

Design & Construction of Tensile Membrane roof at existing Club House, Eden Garden Stadium, Kolkata

May, 2017



OWNER

THE CRICKET ASSOCIATION OF BENGAL

Dr. B. C. Roy Club House,
Eden Garden,
Kolkata

CONSULTANTS



S3M Design Consultants LLP

Ahmedabad -3800051

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SECTION I : INVITATION FOR BID

Bids are invited as per the following details -

Sr. No.	Name	Description
1	Name of the Work	Design & Construction of tensile membrane roof and related works at existing Club House of Stadium, Eden Garden, Kolkata.
2	Last Date & Time for receipt of completed Bids	31st May, 2017 & 06:00 PM
3	Address of returning the completed Bid	The Hony. Joint. Secretary, The Cricket Association of Bengal Dr. B. C. Roy Club House, Eden Gardens, Kolkata - 700021
4	Details of Contact Person for clarifications	Mr. Hiten Shah +91-9825411671 Mr. Ratnesh Singh +91-8981264474

THE **CRICKET ASSOCIATION OF BENGAL** reserves the right to accept or reject any or all Bids without informing any reasons thereof, in their sole discretion and without any liability or costs to the Bidder(s).

THE **CRICKET ASSOCIATION OF BENGAL** may waive any deviations which do not constitute a material modification in the Bids received. In the event that there are any other material deviations in the Bid, THE **CRICKET ASSOCIATION OF BENGAL** may in their sole discretion reject and remove such deviations from the Bid and accept the same as per this Bid document. The decision whether the deviation constitutes a material modification shall solely be that of THE **CRICKET ASSOCIATION OF BENGAL** and such decision shall be binding on the Bidder(s).

QUALIFICATION CRITERIA

- a. Bidder who has satisfactorily completed at least 3 similar projects (in the name of the same company) of Tensile Membrane roof Design & Construction, each having minimum area of 3000 sq.m. at a height of not less than 25 m. - during the last three (3) years, shall **ONLY** be qualified for the Work covered under this Bid.
- b. The Bidder shall submit with his Bid relevant work orders and reference details of minimum 3 Projects completed in last 3 years that he wants to show for his qualification. Bid submitted without such documents are liable to be considered as invalid and shall not be considered for any further evaluation.
- c. The Bidder shall submit with the Bid a Demand Draft of Rs. 5,00,000/- (Rupees Five Lakhs Only) drawn in favour of 'The Cricket Association of Bengal' and the same shall be refunded free of interest to the Bidder within a period of 60 days, to be calculated from the last date of submit of Bids.

EXCLUDED ENTITIES

The under mentioned Entities are expressly excluded and disqualified from being eligible to submit any Bid and if any Bidder is found to be so disqualified, the Bid shall forthwith be rejected notwithstanding that such entity otherwise fulfills the Requirements set out in this TC.

- (a) No consortium Bid would be acceptable, i.e., Bids must be submitted by an independent Entity without any process of joint venture or as Group Entities or forming a Consortium for submitting the Bid.
- (b) Broker, Facilitator, Agents or Arrangers on behalf of any principal, whether as an individual Company or as part of a Consortium.
- (c) Bidder and/or its Officials must not have suffered of being charged with penal laws;
- (d) Bidder and/or its officials must not have any association with The Cricket Association of Bengal and/or any of its Officials or any of the affiliated Units directly or indirectly or through its Officials and/or their near relatives ;
- (e) The Bidder must not be incorporated in jurisdictions where the standards of corporate governance and financial regulation are unacceptable to The Cricket Association of Bengal.
- (f) The Bidder is not (i) currently involved in any legal proceedings, civil or criminal, or legal dispute of any kind with The Cricket Association of Bengal and/or any of its members or (ii) deemed by The Cricket Association of Bengal to be in default of any contractual obligation or undertaking owed to The Cricket Association of Bengal (including, without limitation, any payment obligation) or (iii) which is otherwise connected with any entity (including by way of being a subsidiary, undertaking or a parent company or companies under common ownership and/or control) that is currently involved in any litigation proceedings, civil or criminal, or dispute of any kind with The Cricket Association of Bengal (and/or any of its members) and/or in default of any contractual obligation or undertaking owed to The Cricket Association of Bengal and/or its members (including, without limitation, any payment obligation).
- (g) The Bidder or any of its management personnel is not under the scanners of any investigative enquiries of any nature by any Investigative Authority either under Prevention of Money Laundering Act or FEMA or any Chit Fund or Bank Fraud and other related acts and conduct.

The Cricket Association of Bengal shall not pre-judge or advise or provide any clarification to a Bidder whether it is qualified or not. The Bidder must submit its Bid, or as applicable based on the details provided in this TC.

