

Name and Address of Certificate Holder: M/s Novel Assembler Pvt. Ltd. B-1418, Dalamal Tower, Nariman Point, Mumbai-400021 Maharashtra Tel: +91 22 22872096 E-mail: www.novelbuildtec.com Performance Appraisal Certificate No. PAC No.:**1044-S/2019**

Issue No. 01

Date of Issue: 29.04.2019





STAY-IN PLACE PVC WALL FORMS

pulbc

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





PERFORMANCE APPRAISAL CERTIFICATE

FOR

STAY-IN PLACE PVC WALL FORMS

ISSUED TO

M/s NOVEL ASSEMBLER PVT. LTD.

STATUS OF PAC: 1044-S/2019

| S. No | Issue No. | Date of Issue | Date of renewal | Valid up to (Date) | Remarks | Signature of authorized signatory |
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PAC NO. 1044-S/2019

Issue No. 01 Date of Issue: 29-04-2019





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PART 1 CERTIFICATION

1.1Certificate Holder:M/S NOVEL ASSEMBLER PVT.LTD
B-1418, Dalamal Tower, Nariman Point,
Mumbai (Maharashtra) - 400021
Tel: 022-22872096
Email: vj@novelbuildtech.com

1.2 Description of System

- **1.2.1** Name of the System "Stay-in-Place PVC Wall Forms"
- 1.2.2 **Brief Description** – Novel wall System consists of rigid poly-vinyl chloride (PVC) based polymer components that serve as a permanent stay-in-place durable finished form-work for concrete walls. The extruded components slide and interlock together to create continuous formwork with the two faces of the wall connected together by continuous web members forming hollow rectangular components. The web members are punched with oval-shaped cores to allow easy flow of the poured concrete between the components. The hollow Novel Wall components are erected and filled with concrete, in situ, to provide a monolithic concrete wall with enhanced curing capacity due to water entrapment, as the polymer encasement does not allow the concrete to dry prematurely with only the top surface of the wall being exposed to potential drying. The polymer encasement provides crack control vertically and horizontally for the concrete, and provides vertical tension reinforcement thus increasing the structural strength of the wall. The resulting system is unique and provides substantial advantages in terms of structural strength, durability enhancement, weather resistance, seismic resistance, design flexibility, and ease of construction. Steel dowels are necessary to anchor the wall to the concrete foundation.

This system is adaptable to any building design i.e. residential, commercial, industrial, low and high rise buildings. Novel Wall is very efficient in terms of acoustic performance, weather proof and highly resistant to termites attack, and is virtually maintenance free. The polymer components contain up to 55% recycled content and are recyclable. The system has specific advantage to use near coastal areas as durability not affected due to salt-peter action.

1.2.3 Size of Panels

1.2.3.1 *Size:* Novel Walls have been developed in various cross-sectional sizes as per project requirement. The common sizes are 64mm, 126mm, 166mm & 206mm. However available Novel System types are as follow:





| Novel | Wall Thickness | | |
|-------|----------------------|------------------|-------------------------|
| | Overall (Nominal) | Concrete Core | Insulation ¹ |
| N64 | 64 mm | 60 mm | 0 |
| N126 | 126 mm | 120 mm | 0 |

- N64 walls are erected individually and not preassembled, • except for headers and sills.
- Pre-assembled walls sections are used for walls over 4300 mm (14') high
- The height of walls made with the Formwork vary according to • the requirement.
- N126 walls less than 4300 mm (14') high are erected • individually except for walls of unique projects and for headers and sills.

1.3 **Panel Components**



Main Panel - 250 mm



90.00

Connector – 158mm



Connector -33mm















78.00

78.00

Jointer Connector



Window Frame



Starter











3-WAY (T-CONNECTOR





Basic Frame



Azteca Frame





Jointer Panel





1.4 Uses and Limitations of System

1.4.1 Uses:

As high capacity vertical and shear load bearing structural walling in multi-storey construction: the Novel Wall shall be filled with reinforced concrete suitably designed to resist the combined effect of lateral and gravity loading.

- **1.4.2** *Limitations* for using Novel System on the basis of performance, safety, geo-climatic Conditions:
 - Stay in Place PVC Forms Walls shall need preplanned & installed MEP/Services for concealed network.
 - Door and Window position shall not be changed after pouring of concrete.
 - Erection of panels shall be under supervision of trained staff.

