This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 754059.

Design of 2 Fit-to-NZEB training and demonstration models, dedicated to deep energy retrofits

Deliverable 3.1 of the FIT-TO-NZEB project

financed under grant agreement No 754059 of HORIZON 2020 Programme of the EU

MosArt / Passive House Academy

Design of 2 Fit-to-NZEB training and demonstration models, dedicated to deep energy retrofits

A key component of the Fit-to-NZEB project is the design of retrofit models for the purpose of training in Building Knowledge Hubs (BKHs), namely Deliverable 3.1 (Figure 1). The Project requires that two core construction types be developed by the Passive House Academy (PHA, Ireland) as core models, that is, as indicative of model types and their illustration for subsequent adaptation and development by the other Partners reflecting both their respective construction traditions and climates and the higher standards required for nZEB (Nearly Zero Energy Building) performance.

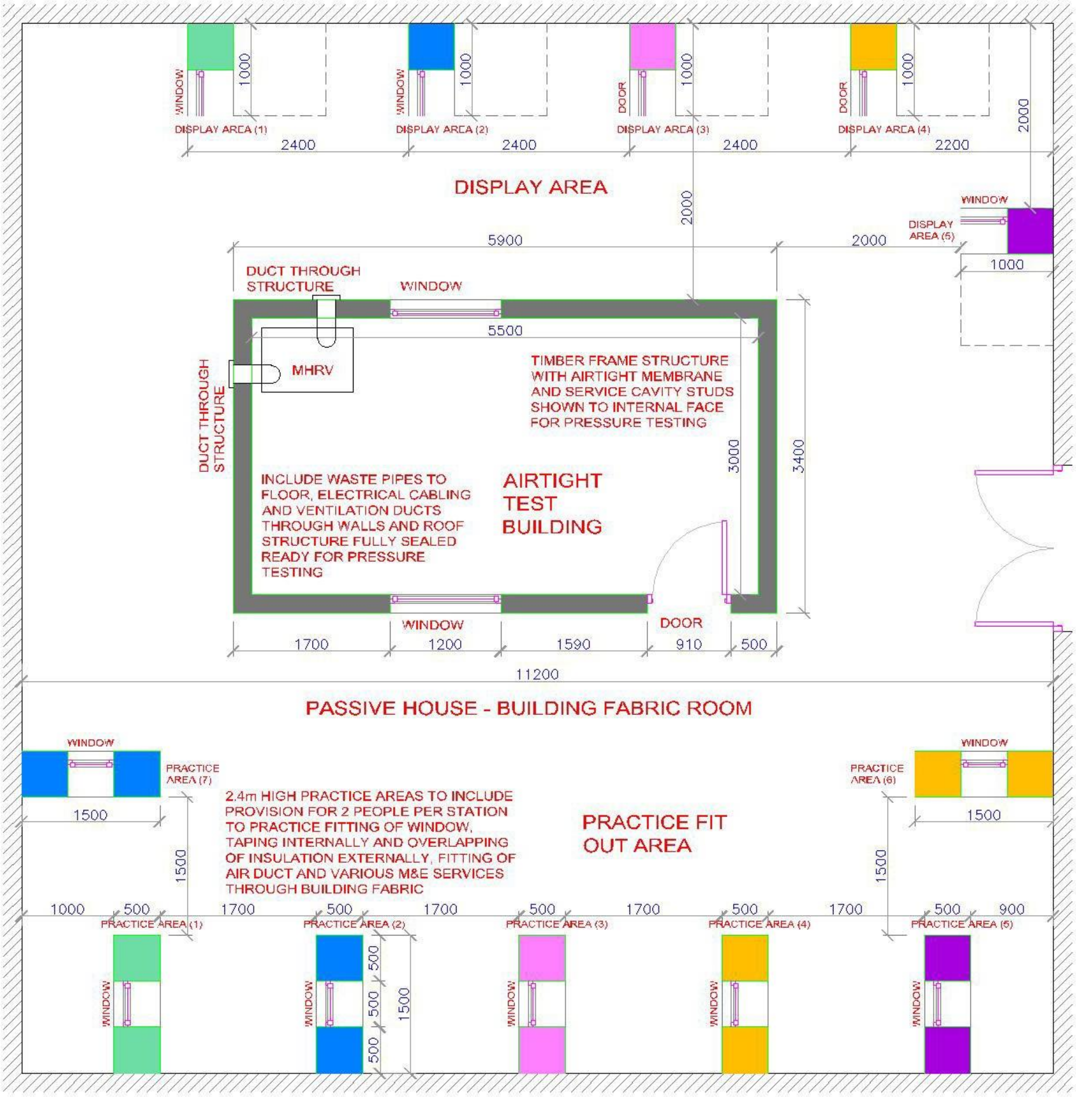


Figure 1 Example of a BKH including demo and practice models and an airtight Room at centre

These models serve two functions, namely:

a) **Demo models** for the purpose of demonstration of typical construction detailing and sequence of elements as well as for sketching exercise, discussion and oral examination. These models comprise simply one complete solution alternative in respect achieving the unbroken continuity of airtightness, insulation, minimal thermal bridging and, preferably, wind-tightness. The construction types selected should be typical for a given country or region but retrofitted in respect of the higher building performance required under nZEB (Figure 2).

b) **Practice models** that more or less correspond to the demo model construction types but for the purpose of hands-on practical training and examination. Unlike the complete demo model, these models are stripped to their basic structure, providing the basis for the practical retrofitting work (Figure 3).

Figure 2 Example of demo models

Figure 3 Example of practice models, including a massive / solid brick wall intended for retrofit training

Developing the Brief - responding to Partner requests

Models

During the process of developing models types for use by the Fit-to-NZEB, some Partners requested that their respective country's typical construction types would be considered by MosArt. Sets of details were, accordingly, forwarded by the Bulgarian, Croatian and Greek Partners. Having reviewed these, MosArt deemed the best response was to provide on each detail sheet a critical comment, as included in Appendix A, B and C.

The fulfillment of the contractual requirements is served, not by MosArt attempting to create details for each of the countries concerned as it is the Partners who better understood their own construction traditions and economy as well as climate and seismic challenges. Rather, it was deemed more appropriate to produce a set of drawings of the demo and practice models for the purpose of providing the Partners with guidance on how they can produce their own designs as bases for appropriate model construction and training. Thus, in a sense, the MosArt models were to function as 'models of modes'. These models provided must not be seen as limiting alternative retrofit solutions but merely to indicate options to some typical conditions. The Partners are expected to develop model designs best suited to their respective countries. The same obtains regarding physical size – window and wall heights can be adjusted in order to ensure models fit into a given workshop.

In order to cover a range of construction types as well as construction elements, MosArt decided to provide three core model types, some of which being two-part with one retrofit option above and another below on the same model section. These models comprise masonry walls of concrete and solid / massive brick as well as of timberframe with a cavity and external leaf of rendered concrete block, and they each incorporate a window or door. The following is an outlined of these wall types. Drawings of these demo models, Drawing Nos: D3.1 A – D3.1 E and for practice models, Drawing Nos: D3.1 F - D3.1 H as A3 (fold-out) sheets are presented at the end of this Report.

Demo Models

- Concrete walls:
  - with flat concrete roofs and parapets (existing / new using aerated block)
  - junction of wall panels sealed with EPDM tape or similar
  - solar shading alternative (bris soleil / integrated louvered blinds)
  - shallow and deep foundations

- Massive brick walls:
  - with existing pitched roof adapted to achieve continuity of insulation
  - external (upper part) and internal insulation (lower part), the latter being limited in respect of condensation risk and determined by climate specific hygrothermal analysis

- Timberframe with cavity and external leaf of rendered concrete block:
  - with raised pitched roof
  - replacement of external block leaf with woodfibre insulation

- replacement of external block leaf with secondary timberframe structure and cellulose insulation
- filling of cavity with bonded bead insulation and mounting EPS insulation onto the existing concrete block wall the viability of this being verified by climate specific hygrothermal analysis.

Practice Models

- Concrete wall with a fixed window and a 150mm and 50mm pipe and cable penetrating the wall
- Massive brick wall with a fixed window and a 150mm, 50mm pipe and cable penetrating the wall
- Timberframe with a fixed window and a 150mm and 50mm pipe and cable penetrating the wall

These models provide the basis for solutions that should be adapted to and developed in each Partner country and workshop environment. A window frame unglazed can be pre-fixed into the ope and whatever services are deemed appropriate fitted through the walls. Whilst it is preferable in the case of external insulation that windows are located just beyond the wall in the new insulation layer, it can be pragmatically realistic to retain, as an example, one window in the original position, that is, in the masonry layer, but requiring the packing of sufficient insulation around it and over the front frame in so far as is possible in order to avoid a thermal bridge. The Partners need to consider such matter for themselves.

