

# **DELHI DEVELOPMENT AUTHORITY**

## **PROJECT SPECIFICATIONS**

**Name of work: Construction of Archery  
Qualifying and  
training venues for  
Archery, Lawn  
Bowls, Hockey and  
Refurbishment of  
Aquatics, &  
Rhythmic  
Gymnastics Venue  
at Yamuna Sports  
Complex for  
Commonwealth  
Games 2010**

### **CIVIL SPECIFICATIONS**

- 1) For all materials manufactured in India, unless otherwise specified, standards laid down in Bureau of Indian Standards (BIS) shall be followed. For the imported materials standards such as Australian standard (AS), ASTM, EN, DIN, British standard (BS) etc, suggested by the manufacturing firm shall be followed for the material /product. The agency/contractor shall supply test certificate issued by the manufacturer as per relevant standard, however the department reserves the right to get the material tested before payment. In case the material/product fails to conform to the relevant standards as a result of testing from any approved lab as decided by Engineer-in-charge, the testing charges shall be recovered from the contractor. Before dispatch of material to the site, contractor shall inform Engineer-in-charge well in advance so as to make necessary arrangement for getting the same inspected/tested. No material shall be dispatched unless otherwise exempted by the Engineer-in-Charge.

#### **QUALITY ASSURANCE & TESTING OF MATERIAL:-**

- 2) The contractor shall submit his detailed quality assurance plan and quality assurance manual and get it approved from the Engineer-in-charge within fifteen days of issue of letter of acceptance of work.
- 3) Samples of materials required for testing shall be provided free of charge by the contractor. The cost of tests shall be borne by the contractor.
- 4) All other expenditure required to be incurred for taking samples; conveyance, packing etc. shall be borne by the contractor himself.
- 5) However, if any ultrasonic pulse velocity / load test or special testing is to be done for concrete whose strength is doubtful, in the opinion of Engineer-in-Charge the cost of the same shall be borne by the contractor.
- 6) In case there is any discrepancy in frequency of testing as given in list of mandatory tests and that in individual sub-heads of work as per CPWD Specifications, higher of the two frequencies of testing shall be followed and nothing extra shall be payable on this account.
- 7) The contractor has to establish field laboratory at site including all necessary equipments and skilled manpower for field tests as required, at his own cost to have proper quality control within 15 days of the stipulated date of start of work. Equipments are to be installed should be as stipulated in schedule-F and any other instrument/equipment as desired by the Engineer-in-charge for site testing of materials. Calibration certificates of all the equipments required to be submitted at the time of installation.
- 8) Any of the following laboratories in and around Delhi shall be made use for external / independent testing of materials and products:
- a) AES Testing & research Laboratories (AES)
  - b) Central Road & Research Institute (CRRI)
  - c) Indian Institute of Technology, Delhi (IITD)
  - d) National Council for Cement & Building Materials (NCCBM)
  - e) Regional Testing Centre (RTC)
  - f) Sunbeam Testing (SBC)

- g) *Delhi Test House*
- h) *Shriram Institute of Industrial Research (SIIR)*

- 9) *The work shall be executed and measured as per metric dimensions given in the schedule of quantities, drawings etc. (FIS units, if any, are for guidelines only)*
- 10) *The rate of items of flooring is inclusive of providing sunk flooring in bath-rooms, kitchen, etc. and nothing extra on this account shall be payable.*
- 11) *The work should be planned in a systematic manner so that chase cuttings in the walls, ceilings and floors is minimized. Wherever absolutely essential, the chase shall be cut using chase cutting machines. Chases will not be allowed to be cut using hammer / chisel.*
- 12) *All the hidden items such as water supply lines, drainage pipes, conduits, sewers etc. are to be properly tested before covering.*
- 13) *The work shall be carried out in accordance with the Architectural drawings, structural and services drawings, to be issued from time to time, by the Engineer-in-Charge. Before commencement of any item of work the contractor shall correlate all the relevant architectural, structural drawing and services issued for the work, nomenclature of items; specifications etc. and satisfy himself that the information available there from is complete and unambiguous. The figures & the written dimensions of the drawing shall supersede the measurement by scale. The discrepancy, if any, shall be brought to the notice of the Engineer-In-Charge for immediate decision before execution of the work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and/or incomplete information and no claim, whatsoever shall be entertained on this account.*

#### **OPERATION AND MAINTENANCE STRATEGY AFTER COMPLETION:**

- 14) *MAINTENANCE: Prior to Practical Completion, supply the three copies of a maintenance manual prepared on the guidelines as described in the chapter for Operation and Maintenance. Contractor have to provide the following for all the specialized.*
  - a) *relevant contractor and supplier addresses & contact details,*
  - b) *an outline description of the installation and detailed description of specific items with product names, types, serial numbers, etc.,*
  - c) *recommended maintenance procedures,*
  - d) *copies of manufacturer's warranties or guarantees, recommendations, etc.,*

#### **CONDITIONS FOR CEMENT:-**

- 15) *The contractor shall procure 43 grade (confirming to IS 8112) ordinary Portland cement, as required in the work from reputed manufacturers of cement of approved make and having a production capacity of one million tonnes as approved by Ministry of Industry, Government of India and holding license to use IS*

certification mark for their product whose name shall be got approved from Engineer-In-Charge. The tenderers may also submit a list of names of cement manufacturers which they propose to use in the work. The tender accepting authority reserves right to accept or reject name(s) of cement manufacture(s) which the tenderer proposes to use in the work. No change in the tendered rates will be accepted if the tender accepting authority does not accept the list of cement manufacturers, given by the tenderer fully or partially. Supply of cement shall be taken in 50 kg. bags bearing manufacturer's name and ISI marking, along with manufacturers test certificate for each lot. Samples of cement arranged by the contractor shall be taken by the Engineer-In-Charge and get tested in accordance with provisions of relevant BIS Codes. The cement for such testing purpose shall be supplied by the contractor free of charge. In case test results indicate that the cement arranged by the contractor does not conform to the relevant BIS Codes, the same shall stand rejected and shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer-In-charge to do so. The cost of tests shall be borne by the contractor/department in the manner indicated below:

- a) By the contractor, if the results show that the cement does not conform to relevant BIS Codes.
  - b) By the department, if the results show that the cement conforms to relevant BIS Codes.
- 16) The cement shall be brought at site in bulk supply of approximately 20 tonnes or as decided by the Engineer-In-Charge. Each lot of cement 20 MT or smaller brought to site will be subjected to testing. Testing charges will be governed as per provisions of contract.
- 17) Cement bags shall be stored in two separate godowns, one for tested cement and the other for fresh cement (under testing) to be constructed by the contractor at his own cost as per sketches given in C.P.W.D Specifications - 1996 having weather-proof roofs and walls. The size of the cement godown is indicated in the sketch for guidance. The actual size of godown shall be as per site requirements and nothing extra shall be paid for the same. Each godown shall be provided with a single door with two locks. The keys of one lock shall remain with Engineer-in-charge of the work and that of other lock with the authorised agent of the contractor at the site of work so that the cement is issued from godown according to the daily requirement with the knowledge of both parties. The account of daily receipt and issue of cement shall be maintained in a register in the prescribed proforma and signed daily by the contractor or his authorised agent and Engineer-in-charge or his authorised representative in token of its correctness. The day to day receipt and issue accounts of different grade/brand of cement shall be maintained separately in the standard proforma by the contractor or his authorised representative which shall be duly signed by the authorised representative of the Engineer-in-charge before issue to the work on day to day basis.
- 18) The capacity of each cement go-down shall be 2000 bags of cement or more as decided by the Engineer-in-charge and shall be constructed by the contractor at site of work and at the site of batching plant for which no extra payment shall be made. The contractor shall be responsible for the watch and ward and safety of the cement go-down. The contractor shall facilitate the inspection of the cement go-down by the Engineer-in-charge at any time.
- 19) The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in Clause-42 of the contract and shall be governed by the conditions laid therein.

- 20) If the quantity of cement actually used in the work is found to be more than the theoretical quantity of cement including authorized variation, nothing extra shall be payable to the contractor on this account. In the event of it being discovered that after the completion of the work, the quantity of cement used is less than the quantity ascertained as herein before provided (allowing variation on the minus side as stipulated in Clause - 42), the cost of quantity of cement not so used shall be recovered from the contractor as specified in schedule. Decision of the Engineer-In-Charge in regard to theoretical quantity of cement which should have been actually used as per the schedule and recovered at the rate specified, shall be final and binding on the contractor.
- 21) For non-scheduled items, the decision of the Engineer-in-Charge, regarding theoretical quantity of the cement which should have been actually used, shall be final and binding on the contractor.
- 22) Cement brought to site and cement remaining unused after completion of work shall not be removed from site without written permission of the Engineer-in-charge.
- 23) In case the contractor brings surplus quantity of cement the same shall be removed from the site after completion of work by the contractor at his own cost after approval of the Engineer-in-charge.
- 24) The stacks of cement shall be in rows of two bags deep and 10 bags high with a minimum of 60 cm. clear space all-round. The bags should be placed horizontally continuous in each line and nothing extra shall be paid on this account.
- 25) Cement which is not used within 90 days from its date of manufacture shall be tested at approved laboratory. Until the results of such tests are found satisfactory, it shall not be used in any work.

#### **CONDITIONS FOR STEEL WORKS:-**

- 26) The contractor shall procure Thermo Mechanical Treated (TMT) Steel Reinforcement bars from either Main producers of steel like SAIL, Rashtriya Ispat Nigam Ltd. JSSTCO, JISCO. The documents in support of the purchase of steel shall be produced by the contractor along with the particulars of the manufacturer/supplier of steel for every lot of steel.

<b><u>Mechanical Properties</u></b>	
<u>Parameter</u>	<u>Minimum Value</u>
<u>Yield Strength</u>	415 N/mm sq.
<u>Tensile Strength</u>	500 N/mm sq.
<u>Elongation Percentage</u>	20%
<b><u>Chemical Properties</u></b>	
<u>Chemical Constituents</u>	<u>Maximum Allowable Composition in %</u>
<u>Carbon</u>	0.25
<u>Sulphur</u>	0.05
<u>Phosphorus</u>	0.05
<u>Sulphur + Phosphorus</u>	0.10

- 27) The contractor shall submit original vouchers from the manufacturer for the total quantity of steel supplied under each consignment to be incorporated in the work. All consignment received at the work site shall be inspected by the Site staff along with the relevant documents before acceptance. The contractor shall obtain Original Vouchers and Test Certificates and furnish the same to the Engineer-in-Charge in respect of all the lots of steel brought by him from approved supplier to the site of work. The original vouchers and test certificates shall be defaced by the Site staff and kept on record in the site office.
- 28) Samples shall also be taken and get tested by the Engineer-in-Charge as per the provisions in this regard in relevant BPS codes. In case the test results indicate that the steel arranged by the contractor does not conform to BPS codes; the same shall stand rejected and shall be removed from the site of work by the contractor at his OWN cost within a week's time from written orders from the Engineer-in-Charge to do so. Unless OTHERWISE specified elsewhere in the contract document, the testing (nominal mass, tensile strength, bend test, rebound test etc.) shall be done as per frequency of samples not less than as given below:-

SIZE OF BAR	FOR CONSIGNMENT BELOW 100 TONNES	FOR CONSIGNMENT OVER 100 TONNES
Under 10 mm dia	One sample for each 25 tonnes or part thereof.	One sample for each 40 tonnes or part thereof
10 mm to 16 mm dia	One sample for each 35 tonnes or part thereof.	One sample for each 45 tonnes or part thereof
Over 16 mm dia	One sample for each 45 tonnes or part thereof	One sample for each 50 tonnes or part thereof

- 29) The steel reinforcement shall be brought in bulk supply of 10 tonnes or more or as decided by the Engineer-in-Charge along with manufacturer test certificate for each lot.
- 30) The steel reinforcement shall be stored by the contractor at site of work about 30cm. to 45 cm. above ground. A coat of cement wash shall be given to steel bars when stored at site for long duration so as to prevent corrosion. Nothing extra shall be paid on these accounts. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.
- 31) The contractor shall supply free of charge the steel required for testing. The cost of tests shall be borne by the contractor/Department in the manner indicated below.
- a) By the contractor, if the results show that the steel does not conform to relevant BPS codes.
- b) By the Department, if the results show that the steel conforms to relevant BPS Codes.
- 32) The Actual issue and consumption of steel on work shall be regulated and proper account maintained as per provision of the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in Clause 42 of the contract and shall be governed by conditions laid therein.
- 33) The actual issue of steel shall be actual weight of total quantity of Steel received at the site less actual weight of balance quantity of steel lying unutilized at the work site.

- 34) *Steel brought to site and steel remaining unused shall not be removed from site without the written permission of the Engineer-in-Charge.*
- 35) *In case the contractor bring surplus quantity of steel the same after completion of the work will be removed from the site by the contractor at his own cost after approval of the Engineer-in-Charge.*
- 36) *Reinforcement including authorized spacer bars and lappages shall be measured in length of different diameters as actually (not more than as specified in the drawings) used in the work nearest to a centimeter. Wastage and unauthorized overlaps shall not be measured.*
- 37) *The standard sectional weights referred to as in Table IV in para 5.3.3 in CPWD Specifications for works 1996 will be considered for conversion of length of various sizes of M.S. Bars, Tor Steel Bars and T.M.T. Bars into Standard Weight.*
- 38) *Records of actual Sectional weights shall also be kept dia-wise and lot-wise. The average sectional weight for each diameter shall be arrived at from samples from each lot of steel received at site. The decision of the Engineer-in-Charge shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute one single lot for the purpose. The weight of steel by conversion of length of various sizes of bars based on the actual weighted average sectional weight shall be termed as Derived Actual Weight.*
- 39) *If the Derived Weight as in sub-para above is less than the Standard Weight then the Derived Actual Weight shall be taken for payment. If the Derived Actual Weight is found more than the Standard Weight, the Standard Weight shall be taken for payment. In such case nothing extra shall be paid for the difference between the Derived Actual Weight and the standard Weight.*

## **I) R.C.C. WORK**

### **1.1. Design Mix Concrete**

1.1.1 *The RCT work shall be done with Design Mix Concrete. Wherever letter M has been indicated, the same shall imply for the Design Mix Concrete. The Design Mix Concrete will be designated based on the principles given in IS: 456:200, 10262 & SP 23. The conditions & specifications stated herein shall have precedence over all conditions & specification stated in relevant I.S. Codes / C.P.W.D. Specifications. The concrete mix shall be designed for the specified target mean compressive strength in order to ensure that work test result do not fall below the acceptance criteria specified for the concrete mix. The Contractor shall design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements specified. The mix shall be designed with required quantities of admixture / plasticizer to achieve required workability & strength.*

1.1.2 *The sources of coarse aggregate, fine aggregate, water, admixture & cement to be used in concrete work shall be identified by the contractor & he will satisfy himself regarding their conforming to the relevant specification & their availability before getting the same approved from the Engineer-In-Charge.*

- a) **Coarse Aggregate:-** *As per CPWD Specifications with up to date correction slips.*
- b) **Fine Aggregate:-** *As per CPWD Specifications with up to date correction slips.*
- c) **Water:-** *It shall conform to requirements laid down in IS:456-2000 / Para 5.4. If the contractor uses water from bore well, it should be got tested as per norms and frequency laid down in CPWD specification. In case, it does not meet the standard, the contractor shall install softening plant for purification to bring it to within acceptable limit of CPWD specification for which nothing extra shall be paid to him.*
- d) **Cement:-** *OPC of grade 43 or grade 53 shall be used for design mix concrete and shall conform to IS-8112, or IS-12269. However, if higher grade of cement is used by the contractor nothing extra shall be paid on this account.*

*The record of white cement shall be kept in the same performa and same manner as applicable for the grey cement.*

- e) **Admixture / Plasticizer** – *The admixture shall conform to IS:9103. Wherever required, the admixture of approved quality only shall be used to attain the required workability. Nothing extra on account of use of Admixture / Plasticizer shall be payable. The chloride content in the admixture shall satisfy the requirements of IS:5075. The total amount of chlorides in the admixture mixed concrete shall also satisfy the requirements of IS 456-2000.*

*The contractor shall not be paid anything extra for admixtures required for achieving desired workability without any change in specified water cement ratio for RCC/CC work, if concrete pumps are used. No admixture shall be mixed, if concreting is done without aid of concrete pumps.*

*Admixture may be added (by maintaining the minimum cement content as specified above). In case of specific technical requirement, so as to meet the workability/ slump requirement or for any other reason. But nothing extra is to be paid to contractor on account of adding admixtures.*

1.1.3 **Grade of Concrete:-** *The compressive strength of various grades of concrete with various parameters shall be as follows :-*



GRADE DESIGNATION	COMPRESSIVE STRENGTH HON <sub>15</sub> Cm. TUBES min. 7 DAYS (N/mm <sup>2</sup> )	SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF 150 mm TUBE 28 DAYS (N/mm <sup>2</sup> )	MINIMUM CEMENT CONTENT (Kg. Per Cub. Mtr.)	MAXIMUM WATER CEMENT RATIO	SU P
(i) M <sub>20</sub>	As per Design	20	360	0.55	75-120
(ii) M <sub>25</sub>	As per Design	25	380	0.50	75-120
(iii) M <sub>30</sub>	As per Design	30	400	0.45	75-120
(iv) M <sub>35</sub>	As per Design	35	420	0.45	75-120

**NOTE:-**

- In the designation of a Concrete mix letter M refers to the mix and the number of the specified characteristic compressive strength of 15 cm - Tube at 28 days expressed in N/mm<sup>2</sup>.
- It is specifically highlighted that in addition to the above requirements. The maximum cement content for any grade shall be limited to 450 kg. / cubic metre.
- The minimum / maximum cement content for design mix concrete shall be maintained as per the quantity mentioned above. Even in the case where the quantity of cement required is higher than the minimum specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the contractor.

**1.1.4**

The Contractor shall engage one of the following approved laboratories/ test house for designing the concrete mix in accordance with relevant IS Code and to conduct laboratory tests to ensure the target strength & workability criteria for a given grade of concrete.

- IST, Delhi
- C.R.R.I. Delhi
- National Council for Cement & Building Material, Ballabhgarh.
- Sri Ram Test Laboratory.

The various ingredients for mix design / laboratory tests shall be sent to the lab/ test houses through the Engineer-in-charge and the samples of such aggregates sent shall be preserved at site by the department.

In the event if all the four laboratories are unable to carry out the requisite design / testing, the contractor may have it done from any other laboratory with prior approval of the Chief Engineer (SWZ) DDA i.e., T.S. Authority.

**1.1.5**

The contractor shall submit the report on design mix from any of the above approved laboratories for approval of Engineer-in-Charge within 45 days from the date of issue of letter of award of

work. No concreting shall be done until the design mix is approved. In case of white Portland cement and the likely use of admixtures in concrete with ordinary Portland/white Portland cement, the contractor shall design and test the concrete mix by using trial mixes with white cement and / or admixtures also, for which nothing extra shall be payable.

1.1.6 In case of change of source or characteristic properties of the ingredients used in the concrete mix during the work, a revised laboratory mix design report conducted at laboratory established at site shall be submitted by the contractor as per the direction of the Engineer-in-charge.

1.1.7 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the Contractor including redesigning of the concrete mix whenever required & as directed by Engineer-In-Charge.

1.1.8 The mix design for a specified grade of concrete shall be done for a target mean compressive strength  $f_{ck} = f_{ck} + 1.65s$

Where;

$f_{ck}$  = Characteristic compressive strength at 28 days.

$s$  = Standard deviation which depends on degree of quality control.

The standard deviation for different grades of concrete shall be as follows:-

GRADE OF CONCRETE	FOR ``GOOD`` QUALITY OF CONTROL
$M_{20}$	4.0
$M_{25}$	4.0
$M_{30}$	5.0
$M_{35}$	5.0

The degree of quality control for this work is "good" for which the standard deviation ( $s$ ) obtained for different grades of concrete shall be as above.

Out of the six specimen of each set, three shall be tested at seven days and remaining three at 28 days. The Preliminary tests at seven days are intended only to indicate the strength to be attained at 28 days.

All cost of mix designing and testing connected therewith including charges payable to laboratory shall be borne by the contractor.

1.1.9 **TRIAL BATCHES**

a) The designed mix proportions shall be checked for target mean compressive strength by means of trial batches.

b) Minimum three sets of separate preliminary tests shall be carried out for each trial batch of concrete mix. Each test shall comprise of six specimens and only one test-set of six specimens shall be made on any particular day.

