

JICA Group and Region-Focused Training "Building Disaster Prevention (Concerning Earthquakes, Tsunami, Fire, Typhoon, Etc.) Course"

Masonry Construction in Japan

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The oldest extant masonry structure Kosuge Repair Dock (1868, Nagasaki Prefecture)



Nationally designated important cultural property Former Ministry of Justice Headquarters Building (1895, Tokyo Metropolis)



Nationally designated important cultural property Usui Pass railroad facilities Former Maruyama Substation (1912, Gunma Prefecture)



Nationally designated important cultural property Former Usui No. 3 Arch Bridge (1892, Gunma Prefecture)



National treasure/world cultural heritage Former Tomioka Silk Mill
East Cocoon Warehouse (1873, Gunma Prefecture)



Nationally designated important cultural property Former Hokkaido Government Office Building (1888, Hokkaido Prefecture)



Masonry
structure

Traditional wooden
structure



An imported Western-style masonry structure and a traditional Japanese wooden structure inherited from olden times are united.



Earthquake damage caused to masonry structure buildings

Monochrome: Great Kanto Earthquake (occurred on Sept. 1, 1923)

Color: Great Hanshin-Awaji Earthquake (occurred on Jan. 17, 1995)



2007 Niigata Chuetsu-oki Earthquake (occurred on Jul. 16, 2007)



Great East Japan Earthquake (occurred on Mar. 11, 2011)

Former Nomura Shoten Salt Warehouse (1892)
Registered cultural property Tsuchiura
Machikado Kura Nomura / Coffee Shop Kura

Chuo, Tsuchiura City, Ibaraki Prefecture





Château Kamiya former brewery
facility fermentation room (1903)

Ushiku City, Ibaraki Prefecture

Nationally designated
important cultural property



Masonry structure buildings in Tsuchiura City (circa 1892)

Chuo, Tsuchiura City, Ibaraki Prefecture
Not designated



Great East Japan Earthquake (occurred on Mar. 11, 2011)



Nationally designated important cultural property
Yokotone Lock Gate



Kumamoto Earthquake (occurred on Apr. 14, 2016)



On the features of earthquake damage to masonry structure buildings (lectures given by Yoshimi Sato/Masayoshi Tanaka as held by the Architectural Institute of Japan, 1924)

- (1) The destruction of walls was more remarkable in upper floors.
- (2) Damage was remarkable in projecting parts such as gable walls and chimneys.
- (3) Corner sections are likely to be destroyed.
- (4) Damage is likely to concentrate on openings such as windows as well as entrances and doorways.
- (5) Flexural cracking is dominant in masonry walls.

Cultural property masonry structures that did not suffer earthquake damage (all the photos on this page were taken after the quake)



Hoffman kiln at the former Shimotsuke Brick Company
Important cultural property (Nogi Town, Tochigi Prefecture)



Gokiso Brick Warehouse
Registered (Mitsukaido, Josu City, Ibaraki Prefecture)



Red brick factory at the former Ashikaga Orimono Company
Registered (Ashikaga City, Tochigi Prefecture)



Former Kanaya Lace Manufacturing Corporation Sawtooth
Roof Mill Registered (Kiryu City, Gunma Prefecture)

Former Kanaya Lace Manufacturing Corporation Sawtooth Roof Mill
Currently used as Bakery Cafe Renga (Kiryu City, Gunma Prefecture)





Gokiso Brick Warehouse

Seismic diagnosis of masonry structure buildings

Guidelines for seismic diagnosis of important cultural properties (structures)

Decision of the Cultural Properties Protection Department Manager dated April 8, 1999