The Partners are also encouraged to develop further these practice models, for example, by creating a corner or a room-like structure in order to provide more surfaces on which trainees can work as well as internal and external corner conditions, or to incorporate part of a roof, whether flat or pitched (Figures 4, 5 and 6). Please note that Figures 4, 5 and 7 below are taken from the Train-to-NZEB project (see http://www.train-to-nzeb.com/).

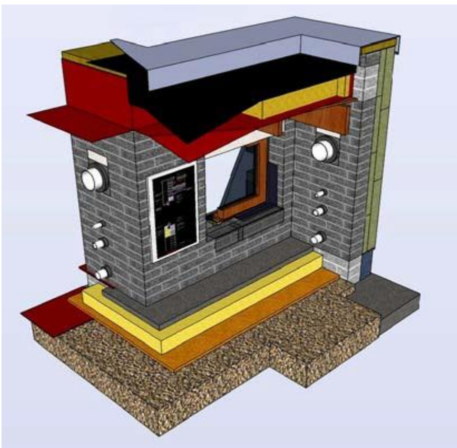


Figure 4 3-D model of masonry construction model type. Source: Terms of Reference for local teams for the creation of Building Knowledge Hubs. Deliverable 2.1 of the Train-to-NZEB project. Available at http://www.train-to-nzeb.com/what-weve-delivered.html

Figure 5 Z-shaped timberframe structure. Source: Terms of Reference for local teams for the creation of Building Knowledge Hubs. Deliverable 2.1 of the Train-to-NZEB project. Available at http://www.train-to-nzeb.com/what-weve-delivered.html

Figure 6 Room-like masonry model of concrete block and brick

Even greater likeness to real life conditions would be achieved with comprehensive and integrated room-like structure, whether in masonry (concrete or brick) fitted with doors and windows, as well as a generously sized roof. This is much the same as the kind of training rig used for apprentice carpenters but is ideal for retrofit training as it is representative of a significant number of existing conventional domestic structures requiring upgraded building fabric. For safe access and training practice it would be necessary to include a gallery platform structure (like permanent scaffolding) with stairs and rails (Figures 7, 8 and 9).

Figure 7 Bare masonry walls and roof framing above to be retrofitted, including the junction between these two elements, including gallery platform (and stairs beyond) for safe access. Source: Terms of Reference for local teams for the creation of Building Knowledge Hubs. Deliverable 2.1 of the Train-to-NZEB project. Available at http://www.train-to-nzeb.com/what-weve-delivered.html

Figure 8 Open roof framing on bare masonry walls ideally suited to practical retrofit training, including gallery platform for safe access

Figure 9 Standard timberframe structure (without rainscreen of masonry or light weight construction) with exposed floor, wall and roof framing suited to retrofit practical training

Mechanical Systems: Renewable Energy and MVHR

In addition to the above demo and practice models, MosArt includes in this Report guidance on the provision of renewable energy systems (RES) and other appropriate mechanical systems. Given that part of the provision in each BKH is an airtight room for operating airtight testing equipment, it is deemed spatially efficient to use this structure to accommodate commonly available equipment and associated components necessary for their operation (Figure 6). Further spatial efficiency can be achieved by using the roof of the airtight Room for training on PV and solar thermal panel installation, but this would necessitate a gallery platform and stairs for easy access and safety. Figure 7)

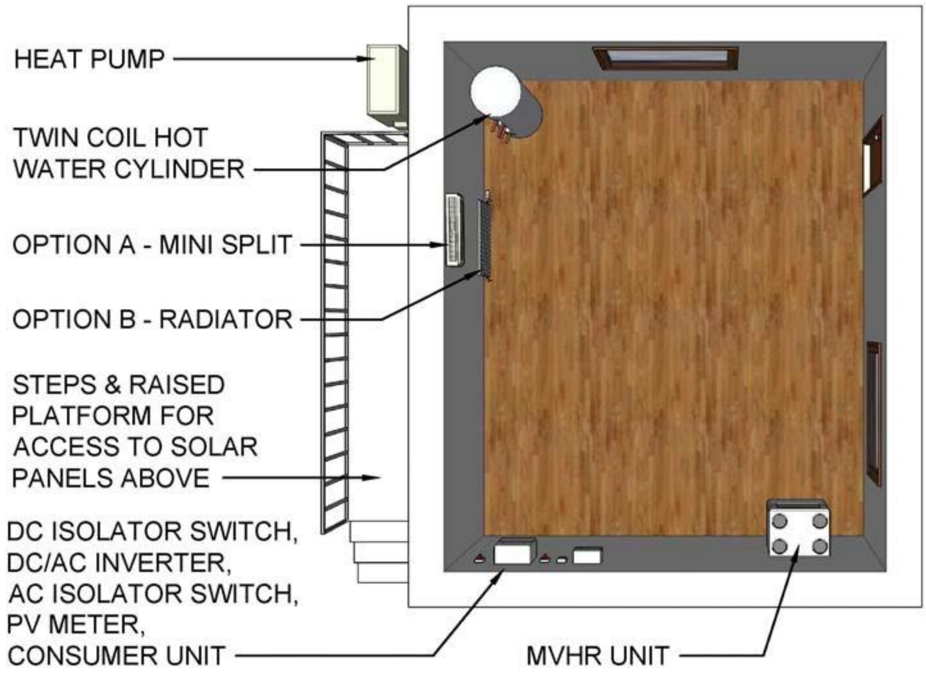


Figure 6 Plan of Airtight Room indicating positioning of RES and MVHR equipment as well as low gallery platform and steps for access to panels on roof

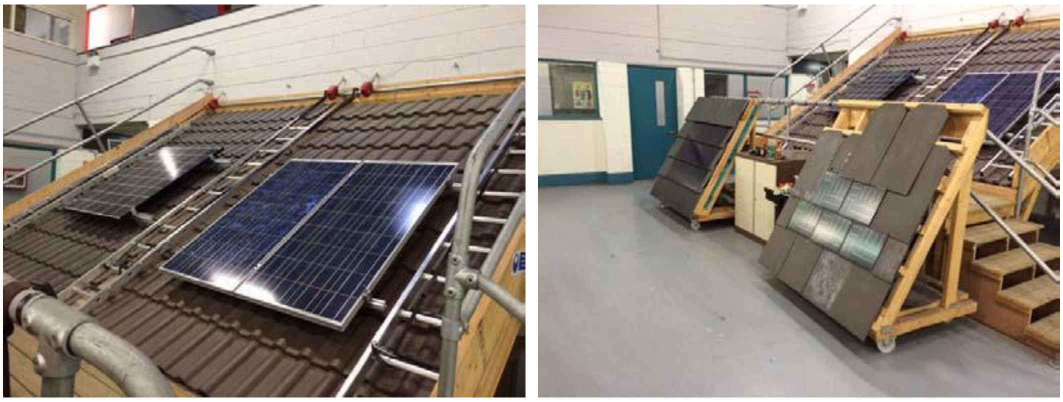


Figure 7 Images of a roof rig for training on RES panels providing safe and easy access via a stairs and gallery platform

The mechanical systems can comprise:

- PV panel(s) on the roof, including a DC/AC inverter, PV generation meter and battery bank for energy storage inside and a consumer unit (trip-switch) (Figure 8).

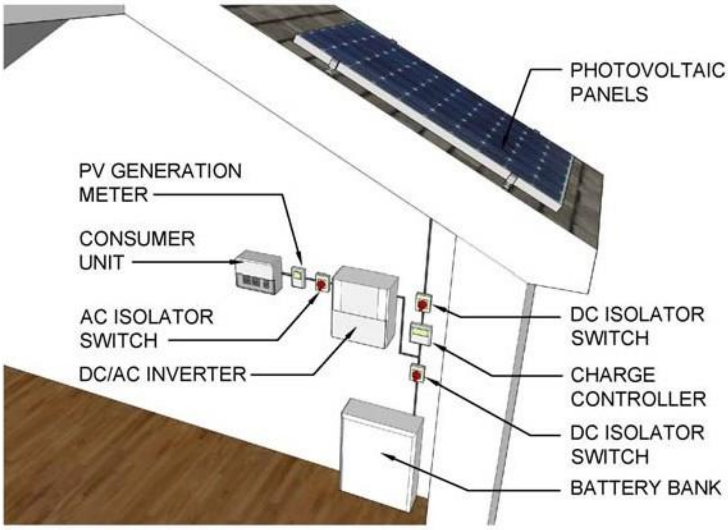


Figure 8 Photovoltaic (PV) panel on roof, including inverter connecting to battery bank and consumer unit (trip-switch)

- Solar thermal panel on the roof feeding into a twin-coil water storage vessel, supplemented by a heatpump, for heating and domestic hot water (DHW). Heating is delivered through a low temperature radiator (for a heating climate)(Figure9).

