

Name and Address of Certificate Holder: **M/s HIL Ltd.** SLN Terminus, 7th Floor, Near Botanical Garden, Gachibowli, Hyderabad – 500032 (Telangana) Tel: 040- 30999185 E-mail: jayakrishnan.nk@hil.in Performance Appraisal Certificate

PAC No.**1030-S/2017** Issue No. **01** Date of Issue: **13.01.2017**





Prefabricated Fibre Reinforced Sandwich Panels

bmlpc

User should check the validity of the Certificate by contacting Member Secretary, BMBA at BMTPC or the Holder of this Certificate.

Building Materials & Technology Promotion Council Ministry of Housing & Urban Poverty Alleviation Government of India

Core 5A, First Floor, India Habitat Centre, Lodhi Road, New Delhi – 110 003

Tel: +91-11-2463 8096, 2463 8097; Fax: +91-11-2464 2849 E-mail: <u>bmtpc@del2.vsnl.net.in</u> Web Site: <u>http://www.bmtpc.org</u>

PERFORMANCE APPRAISAL CERTIFICATE

FOR

Prefabricated Fibre Reinforced Sandwich Panels

ISSUED TO

M/s HIL Ltd.

STATUS OF PAC No. 1030-S/2017

S. No.	Issue No.	Date of Issue	Date of renewal	Amer	ndmen t	Valid up to (Date)	Remark	Signature of authorized
				No.	Date			signatory
1.	2.	3.	4.	5.	6.	7.	8.	9.
1	01	13-01-2017	13-01-2019			12-01-2019		Autosamal
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PAC No. 1030-S/2017

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Issue No. 01 Date of issue: 13-01-2017

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PART 1 CERTIFICATION

1.1	Certificate Holder:	M/s HIL Ltd. SLN Terminus, 7 th Floor, Near Botanical Garden, Gachibowli, Hyderabad – 500032 (Telangana) Tel: 040- 30999185 E-mail: jayakrishnan.nk@hil.in
	Factory (Panel)	1. Timmapur Village, Kothur – Mandal, Mahabubnagar 509325 Tel: 08008579029
	Factory (Sheet)	Email: <u>venkataramana.b@hil.in</u> 2. Sanathnagar, Hyderabad – 500018 Tel: 09490167906 Email: <u>bpdps@hil.in</u>

1.2 Description of System

- **1.2.1** Name of the System Prefabricated Fibre Reinforced Sandwich Panels
- **1.2.2** Brand Name -- Aerocon
- 1.2.3 Brief Description Aerocon panels are sandwich panels, made of two fibre reinforced cement facing sheets, on either sides of a lightweight concrete core. The core is made from a mix of portland cement, binders and silicaceous & micaceous material aggregate. These panels have a unique tongue and groove jointing system that facilitates rapid construction and are fully cured at the factory itself. These panels are of manufactured by using Flexo Board (FOB)/ Fibre Cement Board (NT). Details of these panels are shown in Figs. 1, 2 & 3.



Fig. 1

Fig. 2

Table 1					
S. No	Sizes	Thickness	Edges		
1.	2400 mm height x 600 mm width	50 mm & 75 mm	Square edge (Fig. 4)		
2.	2700 mm height x 600 mm width		Recess edge		
3.	3000 mm height x 600 mm width		(Fig. 5)		

The product range of these panels shall be as shown in Table 1.



Fig. 4 Square edge Panel



1.3 Uses of Aerocon Panels

1.3.1 Uses

These panels may be used for the applications given in Table 2

	Table 2					
S. No	No Description Areas of Applications					
1.	Partitions					
	a. Full Height	Residential, commercial, educational and				
	b. Half Height	industrial buildings				
	c. Jumbo Height					
2.	Prefab Structures (Sing	gle storey)				
		Accommodation units, Site offices,				
	a. Load bearing	Security & store rooms, Ware				
	b. Non-load bearing	house/godowns, schools, Army barracks,				
		low cost housing				
		Shopping malls, school/ College/				
3.	Cladding	University, Duct covering, Site offices &				
		Administration offices				

4.	Mezzanine Floor	Industrial, Warehouses/godowns, Store	
		Desidential Commencial Cost (defense	
5	Boundary Walls	Residential, Commercial, Govt./defence	
0.		etc.	
6.	Fins / Vertical Lovers Residential & Commercial Buildings		
_	D ' O 11	Shopping malls, Hotels, Stair case	
7.	Fire Separation walls	enclosures etc.	

1.4 Assessment

1.4.1 Scope of Assessment

- **1.4.1.1** Scope of assessment included conformance of manufactured panels to the specified requirements for use in building construction as prefab structures, partition walls, cladding, boundary walls fins and fire separation walls etc.
- **1.4.2** Basis of Assessment Assessment of the suitability of the Aerocon panels is based on:
 - (i) Inspection of the factory for production and quality assurance of the raw material & finished products as per specified specifications by TAC members and BMTPC Officers.
 - (ii) Tests got done on 50 mm & 75 mm thick Flexo Board (FOB) and Fibre Cement Board (NT) panels and facing sheet for Fire propagation for Products, Fire resistance, Ignitability evaluation for materials by Fire Research Lab., CBRI Roorkee.
 - (iii) Tests got done on 50 mm & 75 mm thick Flexo Board (FOB) and Fibre Cement Board (NT) panels and facing sheet for Fire propagation for Products, Fire resistance, Ignitability evaluation for materials by Fire Research Lab., CBRI Roorkee with facing sheet for Sound transmission Class by Prasar Bharati, New Delhi
 - (iv) Tests got done on 50 mm & 75 mm thick Flexo Board (FOB) and Fibre Cement Board (NT) panels for Thermal Conductivity by Indian Institute of Chemical Technology, CSIR, Hyderabad.
 - (v) Tests got done on 75 mm thick Flexo Board (FOB) and Fibre Cement Board (NT) panels for various properties of the panels by JNTUH College of Engineering, Hyderabad, Indian Institute of Technology Bombay & Lucid Laboratories, Hyderabad.
 - (vi) Report on wind load effect on using 75mm thick panels as external cladding of Indian Institute of Technology, Madras.

- (vii) Report on the performance of structures built with Aerocon Insta panels during the 26th January, 2001 earthquake by JNTU College of Engineering, Hyderabad.
- (viii) Assessment of quality assurance procedures implemented in the factory for Quality Assurance Scheme followed by the Certificate holder for process control as per Quality Assurance Plan attached at Annex I.
- **1.4.3** Scope of Inspection Scope of inspection included the verification of production, performance and testing facilities at the factory including competence of technical personnel and status of quality assurance in the factory.

1.5 Manufacturing Machinery & Equipment

The manufacturer has got the following major equipment at the site, as reported:

(i) Fly ash silo, weighing hopper for fly ash and horizontal mixer for raw materials preparation

(ii) Slag silo tank, gypsum silo tank, cement silo and dust collector for raw materials feeding

(iii) Dry tanks, pulp mixing tanks, de-watering pit and storage tank for raw materials storage

(iv) Weigh hopper for cement, dosing tank, main mixers, measuring tanks, feeder mixers and dust collector for raw materials mixing

(v) Header pipe, distribution tank and pouring chute for material discharging

(vi) Stripping, crusher and reclamation machines

(vii) Compressors, DG sets & Cranes of different capacities and weighing bridge.

