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Autor: Culham, G.A.

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3. NOVA Head Office Buildings, Calgary (Alberta)

Owner:	*Novalta Properties Ltd.*
Architects and Stuctural Engineers:	*J.H. Cook Architects and Engineers*
Contractor:	*CANA Construction Co. Ltd.*
Construction Dates:	*July, 1979 to September, 1982.*

General Description

The 37 storey building contains the Corporate Headquarters for NOVA, An Alberta Corporation (Fig. 1). In addition to providing unique office space, the complex includes a North Service Building, Cafeteria, glass enclosed Restaurant and Garden Court, connecting bridges to adjacent buildings and below grade parking for 340 cars. The floor areas are as follows:

Office Tower:	85,763 m^2
North Service Building:	5,067 m^2
Garden Court:	827 m^2
Restaurant:	530 m^2
Bridges:	676 m^2

Fig. 1 Completed building

Structural Design and Analysis of the Tower

The unique configuration of the building (Fig. 2) derives from the requirement that a maximum amount of sunlight should be permitted into the adjacent Century Gardens Park. The non-symmetrical eccentric shape of the building presented an interesting and challenging engineering problem. The building exhibits unique aerodynamic properties such that it behaves like a crude air foil in addition to having a significant torsional mode of behavior. This behavior resulted from the building's unusual non-symmetrical shape and the eccentricity of its mass centre from the centre of resistance.

Lateral and torsional wind loads are resolved by the composite floor deck diaphragms to the central concrete core, and structural steel post and beam construction is utilized to efficiently follow the irregular configuration of the outside wall of the tower and to carry gravity loads (Fig. 3).

Current technical literature gives adequate direction for analyzing dynamic load for the two basic modes of sway of a structure, however little information is available as to how to compute the dynamic load for the torsional mode of behavior, or as to the resolution of structures of unique configuration. Therefore, an analytical approach was pioneered to predict the true dynamic response of the structure in the two basic modes of sway coupled with the torsional mode.

Exhaustive dynamic and static finite element computer analyses were performed on the structure to determine stress, displacement, acceleration, frequencies and the degree of coupling of the modes of behavior. Extensive wind tunnel testing was conducted on both a static and aeroelastic model of the building in the Boundary Layer Wind Tunnel at the University of Western Ontario, London, Ontario to determine the wind pressures on the structure and to confirm the dynamic response of the building in its environment.

Foundations

The building is founded on spread footings that were placed on the underlying sandstone and shale and were designed on a 800 KPa bearing pressure.

Shoring

Four levels of underground parking were provided. Therefore, extensive shoring was required to accommodate the 14 metre-deep excavation.

Floor Framing System

There was an architectural requirement that the floors should be clear spanned 12.5 metres from the centre core to the exterior wall to provide maximum flexibility in office layout.

An all-air heating and ventilation system was selected for the building which required numerous duct penetrations through the beams or a significant increase in floor to floor height to permit passage of this ductwork below the beams.

