

B4 FRAMED FABRIC STRUCTURES



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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.
LTA TF		Lawn Tennis Association Tennis Foundation
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 TF 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.

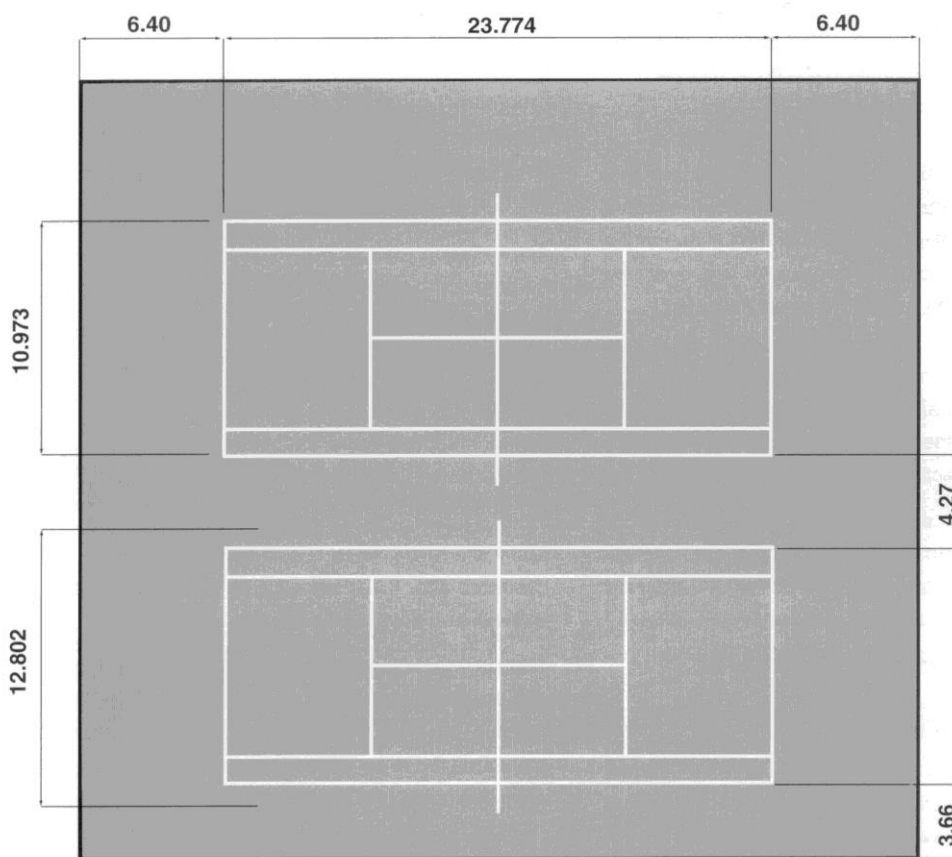
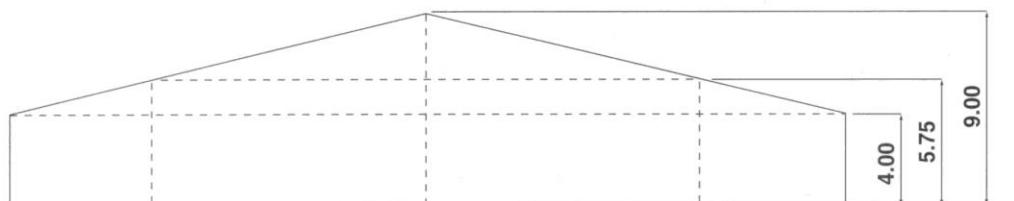
PROJECT LIFE CYCLE

Key Stage	One: Feasibility/Planning	Two: Design	Three: Construction	Four: Operation and Maintenance
	<ul style="list-style-type: none"> • Confirm funding. • Appoint project manager and project team. <p>Project team to decide;</p> <ul style="list-style-type: none"> • 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. <p>PM to submit planning application.</p>	<p>Project team to</p> <ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • Review contractors bids and submit to LTA for review and comment. • Appoint contractor. • Review design packages. 	<ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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.



