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3. One Magnificent Mile, Chicago, Illinois (USA)

Owner:	<i>The Levy Organization, Chicago, Illinois</i>
Architects:	<i>Skidmore, Owings & Merrill, Chicago, Illinois Brancik, Conte & Associates, Chicago, Illinois</i>
Structural Engineers:	<i>Skidmore, Owings & Merrill, Chicago, Illinois</i>
Construction Manager:	<i>Schal Associates, Chicago, Illinois</i>
Construction dates:	<i>1981-1983</i>

Introduction

One Magnificent Mile project is a 57-story, multi-use project involving parking, commercial, office and condominium spaces, all in one building. The structure occupies a prominent L-shaped site facing Lake Michigan with a diagonal vista. A free-form structure was conceived that can be molded around the L-shaped site, and which would also provide vertical modularity to suite office and condominium spaces. The result was a clustered tube reinforced concrete system involving three hexagonal-shaped modules, as shown in Fig. 1. The north tube is 57 stories, the south tube is 49 stories and the west

tube is 22 stories. The structural system has been developed to provide for parking at lower levels and condominiums in the north and south tubes above the 22nd level. All three tubes are used for office space and a 7-story bustle on the northeast corner is added for the commercial floors.

Structural System

A typical office floor plan is shown in Fig. 2. An optimum interior column spacing of 30 ft. x 30 ft. (9.15 m x 9.15 m) was selected for the west tube. It is obvious that this spacing could have been much smaller for an apartment flat plate floor. In the north tube where all the elevator cores are located, the location of the interior columns were determined exclusively by the most desirable apartment layout plan. In the south tube, a staggered column arrangement, 20 ft. x 30 ft. (6.1 m x 9.15 m) was found to be optimum because while it satisfied the apartment layout plan for the upper floors (Fig. 3), it also worked very well for the office space and also for the two parking levels. As for the exterior framed tube, architecturally the requirement was such that the column spacing would be different for different functions. At the apartments it varies from 2'-6" to 9'-0" (0.76 m to 2.74 m). At the office floors the spacing was 10 ft. (3.05 m) and at the commercial and parking levels it was 20 ft. (6.10 m) typically. The interior tube column spacing at both the apartment and office levels was kept to 10 ft. (3.05 m) typically. The three framed tubes bundled together in a free form arrangement made it possible to satisfy both the interior as well as exterior column spacing requirements for each of the multiple use functions in this complex building. The structural efficiency of the bundled tube system further made the design and selection of the form a logical choice.

One of the advantages of the concrete tube system is that wall openings can be rearranged according to the requirements of each function. The office space required a uniform grid of columns at 10 ft. centers, while the apartment grid was variable due to locations of different types of rooms. In the punched wall tube, these are accomplished simply by providing opening and modulating the spandrel depths in order to transfer loads appropriately.

Structural Design

A three-dimensional model was used to analyse and optimize the structure under gravity and wind loads. Flat plate was used in condominium levels and flat slab with drop panel was used in office, parking and commercial areas. Concrete strength varied between 4,500 psi to 5,500 psi (31.03 MPa to 37.92 MPa). Due to the free form floor support layout, finite elements analysis of the reinforced concrete were carried out.



Fig. 1 One Magnificent Mile building, Chicago, Illinois — A rendering

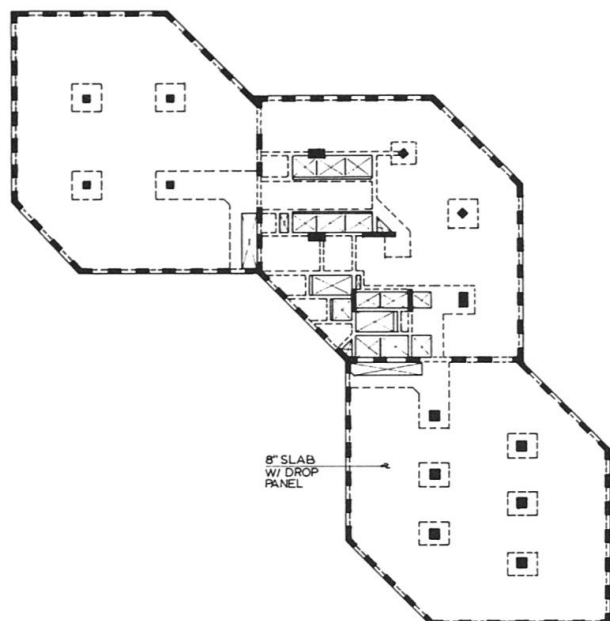


Fig. 2 Typical office framing plan

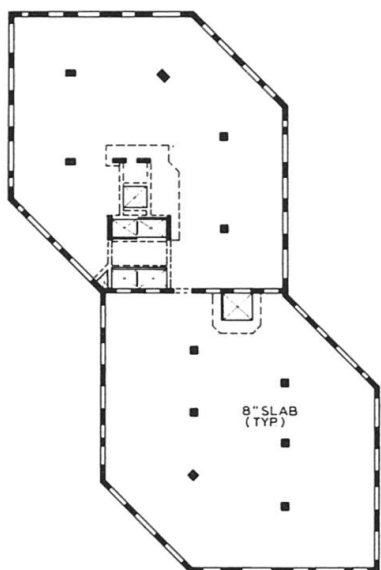


Fig. 3 Typical condominium framing plan

Column concrete strength ranged from 8,000 psi (55.16 MPa) at ground level to 5,000 psi (34.47 MPa) at near roof levels. Columns have been instrumented to measure shrinkage due to elastic shortening, shrinkage and creep.



Fig. 4 One Magnificent Mile building under construction

The exterior spandrel beams at the apartment levels had to be upturned, which needed particular care in detailing, to avoid an increase in the cost of construction of these beams. However, along the interior column line between the north and south tubes, some of the beam segments had to be downturned to allow for a corridor to pass through. The changing of the spandrel beams from an upturned position to a downturned position presented a special detailing and design problem. The building is now under construction, as shown in Fig. 4.

Summary

The One Magnificent Mile project is indeed a synthesis of recent concrete structural developments for tall buildings and represents the trend in multi-use urban projects.