Indoor Structures

Contents

B2 – INDOOR COURTS BUILDING BRIEF – TRADITIONAL BUILDINGS

LTA BRITISH TENNIS
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Introduction

The purpose of the Lawn Tennis Association (LTA) Indoor Building Brief is to provide a guide to the minimum standards to which indoor courts should be constructed. The Brief consists of recommended minimum design parameters. This information should not be considered to be a complete brief in itself but the basis from which a full project brief, design and specification can be evolved.

It should be noted that the standards contained in this document are for most levels of play however some dimensions require to be exceeded for specialist events, services and tournaments. In these instances further advice should be sought from the LTA. Further requirements will also need to be agreed where space is to be allocated for coaching, LTA county and area offices.

Project Life Cycle

START ON SITE

Key Stage	One FEASIBILITY / PLANNING	Two DESIGN STAGE	Three CONSTRUCTION STAGE	Four OPERATION AND MAINTENANCE
	Confirm funding for tennis structure Appoint PM/ project team. Project team to decide • Type of court surface • Type of structure • Sixe of structure (LTA dimensions met including foundations and drainage). • Number, type and location of doors. • Power supply required. • Lighting (levels to be obtained and location) and heating required. • Contact planning officer for there opinions on gaining planning permission. PM to submit planning application.	Project team to: • Select procurement route. • Produce project brief / scope of works document. • Prepare tender package (based on guidance note B2). • Submit tender package to LTA for review and comment. • Send approved tender to suitable suppliers. • Review contractors bids and submit to LTA for comment and review. • Appoint contractor. • Review design packages submitted by contractor. • Review design packages submitted by contractor. • Submit final design to LTA and other bodies.	PM to arrange a pre start meeting to confirm site logistics. PM to monitor construction of the building to ensure that it complies with the Employers Requirement and guidance note B2. On completion of the project the purchaser receives a maintenance manual from the contractor. PM in association with the LTA to undertake completion and commissioning checks and tests. Club to appoint person (s) to be responsible for maintenance.	Commence maintenance regime in accordance with maintenance manual. Submit records to LTA quarterly.

LTA Funding

All LTA funding for Indoor Tennis Court projects is conditional upon compliance with the minimum requirements of the LTA Indoor Building Brief.

Standards

All construction projects should conform to the minimum requirements of all relevant current building legislation, including British Standards and Codes of Practice.

Statutory Approvals

The LTA requires confirmation in writing that Building Regulation and appropriate Planning approvals have been obtained before construction begins.

It should be noted that the Construction Design & Management Regulations 1994 (CDM Regulations) will apply to all but a few minor projects.

Disabled Users Policy

Please refer to Guidance Note B1 for details of the Disabled Users Policy.

Contract

All projects that require LTA funding should use a recognised standard form of building contract eg Joint Contracts Tribunal (JCT) standard forms, which are suitable for dealing with a range of project values and types.

Space should be allocated on the construction site signboard for an “LTA Building for Tennis” sign (310mm x 1220mm).

Design Principles

The design of the centre should create a building with warmth of character and environment that will be attractive to users of all ages and abilities.

The accommodation should be fit for its intended purpose and made attractive by the considered use of materials, textures and colours in suitable combinations.

In addition to satisfying the fundamental requirements of function, safety, elegance and economy, the design must minimise future maintenance needs and running costs.

Effective regulation must be maintained of both natural and artificial lighting and of the internal environment. Mechanical and electrical systems should meet the requirements of the brief, be suitably concealed without prejudice to their operation and maintenance. They should not interfere with the use of the indoor courts or conflict with the clear height requirements above the courts.

The relationship between internal and external spaces and between the tennis courts, and ancillary accommodation, etc should show creativity in design but should also provide an economically suitable solution. The following key issues should be considered:

- views from social area to indoor/ outdoor courts positioned so as to avoid distracting players
- accessibility for users to coaching/tennis development staff
- accessibility from car park to main entrance for all users
- a viewing area within the tennis hall, behind the baseline of indoor courts with easy access for disabled and family users
- good clear signage internally and externally combined with a considered use of colour and texture
- parent and child bays or a drop off point system should be included in any scheme in addition to statutory minimum requirements
- revenue facilities should be easily accessible to social/entrance spaces

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- each internal and external court should be easily accessible without disturbing users on adjacent courts e.g. by the use of separate access doors for each court
- the indoor hall should be positioned so that it does not overshadow any outdoor courts.

Environmental Issues

The LTA embraces environmental issues in the design of tennis facilities. The following areas should be considered:

- use of materials obtained from renewable sources
- measures to minimise dependence on finite fossil fuels, emissions and operating costs and improve energy efficiency.

Design Parameters

Tennis Hall Dimensions

Principal Play Area

Length	23.77m (78’ 0”)
Width	10.97m (36’ 0”)
Length of net (doubles)	12.8m (42’ 0”)
Width of lines (white) included within above court size	see drawing

Other Dimensions

Min Runback (ie clear depth behind baselines, at each end)	6.40m (21’ 0”)
Min Side-run (ie clear width beside each side)	3.66m (12’ 0”)
Min Side-run between courts not separately enclosed	4.27m (14’ 0”)
Unobstructed height at netline	9.00m (29’ 6’) min
Unobstructed height at base line	5.75m (18’ 11”) min

Unobstructed height at rear of run-back	4.00m (13’ 1”) min
Total length	36.57m (120’ 0”)
Width for one enclosed ct	18.29m (60’ 0”)
Width for two enclosed cts	33.53m (110’ 0”)
Width for three enclosed cts	48.77m (160’ 0”)
Width for four enclosed cts	64.01m (210’ 0”)

The minimum clearances and dimensions given above shall not be infringed without the prior approval of the LTA. In certain circumstances, space restrictions may reduce the available clearance, and the LTA will consider such situations on their individual merits. Special clearance requirements apply in the case of air-supported structures, as defined in the separate LTA Brief for Non-Traditional Structures (B3).

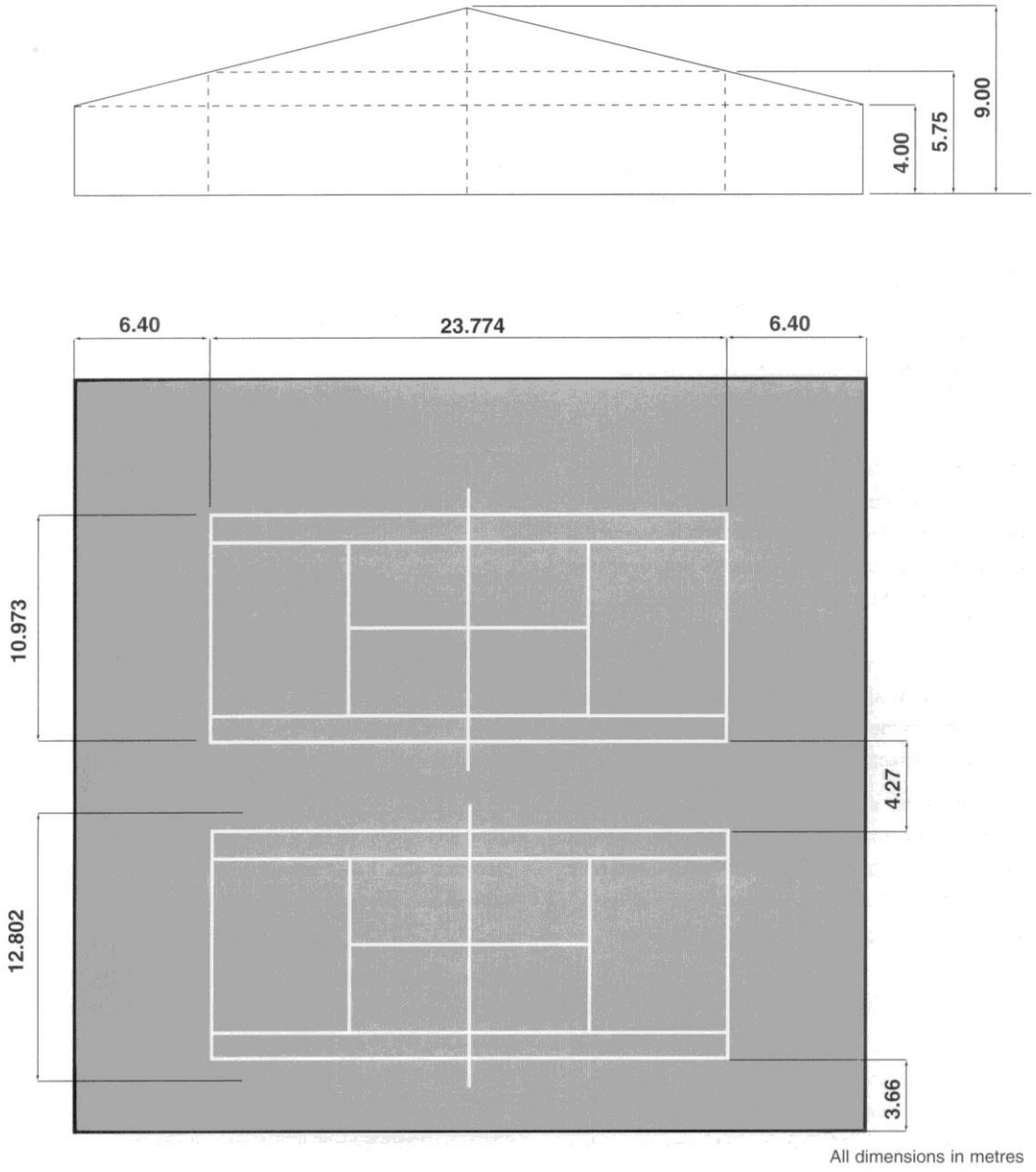
Court Surface

The LTA must approve the choice of playing surface and its colours.

The main contractor will be required to obtain the written approval of the playing surface installer as to the suitability of the prepared sub-base before laying of the playing surface commences. This approval must be copied to the LTA.

The playing surface must lie in a single level horizontal plain with no gradient. The maximum permitted tolerance in the level of the finished playing surface is a 6mm gap under a 3m straight edge.

Movement joints will not be allowed in the court surface of the principal playing area.



Walls

Walls should be flat and continuous with a minimum of obstructions or protrusions and be of a single light matt colour other than brilliant white.

Single colour backdrop drapes are to be provided to the walls behind the baseline of the tennis courts. These should span from ground level to eaves level or to a minimum of 2m to

the underside of viewing gallery handrails. Netting should be used above the curtains to ceiling level. Suitable colours for drapes and netting include dark green and dark blue.

Adequate durable protection is to be provided to any protrusions eg. steel columns, to a minimum height of 2m above floor level and should be coloured to match the canvas drapes. The steelwork above this protection should be coloured to match the canvas drapes up to their maximum height to give a level backdrop. Alternatively, the lower portion of the structure may be positioned so that it does not project into the hall and is continuous with the wall surface.

Court divider netting should be provided, positioned between courts with the ability to be withdrawn if required.

Where glazing is proposed it must be fit for its intended purpose and position relative to the playing area. The effects of glare, shading and shadowing must be considered and avoided.

Rooflights

Rooflights should have a net area not less that 10% of the gross tennis hall floor area when measured on plan. They should be located in the plane of the roof between and not over the Principal Playing Areas.

Ceilings

Ceilings and secondary steelwork should be coloured with the same single matt finish to give a continuous effect.

Consideration should be given to the use of acoustic perforated liner trays or similar systems to improve the overall acoustic performance of the hall.

Monopitch roof shapes should be avoided.

