

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

(Approved by the decision of the Director-General
for Cultural Properties Protection Department,
Agency for Cultural Affairs on April 8, 1999)
(Revised on June 21, 2012)

These are revised guidelines which present the recommended standard procedures, methods, and points to note in the seismic assessment of Important Cultural Properties (buildings) by owners as specified in Cho-Ho-Ken No. 149, “Notice of Establishing Guidelines for Assessing the Seismic Resistance of Important Cultural Properties (buildings)” issued by the Director-General for the Cultural Properties Protection Department, Agency for Cultural Affairs on April 8, 1999.

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

Purpose

1. These guidelines are formulated to present the recommended standard procedures, methods, and points of notice, which are necessary for owners, chief administrators, and administrative organizations (hereinafter referred to as "owners") to assess seismic damage and establish suitable countermeasures for cases in which the necessity has already been described in "Guidelines for Ensuring Safety of Cultural Properties (Buildings) During Earthquake" Technical details regarding seismic assessment are shown in implementation guidelines provided separately.

Objects of Assessment

2. In order to secure the safety of Important Cultural Properties (buildings) during earthquakes, owners are required to adhere to their obligations of management stipulated in Article 31 of the Law of the Protection of the Cultural Properties of 30 May 1950 (Law No. 214), and owners of all Important Cultural Properties (buildings) should voluntarily conduct seismic assessments of their buildings.

Registered Tangible Cultural Properties (buildings) and Historic Buildings in Important Preservation Districts for Groups of Historic Buildings that apply to the Building Standard Law (24 May 1950, Law No. 201) should satisfy the criteria for application, and efforts must be made to ensure safety during an earthquake while respecting the goals of these guidelines.

Scope

3. These guidelines are applied to Important Cultural Properties (buildings).

Specific methods for making seismic assessments indicated in these guidelines are directed at Important Cultural Properties (buildings) made entirely of wood.

Even in cases where it is difficult to apply these guidelines to applicable wooden structures, especially large ones or those with special structural elements, the purpose of these guidelines should be observed while making seismic assessments using methods that are appropriate for the structural characteristics.

