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7. Stadium at B.C. Place, Vancouver, (British Columbia)

Owner:	*British Columbia Place Ltd., a Provincial Crown Corporation*
Architect and Engineer:	*Phillips Barratt, Vancouver, B.C.*
General Contractor:	*Dillingham Construction, North Vancouver, B.C.*
Duration of Work:	*30 Months*
Opening Date:	*June, 1983*

The Stadium at B.C. Place (Fig. 1) is a covered multi-purpose stadium with 60'000 seats, serving the 1.5 million people of the British Columbia lower mainland. Located in downtown Vancouver, it accommodates football, soccer and baseball, and in the half-stadium mode, tennis and basketball, as well as concerts, exhibits, trade shows and circuses. Overall dimension are 190 m × 231 m, in a superelliptical shape. The interior clear height is 60 m.

Design Concept

The roof, with an unsupported area of 4 hectares (10 acres), had a major impact on the entire design and cost. An inflated fabric roof was selected, necessitating special provisions for air tightness, revolving and pressure balanced doors, a double air-lock system for loading doors, a roof snow-melt system, and emergency generators to supply the fans in the event of a power failure.

The super-elliptical shape was adopted as it satisfied all of the major criteria. It most closely approximates the thrust line of the outer compression ring which anchors the roof cables, minimizing the bending moments. It allowed the optimum sight distances to the playing field, and was the shape most easily contained on the site which is restricted by two adjacent bridges.

Soil conditions were favourable, with good glacial till near the surface over most of the site. All foundations are spread footings, with only one minor exception. Allowable bearing pressure was 380 kN/m^2. This structure is in seismic Zone 3. The light weight of the roof was a major factor in reducing the cost of seismic resistance.

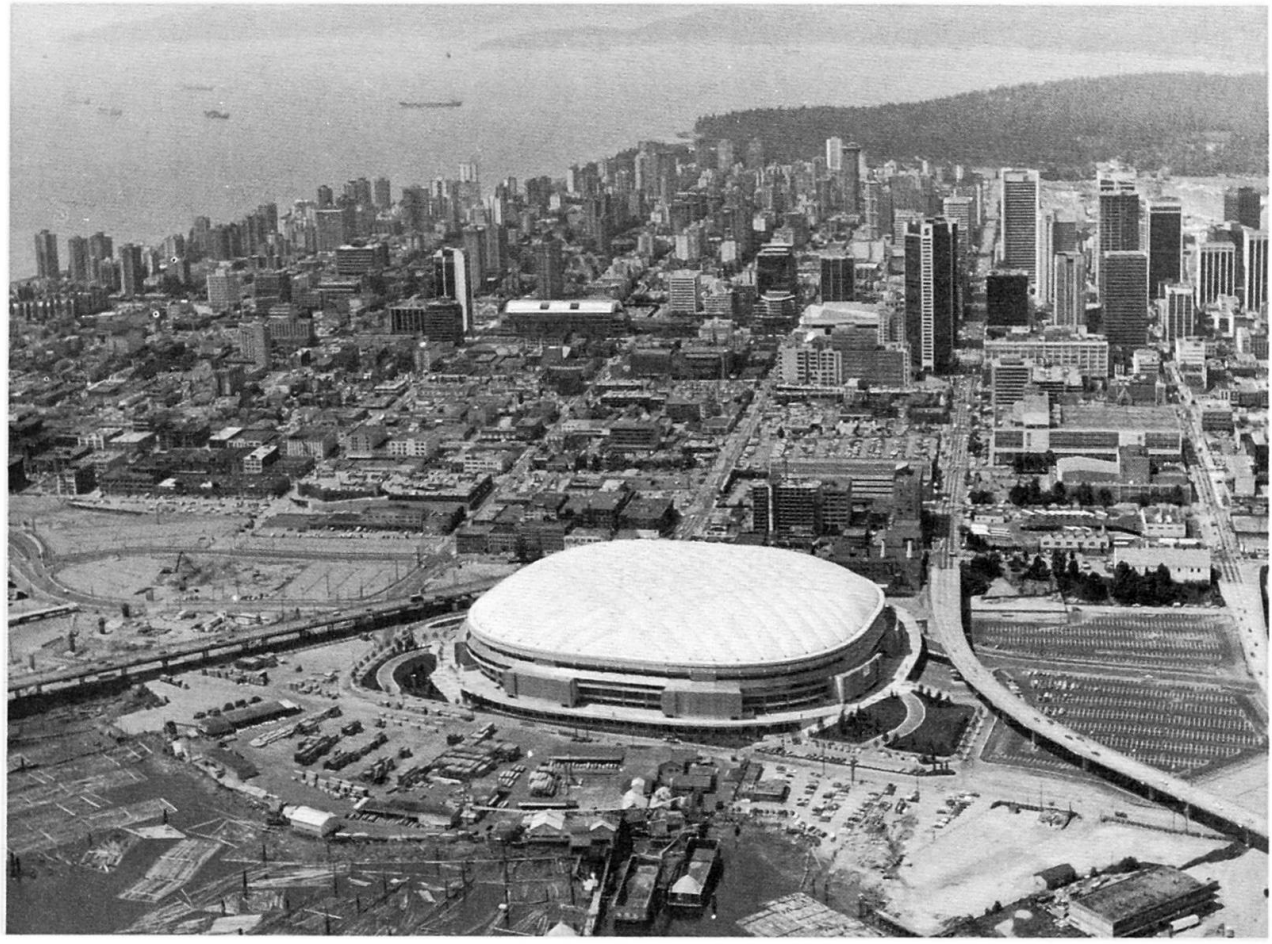

Fig. 1 Stadium at B.C. Place

Due to the Canadian football field being larger than in the U.S., the 60'000 seats could be arranged on two tiers instead of three, allowing a reduced height and excellent sight lines with much lower slope of risers than in most comparable stadia (Fig. 2). Four perimeter levels provide access to the playing surface, seating, and various services such as storage, food concessions, and media facilities. Levels 1 to 4 are connected by a series of enclosed sloping ramps, evacuating on to an open-air elevated plaza surrounding the stadium.

