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4. Onerie Center, Chicago, Illinois (USA)

Owner: PSM International Corporation, Chicago, Illinois
Architects/Engineers: Skidmore, Owings & Merrill, Chicago, Illinois
Construction Manager: PSM International Corporation, Chicago, Illinois
Completion date: 1984

Introduction

Onerie Center is a multi-use high-rise complex located on the Lake Michigan shore line near downtown of Chicago. It is comprised of two towers, a 58-story main tower with a tapering auxiliary low-rise building (Fig. 1). The total building, with an area of 92,000 sq. ft. (85,000 m²), is divided into five distinct areas by function (Fig. 2). On the ground floor of the main tower and the connecting low-rise building is the main public lobby and 1,860 m² of commercial space. Parking area occupies the basement and four floors above the lobby. Floors 6 through 10 of the tapering base as well as floors 2 through 11 of the auxiliary tower provide office space and are organized around two interior atriums.

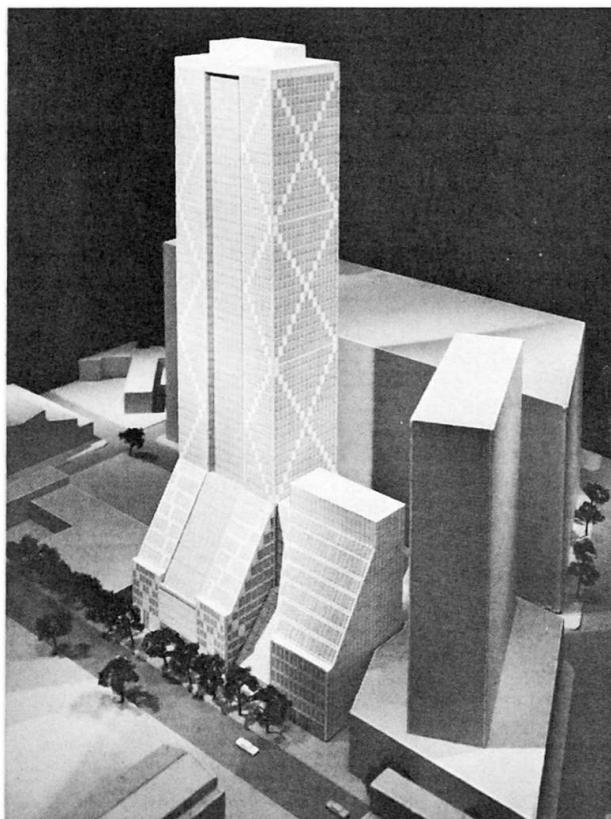


Fig. 1 Onerie Center, Chicago, Illinois – A rendering

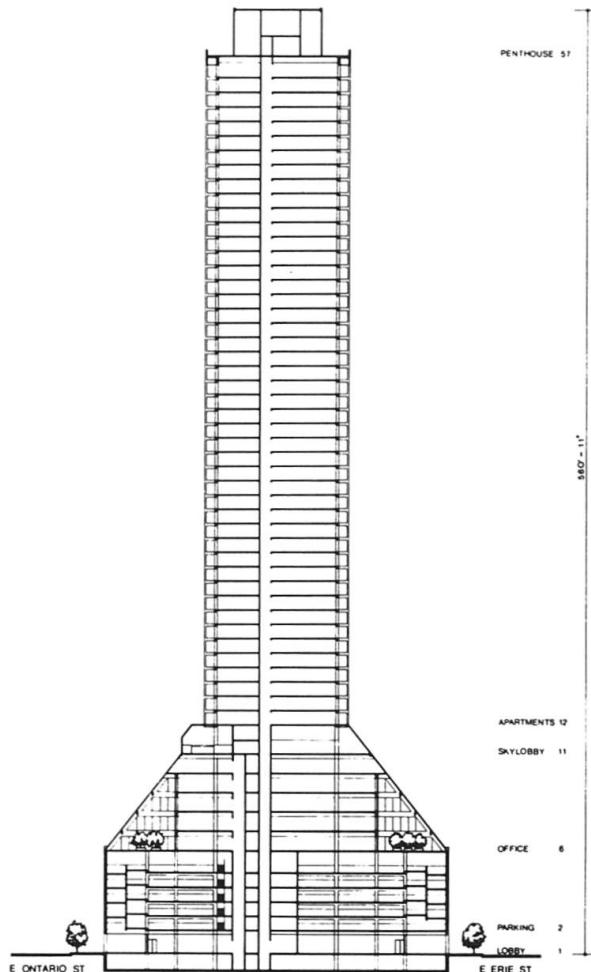


Fig. 2 Onerie Center – North-South section

The sky lobby at level 1 includes a health club, swimming pool, hospitality room and mechanical equipment space. Levels 12 through 58 consist of one, two and three-bedroom apartments, for a total of 593 units.