Heating & Ventilation

The installation should comply with the current Building Regulations, The Chartered Institute of Building Services Manual, all relevant British Standards and BS codes of practice, the requirements of the Fire Officer, and the requirements of the Environmental Health Officer.

Air temperature should be a minimum of 8 degrees C during occupied periods without differential between courts. During unoccupied periods a frost protection level of 1 degree C is to be maintained.

Air velocity should be in the range of 0.1 to 0.5m/sec. The air change rate should be:

0.5 changes/hr (winter)

2.0 changes/hr (summer)

The tennis hall should have noise rating NR45 or better.

The thermal efficiency of enclosure should conform with the minimum requirements of the current Building Regulations.

Electrical Services

The installation should conform with the current edition of the IEE Regulations.

One double socket should be located behind the run back of each court at 300mm above finish floor level.

Lighting

Definitions

Principal Playing Area (PPA*)* - The area bound 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 ratio - The ratio of Minimum illuminance value to Average value within the prescribed area

Initial Illuminance - The value of illuminance predicted at initial installation and/or cleaning of reflectors

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

Measurement Grid - A total of (15) fifteen readings are required on the PPA. A total of (35) thirty-five reading are required on the TPA. Illumination standards are to be based on measurements taken after dark at ground level.

Performance

Average maintained level of illuminance measured at the playing surface within the ***PPA:***	600 Lux
	0.7 Uniformity Factor (Minimum/Average)
Average maintained level of illuminance measured at the playing surface within the ***TPA****:*	500 Lux
	0.6 Uniformity Factor (Minimum/Average)
Minimum colour temperature:	min 3,600k
Min height of luminaires	6.5m located outside the *Principal Playing Area*

Standards are set court by court and are measured when the courts are individually operated.

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 the 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.

Protection

Protection of the fittings must be provided by the application of permanent proprietary guards or louvres in accordance with the manufacturer's recommendations.

Switching

This should be arranged via a central control at reception so that the lighting levels to each court can be individually adjusted.

Reflective Values

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

Emergency Lighting

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

Fire Alarm

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

Security

Any Intruder Alarm system should comply with BS 4737 integrated with the main building system and linked to a central monitoring station where such exist.

Commissioning

The complete services installation should be fully commissioned in accordance with the CIBSE current codes of practice.

Copies of all test reports, record drawings and manufacturers data are to be included in a services manual to be available at handover.

Storage

A minimum of 10sqm of secure storage must be provided, accessible from the indoor courts with no differential in floor level and with ramped access to the outdoor courts.

Viewing Area

An access lift or ramp should be provided to raised viewing areas.

The physical relationships between spaces within the building should be considered when designing an indoor facility. These may include:

- Cafe/bar areas
- Reception area
- Development officers and coaches office

Provisional Sums

Signage

A provisional sum of £5,000 should be included for the design and installation of an appropriate scheme to be agreed with the LTA towards the end of the project.

Fees

For indoor project, the allowance for fees should be set at 12% of the total project cost.

Contingencies

For all projects contingency allowance should be set at 10% of the total project cost.

Outdoor Courts

Refer to the Tennis Courts - Building Brief (A1) for further information. Indoor Courts should be positioned so as not to overshadow outdoor courts.

Non-Traditional Structures

Refer to Airhall Guidance Note (B3) and Framed Fabric Guidance Note (B4) for detailed requirements specific to low cost indoor structures.

B3 – AIR SUPPORTED STRUCTURES

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Glossary

The following terms used in this guide are defined below:-

Purchaser		The Organisation, Centre, Facility or Organisation buying the airhall.
Supplier		The company the Organisation, Centre or Facility purchases the airhall from. Depending on the size of the project and the nature of other work being carried out at the same time, it could be the Airhall Manufacturer or Agent or a General or Court Contractor.
LTA		The Lawn Tennis Association.
Contract		Legally binding agreement between the Purchaser and the Supplier.
Design Inflation Pressure		The pressure inside the Airhall at storm wind speeds.
Principal Play Area	(PPA)	The area within the court lines.
Total Play Area	(TPA)	The court area comprising the PPA plus 4.5m of each run back and 2.5m of each side run.

Introduction

These Guidance Notes are intended to help those planning to purchase an airhall select and specify an appropriate product. The notes define the LTA's minimum requirements to which airhalls should be designed and constructed in terms of functionality, performance, safety and quality. There are five parts to this document;

Design Parameters - general guidance on dimensions, infrastructure, lighting etc.

Minimum Design Requirements - this section defines important criteria that the airhall supplier must meet including criteria for structural design, materials, inflation fans, control systems and the quality of workmanship.

Further Design Requirements – this section defines further design criteria that suppliers should comply with including wind loading, dynamic pressures, membrane tensions etc.

These further design requirements substantially increase the robustness and reliability of an airhall, and the purchaser should establish potential suppliers' ability to meet these criteria during the project planning stage.

Optional Extras – desirable extra features to add into an airhall scheme.

Maintenance Manual -A tool intended for use by purchasers once the airhall has been installed listing the routine checks that need to be carried out as well as a practical check list.

The requirements contained in this guide should be included in the specification forming part of the Contract between the purchasing body and the Airhall Supplier, to ensure that the Airhall Supplier is obliged and legally bound to supply an Airhall that meets the LTA's minimum standards.

Contract

All projects that require LTA funding should use a recognised standard form of building contract eg Joint Contracts Tribunal (JCT) standard forms, which are suitable for dealing with a range of project values and types.

The Construction Process

The key stage project guide over the page illustrates the main processes involved in an airhall scheme. Although apparently a relatively simple method of covering courts, airhall construction is in reality a complex operation that needs careful management if the purchaser is to achieve the desired end product. It is always important to remember that each project is unique and additional steps or procurement methods may be required to deal with site specific issues. The first major step, once funding is achieved, is to appoint a Project Manager to help develop the project.

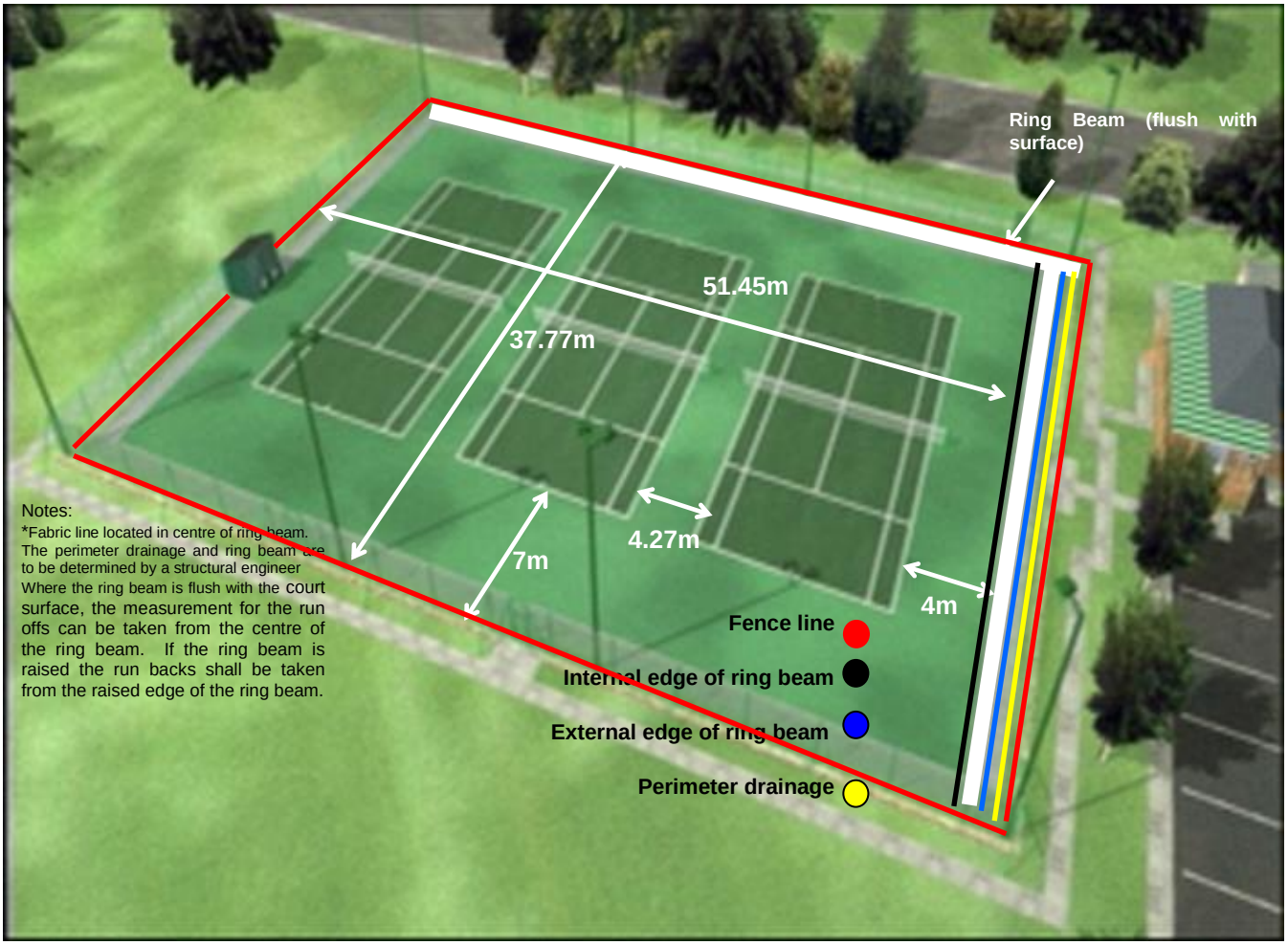
PROJECT LIFE CYCLE.

Key Stage	INCEPTION One Feasibility/Planning	START ON SITE Two Design	Three Construction	COMPLETION Four Operation and Maintenance
	• Confirm funding. • Appoint project manager and project team. Project team to decide; • Type of court surface. • Size of air hall building allowing for foundations, drainage and fencing. • Number type and location of doors and openings. • Power supply required. • Drainage required • Lighting and heating required. PM to submit planning application.	Project team to • Select procurement route. • Produce product brief / scope of works document. • Prepare tender package (based on guidance note B3). • Submit tender package to LTA for review and comment. • Send approved tender package to Air Hall suppliers. • Review contractors bids and submit to LTA for review and comment. • Appoint contractor. • Review design packages.	• PM to arrange a pre start meeting to confirm site logistics. • PM to monitor construction of Air Hall to ensure it complies with Employers requirements and Guidance Note B3. • On completion of the project the purchaser receives a maintenance manual from the Air Hall Supplier. • PM in association with LTA to undertake completion and commissioning check and tests. • Club to appoint person(s) responsible for maintenance. • Notify LTA of person responsible.	• Commence maintenance regime in accordance with maintenance manual. • Submit records to LTA on a quarterly basis.