- c) *The quantities of materials for each trial mix shall be sufficient for at least six specimens (cubes) and the concrete required for carrying out workability tests.*
- d) *The workability of trial mix No.1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics. The water content, if required, shall be adjusted corresponding to the required changes in the workability.*
- e) *With the modified water content, the mix proportions shall be recalculated by keeping with water cement ratio unchanged. The mix proportion, as modified, shall form the Trial Mix No.2 and tested for the specified strength and workability.*
- f) *In addition, trial mix No.3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio by  $\pm 10$  percent of the specified value and tested for their design characteristics.*
- g) *Out of the six specimen of each set, three shall be tested at seven days and remaining three at 28 days. The preliminary tests at seven days are intended only to indicate the strength to be attained at 28 days. While the design mix shall be approved only on the basis of test strength at 28 days.*

1.1.10

#### *APPROVAL OF DESIGN MIX*

*The design mix shall be considered satisfactory and approved if at least three preliminary test-sets individually satisfy the following strength and workability criteria :*

- a) *The average strength of each test-set is not less than the specified target mean compressive strength ( $f_{ck}$ ).*
- b) *The strength of any specimen cube is not less than  $0.85 f_{ck}$ .*
- c) *The concrete mix is of required degree of workability and acceptable concrete finish.*

1.1.11

#### *BATCHING & MIXING:-*

- a) *All concreting shall be done using computerized automatic concrete batching plant with automatic admixture dispenser which shall be installed by the contractor at site, calibrated & tested. The batching plant shall conform to IS: 4925. It shall have the facilities of data print-outs, presetting the quantity to be weighed with automatic cut-off when the same is achieved.*
- b) *In case of non-availability of batched concrete, ready mix concrete (RMC) may be used. The concrete to site shall be transported by transit mixtures. All the precautions shall be taken during the transportation and handling of concrete to achieve the desired strength, durability, etc. as envisaged in the mix design. Contractor has to get the approval from Engineer-In-Charge regarding source of ready mix concrete by giving the details of such plants indicating name of owner / company, its location, technical establishment, past experience and text of Memorandum*

of understanding (proposed to be entered between purchaser and supplier) who, after satisfying himself about quality / capability of the company, shall give approval in writing (subject to drawl of M.O.U.). The M.O.U shall be drawn with RMC plant owner / company and submitted to Engineer-in-Charge within a week of such approval. The contractor will not be allowed to purchase ready-mixed concrete without completion of above formalities for use in his project. Notwithstanding the approval granted by Engineer-in-Charge in aforesaid manner, the contractor shall be fully responsible for quality of concrete including input control, production, transportation and placement etc.

The Engineer-in-Charge will reserve the right to deploy his supervisor at plant site to inspect at any such stage and reject the material / concrete etc if he is not satisfied about quality of material / product.

The design mix concrete will be designed based on principle given in IS-456, 2000 and SP 23 for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirement specified. In case of use of admixture and / or white cement, the mix shall be designed with these ingredients as well.

Nothing extra shall be paid for using ready mix concrete instead of batched mixed concrete.

- c) All measuring equipment shall be maintained in a clean and serviceable condition and their accuracy shall be checked at least once a month.
- d) Only single sized good quality stone aggregate shall be brought to site of work from the approved source. The grading of the stone aggregate shall be controlled by blending the aggregate of different sizes in the required proportions at site of work as design mix approved. The aggregate of different sizes shall be stock-piled separately, preferably a day before use. The grading of coarse and fine aggregates shall be checked as frequently as possible and as directed by the Engineer-In-Charge to ensure that the specified grading and quality of aggregate is maintained.
- e) It is important to maintain the water cement ratio constant at its specified or approved value by making adjustment for the moisture contents of both fine and coarse aggregates. The moisture contents in the aggregate shall be determined as frequently as possible in keeping with the weather conditions and as per the provisions of IS:2386 (Part-III).

1.1.12

**LAYING** -The concrete shall be placed in position using tower crane or concrete pumps or mechanical hoist or combination of adequate capacity. Nothing extra for laying concrete using concrete pumps or for extra concrete mix design shall be paid.

1.1.13

All other operations in concreting work like mixing, slump, laying, placing of concrete, compaction, curing etc. not mentioned in this particular specifications for Design Mix of Concrete shall be as per CPWD specifications with up to date correction slips.

1.1.14

#### **SAMPLING:-**

- a) Samples from fresh concrete being used at work shall be taken as per IS 1199-1959 and the test cubes shall be made, cured and tested in accordance with IS:516-1959.
- b) Each test sample shall comprise of six test cubes (specimen), three of which shall be tested at 7 days and remaining for tests at 28 days.
- c) **FREQUENCY OF SAMPLING:-**
- (i) A random sampling procedure shall be adopted to ensure that the sampling is spread over the entire period of concreting and cover all mixing units. The concrete work shall be notionally divided into lots as under for the purpose of sampling conditions.
- Footings, rafts etc.
  - Columns and walls at all levels.
  - Beams at all levels.
  - Slabs at all levels.
- (ii) At least one test sample shall be taken for each lot of concrete work.
- (iii) Each grade of concrete shall form different lot for testing.
- (iv) The minimum frequency of sampling of concrete of each grade shall be in accordance with the following:-

QUANTITY OF CONCRETE IN THE WORK, CUBIC METRE PER DAY	NUMBER OF SAMPLES
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 Plus one additional sample for each additional 50 cubic metre or part thereof.

**NOTE:-** At least one sample shall be taken from each shift.

- (v) The concrete work shall be assessed on day to day basis & samples shall be taken as specified.
- (vi) Work strength test shall be conducted in accordance with IS:516 on random sampling.

#### 1.15 TEST RESULTS OF SAMPLES:-

The test results of the sample shall be the average of the strength of three specimens. The individual variation shall not be more than  $\pm 15\%$  percent of the average. If variation is more, the test results shall

*be treated as invalid. 90% of the total tests shall be done at the laboratory established at site by the contractor and remaining 10% in the laboratory as directed by the Engineer-in-Charge.*

**1.16 STANDARD OF ACCEPTANCE:-**

- i) In case the test results of all the samples are above the characteristic compressive strength, the concrete shall be accepted.*
- ii) In case the test result of one or more samples fails to meet the requirement (i) above, it shall be accepted if it meets the requirement as laid down in CPWD Specification.*
- ii) Concrete of each grade shall be assessed separately.*
- iv) Concrete is liable to be rejected, if it is porous or honeycombed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met.*

**1.17 Measurement –**

- (i) As per CPWD Specifications with up to date correction slips.*
- (ii) In respect of all projected slabs at all levels including cantilever, canopy, the payment for the RCC work shall be made under the item RCC slabs. The payment for shuttering at the edges shall be made under item of centering and shuttering for RCC slabs. Nothing extra shall be paid for the side shuttering at the edge of these projected balconies / projected verandah slabs.*

**1.18 Tolerances - As per CPWD Specifications with up to date correction slips.**

**1.19 Rates: -**

- (i) As per CPWD Specifications with up to date correction slips.*
- (ii) The rate includes the cost of materials, labour and T&P, including mixing, placing, transportation involved in all the operations described above except for the cost of centering, shuttering & reinforcement which will be paid for separately.*
- (iii) In case of rejection of concrete on account of unacceptable compressive strength, governed by para "Standard of Acceptance" as above, the work for which samples have failed shall be redone at the cost of contractor. However, the Engineer-in-charge may order for additional tests (like cutting cores, ultrasonic pulse velocity test, load test on structure or part of structure, etc) to be carried out at the cost of contractor to ascertain if the portion of structure wherein concrete represented by the sample has been used, can be retained on the basis of results of individual or combination of these tests. The Contractor shall take remedial measures necessary to retain the*

*structure as approved by the Engineer-in-charge without any extra cost. However, for payment, the basis of rate payable to contractor shall be governed by the 28 days cube test results and reduced rates shall be regulated in accordance with CPWD Specifications with up to date correction slips.*

*(iv) In case of actual average compressive strength being less than specified strength which shall be governed by Para "Standard of Acceptance" as above the rate payable shall be worked out accordingly on Pro-rata basis.*

## **2.0 FORM WORK**

*2.01 The work shall be done in general as per CPWD specifications with up to date correction slips.*

*2.02 Only M.S. centering / shuttering and scaffolding material unless & otherwise specified shall be used for all R.C.C. work to give an even finish of concrete surface. However, marine-ply shuttering shall be used as per site requirement on specific request from contractor as approved by Engineer-in-Charge.*

*2.03 Nothing extra shall be paid for the centering and shuttering, circular in shape whenever the form work is having a mean radius exceeding 6m in plan.*

*2.04 In order to keep the floor finish as per architectural drawings and to provide required thickness of the flooring as per specifications, the level of top surface of R.C.C. shall be accordingly adjusted at the time of its centering, shuttering and casting for which nothing extra shall be paid to the Contractor.*

*As per general engineering practice, level of floors in toilet / bath, balconies, shall be kept 12 to 20mm or as required, lower than general floors shuttering should be adjusted accordingly. Nothing extra is payable on this account.*

*2.05 Steel shuttering as approved by the engineer-in-charge shall be used by the contractor. Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required to complete the shuttering panels.*

*Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work.*

*The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or de-bonding compound shall be applied on the surface of the shutter plates in the requisite quantity before assembly of steel reinforcement.*

## **3.0 REINFORCEMENT:-**

*3.01 The reinforcement shall be done as per CPWD Specifications with up to date correction slips.*

- 3.02 The rate of item of reinforcement of *RCC* work includes all operations and annealed steel wire including straightening, cutting, bending, welding, binding with annealed steel wire or welding and placing in position at all the floors with all leads and lift including cost of cover block complete.
- 3.03 The contractor shall provide approved type of support for maintaining the bars in position and ensuring required spacing and correct cover of concrete to reinforcement as called for in the drawings, spacer blocks of required shape and size. Chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. Spacer blocks shall be cast well in advance with approved proprietary pre-packed free flowing mortars (conbextra as manufactured by *M/S Fosroc Chemicals India Ltd.* or approved equivalent) of high early strength and same colour as surrounding concrete precast cement mortar/concrete blocks/blocks of polymer shall not be used as spacer blocks unless specially approved by the Engineer-in-charge, rate of *RCC* items is inclusive of cost of such cover blocks.
- 3.04 The reinforcement bars not to be placed directly on the ground, in rainy season, due to lack of drainage, the water accumulates causing considerable corrosion of steel to avoid this, steel bars should be stored about 30 to 45 cm above ground. The treatment should be given to steel bars as prescribed in item of reinforcement. Nothing extra shall be paid on this account.
- 3.05 Every care shall be taken to avoid mixing different types of grades of bars in the same structural members as main reinforcement to satisfy clause 25.1 of *IS:456*. In case of buildings, wherever the situation necessitates, the change over shall be made only from any one level onwards. In case of foundations, all foundation elements (footing and grade beams) shall have the same kind of steel. In the case of columns, all structural elements upto the level of change, where the change over is taking place should have the same kind of steel as those in columns. However, in the case of slabs, at any level, it is permissible to use a different kind of steel other than used in beams and columns, provided the entire steel in the slab at that level is of same kind of steel. It is also permissible to use a different kind of steel for stirrups/binders for beams and columns than the main steel used in them.
- 3.06 The point of change over shall be planned at any one particular level and shall be done through columns only. At the point of change over, it shall be necessary to increase the area of main steel in columns by 10% and the length of lap of bars by 50%.
- 3.07 *TMT* bars of appropriate grade from approved manufactures having *Thermax* or *Tempcore* system of treatment and valid *BIS* licence under *IS : 1786* shall only be allowed to be used in the work. However, in case of any unforeseen reasons, if *TMT* bars are not available in the market, from any of the approved producer, in exceptional circumstances, (for which approval is to be taken by the contractor in writing from Chief Engineer for use of Cold Twisted deformed bars conforming to *IS:1786-1985* manufactured by main producers as approved by Minimum of Steel, can be allowed subject to conditions in Para 3.4.5 and 3.4.6 above. However, deduction in payment rate for such *C.T.D.* bars actually used and measured in place of *TMT* bars shall be made at the market rate differences as found reasonable & certified



by Engineer-in-Charge in writing or minimum rate of ₹.2/= per kg. less than the rate for TMT bar quoted by the contractor for this work. The decision of Engineer-in-Charge regarding reasonability of rates shall be final & conclusive to the contractor.

- 3.08 In case of using Fe-415, due to non availability of Fe-500 (after obtaining necessary approval from the competent authority), relevant provision of BJS shall be satisfied.
- 3.09 The reinforcement steel for RCC is to be procured from the main producers only such as JSSTCO, SAIL, RINL, etc. In case of non-availability with the main producers, the procurement can be made from BJS licensee secondary producers also, after getting the necessary Certificate from the main producer.
- 3.10 The standard sectional weights as referred to in standard table of CPWD specifications shall be treated for conversion of length of various sizes of Mild steel/ TMT bars into weight are as given below :

Dia in mm	Weight in Kg / Metre
6	0.222
8	0.395
10	0.617
12	0.888
16	1.58
18	2.00
20	2.47
22	2.98
25	3.85
28	4.83
32	6.31
36	7.99
40	9.85
45	12.50
50	15.42

- 3.11 However, the average sectional weight of each diameter shall be arrived at from samples from each lot of steel received at site. The actual weight of steel if less than the standard co-efficient given in CPWD Specification & is within the tolerance limit of acceptance co-efficient shall be modified to take into account the variations between the actual and standard co-efficient. The Contractor shall be paid for the modified weight of steel.

#### 4.00 READY MIXED CONCRETE FROM RMC PRODUCER

The contractor shall use Ready MIX concrete (RMC) only from the RMC producing plants (located within 50 km distance from the site of work) for carrying out concreting for piles, RCC Columns, Beams, Slabs, etc.

- 4.01 *The contractor shall, within a 15 days of award of the work, submit list of at least three RMC producers of repute or as per list of approved RMC producer as appended later along with details of such plants including details and number of transit mixers & pumps etc. to be deployed indicating name of owner/company, its location, capacity, technical establishment, past experience and text of MOU proposed to be entered between purchaser (the contractor) and supplier (RMC producer) to the Engineer-in-Charge. Engineer-in-Charge shall give approval in writing (subject to drawl of MOU) failing which the contractor shall give list of other RMC producers of repute along with required details of approval of Engineer-in-Charge. The Contractor shall draw the MOU with approved RMC producer and submit to Engineer-in-Charge with in a week of such approval. The contractor will not be allowed to use ready mixed-concrete without completion of above stated formalities.*
- 4.02 *Notwithstanding the approval granted by Engineer-in-Charge in aforesaid manner of provisions in CPWD specification 2002, the contractor shall be fully responsible for quality of concrete including input control, transportation and placement, etc.*
- 4.03 *For all purposes the contractor shall carry out fully, the responsibilities of the "placement contractor" and the "manufactures of concrete".*
- 4.04 *The Engineer-in-Charge will reserve right to inspect at any stage and reject the concrete if he is not satisfied about quality of product at the user's end.*
- 4.05 **The Engineer-in-Charge reserves the right to exercise control over the :**
- i) *Ingredients water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials, recording of test results and declaring the materials fit or unfit for use in production of mix.*
  - ii) *Calibration check of the RMC Plant.*
  - iii) *Weight and quantity check on the ingredients, water and admixtures added for batch mixing.*
  - iv) *Time of mixing of concrete.*
  - v) *Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action, if required.*
  - vi) *For exercising such control, the Engineer-in-charge shall periodically depute his authorized representative at RMC plant. It shall be responsibility of the contractor to ensure that all necessary equipment, manpower & facilities are made available to Engineer-in-charge and/or his authorized representative at RMC plant.*
- 4.06 *The contractor should therefore draw MOU/agreement with RMC producer very carefully keeping in view all terms and conditions/specifications forming part of this tender document.*
- 4.07 *All required relevant records of RMC shall be made available to the Engineer-in-Charge or his authorized representative. Engineer-in-Charge shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production & transportation of concrete mix which shall be binding on the contractor & RMC plant. Only concrete as approved in design mix by Engineer-in-Charge shall be produced in RMC Plant and transported to the site.*
- 4.08 *In addition, the contractor may install fully automatic batching plant at site having minimum production capacity of 15 cum concrete per hour for carrying out other concrete works than those specified in 3.14. The layout of site for installation of the batching plant and storage of aggregate for its functioning shall be prepared by the contractor and get it approved by the Engineer-in Charge beforehand.*
- 4.09 *43 grade OPC (Conforming to IS 8112) of brand/make/source as approved by Engineer-in-Charge shall only be used for production of concrete.*
- 4.10 **Quality Control of Ready-mixed concrete**

*It shall be the responsibility of the contractor to ensure that RMC producer provides all necessary testing equipments and takes all necessary measures to ensure Quality Control of ready mixed concrete. In general the required measures*

#### **4.11 Use of Design mix Concrete**

*4.11.1. Design mix concrete produced in Ready mix concrete plant arranged by the contractor from the RMC producers shall be used for piles, RCC columns, beams, slabs etc.*

*4.11.2. For design mix concrete of RCC other than those specified the contractor shall use the design mix concrete produced by a central batching and mixing plant as defined at his own cost. The contractor, if he so desires, can arrange the design mix concrete mentioned here in also from Ready mix concrete producer as defined in after obtaining written approval of the Engineer-in-charge. Nothing extra whatsoever shall be payable on this account.*

*4.11.3. Ready mix concrete shall be arranged in quantity as required at the site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by the Engineer-in-charge. Nothing extra shall be payable on this account.*

*4.11.4. The item of design mix cement concrete (produced at the site as well as arranged from RMC producer) shall be inclusive of all the ingredients including admixtures if required, labour, machinery, T & P, transportation etc. required for a design mix concrete of required strength and workability. The rate quoted by the agency shall be net & nothing extra shall be payable on account of changes in quantities of concrete ingredients like cement and aggregates and admixtures etc. as per approved mix design.*

### **5.0) WATER PROOFING TREATMENT**

#### **1) GENERAL**

a) *All the water proofing treatment shall be got executed through the specialized agencies. The specialized agencies shall be got approved from the Chief Engineer.*

b) *The contractor shall furnish the following particulars immediately after the issue of letter of acceptance by the Department.*

i) *The name of the specialized firm.*

ii) *The trade names of the product, which would be used.*

iii) *List of works where the treatment has been used.*

iv) *Quantity of chlorides and sulphides used in the product.*

c) *The water proofing treatment for the Sunk portions shall be tested by filling the sunk portions completely with potable water and observing for leakage for minimum 72 hours. All the arrangements for testing including supplying water, closing all the outlets temporarily and restoring after the test etc. shall be made by the contractor at his own cost. Any leakage noticed shall be rectified by the contractor at his own cost. Nothing extra shall be payable on this account.*

d) *The water proofing treatment over the terrace slab, slab in the sunk / depressed slabs shall be tested by ponding water as specified for curing as well as observing for leakage for minimum 2*

*weeks. All the arrangements for testing including supplying water, making temporary bunds using mortar, removing bunds after testing etc. shall be made by the contractor at his own cost. Any leakage noticed shall be rectified by the contractor at his own cost. Nothing extra shall be payable on this account.*

## 2) GUARANTEE FOR WATER PROOFING TREATMENT

*Ten years guarantee in prescribed proforma attached shall be given by the contractor for the water proofing treatment. In addition 10% (ten percent) of the cost of these items of water proofing under this sub head shall be retained as guarantee to watch the performance of the work executed. However, half of this amount (withheld) would be released after five years from the date of completion of the work if the performance of the waterproofing works is satisfactory. The remaining withheld amount shall be released after completion of ten years from the date of completion of work, if the performance of the waterproofing work is satisfactory. If any defect is noticed during the guarantee period, it should be rectified by the contractor within seven days of issuing of notice by the Engineer-in-Charge and, if not attended to, the same shall be got done through other agency at the risk and cost of the contractor and recovery shall be effected from the amount retained towards guarantee. In any case, the contractor and the specialist agency, during the guarantee period, shall inspect and examine the treatment once in every year and make good any defect observed and confirm the same in writing. The security deposit can be released in full, if bank guarantee of equivalent amount, valid for the duration of guarantee period, is produced and deposited with the Department.*

## 6.00 STAINLESS STEEL BALUSTRADES AND HANDRAILS

7.01 *GENERAL: All balustrades, handrails and the like, including parapets and railings to all roofs are to be capable of resisting live loads in accordance with IS 875 (PART) 1987. The design live load shall be a static load of not less than 3.0 kN/m acting inward, outward or downward, or the appropriate wind load as per IS Code, whichever produces the most adverse effects.*

## 7.00 FLOORING AND WALL FINISHING:

### FLOORING:

### 7.1 TIMBER SPORTS FLOORING

SUMMARY: The summary of the work included in this section of the specification generally comprises the supply and laying of

(a) timber sports flooring

Together with all consequential and/or incidental work which may be or may become necessary though not specified or shown in detail.

## **STANDARDS**

**REFERENCED DOCUMENTS:** The following documents have reference to this Section of the Specification. Where revised or reaffirmed, the latest version of the document shall prevail.

Where no Indian Standards exist to cover materials, installation, testing and the like as herein specified. Manufacturers and Suppliers referenced standards to the particular materials, installation method or testing shall apply.

Where this specification requires standards higher than those applicable under the relevant Indian Standard or Code, this specification shall prevail.

## **SAMPLE**

**SAMPLE PANEL:** Lay and finish a sample area of flooring of not less than 3000 x 3000mm where directed, for final approval by the Consultant Engineer in Charge of the workmanship, appearance, gloss level and durability of the proposed Sports flooring system.

THE SPORTS FLOORING SHALL BE SPECIALISE PRODUCT FOR THE SPECIFIC USE OF SPORTS FLOORS AND THE TYPE AND AMPLITUDE OF THE TIMBER FLOORING SHALL BE APPROVED BEFORE INSTALLATION OF THE SAME.

## **MATERIALS**

**TIMBER GENERALLY:** To be kiln dry and well seasoned, straight grained, free from wind, sapwood, gum veins, large, loose or dead knots, borer, borer holes and other defects.

**KILN DRIED HARDWOOD(KDHW):** Where shown or specified as “KDHW” is to be select grade, first quality, kiln dried and reconditioned to an approved moisture content not exceeding 12% quarter sawn, of even grain and light colour and of acceptable brand.

**SEASONED HARDWOOD:** Where shown or specified as “seasoned hardwood” is to be Seasoned Building Grade with the following properties.

