Seismically Isolated Building for Disaster Prevention and long Life

Satoru Nagase
Chief Structural Engineer
Nikken Sekkei Ltd.
Tokyo, Japan
nagases@nikken.co.jp

Satoru Nagase, born 1959, received his master of architectural engineering degree from the Univ. of Chiba.

Yasuhiro Tsuneki
Director
Nikken Sekkei Ltd.
Tokyo, Japan
tsuneki@nikken.co.jp

Yasuhiro Tsuneki, born 1956, received his doctor of architectural engineering degree from the Tokyo institute of technology.

Norio Nakanishi
Structural Engineer
Nikken Sekkei Ltd.
Tokyo, Japan
nakanishin@nikken.co.jp

Norio Nakanishi, born 1974, received his master of architectural engineering degree from the Tokyo institute of technology.

Summary

Japan is one of the most earthquake prone country. Seismically isolated structure is not only reduces damage and maintains building functions but it's also an excellent structural system that contributes to environmental protection in the sense that buildings have longer service life.

In addition to the fundamental "base isolation" in which the seismic isolation layer is installed in the lowest part of building, there are many other applications. For example, the "middle floor isolation" in which seismic isolation layer is installed on the middle floor, and "seismic retrofitting" in which existing historical buildings dramatically improve their earthquake-resistant performances.

We introduce a recent innovative application in this paper, seismically isolated office building that uses Superframe in combination with suspension structure.

Keywords: seismically isolated structure; disaster prevention; maintains building functions; column-free; flexible; superframe; suspension-column; environmental protection; long life

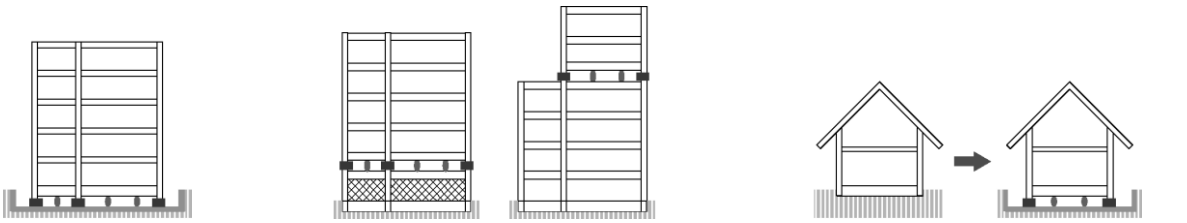


Fig. 1: Applications of seismically isolated Structure

1. Recent innovative Application in new Office building

Fig. 2: Headquarters of "Shinano-mainichi shinbun"

This project is new 12-storied head office building about 60 m tall for a newspaper publishing company. (Fig.2) The design concept is as follows.

1. Deliver a building of high seismic capacity and thus capable of retaining its operational functions in the event of disasters as a new headquarters of a newspaper company.
2. Develop a plan that allows the construction of a new building while maintaining the functions of the existing building.
3. Create an office space of great openness and high flexibility as well as a long life span.

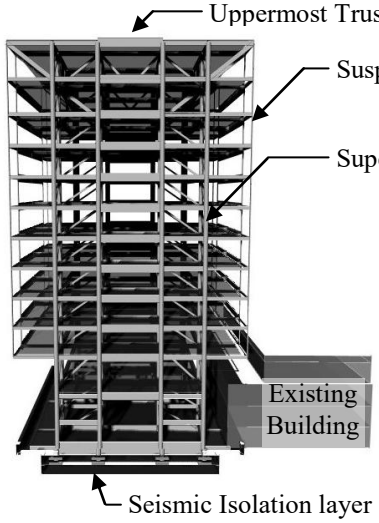
https://doi.org/10.2749/222137809796089098

2. Structural Concept

Fig.3 shows the structural concept.

Seismically isolated structure for securing good earthquake resistance

- The building is designed to allow newspaper publication to continue even after a major disaster.
- Safety assured during major earthquakes that could occur at active faults in the vicinity of Nagano City.
- All loads are transmitted to the isolation members directly below the eastern and western cores. A minimum number of large-diameter bearings is adopted.
- Best use is made of the advantages of a seismically isolated structure, lengthening the natural period of the building and slowing building sway.



Transmission of loads with suspension structure

- The floor overhang of about 7 m is supported by suspension columns on the northern and southern exterior walls. These transmit the loads to the superframe.
- Large floor areas are secured on the standard floors and the new building was built while avoiding interference with the existing low-rise office building and keeping the existing building functioning.

Superframe with columns in the cores

- The columns are in the eastern and western cores and 25.6 m span beams connect the cores to create column-free easy-to-use office space.
- Vertical and horizontal loads are all borne by the superframe.

Foundation plan that capitalizes on the good bearing stratum conditions

- Capitalizing on the good bearing stratum conditions, the foundations are placed directly below the eastern and western cores.
- Economy is achieved with the foundations by minimizing the footprint and depth of the foundations while reducing the excavation volume.

Cost effective structure

- The earthquake forces transmitted to the superframe are reduced by adopting a seismically isolated structure.
- The weight of steel in the superframe is reduced.
- The weight of steel is further reduced by adopting concrete-filled steel tube columns and truss beams.
- The cost of earthquake-resistant fixings for equipment and pipes is reduced.

Fig. 3: Structural Concept

Fig 4: Interior view of column-free open Office space

Fig.4 shows interior views of the building. The column-free open spaces enhance the flexibility of office space layout and realize office spaces that are long-lasting and easy to use.

3. Conclusions

The authors are proud to have realized a long-lasting and attractive building with column-free easy-to-use office space that is not only resistant to earthquakes but also good for the environment through the adoption of a seismically isolated structure that utilizes a combined superframe and suspension structure.