**Corby Tennis Centre**

**Specification for Air Supported Domes**

Dome B

Dome A

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Dome A

Dome B

1. **Dimensions and Clearances**

The following dimensions are required for each Air Dome:

* Run-back 7.0m (23’0”) Outer Side-run 4.0-5.0m Intermediate Side-run between courts 4.27m Total length 37.8m (124’0”) Total width for four enclosed courts 66.7m (218’10”)
* Allow for a further 2m on each end of the total lengths and widths to allow for the ring beam, perimeter fencing and drainage.
1. **Electrical Services Power Supply**

Every Air Dome will need an adequate supply to power the various features. The provision of a correctly rated supply, to a point local to the inflation unit, will be the Contractors responsibility.

The Contractor will be required to connect to the Intake Point a Main Isolator and a ‘switchboard’ or ‘switchfuse’ or provide new for each Air Dome if the existing equipment cannot be used. . The function of this equipment is to control and protect the feed cables to the various locations. The cables are called ‘sub-mains’.

Any contractor or sub contractor instructed to carry out the provision of the intake equipment and / or the sub main cable[s] needs to be briefed accordingly and advised that the “Zs” value must not exceed 0.3 ohms. The sub-main will be terminated at the isolator of a Power Distribution Unit [PDU], inside or local to the building. The supply voltage will be measured when the building and the lighting is operating under full load.

Failure to follow this guidance, in respect of sub main design, can lead to an unacceptable loss of performance from the floodlighting. (Typically a Three Phase and Neutral (TP & N) 400 volts, 50 Hz, 4 wire supply will be required).

The power factor of the proposed lighting

Total load for the complete airhall facility (Kva rating)

The Contractor is to include a Power Distribution Unit (PDU) to control and protect the power supply to each part of the installation if they cannot use the existing. The PDU will be sited local to the inflation unit.

All permanently or seasonally external equipment shall be housed in robust IP55 rated enclosures.

The enclosures shall be secure and shall not permit adjustment to the control device settings by unauthorized personnel. They shall permit easy unhindered access for maintenance.

The noise generated by the inflation system shall be minimised by suitable design of the equipment and enclosures.

All electrical cables shall be housed in suitable ducts and/or trunking. They shall be properly secured and protected to provide a complete containment system. Where possible, ducts, cast into the ground, shall be provided for electrical control cables and pressure hoses where they cross the Air Dome perimeter. At the door positions perimeter cabling shall be run in a cable duct under the floor or routed, in electrical conduit or cable trunking, over the door frame to ensure that disabled and emergency access is unhindered.

1. **Standby Power Supply**

A reserve power supply in the form of a generator is provided. It is to automatically operate in case of a main power supply failure.

1. **Control Systems**

The overall control system for the complete facility should be considered as comprising two distinct parts

Those systems required monitor and controlling the inflation unit and hence the air dome structure.

Those required monitor and controlling the operation of all the other electrical services, particularly the lighting.

1. **Power Sockets**

The air dome installation must include the provision of new small power, in the form of metal clad socket outlets if the existing cannot be used. They are to be located behind the run back areas of the courts, between the play lines at each end and at 300mm above finish floor level. The sockets are to be protected by a Residual Current Device (RCD).

1. **Court LED Lighting Layout**

Fittings are to be arranged so that they are not in the centre of the field of view during play; are not within the clear height zone of the court and should be related to any natural lighting. Care should be taken to avoid glare from the installation caused by either the location of fittings and/or the contrast between the source and the surfaces of the hall.

**Reflectance Values**

The reflectance values of the surface finishes are to be fully co-ordinated into the design and selection of the lighting system.

**Protection**

Protection of the fittings must be provided in accordance with the manufacturer’s recommendations.

**Definitions**

Principal Playing Area (PPA) -The area bounded by the outside of the court lines

Total Playing Area (TPA) - The PPA plus the run-back areas to a depth of 4.5m and the side-runs to a width of 2.5m

Uniformity Factor - The ratio of Minimum illuminance value to Average value within the prescribed area

Maintained Illuminance - The value of illuminance predicted after initial reduction in output and to be experienced over the working life of the lights.