1.6 Manufacturing Process

Aerocon panels shall be made up of two fibre reinforced cement sheets with a core separating sheets. The core of the panels shall have binders like portland cement and reinforcing bars such as cellulose and synthetic binders. The core shall contain materials such as pulverized fly ash, light weight aggregates as fillers and foaming agents. These materials shall be mixed thoroughly with water in conventional manner and sandwiched between a pair of fibre cement facing sheets which shall be separated and supported by using conventional jigs and fixtures.

The adhesion between the core material and fibre cement sheets is achieved by inorganic bonding by aeration while manufacturing the panel in-situ. The panels so prepared shall be allowed to harden for a predetermined period and thereafter jigs/fixtures shall be separated. The panels shall be cured by retaining the humidity of the composite by wrapping the composite with polymeric films. No water is required for curing.

Manufacturing process in detail shall be as follows:

- Moulds shall be prepared as per required size and thickness by inserting fibre reinforced cement sheets to each mould. These moulds shall be fixed on trollies. After insertion of cement sheets trolley shall be locked with two tie rods on each side.
- Raw material (i.e. OPC Cement, Pulverized Fly Ash, Quick Lime, Cotton pulp, Gypsum etc.) which are stored in different silos shall be mixed with water as per raw mix design into mixing tank after weighing. This mixing takes about 10-15 minutes.
- After 10-15 minutes of mixing, aeration agent shall be mixed with slurry into the mixing tank to start the aeration process.
- Slurry from mixing tank shall be discharged to the distribution tank and then this slurry shall be poured on to the molds fixed on trollies through pouring chute.
- After about 16-18 hrs, de-moulding process starts with the help of stripping machine.
- The panels shall be covered with tarpaulin or plastic sheets and curing shall be done for the next 10 days.
- After 10 days of water curing, panels shall be shifted to the yard and inspected for the next 18 days. After inspection panels are ready for dispatch.

Manufacturing process flow chart is shown in Annex II.

Accessories required for manufacture of these panels is given in Annex III.

1.7 Conditions of Certifications

1.7.1 *Technical Conditions* – Raw materials and the finished product shall conform to the requirements of the prescribed specifications.

1.7.2 *Quality Assurance*

The Certificate Holder shall implement & maintain a quality assurance system in accordance with Quality Assurance Plan (QAP) given in Annex I attached with this Certificate.

1.7.3 *Handling of User Complaints*

- **1.7.3.1** The Certificate holder shall provide quick redressal to Consumer /user complaints proved reasonable & genuine and within the conditions of warranty provided by it to customer/purchaser.
- **1.7.3.2** The Certificate holder shall implement the procedure included in the SQA. As part of PACS Certification he shall maintain data on such complaints with a view to assess the complaint satisfaction and suitable preventive measures taken.

1.8 Certification

1.8.1 On the basis of assessment given in Part 3 of this Certificate & subject to the conditions of certification, use & limitations set out in this Certificate and if selected, installed & maintained as set out in Parts 1 & 2 of this Certificate, the panels covered by this Certificate are fit for use set out in the Scope of Assessment.

PART 2 CERTIFICATE HOLDER'S TECHNICAL SPECIFICATIONS

2.1 General

2.1.1 The PAC holder shall manufacture the panels in accordance with the requirements specified in the relevant Standards. In addition it shall follow the specific requirements of various materials used in the manufacture of these sections (see Part 5)

2.2 Specifications

2.2.1 *Raw Materials*

(i) OPC 53 grade cement shall conform to IS 12269:2013

- (ii) Fly ash shall conform to IS 3812 (Part 2):2003
- (iii) Slag shall conform to IS 12089:1987
- (iv) Quick lime shall conform to IS 712:1984

(v) Anhydrous gypsum shall conform to IS 2547 (Part 1):1976
(vi) Fibre cement sheets shall conform to IS 13000: 1990 for asbestos cement sheets and 14862: 2000 for fibre cement sheets
(vii) Pulp (cotton rag) shall be as per manufacturer's specifications

2.2.2 Performance CriteriaAerocon panels shall meet the performance criteria given in Table3:

S.	Properties	Test Method	F	Requirem	ents *	ents *	
No			50 mm	50 mm thick		thick	
			FOB	NT	FOB	NT	
1.	Weight (dry) (kg/m ²)		39	38	54	51	
2.	Axial load (kN/m)	Factor of safety = 2.5	53	50	83	65	
3.	Bending (kg/m ²)	Factor of safety					
	(a) 1.5m span	= 2.5	66		95		
	(b) 2.9m span		198	300	265	400	
4.	Flexural strength (kg/cm ²)	IS 2380 (Part 4):1977	67	42	58	48	
5.	Compressive strength (kg/cm ²)	Typical test results	30		40		
6.	Thermal conductivity (W/m°.K)	IS 3346:1980/ BS 4370 (Part 2): 1993	0.22	0.16	0.21	0.17	
7.	Sound transmission class (dB)	IS 9901 (Part 3): 1981/IS 11050 (Part 1):1984	34	37	37	39	
8.	Fire resistance (minutes)	IS 3809:1979/ BS 476 (Part 20-22):1987	60	120	120	120	
9.	Surface spread of flame	BS 476 (Part 7): 1997	Class I		Class	Ι	
10.	Fire propagation index (I)	BS 476 (Part 6): 1989	3.7	4.7	3.7	4.7	
11.	Ignitability	BS 476 (Part 5):	Class P (not	Class P	(not	
		1979	easily ignitable) easily ignitabl		nitable)		

Table 3

* The above requirements are the minimum values for the panels.

2.3 Installation of Aerocon Panel Applications & Jointing Procedure

2.3.1 Partition Walls

2.3.1.1 Full height partition

- Recess or square edge panels shall be used for full height partitions.
- Floor plan shall be marked as per approved drawings.
- The floor channels (F.C.) shall be cut as per required lengths and the ceiling shall be marked with plumb to floor channels and ceiling channels shall be fixed with self-expansion screws.
- The floor channels shall be placed & fastened with self expansion screws of size N 6×50 mm at every 600 mm centers on 50mm face of channel.

- The height needs shall be checked for each individual panel before inserting, the same method shall be followed for all panels.
- The floor channels, tongue and groove portion of panels shall be cleaned for firm fixing.
- The 600 mm side of panel shall be lifted & kept parallel to floor. The groove side of panel shall be kept towards wall or column end.
- The panel shall be inserted by tilting it into ceiling channel first and then position the same from 14 mm side of the floor channel as shown in Fig. 6.
- The panel shall be slowly pushed into the floor channel with two heavy duty screw drivers without damaging the corners as shown in Fig. 7.
- The panel shall be positioned & pushed towards wall and right angle of panel shall be checked as shown in Fig. 8.
- Plugs/packings shall be inserted, if required in floor channel to ensure right angle.
- The jointing material shall be applied along entire length of tongue and groove for jointing and inserting the next panel. The panel shall be pushed to secure a rattle free joint.
- The partition shall be completed by jointing panel by panel as per the above procedure.