The Cricket Association of Bengal reserves the right to reject any Bid, including without any limitation, which in the opinion of the Cricket Association of Bengal and at its discretion does not satisfy the Eligibility Criteria under this Section.

RESERVATIONS :

- a. It is expressly informed that any Bid, irrespective of being highest and/or acceptable, shall not provide any right to the Bidder to claim awarding of right.
- b. Mere submission of any offer would not inure any right in favour of any Entity/Bidder on any ground of whatsoever nature, unless and until the appropriate Contract/Work Order is executed by the Cricket Association of Bengal.
- c. This TC does not contain any warranty, assurance or representation of any kind upon which any Bidder is entitled to rely at any point in time in order to bring any claim, action or proceedings against The Cricket Association of Bengal or any other person (whether for alleged misrepresentation, breach of any duty or otherwise).
- d. The Cricket Association of Bengal, at any time prior to submission of Bids, reserves the right to amend the terms and to provide amended versions to those Entities who have collected this TC.
- e. The Cricket Association of Bengal at its sole discretion shall be entitled to disqualify or reject any Bid or to cancel or retender afresh, without assigning any reason therefor.

- f. The Cricket Association of Bengal reserves the right in its absolute discretion, at any stage, without providing any reason to:
- Abandon/Cancel/revoke the entire process of Bids and the TC;
 - Launch additional or modified tender process(es);
 - Request for further Bids from Bidders;
 - Alter, add or delete statements, terms or conditions to this TC;
 - Negotiate for arriving at decision making process.
- g. Any action by The Cricket Association of Bengal under this Section may be made without any liability attaching to it, and shall not afford any right to any Bidder and/or potential Bidder to raise a claim or dispute of any kind against The Cricket Association of Bengal.

Under no circumstances will The Cricket Association of Bengal or its associated/appointed entities or any of their respective officers, employees, representatives, agents and/or advisers be responsible or liable in any manner or mode of any kind for any costs, liability, losses, damages or expenses of any kind whatsoever incurred or suffered in connection with or as a consequence of the preparation or delivery of any offer, or compliance with any of the requirements of this TC and/or process by any Bidder, or rejection of any Bid from a Bidder by The Cricket Association of Bengal.

GOVERNING LAWS AND DISPUTE RESOLUTION

- a. This TC and the entire process shall be governed by and construed in accordance with the prevailing laws of India and only the Arbitrator nominated by the President of the The Cricket Association of Bengal shall have jurisdiction to entertain any dispute in accordance with the provisions of the Arbitration and Conciliation Act 1996 read with its Statutory Amendments and Enactments, as the case may be whose award, interim and/or final shall be binding. The competent Court at Kolkata shall have exclusive jurisdiction in relation to the same.
- b. It is clarified that by submitting a Bid, the Bidder hereby waives, abandons and gives up its right to bring any such action seeking specific performance and/or injunction and/or any other equitable relief, whether interim or final, before any court to enforce any obligation under the ITT, except in the event of fraud.

SECTION II: GENERAL CONDITIONS

1. Definitions

In the Contract, as hereinafter defined, the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

- a. The following words mentioned as such in the Contract Documents shall mean:

Owner: **THE CRICKET ASSOCIATION OF BENGAL, KOLKATA.**

Consultant: **S3M Design Consultants LLP**

Contractor: Successful Bidder

Engineer: Representative of **THE CRICKET ASSOCIATION OF BENGAL**

and shall include their legal representatives, permitted assigns or successors as the case may be.

- b. The "Parties" shall mean the Owner and the Contractor stated herein.
- c. "Site" shall mean the place or places envisaged by the Owner, within the plot of Eden Garden Stadium at Kolkata, where the Works have to be executed and shall include any building and erections thereon and any other land allotted by the Owner for Contractor's use.
- d. "Contract Period" shall mean the period during which the Contract shall be executed as agreed between the Contractor and the Owner in the Contract. The time limits stated in this Document are the essence of the Contract.
- e. The "Date of Virtual Completion" of a project or specified area of a project is the date when construction is sufficiently completed, in accordance with the Contract Documents as modified by any change or variation orders agreed to by the parties, so that the Owner can occupy the project for the use it was intended.

2. Water & Electric Power for Construction

The Contractor shall be provided Water required for the Works covered under this Contract free of cost at one point within the Site. All subsequent arrangement for further distribution & supply shall be carried out by the Contractor at his own cost.

The Contractor shall be provided Power required for the Works covered under this Contract free of cost at one point within the Site. All subsequent arrangement for further distribution & supply shall be carried out by the Contractor at his own cost. Contractor shall make at his cost, arrangement for stepping down and local distribution and shall include for enough lighting to ensure safety and security on site.