Characteristic Strength MPA			Characteristic short duration average modulus of elasticity parallel to the grain, MPA
Bending	Tension parallel to grain	Compression parallel to grain	
80	50	60	18.500

**RESILIENT PADS:** To be 75 x 50 x 19mm Bridge quality rubber with 50-55 durometer hardness, Granor Rubber, or equal or better approved by the Consultant and Engineer in Charge at 250mm c/c.

**FLOORING** To be 57x 26 mm first quality select at mill grade T&G offset rounded tongue, in long lengths, tightly cramped with end Joints T&G made over battens and with each board secretly fixed to each batten with stainless steel staples.

**FRAMING:** To be constructed where shown and as set out below. Hardwoods like Fir, spruce or pine or as decided by Engineer-in-charge shall have the following properties.

Characteristic Strength MPA			Characteristic short duration average modulus of elasticity parallel to the grain, MPA
Bending	Tension parallel to grain	Compression parallel to grain	
20	15	20	9.100

- (a) fixing bearers of 50 x 50mm HW in long lengths, spaced at minimum 300mm centres to the maximum 600 centre or as decided by Engineer-in-charge.
- (b) Fixing joists of 50 x 50mm HW in long lengths to bearers, joists to be at a maximum 300mm centres, perpendicular to the bearers.
- (c) The bearers and joists are to be configured to allow full air circulation under the flooring.

- (d) Provide double joists at locations where the retractable seating rollers will run.
- (e) Provide 600 micron PVC sheet over CC/ RCC surface over to act as vapour barrier before framing.

### **WORKMANSHIP**

WORKMANSHIP. All work is to be carried out by competent tradesmen in accordance with the best trade practices.

The work is only to commence after all the conditions as below, have been met.

The conditions provide that

- (a) the sub-floor has dried out,
- (b) All wet trades are completed,
- (c) All services are installed and operating,
- (d) All windows are fitted and glazed,
- (e) All doors are hung,
- (f) The interior of the area has dried out,
- (g) The building is weather sealed,
- (h) Adequate lighting and ventilation are provided.

Do all checking, housing, halving, mitring, spiking, bolting, screwing, etc, required to provide first class work.

All timbers are to be accurately placed in position, levelled and / or plumbed and in an even plane.

**ACCEPTANCE OF SURFACES:** Before any work is commenced, provide the Engineer in Charge with a written statement advising that the suspended slab sub floor areas are suitable to timber sub floor. Subsequent claim as to the unsuitability or otherwise of the sub floor area will not be accepted.

**FIXINGS:** Provide all screws, nails, spikes, bolts, masonry anchors, plugs, etc as required for proper fixing of the works.

Drill timbers for fastenings where appropriate and where necessary to prevent splitting.

Use power or explosive driven fastenings only where specified or approved, and then only subject to taking all necessary safety precautions.

Nails are to be of the types appropriate for the purpose, or as recommended by the manufacturer for the fixing of building boards or other manufactured sheets.

Masonry anchors are to be approved patent expansion type.

Fastenings for timber engineering purposes, including bolts, coach screws, split ring connectors, shear plate connectors, tooth plate connectors, and nail plate connectors, are to comply with AS 1720 and are to be of galvanized steel, unless otherwise specified.

Where any part of a steel fastening is exposed to weather, or in contact with chemically treated timbers, the fastening is to be hot dip galvanized.

Plastic plugs in masonry are to be of an approved type.

**SET OUT :** Set out all work properly and accurately and carry out all cutting, trimming, notching etc.

Indiscriminate notching of structural timbers will not be permitted.

**FINISHED SURFACES:** The floor surfaces are to finish uniformly level and free from bumps, hollows and other irregularities.

**MAINTENANCE INSTRUCTINS:** Provide the Principal with two copies of printed or typed instructions from the manufacturer recommending the correct maintenance for the flooring.

**Defects:** All works which wraps or gets in winding is to be replaced and finished without cost to the principal.

## **FLOORING INSTALLATION**

### **LAYING**



Lay flooring level top of joists to a true even plane, all in long lengths, tightly cramped in panels, with T&G ends made over joists and with each board secretly nailed to each joist crossing.

Packing will not be permitted between joists and flooring.

Provide control joints 1.5mm wide between panels at maximum 1200mm centres throughout the floor area and 50mm wide at perimeter walls.

Additional joists shall be included where necessary for the support below flooring, of the runners for the retractable seating. The contractor shall coordinate these runners for number and position, with the retractable seating supplier.

**FINISHING:** Leave the flooring for 7 days minimum after laying and then machine sand the surface with coarse and fine sandpapers to a smooth even surface free from scratches.

Areas not accessible to the machine are to be hand scraped and hand sanded with fine sandpaper to a finish as specified above.

On completion of sanding, remove all dust and apply 4 coats of Peerless "Duel Coat" oil modified polyurethane protector / sealer coating, applied in accordance with the manufacturer's instructions.

Marking of court lines with approved paint as per sports federation guidelines .  
**CLEAN DOWN:** On completion, clean down the parquet and leave the surface free from stains, dirt, etc.

**PROTECTION:** Protect the timber flooring against damage until practical completion and these surfaces are to be clean and in perfect condition at that time.

Any cracked, loose or drummy areas are to be replaced and made good without cost to the Principal.

## **MAINTENANCE**

MAINTENANCE: Prior to Practical Completion, supply the Principal with three copies of a maintenance manual which is to include:

- (a) Relevant contractor and supplier address & contract details.
- (b) An outline description of the installation and detailed description of specific items with product names, types, serial numbers etc.
- (c) Recommended maintenance procedures.
- (d) Copies of manufacturer's warranties or guarantees, recommendations etc.

### **Guarantee**

In addition 5% (five percent) of the cost of installation of wooden flooring shall be retained for five years as guarantee to watch the performance of the work executed. If any defect is noticed during the guarantee period, it should be rectified by the contractor within seven days of issuing of notice by the Engineer-in-Charge and, if not attended to, the same shall be got done through other agency at the risk and cost of the contractor and recovery shall be effected from the amount retained towards guarantee. In any case, the contractor and the specialist agency, during the guarantee period, shall inspect and examine the work once in every three months and make good any defect observed and confirm the same in writing. The security deposit can be released in full, if bank guarantee of equivalent amount, valid for the duration of guarantee period, is produced and deposited with the Department

## **DIN TESTING STANDARDS**

### **1. Shock Absorption**

- \* Amounts of load absorbed by the floor.
- \* DIN Standard: Minimum 53%

### **2. Deflection**

- \* Floor travels downward at point of impact and 20 degrees from point of impact
- \* DIN Standard: Minimum 2.3mm

3. **Ball Bounce**
  - \* Ball return compared to concrete
  - \* DIN Standard: Minimum 90%.
4. **Friction**
  - \* Surface slide characteristics
  - \* DIN Standard: Range: 0.5 – 0.7
5. **Rolling Load**
  - \* Weight capacity without damage
  - \* DIN Standard: 337.6lbs.

method of testing floors referred to as the “DIN Standard 18032, Part II”, the most universally recognized standards for sports surface testing. DIN Standards were the first such standard to recognize the importance of the interaction between athlete, surface and activity and their effect on enhancing comfort, safety and heightened performance. The tests measure the safety, performance and durability of a sports floor system. There are 6 main criteria to DIN.

### **CRITERIA**

1. **SHOCK ABSORPTION** – Measured as a percentage against a non-resilient floor such as concrete, the minimum shock absorption is 53%. This standard insures the lowering of impact forces to the lower body during participation. This reduces the potential of injury such as shin splints, stress fractures and lower back injuries to the athlete/ dancer that can occur as a result of performing on rigid hard surfaces.
2. **DEFORMATION UNDER LOAD (DEFLECTION)** – Used to compare floor deflection along a vertical axis, this value represents the distance the floor travels downward during impact. In order for a floor system to absorb energy, it must deflect or yield during the interaction of the athlete/ dancer with the floor surface. By deflecting 2.3 millimeters or .090 of an inch under foot strike

or impact, the impact forces, or jolt, is lessened and spread out over a longer period of time; thereby allowing the muscular skeletal system to biomechanically respond and adapt in a safe manner. This is especially important during leaps and jumps where large deceleration forces can occur. A system that deflects under impact greatly reduces maximum forces that can result in discomfort and/or injury.

3. **ISOLATION OF DEFLECTIVE IMPACT OR INDENTATION** – Insures that a trampoline effect is not experienced by one participant because of another's movement. The deflection of a floor 50 centimeters (19 3/4") away from the point of impact, both in the vertical and horizontal plane, is not to exceed 15% of the original deflection.
4. **FRICTION OR SLIDING CHARACTERISTICS** – Determined as a kinetic coefficient of friction, the interaction between the shoe and floor surface is important, to provide a delicate balance between slide, glide and traction.
5. **BALL REFLECTION** - Assures that the bounce of a basketball on DIN standard floor will be at least 90% of the bounce height of the same ball dropped on concrete surface.  
Game action response, or ball bounce, insures that the surface may be used for sports such as volleyball, basketball, racquet sports, etc., as well as multi-purpose activities such as aerobics and dance.
6. **ROLLING LOADS (SHEAR)** - DIN standards withstand heavy concentrated loads without breaking or sustaining permanent damage. Testing was performed by subjecting a DIN surface to the weight of 337.5 pounds over a specified steel wheel.

## 7.2 Pool Tiles:-

*Pool tiles, where ever specified shall be of 1st quality confirming to IS: 15622:2006 (group B1B) of minimum thickness 8mm for various tiles of approved make like H.R. Johnson or equivalent make or better as approved by the engineer-in-charge to be fixed over 3mm to 4mm bed of polymer adhesive as*

per IS 15477 (ardex, endure ferrous create by manchanda enterprises, pidilite make) to correct line & level. Method in application will be guided by the manufacturer's specifications.

### 7.3 Glass mosaic tiles: of sizes 50mmx50mm or 20x20mm

Glass mosaic tiles of make "Acura", "Bissaza", "Mridul", or equivalent or better as approved by engineer-in-charge. Tiles to be fixed over 3 to 4mm bed of approved diamond star. Adhesive as per IS 15477 (BAL, Endura Ardex, Ferrous crete layer Manchanda Enterprises, Pidilite make or equivalent) to correct line, level and plumb and to be grouted with ready made polymer grout as per manufacture's specifications.

### 7.4 WALL TILES:

7.4.1) LOCATIONS: To walls of WC/Shower.

#### MATERIALS:

- a) GLAZED WALL TILES: To be selected colour first quality Boss Profile or equivalent of size 300 x 100mm glazed wall tiles, or equivalent or of better quality as approved by the Engineer in Charge, including all matching glazed edge tiles required.
- b) Shower Wall tiles to be Boss Profile or equivalent of size 300 x 100mm in required colour and pattern as approved by the Engineer in Charge.
- c) Wall tiles to be Boss Profile or equivalent in required colour and pattern as approved by the Engineer in Charge.
- d) Twisted, warped, cracked, chipped or otherwise defective tiles are not to be used and are to be removed from the site.
- e) ADHESIVE: As approved by manufacturer.

GROUT: To be a cement base proprietary grout approved by the Engineer in Charge. Colour is to be white unless otherwise directed.

### 7.4.2 CUTTING AND LAYING:

- a) Cut and drill tiles neatly and accurately as required to fit around fixtures and fittings and at margins
- b) Drill holes without damaging tile faces.
- c) Rub edges smooth without chipping.
- d) Return tiles into sills, reveals and openings and butt up to returns, frames, fittings, and other finishes.
- e) Cut recesses where necessary for scap holders, etc.

- f) If necessary, distribute variations in hue, colour area or pattern uniformly by mixing tiles or tile batches before laying.
- g) Lay glazed edge tiles, as required, to all external corners of tiled areas and to all free edges of tiled areas abutting other wall finishes.

#### 7.4.3 SETTING OUT:

- a) Unless otherwise specified or shown, set out tiling with straight joints in both directions, level and plumb.
- b) Set out to use whole tiles throughout, where practicable, or to give equal margins of  $\frac{1}{2}$  tile or larger. Where margins of less than  $\frac{1}{2}$  tile are unavoidable, locate them where they will be least conspicuous.
- c) Make trial set-out for each area and obtain the Engineer in Charge's approval before fixing. If minor variations in joint widths or overall dimensions will avoid cut tiles, submit proposal for approval. Do not vary the approved set-out.
- d) Before commencing tiling, ensure that pipes, switch boxes, fittings, wiring outlets, etc., penetrating or interrupting the tile surface are accurately positioned in their designed or optimum locations relative to the tile layout.
- e) Where possible, position tiles so that penetrations through the tiles occur at the junction of horizontal and vertical joints or on the centre lines of tiles.

#### 7.5 BEDDING:

- a) Thin bed may be used when the background is true to within 3mm when tested with a 2000mm straight edge. Thin beds are not to exceed the maximum thickness recommended by the manufacturer.
- b) If the surrounding conditions are dry, application may be by the notched trowel method; otherwise the solid bed method is to be used. With either method, the whole back of the tile is to be covered by adhesive when the tile is bedded.

#### 7.6 GROUTING:

- a) On completion of tile laying, solidly grout up all joints except movement and caulked joints with grout as previously specified.
- b) Commence grouting as soon as practicable after bedding has set, to prevent building dust and debris collecting in the open joints.
- c) Grout exposed edges of tiles as specified for the face joints.
- d) Apply the grout in accordance with the manufacturer's instructions and, on completion, remove all surplus grout and clean the tile surface.

#### 7.7 MOVEMENT JOINTS:

- i) Provide movement joints
  - a) at internal corners,
  - b) over movement joints in the background,
  - c) at junctions between different background materials,

- d) *at fixtures interrupting the tile surface, e.g. beams, bolts, brackets, etc.,*
- e) *And where shown on drawings.*
- ii) *Movement joints are to go right through the tile bed to the background and are to be not less than 6mm or more than 10mm wide, or width shown.*
- iii) *Clean the joints and completely fill the joint with caulking, as previously specified, finishing flush with the tile surface.*

#### 7.8 **CAULKED JOINTS:**

- i) *Provide caulked joints.*
  - a) *Where tiling is cut around sanitary fixtures.*
  - b) *At junctions with door frames, built in cupboards, etc.*
- ii) *Joints are to be 5mm wide for the depth of the tile.*
- iii) *Clean the joints and completely fill the joint with caulking, as previously specified, finishing flush with the tile surface.*
- iv) *Caulking is to be as previously specified.*

#### 7.9 **CLEAN DOWN:** *On completion, clean down all tiled surfaces and leave the surfaces free from stains, jointing cement, dirt, etc.*

#### 7.10 **PROTECTION:** *Protect all glazed tile surfaces against damage until Practical Completion and these surfaces are to be clean and in perfect condition at that time.*

### 8.0 **PLUMBING:**

#### 8.1 **SCOPE**

8.1.1 *The form of contract shall be according to the "conditions of contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the contractor.*

8.1.2 *Work under this contract shall consist of furnishing all labour materials equipment and appliances necessary and required. The contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities and/or shown on the plumbing drawings.*

8.1.3 *Without restricting to the generality of the foregoing, the sanitary installations shall include the following:-*

- i. *Sanitary fixtures*
- ii. *Soil, waste & vent and rainwater pipes & fittings*
- iii. *Water supply system*

iv. *Sewerage & Storm water drainage*

8.1.4 *Services rendered under this section shall be done without any extra charge.*

8.1.5 *The work shall be carried out generally as per CPWD specifications with up to date modifications.*

8.2 **STANDARDS**

8. **STANDARDS**

2. **LIST OF CODES (INDIAN STANDARD CODES)**

*Standards, specifications, associations, and regulatory bodies are generally referred to throughout the specifications by their abbreviated designations. The material workmanship shall be in accordance with the requirement of the appropriate Code of Practice (CP), I. S. code wherever applicable together with any building regulations or bye-laws governing the works.*

*The following list is included for guidance only and the omission of any CP, I. S. codes from the list does not relieve the contractor from compliance therewith:*

*The important codes, standards and publications applicable to this section are listed hereinafter:*

8.2.01 **General**

IS 1200 *Mode of measurement*

IS 12183 (Part 1) *Code of practice for plumbing in multistoried buildings (Water supply)*

SP 7 *National building code of India (part IX plumbing services)*

IS 27 *Pig Lead*

IS 1172 *Code of basic requirements for water supply drainage and sanitation*

IS 1367 *Technical supply conditions for threaded steel fasteners; part 1 introduction and general information*

IS 1367 *Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.*

IS 2064 *Selection, installation and maintenance of sanitary appliances- code of practice*

IS 2065 *Code of practice for water supply in building*

IS 2643 *Dimensions for pipe threads for fastening purposes : part 1 basic profile and*



	<i>(Part-1)</i>	<i>dimensions</i>
	<i>IS 2643</i>	<i>Dimensions for pipe threads for fastening purposes: part 2 tolerances.</i>
	<i>(Part-2)</i>	
	<i>IS 2643</i>	<i>Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes</i>
	<i>(Part-3)</i>	
	<i>IS 2104</i>	<i>Specification for water meter boxes (domestic type)</i>
	<i>IS 2373</i>	<i>Specification for water meters (bulk type)</i>
	<i>IS 2379</i>	<i>Color code for the identification of pipe lines</i>
	<i>IS 7558</i>	<i>Code of practice for domestic hot water installations</i>
	<i>IS 5329</i>	<i>Code of practice for sanitary pipe work above ground for buildings.</i>
	<i>IS 2527</i>	<i>Code of practice for fixing rainwater gutters and down pipes for roof drainage.</i>
	<i>IS 9668</i>	<i>Code of practice for provision and maintenance of water supplies and fire fighting.</i>
8.2.02	<b>Pipes and Fittings</b>	
	<i>IS 1536</i>	<i>Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.</i>
	<i>IS 7181</i>	<i>Specification for horizontally cast iron double flanged pipes for water, gas and sewage.</i>
	<i>IS 1729</i>	<i>Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.</i>
	<i>IS 3989</i>	<i>Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories</i>
	<i>IS 3486</i>	<i>Cast iron spigot &amp; socket pipes</i>
	<i>IS 1879</i>	<i>Malleable cast iron pipe fittings</i>
	<i>(Part-1 to 10)</i>	
	<i>IS 1538</i>	<i>Cast iron fittings for pressure pipes for water, gas and sewage</i>
	<i>(Part-1 to 23)</i>	
	<i>IS 6418</i>	<i>Cast iron and malleable cast iron flanges for general engineering practice.</i>
	<i>IS 3589</i>	<i>Seamless of electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter)</i>
	<i>IS 1239</i>	<i>Mild steel tubular and other wrought steel pipe fittings</i>
	<i>Part 1</i>	<i>Mild steel tubes</i>
	<i>Part 2</i>	<i>Mild steel tubular and other wrought steel pipe fittings</i>
	<i>IS 458</i>	<i>Specification for pressure concrete pipes (with and without reinforcement)</i>
	<i>IS 651</i>	<i>Salt glazed stone - ware pipes and fittings</i>
8.2.03	<b>Valves</b>	
	<i>IS 780</i>	<i>Specification for sluice valves for water works purposes (50 to 300 mm size)</i>
	<i>IS 2906</i>	<i>Specification for sluice valves for water works purposes (350 to 1200 mm size)</i>
	<i>IS 1703</i>	<i>Specification copper alloy float valves (horizontal plunger type) for water supply</i>
	<i>IS 778</i>	<i>Specification for copper alloy gate, globe and check valves for water works purposes</i>

IS 3950	Specification for surface boxes for sluice valves
IS 5312 (Part-1)	Specification for swing check type reflux (non return) valves : part 1 single door pattern.
IS 5312 (part-2)	Specification for swing check type reflux (non return) valves : Part 2 Multi door pattern.
<b>8.2.04 Sanitary Fittings</b>	
IS 8931	Specification for cast copper alloy fancy bib taps and stop valves for water services
IS 8934	Specification for cast copper alloy fancy pillar tap and stop valves for water services.
IS 781	Specification for cast copper alloy screw down bib taps and stop valves for water services
IS 782	Specification for caulking lead
IS 2692	Specification for ferrule for water services
IS 6249	Specification for flush valves and fittings for marine use
IS 2326	Specification for automatic flushing cistern for urinals
IS 774	Specification for flushing cisterns for water closets and urinals (other than plastic cistern)
IS 775	Specification for cast iron brackets and supports for wash basins
IS 6411	Specification for gel-coated glass fiber reinforced polyester resin bath tubs
IS 771	Specification for glazed fire clay sanitary appliances (Part 1 to 6)
IS 5961	Specification for cast iron gratings for drainage purposes.
IS 7231	Specification for plastic flushing cisterns for water closets and urinals
IS 2548 (Part-1)	Specification for plastic seats and covers for water closets, thermoset seats and covers.
Part 2	Specification for plastic seats and covers for water closets, thermoplastic seats and covers.
IS 2556 (Part-1)	Specification for vitreous sanitary appliances (vitreous china) Part 1: General requirements
IS 2556 (Part-2)	Specification for vitreous sanitary appliances (vitreous china) Part 2 : Specific requirements of wash-down water closets.
IS 2556 (Part-3)	Specification for vitreous sanitary appliances (vitreous china) part 3 : specific requirements of squatting pans
IS 2556 (Part-4)	Specification for vitreous sanitary appliances (vitreous china) part 4 : specific requirements of wash basins.
IS 2556 (Part-6 Sec-2)	Specification for vitreous sanitary appliances (vitreous china) part 6 : specific requirements of Urinals Section 2 Half stall urinals
IS 2556 (Part-6 Sec-4)	Specification for vitreous sanitary appliances (vitreous china) part 6 : specific requirements of urinals Section 4 partition slabs
IS 2556	Specification for vitreous sanitary appliances (vitreous china) part 6 : specific