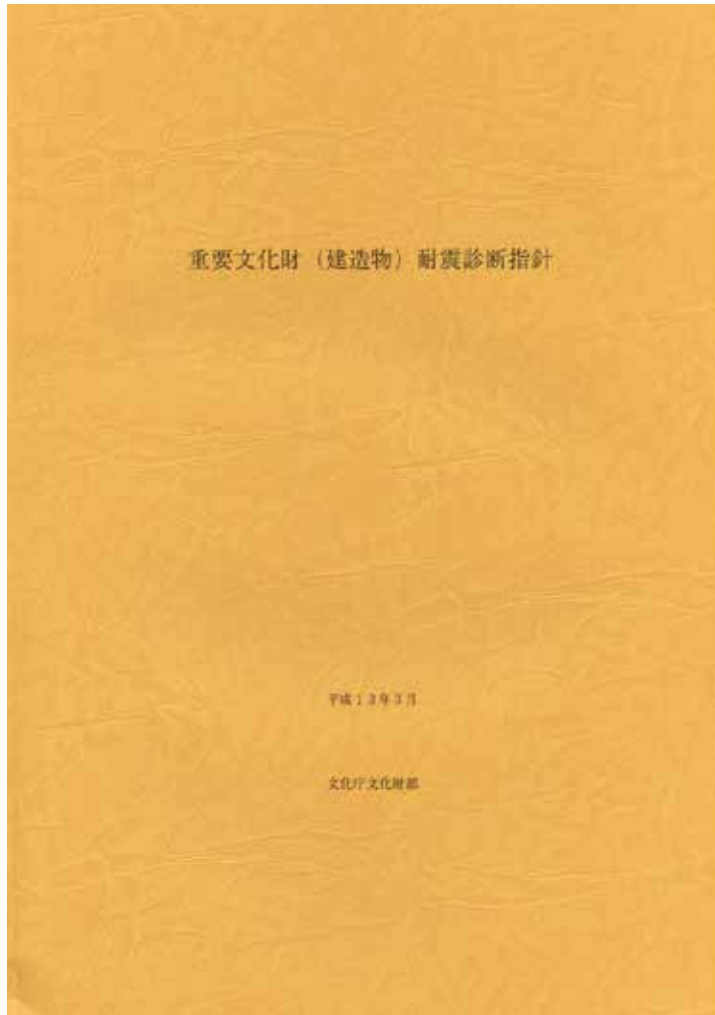
(Scope)

3 The specific techniques of seismic diagnosis shown in these guidelines are intended for, of the important cultural properties (structures), buildings with purely wood construction.

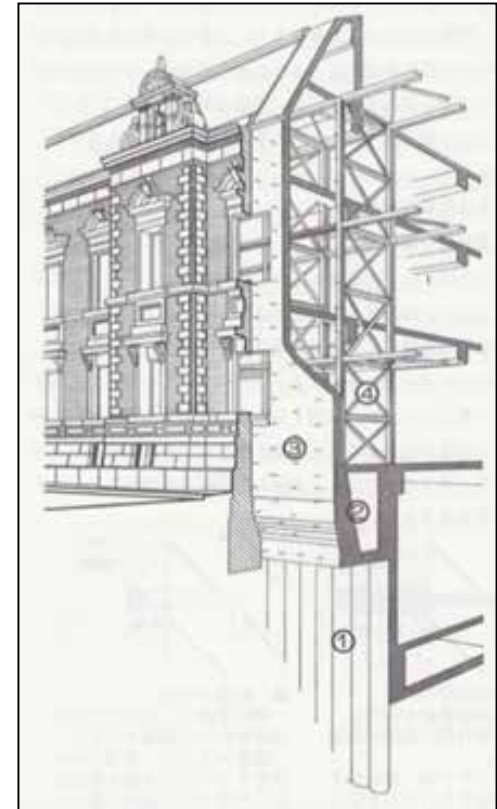
Note that seismic diagnosis shall be made on buildings other than those with wood construction (such as those of masonry construction, steel frame construction, and concrete construction) and civil engineering structures (such as bridges, tunnels, and dykes) as well, by means of techniques according to the type of construction of the applicable structure, by showing respect for the intent of these guidelines.

