



Ferron Panel as part of Ferrobuild Design System

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

Name and Address of Certificate Holder:
M/s Sanjivani Cement Products,
H. No. 852 (GF), Post -Belhe,
Tal - Junnar, Pune, Maharashtra, Pin-
412411
Email: sujitmatale@gmail.com
Website: www.ferrobuild.in

Performance Appraisal
Certificate
PAC No. **1066-S/2023**
Issue No. **01**
Date of Issue: **14.07.2023**



Building Materials & Technology Promotion Council
Ministry of Housing & Urban Affairs
Govt. of India
Core 5 A, First Floor, India Habitat Centre
Lodhi Road, New Delhi -110003

Tel: 011-24636705, Fax: 011-24642849
E-mail: info@bmtpc.org Website: www.bmtpc.org


**Performance Appraisal Certificate
For**

Ferron Panel as part of Ferrobuilt Design System

Issued to

M/s Sanjivani Cement Products

STATUS OF PAC

S. No.	Issue No.	Date of Issue	Date of Renewal	Amendment		Valid upto (Date)	Remarks	Signature of Authorized Signatory
				No.	Date			
1	01	14.07.2023				13.07.2024		

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PART 1: CERTIFICATION

1.1 Certificate Holder: **Sanjivani Cement Products,**
H. No. 852 (GF), Post -Belhe,
Tal - Junnar, Pune, Maharashtra, Pin-412411
Email: sujitmatale@gmail.com
Website: www.ferrobuild.in

Factory address:

At Post Nighoj, Taluka Parner,
District Ahmednagar, Maharashtra

1.2 Description of the System

1.2.1 Name of the System – Ferron Panel as part of Ferrobuild Design System

1.2.2 Brand Name – Ferron Panel / Ferrobuild Design System

1.2.3 Brief Description

Ferron panel is cladding solution for light gauge steel frames. It consists of two layers of steel mesh of galvanized mild steel, 250 MPa yield strength (minimum) with minimum cover to mesh as 2.5 mm. The two layers of weld mesh, minimum 1 mm diameter, at required intervals on either side are encased in mortar of M35 Grade. The thickness of panel comprising of steel weld mesh and mortar composite is 18 mm or above (as per the requirement). This makes Ferron panel a light weight and sleek wall unit, easy to be fitted.

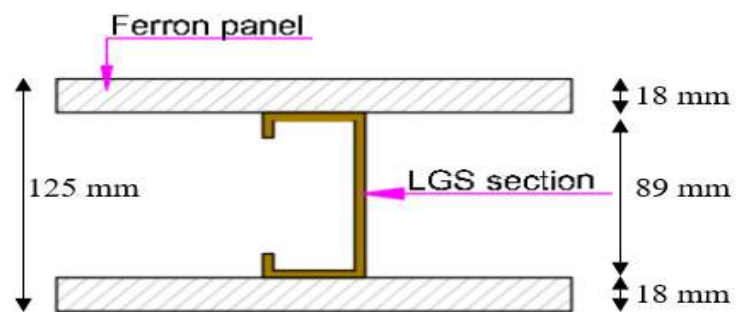
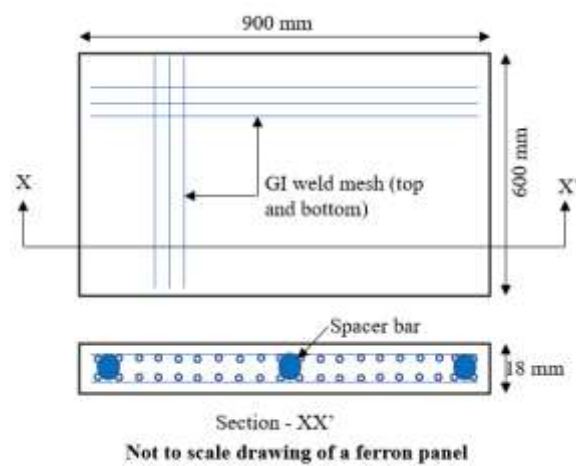
Since, ferrocement is the base material, the ferron panels have relatively high strength in direct tension, flexural tension, compression and shear. Ferron panels are screwed and/or glued to the light gauge steel frames mobilizing composite action and forming novel structural system for walls, beams and slabs. This structural system is also referred to as 'Ferrobuild Design System' or Light gauge steel and ferron composite structure.

Ferron cladding help achieve greater strength, reduced LGS consumption and durability of the structure. Transport and handling of structural components is easy as weight of individual component is less than 25 kg. On site wet work and curing is eliminated.

