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## Two Aspects of Structural Reinforcement of Historic Monuments

Deux aspects du renforcement structural des monuments historiques

Zwei Aspekte struktureller Verstärkung historischer Bauwerke

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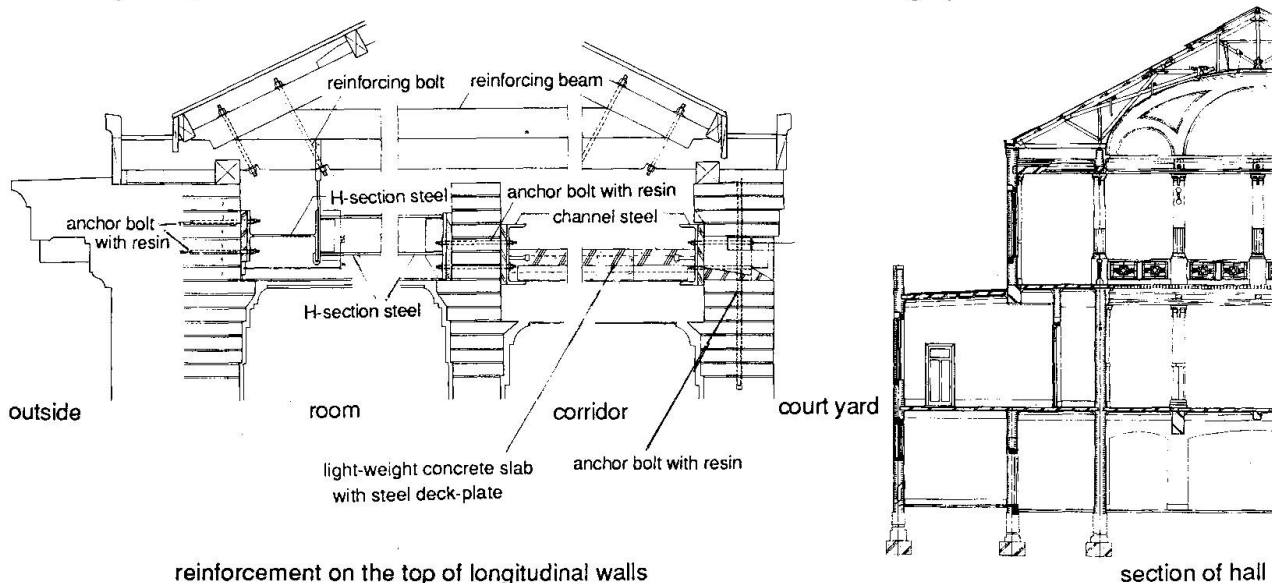
Structural reinforcement of historic monuments can be induced to preserve buildings either in their authentic condition or only in their outer appearance. Among recent restoration-conservation in Japan, remarkable examples are introduced in the following:

### Example 1. Nagoya High Court and District Court Building (Important Cultural Property)

Completed in 1922, Baroque Revival Style, building area: 2,241.8m<sup>2</sup>, 3 stories, base: brick & concrete, wall: brick, slab: reinforced concrete, beam: reinforced concrete, arch: brick, roof truss: timber, roof: copper, restoration: commenced in 1984 and completed in 1989,

Reference: Japanese Association for Conservation of Architectural Monuments, "Restoration of Nagoya High Court and District Court Building 1984-1989", Nov. 1989, Nagoya City.

On the poster, the whole structural reinforcement will be shown in detailed graphic form.



