizontal rigidity in roof trusses.
(2) Addition of steel frames to the shaft to increase seismic rigidity
(3) Improve the cross-sectional performance of posts by reducing the internal penetrating tie beams to prevent columns from breaking

The subsidy for the preservation and utilization of national treasures and important cultural properties and Miyagi Prefecture subsidies were used to finance this restoration work.

The building has an open structure so that the view of the garden pond from the tatami room is not blocked. The view from the tatami room was an important part of the value of the building, so we

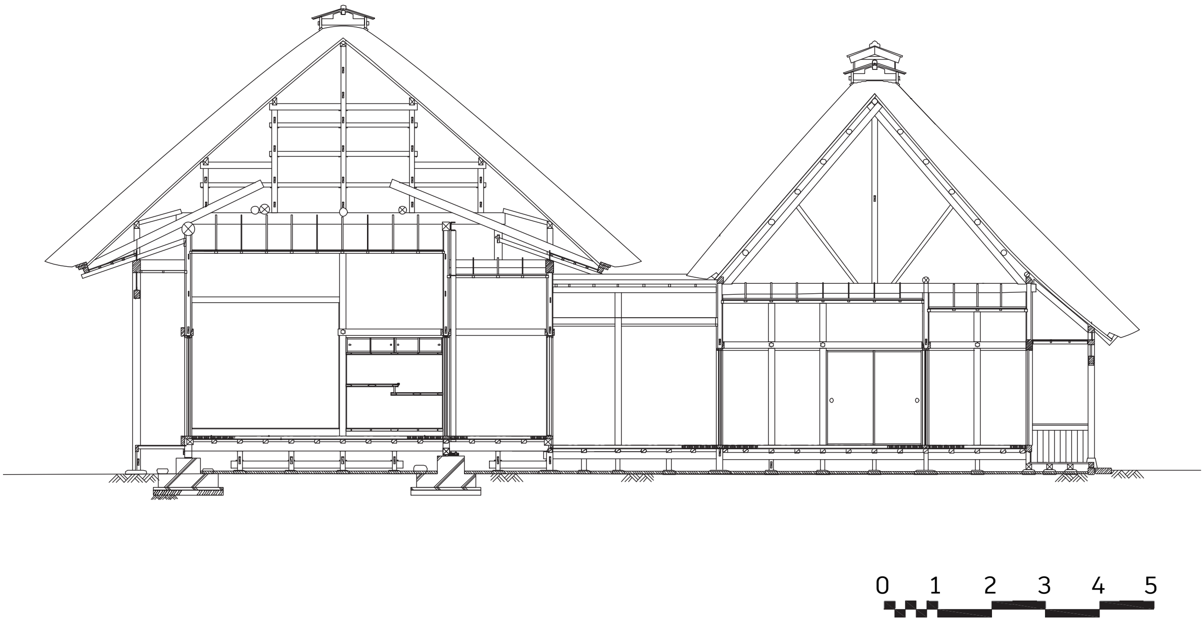
South view, after restoration (main building in front, the annex at the back)

Roof truss with iron rod bracings

Structural reinforcement example, steel framing

South view, damage conditions (main building in front, the annex at the back)

Erecting of floor frames, posts, and truss



Post-restoration cross-section drawing (Main building to the left, annex to the right)

worked to implement seismic reinforcement in hidden areas as much as possible. In addition, in considering seismic reinforcement, we carefully investigated the state of collapse and damage to components and clarified the cause of the collapse before implementing the reinforcement.

(Rika Masuda)

Sendai Castle Site [Index Map no.11]

Aoba Ward, Sendai City, Miyagi Prefecture
National Historic Site

The Sendai Castle was built by Masamune Date, a feudal lord of the early modern period. It consists of the central compound (main compound) on the edge of a 120-meter-high hill overlooking the city and the surrounding enclosures such as the second compound and the east compound (third compound). Each of these is divided by skillfully utilizing the natural terrain. The castle buildings were destroyed both by fires and modern era demolitions, and today only earthen walls remain to the north of the Otemon Gate ruins. However, the remaining stone retaining walls, earthen mounds, and moats provide a glimpse of the castle's appearance in those days.

The Great East Japan Earthquake in March 2011 measured 9.0 on the Richter scale, with a maximum intensity of 6 on the Japanese scale within Sendai City. Damage included the collapse and deformation of the stone wall northwest of the central compound, the collapse of the Torino-mon Gate stone wall, the collapse and deformation of the stone wall of the Nakano-mon Gate, the deformation of the Shimizu-mon Gate, and the collapse and deformation of the earthen wall on the north side of the Ote-mon Gate. In addition, the cliff face on the east side of the central compound collapsed, causing ground cracks in various places and other damage to the topography. The restoration project was completed in 2016, and after recovery, the area was hit by a number of aftershocks of a seismic intensity of 4, but no significant impact was observed on the restored areas. However, the "Earthquake off the coast of Fukushima Prefecture" in February 2021 (M7.3, maximum seismic intensity of lower 5), the "Earthquake off the coast of Miyagi Prefecture" in March 2021 (M6.9, maximum seismic intensity of lower 5), and the "Earthquake off the coast of Fukushima Prefecture" in March 2022 (M7.4, maximum seismic intensity of upper 5) caused the collapse and deformation of the northwest stone wall of the central compound, the collapse and deformation of the Torino-mon Gate stone wall, the deformation of the Shimizu-mon stone wall, and the deformation

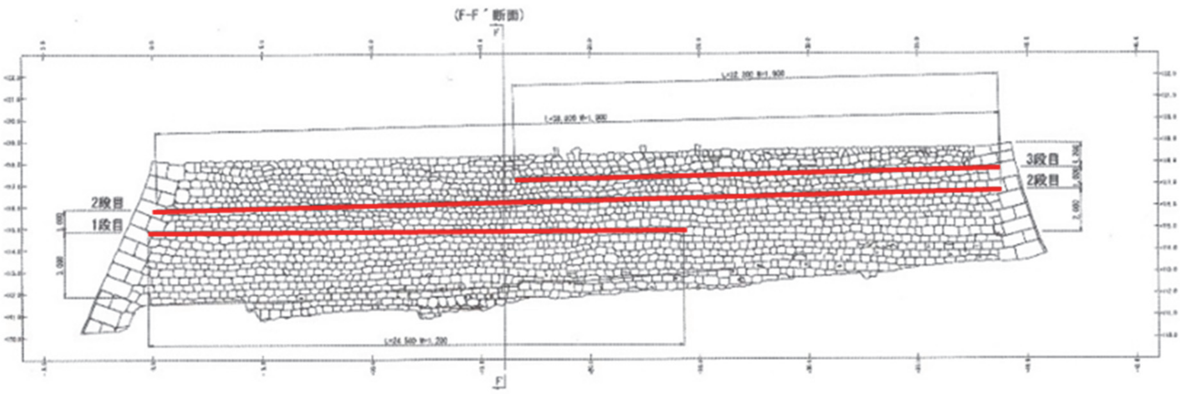
C-side of the northwest stone wall of the central compound after recovery

The c-side of the northwest stone wall of the central compound collapsed due to the Great East Japan Earthquake in 2011

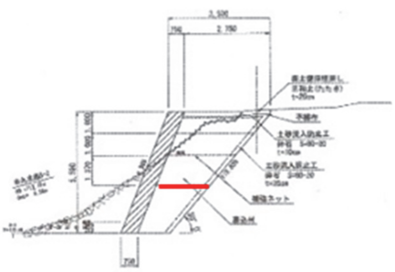
Deformation of the C-side stone wall northwest of the central compound caused by the Earthquake off the coast of Fukushima Prefecture in 2022

of the earthen wall on the north side of the Otemon gate. The earthquakes repeatedly hit the same location and caused extensive damage.

Regarding the restoration after the Great East Japan Earthquake, since the Sendai Castle Site is a nationally designated historic site, we aimed for the restoration to reach a state as close as possible to the pre-damage, original state, using traditional construction methods as much as possible. Following this policy, the north stone wall of the Nakanomon Gate, which was renovated in 1977 by altering staking techniques with a non-traditional method using concrete, was restacked to the traditional dry masonry form by removing the concrete. The earthen wall on the north side of the Otemon gate had been renovated with mortar during the recovery from the Earthquake off the coast of Miyagi Prefecture in 1978, so the entire surface was removed and the wall was restored using traditional dry masonry. In the recovery of the collapsed earthen wall, the clay and roof tiles used for the wall were collected and reused. It was found that the bases of the north stone wall of the central gate and the northwest stone wall of the central compound had been raised with mortar where the footstones partially subsided. Since the mortar could deteriorate over time and be damaged by the load, it was removed and replaced with new, tall manufactured stones. While recovering the collapsed stone wall, we identified the location of each stone material based on past survey maps, photographs, and location maps that recorded how the collapsed stones were scattered, and re-stacked them in their original positions to the extent possible. In the recovery work, the damage conditions made it necessary to determine how to ensure visitor safety in the event of future earthquakes. In particular, the need to strengthen the stone walls for future earthquakes was discussed regarding the southern part of the northwest stone wall of the central compound, which is close to the city road. As a countermeasure,



Elevation
(Construction diagram of geotextile reinforcement northwest stone wall of the central compound)



Cross-section view
(Construction diagram of geotextile reinforcement northwest stone wall of the central compound)

Geotextile reinforcement work at the C-side of the northwest stone wall of the central compound

the remains of the castle were preserved, and some modern construction methods were adopted in order to build within the scope of modern era construction. Regarding the construction method, several layers of synthetic fiber reinforcement nets (geotextiles) were inserted into the backfilling stone layers for the recovery work to reduce the earth pressure.

The Great East Japan Earthquake recovery work was conducted based on traditional construction methods, along with some modern construction methods. However, the earthquake resistance measures were not strong enough to cope with the seismic intensities of upper 5 that occurred in 2021 and 2022, and stone and earthen walls collapsed and deformed once again. Therefore, under the new recovery policy starting in 2022, following a detailed investigation of the causes of collapse and deformation, if it is determined that sufficient strength cannot be attained using traditional construction methods alone, reinforcement using modern construction methods will be considered to the extent that the cultural property value is not compromised. Currently, research and design are underway.

The Agency for Cultural Affairs subsidized 70% of the construction costs as a Great East Japan Earthquake disaster recovery project, and the remaining 30% of the costs were covered by the Great East Japan Earthquake recovery subsidy from the national government. The restoration work for the damaged remains after 2021 is also subsidized by the Agency for Cultural Affairs.

Since the Sendai Castle Site was nationally designated as a historic site in 2003, the remaining stone walls within the castle, whether in designated or undesignated areas, have been photographed, surveyed, and documented using the financial assistance of the Agency for Cultural Affairs. These records served as basic data for the recovery to the original state during the Great East Japan Earthquake disaster recovery project.

At the time of the Great East Japan Earthquake, the damaged western part of the central compound (where the northwest stone wall of the central compound and the stone wall of the Torinomon Gate are located) was originally included in the area to be designated as a historic site. However, as this part was undesignated land owned by the "Miyagiken Gokoku Shrine," it was not eligible for assistance from the Agency for Cultural Affairs, which targets designated historic sites. Asking the shrine to restore the site to its original state was difficult, as it would require a large amount of money. The City of Sendai, therefore, consulted

Earthen wall on the north side of the Otemon gate collapsed by the Great East Japan Earthquake

Earthen wall on the north side of the Otemon Gate after completion of recovery work from the Great East Japan Earthquake

Earthen wall on the north side of the Otemon gate deformed by the Earthquake off the coast of Fukushima Prefecture in 2022

with the shrine and the Agency for Cultural Affairs, and the shrine agreed to designate approximately 25,000 m^2 of the western part of the central compound, including the damaged stone wall, as an extension to the existing historic site. The Agency for Cultural Affairs approved the restoration work in this area as it was now eligible for the subsidy program, on the condition that the necessary designation procedures would be appropriately followed, which would facilitate the work.

During the stone wall recovery work, the original stone materials were used whenever and wherever possible, but there were many heavily damaged stones that could not be reused. To compensate for this, we processed and utilized the stones that had been stocked in the castle compound during the 1997-2004 restoration and maintenance works for the north wall of the central compound.

The stone retaining wall in the area where the reinforcement net was placed during the recovery from the Great East Japan Earthquake was 5 to 6 meters high. We initially planned to insert about 5 tiers at 1-meter intervals, but due to the importance of traditional construction and the uncertainty of how introducing this construction method would affect the stone wall itself in the event of an earthquake, we decided to insert 2 to 3 tiers as the minimum number of tiers that would maintain stability in the event of an earthquake of the same magnitude as that of the Great East Japan Earthquake. As a result, the collapse was avoided even with the 2021 and 2022 earthquakes of seismic intensities of upper 5 in, but the structure was greatly deformed and required re-construction. Future issues to be addressed include the appropriate number of reinforcement nets to be used, their fabrication method, and how to connect (integrate) them with the ground or rear embankment layer. It is necessary to fully discuss and examine whether the existing remains can be reinforced without damage. If that is not the case, it is necessary to coordinate the preservation of the cultural properties and the safety of visitors, carrying out restoration that is appropriate for the cultural properties.

E-side of the northwest stone wall of Central Compound (Main Compound) after completion of the recovery work from the Great East Japan Earthquake

Northwest stone wall E-side of Central Compound (Main Compound) that collapsed again after the Earthquake off the coast of Fukushima Prefecture in 2022

During the recovery work from the Great East Japan Earthquake disaster, the city set up days for site tours and presentations of the recovery progress to the public and also published information on the progress of the work on the city's website.

(Akiyoshi Sekine, Tetsuji Kudo)

Ruins of the Tokiwabashi Bridge Gate [Index Map no.19]

Chiyoda City, Tokyo

National Historic Site

This stone arch bridge was built in June 1877 by the (then) Tokyo Prefectural Government. It was built on the outer moat of Edo Castle and replaced the temporary wooden bridge in front of the Tokiwabashi Gate of the outer moat. Of the 13 stone arch bridges built in Tokyo in the early Meiji period, this is the only one still in existence and in use. It is a stone double-arch bridge with a girder and masonry construction. The arch span is 13.39m, the arch height is 4.42m, the rise/span is 3.0m, and it is relatively flat by Japanese standards. The lower part uses a wooden foundation called *soroban* or abacus foundation, a technique that has been used since the Edo period to deal with soft ground. The voussoirs were made with the stones used for the previously demolished outer moat gate. The stone material is andesite from the Izu Peninsula, which was commonly used in the Edo Castle construction. White marble from Ibaraki Prefecture was used for the newel posts. The road surface is divided into a foot and a vehicle path, indicating the advancement associated with horse-drawn traffic. Wear-resistant granite was used exclusively for the carriageway. Generally, the side walls risers (spandrels) are straight, but here the *norisori* or reverse warping technique used for traditional Japanese stone walls was applied. Thus, the traditional Japanese elements of drystone masonry and *soroban* foundations interwoven with Western design characterizes Tokiwabashi as the model bridge representing the architecture of early modern Japan.

The bridge had been in service since 1877 but was damaged by the Great Kanto Earthquake in 1923, and was partially demolished and repaired in 1934 as part of the reconstruction of the Imperial Capital. The Great East Japan Earthquake deformed the structure to such an extent that there was a risk of the voussoirs falling out or collapsing. An overview of the damage is given below.

Deformation of arches and protrusion of voussoirs

An overlay map was created from 3D survey data collected in October 2009 (before the earthquake) and a 3D survey was carried out in April 2012 (after the earthquake) to determine the amount of displacement and to understand the deformation of the stone rings and base. The back of the arch subsided locally by 4.5cm, and the general surface was displaced by up to 35cm, indicating that rocks or the whole bridge could fall. The arch on the right bank had a pronounced diagonal twist (from the upstream right bank to the downstream left bank), which was considered to cause damage such as deformation of the voussoirs, the protrusion of the wall stones, the sinking of the surface deck, the parapet breaking and the water barrier stone tilting towards the left bank.

Wall stone flaring out

Wall stone flared out in the downstream spandrel section of the arch on the right bank side, and there was concern that it might collapse.

Deck paving stones caving in

There were significant voussoirs jutting out of the back of the arch on the right bank side, which caused the deck surface to cave in.

Disaster conditions

Damage to the newel posts

The newel posts consist of two halves on the upstream and downstream sides. The balustrade fence fits in the center of the columns. This damage was considered to be caused by the vibration difference between the main column and the balustrade fence, as well as by the structurally weak half-split section, and the deck surface subsiding.

Damage to the stacked stones

Some of the piled stones were greatly weathered. The most weathered areas were the upstream wall stones at the central pier and the downstream right-bank stacked-up stones. The surface of the stones showed a tendency towards delamination and some of them were broken. It is unknown whether the direct impact of the earthquake caused these conditions, but they could be attributed to the effects of the sudden compressive force.

Damage to the ground cover stones

Some of the balustrades' ground cover stones were broken. The damage was mainly found at the joints of the ground cover stones, and here the balusters of the handrail railings of served as a barrier. It is thought that the difference in vibrations between the ground cover stones and the handrail railings caused this damage.

The basic policy for restoration was to preserve and restore the masonry arch and the wooden foundation, and to preserve the original technique and original components. For this reason, a policy of total dismantling and repair was adopted, and steel-framed supports were installed. If reinforcement was necessary, care was taken to ensure reversibility.

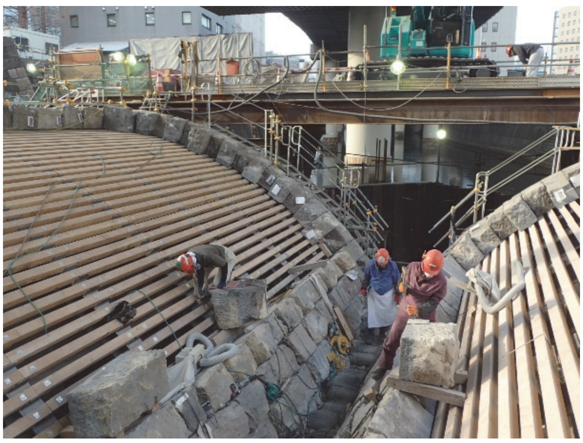
Judging the re-use of the dismantled components.

All dismantled stones were examined after cleaning, and the damage and weathering conditions were recorded. Based on the results of the investigation, all materials were reused except for those that were replaced with new complementary materials. The re-use decision was made separately for the main structural components of the bridge (root stones, wall stones, built-up stones, voussoirs, and paving stones) and the non-structural components around the balustrades (newel posts, balusters, ground cover stones, and sleeve railings).

In the main structural components, different decisions were made for each part of the structure, even if the extent of damage was the same. For example, the stress on the voussoirs is caused by the arch-axial forces, while the stress on the paving stones is mainly caused by pedestrians and, in the largest case, by custody vehicles. Thus, the loads on the stones are very different. Also, judging the individual stones is different for each face of the stone, as there is a significant difference in the way the load is applied between the face perpendicular to the arch axis force and the face horizontal to it.

The wooden members of the foundation structure were judged according to their damage and decay after cleaning. The damage conditions were determined visually and measured with a measuring stick.

Condition of the foundation



Restoration situation

New complementary material replacement policy

Materials that were severely damaged or deteriorated and could not regain the required strength through repair, or materials that were aesthetically displeasing in appearance due to significant salt weathering were replaced with new complementary materials.

Reinforcement policy

The river is narrow in the vicinity of the Tokiwabashi Bridge, which forms a bottleneck in the Nihombashi River, and excavations are planned for the riverbed down to the planned riverbed (-3.0 m A.P.).

The foundation structure is an important part of Tokiwabashi Bridge's intrinsic value, so the guiding policy was its preservation. Assuming this policy, excavating the river bed would result in a bulging foundation structure, which could lead to exposure and run-off of the ground around the topographic pile heads. To solve this problem, the foundations of the central pier section were protected with steel sheet piles temporarily laid for the dismantling survey of the central pier base, making excavations possible while securing the foundation structure.

Voussoir stones

The voussoir stones were mostly reused stones taken from the wall of the Koishikawa Gate. The stones were uneven in length, making them structurally fragile. The axial force transmission, an important function of the voussoirs, was assumed to be only slightly over half of that of a normal stone bridge, and reinforcement measures had to be taken.

Each stone material was repaired based on the basic policy of ensuring structural integrity while maintaining the special features constructed from diverted materials. In addition, dowels were employed to prevent the loss of stones with defective shapes (e.g., in areas where small inverted trapezoids were reused).

The project started in January 2012 and finished in September 2020, taking eight years and eight months. Agency for Cultural Affairs subsidies were used to finance the restoration work.

During the dismantlement process, various findings were obtained. Historical, archaeological, and structural investigations were carried out. For example, FEM analyses of the superstructure, substructure, and surrounding ground were carried out in conjunction.

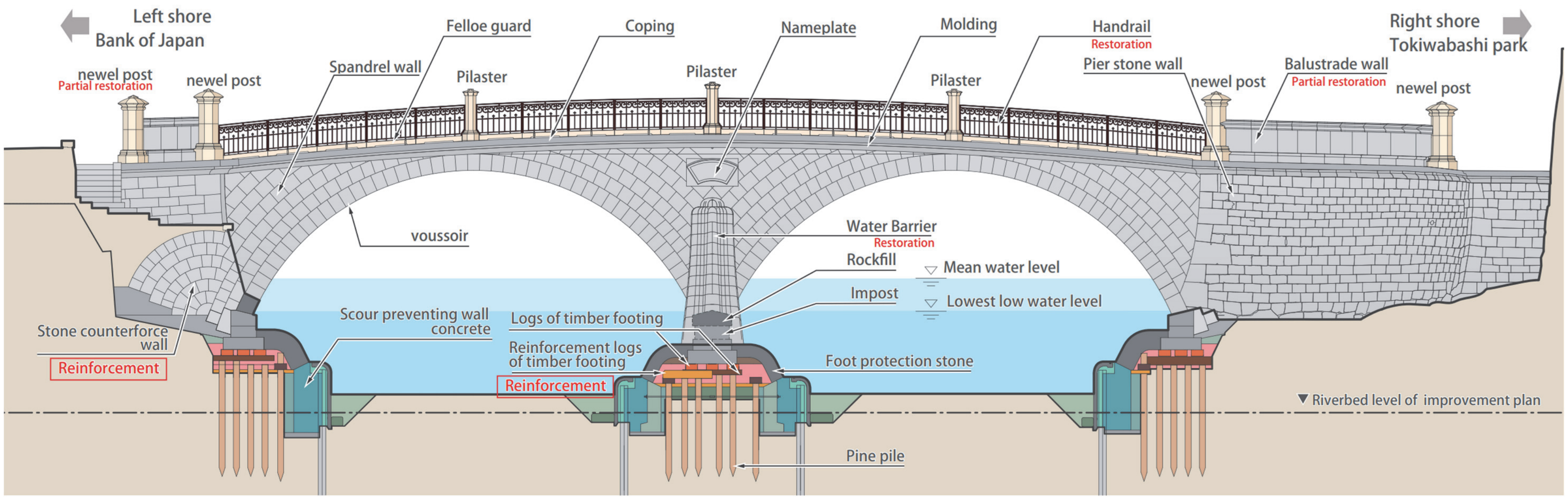
Changes and settlements due to completion and aging were predicted. The amount of wood component penetration was estimated at the restoration level, taking into account the displacement difference between new and old timber, and the reduction in contact area (contact pressure) between existing members due to the riverbed improvement and the addition of reinforced timbers.

The inclination of the root stones and rolled-out stones in the longitudinal direction of the bridge was corrected, but the horizontal displacement of each tier was attributed to both the original and the later displacement. After observing the situation at the joint end, the original stones were restored with displacement to the extent that their degree did not interfere with the structure. If the displacement was deemed to be of a later date, it was moved to its normal position and restored.

For the restoration of the voussoirs, as a measure to compensate for the shortcomings of the stone shapes (which had insufficient depth) while reducing the replacement rate of new stones, the gaps created behind the stones were edged with Japanese paper, the split wood ends were cut into small pieces, and the gaps were filled with high-strength mortar to reinforce the transmission of axial forces.

It should be noted that after this repair, there are plans for the preservation and maintenance of the square of the Tokiwabashi Bridge Gate, and it is hoped that this will be linked to the redevelopment of the neighboring area.

(Kazuyuki Yano)



Elevation Overview

Former Ishinomaki Orthodox Church (Church of Saint John the Apostle) [Index Map no.10]

Ishinomaki City, Miyagi Prefecture

Ishinomaki City Designated Cultural Property

South View after the disaster, March 2011

View after restoration work, August 24, 2022

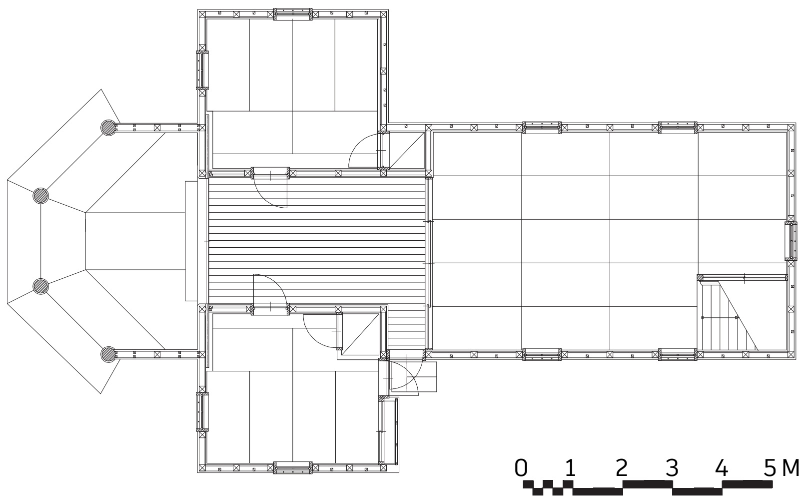
The former Ishinomaki Orthodox Church was built in 1880 in Shinden-cho town (now Sengoku-cho). It was damaged in the Earthquake off the coast of Miyagi Prefecture in 1978 and was moved and reconstructed at its current location in Nakase Park in 1980. It is a two-story wooden construction with pantile roofing (the cross-shaped ridge decoration is made of copper) and is constructed using the post-and-beam construction method. Both the interior and exterior have large walls with wooden substrate boards and a lime plaster finish. The plan is cross-shaped, with a longer north-south axis and a shorter east-west axis. The front of the building (currently facing south, originally east) is an octagon holding a portico with columns and eaves at the corners around a central "*fukube* cross" on the second floor. For the external entrance, a vertical iron lattice is fitted in the vertical sliding window. The first floor has a *tatami*-mat living room and a meeting room on the wings of the entrance hall, while the second floor has an altar at the back of the *tatami*-mat sanctuary. Further back to the sanctuary, ceremonial equipment is found in between both wooden wings. The second floor is a pseudo-Western-style building with a mixture of Japanese and Western designs on the decorated chamber walls. The total building area is 83.38 m^2 and the total floor space is 166.76m^2.

The Great East Japan Earthquake caused devastating damage from the tsunami. Fortunately, the building did not collapse or wash away, but the tsunami passed through the interior, damaging most of the fixtures. Many interior and exterior wall finishes peeled off, exposing the sublayer of the building. Drifting ships caused external physical damage to the east side of the building. Structurally, it was miraculous that only the middle of a two-story-post on the north side was broken. The south and north external sides of the building were more severely damaged, and the entire structure is tilted to the northwest. In addition, the roof eaves (and the *nokijabara* or the cornice) and the cornices around the portico were missing, wall finishes were spalling, many fixtures at the exterior openings had fallen out, the round columns of the portico were tilted (up to 60 mm northwest of the foundation stone), and three two-story-posts on the north side were broken. Inside, many interior finishes on the first and second floors fell off, especially on the north and south façades, as was the case on the exterior. In addition, following the deformation of the building as a whole, cracks appeared at the joints of the gypsum boards that were used as the base for the lime plaster finish (a measure taken during the 1980 relocation). Japan Cultural Heritage Consultancy Inc. (JCHC) was commissioned by the Ishinomaki City Board of Education to conduct a damage survey and plan the dismantling work from June to November 2013, on the assumption that the building would be repaired with full-scale dismantlement. Takumi Co., Ltd. was contracted by Ishinomaki City to undertake the restoration, and JCHC was commissioned to supervise between March and May of 2014. The dismantled materials were stored in four prefabricated warehouses set up in the parking lot of the Ishinomaki City Buried Cultural Properties Research and Arrangement Storage Facility, and then moved and stored in the former school building of Minato Daini Elementary School. The same location before the damage was set as the place for the reassembly. JCHC was commissioned to conduct a reconstruction design plan from December 2015 to June 2016, based on a survey conducted during the dismantling work. The "Ishinomaki City Modern Architecture Preservation and Maintenance Research and Study Expert Committee," of experts deliberated and decided on design specifications and other details. Takumi Co., Ltd. was contracted by Ishinomaki City to undertake the work, and JCHC was commissioned to supervise the construction work.

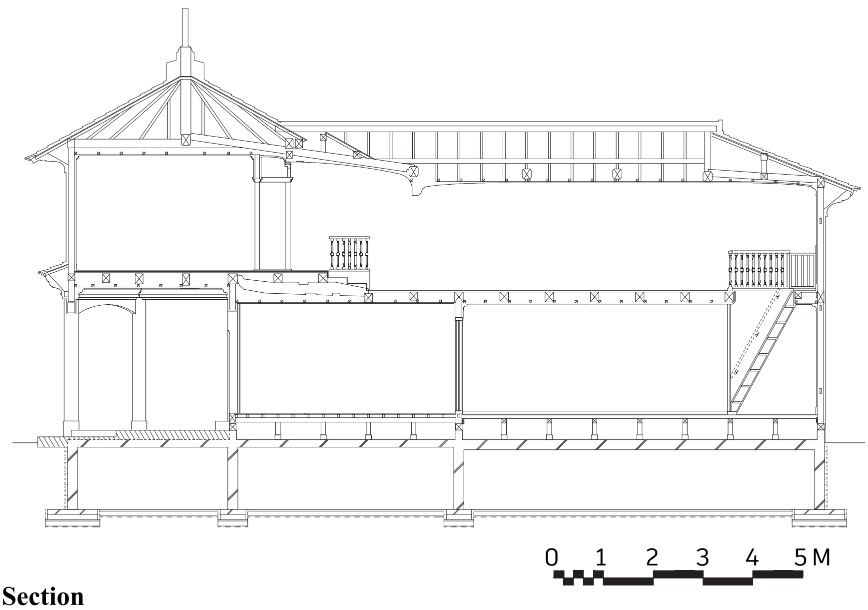
Owner's funds and donations from several organizations financed the recovery work (the details are unknown as we are not in charge of Ishinomaki City.)