1.2.4 Sizes of Panels

Materials used: Combination of light gauge steel (Galvanised iron) and Ferrocement (Ferron) panels

Dimension: Ferron Panel- 900x600x18mm, & Cold formed galvanised iron section having thickness 0.55 to 1.00mm



Not to Scale cross section of ferron and
Light gauge steel composite wall

Fig. 1 Ferron Panel Drawing

1.2.5 Special features

The Ferron Panels based Ferrobuilt design system has following features;

- i. Stronger walls having higher flexural strength compared to brick masonry walls
- ii. For typical G+3 residential building, there is reduction in steel consumption, cement consumption, CO₂ emission, water consumption & dead weight in comparison to conventional RCC construction
- iii. Smaller & economical foundation size due to reduced self-weight of the building
- iv. Higher speed, quality & better seismic performance compared to RCC Construction
- v. Composite action between steel and ferron panels enhance the capacity of bare LGS sections
- vi. Higher thermal insulation of the wall. The same can be further improved with insulation material in cavities.
- vii. In case of the failure in buildings, the debris will never be formed enabling easy evacuation. Hence, suitable for strategic buildings like fire stations, hospitals etc.
- viii. For defence, ready to use bunkers can be made and transported easily. The walls have high strength under impact loads hence are suitable. The strength of the walls can be further enhanced as per the requirement.
- ix. The Ferron panels are maintenance free & its replacement is easy.

1.3 Assessment

1.3.1 Scope of assessment

Scope of assessment included conformance of manufactured Ferron panel for use as external & internal wall cladding and shuttering for slab for construction of Light Gauge Steel/mild steel based residential, commercial & industrial buildings.

1.3.2 Basis of assessment

Assessment of the suitability of Ferron Panel / Ferrobuilt Design System is based on;

- i. Verification of Static and Impact Load of LGS Sections and Ferron Panels in comparison with 230 mm Brick Wall, and Certification of Mathematical modelling for this Impact Load analysis, by College of Engineering, Pune.
- ii. Test Report for Ferron Panel Load (Flexural Strength) and Water absorption by Third Party Laboratory.
- iii. Comparative assessment of G+3 building designed with Ferrobuilt Design System & with traditional Reinforced cement concrete construction (RCC) system, published in Journal of Engineering Sciences (JES), Vol 11, Issue 7 July, 2020 ISSN.
- iv. Quality Assurance Plan adopted by PAC Holder.

- v. The visit of the Manufacturing Facility at of the Agency at Pune & Interaction with concerned Officials through Video conferencing on May 22, 2023 by BMTPC Officials, wherein the raw material specifications, Quality assurance plan, evaluation results of panels, etc. were presented in details by the Agency.

1.4 Uses and limitation of system

1.4.1 Uses

- i. Ferron panels are used as Wall cladding on light gauge steel / mild steel & Lost form shuttering for slabs in various types of building construction.
- ii. The capacity of ferron panels can be enhanced based on the requirement.

1.4.2 Special Aspects of Use/Limitations

Ferron panel is tough/hard making screwing laborious compared to other soft materials.

1.5 Conditions of Certification

1.5.1 Technical Conditions

1.5.1.1 Specification

- i. Raw materials and the finished product shall conform to the requirements of the prescribed specifications.
- ii. Since concrete cover to reinforcement is very less (about 3 mm) in the Panel, ensuring measures for protection of the wire mesh from corrosion is important. One of the important measures in this regard, is to ensure the concrete mix design with low water cement ratio & low permeability.
- iii. Adequate safeguards need to be taken to prevent the cracks in the corners/edges of the panel & while screwing the panel with steel frame.

1.5.1.2 Design Procedure

The building to be constructed using Ferrobuilt Design System shall be designed by competent structural engineer in accordance with the specifications following relevant codal requirements and constructed by trained persons only with technical support or supervision by qualified engineers and builders, based on structural designs including seismic evaluation, wind forces etc.

- 1.5.1.3** The structural engineers and building designers associated with such type of construction should be thoroughly familiar with its various structural aspects. It is also recommended that Architects and Construction Engineers who undertake such building design and construction gain familiarity with the properties and materials characteristics of Ferrobuilt Design System and its applications.

1.5.2 Quality Assurance

The Certificate Holder shall implement & maintain a quality assurance system in accordance with Quality Assurance Plan.

1.5.3 Handling of User Complaints

1.5.3.1 The Certificate holder shall provide quick redressal to Consumer/user complaints which proved reasonable & genuine and within the conditions of warranty provided by it to customer/purchaser.

1.5.3.2 As part of PACS Certification, it shall maintain data on such complaints with a view to assess the complaint satisfaction and suitable preventive measures taken.

1.6 Certification

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 Part 1 & Part 2 of this Certificate, the Ferron Panel as part of Ferrobuild Design System covered by this Certificate is fit for use set out in the Scope of Assessment.

PART 2: CERTIFICATE HOLDER'S TECHNICAL SPECIFICATIONS

2.1 General

The PAC holder shall manufacture the ferron panels in accordance with the requirements specified in the relevant Standards (See Part 5). In addition it shall follow the Company standards specifying requirements for various materials used in the manufacturing of the product.