2.3.1.2 Half height partition

- The partitions shall always end in 'L' or 'T' shape of 300 to 600 mm panel width as shown in Fig 9.
- The floor channel shall be fixed with self -expansion screws at every 600 mm center to center.
- The first panel starting from the existing brick wall should be fixed as per the following two options:
- Option 1 Starting with existing brick wall, a drill shall be made to brick wall and panel at the distance of 300 mm as shown in Fig. 10 from top and bottom side of the panel and insert the steel rod.
- Option 2 The L angle cleat shall be fixed at corner with nuts and bolts as shown in Fig. 11.
- The top end & free end walls must be covered using beading as shown in Fig. 12.
- Different materials like timber, medium density fibre boards, PVC, Aluminium etc. as per required design shall be used as shown in Fig. 13.
- Fevicol shall be applied on the inner surface of the beading before fixing to the panels.
- All screws should be dipped in Fevicol before fixing to the beading. In factories and workshops Aluminium/galvanized iron channels (ceiling channel) shall be used as beading.
- Jointing material shall be applied on entire length of tongue & groove portion before fixing panels to improve stability & prevent the lateral movement.
- With this half height partition will be ready for finishing.



Fig. 9

Fig. 10 Option 1

Fig. 11 Option 2



2.3.1.3 Jumbo height partitions (above 3.0m)

- Panel partition work can be done without steel frame up to 4.50 m height & 4.80 m width.
- Frame work shall not be required for these type of partitions up to 4.5 m.
- Panels shall be staggered for strength & rigidity as shown in Fig. 14. Height of the panels shall be decided accordingly.
- Partition shall be supplied with top support, such as steel, concrete etc.
- The floor & ceiling channel shall be fixed as per laid procedure.
- For horizontal joining, the full length panel shall be fixed first and jointing material shall be applied in the groove portion.
- Hexagonal PVC/wooden beading shall be placed on top groove of the 3 m panel before placing the 1.5 m panel and the same pushed into the ceiling channel as shown in Fig. 15.
- The 1.5 m panel should come next in lower side and 3 meter panel in upper side & proceed in the similar way. The partition shall be completed by fixing panels one by one as per the above procedure. For joint finishing of panels, Clause 2.3.2.7 may be referred.
- If the partition exceeds 4.50 m length and 4.80 m width, then steel support shall be provided as shown in Fig.16.



Fig. 14





Fig. 16

2.3.2 Aerocon Pre-fabricated Structures (Single storey)

Pre-fabricated structures shall be of two types: a. Load bearing structures b. Non-Load bearing structures

2.3.2.1 Load-bearing structures (Single storey)

These structures shall be made based on size, location and functional requirements. These load-bearing structures can be designed to a maximum span of 5.2 m as these are suitable with roofing option of the panels as shown in Fig. 17. The length of each room can be upto 6 m i. e. each room with a carpet area of 5.2 x 6 meter. These rooms can be constructed in a row, with multiples of 5.2 m x 6 m.

Typical layout for possible load bearing structures is shown in Figs. 18 to 20.

Details of typical foundation for walls and columns are shown in Figs. 21 & 22.









Fig. 19

Fig. 20

Panels with Recess/Square edge shall be used for construction of walls.

- The four corners shall be marked and position the 'L' Base plate component and diagonals checked as per the approved drawing as shown in Fig. 23.
- The base plate shall be fixed by drilling 12mm dia holes with hammer drill and fasten self expansion anchor fasteners of size M 8 x 65 mm (Hilti/Fischer) as shown in Fig. 24.
- The floor channel shall be fastened with N 6 x 60 mm selfexpansion screws at 600 mm center to center.
- The panels shall be erected from a corner. It shall be ensured with plumb that the first panel is perfectly vertical. After fixing at least two panels on one side start fixing the panels at right angle as per the drawing to ensure stability to the structure.
- The corner cover plate shall be fixed from outside to make the corner rigid as shown in Fig. 25.
- Jointing material shall be applied on tongue & groove portion of the panels to make the joints firm.
- The second panel shall be positioned 550 mm away from the first panel and slowly drop slide towards first panel. This technique enables fast & proper joining of panels. It must be started the gable side and all sides complete one by one as shown in Fig. 26.
- During installation suitable temporary support shall be provided using 75 mm dia. timber log or M.S. pipes of 50mm dia firmly grouted into the ground on either side of panels in 450 angle.
- Every 3rd panel on either side should be tied with temporary support as shown in Fig. 27.
- Fixing of purlin shall be completely resting on panels and duly connected with base plates by fixing with M 10 bolts & nuts as shown in Fig 28.
- The day's work shall be stopped only after completing the four walls and tying each other by truss and purlins as shown in Fig. 29.
- All panels shall be fastened to the plinth with anchor bracket of size 75 x 75 x 75 x 6 mm thick as shown in Fig. 30.
- After completion of erection of pre-fab structure, the exposed anchor brackets shall be covered using 1:2:4 concrete with baby chips from outside.









Fig. 23





Fig. 25





Fig. 29



2.3.2.2 Corner Joints

- The 'L' and 'T' joints shall be made by fastening straight ends of the panels with self-expansion screws or 10 dia. x 100 mm long pin as shown in Figs. 31 & 32.
- The core of one panel shall be removed upto 15 mm depth in which the pin will be fastened only in the core, for filling grout cement.
- The panels shall be positioned in right angle and fastened with 150 mm long self-expansion screws at every 900 mm lengthwise using Hilti make or standard bolts 150 mm long galvanized/zinc coated threaded rod dipped in sodium silicate. The bore shall be filled with sodium silicate & flyash.
- 8mm dia. holes shall be drilled at 600 mm centres height wise and 15 mm prepared groove shall be filled with grout cement using cocking gun.
- The facing of core (exposed part) shall be finished using silicon acrylic paste. In case of external application, the joints shall be covered with steel cover plate to protect the corner from knocks and other mechanical impacts.
- Lintel panels shall be firmly fixed with fastening the same to lateral panels with 12 mm dia. rods and cement grout. Minimum bearing of 150 mm shall be maintained on either side or for the gable walls where the height is more than 3 meters, panels shall be cut in triangular shape to fill the top gable as shown in Figs. 33 & 34.
- These triangular panels should be fixed from inner side by routing the face to the size 25 mm width x 25 mm depth and 200 mm length (100 mm in top panel and 100 mm in bottom panel) positioning the 200 mm long 12 dia. GI coated mild steel rod in the rout and filled with cement grout.
- Temporary bracing shall be fixed with timber/steel for one day and remove or putting of back to back G.I ceiling channel as shown in Fig. 35.





Fig. 32



2.3.2.3 Non-load bearing structures

For non-load bearing structures, steel columns, trusses and purlins shall be designed as per soil condition and wind velocity.

- It shall be ensured that quality workmanship of the structure shall be checked at every stage of fabrication as per drawings and specification.
- It shall be ensured that the structure is complete in all respect before erection of the panels.
- The floor channel shall be fixed between two columns using self- expansion screws at every 600 mm centers, leaving gaps at door positions.

Typical layout plan for a non-load bearing structure and steel drawing shall be shown in Figs. 36 & 37.

- Columns, trusses and purlins work shall be completed as per the approved drawing.
- Requisite number of panels shall be laid on the levelled ground with tongue & groove matching and a tie beam shall be provided from eave and gable walls to hold the panels. Isometric view and gable & eave wall connection details are shown in Figs. 38 & 39.
- The panels shall be erected from a corner of a column and the panel erected as the load bearing structure procedure.



Fig. 36 Typical layout plan for a non-load bearing structure



Fig. 37 Steel drawing





Fig. 39 Gable & eave wall connection details

2.3.2.4 Doors and Windows

Mild Steel, Wooden and Aluminium doors and windows can be fixed with Aerocon Panel as per the details given below:

- Mild Steel (MS) door & window frame shall be fixed as shown in Figs. 40 & 41 which is generally used for prefab structures.
- Aluminium door & window frame shall be fixed as shown in Fig. 42.
- Wooden Door & Window frame shall be fixed as shown in Fig. 43.