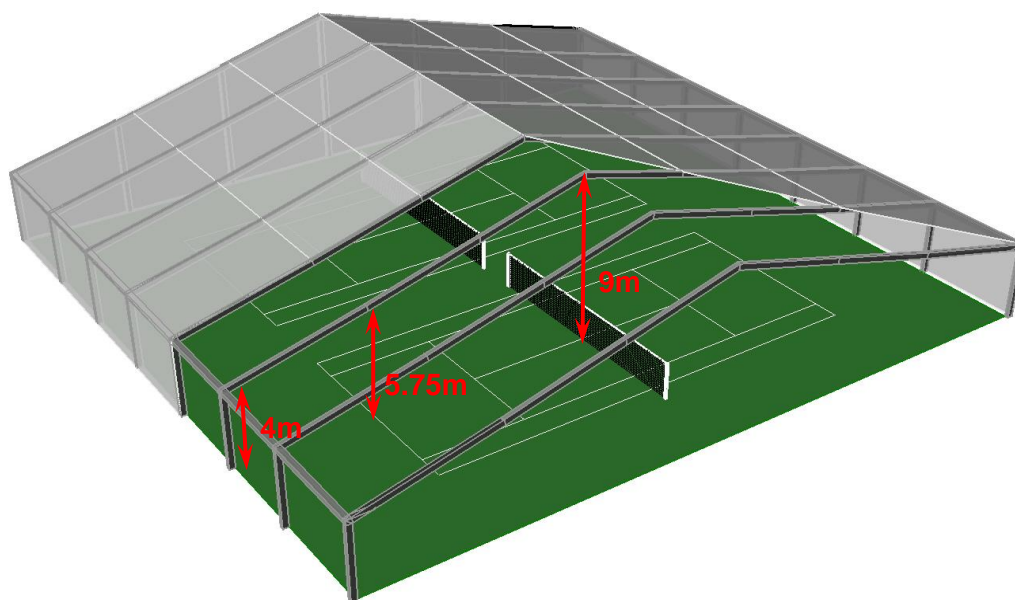
All dimensions in metres

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

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.

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 Control Regulations.

Note: Framed fabric buildings by their nature of construction will be non-heated structures with any heating provision being installed for the purposes of removing any potential snow load. Provision for the control of the incidence of moisture / condensation (i.e. de humidifier) can be included if considered necessary by the Employer.

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

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 (45) forty-five readings are required on the PPA. A total of (117) one-hundred and seventeen 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 Calculation Grid Points 45 (5x9)
	0.7 Uniformity Factor (Minimum/Average)
Average maintained level of illuminance measured at the playing surface within the TPA :	500 Lux Calculation Grid Points 117 (9x13)
	0.6 Uniformity Factor (Minimum/Average)
Minimum colour temperature:	min 4,000k
Min height of luminaires	4.5m located outside the <i>Principal Playing Area</i>

The L.T.A. performance standards are set on a court by court for both design (and measurement) when each court is operated individually.

Lighting designs are required to indicate the individual performance of each court operating on its own without adjacent courts 'switched on' and also overall 'block' performance when all courts are operating.

Details of the proposed LED fitting should be provided within the lighting design.

An emergency lighting calculation in accordance with the British Standard 5266 will be required to be submitted with the tennis court lighting design in order to establish if this is a combined system within the tennis court fittings or a separate dedicated emergency lighting fitting.

A maintenance factor of 0.85 shall be applied to all tennis hall lighting designs.

Layout : LED 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 above each individual marked court area and should be related to the natural lighting provision (where incorporated).

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.

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.

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 switched on and off.

Additional local controls within the tennis hall such as PIR detection, pre-set dimming levels of differing performance / cleaning and daylight harvesting should be included (where possible) to reduce energy consumption.

REFLECTIVE VALUES

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

Reflectance values shall fully be representative of the tennis hall environment.

EMERGENCY LIGHTING

This should be provided in accordance with the relevant British Standard.

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.

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.

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.

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 unauthorised 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 facilityKva

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 V_e 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 V_e will in general be derived for each selected wind direction.

The Altitude Factor S_a 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 S_a shall be derived for each different wind direction.

The Direction Factor S_d 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 S_s shall be taken to be 1.00

The Probability Factor S_p shall be taken to be 1.00.

The Terrain and Building Factor S_b 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.

<i>Item</i>	£	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 V_e , and for different structural elements as noted below.

The Size Effect Factor C_a 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 C_a 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 C_a shall be taken to be 1.00.

For the design of continuous perimeter beam foundations the value of C_a 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 C_a 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 at 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:

Anchorage 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.