2.2 Technical specifications

2.2.1 Raw materials

The manufacturer shall only use the raw materials supplied with the relevant documents/ prescribed Quality Assurance Plan. The raw materials shall be subject to agreed controls and tests by the manufacturer before acceptance. The list of raw materials/component & its specifications used by the Agency to manufacture Ferron panels;

S. No.	Raw materials/ component	Source	Specification	If quality certified in any form, state
1.	Cement	Ambuja Ltd.*	IS 269:2015	MTC per lot
2.	Sand	Local	IS 383:2016	Testing in 3 rd party lab
3.	Water	Local	IS 456:2000	Testing in 3 rd party lab
4.	Weld mesh	Jindal Steel*	IS 1566:1982 (Reaffirmed: 2020)	MTC per lot

**Equivalent make*

2.2.2 Performance parameters for Ferron Panel

S. No.	Performance Characteristics	Criteria	Test Method	Codal reference
1.	Flexural strength	Minimum flexural strength: 24 N/mm ²	Two-point flexural test on actual ferron panel	IS 516 – Methods of tests for strength of concrete.
2.	Water absorption	Less than 10%		IS 2185 - 2005
3.	Density	Not less than 2200 kg/m ³		IS 1199 – Methods of sampling and analysis of concrete

2.3 Manufacturing of the product

2.3.1 List of Manufacturing Equipment with the Agency

S. No.	Date of installation	Name of machine and ID no.	Capacity	Number of machine	Does the unit have maintenance schedule	Remarks
1	2	3	5	7	8	9
1.	10-08-2021	Vibrating table	1 panel at a time	2	Yes 10 days	
2.	11-08-2021	Ferron moulds	1 panel at a time	200	Yes 6 days	
3.		Miscellaneous instruments*				

**Miscellaneous instruments include cutting, bending & welding Tools for bar skeleton of Ferrocement, Pliers, hooks, Mortar Mixer, Trowels, Plumbs, curing hose, small nozzles and water pumps.*

2.3.2 The manufacturing process comprises of the following steps;

- i. Preparation of reinforcement cage as per design
- ii. Preparation of mortar as per design
- iii. Preparation of moulds for casting (cleaning and applying oil to moulds)
- iv. Inspection of prepared mould prior to casting
- v. Laying of the reinforcement in moulds
- vi. Pouring of mortar inside the moulds
- vii. Compaction of poured mortar
- viii. Setting of poured mortar
- ix. Demoulding of the panels
- x. Curing of panels in water tanks for 7 days
- xi. Curing of panels in stacking yard up to 14 days
- xii. Subjecting panels to daylight up to 28 days
- xiii. Check for quality
- xiv. Transfer to dispatch yard

The process is in batches. The batch size depends on number of moulds available for casting on a given day. Usually, the batch size is 200 panels. Procurement of machinery to increase the batch size per day to 500 panels is in process.

2.4 Construction Sequence for Ferrobuilt Design System

This construction form involves two constituents namely;

- a) Factory cast Ferrocement panels (600 mm x 900 mm x 18 mm)
- b) Light Gauge Steel (LGS)

Ferrocement is thin reinforced cement mortar. It involves closely spaced small diameter reinforcement mostly in the form of mesh. The reinforcement details of the Ferrocement – panels employed in the present work are shown Fig. 2

as below. LGS steel is cold form steel. Due to slender cross sectional elements it is susceptible to local instability, if not stiffened. The Fig. 3 presents the plan view of Ferrocement-LGS composite wall. The wall has LGS section sandwiched between two Ferrocement panels. As per construction sequence, LGS column-beam framing is erected at the site, Ferrocement panels are subsequently attached (with 900 mm side vertical) from both sides employing self-taping screws at regular spacing along the length and polymer based binder (Fig. 3). The thickness of the wall works out to be 125 mm if LGS leap channel of 89 mm x 40 mm x 1 mm is employed.

The Fig. 4 provides a typical photograph of partially complete Ferrocement-LGS composite building. Under lateral loads, wall in such form of construction would behave more like a shear wall than infill in framed buildings, thus ensuring box action.