Maintenance Factor – The ratio applied to the initial level of illuminance to achieve the required maintained level of lighting. Whilst the industry standard generally for sports lighting utilises a factor of 0.8 (to allow for 20% degradation in lighting performance), due regard must be given to the fact that the lighting performance in air halls, to a significant extent, will depend upon the cleanliness of the skin (single skin air halls) or the inner liner (double skin air halls).

Average maintained level of illuminance measured at the playing surface within the PPA:

= 600 Lux

Uniformity Factor (Minimum/Average) = 0.7

Average maintained level of luminance measured at the playing surface within the TPA:

= 500 Lux

Uniformity Factor (Minimum/Average) = 0.6

Minimum colour temperature - Min 3,600K

Minimum height of luminaires if perimeter lighting within the airhall - 4.5m located outside the TPA

Minimum height of luminaires if lighting through the membrane - 8m, located 1.2m from the ring beam.

The performance standards are set court by court and are measured when the courts are operated in unison.

1. **Emergency Lighting**

This should be provided in accordance with the relevant CIBSE Codes of Practice or equivalent.

1. **Fire Alarm**

Any fire alarm system should be provided in accordance with BS 5839 or equivalent and integrated with the main building fire alarm system to the satisfaction of the local fire officer.

1. **Testing & Commissioning**

Full test certificates are required in respect of any mechanical services installations.

A full electrical test certificate is required in respect of the electrical installation.

A lighting test certificate is required for each court to identify both the initial and maintained performance values. These are to be taken on a court by court basis. As courts within an Air dome are switched as a single group they are to be tested with all courts illuminated.

The maintained performance is to be calculated from the initially recorded values using the maintenance factor agreed in the original design

Copies of all test reports, ’as fixed’ record drawings, ‘as commissioned’ settings of all control devices and manufacturers’ data are to be included in a services manual to be available at handover.

1. **Minimum Design Requirements**

**Design Standards**

The Air Dome shall fully comply with the minimum design requirements specified in this section.

**Membrane Deformations**

Deformations of the membrane under wind and snow loading are likely to occur and should be accounted for in the design. Bellows or other means of flexibility shall be provided in the membrane around any door frame or other rigid elements connected to the membrane in order to accommodate such predicted movements.

The connection between the membrane and the inflation units shall similarly have sufficient slack to accommodate the expected movements in the air dome.

All ancillary elements such as lamps and fences shall be placed far enough away from the surface of the membrane in order that they would not come into contact with it under the large deformations associated with high wind or snow conditions.

**Tension Cables**

Cables and their end terminals shall be stainless or galvanised steel, carefully designed, detailed and installed to avoid any undue chaffing or damage to the membrane.

**Inflation Fans**

Connection to the existing fans is required that allows sufficient capacity should be provided to ensure that the Air Dome specified inflation pressure (Design Inflation Pressure) can be reliably provided under storm conditions.

The inflation system shall be robust, designed and rated for continuous running, and shall be easily maintainable.

1. **Doors and Emergency Exits**

The main door shall comprise either a revolving door or a tunnel airlock type door. The main doors shall permit safe opening and closing by all users without undue differential pressure effects. Provision should be made for disabled users.

All doors, including emergency exits, should be fitted with clear viewing panels from top to bottom to ensure that they are not opened when someone is standing on the other side.

1. **Anchorages**

The anchorages, fixings and attachments shall be detailed to prevent any sharp edges, corners or protrusions from bearing onto the membrane material, and to avoid any stress concentrations.

The following requirements shall be met:

* Punched bolt holes in steel components shall be ground smooth where they attach to the membrane.
* Anchorage steel sections must be properly aligned without any steps or sharp protruding edges.
* Punched bolt holes in steel components shall be ground smooth where they attach to the Holes in membranes, for example to permit bolts to pass through, shall be punched with an appropriate circular punch, to ensure a smooth circular profile avoiding scores, sharp over cuts.
* All anchorage components shall be sufficiently stiff to ensure that their deflection does not result in excessive air loss or stress concentrations in the membrane material.

The anchorages shall be designed such that there are no elements remaining such as upstanding bolts or angles which could present a trip hazard to players or spectators.

1. **Foundations**

The perimeter foundation shall be arranged to resist the maximum uplift and horizontal forces imposed upon it, taking into account the deflections of the membrane and the changes in profile which occur under extreme loads.