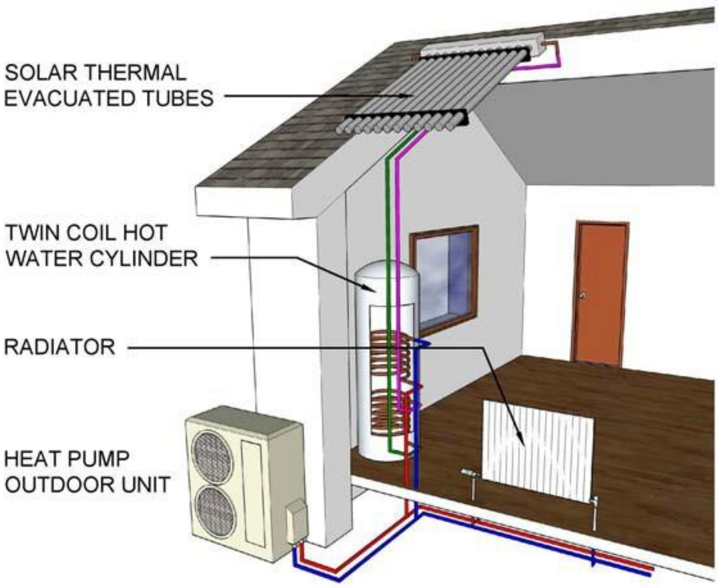


Figure 9 Solar thermal panel, heatpump connecting to twin-coil water storage cylinder and low temperature radiator

- Twin-coil water storage cylinder heated primarily by solar-thermal evacuated tubes for domestic hot water (DHW) and supplemented by a heatpump. Heating and cooling are provided by the heatpump and delivered through a fan coil unit using re-circulated air (heating and cooling climates) (Figure 10)

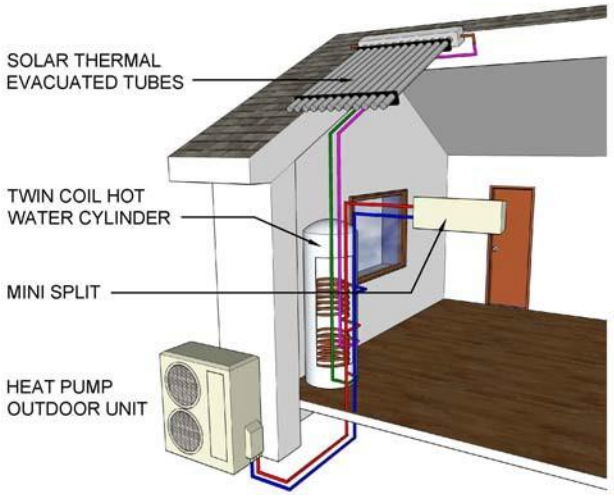


Figure 10 Twin-coil water storage cylinder and + solar thermal panel for DHW, heatpump connected to fan-coil for heating and cooling

- MVHR unit, including a post-heater and sound attenuators, with intake and exhaust ducts connecting to the exterior and supply and extract ducts and their registers serving the interior – four supply and four extract registers mounted in an accessible suspended ceiling (Figures 11 and 12).

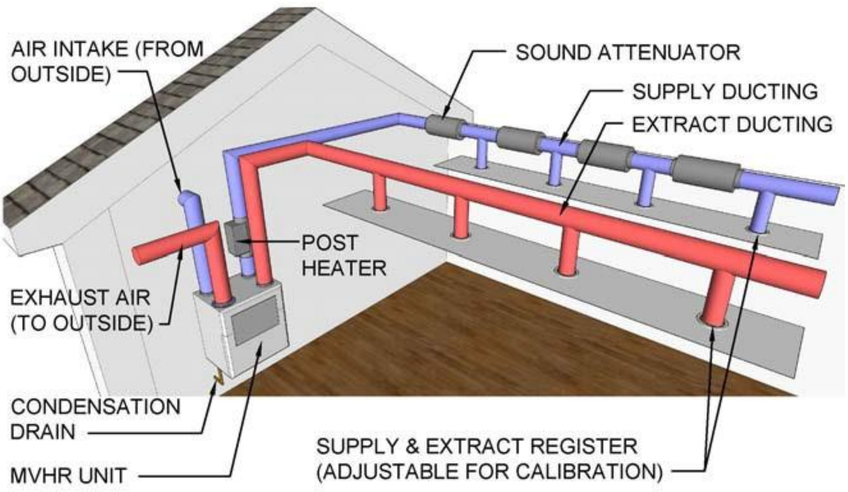
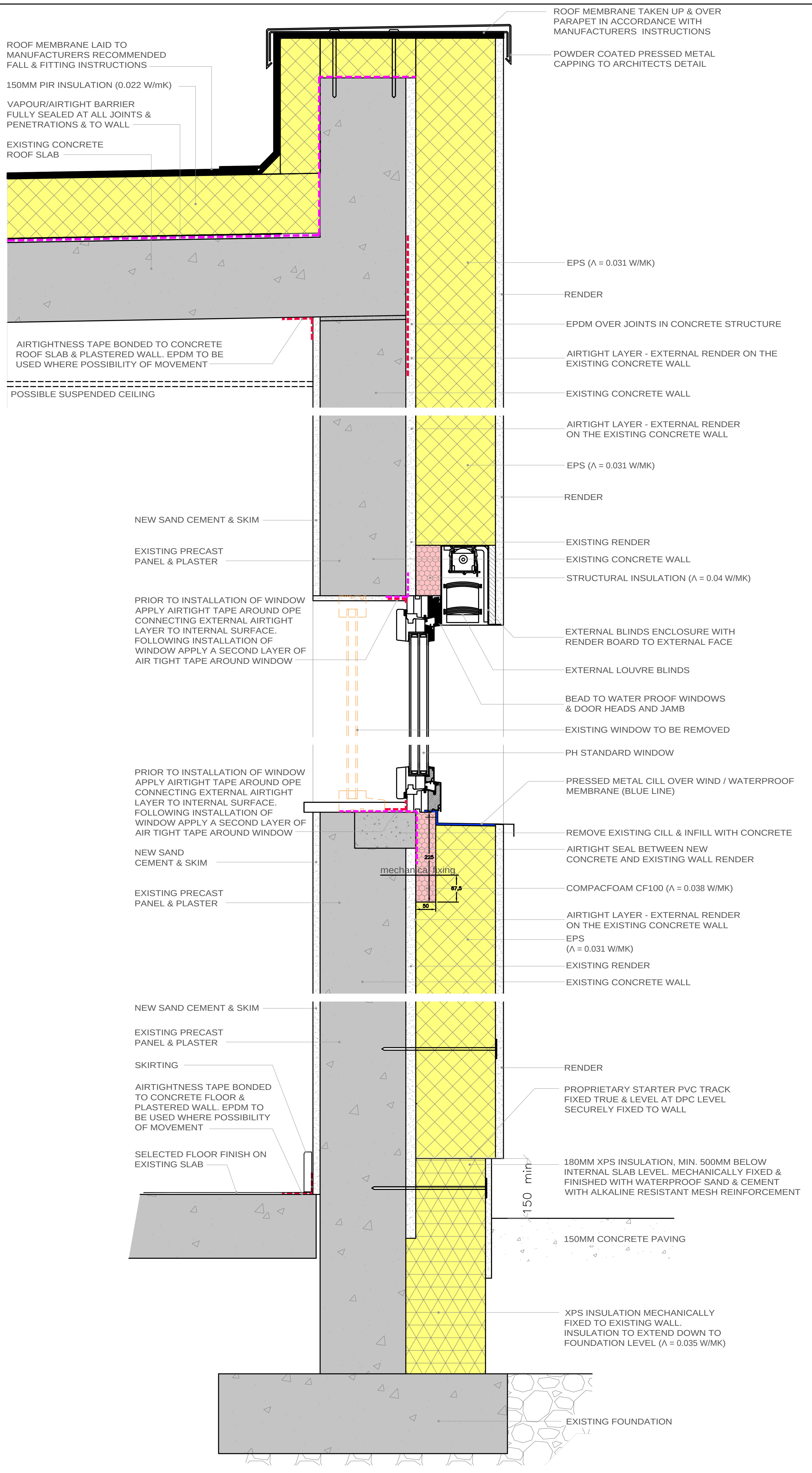


