



NANO LIVING SYSTEM TECHNOLOGY

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

Name and Address of Certificate
Holder: **M/s Nano Living System
Pvt. Ltd. (India)**
**B-14, Sagar Apartment, 6 Tilak
Marg, New Delhi - 110001**
Tel.: 9999755874
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**Founding Promoter: Gabriela Strehler
and Jangi Bakshi**

Performance Appraisal
Certificate No.
PAC No.:1047-S/2019

Issue No. **01**

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Building Materials & Technology Promotion Council
Ministry of Housing & Urban Affairs
Government of India
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PERFORMANCE APPRAISAL CERTIFICATE


FOR

NANO LIVING SYSTEM TECHNOLOGY

ISSUED TO

M/s NANO LIVING SYSTEM PVT. LTD. (INDIA)

STATUS of PAC No.:1047-S/2019

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Dr. Shalish 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

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PART 1 CERTIFICATION

1.1 Certificate Holder: M/s Nano Living System Pvt. Ltd. (India)

B-14, Sagar Apartment,

6, Tilak Marg,

New Delhi -- 110001

Tel.: 9999755874

Email: jangibakshi@nanolivingsystem.com

1.2 Description of System

1.2.1 Name of the System – Nano Living System Technology

1.2.2 Brief Description – Nano Living System Technology comprise of an inner and outer skin of magnesium oxide board, with an injected core of closed cell, polyurethane foam, free of Chlorofluorocarbon (CFC) blowing agent. Cold formed metal studs are incorporated within the foam and between the magnesium oxide board skins at nominal 600mm centres.

The panels are manufactured in 150mm thickness having 80 mm cold formed steel studs, 10mm magnesium oxide board on each side and 50mm thermal packer between the internal stud and exterior magnesium oxide board with core insulation of 130mm closed cell and polyurethane foam.

The technology by the name Nano Composite Wall (NCW) was originally developed by Nano Living Systems, London, UK and Nano Living System Pvt. Ltd. (India) is a partnership firm.

The firm proposes to install the plant in India shortly for manufacture of the panels. If required, the firm will import the panels from U.K. for any construction activity in India.

An isometric view of the Nano panels is shown in Fig. 1.

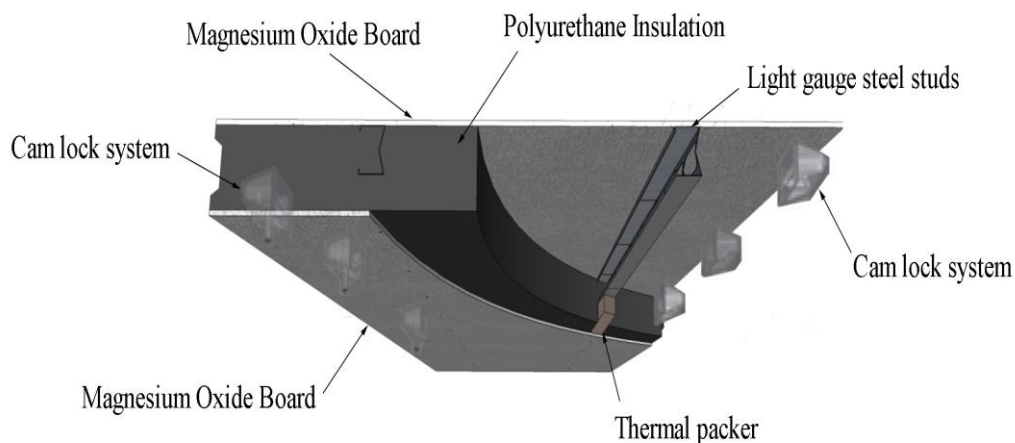


Fig. 1 Isometric view

1.3 Classification of the Panels

- 1.3.1** Panels are available in standard dimensions of 1200mm x 2400mm and thickness of 150mm with wide variety of widths and permissible heights of up to 3.1 metres. Typical weight is 32 kg/m² for 150 mm thick panel. Panels are also available to order with additional insulation and plasterboard components added to the inner face to improve the thermal properties. The core of the walling panels consists of polyurethane foam with a minimum density of 35 kg/m³.
- 1.3.2** Head and base fixing channels/angles are manufactured from 1.2mm thick steel. The internal metal studs are manufactured from a variety of material thicknesses between 0.7mm and 3mm to suit loading conditions. These components are manufactured from steel conforming to *BS EN 10326:2004* with a hot dip galvanized grade of *S220 GD + Z275 N-A-U* (IS 801:175 with a hot dip coating of min. Z 275 conforming to IS 277:1992 or equivalent as per the performance requirement).
- 1.3.3** The base & head channels for the panels and metal sigma studs within the panels are manufactured from 1.2mm thick galvanized steel and lintel angles are made from 2.4mm thick steel. The channel dimensions are 154.5mm by 40mm deep for the base channel and 54.5 by 60mm deep for the head channel for two-sided fixing.
- 1.3.4** Each walling panel contains three camlocks on each vertical edge. The camlock casings are manufactured from high-impact styrene, and the hooks from 3mm thick mild steel with a zinc die-cast cam and mild steel-plated, hook- locating rivet (Fig. 2).

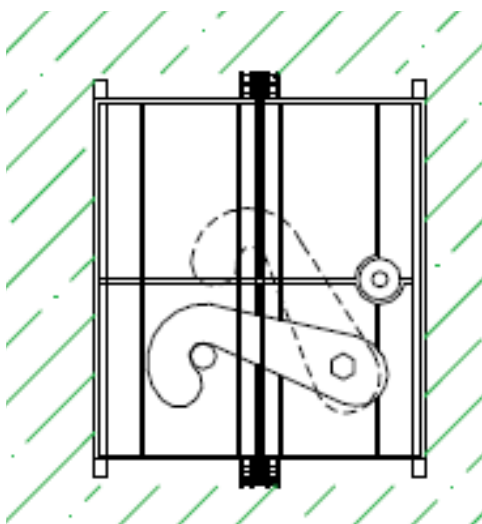


Fig. 2 Camlock detail

1.4 Use & Special Aspects of Nano Living System

- 1.4.1** The Nano Living System Technology is suitable for use as load bearing walls in residential buildings up to G+3 storey high for the present till

a prototype structure is constructed in India for studying its seismic behavior and suitability as load bearing walls for buildings up to G+7 storey high as indicated in BBA 2010 pertaining to Nano Composite Wall Performed Structural System.

Where the panels are used as load-bearing walls, the overall building design should take due account of stability and differential movement.

1.4.2 *Special Aspects of use:*

- The building to be constructed using Nano Living System Technology shall be in accordance with the specifications prescribed in Technical Manual of Nano Living System and designed by competent structural Engineers.
- Plumbing and Electrical services shall be governed by the provisions and details given by the manufacturer. Good practices of plumbing services should be followed.
- Nano Living System should be constructed only with technical support or supervision by qualified engineers and builders, based on structural designs complying with prevailing standards and specifications; this is applicable even for low rise and affordable mass housing to provide safety of structures.
- It is strongly recommended that structural engineers and building designers associated with Nano Living System construction should be thoroughly familiar with the various structural aspects. It is also recommended that architects and construction Engineers who undertake Nano Living System building design and construction gain familiarity with the properties of material, characteristics of Nano Living System and its application and construction system.

1.5 Design Considerations

1.5.1 *General*

1. Nano Living System Technology can be designed using any appropriate framework calculation software. The system can be used as an alternative solution to a design using conventional masonry.
2. The system is intended for use where architectural drawings are available to meet different requirements. The Architects and the designer team of the developer (client) is responsible for ensuring that the plans and overall design comply with the various regulatory requirements applicable to the area.
3. The structural design of any project must be done by the engineer trained by Nano Living System Pvt. Ltd. The firm's engineer will also contact the developer's engineer 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 forces as per IS 1893 (Part 1):2016.

5. Foundation shall be specifically designed in accordance with provision given in IS 1904:1986. 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. Where the panels are used to construct the inner leaf or an external cavity wall, the outer masonry leaf and all masonry below the DPC must be designed and constructed in accordance with IS 1905:1987.

8. When the panels are used as a single-leaf external wall the joints should be sealed with a suitable silicone sealant and can be painted with the supplier's recommended resin-based paint.

9. In addition, any other requirement regarding safety against earthquake need to be ensured by the designer as per prevailing codal requirements.

1.5.2 *Structural Performance*

1.5.2.1 *General*

1. The wall panels will have adequate strength and stiffness when used in accordance with the provisions of this Certificate. Due consideration must also be given to any fire-resistance restrictions.

2. The strength of all connection details which tie walls constructed from the panels to other structural elements (such as walls, floors, roofs and columns) must be evaluated and provide adequate stability for the overall building design. The specification and design for these items must be determined by the structural engineer responsible for the stability of the building. Guidance on the design of connection details may be obtained from the PAC holder.

3. As part of the structural design, consideration should be given to the support of eccentric loads imposed by central heating systems or kitchen appliances.
4. As the wall panel is designed to be part of a closed panel system, the requirements for extra anchors to the structure through use of holding-down brackets or straps should be considered by the structural engineer at the design stage.
5. The Certificate holder can vary the lateral load capacity and panel heights by varying the gauge and spacing of the internal steel studs provided within the panel. The panel has an associated suite of differing gauges of internal steel studs and reveal steels which trim window and door openings.
6. Lintels and framing brackets around openings which form an integral part of the Nano Living System shall be supplied by the PAC holder.

1.5.2.2 *Condensation risk*

1. Provided the panels are properly assembled, the risk of surface and interstitial condensation under normal domestic use will be minimal.
2. The risk of interstitial condensation in both the external walling and the roofing shall be greatest when the building is drying out after construction.
3. When used in a typical construction, the risk of damage due to interstitial or surface condensation in normal domestic conditions shall be minimal.
4. It is essential that joints between the walling panels are properly made to prevent the passage of water vapour into the wall construction. When fibre cement board is used with a service space behind, penetrations of the board (e.g. for electrical services) should be kept to a minimum.

1.5.2.3 *Air leakage*

1. The joints between the structural frame and infill panels and base and head joints can potentially allow air leakage without additional sealing and the main contractor should make provision for this in the overall construction.

1.5.2.4 *Sound insulation*

1. Good working practice should be adopted for sealing all joints.

2. It is essential that care is taken in the design and during installation to avoid direct paths for airborne sound transmission and to minimize paths for flanking sound transmission.

1.5.2.5 *Damp-proofing, weather tightness*

1. The panels can be used in the construction of single external walls in sheltered exposure conditions. The DPC should be positioned in accordance with IS 1905:1987 and all panel joints should be sealed using a suitable silicone sealant.

2. When used with other outer leaf construction, cladding or render systems, the final weather resistance of the building shall be dependent upon the efficient positioning and sealing of all joints.

For further details of the Design Considerations, reference may be made to BBA 2010 pertaining to Nano Composite Wall Performed Structural System.

1.6 **Basis of Assessment**

1.6.1 *Scope of Assessment* – Suitability of Nano Living System panels for use as a load bearing and in-fill internal or external walls to build residential, commercial and industrial buildings.

1.6.2 *Assessments*

Assessment of the suitability of Nano Living System Technology is based on:

- (i) British Board of Agreement (BBA) 2010 pertaining to Nano Composite Wall Performed Structural System issued to Nano Living System Ltd.
- (ii) Testing of Nano Composite Wall to earthquake forces for Seismic Design of structures by Trac, Florida (USA).
- (iii) Thermal Performance of Nano Composite Wall by BRE Scotland, Glasgow (UK)
- (iv) Testing of physical, mechanical and chemical properties of Magboard by NTA Inc, Indiana, (USA)
- (v) SCI/NHBC Stage 1 Certification for Light steel framed walls for use in Nano Composite Wall (UK).

1.7 **Conditions of Certification**

1.7.1 **Technical Conditions**

1. The Certificate holder shall inform BMTPC as and when any plant is set up in India. Nano Living System Pvt. Ltd., shall provide full details of design, manufacture and erection of the panels to the agency who may be engaged for production and construction.

2. Nano Living System Pvt. Ltd., shall also provide necessary training to the technical persons of the agency engaged for production, design and construction.
3. The Certificate holder shall provide a detailed Quality Assurance System for production and execution of the system in the field.
4. Nano Living System Pvt. Ltd., shall submit evidence of performance of the G+3 or higher structure against earthquake forces as per IS 1893 (Part 1):2016 before undertaking project using load bearing wall panels for structures more than G+3 storey.
5. The Certificate is being issued provisionally for a period of one year and will be reviewed after one year when more information and experience is available in India.