Structural Concepts

Mixed-use high-rise structures demand flexibility in column spacing and core layout. Therefore, maximum structural efficiency and functional flexibility can be achieved by utilizing the exterior frame of the building only for the lateral force-resisting system. In the Onerie Center's main tower, the entire lateral force-resisting system is achieved by closely spaced exterior columns and spandrels of reinforced concrete construction. Additional lateral stiffness and structural efficiency was achieved by infilling the window space with concrete in a diagonal pattern. These reinforced concrete infill panels act not only as diagonal braces as in steel high-rise structure but act as a shear panel as well (Fig. 3).

By going diagonally across the building, the infill panels tie columns and spandrels together and help to evenly distribute the gravity loads on adjacent columns. They also help to reduce the shear lag in the tube frame and thus contribute to the structural efficiency of the system. As a result the entire lateral stability of the building is achieved by two exterior diagonalized tubular channels located at each end of the tower structure. Interior columns carry gravity loads only thus allowing more flexibility in planning the interior space and eliminating the differential creep between the core walls and adjacent columns, had a core wall been utilized in resisting lateral loads.

Structural Design

A three-dimensional computer model was used to analyse gravity and wind load cases. It was found that the lateral drift due to design wind pressures at the top of the building was well below the $H/600$ design limit. Perimeter columns are 48 cm x 51 cm and about 1.68 m on center. The 51 cm thick infill panels have diagonal reinforcing bars as well as horizontal and vertical reinforcement (Fig. 4). The concrete cylinder strength for the exterior tube and the interior columns varies from 7,500 psi (52 MPa) at the base to 4,000 psi (28 MPa) at the top. The floor structural system is flat slab construction with thicknesses that vary between 17.8 cm for the apartment floors to 21.6 cm for the commercial floors. The concrete strength for the flat slab is 35 MPa. Interior column spans are about 6.71 m on center. Exterior columns, spandrel and infill panels are insulated to minimize temperature deformations between perimeter and interior columns. The building foundation consists of circular concrete caissons founded on the hard pan, a silty clay formation located about 24 m below grade level. The caisson bottoms are flared out in circular and oval bells to afford more bearing area. The allowable soil pressure is 1.95 MPa.

Summary

The combination of exterior tubular concept and diagonal shear panels introduced in the Ontario Center provides a unique example in achieving a higher level of structural efficiency and creating different architectural expression.

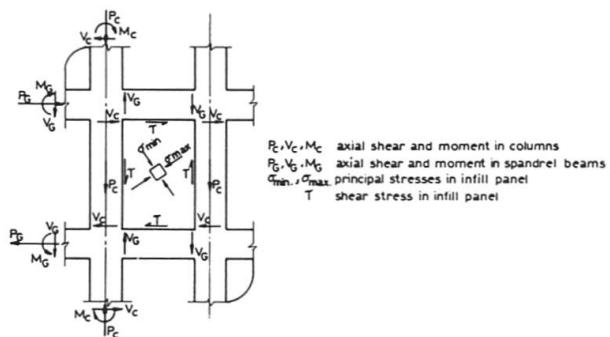


Fig. 3 Forces on typical infill panel caused by lateral loads

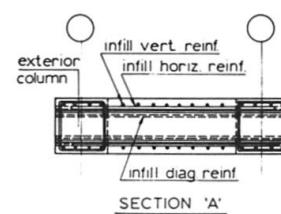
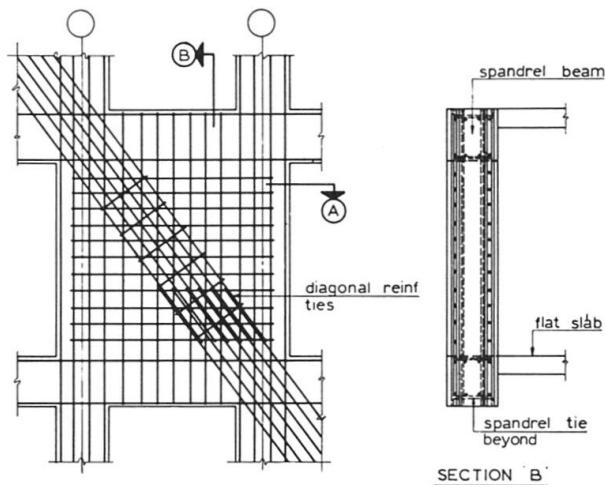


Fig. 4 Typical infill – Panel detail