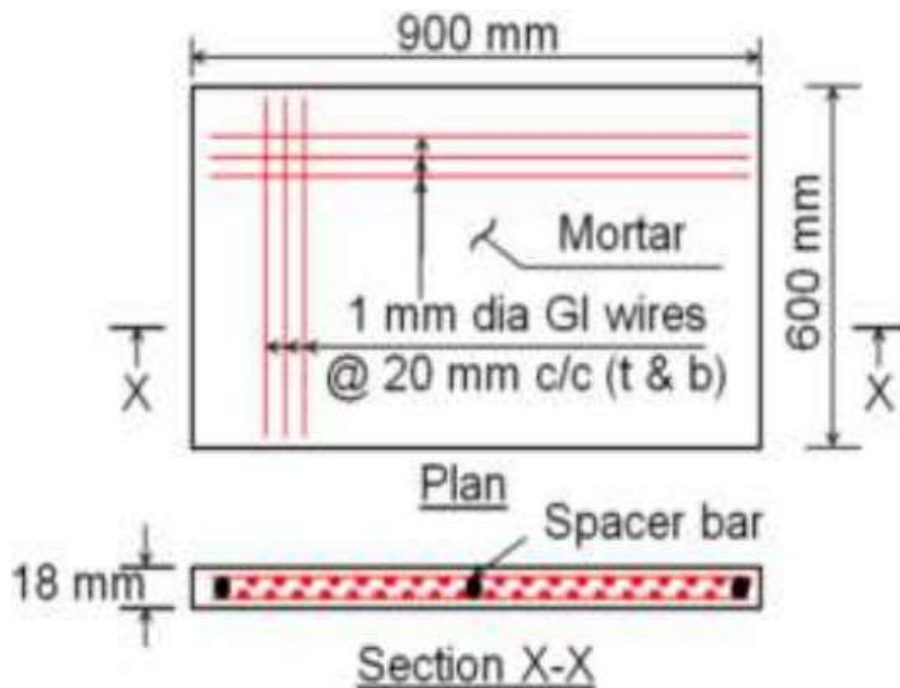


Fig. 2 Reinforcement details of Ferrocement panels

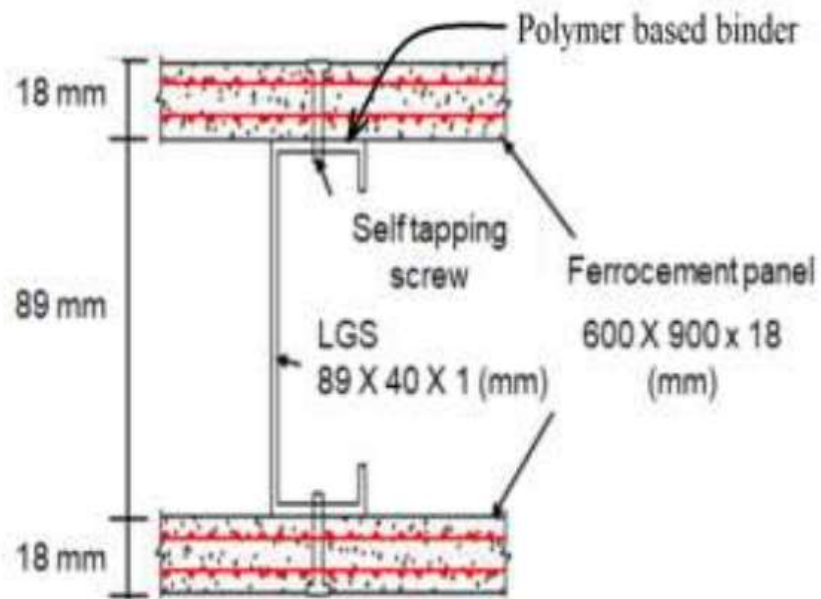


Fig. 3 Plan of Ferrocement-LGS wall section



Fig. 4 Photographic view of partially completed composite building

Panel Junction details

Jointing of panel including the joint treatment with recron tape and polymeric binder are as per the details below;

i. L Junction:

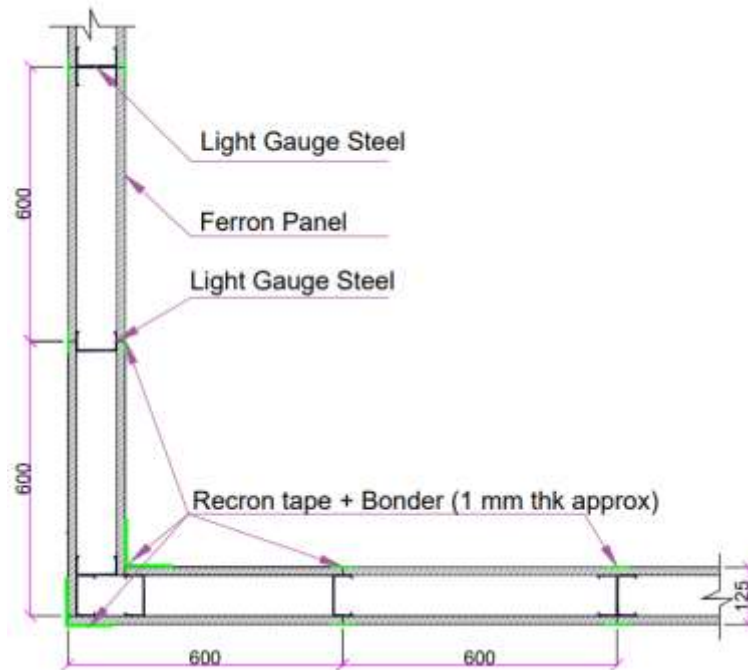


Fig. 5 L Junction

ii. T Junction:

