Sustainable and Quake-resistant Façade for Existing buildings

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Summary

This research challenges the customary reinforcement methods which are only focusing on the structural performance and proposes an integrated-façade-system which not only consists of the necessary seismic retrofit, but also significantly improves the environmental and architectural quality of existing buildings. A buckling restrained brace to increase the seismic resistance was developed with minimum dimensions and in such way that it can be perfectly integrated and harmonized with a façade louver system. The louver system makes it possible to control and optimize the heat load and the daylight entering the building at the perimeter. Furthermore, deploying the system on the outside of the building also ensures continuity in its usage. At first the system has been singled out to be used for the main gathering points in the cities' disaster evacuation plans, but due to its flexibility it could easily be extended to other facilities in the future.

Keywords: integrated facade; seismic retrofit; refurbishment; sustainablity.

1. Introduction

Throughout history, the attitude of the major cities in Japan has been one of wanting to have the newest and most modern buildings, which has been intrinsically linked to repeatedly demolishing and replacing the existing infrastructures by fancy new ones. This short life span of buildings in Japan is remarkable and in the current climate of sustainable design, promoting the continued usage of buildings through improvement of their functionality will be an important factor in the process of decreasing the usage of resource materials and reducing the emission of CO2, both associated with the construction process and the operation of the building.

Meanwhile, Japan's history has been characterized by several severe earthquakes. The most recent one in Kobe in 1995 (magnitude 7.3 on the moment magnitude scale) has caused 6434 dead and 43792 injured people (reference1) and it was assessed that in particular buildings from before the change of Japan's building regulations in 1981 were unable to resist a major quake. Considering the fact that about 50 percent (reference2) of the current building infrastructure in Japan dates back from before 1981, an important amount of buildings are in need of a seismic resistance structural retrofit to meet the current regulations and to reduce the amount of casualties in case of a major disaster. In that way, it is clear that the renovation of buildings will become prevailing over the current tabula rasa approach.

Keeping the above in mind, this research is challenging the widely spread retrofit methods which purely focus on the structural aspect and proposes an integrated-façade-system which integrates façade engineering techniques in the fields of structural engineering, environmental and architectural design and adds extra value to the reinforcement of the existing buildings.

The functions aimed for in this integrated-façade-system are shown in Figure 1. The structural function seeks to reduce the maximum response displacement and to improve the load-bearing capacity through energy absorption by a bracing system. The environmental function seeks to reduce the seasonal energy input through the addition of control mechanisms that block direct

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