Preservation and Restoration of Tokyo Station Marunouchi Building

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Isamu SUZUKI, born 1969, engaged in design supervision as a structural engineer, from 2005 to 2012, for the Preservation and the Restoration of Tokyo Station Marunouchi Building.

Summary

Tokyo Station Marunouchi Building that is a huge structure, its over 330 m-long and 3-stories high brick building was completed as the central station of Tokyo about 100 years ago. Since the roof and the inside were burnt down in the W.W.2nd.1945, it had existed in a temporarily restored form. For the purpose of preservation and restoration of the building to its original appearance, isolation system was adopted. The building has a complex relative location to the nearby structures, such as the viaduct located next to the east side, and the large passage leading to underground station for using all time on center of the building. As many as 352 isolators units and with 158 oil dampers have made it possible to control the shaking of the structures and prevent contact with the neighboring viaduct. This work was carried out safely, while many passengers have been using this nation's largest terminal station every day.

Keywords: brick wall structure; seismic isolation system; underpinning; inversed placing method; oil damper; time history response analysis; Prestressing steel strand

1. Introduction

This building is widely known as the "Redbrick Station Building" (designated as a national important cultural property in 2003), designed by Kingo Tatsuno. The isolation system was achieved by placing the existing upper structure on temporary supports (underpinning), adding an underground part by inverted construction. This construction was the first try for jacking up such a long and massive building, while continuing to use the building. And the system which can go through this building without using seismic isolation floor at all times was devised.

2. History of Tokyo Station Marunouchi Building

As an emergency repair work, the floors of three-stories were removed to two stories. And the north and south rotundas were covered with makeshift octagonal roofs instead of the original symbolic ribbed domes. To prevent the reduction of the architectural value of the original, therefore, isolation system was adopted, since it requires little additional structural reinforcement (Fig. 1). The situation which made this to be the most difficult problem was the fact that people were walking across over the boundary between the buildings with and without isolation measures.

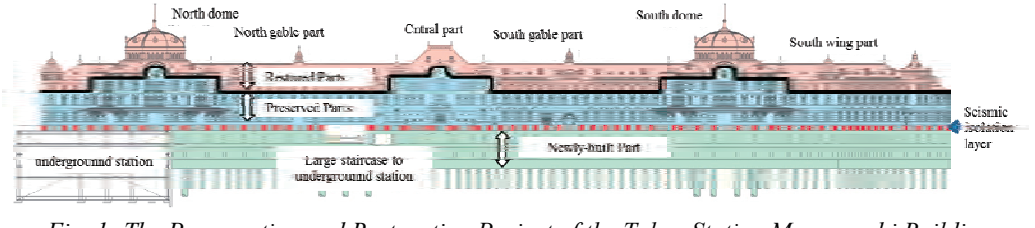

Fig. 1: The Preservation and Restoration Project of the Tokyo Station Marunouchi Building

3. Technology for preservation and restoration

The total weight of the aboveground structure is about 700,000kN, and the seismic isolation system used for this huge building is the largest in the history of Japan. It is possible to hold the seismic isolation layer deformation to about 12 cm even in a major earthquake (Fig. 2). The system which can go through this building without using seismic isolation floor at all times was devised (Fig. 3). For this system, in the central part of the building, passing to the underground concourse was enabled, without encountered at the boundary. Brick walls on both sides of the dome have been reinforced locally by prestressing with steel strands. By this method, risk of cracks has been reduced, without imparting appearance. Above and below the brick walls, It became possible to hand the axis power of the prestressing steel strands down to a brick wall uniformly by arranging RC beams at the top and the bottom of the brick wall(Fig. 4).

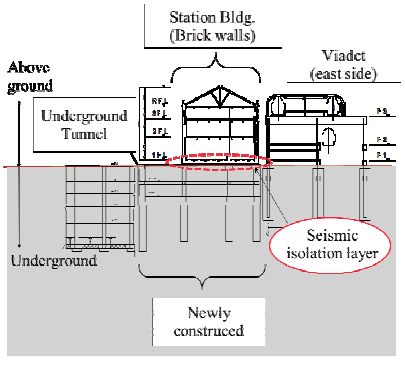

Fig.2: Location

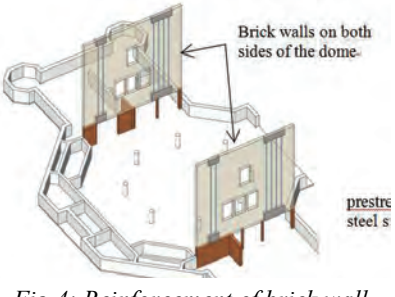

Fig.4: Reinforcement of brick wall with prestressing steel strands

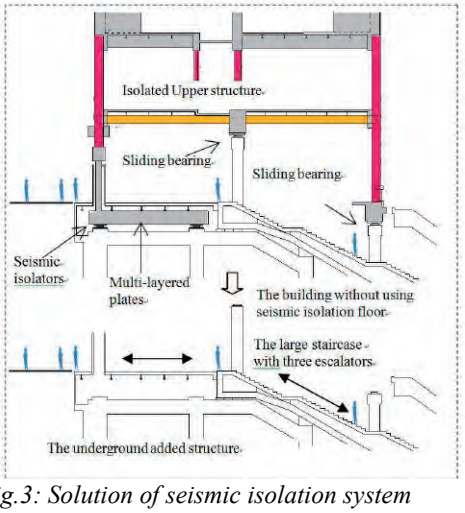

Fig.3: Solution of seismic isolation system for passenger traffic

4. Conclusion

This work was completed in October 2012 (for 5 and a half years), and carried out safely while many passengers continuing to use this nation's largest terminal station. This specialized structural system was developed for keeping not only the cultural but also the utility value of the building.

4.1 References

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