Figure11 Model of MVHR with post-heater, sound attenuation and supply and extract registers

Figure 12 MVHR and associated components installed in an Airtight Room being used for training



MosArt
ARCHITECTURE LANDSCAPE URBAN DESIGN

Construction type:

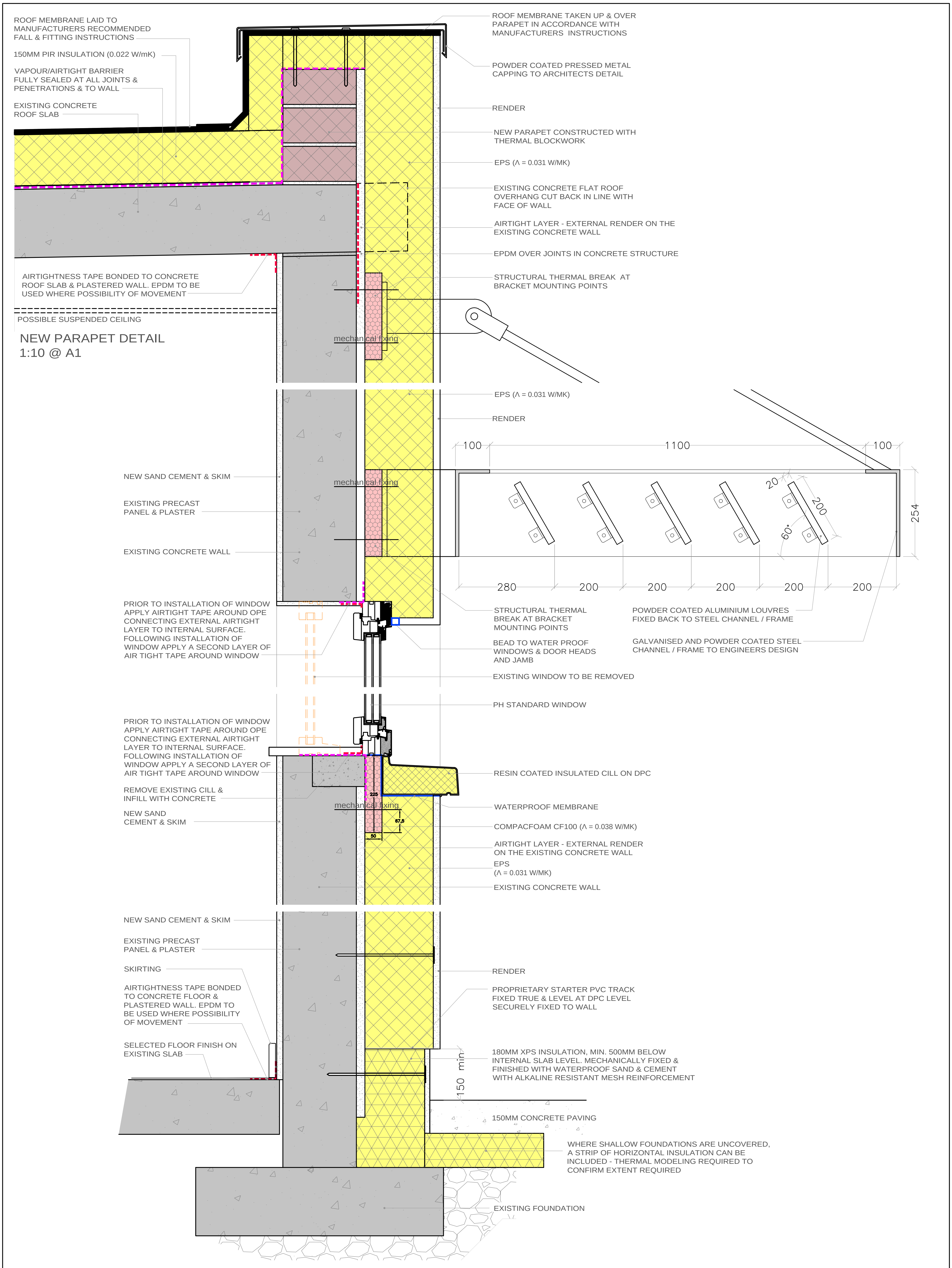
Existing concrete walls retrofitted with external EPS & flat roof retrofitted with PIR insulation

Drawn By: AB	Checked: AMcC	Date: January 2018
Scale: 1:10 @ A3	Drawing no.: D3.1 A	

Project:

Fit-to-NZEB
Innovative training schemes for retrofitting to nZEB-levels

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 754059



MosArt
ARCHITECTURE LANDSCAPE URBAN DESIGN

Construction type:

Existing concrete walls retrofitted with external EPS & flat roof retrofitted with PIR insulation

Drawn By: AB	Checked: AMcC	Date: January 2018
Scale: 1:10 @ A3	Drawing no.: D3.1 B	

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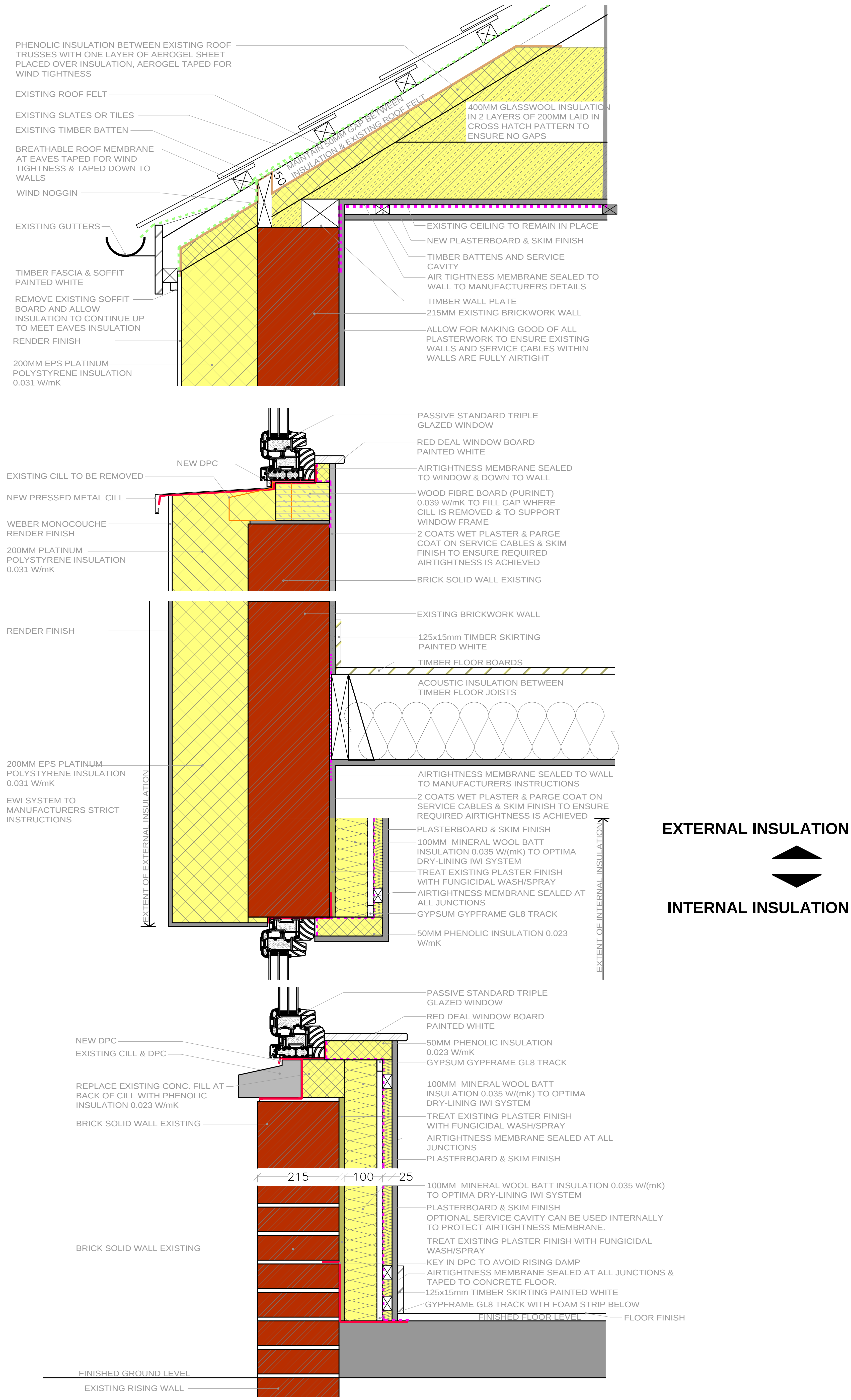