3. Experience of Similar Works

Bidder shall supply details of similar Projects handled in last 5 years in the format attached as an Annexure A attached to this Section.

4. Time of Completion

All the Works covered within the Scope of this Contract shall be completed within a Time period of 14 weeks from the date of issuing the Letter of Intent (LOI).

5. Liquidated damages

If the Work is not completed within the time of Completion stipulated above, pre-estimated genuine Liquidated damages at the rate of 1 % of the Contract value per week of delay (not to exceed 5 % of the Contract Value) shall be paid by the Contractor.

6. Rate to Include

Quoted rate shall be for finished work and shall include for all the obligations to be fulfilled by the Contractor as stated in the contract document. Generally, it shall include for necessary dismantling, material, fixing media, plant & tools, scaffolding, labour, incidental materials, fixing, packing, loading, transportation, delivery, unloading at Site, storage, returning, handling, hoisting, lowering, insurance, wastage, cutting, establishment costs including stipulated safety measures, temporary works, tests, preliminaries, overheads, royalties, VAT, all taxes, profit and any other costs to complete the Work in its final form and state. **Service tax, as applicable, shall be quoted separately.**

7. Retention

Retention money at the rate of 10% (Ten percent) from the running bills will be recovered. 50% (Fifty percent) of the money so retained will be released on virtual completion against submission of Performance Bank Guarantee and balance will be released after twelve (12) months from the date of virtual completion. The date of virtual completion will be decided by the Engineer \ Owner.

8. Defects Liability Period

The Contractor shall make good at his own cost and to the satisfaction of the Engineer, all defects, shrinkages or faults, arising in the opinion of the Engineer from work or materials not being in accordance with the Drawings or Specifications or the Instructions of the Engineer, which may appear within "Defects Liability Period" of Twelve (12) months from the date of Virtual Completion.

If the Contractor refuses/ fails to make good the defects or faults, Owner may, in lieu of such amending and making good by the Contractor, deduct from any moneys due to the Contractor (including the Performance Bank Guarantee), a sum to be determined by the Engineer as equivalent to the cost of amending such work and in the event of the PBG Amount being insufficient, recover the balance from the Contractor, together with any expenses the Owner may have incurred in connection therewith.

9. Approval by the Owner / the Engineer

Any approval or any approval given with changes, by the Owner, Engineer or their representative shall not relieve the Contractor of any of his obligation, responsibility and liability for the safety, correctness and performance of the Works including that of drawings and design.

10. Insurance

- a. The Contractor shall indemnify the Owner and every member and Employee thereof and the Engineer and the Engineer's Agents and Representative and every member of his staff from any claim or demand from accident, injury, damage, loss and/or compensation of any kind whatsoever arising out of or in connection with all claims and demands which may be made against the Owner or the Engineer for or in respect of or arising out of failure by the Contractor in the performance of his obligation under any of the provisions of the Contract. The Contractor shall take necessary insurance to protect himself against claim or demand.
- b. Without prejudice to his liability to indemnify the Owner under Article (a) of these Conditions, the Contractor shall maintain and shall cause any Sub- Contractor to maintain :-

Such insurances as are necessary to cover the liability of the Contractor or as the case may be of such Subcontractor, in respect of personal injuries or deaths arising out of or in the course of or caused by the carrying out of the Work; and

Such insurances as may be specifically required by the Contract Bills in respect of injury or damage to property real or personal arising out of or in the course of or by reason of the Contractor or his Sub-Contractor carrying out the work, and caused by any negligence, omission or default of the Contractor, his servants or agents or, as the case may be of such Sub- Contractor, his servants or agents.

- c. The Contractor shall obtain and maintain a comprehensive all risk policy which should also cover insurance against loss or damage by fire, storm, tempest, lightning, flood, earthquake, aircraft or anything dropped there from, aerial objects, riot and civil commotion for the full value thereof all work executed and all unfixed materials and goods intended for, delivered to and placed on or adjacent to the work until Virtual Completion of the work. Should the Contractor make default in insuring or continuing to insure as aforesaid, the Owner may himself insure against any risk with respect of which the default shall have occurred and deduct a sum equivalent to the amount paid by him in respect of premium from any monies due to or to become due to the Contractor.

11. Storage & Safety of Materials

It will be Contractor's responsibility to unload and store materials properly. Safety of materials received at site will be Contractor's responsibility. Client will not inspect materials and Contractor will be responsible for it till the handover of site.

12. Examination of Site :

It is mandatory for each Bidder to visit site before submitting his Bid.

