Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 71 (1994)

Artikel: National Indoor Arena of Birmingham designed for flexible operation
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DOI: https://doi.org/10.5169/seals-54141

National Indoor Arena of Birmingham Designed for Flexible Operation

Stade national couvert de Birmingham conçu pour de multiples utilisations

Nationale Sporthalle von Birmingham konzipiert für Mehrzwecknutzung

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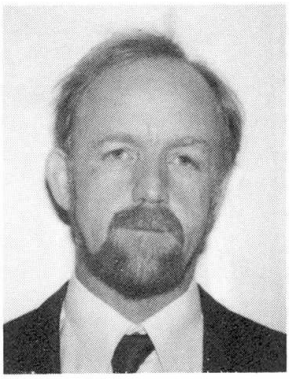

David Phillips obtained his degree in Civil Engineering at the Univ. of Surrey, Guildford in 1974. Since then he has worked for John Laing Construction on many projects, principally in the Midlands area. From 1982 he has been regional engineer for Laing Midland.

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Alan Carney gained his initial experience in the aerospace manufacturing industries. Since 1989 he has been the Engineering Manager initially for the International Convention Centre and, on completion, of the National Indoor Arena, responsible for both the ICC and NIA.

SUMMARY

The National Indoor Arena was designed and built for the City of Birmingham to provide Birmingham with a first class venue for indoor sporting events and to accommodate a wide variety of non sporting events. The building complements the facilities at the International Convention Centre and the National Exhibition Centre. This paper describes how the key elements of the structure were designed to allow for flexible operation and to provide a low maintenance structure.

RÉSUMÉ

Le Stade national couvert a été conçu et construit pour la Ville de Birmingham afin d'offrir un lieu de première classe équipé pour accueillir des compétitions sportives en salle et un grand nombre d'événements non-sportifs. Le bâtiment est un complément aux facilités du Centre International des Congrès et du Centre National d'Expositions. Cet article décrit le projet des éléments clés de la structure en vue d'un fonctionnement flexible et d'un entretien minimum .

ZUSAMMENFASSUNG

Die Nationale Sporthalle wurde für die Stadt Birmingham entworfen und gebaut. Sie sollte Birmingham einen erstklassigen Zusammenkunftsort für die verschiedensten Veranstaltungen sportlicher und nicht sportlicher Art bieten. Das Gebäude ergänzt die Einrichtungen des Internationalen Kongresszentrums sowie des Nationalen Messegeländes. Dieser Bericht beschreibt, wie die Hauptelemente des Bauwerks entworfen wurden, um flexible Einsatzmöglichkeiten und ein Gebäude mit geringen Instandhaltungsanforderungen zu gewährleisten.

1. LOCATION

The National Indoor Arena is situated to the North West of the International Convention Centre and is bounded on the South and East sides by the Birmingham canal network and on the North and West sides by local roads. The site is split by the main London - West Coast Inter city rail line, the building forming an extension to the Monument Lane Railway Tunnel which passes under the International Convention Centre. A plan of the Arena and surrounding multi-storey car parking is shown in Figure 1.