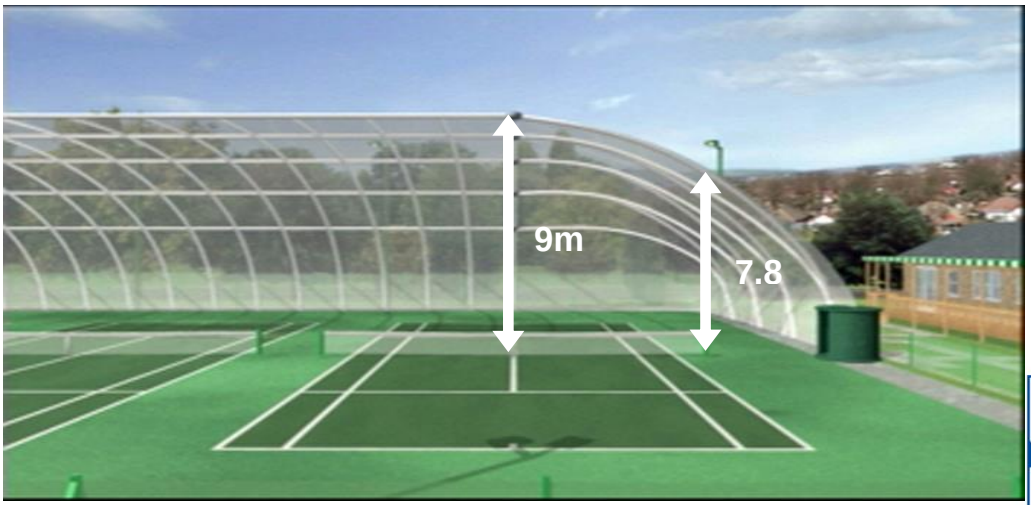
Design Parameters

Dimensions

The diagram below illustrates the space required to construct an airhall to the LTA recommended minimum dimensions. These recommendations should be followed wherever possible.



*The columns illustrate the layout that may apply to single skin airhalls only.



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Internal Dimensions

Principal Play Area	
Length	23.77m (78’0”)
Width	10.97m (36’0”)
Length of net (doubles)	12.8m (42’0”)
Width of lines (white) included within above court size	0.05m (0’2”)
Unobstructed height at centre of net	9.0m (29’44”)
Unobstructed height at outer net post on end court	7.80m (25’7”)

The profile of an air-supported structure can vary. To achieve recommended minimum height clearances the following dimensions are required:

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 two enclosed courts	36.3m (118’10”)
Total width for three enclosed courts	51.5m (168’10”)
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, drainage and where applicable on single skin airhalls the lighting columns illustrated.

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Court Surface

Please refer to LTA Court Surface Guide, Guidance Notes, available on the LTA website for further information.

Walls

Drapes, netting or high coloured fabric panels can be used as backdrops in the airhall.

Court divider netting when provided, should be positioned between courts with the ability to be withdrawn if required.

Noise

Noise should be considered in relation to the court location and nature of the surroundings and where possible the airhall inflation machinery should be located in a position that reduces the impact on neighbouring properties. Noise from the airhall inflation machinery, the playing environment and subsequent increase in traffic should be carefully considered, and mitigation measures introduced into the scheme if necessary.

Electrical Services

Power Supply

Every airhall project 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 Organisation's responsibility.

Please note that during the project development it may prove more economic for the power supply to be terminated at an Intake Point local to the site boundary, instead of within the building. This will minimise the work done by the Electricity Co. and hence contain the cost by utilising the services of either a local contractor or the floodlighting contractor. They will complete the feed cable installation from the intake point. This arrangement is commonly used if there are other facilities being installed, on other parts of the site which may also require electric power now or at a future date. [E.g. floodlighting for outdoor courts, a pitch or clubhouse etc.]

In this case, at the Intake Point a Main Isolator and a 'switchboard' or 'switchfuse' will be needed. The function of this equipment is to control and protect the feed cables to the various locations. The cables are called 'sub-mains'.

When any sub-main serves an area that includes floodlighting it is critical that this cable is designed to ensure that the volt drop on it does not exceed 1.5% of the supply voltage.

Any local 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 floodlighting 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.

To ensure the power requirement is correctly quantified the following information must be advised by the airhall supplier, in respect of their proposed equipment and ancillary features

Confirmation of the supply voltage and frequency required for the electrical supply.

(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 airhall supplier is to include a Power Distribution Unit (PDU) to control and protect the power supply to each part of the installation. The PDU will be sited local to the inflation unit.

Standby Power Supply

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

Control Systems

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

Those systems required to monitor and control the inflation unit and hence the airhall structure.

Those required to monitor and control the operation of all the other electrical services, particularly the floodlighting.

Power Sockets

The airhall installation must include the provision of small power, in the form of metal clad socket outlets. 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).

Court 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 by the application of permanent proprietary guards or louvres 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 lamps

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).

Accordingly the factor should be increased to 0.6 (to allow for 40% degradation in lighting performance) due to the build up of fabric dirt. If the higher maintenance factor is applied, to minimise capital costs, the end user must be made aware, at the initial offer stage, of the need for a higher frequency of lamp replacement and the associated costs.

Measurement Grid - A total of (15) fifteen readings are required within the PPA. A total of (35) thirty-five readings are required within the TPA. Illumination standards are to be based on measurements taken after dark at ground level.

The grid layout, to meet the LTA requirements, is to be agreed in advance of the testing with the Contract Administrator

Performance standards

Lighting Schemes	Double Skin Airhalls LTA Standard	Single Skin Airhalls LTA Minimum
Average maintained level of illuminance measured at the playing surface within the PPA:	600 Lux	400 Lux
Uniformity Factor (Minimum/Average)	0.7	0.7
Average maintained level of illuminance measured at the playing surface within the TPA:	500 Lux	300 Lux
Uniformity Factor (Minimum/Average)	0.6	0.6

N.B. The single skin performance figures are based on lighting installed on 10m columns, outside the airhall, the designer having made due allowance for the light loss through the membrane.

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.

Emergency Lighting

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

Fire Alarm

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

Testing & Commissioning

Full test certificates are required in respect of all the 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 hall 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.

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 and related to the switching arrangements.

Copies of all test reports, record drawings and manufacturers' data are to be included in a services manual to be available at handover.

Due allowance should be made for witness testing of the court lighting by a representative of the LTA.

Minimum Design Requirements

Design Standards

The Airhall 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 airhall.

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

Enough fans of sufficient capacity should be provided to ensure that the Airhall Designer's specified inflation pressure (Design Inflation Pressure) can be reliably provided under storm conditions.

The fans shall be configured to comply with the following requirements:

There shall be a minimum of two fans. These may be configured as one main and one standby fan, one main and one supplementary fan (which operates only at higher pressure levels) or both fans may operate together.

The fans may be linked, but each fan shall be capable of operating independently in case of failure of the other fan.

If the fan is configured as a standby or supplementary fan it shall start automatically if the main fan fails.

Each fan shall be capable on its own of supplying enough air to maintain the airhall at a pressure of at least 60% of the Design Inflation Pressure.

All fans should be capable of operating from either the main or the reserve power supply.

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

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 to ensure that they are not opened when someone is standing on the other side.

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.

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 corners or overcuts.

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.

In cases where it is intended to remove the air-structure during the summer months, 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.

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 airhall is not in place) and the runoff from the airhall (when the airhall is in place). Drainage may need to be incorporated within or to pass through the foundation.

Routes for electrical and mechanical services associated with the airhall 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.

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.

The top surface of the perimeter foundation shall be flat, level and smooth, with a small outward crossfall to prevent ponding of rainwater.

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 airhall and the aggressiveness of the soil conditions.

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

Fencing

The perimeter of the air-structure, including the inflation units, shall be protected by a tall robust security fence at least 2.75m high and/or some other system designed to deter vandals from gaining access to the structure and inflicting any damage.

Sufficient space must be provided between the structure and the fence to facilitate maintenance access.

Power Supply

The airhall supplier is to include a Power Distribution Unit (PDU) to be sited local to the inflation unit.

The PDU is to contain;

Mains isolation

A distribution Board to control and protect the supplies to:

The inflation unit, including the heating system

A power supply monitoring system.

The court Lighting

Small power

Control Systems

Emergency Lighting

Fire Alarm

Security system (CCTV)

Communication Systems(Alarms)

Electricity ‘check meter(s)’, to monitor the energy usage.

The extent of this monitoring is prescribed by the Building Regulations.

Standby Power Supply

The reserve power supply shall have sufficient capacity to power all fans, at the level necessary to produce the Design Inflation Pressure, emergency lights and control systems for a minimum period of 14 hours.

Control Systems

The following minimum facilities should be included:

Inflation Unit Control System

The inflation unit control system 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 windspeed and inflation pressure monitoring and shall automatically adjust the inflation pressure in response to changes in the windspeed. The controls shall be set so that the required inflation pressure at each windspeed up to the maximum design windspeed is achieved. In this case at low windspeeds 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.

Gauges and Instrumentation

Gauges to measure the internal pressure in the airhall 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 airhall. The recorded wind speed shall be displayed on an analogue gauge.

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

In a prominent position inside the airhall.

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%.

.

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.

An ‘hours run’ counter for each set of court lighting to monitor the ‘burning hours’. This can be used as a guide for checking the degradation in performance that will occur and the need for re-lamping each court, with a complete set of lamps when performance falls below the LTA Minimum Maintained Level.

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.

Alarms

An audible and visual alarm signal shall be incorporated which operates inside the airhall 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 windspeed.

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.

Electrical Power Sockets

Metal clad double switched socket outlets are to be provided and located behind the run back areas of the courts, between the play lines of each pair at each end and at 300mm above finish floor level.

The sockets are to be protected by a Residual Current Device (RCD).

Equipment Enclosures and Cable Routing

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 Airhall 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.

Design Submissions

The Airhall Supplier shall submit at Tender Stage the following information using the pro forma in Appendix :

General arrangement plans and elevations showing the location, orientation and overall dimensions of the air-structure, the inflation units, perimeter anchorage and foundations, and the main and emergency doors, together with the layout of the tennis courts within.

The type and grade of membrane fabric to be used.

The type and arrangement of the structure cables and wires including details of door cables.

The perimeter anchorage arrangement including:

angle size and grade

bolt type, material and spacing

details of door cable anchorages

The foundation size and arrangement including:

reinforcement details (bar sizes and material grades)

concrete grade

The type, number, size and control arrangement of fan units.

The design inflation pressures and, if applicable, the variation of pressure under different design conditions.

General arrangement of the Power Distribution Unit [PDU] proposed.

General arrangement of the lighting together with details of predicted MAINTAINED performance.

A sketch layout to illustrate extent of the ducting and draw pits [the containment system] included in the price tendered.

Outline details of all other items to be provided under the Contract, including the relevant optional extra items described in Section 4.

Information provided may be subject to review by the LTA. If requested the Supplier shall provide full supporting data and information, including test results, to accompany the above submissions.

All data submitted will be taken to constitute the proposed design. The installation and construction of the airhall shall in every way conform to the concepts detailed within this information, unless otherwise notified and agreed by the Purchaser in writing.

Maintenance Manual

At least 2 weeks before inflation of the airhall, the Supplier shall provide a comprehensive Maintenance Manual tailored to the site. This shall describe all aspects of the equipment and its Mechanical & Electrical (M & E) services together with the inspection and maintenance regime required for the secure and safe operation of the airhall. The following items shall be included:-

The Design Inflation Pressure under normal and extreme wind conditions, together with the wind speed(s) and conditions at which the internal pressure is set to change (if applicable).

The membrane fabric itself, detailing repair methods and procedures, cleaning techniques, and highlighting areas which may require particular care and attention such as points where abrasion or stress concentrations may occur.

Ducts and bellows connecting the Airhall membrane to the inflation unit and doors, paying particular attention to the fixings and attachments, and required amount of bellows movement.

All perimeter anchorage fixings, cables, wires and attachments.

All doors, emergency exits and other elements.

The fan units including, switches, fan belts, air intakes, dampers and outlet grilles, and sufficient details to fully service or replace all mechanical and electrical parts.

The heater unit, if fitted.

The reserve power supply including batteries, fan belts, fuel and oil levels and sufficient details to fully service or replace all mechanical and electrical parts.

A fully detailed description of the power distribution and controls system.