Fig. 40 Typical MS Door & Window frame



Fig. 41 Typical MS Door frame & shutter details





2.3.2.5 Electrical Wiring

1. *External wiring*

External wiring shall be done on the panels by using PVC caps/ pipes duly fixed to the surface as shown in Figs. 44 & 45. This shall be done after installation of the wall.



Fig. 44 PVC Pipe clamping

Fig. 45 PVC caps

- **2.** Concealed wiring
 - Electrical drawings shall always be referred before starting the work.
 - Surface routing shall be done by cutting the facing sheet and removing core.
 - Face chasing should be avoided for panels used in prefab structure external and load bearing especially the panels on which the trusses & purlins are fixed.

- Maximum depth of route shall be 50 percent of the thickness of material i.e. for 50 mm panel – 25 mm route and for 75 mm panel – 38 mm route.
- Switch box upto 40 mm depth shall be fixed in 50 mm panels and upto 60 mm depth in 75 mm panels as shown in Fig. 46.
- Load bearing walls should not be routed horizontally.
- Horizontal face routing in non-load bearing walls shall be max. 300 mm from the joint as shown in Fig. 47.
- Jointing material shall be fixed in route and P.V.C. casing fixed, after setting electrical wiring as shown in Figs. 48 & 49
- In case of mains or where multiple conduting is to be carried out, double skin partition wall shall be used.





Fig. 46 Switch Box





Fig. 48 Option 1

Fig. 49 Option 2

2.3.2.6 *Plumbing Installation*

- In Prefab structures, the toilets can be constructed with these panels. The required pipelines shall be fixed on the panel externally as shown in Fig. 50.
- If pipe lines need to be concealed, a false wall should be created with 50/75 mm panel to the required height on the internal side only as shown in Figs. 51 & 52.
- Water Closet (WC) shall be fixed with bolts & nuts. However, detailing needs to be worked out based on site conditions. The WC shall preferably be fixed on floor and bolted to the panel wall.
- The surface of the panel shall be treated with marble/ granite/ceramic/glazed tiles using appropriate tile adhesive chemicals as per the procedure recommended by the tile adhesive manufacturer. It is recommended to use smaller tiles.





2.3.2.7 *Panel Jointing Procedure*

Aerocon Smart bond comprises of the following components:

- Smartglu Two part primary binder (powder & liquid): This glue is used for bonding as well as a filling in solid wall panel installations.
- Smartflex Fixing paste: A ready to use paste to render a non-cracking, tensile but elastic skin over the joint gaps.
- Smartpoly Self saturating tape: Non-woven, selfsaturating polyester tapes, ranging in width from 16-80 mm, to reinforce the exposed skin of the joint.

Fixing process



Take SmartGlu powder + Liquid in 1:1 ratio and brush on edges before sliding tongue and grove panels.



Immediately paste Smartpoly tape on it. Allow 6 hour shrinkage time



Let dry for 6 hours then wall putty.



After 2 hour interval, take SmartGlu powder + Liquid in 2:1 ratio, apply into the grooves and fill to the surface level



Apply Smartflex paste along the joint



Apply one coat of SmartFlex upto 0.10 mm thick on the Smartpoly tape.



Apply primer and paint or final finish

Jointing procedure is shown in Fig. 53.

The wall shall be ready for whole surface primer & paint in normal way. Possible finishes on the panels after joint finishing: A variety of wall finishes, which may be adopted, are given below:

(a) Painting: one coat of water soluble cement primer and two to three coats of paint shall be applied with a roller.

(b) Wall Paper: Approved glue supplied by the manufacturer shall be applied and stick with the same as per the recommendation procedure from manufacturer.

(c) Hard Lamination: Hard lamination is recommended for internal horizontal applications like work station tops. The procedure for fixing hard lamination shall be as follows:

- A sanding machine shall be used on entire surface of panel to be laminated.
- The dust particles shall be remove from the sanded surface.
- A thick coat of SR 990 (Fevicol) shall be applied on panel & laminate.
- The surface shall be allowed to dry to tack free.
- The laminate shall be fixed and rubbed with a cloth by applying pressure.
- Keep even weight for one day on the laminated surface before use.

(d) Ceramic/Clay/Granite tiles (as required): These tiles shall be fixed to the panels using suitable cementations tile adhesives as per the manufacturer's recommendations. The procedure for fixing hard lamination is as follows:

- Smaller size of tiles shall always be used for better adhesion.
- All plumbing fixtures shall be fixed before tiling the surface.
- The tiles shall be staggered for proper fixing.



Fig. 53 Jointing procedure

2.3.3 Cladding

Aerocon panels shall be laid horizontally and structural steel shall be designed as per the span/height and each panels fixed with nut and bolt.

Cladding detail is shown in Fig. 54.



Fig. 54 Cladding details

Design for using the panels as external Cladding by IIT Madras is Given in Annex IV.

2.3.4 Mezzanine Floor

- **2.3.4.1** Mezzanine flooring shall be constructed using 50 mm and 75 mm square edge panels. The supporting structure should be designed by a structural engineer as per the loading requirement and shall be fabricated before installing panels. However, basic guidelines for selection of panels and design of Mezzanine floors is as follows:
 - For residential, commercial usage and industrial loading up to 400 kg/m² (Uniformly distributed load), 50mm thick panels shall be used.
 - For heavy loading usage and industrial loading up to 800 kg/m² (Uniformly distributed load), 75 mm thick panels shall be used.
 - For office space and personal applications, minimum load for a mezzanine floor shall be 350 kg/m² and for material handling or storage the minimum load shall be 500 kg/m²
 - Economical column grid is of 3m x 3m. Height of finished mezzanine flooring should preferably be 3m as it saves the cost of mid landing.

- The supporting frames shall be made in open or closed steel sections.
- The panels shall be placed on frame and 11.5 mm dia holes shall be drilled from bottom side.
- The panels shall be fastened to MS section using CSK bolts of size M10 of required length.
- It shall be ensured that staircases are always fitted externally to the mezzanine structure.
- Sharp point loads, impact loads and rolling loads shall be avoided on mezzanine floor.
- It is recommended to use rubber beading of 5mm thick duly stuck with rubber adhesive between panel and Steel section for cushioning effect in between panels and steel supporting sections.
- Aerocon panel mezzanine flooring should not be used without any cover. Flexible flooring material like screed concrete, PVC, rubber tiles, carpet, linoleum & wood etc. and finishing and fixing shall be done by tile adhesive only as recommended by the manufacturer. Before covering, it must be ensured that the panel joints are filled with PU foam/ Acrylic putty/POP etc.

Recommended support for secondary beam laying is given in Table 4:

Table 4					
Loading	Spacing of	Steel section for 3.0m span			
(secondary seams(iii)	50mm thick	75mm thick		
Up to 300	0.60	ISMC 75	ISMB 75/		
			ISMC 100		
300 to 400	0.60	ISMC 75	ISMB 100/		
			ISMC 125		
400 to 500	0.60		ISMB 100/		
			ISMC 125		
500 to 650	0.60		ISMB 100/		
			ISMC 125		

2.3.4.2 Laying procedure:

- The frames can be in open or closed steel sections. Provide support at every 600 mm perpendicular to the panel. (See Fig. 55)
- The panels shall always be supported lengthwise with beams below the tongue and groove joint.