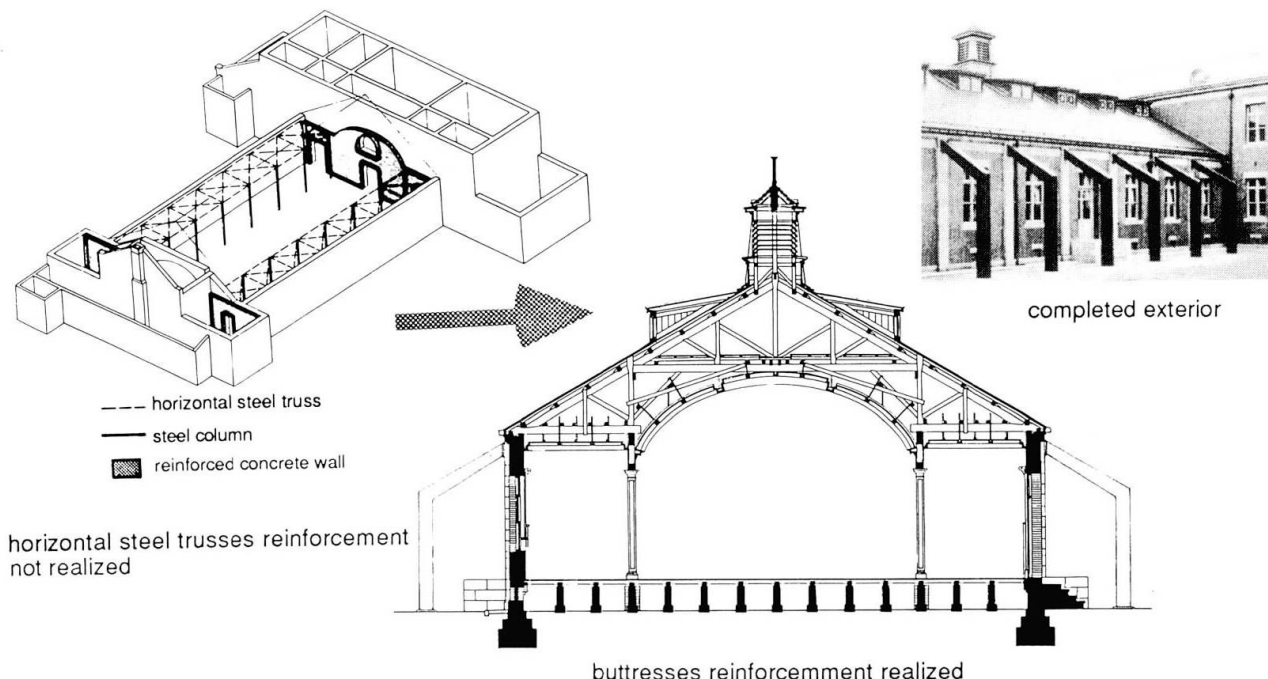
The highlight of this building is the central hall, a square of approximately 17x11 meters, which has an open space, 10.9x8.2 meters, from the ground floor to the ceiling of the 2nd. floor covered with a big top light. This space supported by brick columns and walls bound together with reinforced concrete beams and slabs was insufficient concerning resistance against earthquake. In order to prevent at the top of brick wall from bending, it was necessary to achieve a monolithic horizontal reinforcing structure. As important as the hall's spatial qualities as a cultural property are, as weak they are seen from the structural point. After thoroughly examination and discussion, they innovated careful and proper ways that the original appearance of hall was maintained without reminding any trace of reinforcement. To achieve a monolithic structure against the earthquake, the top of hall and roof trusses were reinforced by using buttresses, reinforcing bar, anchor bolt with resin and steel. The buttresses along the 2nd floor's wall face to the court yard can be seen only from the 2nd floor's veranda behind the hall. To connect walls/columns to beams/slabs, reinforcing bars and anchor bolts with resin were inserted in the brick columns, walls and beams, channel steel beams were used along the top of the brick walls and H-section or channel steel beams were used along the top of the façade and back walls. These reinforcements were put inside the structural frame and roof trusses.



**Example 2. Yamagata Prefectural Government Assembly Hall (Important Cultural Property)**  
Completed in 1916, Gothic Revival Style, building area: 866.4m<sup>2</sup>, 1 story/partially 2 stories,  
base: brick, wall: brick, floor framing: timber, roof truss: timber, roof: slate,  
restoration: commenced in 1986 and completed in 1990,

Reference: Japanese Association for Conservation of Architectural Monuments, "Restoration of Yamagata Prefectural Government Building and Assembly Hall Vol.1 / The Assembly Hall Report on the work 1986-1990", Mar. 1991, Yamagata Pref.

On the poster, the whole structural reinforcement will be shown in detailed graphic form.



The design of this building, which has a Basilica style vaulted ceiling with top lights, is unique for governmental assembly halls in Japan. Although the interior had been changed, the close investigation during dismantling made it possible to reconstruct the original condition with original materials. Reinforcing bars and structural steel were needed to strengthen the structure against earthquakes. For there was not adequate space to put horizontal reinforcing trusses along the top of the brick walls, the common reinforcing way like Ex.1. could not be applied. It would have been inevitable to change the original interior condition with additional new walls to support the trusses and they would have overlaid important vestiges on the original wall. After many examinations and discussions, it was decided that the walls of the hall were to be reinforced by using exposed structural steel such as flying buttresses on the exterior. Although buttresses are very striking and disturbing on the exterior, it was judged that the authenticity of the interior with its historical materials is more valuable and has to be given preference against an outer appearance with no reinforcing additions. This was the first time of this kind of restoration of a designated cultural property. In almost all previous restoration cases, preserving the historical outer appearance as a landmark in the townscape and preserving the historical materials was considered as equally important. The way of reinforcement in this case has given the chance to reconsider when restoring and preserving historical architecture.

Recently, conservation of Western style architecture built of brick during the Meiji and Taisho periods (1868 ~1912/1912~ 1926) is increasing. Brick structures which are relatively new to Japanese architectural tradition were not as highly developed as wooden structures. As was the case with wooden buildings in Japan, brick structures have also been refined in a principle that conceals the reinforcement in the interior and façade appearance, using reinforcing bars, braces and trusses in the roof or floor framing. But reinforcement sometimes deprives the architecture of some authenticity, in which the historical meaning which shows the particularity of that period is inherent. Reinforcement and authenticity are often contradictory.

When we decide what and how we must conserve, it is inevitable to define in detail what is authentic in the architectural construction, i.e., authentic style and authentic design. Yamagata's example, where the reinforcing structural steel is exposed, is in this sense remarkable. Planning the conservation and active reuse of historic monuments, we must primarily consider their "authenticity". It is very important to identify the historical value and meaning from various points of view. Suitable reinforcement should be decided according to these considerations.