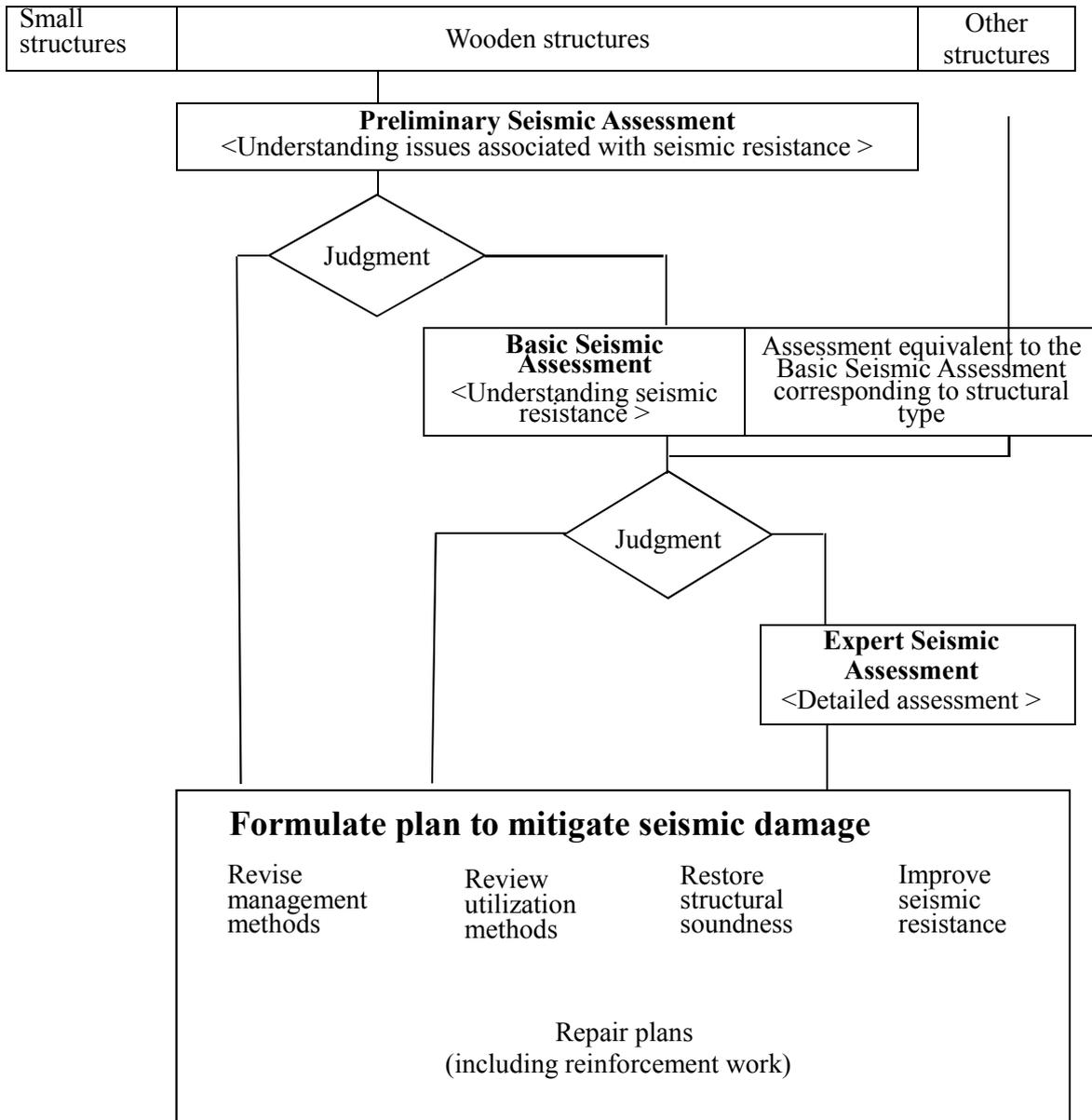
It should be noted that regarding non-wooden structures (masonry, steel frame, concrete structures, etc.) and civil engineering works (bridges, tunnels, dams, etc.), the purpose of these guidelines should be observed while making seismic assessments using methods that are appropriate for the types of structures.

In cases where either (1) or (2) below applies, these guidelines are not applied, but other methods may be used to ensure safety during earthquakes.

(1) Structures whose areas do not exceed 10 square meters

(2) Other types of small-scale structures (*torii* (shrine gates), stone towers, walls, etc.)

< Important Cultural Properties (buildings)>



When asked by owners, prefectural education committees can:

- (i) hear the opinions of municipal education committees, cultural property preservation committees, etc., to provide advice and guidance regarding the necessity of conducting a Basic Seismic Assessment;
- (ii) hear the opinions of architectural experts to provide advice and guidance to determine the need for Expert Seismic Assessments; and
- (iii) when necessary, obtain the assistance of the Agency for Cultural Affairs to provide advice and guidance for formulating and implementing future measures.

Figure. Flow chart of seismic assessment and formulation plan

Assessment Guidelines

4. The seismic assessments in these guidelines are divided into 3 stages: “Preliminary Seismic Assessment,” “Basic Seismic Assessment” and “Expert Seismic Assessment.” A “Preliminary Seismic Assessment” refers to what owners should do on their own initiative; after that, experts may be needed to conduct a Basic Seismic Assessment and Expert Seismic Assessment, if necessary (see Figure). During these assessments, owners should create opportunities for discussion with experts on seismic studies, architectural history, and conservation of cultural properties.

(1) Preliminary Seismic Assessments are designed so that owners can understand the locational environment, structural characteristics, and state of preservation of Important Cultural Properties (buildings) as they relate to seismic conditions. In most cases, the owners themselves conduct these assessments, but when necessary, they may obtain assistance from the education committee of the applicable municipality (including unions and special districts; hereinafter, “municipality”).