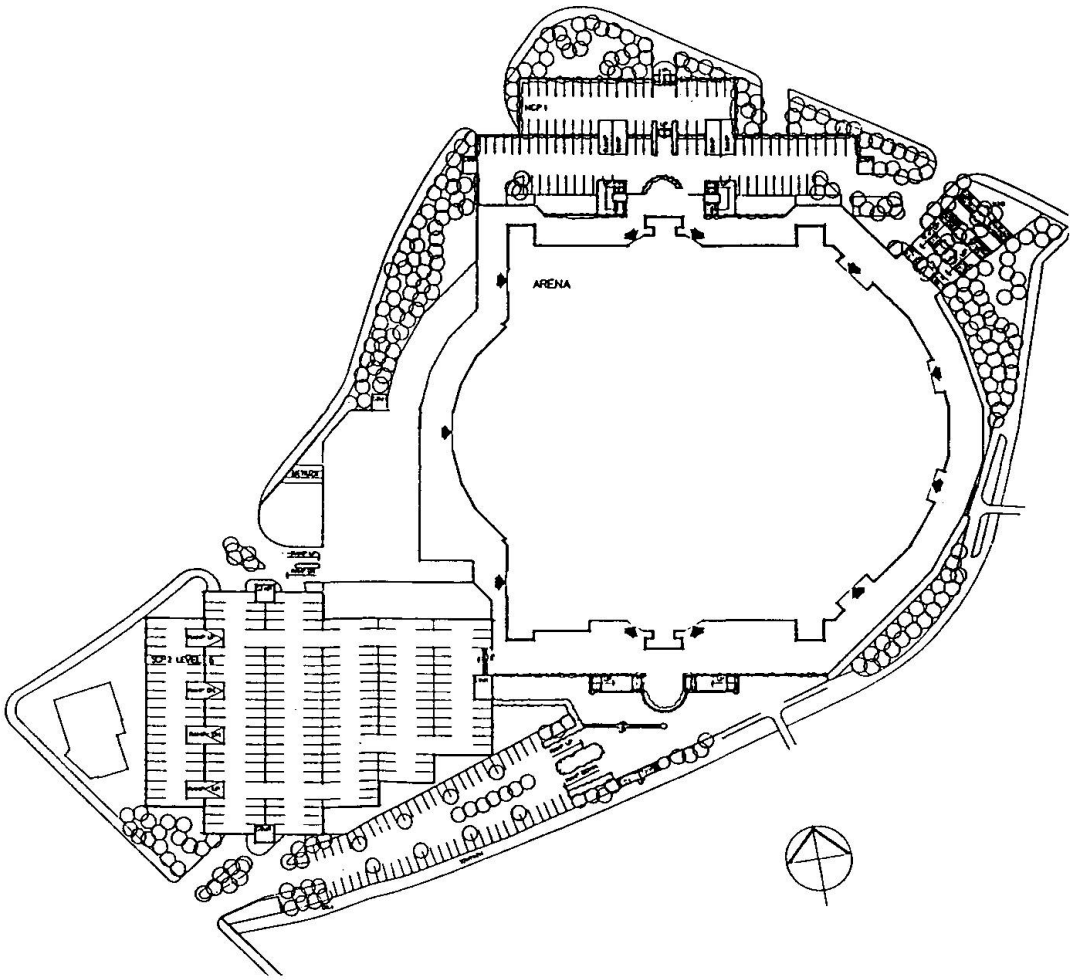

Fig.1 Plan of the Arena and car parks

2. OPERATION

2.1 Flexibility of Use

The National Indoor Arena is designed to be adaptable to enable many types of indoor sporting events to the held, typical uses are:

Athletics Tennis Badminton Squash Volleyball Basketball Boxing Wrestling Ice Skating Gymnastics Powerlifting Bowls

and many others.

The National Indoor Arena also caters for a wide variety of non-sporting events, typically:

Rock concerts TV shows (e.g. Gladiators) Conferences Opera Classical Concerts Company Meetings Exhibitions.

The National Indoor Arena is used in conjunction with the International Convention Centre to provide the facility for large plenary sessions at the NIA with smaller or breakout meetings and conferences at the ICC for major political, international and world conventions. If the requirement is large enough this can be expanded to utilise the facilities at the National Exhibition Centre as well as the ICC and the NIA as in the World Gymnastics held in 1993 and the planned Lions International Convention with 30,000 delegates later in the 90's.

2.2 Flexibility of size and seating arrangement

Events listed above range from major interest to minority sports and events requiring the maximum Arena floor space, e.g. Athletics, to those requiring the maximum seating capacity. This flexibility is catered for in two ways. First, the size of the area can be configured to suit the anticipated audience size for a particular event using full height curtains. Second, the seating arrangements can be varied between 3000 and 12000 seats and to suit end stage or central events as follows.