The anemometer (if applicable) and the pressure gauges.

The alarm systems

“As installed” layouts of the ducting and draw pit installation.

“As installed” wiring diagrams.

A schedule of the ‘as-commissioned’ settings for all control and protective devices.

Copies of the FULL Electrical and Lighting Test Certificates generated during commissioning and testing. Any special Instructions for the changing of lamps in the floodlighting fittings

Any special Instructions for the changing of lamps in the floodlighting fittings

Any special procedures in the event of extreme conditions e.g. high winds and snow.

Requirements for deflating, handling, storage and re-erection, including, for cable supported air halls, cable spacing and requirements for the membrane profile between the cables.

The tennis centre staff have a duty to carry out the routine tasks described in the Maintenance Manual, and to establish procedures for dealing with any emergency or extreme conditions. The LTA may periodically review the ongoing operation, inspection and maintenance activities, to ensure that the safety, reliability and quality of the facility are not compromised. The tennis centre staff have a duty to monitor and record the ‘burning hours of the floodlighitng as part of the routine maintenance

The Manual should contain an inspection log book to record the daily, weekly, monthly and annual inspections. A model airhall maintenance guide is included in this document.

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 airhall.

A notice shall be fixed on the inside of the airhall 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. Inappropriate use of emergency exits, particularly during strong wind or heavy snow conditions can increase the risk of damage to the Airhall.

Site Supervision

The Airhall Supplier shall use a suitably qualified and experienced person or persons to supervise the inflation and deflation of the airhall and carry out the adjustment and commissioning of all control systems in accordance with the design assumptions. The

supervision is to include the electrical and mechanical services installations and a witness test of the court lighting.

Further Design Requirements

The Airhall shall fully comply with all the design requirements specified in this section.

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 Direction Factor Sd shall either accord with the particular wind direction considered or shall conservatively be taken to be 1.00 for all wind directions.

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.

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

$$q = 0.613\ Ve^2 \times Ca$$

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.

Dead Loads

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.

Combined Loading

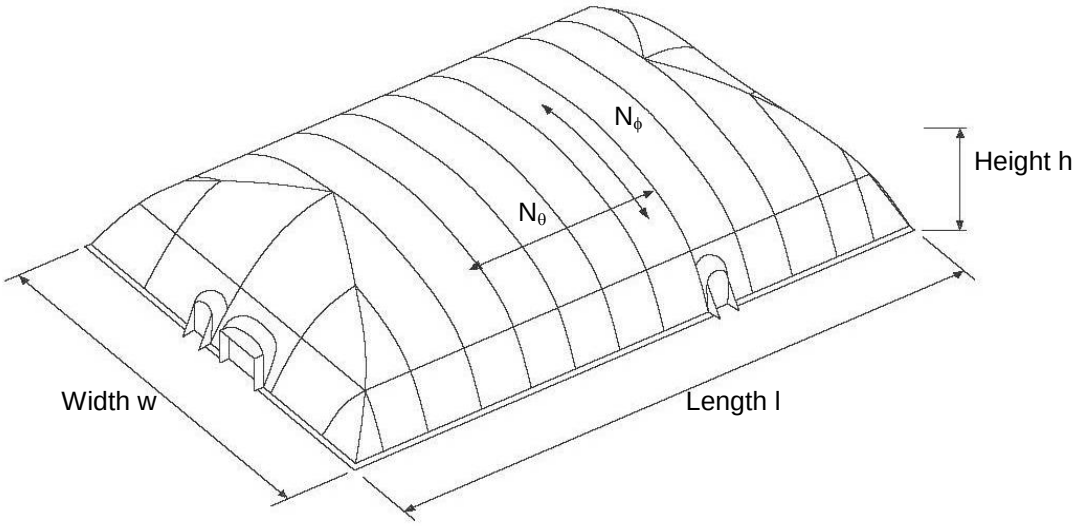
Where an allowance is made for the dead weight of the membranes or added loads, as noted above, the design shall consider these in combination with other applied loads as appropriate. In most cases it will only be necessary to consider dead loads in combination with snow loads.

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.

3.7 Membrane Surface Tensions and Design Inflation Pressures

For airhalls of Standard Shape, defined as a simple cylindrical profile with enclosing end vaults on a rectangular base, tabulated solutions for surface tensions and minimum Design Inflation Pressures are given in Table 1 below. Definitions of parameters used in Table 1 are given in Figure 1.

Figure 1 -Definitions of parameters used in Table 1



Airhall radius = r where $$r = \frac{\left(\frac{w}{2}\right)^2 + h^2}{2h}$$

$N\phi$ is the surface tension (meridional)

$N\theta$ is the surface tension (longitudinal)

Pi is the inflation pressure

q is the wind impact pressure

Table 1 - Design Surface Tensions and Design Inflation Pressures (minimum) for Standard Shape Airhalls.				
Shape	Width/Length ratio	Design surface tension per unit width		Design Inflation Pressure pi (min)
		Nϕ	Nθ	
h = r	¾	0.9qr + pir	1.3qr + 0.5pir	0.6q
	½	0.8qr + pir	1.4qr + 0.5pir	
	⅜	0.8qr + pir	1.5qr + 0.5pir	
	¼	0.8qr + pir	1.75qr + 0.5pir	
h = ¾ r	¾	1.0qr + pir	1.1qr + 0.5pir	0.5q
	½	0.9qr + pir	1.3qr + 0.5pir	
	⅜	0.9qr + pir	1.6qr + 0.5pir	
	¼	0.9qr + pir	2.3qr + 0.5pir	
Note: interpolation may be used				

For Airhalls where the membrane carries the structural loads the design membrane tensions may be taken as the design surface tension.

For airhalls in which a cable net carries the structural loads the design cable tensions may be derived from the direction and width of surface and hence surface tension each cable is replacing. The membrane between the cables may be designed by assuming the membrane acts as a catenary spanning between cables.

The majority of air-structures for indoor tennis will be of Standard Shape. Airhalls which are not of Standard Shape require special treatment in the design, and specialist advice should be sought for the determination of the inflation pressures and wind loads and for the detailed analysis of the structure. Appropriate wind tunnel tests may be necessary to determine the surface pressures. Structural analysis shall take into account the geometrical and material non-linearities.

Operating Inflation Pressures

Airhalls which have a control system in which the pressure is altered automatically in response to the wind speed shall operate at an Operating Inflation Pressure po under no snow or light wind conditions. The Operating Inflation Pressure must be sufficient to safely support the dead weight of the structure and provide sufficient rigidity as required by the design, but not so high that the fan system is constantly running at an uneconomical level. An Operating Inflation Pressure po typically in the range of 150 - 200 Pa is usually sufficient.

The Design Inflation Pressure pi (min) appropriate to the design Effective Wind Speed Ve is derived from Table 1 in Section 0

For lower values of wind speed (V), the required Inflation Pressure (pv) may be determined from the simple relationship

$$pv = pi(min) (V / Ve)2$$

The actual inflation pressure in the air-structure shall not be less than this design value at all levels of wind speed V up to and including the maximum Effective Wind Speed Ve.

Under snow loading conditions, the actual inflation pressure in the air-structure shall be equal to the maximum predicted snow intensity derived from BS 6399 Part 3 multiplied by 1.10.

Higher pressures increase the loads in the membrane and on the anchorages and foundations. The Maximum Inflation Pressure pmax allowed for in the design shall be clearly defined and the actual inflation pressure shall not exceed this value at any time.

Anchorages

The perimeter anchorage details and all fixings and attachments shall be properly designed and detailed in accordance with current good practice and the relevant British Standards. The loads on them shall be derived from the maximum forces on the membrane, and the details should permit the forces to pass to the foundations along smooth load paths, taking care to avoid stress concentrations and eccentricities which could cause distress in any components of the structure.

The design strengths of proprietary anchorage fixings shall be proven by tests demonstrating their adequacy, and copies of the relevant test certificates shall be made available by the Airhall Supplier upon request.

Safety Factors

The following safety factors shall be applied to component capacities subjected to the loads derived from and calculated in accordance with the above.

Where the Purchaser is prepared to accept a greater risk of failure, these safety factors may be reduced with the written consent of the LTA. The LTA shall not be obliged to consider or accept a proposal for using reduced safety factors.

Membrane

The tensile and tearing strengths of the membrane material shall be determined from suitable tests carried out in accordance with the relevant British or equivalent international standards. Tests shall preferably be performed on samples of the membrane material in a condition representative of the end of its design life as well as on new material.

The membrane joints whether factory or site made shall have a tensile strength of at least 90% of the unjointed material throughout the life of the airhall.

At the end of its design life, taking into account any reduction of strength due to joints or ageing, the tensile strength of the membrane shall have a factor of safety of 4.0 over the applied loads.

Cables, Ropes and their Connections

The strength of all cables, ropes and their connections shall have a factor of safety of at least 2.5

Anchorages

The connections between the membrane and the foundation shall be designed with a factor of safety of at least 2.0

Foundations

Anchorage devices such as ground anchors shall be designed with a factor of safety of 2.0 providing each and every ground anchor is load tested to the design load. If ground anchors are not load tested the factor of safety shall be 2.5

Continuous dead weight foundations such as concrete ringbeams shall be designed with a factor of safety of 1.5 assuming the most unfavourable ground conditions. Friction between the ringbeam and the ground may be taken into account, but shall not account for more than 20% of the design resistance.

Additional Design Submissions

In addition to the submissions required in section 2 the Supplier shall make the following additional submissions at Design Stage and at least three weeks before any material order or component fabrication commences.

Membrane properties: the Airhall Supplier shall provide evidence including test results to support the particular value of the membrane strength and strength reduction factors (for ageing and for factory/site joints) adopted in his calculations.

Material properties and proof of capacity of all cables, wires, end terminations and attachments.

Full details of the foundations as applicable to the project including: For ring beams – full structural drawings; for ground anchors - anchor and rod/cable types and sizes, materials, capacities and proving test results; for other foundation types – all relevant dimensional, material and capacity details.

Full details of the electric cable ducting, draw pits, conduit and / or cable trunking sizes & routes.

Full details of the control systems, instrumentation, display gauges and alarm facilities.

Full details of the doors, security systems, lighting, heating, drainage and all ancillary items.

Full structural calculations

Optional Extras

The following features are highly desirable additions to an airhall scheme, and shall be included in the scheme if possible or if they are specified in the Employer's Requirements:

Control System Options for the Inflation Systems

Remote Operation

A facility to remotely monitor the control system and make adjustments including pressure and temperature settings (e.g. via a telephone or computer)

Emergency Door Ajar Status

A facility to instantaneously detect an open door and make corresponding adjustments to the control system to compensate for the pressure loss

Remote Monitoring

A facility to monitor pressure, wind and temperature gauge readings remotely.

Alarm Options

Remote Monitoring

A facility to monitor the alarm status remotely (e.g. via a telephone or computer)

Snow Detection

Automatic Detection

A facility to automatically detect snowfall and to trigger the system to operate at the Design Inflation Pressure (and temperature if heating is provided), without the need for manual intervention. Automatic snowfall detection shall be via instruments mounted in an exposed position, but protected from strong winds and accidental interference, on top of nearby buildings or structures where snow can accumulate

Door Options

Emergency Doors

Wherever possible, pressure balanced rather than butt-hinged emergency doors shall be used, with self-closers strong enough to close the door against the action of the internal pressure.

Security Options

Alarms and CCTV

Consideration shall be given to the installation of automatic alarm and/or video surveillance security systems around the airhall.