MosArt
ARCHITECTURE LANDSCAPE URBAN DESIGN

Construction type:

Existing brick wall retrofitted

Drawn By: AB	Checked: AMcC	Date: January 2018
Scale: 1:10 @ A3	Drawing no.: D3.1 C	

Project:

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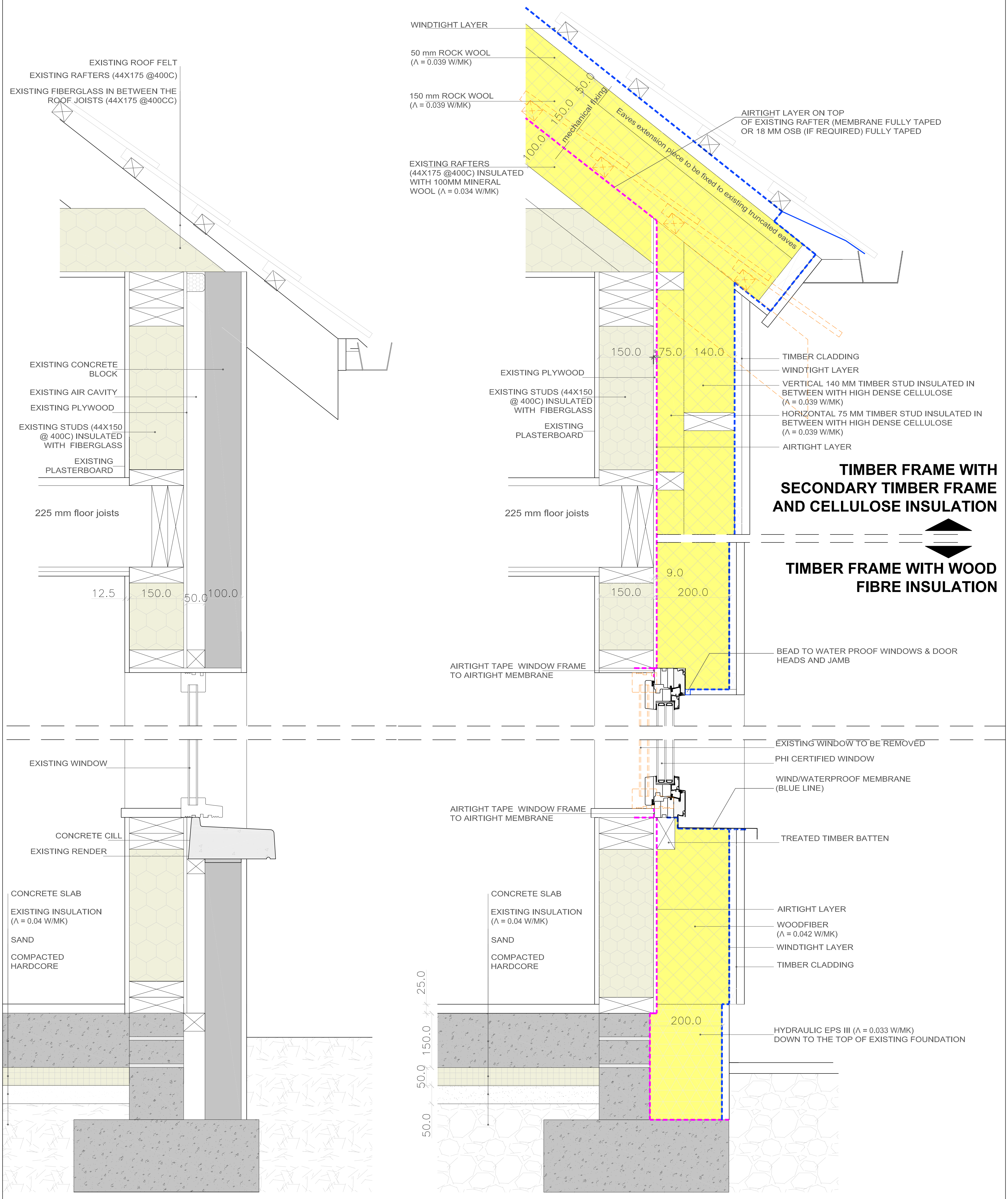

SECTION SHOWING EXISTING TIMBER FRAME WALL

MosArt
ARCHITECTURE LANDSCAPE URBAN DESIGN

Construction types:
UPPER SECTION
Timber frame with secondary timber frame and cellulose insulation
LOWER SECTION
Timber frame with wood fibre insulation

Drawn By: AB	Checked: AMcC	Date: January 2018
Scale: 1:10 @ A3	Drawing no.: D3.1 D	

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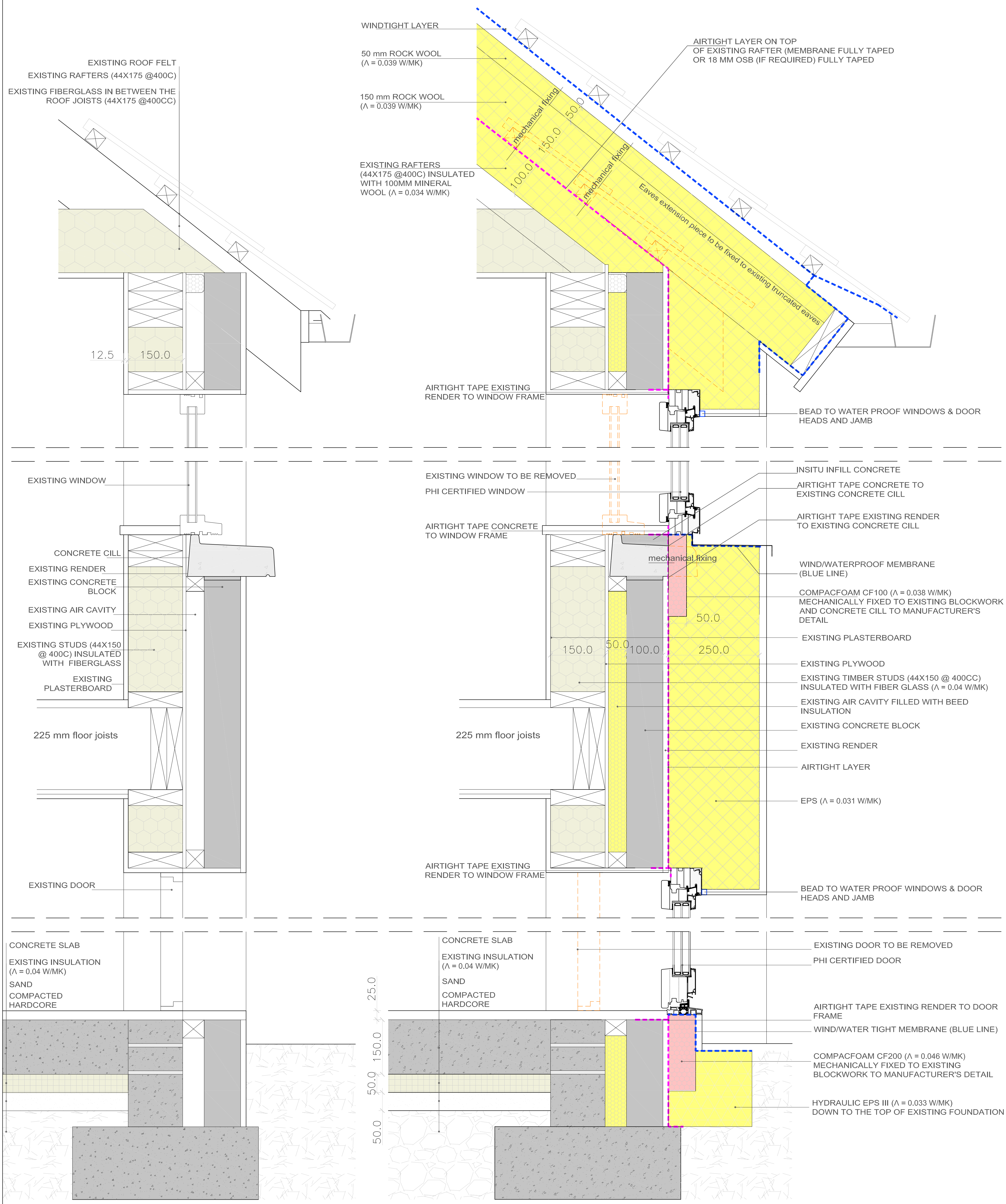