2.2.1 Fixed tiered seating

Approximately 6000 fixed, upholstered tiered seats are mounted from concourse level upwards on precast 'L' shaped concrete units spanning 10m between insitu concrete raker beams. The rake of this seating is designed so that for most events spectators have a clear view to within 1m of the edge of the performance area. Raker beam positions are used for aisles.

2.2.2 Retractable tiered seating

Approximately 1600 retractable tiered seats are mounted between concourse level and the arena floor. These seats comply with the same sight line criteria as the fixed tiered seats but have seat centre spacings of 500mm. These are mounted on laminated timber floors on steel subframes and are mounted in blocks of 5m width. Each block has a power operated retraction unit. In its retracted state each block is moveable by fork lift truck to allow for all round seating for appropriate events. Figure 2 shows a plan of the Arena with seating configured for a centre floor event.

2.2.3 Demountable temporary seats

A further 4000 demountable seats can be positioned in blocks on the arena floor for end stage events or similar.

2.2.4 V.I.P seating

Approximately 150 further seats are available in the VIP suites at high level on the South side of the area.

2.3 Ease of access

A major consideration in the design of a venue holding up to 12000 spectators is the need for easy access and particularly easy exit at the end of an event.

Reference to Figure 2 shows 12 exit doors at concourse level between the upper and lower seating tiers. Figure 1 shows 11 external exit doors (shown arrowed) exiting on to the external concourse surrounding the building. Figure 1 also shows 5 separate exits from the car park exiting on to 3 roads allowing rapid exit from the car parks.

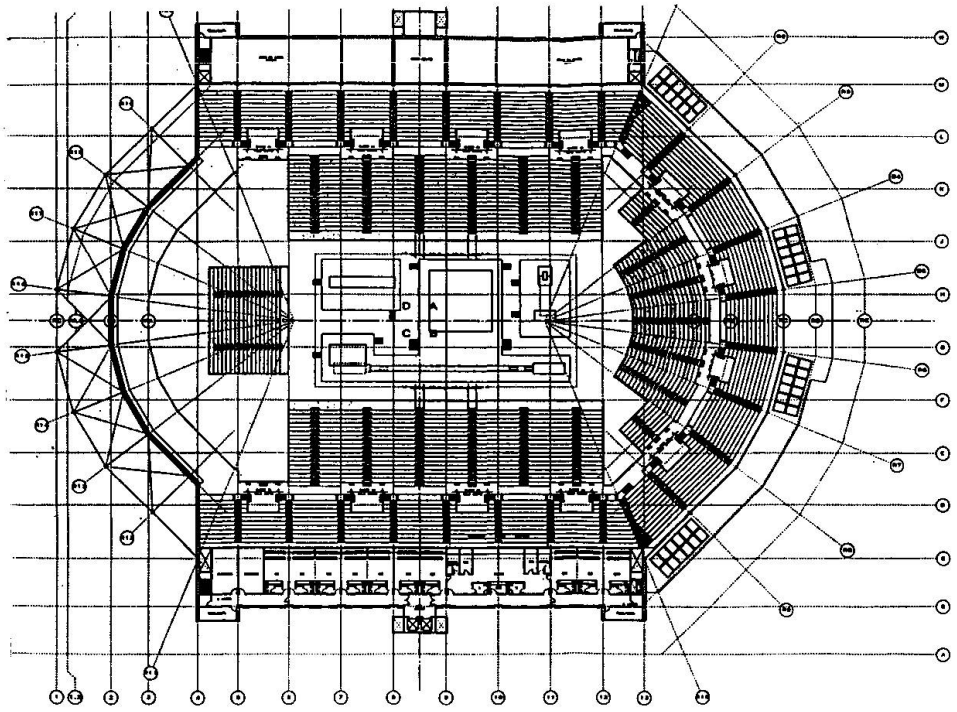

Fig.2 Plan of Arena showing tiered seating

3. STRUCTURE

The main elements of structure which allow the arena the flexibility to operate in the optimum format for a particular event and to be quickly altered from one format to another are the event floor, seating structure and roof.