→ With regard to seismic diagnosis of masonry structure buildings, the aim of the guidelines is shown, but specific "procedures of diagnosis" are not shown.

http://www.bunka.go.jp/bunkazai/bosai/pdf/kokko_hojyo_taisin11.pdf



Seismic measures for masonry structure buildings

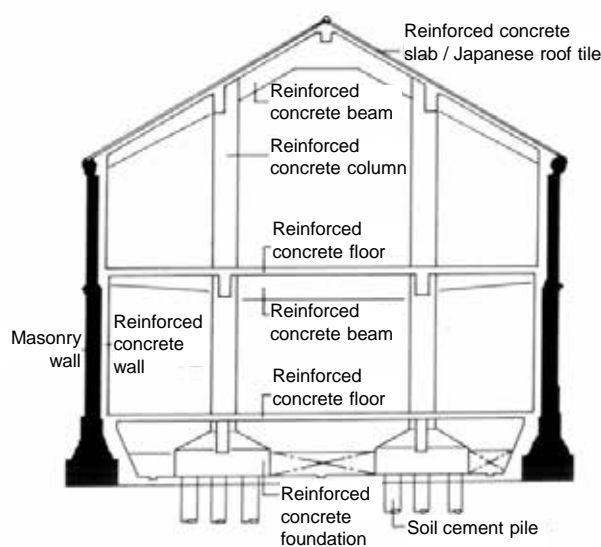


At the Nakagyo Post Office building, **reinforced concrete walls (200 - 300 mm) were newly built inside of the original masonry exterior walls**, and the walls were fastened tightly with anchor bolts. in the figure shows the newly built wall, and shows the temporarily built steel frame tower.

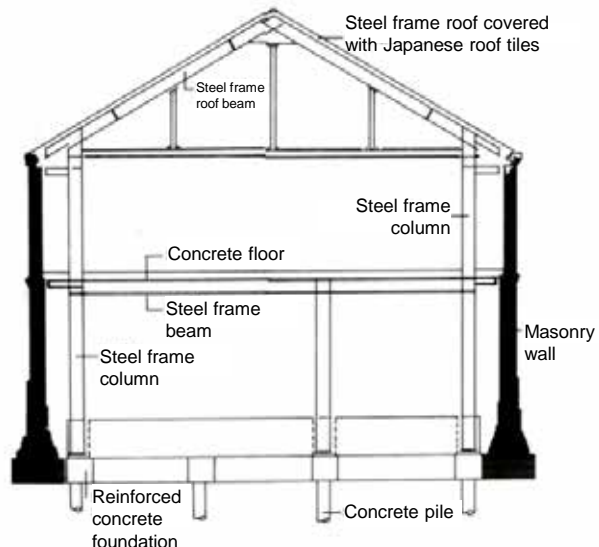
Nationally designated important cultural property

Former Kanazawa Army Arsenal Branch Factory (Ishikawa Prefectural Museum of History) 1909 - 1914