<i>(Part-6 Sec-5)</i>	<i>requirements of urinals</i>
<i>IS 2556</i>	<i>Section 5 waste fittings</i>
<i>(Part-6 Sec-6)</i>	<i>Specification for vitreous sanitary appliances (vitreous china) part 6 : specific requirements of urinals</i>
<i>IS 2556</i>	<i>Section 6 water spreaders for half stall urinals</i>
<i>(Part-6 sec-7)</i>	<i>Specification for vitreous sanitary appliances (vitreous china) part 7 : specific requirements of half round channels</i>
<i>IS 2556</i>	<i>Specification for vitreous sanitary appliances (vitreous china) part 8 : specific requirements of siphonic wash down water closets.</i>
<i>(Part-8)</i>	
<i>IS 2556</i>	<i>Specification for vitreous sanitary appliances (vitreous china) part 11 : specific requirements for shower rose</i>
<i>(Part-11)</i>	
<i>IS 2556</i>	<i>Specification for vitreous sanitary appliances (vitreous china) part 12 : specific requirements of floor traps</i>
<i>(Part-12)</i>	
<i>IS 2556</i>	<i>Specification for vitreous sanitary appliances (vitreous china) part 15 :</i>
<i>(Part-15)</i>	<i>specific requirements of universal water closets.</i>

8.2.05

## Water Quality

### *Tolerance*

<i>IS 10500</i>	<i>Drinking water</i>
<i>IS 4764</i>	<i>Tolerance limits for sewage effluents discharged into inland surface waters</i>
<i>IS 1700</i>	<i>Specification for drinking fountains</i>
<i>IS 1978</i>	<i>Line pipe</i>
<i>IS 2002</i>	<i>Steel plate for pressure vessels for intermediate &amp; high temperature service including boilers</i>
<i>IS 2629</i>	<i>Recommended practice for hot dip galvanizing on iron and steel</i>
<i>IS 2717</i>	<i>Glossary of terms relating to vitreous enamelware and ceramic-metal system</i>
<i>IS 2825</i>	<i>Code for unfired pressure vessels</i>
<i>IS 2963</i>	<i>Specifications for copper alloy waste fittings for wash basins and sinks</i>
<i>IS 3025</i>	<i>Method of sampling and test (physical and chemical) for water and waste water</i>
<i>(Part-1 to 44)</i>	
<i>IS 3114</i>	<i>Code of practice for laying of cast iron pipes</i>
<i>IS 3311</i>	<i>Specification for waste plug and its accessories for sinks and wash basins</i>
<i>IS 3468</i>	<i>Pipe nuts</i>
<i>IS 3589</i>	<i>Seamless or electrically welded pipes for water, gas and sewage.</i>
<i>IS 4127</i>	<i>Code of practice for laying glazed stoneware pipes</i>
<i>IS 4346</i>	<i>Specifications for washers for use with fittings for water services.</i>
<i>IS 4711</i>	<i>Methods of sampling steel pipes, tubes and fittings</i>
<i>IS 4853</i>	<i>Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes</i>
<i>IS 6159</i>	<i>Recommended practice for design and fabrication of materials prior to galvanizing</i>
<i>IS 6411</i>	<i>Specification for gel-coated glass fiber reinforced polyester resin baths</i>
<i>IS 8090</i>	<i>Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting</i>

IS 8321	Glossary of terms applicable to plumbing work
IS 8419 (Part-1)	Requirements for water filtration equipment part 1 filtration media-sand and gravel requirements for rapid sand gravity filtration equipment.
IS 8419 (Part-2)	Requirements for water filtration equipment part 2 under drainage system
IS 6392	Steel pipe flanges
IS 9758	Specification for flush valves and fittings for water closets and urinals
IS 9842	Preformed fibrous pipe insulation
IS 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
IS 10221	Code of practice for coating and wrapping of underground mild steel pipelines
IS 10446	Glossary of terms relating to water supply and sanitation
IS 11149	Rubber gaskets
IS 11790	

**Code of practice for preparation of  
butt welding ends for pipes, valves  
flanges and fittings**

BS 2871, Part I	Copper pipes
1971	
BS 864, Part II	Copper pipe fittings
1971	

### 8.3.00 MATERIALS

#### 3.01 Cast iron pipes & fittings

##### 3.01 Pipes

- a. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. Pipe shall be centrifugally spun iron soil pipes conforming to I. S. 3989 or sand cast to I. S. 1729 (as per B.O.Q.).
- b. Standard weight, dimensions and pig lead required for joints shall be as follows:-  
For pipes conforming to I. S. 3989 (Centrifugally spun soil pipes)

Nominal (inch)	Dia (mm)	Thickness (mm)	Overall weight & length 1.83 (kg)	Internal diameter of socket (mm)	Depth of lead (mm)
2	50	3.5	8.5	73	25
3	75	3.5	12.7	99	25
4	100	4.0	19.2	126	25
6	150	5.0	35.5	178	38

*For pipes conforming to I. S. 1729 sand cast iron soil pipes and fittings*

Nominal	Dia	Thickness	Overall weight & length 1.83	Internal diameter of socket	Depth of lead
(inch)	(mm)	(mm)	(kg)	(mm)	(mm)
2	50	5	11.41	76	25
3	75	5	16.52	101	25
4	100	5	21.67	129	25
6	150	5	31.91	181	38

*c. Tolerance*

*Acceptable tolerance for pipes to I. S. 3989 and I. S. 1729 shall be as follows:-*

- a. Wall thickness* - 15%
- b. Length* + 20 mm
- c. Weight* - 10%

### 8.3.02 Fittings

- a. Fittings shall conform to the same Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specifications.*
- b. Fittings shall be of the required degree of curvature with or without access door.*
- c. Access door shall be made up with 3 mm thick insertion rubber washer and white lead. The bolts shall be with grease or white lead for easy removal later, the fixing shall be air and watertight.*

## Traps

### 8.3.03 Nahani trap or Floor traps :

*Nahani traps or floor traps shall be cast iron, deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cms of the required depth.*

### 8.3.04 Urinal traps:

*Urinal traps shall be cast iron P & S traps with or without vent and set in cement concrete block specified in Para above without extra charge.*

### 8.3.05 Floor trap inlet

*Bath room traps and connections shall ensure free and silent flow of discharging water where specified contractor shall provided a special type cast iron inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and hopper inlet socket shall be lead caulked. Hopper shall be*

connected to a G.I. P or S trap shall be paid for separately) floor trap inlet hoppers and the traps shall be set in cement concrete blocks as specified in Para above without extra charge.

#### 8.3.06 S Grating

Floor and urinal traps shall be provided with 100-150 mm square or round G.P. / Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm or as specified in the schedule of quantities.

#### 8.3.07 Cleanout plugs

Contractor shall provide cast brass clean out plugs as required. Clean out plugs shall be threaded and provided with keyholes for opening. Cleanout plugs shall be fixed to the pipe by a G.I. socket and lead caulked joint.

### 8.3.08 Waste pipe from appliances

8.3.09 Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of galvanized steel as given in the schedule of quantities or shown on the drawings.

8.3.10 All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside the toilet room shall be in chase unless otherwise shown on drawings.

	Vertical	Horizontal
G.I. pipes	300 cms	240 cms
P.V.C. pipes	180 cms	120 cms

#### 8.3.11 Galvanized pipes

Pipes shall be galvanized steel tubes conforming to IS 1239 (medium class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows unions reducers nipples plugs all G.I waste pipes shall be terminated at the point of connection with the appliances with an outlet of suitable diameter. Pipes in chase shall be painted with two coats of red oxide primer and two or more coats of synthetic enamel paint or as given in the schedule of quantities.

### 8.3.12 Cast iron pipes for drainage

8.3.13 All drainage lines passing under building, floors, in exposed position above ground e.g. service floor, basement ceiling etc. shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.

8.3.14 Cast iron pipes shall be centrifugally spun iron pipes conforming to IS 1536. Quality certificates shall be furnished.

#### 8.3.15 Fittings

- a. *Fittings used for C.I drainage pipe shall conform to IS 1538 wherever possible junction form branch pipes shall be made by a Y/Tee.*
- b. *Cleanout plugs shall be provided on head of each drain and at location indicated on plans or directed by Project Manager. Cleanout plugs shall be of size matching the full bore of the pipe. Plugs shall be made out with G.I. coupling caulked into the socket of the pipe or fittings. The end shall be provided with a brass screwed plug with suitable key for opening.*

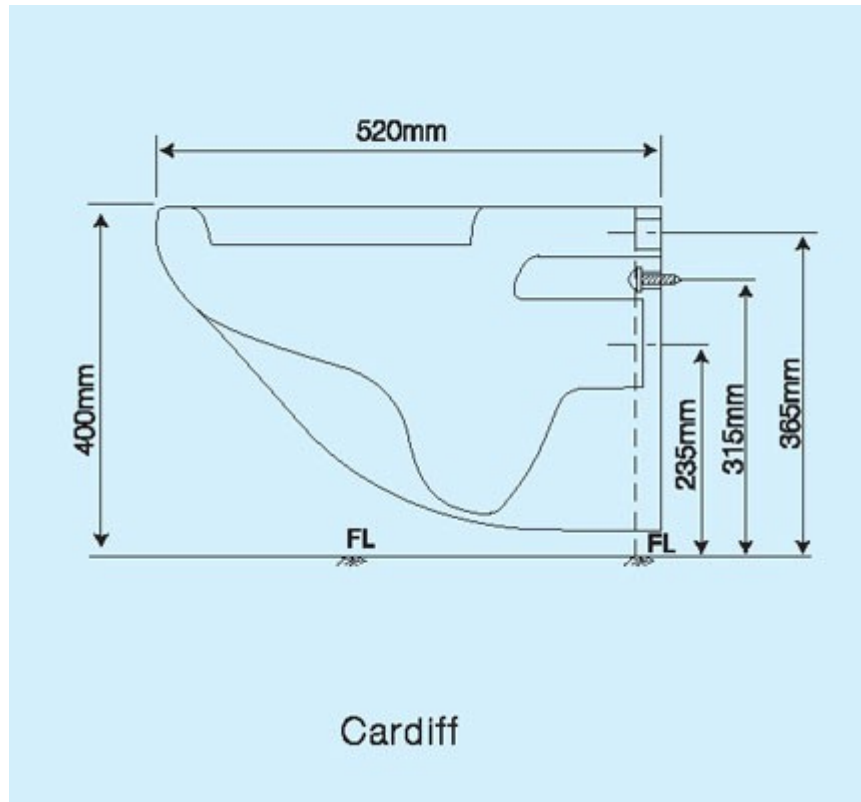
8.3.16

### **Water Closet**

**Materials:** *Shall conform to the relevant Indian standard.*

*Water closet (wall hung) with Geberit duofix wall fastening set (111.815.00.1) / Angel Parryware concealed (C8136) for wall hung type (European type) wall mounting system.*

*Water closet shall be of white or any specified colour vitreous china confirming to IS: 2556 (Part-I) and 2556 (Part II) as specified and shall be of "wash down type". The closet shall be 360x540mm size suitable for wall hung mounting in one piece construction and shall have not less than two holes having a minimum dia meter of 10mm for fixing to wall. The closet shall have an integral flushing rim of suitable type and inlet for connecting the flushing pipe. Each closet shall have an integral trap with either 'P' or 'S' outlet with at least 50mm water seal. For 'P' trap the slope of the outlet shall be 14 degrees below the horizontal. The inside surface of water closet and traps shall be uniform and smooth in order to enable an efficient flush. The tolerance in dimensions of water closet shall be  $\pm 4\%$ . The closet is to be mounted on special mounting element with dual flush of Geberit make.*



### Seat & Cover

The seat and cover shall be soft close seat cover with CP brass hinges and rubber buffers, adapter, rubber joints fixed to WC. CP brass screwed washers, flange as per manufacturer's specification.

### Wall mounting element (Geberit make or equivalent)

For water closet (wall hung) with fastening distance 18 cm or 23 cm, installation on dry wall construction with panels. The mounting element characteristic

- a) Element height 112cm
- b) Adjustment flushing volume
- c) Dual flush with actuator plate "Samba", "Twist", or "Belere" flush range large 6-7.5l
- d) Stop and go flush actuator plate "Kumba", "Mambo" or "Tango"
- e) Water supply connection at center back or at the top
- f) Fastening for outlet bend sound-absorbing
- g) Self supporting
- h) Power coated, color Geberit Blue



- i) Galvanized leg supports, adjustable from 0-20cm, with detent mark
- j) Rotating foot plate

### **Concealed dual flush**

#### **Duo fix – Front Actuator-for Drywalls**

#### **Concealed dual flush Cisterns Type “wall-hung” Geberit**

*The cisterns shall be made of high density polyethylene and fitted with W<sup>®</sup>R<sup>®</sup>AT approved fill valves and drop valves (Duo fix).*

*Concealed dual flush W<sup>®</sup>C cistern mounted within a steel carrier frame designed for a static weight of 400kg, as “wall hung - W<sup>®</sup>C’s” drywall structures. Installed dimensions should be a maximum height of 1120mm and maximum width 500mm.*

*The actuator shall be front mounted dual flush with chromium - plated matt finish, made of die cast zinc (heavy duty). The cistern must be fully insulated against condensation.*

*The water supply connection must be located at center back or at the top with an angle stop valve in  $R_{1/2}$ ". The filling valve should be designed as low pressure and low noise type.*

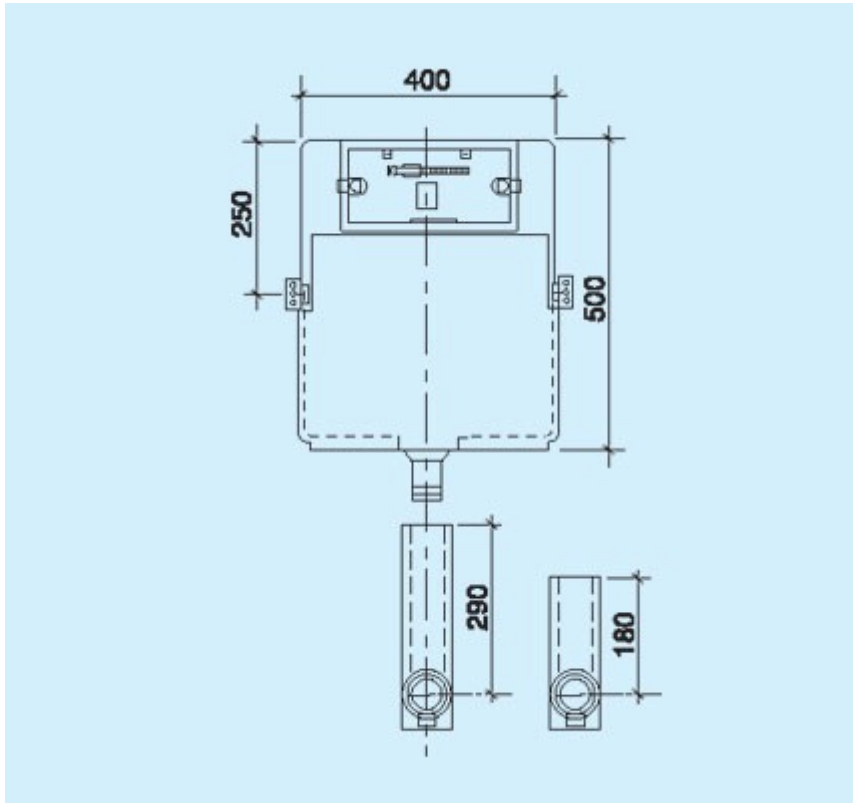
*(Inlet valve 0.1-10 bar supply pressure).*

*Any damage caused to the building or to electric, sanitary, water supply or other installations etc. therein either due to negligence on the part of the contractor, or due to actual requirements of the work, shall be made good and the building or the installation shall be restored to its original condition by the contractor. Nothing extra shall be paid for such restoration works except where otherwise specified.*

*All exposed G. I., C. I. or lead pipes and fittings shall be painted with approved quality of paint and shade as specified. The painted work shall conform to specification of Painting works.*

*All sanitary and plumbing work shall be carried out through licensed plumbers.*

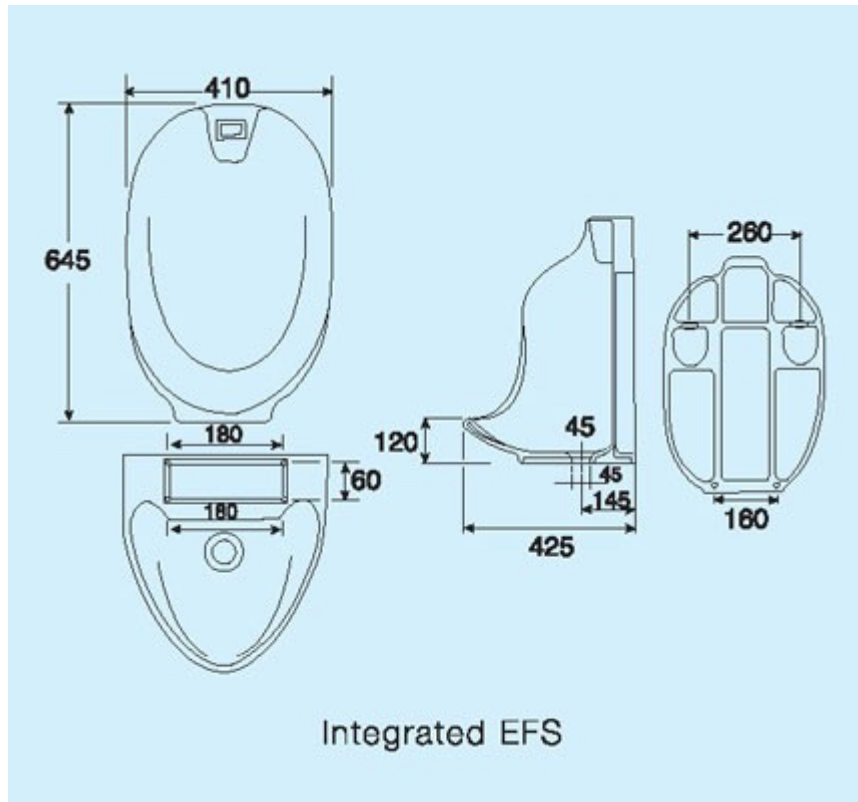
*On completion of the work the site shall be cleaned and all rubbish disposed off as directed by the Engineer-in-charge.*



### 8.3.17 HALF STALL URINAL

8.3.17.1 To be of white or any other color vitreous china confirming to IS: 2556 (Part V) as specified in the item of schedule of make Parryware Reca model integrated EFDG (Code C 8098) EFDG with power source. The stall shall be 450 wide with 350mm over all depth of the base. The inside surface of the stall and to screws shall be regular and smooth to ensure efficient flushing.

*The half stall urinal shall be fixed in position with wall mounting elements.*



### 8.3.18 Lavatory Basin( Wash Basin)

8.3.18.1 *Wash Basin shall be of white or any other color vitreous china conforming to IS: 2556 (Part-I) and IS: 2556 (Part-VI). Wash basins oval shapes shall be of one piece construction, including a combined overflow. All internal angles shall be designed so as to facilitate cleaning. Each basin shall have a rim on all sides shall be provided with single or double tap holes as specified. The tap holes shall be 28mm square or 30mm round or 25mm round for pop up hole. A suitable tap hole button shall be supplied if one tap hole is not required in installation. Each basin shall have circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or beveled internally with dia mater of 65 mm at top. Each basin shall be provide with a non-ferrous 32mm waste fitting. Stud slots to receive the brackets on the underside on the wash basin shall be suitable for a bracket with stud not exceeding 13mm diameter, 5mm high and 305mm from the back of basin to the center of the stud. The stud slots shall be of depth sufficient to take 5mm stud. A slot type of overflow having an area of not less than 5 sq. cm shall be provided and shall be so designed as to facilitate cleaning of the overflow.*

*Oval shape wash basin are required to be fixed preferably in RCC Platform with local available stone topping either fully sunk in stone top or top flush with the stone topping.*

*The basin shall be fixed in position with wall mounting element of Geberit make with characteristic:*

- (a) Element height 98/82,112 cm.
- (b) Holes dia. 9 mm for fastening in wood frame construction.
- (c) Galvanized leg supports, adjustable from 0-20cm, with depth mark
- (d) Self supporting

(e) Power coated, color Geberit blue

(f) Rotating foot plate

(g) Faucet connection plate with adjustable height and depth

The following tolerances may be allowed on dimensions specified:-

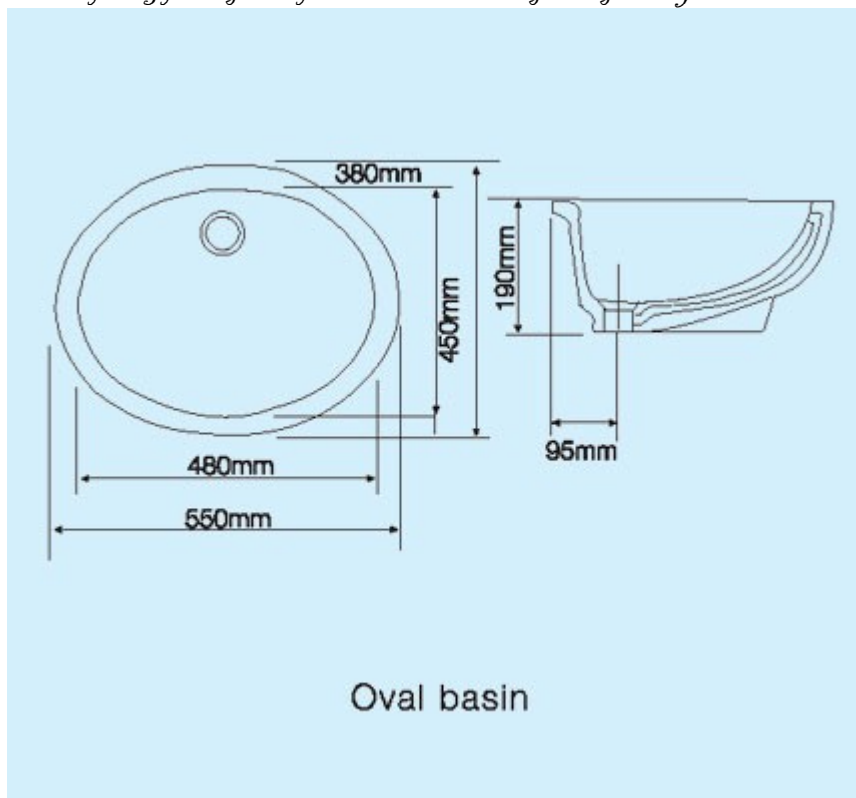
(a) On dimension 75mm and over  $\pm 4$  percent

(b) On dimensions Less than 75mm  $\pm 2$ mm

(c) Diameter of the waste hole  $\pm 3$ mm

Waste fittings for wash basins. The waste fittings shall be of nickel chromium plated brass, with thickness of plating not less than services grade 2 of IS: 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect to IS: 2963 and shall be sound, free from laps, low holes and pitting and other manufacturing defects. External and internal surfaces shall be neatly dressed and be truly machined so that the nut smoothly moves on the body.