Storage

Storage Facility

For seasonal airhalls, if a suitable storage facility does not already exist a suitable facility shall be provided, either by the Airhall Supplier or by the Purchaser as defined in the Employer's Requirements. The storage facility shall permit the airhall to be stowed and retrieved easily and provide a secure, dry and pest free environment.

Heating Option

Consideration shall be given to fitting heating unit(s). The heating unit if fitted shall be compatible with and incorporated into the inflation system. The control of temperature is to be fully automatic.

Air temperature should be maintained at a minimum of 8 degrees C. when the ambient temperature is -4 degrees C.

The control system is to include a master timeclock to switch the heating on and off to match usage patterns.

During unoccupied periods a frost protection system is to maintain a minimum temperature of 2 C.

Any temperature sensors within the air hall are to be fitted with wire guards to protect the devices.

Disclaimer

Compliance with the requirements of this guidance note does not infer any guarantee of safety or satisfactory airhall performance, and the LTA cannot accept responsibility for any failure or fault in the structure, its operating equipment or ancillary items.

APPENDIX A – Pro Forma For Tender Stage Design Submissions.

The following must be regarded as a sample of the information to be included. Actual projects will need each section in further detail.

Item	£ p
Section 1 - Building	
Membrane	
Foundations and ring beam	
Court Surfaces	
Fitting out	
Section 2 – Services	
Mechanical Services (H and V)	
General Electrical Services	
Court Lighting	
Testing	
Commissioning	
Any other items not included above	
Total tender value for Tennis Hall	

Extra Over items from Section 4 (To be included as applicable for each project.)

Item	£ p
Control systems	
- Remote operation	
- Emergency Door Ajar Status	
- Remote monitoring	
Alarm Options - Remote monitoring	
Snow Detection - Automatic detection	
Security Options - Alarms and CCTV	
Storage -Storage Facility	
Heating Option -Heating system -Heating Controls	
Total value for Optional items.	

Note: Where space provided is insufficient further pages may be appended to the standard pro forma.

General Arrangement
Plans and Elevations Showing: -Location and orientation -Overall dimensions of the airhall together with the layout of the tennis courts within. -Perimeter anchorage and foundations. -inflation units.

General Arrangement (continued)

Membrane and Cables
Arrangement of cables including door cables (diagrams)
Membrane type and grade
Cable type(s) and size (s)

Perimeter Anchorage
Anchorage Arrangement (diagram):
Angle size and grade
Standard bolt type, material and spacing:
Details of door cable anchorages:
Door cable anchorage: bolt type and material.

Foundations
Foundation arrangement (please indicate dimensions and reinforcement details as necessary):
Concrete grade:
Reinforcement details including grade(s) and bar size(s):

Fans and Power Supply	
Description of fan units (including type, number, size and control arrangement):	
Design inflation pressures and, if applicable, the variation of pressure under different design conditions:	
Details of the main power supply needed No of phases……. Single Phase / Three Phase and Neutral…….. Voltage……Volts Frequency…50Hz	
Basic Power Loads Fan(s): Running current …… Amps / Phases Starting current ……...Amps / Phases	Court Lighting Running current …… Amps / Phases Starting current ……...Amps / Phases
Total load of complete air hall facility ……Kva Sub main circuit protection required: Type HRC fuses (BS88) rating…… Amps / Phase MCCB rating ……Amps / Phase	

Details of the reserve power supply offered:

Arrangement of Court Lighting
Provide general arrangement drawings and attach a data pack to identify the predicted performance:

Further Information
Provide below outline details of all other items to be provided under the contract, including the relevant optional items described in Section 4:

AIR HALL MAINTENANCE GUIDE

Introduction

Unlike most buildings, airhalls rely on mechanical equipment and the air tightness of their membrane to remain structurally sound. It is therefore essential that a regular inspection and maintenance regime is diligently carried out. This will greatly reduce the chances of structural failure. An outline of such a regime is described in this guide.

The daily, weekly and monthly checks should be carried out, the record sheets on pages 3 and 4 completed and the boxes initialled by the Inspector, to provide a permanent record of the inspections and maintenance undertaken.

The recommendations for longer term maintenance and preventative measures in case of high winds and heavy snow should also be followed.

IMPORTANT NOTE

This maintenance guide should be used in conjunction with the Airhall Maintenance Manual issued by the Airhall Supplier. If there are any doubts or conflicting requirements the Supplier / Manufacturer should be consulted.

In addition to the checks, recommended within this Maintenance Guide, any further routine maintenance recommended by either the membrane or the inflation equipment supplier / manufacturer should be carried out, and entered into the records sections of this guide.

<table>
<tr><td colspan="3">The following reference information should be recorded so that it is easily available at all times.</td></tr>
<tr><td>Contact Details of Airhall Supplier.</td><td>Contact details of Airhall Manufacturer.</td><td>The Inflation System Manufacturer.</td></tr>
<tr><td colspan="3">If available and applicable to the inflation sustem installed (if unavailable all fan settings should be noted):-

The Design Inflation Pressure (Pressure at storm windspeeds)
The Normal Inflation Pressure (Pressure at low windspeeds)
Trigger Windspeed (Winspeed at which pressure is raised from Normal - Design Pressure)…
Maximum Inflation Pressure (Maximum Pressure the Airhall is designed for)
Alarm Settings (Pressure and Windspeed settings the alarms are triggered at) ……..
Fan and other control settings ……</td></tr>
</table>

Record Sheet for
……..(Month)……(Year)

Daily Checks

Inflation Fans and Control Systems
Check the main fan(s) is operating and all warning lights are normal.
Check reserve power/fans are set to operate automatically.
Check level of reserve power supply fuel and top up if necessary.
Check all gauges are operating and readings are normal.

Membrane and Anchorages
Walk around and check for obvious tears, holes, undue distortion or other damage.
Doors
Check emergency doors are shut and secure and panic bars in place.
Weather Forecast
Check forecasts for strong winds and snow, and take preventative actions (see Page 6).

Weekly Checks

Inflation Fans and Control Systems
Test operation of reserve power supply and standby fans (See note 1).
Check main fan(s) belt tensions (See note 1).
Lighting
Check all interior lights and controls are operating properly.
Check and test emergency lighting.
Heating (If fitted and during winter only)
Check heating setting and fuel level.

Monthly Checks

Inflation Fans and Control Systems
Carry out emergency door test (See note 2).
Check standby fan(s) belt tensions (See note 3).
Clear the fan inlet grilles and louvres of leaves and debris and ensure area around inflation and heating equipment is clear of vegetation and loose material.

Membrane and Anchorages
Check membrane closely at potential problem sites for damage or distress, e.g. around door frames, under cables and cable fixings, and at the attachment to the perimeter anchorages.

Check anchorage components, bolts, cables, ground anchors (if applicable) and attachments for signs of deterioration, wear damage, movement or loosening.

Doors
Check all doors including main doors and emergency exits for signs of distress and damage. Lubricate locks and hinges if necessary.

Daily			
1	9	17	25
2	10	18	26
3	11	19	27
4	12	20	28
5	13	21	29
6	14	22	30
7	15	23	31
8	16	24	

Weekly	
1	
2	
3	
4	
5	

Monthly
1

Notes From Daily Inspections	

Additional Maintenance Activities / Repairs Carried Out:	

Notes From Weekly Inspections:	

Additional Maintenance Activities / Repairs Carried Out:	

Notes from Monthly Inspections	

Additional Maintenance Activities / repairs carried out:	

Maintenance Tasks Carried Forward From Previous Month	Maintenance Tasks To Be Carried Forward to Next Month	Task Complete

LTA BRITISH TENNIS
IN PARTNERSHIP
Tennis FOUNDATION

Airhall Maintenance Guide – Test and Procedures

Note 1 – Testing of reserve power supply and standby fans, and main fan belt tensions (Weekly)

- Carry out routine checks of the reserve power supply unit such as fuel, engine oil and battery water levels.
- If heating is in use, turn off the heater and wait for the heater to cool down.
- Ensure that the power and fan changeover switches are set to automatic.
- If an alarm is fitted, warn any occupants of the airhall that the alarm is about to operate and disable any telephone auto-dialler remote alarm facility.
- Turn off the mains power supply, and the reserve power supply should automatically cut in. (Run the reserve power supply for at least 15 minutes in order to avoid draining the battery).
- Depending upon how the inflation system is configured the standby fan may also cut in and replace the main fan. If the main fan is still running it should be switched off manually to leave the standby fan or supplementary fan(s) running alone.
- While the main fan is off, check the main fan belt tension. If the belt can be deflected by hand through more than 2 cm (or in accordance with the manufacturers specification) then it must be re-tensioned. Also check the belt and belt wheels for signs of wear and damage.
- If the inflation system is configured so that more than one fan operates continuously, restart the fan switched off, and switch off the other fan(s) in turn to check their belt tensions.
- Check that the airhall internal pressure reading from the gauge, after operating the standby or supplementary fan alone for 15 minutes and before switching back to the main fan, is within the manufacturers guidelines.
- Turn the main power and fan switches back to their previous positions before the test. Any standby fan should automatically stop.
- Restore heating operation if previously in use.
- Reset the alarm and re-instate any telephone auto-dialler remote alarm facility.

Note 2 – Emergency door test (Weekly)

- If an alarm is fitted, disable any telephone auto-dialler remote alarm facility, and warn any occupants of the airhall that the alarm is about to operate.
- With the main fan operating at normal pressure and under still air or low wind conditions with no snow, open an emergency exit for a period of about ½ minute and check that the alarms operate, and the fans increase their output/ or standby fan operates (as applicable)
- Close the door and check that the system returns to normal.
- Reset the alarm (if any) and reinstate any telephone auto dialler remote alarm facility.

Note 3 – Test of standby fan belt tension (Monthly)

- With the main fan running turn off the standby fan switches to prevent accidental operation.
- Check the belt tension. If the belt can be deflected by hand through more than 2 cm (or in accordance with the manufacturers specification) then it must be re-tensioned. Also check the belt and belt wheels for signs of wear and damage.

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- Return the standby fan switches to their normal operating positions.

Procedures for Long Term Maintenance

6-Monthly Checks

- The following activities should be carried out every six months in addition to the normal monthly checks.
- The inflation unit should have a complete overhaul by an experienced mechanic with detailed knowledge of the fan systems and controls.
- The membrane should be cleaned to improve its appearance and prolong its life. The manufacturers recommended cleaning techniques and cleaning agents should be used. Heavy, aggressive or industrial dirt should only be removed by using special detergents and processes, and the advice of the manufacturer must be sought.
- A review of the airhall performance and routine maintenance activities should be carried out and any changes noted in the records section of this guide.
- The 'burning hours' of the court lighting should be recorded from the counter provided.

12 - Monthly Checks.

- The following activities should be carried out every twelve months in addition to the normal six monthly checks.
- It is recommended that the airhall supplier/manufacturer carries out a complete check of the hall and all associated control systems.
- The electrical installation should be checked, paying particular attention to the floodlighting to ensure the lenses of the fittings are clean, that there is no ingress of moisture and that all
- electrical connections are secure.
- When dictated by the extent of the 'burning hours' recorded of the floodlighting, a performance test, identical to that conducted at handover, should be carried out to establish the extent of performance degradation and the need for lamp replacement. A test at 2000 hours is recommended.
- Lamps must be replaced as a complete set per court, to ensure uniformity of lighting
- performance.