1.7.2 *Handling of User Complaints*

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

1.7.2.2 The Certificate holder shall implement the procedure included in the SQA. As part of PACS Certification he/she shall maintain data on such complaints with a view to assess the complaint satisfaction and suitable preventive measures taken.

1.7.3 *Durability*

The panels will have a durability comparable to or beyond that of *Portland cement bonded particle board defined in BS EN 634-2:1997*. Providing all aspects outlined in the weather tightness sections of this Certificate are adhered to, a lifetime of at least 60 years may be expected.

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 Part 1 & 2 of this Certificate, Nano Living 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 panels in accordance with the requirements specified in the PAC (See Part 5). In addition it shall follow the requirements of these sections for various materials used in the manufacturing of these panels.

2.2 Specifications of the Nano Living System

2.2.1 Technical Specifications

2.2.1.1 Raw materials

- (i) Stud & Track profiles: Shall be manufactured from pre-galvanized high tensile steel conforming to IS 801:1975 and IS 277:2018/ BS EN 10346:2004 Grade 350 having Yield stress of min. 350 MPa & Tensile stress of min. 380 MPa and coating of min. Z 275 or equivalent as per the performance requirement.
- (ii) Polyurethane Core (PUF): Shall be Chlorofluorocarbon (CFC) free & self-extinguishing and shall conform to IS 12436: 1988.
- (iii) Magnesium (MgO) Board: Shall conform to the manufacturer's specifications.

2.3 Manufacturing Machinery & Equipment

As reported, the parent firm Nano Living Systems, London, UK has got various machines and equipment for manufacture of these panels and the PAC holder shall also install similar machines and equipment while installing the plant in India.

2.4 Fabrication Process of Panels

- Initial design work shall be conducted using specialized computer aided design and drafting software that is integrated with all of the machinery involved in development of the Nano Living System.
- Once finished, the final design work shall be transferred electronically to the various machines for maximum accuracy and efficiency.
- Once the data has been received by the machine, the computer automated systems shall initiate the steel forming process.
- The final result is the production of light gauge steel framing studs and tracks, as well as floor joist and roof truss systems.
- Frames shall then be assembled in accordance with the design plans and drawings.
- Upon completion, the frame shall be placed inside of the mold and entered into the polyurethane injection machine.
- Once finished the NLS panels shall be moved to a storage area to be shipped out.

Process Flow Chart followed by the parent firm Nano Living Systems, is given in Annex I.

2.5 Selection & Installation

Any installation work should follow the details and information contained in the construction drawings, as prepared by the PAC holder or approved designers.

2.6 Installation Procedure

2.6.1 General

- The installation of the Nano Living System must comply with the Certificate holder's installation instructions. Installation should be carried out by an approved contractor who has completed the Certificate holder's training programme.
- For loadbearing walls and infill panels the main contractor should provide all setting-out grid lines for locating the outer face of the angle supports and centre point of window, door and service openings. The external face of the base channel is positioned from the setting-out lines.
- For infill walls the main contractor should provide the setting-out grid line for base and head channels. (Fig. 3)

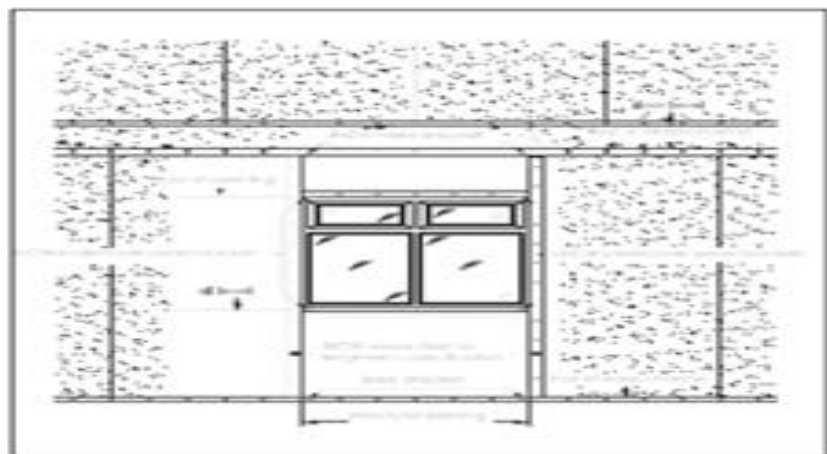


Fig. 3 Typical infill construction

- The overall plan dimensions are checked for squareness and size against the construction drawings before installation commences. The high point of the bearing must be identified and used as a datum to which all base channels on the bearing will be set.
- Base channels may be raised above the bearing by packing to level. Any void under the channel must be filled with a loadbearing material (e.g. mortar) as work proceeds.

- Where any galvanized steel base channel, head channel or corner angle or lintel is cut on site, the cut face must be re-treated with a zinc-rich paint.
- It is essential that the design and installation is strictly in accordance with good building practice and the requirements of this Certificate, to ensure that paths for sound transmission through the separating wall assembly and the flanking elements are minimized.

2.6.2 Procedure

- Base channels must be fixed to the bearing using the appropriate self-tapping anchor fixings at 200 mm c/c, installed working away from the first corner.
- The first section of the walling panel is erected working from the corner for stability and head channels located onto the walling as work proceeds away from this point. (Fig. 4)

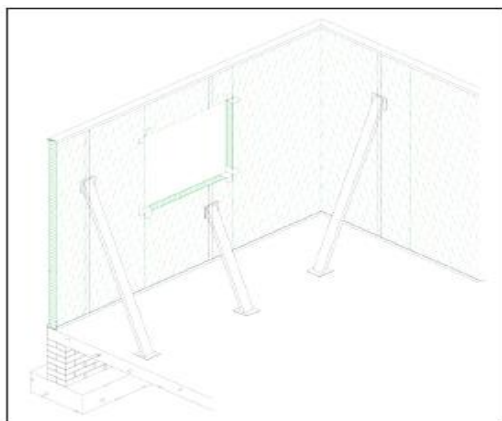


Fig. 4 Erection showing propping

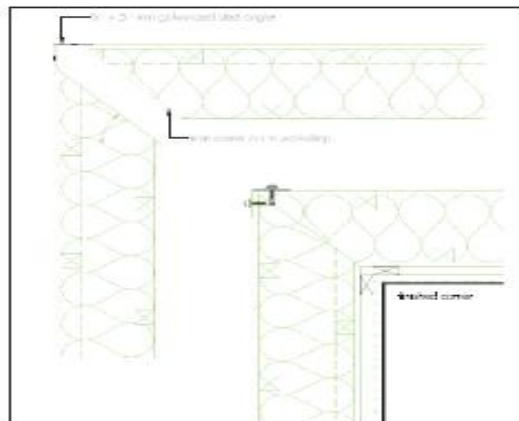


Fig. 5 Corner detail

- The corner panels are joined together vertically using site-formed lapped joints (see Figure 8). Top and base channels lock the corner panels into position with self-drilling screws being provided at 200 mm c/c. A pressed steel corner angle is screw fixed to the external face to provide additional protection. (Fig. 5)
- The next walling panel in the sequence is erected and the joint is secured using the camlocks within the panel (see Fig. 2). The walling must be supported at a maximum of 3600 mm c/c, i.e. every third walling panel. This process is repeated accordingly.
- Walls are checked for line and level and props adjusted as necessary.
- The wall panels are secured to the base, head, corner channels and lintel sections, using the self-drilling fasteners provided and the pre-drilled holes in the channel and lintel sections, at 200 mm c/c (Fig. 6).

- Where internal intersecting walling panels are required, a vertical channel is fixed to the internal face of existing external or cross-walls and secured with screws at 200 mm c/c through the vertical channel pre-drilled holes. The installation is then completed as for external walls.
- On external walls, the joint between the external up stand of any galvanized channel and the walling panel must be sealed with proper sealant.
- Additional storeys can be constructed using the same procedures. Intermediate floor connections are detailed in the Certificate holder's installation instructions and can be adapted according to the walling panel height and detail required (Fig. 7).