1.5 Design Consideration

1.5.1 General

The walls shall be designed to accommodate a wide range of axial, wind and seismic load conditions, using the equations developed for conventional and slender concrete walls. However, one of the unique properties of Novel walls is the ability of the permanent polymer formwork to provide concrete confinement and reinforce the concrete in tension. There are two main structural elements used in the wall, namely panel sections and box connectors. The panels come as three-cell sections 250 mm wide, while the box connectors are one-cell sections 64 mm wide. The webs of these elements have oval cores which allow lateral flow of the poured concrete between the adjacent cells and provide a mechanical transfer of forces between the concrete and the polymer thus creating a composite action.

1.5.2 Structural

- 1 The buildings constructed with Novel walls shall be studied and designed as reinforced concrete structure since the parameters required for their design are the same as needed for traditional reinforced concrete. In the calculation model, the building shall be designed in accordance with IS 456:2000, as applicable.
- 2 The system is intended for use where Architectural drawings are available and satisfy the various requirements. The Architects and the designer team of the concerned developer (client) is responsible for the drawings and overall building design to comply with the various regulatory requirements applicable to the area.





- 3 The design engineer shall liaise with the engineer of the developer and provide the necessary loading information for the design of the foundation.
- 4 The system shall be designed to provide the required performance against the loads to be taken into account in accordance with IS 875 (Parts 1-5):1987 and the data given by manufacturer for various panels. It shall also provide the required bearing resistance for earthquake and wind forces as per IS 875 (Part 3):2015 and IS 1893 (Part 1):216, wherever applicable.
- 5 Foundation shall be specifically designed in accordance with provision given in IS 1904:2005. The design concept is same as that of the conventional building design. The safe bearing capacity and soil properties (soil investigation report)) shall be provided from the site after soil investigations. Foundation shall be designed based on the soil investigation report. Both single and double panels should have starter bars from either foundation or ground floor slab. All foundations should be designed by experienced engineer with appropriate reference.
- 6 The design assumptions, detailed calculations, references to necessary and detailed design drawings shall be made available on demand, if required. The structural design calculations should clearly demonstrate structural integrity and stability including connection details. Design calculations should have proper sketches annotated in English.
- 7 In addition, any other requirement regarding safety against earthquake need to be ensured by the designer as per prevailing codal requirements.

1.6 Basis of Assessment

1.6.1 Scope of Assessment

1.6.1.1 Scope of assessment- Suitability of Novel System for use as a load bearing and non-load bearing internal and external walls to build residential, commercial and industrial buildings.

1.6.2 Basis of Assessment

Assessment of the suitability of the Stay in Place PVC Forms for shear walls is based on:

1 Recommendations of IIT, Hyderabad after test results for load carrying capacity of 64mm thick Novel wall.





- 2 Quality Assurance of flexible PVC components, Calcium carbonate precipitated & activated for paints, Titanium dioxide, TMT bars and Ready Mixed Concrete.
- 3 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.
- 4 Fire Resistance Test on a test specimen of size 3000 x 3000 x 150mm with M30 Grade infill concrete by Spectro Analytical Labs Ltd.
- 5 Test Reports of thermal performance on panel units filled with concrete and insulated on the exterior with rigid polymer insulation by Trow Consulting Engineers Ltd. for Royal Building Systems (cdn) Ltd.
- 6 Assessment of quality assurance procedures implemented for Quality Assurance Scheme followed by the Certificate holder for process control as per Quality Assurance Plan attached at Annex I.
- 7. Test results of Tensile and Impact strength of Novel Wall by Atmy Analytical Labs Pvt.,Ltd, Faridabad

1.7. Production Machinery & Equipment

The manufacturer has installed the following major equipment in the plant for production and installation of panels, as reported:

| S 1 | Date of | Name of machine | Make | Capacity | No. of |
|------------|--------------|--|----------------------|---|---------|
| No | installation | and ID No | | | machine |
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1. | Jan., 2018 | Conical Twin screw Extuder(SJZ65/132) | Edward | 3tons/day | 1 |
| 2. | Jan., 2018 | Conical twin screw extruder | Edward | 3tons/day | 2 |
| 3. | March, 2018 | Punching m/c | SIVIA | 33 holes / min / head 1.3-1.5 meter /min | 1 |
| 4. | Jan., 2018 | Double head saw | SIVIA | 0-90 ⁰ Angle cutting | 1 |
| 5. | Jan., 2018 | Milling machine | SIVIA | 6 holes/min | 1 |
| 6. | Dec., 2017 | Mixer | Jogindra | 5 batch/hr | 1 |
| 7. | Jan., 2018 | Air compressor | Chicago pneumatic | 84cfm | 1 |
| 8. | Jan., 2018 | Chiller | GWK | 206 KW / 59TR | 1 |
| 9. | Feb., 2018 | Grinder | Jogindra | 120KG/HR | 1 |
| 10. | June, 2018 | Pulverize | Trichy Plastics | 300KG/HR | 1 |