As it is a designated cultural property by the city, even though some parts were missing, the original form of the building remained intact. Therefore, it was assumed that, in principle, the building would be preserved and repaired to the pre-damaged state, but there was a campaign for its preservation by citizen groups. However, there was a campaign for preservation by citizens' groups and others. During the survey and construction, there were negotiations with preservation groups, and some measures were taken, such as handing over some of the remaining materials. The original specifications of the building were unclear, and the issue was whether or not to follow the specifications to those used at the time of relocation. Some parts of the building were restored to what was believed to be the original specifications. In addition, there were long discussions about whether the building should be reconstructed in its current location, where similar tsunami damage was expected, or moved to a different site, along with the reconstruction and maintenance of the surrounding area. Since the building was built under Article 3, Paragraph 1, Item 3 of the Building Standards Act, alternative measures were considered for some items that were not in compliance with current standards, and the consent of the Building Review Board was obtained.

(Yasunori Tsumura)



Plan



Section

Fukushima City Museum of Photography "Flower Photo Studio" [Index Map no.12]

Fukushima City, Fukushima Prefecture

Fukushima City Designated Cultural Property

This building holds the remains of the Fukushima Testing Laboratory, which was established in 1922 by the then Ministry of Telecommunications as the Fukushima Testing Laboratory of Electricity for the Tohoku, Hokkaido, and Sakhalin regions. The main building was transferred to Fukushima City in 2000, and in April 2003, it was opened as the Fukushima City Museum of Photography (also known as the Flower Photo Studio), which has been enjoyed by many citizens, including photography enthusiasts. After a 10-year closure due to the Great East Japan Earthquake, the museum reopened as the Museum of Photography in 2021.

The two-story building is 25.5 m long and 12.8 m wide, beam-to-beam, with a total floor area of 645 m^2. It is a masonry construction (made of a tuff stone called Kunimi), with a hipped roof that has Western-style roof tiles. The parapet extends above the roof, and the reliefs and design of the roof around the entrance make the building distinctive.

This masonry construction has no reinforcing bars or other structural elements embedded inside. Therefore, the only element of seismic force resistance is the frictional force of the masonry stones. During the earthquake, many of the walls cracked due to the displacement of the stones. In addition, the pediment (decorated chamber walls above the entrance) was protruding, and tilted significantly outward during the earthquake, being in danger of collapse. As for the interior, the ceiling, which was made of lime plaster, cracked and part of it had fallen.

The building was tentatively scheduled for dismantling and demolition because of the damage it sustained. However, in response to disaster recovery efforts such as a building diagnosis by a Cultural Property Doctor preservation activities by architectural organizations, and suggestions made by Fukushima citizens, it was decided to carry out recovery and seismic reinforcement work, redeveloping the building for presentation as a photography museum. The work focused on restoring the exterior and interior using the same materials and construction methods. To improve seismic performance, the following measures were taken: (1) building a new foundation, (2) placing horizontal braces on the second floor, (3) placing laminated wood (500mm x 200mm) beams at the top of the masonry walls, (4) inserting high strength steel bars (ϕ23, prestressing (PS) = 50 KN, 47 bars) into the masonry walls, and (5) supporting the pediment with a steel frame. The Ministry of Education, Culture, Sports, Science and Technology's Disaster Recovery Project for Public Social Education Facilities was used to finance the recovery work.

Damage of the pediment

View after the recovery

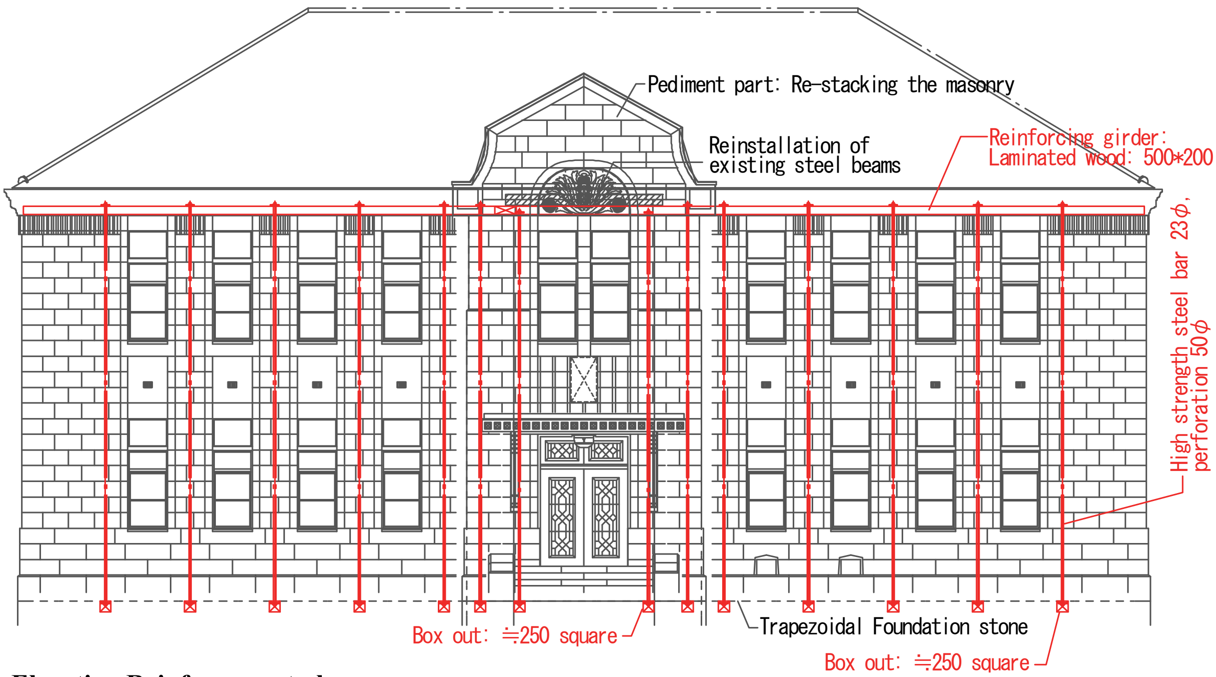
Prior to the recovery work, the existing building underwent a detailed diagnosis and the building materials were tested. Prestressed construction methods were adopted because the stone masonry has a low joint adhesion performance of joints but a friction coefficient of approximately 1.5. This means that the shear capacity will be maintained as long as the materials do not separate from each other. The tensile force of prestressing was evaluated from the seismic response analysis using 3-dimensional FEM analysis so that the tensile stress generation induced in the joint could be within the allowable range. In such decision making process, it was also considered that the prestressing would not prevent the weaker stones from being crushed.

Since there are reports that reinforcement with rigid reinforced concrete induced damage during the 2009 L'Aquila earthquake, laminated wood from Fukushima Prefecture was used for the beams above the walls. Since these laminated wood beams supported the tops of the high strength steel bars, the loosening of the prestress over time became an issue. In addition, monitoring of the prestressing value of the installed high strength steel bars is being monitored as of 2022.

(Shigeki Kita)

Laminated wood beams above the walls

Drilling holes in the masonry wall



Elevation Reinforcement plan

Kakuboshi Sake Brewery Store [Index Map no.2]

Kesennuma City, Miyagi Prefecture

National Registered Tangible Cultural Property / Kesennuma City Designated Cultural Property

It is a *sake* brewing business store founded in 1905 (the brewery is located nearby). When the company was founded, the store owner offered their *sake* to the Murone Shrine (Ichinoseki City, Iwate Prefecture), and a bright morning star was reflected in the sacred mirror while the circular light shone on the *sake* in the square wooden cup, which is why the shop name (and shop seal) was chosen as "Kakuboshi," meaning a "square star."

This wooden, two-story building was constructed around 1929 (after the great fire of 1929), with the front of the building facing the sea. Because the site shape is a quadrilateral with no parallel sides, the building also followed this shape. Therefore, the columns, girders, and rafters are cut into diamond-shape, and the roof tiles and brackets are angled.

The first floor was washed away by the tsunami of the Great East Japan Earthquake, and the second floor was swept away to the north about 30 meters from its former location. The house was temporarily moved to the pre-disaster site and cured until the land readjustment project policies were established and restoration became possible. In the end, the restored building was moved approximately 8m west of the pre-disaster site due to land conversion and site shape changes. The restoration work was completed in September 2016, the first of the six cultural property sites in the Kazamachi district.

First, the rescued second-floor components were dismantled and stored, and at the same time, a search and investigation of the lost materials was conducted. Original materials were reused as much as possible. The remaining roof trusses, second-floor posts, beams, girders, baseboards, rafters, floorboards, walls, ceiling materials, copper grids, and some other materials found in the surrounding area were all reused, and the lost first-floor posts, floor joists, and severely damaged eaves were replaced with new materials. The exterior finish was, in principle, restored. All of the exterior plastering,

Before the earthquake (Photo provided by Kesennuma 311 Archives/Kesennuma Tsunami Field Museum)

The tsunami swept the first floor away and pushed the second floor about 30 m north

The remnants were rolled back close to their original location

After restoration (September 2016)

however, was newly replaced, and the newly constructed stairwell was sprayed with a ricin finish to distinguish it from the original materials. For the roof, decorative end-tiles and recovered tiles were reused, and the rest were collectively used for the shed roof. The ridge design was restored to the *sei-gaiha* or repeating wave style using old photographs as a reference.

The structural plan respected the original materials, construction methods, specifications, and design, and the necessary seismic resistance was established considering the conservation of its value as a cultural property and its safety. Since the first floor was new construction, its whole structural design was also new, but for the second floor, the remaining materials were used as much as possible, including the structural elements. The new building design reflected the analysis and evaluation. The load-bearing walls were designed in accordance with the specifications for the type of framing and wall ratio stipulated in Article 46 of the Order for Enforcement of the Building Standards Act and Notice No. 1100 of 1981.

In addition to the owner's private funds, the restoration work was financed by the SOC Fund (Save Our Culture: Support for Cultural Properties Damaged by the Great East Japan Earthquake), the compensation for rezoning and relocation (MLIT), the assistance for design and supervision of registered cultural properties (Agency for Cultural Affairs), and subsidies for the recovery of small and medium enterprise facilities (METI).

To convey the building's history, the tsunami damage it sustained, and the restoration processes, some of the original exterior walls were removed and restored, showing the irregular wooden joints

Exhibit showing the process of traditional earthen wall construction

Exhibiting the unique structural wooden joinery in the irregularly shaped land and building

unique to this building located in an irregularly shaped site and installing protective transparent glass, displaying the arrow feathers to break evil spirits inside the shed.

In order to protect the value of the nonconforming parts of the Building Standards Act (fire protection structure of exterior walls, fire protection facilities for openings, and structural specification rules) for cultural properties, an application for exemption from the Miyagi Prefecture Building Standards Act, Article 3, Paragraph 1, Item 4 (reproduction buildings), was filed along with the building restoration work , and alternative measures (reinforced liquid fire extinguishers, alternative nonreinforced liquid fire extinguishers, new permanent entrances, measures to prevent human-caused fires, etc.) were introduced.

(Hiroko Wada, The Kesennuma Kazamachi Cityscape Preservation Association for Community Recovery)

Otokoyama Honten Sake Brewery Store [Index Map no.3]

Kesennuma City, Miyagi Prefecture

National Registered Tangible Cultural Property / Kesennuma City Designated Cultural Property

This is a *sake* brewing business store founded in 1912 (the brewery and the receiving hall are located nearby, and all sites became a national registered tangible cultural property after the earthquake). When the shop was a retail store, it sold the "Otokoyama" *sake* brand by Shiogama Abe-kan, so it is said that its own sake was also named "Otokoyama" and "Fushimi Masamune".

Built around 1931, this three-story wooden construction faces the sea. The exterior walls have a natural washed-off stone finish, with parapets on three sides and vertical double-hung windows, all of which are characteristic of early Showa period modern architecture.

The first and second floors were swept away by the tsunami of the Great East Japan Earthquake, but the third floor remained, slightly encroaching into the neighboring land. Until the land readjustment project policies were established, and making restoration work possible, the remains of the building were temporarily moved to their pre-disaster location and protected. The restored building was finally relocated 10m east of the pre-disaster location due to the land replacements and changes. The restoration was completed in June 2020, the fifth of six cultural property restoration projects in the Kazamachi district.

Regarding the interior of the building, the third floor, which had been rescued, was dismantled and temporarily stored, and a search and investigation were conducted to determine which materials had been lost. Original materials were reused as much as possible, and the remaining roof trusses, columns, beams, girders, baseboards, rafters, window frames of the second and third floors, and coffered ceilings of the third floor were reused, while the lost components such as columns, foundations, and beams were replaced with new materials.

In principle, the exterior of the building was restored: as the same materials were used to replace lost exterior walls, and the urethane coating that was originally applied to the exterior walls was

Before the earthquake

The tsunami swept the first and second floors away, leaving the third floor

Preparing the rails to roll and move the remaining building part

Rescuing the pediment of the third floor to be stored

After restoration (June 2020)

New reinforcement steel columns were installed to retain the open space of 8 m

washed away to reveal a washing finish of stucco. Referencing old photographs, the fixtures were restored to their actually original wooden frames, not the frames used before the disaster. The exterior walls of the newly constructed staircase and elevator were sprayed with elastic ricin finish to distinguish them from the original materials.

Original structural materials were used for the third floor to the extent possible, and the design reflected the analysis of actual new building evaluations. In order to restore the large space of approximately 8 meters, steel columns and beams were used for reinforcement, and steel frames reinforced the front exterior wall, which carried the load from the exterior walls of the first floor.

In addition to the owner's private funds, the restoration work was financed by the SOC Fund (Save Our Culture: Support for Cultural Properties Damaged by the Great East Japan Earthquake), compensation for rezoning and relocation (MLIT), the assistance for design and supervision of registered cultural properties (Agency for Cultural Affairs), and subsidies for the recovery of small and medium enterprises (METI).

In order to maximize the reuse of decorated chamber walls with a washing finish of stucco and pediments, the building was dismantled on a large scale, and a steel base reinforcement technique was developed to reinstall these decorated chamber walls within the frames.

In order to protect the value of the cultural properties, the nonconforming parts of the Building Standards Act (fireproofing of the main structure, fireproof building requirements, interior restrictions, fireproof construction requirements, fire protection facilities for openings, and pit compartments) were exempted as part of the Miyagi Prefecture Building Standards Act, Article 3, Section 1-4 (reproduction buildings). As a designated tangible cultural property of Kesennuma City, alternative measures (reinforced liquid fire extinguishers, evacuation equipment, new alternative emergency entrances, measures to prevent human-caused fires, etc.) were introduced.

(Hiroko Wada, The Kesennuma Kazamachi Cityscape Preservation Association for Community Recovery)

Sekinoichi Sake Brewery Building Complex [Index Map no.4]

Ichinoseki City, Iwate Prefecture

National Registered Tangible Cultural Properties

This is a group of mud-walled and stone-built brewing warehouses and storehouses built in 1919. Seven buildings of the complex were individual national registered tangible cultural properties, registered in 1999. They are the former brewing warehouse and *sake* starter house (a two-story, mud-walled storehouse), the former store and office (a two-story, mud-walled storehouse), the former rice storing and milling house (a single-story stone construction), the former bottling cellar and *koji* malt room (a single-story, brickwork construction), the former workshop and steam boiler room (a single-story, wooden construction), the former tank and sales warehouse (a single-story, stone construction), and the former sales warehouse (a single-story, mud-walled storehouse). It is owned by a brewing company and reused as a folk museum, souvenir store, restaurant, and microbrewery.

The site is located along the Iwai River and was affected by floods in 1947 and 1948. Although the seismic conditions are relatively stable, the surface layer of 2 m or less is soft, and the Great East Japan Earthquake disaster in March 11, 2011, followed by the Earthquake off the coast of Fukushima Prefecture in March 16, 2022, caused deformities such as the ground partial rise of the of several centimeters in the surface.

The seismic intensity of Ichinoseki City, where the building is located, was observed to be lower 4 in the main shock of the Great East Japan Earthquake disaster in 2011, lower 5 (in the Japan Meteorological Agency seismic intensity scale) in the Earthquake off the coast of Fukushima Prefecture in February 13, 2021, and upper 5 in the Earthquake off the coast of Fukushima Prefecture in February 16, 2022. The Sekinoichi Sake Brewery Building Complex was damaged by the Great East Japan Earthquake, as described below, and was subsequently restored. However, the old stone constructions of the rice storing and milling house and the old mud-walled storehouses were damaged again by the earthquake off the shore of Fukushima Prefecture. The former brewing warehouse and *sake* starter house (a mud-walled storehouse) one of the

Former rice storing and milling house (collapsing stone walls)

Former brewing warehouse and sake starter house (Sake folklore museum)

Former sales warehouse (inclined building and damaged eaves)

Steel buttress and truss reinforcement to increase horizontal rigidity in the former sake brewing warehouse and sake starter house

largest mud-walled storehouses in the Tohoku region, was damaged in the Great East Japan Earthquake. The building seismic reinforcement escaped damage from the February 16, 2022, the Earthquake off the coast of Fukushima Prefecture. The stones used in the constructions are from a tuff called Shiogama-ishi, which is thought to have been transported using the Kitakami River as a shipping route.

Former brewing warehouse and sake starter house (Mud-walled storehouse)

The roof truss is a Western-style queen post structure. With a girder length of 27 m and a beam length of 16 m, it is one of the largest mud-walled storehouses in the Tohoku region. The building was not structurally damaged by the Great East Japan Earthquake, but underwent seismic reinforcement because it will be opened to the public as a *sake* folk art museum. The seismic reinforcement included adding steel buttresses and steel braces to the roof trusses to ensure horizontal structural rigidity. When the buttresses were designed, structural calculations were made with the design load as a base shear factor of 0.4.

Former sales warehouse (Mud-walled storehouse)

The building was tilted 1/30 radian in the beam-to-beam direction by the Great East Japan Earthquake. In addition, the eaves were damaged. Subsequently, the tilting was forcibly corrected using wires, and the roof trusses were reinforced with wood. However, the March 16, 2022, the Earthquake off the coast of Fukushima Prefecture struck again, damaging the eaves and falling roof tiles. The building is used as a store and office.

Former store and office (Mud-walled storehouse)

Cracks in the mud walls were caused by the Great East Japan Earthquake disaster. The cracks were repaired, but they were damaged again by the March 16, 2022, the Earthquake off the coast of Fukushima Prefecture. It is currently used as a café and rest area.

Former tank and sales warehouse (Stone construction)

The upper part of the stone constructions (which had no reinforcements) collapsed during the Great East Japan Earthquake. The upper part of the collapsed gable wall was later repaired by replacing it with a board wall. The building was closed after the disaster, but it is currently being renovated to be used as a *sake* brewery. For the process, reinforcements with RC foundations and steel frames are underway.

Former rice storing and milling house (board wall repairs)

Former rice storing and milling house

The repeated crack damages by the February 16, 2022, the Earthquake off the coast of Fukushima Pre-fecture (Former rice storing and milling house)

Former rice storing and milling house (stone constructions)

Cracks appeared in the (unreinforced) stone constructions after the Great East Japan Earthquake. The cracks were later repaired, but they were damaged again by the Earthquake off the coast of Fukushima Prefecture in 2022. In addition to being used as a restaurant, the building was the site of a symposium in the fall in 2011.

The seven buildings with cultural property status have a variety of uses and structural forms. Since the Great East Japan Earthquake, conservation work had been carried out sequentially to each building, but they were affected again by the Fukushima Prefecture earthquakes in February 2021 and March 2022. The buildings are registered tangible cultural properties and have been undergoing conservation repairs with the idea of repurposing and utilizing them.

The survey for the Great East Japan Earthquake disaster was conducted with the assistance of the national and prefectural governments and World Monument Fund aid. In addition, an application has been submitted the group subsidies (*see p.40 for more detail about the subsidy) aimed at repairing the damage caused by the Earthquake off the coast of Fukushima Prefecture in 2022.

(Toshikazu Hanazato)

Makabe Preservation District for Groups of Traditional Buildings [Index Map no.16]

Sakuragawa City, Ibaraki Prefecture

Important Preservation Districts for Groups of Traditional Buildings

Makabe, in Sakuragawa City, has its origins in the castle town of Makabe Castle, which was built in the late 16th century. After the castle was abandoned in the Edo period (1603-1867), the town layout was completed placing the magistrate's office in the center, and it still remains there today. In the latter half of the Edo period, the town developed as a *zaigomachi* (a town that once prospered as a regional hub) that distributed the products from the surrounding area, and a variety of historic buildings constructed from the 1800s to the early 1900s (early Showa period) still exist today. The preservation and utilization of the historic town began in earnest around 2000 when 104 historic buildings in the central city area were registered as tangible cultural properties through the national system. In March 2009, the town was acknowledged as one of the cities recognized under the Plan for the Maintenance and Improvement of Historic Landscapes in a Community (Law on the Maintenance and Improvement of Historic Landscapes). In June 2010, the city was selected as an Important Preservation District for Groups of Traditional Buildings (Important Preservation Districts).

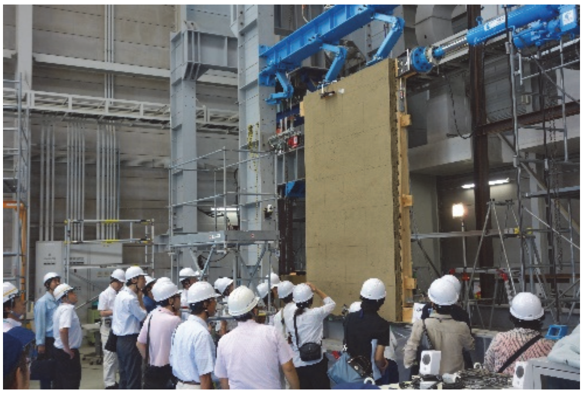
Nine months after being selected as an Important Preservation District for Groups of Traditional Buildings, the area was hit by the Great East

Conditions of disaster-struck traditional buildings (Photo provided by Sakuragawa City)

Conditions of a damaged registered cultural property building located outside of the preservation district (Photo provided by Sakuragawa City)

After the restoration of the traditional buildings (Photo provided by Sakuragawa City)

After the restoration of the registered cultural property building located outside of the preservation district (Photo provided by Sakuragawa City)



Production of mud walls and horizontal load testing

Japan Earthquake, with an intensity of 6. Two mud-walled storehouses and one stone masonry storehouse collapsed, and more than 80% of the 106 traditional buildings in the Important Preservation District were damaged, as were most of national registered tangible cultural properties located in the vicinity. The damage to most historic buildings was limited to roof tiles or clay roofing slipping and cracking, and mud walls collapsing, with little damage affecting the structural safety. The mud-walled storehouses in particular, which have a strong presence not only in this area but also in other historic towns in the northern Kanto region, suffered much damage, including damage to the 200-300 mm thickness fire-retardant mud walls and to the *kagemori* and *hachimaki*, which are characteristic elements of mud-walled storehouses. On the other hand, the damage to historic buildings that had been regularly maintained tended to be small, underscoring the importance of regular maintenance in the management of historic buildings.

Because the building was damaged without any experience in repair under the system of the Important Preservation District, the National Council for the Preservation Districts of Groups of Traditional Buildings provided support for damage survey and recovery by dispatching officials with repair experience from other municipalities.

The subsidies for disaster recovery were made possible by raising the normal subsidy rate, eliminating the maximum subsidy amount, and relying on the prefectural rehabilitation funds to provide a substantial support that minimizes the owners' financial burden. There was no subsidy system for repairing damaged registered tangible cultural properties of the preservation district, but in 2009, the "Plan for the Maintenance and Improvement of Historic Cultural Properties," which was approved by the National government, was modified. The modifications allowed the damaged registered tangible cultural properties to be eligible for subsidies by additionally designating them as structures that form historical scenic beauty. Additionally, a system to subsidize repair costs and facilitate recovery was created. (for traditional buildings in the preservation district 90% was covered by the national government and the city, 7.5% by prefectural rehabilitation funds, and 2.5% by the self-payment; for historic buildings that form historical scenic beauty in the vicinity of the preservation district 2/3 were subsidized by the city with an upper limit of 2 million yen, and 3/4 of the self-paid expenses were subsidized by the prefecture).

For traditional buildings in the preservation district, the above-mentioned generous subsidy system was provided, and repair using traditional construction methods was the basic policy. On the other hand, structures that form historical scenic beauty were allowed to be repaired using metal joints and conventional construction methods as long as the traditional design of the exterior remained like the original.

The disaster recovery project took 10 years to complete for the preservation district and approximately 3 years for the structures that contributed to the historical scenic beauty of the district. This difference in recovery time can be attributed to the above-mentioned difference in repair policies, which required more time for traditional repairs, especially for mud-walled storehouses. Furthermore, there were more pressing cases in the preservation district, and many brewery buildings were damaged, so repairs had to be carried out there in turn.

Nationwide, examples of seismic studies on the performance of mud wall warehouse buildings are scarce. It was necessary to accumulate technologies to enhance their seismic reinforcement performance and to train local engineers to become familiar with these technologies. In response to this, in collaboration with local craftsmen, the committee evaluated the structural performance of mud walls in the northern Kanto region, verified the methods and effectiveness of repairing damaged mud walls, developed seismic reinforcement design, and created guidelines for their design and construction.

With the technical support of engineers from all over the country, a recovery support policy for historic buildings could be established in three and a half months. This was due to the fact that the National Council for the Preservation District for

Local residents and children also supported the restoration

Groups of Traditional Buildings (a national network of local governments and preservation districts together with other groups of people with similar interests) had been meeting and exchanging information regularly before the disaster, which led to developing a support system that was organically connected for the event of a disaster.

The challenges of passing on traditional techniques are not just for Sakuragawa City but also for other Preservation Districts for Groups of Traditional Buildings in the northern Kanto region.

Efforts have been made to strengthen the neighborhood network by involving scholars and regularly exchanging information with administrations, as well as involving repair-related businesses in these exchanges in order to work towards a resolution.

(Hajime Yokouchi)

Sawara Preservation District for Groups of Traditional Buildings [Index Map no.18]

Katori City, Chiba Prefecture

Important Preservation Districts for Groups of Traditional Buildings

Along the Katori highway and Ono River in Katori City, Chiba Prefecture, a riverside town remains that prospered from the Tone River's boat transportation business. The town still retains the atmosphere of a commercial city of the 19th and early 20th centuries. Its value was recognized by the national government and it was selected as an important preservation district for groups of traditional buildings in 1996. The "Great Sawara Festival" held in the district was also designated as an important intangible folk cultural property in 2004, and the town has come to be known as a place that preserves its history and cultural property. In recent years, many tourists visited this elegant town, and it has come to be regarded as an important

Damage to the townscape (Photo provided by Katori City)

Restoration of the townscape (Photo provided by Katori City)

Damage to the revetment in the preservation district (Photo provided by Katori City)

Restoration of the revetment in the preservation district (Photo provided by Katori City)

tourim resource that supports the community.

Katori City was hit by the Great East Japan Earthquake with a seismic intensity of upper 5 which caused the large-scale liquefaction of the ground in the new urban area, damage to the infrastructure, prolonged water and power outages, and damage to approximately 6,000 residential buildings. In the Preservation District for Groups of Traditional Buildings, approximately 2/3 of the traditional buildings sustained damage, both major and minor, and many other historic buildings were damaged. Most of the damage to historic buildings involved the displacement of roof tiles and brick masonry, and only a few of the structural frames were affected. This can be said to be the result of systematic conservation repairs that have been carried out since 1994. On the other hand, buildings that had been neglected in terms of repair and management suffered significantly: 13 prefectural designated cultural property buildings built in the late 1800s (late Edo to mid-Meiji periods) sustained damage and need repairs. These buildings were more severely damaged than the ones that underwent regulatory maintenance through the Preservation District because they had already sustained age-related deterioration.

In the Sawara Preservation District for Groups of Traditional Buildings in Katori City, repairs have been conducted since before the earthquake to replace the foundations even of traditional buildings with solid foundations. This work was carried out to protect the foundation stones and the foundations themselves from the ground moisture because the *choshi* stone material used there this sandstone, which is highly water-absorbent and brittle. However, the Great East Japan Earthquake disaster had a different effect. The earthquake moved the revetment of the Ono River to the river, causing lateral flow and soil-structure subsidence at the foot of the historic buildings, but buildings with solid foundations maintained their integrity and their superstructure sustained no damage. In contrast, buildings that were not built on solid foundations suffered damage to their superstructures, in some cases as the foundations moved apart. In addition, buildings where only the footing of the main building had been repaired to the solid foundation suffered more damage, through a separation caused between the main building and the eaves.

The originally planned repairs of the traditional buildings was almost completed in two years by allowing the use of modern materials and construction methods for the foundation and other parts of that would not affect the overall landscape. These repairs were carried out on the assumption that traditional construction methods would be used in the major repairs to be made later.