The foundation arrangement shall make allowance for:

* The drainage requirements of the court playing surfaces (when the air dome is not in place) and the runoff from the air dome (when the air dome is in place). Drainage may need to be incorporated.
* Routes for electrical and mechanical services associated with the air dome systems. Ducts and electrical trunking including those cast into foundations shall be waterproof and of robust external construction quality.
* The need for perimeter security fencing, maintenance access and, in the case of air-structures using transparent membranes, external floodlighting.
1. **In the case of a concrete ring beam:**

Any concrete upstand above finished ground level should be constructed to a high standard with clean shuttered sides and chamfered corners and edges in order to achieve an attractive and durable finish.

Reinforcement shall be provided within the concrete foundation to at least the level required to control cracking. Consideration shall be given to ensure continuity of shear strength at construction joints and expansion joints.

The back-fill material shall be properly compacted in layers on both sides of the ground beam.

In the case of ground anchors:

Component materials shall be chosen with due consideration given to the design life of the air dome and the aggressiveness of the soil conditions.

All anchors shall be installed according to the manufacturer’s instructions and by a manufacturer approved installer.

1. **Fencing**

Any perimeter fencing shall be protected from any damage during installation of the domes. If any damage occurs, repair or replacement will be required.

1. **Inflation Unit Control System**

The Contractor will be required to use the existing Inflation Unit Control system if it is compatible.

If this is not possible the contractor will be required to provide new Inflation Unit Control systems for each Air Dome and shall comply with one of the following principles:

* The fan(s) shall operate to maintain the Design Inflation Pressure at all times.
* The control system shall incorporate automatic wind speed and inflation pressure monitoring and shall automatically adjust the inflation pressure in response to changes in the wind speed.
* The controls shall be set so that the required inflation pressure at each wind speed up to the maximum design wind speed is achieved. In this case at low wind speeds the inflation pressure is reduced to produce savings in running costs.
* The system shall incorporate a manual override facility to enable duty staff to perform emergency or routine maintenance tasks. A single switch shall be provided to manually increase the output immediately to the Design Inflation Pressure. This is necessary to cater for events of extreme snow or wind conditions or the emergency door being open when the automatic monitoring is not operable for some reason.

Whichever of the above systems is selected the control system shall incorporate all the following features:

* The system shall incorporate a pressure sensor and shall seek to maintain the internal pressure at the design level in event of pressure loss, for example due to the opening of emergency doors or the failure of a fan.
1. **Gauges**

Gauges to measure the internal pressure in the air dome shall be fitted in all cases.

If the control system depends upon wind speed monitoring to adjust the inflation pressure the anemometer shall be securely mounted and sited in an exposed location away from or higher than any objects that might shield it from the full effects of the wind. If possible, the mounting height of the anemometer shall be greater than or equal to the height of the air dome. The recorded wind speed shall be displayed on an analogue gauge.

Air dome internal pressure gauges, and windspeed gauges if applicable, shall be mounted in the following locations:

* In a prominent position inside the air dome.
* Where they can be read while making adjustments to the inflation control system settings.

The gauge calibrations shall be checked by independent monitoring devices during commissioning and the gauge range shall read from zero to the maximum design values +25%.

1. **Lighting Control System**

A master time clock to ensure all lighting is switched off overnight.

A manual control system for the court lighting arranged to ‘default to off’ at the end of each

day.

1. **Heating Control System (when included in the Employer’s requirements)**

Thermostatic Controls with manually adjustable and lockable, temperature settings shall be provided to operate the heating system, if one is fitted.

1. **Alarms**

An audible and visual alarm signal shall be incorporated which operates inside the air dome if the inflation pressure drops below 90 per cent of the minimum value required for the conditions at the time

The alarm shall operate if the recorded wind speed exceeds 75 per cent of the design wind speed.

Resetting of the alarms shall only be possible via a key operated switch. The audible alarm shall be set to turn off automatically after a period of 15 minutes so as not to create a nuisance to neighbours, but the visual alarm shall continue until the alarm has been reset.

1. **Notices**

A notice shall be fixed on the outside of the air-structure adjacent to the main entrance giving details of the following:

Supplier's name, address and contact telephone number. Name address and telephone number of the Maintenance Officer or other person responsible for the maintenance of the air domes.

A notice shall be fixed on the inside of the air domes adjacent to the main entrance giving instructions for occupants to follow in the event of an alarm sounding. Emergency doors shall be clearly signed.