Procedures for High Winds and Heavy Snow

Strong Winds

- In the event of a forecast of strong winds, the following actions should be taken:-
- Ensure that the reserve power supply fuel tank is full.
- Ensure that all the emergency doors are securely fastened and that there are no excessive air losses anywhere.
- Remove all objects within about 1.5 metres of the membrane, inside and outside.
- Prepare to lower the lights in the event of an extreme wind.
- In the event of an extreme wind, that is a recorded windspeed at the site in excess of the windspeed at which the alarm should sound or 75% of the Design Windspeed whichever occurs first, the following additional actions should be taken:-
- Evacuate the airhall and ensure that no unauthorised persons enter it or stay too close to it.

- Ensure that the standby fan unit (if applicable) is operating and check that the internal pressure is at the Design Inflation Pressure.
- Lower the internal lights to the floor, and ensure that all remaining objects are laid flat or moved well away from the membrane.
- From a safe location, away from the airhall, observe and record the behaviour of the airhall during the storm, taking regular windspeed and pressure readings from the remote gauges if possible and noting the deflections and movements of the airhall, particularly around the doors and adjacent to the anchorages.
- After the storm has passed carry out a through inspection, equivalent to a combined daily, weekly and monthly inspection, and ensure that all parts are restored to normal operation.

Heavy Snow

- In the event of a forecast of heavy snow, ensure that the heating system (if fitted) is operating properly and that the oil or gas supply to the heater is full. Also ensure that the reserve power supply fuel tank is full.
- If there is no normal heating system installed, obtain some industrial space heaters from a local hire firm or other suitable supplier. These must be capable of raising the internal at temperature to at least 8ºC.
- In the event of an actual heavy snowfall, check that the internal temperature is held to a level of at least 8ºC, and that the snow is not accumulating and building up on the surface of the airhall. Check also that the inflation unit's inlet and exhaust grills are clear, and that the fabric bellows tubes between the airhall and inflation unit are not constricted or damaged by the snow.

If the heating fails and/or snow build up occurs, the following actions should be taken: -

- Manually turn on the standby fan (if applicable) or use the override switches to ensure that the internal pressure reaches and is sustained at the Design Inflation Pressure.
- Attempt to physically remove the snow using either water jets, long poles and brushes or by passing a rope right over the airhall and dragging it backwards and forwards across the top. (Avoid using objects with sharp edges or that may damage the membrane).
- If more than 40 mm of snow accumulates, the internal lights must be lowered, the nets and net post taken down and laid flat and all other internal objects removed or laid flat with all sharp edges protected.
- If the snow accumulation continues and the airhall collapses to the ground the fan units should be turned off once the airhall has collapsed. After the snow has melted the airhall can be re-inflated in accordance with the manufacturer's instructions.

B4 Framed Fabric Structures

Contents

Glossary

The following terms used in this guide are defined below:-

Purchaser		The Club, Centre, Facility or Organisation buying the framed-fabric structure.
Supplier		The company the Club, Centre or Facility buys the framed-fabric structure from. Depending on the size of the project and the nature of other work being carried out at the same time, it could be the framed-fabric structure Manufacturer or Agent or a General or Court Contractor.
LTA		The Lawn Tennis Association.
Contract		Legally binding agreement between the Purchaser and the Supplier.

Introduction

These Guidance Notes are intended to guide those planning to purchase a framed-fabric structure through the specification process. The aim of the specification process is to ensure that the framed-fabric structure purchased meets the LTA's minimum standards in terms of functionality, performance, safety and quality.

The specification lays down important criteria for the framed-fabric structure Supplier to meet. These include, amongst others, criteria for the structural design of the framed-fabric structure, the materials used, and the quality of the workmanship.

These guidance notes must form part of the Contract between the purchasing body and the framed-fabric structure Supplier, to ensure that the Supplier is obliged and legally bound to supply a framed-fabric structure that meets the LTA's minimum standards. There are four parts to this document

1. Design Parameters - general guidance on dimensions, infrastructure, lighting etc.
2. General Requirements for Framed Fabric Structures - this section defines important criteria that the supplier must meet including requirements for design, the quality of workmanship, submission of documents and drawings and maintenance.
3. Design of Framed-Fabric Structures – this section defines more detailed design criteria that suppliers should comply with. The purchaser should establish potential supplier's ability to meet these criteria during the project planning stage.

4. Optional Extras – desirable extra features to add into a Framed-Fabric scheme.

Contract

All projects that require LTA funding should use a recognised standard form of building contract eg Joint Contracts Tribunal (JCT) standard forms, which are suitable for dealing with a range of project values and types.

The Construction Process

The key stage project guide over the page illustrates the main processes involved in a framed-fabric scheme. Although apparently a relatively simple method of covering courts, framed-fabric construction needs careful management if the purchaser is to achieve the desired end product. It is always important to remember that each project is unique and additional steps or procurement methods may be required to deal with site specific issues. The first major step, once funding is achieved, is to appoint a Project Manager to help develop the project.

Project Life Cycle

PROJECT LIFE CYCLE.

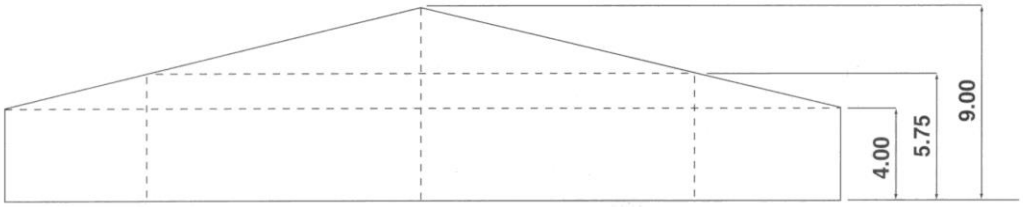
START ON SITE

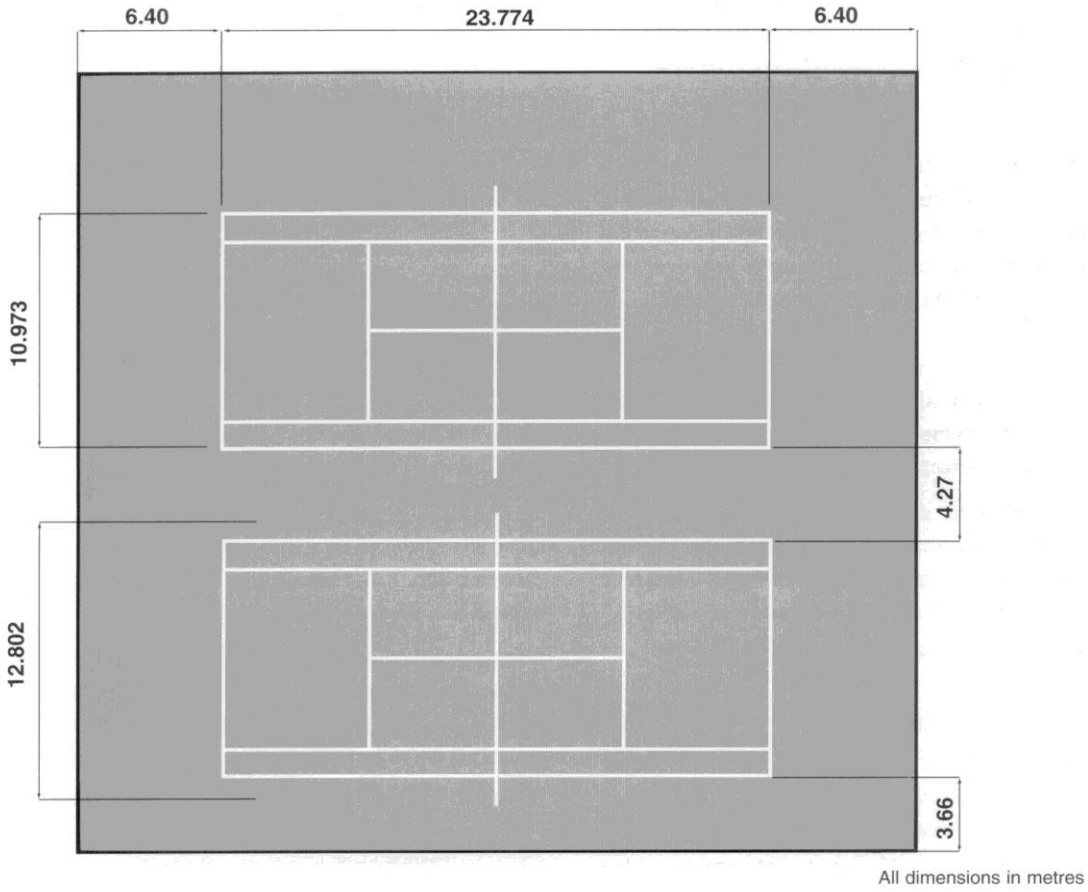
Key Stage	One Feasibility/Planning	Two Design	Three Construction	Four Operation and Maintenance
	• Confirm funding. • Appoint project manager and project team. Project team to decide; • Type of court surface. • Size of air hall building allowing for foundations, drainage and fencing. • Number type and location of doors and openings. • Power supply required. • Drainage required • Lighting and heating required. PM to submit planning application.	Project team to • Select procurement route. • Produce product brief / scope of works document. • Prepare tender package (based on guidance note B3). • Submit tender package to LTA for review and comment. • Send approved tender package to Air Hall suppliers. • Review contractors bids and submit to LTA for review and comment. • Appoint contractor. • Review design packages.	• PM to arrange a pre start meeting to confirm site logistics. • PM to monitor construction of Air Hall to ensure it complies with Employers requirements and Guidance Note B3. • On completion of the project the purchaser receives a maintenance manual from the Air Hall Supplier. • PM in association with LTA to undertake completion and commissioning check and tests. • Club to appoint person(s) responsible for maintenance. • Notify LTA of person responsible.	• Commence maintenance regime in accordance with maintenance manual. • Submit records to LTA on a quarterly basis.

1. Design Parameters

Dimensions

The table below illustrates the space required to construct a framed-fabric structure to the LTA recommended minimum dimensions. These recommendations should be followed wherever possible. .





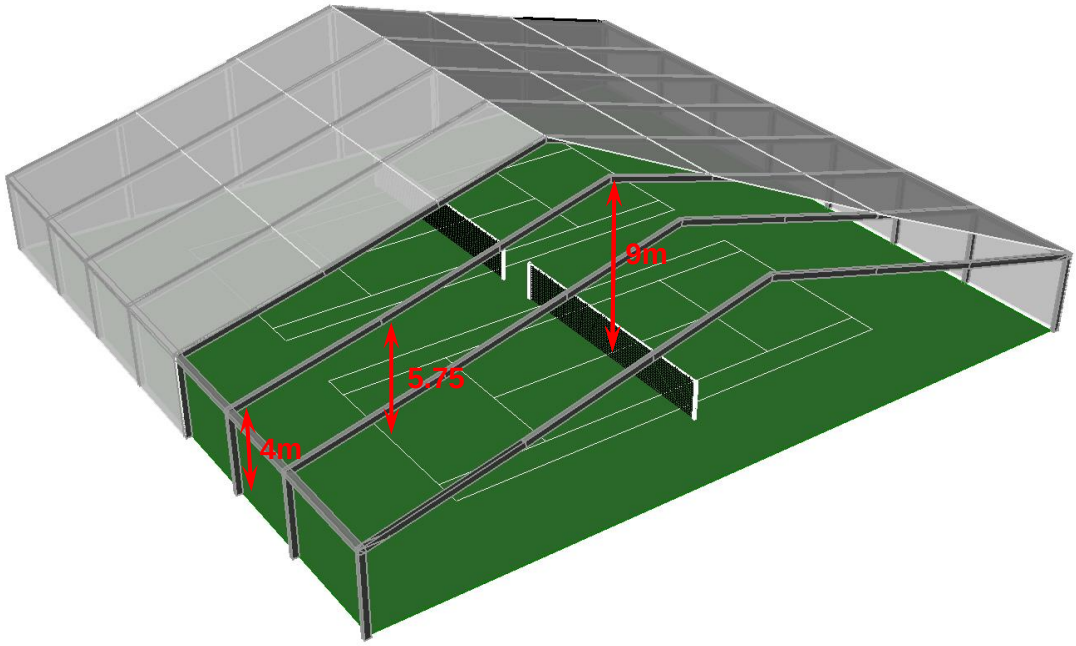
All dimensions in metres

Internal Dimensions

Principal Play Area	
Length	23.77m (78’0”)
Width	10.97m (36’0”)
Length of net (doubles)	12.8m (42’0”)
Width of lines (white) included within above court size	0.05m (0’2”)
Unobstructed height above the net (from floor level) at the centre of the net	9.0m
Unobstructed height at the baseline for the full width of the court	5.75m
Unobstructed height at rear of run-back	4.0m

To achieve recommended minimum height clearances the following dimensions are required:

Run-back	6.4m
Side-run	3.66m
Total length	36.58m
Total width for two enclosed courts	33.53m
Total width for three enclosed courts	48.77m
Total width for four enclosed courts	64.01m
Allow for a further 2m on each end of the total lengths and widths to allow for the foundations, perimeter fencing and drainage.	
Space between courts	4.27m



Court Surface

Please refer to LTA Guidance Notes for further information

Walls

Drapes, netting or high coloured fabric panels should be used as backdrops in the structure.