Regarding the repairs of the buildings where the foundation and eaves separated, they were connected using post-construction anchors. In addition, to prevent the roof tiles from collapsing, which was the most common type of damage, safety measures were taken during the recovery process, including connecting all flat tiles and ridge tiles with guide wires, following the "Standard Design and Construction Guidelines for Roof Tiles" (issued by the All Japan Tile Contractors Association). This method helps avoid affecting the appearance of the roof tiles.

The maximum subsidy for disaster recovery was raised to a maximum of 10 million yen by the national, prefectural, and municipal governments, lowering the financial burden on the owners. The prefectural government increased the subsidy rate for prefectural designated cultural properties from 50% to 75%, and the city increased the subsidy rate from approximately 17% to 20%, making it possible for owners of cultural property to conduct repairs within their means. In addition, a non-profit organization, the "Association for the Townscape of Onogawa and Sawara," organized a support committee immediately after the earthquake to persuade and assist the owners. While working hard to raise funds, they also approached the World Monuments Foundation and received $200,000 in support from American Express, which was a great help to the owners. As a result, buildings contributing to the significance of the district could be recovered without being destroyed.

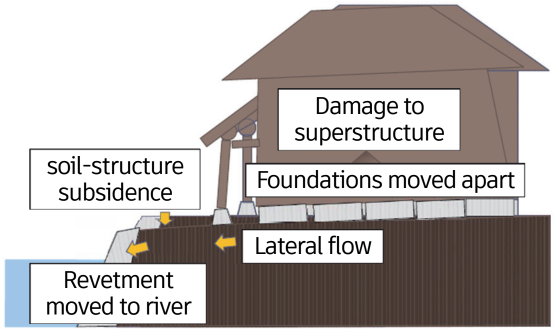


Image of damage to the buildings due to ground settling

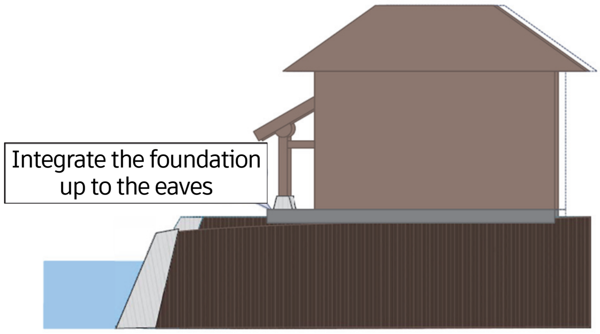


Image of the effect of having a solid reinforced foundation

An example of repairing the roof ridge tiles using the guidelines (Photo provided by Katori City)

Post-Earthquake Temporary Risk Evaluation was conducted after the disaster, but in order to prevent premature dismantling in the Preservation District for Groups of Traditional Buildings, efforts were made to ensure safety by talking to individual owners and alerting them about the condition assessments instead of simply indicating the results such as “inspected”, “caution”, or “dangerous”.

The local Architects & Building Engineers Associations started gathering personnel for the

Post-Earthquake Temporary Risk Evaluation the day after the disaster, and while the government was unable to help, member architects and carpenters took the lead in everything from research and study to planning, construction, and supervision.

In Katori City, the Urban Development Division is in charge of the system of Preservation Districts for Groups of Traditional Buildings. At the time of the earthquake, the department looked after both general housing and buildings in the preservation districts of the city. What became apparent was the disparity in relief measures between general housing and the construction of the preservation district. General housing in the city center, where liquefaction damage was severe, was damaged to the extent that it could not be used continuously, but financial support for reconstruction was not as available as it was for the preservation district. Under such circumstances, the administrative staff felt a strong sense of crisis, worrying that the preservation district would become the target of citizen discontent, as residents were exposed to media reports that informed about the generous subsidies provided for traditional buildings in the area. Therefore, in addition to responding to the media reports, they made efforts to carefully respond to the situation by checking on the status of the housing support expansion, including the timing of the increase in the maximum subsidy amount.

(Hajime Yokouchi)

7.1.2 The Kumamoto Earthquake in 2016

Kumamoto Castle [Index Map no.24]

Chuo Ward, Kumamoto City, Kumamoto Prefecture

National Special Historic Site and Important Cultural Property

History of Kumamoto Castle

Kumamoto Castle is commonly described as a vast *hirayama* or flatland castle built by Kato Kiyomasa on a hill called "Chausuyama" in the center of Kumamoto City. The first mention of its predecessor castle, Kumamoto Castle (with different Kanji characters), in an ancient document, is a brief mention in 1377, and it seems to have faced "Fujisaki Castle," but its specific location is unknown. It was thought to have been a very small mountain castle in its time. According to documents from the mid-Edo period onward, Kumamoto Castle in the latter half of the 15th century was located in what is now the Chiba Castle area, and it was believed to have been moved to the Furushiro area in the first half of the 16th century. After the pacification of Kyushu by Toyotomi Hideyoshi, the old Kumamoto Castle was occupied by Sassa Narimasa, but the following year Kato Kiyomasa became the lord of the castle.

Kato Kiyomasa first worked on the refurbishment of the old castle, including the construction of stone walls in the Furushiro area, but after Hideyoshi's death, he built a new castle on the adjacent Chausuyama. It was believed that Kiyomasa started construction of the castle in the year 6 in 1601 and completed Kumamoto Castle in 7 years, but recent research has led to the theory that he started construction in the years between 1598 and 1599. According to the written records, 1607 was the year when the new castle was completed and renamed "Kumamoto Castle" (to the present Kanji characters). After that, Tadahiro, the succeeding lord, and the Hosokawa clan continued to carry out *fushin* (infraestructure work) and *sakuji* (architectural construction work), and the castle was said to have had 49 turrets, 18 turret gates, 29 castle gates, as well as donjons, some large and some small, making the castle area as vast as 100 hectares. The lord's residence was located on the opposite bank of the river (Tsuboi River) and it was called Hanabatake Yashiki (about 5 ha).

In the Meiji period (1868-1912), a *chindai* or military outpost was established in the central compound (main compound) and Hanabatake Yashiki and Kumamoto Castle became a military base. During the Seinan Civil War (1878), the castle town, as well as the donjon and central compound, were destroyed by fire. After World War II, most of Kumamoto Castle was managed by Kumamoto City as a park with National Special Historic Site status. The castle's donjon was reconstructed in 1960, and the central compound was reconstructed in 2008. The castle is well known as the number one tourist destination and historical heritage in Kumamoto City.

Damage and recovery of stone walls

Kumamoto Castle has 973 stone wall segments covering approximately 79,000 m^2. Of these, 229 segments, or approximately 8,200 m^2 collapsed due to the earthquake, which is approximately 10% of the total area. If we add the areas that were assumed to require partial repair due to loosening or bulging, we will get 517 segments or approximately 23,600 m^2, which is approximately 30% of the total area. Naturally, the damage figures will fluctuate as the recovery project progresses, but fortunately, there have been almost no secondary collapses due to aftershocks. On the day after the foreshock, aftershocks were still severe, and the staff was scattered at emergency posts, such as evacuation centers, so the initial survey was limited to a brief preliminary level; then the main shock occurred before a full-scale assessment could be conducted.

Damage survey results after the "foreshock"

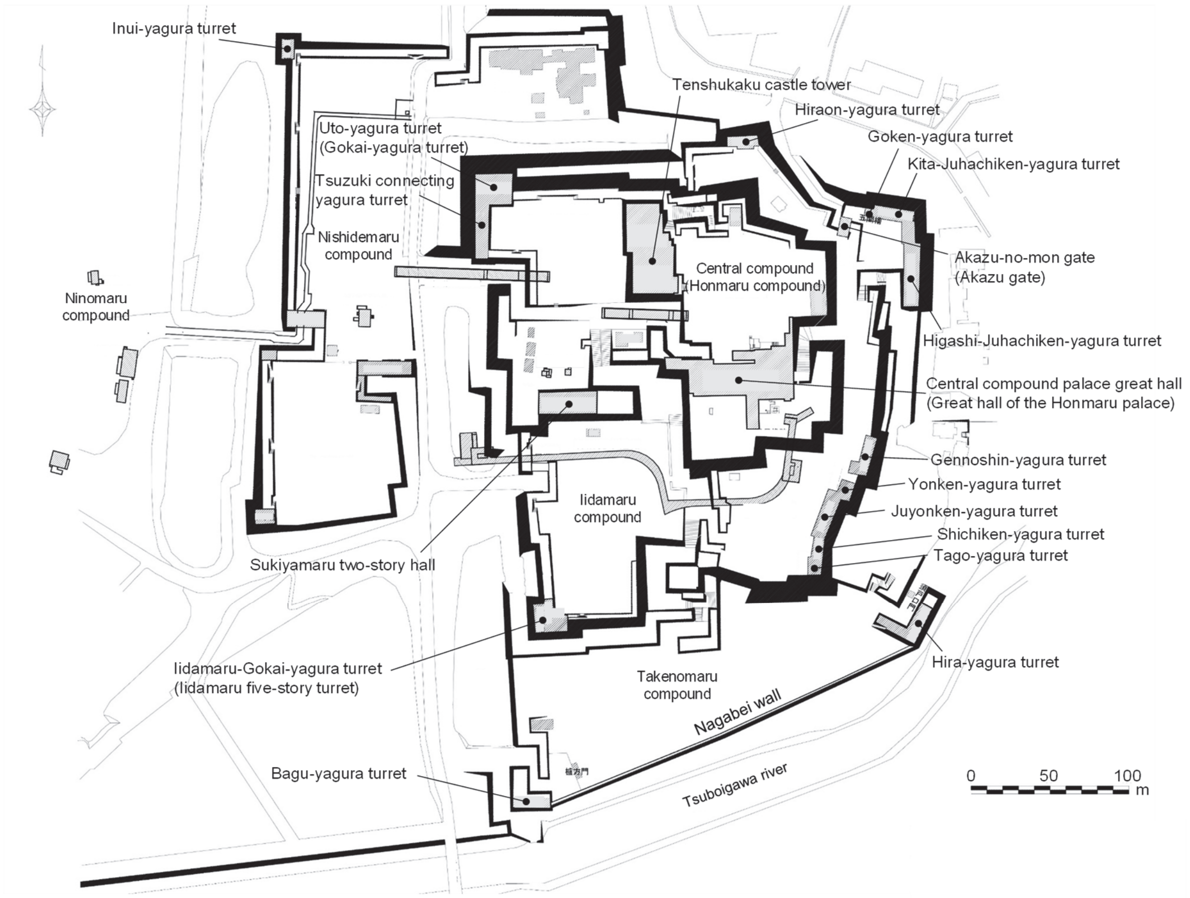
Stone walls	6 collapsed, many bulging and loose
National Important Cultural Properties	10 buildings (1 partially collapsed)
Reconstructed buildings	7 buildings

Damage survey results after the "main shock" (including collapses in early May)

Stone walls	517 areas requiring restoration, 23,600 m² (including 50 areas with collapsed walls, 229 areas, 8,200 m²)
Ground	70 sink holes and cracks, 12,345 m²
National Important Cultural Property Buildings	13 buildings (2 collapsed, 3 partially collapsed)
Prefectural Important Cultural Property Buildings	1 building
Reconstructed buildings	20 buildings (5 collapsed)
Convenience and Management facilities	26 buildings (no collapses)

The conservation of the stone walls, except for the Tenshukaku castle towers or donjon and the Iidamaru-Gokai-yagura turret, is being carried out with priority given to the stone walls of the buildings with Important Cultural Property status. The stone walls of the donjon have already been re-stacked, and the stone walls of the Iidamaru-Gokai-yagura turret are currently in the process of re-stacking. On the other hand, there are many areas where the primary work has been completed,

Damage to stone walls



Overall layout

including the recovery and storage of collapsed stone walls, such as those that obstructed the passage of people and vehicles.

Damage and recovery of buildings

Of the 13 nationally designated Important Cultural Property buildings, the Higashi-Juhachiken-yagura turret and Kita-Juhachiken-yagura turret were completely destroyed, and 11 other buildings were partially collapsed or damaged and required restoration. In Uto-yagura turret, the Gokai-yagura turret was partially damaged, but Tsuzuki-yagura turret located at the south collapsed.

All 20 of the later reconstructed buildings were also damaged. Many of the fences collapsed, and seven of the buildings, including the Iidamaru-Gokai-yagura turret, Inui-yagura turret, and Suki-yamaru two-story Hall, were threatened with collapse due to partial collapse of the stone walls. The Tenshukaku castle tower, a steel-reinforced concrete construction completed in 1960, sustained relatively minor damage, but the top floor of the main donjon and the first floor of the small donjon were somewhat heavily damaged. The central compound palace was also lightly damaged, with only partial damage to the walls and floors due to the settling of the stone walls. The former Mototaiko-yagura turret, which had been leaning due to the collapse of stone walls, collapsed in the rain on June 20, 2008.

The former Hosokawa Gyobu Residence, a prefecturally designated Important Cultural Property, was also severely damaged, but the Hosokawa family boathouse (Naminashimaru), a nationally designated Important Cultural Property, displayed in the Tenshukaku castle towers, was safe. To ensure the safety of the damaged buildings, it is essential to prioritize the restoration and reinforcement of their foundation stone walls and the ground under them.

Damage to the Tenshukaku castle towers

After the restoration of the Tenshukaku castle towers

Seismic reinforcement (cross damper) in the Tenshukaku castle towers

<u>Tenshukaku castle towers (Reconstructed buildings)</u>

The large and small donjons are steel-reinforced concrete reconstructions (buildings recreating the historic external appearance) completed in 1960. Most of the roof tiles on the top floor of the main donjon have fallen off, damaging the tiles on the lower floors. Inside the top floor, the base of the posts was severely damaged, and many cracks have developed in both the concrete walls and floor. The top floor of the donjon was therefore dismantled and rebuilt. During the recovery work, seismic retrofitting was conducted by reducing the weight of the roof and installing braces and dampers. Efforts were also made to introduce universal design by installing elevators, a ramp at the entrance to the small donjon, universal toilet facilities, and the use of a smartphone application. The interior and exhibits were also renovated, and construction was completed on March 24, 2021. The building restoration project was financed by a subsidy from the Ministry of Land, Infrastructure, Transport and Tourism (Urban Disaster Prevention Recovery Project and Disaster Prevention and Safety Grant), and the stone walls were financed by a subsidy from the Agency for Cultural Affairs ("History in Motion!" Comprehensive Rehabilitation of Historic Sites), and the exhibition was funded by a donation from the Nippon Foundation.


Earthquake damage to the Iidamaru-Gokai-yagura turret


Preventing the Iidamaru-Gokai-yagura turret from collapsing

Iidamaru-Gokai-yagura turret
(Reconstructed building)

It is a wooden reconstructed building completed in 2005. The stone wall directly below the building had collapsed, and the building was supported only by the stone wall at the southeast corner, hence it came to be known as the "single stone wall" building. The building was in danger of collapsing due to cracks in the exterior walls and deflection of the foundation. In order to prevent the building from collapsing, a temporary support structure was first set up behind the building to hold the turret in place, and then the collapsed stone wall was recovered. The next step was to dismantle the stone walls, and it was during this process that the old stone walls from the original construction were discovered. The stone walls are currently being rebuilt. The project is financed by a subsidy from the Ministry of Land, Infrastructure, Transport and Tourism (Urban Disaster Recovery Project), and a subsidy from the Agency for Cultural Affairs ("History in Motion!" Comprehensive Rehabilitation of Historic Sites, and Important Cultural Properties disaster prevention management project).

Great hall of the Honmaru palace
(Reconstructed building)

This is a wooden reconstructed building completed in 2008. Overall damage was minor, but the building suffered partial damage to the walls, the section of raised floor suffered uneven settlement and the sukiya section was deformed due to ground subsidence. As with the building, the west side of the stone wall suffered more damage, and some of it collapsed and bulged. Currently, a design for the recovery of the stone wall is underway. The stone wall is being rehabilitated with a subsidy from the Agency for Cultural Affairs (for the presentation of disaster prevention facilities such as Important Cultural Properties).

Nagabei wall
(Important Cultural Property building)

Located on the stone wall of the Take-no-maru facing the Tsuboigawa river that runs along the south side of Kumamoto Castle, this 242.44 m long fence is flanked by Hiraon-yagura turret on the east and Bagu-yagura turret on the west. The original fence was built at the end of the Kato Kiyomasa period, and it is thought that it was during the Hosokawa period that the fence was connected into a straight line. It was temporarily removed around the time of the Seinan Civil War (1878), but seems

After completion of restoration work of the Nagabei wall

Reinforcement to the stone pillar supports of the Nagabei wall

to have been reconstructed by the Japanese Army. The western half was tilted by a typhoon in 2015, and the eastern part collapsed by the 2016 earthquake and was completely dismantled as part of the recovery process. The stone walls were not severely damaged and were not repaired. The damaged supporting stone pillars were also repaired, and an archaeological excavation of the foundations was carried out. Stainless steel braces were newly installed as seismic reinforcement. Repairs were completed in January 2021 with a subsidy from the Agency for Cultural Affairs (Important Cultural Properties Repair Project, Disaster Prevention, and Presentation Adaptive Reuse Project).

Kenmotsu-yagura turret
(Important Cultural Property building)

This single-story turret stands facing the "Shinbori" moat that separates the castle from the Kyomachi plateau on the north side of Kumamoto Castle. The entire building was damaged, including posts and walls, and was dismantled completely. The topmost stone wall collapsed and shifted, so it was partially repositioned. The building is currently being reassembled. Additional lattice walls will be installed as earthquake-resistant reinforcement. Funding is being provided by a subsidy from the Agency for Cultural Affairs (Important Cultural Properties Repair project, Disaster Prevention and Presentation Adaptive Reuse Project, and facilitation project of disaster prevention for Important Cultural Properties).

Hiraon-yagura turret
(Important Cultural Property building)

Located northeast of the central compound, it is one of a group of turrets existing in the east of Take-no-Maru. The stone wall under the turret was bulged, and the entire building was damaged, including the roof and walls. The turrets and lean-to-shed sections were tilted, posing a risk of collapse.

Currently, the stone walls have been dismantled and preparations (change of design and excavation) are being made for re-stacking. Financial resources are being provided by Agency for Cultural Affairs subsidies (Important Cultural Properties Repair Project, Disaster management and presentation adaptive use project, and Important Cultural Properties disaster prevention facility adaptive use project).

Uto-yagura turret
(Important Cultural Property building)

It consists of a five-story turret and Tsuzuki-yagura or continuation turret built at the northwest corner of the central compound. The Tsuzuki-yagura turret collapsed along with the inner stone wall. The fence also suffered significant collapse along with the stone wall. The turret and fence were recovered, as well as the collapsed stone wall. The stone wall under the Gokai-yagura turret (five-story turret) was not seriously damaged, but it was deemed necessary to repair the turret with full-scale dismantlement and reassembly of original structures due to damage such as the tilting and uneven settling of the building and the broken posts. The high stone walls are currently undergoing a study of their conservation, and work on the Gokai-yagura turret is ready for dismantlement having a covered protecting awning since 2022. Funding is provided by a subsidy from the Agency

The Uto-yagura turret before the earthquake

The Uto-yagura turret after the earthquake

for Cultural Affairs (Important Cultural Properties repair project, disaster prevention and presentation adaptive use project, and Important Cultural Properties disaster prevention facility adaptive use project).

<u>Akazu-no-mon gate</u>
<u>(Important Cultural Property building)</u>

Akazu-no-mon or the gate-never-to-be-opened was named after its inauspicious location at the north-east, and it was usually not used. The turret on the second floor collapsed and the gate was distorted but parts of it were recovered. The surrounding stone walls also collapsed extensively, and the collapsed stones were recovered. The funds were provided by a subsidy from the Agency for Cultural Affairs (Important Cultural Properties repair project, disaster prevention, and presentation adaptive use project, and Important Cultural Properties disaster prevention facility adaptive use project).

<u>Higashi-Juhachiken-yagura turret, Kita-Juhachiken-yagura turret, Goken-yagura turret</u>
<u>(Important Cultural Property buildings)</u>

Single-story turrets line the northeast side of the East Takenomaru. Higashi-Juhachiken-yagura turret and Kita-Juhachiken-yagura turret suffered major collapses of the stone walls of their foundations, followed by the collapse of the buildings. Goken-yagura turret escaped collapse, but its walls and posts were severely damaged and tilted. The funds are being provided by Agency for Cultural Affairs subsidies (for Important Cultural Properties repair projects, disaster prevention, and presentation adaptive use, as well as for the "History in Motion!" Comprehensive Rehabilitation of Historic Sites).

Damage to the Higashi-Juhachiken-yagura turret by the earthquake

Stone wall of the Higashi-Juhachiken-yagura turret (after dismantling)

<u>Tago-yagura turret, Shichiken-yagura turret, Juyonken-yagura turret, Yonken-yagura turret and Gennoshin-yagura turret</u>
<u>(Important Cultural Property buildings)</u>

These *hira-yagura* or single-story turrets are located on the southeast side of the East

Takenomaru. Since the stone walls of the foundation were not severely damaged, all of the buildings remain standing. However, Tago-yagura turret and Shichiken-yagura turret, the southernmost turrets in the group, were towed with wires because the buildings leaned toward the stone wall. Currently, the stone walls are not subject to restoration, and seismic reinforcement design and restoration of the buildings are underway. The Agency for Cultural Affairs subsidy (Important Cultural Properties repair project, disaster prevention, and presentation adaptive use) is being used as a source of funding.

Summary
(Introduction of seismic reinforcement)

Kumamoto Castle is currently undergoing recovery work based on the Kumamoto Castle Recovery Basic Plan. The original 20-year plan was revised in 2023 to a 35-year plan. In 2021, conservation of the Nagabei wall and Tenshukaku castle towers were completed, but the rest of the buildings are still in the process of restoration or untouched. Currently, construction, design, and research are underway, with the highest priority given to Important Cultural Property buildings.

Seismic assessments are also being conducted on cultural property buildings, and earthquake-resistant reinforcement measures such as the addition of columns, walls, and braces are considered necessary. Seismic assessments are also ongoing for the stone walls. However, the application of seismic retrofit technology is being meticulously evaluated, considering various factors such as safety measures, repair policies, the results of seismic assessments, conditions of stone walls and buildings, human safety, damage situation, repair history, and other factors.

(Tatsuo Amita)

Aso Shrine (Shinto shrine) [Index Map no.38]

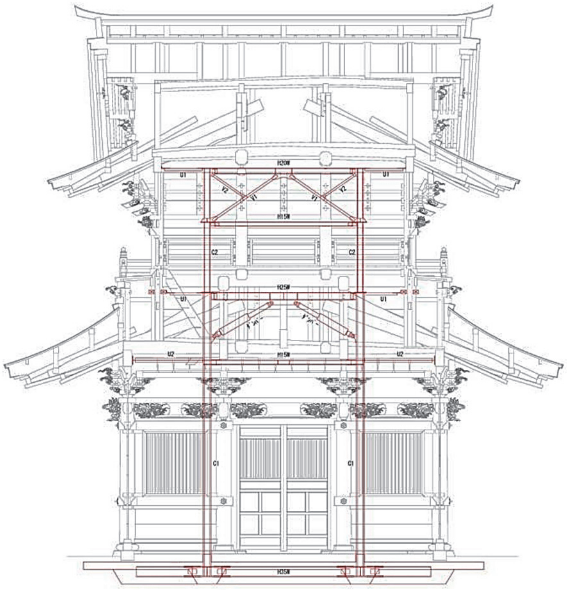
Aso City, Kumamoto Prefecture
National Important Cultural Property (buildings)

Aso Shrine is said to have been founded in the 9th year of Emperor Korei period (282 BCE). Twelve deities are enshrined in Aso, including Takeiwatatsu-no-mikoto (Ichinomiya), Aso-hime-no-mikoto (Ninomiya), and Kunitsukuri-no-kami (Jyuichinomiya), which are listed in the "Shinmei-cho" of "*Engishiki*" among the four great deities of Higo Province. It has long been revered as the first shrine in Higo Province. The present shrine halls were rebuilt between 1835 and 1850 as a community project of the Hosokawa clan. The symmetrical layout consists of a Romon, or a Tower Gate in front of the premise, Miyuki-mon Gate and Kangyo-mon Gate on each side and the First, Second, and Third Shrine Halls behind the Tower Gate. Carpenter Motokichi Mizutami built the three Shrine Halls and the Tower Gate, while his disciple Sadakichi built the Miyuki-mon Gate and Kangyo-mon Gate.

Tower Gate
(Right after the earthquake damage occurred)

Tower Gate (August 2022)

Wooden staff reinforcement under the Shrine floor



Seismic reinforcement plan of the tower gate

Steel Seismic Reinforcement Frames and Dampers, Tower Gate interior

Joints at the top of the posts using aramid rods

Six buildings on the premise were nationally designated as Important Cultural Properties in June 18, 2007:

First Shrine Hall: 5 bays wide and 2 bays deep, single, hip-and-gabled roof, *chidorihafu* (triangular bargeboard) to the front, 3 bay porch with *noki-karahafu* (arched bargeboard), copper plate roofing, dated 1840 (Tempo 11)

Second Shrine Hall: 5 bays wide and 2 bays deep, single, hip-and-gabled roof, *chidorihafu* (triangular bargeboard) to the front, 3 bay porch with *noki-karahafu* (arched bargeboard), copper plate roofing, dated 1842 (Tempo 13)

Third Shrine Hall: 3 bay wide *nagare-zukuri* style, with *chidorihafu* (triangle bargeboard) to the front, copper plate roofing, dated 1843 (Tempo 14)

Romon or Tower Gate: 3 bays wide, one-door, two-story, double-roof gate, hip-and-gabled roof, eaves with *noki-karahafu*, copper plate roofing, dated 1850 (Kaei 3)

Miyuki-mon Gate: gable roof, copper plate roofing, dated 1849 (Kaei 2)

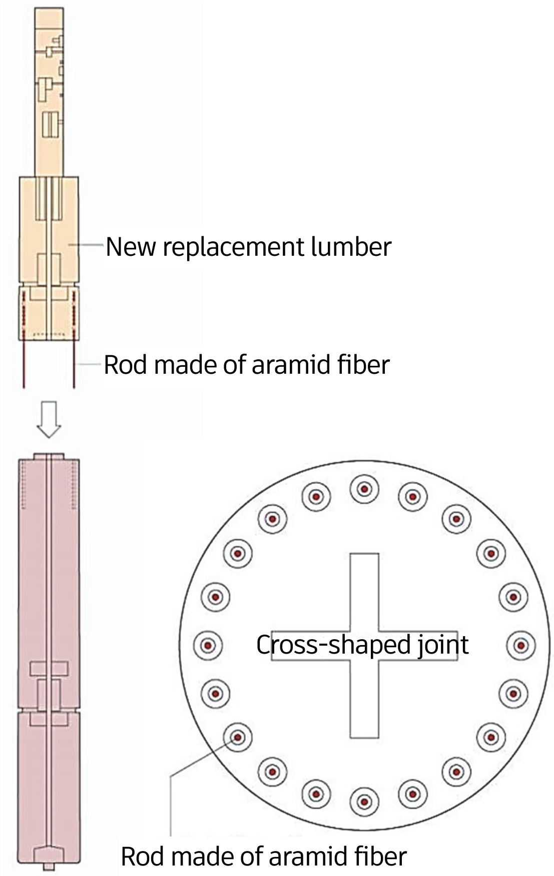
Kangyo-mon Gate: gable roof, copper plate roofing, dated 1849 (Kaei 2)

The Kumamoto Earthquake damage situation was as follows: the Tower Gate was a three-bay, one-door, two-story, double roofed structure with a very heavy upper part and the posts were not adequately connected to the beams, leading to excessive distortion caused by the main shock, which exceeded the building's capacity. Combined with the weight of the upper layer, the lower layer collapsed towards the north and the upper layer twisted clockwise towards the west side. At Miyuki-mon Gate and Kangyo-mon Gate, slight distortions occurred throughout the building, causing damage to the wooden joints and some decorations fell down. In each of the three shrine halls, the southwest post of the main building shifted and the ground floorboard of the porch was damaged. The damage to the Third Shrine Hall was particularly severe, causing the building to tilt.

The repair policy was to treat the Tower Gate with complete dismantlement and reassembly of the original structures, perform partial repairs on all damaged parts of the other gates, and provide necessary retrofit to ensure seismic reinforcement to withstand a seismic intensity scale equivalent to that of the main shock. The overall construction process is as follows: from FY2016 to FY2018, the Tower Gate was to be dismantled, stored, and investigated, and restoration with complete dismantlement and reassembly of the original structure (Phase 1) was to be carried out. Assembly work on the Tower Gate began in FY2019 and is still in progress, with completion scheduled for FY2023.

To finance the restoration work, the project is being carried out with subsidies for cultural property preservation projects from the national, prefectural, and municipal governments.

Seismic reinforcement of the shrine was performed by installing wooden braces under the floor to ensure seismic resistance performance. The collapsed Tower Gate was repaired by a new method using rods made of aramid fiber, used for the first time for repairs to wooden constructions of cultural property buildings. The motivation was to reuse broken posts and corner rafters as much as possible. In the process of repairing the building, a large number of old ink writings were discovered on the original building materials, revealing the names of the carpenters involved in its construction, their hometowns, and the places where the lumber was produced. As for social inclusion and contribution efforts, the shrine invited local high school and university students in the field of architecture to provide educational opportunities, offered training opportunities for heritage management interns, and provided on-site tours for local elementary school students.



Schematic diagram of the joints at the top of the gate columns using Aramid rods

(Toshikuni Miyamoto)

Eto Family Residence (including a main building and 6 other buildings) [Index Map no.22]

Ozu Town, Kumamoto Prefecture

National Important Cultural Property (buildings)

The Eto Family Residence is located in Jinnai, Ozu Town, Kikuchi-gun, Kumamoto Prefecture, at the foot of the outer rim of Mt. Aso. It was designated as a National Important Cultural Property in 2005 as a building that retains the traditional upper-class residential structure in the Higo region. The main house faces south and is located in the center of the 80m square site, with the *nagaya-mon* gate, stable, and shed in the southwest corner, and the middle storehouse in the southeast corner of the main house. Stone walls line the north boundary and part of the west side of the site with the back gate in the center of the west side. In addition to the main building, four other buildings and one annex (including a hut, other stone walls, a waterway, and a housing site) are individually designated. Based on previous research,

Damage to the main building: South front (West side tiles have fallen. The frame is largely tilted.)