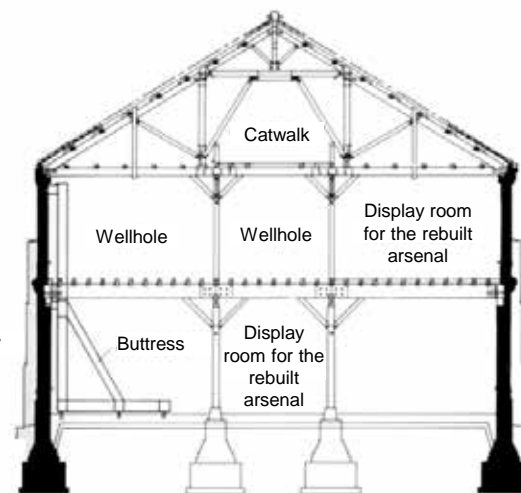




First building
<Reinforced concrete construction>

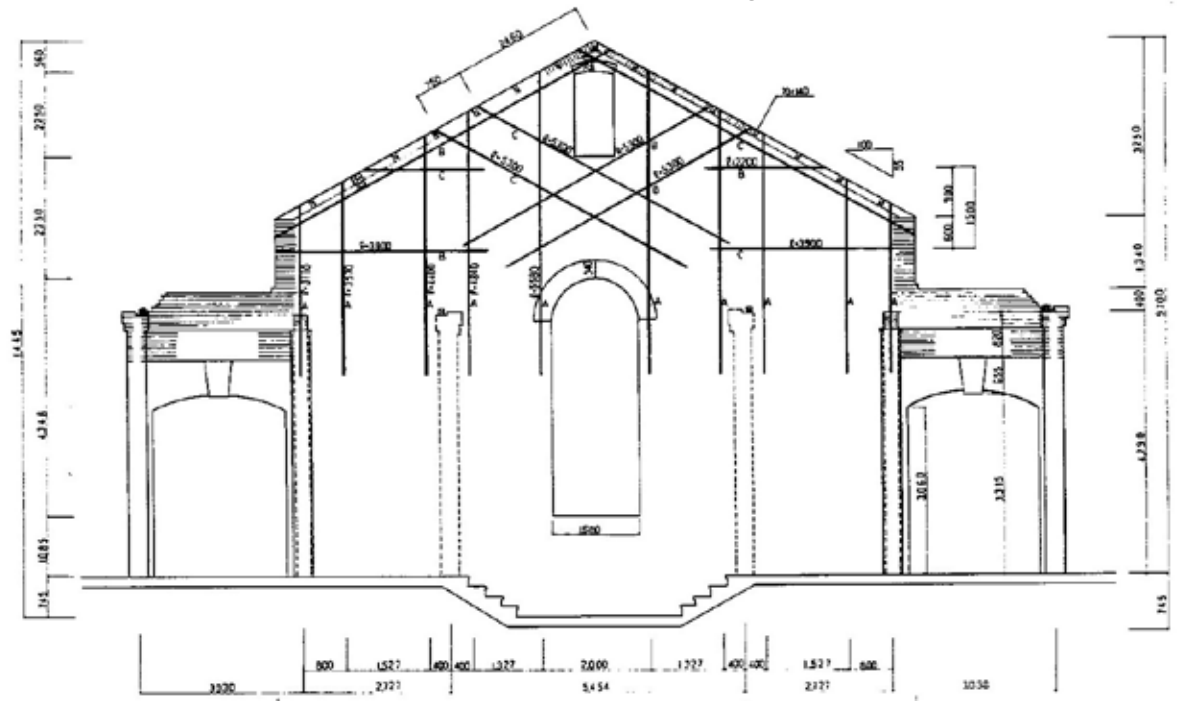


Second building
<Steel frame construction>



Third building
<Masonry construction + Steel-frame reinforcement>

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Nationally designated important cultural property

Former prefectural assembly hall of the Yamagata Prefectural Government



- With a view to increasing rigidity and withstanding strength of horizontal diaphragms, steel-frame made horizontal trusses were tightly fastened to the masonry wall with anchor bolts.
- With a view to increasing the seismic performance of masonry walls, inverted L-shaped buttresses of steel frame construction were provided in the exterior wall column-shaped portion, and at the indoor side L-shaped steels were installed in the wall crest portion.

Nationally designated important cultural property Former prefectural assembly hall of the Yamagata Prefectural Government





Reinforcement of the Château Kamiya former brewery facility fermentation room (a nationally designated important cultural property) **with steel frame buttresses**. Here, design properties of reinforcing materials were pursued such as the shapes of round steel pipes and jointed parts, their colors and texture.