Single colour backdrop drapes are to be provided to the walls behind the baseline of the tennis courts. These should span from ground level to eaves level. Suitable colours for drapes and netting include dark green and dark blue.

Adequate durable protection is to be provided to any protrusions e.g. steel columns, to a minimum height of 2m above floor level and should be coloured to match the canvas drapes.

Court divider netting when provided, should be positioned between courts with the ability to be withdrawn if required.

Mechanical services

The complete installation must comply with the current Building Regulations, the Codes of Practice published by the Chartered Institute of Building Services Engineers, all relevant

European codes of practice, British Standards (BS) codes of practice, the requirements of the Fire Officer, and the requirements of the Environmental Health Officer.

The control systems are to be fully automatic and make due allowance for energy monitoring of the services, to meet the current Building Regulations

The particular attention of designers is drawn to the following,

Ventilation

A ventilation system is to be installed.

Air velocity should be in the range of 0.1 to 0.5m/sec. The air change rate should be:

- 0.5 changes/hr (winter)
- 2.0 changes/hr (summer)

The thermal efficiency of enclosure should conform to the minimum requirements of the current Building Regulations.

Noise

The noise level in the tennis hall is directly related to the nature of the surroundings and in particular the operational needs of coaches to be heard, during coaching sessions.

Accordingly, noise from the mechanical services machinery must be limited to ensure the playing environment is protected.

The tennis hall is to be design with a noise rating NC45 or better.

Electrical Services

The installation should conform to BS 7671; as amended, the current Wiring Regulations.

Power Supply

Every project will need an adequate supply to power the various features.

The provision of a correctly rated supply, to an intake point within the building will be the Organisation's responsibility.

Please note that during the project development it may prove more economic for the power supply to be terminated at an Intake Point local to the site boundary, instead of within the building. This will minimise the work done by the Electricity Co. and hence contain the cost by utilising the services of either a local contractor or the floodlighting contractor. They will complete the feed cable installation from the intake point. This arrangement is commonly used if there are other facilities being installed, on other parts of the site which may also require electric power now or at a future date. [E.g. floodlighting for outdoor courts, a pitch or clubhouse etc.]

In this case, at the Intake Point a Main Isolator and a 'switchboard' or 'switchfuse' will be needed. The function of this equipment is to control and protect the feed cables to the various locations. The cables are called 'sub-mains'.

When any sub-main serves an area that includes floodlighting it is critical that this cable is designed to ensure that the volt drop on it does not exceed 1.5% of the supply voltage.

Any local 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 floodlighting 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.

To ensure the power requirement is correctly quantified the following information must be advised as part of the Tender submission, in respect of their proposed equipment and ancillary features

Confirmation of the supply voltage and frequency required for the electrical supply.

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 facility (Kva rating)

The Contractor is to include a Power Distribution Unit (PDU) to divide, control and protect the power supply to each part of the installation. The PDU is to be located either within a cupboard of the building, or, more commonly, in an IP55 rated external enclosure next to the building

Control Systems

The overall control system for the complete facility should be considered as one coordinated design for the building.

It is required to monitor and control the operation of all the electrical services, particularly the floodlighting.

The control system must be able to monitor energy usage of individual items of plant, in conformity with the latest Building Regulations

Power Sockets

The tennis hall installation must include the provision of small power, in the form of metal clad socket outlets. 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.

Court Lighting

Layout

Fittings are to be arranged so that they are not in the centre of the field of view during play or 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.

Reflective Values

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

Protection

Protection of the fittings must be provided by the application of permanent proprietary guards or louvres 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 lamps

Maintenance Factor – The ratio applied to the initial level of illuminance to achieve the required maintained level of lighting. The industry standard utilises a factor of 0.8. This is the basic value to be applied.

Measurement Grid - A total of (15) fifteen readings are required within the PPA. A total of (35) thirty-five readings are required within the TPA. Illumination standards are to be based on measurements taken after dark at ground level.

The grid layout, to meet the LTA requirements, is to be agreed in advance of the testing with the Contract Administrator

Performance standards

Average maintained level of illuminance measured at the playing surface within the PPA:	600 Lux
	0.7 Uniformity Factor (Minimum/Average)
Average maintained level of illuminance measured at the playing surface within the TPA:	500 Lux
	0.6 Uniformity Factor (Minimum/Average)
Minimum colour temperature:	min 3,600k
Minimum height of luminaires	6.5m located outside the Total Playing Area

Standards are set court by court and are measured when the courts are individually operated. The tests must be carried out after dark and at ground level.

Egress lighting

To ensure safe egress a small group of luminaires is to be retained in operation for a pre-set but adjustable period on each court still in use, at the end of the operational day.

Emergency Lighting

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

Fire Alarm

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

Testing, Commissioning and Handover Manual

Full test certificates are required in respect of all the 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 the courts are lit and controlled individually they are to be tested with all others switched off.

The maintained performance is to be calculated, from the initially recorded values, using the maintenance factor agreed in the original design and compared with the LTA standards, scheduled in this document.

Copies of all 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.

Due allowance should be made for witness testing of the court lighting by a representative of the LTA.

General Requirements for Framed-fabric structures

Design Standards

The framed-fabric structure shall fully comply with the general requirements specified in this section, in addition to the design requirements contained within section 0 of this Guide.

Structural Frame

Structural frames shall be sufficiently stiff and well braced to ensure that their deflection does not result in excessive stress concentrations in the membrane panels.

Durable padded protection shall be provided to exposed columns and rigid bracings to a minimum height of 2m above floor level.

Bracing 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 adjacent membrane material.

Frame Splices and Connections

Frame splices and connections shall be designed and detailed to prevent any sharp edges, corners or protrusions from bearing onto the membrane material, and to avoid local membrane stress concentrations.

Membrane Panels

All membrane panels should be tensioned and shaped in such a way as to ensure stability under wind loading and to avoid flapping or chaffing. Where membrane materials are expected to creep and stretch over time, re-tensioning of the membrane panels shall be possible.

All membrane panels shall also be tensioned and orientated to shed water and to avoid ponding occurring during and after rainfall.

Membrane Attachment System

The attachment system shall be detailed to prevent membrane damage occurring. Membrane attachment and tensioning devices shall be designed to evenly distribute the tensioning force into the membrane material.

The following requirements shall be met:

Punched bolt holes in steel or aluminium components shall be ground smooth where they attach to or come into contact with the membrane.

Steel or aluminium sections shall be properly aligned without any steps or sharp protruding edges.

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 corners or overcuts.

Where the membrane is directly tensioned by rope or cable, corrosion proof eyelets shall be used to reinforce the holes.

All attachment components shall be sufficiently stiff to ensure that their deflection does not result in uneven stress distribution in the membrane material

Panel and Structure Openings

In cases where it is intended to remove membrane panels or part of the structure during the summer months, the attachment system, any holding down bolts, or anchorage to the foundation shall be designed such that there are no elements remaining (e.g. upstanding bolts or angles) which could present a trip hazard to players or spectators. All membrane materials shall be stored in a secure, rodent-free, dry environment during the summer months.

Doors and Emergency Exits

Provision for disabled users shall be made either through the main door or via an adjacent emergency exit.

All doors, including emergency exits, shall be fitted with clear viewing panels to permit safe entry and exit.

Foundations

The foundations shall be arranged to resist the loads imposed upon them including uplift and horizontal forces.

The foundation arrangement shall make allowance for:

The drainage requirements of the court playing surfaces (i.e. when removable membrane panels are not in place) and the runoff from the framed-fabric structure. Drainage may need to be incorporated within or to pass through the foundation.

Routes for electrical and mechanical services associated with the framed-fabric structure heating and lighting 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 and maintenance access.

In the case of concrete ring beams, pads or pile caps:

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.

The top surface of the foundation shall be flat, level and smooth, with a small outward crossfall to prevent ponding of rainwater.

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

In the case of foundations incorporating ground anchors:

Ground anchors component materials shall be chosen with due consideration given to the design life of the framed-fabric structure and the aggressiveness of the soil conditions.

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

Fencing

The perimeter of the frame-fabric structure shall be protected by a tall robust security fence at least 3m high and/or some other system designed to deter vandals from gaining access to the structure and inflicting any damage.

Sufficient space must be provided between the structure and the fence to facilitate maintenance access.

Power Supply

The design is to include a Power Distribution Unit (PDU) to be located either within a cupboard of the building, or, more commonly, in an IP55 rated external enclosure next to the building

The PDU is to contain;

Mains isolation

A switchboard to divide, control and protect the supplies to:

The Ventilation services and the associated controls.

The court Lighting and associated controls

The general electrical services including, but not limited to:

Small power

Emergency Lighting

Fire Alarm

Security system (CCTV)

Communication Systems(Alarms)

Electricity ‘check meter (s)’ are to be installed to monitor the energy usage of the facility.

The extent of this monitoring is prescribed by the Building Regulations.

Control Systems

The following minimum facilities are to be included:

Lighting Control System

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

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

Consideration should be given to the provision of controls to reduce the extent of artificial light provided against rising ambient levels.

If occupancy sensors are applied to the court lighting, an override key switch is to be installed to facilitate maintenance checks and performance testing

Egress lighting

To ensure safe egress, at the end of the operational day a small group of luminaires to be retained in operation for a pre-set but adjustable period, on each court still in use at the curfew time set on the master timeclock.

An ‘hours run’ counter for each court. These are to monitor the ‘burning hours’ of each set of court lighting. This should be used as a guide for checking the degradation in performance that will occur and the need for re-lamping each court. Re-lamping will comprise the replacement of the complete set of bulbs, on a court by court basis, when performance falls below the LTA minimum Maintained level.

Re-lamping also includes a lighting test to confirm the performance.

Ventilation Control Systems

Thermostatic controls with manually adjustable and lockable temperature settings shall be provided.

Alarms

A visual alarm signal shall be incorporated which operates inside the tennis hall, just prior to the curfew time. This is to warn players that the court lighting will shortly be switching off and that they should promptly clear the courts.

Electrical Power Sockets

Metal clad double switched socket outlets are to be provided and located behind the run back areas of the courts, between the play lines of each pair at each end and at 300mm above finish floor level.