Damage to the Nakanokura storehouse: From the northwest

Damage to the stone wall

Damage to the back gate

the main building is thought to have been in a state close to its present condition by 1830.

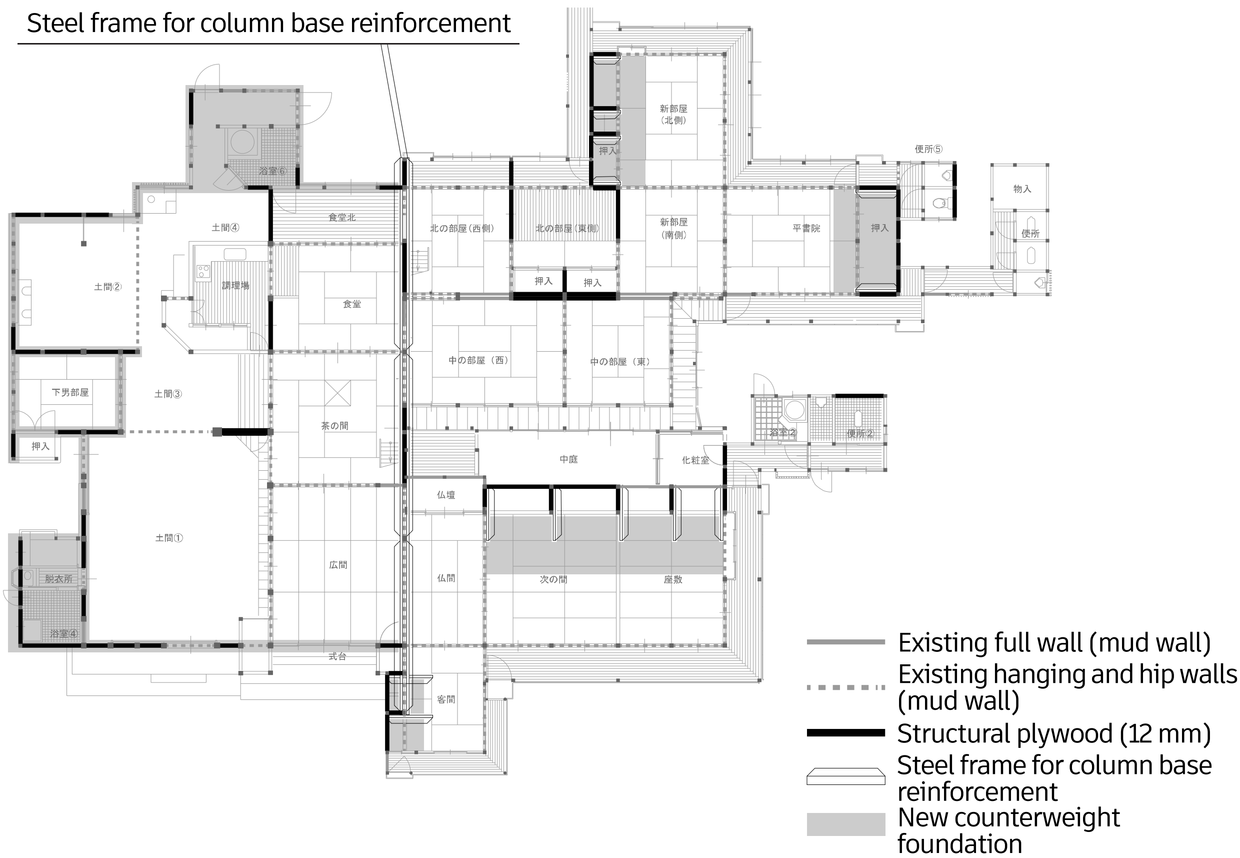
Multiple extensions have been made to the house during the Meiji, Taisho, and Showa periods, and the high-quality interior design of each period has been maintained in good condition. The house is still used as the Eto family's residence today.

The main building is structurally divided into the following three parts: the earthen floor wing, the *tatami* room wing for receiving guests on the south side, and the residential wing on the north side. Each part of the building suffered damage, such as loosening of joints. The northwestern part of the main building was repeatedly remodeled, and there was a lot of damage to the building due to the makeshift way in which wooden members are assembled in this wing. On the other hand, the shafts of the long lintels had not yet fallen off, although the plugs inside the post had failed. The stable's west exterior wall had fallen off, and it tilted heavily toward the road on the west side. It is believed that this was due to the fact that the shafts had been damaged by termites and rotting before the earthquake.

In Nakanokura storehouse, a row of posts was displaced from the foundation stone, and the main frame was tilted towards the west. In addition, most of the mud walls fell down, the ridge of the roof collapsed, and most of the roof tiles slid off the roof. The back gate collapsed onto the west side of the road, blocking the road, and was dismantled by local residents. The west side mud wall of nagayamon gate collapsed, causing the shaft to tilt. Most of the roof tiles of the attached shed slipped off. The stone wall on the north side of the property partially bulged and collapsed near the corner layers, and some of the top stones were knocked out and toppled over.

In order to prevent the spreading of damage from aftershocks and to ensure the safety of nearby residents and workers, the project was pre-commenced before the official start of the government aid project. The main building was temporarily reinforced outside and inside on the west side, where the inclination was significant, to prevent the structure from collapsing. The roof was covered with blue tarpaulins as emergency treatment, but when it rained, there were concerns that leaked water would damage the interior decorative finishes of fittings in the *tatami* room, so the valuable decorative finishes were removed and secured separately. After conducting an investigation, the stable was dismantled and its parts were stored due to significant inclination toward the roadside posing a potential risk of collapse. All mud walls of the storehouse were dismantled and temporarily reinforced with braces to prevent the building from tilting further. The stone walls, which had sections that had fallen and bulged, were numbered and dismantled for storage. Six months after the preliminary start of construction, a competitive bidding process was conducted, and the restoration work was officially started. The earthen floor wing of the main building was repaired with full-scale dismantlement with reassembly of original structures, and other areas were repaired with partial dismantlement and reassembly of original structures. The construction period was approximately 4 years, from 2016 to 2020. The storehouse was repaired with complete dismantlement and reassembly of the original structures. The stable was also reassembled after its frames were restored to sound condition. Construction of both buildings began in 2021 and was completed in 2021. Currently, recovery work is underway on the *nagayamon* (long house gate), *tsukegoya* (attached shed), and rear gate, and the work is scheduled to be completed in 2022.

As a recovery policy, only defective parts of the original materials were repaired, and efforts were made to reuse existing materials. The roof had distinctive strip roof tiles unique to the Higo region, and every effort was made to reuse them as much as possible. In this project, conservation clauses to restrict changes that would affect preservation in terms of maintenance and management were removed and some changes in current status were made for safety, but such changes were kept to a minimum in order to respect the original specifications. In addition, since the Eto Family Residence is the living space of the owner's family, the presentation of the kitchen and insulation of some rooms, etc., were made separately from the subsidized project to enhance comfort as long as the preservation



Structural reinforcement plan of the main building

of the building was not affected.

Seismic assessment: Safety against seismic force and wind load was verified for the main building divided into three sections (earthen floor, ridge, and residential wing) and for the entire building. The safety of the superstructure was verified by the calculation of response and limit strength. As a result, both in the beam-to-beam direction and in the girder direction, the response displacement during a major earthquake was unmeasurably large for both the case of each section and the case of the entire building, indicating a high risk of collapse. However, the actual damage showed a clear difference from the calculation results, as the building as a whole avoided collapse, although there were some partial collapses. Therefore, in the study of seismic reinforcement, the behavior of each building section was individually assessed, along with the behavior of the building as a whole when separate buildings were joined. Each building was evaluated in five major criteria (insufficient horizontal bearing capacity, broken posts, disconnected joints, vertical displacement of posts and columns, and horizontal structural plane), and reinforcement methods were studied for each problem. For the main building as a whole, we used a three-dimensional analysis model to calculate the stresses generated in the joints between annexes and additions. We also examined the reinforcement methods necessary to prevent the separation of sections and the breakage of columns. All of the studies were based on the results of the seismic assessment, but many reinforcement methods reflected the actual damage situation confirmed by the dismantling survey, and efforts were made to take appropriate measures under the actual situation. For buildings other than the main building, seismic reinforcement was also examined based on the calculation of response and limit strength, as well as a three-dimensional analysis model to ensure that reinforcement methods were not excessive or insufficient.

Reinforcement details: The joints of the three wings in the main buildings were securely joined on all sides using hardware and structural plywood. Hold-down hardware and corner hardware were used to prevent pulling out. RC foundations were installed in the earthen floor wing to hide the structural members from view. Fabricated channeled steel hardware was used to prevent column breakage under compressive forces. The roof on the north side of the earthen floor wing was reinforced directly with horizontal braces because, as mentioned above, it was an extended roof part and showed evidence of significant shaking as a result of damage. In order to solve the lack of horizontal bearing capacity, reinforcement walls were placed between the back and the floor to concentrate the

Assembling the main building's earthen floor wing (up to the truss and purlins)

Channeled steel hardware installed for reinforcing column legs at the boundary between the earthen floor and tatami floor wings

Horizontal braces installed on the north roof of the earthen floor wing

horizontal bearing capacity. To prevent the vertical column displacement, a new counterweight foundation was built under the floor, and grooved steel bolts were fastened to the column legs. To reinforce the roof structure, horizontal braces were installed behind the ceiling taking into account the presence of bamboo sheathing. Structural plywood was directly attached to the lower eaves roof to ensure the integrity of the structure. Reinforcement materials for the other buildings were selected following the same basic concept. In the Nakanokura storehouse, since the beam-to-beam bearing capacity was insufficient, a wing wall with reinforcement at a 1-ken pitch was extended to the second floor for rehabilitation as a storage cabinet.

The restoration work was financed by the subsidies for the conservation and utilization of National Treasures and Important Cultural Properties, as well as by the Kumamoto Prefecture's subsidies for the conservation and utilization of cultural properties (Category: Cultural Properties Disaster Recovery Project), in addition to the owner's funds.

In addition to the restoration work, the following efforts are being made: First, the restoration process is viewed as an opportunity to learn more about local cultural property and is being actively used as an integrated learning curriculum for local elementary schools and as a training site for high school interns. Second, the Eto family residence is regularly open to the public so that it can become a "cultural asset that is supported by the community," and third, the Eto Family Residence is being used as a cultural property for the local community. The "Eto Family Residence Conservation Association" (currently 47 members), formed by local volunteers, takes the lead in preparing for the on-site presentation. The day-to-day management of a large-scale *minka* or folk house (houses of the people) is a heavy burden for an individual owner, but the conservation association is a strong supporter, and the prospect of the on-site presentation is a good opportunity to strengthen the unity of the association. Folk houses must be lived in, and the best rehabilitation of a folk house is to live in it. What we feel in connection with this recovery project is the determination of the owner of the *minka* to keep it alive in the community, and the trust of the local

Local elementary school students learning about the community

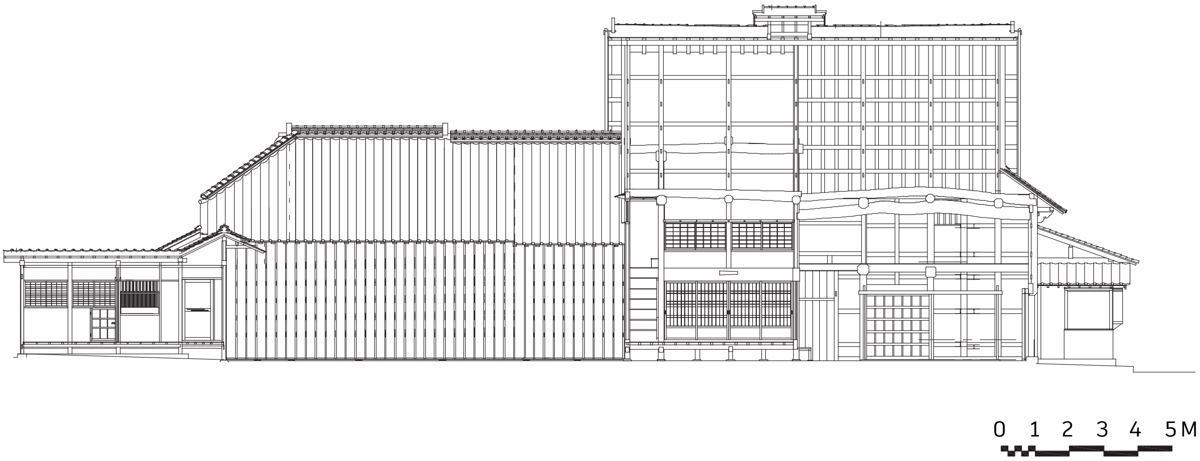
Completion of the restoration work: the main building

Completion of the Nakanokura storehouse: the main building

Stone wall reinstallation completed

people who support the owner in this endeavor. The mutual support system established and alive between the Eto family, who have been making contributions to the community as community warriors from the end of the Edo period to the modern era, and the people in the surrounding area itself is the valued essence of this community. In a community that is becoming less and less connected, the influence of cultural properties that help to connect the local people and foster a sense of identity is not to be underestimated.

(Taijiro Kimoto)



Section: the main building (after recovery)

Kumamoto University Fifth High School Main Building [Index Map no.25]
Chemical Laboratory
Front Gate
Former Machine Experiment Factory, Faculty of Engineering, Kumamoto University
(Former Kumamoto High School of Technology)

Chuo Ward, Kumamoto City, Kumamoto Prefecture
National Important Cultural Properties (Buildings)

The main building (#1), Chemical Laboratory (#2), and Front Gate (#3) were all designed by Hanroku Yamaguchi and Masamichi Kuru, engineers of then the Ministry of Education, and completed in 1889 (Meiji 22). The main building #1 is of brickwork construction, a two-story, hipped roof with pantile roofing with a wooden truss. It is said to have been designed to prevent the hot sun from directly entering the classrooms. The Chemical Laboratory #2 is located on the east side of the main building and is of brickwork construction. It is a single-story structure with pantile roofing and wooden roof trusses. The ridge extends in a north-south direction, housing a two-story high staircase. At the southern end, there are classrooms and a draft chamber, which was already in place when the laboratory was first built. The Front Gate is of brickwork construction with a fence on both sides. Although there are still metal fittings for attaching the gate to the two pillars and a blueprint depicting the

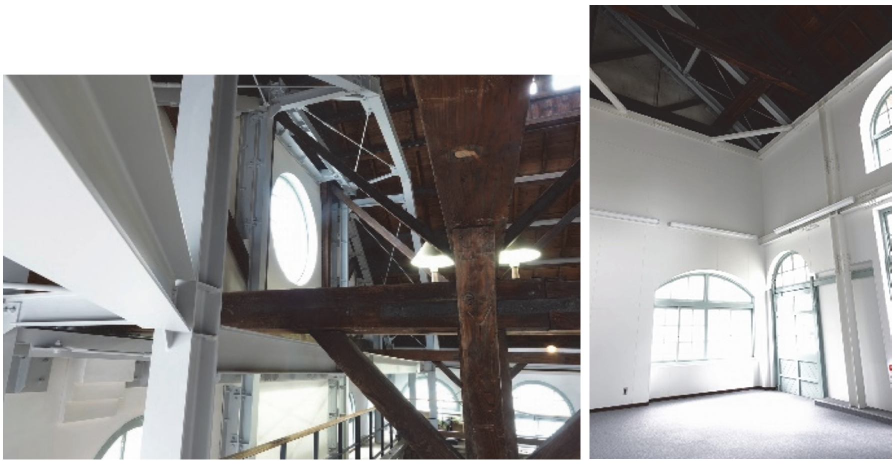
Chemical Laboratory, the broken and fallen chimney

gate remains, there is no evidence that the gate was actually attached to the posts. The center of the gateposts has been reinforced with rebar. The experimental factory for mechanical engineering of the Higher Technical School (#4), completed in 1908, is a two-story brickwork construction with pantile roofing and wooden roof trusses, designed by Jirokichi Ota, an engineer of the former Ministry of Education. The west side of this elongated east-west building has two small rooms, a boiler room, and a steam engine room. The east side has a laboratory with a large atrium in the center. Inside the building, a collection of machine tools is preserved, including 11 units designated as cultural property.


The Experimental Factory for Mechanical Engineering, cracks entering at an angle from the round window in the gable wall

Common damage to these four buildings in the Kumamoto Earthquake were cracks and misalignment of the frames. In (#1), (#2), and (#4), the cracks can be observed entering at 45 degrees from the corners of the openings. In (#1), a large crack appeared at the junction between the interior wall dividing the classrooms and the exterior wall in the east-west direction. In (#4), at the height of the window sill, both the upper and the lower structures were cut and displaced. Additionally, it appears that the east-west gable wall might have been severed from the north-south wall at some point and subsequently resettled, particularly noticeable towards the top section. In (#1) and (#2), where the chimneys are located, there is evidence of chimney breakage on the roof surface, and a broken chimney causing damage to the roof. In (#1) and (#2), the arches above the corridor were also cracked. The second floor of (#1) was particularly badly damaged, with the lime plaster of the arch falling and some of the brickwork collapsing. In addition, in (#4), part of the roof truss was detached, and some of the surrounding timbers were damaged.

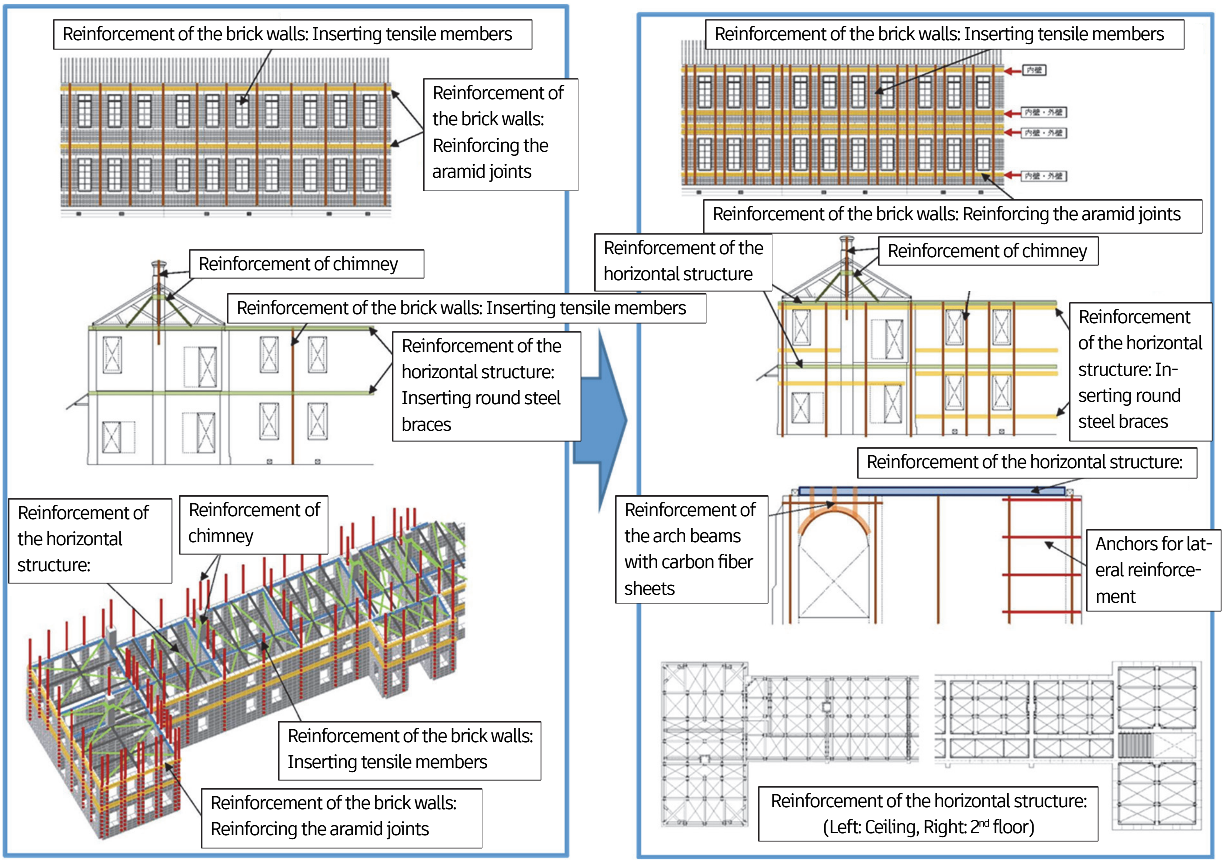

The experimental factory for mechanical engineering, displacement of the brick pillar


The experimental factory for mechanical engineering, steel reinforcement after the recovery

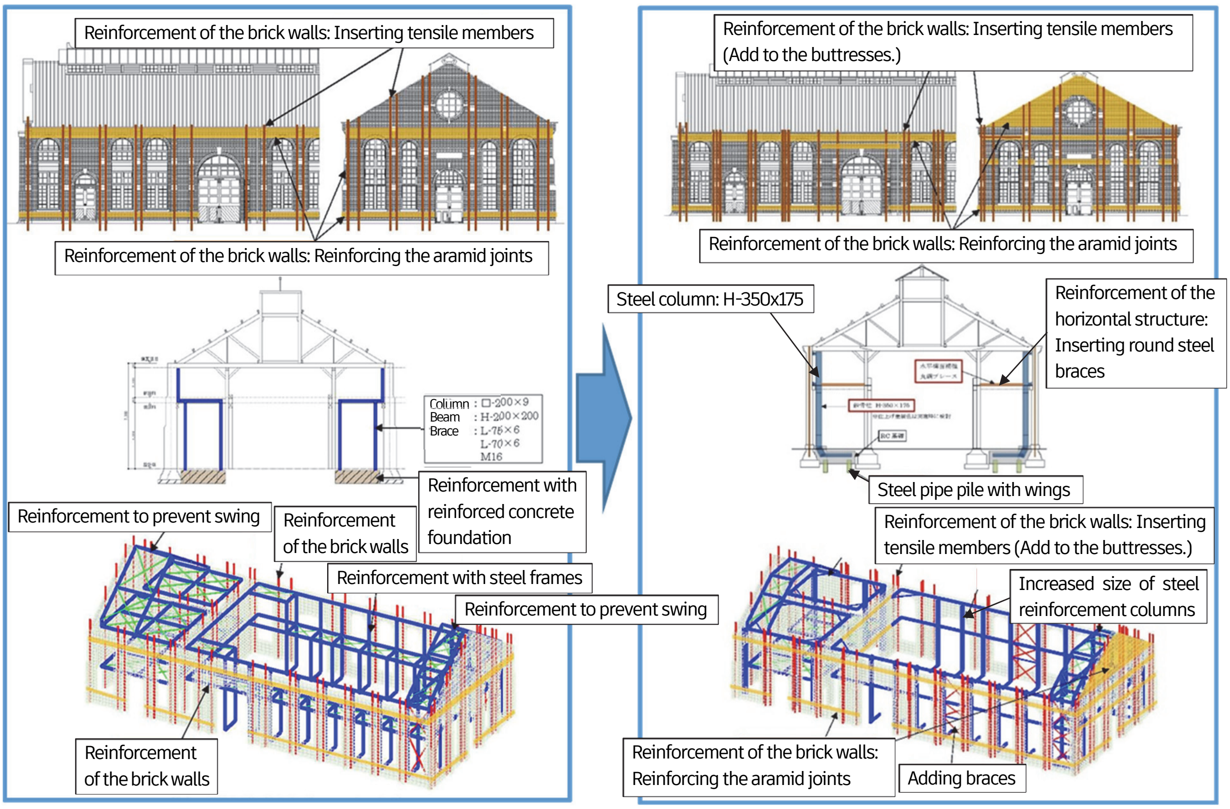
Completion of the restoration work: Fifth High School Main Building

Completion of the restoration work: the Experimental factory for mechanical engineering

After the damage caused by the Kumamoto Earthquake in April 14 and 16, 2016, emergency response work included chimney removal (November of the same year), temporary reinforcement of (#4) (completed in October 2017), temporary reinforcement of (#1) and (#2) (completed in March 2018), followed by permanent recovery of (#3) in March 2018, the same work on (#1) and (#2) in December 2021, and the same work on (#4) completed in February 2022. The policy for the recovery was basically to use the same materials and construction methods as the ones used before the disaster. In addition, structural reinforcement was applied to improve seismic resistance performance, as well as the soundness of the members. The brick frame was reinforced by inserting tensile members and reinforcing the aramid joints in all cases (#1)



Fifth High School Main Building (Left: Reinforcement plan before the Kumamoto earthquake, Right: Reinforcement plan based on the earthquake after the Kumamoto Earthquake)



Kumamoto University Faculty of Engineering, Former Fifth High School, the Experimental factory for mechanical engineering (Left: Reinforcement plan before the Kumamoto Earthquake, Right: Reinforcement plan based on the earthquake after the Kumamoto Earthquake)

through (#4), and the steel frame was reinforced in cases (#3) and (#4). As for reinforcement of the horizontal structure, ceiling bracing was installed in (#1), (#2), and (#4). Furthermore, reinforcements with tensile material insertion (horizontal direction) and carbon fiber sheets were used to increase the resistance capacity of the arch beams in (#1). As a result, although the steel frame was exposed at the rear of (#3) and inside of (#4), the interior and exterior appearance of the building as it was before the disaster was largely maintained.

The Ministry of Education, Culture, Sports, Science and Technology's disaster recovery project (subsidy for facility presentation) was used as the source of funds for the recovery work (other than the owner's own funds).

As a distinctive feature of the recovery work, in (#1), which is being rehabilitated as a museum, the cracks from the disaster damage survey and the old blackboard discovered during the survey were made a part of the exhibition. In (#4), the restoration of the small room on the west side of the building made it possible to understand the system of machine tool operation utilizing the boiler present within the building.

(Ryuichi Ito)

Tsujunkyo Bridge [Index Map no.37]

Yamato Town, Kamimashiki-gun, Kumamoto Prefecture

*National Important Cultural Property (structure) * To be designated as National Treasure in 2023.*

It is a single-arch stone masonry bridge built in 1854. The bridge is 84.0m long, 6.5m wide, and has an arch span of 27.3m. The voussoir is single-layered, and the wall stones are stacked in a scaled pattern. Three rows of stone gutters are embedded in the ground for approximately 100m before and

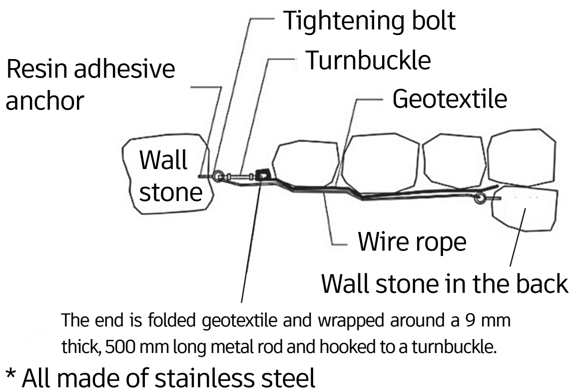
After the earthquake, leakage from the arch bridge

Collapsed stone wall due to heavy rain

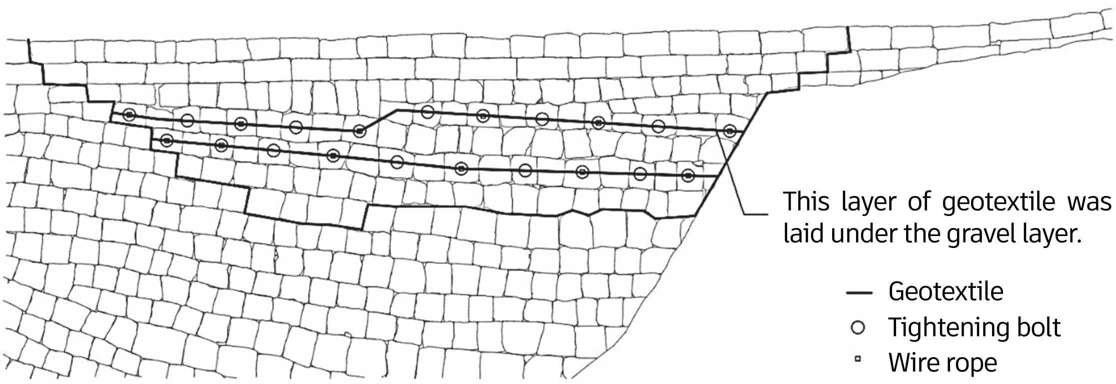
Tightening connections of the geotextile

after the bridge (one additional row of iron pipes is currently being installed). It is the largest stone masonry aqueduct in Japan with a beautiful shape based on concave curved surfaces.

Direct damages caused by the Kumamoto Earthquake included leakage of water due to lime plaster damage at the joints of the through-water stone ducts, cracks at the joints of the water intake and the water outlet, bulging of the handrail stones above the bridge wall stones, and ground cracks observed in the covering soil between the wall stones and the through-water duct. In addition, the inspection revealed cracks in a section of the red clay *tataki* tamping in the direction of the bridge axis along the wall stones, settling, and damage by Japanese termites to the wooden pipe (made of pine wood). Furthermore, just before the repairs were completed, the heaviest rainfall ever recorded in Yamato Town (39mm per hour) occurred on May 7, 2018 (Heisei 30), causing 93 of the wall stones and handrail stones on the upstream right bank to collapse. Some of the fallen stones were found to have surfaces chipped and peeled due to losses and



Cross-sectional view of geotextile



The diagram shows the scope of the geotextile installation

After the restoration: the completion ceremony of the Tsujunkyo Bridge (July 21, 2020)

3D survey of collapsed stones

cracks.