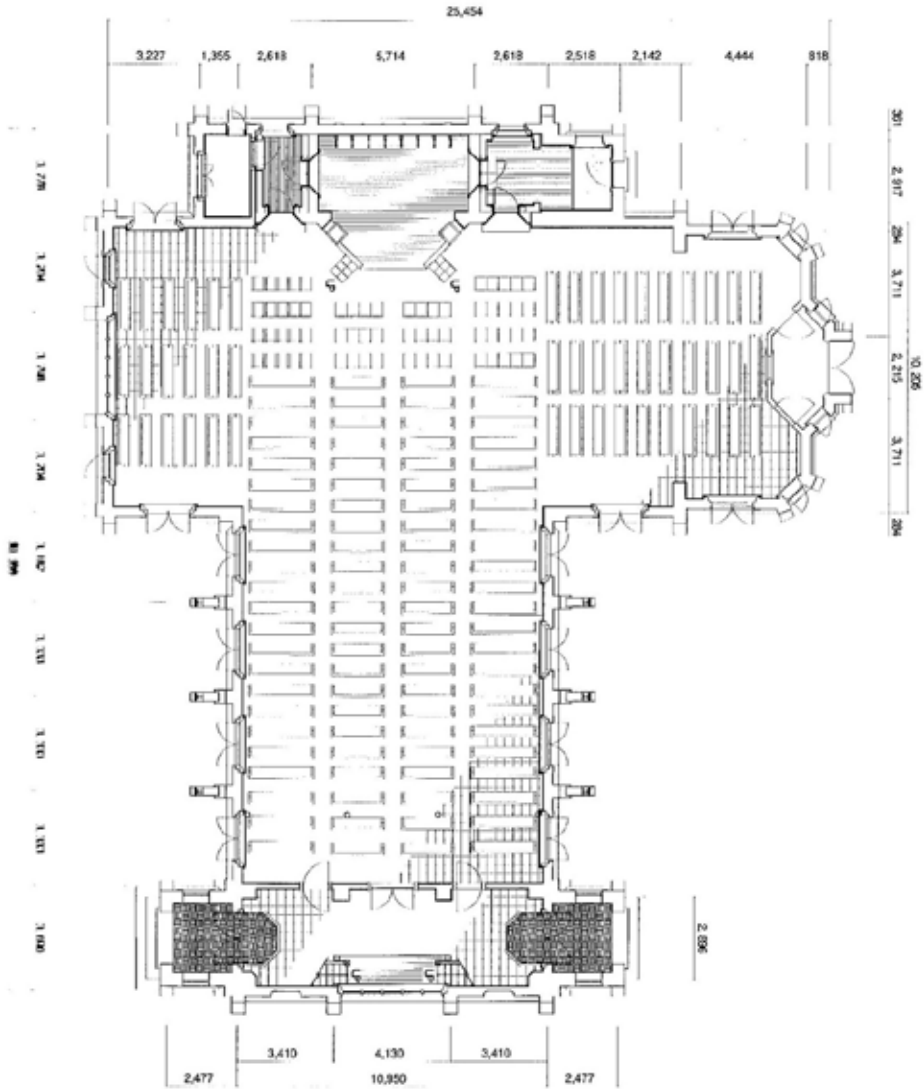


In order to protect the values of internal space, reinforcement from the inside was avoided, and seismic reinforcement was performed by newly installing external buttresses. With regard to cultural property structures, ways of reinforcement that involves external exposure of foreign matter were deemed to be out of the question 27 theretofore.



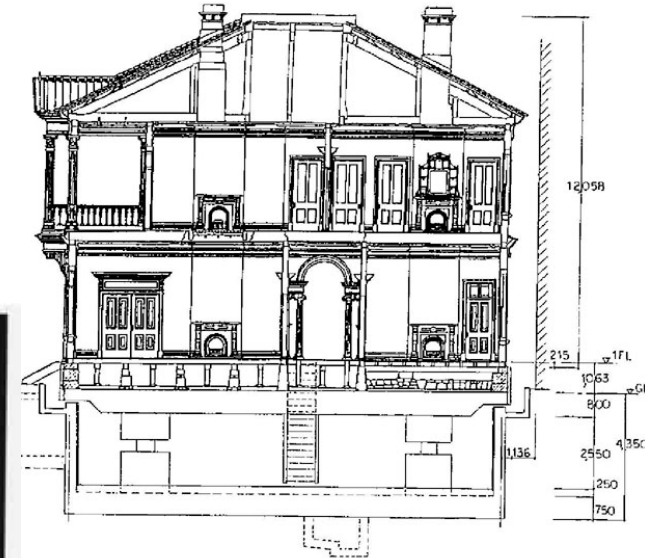
Repair of the Château Kamiya former brewery facility storehouse (a nationally designated important cultural property) after its damage caused by the Great East Japan Earthquake (Ushiku City, Ibaraki Prefecture)