A Bidder shall be deemed to have inspected, noted and examined the existing structure, Site and its surroundings and satisfy himself of physical conditions upon and below the surface of the Site, the climatic and geological conditions at the Site and the surroundings and access thereof, the nature of the work and materials necessary for the execution of Works, the means of access to the Site, the availability of labour and accommodation, regulations concerning employment of labour and in general shall have himself obtained all necessary information as to risks, contingencies, and other circumstances which could have an effect upon his Bid and the performance of Works.

Pleading ignorance of the existing structure, Site conditions, its surrounding and access shall not a reason for making any claims for delays, claims, or damages at a later date.

13. Safety

- a. Generally, the Contractor shall adhere to safe construction practice and guard against hazardous and unsafe working conditions. Special measures shall be adopted by the Contractor to train his People so that they follow safe work practices on daily basis. Adequately trained supervisory staff shall be employed by the Contractor for this purpose.
- b. The Contractor shall comply with Owner's safety rules.
- c. Workers required to work at higher elevations shall be provided with safety belts and shall be instructed not to work without wearing the Belt.
- d. When persons are employed on a roof, where there is danger of falling from a height exceeding 3.25 m., suitable precaution shall be taken to prevent the fall of persons or material. Suitable precautions shall also be taken to prevent persons being struck by articles, which might fall from scaffolds or other working places.
- e. Good quality safety helmets shall be provided to Workers posted at Site of operations and Contractor will take adequate measures to make usage of these helmets mandatory.

13A. Responsibilities

- a. The Contractor shall be responsible for due compliance of all laws, rules and regulations, safety & precautionary measures as may be applicable from time to time and the Owner shall under no circumstances be liable and/or responsible or be held responsible and liable for any of the same.
- b. During the course of execution of the work, if any loss or injury or damage being caused of any nature including injury and/or damage to any person or persons or property or any loss of life, the Contractor shall be exclusively responsible for the same and the consequences arising therefrom in all respect. All actions, proceedings and consequences arising therefrom and/or settlement shall be attended to and complied with by the Contractor at its own costs and expenses and shall keep the Owner indemnified from all or any loss, damages, costs, and consequences if any suffered or incurred therefrom.
- c. All labourers, workmen, supervisors and other employees or persons by whatever definition employed, engaged, deputed, appointed or required for execution of the work to the satisfaction of the Cricket Association of Bengal, shall be regarded as the employees or workmen of the Contractor and the Owner shall have no concern or liable for meeting any obligations to any of them in any manner whatsoever.
- d. The Contractor shall always keep the Owner indemnified of and from all litigations, suits, and/or proceedings of whatsoever nature arising out of the said execution of the work.

ANNEXURE A

DETAILS OF PROJECTS & WORKS EXPERIENCE

DETAILS OF ALL WORKS OF SIMILAR CLASS ONGOING / COMPLETED DURING THE LAST FIVE YEARS

Sr.NO	Name of Work / Project & Location	Details of the Owner	Cost of Work in Crores	Date of Commencement as per Contract	Stipulated Date of completion	Area of Tensile Roofing	Actual Date of completion	Litigation / Arbitration pending / in progress with Details*	Name and Address /Telephone Number of officer to whom reference may be Made	Remark/ brief details of the project relating to tensile fabric & structure work
1	2	3	4	5	6	7	8	9	10	11

Signature of bidder

SECTION III: SCOPE OF WORK

1. GENERAL

- The Stadium at Eden Garden is one of the Largest & most Prestigious Stadium in the World for hosting Cricket matches.
- The Stadium consists of a Club House at the South of the Cricket ground – apart from several Stands for Spectators all around the Ground. It houses the offices of the Cricket Association of Bengal (CAB) and also other Match hosting facilities like Players' rooms, Umpires' room, Press Box, VIP Boxes & Spectators' seating, etc.
- The Club house is having RCC frame structure up to the top tier and steel structure above top tier to support the Roof. Roofing sheets (Corrugated FRP) existing over the steel structure have deteriorated, causing issues related to aesthetics and leakages apart from safety. CAB has decided to replace the existing roofing sheets.
- Considering the prominence of Eden Garden & to subscribe to the modern developments in the Game, CAB is looking forward to create a modern, futuristic image through installation of tensile membrane roof over the existing steel structure.