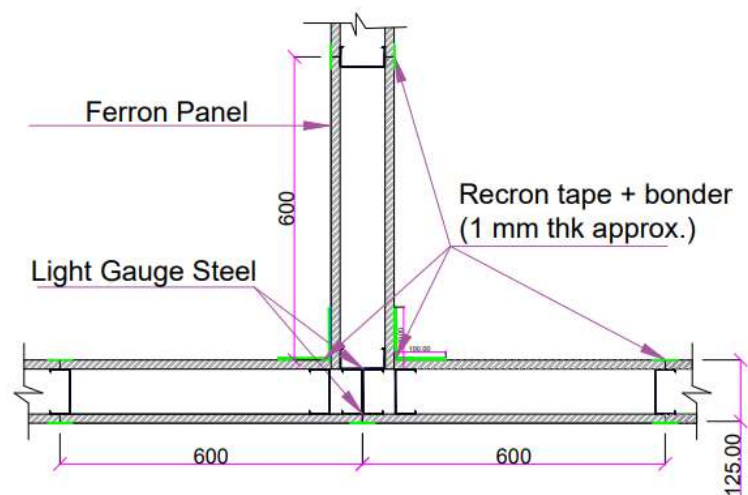


Fig. 6 T Junction

Treatment of Vertical and horizontal joints

Recron tape with high strength non shrink epoxy bonder (as seen green in colour in images below) is used at all the joints. The width of the recron tape is 50 mm and runs all along the length of the joint and the thickness is approximately 1 mm as seen in images below. At 90-degree junctions, the width of recron tape is increased to 100 mm for additional strength.



Fig. 7 Recron tape + epoxy bonder at joints for walls



Fig. 8 Recron tape + epoxy bonder at joints for slabs

Electrical & Plumbing Services

Electrical and plumbing services are outside the scope of this Certificate, however, in designing and installing these services, precautions must be taken to avoid the possible risk of long term damage to the structure or the services by e.g. the ingress of water, water vapour or condensation from

water service pipes. The insulation may be provided as per the requirement. One unit with internal finishes has also been shown below.



Fig. 9 Electrical conduits



Fig. 10 Provision of Insulation



Fig. 11 Internal finish and Accessories

2.4.2 Design & Installation Procedure

- i. The prerequisite in design for ferron installation is to have supporting light gauge steel members along the long edges of the ferron panels. This care is taken during the detailed design process.

- ii. The panels are bolted with LGS Channel section with self-tapping screws (3-4 mm diameter), 4 in numbers along each of the long edges and 2 in numbers along each of the short edges.
- iii. Typical drawing for ferron installation is provided during training and also on site.
- iv. Care needs to be taken while cutting the ferron panels on site to meet the actual on site dimensional requirement.
- v. Any person involved in fabrication of mild steel structures is suited to perform this job. All the resources are trained prior to work on site.

2.5 Inspections & Testing

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

2.5.1 Storage & Handling at the factory end before dispatch

Storage - Final manufactured product lot sample are to be tested for required performance, and then to be packed for despatch, as per the industrial norms.
Handling - Product needs to be packed & handled as per industry standards or contract terms.

2.5.2 Guarantee/Warranty provided by the PAC Holder

Responsibility of the product is taken up to delivery on site. Any panel which is not fit for use on site is to be given replacement. The terms are decided on case-to-case basis prior to dispatch.

2.5.3 Services provided by the PAC holder to the Customer

The PAC holder shall provide pre-sale advisory regarding the product. Customer/user may obtain from the PAC holder details of the advice that may be provided to him.

The PAC holder shall also provide after sales service on customer to customer basis. Users / Customers shall ascertain from the PAC holder the type of services and the conditions, the PAC holder is prepared to provide.

2.5.4 Responsibility

The specific design & construction using Ferron Panels is the responsibility of the Client with the instructions, supervision and guidance of the PAC holder.

PART 3: BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

3.1 Assessment

3.1.1 The assessment has been done as per the provisions of the standards listed in Part-5 of this Certificate.

3.1.2 Finite Element Method (FEM) Analysis Report titled “Verification of Static and Dynamic impact Load of LGS sections and Ferron Panels in comparison with 230 mm thick brick wall” has been developed by Civil Engineering Department MIT Kothrud, Pune. This mathematical modeling for the impact load analysis for Ferron panel has been certified by Applied Mechanic Division, Civil Engineering Department, College of Engineering, Pune. The evaluation results are as per the details below;