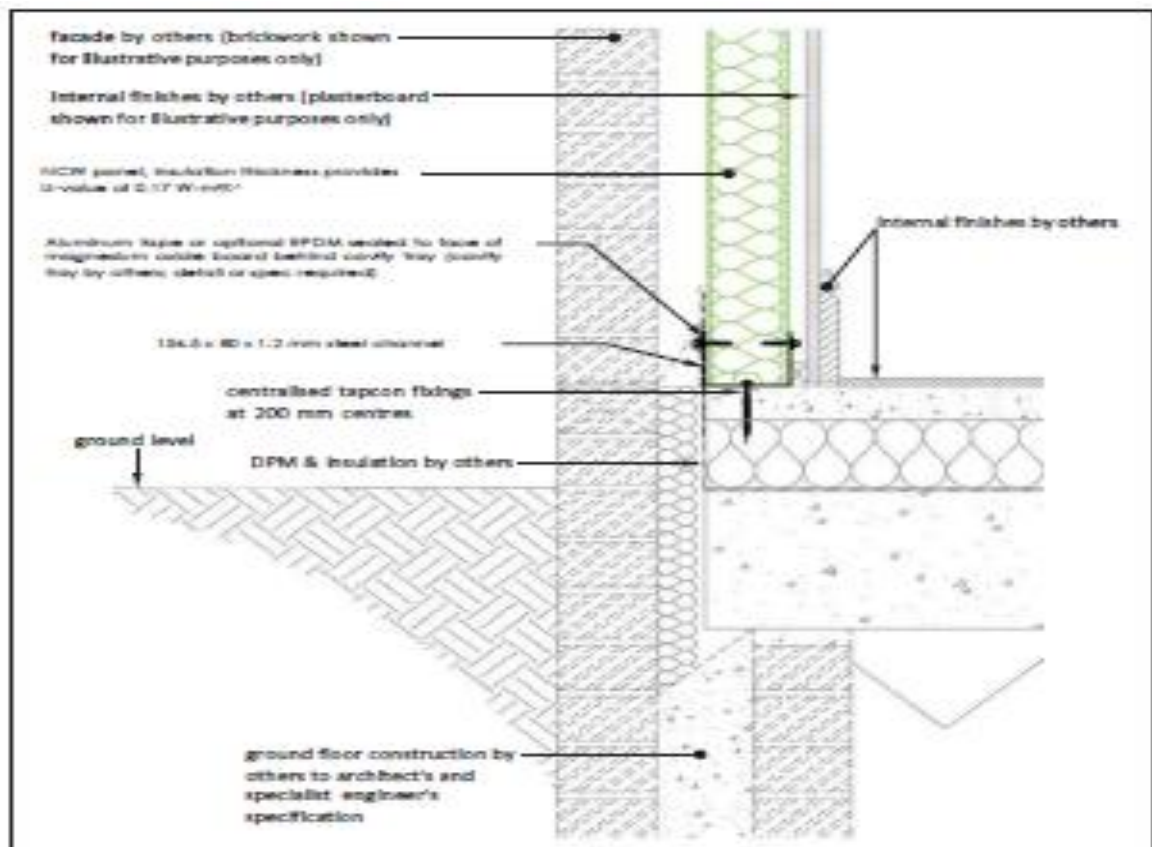


Fig. 6 Panel connection to base channels

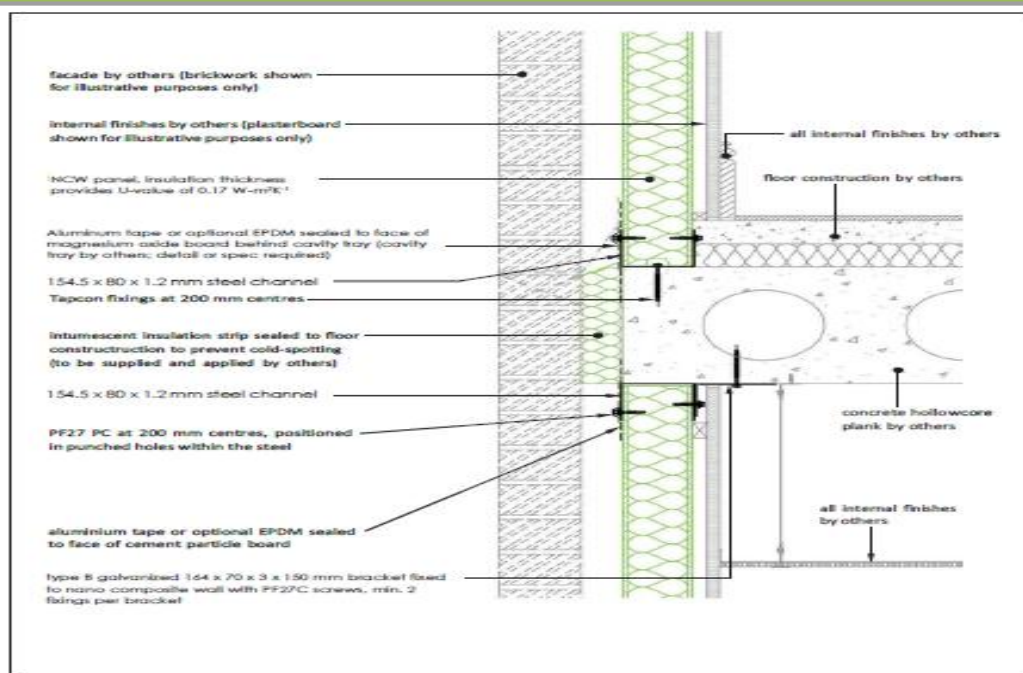


Fig. 7 Intermediate floor jointing

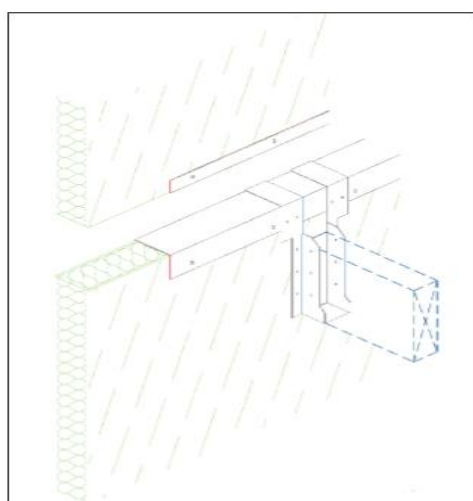


Fig. 8 Joist hanger detail

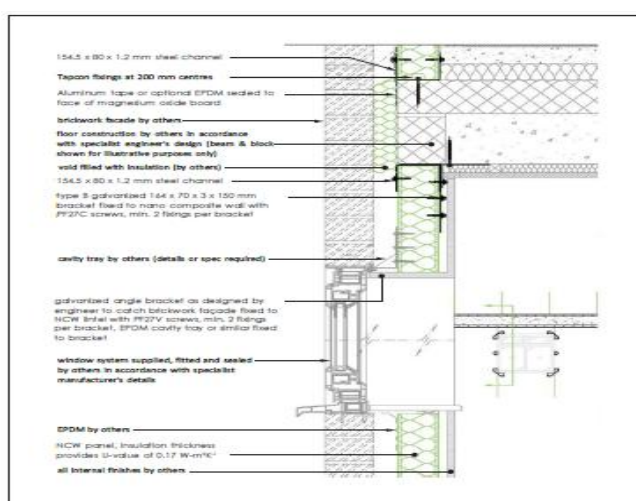


Fig. 9 Forming a structural opening

- The legs of joist hangers must be bent over the top and down the back face of the panel. The hanger and the leg are fixed by screws. Details of suitable hangers and screws (including number and positioning) can be obtained from the Certificate holder. (Fig. 8)

2.6.3 Openings

- Openings should be carefully planned and the preferred method of forming the opening selected. Two methods for forming openings are detailed in the Certificate holder's installation instructions: (Fig. 9)
- Method 1: Openings are cut into the skin of the erected walling panel. A lintel must be installed over the opening.

- Method 2: Openings are formed as work proceeds by the installation of cut panel sections over and/or under the required opening. A lintel must be installed over the opening.
- Where cut walling panels are used, a butt joint is necessary due to the removal of the camlocks. Joint stability is maintained by the use of metal plates, and foam applied to the joint to reinstate the insulation properties of the walling panel.
- Where openings continue to floor level, the base channel may be omitted from the area of the opening as work continues, or removed at a later stage. A lintel must be installed over the opening.
- Structural openings are formed within loadbearing walls using cut down sections of wall panel and steel corner angle brackets fixed each side of the panel using *PF27C* screws. For infill panels, an arrangement of galvanized steel reveal channels and corner brackets can be used. Reveal channels require sizing by
- the structural engineer responsible for the building design and depend on storey height, opening dimensions and local wind conditions.

2.6.3.1 Fixing of windows and door frames, service battens and wall ties

- Window and door frames are fixed to the external face of the panels using brackets (Fig. 10).

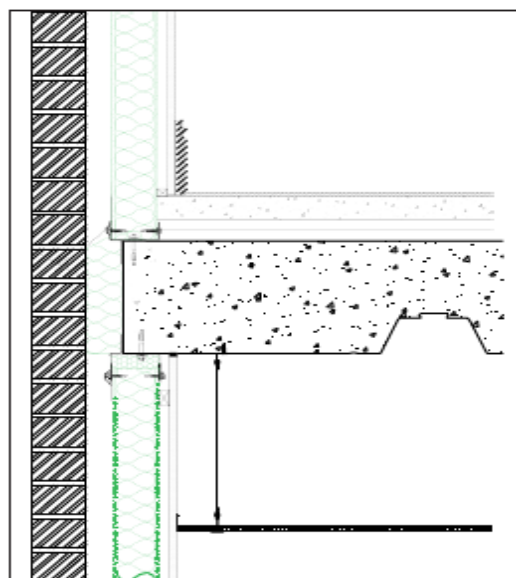
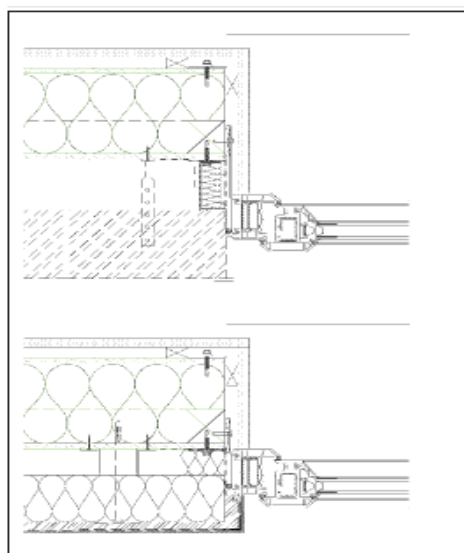


Fig. 10 Typical window fixing detail Fig. 11 Infill panel head & foot detail

- Services battens are fixed to the inner face of the panels at 600 mm c/c using the fixings provided. A plasterboard facing is then fixed to the battens to provide a service void and a surface for internal decoration.

- Approved wall ties to receive external brick leaf must be screwed into the face of the panels, or through the face into the metal studs or packers at the required spacing using suitable fasteners. Dovetail slot ties in accordance with BS 5628-1: 1992 or frame cramps to BS EN 10327: 2004 can also be used.

2.6.4 *Infill Panels*

- The base channel is secured to the structural floor or edge beam using the setting out lines and specified screw fixing (Fig. 11).
- The head channel is positioned along the setting out line, plumbed up from the base channel, and secured to the structure using the specified screw fixing. A 1200 mm length of channel is left out to allow for the insertion and positioning of the panels or where a gap in the channel has been left for a door or window opening.
- Panels are slid from the pallet and the bottom edge of the panel butted against the base channel adjacent to the 1200 mm gap.
- The panel is then lifted into the upright position and slid into and along the base channel into its final position.
- The procedure is repeated for the next panel and once butted against the first panel is mechanically locked using the camlocks.
- When the last section of wall panel is installed the base and head angle (replacing the channel) can be located at the same time.
- As installation of the wall panel's proceeds low profile screws 12-14x15mm, at 20 mm centres each side, are used to mechanically fix panels to base and head channels.

For further details of the Installation process, reference may be made to the Nano Composite Wall Site Erection Manual available with the manufacturer.

Structural drawings showing Erection & Fixing details of the Ground Floor, Roof and Services are appended at Annex II.

2.7 Skills/Training Needed for Installation

The panels should only be installed by installers who have been trained and approved by the PAC holder. For further details of training, reference may be made to the Nano Composite Wall (NCW) Training Manual available with the manufacturer.

2.8 Maintenance and Repair

1. To ensure adequate durability of single-leaf construction, regular maintenance inspections followed by appropriate remedial action should be carried out on the weather protective systems. The required frequency of routine repainting will be similar to that

normally associated with external woodwork, the interval not exceeding 8 to 10 years.

2. Although maintenance is not envisaged for the panels, regular checks should be carried out on the finishes to ensure that any damage is detected and repaired as soon as is possible.

3. Minor repairs to the system can be carried out to the wall panels prior to erection. The advice of the PAC holder should be sought for guidance.

4. Following erection, repairs can also be carried out to small areas of damaged panels using expanding foam, a replacement piece of magnesium oxide board [at least 100mm larger than the hole and fixed to the panel using compound epoxy (damp environment grade)], and suitable fixing screws at nominal 100mm c/c. Repair of larger areas of damage, between metal studs, or the filling in of window openings, can be carried out using an infill patch piece. Full details of methods of repairing panels can be found in the Certificate holder's installation manual, which should be consulted for further details.

5. Individual panels can be replaced selectively within a building, subject to initial consultation with the Certificate holder and a qualified structural engineer. The structural implications must be carefully considered prior to any alterations being carried out. The advice of the Certificate holder should be sought for guidance. Adequate temporary propping must be provided before unlocking individual panel camlocks and prising out the panel.

2.9 Services Provided by the PAC Holder to the Customer

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

2.9.2 Users/Customers should ascertain from the PAC holder the type of service, the PAC holder is prepared to provide.

PART 3 BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

3.1 Assessment

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

3.2 Tests Done for Assessment

3.2.1

- (i) Testing of Nano Composite Wall to earthquake forces for Seismic Design of structures by Trac, Florida (USA)
- (ii) Thermal Performance of Nano Composite Wall by BRE Scotland, Glasgow (UK)

- (iii) Testing of physical, mechanical and chemical properties of Magboard by NTA Inc, Indiana (USA)

3.3 Execution of Projects

The main buildings constructed by Nano Living System Ltd., UK (as reported) using Nano Composite Wall (NCW) in UK, Canada and USA are given below:-

(Photographs of the buildings constructed are given in Annex III)

S. No.	Name of Project and Location	Quantity
1.	Construction of 350 rooms for Student accommodation at St. Georges, London (UK)	100,000 sq. ft.
2.	Construction of 43 flats for Minerva Care Home at Islington, North London (UK)	140,000 sq. ft.
3.	Construction for Brightwell Court Care Home at Islington, North London (UK)	35,000 sq. ft.
4.	Construction of Calgary Hotel at Ontario, Canada	96,000 sq. ft.
5.	Construction of Oakville Hotel at Ontario, Canada	82,000 sq. ft.
6.	Construction of Vancouver Hotel at British Columbia, Canada	140,000 sq. ft.
7.	Construction of Tucson Hotel at Arizona, USA	2.5 million sq. ft.

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.

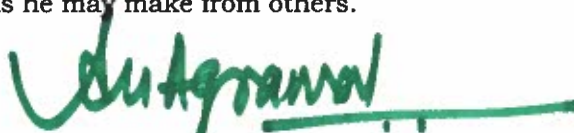
4.13 It should be noted that any recommendations relating to the safe use of the product which are contained or referred to in this Certificate are the minimum standards required to be met with when the product is installed, used and maintained. They do not purport in any way to restate or cover all 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.



Place: New Delhi

Date of issue: **04.09.19**

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

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

PART 5 LIST OF STANDARDS AND CODES USED IN ASSESSMENT

Part 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 277:2018 - Specifications for galvanized steel sheets (plain & corrugated)

5.1.2 IS 801:1975 (Reaffirmed 2010) - Code of practice for use of cold formed light gauge steel structural members in general building construction.

5.1.3 IS 456:2000 (Reaffirmed 2016) - Code of practice for plain & reinforced concrete (fourth revision)

5.1.4 IS 875 (Parts 1 to 3):1987 (Reaffirmed 2008) - Code of practice for design loads (other than earthquake) for buildings & structures

5.1.5 IS 1893 (Part 1):2016 - Criteria for earthquake resistant design of structures

5.1.6 IS 1904:1986 (Reaffirmed 2010) - Code of practice for design and construction of foundations in soils: General requirements.