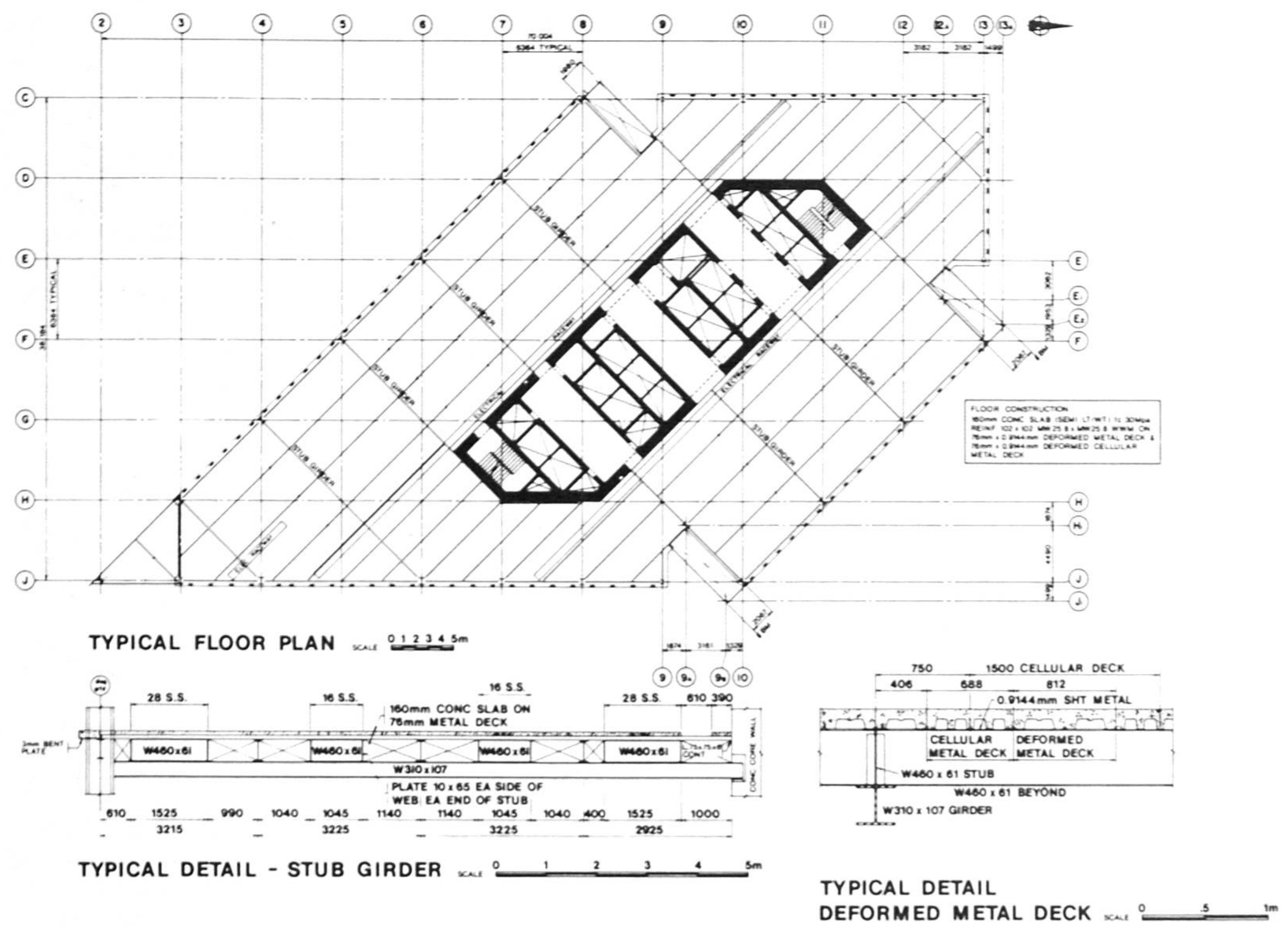

Fig. 2 Typical floor plan and details

A structural steel stub girder composite floor system was selected because it efficiently and economically solved the previously mentioned requirements.

The stub girder system permits the use of continuous composite secondary floor members which are economical, and provide a stiff floor with excellent dynamic characteristics.

Electrical trenches and cellular decking were provided on a 1.5 metre module in the structural slab for electrification of the floor. The modular layout of the floor and the use of the stub girder system permitted complete integration of the structural, mechanical and electrical systems (Fig. 2).

The use of the stub girder floor system for the NOVA Head Office Building was a first for Canada, and was developed by the Engineers in concert with the Canadian Institute of Steel Construction. A full scale test girder was tested at the University of Alberta, Civil Engineering Testing Laboratory to verify the computer analysis and the design of the girders. The tests provided sufficient information to permit a reduction in the number of stiffeners and welds that were originally tought to be required. The stub girder framing system served to reduce the overall building height by an equivalent two storeys and shortened the construction schedule by several months, thus resulted in a significant cost saving to the Owner.

(G.A. Culham)

Fig. 3 Tower under construction