Waste fitting for wash basins shall be of nominal size of 32mm. The CP brass bottle trap 32mm shall be fixed to waste fitting for disposal of works water and to be paid separately.



### 8.3.20 Disable Toilets

8.3.20.1 Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by the Engineer-in-charge.

## 8.4.00 WORKMANSHIP

### 8.4.01 Specifications

*Work under this contract shall be carried out strictly in accordance with specifications attached with the tender.*

*Items not covered under these specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per specifications of the latest central public works department (CPWD) with up to date amendments as applicable in the contract.*

*Works not covered under Para 2.1 and 2.2 shall be carried out as per relevant Indian Standards and in case of its absence as per British standard code of practice.*

### 8.4.02 Execution of Work

*The contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.*

*The work shall be carried out in conformity with the plumbing drawings and within the requirements of architectural, HVAC, electrical, structural and other specialized services drawings.*

*The contractor shall co-operate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.*

*On award of the work contractor shall submit a schedule of construction in the form of a PERT chart or BAR chart for approval of the project manager/architect/consultant. All dates and time schedule agreed upon shall be strictly adhered to, within the stipulated time of completion/commissioning along with specified phasing, if any.*

### 8.4.03 Drawings

*Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings.*

*Architectural drawings shall take precedence over plumbing or other services drawings as to all dimensions.*

*Contractor shall verify all dimensions at site and bring to the notice of the project manager all discrepancies or deviations noticed. Decision of the project manager shall be final.*

*Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.*

*Any drawings issued by the Architects/Consultant for the work are the property of the Architects/consultant and shall not be lent, reproduced or used on any works other intended without the written permission of the architects/consultant.*

#### **8.4.04 Inspection and testing of materials**

*Contractor shall be required, if requested, to produce manufacturers test certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.*

*For examination and testing of materials and works at the site contractor shall provide all testing and gauging equipment necessary but not limited to the following:-*

- a. Theodolite*
- b. Dumpy level*
- c. Steel tapes*
- d. Weighing machine*
- e. Plumb bobs, spirit levels, hammers*
- f. Micrometers, tachometers*
- g. Thermometers, stoves*
- h. Hydraulic test machine*
- i. Smoke test machine*

*All such equipment shall be tested for calibration at any approved laboratory, if required by the project manager.*

*All testing equipment shall be preferably located in special room meant for the purpose*

*Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Engineer-in-Charge. Any materials declared defective by Engineer-in-Charge shall be removed from the site within 48 hours.*

#### **8.4.05 Metric Conversion**

*All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.*

*Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.*

#### **8.4.06 Reference points**

*Contractor shall provide permanent bench marks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.*

*All such reference points shall be in relation to the levels and locations, given in the architectural and plumbing drawings.*

#### **8.4.07 Reference drawings**

*The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.*

*All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporations in the completing drawings. All changes to be made shall be initialed by the Project Manager.*

#### **8.4.08 Shop Drawings**

*The contractor shall submit to the Engineer-in-Charge, four copies of the shop drawings.*

*Shop drawings shall be submitted under following conditions:-*

- a. Showing any changes in layout in the plumbing drawings.*
- b. Equipment layout, piping and wiring diagram*
- c. Manufacturer's or contractor's fabrication drawings for any materials or equipment supplied by him.*

*8.4.08.1 The Contractor shall submit four copies of catalogues, manufacturer's drawings, equipment characteristics data or performance charts are required by the Engineer-in-Charge.*

#### **8.4.09 Completion Drawings**

*4.9.1 On completion of work, contractor shall submit one complete set of original tracings and two prints of "as shall have the following information.*

- a. Run of all piping, diameters on all floors, vertical stacks and location of external services.*
  - b. Ground and invert levels of all drainage pipes together with location of all manholes and connections up to cut fall.*
  - b. Run of all water supply lines with diameters, locations of control valves, access panels.*
  - c. Location of all mechanical equipment with layout and piping connections.*
- No completion certificate shall be issued unless the above drawings are submitted.*

*4.09.2 Contractor shall provide four sets of catalogues, services manuals manufacturer's drawings, and performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.*

*4.09.3 All warranty cards given by the manufactures shall be handed over to the Engineer-in-Charge.*

#### **8.4.10 Contractor's Rates**

*8.4.10.1 Rates quoted in this tender shall be inclusive of cost materials, labour, supervision erection tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage*

*and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.*

- 8.4.10.2 *Rates quoted are for all heights and depths and in all positions as may be required for this work.*
- 8.4.10.3 *All rates quoted must be for complete items inclusive of all such accessories, fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.*
- 8.4.10.4 *All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/ concrete/ water proofing of appropriate mix and strength as directed by project manager. Contractor shall provide holes, sleeves, recesses in the concrete and masonry work as the work proceeds.*
- 8.4.10.5 *The contractor shall furnish the Engineer-in-Charge with vouchers & test certificates, on request, to prove that the materials are as specified and to indicate that the rates at which the materials are purchased in order to workout the rate analysis of non tendered items which he may be called upon to carryout.*
- 8.4.11 **Testing**
- 8.4.11.1 *Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.*
- 8.4.11.2 *Tests shall be performed in presence of the Engineer-in-Charge.*
- 8.4.11.3 *All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.*
- 8.4.11.4 *Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.*
- 8.4.11.5 *Contractor shall provide all labour, equipment and materials for the performance of the tests.*
- 8.4.12 **License Permits and Authorities**
- 8.4.12.1 *Contractor must hold a valid plumbing or any other as required license by the municipal authority or other competent authority under whose jurisdiction the work falls.*
- 8.4.12.2 *Contractor must keep constant liaison with the municipal/statutory authority and obtain approval of all drainage, water supply and other works carried out by him.*
- 8.4.12.3 *Contractor shall obtain, from the municipal and other authorities completion certificate with respect to his work as required for occupation of the buildings. Contractor shall obtain permanent water supply and drainage connections from authorities concerned. Employer shall reimburse the fees paid to the authorities towards the connection charges on production of receipts for money paid.*

#### **8.4.13 Cutting of Structural Members**



*No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.*

#### 8.4.13.1 General

*All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-Charge.*

*Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.*

*Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.*

*Pipes shall be securely fixed to walls and ceilings by suitable clamps (clamps of standard make as mentioned in list of recommended makes) at intervals specified.*

*Access doors for fittings and clean outs shall be so located that they are easily accessible for repair and maintenance.*

#### 8.4.14 Piping System

##### *Soil, Waste & Vent Pipes*

- a) The soil and waste pipe system above ground has been planned as one pipe vented system with common vertical stack for soil connection from W.Cs, bidet and urinals and waste connection from bath tubs, showers and wash basins.*
- b) Vertical soil & waste stacks shall be connected to a common horizontal drain line at basement ceiling or to an external manhole directly where feasible and as shown on the drawings.*
- c) All waste water from AHU's mechanical plant room and pump room shall be provided with a deep seal trap before connection to the main drain.*
- d) All soil and waste drainage from area below general ground level (in basement) will be collected in sumps and pumped into ground sewer.*
- e) 50 mm dia anti siphon-age pipe (ASAP) shall be provided for soil fittings. It may be provided for waste lines where shown the drawings.*
- f) Head of all external drains shall be provided with a 100 mm vent pipe.*
- g) All waste lines from kitchen areas shall be first discharged to a grease trap of adequate capacity, as given in the schedule of quantities, before connection to external sewer.*
- h) All soil and waste water from the last manhole of the site shall be discharged to the main sewage line located outside the site.*

##### *Balcony/ Planter drainage*

*All balconies, terraces, planters and other formal landscape areas will be drained by vertical down takes as per the drawings and details. Except for planters at ground level no spouts shall be provided and shall be connected as far as possible to vertical rainwater pipes.*

#### 8.4.15.0 Fixing

*All vertical pipes shall be fixed by M.S. clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).*

*Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them*

*Contractor shall provide all sleeves openings hangers necessary information to the building contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.*

#### 8.4.16.0 Laying

- a. *All cast iron pipes and fittings shall be jointed with best quality soft pig lead (conforming to IS 27) which shall be free from impurities in wet trenches joints shall be made from lead wool. Noting extra will be paid for lead wool joints. Depth of pig lead and weight for joints shall be as per IS code.*

#### 8.4.17.0 Testing

*All cast iron pipes for drainage shall be tested to a hydraulic test of 3 m head. A test register shall be maintained which shall be signed and dated by contractor & Engineer-in-Charge.*

#### 8.4.18 Cement Concrete

*Cast iron soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 12 mm size) 75 mm in bed and a round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m. rate for concrete round pipes shall be inclusive of pillars, supports shuttering and centering.*

#### 8.4.19 Painting

*All cast iron, soil, waste vent anti syphonage and rainwater pipes in exposed location in shafts and pipe spaces shall be painted with two or more coats of synthetic enamel paint to give an even shade. Paint shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe color code.*

*G.I waste pipes in chase shall be painted with two coats of bitumen paint, covered with polyurethane tape and final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint.*

*G.I soil and waste pipes below ground and covered in cement concrete or lead pipes shall not be painted.*

#### 8.4.20 Cutting and Making Good

*Pipes shall be fixed and tested as building proceeds. Contractor shall provide all necessary holes cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement : 2 coarse sand) or the surface restored as in original condition.*

#### 8.4.21 Testing

*Before use at site all G.I soil waste and anti pipes shall be tested by filling up with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipe shall be rejected and removed from the site within 48 hours. Pipes with minor sweating may be accepted at the discretion of the Engineer-in-Charge.*

*Pipes shall be tested after installation, by filling up the stack with water. All opening and connections shall be suitably plugged. The total head in the stack shall be however not exceed 3 m. Alternatively contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlets and connections.*

*The top end shall, however, be left open. The stack shall then be observed for leakage's and all defective pipes and fittings removed or repaired as directed by the Engineer-in-Charge.*

*A test register shall be maintained and all entries shall be signed and dated by contractors and Engineer-in-Charge.*

#### 8.4.22 Water supply system

*Contractor should study the site plan and water supply system diagram for an over view of the system.*

*It is proposed to provide flushing cistern for WCs provided. WCs in all public toilets shall be flushed with flushing cisterns. Infra red NO-TOUCH flush valves shall be provided for urinals.*

*PPE: Polyethylene aluminum polyethylene PE - AL - PE conforming to I.S.1550*

#### 8.4.23. Testing

*All pipes fittings and valves after fixing at site shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7 kg / sq.cm whichever is more.*

*Pressure shall be maintained for a period of at least thirty minutes without any drop. A test register shall be maintained and all entries shall be signed and dated by contractor and Engineer-in-Charge.*

*In addition to the sectional testing carried out during the construction, contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakage's and shall replace all defective materials in the system. Any damage done due to*

carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the contractor during the defects liability period without any cost.

After commissioning of the water supply system, contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

#### 8.4.24.0 Making Connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original conditions. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

#### LIST OF APPROVED MAKES OF MATERIALS

S.NO	MATERIALS	IS NO.	BRAND NAME	MANUFACTURER
1	Soil, waste & rainwater pipes & fittings			
	a) Sand Cast Iron	1729	SRIF RIF Kajeco	Sri Ram Iron foundaries, Mathura Raj Iron Foundry, Agra Kajeco industries Agra
2	G.I. pipes/M. S pipes	1239/3589	TATA JINDAL G. S. I	TISCO Tubes Divn. Jamshedpur Hissar Gujarat Steel Tubes Co. Ltd. Gujarat
3	Gunmetal valves (Fullway check and globe Valves)	778	Leader Sant	Leader Engg. Works Jalandhar Sant Brass Metal Works Jalandhar
4	Ball cocks	1703	Leader Sant	Leader Engg. Works Jalandhar Sant Brass Metal Works Jalandhar
5	Stoneware Pipes & Gully Traps	651	Perfect	Perfect Potteries Jabalpur
6	RCC pipes	458	Pragati	Pragati Concrete Udyog

			Usha	Usha Scun Pipe Co. New Delhi
			JSP	Jain spun pipe Co. New Delhi
7	C.I. Manhole cover & frame	1726	SRF	Sri Ram Iron Foundaries, Mathura
			RJF	Raj Iron Foundry, Agra
			Kajeco	Kajeco Industries Agra
8	PCC / SFR Manhole covers & frame		KK	KK Manholes & Gratings pvt. Ltd. New Delhi
9	Anti Corrosive Tape (U.G. Water Lines)		PayPKOT	Integrated water Proofing Ltd. Madras
10	All type of clamps (G.I), dash fasteners, pipe supports, hold fast etc.		CHILLY	
11	Perforated Aluminium composite Panel wall cladding	Lennox, Reynobond, Alpelic		
12	Aluminium False Ceilings		Luxalon, lennox	
13	Arena Stadia Seating		Albany, Camatic, Sebel	
14	C.P. Waste		Jaquar	
15	Bottle Trap		Jaquar	
16	Sesotronic Sensor Faucet		Jaquar	
17	C.P. Angle Valve		Arco	
18	Wall Mixer Diverter		Jaquar, Grabtree, Greche	
19	C.P. Brass bib cock		Jaquar	
20	Aluminium Composite panel Ceiling		Lennox, Reynobond, Alpelic	
21	Pool Basin Equipment		Abyss, Astral (Spain)	

**NOTE :-**

- ❖ The above is the proposed vendor list.
- ❖ The bidder shall provide list of makes.
- ❖ In case, make of some of the items are neither included in the above list nor it is enumerated in the detailed nomenclature of item than prior specific approval has to be obtained from the Engineer-in-Charge, before placement of order.
- ❖ Material should conform the relevant standard.

### 9.11.0 TENSIONED FABRIC CANOPY

#### GENERAL

#### a) Scope of Works

- (i) The Fabric Canopy/Roof Contractor (hereafter referred to as the `subcontractor to the general contractor`) shall be responsible for the design, engineering, patterning, fabrication, supply and installation of the tensioned membrane structures as shown on the drawings including the follow:

- Design, engineering, and patterning of Architectural Membrane, cables and related perimeter attachment hardware.
- Supply of Architectural Membrane, cables, complete perimeter attachment system, and all normally associated components.
- Fabrication of Architectural Membrane.
- Delivery of all supplied components to the project site.
- Installation of all supplied items.

- (ii) For steelwork the subcontractor shall be responsible for the:

- steel roof design and documentation
- engineering drawings
- Steel shop drawings
- Steel fabrication
- Painting of the steel structure
- Steel installation

- (iii) The work shall consist of the supply of all labor, tools, plant and materials necessary to complete the design, supply and installation of the tensioned membrane. The work shall be executed in the best trade practice by a Specialized Tradesman, all strictly in accordance with a reputable manufacturer's written instructions.

#### b) Fabric Canopy

As depicted in the tender drawings. The canopy shall be an engineered tensioned membrane structure. The fabric shall be PVDF coated Architectural Membrane.

#### c) Design

The following items shall be the design responsibility of the Nominated sub-contractor. All calculations and drawings shall be endorsed by a Registered Structural Engineer employed by the Sub-Contractor certifying that the structural design complies with the design criteria, codes and standards as listed hereinafter.

- i) Calculation of wind and other loads from information supplied on the Contract drawings and considering local conditions;
- ii) Computer analysis of structure and supporting steelwork;

- iii) Provision of computations;
- iv) Detailed design of structural steel to support tensioned membrane;
- vi) Design of steel tensioning cables;
- vii) Provision of reactions and geometry to enable others to check the design and capacity of the foundations and supporting superstructure;
- viii) Check of as-installed survey data.

d) Design Criteria, Codes and Standards

i) The membrane structure shall be designed to comply with all statutory requirements under the Building Ordinance and inter-related Regulations and Codes of Practice

1. Live Load: 0.25kPa
2. Wind Load: IS 875 Indian Wind Code: V=47m/s (Delhi) TC=3 (Delhi)
3. Wind pressure coefficient: BS6399: Part 2: 1995 or equivalent.

ii) Life Safety

1. All fabric structures shall be designed so no life safety issue is created in the event of a loss of a part of the fabric.
2. The fabric structure shall not rely completely on the fabric for structural stability.

iii) The tensioned membrane shall conform to the current relevant standards and to the requirements of the statutory authorities. Relevant publications of particular importance are as follows:

- 1) IS 875 : Indian Wind Code
- 2) BS 5950: Structural Use of Steelwork in Building
- 3) BS 6399: Loading for Building
- 4) BS 8118: Structural Use of Aluminum
- 5) BS 8110: Structural use of Concrete
- 6) BS 8004: Foundations
- 7) AS 1441: Method of Test for Coated Fabrics
- 8) AS 1530: Methods for Fire Tests on Building Materials, Components and Structures
- 9) AS 2001: Methods of Test for Textiles
- 10) American Society for Testing Materials (ASTM)
- 11) American Welding Society
  - a. Structural Welding Code AWS D1.1
  - b. Symbols for Welding and Nondestructive Testing AWS 2.4

e) Approved Tensioned Membrane Structure Fabricator

Design, fabrication and erection of the canopy structure shall be limited to firms with proven experience in design, fabrication and construction of complex fabric structures. Such firm shall meet the following minimum requirements.

The manufacturer shall have a solid background with a minimum of 10 years in design, manufacture and installation of tensioned membrane structures. To ensure the quality of the product, such firm shall have its own design and production facilities, in-house architects, designers, engineers, draftspersons, project manager, QA manager, manufacturing and production manager, dispatch staffs and installer. Such firm shall employ the latest in CAD/CAM manufacturing technologies and under its possession state of the art CAD/CAM plotter and various types of membrane welders for high quality works. Such firm shall be capable of providing a single source responsibility on the design, engineering, drawing preparation, patterning & fabrication, and installation of the fabric membrane. Manufacture of membrane to be undertaken in a purpose built membrane production facility with Quality Assured Accreditation.



f) Submissions

- i. Computer generated model indicating the shape and overall appearance of the Tensioned Membrane.
- ii. Schedule indicating key milestone dates during the project.
- iii. Specification sheets for the Membrane proposed to be used by the Subcontractor, demonstrating compliance with the requirements herein.
- iv. Test Certificate issued by a recognized Testing Laboratory indicating that the fabric material proposed for use in the Membrane are non-combustible when tested under the criteria of BS 476, Part 4.
- v. A complete outline of the subcontractor's Quality Control Program, which shall be in accordance with ISO 9000.
- vi. Number of years showing the company has been in the business of fabric structures for not less than 10 years.
- vii. All names under which the company has operated and time periods during which each name was used.
- viii. Country and region in which the company is incorporated and date of incorporation.
- ix. A complete list of all projects completed in the preceding 10 years, including the Project Name, Client, and Architect.
- x. Any projects on which the contractor has defaulted, and complete details regarding the default.
- xi. Fabric canopy system drawings defining the complete structure, connection details, interfaces, and general fabric seam arrangement shall be submitted by the subcontractor for review and approval by the project engineer/architect. Drawings shall confirm the general arrangement submitted with the tender.