- Holes of size 11.5 mm dia. in panels shall be drilled from bottom side after placing them on frame and CSK bolts size M10 of required length shall be used to fasten the panels to mild steel sections at 450mm center to center. (See Figs. 56 & 57)
- For areas of high traffic load, neoprene rubber beading of 6 mm thickness shall be used for fixing using rubber adhesive between panel & MS section, to avoid direct contact of panels to steel supporting sections. (See Fig. 58)
- The joints shall always be staggered to avoid expansion stresses at panel joints, wherever the length is more than the panel length i.e. 3m. (See Fig. 59)
- Minimum 10 mm gap shall always be left at peripherals where panel touches the wall. The gap shall be filled with flexible material like PU foam and covered with skirting. (See Figs. 60 & 61)



2.3.5 Boundary Walls

- For construction of boundary walls with these panels, concrete or steel column shall be provided at every 2400 to 3000 mm distance based on site requirement.
- Panels shall be laid as per the sketch shown in Fig. 62.
- Jointing material shall be applied at the tongue and groove joint.



Fig. 62 Boundary Wall details

2.3.6 Fins

- Square edge panels ensure accurate dimensions and shall be fixed vertical and at required levels and heights with minimum scaffolding.
- The maximum height of these louvers shall be limited to 3 meters.
- It shall be ensured that the panel is properly inserted into the floor and ceiling channels.
- The panels shall be secured with 'L' brackets and anchor fasteners.
- Two cleats on either sides at roof level and two cleats at bottom level shall be fastened to secure the panel in position.

Details of fins are shown in Figs. 63 & 64.



2.3.7 Fire Separation Wall

For the Seperation Wall, requirements of relevant Indian standards must be fulfilled.

Fire Separation Wall has the following unique properties:

- Recess or square edge panels shall be used for Fire separation partition walls.
- The floor plan shall be marked as per approved drawing and as shown in Fig. 65.
- For laying the partition, the same procedure shall be followed as mentioned above in full height partition page



Fig. 65 Fire Separation Wall details

2.3.8 Do's and Don'ts for Aerocon panels

2.3.8.1 Do's:

- Panels shall be loaded in the truck vertically with long side parallel to the ground.
- At site if the support frames are not available, the panels shall be stacked vertically leaning on to a wall and the panels shall be covered with polythene/water proof covers.
- If nails or screws required to be fastened make a pilot hole at the required place, drill with machine approximately 1mm smaller than screw dia i.e. for 6mm screw drill 5mm pilot hole and then drive the screw/nail.
- The panels shall be with granite cutting machine.
- After completion of electrical work, the panel routs shall be filled with P.O.P/fine cement mortar and allow for drying.
- If any hangings/shelves shall be put on partitions, screws/ bolts and nuts shall be used only.
- Self-expanded CSK screws shall be used for lesser weight hangings.
- For heavy weight and shelf loads, bolt & nuts shall be used distributed to no of bolts.
- Water based primer and Acrylic based paints shall be used for internal & external applications.
- Tiles shall be fixed as per recommendations of adhesive manufacturers.
- An edge clearance of 50 mm thickness of panel shall be maintained from the corner by a min 75 mm and for 75 mm panel maintain 100 mm.
- The panels shall always be covered with screed concrete and floor tile for mezzanine floor application.

2.3.8.2 Don'ts

- Don't load panels in the truck horizontally.
- Don't place the panels on the truck body directly without covering the truck floor with enough husk bags.
- Don't lift the panels directly by cranes as it may damage the tongue and groove or edges.
- Don't drag the panel as it will damage the edges.
- Don't use cut panels less than 150 mm wide in partition
- Don't use hammer/nails on panel partitions.
- Don't fasten nails and screws directly without pilot hole.

- Don't chase/groove panels after execution and jointing is done.
- Don't fastened the nail and screws directly without pilot hole.
- Don't fastened screws in the tongue & groove joints as the screw holding capacity in the joint will not be sufficient to hold any articles.
- Avoid vibrations/impact loads on panels.

For detailed information of the above applications, Aerocon Panel Installation Guide shall be referred which is available with the manufacturer.

2.4 Inspections & Testing

Inspections & testing shall be done at appropriate stages of manufacturing process of all the elements. The inspected panels shall be stored & packed to ensure that no damage occurs during transportation. As part of quality assurance, regular in process inspections shall be carried out by the trained personnel of the PAC holder.

2.5 Good Practices for Installation & Maintenance

Good practice as per requirement of Aerocon panels of the manufacturer shall be followed for installation and maintenance of these panels.

2.6 Skilled /Training Needed for Installation

The PAC holder shall provide training for carrying installation of the panels at site through authorized trained franchisees. Alternatively, if the customer wants to execute the installation work of his own, the manufacturer shall provide training to client at different stages of the project, as and when required.

2.7 Guarantees/Warranties Provided by the PAC Holder

PAC holder shall provide necessary warranty of the system for manufacturing defects for a period of 6 months to the client.

2.8 Responsibility

• Specific design using Aerocon technology is the responsibility of the designer with the instructions, supervision and guidance of the PAC holder.

• Quality of installation/construction of the system on site is the responsibility of the trade persons engaged by the building owner under the guidance of the manufacturer.

• Quality of maintenance of the building is the responsibility of the building owner under the guidance of the manufacturer.

• Providing necessary facilities and space for movement of cranes and vehicles is the responsibility of the building owner.

PART 3 BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

3.1 Assessment

3.1.1 The technical assessment was done as per provisions of the Standards listed in Part 5 of this Certificate.

3.2 Site Inspection

Inspection of a 6 storey under construction South India Shopping Mall at Hyderabad where all the inner and outer walls being laid by using Aerocon panels of approx. 12000 sqft area was made by the TAC members Sh. Samir Mitra, Chief (Projects) HUDCO & Sh. M C Yadav, Chief Engineer DSIIDC and representatives of the Council. The work was found to be satisfactory.

3.3 Tests Performed

3.3.1 By Fire Research Laboratory, CBRI, Roorkee (IS 3614:1979)

3.3.1.1 Test 1: Fire propagation for products

(i) Specimen for evaluation: 225 x 225 x 50 mm thick panel facing sheet (FOB) was exposed Result: Fire propagation Index, I = 3.7 Sub-indices $i_1 = 2.0, i_2 = 1.2 \& i_3 = 0.5$

(ii) Specimen for evaluation: $225 \times 225 \times 50$ mm thick facing sheet (NT) was exposed Result: Fire propagation Index, I = 4.7 Sub-indices $i_1 = 2.4, i_2 = 1.7 \& i_3 = 0.6$

3.3.1.2 Test 2: Fire resistance

(i) Specimen for evaluation: 3000 x 3000 x 50 mm thick sandwich wall (FOB) panel (Partition)

Result: The data of evaluation revealed that the sandwich wall panels (Partition) withstood the standard fire for 60 minutes with respect to stability, integrity and thermal insulation.

(ii) Specimen for evaluation: 3000 x 3000 x 50 mm thick sandwich wall (NT) panel (Partition)

Result: The data of evaluation revealed that the sandwich wall non-asbestos panel (Partition) withstood the standard fire for 120 minutes with respect to stability, integrity and thermal insulation.

(iii) Specimen for evaluation: 3000 x 3000 x 75 mm thick sandwich wall (FOB) panel (Load bearing)

Result: The data of evaluation revealed that the sandwich wall panels (Load bearing) withstood the standard fire for 120 minutes with respect to stability, integrity and thermal insulation.