Tangible cultural property designated by the Minato Ward Government in Tokyo
Metropolis Meiji Gakuin University Chapel Construction completed in 1916

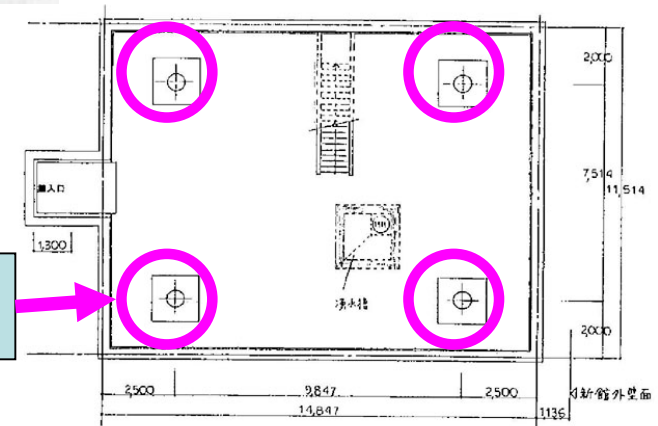


Nationally designated important cultural property Former Kobe Foreign Settlement House No. 15

- Damaged by the South Hyogo Prefecture Earthquake (Jan. 17, 1995). Rebuilt on a seismic isolation system