2. BRIEF DESCRIPTION OF THE EXISTING STRUCTURE OF THE CLUB HOUSE:

- Present roof at the Club house covers a Plan area of approximately 1250 sq.m. Approximate length along the radial direction is 23.5 m. and approximate average width along circumferential direction is 53 m.
- Shape of the roof is similar to segment of a circle.
- General arrangement drawing showing Plan & Section of the existing roof structure is attached as part of this document.
- Presently, the roof of the Club House has FRP Corrugated sheets supported over steel structure.
- The steel structure consists of fabricated box rafters spanning in radial direction. Each Rafter is supported over 2 nos. fabricated columns (Grid A & Grid C as per the attached Bid drawing). Each rafter cantilevers towards Cricket ground by approximately 11.50 m.
- The fabricated steel columns on Grid A & Grid C are supported at Upper tier level over the RCC framed structure of the Club House.
- As the building is very old & has been developed in various Phases, any drawings showing structural details of the Building are not existing. However, checking the adequacy and/or taking responsibility of the existing RCC framed structure for the proposed tensioned membrane roofing system is NOT in the scope of the Contractor.

3. PROPOSED WORK

The scope of work shall generally consist of the supply of all labour, tools, plant and materials necessary to complete the dismantling of existing roofing, design, engineering, supply, patterning, fabrication, transportation, loading, unloading and installation of the proposed tensioned membrane roofing system detailed out as follows -

- Dismantling of existing corrugated roofing sheets, Purlins, Gutters, flashings/ corner pieces/ end trims, down spouts, etc. and bring down the dismantled materials / debris to ground level. All dismantled materials shall be the property of Client.
- Architectural & Structural design of the proposed Tensile membrane roof system over the existing steel structure. **The Bidder has the freedom to propose his own shape of the roof system.**
- **Verify/ check the adequacy of the existing steel structure** for the loads/ reactions/ forces acting on the same due to provision of Tensile membrane roof system proposed by the Bidder – instead of the FRP corrugated roof existing earlier. Design, supply & carry out strengthening measures for the existing steel structure, if found necessary.

- **Proof checking** : Checking of the structural design carried out by the Contractor shall be carried out by a third party structural consultant having at least 10 years of experience in designing tensile membrane structures. Details of the structural consultant proposed for proof checking shall be submitted together with the Bid. All costs for such Proof checking shall be borne by the Contractor.
- Supply, Fabrication and installation of Tensioned membrane roofing system as per specifications & final inspection after installation of the structure.

4. BID STAGE SUBMISSIONS

Documents/ details to be submitted include –

- A complete list of all projects completed in the preceding 5 years, including the Project Name, Technical details, Name of the Client, etc.
- Documents substantiating the Bidder's qualification as per the qualification criteria specified in the Bid document.
- Proposed Architectural scheme of the Tensioned membrane roof system.
- Concept design of the structural system for the proposed Tensioned Membrane roof system. Mention the name of the finite element software to be used for the analysis.
- Technical specifications & name of the Supplier of the PVC/PES membrane proposed to be used for the Project.
- Brand name & paint system proposed for the structural steel.
- Details of the Structural consultant proposed for Proof checking.
- Method statement – enumerating stages like –
 - Design & Engineering with special emphasis on structural adequacy of the existing structure
 - Fabrication procedures & erection methodology with regards to existing Site conditions of the Club house
 - Quality control/ assurance measures of fabrication & erection
 - Sequence of events & Time schedule
 - Exclusions & Assumptions

Bid submitted without all the above mentioned documents are liable to be considered as invalid and shall not be considered for any further evaluation.

SECTION IV : TECHNICAL SPECIFICATIONS

1. CODES & GUIDELINES

The design is to be performed according to the relevant Indian Standards (IS).

- IS 800 (2007): General construction in steel - code of practice.
- IS 875 (1987): Part 2 - Code of practice for design loads (other than earthquake) for buildings and structures – Imposed Loads.
- IS 875 (2015): Part 3 - Code of practice for design loads (other than earthquake) for buildings and structures – Wind Loads.
- IS 1893-1 (2002): Criteria for earthquake resistant design of structures, part 1.

For the information missing in the aforementioned standards, following codes shall be adopted -

- Eurocode 3 - Part 1-8 (EN1993-1-8) Design of steel structures - Part 1-8 Design of joints.
- CIDECT 1: Design guide for circular hollow section (CHS) joints under predominantly static loading. Second edition.

2. STRUCTURAL ANALYSIS & DESIGN :

2.1. Loads :

- All applicable loads shall be considered as per relevant Indian standards – latest revision.
- Self weight of the membrane shall be considered as per the manufacturer's data.
- Special attention shall be given to the cross sectional shape and façade of the existing Building with regards to wind actions.