(2) When deemed necessary based on the results of Preliminary Seismic Assessments, owners should hire suitable architectural structure specialists and conservation architects, to conduct Basic Seismic Assessments with advice and guidance from prefectural education committees. Based on data obtained mainly from observations of external appearance, existing materials such as geological maps, etc., these assessments are designed to determine whether or not the “current seismic resistance” of structures of important cultural properties and the building’s foundation meets the standards for “necessary seismic resistance” that can preserve the cultural value and ensure safety during use.

(3) When they are deemed to be necessary based on the results of Basic Seismic Assessments, Expert Seismic Assessments should be undertaken to provide detailed data on the specifications, etc., of structural members obtained during repairs, etc., that can be used for making detailed assessments with methods adapted to the structural characteristics of the Important Cultural Properties (buildings) in question. With the advice and guidance of prefectural education committees, owners should hire an appropriate architectural structure expert.

Assessment Procedure

5. Seismic assessments are conducted according to the following procedure:

(1) Preliminary Seismic Assessment

1) If owners have conducted a Preliminary Seismic Assessment and filled out a Preliminary Seismic Assessment form provided separately, the assessment sheet can be submitted to the prefectural education committee for advice and guidance.

2) Before providing the advice and guidance described in 1) above, the prefectural education committee shall hear the opinions of architectural experts, the municipal education committee, the cultural property preservation committee, etc., that have an understanding of the conditions at the site, and, when necessary, meet with the Agency for Cultural Affairs.

(2) Basic Seismic Assessment

1) If owners have had a Basic Seismic Assessment conducted and filled out a Basic Seismic

Assessment form provided separately, the assessment form can be submitted to the prefectural education committee for advice and guidance.

2) Before providing the advice and guidance described in 1) above, the prefectural education committee shall hear the opinions of architecture structural experts, and meet with the Agency for Cultural Affairs.

(3) Expert seismic assessment

1) If owners have had an Expert Seismic Assessment conducted and filled out an Expert Seismic Assessment form, they can ask the prefectural education committee to submit the assessment form to the Agency for Cultural Affairs for advice and guidance.

Plans to Mitigate Seismic Damage

6. Plans to mitigate seismic damage are set based on the results of assessments described in 5 above, and owners may receive advice and guidance from the prefectural education committee.

7. When providing the advice and guidance described in 6 above, the prefectural education committee, when necessary, may meet with the Agency for Cultural Affairs to discuss a course of action.

Preliminary Seismic Assessment

8. The Important Cultural Properties (buildings) targeted for Preliminary Seismic Assessments described in these guidelines are wooden structures (except for 3 (1) and (2) above).

Even if it is difficult to apply all the assessment procedures to a structure, it would be preferable to conduct Preliminary Seismic Assessments using whatever assessment criteria can be applied.

9. Regarding the items covering locational environment, structural characteristics, and state of preservation, Preliminary Seismic Assessments are designed to gain an understanding of the issues associated with the seismic resistance of the building in question by grading the items with a simple method. Details of assessment items and methods are given separately in the "Implementation Guidelines for Preliminary Seismic Assessments."

10. Based on the results of the aforementioned surveys, the standard categories shall be decided after determining which of the following applies:

(1) The Important Cultural Property (building) appears to have nearly adequate seismic resistance.

(2) Measures (including minor temporary reinforcement) must be taken to restore an Important Cultural Property (building) to its original structural soundness, or measures must be taken to revise management and utilization methods.

(3) There is a high possibility that major repairs (including reinforcement) or reviews of utilization methods will be necessary, and Basic Seismic Assessments shall be conducted as soon as possible.

Basic Seismic Assessment

11. The results of Preliminary Seismic Assessments will be used to determine whether Important Cultural Properties (buildings) should be targeted for Basic Seismic Assessments. When a building is not wooden, but its total floor area exceeds 10 square meters, then it shall, as a matter of principle, be subject to an assessment equivalent to the Basic Seismic Assessment.