1.8 Extrusion Process:

- 1. Novel Components are manufactured from extruded polyvinyl chloride (PVC). The extrusions consist of two layers, the substrate (inner) and Modifier (outer). The two layers are co- extruded during the manufacturing process to create a solid profile. A few of the components are manufactured with a single extrusion of solid Modifier material.
- 2. The extruder for the substrate material laying horizontally and the extruder for the modifier is on approximately a 45° angle. The two extruders operate concurrently. Each extruder has a separate, individual hopper that is filled with the appropriate material. The raw material is fed into the screw barrels of the extruders. The material is heated in the barrels to molten form where the temperature is electronically controlled. The screws push the molten raw material through the die. The substrate and Modifier are combined in the die, with the Modifier covering the base layer substrate.
- 3. The extruded profile is run through one or more watercooled vacuum dies until it hardens and is approximately at room temperature. Then the profile is pulled by a beltpuller and is extended through to a chop saw that is activated by a measuring wheel, which ensures pieces are cut to the correct length.
- 4. Labeling of the components takes place in the coring, cutting, foaming or assembly areas, whichever is performed last.

1.8.1 Storage

- 1. Before and after fabrication, the product is stored on carts, pallets or in isolated stacks. The carts, pallets and stacks are tagged with the Sales Order and Bill of Material Number to provide tracking.
- 2. Material is stored flat and in a manner that prevents distortion and warping of the finished profiles.

1.8.2 *Packaging and Shipping*

1. Product is normally held for a minimum of 24 hours prior to shipping. Product is packaged in skids, loaded as loose components into trailers or containers, or loaded as assembled sections onto flatbed trucks. Final inspection is performed during packaging and shipping.





2. Packing materials such as cardboard are used to protect product loaded as loose component.

Process flow chart is shown in Annex II.

1.9 Conditions of Certifications

1.9.1 Technical Conditions

- 1. Raw materials and the finished wall components shall conform to the requirements of the prescribed specifications.
- 2. Novel Assembler Pvt.Ltd shall provide full details of erection of the panels to the agency who may be engaged for construction.
- 3. The Certificate is being issued after visit to the site and satisfactory test results of the panels from NABL Accredited labs/ Institutes as per Indian conditions and Standards.

1.9.2 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.

1.9.3 Handling of User Complaints

- 1.9.3.1 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.
- 1.9.3.2 The Certificate holder shall implement the procedure included in the Scheme of Quality Assurance (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.

1.10 Certification

1.10.1 On the basis of assessment given in Part 3 of this Certificate & subject to the Conditions of Certification, uses & limitations set out in this Certificate and if selected, installed & maintained as set out in Parts 1 & 2 of this Certificate, the Novel System covered by this Certificate are fit for use as 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 Novel Components 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 panels. (Part 5)

2.2 Specifications

| Sr. | Raw material/ | Source | Specifications |
|-----|---|--|----------------|
| No. | component | | |
| 1 | 2 | 3 | 4 |
| 1 | PVC-Resin | Reliance Industries, Ryan International | IS 9766-2013 |
| 2. | Calcium carbonate (CaCO ₃) | PV Enterprises, Chemie Range | IS 8767-2014 |
| 3. | Titanium dioxide (TiO ₂) | Chemie Range | IS 9788-2014 |
| 4. | Polyethylene Wax | Eklingjee Polymers Private Limited, Unicorn Petroleum Industries Pvt. Ltd. | ISO 1133-2011 |
| 5 | TMT Steel | Jindal Steel, JSK Corporation Pvt. Ltd. | IS 1786-2013 |
| 6 | RMC-M20 grade or as per requirement | Pavani RCM, K&T Enterprises | IS 42926-2017 |

2.2.1 Raw Materials

2.3 Construction and Workmanship

2.3.1 Erection of panels

- 1. As per the building plan and design, each wall components shall be cut at the factory using an automated cutting saw.
- 2. The first course shall be begin with a box connector at a corner or a T-intersection and the two adjacent panels. The corner box connector or three way box connector shall be lifted and guided 100 mm (4") onto the top of one panel.
- 3. These two components shall be lifted together to allow the box connector to be joined onto the top of the other panel. The box connector shall be slide down between the two panels and is located over the foundation dowel.
- 4. The pieces shall be checked to ensure that the correct components are installed and properly oriented and that the coring is aligned.
- 5. Bracing shall be provided at the top and bottom of the corner or T-intersection assembly and the components are screwed together at the top after the assembly is accurately plumbed.