- xii. A compilation of all calculations and the basis therefore shall be submitted as substantiation for the sizes, loads, and dimensions shown on the drawings.
- xiii. Maintenance manual: Submit two (2) copies of a maintenance manual for the fabric roof structure to the Client. The manual shall include a schedule for routine inspection, an inspection checklist, instructions for emergency repair and use of emergency repair materials, and warranty.
- xiv. Test reports, indicating that the PVDF-coated tensile fabric structure meets the criteria listed: Physical test data of the actual roll goods to be used in the project confirming conformance with specifications for the fabric.

g) Engineering

Structural calculation for the project shall be prepared by, or under the direct supervision of a Registered Structural Engineer. Drawings shall define the completed structure, precise interface geometry determination, definition and co-ordination with the superstructure, reaction loads, connections, details, interfaces and seam layout together with foundation layout. All structural drawings and calculations shall be prepared under the supervision of, and endorsed by a fully qualified engineer - the Designer. The Designer must also possess competence and experience in the design and construction of tensioned fabric structures, acceptable to the Architect. Structural calculation for the tensile structure shall include the following:

- i. Large deflection numerical shape generation that will insure a stable, uniformly stressed, three dimensionally curved shape that is in static equilibrium with the internal prestress forces, and is suitable to resist all applied loads.
- ii. Large deflection finite element method structural analysis of the membrane system under all applicable applied wind, snow and live load conditions.
- iii. Large deflection finite element method structural analysis of the support frame system.
- iv. Biaxial fabric test specification, interpretation, and fabric compensation determination.
- v. Accurate generation of the two-dimensional compensated fabric templates required to generate the three-dimensional equilibrium shape.
- vi. Member size calculations of all primary structural members.
- vii. Connection design including bolts, weld, and secondary member sizing.

h) Warranty

- i. All materials supplied and installed or erected shall be in accordance with this specification and shall be guaranteed against water leakage, faulty materials and workmanship for 10 years.
- ii. The warranty shall be underwritten by the tensioned fabric structure manufacturer.

i) Maintenance Kit

The materials shall be packaged into a maintenance kit for storage by the Client. Supply the Client with the following materials for emergency repair or maintenance:

- 3 no. 300 mm diameter patch of PVDF Fabric sheets
- 3 no. 100 mm x 200 mm rectangular patch of PVDF Fabric sheets
- 1 no. Utility Knife
- 1 booklet repair manual

j) Quality Assurance

Fabrication and erection of the tensioned membrane canopy structure is limited to firms with proven experience in design, patterning & fabrication and construction of complex fabric structures and such firms shall meet the following minimum requirements. Evidence of compliance shall be submitted with the Tender:

Provide written evidence to the Architect of experience and skills of all personnel proposed for this project.

Evidence of compliance shall be submitted with the Tender:

- i. The tensioned fabric manufacturer shall have at least 10 continuous years of experience in the engineering, patterning & fabrication and erection of permanent fabric structures and have successfully designed, fabricated and installed not less than 10 similar size or larger tensioned membrane structures. The tensioned fabric manufacturer shall have completed at least 10 Teflon coated fiberglass fabric structures.
- ii. The tensioned fabric manufacturer shall have their own solidly and well-established fabricating facilities (exceeding 10 years continuous fabrication experience) for the patterning and fabrication of the fabric structures.
- iii. The tensioned fabric manufacturer shall demonstrate that it has professional staffs in the capacities of architects, designers, engineers draftspersons, project manager, QA manager, manufacturing and production manager, dispatch staffs and installer and will provide engineering drawings that have been prepared by Professional Engineers.
- iv. The subcontractor shall demonstrate that it has an employ staff of experienced fabric structure installation personnel who will undertake the installation of the project.
- v. The subcontractor shall submit a Corporate Quality Control Manual (inclusive of the manufacturer's) describing their complete quality assurance program. The Quality Control Manual shall be in accordance with ISO 9000.

k) Qualified Canopy Contractors/Manufacturer

1. McCoy Architectural systems Pvt Ltd.,  
309-A, Gedore House,  
Nehru Place  
New Delhi-19
2. M/s Novum Structures India Engineering Private Limited  
35, Park enclave, Park Road  
Taskar Town  
Banglore - 560051

l) Fabric Materials

- i. The fabric membrane shall comprise high quality PVDF / PTFE coated fiberglass fabric.
- ii. The primary materials shall be obtained from one manufacturer.
- iii. The entire membrane shall be fabricated from one type of fabric.
- iv. Base fabric and fluorocarbon coating:
  1. The yarns used shall be of the highest commercial quality, essentially free of broken fibers and fully suitable for coating. The yarns shall be constructed from continuous **AGY "Beta" glass filaments measuring 3.3 to 4.1 microns** in diameter. The fabric shall be woven with uniform tension and crimp in the warp and fill yarns and free of defects deleterious to the coating process. The base fabric shall be of sufficient width to allow for finished coated goods of at least 3.8 meters.
  2. The coating materials shall be fluorocarbon resins formulated specifically for architectural applications. These materials shall be applied to form a weatherized barrier between the glass yarns and the environment. The bulk of the coating shall be comprised of formulated dispersions of PVDF / PTFE Fabric.

- v. After weaving, the base fabric shall be cleaned and primed to achieve optimum mechanical properties of the coated fabric. The coating, described above, shall be virtually free of mud cracks and pinholes. The coating shall be applied evenly to both sides of the fabric.
- vi. The final color of the membrane following natural bleaching shall be bright white, uniform in color, and without visible defect or blemish, upon inspection from a distance of three meters. A blemish is defined as an area of material where there is no discontinuity but there is a risk of non-acceptance on visual grounds. The size of the blemish shall be limited to a diameter of 5mm at a spacing of greater than 5 meter when inspecting roll.
- vii. Coating defects such as pinholes, cracks, lumps and broken yarns which reduce the weathering protection to the yarns shall be limited to less than 1% of the surface area of the fabric and shall not affect the complete protection of the glass fibers.
- viii. Strict QA procedures shall be applied during the coating of the fabric to ensure uniformity in properties required of the coated materials.

m) Patterning

i. Design

Membrane-form finding design analysis and patterning shall be **by computer finite element analysis conducted by the manufacturer's engineer experienced in the field** of tensile membrane engineering.

ii. Seam Layout

Submit to the Architect for approvals a seam layout indicating the proposed location of all seams to be included in the complete membrane.

n) Fabrication of Fabric Panel

i. General

1. Fabrication shall only be by an approved specialist fabricator experienced in the work.
2. 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.
3. The fabricator shall 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. He shall 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 or marks, surface imperfections or welding aberrations. The fabric shall be cut along marked lines to an accuracy of +1mm and -1mm.
4. The fabric membrane shall be fabricated in a sizable, clean, properly equipped and systematically established factory shop condition specialized in the fabrication of tension membrane.
5. 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. Manufacture of membrane to be undertaken in a purpose built membrane production facility with Quality Assured Accreditation.

ii. Fabric Joints

1. Joints shall be formed under pressure at the appropriate temperature and to a tolerance of +1mm, -1mm. Adjacent panels shall be overlapped, FEP ribbon inserted between the two panels then heat and pressure applied. All excess FEP ribbon, markings etc. shall be removed from the membrane before packing.
2. The fabricator shall carefully plan his assembly to ensure that seams are always single laid and that a cut edge does not face uphill.
3. Joints shall be symmetrical as specified by the cutting pattern. No short pieces or selvage will be permitted.
4. All fabricated joints shall have a minimum of 90% of the total strength of the coated fabric in strip tensile testing. All structural joints shall be fused in accordance with industry standards and shall maintain the integrity of the coating. Teflon-coated fiberglass shall be heat sealed only.

iii. Hole Punching

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.

iv. Rope Edges

Rope edges shall be formed using VPDM 90 hardness polypropylene or 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.

v. Field Splices

The structure fabricated using field splices shall be limited to places where factory seaming is not possible and applied only where shown and approved by the Architect. Where splices are not specified and the fabricator proposes the use of same, full description including details of location and design shall be provided to the Architect for approval.

o) Packing

The sub-contractor shall be wholly responsible for employing particular measures to prevent any damage occurring to the fabric coating and/or the base cloth. The fabric shall be folded in such a manner as to minimize sharp creases and folds. All materials shall be packed in substantial crates and shall be designed to protect the materials contained against hazard both during transit and whilst stored at the site.

p) Erection

i. No trade shall have access to, or work from the fabric, unless authorized by the subcontractor in writing.

ii. Method of Erection

1. Erection shall only be executed by the fabricator's experienced installation supervisor. Such person shall have at least 10 years experience in tensile membrane structures installation. They shall attend all membrane erection actions at the site. Provide guidance where necessary and appropriate.
2. The erection procedure shall be examined with respect of practicality and compatibility with other work on the project. Where the sub-contractor proposes to use a different basis for the erection procedure, full details shall be submitted for approval.

iii. Preparation for Installation of Fabric

1. A clear and level site shall be provided for undertaking erection and assembly procedures of the fabric element. The Contractor shall arrange for activities on the site to co-operatively fit in with the erection procedure of the fabric membrane.
2. Prior to commencement of erection, the sub-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.
3. The sub-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.
4. The Main Contractor together with the sub-contractor shall limit access to the area where the fabric is to be installed to only the subcontractor's personnel during the preparation and installation of the fabric structure for proper protection. The fabric shall be protected from damages upon installation.

iv. Installation of Fabric

1. The sub-contractor shall install the fabric structure in a sequence and with sufficient bracing to ensure stability of the structure.
2. No creasing or folding of the fabric around sharp corners will be permitted. The fabric shall not be abraded in any manner.

v. Pretension

1. The structure is to be tensioned after erection to maintain a taut smooth surface to minimum of +10%, -10% specified prestress levels. Ensure instrumentation for measurement of prestressing levels is approved by the Architect and confirm to appropriate International Standard specifications.
2. The fabric shall be stressed uniformly to avoid local over stresses. The Architect shall be informed of any condition, which is unexpected or causes concern.

- vi. 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.

q) Cleaning

Clean the fabric membrane after erection. Remove all signs of dirt and panel markings where visible by the naked eye from 3 meters from the fabric.

r) Final Inspection

The specialist sub-contractor shall give one full working day's notice to the Architect on completion of installation of tensioned membrane and shall execute immediately any adjustments, making good damage or defects.

s) Wrinkles

- i. There shall be no wrinkles in the completed membrane that in the Architect's opinion are visually objectionable whether viewed internally or externally. Some tolerance on uniformity of the tensioned fabric against wrinkling is accepted.
- ii. As a guide isolated wrinkles up to 200 mm long should be limited to a maximum of one only per 200 sq. meter area of fabric.
- iii. Minor wrinkles are accepted as being expected around convergence points.
- iv. For the purpose of this clause, a wrinkle shall be a fold in the tensioned membrane in the prestressed condition in still air, and which is visible from the ground below the structure.

- t) Patches
  - i. Minor patching resulting from events on-site during erection shall be permitted at a maximum number of one only per 200 sq. meters area of fabric.
  - ii. Patching is only to be carried out where the damage shall be rectified is relatively minor and the effect of the patching is not visually dominant.
  - iii. Patching shall be carried out in an approved manner using appropriate seaming equipment and techniques.

## 9.2.0 STRUCTURAL STEELWORK

### GENERAL

- a) Scope of Works
  - i. The work shall consist of the supply and fabrication of all the steelwork for the support of the tensioned membrane structure(s) as shown on the drawings, and includes surface treatment/painting, storage, delivery to the site, connections and their fastenings and miscellaneous attachments.
  - ii. The work shall consist of the erection of all the above stated steelwork and includes offloading, erection, field welding, bolting, making the steel to steel connections, connections to anchor bolts, permanent grouting and repairs to surface treatment.

- b) Codes and Standards

All steelworks shall comply with General Specification. All structural steel shall comply with Grade 43 or 50 of BS 4360: 1986 or Grade 275 or 355 BS EN 10210: 1994

Other acceptable codes are:

AS1252 (1983) -High Strength Steel Bolts with associated nuts and washers for structural engineering.  
 AS1394 (1984) -Round Steel Wire for Ropes  
 AS1627 -Metal finishing - Preparation and Pre-treatment of surfaces  
 AS1650(1988) -Hot-Dipped Galvanized Coatings on Ferrous Articles  
 .AS2312(1984) -Guide to the Protection of Iron and Steel against exterior atmospheric conditions  
 AS2319 (1984) -Rigging Screws and Turnbuckles  
 AS2741 (1984) 1Shackles  
 AS2759 (1985) -Steel wire Ropes Application Guide  
 AS3569 (1985) -Steel Wire Ropes  
 AS4100 (1991) -Steel Structures

AS1441 - Methods of Test for Coated Fabrics  
 AS1530 -Methods for Fire Tests on Building Materials, Components and Structures

- c) Shop Drawings

The Contractor shall supply shop drawings of the structural steelwork endorsed by a Registered Structural Engineer in India for review and shall obtain an approved copy before commencing fabrication. 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. When preparing the drawings, the following shall be included:-

- i. Ensure that Shop Drawings conform to the requirements of the Contract.
- ii. Prepare all drawings of consistent standard size.
- iii. Submit two (2) initial copies to the Architect and Engineer for examination. If amendments are required, the Architect shall mark one (1) copy and return to the Contractor for amendments to the original Shop

Drawings. [This process may be repeated until the Architect and Engineer considers that the Shop Drawings are satisfactory ].

- iv. Acceptance of the Shop Drawings shall imply only that the Architect's interpretations of the relevant requirements of the Contract are generally correct, but shall in no way relieve the Contractor of his obligations under the Contract to construct and complete the Works correctly and accurately.

d) Set-Outs and Survey - Steelwork

- i. A survey of installed anchor bolt or steel stub positions and foundations shall be carried out by the Specialist Steelwork Sub-Contractor for checking accuracy a minimum of 21 days before the scheduled erection of the steelwork.
- ii. The survey is to include a check that the Main Contractor's design and built foundations on which steel is to be placed by the steelwork sub contractor are at the correct levels to receive base plates and/or other fixings and verify the correctness for location and level of all anchor bolts set in the bases. Immediately notify the Architect of any inaccuracies.
- iii. Give at least two (2) working days notice of the intention to commence erection so that an inspection of the steelwork can be made and satisfy the Architect and Engineer that the work will meet the requirement of the Contract.

c) Handling and Storage and Protection

- i. Handle and store steelwork items carefully and in such manner as to avoid damage and to protect from the elements. Proprietary items shall be stored as recommended.
- ii. Make good damage to conform to the original specification or replace completely.
- iii. Protect all surfaces from damage from any cause whatsoever, and where necessary, cover with a protective membrane or a strippable temporary coating. Remove all temporary protective measures on completion.

f) Welding

- i. Provide an experienced and competent operative to supervise welding. Submit evidence that all welders are capable;
- ii. When directed by the Architect, keep a site record that identifies the welders responsible for major welds.
- iii. Plan the fabrication and erection of structural steelwork to avoid the need for the site welding. Site welding will not be permitted unless Approval is given by the Architect.
- iv. Where site welding is permitted follow the procedures described below:-
  - 1. Surfaces to be welded must be clean, free from paint, grease, contaminants dry and free from condensation. Where the steel is damp or the temperature is low then warming with a low temperature flame may be used. Thermal indicating crayons may be used to determine the plate temperature and the area pre-heated;
  - 2. Protection from the weather: provide adequate protection to shield the welding from the weather. Tent type structures made from fireproof and waterproof material may be used to shield the weldment from the wind and rain. Such temporary structures to be mounted on stable scaffolding supports, and a stable platform to be provided for the welder. Where welding to hollow sections is required ensure draughts are prevented from blowing through the section;
  - 3. Electrodes: bake on site at a temperature between 100/C and 150/C and where necessary store in heated quivers for use at the welders convenience;
  - 4. Power supply: may be from a transformer or generator to provide a three phase power supply of the required voltage. Locate the generator or transformer as close as possible to the welder to



prevent a drop in voltage along the cables length. Ensure all the cables are as short as possible, routed away from the path of construction vehicles, and adequately protected.

- 5 Earth run: adequately earth all electrical plant. Ensure the welding return from the weldment is adequate in cross section and correctly connected and earthed.
- 6 Weld detail: ensure the welded joint is of the correct profile and fit up. As a general guide do not carry out welding where the gap is less than 1 mm or more than 3 mm unless a backing strip is provided. Where a backing strip is provided the weld gap is not to exceed the greater of 5 mm or the thickness of the material being welded. Adequately support all welded joints with props or restraints that ensure relative movement of the fusion faces is prevented;
- 7 Work in confined spaces: provide adequate ventilation and formulate plans of evacuation and escape before the work commences.

## MATERIALS

### g) Base Plates and Anchor Bolts

- i. Base plates supported on concrete, whether shop attached or shipped loose, shall be furnished and set on shims or leveling plates. Grouting shall be by the Steelwork Sub Contractor.
- ii. Anchor bolt locations shall be furnished by the steelwork subcontractor and used by the Concrete Contractor to install the bolts to the required tolerances. The Concrete Contractor shall check carefully the setting of the bolts to the proper position prior to pouring of concrete. Anchor bolts shall have nuts and washers and shall have threads protected during the concrete pour. Damaged threads shall be repaired or be cut to permit full tightening of nuts.
- iii. Where dissimilar metals are in contact or where like metals are fixed in just a position in a situation where exposed to the weather and corrosion due to crevice effect is likely, separate the mating or contacting surfaces by one of the following means:-
  1. By coating one (or both) of the contact surfaces with two (2) coats of zinc or barium chromate based primer,
  2. By coating as above, two (2) coats bituminous or zinc rich paint.
  3. By inserting continuous strips of non-hardening chromate or pressure sensitive PVC tapes.

### h) Finishes

All structural steel members including bolts, nuts and welded connections shall be hot-dip galvanized to BS EN 1461: 1999. Protective coating to all structural steelworks shall be according to General Specification. Submit paint manufacturer's data for approval before use.

## 9.3.0 STRUCTURAL CABLES AND FITTINGS

### GENERAL

#### a) Scope of Works

This work shall consist of the fabrication and supply of all the structural cables and fittings for the support of the tensioned membrane structures as shown on the drawings.

### MATERIAL

#### b) Cables

All cables shall be manufactured from galvanised steel wire of required strands thickness & dimensions. All terminations shall be hot dip galvanised. The sub-contractor shall design and supplied the appropriate size and strength of cable for the tensioned membrane structure.

c) Joints in Cables

No splicing or joining of wires, strands or ropes shall be permitted.

Wire rope shall be packaged in coils or reels at the discretion of the manufacturer, and handled throughout in such a manner as to avoid permanent deformation of wire, rope or strand.

d) Swaged Terminals

All terminations shall be hot dip galvanised. The materials, thickness and swaging system employed shall be chosen by the specialist sub-contractor to achieve a breaking strength of the terminal detail not lower than the specified minimum breaking strength of the cable.

e) Shackles, Rigging Screws and Turnbuckles

All fitting shall be hot dip galvanised. The strength of the shackles, rigging screws and turnbuckles etc shall exceed the minimum breaking load (MBL) specified on the drawings. The shackles, rigging screws and turnbuckles etc shall meet the tensioning and tolerance requirements for the fitting.

FABRICATION

f) Cutting

Cables shall only be cut using carborundum disc cutters or other approved mechanical devices. Under no circumstances will thermal cutting be approved.

**PART I - GENERAL**

**9.3.1 Scope**

This section of the specification includes, but is not limited to, the supply, fabrication, delivery and erection of the following items:

Steel masts  
Steel membrane plates and fitments  
Wire, ropes and cables  
Shackles, rigging screws, clamps and tensioning hardware  
Supply, fabrication and erection of membrane fabric and steelwork where specified.

**9.3.2 Related Work**

Main Contractor to complete all related work and materials in accordance with the architectural and structural drawings.

**9.3.3 Quality Assurance**

- A. Provide written evidence to the Architect of experience and skills of all personnel proposed for this project.
- B. Ensure all welding is performed only by welders with qualifications as described in AS1554 Section 4.11, under this supervision of a Supervisor qualified under this same Section 4.11.

**9.3.4 References**

Comply with the applicable portions of the following Australian Standards:

AS1252 -High Strength Steel Bolts with associated nuts and washers for structural engineering.  
AS1394 - Round Steel Wire for Ropes  
AS1418 - SAA Crane Code  
AS1554 - Structural Steel Welding Code 1554.1 1985 Welding of steel surfaces

- AS1627 - Metal finishing - Preparation and Pretreatment of surfaces
- AS1650 - Hot-Dipped Galvanised Coatings on Ferrous Articles
- AS2312 - Guide to the Protection of Iron and Steel against exterior atmospheric conditions
  
- AS2319 - Rigging Screws and Turnbuckles
- AS2741 - Shackles
- AS2759 - Steel Wire Ropes Application Guide
- AS2841 - Galvanised Steel Wire Strand
- AS3569 - Steel Wire Ropes
- AS4100 - Steel Structures
- AS1441 - Methods of Test for Coated Fabrics
- AS1530 - Methods for Fire Tests on Building Materials, Components and Structures
- AS4100 - Steel Structures Code

### 9.3.5 Submissions

#### A. Welded Seams Test:

All welds shall be of sufficient strength to develop the full strength of the fabric at 30 degrees C in direct tension across the weld. Generally, an appropriate weld should, when pulled apart, delaminate all PVC from the substrate, to one or both surfaces.

#### B. Provide an emergency repair instruction manual.

#### C. Engineering Data.

The equilibrium shape of the finished membrane structure shall be as defined by the geometry and stress state shown on the drawings.

The structure shall be checked for stability under applied loads including wind and maintenance loads.

A Registered Professional Engineer shall carry out all analysis of the membrane structures with experience in membrane structures and using large displacement finite element techniques.

Comply with the requirements of AS 1170 Part 2 Wind Loads

Region:	DELHI
Max Design Wind Speed:	47 m/s
Terrain Category:	(As per relevant data for Delhi)
Shielding Factor:	(As per relevant data for Delhi)
Topographic Factor:	(As per relevant data for Delhi)
Importance Factor:	(As per relevant data for Delhi)

The submission of the tender shall imply that the necessary detail design for the successful fabrication and erection of the structure is included, up to the structures' interface with footings and steel structure.

### 9.3.6 Shop Drawings

'Shop Drawings' mean complete drawings showing all details of fabrication, assembly, installation, fixing and waterproofing methods of specific items or components. Include all necessary explanatory notes and specifications.

### 9.3.7 Warranty

Provide warranty in writing stating physical properties of the fabric materials. The warranty term shall extend to a total of no less than 10 years.