Seismic isolation system
of laminated rubber
mounts integrated with
lead

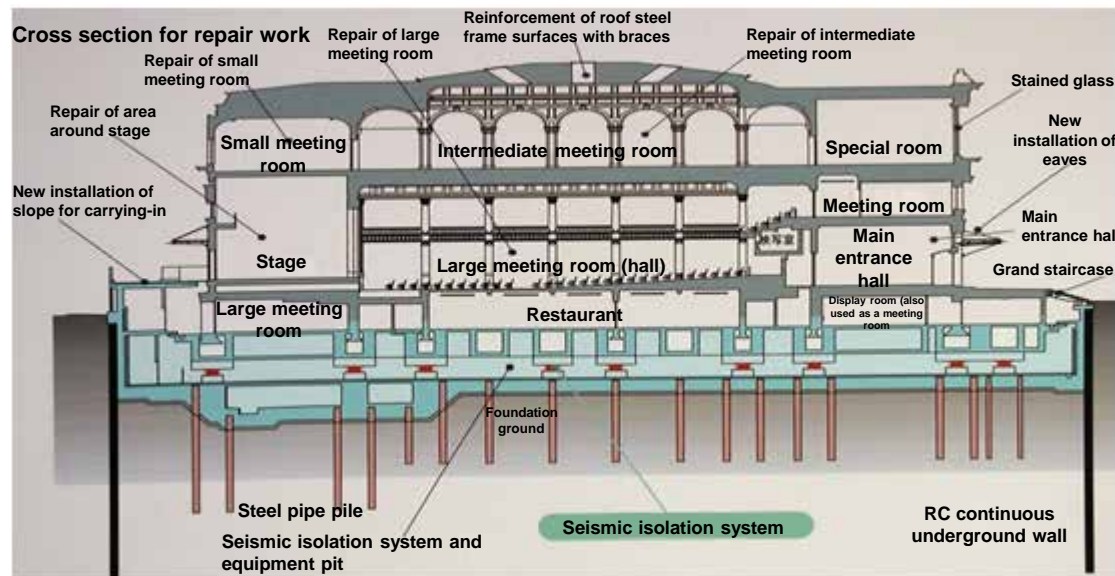




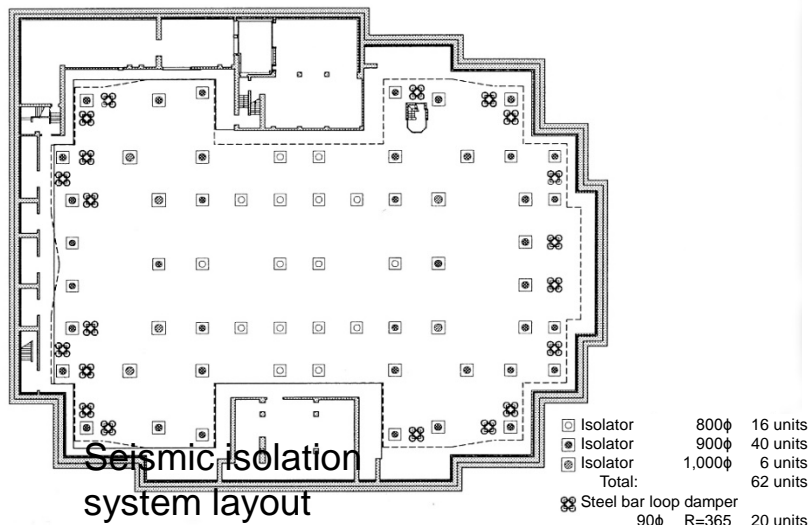
Nationally designated important cultural property Osaka City Central Public Hall Construction completed in 1918 / Repaired in 2001

- 3 floors above ground / 1 underground floor / 1 tower floor
- Total floor area: 8,425m²
- Masonry construction with steel frames
- Eaves height: 19.48m



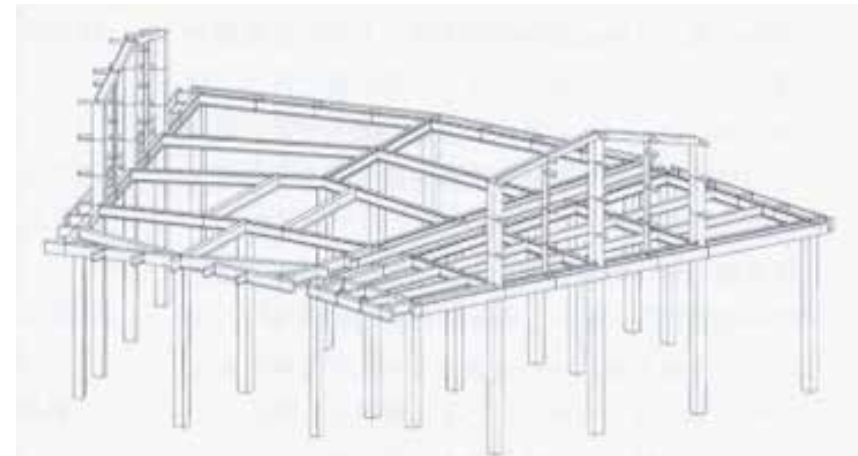


- With a view to improving the withstand strength of the foundation, a new RC structure was built under the foundation. The structure was integrated with the foundation by means of newly installed RC reinforcing beams.
- With a view to reducing seismic force to be input into the building, a foundation seismic isolation method was adopted.



Nationally designated important cultural property
Former Temiya railroad facility locomotive warehouse No. 3





In the former Temiya railroad facility locomotive warehouse No. 3 (a nationally designated important cultural property), **reinforcement** was performed **by means of steel frames**. Although rectangular steel pipes having a relatively large cross section were used, because black was used as their color and possibly due to their similarity to the displayed locomotive, the steel pipes are not so conspicuous. The deep layer mixing method, which is one of the ground improvement work methods, was used for the foundation for the newly installed steel frames.

Nationally designated important cultural property /
world cultural heritage

Mitsui Miike Coal Mine Former Manda Mine facility

Construction completed in 1909



Masonry Construction in Japan

Thank you for your attention.