- 6. The erection of Novel components shall continue sequentially, in accordance with the Novel layout drawings, including the components for doors, windows and openings.
- 7. Temporary bracing and steel reinforcing bars shall be installed as the wall erection proceeds.

2.3.2 Placing of Reinforcement

Reinforcing steel bars are provided as specified on the structural drawings for the project.

Vertical steel reinforcement (re-bar) required as per design shall be placed in the box connectors or in the cells of the panels at regular intervals to correspond with the design of reinforcement required in the wall. The vertical bars shall be tied to the foundation dowels by lifting the box connectors approximately 12". This must be done prior to placing the horizontal bars except corners. This will provide solid attachment to footings. The vertical re-bar is most easily put in place full length after the wall assembly is erected and prior to concrete placement.

Horizontal bars shall be installed after the vertical bars are placed through the coring in the Novel components. The recommended length for a horizontal bar is 5500 mm (18'). The horizontal bars shall be installed after each 4667 mm (16') length of wall is erected. The spacing of performed cores can be adjusted as per structural requirement of spacing of horizontal bars. The horizontal bars shall be lapped with the previous bars, as specified in structural drawings.

At the first corner, the hooked horizontal bars are installed from both directions.





Horizontal hooked bars are installed at the ends of straight walls prior to installing the next corner and are installed at intersections after erecting a sufficient length of wall.

2.3.3 Concrete Pour

Prior to start concrete pour, the bracing must be re-checked to ensure that all members are properly installed and that the Novel System components are located, aligned and plumbed. The concrete specified shall be highly workable, free flowing mix





poured from the top into the cavities using a small hose to go down at least 1.5 to 2m into the cavities for directly pumping the concrete from ready mixed concrete truck. For small building construction, concrete can be poured manually using a funnel. Filling the panels with concrete shall be done in three layers of 1m height with an interval of 1 hour between each layer. There is no need to use vibrator because gravitational pressure acts to selfcompact the concrete inside the water tight cavities when selfcompacting concrete is used. When normal concrete is used the vibration is provided with flat hand floater at the lower joint of stay form.

2.3.4 Electric and Plumbing Ducts

The electric and plumbing ducts etc. shall be placed inside the ducts. For connectors, small openings shall be made in the expanded metal.

2.3.5 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.

2.4 Manuals

PAC holder shall provide Construction, Installation and Quality Manuals and showing necessary diagrams, drawings, detailing to the customers and / or their structural designer.

2.5 Skilled/Training Needed for Installation

Skilled labourers like carpenter, masons shall be trained on the system and other unskilled labourers shall be trained in max. 30 days' time by the PAC holder. Training shall be conducted on or off site depending upon the numbers.

2.6 Guarantees/Warranties Provided by the PAC Holder

PAC holder shall provide necessary warranty of the system for manufacturing defects for a period of 2 Years and as per contract agreement of construction.

2.7 Responsibility

• Specific design using Novel Wall panels 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 machines and vehicles is the responsibility of the building developer.





PART 3 BASIS OF ASSESSMENT AND ASSESSMENT PROCEDURE BRIEF DESCRIPTION

3.1 Basis of Assessment

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

3.1.2 The assessment is based on the results & reports of

- (i) Inspection of the factory.
- (ii) Inspection of the test equipment used, test procedures followed and testing personnel involved in the laboratory of the factory.
- (iii) Assessment of quality assurance procedures implemented in the factory.
- (iv) Tests done in the factory on random samples of the panels taken by IO during inspection on the basis of performance characteristics given by the manufacturer.
- (v) Tests got done in independent laboratories by the manufacturer.
- (vi) Construction of a Demo unit of affordable housing at Amravati, Vijayawada (A.P).