Comparison of Impact Resistance of Wall Panels

Case	Wall description	Static flexural load capacity (N)	Static Flexural strength of LGS + Ferron panel w.r.t., Brick masonry	Dynamic factor (η)	Striking velocity of object	Equivalent dynamic load (N)	Impact Strength of LGS + Ferron w.r.t. Brick masonry
1	Brick wall 600 mmx 900 mmx 230 mm thick	3,500 N	--	$\eta = 28.35$ velocity	20 KMPH	123.46 N	--
			--	$\eta = 51.52$ for	50 KMPH	61.94 N	--
2	LGS channel with one ferron panel	35,000 N	10 times	$\eta = 3.51$	For 20	9971.5 N	80.76 times
				$\eta = 6.391$	50 KMPH	5476.45 N	88.41 times
3	LGS channel section with two ferron panels, each attached to channel flange	142,000 N	40 times	$\eta = 2.483$	20 KMPH	56383 N	456.69 times
				$\eta = 4.5152$	50 KMPH	31006.38 N	500.58 times

3.1.3 Test Report for Ferron Panel Load (Flexural Strength) and Water Absorption as conducted at Durocrete Engineering Services Pvt. Ltd., Pune

Description	Panel Size	Date of Testing	Flexural strength of the panel sample (3PL/2BT ²)
Sample 1	0.6 x 0.9 m 1.2 mm dia wire mesh	May 11, 2017	34.41 N/mm ²
Sample 2	0.6 x 0.9 m 1.6 mm dia wire mesh	May 17, 2017	32.75 N/mm ²

Concrete Unit Water Absorption

Concrete Block Description: Size 295 x 150x 20 mm

Date of Testing: July 13, 2017

S. No.	ID Mark	Wet Weight (g)	Dry Weight (g)	Water Absorption (%)	Avg. Water Absorption (%)
1	--	2007	1859	7.96	***

3.1.2 Optimal Design in comparison to RCC System as per Published Journal Paper

A published journal paper (Journal of Engineering Sciences JES, Vol 11, Issue 7 July, 2020 ISSN) illustrates the comparison between quantities required for a G+3 building in RCC and LGS+ferron composite. The paper is authored by Dr. Arun N.Purandare, Chartered Engineer & promoter of Ferrobuild Design System, and faculty & Post Graduate Student from MIT World Peace University, Pune. The paper includes the architectural as well as design details for both the systems.

The results in terms of reduction in various raw materials quantities & Co₂ emission with use of Ferrocement LGS building vis-a vis RCC building is summarized in table below:

Reduction in various Raw Materials quantities & Co₂ emission with LGS+ Ferro Composite vis-à-vis RCC Construction

Description	RCC building	Ferrocement LGS building	Reduction
Dead weight (KN)	11011.49	5769.319	60%
Cement (Kg)	342750	235000	30%
Steel (Kg)	44514	32000	28%
Brickwork (Kg)	1083000	0	100%
Chemically bound water (Kg)	171375	50000	70%
CO ₂ emission	501.8	354.55	30%

The Agency has been advised to get the Assessment/ Evaluation of the design efficiency achieved with the use of Ferron panels (with high flexural strength) as load bearing component with LGS, through reputed Institution/ Laboratory. In response to the same, the Agency has informed that it has initiated the work in this regard with IIT, Roorkee.

3.2 List of projects – Design & Supply

The Agency has submitted the list of projects (Design + Supply), as per the details below;

I. Residential

- i. G+2 Hybrid, 4500 sq.ft., Pune (Completed)
- ii. G+1 LGS, 4000 sq.ft., Pune (Completed)
- iii. Ground Floor structure, 2300 sq.ft., Sangli, Maharashtra (Completed)
- iv. G+1 LGS, 4000 sq.ft., Nipani, Karnataka (Completed)
- v. 5th Floor Extension, 1900 sq.ft., LGS with Ferron roof, Pune (Completed)
- vi. G+1. LGS, 5000 sq.ft. Hedvi, Dist. Ratnagiri, Maharashtra (Completed)
- vii. Terrace enclosure, 200 sq.ft., Pune (Completed)
- viii. G + 1 Farmhouse, 2000 sq.ft., Pune (Completed)
- ix. Terrace Extension, 300 sq.ft., Pune (Completed)
- x. Terrace Extension, 150 sq.ft., Pune (Completed)
- xi. Terrace Extension, 1200 sq.ft., Pune (Completed)
- xii. G+1 Villa. 7500 sq.ft., Palghar (LGSF design Completed)

II. Non-residential

- i. EnPro Engineering, 20,000 sq.ft., LGS- Ferron walling within steel foundry (Completed)
- ii. ISB&M College, Lavale, Pune, Floors 3 & 4 of hostel, LGS with Ferron as slab (Completed)
- iii. Primary Education Centres, 5000 sq.ft., Baramulla, J & K (Completed)
- iv. Hangout Hotel, 1300 sq.ft., Pune (Completed)
- v. Indian Consulate, 24,000 sq.ft., Kabul, Afghanistan (In-process)

III. Resorts

- i. Anandam Resort, 1300 sq.ft., Villa, Velhe, Pune (Completed)
- ii. Woolloomooloo Resort, 1600 sq.ft., Tiny Cottages, Shilimb (Completed)
- iii. Karandi Valley Resort, LGS + Ferron walls (Completed)
- iv. The Farmhouse, Hybrid, 1000 sq.ft., Karjat (Completed)
- v. Chira Meadows, 8000 sq.ft., Dapoli (Completed)