SECTION SHOWING EXISTING TIMBER FRAME WALL

MosArt
ARCHITECTURE LANDSCAPE URBAN DESIGN

Construction type:
Existing timber frame retrofitted with external EPS insulation boards

Drawn By: AB	Checked: AMcC	Date: January 2018
Scale: 1:10 @ A3		Drawing no.: D3.1 E

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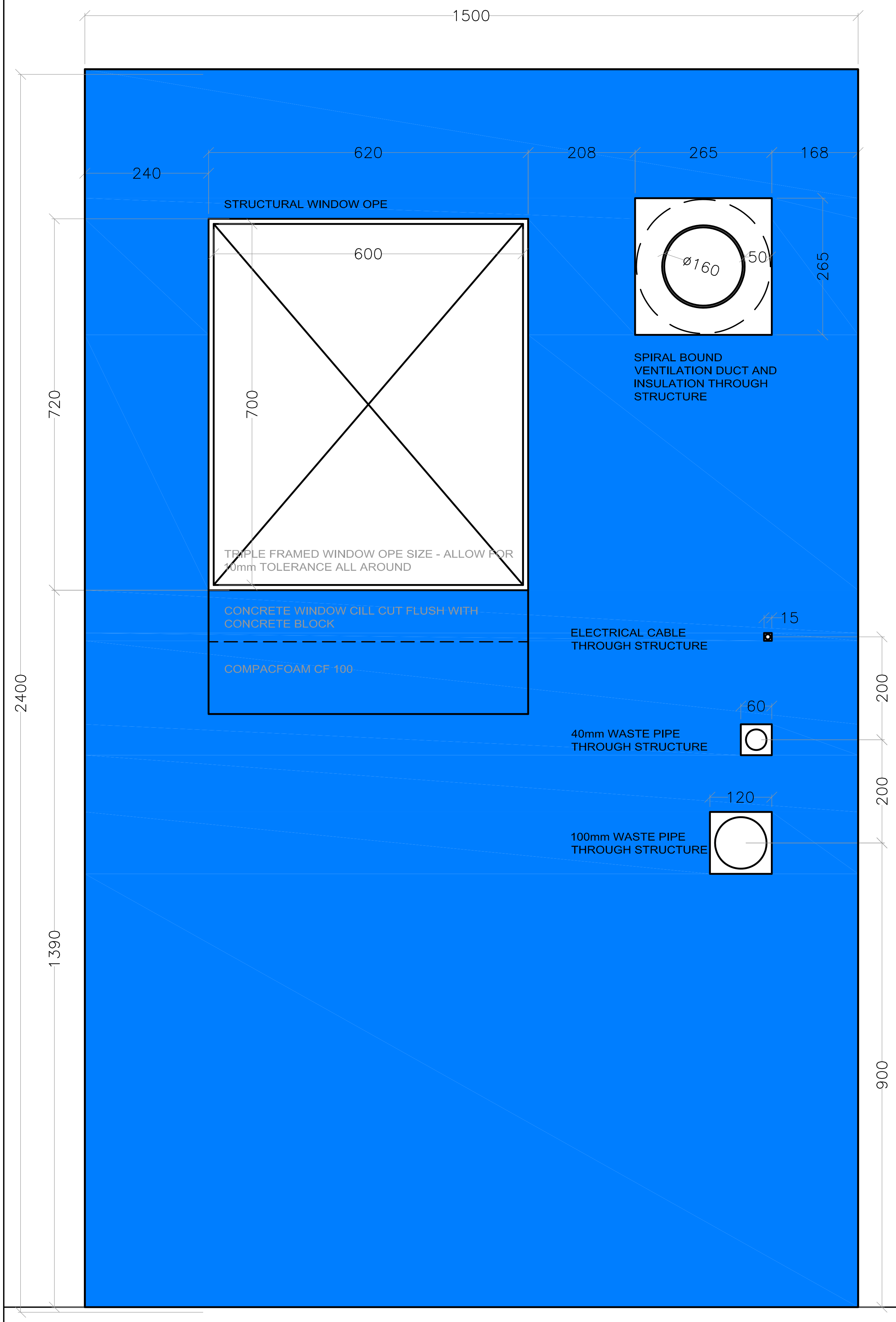
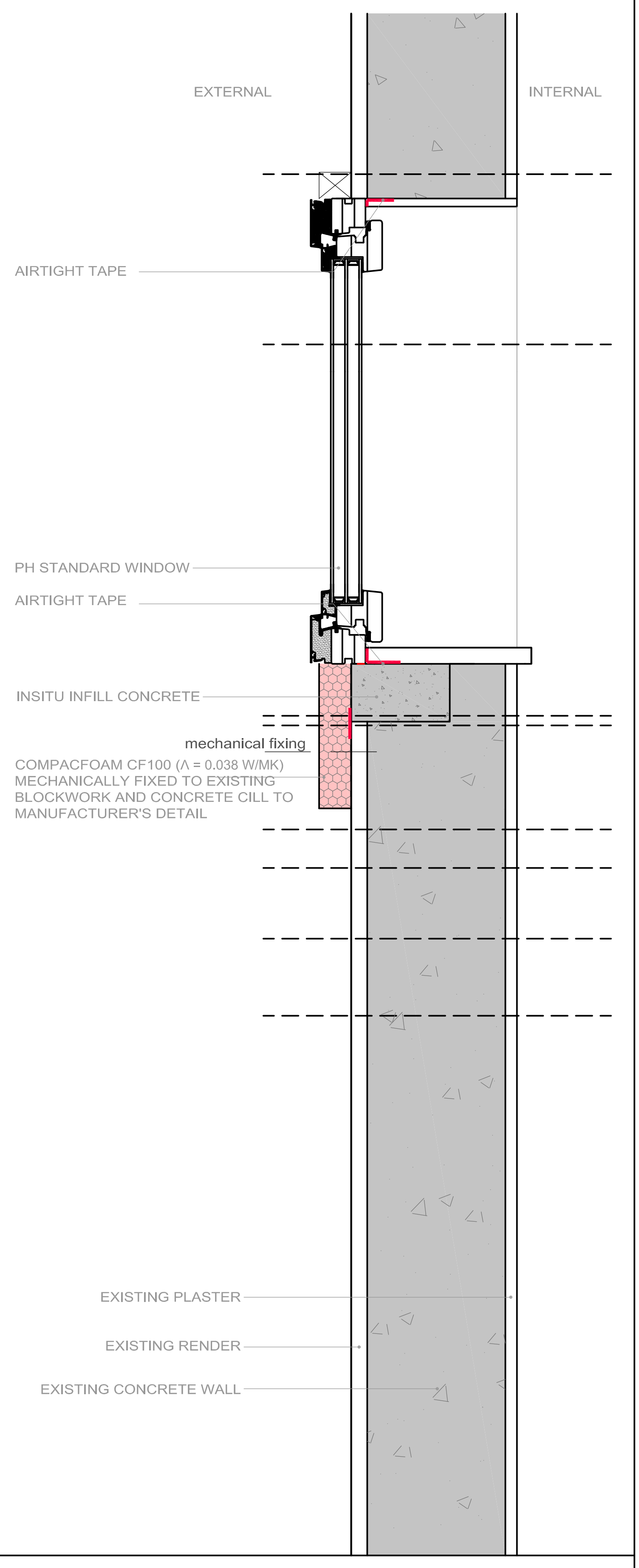
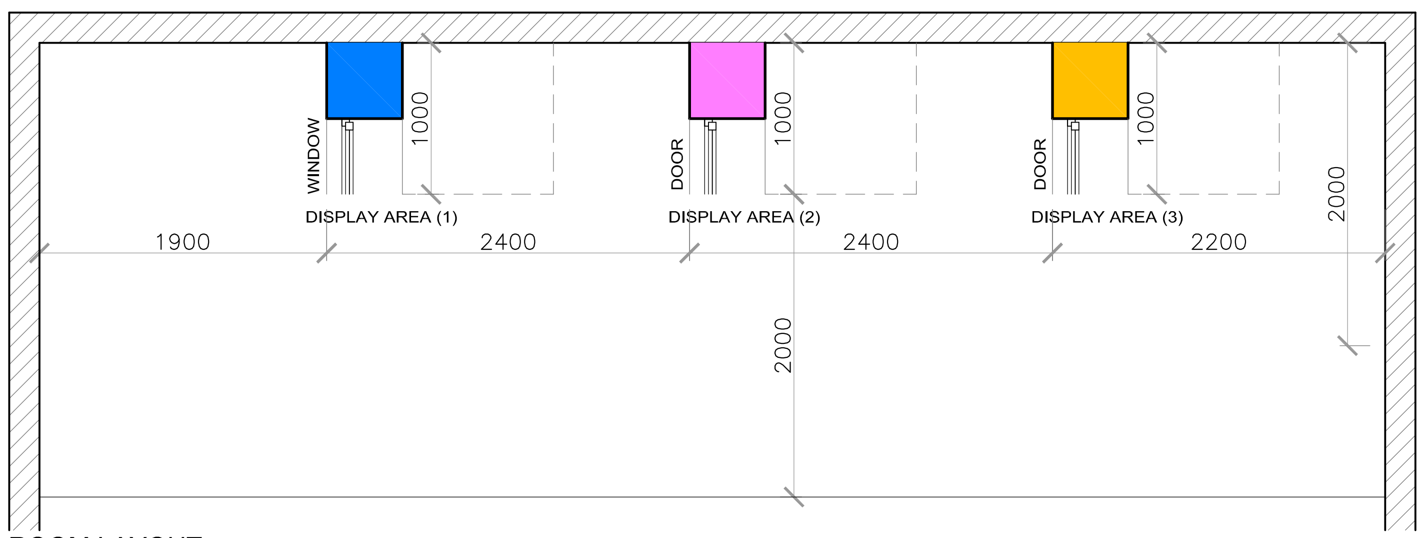