Moveable and telescopic bleachers provide for quick conversion from one event to another. The rubber-tired moveable steel stands, which are stored under the concrete seating in the baseball mode, were designed by the Engineer and fabricated locally at a comparatively low cost. The synthetic turf system is German-manufactured, 100% polypropylene, and behaves more like natural grass than most others on the market today.

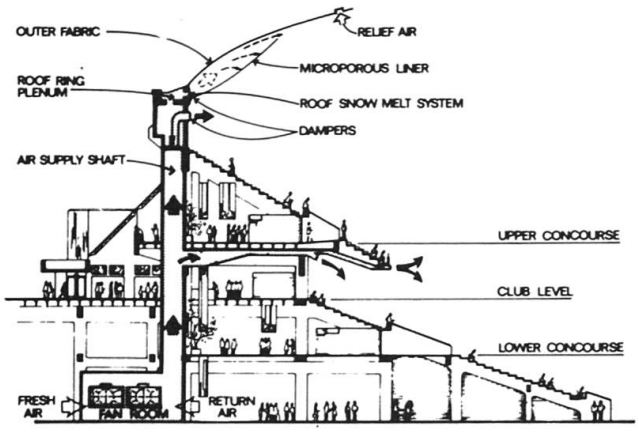

Fig. 2 Cross section of stands

Roof and Structure

As distinct from conventional rigid roof structures, the fabric roof and its steel cable net do not act in bending or shear, but in tension under the action of internal pressure maintained by large fans. Due to the low dead load of approximately 7.3 kg/m², an internal pressure of only 23 kg/m² (255 Pa) can easily maintain the inflated mode. To this end, the exterior skin of the building is designed and built to be reasonably airtight. In high wind conditions, a pressure of 600 Pa can be maintained to limit roof motion. Although sixteen 100 h.p. fans are provided, only onehalf the capacity of one fan is required to maintain roof inflation.

In the inflated mode, should a snowfall occur, warm air is introduced into the space between the inner and outer fabrics, thus melting the snow and allowing it to slide off the roof. In the deflated mode, the roof will support a snow load of 117 kg/m². The roof panels have drains which open under a low head to facilitate drainage in the deflated mode.

The outer roof membrane is Teflon-coated fibreglass fabric, 1.27 kg/m² in mass, and 0.81 mm thick. The inner liner is Teflon-coated microporous acoustic fibreglass fabric, 0.41 kg/m² in mass and 0.31 mm thick. The two-way cable net consists of 11 strands in each direction,

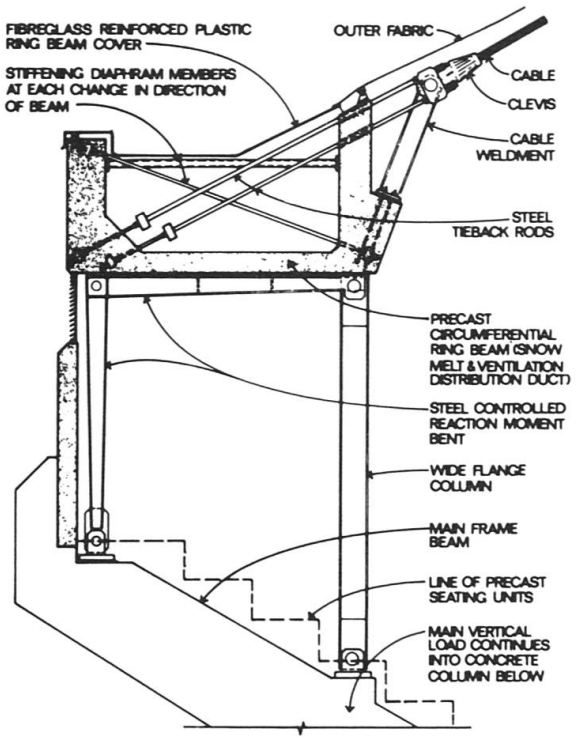

Fig. 3 Compression ring and bent

18 of which are 70 mm in diameter and 4 are 76 mm in diameter, with ultimate strengths of 4022 and 4790 kN respectively. These are anchored into a 700 metre long concrete compression ring, which is supported on stiffness-limited steel bents to control lateral movement, (Fig. 3).

Fifty-four main frames radiate from the field, extending to the underside of the ring support bents. They are cast-in-place concrete, analyzed as ductile moment-resisting frames, and support the precast-prestressed seating and concourse floor units. To facilitate multi-use formwork, most of the beams and columns are sized 600 mm by 1200 mm. Parallel to the field, a cast-in-place tie beam and shear wall system resists the seismic forces.

(I.M. Nitkin)