The policy and construction outline of the recovery is as follows. A government subsidy was used to finance the recovery work.

Stonewall re-stacking: Since the areas that were noticeably bulged by the post-earthquake shake had been recognized even before the earthquake, the two handrail stones on both upstream banks that were found to be displaced by a maximum of 10-15 cm were re-stacked.

Damage to the through-water stone duct: No leakage from the crack and no structural problems were observed, so only the current condition was recorded.

Cracks on the surface of the wall stone: No drastic change from the condition before the earthquake and no structural problems were observed, so the building is monitored.

Replacing joint lime plaster: Identified leakage points through water flow tests, and repointed the joints based on Tsujunkyo Bridge specifications and the Tsujunkyo District Land Improvement District's maintenance and management records.

Cracks and cavities in the red clay tampering: A new layer of red clay tampering was placed on top of a typical lime plaster laid flat in strips.

Wooden pipe: The damage was too severe to be repaired, so it was decided to replace it in accordance with the conventional method.

The basic scope of repair was to correct the bulging up to the early Meiji period when the reinforced stone wall was added. In order to prevent future displacement and collapse, geotextile was laid on the back of the wall and reinforced by bonding it to the wall stones with metal fittings.

Using a laser survey, UAV photography, and 3D survey with a gigapixel imaging system, the existing condition before and after the Kumamoto Earthquake was compared, then the extent of cracks, displacement condition of the stone walls and the bridge deck were quantified. A 3D survey of the stones that collapsed due to the heavy rain was conducted to simulate masonry, and the original locations of 92 out of the 93 stones in the wall were identified. Furthermore, after the construction was completed, interviews were conducted with the builders, experts, design and supervision staff, and the client to document the characteristics of the stone walls and backfill. The goal was to preserve and share their knowledge and experiences for future generations, creating an oral history archive.

Reference

Report on restoration Tsujunkyo Bridge, an important Cultural property designated by the National Government, 2020

*Figure courtesy of Lifelong Learning Division, Yamato Town Board of Education.

(Yasuhiro Honda)

Western School Teachers' Building (Janes' Residence) [Index Map no.26]

Kumamoto City, Kumamoto Prefecture

Prefectural Designated Important Cultural Property (building)

It was built in 1871 as a residence for Leroy Lansing Janes, who was invited from the U.S. to teach at the Kumamoto Western School, in the Furushiro district where the Kumamoto Prefectural First High School is now located. Janes lived in this building for five years until 1876 (9th year of Meiji). In 1877 (Meiji 10), during the Seinan War (1878), the building became the headquarters of lord Arisugawa, the governor-general of the conquest of Japan, and Tsunetami Sano received permission from lord Arisugawa to establish the benevolent society (the forerunner of the Japanese Red Cross Society). In 1894 (Meiji 27), the building was moved from the Furushiro area to the present Minamisendanbara, where the Kumamoto Prefectural Government Office was located at the time, and was used as a product store, a temporary school building for the Prefectural High School for Girls (present-day Daiichi Prefectural High School), and a camp during the Russo-Japanese War and WWI. In 1932, the building was moved to the premises of the Kumamoto branch of the Japan Red Cross in Suidocho, where it was used as the Japan Red Cross office and blood center. In 1970, the building was moved to the site of the old former zoo on the east side of Suizenji Joujuen and became open to the public as the Western School Teachers' Building (Memorial Hall). In the same year, it was designated tangible cultural property by the city, and the following year it was designated by the prefecture as important cultural property. The Kumamoto Earthquake collapsed the building, and in the course of its recovery, it was moved to a corner of the Suizenji Ezuko Park (Suizenji area).

The building is a two-story wooden construction with a hipped roof, and pantile roofing. The building footprint is 227.68 m^2, and the total floor

Damage from the foreshock (front)

Damage from the main shock (front) Totally collapsed

Before the earthquake (front)

After the completion of the restoration (front)


Construction progress photo (first floor)


Construction progress photo (the first-floor interior)


After the completion of the restoration (the first-floor interior)


Construction progress photo (interior)

area is 454.20 m^2 (first floor: 227.68 m^2, second floor: 226.52 m^2). It is the oldest Western-style building existing in Kumamoto Prefecture.

During the Kumamoto Earthquake, the foreshock (April 14) severely damaged the inner and outer walls (finished with lime plaster and stucco walls). It was then collapsed by the main shock (April 16).

Recovery Policy:

The restoration was based on reusing existing materials and following traditional specifications and construction methods as much as possible.

The exterior of the building was recovered using old photographs as a point of reference (including those taken during its initial construction).

In addition to restoring the building to its pre-disaster appearance, seismic reinforcement was performed. Reinforcement works encompassed several tasks, such as soil improvement under columns, implementation of a reinforced concrete mat slab foundation, installation of steel columns, steel and reinforced concrete reinforcement at the chimney. Additionally, reinforcement bracing was employed on the second floor along with horizontal brace structural reinforcement to prevent columns from bending and breaking. Joints were reinforced, and base stones underwent reinforcement measures as well.

Construction Summary:

Disaster recovery work (construction work, electrical equipment work, mechanical equipment work)

Construction period: From March 25, 2020 to August 31, 2022

Others:

In order to examine the restoration policy and details of the restoration, the "Examination Committee for the Preservation and Repair of the "Western School Teachers' Building, a prefectural-designated cultural property," convened during both the design and construction phases of the project.

As a source of funding for the restoration work (other than the city's own share), subsidies for disaster recovery of public social education facilities and Kumamoto Prefecture's subsidies for the preservation and utilization of cultural properties were utilized.

After the collapse, a tent was set up to protect all structural elements of the building from weathering, thanks to the cooperation of many people. This minimized the decay-related damage to components of cultural significance, consequently facilitating their reuse during the process of recovery and reconstruction.

(Motoko Kihara)

Miyayama Shrine [Index Map no.39]

(Main hall at the Hachio-sha Shrine, Worship Hall, Hall of Offerings, Amamiya Shrine)

Nishihara Village, Aso-gun, Kumamoto Prefecture

Nishihara Village Designated Tangible Cultural Properties

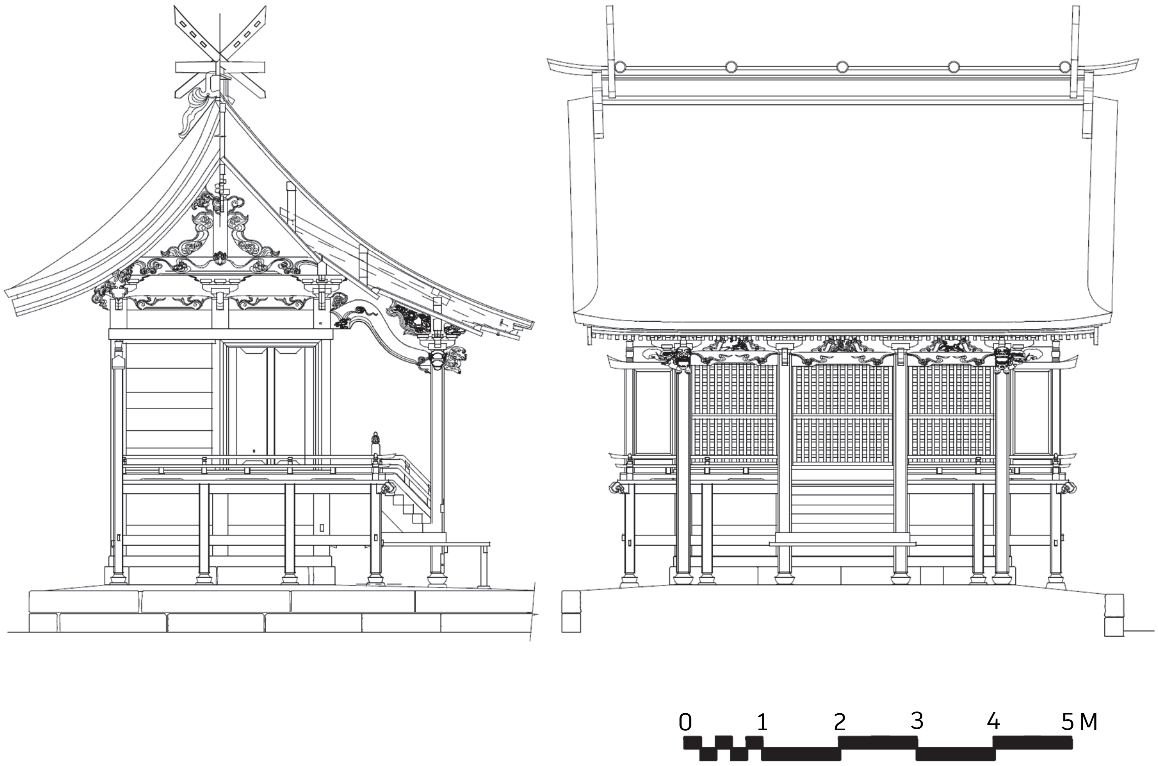
Miyayama Shrine is located in the Miyayama area of Nishihara Village. Hachio-sha Shrine, consisting of a main hall, a hall of offerings, and Worship Hall, and Amamiya Shrine are standing side by side, facing west, at the edge of deciduous forest at the end of a long line of cedar trees. It is said that Hachio-sha Shrine was previously located at a neighboring village in Futa area, but was moved and reconstructed in Miyayama in 1735 due to a torrential rainfall disaster, which was confirmed by a ridge tag.

The main shrine is a 3-ken wide *nagare-zukuri* style structure with a copper plate roofing. The front features *hajitomi* (half latticed shutters), while the sides are adorned with *ita-karado* (wooden shutters. The remaining sections are embellished with *yokoitabari* (horizontal wooden panels). The interior consists of a single room with an altar and three sanctuaries. The structure and the walls of decorated chamber have a clear and simple design, but the *kaerumata* frog-leg struts and *tabasami* bargeboards are intricately carved, exhibiting the flourishment of decorative shrine architecture of the region. The original thatched roofs were replaced with copper shingles in 1952, and the eaves on the gable side were extended by three rafter widths.

Damage right after the earthquake: Hachio-sha Shrine main frame

Reassembly in progress: Hachio-sha Shrine main hall

Exterior view of the main hall after recovery work



Elevation of the main hall of Hachio-sha Shrine: north (left) and west (right)

Nishihara Village was severely damaged by the Kumamoto Earthquake, as the epicenter of the earthquake was located along the Futagawa fault, which passed through the village. Although the damage due to age was relatively minor, the extensive distruction can be attributed to structural flaws resulting from the unstable foundation and platform construction method along with the 1952 roof alteration. The raised platform was structurally unstable, and many of the foundation stones toppled over, causing the shafts to become severely unbalanced. The frame of the roofed porch collapsed and the building center tilted sharply to the north. All three main posts on the north face were broken at the points where they intersected with the penetrating tie beams and were on the verge of collapse. In addition, the roof trusses were pushed up by the vertical shaking and shifted, and the eccentricity of the roof load exacerbated the damage condition. Worship Hall and Hall for Offerings suffered complete collapse.

The restoration plan determined that the main shrine of Hachio-sha Shrine, Worship Hall, and their foundation would undergo a full scale dismantlement and reassembly of original structures.

Dedication of Oni-Kami Kagura after restoration November 23, 2021

The main shrine foundation and platform were reinforced, and the framework was repaired without using excessive structural reinforcement to ensure that the members were firmly connected to each other, in accordance with traditional construction methods and specifications. Since the roof trusses were structurally deficient with huge cantilever beams, the truss was reconfigured with introduction of such structural elements such as *doi* girders, struts, and corner cantilevers. The reuse rate of the original wood was 80%. Amamiya Shrine was re-erected and partially repaired.

The project lasted from August 2019 to March 2021. In addition to the burden borne by the shrine parishioners, the Nishihara Village subsidy, the Kumamoto Prefecture Kumamoto Earthquake recovery and rehabilitation fund, combined with donations, financed the rehabilitation work.

Since this building was undesignated cultural property at the time of the disaster, the rushed administrative procedure was taken to designate it as village tangible cultural property. Thus the shrine was repaired with the village subsidy through Kumamoto Prefecture Kumamoto Earthquake recovery and rehabilitation fund. It is an example of how the burden on shrine parishioners could be greatly reduced in the wake of the earthquake.

The repair project was carried out by a repair committee, designed and supervised by cultural property building specialists, and executed by a local construction company.

It is noteworthy that the 1735 ridge tag has a section that was later artificially rubbed off, and that this section was related to Buddhism scripture. In the Edo period (1603-1867), when the syncretism of Shinto and Buddhism was the norm, a statue of Buddha was enshrined together with a Shinto deity. But it is said that after the Meiji government issued Buddhism abolishment order, the statue of Buddha was relocated and kept at a nearby temple. (The statue is now enshrined at Amamiya Shrine).

(Manabu Takeda)

Kaijo-ji Temple Hon-do and San-mon [Index Map no.43]

Mashiki Town, Kamimashiki-gun, Kumamoto Prefecture
Mashiki Town Designated Important Cultural Properties

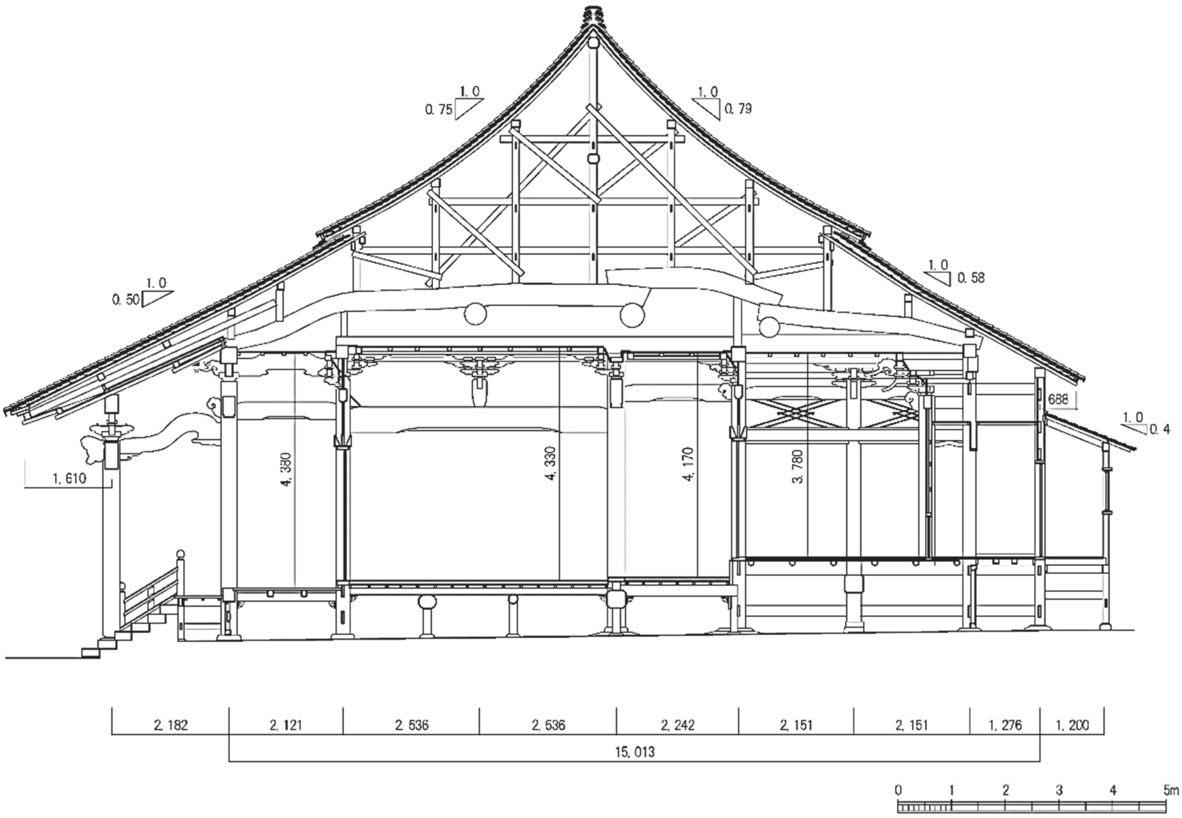
Kaijo-ji is a temple belonging to the Jodo Shinshu Otani-ha sect. Originally established as Jogen-ji Temple in 1659, it was renamed as Kaijo-ji Temple in 1709, to avoid confusion with the feudal lord's title. Surviving ridge plate building records indicate that a dedication ceremony for the temple's main building and gate was held in 1766. The present Hon-do or main hall and San-mon Gate, donated by the temple's priest's father, Kozaemon Yano, were built in 1818, and are still standing today.

The main hall is 6.5 ken (15.013 m) deep and 5 ken (12.334 m) wide. It features a hipped roof with *shikoro*, a two-tiered roofing, and a roofed porch adorned with shingle tiles. The inner sanctum, at the back center, is 2 ken deep and 3 ken wide, with *raigo* sacred columns, a *shumiden* and a sanctuary. The tana-butsudan (Buddhist altar) is located in the back of the side sanctum, which is a characteristic feature of the main hall layout found in Jodo Shinshu temples.

Except for the *raigo* columns in the core frame section, the round columns, with or without penetrating joineries, served as extending supports for the girders and beams above the ceiling. In contrast,

Before repair: Kaijo-ji, the main hall

Roof dismantlement in progress, Kaijo-ji the main hall, view from the northeast



Section after the recovery

the roof trusses supporting the roof were placed independently of the underlying framework, which was a distinctive feature of the latter half of the early modern period.

While the scale of the building may have been influenced by the Shrines and Temples Law during the Edo period, it also showcased the vibrant and ornately decorated chamber walls typical of the late Edo period. Despite the imposed restrictions, the temple incorporates an extensive use of cleverly crafted sculptural decorations.

Kaijoji Temple is located on the north side of the Futagawa fault line. This area is estimated to have fluctuated up to 1 m to the east and sunk up to 1 m or more after the earthquake. There were cracks right in the temple precinct, indicating that the building experienced significant shaking. Damages to the main building were mainly around the roofed porch and the *shikoro* roof tier. The roofed porch and columns were tilted forward. Around the *shikoro* roof tiers, rafter-ends were detached from the struts due to the failure of the intersecting purlins that either got crashed at the corners or broken in the area between the two roof tiers. In addition, the

After roof restoration, Kaijo-ji the main hall, view from the southwest

After roof restoration, Kaijo-ji the main hall and San-mon Gate, view from the southwest

pine wood, especially in the side girders, was severely damaged due to decay caused by rain leaks after the earthquake. The San-mon Gate lost the roof ridge. Furthermore, the cleats attached to the column legs were severely distorted.

Drafting of the implementation plan began in June 2018, and the repair work began in June 2019 and has been completed by the end of December 2021. The main hall was repaired with partial dismantlement and reassembly of original structures due to partial damage to most of its components, while the components of the roofed porch, mud walls, and failed roof tiles had already been removed during the emergency work. In principle, the building was restored to its pre-disaster appearance, but some modification were introduced in the restoration process, These included restoration of the outer sanctum and open veranda, replacement of aluminum sashes with wooden fixtures and fittings, and restoration of the pantiles of the main roof. Seismic reinforcement was also carried out. As a result of seismic reinforcement assessment, some of the walls were converted into seismic resistant walls using structural plywood. The horizontal structure was reinforced by connecting the girders with horizontal braces. In addition, the roof trusses were reinforced with braces to improve their rigidity. Penetrating tie beams and joints as well as cantilevered beams were also re-tightened and reinforced.

In addition to funds from the owners, etc., Mashiki Town subsidies and Kumamoto Prefecture's Kumamoto Earthquake recovery and rehabilitation fund were used to finance the rehabilitation work.

Since this building had not been designated at the time of the disaster, plans were made to rebuild it. The town managed to expedite the designation as a town-designated cultural property as a "historic building of the Kumamoto clan in the early 19th century." With the help of town subsidies and the Kumamoto Prefecture Kumamoto Earthquake recovery and rehabilitation fund, the repair work was steered into action. Kiyama Jingu Shrine and Joshinji San-mon Gate, temple gate in Mashiki Town were also repaired in similar manner.

(Takeru Suzuki)

Kiyama Jingu Shrine [Index Map no.44]

Mashiki Town, Kamimashiki-gun, Kumamoto Prefecture

Mashiki Town Designated Important Cultural Property

It is a one-story wooden construction building made by the traditional construction method. This three-bayed *nagarezukuri* style shrine has copper plate sheet roofing. The projections of eaves are supported by three-stepped brackets, and rafters consist of threelayers in the front and two layers in the back. It features frog-legged struts as intercolumnar central supports. The shrine has circular

West Front of the Shrine: Before restoration

Damage condition: fallen posts

columns at the sanctuary and the remaining columns are square. The structure comprises a foundation, waist-height tie-beams, above-window-height tie-beams, and penetrating tie-beams.

This shrine is located directly above the epicenter of the earthquake, the Futagawa fault. It was hit twice by seismic intensity scale 7 earthquakes on April 14 and 16, which collapsed all of the shrine buildings. Not only the shrine but most of the town was reduced to piles of rubble by these earthquakes. Roads and other structures exhibited wave-like distortions, and bridges over the river were in a miserable condition, with a maximum height difference of 1m due to upheaval and sinking.

During the foreshock, the main hall of the shrine experienced significant tilting but remained intact. However, it unfortunately collapsed during the main shock. In addition to the vertical movements, it swayed hard from east to west. The concrete foundation of shrine fence had several cracks, each approximately 15 cm in size, running in the north-south direction. However, no cracks were observed in the east-west direction. There were broken or sheared columns, penetrating tie beams, and penetrating extension brackets. The roof trusses and the eave's roof on brackets fell to the ground. The roof trusses were also sagging and unstable. The copper plate roof and its base were covered with blue tarps, which prevented further damage by rain to the components.

As it is a town-designated cultural property, the same type, method, and finish were used for the new supplemental materials, following the basic repair policy for cultural properties. The materials that could be reused were grafted or fletched. Where traditional construction methods had been replaced by conventional construction methods, the decision was made to revert back to the traditional construction methods.

The following seismic and structural reinforcements were made:

a. Installation of lattice reinforcement wall at axial section: 60x60-@120 lattice reinforcement walls of cypress are installed in the axial section under the floor and over the floor.

b. Coffered ceiling: board ceiling is built on top of the board and batten ceiling to increase horizontal surface rigidity.

c. Seismic rings: To improve longitudinal restorative capacity, 8 rings are to be installed on the 4 front and rear center columns and on the floor and foundation beams.

d. Ace line ropes: the columns were tied to the concrete foundations at six locations to prevent them from slipping and falling off the foundation stones.

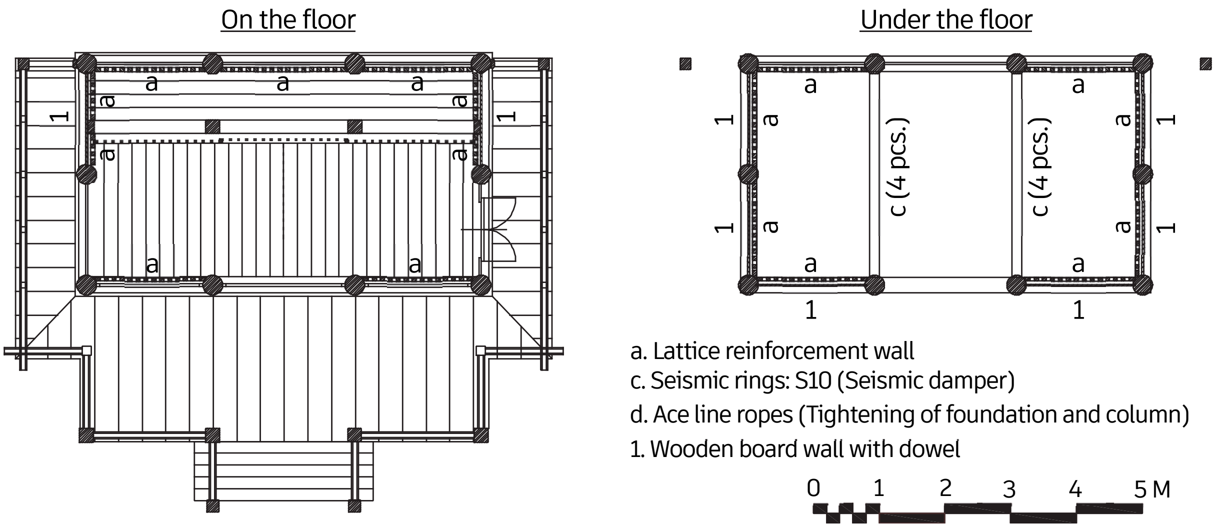
e. Installation of piles and concrete foundation: Since the site stands on soft ground, the 10 steel piles are to be installed up to 15 m below ground surface under the columns. RC footing foundations and underground beams are to be turned on top of the piles.

Funding for the recovery work is provided by Kumamoto Prefecture subsidy: 25% (Kumamoto Earthquake recovery and rehabilitation fund), Mashiki Town: 50% (town subsidy), and personal funds: 25%.

Although 12 shrines bordering the Futagawa fault line have been damaged by large-scale disasters such as the recent Kumamoto Earthquake,

West Front of the Shrine: After completion

Reinforcement latticed walls over the floor



Reinforcement outline plan

there are many shrines that cannot receive subsidies for restoration repairs due to their designation status. If they only use their own funds, they will not be able to make conservation repairs to the original state, and in general, it is unlikely that they will be repaired using traditional construction methods. The construction methods, culture, and customs that we wish to preserve for future generations are vanishing before our very eyes, often without our realization.

There is a shortage of highly skilled technical personnel (temple carpenters, general carpenters, plasterers, painters, and sheet metal workers) due to the aging of the workforce and a shortage of workers. There is an urgent need to train successors for each of these occupations. In addition to repair technicians, there is also a need to train managers of conservation repair work and architectural technicians, who are involved in surveying, design and supervision. We firmly believe that both ordinary carpenters and architects can excel in their respective roles by accumulating experience in traditional construction and repair of cultural properties.

(Nobuyoshi Yofu)

Yano Family Residence (Main House) [Index Map no.40]

Main building, Warehouse, Miso warehouse, Naya(barn), Front Gate, Rear Gate, Middle Gate

Nishihara Village, Aso-gun, Kumamoto Prefecture

National Registered Tangible Cultural Properties

The Yano Family Residence (Main House) was built in 1873, soon after the abolition of the feudal domain. The house retains the structure of the old domain residence of the local nobility. In addition to the main house, there is a miso warehouse, a naya (barn), a front gate, a rear gate, a middle gate, and a warehouse (rice warehouse) outside the middle gate. Seven of these buildings are nationally registered as National Registered Cultural Properties.

The main house has a complex plan with two stories, and has eight rooms including a *tatami* room, a second room, a room with a Buddhist altar, etc., and a space with an earthen floor. The *tatami* rooms are quipped with built-in desk and shelves called *shoin* along with decorative shelves. The *shoji* screen sliding doors are painted by a famous painter of the time. The main garden is located to the south of the *tatami* room and is surrounded by a bamboo fence, on which panel strip roof tiles are placed. The front gate and rear gate have panel strip roof tiles, indicating the dignity of the residence. The warehouse (rice warehouse) was built in 1886, and is a large building with a depth of 7.9 m and a width of 21.6 m, with a part that has two stories. The front gate, the rear gate, and the middle gate are all in the *yakuimon* style. These are all roofed with panel strip tiles unique to Kumamoto, whereas the main building, the rice warehouse, and the barn were roofed with regular panel strip tiles at the time of the earthquake.

Three cracks have emerged across the barn, the main building, and the warehouse extending broadly in east-west direction on the site, indicating that the building shook significantly in the north-south direction and that the ground shifted in the south direction. As a result, the frames have been dislodged from the foundation stones in many places. However, this displacement is primarily attributed to the shifting of the ground, rather than the frames themselves shifting. The roof of the main building had been reroofed and was mostly sound, but some of the walls had collapsed substantially and many fissures and cracks were also apparent. By and large, therefore, the damaged walls were not in sound condition. In the frame of the building, the posts are partially inclined, and there are many places where they deviate from their intended or designated positions. Cracks under the main building have caused the ground to shift in the north-south direction, causing the main living room *otoshigake* lintels and *kamoi* tie beams to fall out or come off. The warehouse had cracks running through the interior. The foundation stone and the frames were greatly displaced due to ground movement, and the beams were pushing the posts, which could have collapsed. The gates have roof tiles that have slipped off, and the front gate, which is a yakuimon style gate, leans heavily toward the front (west) side. The middle gate had been reinforced with bracing, so it fell over while maintaining its structure as a whole. It is interesting to note that the traditional construction, which does not bond building elements to the foundation stone, is more resistant to collapse.

The repair work began in the fall of 2017 with a subsidy from the Agency for Cultural Affairs, and was completed in February 2019. The main building was not repaired in a drastic manner, but rather under a partial repair policy. Posts that had tilted due to cracks in the ground were re-erected, some walls that had collapsed were repaired, the top coat of the tatami room walls was repaired, and fixtures and fittings were adjusted. The front gate had its

Damage to the warehouse

The ground crack in the barn

The displacement of the frame post and the foundation stone

columns rectified, walls repainted, and fixtures and fittings adjusted. The middle gate had fallen down, so it was rectified, and roof tiles were replaced. The rear gate was partially reroofed with no damage to the shaft. The barn had a large crack and the frames were so deformed that it was appropriate to repair it with partial dismantlement and reassembly of original structures, but the repair was only partial, and a wall was added for reinforcement. The miso


Collapsed middle gate


Collapsed living room interior wall of the main building


The middle gate and the eastern fence: after restoration


The receiving room of the main building: after restoration

warehouse was reroofed and the exterior lime plaster together with *namako* walls were maintained. The rice warehouse needed to be repaired with full-scale dismantlement and reassembly of original structures due to ground displacement caused by a small fault, but it was dismantled and stored due to the huge cost.