### 9.3.8 Quality Control

Condition relating to architect's approval:

Any approval given by the Architects in pursuance of this specification shall not be deemed in any way to relieve the Contractor of any of his obligations or responsibilities under the Conditions of Contract.

### 9.3.9 Handling and Transport of Components

Transport and store components under dry, well-ventilated conditions to prevent the formation of wet storage staining which may occur on articles unable to be stored in dry, well-ventilated conditions. If stored, place above ground on blocks.

During the handling, storage, transportation and unloading take care not to damage, crush or kink any wire rope cables.

Arrange for facilities for storing the materials so they are in no way damaged between being delivered to site and erected in position.

Take precautions to minimise the damage to the paintwork during handling, storage and transport to site and during the erection.

## **9.4 - MATERIALS**

### **9.4.1 Description of Fabric**

The proposed fabric

- Ferrari 702 S or similar fabric

Colour: White or any other colour as approved by the Engineer-in-Charge.

Light Transmittance: approximately 13.5%

Required minimum strip tensile: 270 cms

Minimum Coated Weight: 750g/m<sup>2</sup>

Tensile Strength (WARP / WEFT) : 280 / 280 da N / 5 cms

Tear Streangth (WARP / WEFT) : 30/28 da N

### **9.4.2 Cables and Fittings**

All cables to be Galvanised fitted with stainless steel Threaded Terminal swages. All tensioners nuts and fabric plates to be Hot-Dip Galvanised and treated with 2 coats of 2-pack epoxy paint.

### **9.4.3 Support Columns**

Type: Circular hollow section

Material: Grade ... steel

### **9.4.4 Making Good Defective Work**

Work which does not comply with this specification is liable to total or partial rejection. Replace at no cost to the Principal and to the approval of the Architect.

The Architect will determine the extent of the work removed and the methods of removal and replacement.

### **9.4.5 Care in Execution**

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 and interfaces lacking wrinkling, cuts, abrasions, stains or marks, surface imperfections or welding aberrations.

### **9.4.6 Delivery to Site**

Arrange with the Builder for delivery of all completed fabric material to the site.

Take care in handling, loading, delivery, unloading and storage on site in a location nominated by erection contractor, and in accordance with the Engineer's instructions.

#### **9.4.7 Attendance at Site**

Provide a Supervisor to attend all fabric erection actions at the site. Provide guidance where necessary and appropriate.

Be responsible for arranging for any repair actions which may or may not involve repairs on site or in fabrication workshop.

Arrange for and carry out all clearing on site as instructed by Architect.

### **9.5 - EXECUTION**

#### **9.5.1 Examination**

Refer to the architectural site plan which shows the adjacent buildings, roads, etc at the scheduled time of erection. Refer CONDITIONS OF CONTRACT. Visit the site to verify the existing conditions prior of deliver and erection of any materials. Start of any work means total acceptance of all conditions.

#### **9.5.2 Set-out and Survey - Steelwork**

Give at least two (2) working days' notice of the intention to commence erection so that an inspection of the steelwork can be made and satisfy the Architect that the work will meet the requirement of the contract.

Check that the foundations on which steel is to be placed are at the correct levels to receive base plates and/or other fixings and verify the correctness for location and/or level of all anchor bolts set in the bases and immediately notify the Architect of any inaccuracies.

If these inaccuracies are outside of tolerance shown on drawings, the matter shall be referred to the Architect.

#### **9.5.3 Fabrication**

All steel work shall comply with 'Steelwork' section of this specification.

Co-ordinate with the Builder for shipping, accommodation and comply with the requirements of AS4100 Steel Structures Code.

Supply the components to site in a pre-fabricated state ready for erection with little or not fabrication required on site.

- . On site welding is not permissible.
- . Ensure all items of equipment for welding and gas cutting are of a suitable design and in good condition.
- . Perform all welding of type SP welding conforming to the requirements of AS1554.
- . Ensure that surfaces to be welded are free from scale, slag, rust, grease, paint and any other foreign material.

#### **9.5.4 Erection of Steel**

Be responsible for the accurate bearing of the steel on the foundations, for correct location, shimming to suit correct levels and placement of all members.

Supervision: Erect steelwork under the supervision of an experienced and qualified person who has specifically had involvement with the erection of fabric structures. The erection operation is to be supervised by a licensed rigger at all times.

Be wholly responsible for the erection of the steelwork, cables and incidental metalwork.

### 9.5.5 Completion of Steel Erection

Complete all the steelwork, cables and fitments to the Architects approval. Give one (1) working days notice where the work is to reach 'Practical Completion' so that an inspection can be made.

Execute any making good immediately to the Architects approval.

## 10.0 INSULATED STEEL ROOF SPECIFICATIONS

### 10.1 Detailed Product Specification Language

APPLICATION	: Double Skin Insulated LYSAGHT® ROOFING SYSTEM
BASE METAL THICKNESS (BMT)	: Top : 0.45 mm BMT Bottom : 0.45 mm BMT
SPECIFICATION	: 550 MPa (G550)
PRODUCT	: COLORBOND steel pre- painted steel as per AS/NZS 2728 Class 3
PROFILE	: Top: LYSAGHT KLIP-LOK 700 Concealed system Bottom : LYSAGHT TRIMDEK
FASTENER	: Self drilling screws as per AS 3566-2002 Class 3

### 10.2 General

Providing and erection/ fixing of Double skin LYSAGHT Insulated system with top sheet is LYSAGHT KLIP-LOK concealed system profile sheeting with nominal 700 mm effective cover width, nominal 43 mm crest depth at pitch of nominal 233 mm centre to centre distance along with stiffeners perpendicular to ribs for strength. The bottom sheet is LYSAGHT TRIMDEK profile sheet of nominal 1015 mm effective cover width and nominal 28 mm deep ribs with subtle square fluting in the five pan at nominal 203 mm centre-to-centre. The feed material for top and bottom sheet is manufactured out of 0.45 mm Base Metal Thickness (BMT), Hi-Tensile steel with min. 550 MPa yield strength, metallic hot dip coated with Zinc/Aluminium alloy (55% Aluminium, 45% Zinc) as per AS 1397 - Zinalume AZ150 (min. 150 gms/sq.mt total on both sides) with Colorbond steel quality paint coat as per AS/NZS 2728 Class 3 of BlueScope Steel make. The paint shall have a total coating thickness of nominal 35 µm, comprising of nominal 20 µm exterior coat on top surface and nominal 5 µm reverse coat on back surface over nominal 5 µm primer coat on both surfaces of approved colour shade for the top sheet by the concern authority. The top profile sheet shall be rolled over specially designed concealed fixing clip KL-70, manufactured from hi-tensile Zinalume steel base and galvanized hooks as per manufacturers recommendation and approved by concern authority. The clip KL-70 shall be fastened with min. 40 µm Zinc coated / min. 25 µm Zinc-Tin alloy coated, Hex head, self-drilling screw as per AS 3566-2002 Class 3 fasteners of approved make (Buildex or equivalent). The fastener size shall be calculated as per the design

for the top and bottom sheet. The two sheets shall sandwich with 100 mm thick Glass wool 24 Kg/m<sup>3</sup> insulation with aluminium foil. All the accessories like gutter / flashing / capping shall be

made from the G550 or G330 in approved colour shade as per manufacturers' recommendation. The entire Double skin system is installed over the structure purlin. The measurement shall be based on finished/covered surface area. The contractor shall prepare the shop drawings based on the drawings supplied by the Engineer in charge or the concern authority. These shall be submitted in five sets sufficiently in advance to the concern authority for approval.

#### 10.2.1 STEEL SHEET MATERIAL

**Base Steel:** The top and bottom sheet steel base shall manufactured from 0.45 mm (nominal) base metal thickness with minimum 550 MPa Yield Strength. The steel manufacturers test certificate for the chemical and mechanical properties of steel must be concerned authority prior to installation.

**Metallic Coating:** The top and bottom sheet shall have a hot dip metallic Aluminium-Zinc alloy coating of Aluminium (55%) & Zinc (45 %) with total mass coating of 150 gms/sq.mt on both sides as Zinalume AZ150 or equivalent coating as per AS 1397.

**Colour Coating:** The top and bottom sheets shall be factory painted and oven-baked conforming to AS/NZS 2728 type 3- 4, the total coating thickness of 35 µm (nominal) of Colorbond steel quality paint system of BlueScope Steel make, comprising of nominal 20 µm exterior coat on top surface and nominal 5 µm reverse coat on back surface over nominal 5 µm primer coat on both surfaces of approved colour shade.

#### 10.3 Profile:

**Top Sheet:** The LYSAGHT KLIP-LOK 700 profile sheet having nominal 700 mm effective cover width nominal 43 mm crest depth at pitch of nominal 233 mm centre to centre distance along with stiffeners perpendicular to ribs for strength. The GI subgirt of thickness 1.5 mm (120 gsm) will hold the outer sheet.

- The profile shall be roll-formed at site in single length from ridge to eave without any end lap or as approved by concern authority.
- **Fixing Clip:** The profile sheet shall be rolled over specially designed concealed fixing clip KL-70 type, manufactured from Zinalume steel base and galvanized hooks as per manufacturers recommendation and approved by concern authority.

**Bottom Sheet:** LYSAGHT TRIMDEK profile sheet of nominal 1015 mm effective cover width and nominal 28 mm deep ribs with subtle square fluting in the five pans at nominal 203 mm centre-to-centre

#### 10.4 Sound & Thermal Insulation

The sound & thermal insulation material is GLASSWOOL as indicated with 24 kg/m<sup>3</sup> density, to a 100 mm thickness as per IS8183. The thermal conductivity of insulation should be 0.033 w/mk (nominal) at 25°C and R value of nominal 1.52 (nominal) as per ASTM C177. The fire rating shall be Class O/ Class1( BS 476 part 6 & 7), Non-combustible as per BS 476 part 4, Non ignitable as per BS 476 part 5. The NRC shall be 1.18 nominal as per ASTM C423.

#### 10.5 TRIMS, GUTTERS & DOWN TAKE PIPES

**Wall flashing** and trims (gable, corner, framed opening, accessories, etc.) are manufactured from same color, finish and thickness as wall panels.



**Roof flashing** and trims (parapet flashing, transition trims, expansion joint trims and ridge caps) are manufactured from same color, finish and thickness as roof panels.

**Eave gutters** and downspouts are manufactured from same color, finish and thickness as wall panels (or manufacturer's recommendation).

**DOWN Pipes:** Should be manufactured out of 0.45mm BMT G300 COLORBOND steel with SURFMIST color

#### 10.6 ACCESSORIES:

- **Self drilling roofing and wall cladding Fasteners:** The steel sheet shall be fastened with min. 40 µm zinc coated (hot dipping) or min. 25 µm Zinc-Tin alloy coated (mechanically plated with min 8 porosity rating, coating composition should be 20-30%Sn) Hex head, self-drilling screw as per AS 3566; 2002 Class 3 fasteners of approved make (Buildex Australia make) with EPDM washer on each crest of sheets for connecting with purlin (or as per design) perpendicular to the sheeting and in the centre of the corrugation or rib. The fastener size shall be calculated as per the design requirement.
- **In-fill strips (foam closures):** The infill strips are manufactured from closed cell polyethylene foam. This material should have uniform compressibility, waterproof, weather resistance, UV resistance, chemical resistance, non toxic, odorless and environment friendly to meet installation requirement in accordance with AS 2424-4 3 A & B or equivalent and approved by engineer-in-charge.
- **Sealant:** It should be acetic acid -free and amine- free neutral curing silicone rubber sealant of approved make. It shall be applied at all end laps as per manufacturer's recommendation and approval by engineer-in-charge.
- **Skylight Translucent sheeting (This may be replaced with the glass north light panels)**  
The panel shall be nominal 1.5 mm thick, composed of a translucent, thermosetting polyester resin with a thoroughly impregnated glass fiber reinforcing mat (FRP) with or without an integrally bonded translucent film on the weathering face comply with AS/NZS 4256. The profile should match with cladding profile (Ampelite Thailand make). The fixing shall be done with specially designed Lapseal and weather-tight washer for fixing the translucent sheeting.

#### 10.7 Erection and Fixing:

- The installation shall be done in accordance to the standard practices as specified by the manufacturer and as approved by the concern authority. All sheets and accessories must be stored and finally erected without any damage.
- Single length sheet shall be installed from ridge to eave (on site roll forming) or the end laps shall be 200 mm (min) with appropriate two silicon strip barrier and fasteners as per manufacturers' recommendations.
- The contractor shall also submit methodology for fixing and also a maintenance manual for routine maintenance.
- Flashing, capping and trims shall be manufactured from the material in the length as per manufacturer's recommendation. The shape and girths shall be as per design requirement and shall be approved by the concern authority.
- The contractor shall ensure that panel erector is familiarized with the erection procedure and all the supporting members are straight, level and true (according to AISC) before starting panel erection. Panels shall be erected according to approved shop drawings by the concern authorities.

#### 10.8 Measurement:

- The payment will be done on the actual finish surface area of the sheet separately for item 1 and item 2.
- No separate payment will be made for the laps of sheet and accessories, bolts, nuts, washers, adjustable bolts and supports for gutters and other fixtures. These are assumed to be included in the quoted rates.

## 11.0 False Ceiling

### 11.1 Luxalon™ / Lennox™ ceiling 300C

- (i) *Aluminium un-perforated false ceiling system consisting 300mm wide parallel panels formed from 0.7 mm thick enamelled aluminium strip.*
- (ii) *29 mm high up stands at the ends to give enhance rigidity.*
- (iii) *5mm bevelled edge V-groove joints should be between the panels in length wise EN-1396 and EN-1397.*
- (iv) *Carves Span to be at the distance of 1500 mm-2000 mm centre to centre by means of rigid suspension system.*
- (v) *Integrated locking clips to be provided to prevent the dislocation of panels*

*All materials to be installed as per drgs / details & manufacture specifications complete as per sample approved by the engineer-in-charge.*

### 11.2 Luxalon™ / Lennox™ 30 BD

- (i) *Un-perforated aluminium false ceiling system consisting 30 mm wide x 15 mm deep made out of 0.50 mm three pre-printed enamelled un-perforated aluminium strip.*
- (ii) *The coating to consists of tuff and durable two layer polished finish in nominal thickness 20, applied in a continuous coil coating process.*
- (iii) *Panels to be clipped to a baked enamel aluminium carnet 62 mm, made out of 0.95 mm thick aluminium.*
- (iv) *Open gap of 20 mm between the panels to be maintained.*
- (i) *Traned to be suspended by means of rod hangers and clips at a distance of 300mm from edge and 1700mm C/C.*
- (ii) *Panels spare to be 150mm from the edge and 1850 mm from centre to centre all material to be installed as per shop drag and manufacturers specifications complete as per sample approved by engineer-in charge.*

### 11.3 Luxalon™ / Lennox™ -180B

- (i) *Un-perforated aluminium false ceiling systems consisting of 180mm wide x 15 mm deep, made of 0.60 mm thick repainted enamelled un-perforated aluminium strip.*

- (ii) *Panels to be clipped with luxalon aluminium carnev made from 0.95mm thick enamelled aluminium in a module of 50mm with the prongs to hold the panels.*
- (iii) *Carnevs to be joined by means of special carnevs splices to provide a visible fatal appearance.*
- (iv) *Carnevs to be suspended by means of means of 4mm dia rod hangers by using suspension clips for providing correct level.*
- (v) *Panel span to be 150mm from the edge and 1450mm centre to centre. carriers span to be 300mm from the edge and 1700mm centre to centre.*
- (vi) *20mm open gap between the panels can be filled with a recessed V-shape profile. All materials to be installed as per shepped drawings and manufactured specifications complete as per sample approved by engineer-in-charge.*

12.0

## **Stadium Arena Seats**

### 12.1 Part 1 General

#### **12.1 Description of System**

The Arena Seat should be gravity activated, Tip-up Stadia seat, Injection Moulded in polypropylene and supported on a Hot Dipped Galvanised corrosion resistant steel frame.

#### **Submittals**

##### **Manufacturer's Warranty**

The Contractor should submit the Manufacturer's warranty.

Manufacturers Maintenance Manual

The Contractor should submit the Manufacturer's Maintenance Manual.

#### **12.2 Design Criteria**

**Tip-Up** The tip-up operation should have an initial stop at the **three quarter up** 'wave safe' position, so that the seat can be sprung back to the **fully upright position** for improved access and stadium cleaning.

**Lower Back** **The seat should have a solid lower back to eliminate interference from the feet of the people in the row behind.**

**Flexing Back** **The Seat Should have the flexing back to provide a balance of comfort, performance and flexibility, while maintaining its full strength.**

The design of the parts are to be tested to ensure that the system will not fatigue in its useful life. **The Arena Seat Should not have any screw fixing of the plastic parts. The plastic/steel interfaces are to be press fitted sleeve joints so that loading can be spread over large areas.**

### 12.2 Part 2 PRODUCTS

## 2.1 Design Criteria

### A. General

The Arena Stadia Seat should be gravity activated, tip up plastic stadium seat, injection moulded in polypropylene, UV or UV & FR balanced for strength and colour retention and supported on hot dipped galvanised or powder coated, corrosion resistant steel frame.

#### Specific Specifications

**Centre spacing** shall be 480mm or 500mm to suit Architects layout.

**b. The Seat** shall be supported on two (2) 25mm X 8mm high tensile fingers, welded to a 40 X 40 X 3mm SHS.

**c. No screws**, bolts or mechanical fixings shall be used to attach the plastic seating components to the steelwork.

**d. No vertical** steel members shall be used to attach the plastic back member.

**e. Riser Mounted Steelwork** to be hot dipped galvanised, fixed to straight face riser with Hilti masonry anchors as specified by manufacturer.

**f. Floor Mounted Steelwork** to be hot dipped galvanised, fixed to the floor mounted base plate with Hilti masonry anchors as specified by the manufacturer.

**g. The seat** shall feature a flexing back to provide a balance of patron comfort, performance and flexibility, whilst maintaining its full strength.

**h. The seat** base shall be provided with a minimum of seven (7) ventilation holes and fifteen (15) horizontal grooves to aid air flow over the surface.

**i. The seat** shall have an initial stop at the “three quarter up” wave safe position. The seat shall be capable of being sprung back to the fully upright position for improved stadium access and cleaning.

**j. The seat** shall feature a near silent tip-up mechanism.

**k. The seat** shall incorporate a full lower back to eliminate interference from the feet of the people behind.

**l. The seat** shall be guaranteed to maintain its original colour with minimal fading for a five year guarantee period.

## General Specifications

**a. A single**, two or three digit numbering system shall be supplied as directed by the Engineer-in-Charge.

**b. Aisle** end of row identification plates shall be supplied and the rates quoted by the contractor deems to include the cost of end of row identification plates.

**c. The seat** shall provide posture positions in accordance with AS/NZ 4438 and Work Safe Australia dimensions for fixed chairs.

**d. The seat** shall be supplied so that the system will not fatigue in its useful life.

**The seat** shall embrace the sustainable environment considerations of reduce, reuse, recycle, accordingly all components are to be recyclable.

**End Caps** shall be provided to the end of each row on the steelwork.

**The seat** shall comply with a minimum of 200 kilo Langley UV rating.

## Test Criteria

Seating is to comply with BS EN 12727:2000 – Furniture Ranked Seating Test Methods and requirements for Strength and Durability.  
Class: Level 4 Severe Use.

The seat shall be designed to withstand the dynamic loading of spectators in accordance with BS EN 12727:2000. In addition, the seat shall meet the following load criteria:

Seat Static Load Test: load applied 2000N X 10 times.

Back Static Load Test: load applied 760N X 10 times.

Seat Fatigue Test: load applied 950N X 200,000 times.

Back Fatigue Test: load applied 330N X 200,000 times.

e. Seat Impact Test: impact 6.4kg X 10 times @ 300mm.

f. Back Impact Test: impact 6.4kg X 10 times @ 620mm.

g. The seat shall meet the minimum requirements of BS EN 12727:2000 and be fully tested by independent test authorities. The supplier shall submit such data with each tender.

h. The moulded seat shall be produced from polypropylene impact co-polymers, formulated with ultra violet light stabilization and anti static inhibitors.

i. For seating modules, incorporating a fire retardant to the co- polymer, the following shall apply in accordance with AS1530:3.

<b>Ignitability Index</b>	<b>0</b>
<b>Spread of Flame Index</b>	<b>0</b>
Heat Evolved Index	<b>0</b>
<b>Smoke developed Index</b>	<b>3</b>

In addition, the Seat shall comply with the following: BS5852 – 1990 Section 5 – with Fire Ignition Sources 0, 4, 5, 6 and 7.

The Seat shall also comply with CSIRO BCE Doc 01 / 136 – April 2001: A protocol for the selection of row seating on the basis of fire performance.

#### Structural Steel Criteria

All structural steel elements shall comply with the following or equivalent country standards:

**a. All workmanship** and materials shall be in accordance with AS4100 and AS1554, unless varied by the lead contract documents.

**b. Unless noted otherwise**, all material shall be:

- Grade 300 hot-rolled plates complying with AS3678.
- Grade 300 hot-rolled flats, TFC, TFB, angles 100 X 100 each or 125 X 75 VA and smaller complying with AS3679.1.
- Grade 300 plus UB, UC, PFC and angles 125 X 125 each or 150 X 90 UA and larger.
- Grade C350RHS, SHS complying with AS1163.
- Seat supports will be 25mm x 8mm high tensile steel fingers welded to 40mm x 40mm x 3mm SHS mild steel frame.