2.2. Analysis :

- The structural analysis is to be accomplished with the state of the art finite element program.
- Structural calculation for the tensile structure shall include the following:
 - Large deflection numerical shape generation that will insure a stable, uniformly stressed, three dimensionally curved shape which is in static equilibrium with the internal pre-stress forces, and is suitable to resist all applied loads.
 - Large deflection finite element method structural analysis of the membrane system under all applicable applied wind and live load conditions.
 - Large deflection finite element method structural analysis of the support frame system.
 - Biaxial fabric test specification, interpretation, and fabric compensation determination.
 - Accurate generation of the two-dimensional compensated fabric templates required to generate the three-dimensional equilibrium shape.
 - Member size calculations of all primary structural members.
 - Connection design including bolts, weld, and secondary member sizing.
 - **Checking/ verifying adequacy of the existing steel structure for the proposed membrane roof structure.**
 - Checking the adequacy and/or taking responsibility of the existing RCC framed structure for the proposed tensioned membrane roofing system is NOT in the scope of the Contractor.

2.3. Structural Steel :

- All Steel members shall be designed according to IS 800:2007 for steel structure.
- Deflection limits – According to paragraph 5.6.1 of IS 800: 2007 the deflection under serviceability loads of a structure should not impair the strength of the structure or components or cause damage to finishing. Considering that the PVC/PES roofing does not imply specific deformation limits, the criteria for deflection check are assumed only to limit the impact of visible deformation as follow -
 - Vertical limit for cantilever = $\text{Span}/100$;
 - Lateral limit for columns = $\text{High}/250$.

2.4. PVC/PES Fabric

Design of the PVC fabric is carried out considering an allowable stress approach. The allowable stress is defined as follows:

$$f_d = f_{uk} / SF$$

Where

f_{uk} is the tensile strength in warp or in weft.

SF is the safety factor evaluated as:

SF = 9	Permanent load case (Dead loads pretension)
SF = 4	Short term load case (Live load Wind load)

3. MATERIAL PROPERTIES:

3.1. Structural Steel:

- All structural steel shall comply with - IS 2062. Fusion welding quality steel (Fe 410W Grade A) with minimum yield stress of 310 MPa shall be used for the structural steel works. The structural steel shall be cleanly rolled to proper dimensions and weight subject to Permissible tolerances as per IS: 1852
- Carbon steel pipes shall conform to IS 1161 or IS 1239 of Grade YST-310 or Higher.

3.2. Cables & Fittings:

- The cables are to be considered as Spiral Strands with the following properties according to EN1993-1-11
 - Young’s modulus $E = 150000$ MPa (typical value);
 - Rope grade $F_u = 1570$ MPa (section 3.1 of EN 1993-1-11);
 - Coefficient of thermal expansion = $12 \times 10^{-6} / ^\circ\text{C}$ (section 3.3 of EN 1993-1-11).
- All cables shall have SS 304 end terminations.
- All terminal fittings shall be SS 304 grade – having a breaking strength of the terminal detail not lower than the specified minimum design load of cable system.

3.3. Steel Bolts :

Steel bolts are to be of specified of grade 8.8 conforming to IS 1367 (Part 3) Table 3.

3.4. PVC/PES Fabric:

It is to be adopted as standard PVC/PES type III according to *European Design Guide for Tensile Surface Structures, Section 9.5.2. Table 2*. The mechanical characteristics are reported below.

- Young’s modulus $E_1 = 1150$ MPa (typical value)
- Young’s modulus $E_2 = 650$ MPa (typical value)
- Poisson ratio $\nu = 0.3$
- Tensile strength warp/weft $f_{uk} = 115/102$

Type	1	2	3	4	5
Surface weight (g/m²)					
French design guide	720	1 000	1 200	1 400	2 000
WG Messe Frankfurt	800	900	1 050	1 300	1 450
Yarn linear density (dtex)					
French design guide					
WG Messe Frankfurt	1 100	1 100	1 670	1 670	2 200
Tensile strength warp/weft (kN/m)					
French design guide	60/60	84/80	110/104	120/130	160/170
WG Messe Frankfurt	60/60	88/79	115/102	149/128	196/166
Trapezoidal test warp/weft (N)					
French design guide					
WG Messe Frankfurt	310/350	520/580	800/950	1 100/1 400	1 600/1 800
Yarn number per cm warp/weft					
French design guide					
WG Messe Frankfurt	9/9	12/12	10.5/10.5	14/14	14/14

The PVC/PES fabric of white or any desired Color selected by Client, shall be coated top and bottom with a protective PVDF Coating - weldable without grinding.

The color of the fabric is to be selected by Consultant / Client from the Manufacturers' line of available colors. Color fastness to light of the fabric has to be not less than 6 Note in accordance with the German standard DIN 54004, DIN EN ISO 105 B02.