In addition to the owner's own funds, the Kumamoto Earthquake recovery and rehabilitation fund was used to finance the restoration work. The Agency for Cultural Affairs subsidy was used for design plan and supervision, and the Kumamoto Earthquake rehabilitation fund was used for construction.

A dismantling survey of the rice warehouse revealed that a ridge tag was found, indicating that it was built in 1886. Both Japanese and Western nails were used in this warehouse, indicating the spread of imported Western nails in the region around that time. Plans are underway to rehabilitate the dismantled storehouse and to revive the structure to be used as part of the village development.

(Kazuyuki Yano)

Yano Family Residence (Branch House) Main Building [Index Map no.41]

Nishihara Village, Aso-gun, Kumamoto Prefecture
National Registered Tangible Cultural Property

It is a two-story house of partially wooden construction, with a pan tiled roof, built in 1929 by

Kazuma Yano, the mayor of the former Kawahara Village at that time. It is characterized by a floor plan that seeks to make a living slightly more comfortable than the traditional arrangement, with the front room, entrance, and a room with a Buddhist altar facing north and the living area facing south. The reception room is decorated with a built-in desk or *shoin*, a raised alcove with polished log central pillar and staggered decorative shelves, but the structure is rather simple. The roof truss is designed in Japanese style, and the frames predominantly utilize *sashikamoi* or tenoned structural beams.

The roof was in extremely good condition, with only some damage to the ridge, as the roof had been replaced prior to the earthquake. The frames were in a sound condition, although the building had returned to its original position at the second earthquake, indicating the severe displacement during the foreshock. Partial collapse, cracks, and peeling of the lime plaster overlay were observed on the walls, and the stairway to the second floor was displaced to the west.

It is noteworthy that this building remained mostly sound, even though the perimeter of the structure was quite open and without so-called seismic elements, as is in the case with many other traditional Japanese residential buildings. This can be attributed to the absence of significant soil-structure deformation and the extensive use of *sashikamoi* lintels, which likely contributed to the structural balance of the building.

Repairs began in March 2018 and included repair of damaged roof sections and reinforcement of collapsed wall sections with structural plywood. Fixtures and fittings such as *fusuma* screen sliding doors, *shoji* sliding doors, and glass doors were repaired. Since frosted glass was not manufactured, it was converted from another building and used. The walls were lime plastered in light grey tone on the interior and dark grey tone on the exterior, with a dark green sand-slip finish in the reception room area. Since there was almost no deformation of the frames, no major structural reinforcement was performed. After the construction was completed in September of the same year, the lighting, kitchen, and air-conditioning systems were rehabilitated, which is not the work eligible for public financial assistance.

Exterior of the building after the earthquake

Interior of the building after the earthquake

Interior of the building after the earthquake (collapsed wall top coat)

In addition to the owner's own funds, the Rehabilitation Fund for Cultural Properties Damaged by the 2016 Kumamoto Earthquake was used to finance the restoration work.

The structural posts that are laid simply on the foundation stones survived with no damage to the joints, and the original shape was almost kept intact. The well-balanced traditional wooden structure was found to be earthquake-resistant. The subsidy eligible for the design and supervision for the registered cultural property was considered,


Overall view after completion of restoration work


Repair of the alcove area after the restoration

but was not used because the client's relative was the chief engineer for the repair of cultural property buildings.

The barn, which was not registered, was a two-story building with cement tile roofing and lightweight shingle walls, but was intact despite the lack of earthquake-resistant elements.

(Kazuyuki Yano)

PS Orangerie (PS Kumamoto Center) [Index Map no.27]

Chuo Ward, Kumamoto City, Kumamoto Prefecture

National Registered Tangible Cultural Property

This building was built in 1919 as the Kumamoto Branch of the former Daiichi Bank, and was registered as National Registered Tangible Cultural Property in 1998. It has an ntegrated structure with unreinforced brick masonry exterior and reinforced concrete ramen structure interior. The roof slab is also made of reinforced concrete. The building has two stories above ground and one below. It is supported by a combination of brick and reinforced concrete (RC) foundations with the addition of piles for further support. Located beside the Tsuboigawa River in Furumachi area, a historical district of Kumamoto City, the building was renowned for its architectural style, often referred to as "liberal Taisho architecture" because of its welcoming atmosphere, created by a sequence of graceful arches. The building was once about to be demolished in the late 1990s, but after the preservation movement, PS and Co. acquired ownership of the building, and now use it as a sales office and laboratory.

The Kumamoto Earthquake caused cracks in the brick walls. The cracks were mainly around the openings and corner edges. One notable characteristic of masonry constructions during earthquakes is the deformation of the wall corners, and cracks were observed in this building as a result of such deformation. Shear cracks were also observed on the interior lime plaster walls. No uneven settlement or residual displacement of the building structure was observed. As for damage to non-structural elements, a portion of the wooden board ceiling fell. The exterior walls were finished with cement tiles in the Taisho era, which were peeling from the wall surfaces.


Overall view of the building

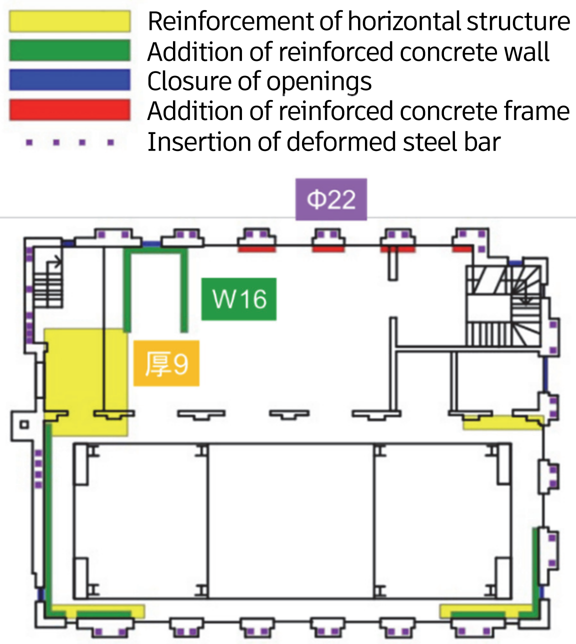
Damage to the wall

Damage situation

Because of its valuable architectural heritage in terms of history and design, and the owner's passion for the building, it was decided to preserve and restore the building and continue to use it without dismantlement. A committee including the owner, designers, conservation project managers, restoration experts, and structural engineers was formed and met regularly to formulate a conservation repair plan with seismic reinforcement work to be carried out. The preliminary investigation began in November 2016. Starting from the beginning of 2017, surveys and diagnostics were conducted in parallel with the drafting of conservation plan. In accordance with the plan, the actual repair work began in October 2018 and was completed in September 2019. Seismic assessments were conducted using the Hokkaido Architectural Technologies Association's (JBDPA) criteria, which were adapted from the Japan Building Disaster Prevention Association's (JBDPA) criteria for seismic assessments of existing reinforced concrete buildings. Since the seismic safety index value was much lower than the target value without reinforcement, it was decided

Insertion of deformed steel bars into brick wall

Reinforcement of horizontal structure in catwalk area



Structural reinforcement outline plan

to implement seismic reinforcement. Here, the concept of "transitional reinforcement" was introduced, and a seismic reinforcement design was proposed to meet the 0.6 safety index value required by the Building Standards Act, with a target of 70% of that value. This is because the existing standard is made for reinforced concrete constructions and does not take into account the structural characteristics of brick constructions, and it is anticipated, that a reasonable evaluation method for seismic reinforcement of brick constructions will be developed in the future. Moreover, implementing the proposed reinforcement design to meet the current code requirements would have a significant impact on the interior spaces and would compromise the historical and design values of the building. Therefore, the decision to set a lower target was made with the agreement of the owners. For earthquake-resistant reinforcement, the foundation structure was reinforced, deformed steel bars were inserted into the brick walls, minimal opening closure and concrete reinforcement methods were employed, and the horizontal structure of the catwalk area was solidified.

In addition to the owner's own funds, the restoration work was rehabilitated with funds from the Subsidy Project for the Recovery and Installation of Facilities for Groups of Small and Medium-sized Enterprises (SMEs), etc., the Subsidy for Conservation and Rehabilitation of National Treasures and Important Cultural Properties, the World Monument

After restoration view

Foundation, the Kumamoto Prefecture Subsidy for Conservation and Rehabilitation of Cultural Properties, Rehabilitation Fund for Cultural Properties Damaged by the 2016 Kumamoto Earthquake, and the Kumamoto City Subsidy for Conservation of Cultural Properties.

One of the distinctive efforts in the recovery work, as mentioned earlier, was the introduction of the concept of "transitional reinforcement" and decision-making by an interdisciplinary team consisting of the owner, project officials, and experts, which was also documented in the process. The team also obtained academically valuable data such as constant microtremor measurements, earthquake observations, and monitoring of crack displacement before and after the retrofit project.

(Toshikazu Hanazato)

The Nio-mon Gate of the Honmyoji Temple [Index Map no.28]

Nishi Ward, Kumamoto City, Kumamoto Prefecture

National Registered Tangible Cultural Property

Designed by Koichi Inoue of the Kobayashi Clan, construction of this reinforced concrete tower gate began in 1919, and its completion ceremony was held in 1920. It is a one-story structure with a 13.21 meter long girder and a 6.36 meter long beam, a 15.07 meter high ridge, and 8.60 meter high eaves. The front of this eight-legged gate is 3-ken long, and the back measures 2-ken. The gate is characterized by its symmetrical shape in both the plan and elevation with cylindrical columns. The arched beams, elbows, rafters, front emblem (called a "hanging fish"), decorative demon tiles, and box ridges are all made of reinforced concrete following traditional designs. There are two walls on each side of the gate, and there are no doors inside the gate. Two Nio statues (temple guardians) and two lion statues, one with its mouth open and the other with its mouth closed (a traditional representation of the sacred Buddhist sound "aum") are placed on either side of the gate for visitors to pass by. The

Front (east side) at the time of the disaster

Damage to the column head, intermediate beam, and elbow section (east side: south side)

Damage near column bases (columns in the northwest corner)

Underground conditions around the column bases (columns in the northwest corner) (Photo courtesy of Mariko Nishijima)

roof is gabled with cusped gable eaves on the front and back. Regarding its foundation, an excavation survey conducted in June 2017 about 1 meter below the earthen floor revealed no underground beams, and the piles and columns appeared to be directly connected. An excavation conducted during foundation work for post-earthquake recovery revealed an approximately 1.3 m square, 30 cm thick concrete footing about 1.4 m below the ground level (GL) of each column. Underneath, early cast-in-place concrete piles, which appeared to be compressor piles, were discovered.

The Kumamoto Earthquake occurred twice in Kumamoto City at 21:26 on April 14 and 1:25 on April 16, 2016. A visual survey conducted in May of the same year revealed (1) bending cracks near the joints between the columns and intermediate beams, (2) detached elbow joints, (3) damage near the bases of the columns, and (4) shear cracks, confirmed on both gable side walls. Subsequent detailed visual inspections in 2018 and 2020 revealed deterioration, concrete loss, and cracks over 0.2 mm wide. Cracks were especially noted around GL+5600mm, and many of them were over 2.0 mm wide, found at the joints between columns and beams. In addition to these cracks, large sectional explosions and defects were observed in the beams, and some of the rebar was exposed.

In order to recover this building and preserve it for future generations, a retrofitting plan was examined based on the following policies:

(1) Deterioration repair and seismic retrofit should be conducted while maintaining the current conditions as much as possible, and the original materials should be preserved to the extent possible. (2) If preserving the current form is difficult, retrofitting would be considered in a way that the

Underground conditions (column bases, footings, cast-in-place piles, additional steel pipe piles)

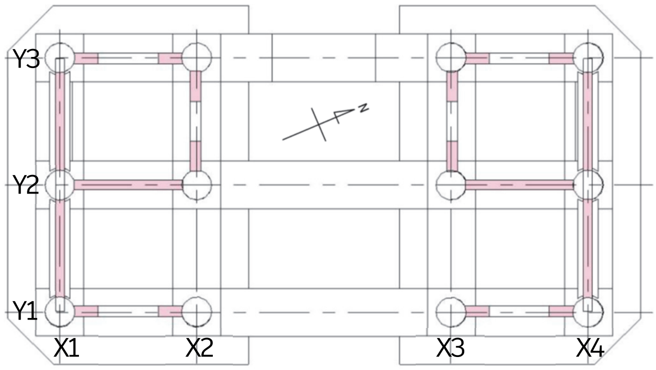
Disc shear key to join the columns to additional footings (Photo courtesy of Den Arch.& Eng. Office)

Reinforcing steel bars in the footings and piles driven in place directly under the footings

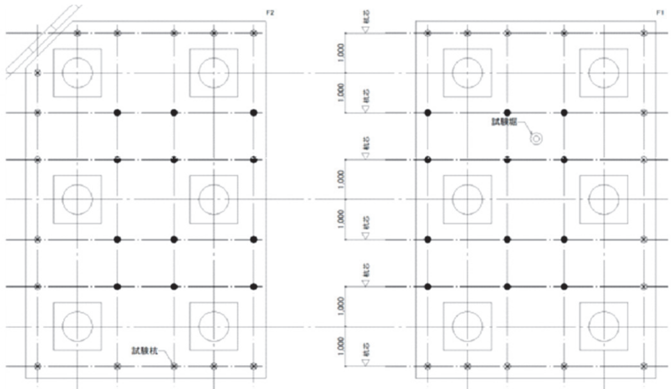
Reinforced concrete beam installed in the attic space (Photo courtesy of Den Arch.& Eng. Office)

cultural property value of the building can be passed on as much as possible.

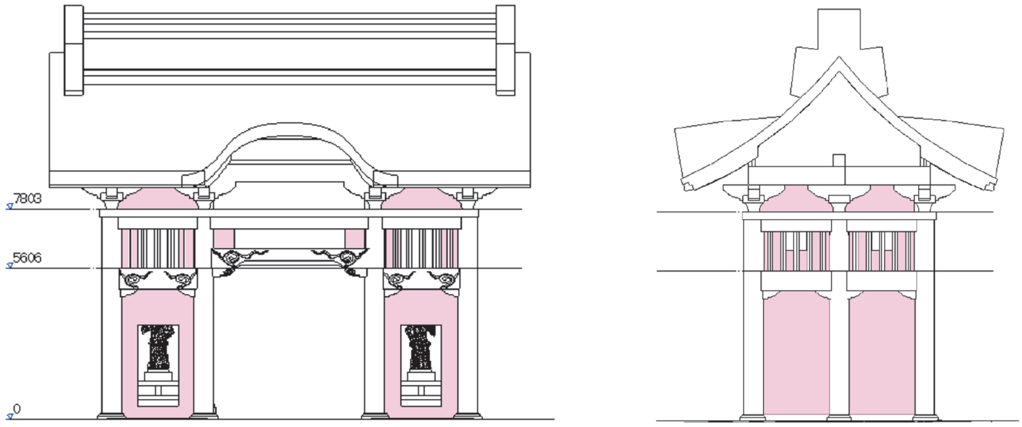
After reviewing the results of the seismic assessment of the building and the seismic ret-rofit plan, reinforcement and maintenance work was carried out on the building frame, focusing on the changes described on the layout shown on the right. [Gable side: south and north] [Flat side: east and west] Reinforced concrete walls were added to the upper part of the beams (with some openings). [Center, X direction] Reinforced concrete walls were added between Y2 and Y3 on X2 and X3 lines (with partial openings). [Center, Y direction] Reinforced concrete walls were added between X1 and X2 and between X3 and X4 on Y2 lines. [Ceiling SL floor] Reinforced concrete beams were added on X2, X3, and Y2 lines. [Foundation] 53 steel pipe piles were added. Re-inforced concrete footings were added to the gate, surrounding 6 columns on each side of the gate.



Layout of the added RC wall (first floor, subfloor plan) (Prepared by Den Arch.& Eng. Office)



Layout of the added RC footings and steel pipe piles (Prepared by Den Arch.& Eng. Office)



Elevation of the final reinforcement proposal (left: flat side (east side), right: gable side) (Prepared by Den Arch.& Eng. Office)

To finance these restoration works, subsidies were provided by the Restoration and Rehabilitation Project for Cultural Properties Damaged by the 2016 Kumamoto Earthquake.

The concrete in this building had undergone considerable neutralization, but since neutralization maintenance is costly, measures were taken to prevent the neutralization from progressing further in the surface finish construction. Although the building was found to be tilted during the field survey, the tilting was not determined to be severe enough to require correction, so the plan was not to correct this inclination. Regarding the piles, since no major settlement occurred after the Kumamoto Earthquake as well as following other past earthquakes, the existing piles were thought to have reached the bearing layer. The plan was to add many small-diameter steel pipe piles to gently grip the area.

(Kentaro Yamaguchi)

Kawashiri Community Hall [Index Map no.29]

Minami Ward, Kumamoto City, Kumamoto Prefecture
Kumamoto City Structure that Composes Historical Scenic Beauty

The building was donated by a local sake brewing company, Zuiyo, in 1931 for the promotion of Kawashiri. In the past, there existed many community halls across the country, but this is said to be the oldest existing wooden constructed community hall in Japan. Later, it was donated to Kumamoto City, and its utilization rate by the locals was very high, with activities taking place on 280 days out of a year.

A seismic assessment in 2013 revealed that the building had a low IW score of 0.17 (a score of 1 or higher is considered to have seismic performance equivalent to the current seismic standard level), so the seismic retrofit plan was ordered. Just prior to the seismic retrofit, the building was damaged by the earthquake of seismic intensity scale 6. barely escaping collapse due to the structural damage in one of its 200 columns. Most of the mud

Overall view after the earthquake (the building was not so rigid that the shaking did not dislodge the foundation strut stones)

walls fell, but they were among the elements that were expected to be repaired. The outer columns were on strut foundations, but their low rigidity paid off: they shook so much that they did not displace from the underfoot, and no columns were stepped off. Instead, the walls, fixtures and fittings were severely damaged.

Considering that the building did not collapse even at a horizontal deformation angle of 1/12 radian due to the earthquake, the safety limit criterion was set at 1/15 radian. The community hall has a truss roof structure with a traditional cogged joint between the girder and the roof truss. Since the load was concentrated at the ends, earthquake-resistant walls were not necessary in the center. Therefore, the 80-mat and two 10-mat *tatami* rooms were left without seismic reinforcement, and lattice transoms with small seismic reinforcements were placed in the corridor section. When the paper sliding doors are closed, the reinforcements are not visible and the building looks as it did in the past.

The recovery work was fully financed by the city of Kumamoto, as it had been donated to the city on condition that no other community center would be built in the Kawashiri area in Kumamoto City.

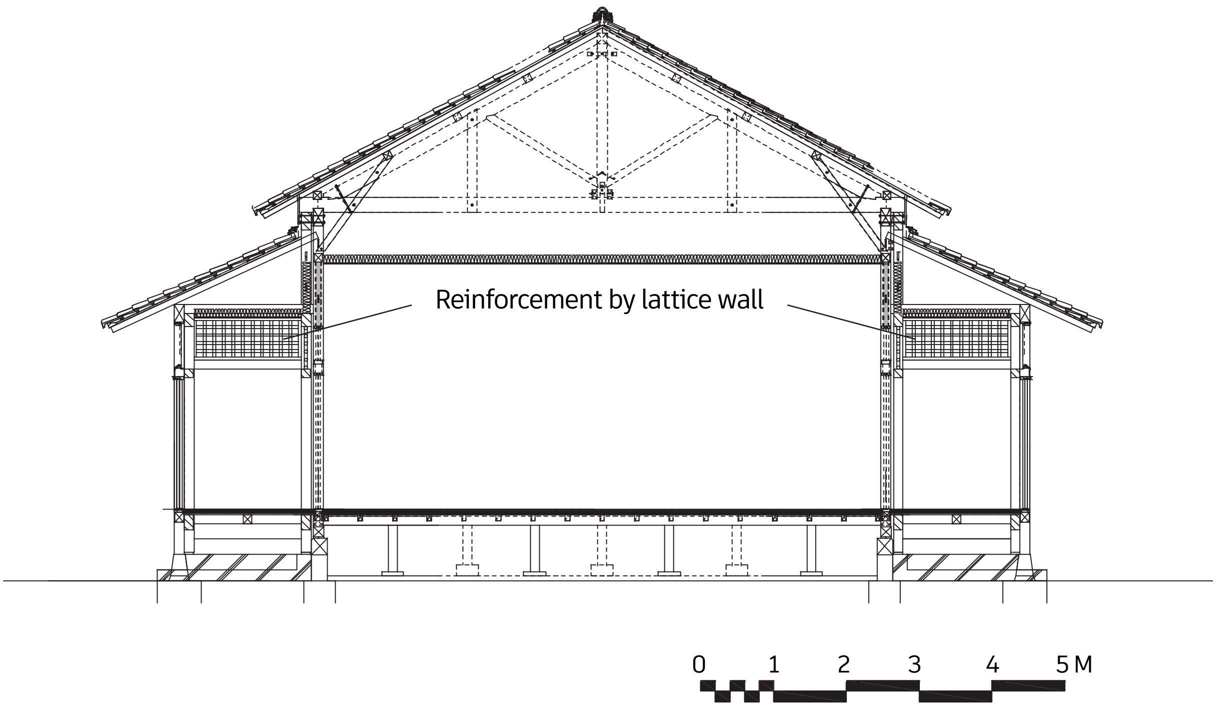
The traditional construction method is characterized by the fact that the damage situation and repair methods can be grasped visibly, and repair

Estimated to have shaken up to 1/12 radian based on residual deformation of the shoji

plans are fairly easy to formulate. If repair methods are unknown after damage, and if a public assistance system that waives the cost of dismantling is issued, many people will like to dismantle their damaged houses. This is the biggest problem.

The following is a summary of observations throughout the recovery process.

(1) In the alluvial plain, an earthquake of seismic intensity scale 6 will cause widespread liquefaction. Reinforcing foundations, ground reinforcement, and pile installation after an earthquake is too costly. It is advisable to separate the foun-



Outline of seismic reinforcement plan

Reinforcement by lattice wall (Add lattice grid at the top opening section. The footing is rigid and takes up a lot of strength.)

dation from the building, allow for a certain degree of settlement, and construct a simple plan for raising the building.

(2) Three sides of the building have full-opening glass doors, which were equipped with storm doors. It is difficult for a single management person to maintain opening and closing the storm doors every day. If the glass pane of the glass doors is thickened and divided into small

Overall view after restoration

sections, even if the glass is damaged by a typhoon, the damage will be limited and can be easily handled by non-professionals with the use of boards, etc.

(3) Long eaves. The underfloor is high. Low air tightness, including attic space. These are the reason for the longevity of the house. Conversely, insulation performance is low. However, the time of use is fragmented, so the energy use cost performance is not the priority in this case.

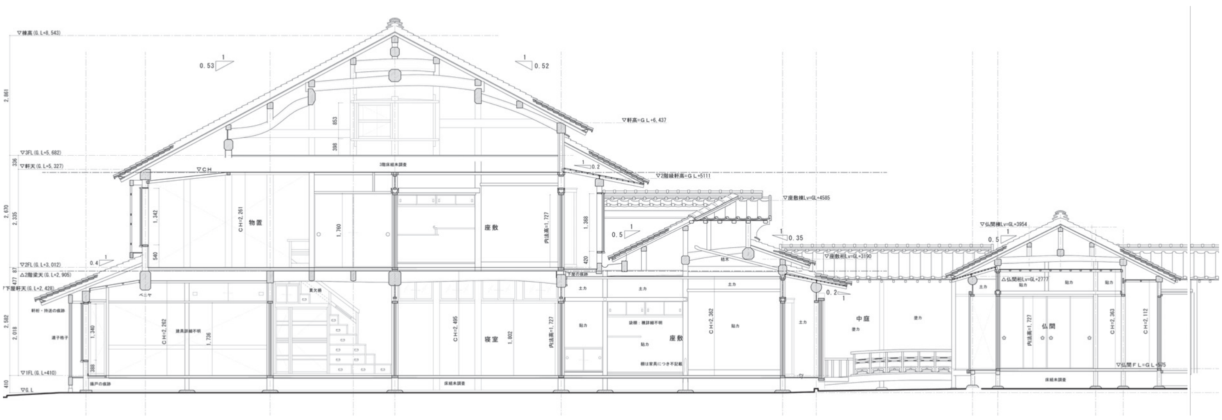
(Tamotsu Furukawa)

Kiyonaga Honten (Main Store) [Index Map no.30]

Chuo Ward, Kumamoto City, Kumamoto Prefecture

Undesignated Cultural Properties

The Kiyonaga family has been a merchant family dealing mainly in household goods since the Horeki era (1760s). Itaro Kiyonaga (the 5th generation), the great-grandfather of Yukio Kiyonaga (the 8th generation), and the head of the family at the time, built this building in 1878. The building is a large two-story wooden construction with a tiled roof, with a frontage that spans 11 ken wide by 15



Section: Kiyonaga Honten, main building

ken deep. In addition to the main building, which includes a shop, a receiving area, a tatami room, and a room with a Buddhist altar, there is a three-story front storehouse and a two-story *mukoukura* (a storehouse in the back).

Kiyonaga Honten, or the main store, is located near the western edge of Nishi-Tojinmachi, directly in front of the Shin 3-chome Bridge (later known as Meihachi Bridge) when crossing it from Shinmachi to the south. The street in front of the shop building is the old Satsuma Street, which crosses the Choroku Bridge at the Shirakawa River from the Satsuma direction and proceeds west to Furukawa--machi, Kajiya-machi, Naka-Tojinmachi, Nishi-Tojinmachi, crossing the Shin 3-chome Bridge over the Tsuboigawa River in front of Kiyonaga Honten, passing through Shin 3-chome gate and entering Shin 3-chome, then proceeding north to Shin 2-chome and Shin 1-chome, and entering Kumamoto Castle through the Shin 1-chome gate. Thus, Kiyonaga Honten is located at a strategic point in the castle town.

Immediately after the Kumamoto Earthquake, by visual inspection of the exterior conducted by the Post-Earthquake Temporary Risk Evaluation Rating gave the building a rating of "Red," and the disaster certificate stated "complete destruction". In addition to the roof tiles and mud walls breaking, the 4-ken wide building on the west side (tenement house), which was built in 1877 and later purchased by the Kiyonagas, was also in great danger of collapsing as columns were tilted and beams were missing. The fallen roof tiles caused severe leaks, and on the day after the rain stopped the roof was covered with plastic sheets, replacing the protecting sheets while the mud walls continued to crumble. Water was pumped out of the water collection vats installed.

The building has been used as a residence rather than a store, and the Kiyonaga family temporarily moved to a rental apartment complex one block away as post-disaster "temporary housing".

For the recovery process, upon confirming the Kiyonaga family's determination to keep living in the house, the following policies were laid out:

1. Complying with the construction cost limit: during the one-and-a-half years of deliberations from the earthquake up until December 2017, the main reason for deciding to dismantle the building was the steep recovery cost, which was too large to bear as an owner even with the support of a subsidy.
2. Dismantling and reassembling the areas at risk: the tenement house and the stone field (washing area) were in an extremely fragile state and on the verge of collapse, and it was difficult to start the construction without dismantling these areas.
3. Maintaining the building habitable
4. Maintaining and improving the cultural values: (1) Preserving the configuration plan of the main building (2) Preserving the front and back storehouses (3) Preserving the façade landscape.

Damage to the main roof

Damage to the reception room in the first floor

The restoration work was financed by (1) a group subsidy [approximately 40 million yen], (2) a Rehabilitation Fund for Cultural Properties Damaged by the 2016 Kumamoto Earthquake [approximately 25 million yen], and (3) financial recovery support from the WMF (World Monuments Fund [approximately 10 million yen]).

The Kumamoto Machinami Trust served as the secretariat of the "Liaison Council of Owners of Damaged Cultural Heritage," formed by 34 owners and managers of undesignated cultural properties in the Shinmachi-Furumachi area and Kawashiri

After completing the restoration of the main roof

After completing the restoration of the reception room in the first floor

area. The head of Kiyonaga Honten was appointed as the Council's chairman. The Council worked together to request the creation of public subsidies and support for subsidy applications. In August 2017, more than a year after the earthquake, the activities of the Council shifted from the Council as a whole to the Kiyonaga Honten Subcommittee. At the 15th subcommittee meeting at the end of 2017, the Kiyonaga family decided to retrofit the damaged house and continue living in it and withdrew the "publicly funded demolition" plan request. Since then, committee meetings have continued every week until the 121st meeting on March 31, 2020, after the construction was completed.

(Kazuhiro Fujikawa)

Damage to the alley side wall (left) and after restoration was completed (right)

Yoshida Shoka-do [Index Map no.31]

Chuo Ward, Kumamoto City, Kumamoto Prefecture
Kumamoto City Structures of Landscape Importance

Junseki Yoshida (first generation), who had studied medicine on Dejima Island in Nagasaki, was unable to return to his hometown of Isahaya due to the so-called Siebold Incident (1828), so he opened a business in Kumamoto. He established a base of operations in the Shinsaiku Town of the Kumamoto Castle area, where he manufactured and successfully sold an herbal medicine called "Shodoku Keshigan" (諸毒消丸). During the Meiji and Taisho periods, the product was distributed throughout the country, creating enormous wealth, and the Yoshida family rose to prominence in Kumamoto. The Yoshida family's mansion became a hallmark of the Kumamoto Castle area, and was repeatedly extended and altered every time it was used to lodge the royal family and other government officials. Today, the medicinal manufacturing methods used at the time of its founding are still practiced. Since these methods were confidential, Yoshida Shoka-do did not offer public access to the interior of his residence. The family continues their solid devotion to their core business, and as a result, the building has secretly maintained its original form for more than 140 years, despite its location in the center of Kumamoto City, where land prices are high.