It should be noted that the buildings to be assessed are those used by the general public that have a special need for ensuring safety, are required to continue to function during a disaster, and have a special need for whatever other items may be determined by the prefectural education committee.

12. Basic Seismic Assessments shall be used to determine whether the current seismic resistance of buildings meets the necessary seismic resistance. Details of assessment items and methods are given in the “Implementation Guidelines for Basic Seismic Assessments of Important Cultural Properties (Buildings).”

(1) A separate survey of the state of damage shall be conducted, and damaged and deteriorated parts and members shall be subject to repairs to restore them to their original condition. Assessments should be conducted based on the assumption that the structure is as sound as it originally was.

(2) When necessary, a separate survey shall be taken of the ground and/or foundation.

Confirming current seismic resistance

13. The current seismic resistance in a Basic Seismic Assessment is analyzed using the following method. However, another method that conforms to this method can be used when necessary.

(1) Scope

The seismic resistance of the building is assessed based on whether any of the following apply. When necessary, an investigation shall be conducted when a moderate (Level.1) earthquake occurs.

1) Functionality can be maintained during a major (Level.2) earthquake.

2) No collapse occurs during a major (Level.2) earthquake.

3) There is a danger of collapse during a major (Level.2) earthquake.

(2) Input seismic motion

Inputs of major (Level.2) and moderate (Level.1) seismic motions, or appropriate seismic motion when necessary, are estimated based on the Enforcement Order of Building Standard Law, etc.

(3) Limit of deformation

1) The respective deformation limits used to assess the level of damage (remaining standing, maintaining functionality, sustaining no damage) are defined based on the structural characteristics of the building.

2) The deformation limit for a building to remain standing is the highest value of deformation at which the pillars can support the roof against repeated forces from both sides..

3) The deformation limit for the maintenance of functionality is the highest value of deformation at which noticeable damage, such as the falling of finishing materials and problems with opening and closing doors, does not occur.

4) The deformation limit for a building to sustain no damage is the highest value at which the load-deformation curve is almost linear.

(4) Estimating response

1) The value of the maximum response displacement during an earthquake is estimated by appropriate methods based on the load-deformation relationship of each level which is derived from the, fixed load, live load, snow load, and load-deformation relationship of structural member.

2) When estimating the value of the maximum response displacement, it is necessary to take the influence of the uneven rigidity, load of each component of the building plan and each floor, and weakness of the horizontal plane into proper consideration.

(5) Fixed load

1) In most cases, the fixed load of each floor is calculated in an integrated manner.

2) When calculations take into account factors such as warping of the building and deformation of the horizontal plane, calculations are to be made of the fixed load of each member which needs to be modeled.

(6) Live load and snow load

Calculations of live load of floors and snow load of roofs are based on actual conditions described in the Enforcement Order of Building Standard Law, etc.

(7) Seismic resistance elements

The main seismic resistance elements are pillars, beams, penetrating tie beams, walls, etc.

It should be noted that reduced resistance based on items related to rotting, insect damage, warpage, loosening of connectors and joints, uneven subsidence of foundations, durability, etc. is not covered here, which assumes that buildings are in sound condition.

(8) Judgment

The following methods should be used to determine whether the building in question has the necessary seismic resistance when the estimated value of the maximum response displacement does not exceed the deformation limit.

1) The necessary seismic resistance is established based on sufficient consideration of maintaining the cultural value of the building and ensuring the safety during its utilization.

2) When determining the necessary seismic resistance, owners should receive advice and guidance from prefectural educational committees and listen to the opinions of architectural experts, as described in 4 (2) earlier.

3) The necessary seismic resistance shall be divided into the following categories, depending on the allowable degree of damage during a major earthquake. When necessary, an investigation shall be conducted during a moderate earthquake.

(i) “Standard for maintaining functionality”: Functionality can be maintained during a major earthquake.