The Contractor shall provide 10 years' manufacturer's warranty for the fabric including the following aspects -

- Fungus and mold growth.
- Structural properties (material strength, seam strength).
- Color and translucency.
- Capability to perform the folding process during the 10 year guaranty time without reduction of stiffness and strength and without visual damage. Folding operation for a temperature range between -5 °C to +50°C.

The warranty must cover the fabrication and installation of the product.

The coated material must be flame retardant, and be of class B1 as per DIN 4102 (no burning drops occurring). A certificate to this effect shall be supplied by the Contractor.

3.5. List of approved makes for Major materials are -

Sr. No.	Material	Approved Make
1	Structural steel	SAIL, RIL, TATA, JINDAL
2	PVC Translucent membrane	Verseidag, Mehler, Ferrari
4	GI wire rope	Ushamartin, Bharat wire rope

4. FABRICATION :**4.1. Structural steel**

- Submit shop drawings. The drawings shall show in standard engineering drawing manner, clear and complete details of each assembly, component and connection in the work, together with information relative to their fabrication, surface treatment and erection.
- Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to IS specifications (IS 7215; IS 12843; IS 800, IS 814; IS 816; IS 9595).
- Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
- Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
- Weld threaded nuts to framing and other specialty items as indicated to receive other work.
- Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
- Materials and workmanship are subject to inspection and test by the Engineer, who is to have access at all times to all parts of the workshop where steelworks is being fabricated and is to be provided with reasonable inspection facilities.
- Unless shown on the drawings, site welding will only be permitted for minor connections subject to written approval from the Engineer.
- Do not place any welds, except those shown on the drawings, without approval even for temporary attachment and repair of faulty plates.
- Provide evidence of welder's competence to undertake specified work.
- Painting :
 - Preparation of surfaces – Sandblasting as per IS : 1477
 - Primer coat – Zinc rich epoxy primer having min. solid volume of 60% and product weight of 2.50 kg/ ltr. DFT = 75 microns
 - Finish coat - Two component Hi-Built Epoxy coat pigmented with Micaceous Iron Oxide having minimum solid volume of 80 % and product weight of approx. 2 kg/ ltr. DFT = 75 microns

4.2. Cables & Fittings

- Accuracy of Fabrication - The overall cable length including terminations shall comply with the following tolerances at the pre-stress load:
 - Strand ± 1 mm for lengths less than 2 meters.
 - ± 2 mm for lengths greater than 2 meters but less than 5 meters.
 - ± 3 mm for lengths over 5 meters.
- Cutting - Cables shall only be cut using carborundum disc cutters or other approved mechanical devices. Under no circumstances will thermal cutting be approved.
- No splicing or joining of wire strands or ropes shall be permitted

4.3. PVC Fabric

- Fabric shop drawings shall include all information necessary for the fabrication of the fabric membrane. They shall include size and shape of envelope, type and location of shop and field connections, size, type, and extent of all heat welded seams.
- The seam lay out needs to be approved by the Engineer / Client.
- The shear angle resulting out of cloth width, length of each cloth and curvature has to be limited to 2 degree. The shear angle can be derived using the European Design Guide for Tensile Surface structures chapter 8.1 (8/3).
- The contractor will determine the correct cut of the membrane. The contractor is to determine, by means of tests for each cloth production unit, the characteristic values which relate to the biaxial expansion behaviour of the membrane and are required in order to ascertain cutting pattern of the membrane.
- The cut out areas are strengthened by attaching one additional membrane layer. Membrane reinforcements joining onto a membrane cable pocket require reinforcing of the membrane pocket itself too.
- Exercise necessary care to plan and assemble the sections such that the assembly has no shop patches. Splices, if any, shall be patterned into a symmetrical and repetitive geometric arrangement within the assembly, shown on the shop drawings and where feasible hidden by structural members.
- Exercise great care in marking, cutting, aligning, checking, welding seams and additions as well as general handling and soiling prevention procedures to produce a smooth uniform surface with even curved edges free from irregularities and interfaces lacking wrinkling, cuts, abrasions, stains of marks, surface imperfections or welding aberrations.
- All membrane shall be patterned using finite analysis computer modeling. The membrane shall be cut using the latest CAD/CAM manufacturing technology with a tolerance of -1mm, +1mm.
- PVC joints shall be formed using ONLY high frequency equipment to a tolerance of +1mm, -1mm.
- Carefully plan the assembly to ensure that seams are always single laid and that a cut edge does not face uphill.
- Joints shall be symmetrical as specified by the cutting pattern. No short pieces or selvage will be permitted.
- The joint between one membrane and the next shall have a welded seam of minimum 75 mm in width. All welds are slightly to be tensioned to line up weld marks during welding and to prevent weld shrinkage or uneven welds.
- All fabricated joints shall have a minimum of 90% of the total strength of the coated membrane in strip tensile testing. All structural joints shall be fused in accordance with industry standards and shall maintain the integrity of the coating.
- At positions where bolt or other penetrations of the fabric is shown or required, holes shall be punched using a sharp 1 mm oversized punch. Holes shall be neat and have uniform edges.
- Rope edges shall be formed using VPDM 90 hardness polypropylene or approved polyester rope of minimum diameter 12 mm. All add-on details to the fabric shall use the same fabric jointing procedures as for structural joints.