The south side of the site is occupied by a circular garden with a hill. The two-story main building (beam length: 8.5 ken, girder length: 8 ken) is located on the north side, and is flanked to the east by a reception space with a 15 *tatami* mats room, a study room, and tea ceremony room, and to the west by a pharmaceutical building and a storehouse. A fence that is 3 meters high surrounds these buildings.

The appearance of the mansion before the Seinan War is unclear. It is highly likely that the mansion burned down during the war, as most of the urban area was destroyed by fires at the time. According to the building tags, the current main building was constructed in 1878, one year after the Seinan War, the storehouse was built in 1880, and the tea ceremony room in 1896. The building reached its present form by 1906, when it was converted into the Fushimi-no-Miya residence.

The Kumamoto Earthquake caused damage to the main building and all other constructions, but none of them collapsed. Indeed, the buildings remained mostly intact after the earthquake, with the exception of the "outer sitting room," which suffered accidental partial destruction during the dismantling of a neighboring house. Most of the damage was caused by collapsed roof tiles and lime plaster walls as well as tilted buildings due to the deformed shafts, fixtures, fittings, and crushed parts that were damaged by ants. The subsequent rainfalls caused leaks that facilitated widespread mold growth, progressively damaging houses and household goods. At that point, the damage was within the range of possible conservation if viewed on a building-by-building basis. However, when viewed on a 13-building basis, the required cost and energy were expected to be enormous, and the owners considered dismantling the houses, only leaving some parts standing.

Regardless, restoration works have begun, supported by the strong desire of the current family head to preserve the building in some way, the voices of local residents who are familiar with this local hallmark, and the local government. However, since it had been closed to the public for a long time, there was little data on the building, so a survey map project was established with the cooperation

Front side (September 2017)

Record of the conditions prior to the roof removal (main building, south shed)

The warehouse (south side) immediately after the Kumamoto Earthquake

Restoration of the main ridge (main building) using the original "*noshi*" roof tiles

Installed cedar plank earthquake-reinforced walls (left side of the board door)

Tea ceremony room ridge and garden

Additional cedar plank earthquake-reinforced walls in the study room

The 15 tatami mats room awaiting conservation

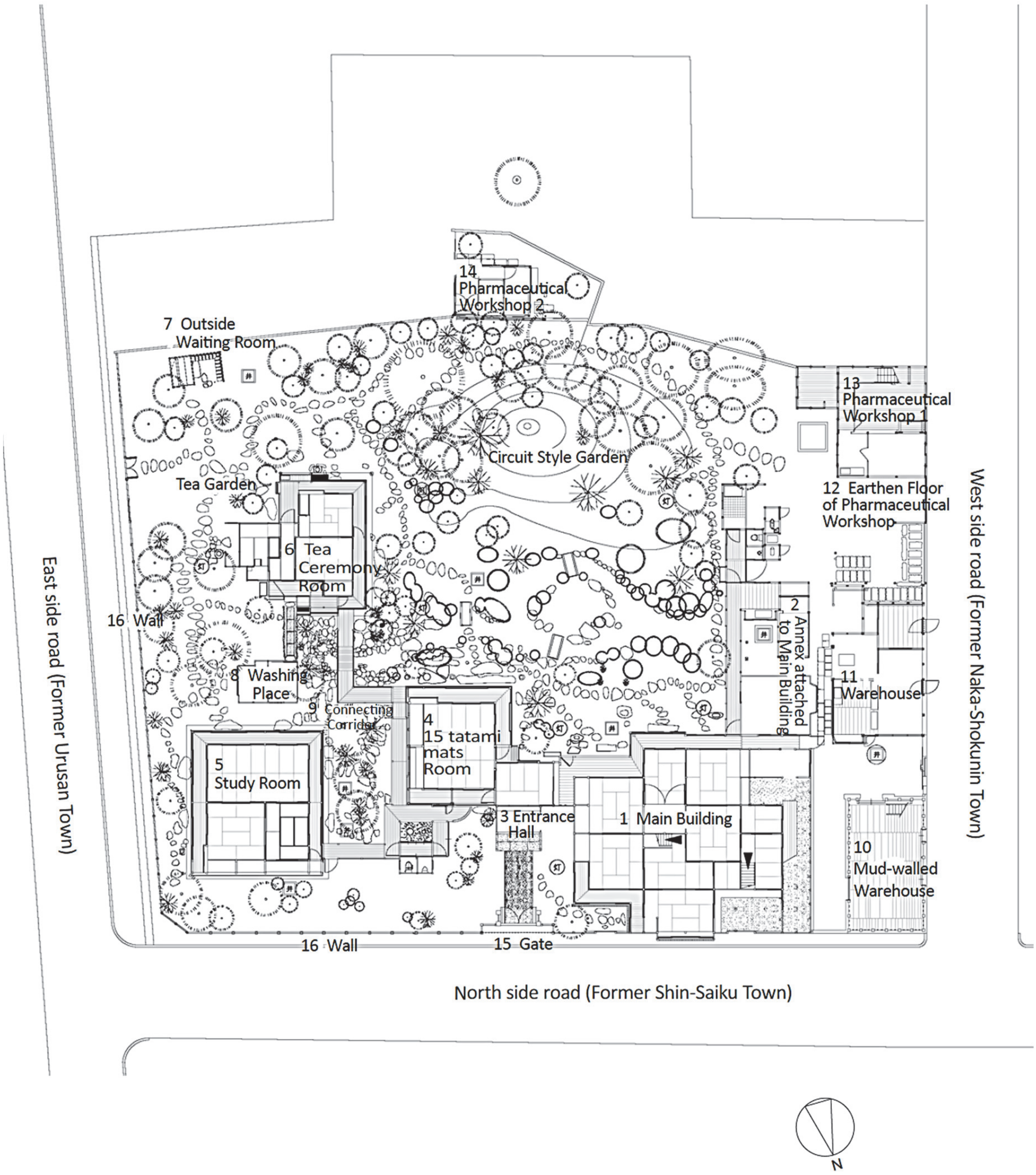
of a university laboratory. In addition, researchers and cultural administration officials from all over Japan were shown the disaster-stricken area, to gather information on conservation and preservation methods. A team from the Prefectural Museum of Art and other organizations (Cultural Property Rescue) removed a vast collection of artifacts such as folding screens and lacquerware from the damaged storehouse immediately after the earthquake. The collection was stored for its preservation, allowing the smooth start of building retrofitting. Toward the end of 2016, the year of the earthquake, the team began to correct the tilted main building and worked on its conservation while preventing the loss of its value as a historic building. These works will be completed in December 2018, approximately two years after the conservation work began.

The buildings and gardens have not undergone any major renovations, and in that sense, they have kept their value as cultural properties. However, since they remained closed to the public for a long time, they have not been known to the outside world, and there has been no official protective action such as a cultural property designation. When the entire mansion was damaged, it became difficult to address its issues using the owner's personal resources, so some form of public support was expected. Therefore, the restoration described above was carried out based on historical data while avoiding any expensive repairs to keep the house in its original state until full-scale retrofitting (which is expected in the future) is completed. The restoration was financed by a group subsidy from the Small and Medium Enterprise Agency and a subsidy from the Restoration and Rehabilitation Project for Cultural Properties Damaged by the Kumamoto Earthquake.

In addition to the supervision of a cultural property conservation specialist, the original roof tile and wall specifications were referenced. Additionally, thick cedar planks were installed to seismically reinforce the walls of the floor plan, which had few earthquake-resistant walls. This work was carried out considering the fact that localized destruction had occurred in components such as the frieze rail in areas where structural plywood reinforcement had been applied prior to the earthquake. Roof tiles and mud walls that had to be removed were preserved as samples, and photographs and other records were kept to serve as reference materials for future full-scale conservation repairs.

Yoshida Shoka-do will continue to manufacture medicines as it has in the past, but the disaster has prompted the company to explore the possibility of preserving a part of the house for public presentation and use. At the same time, there have been considerations on passing the house on to future generations under an official designated cultural property status provided by the national government and other organizations.

(Setsuko Isoda)



Yoshida Shokado Site Plan

Suzuki Family Residence (Former Nakamura Pediatric Clinic) [Index Map no.32]

Chuo Ward, Kumamoto City, Kumamoto Prefecture

Kumamoto City Structure of Landscape Importance (at that time)

In the past, this clinic's red mansard roof stood out from the traditional tile roofs of the town, and it could be seen from a distance. The clinic welcomed many patients and their families, and it is said that the front gate bustled with stalls, creating a prosperity that has been handed down. The two-story wooden construction was built in 1914, and combined the clinic with the residence of the family head. The hospital followed a Western architectural style, while the residence followed the Japanese architectural style. Each part was carefully examined and constructed with materials collected over several years. The designer, Masami Sato, was a graduate of Kumamoto Prefectural Technical School, and after working as a teacher and in the Navy, he served as an engineer for Kumamoto City.

Although the house did not collapse from the main shock, localized damage was observed, including the loss of a column in the entrance porch and the partially collapsed exterior walls, which revealed extensive rotting and termite damage to the wall base and structure. In addition, the interior lime plaster walls collapsed to such an extent that the owner had to spend an inordinate amount of time for cleanup, which became a psychological burden. Because of the height of the building and the design of the vertical windows, the lime plaster of the walls was nearly 3 meters high, even without the waist wall, and when the building shook, the entire lime plaster slid off and hit the floor, much like an iceberg collapsing. It is easy to imagine the horror felt when the remaining parts of the building suddenly collapsed, threatening the owner's desire to bequeath the house to the next generation.

Since a large, plastered and painted wall structure concealed all structural components behind it, drastic repairs would be difficult, because the underlying structure could not be exposed unless all the surface walls were torn down (and the original atmosphere would be lost if they were destroyed). This problem could also occur with other so-called Western-style buildings, and it is necessary to devise architectural technologies to overcome the difficulty of their preservation, which differs from that of Japanese *shinkabe* structures,

Before the disaster

After the disaster

Room after the disaster

where columns are exposed. In fact, there were businesses that wanted to use the western-style building for enterprises such as restaurants, and some wanted to buy it, but these restoration issues and the high land prices hindered new investments from taking shape. The building, including its valuable garden stone artwork, had been the pride and joy of many local residents since the Taisho period, but it needed to be vacated quickly.

Those who felt disheartened by the publicly funded demolition of this building removed its fixtures, fittings and frames one day before. These components have been preserved and recreated as part of a confectionery store space that opened after the earthquake.

The reproduced reception desk

(Keisuke Miyano, Hajime Yokouchi)

Morimoto *Fusuma* Tableware Shop [Index Map no.33]

Chuo Ward, Kumamoto City, Kumamoto Prefecture

Kumamoto City Structure of Landscape Importance (*at that time*)

This building held a business that had miraculously, namely that of a great number of parts and aesthetical components that are part of traditional Japanese *tatami* room spaces, such as beautiful splits, high-grade *fusuma* (sliding door) paper, finely carved sliding door pulls, and nail covers. The exterior of the building, with its symbolic *battari* shogi (a traditional wooden bench), combined with the business it held, gave it a strong personality, and it was widely loved as a wooden construction that represented the Kumamoto Castle town. The front of the building measured about 14 meters. Three ridges, built around 1887, stood side by side, with a courtyard in the middle and another ridge about 50 meters deep.

The storefront, including the *battari shogi*, had few columns, which openined the structure up. This design choice led to local deformations during the main earthquake shock. In addition, the buildings clustered on the site vibrated individually, which resulted in joint damage, falling roof tiles, and collapsed mud walls, changing the building's atmosphere. This damage challenged the efforts made by the owner to keep the building standing. At this point, however, the building did not show signs of collapsing and was thus deemed to be technically fit for conservation.

In order to preserve the building, a group of volunteers led by young locals removed its valuable inventory and household goods, and researchers from the University of Tokyo and other institutions conducted a survey. Although movements sprung in support of the owner to ensure the building's survival, it was dismantled in June 2017. The main reason for the owner's decision to dismantle the property was that the family business was a declining industry with no prospects for the future, and therefore no business successor could be expected. This situation seems to be common in the business environment of many owners of the old *minka* (folk houses) that remain in Japan. When these issues

Front view immediately after the disaster

Volunteers dismantling the building for relocation

become apparent, for example after an earthquake, the buildings disappear without time to make a business decision (even if there is technical viability). This is an unavoidable problem in the preservation of historic buildings, but it is difficult to find an answer. In a historic city, it is necessary to gather wisdom, human resources, and information from the public and private sectors in anticipation of simultaneous and multiple damage to privately-owned historic buildings.

Many people regretted the loss of the Morimoto Fusuma Tableware Shop, and newspaper and television coverage of the event led to its preservation, though only of the facade, including the symbolic *battari shogi*. The city's private art museum (Shimada Museum of Art), which has long introduced Kumamoto's antique art, provided the space, and designers, wood constructors, stonemasons, and volunteers from the general public, all of whom felt disheartened by this series of events, participated in what they could, succeeding in the preservation of a trace of the former castle town.

(Keisuke Miyano, Hajime Yokouchi)

After relocation, the Shimada Museum of Art

7.2 Stone monuments and Garden

Stone Monument of Kodokan [Index Map no.15]

Mito City, Ibaraki Prefecture

National Special Historic Site (stone cultural property)

The Stone Monument of Kodokan is made of a type of marble called “Kansuiseki” (literally “cold water stone”) and is engraved with the spirit behind the founding of the Kodokan. The Kodokan was a clan school of the Mito Domain created in 1841, at the end of the Edo Period, by the ninth lord of the Mito Domain, Nariaki Tokugawa. The Stone Monument of Kodokan has been damaged by air raids in the past. During an air raid on the city of Mito on August 2, 1945, incendiary bombs hit the Hakkedo hall and burned it down. The monument was severely damaged by the fire, cracking and chipping. After being exposed to the open air for some time since the war ended, the Stone Monument of Kodokan was repaired in conjunction with the reconstruction of the Hakkedo hall in 1953. For the repair at that time, the sides and top of the monument were covered with a 45 cm thick layer of concrete, and the back was covered with a 30 cm thick layer of concrete.

The seismic intensity of the Great East Japan Earthquake in Mito was just lower 6, and the east-facing monument was shaken more severely in the front-back direction than in the left-right direction. The Hakkedo remained was mostly undamaged, but the Monument of Kodokan had numerous cracks in various parts of its body. The central part of the body was fragmented in various pieces from the upper right to lower left, which were scattered on the base stone and in front of the monument. The body of the monument, which was approximately 320 cm high, inclined about 4 cm forward, and created a gap between the stone body and the concrete base backing. The causes of the damage are: (1) the Kansuiseki marble had internal cracks due to the heat received at the time of the Hakkedo Hall fire, and the cracks could not be strengthened deeply enough with the repair technology at that time in 1953 , (2) the concrete on the back of the monument body prevented its collapse, but it

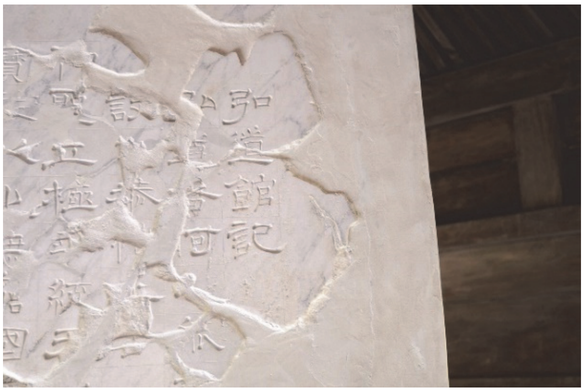
Hakkedo, where the Stone Monument of Kodokan is housed

The heavily damaged Stone Monument of Kodokan

The body of the monument was lifted and moved on rails

leaned from behind, causing the stress to concentrate at the bottom front so that one part of the body collapsed. The surrounding stones also fell apart, which was also considered to have been induced.

The conservation policy was based on the recovery of the damaged stones, a survey of the surrounding ground, an excavation survey of the foundation of the Hakkedo hall, a connectivity assessment between the monument body and the base stone to determine the cause of the damage, as well as a comprehensive assessment of the appearance of the Stone Monument of Kodokan and Hakkedo hall. The conservation policy was to remove the covering concrete material and other destabilizing elements from the back of the monument and strengthen the body itself to conserve the original structural stability. In addition, although not originally stipulated, the monument body and the base stone was glued together to make the monument more earthquake resistant. The lower half of the monument was removed and disassembled. The upper half, which had not been disassembled, still had cracks running vertically and horizontally, and there were voids created by previous repairs. To integrate the large stones together, holes were drilled



Restored inscription surfaceof the Stone Monument of Kodokan

Conservation work of the Stone Monument of Kodokan was completed so that its appearance was closer to the original than the appearance the monument had before the earthquake.

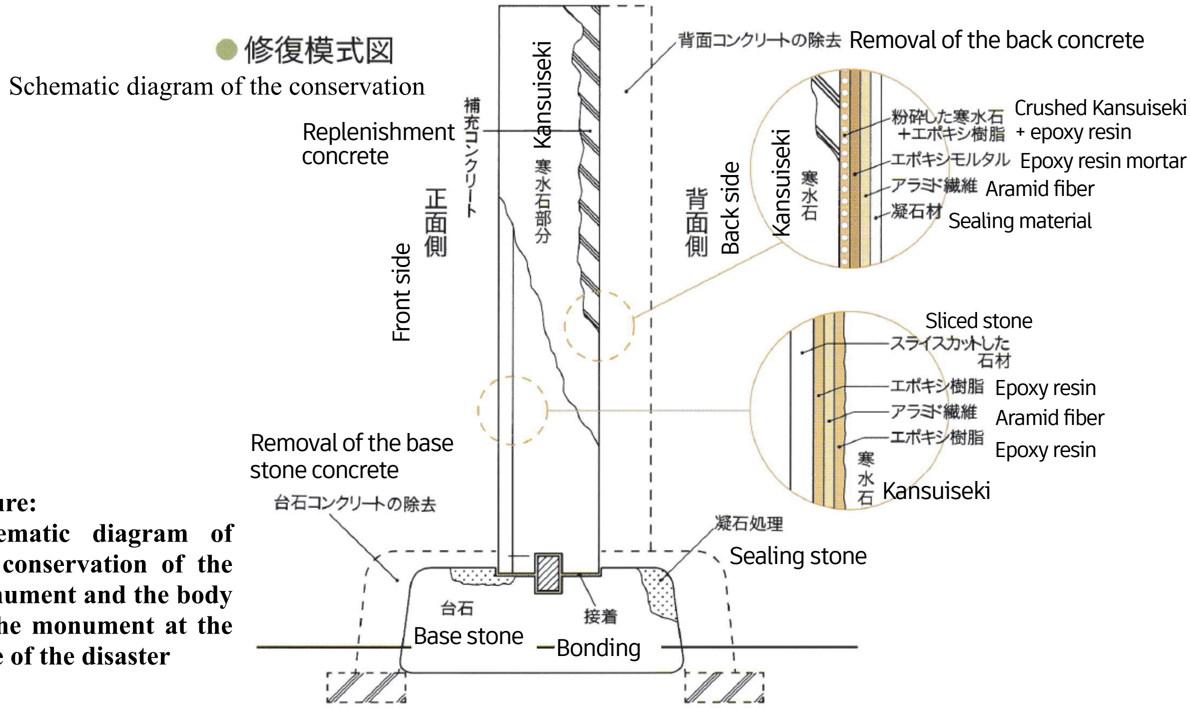


Figure:
Schematic diagram of the conservation of the monument and the body of the monument at the time of the disaster

Cite the figures used in the Japanese report and added English translations to them.
(Report on the conservation project of the Stone Monument of Kodokan at the time of the Great East Japan Earthquake, Monument Division, Cultural Properties Department, Agency for Cultural Affairs, pp. 38, 2015)

in both halves, stainless steel bolts were inserted, and epoxy resin with middle viscosity was used to secure them together. At the back of the monument, after the concrete was removed, the cracks were stabilized with resin and smoothed with epoxy-type pseudolithic substance. Then, aramid fibers with tensile strength were attached to the cracks, and the pseudolithic substance was applied and polished to finish. The conservation work was completed in the fall of 2013. This restoration was financed by the national government.

Aramid fiber with tensile strength was attached to the inside of the inscription surface and used as a substrate to attach the sliced inscription stones. For the conservation of the inscription surface, the stones with the smooth surfaces of the inscription and margins were sliced into plates 5 cm from the surface. These plate pieces were placed in the right location guided by the letterforms, ruled lines, and rubbings available from pre-disaster times, so that the inscription surface was completely flat.

(Takeshi Ishizaki)

Motsu-ji Keidai Tsuketari Chinjusha Site and Motsuji Garden [Index Map no.5]

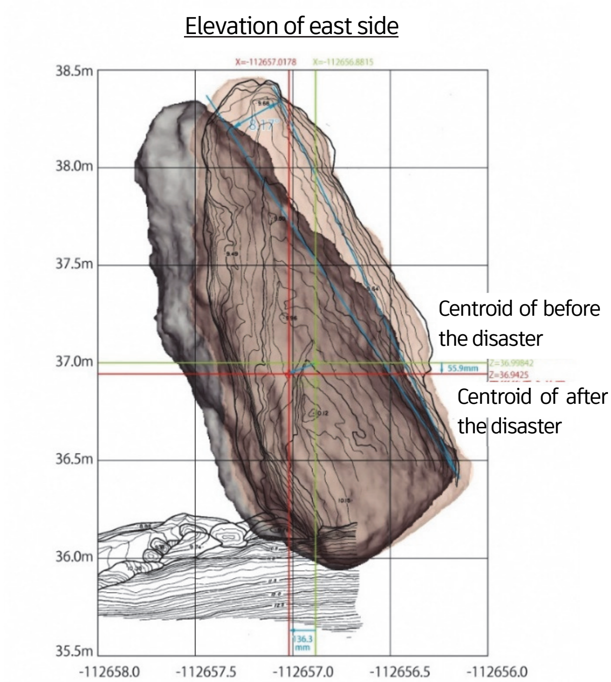
Hiraizumi Town, Nishiiwai-gun, Iwate Prefecture

National Special Historic Site and Place of Scenic Beauty with High Artistic or Scenic Value

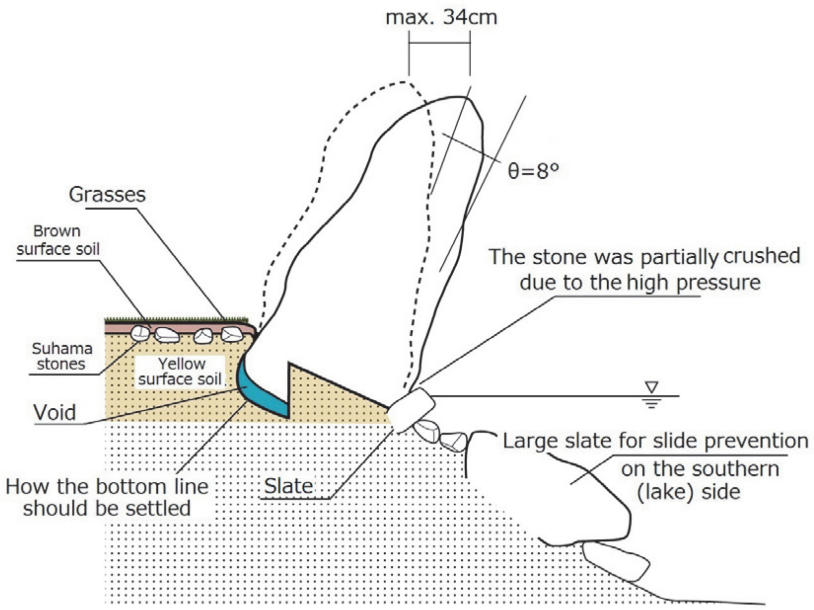
Motsuji Temple in Hiraizumi, Iwate Prefecture, was built by Motohira, the second Oshu Fujiwara lord. It is one of the sites that make up the “Hiraizumi’s Cultural Heritage,” and the Motsuji Garden is a designated special historic site (Motsu-ji Keidai Tsuketari Chinjusha Site) and a place of scenic beauty with high artistic or scenic value (Motsuji Garden). The garden is famous as a Pure Land Buddhist garden from the late Heian Period. The 2.5-meter-high rock standing in the Oizumi pond is called *tateishi* (or standing rock), and is the symbol of the garden. Located in the southeastern part of the pond, the standing rock is a 2.5-meter-high serpentinite with an estimated weight of 4 tons, which

After the restoration was completed

When the emergency support was installed



Elevation of the standing rock



Schematic diagram

adds a three-dimensional accent to the pond.

The Great East Japan Earthquake disaster that occurred in March 11, 2011 and its largest aftershock (April 7, 2011) caused the standing rock to tilt approximately 8 degrees (up to 34 cm). The damage was confirmed at the end of May 2011, just before the 35th meeting of the World Heritage Committee in Paris to discuss the cultural heritage of Hiraizumi. Aftershocks were ongoing, so emergency treatments were taken to prevent the stone from collapsing The Agency for Cultural Affairs reported the damage to UNESCO, while the town of Hiraizumi launched an emergency repair project and a maintenance guidance committee. Under the advice of the guidance committee, a survey and excavation of the standing rock and the island were conducted in 2011, and based on the results, a repair policy was formulated and repairs were carried out over 2011 and 2012.

Excavations in 2011 revealed that the standing rock tilted because the kaiishi (slate) that was placed under the standing rock was crushed by the tremors of the earthquake, which created a void.

Since the standing rock had been surveyed in 1990, the policy for recovery was to return it to the place indicated on the survey map. As part of the recovery work, the standing rock was carefully raised with a chain block and returned to its 1990 position, and the root voids created by the crushed rock were filled with new kaiishi filler and clay consolidation to secure it. The kaiishi that was added during the restoration was marked with a cross to indicate that it was a restoration work addition. The restoration was financed by national subsidies and Hiraizumi Town contributions.

The excavation that was conducted to establish a recovery plan was the first investigation of the s tanding rock and the island, and thus provided insight into the previously unknown techniques of standing rock placement and the island's construction methods. In particular, the 2.5-meter-high standing rock had a shallow base of just about 30 cm, and was placed on top of a mortar-shaped kaiishi with hard-packed clay base.

(Hiroyuki Shimahara)

7.3 *Kofun* (Ancient Burial Mounds)

Idera Ancient Burial Mound [Index Map no.45]

Kashima Town, Kamimashiki-gun, Kumamoto Prefecture
National Historic Site (Tumulus)

The site was one of the first nationalhistorical sites, designated in 1921. The main part of the ancient burial mound is a Higo-style horizontal stone chamber tomb built of tuff rock. It is a decorated burial mound with straight-and-curved line engravings on the stone walls, which are also decorated with colors.

Located on the Futagawa fault zone, the site is close to the epicenter of the main shock, which registered a seismic intensity of upper 6. As a result, numerous cracks were found in the mound, and the stone chamber, including the stone barrier on the back wall, suffered extensive damage, with stones cracking and falling off.

Since the mound cracks could cause a landslide, emergency measures to prevent the mound from collapsing were carried out in 2021. As a result, the slope of the mound, which had been irregularly shaped for some time, was reinforced with retaining walls. The conditions inside the mound have not changed since FY1991, when the antechamber and pathway were reinforced, and there is no prospect for recovery due to the difficulty of researching safety measures for working inside the mound. The *History in Motion!* fund is providing the funds for the recovery work.

While the emergency measures to prevent collapse were implemented, the mound surrounding the restoration construction area, which been covered with plastic sheets, was covered with CureMat, a curing material made of water-permeable non-woven fabric. About six months after the construction, the dry soil did not seep out, which had been a concern, and it is believed that a balance has been reached between the appropriate rainwater moisture supply and transpiration.

On the other hand, the effect of the dried earth integrated by the builders is unknown because it has not been investigated. However, the survey of the mound confirmed that a considerable amount of soft soil was deposited on the surface. The investigators speculate that this could cause the stone chamber to dry out and collapse, and that the cracks caused by the earthquake may be confined to this layer of soil. However investigations, including monitoring, cannot start until the stone cham-

The burial mound before the emergency measures took place (Photo provided by Kashima Town)

Front yard and leading corridor area (Photo provided by Kashima Town)

Damage inside the chamber (Photo provided by Kashima Town)

ber is safely stabilized, and this situation is somewhat at a standstill.

(Takeshi Hashiguchi)

Eianji-nishi (west) Ancient Burial Mound [Index Map no.20]

Tamana City, Kumamoto Prefecture
National Historic Sites (Tumulus)

The small-scale mounded tomb with decorated chamber walls is a corridor-shaped stone chambers decorated with some circular patterns, etc. It was designated as a National Historic Site in 1992. For public presentation the site was entirely covered with protective dome from 1999 to 2005. Although it is relatively far from the epicenter, an earthquake of seismic intensity scale upper 5 was observed in the vicinity.

Part of the mound collapsed due to the earthquake, and earth and sand covered the floor of the ante-chamber and corridors. In addition, part of the stone materials of the chamber collapsed. The dome of the protection facility is cracked and the foundation is damaged.

Since the public presentation was not possible even before the disaster, a fundamental review of preservation measures is being considered for the future.

For the protection facility and mound area, the current status of the protection facility will be determined by laser survey and the results will be compared with the drawings made at the time of initial presentation. The study findings will then be used to re-evaluate the current protection facilities, after which a recovery policy will be discussed.

National subsidies (Historic Revitalization and Comprehensive Utilization Project) was used to finance the restoration work.

The Eianji-nishi Ancient Burial mound has significant microbial contamination throughout the entire protection facility. The entire mound was covered with a dome for presentation, but the dome itself is also damaged. Since the interior environment of the mound had been difficult for public presentation before the damage, it is necessary to examine the previous method of presentation, etc.