5.1.7 IS 1905:1987 (Reaffirmed 2007) - Code of practice for structural use of un-reinforced masonry

5.1.8 IS 12436:1988 (Reaffirmed 2017) - Specifications for performed rigid polyurethane foam for thermal insulation.

5.1.9 IS 14246:2013-- Specifications for continuously pre-painted galvanized steel sheets and coils

5.1.10 IS 14862:2000 (Reaffirmed 2010) - Code of practice for fiber cement flat sheets

5.1.11 ASTM A 568 - Standard specifications for thickness tolerances of cold rolled steel sheets & coils

5.1.12 ASTM A 653(9) - Standard specifications for steel sheet, zinc coated or zinc-iron-alloy coated

5.1.13 ASTM C 423 - Standard test method for sound absorption by reverberation room method

5.1.14 ASTM C 518 - Standard test method for steady state thermal transmission properties by means of heat flow meter apparatus.

5.1.15 ASTM C 955:2007 - Standard specifications for load-bearing (transverse and axial) steel studs, runners (Tracks) and bracing or bridging for screw application of gypsum panel products and metal plaster bases

5.1.16 ASTM C1513 – Standard specifications for steel tapping screws for cold formed steel framing connections

5.1.17 ASTM D1621 – Standard test method for compressive properties of rigid cellular plastics

5.1.18 ASTM D1622 – Standard test method for apparent density of rigid cellular plastics

5.1.19 ASTM D1623 – Standard test method for adhesion properties of rigid cellular plastics

5.1.20 ASTM E 72 -- Standard test method for conducting strength tests of panels for building construction

5.1.21 ASTM E 84 -- Standard test method for surface burning characteristics of building materials

5.1.22 BS 476-21:1987 -- Fire tests on building materials and structures — Methods for determination of the fire resistance of loadbearing elements of construction

5.1.23 BS 2750-3:1995 -- Measurement of sound insulation in buildings and of building elements — Laboratory measurements of airborne sound insulation of building elements

5.1.24 BS 5250:2002 -- Code of practice for control of condensation in buildings

5.1.25 BS 5950 (Part 5):1998 – Code of practice for design of cold formed thin gauge sections

5.1.26 BS 6093:1993 -- Code of practice for design of joints and jointing in building construction

5.1.27 BS EN 10326:2004 -- Code of practice for continuously hot dip coated steel strip and sheet

Part 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.

Part 5.3 References

5.3.1 British Board of Agreement (BBA) 2010 pertaining to Nano Composite Wall Performed Structural System issued to Nano Living System Ltd.

5.3.2 Testing of Nano Composite Wall to earthquake forces for Seismic Design of structures by Trac, Florida (USA)

5.3.3 Thermal Performance of Nano Composite Wall by BRE Scotland, Glasgow (UK)

5.3.4 Testing of physical, mechanical and chemical properties of Magboard by NTA Inc, Indiana (USA)

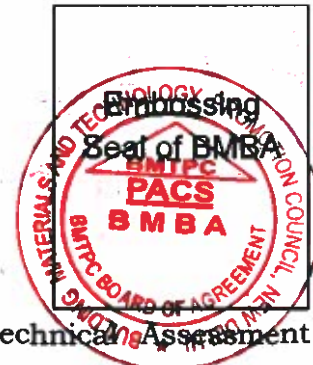
CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Nano Living System Technology** bearing the mark manufactured by M/s Nano Living System Holding (India) Pvt. Ltd., is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No.: 1047-S/2019** is awarded to **M/s Nano Living System Pvt. Ltd. (India)**.

The period of validity of this Certificate is for a period of one year i.e. from 4/09/2019 to 3/09/2020 as shown on Page 1 of this PAC.

This Certificate consists of a cover page and pages 1 to 44.

V. Agrawal



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 Poverty Alleviation, Government of India.

Place: New Delhi

Date: **04-09-19**

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
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.

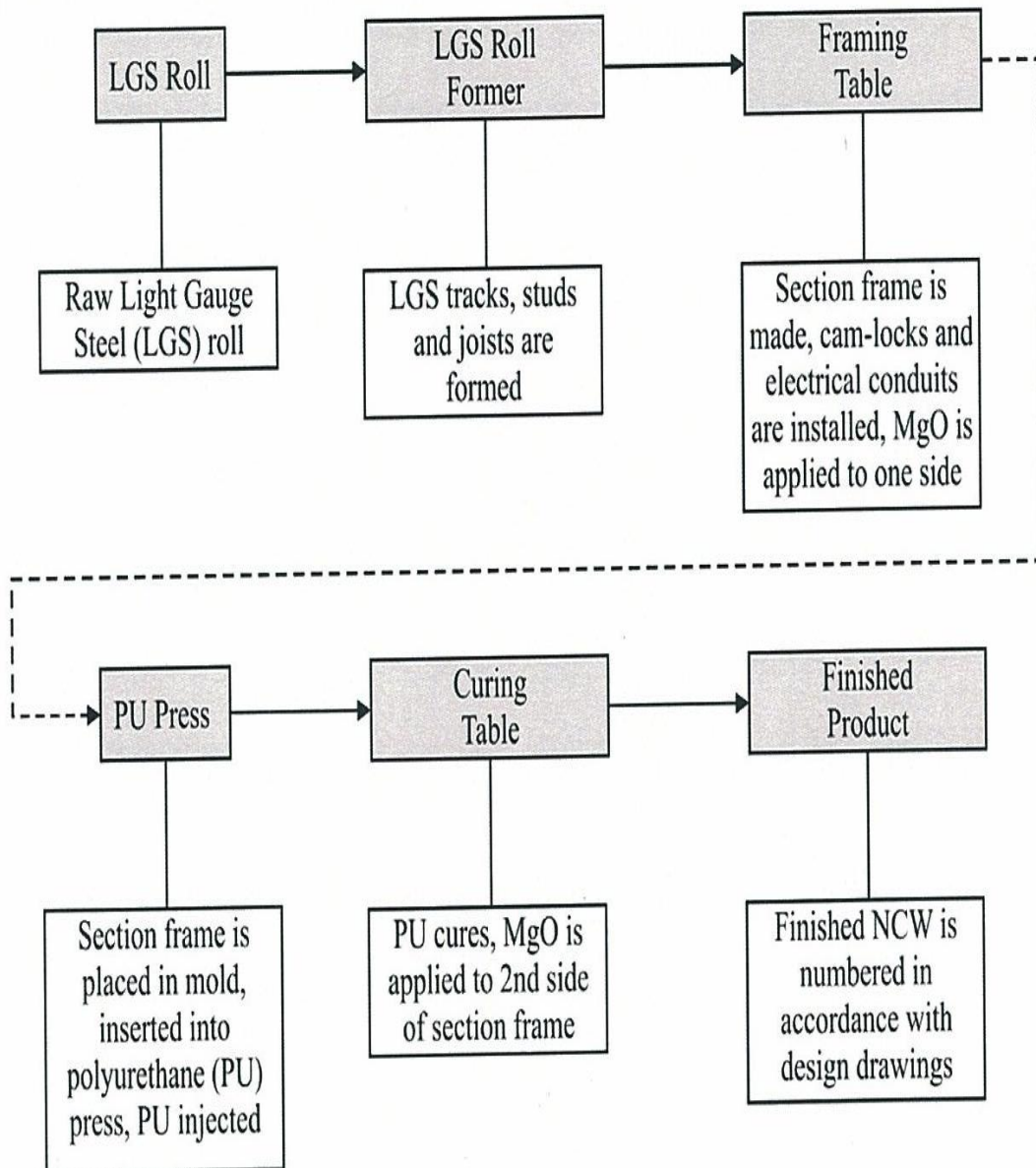
Builders and construction agencies in the Government, public and private sectors can help serve the economic, development and environmental causes for which the people and Government stand committed by giving preference to materials and technologies which have earned Performance Appraisal Certificates.

Further information on PACS can be obtained from the website:

www.bmtpc.org

ANNEX I (Clause 2.4)