5. ERECTION

5.1. Preparations :

- Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
- Ensure that the capacity of plant and equipment used for erection are suitable and are in first class working order.

5.2. Structural Steel :

- Maintain erection tolerances of structural steel as specified in IS 12843
- Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- Level and plumb individual members of structure. Splice members only where indicated.
- Do not use welding equipment on site without approval.
- Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- Ensure bolts are in center of slotted holes after erection of structure.
- Treat sliding surfaces of proprietary joints in accordance with manufacture's recommendations before connecting.
- Friction grip type bolt installation procedure shall conform to IS 4000 (1992): Code of practice for high strength bolts in steel structures.

5.3. PVC Fabric

- Prior to commencement of erection, the Contractor shall check all contact surfaces to be in contact with the fabric for smoothness, and remove causes for rips and/or scratching during the installation of the fabric panels.
- Contractor shall provide ground sheets where the membrane is to be dragged across a surface. Prevention of chaffing of the surface is required at all times.
- Access to the area where the fabric is to be installed shall be limited to only the authorised personnel during the preparation and installation of the fabric structure for proper protection. The fabric shall be protected from damages upon installation.
- The contractor shall install the fabric structure in a sequence and with sufficient bracing to ensure stability of the structure.
- No creasing or folding of the fabric around sharp corners will be permitted. The fabric shall not be abraded in any manner.
- The minimum pre stress in the membrane shall be 2kN/m in both the warp and weft. The structure is to be tensioned after erection to maintain a taut smooth surface to minimum of +10%, -10% specified pre-stress levels.
- The fabric shall be stressed uniformly to avoid local over stresses.
- Damage occurring during the installation sequence may be temporarily repaired with field patches; However, permanent repairs shall be made with full panel replacement from seam to seam or seam to approved splice.
- Clean the fabric membrane after erection. Remove all signs of dirt and panel markings where visible by the naked eye.
- The final installed membrane should be wrinkle free. Maximum up to one place, & up to maximum 100mm wrinkle shall be allowed per 500 sq.m. area of the single structure. If the wrinkles appear at very prominent location and aesthetically unpleasing, the Engineer/ Client reserves all the rights to demand the replacement of the membrane.

SECTION V : LIST OF DRAWINGS

GENERAL :

The Bid Drawings are for the general guidance of the Bidder and shall not be considered as exhaustive. Details/ specifications not appearing in the list, but required to complete the work, shall be considered as part of the Scope and Bidder's offer shall be considered to include the same.

MANUFACTURING PLANT		
SR. NO	DRAWING NO.	TITLE
1	01.TR.01 R0	Club House - Roof Plan & Section 1
2	01.TR.02 R0	Club House - Section 2

SECTION – VII: PRICE SCHEDULE

Bidder shall provide breakup of his offer as per the requirements mentioned below. **Lumpsum total price, without the Break up, shall not be acceptable.**

No.	Description	Unit	Rate in Rs.	Amount in Rs.
A	Detail design & Engineering including Architectural design, structural calculations, proof checking, shop drawings and verification of adequacy of existing steel structure	L.S.		
B	Dismantling of existing roofing, Gutters, Flashings, etc. of the Club house as described in this Bid document	L.S.		
C	Supply and fabrication of new Tensioned membrane roofing system as described in this Bid document	L.S.		
D	Erection/ Installation of new Tensioned membrane roofing system as described in this Bid document	L.S.		
E	Supplying, Fabricating & erecting structural steel for strengthening of existing Steel structure of the Club house to support proposed Tensioned Membrane roofing system. Rate to include for cleaning of existing surfaces, 2 coats of enamel paint over a coat of zinc chromate primer, all hardware, bolts, nuts, washers, welding, wastage, etc. complete. Actual weight of the new structural steel used for strengthening shall be considered for the payment.	10000 KG		
		SUB TOTAL		
		Add Service tax		
		TOTAL		

Note – 1 : Prices should be quoted for the complete scope of work described in the Bid document. The prices should include freight, loading, excise duty, sales tax, service tax, works contract tax and all other applicable taxes & duties including any import duties etc.

Signature of Contractor