Factory inspections

Inspection of manufacturing process was done. Firm has got necessary manufacturing machineries as per the process description given for manufacturing the PVC components. Routine testing of weight, water absorption and compressive strength are done. The firm is advised to establish complete testing facility for routine testing.

3.2 Tests Performed

3.2.1 In Independent laboratory

The performance tests for these panels specified in relevant Standards and listed below have been got done on the samples of PVC Components i.e Box Connectors and main panel in independent institute. The samples conform to the tests as per the performance requirements and specifications given by the manufacturer.

| Sr. No. | Material Property | Test | Unit | Value |
|---------|----------------------|---------------|--------------------|---------|
| 1. | Impact Strength | ISO-179 | Kgf/m ² | 10.275 |
| 2. | Tensile Strength | ASTM D638 | MPa | 47.23 |
| 3. | Density | ASTM D1622 | Kg/m ³ | 1504.90 |
| 4. | Compressive Strength | ASTM D1621 | MPa | 28.96 |





3.3 Execution of Projects

The manufacturer, as reported, has executed the projects as per the details given below (as reported):

| SR. NO. | Name and Address | Type of Building | Status |
|------------|---|-------------------------|--------------------|
| 1. | GHMC Sport Complex Khajaguda, Hyderabad Telangana | Demo Building | Completed |
| 2. | G. Peddi Raju Surdayipeta Village, Machilipatnam, Distt Krishna | Residential Building | Completed |
| 3. | Kuni Umi Asset Management, Behind Preca Site, Beside E3 Road, Rayapudi Village, Tulluru Mandalam, Guntur District- AP | Office Building | Under Construction |





PART 4 STANDARD CONDITIONS

This 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. Complete testing facilities shall be installed for in-process control.
- 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 clients with details of construction on six monthly basis.
- 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.

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





PART 5 LIST OF STANDARDS AND CODES USED IN ASSESSMENT

| IS: 875 (Part-1) -1987 | Code of Practice for Design Loads (Other than | | |
|--------------------------|---|--|--|
| (Reaffirmed 2008) | Earthquake) for Buildings and Structures-Unit | | |
| | Weights of Building Materials and Stored | | |
| | Materials. | | |
| IS: 875 (Part-2) -1987 | Code of Practice for Design Loads (Other than | | |
| (Reaffirmed 2008) | Earthquake) for Buildings and Structures- | | |
| | Imposed loads | | |
| IS: 875 (Part-3) -1987 | Code of Practice for Design Loads (Other than | | |
| (Reaffirmed 2003) | Earthquake) for Buildings and Structures –Wind | | |
| | Loads | | |
| IS: 875 (Part-5) -1987 | Code of Practice for Design Loads (Other than | | |
| (Reaffirmed 2003) | Earthquake) for Buildings and Structures - | | |
| | Special Loads and Load Combinations | | |
| IS: 456 -2000 | Code of Practice for Plain and Reinforced | | |
| (Reaffirmed 2005) | Concrete | | |
| IS: 1893 (Part-1) - 2002 | Criteria for Earthquake Resistant Design of | | |
| | Structures - Part 1: General Provisions and | | |
| | Buildings | | |
| IS: 13920-1993 | Ductile Detailing of reinforced concrete | | |
| (Reaffirmed 2008) | structures subjected to seismic forces -code of | | |
| | practice. | | |
| IS 16700-2017 | Criteria for structural safety of Tall Concrete | | |
| | Buildings. | | |
| IS: 1904–1986 | Code of practice for Design & Construction of | | |
| (Reaffirmed 2006) | foundations in Soils: General Requirements. | | |
| IS: 1642-1989 | Code of practice for Fire Safety of Buildings | | |
| (Reaffirmed 2000) | (General): Details of Construction. | | |
| IS 2950 (Part 1):1981 | Code of Practice for Design & Construction of | | |
| (Reaffirmed 2008 | raft foundation | | |
| IS 2974: 1992 (Part 3) | Code of Practice for Design & Construction of | | |
| (Reaffirmed 2006) | machine foundations. | | |
| IS 10262:2009 | Guidelines for Concrete Mix Proportioning | | |
| ASTM C 518:2017 | Standard test methods for steady state thermal | | |
| | transmission properties by means of heat flow | | |
| | meter apparatus | | |
| ASTM D 638:2014 | Standard test methods for tensile properties of | | |
| | plastic | | |
| ASTM D 1621 | Standard test methods for compressive | | |
| | properties of rigid cellular plastic | | |
| ASTM D 1622:2008 | Standard test methods for apparent density of | | |
| | rigid cellular plastic | | |
| ASTM D 4226:2016 | Standard test methods for impact resistance of | | |
| | rigid PVC building products | | |
| ASTM E 84:2007 | Standard test methods for surface burning | | |
| | characteristics of building materials | | |
| ASTME119-2019 | Standard test methods of tests of building | | |
| | construction and materials | | |





CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), Stay-in Place PVC Wall Forms bearing the mark manufactured by M/s Novel Assembler Pvt.Ltd is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No.: 1044-S/2019** is awarded to M/s Novel Assembler Pvt.Ltd, Mumbai.