The sockets are to be protected by a Residual Current Device (RCD).

Equipment Enclosures and Cable containment systems

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.

All electrical cables shall be enclosed in a suitable conduit and / or trunking system.

They shall be properly secured and protected within a complete containment system. Where required, ducts, set into the ground, shall be provided for electrical cables where they cross the courts and / or under adjacent hard standing around the building perimeter.

The arrangements must ensure that disabled and emergency access is unhindered.

Security

Any Intruder Alarm system should comply with BS 4737 integrated with the main building system and linked to a central monitoring station where such exist.

Viewing Area

An access lift or ramp should be provided to raised viewing areas.

Design Submissions

The framed-fabric structure Supplier shall submit the following information, which may be subject to review by the LTA as a condition of financial support

At Tender Stage

General arrangement plans and elevations showing the location, orientation and overall dimensions of the framed-fabric structure, and the main and emergency doors, together with the layout of the tennis courts within.

General layout of frames, bracing and all other elements of the structural system including foundations and outline details of the membrane attachment system.

Outline details of the types and grades of membrane fabric, frame material and other structural elements to be used.

Details of the proposed Mechanical and Electrical services

General arrangement of the Power Distribution Unit [PDU] proposed.

General arrangement of the lighting together with a 'Data Pack' to illustrate the predicted MAINTAINED performance of the proposed design.

A sketch layout to illustrate extent of the ducting and draw pits [the containment system] included in the price tendered.

Outline details of all other items to be provided under the Contract, including the relevant optional extra items from Section 0.

Details of the main power supply required.

No. of Phases……Single Phase / Three Phase and Neutral…..

Voltage……Volts Frequency…50 Hz

Basic power loads

Ventilation services

Running current…….Amps / phase

Starting current…….Amps / phase

Court lighting:

Running current…….Amps / phase

Starting current…….Amps / phase

Total load of complete tennis hall facility ……Kva

Sub main circuit protection required:

Type HRC fuses (BS88) rating…… Amps / phase

MCCB rating…… Amps / phase

At Design Stage and at least three weeks before any material order or component fabrication commences.

Full structural calculations demonstrating the compliance of the design with Section 0

Full structural design drawings and specifications

Membrane properties: the Framed-fabric structure Supplier shall provide evidence including test results to support the particular value of the membrane strength and strength reduction factors (for aging and for factory/site joints) adopted in his calculations.

Section sizes, material properties and full details of all components used in the membrane attachment system, including details of the types and sizes of all fixings used to anchor the membrane to the ground and any supporting structures.

Full details of the foundations as applicable to the project

Full details of the doors, security systems, lighting, heating, drainage and all ancillary items.

If requested, the Supplier shall supply full supporting data and information, including test results, to accompany the above submissions.

All information and data submitted and approved will be taken to constitute the agreed design information, and the installation and construction of the framed-fabric structure shall in every way conform to the assumptions and details contained in this information, unless otherwise notified and agreed by the Purchaser in writing, and with the consent of the LTA.

Maintenance Manual

At least 2 weeks before delivery of the framed-fabric structure, the Contractor/Supplier shall provide a comprehensive Maintenance Manual tailored to the site. This shall describe all aspects of the building, M& e services together with the inspection and maintenance regime required for its secure and safe operation.

The following items shall be included, but not limited to:

The membrane fabric itself, detailing repair methods and procedures, cleaning techniques, and highlighting areas which may require particular care and attention.

Frame maintenance requirements.

Bracing cables and attachments.

Membrane attachment system.

All doors and other elements.

Instructions for opening panels or sections.

All the building services

A fully detailed description of the power distribution and controls system.

The alarm systems

“As installed” layouts of all the building services and containment systems, including the ducting and draw pit installations.

“As installed” wiring diagrams.

A schedule of the ‘as-commissioned’ settings for all control and protective devices.

Copies of the FULL Electrical and Lighting Test Certificates generated during commissioning and testing.

Any special Instructions for the changing of lamps in the floodlighting fitting procedures in the event of extreme conditions

The tennis centre staff have a duty to carry out the routine tasks described in the Maintenance Manual, and to establish procedures for dealing with any emergency or extreme conditions. The LTA may periodically review the on-going operation, inspection and maintenance activities, to ensure that the safety, reliability and quality of the facility are not compromised. The tennis centre staff have a duty to monitor the ‘burning hours’ of the floodlighting as part of the routine maintenance.

The Manual should also contain an inspection log book to record the daily, weekly, monthly and annual inspections.

Notices

A notice shall be fixed on the outside of the framed-fabric 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 framed-fabric structure.

A notice shall be fixed on the inside of the framed-fabric structure adjacent to the main entrance giving evacuation instructions for occupants to follow in the event of an emergency.

Emergency doors shall be clearly signed. The signage shall discourage non-emergency use.

Site Supervision

The framed-fabric structure Supplier shall use a suitably qualified and experienced person or persons to supervise the erection of the framed-fabric structure. The supervision is to include the works of adjustment and commissioning of all control systems in accordance with the design agreed in respect of all the mechanical and electrical services installations.

Design of Framed-fabric structures

All framed-fabric structures are required to be designed to British Standards or the equivalent Eurocodes.

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.

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 Direction Factor Sd shall either accord with the particular wind direction considered or shall conservatively be taken to be 1.00 for all wind directions.

The Seasonal Factor Ss shall be taken to be 1.00

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.

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:

APPENDIX A- PRO FORMA FOR TENDER STAGE DESIGN SUBMISSIONS

The following must be regarded as a sample of the information to be included.

Actual projects will need each section in further detail.

Item	**£ p**
Section 1 - Building	
- Building membrane	
- Foundations & Ring beam	
- Court surfaces	
- Fitting out	
Section 2 - Services	
- Mechanical Services (H & V)	
- General Electrical Services	
- Court lighting	
- Testing	
- Commissioning	
Any other items not included above	
Total Tender Value for Tennis Hall	

Appendix B- MAINTENANCE GUIDE

Introduction

Most buildings rely on mechanical and electrical services to function reliably.

It is therefore essential that a regular inspection and maintenance regime is diligently carried out. This will greatly reduce the chances of short term failure, extend the overall life of the equipment and hence protect the capital investment.

Minimum Requirements

The daily, weekly and monthly and annual checks should be carried out, and record sheets completed and initialled by the Inspector, to provide a permanent record of the inspections and maintenance undertaken.

IMPORTANT NOTE: This Maintenance Guide should be used in conjunction with the Tennis Hall Maintenance Manual issued by the Main Contractor. If there are any doubts or conflicting requirements the Supplier/Manufacturer should be consulted.

In addition to the checks recommended within this Maintenance Guide, any further routine maintenance recommended by the specialist floodlighting installer should be carried out, and entered into the records section of this guide.

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 frame and any non-fabric cladding units the value of Ca shall be taken to be 1.00.

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

For the design of continuous perimeter beam foundations 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 framed-fabric structure.

For discontinuous foundations such as pads, ground anchors or individual piles, the dimension ‘a’ used in the derivation of Ca shall be taken to be the minimum distance between foundations.

Pressure and Force Coefficients

Where the building is of a shape which is adequately represented in BS 6399 Part 2, force and pressure coefficients may be derived from BS 6399 Part 2 for use in the design. Where the form is not adequately represented in BS 6399 Part 2 the wind effects in the structure should be obtained from a suitable structural analysis using the results of appropriate wind tunnel tests to determine the surface pressures.

Snow Loading

Snow loading on the framed-fabric structure shall be derived from British Standard BS 6399 Part 3, 1988, and allowed for in the design.

Dead Loads

Dead weights shall be fully taken into account including non-structural elements such as lights or heaters where they are supported by or directly attached to the structure.

Combined Loading

The combined effects of dead, wind and snow loading shall be considered in accordance with the appropriate standard (i.e. BS5950 for steel, BS8118 for Aluminium and BS8110 for concrete components or the relevant Eurocode)

Structural Frames and Systems

The design of the main structural elements shall be in accordance with the relevant British Standards or Eurocodes. Where suitable standards or criteria do not exist, the Supplier shall propose detailed criteria for the design of the structural elements, and provide full details with his tender.

Membrane attachment system

The membrane attachment system shall be properly designed and detailed in accordance with current good practice and the relevant British Standards or Eurocodes. The loads on them shall be derived from the maximum forces on the membrane, and the details should permit the forces to pass along smooth load paths, taking care to avoid stress concentrations and eccentricities which could cause distress in any components of the structure.

The design strengths of proprietary membrane attachment systems shall be proven by tests demonstrating their adequacy, and copies of the relevant test certificates shall be made available by the Framed-fabric structure Supplier upon request.

Foundations

Foundations shall be properly designed and detailed in accordance with current good practice and the relevant British Standards or Eurocodes.

Safety Factors

The following safety factors shall be applied to component capacities subjected to the loads derived from and calculated in accordance with the above sections.

Membrane

The tensile and tearing strengths of the membrane material shall be determined from suitable tests carried out in accordance with the relevant British or equivalent international standards. Tests shall preferably be performed on samples of the membrane material in a condition representative of the end of its design life as well as on new material.

The membrane joints whether factory or site made shall have a tensile strength of a least 90% of the unjointed material throughout the life of the framed-fabric structure.

For membranes carrying tensions as part of the primary structural system or providing structural stability or restraint, the factor of safety at the end of its design life, taking into account any reduction of strength due to joints or aging, shall be 4.0 over the applied loads.

For membranes acting as cladding but not performing any structural role, the factor of safety at the end of its design life, taking into account any reduction of strength due to joints or aging, shall be 2.0 over the applied loads.

Cables and Ropes and their Connections

The strengths of all cables and ropes and their connections shall have a factor of safety of at least 2.5

Membrane Attachment System

The membrane attachment system shall be designed with a factor of safety of at least 2.0

Foundations

The following factors of safety against uplift shall apply:

Anchorages devices such as ground anchors shall be designed with a safety factor of 2.0 against uplift providing each and every ground anchor is load tested to the design load. If ground anchors are not load tested the factor of safety shall be 2.5

Piles shall be designed with a safety factor of 2.5 against uplift.

Continuous dead weight foundations such as concrete ringbeams shall be designed with a factor of safety of 1.5 against uplift assuming the most unfavourable ground conditions. Friction between the ringbeam and the ground may be taken into account, but shall not account for more than 20% of the design resistance.

For downward and horizontal load effects on the foundations, safety factors shall be as per the appropriate British Standard, Eurocode or current good practice.

Optional Extras

The following features are highly desirable additions to a framed-fabric structure scheme, and shall be included in the scheme if possible or if they are specified in the Employer's Requirements:

Security Options

Alarms and CCTV

Consideration shall be given to the installation of automatic alarms and/or video surveillance security systems around the framed-fabric structure.

Storage

Storage Facility

If a suitable storage facility does not already exist that can house the removable panels or structure parts from framed-fabric structures, a suitable facility shall be provided, either by the Framed-fabric structure Supplier or by the Purchaser as defined in the Employer's Requirements. The storage facility shall permit the removed components to be stowed and retrieved easily and provide a secure, dry and pest free environment.

Heating and Insulation Options

Heating

Consideration shall be given to fitting a heating unit(s).

Insulation

The structure shall, if possible, incorporate a double layer of membrane fabric designed to provide some thermal insulation and prevent the accumulation of condensation on the inside surface.

Disclaimer

Compliance with the requirements of this specification does not infer any guarantee of safety or satisfactory framed-fabric structure performance, and the LTA cannot accept responsibility for any failure or fault in the structure, its operation or ancillary items.