(ii) “Standard for ensuring safety”: There is no collapse during a major earthquake.

(iii) “Standard for possible restoration”: Although there is a danger of collapse during a major earthquake, the building can be restored as a cultural property.

Expert Seismic Assessment

14. Important Cultural Properties (buildings) become subject to an Expert Seismic Assessment when the results of a Basic Seismic Assessment indicate that an Expert Seismic Assessment is necessary.

15. Expert Seismic Assessments shall involve the detailed assessment of current seismic resistance and formulation of associated measures based on methods laid out in the Basic Seismic Assessment or a suitable method that matches the structural characteristics of the building. Such assessments must be conducted with the following important points in mind:

(1) There should be a sufficient understanding of the cultural value of the building, especially the original form and design; materials; and techniques.

(2) There should be an estimation of the seismic motion that could be expected to act upon the structure’s foundation using the following:

1) Obtain materials such as geological maps issued by public organizations and, when necessary, conduct surveys using underground radar, boring, etc.

2) When analyzing the state of the ground, local conditions must be kept in mind.

3) Conduct surveys using historical materials and interviews about the land use history, past disasters, etc.

(3) Detailed observations should be made of uneven subsidence of foundations, deformation of framework, cracking of materials, loosening of joints and connectors, and changes that occurred over the years.

(4) To the fullest extent possible, there should be an accurate understanding of the roles that structural members created with traditional building methods play in seismic resistance.

1) If it is difficult to make a judgment based on a non-destructive survey such that the survey must involve some destructive method such as removing part of the exterior and taking out a core sample, there must be a meeting with the prefectural education committee beforehand to discuss the methodology and location of the survey.

2) When necessary, material tests and structural experiments should be conducted using sample materials.

(5) There should be an understanding of the structural factors related to damage and an assessment of the seismic resistance based on the previously described survey.

(6) A record shall be made of each type of detailed survey made for the assessment, and efforts shall be made to publicly release technical information.

Measures to enhance seismic resistance

16. When implementing measures to enhance seismic resistance based on the results of seismic

assessments, the following important points should be kept in mind:

(1) Original design and form; materials; and techniques should be respected in order to maintain the cultural value as Important Cultural Properties (buildings).

(2) To help improve maintenance and management, every effort should be made to maintain the performance of the building by making necessary repairs, etc.

(3) When it is determined that factors related to durability may hinder the required seismic resistance, efforts should be made to undertake repairs.

(4) This should be done in conjunction with consideration of measures when modification is shown to be possible based on a review of management and utilization methods.

(5) When there is a risk that the cultural value may be lost due to measures such as reinforcement work, there should be a review of the structure's utilization and alternative measures should be considered.

1) Efforts should be made to avoid misapplying measures that exceed the original builders' intentions, to cases where noticeable structural reinforcement is required.

2) Alternative methods should also be considered, such as reviewing how the building will be used, posting notices about dangerous areas, ensuring evacuation routes, etc.

(6) Emergency measures should be considered to restore the structural soundness of a building in question and undertake minor reinforcement work.

(7) Before taking major measures, reinforcement methods should be investigated even for reducing damage.

(8) When the enhancement of seismic resistance is required, necessary seismic resistance should be determined based on judgments about the state of utilization and appropriate assessments of the current seismic resistance. Then, measures to improve the distribution of seismic resistance elements, reducing load, reinforcing members and connecting parts, etc., should be considered.

1) The final decision should be made based on a multi-faceted approach that involves the participation of experts on architectural structures, architectural history, conservation of cultural properties (buildings), etc.

2) A decision shall be made on necessary measures after exhaustive consideration of the numerous aspects involved such as the structure, design and use of the building or other structure, the surrounding environment, etc.

3) When measures that will have a significant effect on external appearance or interior design in conjunction with major alterations in the current state such as changes in room partitions and building framework become necessary, a decision shall be made after an expert seismic assessment has been made.

(9) Efforts should be made to compile and make public a record of the process of how the reinforcement proposal has been considered.