(iv) Specimen for evaluation: 3000 x 3000 x 75 mm thick sandwich wall (NT) panel (Load bearing)

Result: The data of evaluation revealed that the sandwich wall panels (Load bearing) withstood the standard fire for 120 minutes with respect to stability, integrity and thermal insulation.

3.3.1.3 Test 3: Ignitibility evaluation for materials

(i) Specimen for evaluation: $228 \times 228 \times 50$ mm thick (FOB) facing sheet exposed Result: "P" not easily ignitable

(ii) Specimen for evaluation: $228 \times 228 \times 50$ mm thick (NT) facing sheet exposed Result: "P" not easily ignitable

3.3.1.4 Test 4: Surface spread of flame

(i) Specimen for evaluation: $900 \times 270 \times 50$ mm thick (FOB) facing sheet exposed Result: Classification Class 1

(ii) Specimen for evaluation: 900 x 270 x 50 mm thick (NT) facing sheet exposed Result: Classification Class 1

- **3.3.2** By Prasar Bharati, New Delhi
- **3.3.2.1** Test 1: Sound Transmission Loss

(i) Specimen for evaluation: 50mm thick FOB facing sheet Result: 34 dB

(ii) Specimen for evaluation: 75mm thick FOB facing sheet Result: 37 dB

(i) Specimen for evaluation: 50mm thick NT facing sheet Result: 37 dB

(ii) Specimen for evaluation: 75mm thick NT facing sheet Result: 39 dB

- **3.3.3** By Indian Institute of Technology Bombay, Mumbai
- **3.3.3.1** 75 mm thick panel with FOB facing sheet Thermal conductivity: 0.23-0.24 W/°C.m Thermal resistivity: 410-434 °C.cm/W
- **3.3.3.2** 75 mm thick panel with NT facing sheet Thermal conductivity: 0.19-0.21 W/°C.m Thermal resistivity: 478-525 °C.cm/W
- **3.3.4** By JNTUH College of Engineering, Hyderabad
- **3.3.4.1** For FOB Panels 75 mm thick

S.No.	Properties	Test method	Result (Average)
1.	Dimensions (for a span of 2400 x 600 mm)	-	
	(i) Length (ii) Width		2400.3 mm 600.2 mm
	(iii) Thickness		74.96 mm
2.	Transverse strength (for a span of 2400 x 600 mm)	ASTM E-72 :2015	154 kg/m ² with safety factor of 2.5
3.	Deflection	ASTM E-72 :2015	14.67 mm
4.	Compressive strength	ASTM E-72	132 KN/m (average)
	(sample size 1500 x 300 mm)	:2015	with safety factor of 2.5

3.3.4.2 For NT Panels 75 mm thick

S.No.	Properties	Test method	Result (Average)
1.	Dimensions (for a span of	-	
	2400 x 600 mm)		
	(i) Length		2400.3 mm

	(ii) Width		600.1 mm
	(iii) Thickness		74.93 mm
2.	Transverse strength (for a	ASTM E-72	146 kg/m ² with safety
	span of 2400 x 600 mm)	:2015	factor of 2.5
3.	Deflection	ASTM E-72	29.33 mm
		:2015	
4.	Compressive strength	ASTM E-72	121 KN/m with safety
	(sample size 1500 x 300 mm)	:2015	factor of 2.5

3.3.5 By Lucid Laboratories Pvt. Ltd., Hyderabad

3.3.5.1 For FOB Panels 75 mm thick

S.No.	Properties	Test method	Result (Average)
1.	Dry Density	IS 2380 (Part 3): 1977	659.75 kg/m ³
2.	Modulus of rupture	IS 2380 (Part 4):1977	
	(i) Dry condition		55.525 kg/cm^2
	(ii) Wet condition		38.75 kg/cm^2

3.3.5.2 For NT Panels 75 mm thick

S.No.	Properties	Test method	Result (Average)
1.	Dry Density	IS 2380 (Part 3): 1977	714.25 kg/m ³
2.	Modulus of rupture	IS 2380 (Part 4):1977	
	(i) Dry condition		53.85 kg/cm^2
	(ii) Wet condition		36.675 kg/cm^2

3.4 Supply of the Panels

The manufacturer, as reported, has supplied the panels as per the details given below: (These have not been inspected by BMTPC)

S. No.	Name & location of the Client	Quantity supplied (sqm)	Period of supply
1	Oleanie Mall Manshai fan		0010
1.	Classic Mall, Mumbal for	20000	2012
	construction of Phoenix Mall		
2.	D B Reality Pvt. Ltd., Mumbai for	13000	2014
	construction of Millan Mall		
3.	Runwall Builders, Mumbai for	20000	2014
	construction of apartments		
4.	Piramal Group, Mumbai for	8000	2015
	construction of housing complex		
5.	Royal Palm, Mumbai for	15000	2015
	construction of a hotel		

6.	ITC Ltd., Hyderabad for construction of a chocolate factory	6000	2015
7.	Gannon Dunkerley, Tanda, UP for construction of industrial complex	5000	2015
8.	Patel Engineering, Jammu (J&K) for construction of a hydro project	1000	2015
9.	DRDO, Panagarh (WB) for construction of staff accommodation	8000	2015
10.	Future Group, Mumbai for construction of City Centre Mall	4000	2015
11.	DLF, Noida for construction of Mall of India	3500	2015
12.	Larsen & Toubro, Hyderabad for construction of TOD Mall	4000	2015-16
13.	NTPC (Simplex), Noida for construction of industrial complex	5000	2015-16
14.	Shapoorji & Pallonji, Hyderabad for construction of warehouse	6000	2016
15.	Jaya Shree Textiles, Kolkata for construction of textile factory	6500	2016
16.	BGR Energy, Vijayawada for construction of housing complex	15000	2016
17.	MES, Leh (J&K) for construction of army accommodation	20000	2016
18.	Bihar Construction Deptt., Bihar for construction of District counselling centers	10000	2016
19.	Prime Hospitals, Hyderabad construction of a hospital	4500	2016
20.	GMR Infra, New Delhi for construction of Cargo at IGI Airport	4000	2016

PART 4 STANDARD CONDITIONS

The certificate holder shall satisfy the following conditions:

4.1 The certificate holder shall continue to have the product reviewed by BMBA.

4.2 The product shall be continued to be manufactured according to and in compliance with the manufacturing specifications and quality assurance measures which applied at the time of issue or revalidation of this certificate. The Scheme of Quality Assurance separately approved shall be followed.

4.3 The quality of the product shall be maintained by the certificate holder.

4.4 The product user should install, use and maintain the product in accordance with the provisions in this Certificate.

4.5 This certificate does not cover uses of the product outside the scope of this appraisal.

4.6 The product is appraised against performance provisions contained in the standards listed in Part-V. Provisions of any subsequent revisions or provisions introduced after the date of the certificate do not apply.

4.7 Where reference is made in this Certificate to any Act of Parliament of India, Rules and Regulations made there under, statutes, specifications, codes of practice, standards etc. of the Bureau of Indian Standards or any other national standards body and the International Organization for Standardization (ISO), manufacturer's company standards, instruction/manual etc., it shall be construed as reference to such publications in the form in which they were in force on the date of grant of this Certificate (and indicated in Part V to this Certificate)

4.8 The certificate holder agrees to inform BMBA of their distributors / licensees whenever appointed by him and agrees to provide to BMBA a six monthly updated list thereof.

4.9 The certificate holder agrees to provide to BMBA feedback on the complaints received, the redressal provided, and the time taken to provide redressal on complaint to complaint basis as soon as redressal is provided. BMBA agrees to provide the certificate holder the user feedback received by it, if any.