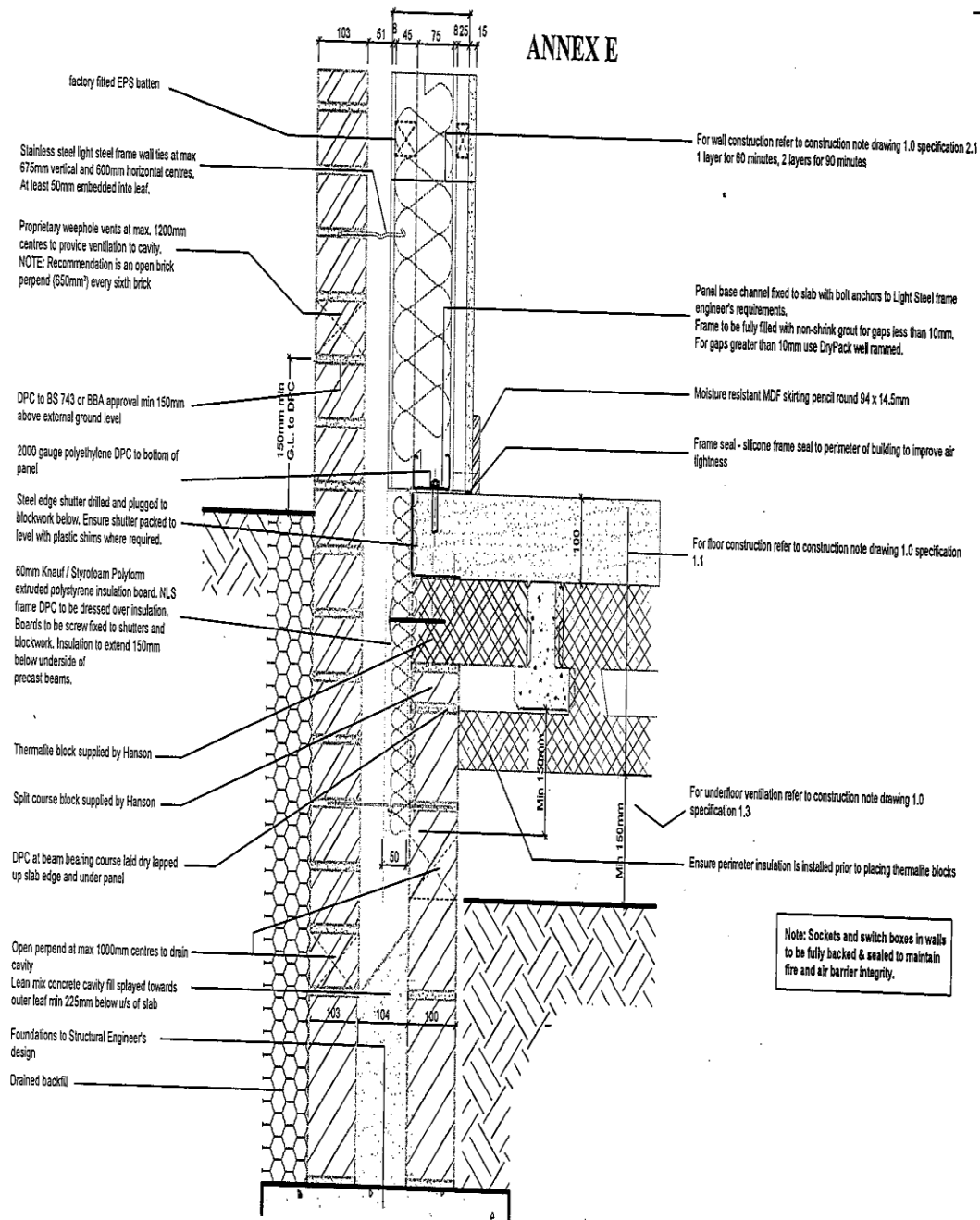
MANUFACTURING PROCESS FLOW CHART



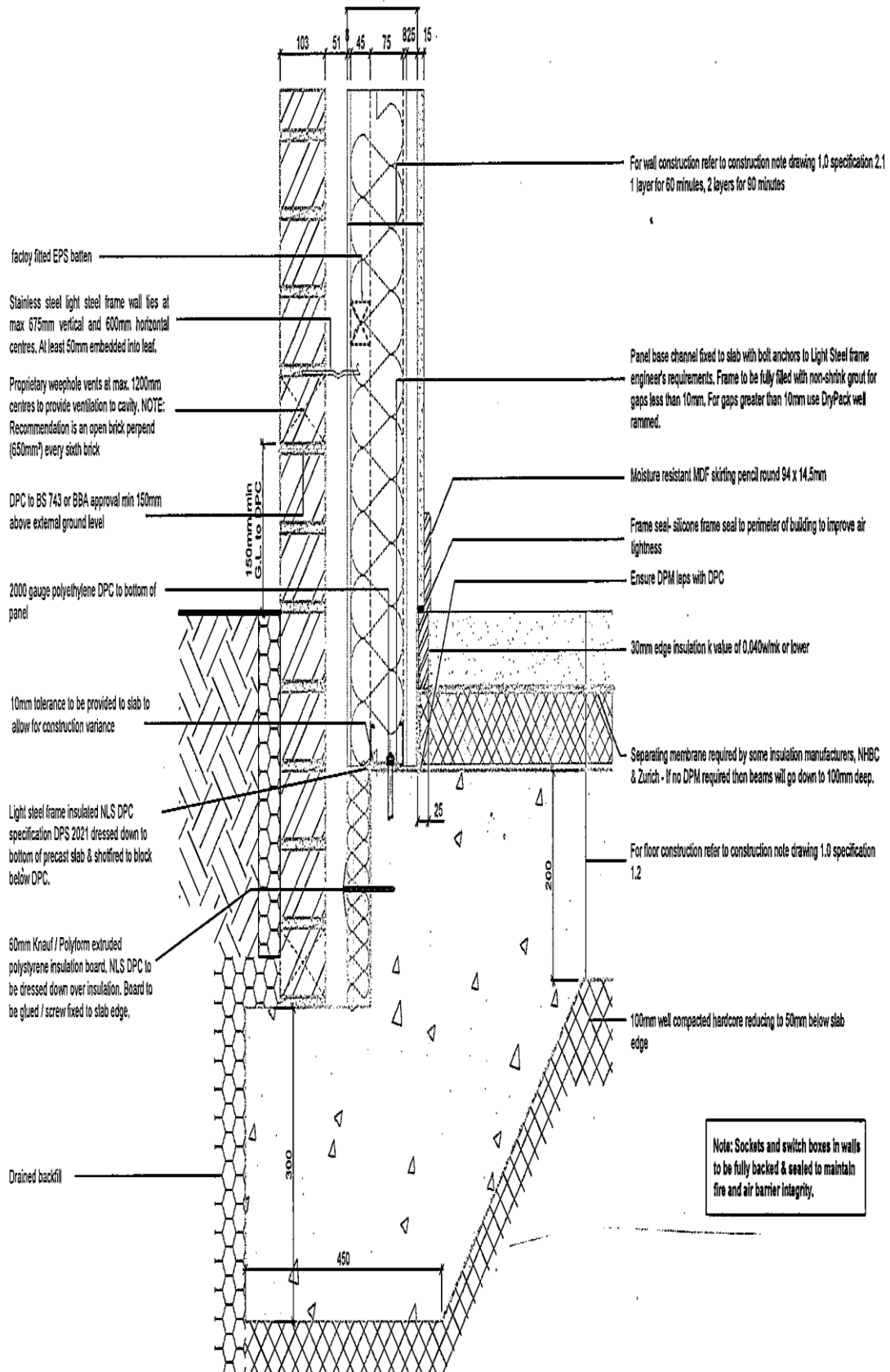
ANNEX II (Clause 2.6.4)

