130m-high Office Building with Transpiration Louvers and Variable Seismic-Isolation System

Miwa Sadamoto
Structural Engineer
Nikken Sekkei LTD.
Tokyo, Japan
sadamoto@nikken.jp

Tomohiko Hayata
Structural Engineer
Nikken Sekkei LTD.
Tokyo, Japan
hayata.tomohiko@nikken.jp

Tomohiko Hayata
Structural Engineer
Nikken Sekkei LTD.
Tokyo, Japan
kounot@nikken.jp

Summary

A major structural theme of the current project was to secure improved seismic resistance by adopting seismic-isolation devices appropriate for an office building in the shape of a thin vertical plane having a height over 130m. Because of the steel-structure flat vertical shape of the building, the anticipated wind load generated by a typhoon would be larger than the seismic load reduced by the seismic-isolation system.

Keywords: High-rise buildings; intermediate level seismic isolation structure; tension structure.

1. Introduction

This is an office building that includes a research and development area, built as part of the redevelopment of the West Area of Osaki Station. In this building a bioskin has been adopted for the façade on the station side (north-east side) to reduce the surface temperature of the building by the transpiration effect, based on the concept “constructing a high-rise building like planting a tree”. This not only controls the environment within the office, but also contributes to controlling the surrounding environment.

An office where it is possible to work without anxiety about earthquakes was a requirement for the new research and development center. Incorporating the relationship with the surrounding buildings into the scheme, an intermediate level seismic isolation structure has been adopted in which the seismic isolation layer is below the 2nd floor pedestrian deck level that connects to the station.

The building has a slender shape in plan in the predominant wind direction out of consideration to the surrounding environment. Therefore, it was necessary that the seismic isolation layer that was designed to be flexible in order to exhibit the seismic isolation effect in an earthquake can ensure safety against large wind loads and ensure dwelling comfort against wind oscillations. In other words, the main task for this building was to produce a building that was safe against the different natural external disturbances of earthquakes and wind.

In this building, oil dampers that have a mechanism capable of closing the movement of oil in the interior were adopted as seismic isolation members. These oil dampers are controlled by a wind anemometer on the roof of the building, displacement meters on the seismic isolation layer, and velocity meters installed on several stories, so that during strong winds the oil dampers lock to resist the wind load. On the other hand, for considerations of economy, steel damping members are used in combination with the oil dampers during an earthquake, to enable the inter-story drift and accelerations in an envisaged large earthquake to be reduced to about half the levels if there was no seismic isolation.

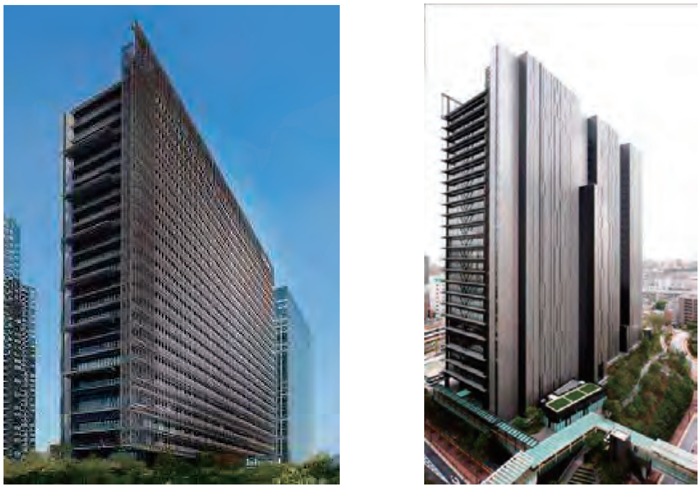

Fig. 1 : Northwest external view

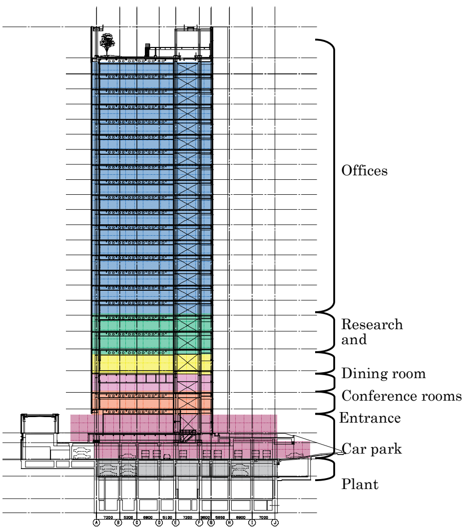

Fig. 2: Cross-section

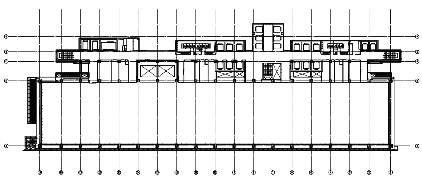

Fig. 3 : Plan: 24m×130m offices with no columns

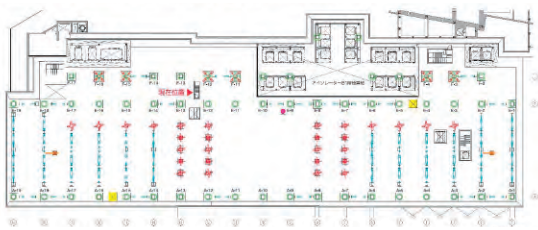

Fig. 3 : Intermediate Level Seismic Isolation

Fig. 9: Oil damper with locking mechanism

Fig. 4 : Tension structure using stainless steel rods