This Certificate has been renewed further and its validity is from 29-04-2020 to 28-04-2021 as shown on Page 1 of the PAC.

This Certificate consists of a cover page and pages 1 to 34.

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Embossing Seal of

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: **93** - **11** - **20 20**





PART 6 ABBREVIATIONS

| BMBA | Board of Agreement of BMTPC |
|-------|--|
| BMTPC | Building Materials and Technology Promotion Council |
| CPWD | Central Public Works Department |
| ED | Executive Director of BMTPC |
| ΙΟ | 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 LOST-IN-PLACE FORMWORK SYSTEM – NOVEL WALLS

| Sr. No. | Performance Characteristics | Criteria | Test Method | Reference to relevant clause of NBC, Building bye laws etc., if applicable |
|---------|--------------------------------|-------------------------|------------------------|--|
| 1 | 2 | 3 | 4 | 5 |
| 1. | Density | 32kg/m ³ | ASTM D 1622:2008 | One time or as per Requirement |
| 2. | Thermal conductivity | 0.150-0.160(at 75ºF) | ASTM C518: 2017 | One time or as per Requirement |
| 3. | Flaming | < 250 | ASTM E84: 2007 | One time or as per Requirement |
| 4. | Tensile strength | 30MPa | ASTM D 638:2014 | One time or as per Requirement |
| 5. | Impact strength | 0.98kg-m | ASTM D 4226:2016 | One time or as per Requirement |
| 6. | Fire resistance | 240 minutes | ASTM E 119: 2019 | One time or as per Requirement |





ANNEX II

PRODUCTION FLOW CHART







Annex – III



| Label | Description |
|-------|--------------------|
| 1 | MAIN PANEL-250MM |
| 2 | CONNECTOR 158MM |
| 3 | CONNECTOR-33MM |
| 4 | PANEL-91MM |
| 5 | CORNER PANEL |
| 6 | 3-WAY(T-Connector) |
| 7 | JOINTER PANEL |
| 8 | JOINTER CONNECTOR |
| 9 | BASIC FRAME |
| 10 | WINDOW FRAME |
| 11 | AZTECA FRAME |
| | |

12 STARTER





Annex - IV

ERECTION DETAILS

1. Walls Erection



Bracing







2. Assembly of Door / Window Frame



Sequence of Door and Window Opening





3. Sequence of Door Opening Assembly – Technical Details







4. Assembly of Window Opening













The following is a method to seal for any possible water leaking from the outside. The metal flashing is not usually provided with the PVC kit. The method can be applied to Basic Frame only.







5. Plumbing and Alignments Techniques



The alignment accuracy on the bottom of the walls depend on the accuracy of the chalk lines and the location of the guides. The alignment accuracy of the top of the walls depends on the top bracing, shoring, and adjustment (e.g. turnbuckles). When mounting only one kit, it is advisable to use the wood of the roof structure or lining bed.

For a repetitive construction of the same model, consider fabricating steel braces that can be used multiple times.

Wood Top Bracing

Bracing Doors and Windows

Consider fabricating windows and doors bracing jigs. The jigs can be used multiple times, and will assure that there are no assembly mistakes, and that all the openings are assembled to specifications.



Window Opening wood jig



Door Opening wood jig



Metal Top Bracing

Doors and Windows Metal jigs





6. Plumbing for Water and Sewer



All service lines can be designed to run under the floor slab. The use of the different types of plumbing materials and water distribution lines under the slab have no impact on the assembly of the PVC wall forming system.

All the locations of the sinks and bathroom utilities should be designed in advance. The water lines can run inside the PVC walls, or surface mount.



The sewage pipes shall not be embedded inside the PVC walls, and should be installed "externally"

As shown in the figure, this assembly method of the sewer pipe does not require for any modifications to the concrete slab or for forming the walls.