ERECTION & FIXING DETAILS OF THE GROUND FLOOR, ROOF AND SERVICES

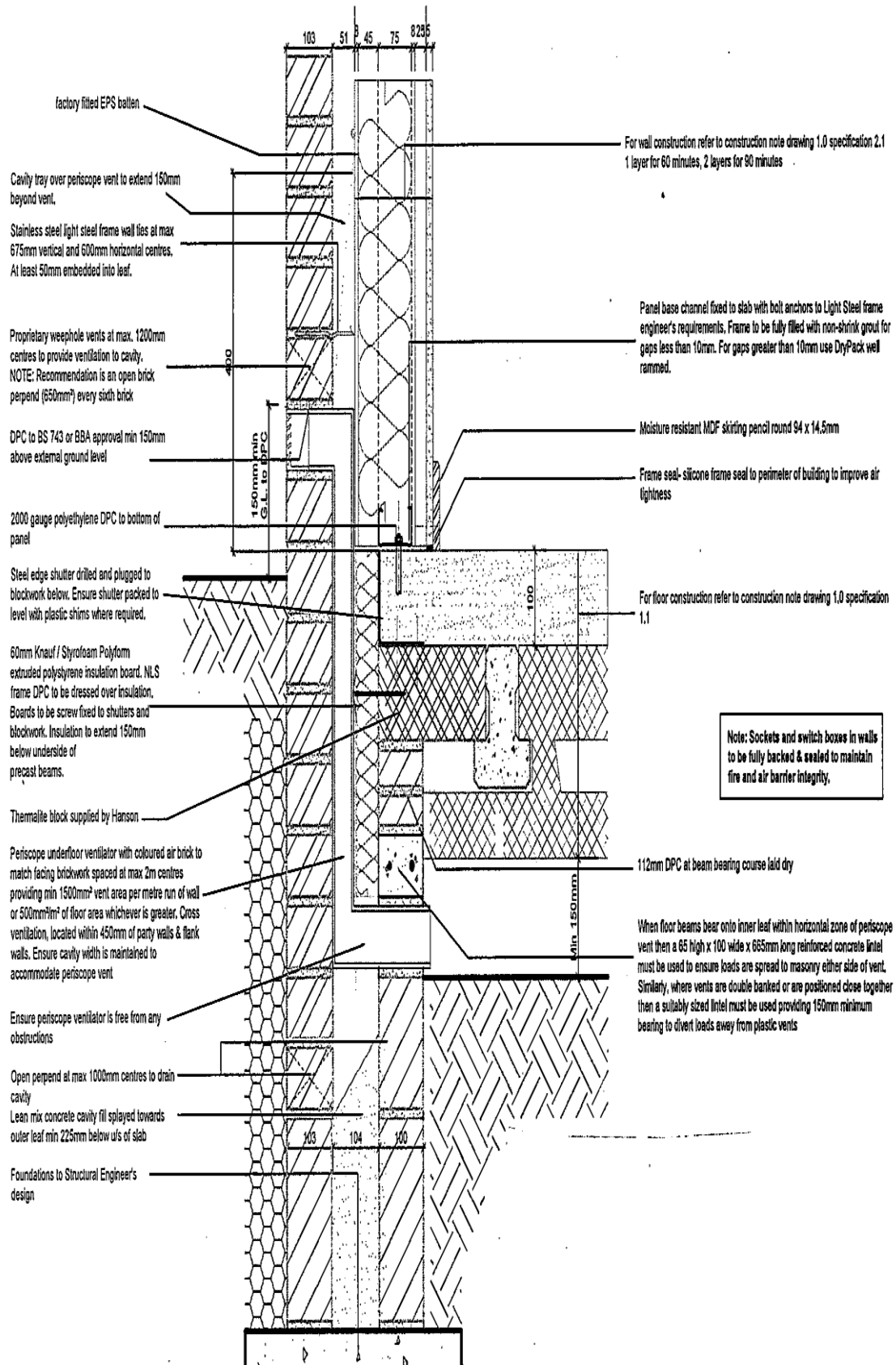
II.1 Ground Floor/Wall Details



External Ground Floor -- Jetfloor

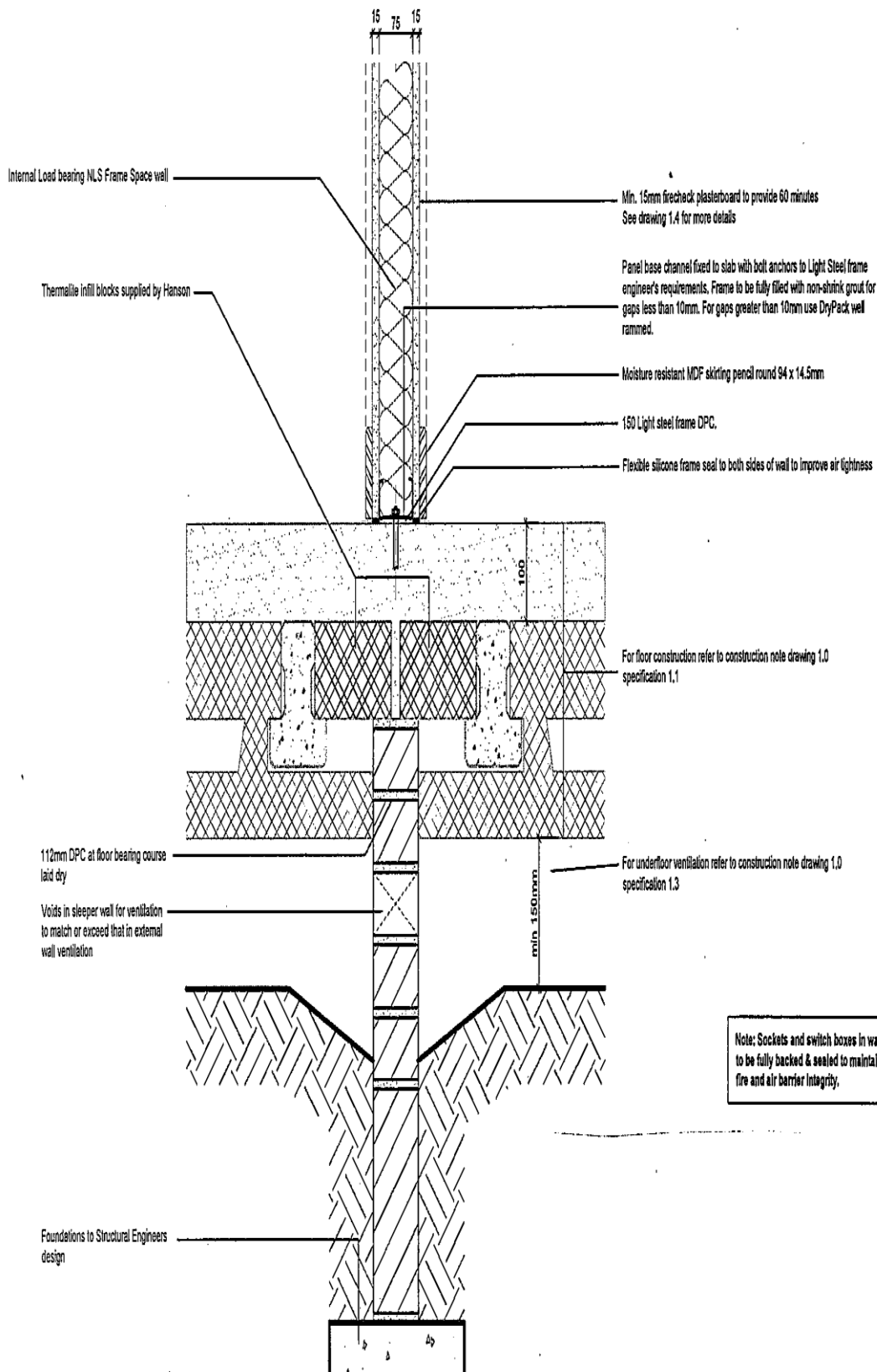


Ground Bearing Slab Detail

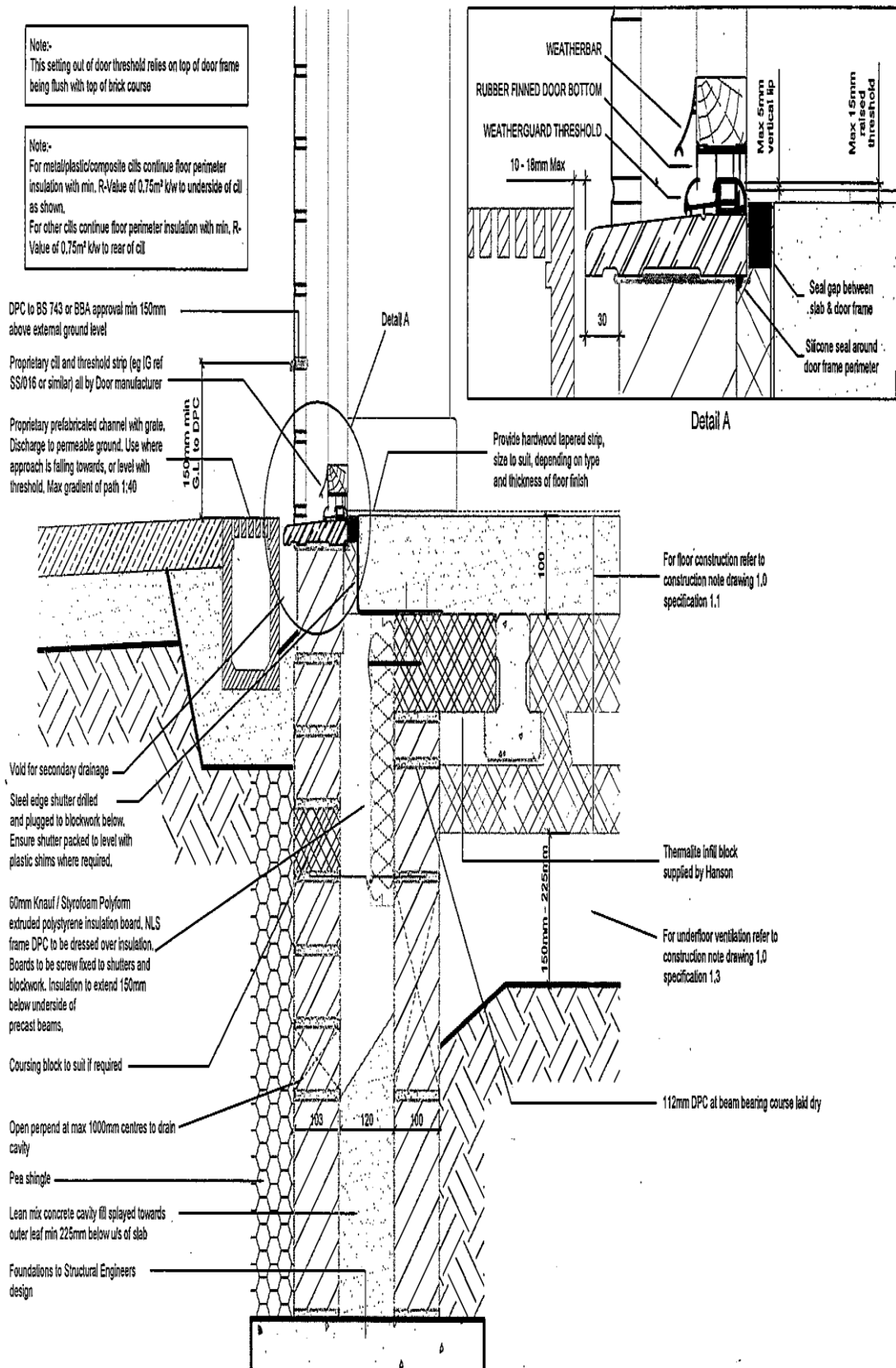


Note: Sockets and switch boxes in walls to be fully backed & sealed to maintain fire and air barrier integrity.