ELEVATION OF PRACTICE AREA NO. (1) PRECAST CONCRETE WALL PANEL
scale 1:10 @ A3



ROOM LAYOUT
scale 1:50 @ A3

WALL TYPE NO. (1)
PRECAST CONCRETE WALL PANEL

WALL TYPE NO. (2)
TIMBER FRAME WITH EXTERNAL LEAF CONCRETE BLOCK

WALL TYPE NO. (3)
BRICK WALL CONSTRUCTION

COLOR CODE LEGEND

MosArt
ARCHITECTURE LANDSCAPE URBAN DESIGN

WORKING MODELS:

Room Layout, Model's elevations and section

Drawn By: AB	Checked: AMcC	Date: January 2018
Scale: as noted	Drawing no.: D3.1 F	

Project:
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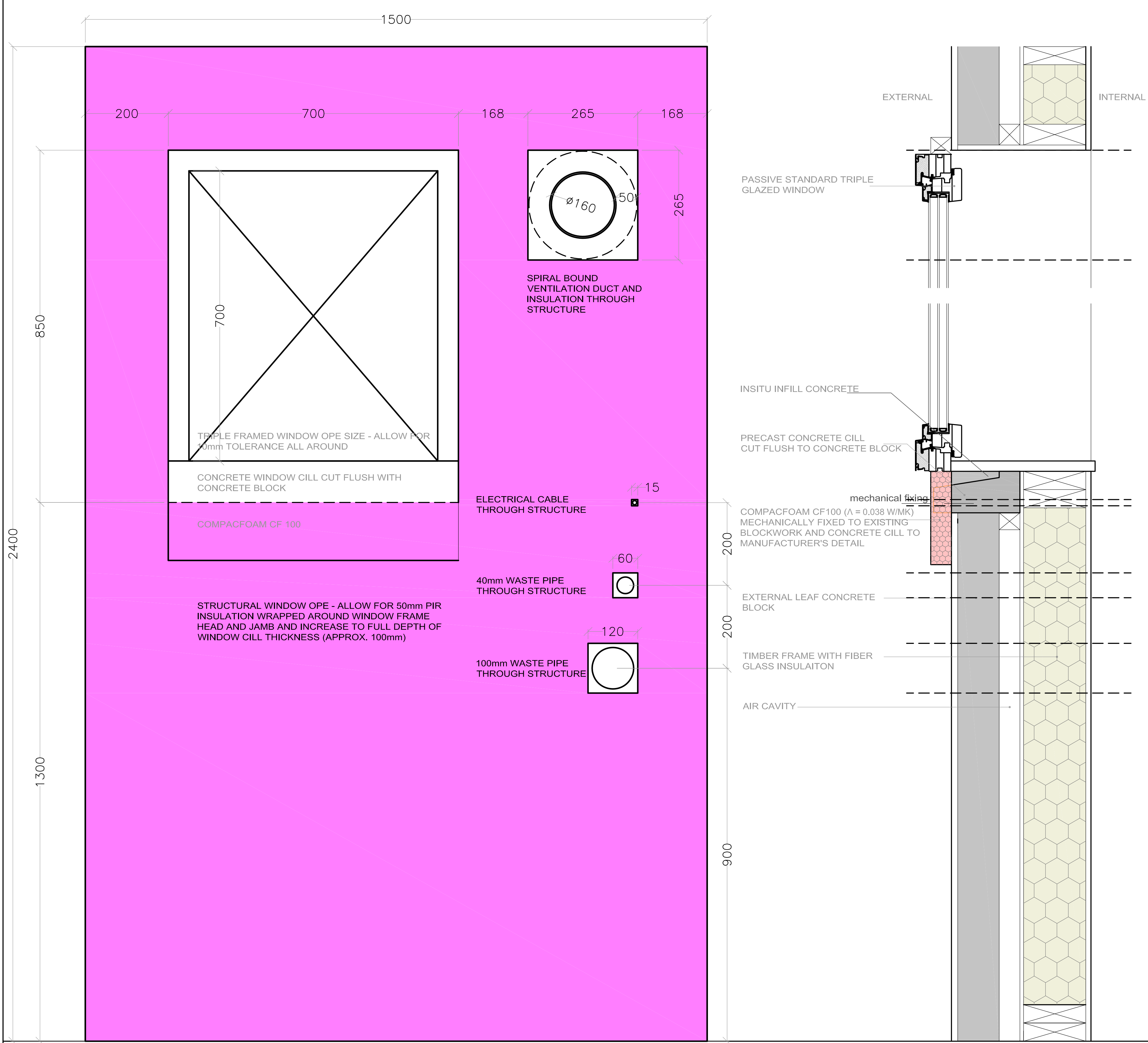
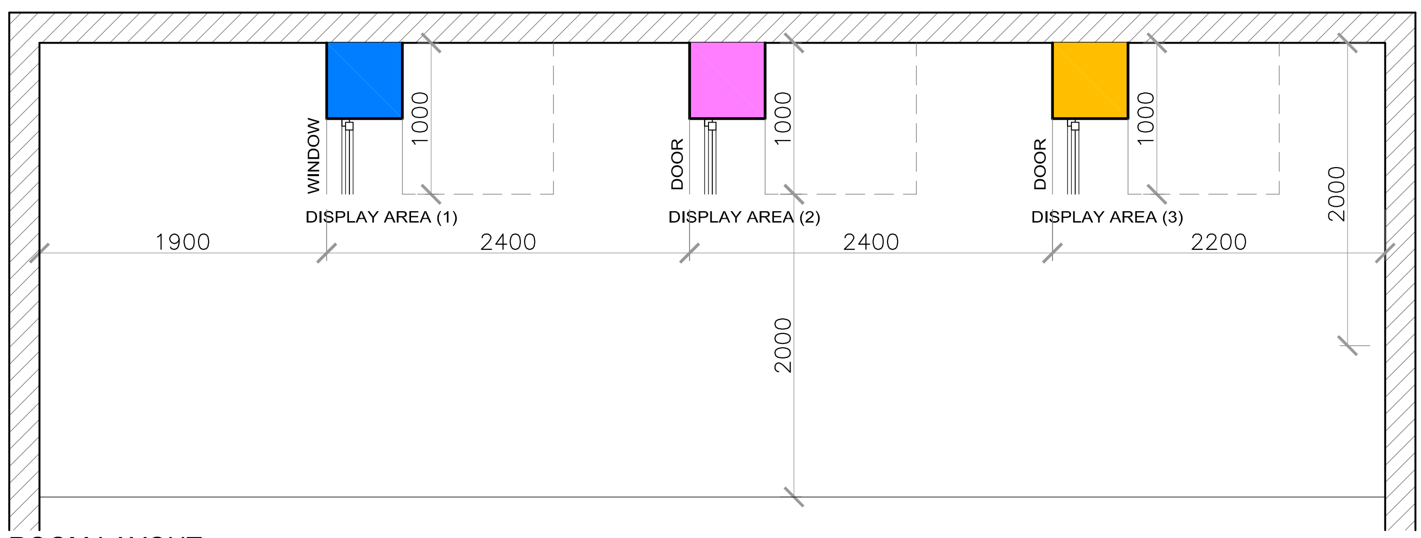