**c. Welding** shall be carried out in accordance with AS1554.1, welding consumables shall be E48XX or W50X U.N.O. All welds shall be 6mm CFWSP category U.N.O. CPBW shall be SP category U.N.O., inspection shall be carried out to AS1554.1, and all welds shall be 100% visually scanned.

For CPBW allow for physical testing (intervals to be nominated). Butt welds shall be complete penetration welds to AS1554.

**d. Provide seal plates** to all hollow sections, provide vent holes to hollow members and drain holes. All members which are hot dipped galvanised.

**e. Structural steelwork** shall have the following surface treatment in accordance with the specifications.

<b>Element</b>	<b>Surface Cleaning</b>	<b>Protective Coating</b>
All	All	Hot dip galvanised

#### F. Fixing Criteria

Fixings - all mechanical anchors nominated shall be a minimum of Hilti M10 X 60mm. HSC under cutting

anchors, or approved equal, installed in accordance with the manufacturers specifications.

G. Assembly Criteria

Seating shall be assembled in accordance with the suppliers, document Q.A. installation procedure.

H. Installation Criteria

Installation shall be in accordance with the clients nominated seating layout drawings for location, seat height, seat number and seat colour.

Any variations between approved client drawings and actual site dimensions are to be clarified and approved by the client prior to proceeding with any set out work.

It is the responsibility of the client to establish aisle location points.

Alternatively, if no aisle locations are established, the installer shall locate a grid reference on the platform (by survey if no existing accurate reference is available), and measure an offset to the nearest aisle edge (distance determined from client drawings). Measure and mark out several aisles on either side of the adopted reference point, or as close as to the next available grid reference

location as possible. Calculate the offset from one of the measured aisle locations to the next nearest grid reference point, check dimension for accuracy. Check measure between aisles for accuracy and have client approve.

Install seat in accordance with suppliers nominated Q.A. procedure.

I. Plastics Criteria

The machine set up and moulding conditions shall be to the moulders Q.A. procedure.

Critical production checks are:

- Remove excess flush around parting lines.
- One sample per hour to be checked using the GO-NOGO jig.
- Component colour, mouldings to be checked each shift against approved colour chips.
- Mouldings to be placed in individual poly bags and placed in carton.

## **12.3 Specification for Arena Stadia Seating Installation**

### **12.3.1. Part 1 INSTALLATION**

#### **A. Albany Seat Installation**

The objective of the following Quality Assurance program is to ensure that the Stadia Seats supplied for the project are installed in the correct manner in conformance to the specification to ensure safety and comfort and the prescribed sight lines to end users,

proper operation of the seat and the longevity of the installation. The following procedures can be used for either off site or on site assembly, and on site installation.

## B. Seat Assembly Procedure

### a. Procedure for Galvanising of Counterweights

Counterweights are to be prepared in accordance with standard preparation for hot dip galvanizing, or electroplating as applicable.

The counterweights shall be galvanised for outdoor use by hot dipped zinc coating or electroplating applied by an approved processor.

The hot dipped coating shall have a density of not less than 610g commercially pure zinc, per square metre of steel surface. Passivate by dipping in 0.2% sodium dichromate solution or equal approved system. Electroplating shall be carried out to approved standards for exterior exposure.

All galvanizing runs and /or dags shall be removed and no excessive build up of galvanizing shall be permitted. Of particular

importance is the need to ensure uniform coverage of the counterweight to ensure fitting of the plastic cover.

Any damaged counterweights are to be returned for re-galvanising and passivating.

### b. Counterweight Assembly

Galvanised protected counterweights shall be placed manually in the counterweight cover.

### c. Seat Assembly

Immediately following counterweight assembly, the weight and its plastic cover shall be placed in the seat. A special jig should be provided for this operation. Care should be taken to ensure that the cover is pressed fully home.

### d. Assembly on to Frame.



The seats and backs shall be assembled onto the frames in the special jigs provided. Upon assembly the seats performance shall be confirmed, and the label placed on the back.

Upon completion of each seat it should be stacked onto transport and it should be ticked off a list of seats to be made in that block.

## **C. Seat Installation procedure**

### **1. Set Out**

#### **a. Aisle Locations**

Seats are to be set out as per the layout drawings for location, seat height, seat number and seat colour. Any variations between approved drawings and actual site dimensions are to be got clarified by the contractor from the Engineer-in-Charge, prior to proceeding with any set out.

If aisles are installed prior to the location of seating, then an aisle may be adapted as a starting point. Check measure the distance between aisles to ensure that this corresponds to the client drawings prior to the mark out of seat positions.

Alternatively, if aisles are not installed, locate a grid reference on the platform (by Survey if no existing accurate reference is available) and measure an offset to the nearest aisle edge (distance calculated from client drawings). Measure and mark out several aisles on either side of the adopted reference point, or as close to the next available grid reference location as possible. Calculate the offset from one of the measured aisle locations to the next nearest grid reference point, and check the dimension for accuracy. Check measure between aisles for accuracy.

#### **b. ITP**

Aisle location set outs are to be reviewed and signed off by the client if not predefined.

Seat centres are to be clearly marked with engineers chalk on the top edge of the platforms. In one satisfactory method the top and bottom rows of a uniform section are accurately laid out, and the intermediate rows seat centres are identified with a chalk line. Any marks placed in error are to be removed from the platform.

#### **c. Drilling**

All drilling machine operators are to be fully trained on site in the operation, adjustment and setting of drilling machines prior to unsupervised use. Such training to include; Electrical safety hazards, Hearing protection, Drilling jig adjustments (edge distance and depth), Checking drill hole position performance, Selection, use and decommissioning of drill bits, Collection and removal of drilling dust, Maintenance of drilling machines, Procedure if reinforcing steel is struck.

Holes are to be pre-drilled in the platforms as per the site set out to the depth and diameter as specified by the anchor supplier.

The drill operator is to check the depth and height settings of the drilling machine on each seating row at the first and last seat between each aisle (ie at the first and last seat location

on each seating row of each seating bay). Checks are to be carried out utilising a template and depth gauge provided.

If steel is hit in the first hole of any seating row, then the drilling machine operator is to consult with the site installation supervisor to determine an appropriate course of action to be followed prior to continuing.

Each bay is to be checked and approved by the site installation supervisor upon completion, prior to the commencement drilling of the next bay. In addition a minimum of three (3) random checks per day are to be carried out by the site installation supervisor on each drilling machines performance and accuracy. Random checks and bay sign offs are to be documented by the site installation supervisor.

#### **d. Anchor Installation**

It is specifically recommended that Hilti HSC Safety Anchors typically M10 x 60 Anchors are used, unless otherwise specifically ordered by the Engineer-in-charge.

#### **e. Hole Preparation**

All holes are to be prepared as per the anchor supplier's specification for the type of anchors to be utilised. This is to include, but not be limited to:

- Cleaning of any dust or debris from the hole by an approved method (eg. compressed air, proprietary hole blowers etc).
- Checking of the hole depth prior to installation of the anchor with an appropriately set depth gauge.

All hole preparation is to take place immediately prior to placement of the anchors.

Anchors are to be installed and/or set as per the manufacturers specification and recommendations, and torque to the appropriate level.

### **D. Seat Installation**

All seats are to be installed as per the layout drawings.

Each installation team is to be provided with a drawing of the seating layout, showing the colour of the seats to be installed and the seat number details. A complete list is also to be provided detailing the seat frame types and heights for each seating row, as per the architect's instructions.

Seat colour samples are also to be provided to each installation team to allow accurate identification of the plastic colours on site, during installation.

The site installation supervisor is to check and approve each seating bay upon its completion and sign off on the bay. In addition, the site installation supervisor is to carry out a minimum of three (3) random checks of seats as per the client's layout. During this check, plastic bags are to temporarily removed and the tip-up performance of the seats proven. The bags are then to be replaced.

Any variations between the seating layout and the clients indicated layout are to be brought to the immediate attention of the site supervisor.

## **12.4 Part 2 Execution**

### **A. Warranty**

GENERAL WARRANTY PERIOD: 12 months after date of Substantial Completion.

**SPECIAL WARRANTIES:** The contractor shall Provide the following special warranties:

- (i) CHAIR STANDARDS: Ten (10) year period, against failure of material, corrosion or excessive colour change.
- (ii) HINGE MECHANISM: Ten (10) year period, against failure of hinge to provide for automatic rising.
- (iii) PLASTIC COMPONENTS: Ten (10) year period, against cracking, crazing or excessive colour deterioration.

warranty duly signed by the manufacturer subject to normal use .

The Colour of seats should be guaranteed against fading for 5 years.

B. MAINTENANCE MANUALS: Provide two maintenance manuals that describe procedures for the cleaning and service and replacement method of the seats. Include replacement part numbers and procedures for replacement.

### **C. Certification**

The minimum design live loading shall be 5kPa for seated areas and 5kPa for aisles. Certification shall be based on AS 4100-1990 with zero sliding friction between wheels and flooring assumed for the strength limit state.

#### **Additional Specifications for Upholstered back and seating, and cup holders**

**Pads:** Polyurethane, Vinyl or Fabric pads. UV or UV & FR standard.

**Armrest:** Plastic or upholstered cupholder armrest.

#### **Specifications for Shower Cubicles.**

The shower, W.C. enclosure / cubicle (modules) shall be 100% water, chemical, moisture,& impact resistant, floor anchored, (as per IS : 2046), made of compact laminates, consisting of 12 mm thick intermediate panel and / or 18mm thick pilasters and doors panels, treated with phenolic treated craft paper on both sides & edges of panel, decorative paper of approved design (as approved by engineer-in-charge), and finally with a protective / impermeable top layer coated with melamine resin of high concentration. (The board should pass BS 476 class I test for fire; the xenon arc wool grade 6; cigarette burn test as per ISI Specifications; and also the board should be joint free in widths up to 1550mm). All pilasters and doors shall be 18 mm thick and intermediate panels shall be 12 mm thick solid compact laminates with edges chamfered, the solid compact laminate (phenolic core board) shall be impregnated with phenolic resin based on thermosetting resins,

#### **Specifications for Lockers.**

The side hung lockers should be made of 100% water, chemical, moisture, & impact resistant, (as per IS : 2046), made of compact laminates, treated with phenolic treated craft paper on both sides & edges of panel, decorative paper of approved design (as approved by engineer-in-charge), and finally with a protective / impermeable top layer coated with melamine resin of high concentration. (The board should pass BS 476 class I test for fire; the xenon arc wool grade 6; cigarette burn test as per ISI specifications; and also the board should be joint free in widths up to 1550mm). All pilasters and doors shall be 18 mm thick and intermediate panels shall be 12 mm thick solid compact laminates with edges chamfered, the solid compact laminate (phenolic core board) shall be impregnated with phenolic resin based on thermosetting resins, homogenously reinforced with cellulose fibres and laminates on both sides with sued finish melamine, performance of the panel board shall possess the characteristics of colour, scratch & impact resistance and shall include cost of providing and fixing of doors, locks, hinges, louvers all complete as detailed below

*The Locker System, Z-type model, of merino make or equivalent or better size of per locker as 915x320x450mm, 3mm thick sides and back partition walls; 9mm thick top, bottom and shelves, Depth of locker unit as 450mm, over all height of locker unit as 915mm having necessary accessories as; Cam/Pad locks, SS Hinges, Aluminium interlocking supporting frame work, rubber door stopper lining, screws and wall plugs etc., all complete as per directions of Engineer-in-charge.*

### **Specifications for Urinal Partitions.**

The Urinal partitions shall be 18 mm thick and with edges chamfered and it should be made of 100% water, chemical, moisture, & impact resistant, (as per IS : 2046), made of compact laminates, treated with phenolic

treated craft paper on both sides & edges of panel, decorative paper of approved design (as approved by engineer-in-charge), and finally with a protective / impermeable top layer coated with melamine resin of high concentration. (The board should pass BS 476 class I test for fire; the xenon arc wool grade 6; cigarette burn test as per ISI specifications; and also the board should be joint free in widths up to 1550mm). the solid compact laminate (phenolic core board) shall be impregnated with phenolic resin based on thermosetting resins, homogenously reinforced with cellulose fibres and laminates on both sides with sued finish melamine, performance of the panel board shall possess the characteristics of colour, scratch & impact resistance and shall include cost of providing and fixing of SS 304 fittings Screws all complete as per directions of Engineer-in-Charge.

## **13.0 POOL BASIN EQUIPMENT**

### **1. MAIN DRAIN**

- Frame and Grille 350 and 450mm
- Frame and grille in SS
- with grille fixing screws.

### **2. FLOOR INLET**

- External thread of 2" with a flow of 14 hr

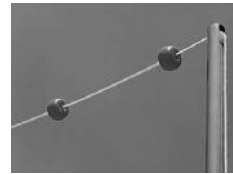
- Internal plain 50mm suitable for flow 9m<sup>3</sup>/hr

### 3. LADDER 3 STEPS

- S.S. TREADS Hand rails Dia 43 mm
- Hand polished SS 304 with S.S. treads,
- Plastic non-slip surface and anchors.
- Tread width 500 mm. 3 Steps

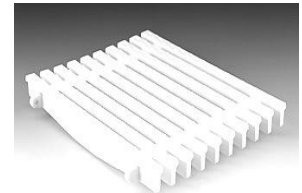
### 4. LADDER 5 STEPS

- S.S. TREADS Hand rails Dia 43 mm
- Hand polished SS 304 with S.S. treads,
- Plastic non-slip surface and anchors.
- Tread width 500 mm. 3 Steps



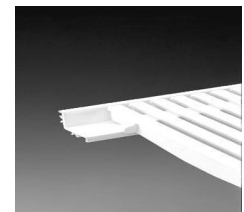
### 5. GRATING

- Tile Grating made of stabilized polypropylene
- Against UV rays, white in color,
- Shape rectangular 10 pcs. 293mm.
- joint together to make cross Wide
- section of 295mm and 20mm.



### 6. GRATING PROFILE

- Grating support holder for grating inner
- dimension is 24mmx37mm



### 7. FLOAT LINES

- Float lines 50m long
- With orange and white balls.

### 8. LINE ROPE (Anchors Cup)

- With rod for concrete pools
- Made of stainless steel.



### 9. FALSE START INDICATOR

- Made of 2 stainless posts
- 1.8m height & 48 ft



### 10. BACK STROKE INDICATOR

- For indicating back stroke swimmers
- Proximity of the end of the pool.
- Comprising of 4 posts in stainless steel 48ft



### 11. STARTING BLOCKS

- Starting block with base in stainless steel platform
- Steps in polyester and fibre glass anti-slip material.
- Horizontal platform adjusts to regulations 120mm
- fixing by anchor nut. Supplied
- Platform of R.C.C. Ht. in 700mm
- Made in SS-316,



### 12. FLOAT LINE STORAGE

- Storage of the float lanes beneath the deck.
- Float lane Box is embedded in the pool surround

### 13. Deck Anchors

- Made of Stainless Steel -316
- With slip-fit cap for covering socket



#### 14. LIFE HOOKS

- Life Saving Loop, made of SS 304 ,
- Connected to telescopic handles
- Butterfly nut ALS001



#### 15. LIFE GUARD CHAIR

- Made in S.S. 304,
- Dia 43 mm pipe with dismountable base plate.
- Steps, platform including parasol holder made of S.S.
- Chair in Polypropylene fiberglass.



#### 16. LIFE BUOYS

- Life Buoy made of Orange colour plastic,
- External dia. 730 mm



## **14.0 TECHNICAL SPECIFICATIONS FOR 3MM THICK ALUMINIUM**

### **COMPOSITE PANEL WALL CLADDING**

Providing and fixing of column / wall cladding with 3mm thick Aluminum Composite Panel (as per technical specifications around the columns / dead walls at all heights. The rate shall include all necessary frame work, tools and plants, scaffolding, technical personal and as per technical specification, complete and as per the directions of the Engineer-in-charge.

(Items includes cost of Aluminum Frame, ACP Panel, Weather Sealant, Gasket, Foam, Scaffolding, Fixtures all machineries and all taxes i.e. sales tax, excise duty, custom duty etc complete). The above work is to be carried out by a specialized Agency approved by the Engineer –in-charge.

#### **GENERAL SPECIFICATION**

The aluminum composite Panel wall cladding shall be of 3mm thick Composite panel made by sand witching two skins of aluminum with antitoxic polyethylene core duly coated on top ensuring superior resistance and weather ability.

#### **PRODUCT COMPOSITION**

The aluminum Composite material shall be composed of a thermoplastic core of low density polyethylene sand witch between two skins of 0.21 mm thick aluminum sheets.

The surface is finished with PVDF – based fluorocarbon coating on one side and polyester coating on the other side.

The external face surface shall be covered with a protective film, which shall be peeled off immediately after installation.

Composition: Skin material 0.50 mm thick Alloy Aluminum Sheet conforming to 3300 H 18 Or 5005 H 16 sourced from ALCOA or Southwest Aluminum company.

Core Material: Anti toxic low-density polyethylene having density  $0.92 - 0.96 \text{ g/Cm}^3$ .

Front Side: Factory pre-finished by the manufacturer with a PVDF KYNAR 500 (70:30) or LUMIFLON or DURAGLOSS 3000 based highly durable exterior grade coating. All Coating shall meet requirements of AAMA605.2. The D.F.T. (Dry film Thickness) of paint should be minimum 25 Micron (+/- 5%).

Rear Side: Reserve side of the panel surface shall be coated in a factory applied protective lacquer or protective primer without protective peel-off-film. The total dry film thickness of the protective lacquer/protective primer shall be minimum 5 microns.

The composite panel shall be light weight with excellent product properties for indoor and outdoor applications.

#### **FIXING ARRANGEMENT**



- i) Frame Work: Mild steel hot dipped galvanized C brackets of size 75mm x 50mm x 1.6mm with slot of 8mm x 35mm are fixed to the existing RCC columns / walls/ Ceiling or any other backing surface, Aluminum hollow section of size 50mm x 25mm of 1.6mm thick are fixed to these brackets both vertically and horizontally by using M6 x 75mm stainless steel bolts and nuts. The frame work can easily be aligned for plumb and straightness panel fixing.
- ii) Panel Fixing: Composite panels are cut to size, routed, corners notched and bend as per the dimensions specified. After the panels are bend aluminum cleats of size 16mm x 16mm by 25mm length are fixed to the edge of the panels by using aluminum pop rivets. The panels are fixed to the frame work by using stainless steel screws. The gap of 12mm or 16mm between the panels (both vertical and horizontal) shall filled with backer rod or size 12mm x 20 mm or 16mm x 20mm, weather proof Silicon Sealant of Wacker, Dow corning or equivalent make shall be used to fill the grooves.

Technical Data : The composite panel shall be of LENNOX™. United Metaltek, REYNOBOND – Alcoa and ALUPOLIC – Mitsubishi with following data or of approved make and colour by the Engineer-in-charge.

Panel thickness	(mm)	3
Cover sheet thickness	(mm)	0.21
Bottom sheet thickness	(mm)	0.21
Weight	(kg/m <sup>2</sup> )	4.5kg
Core Thickness	(mm)	2.58
Polyethylene, type LDPE	(g/cm <sup>3</sup> )	0.92 - 0.96
Top Surface Coating		KYNAR 500 PVDF FINISH minimum 25 Micron (+/-5%)
Bottom Surface Coating		Protective primer shall be minimum 5 microns
Brilliance	(initial value)	30-30 % accord to Gardner
Hardness	(Pencil hardness)	2H (As ASTM D 1737-62)
Temperature resistance		From – 20 to 80 Degree C
UV		Very Good

Technical Specifications of composite panel AS PER ASTM STANDARDS

Panel Thickness	(mm)	3
Tensile Strength (ASTM E 8) (Kg/mm <sup>2</sup> )		4.1
Yield Strength (ASTM 8) (Kg/mms)		3.8
Shearing Strength ASTM D – 732 (Kg/mms)		3.31
Elongation (ASTM E 8)		A50>=1%
Airborne sound Insulation index Rw (db)		24
Temperature resistance		From – 20 to + 80°C
Linear thermal expansion		2.4 mm/m at 100° C temperature difference

## WEATHER SEALANT

Weather Sealant should have minimum tearing strength 4.0N/ sq.mm, Core hardness 20 (ISO 868), joint movement capability  $\pm 15\%$  (as per ASTM C-920), one part natural core equivalent to Sika Elastosil 305, Dow Corning 791 P or equivalent.

### **EPDM GASKET**

EPDM Gasket should not lose its properties of elasticity and it should not become brittle or plastic before 10 years at-least.

### **MEASUREMENT**

Only surface area of the aluminum composite panel along with its groove shall be measured for payment.

### **RATE**

The rate shall include providing and fixing of pallets, MS Angle and Aluminium frame work, fittings and fixtures, wastage, scaffolding, tools, plants, all cost of composite panel and labour involved in all the operations described above including cartage, lift and all taxes like sales tax/VAT, Excise duty, Octroi etc

### **Guarantee**

In addition 5% (five percent) of the cost of installation of Aluminium composite panel shall be retained for ten years as guarantee to watch the performance of the work executed. If any defect is noticed during the guarantee period, it should be rectified by the contractor within seven days of issuing of notice by the Engineer-in-Charge and, if not attended to, the same shall be got done through other agency at the risk and cost of the contractor and recovery shall be effected from the amount retained towards guarantee. In any case, the contractor and the specialist agency, during the guarantee period, shall inspect and examine the work once in every three months and make good any defect observed and confirm the same in writing. The security deposit can be released in full, if bank guarantee of equivalent amount, valid for the duration of guarantee period, is produced and deposited with the Department