Periscope Vent Detail

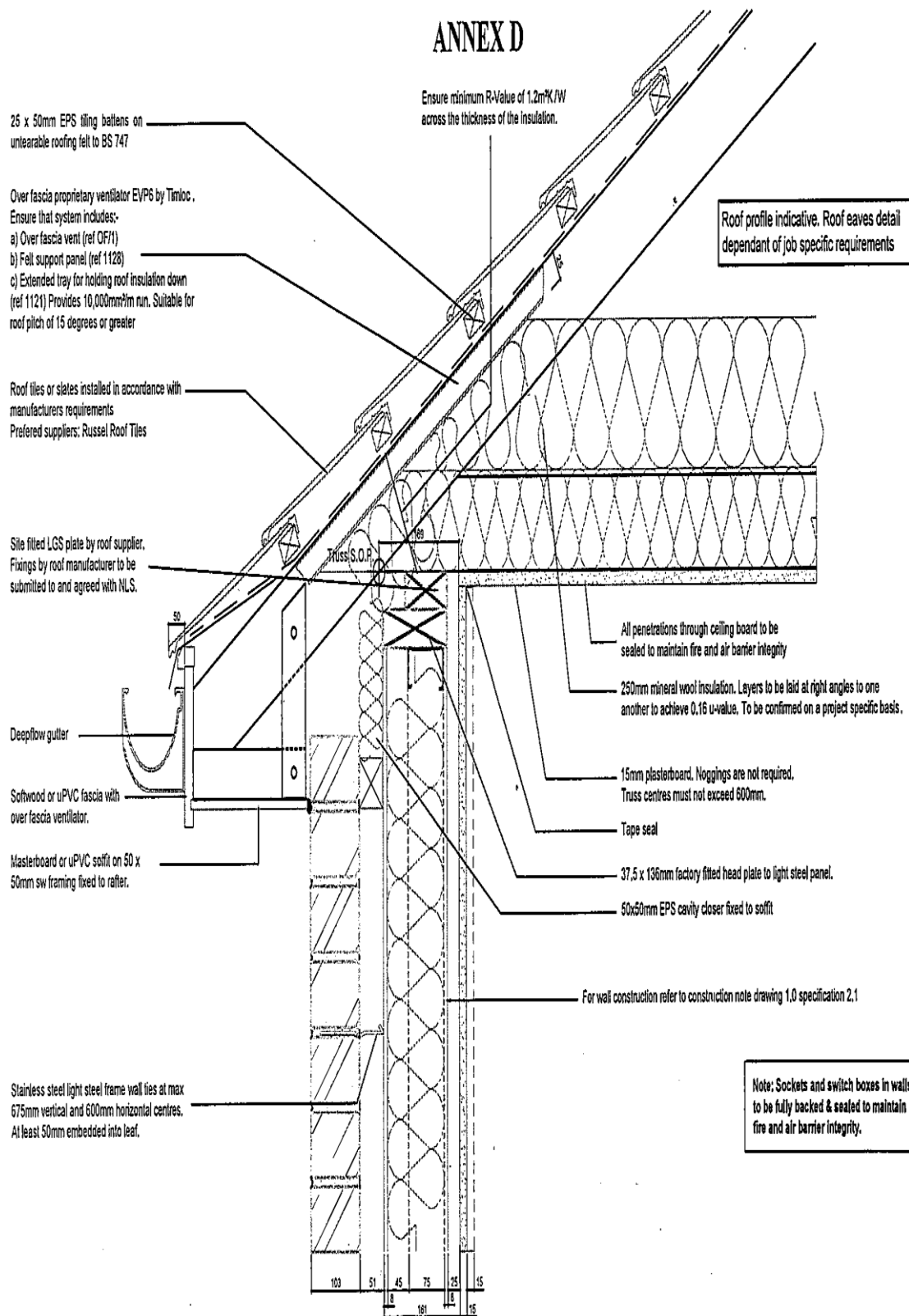


Wall Base Detail – Internal Load Bearing

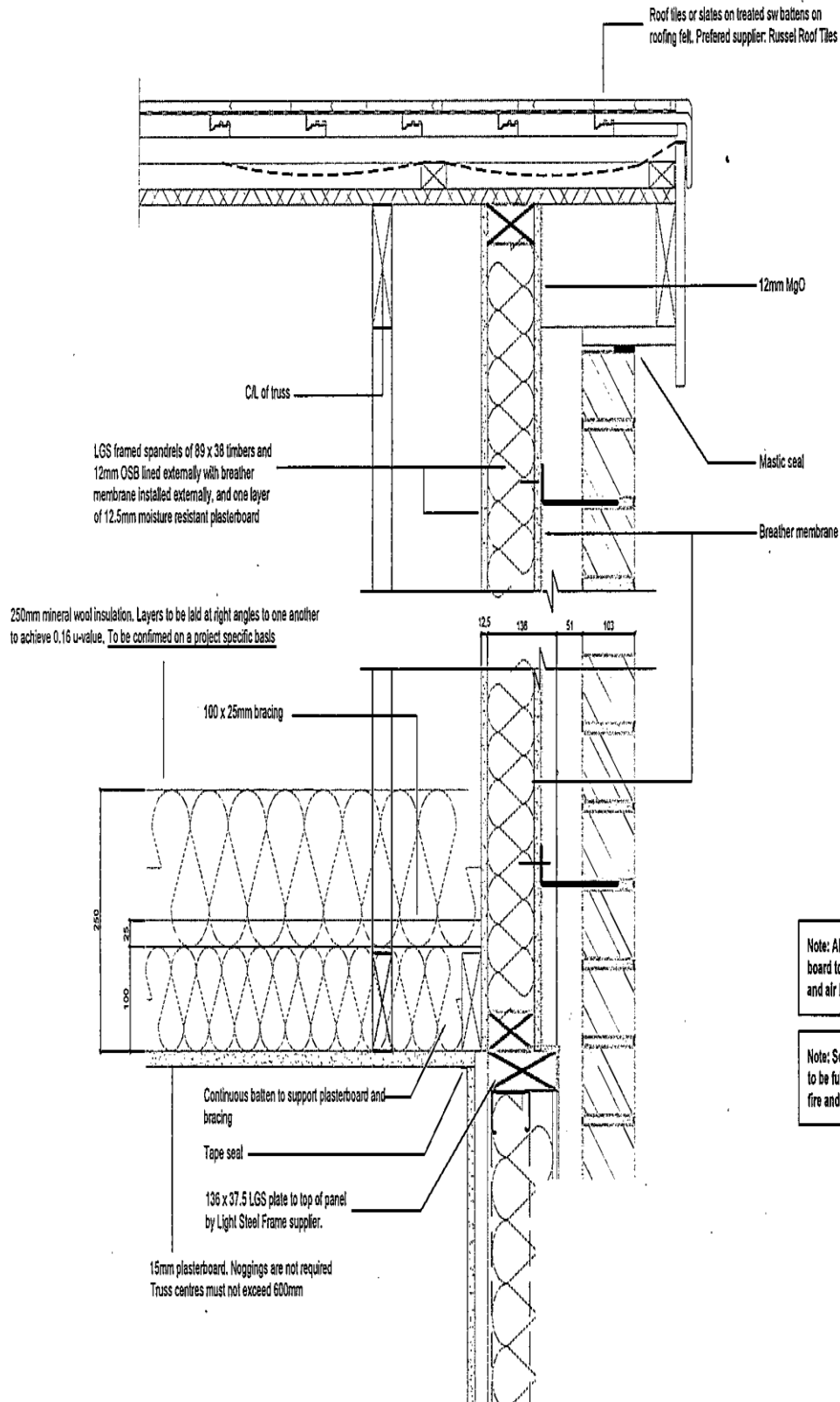


Threshold Detail

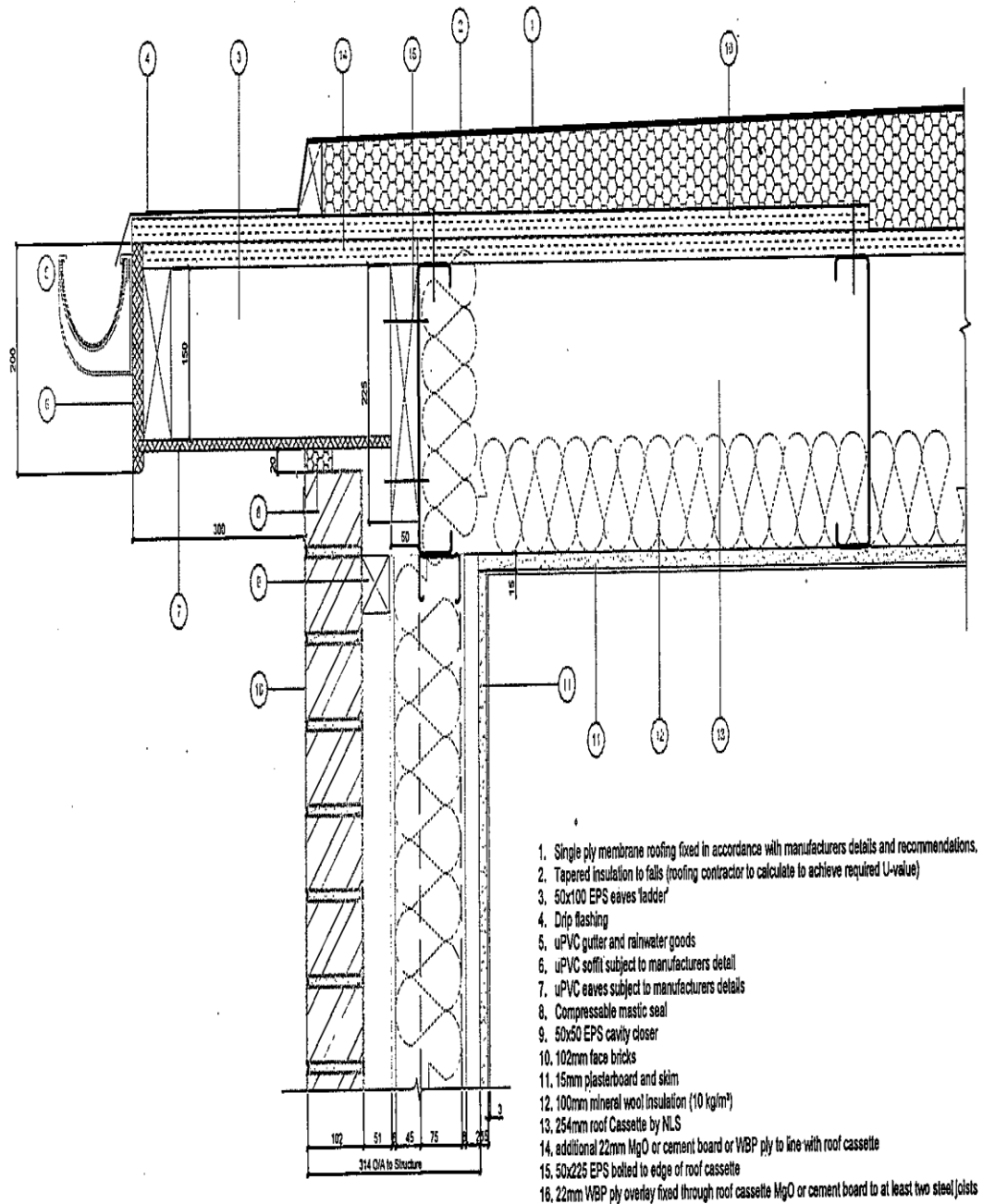
II.2 Roof Details



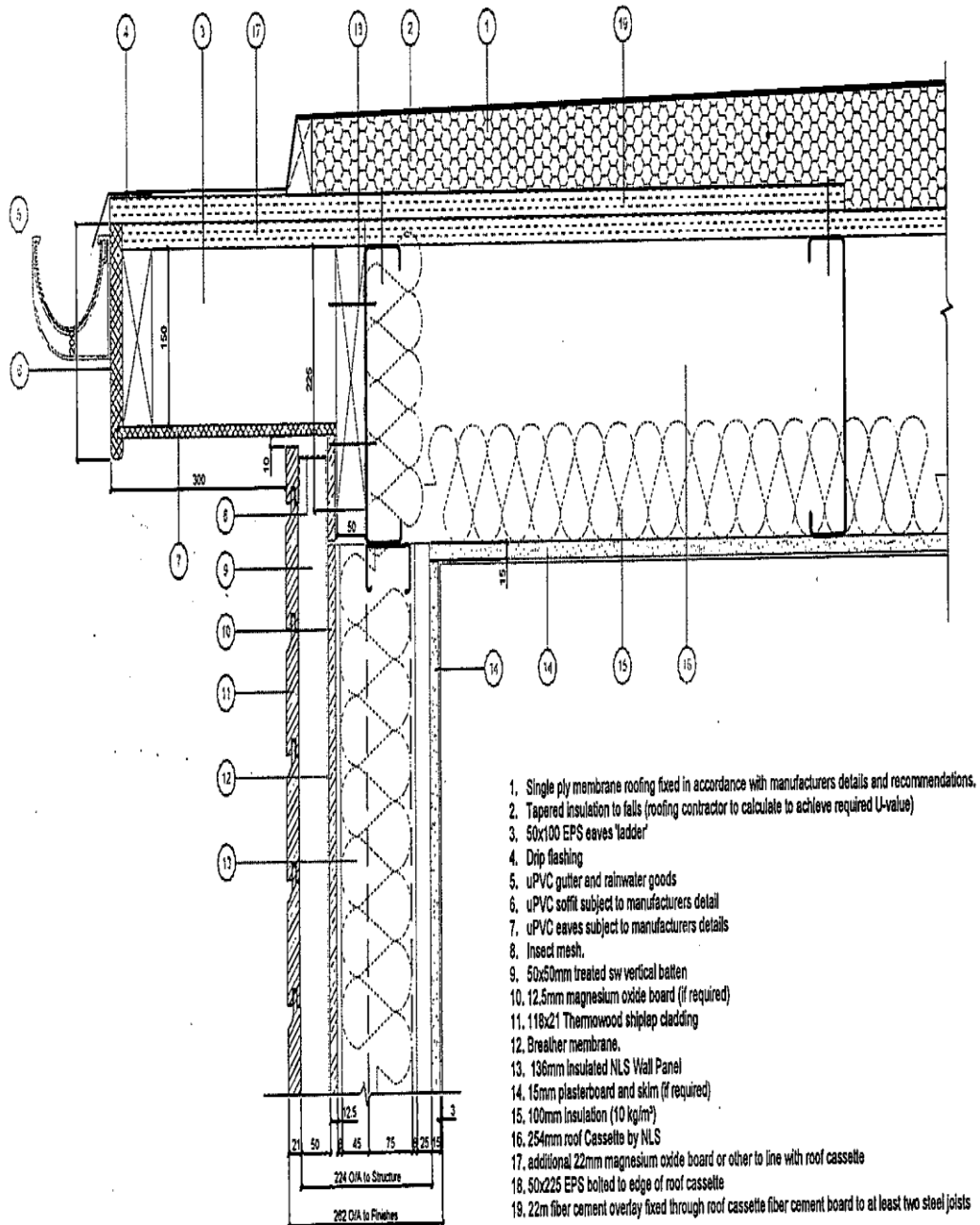
Eaves Detail to Pitched Tiled Roof



Gable End Wall Detail with Tiber Pitched Roof



Flat Roof with 300mm Overhang in Brick



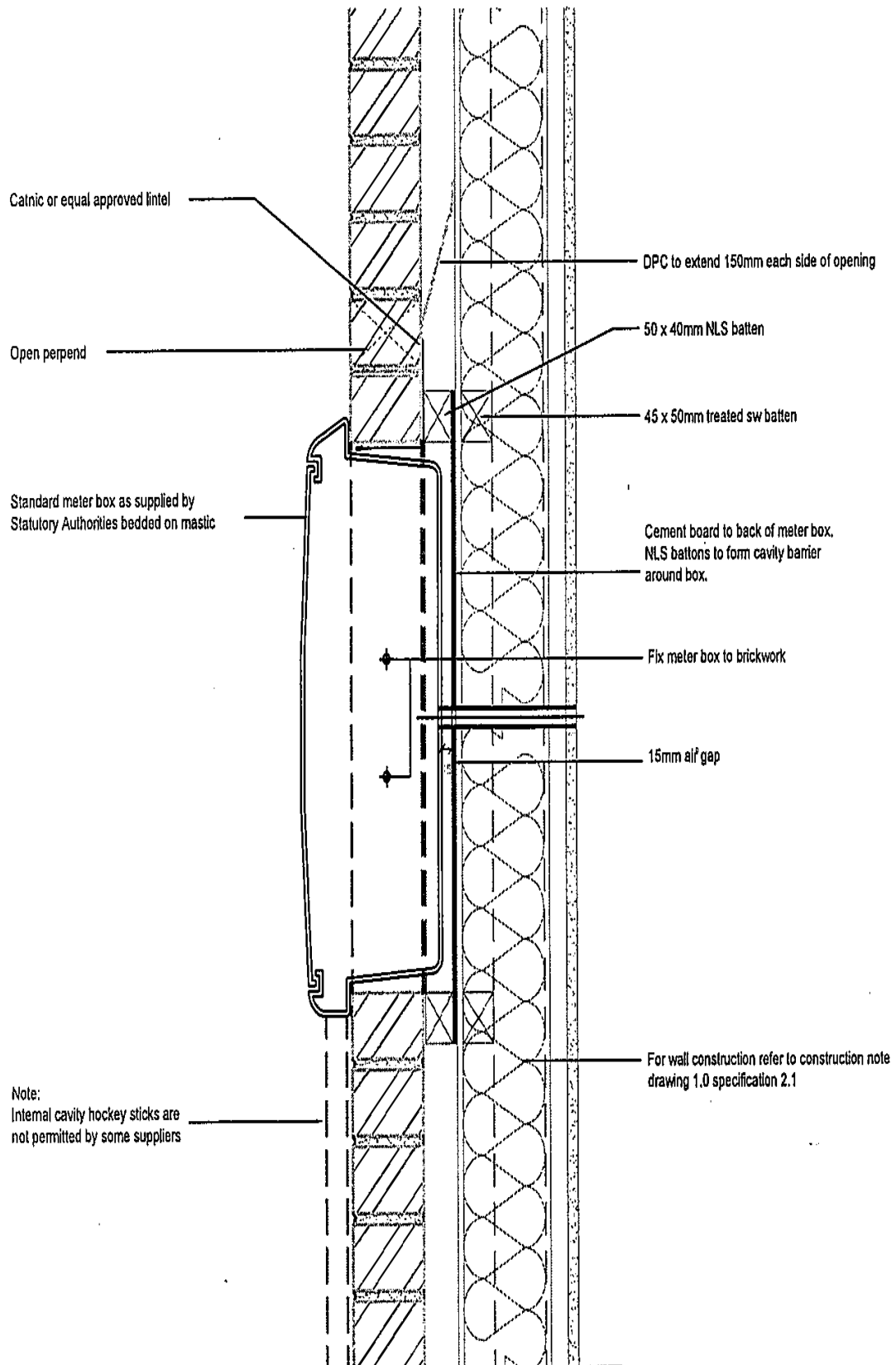
Note: All penetration through ceiling board to be sealed to maintain fire and air barrier integrity

Note: Sockets and switch boxes in walls to be fully backed & sealed to maintain fire and air barrier integrity.

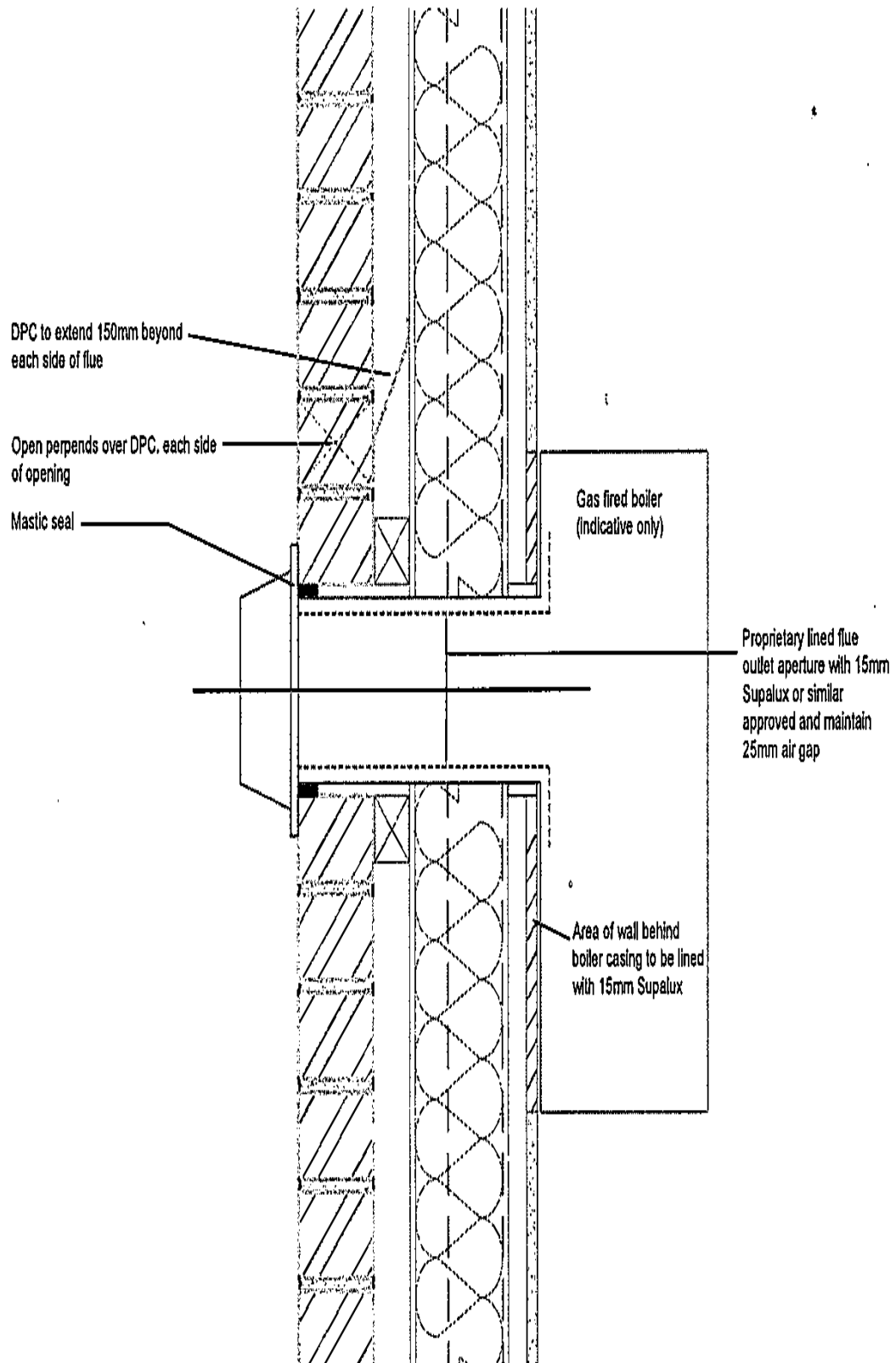
Flat Roof with 300mm Overhang in Clad Wall