3.1 Event Floor

The event floor is an insitu concrete slab, spanning over car parking, the main Birmingham - Wolverhampton Inter city rail line and the community sports hall. To allow rapid build up and take down for events and minimise 'dark time' the floor is designed to allow access for 38 tonne gvw heavy goods vehicles. The floor is a power trowelled slab, finished with a 6mm thick resin topping. The slab spans are 10m span two way spanning slabs over the car parking, 10m span one way spanning slabs onto 20m span downstand beams over the community sports hall and a non structural slab on 23m prestressed bridge beams over the railway line. All slabs are precambered so that during the design life of the building the flatness and slope of the floor complies with the limits for most sporting events. Specialist playing surfaces, include a 6 lane 200m banked athletics track are brought in.

The floor incorporates long jump and pole vault pits, and a full length duct, offset from the arena centreline to allow for cabling from an end stage event. These are infilled with concrete filled steel covers to match the surrounding floors when not in use. Apart from two rotational joints either side of the floor spanning over the railway track there are no other interruptions to the floor surface in the central area. Movement joints are situated around the perimeter of the floor under the retractable seating.

The floor is capable of taking drilled bolts and fixings for equipment, holes are made good after an event with epoxy filler to match the surface colour.

3.2 Seating structure

The seating structure has been described in 2.2 above.

3.3 Roof

The roof is a triple layer flat spaceframe, square on square on a modular grid of mainly 5m x 5m spanning 128m x 90m with an overall depth at the centre of 10m, reducing to 8m at the edges. Contained within the depth of the spaceframe are air handling ducts, cable trays and pipe work and walkways to access gantries for spotlights and television cameras.

Rigging to the roof is allowed for up to a maximum of 0.5 kn/m² over the central area and 0.25 kn/m² over the perimeter seating areas. Rigging is from M20 tapped holes in each bottom chord node. 0.5 kn/m² quoted above is equivalent to 12.5 kn per node if all the nodes in the central area are loaded. Higher loads are permissible on individual nodes if adjacent nodes are not loaded, up to 40 kn per note if every third node in each direction is loaded.

4. **MAINTENANCE**

The NIA is a low maintenance structure. In general, apart from offices, function suites and VIP suites the structural elements are exposed. Key elements are described below.

4.1 External and internal walls

External walls up to concourse low level are cavity walls with an external skin of stone faced concrete blocks with feature banding in engineering facing bricks. The inner skin is concrete blockwork with close textured dense concrete blocks in exposed areas, painted for ease of maintenance.

External walls to concourse high level are 60mm thick steel composite cladding panels with concealed lap joints fixed to a steel support system onto a reinforced concrete or blockwork inner skin. The external steel skin is hot dip galvanised at 275g/m² coated with 25 PVF2. The internal skin is galvanised and coated with 22 white polyester.

Internal partition walls are generally close textured dense concrete blockwork, painted for ease of maintenance.

4.2 Floors

Floors are generally insitu concrete with a power trowelled finish. These are painted in circulation areas. Seating tiers are high quality self finished precast concrete units. The event floor is described in 3.1 above.

4.3 Roof

The space frame roof structure members are hot dip galvanised with a zinc film thickness of 50 to 80 microns to provide inside and outside protection. Nodes are electroplated. Purlins, walkways, platforms and gantries are also galvanised.

The roofing consists of galvanised, coil coated trapezoidal steel sheets, approximately 30mm of acoustic mineral wool, a PVC vapour barrier, 100mm rigid mineral wool slabs and an outer surface of laminated, synthetic fibre reinforced, soft, high polymer PVC roofing membrane designed for permanent exposure in all climatic conditions.