The signage shall discourage non-emergency use and instruct users to close the door immediately upon exit.

The signage shall discourage non-emergency use and instruct users to close the door immediately upon exit. Inappropriate use of emergency exits, particularly during strong wind or heavy snow conditions can increase the risk of damage to the Air Dome

1. **Wind Loading - General**
* The Effective Wind Speeds and Dynamic Pressures for use in the design shall be derived from British Standard BS 6399 Part 2, 1997, using the parameters specified below.
* In applying BS 6399 Part 2, the Standard Method should be used in place of the Directional Method, and the parameters herein have been specified on that basis.
* The Dynamic Augmentation Factor Cr should be taken to be zero, appropriate to a zero value of Kb, to reflect the high expected levels of damping in the structure.
* Note that the pressure and force coefficients given in BS 6399 Part 2 do not in general apply to air-structures. The use of BS 6399 Part 2 should therefore be restricted to the derivation of the Effective Wind Speeds Ve and the Dynamic Pressures q as discussed below.

 **Wind Speeds**

* The following notes shall be taken into consideration in determining the Effective Wind Speed Ve from BS 6399 Part 2 for use in the design:
* The site and the topography around the site shall be examined to determine any significant differences in upwind terrain characteristics for winds from different directions. This should include noting the proximity to the sea (if closer than 100km) any significant hills, ridges or slopes, and the nature and height of surrounding buildings, trees and other obstructions.
* A different value of Ve will in general be derived for each selected wind direction.
* The Altitude Factor Sa shall be assessed based upon the altitude of the site above sea level, modified as specified in the Standard according to the nature of the upwind topography. Where the upwind topography varies around the site, different values of Sa shall be derived for each different wind direction. The Seasonal Factor Ss shall be taken to be 1.00, even if the air-structure is designed to be erected only during the winter months.

The Probability Factor Sp shall be taken to be 1.00.

The Terrain and Building Factor Sb shall be derived from Table 4 of the Standard, taking into account any variation in Effective Height and upwind topography for different wind directions

1. **Dynamic Pressures**

The following notes shall be taken into consideration in determining the Dynamic Pressure q from BS 6399 Part 2 for use in the design:

A different value of q will in general be derived for different wind directions, corresponding to the different values of Ve, and for different structural elements as noted below.

The Size Effect Factor Ca takes into account the non-simultaneous action of gusts over the surface of the whole structure and the nature of the response of the structure to gusty wind.

For the design of the membrane itself and its anchorage to the foundations, including cable elements and their anchorages, the value of Ca shall be taken to be 1.00.

For the design of the foundations, assuming that they comprise a continuous reinforced concrete ground beam, the value of Ca may be determined from Figure 4 of the Standard, using the appropriate site exposure and a value of the Diagonal Dimension ‘a’ equal to the maximum overall crosswind width of the air-structure.

For discontinuous foundations such as ground anchors or individual piles, the dimension ‘a’

used in the derivation of Ca shall be taken to be the minimum distance along the foundation between adjacent discontinuities.

The value of Dynamic Pressure q for use in deriving the wind forces and inflation pressures in the air-structure is given by the formula

q = 0.613 Ve2 x Ca

1. **Heating and Snow Loading**

In cases where no reliable provision is made for maintaining the internal temperature at a level high enough to ensure that no snow accumulation occurs, snow loading on the air structure shall be derived from British Standard BS 6399 Part 3, 1988, and allowed for in the design.

1. **Deadloads**

Unless otherwise specifically permitted, the air-supported structural membrane shall not directly support any heavy non-structural elements such as lights or heaters, as these can substantially increase the collapse time and add to the risk of membrane damage.

In most cases for typical air-structures the dead weight of the structural membrane itself and any inner membrane lining may be neglected in the calculation of required inflation pressures. However, if the total mass of the membrane, including any lining, exceeds 2.0 kg/m2, or special dispensation is given to permit the membrane to support any heavy fittings or other non-supporting elements, then the dead weights should be taken into account.

1. **Combined Loading**

Where an allowance is made for the dead weight of the membranes or added loads, as noted above, the design shall consider these in combination with other applied loads as appropriate. In most cases it will only be necessary to consider dead loads in combination with snow loads.

The combined effects of wind and snow loading need not be considered together in the design, provided that the inflation pressure is sufficient to meet the requirements for each loading case separately.