4.10 If at any time during the validity period, PACH is unable to fulfill the conditions in his PAC, he should on his own initiative suspend using the PAC and notify Chairman, TAC the date from which he has suspended its use, the reason for suspension and the period by which he will be able to resume. He shall not resume without the prior permission of BMBA. He shall also inform, simultaneously, his agents, licensees, distributors, institutional, government, public sector buyers, other buyers and all those whom he has informed about his holding the PAC. He shall also inform all those who buy his product(s) during the period of suspension. He shall provide to BMBA at the earliest the list of who have been so informed by him.

- **4.11** In granting this Certificate, BMBA takes no position as to:
 - (a) The presence or absence of patent or similar rights relating to the product;(b) The legal right of the Certificate holder to market, install or maintain the product:
 - (c) The nature of individual installations of the product, including methods of workmanship.

4.12 BMTPC and the Board of Agreement of BMTPC (BMBA) take no position relating to the holder of the Performance Appraisal Certificate (PACH) and the users of the Performance Appraisal Certificate (PAC) respecting the patent rights / copy rights asserted relating to the product / system / design / method of installation etc. covered by this PAC. Considerations relating to patent / copy rights are beyond the scope of the Performance Appraisal Certification Scheme (PACS) under which this PAC has been issued. PACH and users of this PAC are expressly advised that determination of the Claim / validity of any such patent rights / copy rights and the risk of infringement of such rights are entirely the responsibility of PACH on the one hand and that of the users on the other.

4.13 It should be noted that any recommendations relating to the safe use of the product which are contained or referred to in this Certificate are the minimum standards required to be met with when the product is installed, used and maintained. They do not purport in any way to restate or cover all the requirements of related Acts such as the Factory Act, or of any other statutory or Common Law duties of care, or of any duty of care which exist at the date of this Certificate or in the future, nor is conformity with the provisions of this Certificate to be taken as satisfying the requirements of related Acts.

4.14 In granting this Certificate, BMTPC and BMBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the use of this product.

4.15 The certificate holder indemnifies BMBA, its officers and officials involved in this assessment against any consequences of actions taken in good faith including contents of this certificate. The responsibility fully rests with the certificate holder and user of the product

4.16 The responsibility for conformity to conditions specified in this PAC lies with the manufacturer who is granted this PAC. The Board (BMBA) will only consider requests for modification or withdrawal of the PAC.

4.17 The PAC holder shall not use this certificate for legal defense in cases against him or for legal claims he may make from others.

AnAgramal

Place: New Delhi Date of issue_____ For and Oniberation and Chairman PAC, BC Chairman PAC, BC Member Secretary, BMBA Building har field Secretary, PBMBAuncil Building har field Secretary, PBMBAuncil Ministry of Housing & Urban Poverty Alleviation, (GovL of India) Core 5A, Ist Floor, India Habitat Centre Lodhi Road, 39 New Delhi-110 003

PART 5 LIST OF STANDARDS AND CODES USED IN ASSESSMENT

5.1 Standards - These Standards are referred for carrying out a particular test only and do not specify the requirement for the whole product as such.

5.1.1 IS 712:1984 – Specification for building limes

5.1.2 IS 2380 (Part 3):1977 – Method of tests for wood particle boards – Determination of flexural strength

5.1.3 IS 2380 (Part 4):1977 – Method of tests for wood particle boards – Determination of dimensional stability

5.1.4 IS 2547 (Part 1): 1976 – Specifications for gypsum building plaster – premixed light weight plaster

5.1.5 IS 3346:1980 – Method of determination of thermal conductivity of thermal insulation materials

5.1.6 IS 3614:1979 – Code of practice for Standard heating conditions **5.1.7 IS 3809:1979 –** Fire resistance test for structures

5.1.8 IS 3812(Part 2):2003 – Specifications for flyash for use as pulverized mixture in cement concrete

5.1.9 IS 9901:1981 –Measurement of sound insulation in buildings and building elements

5.1.10 IS 11050 (Part 1):1984 – Rating of sound insulation in buildings

5.1.11 IS 12089:1987 – Specifications for granulated slag for manufacture of Portland slag cement

5.1.12 IS 12269:2013 – Specifications for 53 grade ordinary Portland cement **5.1.13 IS 13000:1990** – Specifications for fibre cement flat sheets

5.1.14 IS 14862:2000 -- Specifications for silica- asbestos cement flat cement sheets

5.1.15 BS 476 (Part 4):1970 – Test method for non-combustibility of building and structures

5.1.16 BS 476 (Part 5):1979 - Method of tests for ignitability

5.1.17 BS 476 (Part 6):1989 -- Method of tests for fire on building materials and structures

5.1.18 BS 476 (Part 4):1997 – Method for fire classification of surface spread of flame

5.1.19 BS 476 (Part 20-22): 1987 – Fire resistance test to building materials and structures

5.1.20 BS 4370 (Part 2):1993 – Method of tests for rigid cellular materials **5.1.20 ASTM E 72:2015 –** Standard test method for conducting strength test of panels for building construction

5.2 Company Standards of the PAC holder – The branded design & specifications of the raw materials and finished product are as submitted by the manufacturer. The PAC holder has to make available the company standards to the consumers according to which testing have been done.

CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Prefabricated Fibre Reinforced Sandwich Panels** bearing the mark manufactured by M/s HIL Ltd. is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No. 1030-S/2017** is awarded to **M/s HIL Ltd., Hyderabad.**

The period of validity of this Certificate is for a period of two years i.e. from 13-01-2017 to 12-01-2019.

This Certificate consists of a cover page and pages 1 to 49.

hailesh Kr. Agarwal

Chairman, TAC ember Secretary, BMBA



On behalf of BMTPOstBoard of Housing and Urban Poverty Alleviation, Government Core 5A, Si Poor Deverty Alleviation, Government New Delhi-110 003 Committee (TAC) of BMBA & Member Secretary, BMTPC Board of Agreement (BMBA) Under Ministry of Housing and Urban Poverty Alleviation, Government of India.

Place: New Delhi Date:

PART 6 ABBREVIATIONS

Abbreviations

BMBA	Board of Agreement of BMTPC
BMTPC	Building Materials and Technology Promotion Council
CPWD	Central Public Works Department
ED	Executive Director of BMTPC
IO	Inspecting Officer
MS	Member Secretary of BBA
PAC	Performance Appraisal Certificate
РАСН	PAC Holder
PACS	Performance Appraisal Certification Scheme
SQA	Scheme of Quality Assurance
TAC	Technical Assessment Committee (of BMBA)

Performance Appraisal Certification Scheme - A Brief

Building Materials & Technology Promotion Council (BMTPC) was set up by the Government of India as a body under the Ministry of Housing &Urban Poverty Alleviation to serve as an apex body to provide inter-disciplinary platform to promote development and use of innovative building materials and technologies laying special emphasis on sustainable growth, environmental friendliness and protection, use of industrial, agricultural, mining and mineral wastes, cost saving, energy saving etc. without diminishing needs of safety, durability and comfort to the occupants of buildings using newly developed materials and technologies.

During the years government, public and private sector organizations independently or under the aegis of BMTPC have developed several new materials and technologies. With liberalization of the economy several such materials and technologies are being imported.

However, benefits of such developments have not been realized in full measure as understandably the ultimate users are reluctant to put them to full use for want of information and data to enable them to make informed choice.

