Seismic isolated building covered with designed RC structural frame

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Summary

Ikebukuro Daiichi-Life building is a new-generation seismic isolated office building which combines safety and security, attractive facade, user-friendly office space. Design of this building is inspired by Japanese traditional lighting equipment. This is called "ANDON" in Japanese. This is also called "Japanese oriental lamp" in English. It's fire bowl is covered with a shade consist of grid-like bamboo frame and Japanese paper. (Fg.1) Like ANDON, this building is covered with grid-like slim RC frame and glass windows (Fg.2). At night, light stream through the RC frame and this building seems like a large ANDON .This outer RC frame is an aggregation of small PCa (Precast) RC units and glass windows are directly embedded to them. This frame is major structure and external material at the same time. This design oriented slim structure is realized by high spec seismic isolated system. The following is a description of the structural design.

Keywords: seismic isolated structure, office building, pre-cast concrete, hybrid structure, seismic response analysis, wind response analysis, designed frame,

1. Building Plan

Name	: Ikebukuro Daiichi-Life building
Building site	: 2-30-11, Minamiikebukuro, Toshima-ku, Tokyo
Client	: The Dai-ichi Life Insurance Company
Design	: Takenaka Corporation
Construction	: Takenaka & Nihon-kensetu joint venture group
Building area	: 502.89 m^2
Total floor area	: 5293.09 m^2
No. stories	: B1 F10 P1
Structure	: Hybrid structure (S+RC)
Height	: 40.63 m

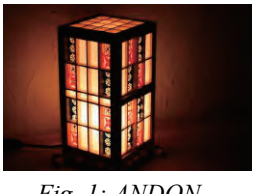

Fig. 1: ANDON

Fig. 2: Appearance

2. Structure Plan

This building is middle layer seismic isolated building. Seismic isolated floor is on B1 column top. Basement floor is RC structure. Foundation type is spread foundation and thickness of basement slab is 2,000 mm. Fig.3 shows Standard Floor Plan. At the standard floor, S structure and RC structure are placed unsymmetrically. The main member of column is □-500×500, beam is H-588×30×12×20, brace is H-488×300×11×17. For the long span beams (pin joint) under the office area, H-496×199×9×14 are used. This girder was put every 1.8 m. By this, low floor height (3.6m) and normal ceiling height (2.7m) were both realized. This building height control eliminated the use of Emergency elevator and expanded effective floor area. Section size of Outer PCa RC Frame becomes progressively smaller (3 steps). Maximum size is 450×600 mm, minimum size is 300×600 mm. Different size PCa RC member was created from same variable form which is developed for this project. By this, streamlining of concrete volume and gradation of facade were realized at the same time. At the lower floor, this thick outer frame interrupt line of sight from the main street in front of this building. At the higher floor, this thin outer frame creates an open office area.

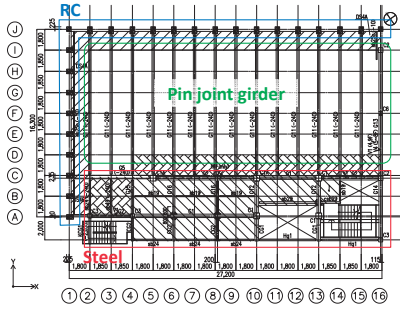

Fig. 3: Standard F Plan

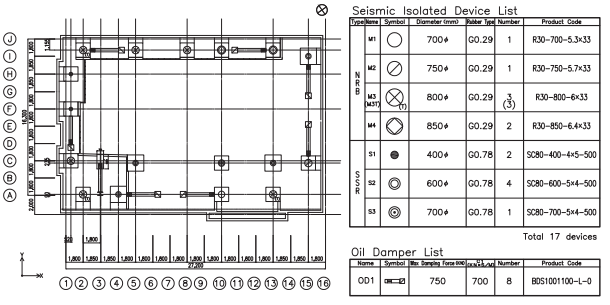

Fig. 4: Types and layout of devises

3. Seismic isolated devices plan

In order to realize both structural safeness and design oriented structure, earthquake load must be cut down as much as possible. For this reason, NRB (Natural rubber Bearing) and SSR (Sliding Support with Rubber-pad) and OD (Oil Damper) are selected. By them, this building achieved excellent seismic capacity. Own natural period of seismic isolated floor is 5.8 second. Base shear factor is 0.075. Fig.3 shows types and layout of devises. Center of gravity of upper structure and center of rigidity of seismic isolated devices are almost same. Eccentricity ratio of devices is 1.1%. Long term stress of NRB is 1.3-10.3 N/mm^2.

4. Precast concrete plan

Fig.5 shows 1 unit of PCa RC member. Fig.6 shows a joint between girder and girder. Joint between girder and girder is pin-joint with HTB. This is dry joints for easy construction. Fig.7 shows a joint between column and column during construction period. Joint between column and column is rigid joint with mechanical joint. This is wet joints. During construction period, before grout injection, temporary support is used to fix and adjust columns. By adopting these systems, construction process of these PCa RC members are simple and short like steel members.

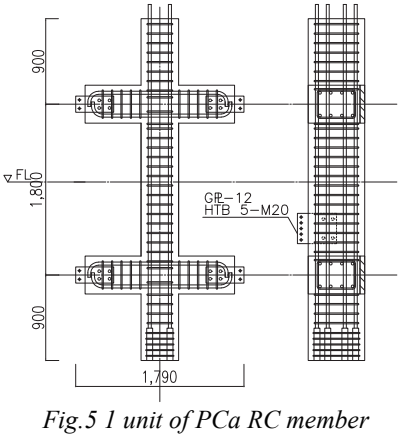

Fig.5 1 unit of PCa RC member

Fig.6 joint (girder-girder)

Fig.7 joint (column-column)

5. Conclusion

For fear of Southeastern sea earthquake, demand for seismic isolated structure must be going to increase in Japan. In addition to this, to attract tenant owner, designed facade and user-friendliness of office space is also important for office building. Ikebukuro Daiichi-Life building achieved important elements for architecture “solid, useful, beautiful” by adopting seismic isolated structure. It is very rare case. In the near future, this building set the pace in Japanese office building I think.