IV. In process (Design + Supply)

- i. Residential bungalow, 1500 sq.ft., Mauritius
- ii. G + 3 residential building, 5200 sq.ft., Pune

- iii. G+1 Farmhouse Villa, 4000 sq.ft., New Delhi
- iv. Terrace Extension on residential building, (5th Floor) 2000 sq.ft., Pune
- v. Terrace Extension on residential building, (5th Floor) 3800 sq.ft., Pune
- vi. Kamayani School Extension, (3rd floor), 5000 sq.ft., Pune
- vii. K.K. Wagh College Extension, (5th Floor), 60,000 sq.ft., Nashik

Photographs of some completed Projects with ferrobuild Design System & Ferron Panels as Cladding;

- i) G+2 on RCC Stilt, 4200 sq.ft. area, Year of construction-2017 (Location; Lane No. 14, Shikshaknagar, Kothrud, Pune)



Fig. 12 Different stages of construction

- ii) G+1 Bungalow Design: Ferrobuilt Design, 5100 sq.ft. area, Year of construction-2018 (Location; Hedvi Village, Tal Ratnagiri, Maharashtra)



Fig. 13 Different stages of construction

- iii) G+1 Private Residence Design: Ferrobuilt Design Systems, 6350 sq.ft. area, Year of construction-2021 (Location; South Extension, New Delhi)



Fig. 14 Different stages of construction

- iv) 5 Individual Cottages Design: Ferrobuilt Design Systems, 1025 sq.ft. area, Year of construction-2021 (Location; Shilimb Village, Pawana, Maharashtra)



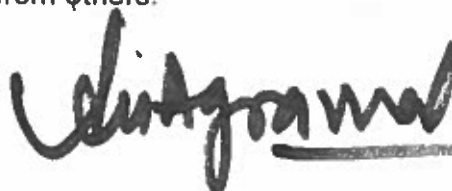
Fig. 15 Different stages of construction

PART 4: STANDARD CONDITIONS

This certificate holder shall satisfy the following conditions:

1. The certificate holder shall continue to have the product reviewed by BMBA.
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.
3. The quality of the product shall be maintained by the certificate holder.
4. The product user should install, use and maintain the product in accordance with the provisions in this Certificate.
5. This certificate does not cover uses of the product outside the scope of this appraisal.
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.
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)
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.
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.
10. If at any time during the validity period, PACH is unable to fulfil 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.
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.
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.
 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.
 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.
 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.
 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.
 17. The PAC holder shall not use this certificate for legal defence in cases against him or for legal claims he may make from others.



Place: New Delhi
Date of issue 14.07.2023

Chairman TAC & for and on behalf of
Member Secretary, BMBA

PART 5: LIST OF APPLICABLE STANDARDS & CODES

The relevant Standards for ferron panel raw materials and finished product are as per the details below;

S. No.	Materials	BIS Code
1.	Cement	<ol style="list-style-type: none"> 1. IS 650:1991 (Reaffirmed: 2018) – Specification for standard sand for testing of cement 2. IS 3535:1986 (Reaffirmed: 2018) – Methods of sampling hydraulic cement 3. IS 4031:1996 – Methods of physical tests for hydraulic cement 4. IS 4032:1985 (Reaffirmed: 2019) – Methods of chemical analysis of hydraulic cement 5. IS 8112:1989 (Superseded by IS 269:2015)– Specification for 43 grade ordinary Portland 6. IS 12269:1987 (Reaffirmed: 2008) – Specification for 53 grade ordinary Portland
2.	Sand (Natural / Crushed)	<ol style="list-style-type: none"> 1. IS 383:1970/ IS 383:2016 – Specification for coarse and fine aggregates from natural sources for concrete 2. IS 2386:1963 (Reaffirmed:2021)– Methods of test for aggregates for concrete
3.	Water	<ol style="list-style-type: none"> 1. IS 456:2000 – Code of Practice for plain and reinforced concrete
4.	Steel	<ol style="list-style-type: none"> 1. IS 432:1982 (Reaffirmed: 2020)– Mild steel & medium tensile steel bars and hard drawn steel wires for concrete reinforcement
5.	Welded mesh and chicken mesh	<ol style="list-style-type: none"> 1. IS 16014:2012 – Mechanically woven, double-twisted, hexagonal wire mesh gabions, revet mattresses and rock fall netting (galvanized steel wire or galvanized steel wire with PVC coating) – Specification 2. IS 1566:1982 (Reaffirmed: 2020) – Specification for Hard-Drawn Steel Wire Fabric for concrete reinforcement 3. IS 280:1982 (Reaffirmed: 2021) – Mild steel wire for general purpose