In order to help the user in this regard and derive the envisaged social and economic benefits the Ministry of Housing &Urban Poverty Alleviation has instituted a scheme called Performance Appraisal Certification Scheme (PACS) under which a Performance Appraisal Certificate (PAC) is issued covering new materials and technologies. PAC provides after due investigation, tests and assessments, amongst other things information to the user to make informed choice.

To make the PACS transparent and authentic it is administered through a Technical Assessment Committee (TAC) and the BMTPC Board of Agreement (BMBA) in which scientific, technological, academic, professional organizations and industry interests are represented.

The Government of India has vested the authority for the operation of the Scheme with BMTPC through Gazette Notification No. 1-16011/5/99 H-II in the Gazette of India No. 49 dated 4th December, 1999.

Builders and construction agencies in the Government, public and private sectors can help serve the economic, development and environmental causes for which the people and Government stand committed by giving preference to materials and technologies which have earned Performance Appraisal Certificates.

Further information on PACS can be obtained from the website: <u>www.bmtpc.org</u>

ANNEX I

(Clause 1.4.2)

QUALITY ASSURANCE PLAN FOR PREFABRICATED FIBRE REINFORCED SANDWICH PANELS

S.	Parameters to be	Requirement	Test Method	Frequency of	
No.	inspected	Specified		Testing	
I. Raw Materials					
1.	O P Cement 53 Grade	As per IS 12269:2013	Manufacturer's	Every	
			test report	batch/lot	
2.	Flyash	As per IS 3812 (Part	As per IS 1727:	Every	
		1):2003	1967	batch/lot	
3.	GGBS slag	As per IS 12089:1987	As per IS	Every	
			4031(Part 2)	batch/lot	
4.	Fibre cement sheet	As per IS 14862:2000	As per IS	Every	
			14862:2000	batch/lot	
5.	Pulp	As per manufacturer's	Manufacturer's	Every	
		test report	test report	batch/lot	
6.	Flexo Boards	As per manufacturer's	Manufacturer's	Every	
		test report	test report	batch/lot	
	II. Finished Panels				
1.	Width (mm)	± 1	Manually	2/100 panels	
2.	Thickness (mm)	± 1.5	Manually	2/100 panels	
3.	Length (mm)	± 1	Manually	2/100 panels	
4.	Edge straightness	± 2	Manually	2/100 panels	
5.	Diagonal difference	± 3	Manually	2/100 panels	
6.	Tongue & groove joint	3 to 5 mm	Visual	2/100 panels	
7.	Voids	Should be absent	Visual	4/100 panels	
8.	Physical observations	Tongue & groove	Visual	4/100 panels	
		should be intact.			
		Panels should be free			
		from edge breakage,			
		cracks and			
		delamination.			
9.	Density	700 to 900 kg/m3	IS 2380 (Part	Twice per	
			3):1977	week	
	Axial Compressive	50 mm thick = 47	ASTM E72	Twice per	
10.	Strength (kN/m)	75 mm thick = 75	:2015	week	
11.	Transverse bending	50 mm thick = 66	ASTM E72	Twice per	
	load (kg/m ²)	75 mm thick = 95	:2015	week	
	Flexural Strength	50 mm thick = 67	IS 2380 (Part	As & when	
12.	(kg/m^2)	75 mm thick = 58	4):1977	major design	
				changes are	
				made	
13.	Thermal Conductivity	50 mm thick = 0.22	IS 3346:1980/	As & when	
	(W/m ^o K)	75 mm thick = 0.21	BS 4370(Part	major design	
			2):1993		

				changes are made
14.	Sound Transmission (dB)	50 mm thick = 33 75 mm thick = 36	IS 9901(Part 3):1981/ IS 11050 (Part 1):1984:	As & when major design changes are made
15.	Fire resistance (Minutes)	50 mm thick = 60 75 mm thick = 120	IS 3809:1979/ BS 476 (Part 20-22):1987	As & when major design changes are made
16.	Surface spread of flame	Class 1	BS 476(Part 7):1997	As & when major design changes are made
17.	Fire propagation index (I)	3.7	BS 476(Part 6):1989	As & when major design changes are made

ANNEX II

(Clause 1.6)

PANELS PROCESS FLOW CHART



ANNEX III

(Clause 1.6)

ACCESSORIES

S.No.	Description / specification	Size
1	Accessories	
	a) Roor channel 25 m 1 14 mm 1 mm thack 50 mm	25 ± 50 ± 14
	b) Geiling channel sa min i ann chick for an ann an an ann an an an an an an an a	38 x 50 x 38
	c) Corner cover plate	125 2 125 2 2 0
	d) Bend plate	160 x 50 x 3
1	e) Verandah support	100 x 100 x 3
	f) G.I. ridge cover	150 x 150 x 3



ANNEX IV

(Clause 2.3.7)

DESIGN OF PANELS FOR USE AS WALL CLADDING

Scope: Checking the safety factor	for using Aero	ocon Paneliastateto esel a	an
external cladding download	diyera si şek	bond bee stadigs. Ic wi	.bead
Documents Used: Industrial const	INTU College o ultancy Service	of Engineering es	
and Marine 1997 - State - Marine Marine and a state and a state of the			
Thickness of the panel considered :	and the second second	75 mm	
Normai Weight		48 kg/m ²	
Dry density		633 kg/m ³	
Modulus of rupture	 A resolution to construct a sub- tion 	Same COD NE/111	
area X.	Dn/	$52.66 ka/cm^{2}$	
	NA/ot St		1.534.5
ransverse load	wet	50.64 kg/cm	
forizontal bending under udl for a shar	n of	A MARCENSE STREET	. 4 A 477
	20 m	110 km/m^2	
with a safety fac	2.3 (ii)	20X × 002	a. Este
Compressive load		2.5	
xial load capacity	·. ·	125 KN/m	
with a safety fac	tor of	25	
•	1999 A. A.	ar galar an an an an an	1. s. / T
xternal wind velocity assumed for desi	gn ⁱ sarei de l	50 m/sec.	aloda
	-		
/ind pressure = $07 \sqrt{v^2}$ and the end of	175 kg/m ²	an 140 mar a dùtha engan _a g. N	The p
ne panel size	6 m	u un n 76 en start Ponesen e ver	00.00
b	4 75 m	ng dia amin'ny tanàna mandritra Mandritra mandritra dia kaominina dia kaominina dia kaominina dia kaominina dia kaominina dia kaominina dia kaomi	20
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Steel Tub	e ,		ļ
	•	· · · · · · · · · · · · · · · · · · ·	
om IS 456 Table Max Mx = α w L _x ²		<u>ل</u>	>
α οι)454		
Assuming Continu	ity along four	edges	

Mx = 0.0454x175x4.75x4.75 = 179.25 kg.m

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Maximum Mx=179.25

Tensile stress under this moment

{179.25 x 100 x (7.5/2)}

{100x 7.5³/12}

19.25 kg/cm²

as against 20 kg/cm²

A Computer model was made in STAAD simulating the test panel 4.75m x 6.00 m. the Staad model is enclosed. The results show that the stresses are within limits for 50 m/ Sec wind

Conclussion

The panel can be used as cladding externally upto a wind velocity of 50 m/sec. bracing and fixity at four edges of the panel are necessary

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ARSon The Kumas 29.10.2015

PROF. A.R. SANTHAKUMAR Former Dean (Civil Engineering) Anna University and Former Emeritus Professor IIT (Madras) Chennai