ELEVATION AND SECTION OF PRACTICE AREA NO. (2) TIMBER FRAME WITH EXTERNAL LEAF CONCRETE BLOCK
scale 1:10 @ A3



ROOM LAYOUT
scale 1:50 @ A3

WALL TYPE NO. (1)
PRECAST CONCRETE WALL PANEL

WALL TYPE NO. (2)
TIMBER FRAME WITH EXTERNAL LEAF CONCRETE BLOCK

WALL TYPE NO. (3)
BRICK WALL CONSTRUCTION

COLOR CODE LEGEND

MosArt
ARCHITECTURE LANDSCAPE URBAN DESIGN

WORKING MODELS:

Room Layout, Model's elevations and section

Drawn By: AB	Checked: AMcC	Date: January 2018
Scale: as noted	Drawing no.: D3.1 G	

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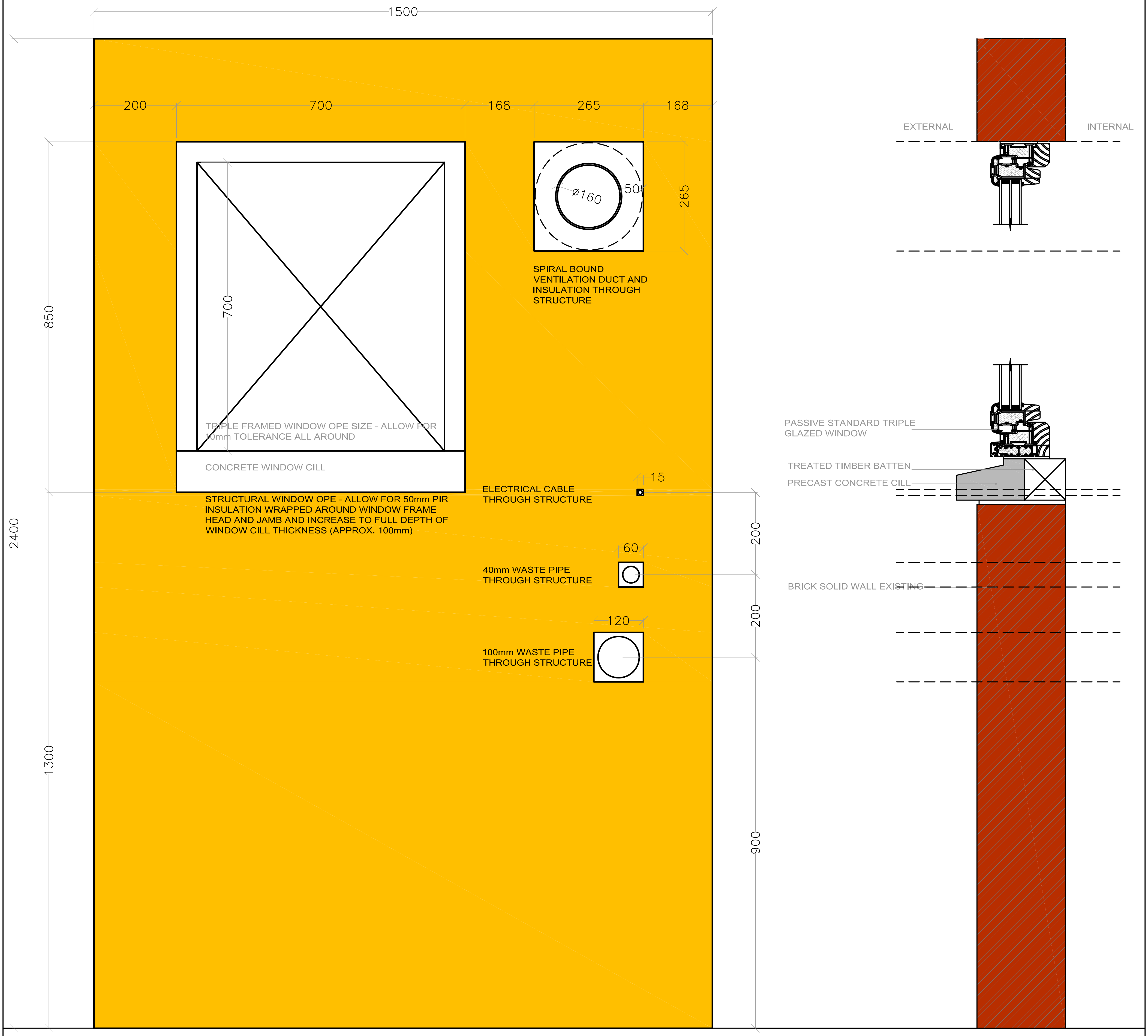
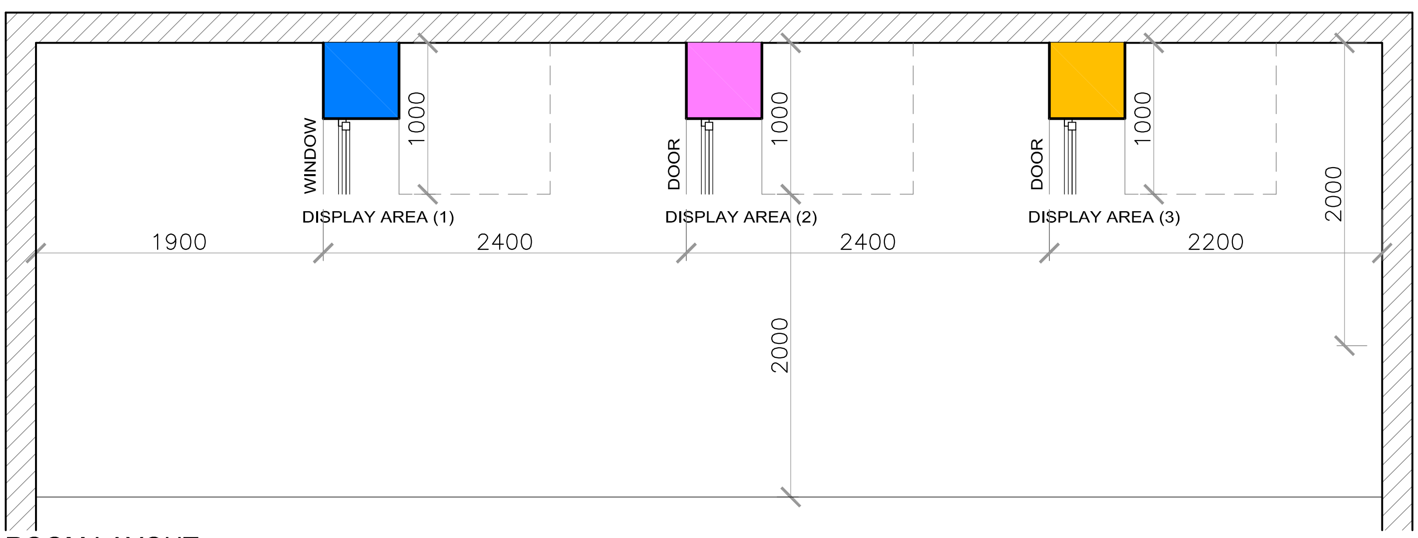


ELEVATION AND SECTION OF PRACTICE AREA NO. (3) BRICK WALL CONSTRUCTION
scale 1:10 @ A3



ROOM LAYOUT
scale 1:50 @ A3

WALL TYPE NO. (1)
PRECAST CONCRETE WALL PANEL

WALL TYPE NO. (2)
TIMBER FRAME WITH EXTERNAL LEAF CONCRETE BLOCK

WALL TYPE NO. (3)
BRICK WALL CONSTRUCTION

COLOR CODE LEGEND

MosArt
ARCHITECTURE LANDSCAPE URBAN DESIGN

WORKING MODELS:

Room Layout, Model's elevations and section

Drawn By: AB	Checked: AMcC	Date: January 2018
Scale: as noted	Drawing no.: D3.1 H	

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