II.3 Services



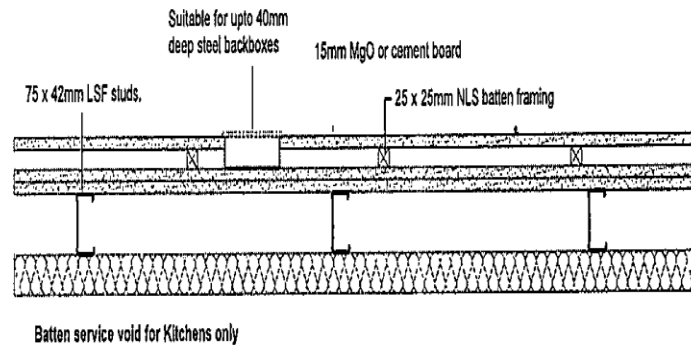
Electrical Meter Box Installation Details



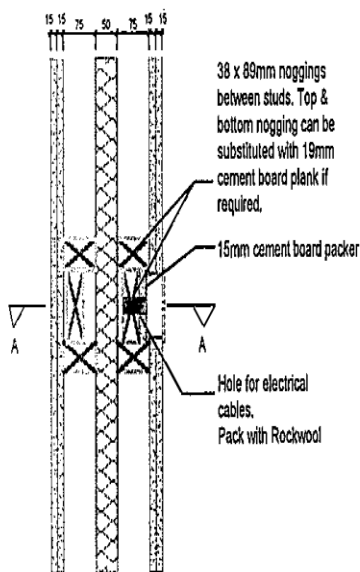
Balanced Flue/ External Wall Detail

Socket details in party walls for steel backboxes deeper than 30mm i.e. tv, shaverpoint, & cookers etc.

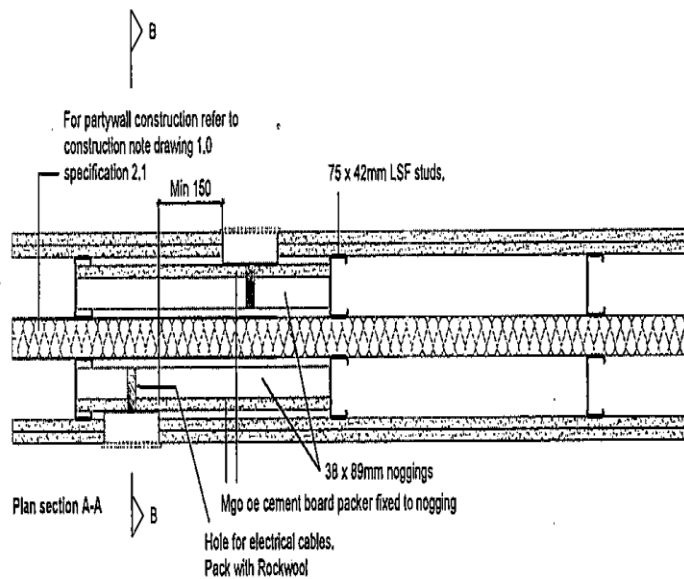
Ensure that sockets are not installed back to back on party walls



Batten service void for Kitchens only



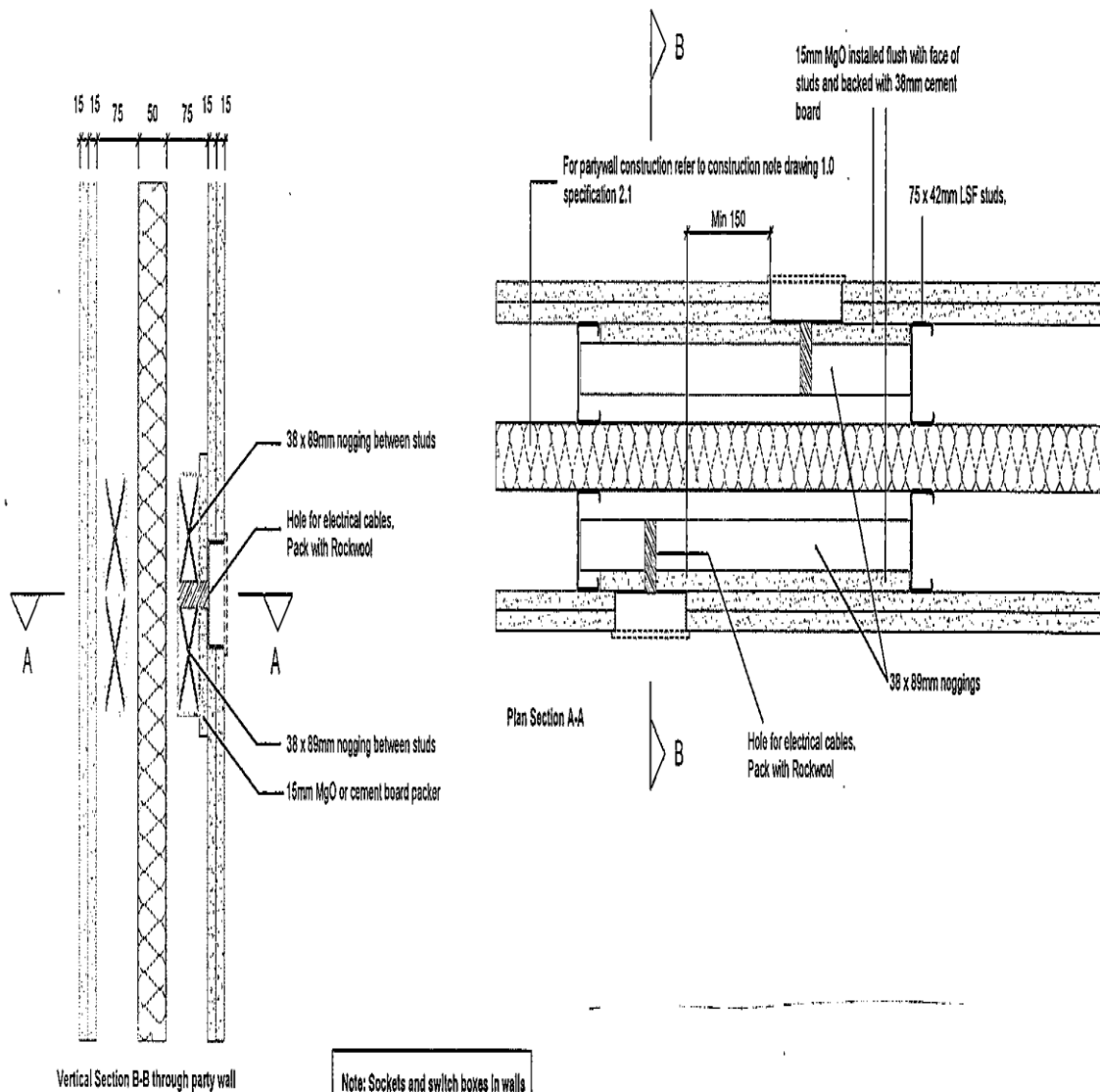
Vertical Section B-B through party wall



Note: Sockets and switch boxes in walls to be fully backed & sealed to maintain fire and air barrier integrity.

Electrical Sockets Deeper Than 300mm in Party Walls

**Socket details in party walls for
steel backboxes upto 30mm deep**

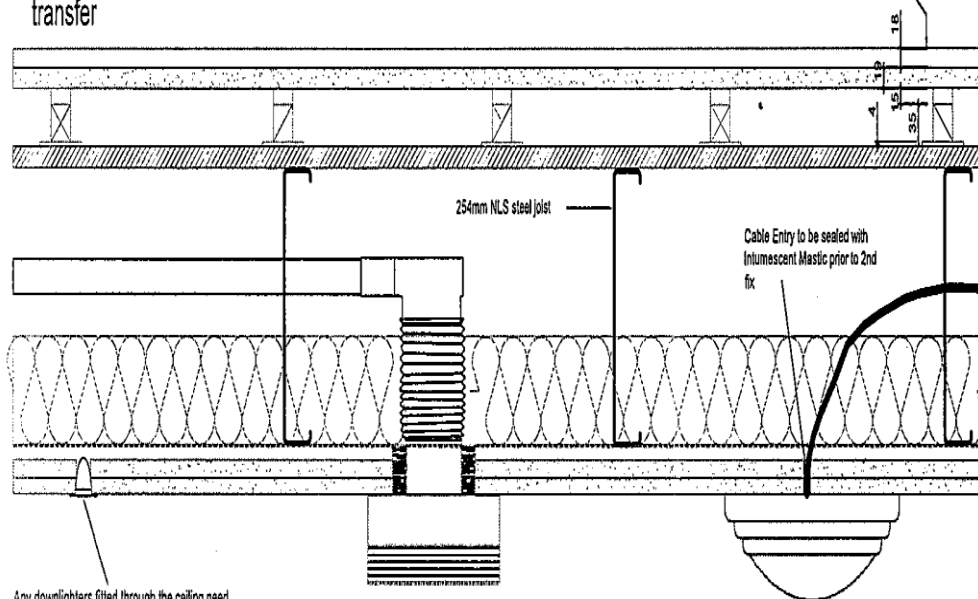


Note: Sockets and switch boxes in walls to be fully backed & sealed to maintain fire and air barrier integrity.

Electrical Sockets up to 300mm Deep in Party Walls

The minimum Airborne Sound Insulation to meet Building Regulations is 45dB $D_{nT,w} + C_{tr}$.
Any ductwork penetrating the floor is to be wrapped with mineral fibre to minimise sound transfer

For floor construction refer to construction note drawing 1.0 specification 4.2



Any downlights fitted through the ceiling need to provide the same level of fire protection as the ceiling

Boiler Flues are NOT permitted to run within the partyfloor. They must be below the fire rated ceiling with access to inspect all joints

This floor is required to perform as a fire separating element. Services that pass through this element must not allow the fire integrity of the floor to be impaired.

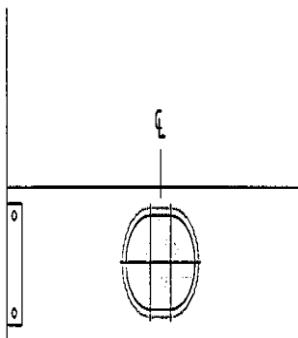
Refer to the project Architects compartmentation drawing to check the fire rating of each compartment, however as a guide vertically:

- | | |
|-----------------------------|---------|
| • Houses | 30 mins |
| • Flats in blocks upto 18m | 60 mins |
| • Flats in blocks above 18m | 90 mins |

Possible solutions are either:

- Fire Damper with thermal fuse and rapid closure spring
- Constructing a fire resisting enclosure along the full length of the duct run within the floor
- The use of Fire Resisting Ductwork
- Proprietary Intumescent sleeves/collars
- Creating a service void at the required depth below the fire rated ceiling

As Standard Two Service Holes Per Span < 1500mm
490mm from end support of each cassette



Note:

NLS to be made aware of any other service hole positions during NLS drawing approval

Not to be Within 490mm of CL unless Agreed by Structural Engineer.

Service Penetrations Upper Floors

ANNEX III

(Clause 3.3)

PHOTOGRAPHS OF COMPLETED PROJECTS



St Georges – Student Accommodation Greenwich Millennium Village – Private Housing



Minerva – Care Home



Brightwell Court – Care Home



Twickenham Road – Private Housing



Wates – Private Housing



Riverside – Private Housing



Calgary – Hotel



Oakville – Hotel



Vancouver – Hotel



Tucson – Hotel