S. No.	Materials	BIS Code
6.	Mortar and concrete	<ol style="list-style-type: none"> 1. IS 456:2000 – Code of Practice for plain and reinforced concrete 2. IS 516:1959(Reaffirmed:2018) – Method of test for strength of concrete 3. IS 2770:1967 (Reaffirmed: 2022) – Methods of testing bond in reinforced concrete 4. IS 3085:1965 (Reaffirmed: 2021) – Method of Testing for permeability of cement mortar and concrete 5. IS 5816:1999 (Reaffirmed: 2018) – Method of test for splitting tensile strength of concrete 6. IS 14858:2000 – Compression testing machine used for testing of concrete and mortar – Specification
7.	Canal lining	IS 10430:2000 – Criteria for design of lined canals and guidance for selection of type of lining (Second Revision)
8.	Ferrocement water tank	IS 13356:1992 (Reaffirmed: 2022) – Code of Practice for Precast Ferrocement water tanks upto 10000 litre

Further, Ferrocement is the base material for ferron panels. Hence, the Codes and Standards applicable for ferrocement are applicable for ferron panels. There is a long history of the use of ferrocement &, Chapter number 11 of Maharashtra PWD's handbook on ferrocement, titled as "Standardization of Ferrocement Technology" has been referred & submitted by the Agency, covering details on the subject.

CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Ferron Panel as part of Ferrobuild Design System** is satisfactory if used as set out above in the text of the Certificate. This Certificate PAC No. 1066-S/2023 is awarded to **M/s Sanjivani Cement Products**.

The period of validity of this Certificate is for a period of one year i.e. from **14.07.2023 to 13.07.2024** as shown on Page 1 of this PAC. This Certificate consists of pages 1 to 32.



Dr. Shailesh Kr. Agrawal
Chairman, TAC
& Member Secretary, BMBA
Building Materials and Technology Promotion Council
Ministry of Housing and Urban Affairs, Govt. of India
Core 5A, 1st Floor, India Habitat Centre
Lodhi Road, New Delhi-110003



On behalf of BMTPC Board of Agreement Chairman, Technical Assessment Committee (TAC) of BMBA & Member Secretary, BMTPC Board of Agreement (BMBA) Under Ministry of Housing and Urban Affairs, Government of India

Place: New Delhi, India

Date: **14.7.23**

PART 6: LIST OF 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 BMBA
PAC	Performance Appraisal Certificate
PACH	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: www.bmtpc.org

Annexure – 1

Quality Assurance Plan

I. QAQC for Raw materials:

- i. Raw materials are procured from certified vendors.
- ii. Visual checks and field tests are performed.
- iii. MTC/Testing is carried out at regular intervals.

II. QAQC in process:

- i. Inspection of moulds prior to casting
- ii. Inspection of reinforcements cages prior to casting
- iii. Inspection of cutting oil
- iv. Inspection of mortar prior to casting
- v. Minimum duration of vibration is controlled by the senior worker to ensure proper

III. QAQC of finished product:

- i. Confirmation of dimension accuracy (especially the thickness)
- ii. Field test like hitting the specimen with hammer/stone and judging the concrete strength based on sound. This test helps the most to ensure strength requirement for site staff.
- iii. Stacking in water tank is done based on casting date to monitor the curing duration in the water tank
- iv. For clients with specific requirements, laboratory tests on the final specimens are performed.
- v. Water cement ratio and/or slump is continuously monitored by the senior worker as guidance from supervisor in charge.

IV. Quality Assurance during Installation/Erection:

- i. The ferron panels should be screwed to the adjoining light gauge steel members with 3-4 mm diameter screws 10 in numbers for a standard sized ferron panel.
- ii. Adjoining light gauge steel frame should provide bearing length of at least 10 mm to the supported edge of the ferron panel.
- iii. The gaps between screwed ferron panels should be filled with non-shrink, high strength, epoxy-based bonder.
- iv. Dimensional accuracy, thickness and the strength of each of the ferron panels must be confirmed by the person performing installation.

Annexure-2**Construction Manual****1. Stacking and transport:**

Ferron panels shall be stacked in sleeping position (900 mm x 600 mm surface should be in contact with the bed) in layers in stacking yard and during transport.

**2. Erection of LGS frames:**

LGS frames shall be designed to meet the ferron panel installation requirements by a qualified engineer. It should be ensured that each of the ferron edges get a LGS supporting member.

3. Installation on light gauge steel frames:

- i. Mechanical connection between ferron panels and light gauge steel frames shall be achieved using 10 self-tapping screws of 4 mm diameter. 3 screws on each of the long edges and 2 screws on each of the short edges.
- ii. Installation of the ferron panels should be done in layers. Bottom layer first.



4. Cutting:

Whenever necessary, ferron panels are to be cut using tile cutter in required shape and size.



5. Groove filling:

The grooves between ferron panels shall be filled in using high strength epoxy bonder.

6. Finish:

Ferron clad walls essentially provide concrete surface. Any finishing compound (render) that works well for relatively smooth concrete surface can be used.