(Sunao Ishimatsu)

Exterior view of the mound, from the east (Photo provided by Tamana City)

Situation after removal of earth and sand (Photo provided by Tamana City)

Eianji-higashi (east) Ancient Burial Mound [Index Map no.21]

Tamana City, Kumamoto Prefecture

National Historic Sites (Tumulus)

The small circular mounded tomb has a corridor-style stone chamber, and is decorated with triangular and circular patterns, boats, and horses painted with bright red pigments. It was designated as a national historic site in 1992, and conservation work was carried out from 1999 to 2005, which included rectifying the collapsed antechamber stones and building a viewing room in front of the mounded tomb that protected it. Although it was located relatively far from the epicenter of the earthquake, an earthquake intensity of upper 5 was observed in the vicinity.

The earthquake caused damage to the stone chamber: some of the stone materials broke anda part of the decorated walls collapsed. Thee broken and fallen of stones f caused earth and sand to flow in. In addition, water leaked into the stone chamber from a crack in the mound that underwent maintenance.

The decorated chamber walls are damaged and must be carefully restored so as not to damage the painted chamber walls. The damaged stones are to be kept in the stone chamber without forcibly joining them. The damage in the stone chamber is to be assessed from various angles by comparing the results of a laser survey and the drawings at the time of initial maintenance work. Then, after understanding the characteristics of the stone materials and the current environment, measures inside the stone chamber will have to be considered to prevent further weathering, dew condensation, and damage to the stone material. For the mound, geological surveys such as boring, radar exploration, and electrical exploration were conducted in 2020. Based on the results of the water leakage monitoring and of the geological survey, the cause of the leaks in the stone chamber will be identified, and a method of recovery will be studied.

Cracks in the mound
(Photo provided by Tamana City)

Decorated chamber walls with stone peeled off
(Photo provided by Tamana City)

A national subsidy (Historic Revitalization and Comprehensive Utilization Project) financed this restoration work.

Microbial contamination was observed in the protection viewing room. The controlled environment in the visitor facility also needs to be studied.

(Sunao Ishimatsu)

Kamao Ancient Burial Mound [Index Map no.34]

Kita ward, Kumamoto City, Kumamoto Prefecture
National Historic Site (Tumulus)

This is a circular-shaped burial mound with decorated chamber walls from the first half of the 6th century. The chamber walls inside are decorated with colorfully painted circular, triangular, and cogwheel-like shaped patterns called *sokyaku-rin*. It is a national historic site.

It was conserved and repaired in 1917, 1923, 1951, and 1967, and the upper part of the stone chamber was re-stacked. In the 1967 repair, a concrete dome was constructed to cover the upper part of the stone chamber, and the top of the dome was covered with soil.

The present mound was built on top of the concrete dome covering the stone chamber, but the consolidated soil collapsed during the earthquake, completely blocking the entrance to the stone chamber. The original soil of the mound was not affected. In the stone chamber, the ceiling stones of the corridor collapsed, the side wall of the front chamber was knocked off, and the stone blocks of the main burial chamber cracked and fell off.

In 2019, an investigation on the condition of the collapsed corridor ceiling stones confirmed that they needed to be re-stacked. Since the decorated chamber walls could potentially be affected by the changes in temperature and humidity due to direct sunlight and the inflow of outside air, a new windbreak chamber was installed at the entrance of the stone chamber for protection. In addition, the mound was cured with anti-grass sheets to reduce fluctuations in the temperature and humidity of the microenvironment inside the stone chamber. The committee plans to discuss recovery methods based on the survey results in the future.

Collapsed soil blocking the entrance to the stone chamber (Photo provided by Kumamoto City)

Damage to the mound (Photo provided by Kumamoto City)

Survey of the interior of the stone chamber using a small camera (Photo provided by Kumamoto City)

Installation of a windbreak chamber (Photo provided by Kumamoto City)

The recovery was funded by a national subsidy (*History in Motion!* Subsidy for the Comprehensive Maintenance and Rehabilitation of Historic Sites).

Since it was impossible to enter the stone chamber when it was first damaged, a damage assessment of the stone chamber was conducted with the assistance of the Nara National Research Institute for Cultural Properties using a small camera. This allowed us to gain a better perspective for subsequent projects.

Because it is a burial mound with decorated chamber walls, the disaster recovery project pays close attention to the fluctuating environment. As regular measures, we are monitoring the temperature and humidity, monitoring the moisture of the mound, installing a windbreak room, and curing the mound with water-permeable anti-grass sheets. During excavation, we cure the concrete dome with insulation, prevent rainwater inflow with plastic sheets, and reduce the impact of outside air inflow.

(Eitaro Miyoshi)

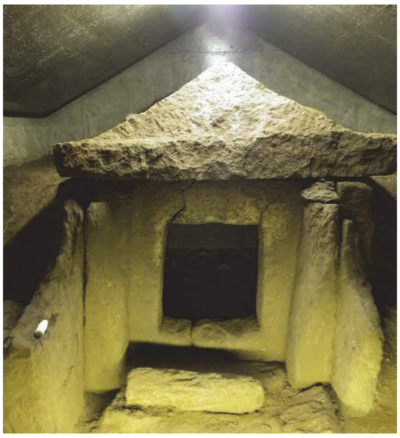
Ishinomuro Ancient Burial Mound [Index Map no.35]

Minami Ward, Kumamoto City, Kumamoto Prefecture
National Historic Site (Tumulus)

The Tsukawara tumulus group is a remarkable site because it was supposed to disappear due to the construction of the Kyushu Longitudinal Expressway. However, a preservation campaign had the construction method changed and the tumulus group was preserved. In 1976, it was designated as a national historic site, and has been maintained as an ancient tomb park, including the adjacent land. The Ishinomuro Ancient Burial Mound is a mounded tomb with decorated chamber walls, the main part of which is a stone coffin with a side entrance made of tuff and decorated with engraved lines.

The side walls of the stone coffin collapsed due to the earthquake, and the ceiling stone fell and was severely damaged. Since the stone coffin is located inside the preservation facility, it is believed

The damaged stone coffin
(Photo provided by Kumamoto City)



The stone coffin before the earthquake
(Photo provided by Kumamoto City)

Adhesive weathering tests
(Photo provided by Kumamoto City)

that the facility will have to be dismantled for recovery. In addition, the Sandanzuka, Kunugizuka, and Biwazuka burial mounds of this group also sustained damage in, showing cracks and depressions.

After surveying the mound and measuring the stone coffin, recovery methods were investigated. An issue was the difficulty of conducting conservation repairs due to the lack of space in the preservation facility. Mound surveys and excavations were conducted to determine the conditions of the Sandanzuka, Kunugizuka, Biwazuka, and Ryuganzuka tumuli, confirming that the damage was limited to the reconstructed mounds. Regarding the recovery for the Kunugizuka tumulus, the mound scraped as little as possible, and the slope was protected with large sandbags and blocks. For the Sandanzuka, Biwazuka, and Ryuganzuka tumuli the mound soil that had been maintained was restored.

The recovery work was financed by a national subsidy (*History in Motion!* Subsidy for the Comprehensive Maintenance and Rehabilitation of Historic Sites).

Since the collapsed house-shaped stone coffin is the main target for recovery, continuous research is being conducted to select an adhesive that does not affect the red pigment while maintaining sufficient adhesive strength. Research is also being conducted on the method of adhesion, and on alternative materials for the crushed stones. A recovery method for the stone coffin will be selected based on the results of this research. An environmental survey is also being conducted to ensure that the surface of the stone with line engravings will not deteriorate.

(Eitaro Miyoshi)

Tenjinyama Ancient Burial Mound [Index Map no.36]

Uto City, Kumamoto Prefecture
Uto City Designated Historic Site

This keyhole-shaped mounded tomb is approximately 107m long. The diameter of the back is approximately 61m, and the front measures approximately 46m. Since it had not been excavated, the internal structure of the mound, including the main body, is unknown. It was designated as a national historic site by the city in 1967.

The mound has been used by local residents as a place to collect soil for agriculture, so it has flattened considerably, mainly on the south side. This

Collapsed soil in the back circle section (from the east) (Photo provided by Uto City)

Large sandbags in the front part (from the southeast) (Photo provided by Uto City)

intervention to the mound was particularly prominent at the front tip and the south-side circular back, and the slope of the mound rose up at a very steep angle even before the earthquake.

The front tip collapsed due to the Kumamoto Earthquake in April 2016, and the backof the mound partially collapsed due to heavy rainfall in June of the same year.

In the front, a nearby warehouse was dismantled to allow the entry of heavy equipment to remove the collapsed soil. Emergency treatments were then carried out by installing large sandbags to hold the soil in place. In the back, part of the mound slid down in a lump along with a tree. The trees at the bottom caught the mound and there was no damage to the adjacent buildings. In a part of the remaining section of the mound, white clay-like soil, different from the surrounding area, was found, and it is thought to be an exposed part of the grave pit associated with the main mound. In addition, several cracks are still visible around the collapsed area, including large cracks with dozens of centimeters wide and deep. In addition, as of 2022, small-scale collapses and soil runoff continue to occur around the collapsed site and the site remains in unsafe conditions. The damaged areas were covered with plastic sheets for protection.

As of FY2022, the damaged area will be divided into three construction zones for the planned disaster recovery work: i, one for the back and two for the front part. Normally, it would be best to reconstruct the mound and return the slope to the original angle of inclination, but there is no space around the mound to do so. Therefore, in order to stabilize the mound even if the slope remains steep to some extent, the most appropriate construction method will be selected for each site, using reinforced mud walls, long-fiber reinforced earthwork, and large block retaining walls in addition to embankment. This is only a plan, and the final method to be used has not yet been decided.

Since all tombs are now privately owned, the project will be financially supported by the owners of the disaster-stricken areas and the districts, and the city will provide subsidies to support the project.

Paving gravels found in the excavation (from northeast)
(Photo provided by Uto City)

In FY2009, a ground-penetrating radar survey was conducted on the upperat the top of the back-posterior of the circular mound in order to find and protect the untouched main part during the recovery work. As a result, we were able to roughly determine the location and scale of the main body.

Since the collapsed soil in the back of the mound was in a lumpy form that retained most of its original shape, an excavation was conducted there, under the assumption that the information was retained on this part of the mound. The excavation showed that a group of gravels that appeared to be paving stones on the slope of a mounded tomb were also found throughout the collapsed soil, This led to the close certainty that the burial mound used to be paved with gravels throughout.

The mound is located close to people's houses, which makes it difficult to obtain sufficient construction area, and the geological survey results indicate that the ground beneath the mound and the soil of the mound are soft.

(Hiroshi Akutagawa)

8. Challenges and Future Prospects for Cultural Property Disaster Prevention

In this report, seven chapters detail the damage the megaquake in Japan caused to cultural heritage, the development of earthquake resistance measures, and specific examples of recovery and rehabilitation. This section summarizes the challenges and future prospects for cultural property disaster prevention, referencing the roundtable discussion records summarized by the authors.

8.1 Challenges in Cultural Property Disaster Prevention

(1) Damage Survey Immediately After the Disaster and Addressing the Owners

Post-Earthquake Temporary Risk Evaluation Methods and Efforts to Reduce Publicly Funded Demolitions

Immediately after a major earthquake or other disaster, local government officials and registered private architects conduct the Post-Earthquake Temporary Risk Evaluation of the buildings. When a red label is posted to a building as a result of the evaluation, owners often have the impression that the experts have declared that preservation or rehabilitation is impossible in the future. This often results in the owner of the cultural property wishing to have the building undergo a publicly funded demolition. Immediately after a disaster, local government officials are busy securing the lives of residents and rebuilding their own lives, and are unable to adequately respond to cultural properties. Therefore, the publicly funded demolition of damaged cultural property buildings should be reduced as much as possible through the Cultural Property Doctor Dispatch Program, in which experts and heritage managers provide timely and accurate support for emergency treatments, repairs with complete dismantlement and reassembly of original structures, and other measures to prevent the spread of damage. These tasks are carried out while paying attention to the cultural property owners' feelings and to the residents. This is necessary to reduce publicly funded demolitions.

Furthermore, after a certain period of time, a triage decision must be made on which cultural property buildings to focus on for preservation and restoration, taking certain factors into consideration such as the condition of the buildings, the intention of their owners, their value as cultural properties, and the financing prospects. It is important to count with a system and personnel capable of making such decisions, providing guidance and advice, and allocating a certain amount of funds during non-disaster times. To this end, preparing a broad list of buildings with cultural property value is effective, regardless of their designation status. The operations of this provisional registered cultural properties system, which some municipalities have begun to use, can be expanded. In addition, comprehensive surveys of undesignated cultural properties, which support regional plans for their conservation and utilization, are very effective for locating and promptly responding to cultural properties in the event of a disaster.

It is important to organically coordinate and link the above-mentioned Cultural Property Doctor Dispatch Program, which deals with immovable cultural properties, and the Cultural Heritage Rescue Program, which deals with movable cultural properties, in order to ensure mobility and a comprehensive initial response in the future.

(2) Public Preservation/Recovery Support

Need for Early Public Support Measures

In the event of a disaster, it is important not only to prevent the spread of the disaster, but also to determine public support measures for recovery as soon as possible. These measures encourage owners to maintain their buildings' conditions. When a public infrastructure facility is damaged, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) dispatches a disaster assessment officer to the disaster site, upon a request from the local government that manages the facility. The officer conducts a field survey, determines the disaster recovery project cost on site, and begins the recovery project immediately. Most cultural property buildings are privately owned, and it is difficult to follow such procedures even for national designated cultural property buildings, although a similar system should be considered in light of these building's public and cultural value in the region.

The Small and Medium Enterprise Agency provides subsidies for rehabilitation to groups of small and medium-sized enterprises (SMEs) in disaster-stricken areas that have prepared a rehabilitation business plan and received recognition from the prefectural government under the "Group Subsidies" program. These subsidies cover the recovery and rehabilitation of facilities and equipment, excluding residential zones, and the subsidy rate is determined at a relatively early stage. However, they have been used for earthquake and other disaster recovery efforts, including those involving cultural property buildings.

Regarding cultural properties, even national designated cultural property buildings require in-depth surveys and detailed estimates, and it takes a long time before a grant decision is made. Although many projects are funded through supplemental budgets, it is difficult to apply these funds to recovery projects that last multiple years. Undesignated cultural properties are not eligible for these subsidies.

Similar to the MLIT's disaster assessments, cultural properties require field surveys and a quick determination of recovery project costs (subsidy amounts). To this end, the Agency for Cultural Affairs needs to reserve a certain amount of funds, prepare a manual for estimating repair costs in response to a disaster, and provide highly skilled personnel who can assess the situation on site.

Recent earthquake disaster recovery projects have achieved significant results in terms of securing funding through the efforts of cultural property owners, local architects, NPO officials, researchers, and local government officials. Funding options include the above-mentioned Small and Medium Enterprise Agency group subsidies, prefectural government recovery and rehabilitation funds, cultural property repair subsidies through the fast-tracked designation of undesignated cultural properties, and funds from private foundations. These efforts take time, but will continue. From now on, it is necessary to establish a mechanism for the immediate response of damaged cultural properties, including municipal designated and undesignated cultural properties. Reserve funds need to be secured to provide disaster response at all times, rather than waiting for the creation of a disaster recovery fund or similar program.

Overall, it will be increasingly important to build a social and technical system that can respond immediately after a disaster.

(3) Training and Deployment of Personnel for Repair and Recovery

Chief engineers approved by the Agency for Cultural Affairs are responsible for repairing national designated cultural property buildings, and structural technology engineers are generally included when repairs that include seismic reinforcement are required. Chief engineers are expected to leverage their long experience, advanced skills, and knowledge, but they cannot adequately respond to the repair needs of many cultural property buildings simultaneously, such as in the event of a major disaster. Heritage managers and other local architects have recently expanded their activities to include the repair and recovery of municipal designated cultural properties, registered cultural properties, and buildings in Preservation Districts for Groups of Traditional Buildings. Thus, heritage managers are expected to play a particularly important role in the event of a disaster.

However, although they have completed a certain level of training, heritage managers do not necessarily have sufficient knowledge and experience to repair cultural property buildings. Their competence varies from person to person and region to region, and since it is not a legal qualification, they are not widely recognized by the society. They should gain greater credibility through on-the-job experience and training under the guidance of chief engineers, improving their ability to explain their work to owners and subcontractors. This would enable a prompt and appropriate response for the maintenance and repair of many cultural property buildings in the region after a disaster and in normal times.

In recent years, architectural structural technologies have been increasingly involved in the seismic assessment and reinforcement of cultural property buildings. These technologies can play an important role in the recovery and rehabilitation of damaged cultural properties. More active participation will be required, for example, by providing owners of damaged cultural properties with easy-to-understand explanations of the need for seismic reinforcement from the standpoint of structural dynamics, and by providing affordable reinforcement options.

Local government officials who deal with cultural properties in a disaster-stricken area also play an extremely important role. These officials are familiar with the local conditions and work in a fair and just manner, and they can provide appropriate advice to residents who tend to feel anxious and upset during the first period immediately after the disaster. In this way, local officials can not only help residents rebuild their lives, but also motivate them to continue and restore the existing cultural property buildings in their possession. In reality, however, the majority of local government officials in charge of cultural properties specialize in archaeology and related fields, and only a few nationwide specialize in buildings. This makes it impossible for them to conduct appropriate professional surveys, advice, and examinations regarding the repair of cultural property buildings. This is a major problem even in normal times, but the limitations are often exposed when there is a disaster. In order to steadily recover and rehabilitate cultural properties and promote their conservation and utilization, it is necessary to ensure that specialized staff is assigned for cultural property buildings. In addition, it is important to have a support system created by building specialists from other departments, and establish a support network from other prefectures and municipalities for emergencies.

(4) Progress and Challenges in the Seismic Assessment/Reinforcement of Cultural Property Buildings

In Japan, seismic measures have dramatically improved since the Great Hanshin-Awaji Earthquake in 1995, by recognizing the importance of assessing and reinforcing cultural property buildings, implementing these measures, and expanding public support through funding programs such as subsidies.

Until then, the theoretical and empirical accumulation of seismic reinforcement methods was insufficient, and immediately after the Great Hanshin-Awaji Earthquake, it was not uncommon for reinforcement to slightly reduce the value of a cultural property or to be too costly to be carried out. Recently, with the accumulation of experimental data and experience in seismic reinforcement, it has become possible to incorporate input seismic motion characteristics that take into account not only the building itself but also the ground conditions. Thus, more rational reinforcement and retrofit measures can be implemented without damaging the historical and cultural value of the building. In addition, this knowledge and experience is being used to conduct seismic reinforcement measures when repairs are carried out in normal times.

In this context, the Agency for Cultural Affairs' "2012 Guidelines for Assessing Seismic Resistance of Important Cultural Properties (Buildings)" is noteworthy. The Agency for Cultural Affairs has set a target performance level for cultural property buildings equivalent to the general seismic standards of the Building Standards Act. From the viewpoint of damage mitigation, the idea is to improve a building's performance through reinforcement, even if it is partial. Alternatively, temporary reinforcement can be implemented when the originally necessary reinforcement is not possible. This concept is also included in the Agency for Cultural Affairs' subsidy program for repairs and seismic resistance measures. In the restoration of damaged cultural property buildings, there are times when, due to the urgency of the restoration and cost constraints, reinforcement measures cannot be taken while maintaining the value of the cultural property. For these cases, "transitional reinforcement" was introduced, which aims to temporarily reinforce up to approximately 70% of the required strength, reaching 100% in the long term. However, whether this transitional reinforcement is acceptable to the owners and whether it can actually save lives and protect buildings in the event of another disaster has not yet been fully discussed, and the technology has not yet been fully established. On the other hand, structural analysis for seismic reinforcement has proven to be comprehensive enough to determine aging, deformation, settlement, and other phenomena of the analyzed buildings, as well as for the evaluation of soil-structure strength. It was found that in some cases, excessive reinforcement had been requested.

While structural analysis technologies have indeed developed and become more sophisticated, they still face challenges in adequately evaluating the safety limits of certain types of structures. Thus the seismic analysis technologies for cultural property buildings are still in their early stages of development. Moreover, quantification of the aging of buildings, including issues like material deterioration, deformation, and settlement, remains a big engineering challenge. Uncertainty of seismic impact depending on ground seismic motion further complicates matters. However, as these obstacles are gradually addressed and resolved, there is potential for significant improvement in the seismic performance of buildings evaluated using current technology. In this regard, the concept of "transitional reinforcement" holds promise as an effective measure to bridge the gap until the technologies mature and become more accurate.

Needless to say, the reinforcement, transitional or not, of cultural property buildings should be based on the principle of "minimum reinforcement" to prevent excessive interventions. Reversible measures should be applied to the extent possible to protect historical and cultural properties, with the first priority given to the safety of human lives. Structural mechanics need to be developed to understand the seismic characteristics of the building in question, taking into consideration its damage and repair history, to utilize this information in seismic reinforcement design.

(5) Challenges in Recovery of Re-damaged Cultural Properties

On the other hand, in Japan, natural disasters such as earthquakes have been occurring frequently in recent years, and there have been many cases in which damaged cultural property buildings that were once reinforced after a disaster have been damaged again. Even though seismic reinforcement will certainly reduce damage, it will not hold up if a larger-than-expected disaster strikes again. This presents a serious challenge as to whether the initial recovery and reinforcement were appropriate, the level and method of rehabilitation, and how to secure the necessary funds for such rehabilitation.

In particular, there have been many cases of stone walls at castle ruins that have been damaged after recovery, and have collapsed or become deflated again. The mechanisms of stone wall collapses are still not fully understood from an engineering standpoint, and further collaboration between experienced masons and other conservation techniques and cutting-edge structural technology will be necessary.

(6) Issues in the Presentation of Manuals for Cultural Properties Disaster Prevention and Recovery

Various manuals and guidelines have been prepared for cultural properties disaster prevention. Since 2012, the Agency for Cultural Affairs has published a series of manuals, pamphlets, guidelines, outlines, reference materials, and examples of seismic reinforcement measures for cultural property buildings and Preservation Districts for Groups of Traditional Buildings, based on the insights of experts in seismic resistance measures, and has made them available on the web. This has had a certain effect on disaster prevention and mitigation management in advance, as well as at the time of a disaster and in response to rehabilitation. It is hoped that the pamphlet and manual will be revised to further improve its theoretical accuracy in line with the progress of research, so that it can be directly rehabilitated for practical use by architects and other specialists, and also provide easy-to-understand explanations of the scope of subsidy eligibility in response to questions and requests from owners and other parties.

8.2 Learning from Examples of Recovery of Damaged Cultural Properties in Japan

This report includes many examples of recovery of cultural properties damaged by the Great East Japan Earthquake disaster in 2011 and the Kumamoto Earthquake in 2016, not only buildings but also Historic Sites and Places in scenic beauty of high artistic or scenic value.

(1) Cultural Heritage Recovery and Community Organizations

The Kazamachi district, Kesennuma city, Miyagi Prefecture, damaged by the Great East Japan Earthquake disaster, and the Shinmachi-Furumachi district, Kumamoto city, Kumamoto Prefecture, damaged by the Kumamoto Earthquake, both achieved excellent results in recovery and rehabilitation through the creative recovery support activities of local NPOs working closely with the owners and others, as well as with the local government and the entire organization and community.

In the Kazamachi district of Kesennuma City, the "Kazamachi City Preservation Association for Community Recovery" had been active since before the earthquake, conducting research and study on historical buildings and their charms. After the great earthquake disaster in 2011, the "Kesennuma Kazamachi City Preservation Association for Community Recovery" was organized with the owners and experts from all over Japan to conduct monitoring tours to visit the site of rehabilitation, the group has been supporting the conservation and restoration work by organizing monitoring tours to visit the restoration site, crowdfunding with original goods in return, and fundraising through donation boxes. In addition, various events and activities have been held to revitalize not only the buildings but also livelihoods and lifestyles.

Shinmachi-Furumachi district, one of the central districts of Kumamoto City, suffered from a decline early on, and community planning organizations had been continuing their community planning activities since the late 1970s. Immediately after the Kumamoto Earthquake in 2016, the Kumamoto Machinami Trust, a citizens' group that has been working on the conservation and utilization of historical buildings in the district, undertook a damage situation survey and a strategy for the preservation of historical buildings, especially undesignated cultural properties. Through a variety of activities, including securing prefectural reconstruction subsidies and private support funding for undesignated cultural properties and organizing reconstruction events, they were able to accomplish the reconstruction and rehabilitation of many historic property buildings. The activities of this NPO, Kumamoto Machinami Trust, received the 2019 Japan ICOMOS Japan Prize for "significant contribution to the preservation and rehabilitation of historic architecture and towns in Shinmachi-Furumachi district in Kumamoto City that were damaged by the Kumamoto Earthquake.

Other examples of the connection between the restoration of cultural properties and the revitalization of communities include: a group of former residents working together to restore the Daihannya Sutra of a local temple that was washed away in the Great East Japan Earthquake; the revival of traditional events such as lion dances playing a major role in the rehabilitation of a lost community; a shrine that had been the nucleus of a local community that was suddenly designated town-designated cultural property and repaired through subsidies; and a community that was able to restore a number of old private homes through a variety of utilization plans. The report also provides examples of the link between the rehabilitation of cultural heritage and the revitalization of local communities, such as the case of a community that was able to restore many old minka(houses of the people) through a variety of regional plans for their rehabilitation.

(2) Learning from Examples of Cultural Heritage Recovery

In addition to the above, the damage situation, progress in recovery, and results of conservation and utilization of damaged cultural properties, including approximately 40 examples of nationally, prefecturally/municipally designated cultural properties, registered cultural properties, and other undesignated cultural properties, were presented. In all of these cases, after the turmoil immediately after the disaster, the participants, with the cooperation of many people concerned, took on many challenges, including persuading the owners and securing funds for rehabilitation, while preventing further damage, and achieved results. In the process, various studies and advanced practices were conducted, including evacuation guidance, precise seismic assessments, implementation of seismic reinforcement that did not damage the value of wooden cultural properties, combined use of traditional and modern technologies in the repair and reconstruction of brickwork constructions and stone buildings/stone walls and earthen walls, and restoration of other ancient tombs, etc., and a lot of valuable data and experience were gained regarding disaster recovery of Japan's cultural properties and how to proceed thereafter. Many valuable data and experiences were obtained regarding the disaster recovery of Japan's cultural properties and how it should be done afterwards. Many remaining issues have also been pointed out.

8.3 Future Prospects

The earthquake resistance level of cultural property buildings: the need for a paradigm shift in the awareness of owners of cultural property buildings

In Japan, there is a strong awareness that even cultural property buildings should have the same seismic resistance performance as newly constructed buildings if the public enters for tours, worship, etc. However, in societies with a large historical stock, such as Italy, the target for seismic resistance measures for historical buildings is set lower than that for newly constructed buildings. In Italy, general firefighters are also engaged in rescuing cultural properties in the event of a disaster, and training and manuals are being prepared for the emergency reinforcement of historic buildings. This is an example of disaster management in a society that coexists with historic buildings.

In Japan, some local governments are consciously working on fire control for cultural properties, for example, fire departments have information on cultural property buildings, including undesignated cultural properties, for use in firefighting measures, and have introduced a system in which fire trucks are dispatched based on automatic alerts from fire alarms installed in cultural properties. However, even in these municipalities, the occurrence of inland earthquakes has been pointed out, and the shortage of water for firefighting in the event of simultaneous fires that could result from such earthquakes has become a major issue. In another municipality, Unsafe active faults in an area where cultural properties are concentrated have been pointed out, but no effective countermeasures have yet been taken. Under these circumstances in Japan, it is necessary to combine hardware and software measures and foster social understanding, including among property owners, of the concept of coexisting with disasters, such as "transitional reinforcement" that does not immediately call for complete reinforcement, and the creation of manuals and methods of dealing with damage situations at the time of a disaster.

Even in the event of The Nankai Trough Earthquake or Tokyo Inland Earthquake that is expected to strike in the near future, daily preventive measures and seismic resistance measures are required to prevent significant loss of value as cultural properties against collapse, damage, and possible occurrence of a major earthquake or a great fire. For this purpose, it would be effective to constantly monitor the seismic performance of historic buildings through constant structural monitoring.

(Yuga Kariya)

Editor's Note

This report was planned by ICOMOS Japan's Special Committee for Supporting Damaged Cultural Properties and was written by 42 researchers, engineers, government officials, and citizens under the supervision of six members. The translation of the report's content related to disaster prevention and earthquake-resistant technology, as well as the specialized Japanese cultural property lingo and expressions, was carried out by a team of five members. The editing and design were performed by two individuals, leading to its publication. I am delighted and deeply grateful to everyone involved in its production, as their cooperation has made the completion of this report possible.

I began studying architecture at university in 1995, the year of the Great Hanshin-Awaji Earthquake. This disaster became a significant turning point that inspired me to devote my life's work to seismic technology for buildings. In Japan, earthquakes and other disasters have recurred, expanding the scope of research from seismic measures for buildings to broader disaster prevention. Cultural property disaster prevention is a highly interdisciplinary field, and the recovery of damaged cultural properties requires collaboration among diverse stakeholders, each contributing their expertise and efforts. I have witnessed this collaborative effort in various disaster-stricken areas.

The content of this report reflects not only academic knowledge but also practical experiences and regional accounts, with specific and general overviews included. Some readers may find certain information lacking, and for any areas of dissatisfaction, I apologize and hope to provide additional details in future opportunities. Nevertheless, through the supervision, writing, and editing of this report, I believe it effectively conveys that the recovery of cultural properties is achieved through the collective efforts and connections of diverse individuals, as previously mentioned.

I sincerely hope this report serves as a reference for disaster measures, including seismic measures, for cultural heritage worldwide and contributes to the better recovery of cultural properties.

(Hajime Yokouchi)

ICOMOS Japan