MORE-CONNECT

Development and advanced prefabrication of innovative, multifunctional building envelope elements for Modular Retrofitting and smart Connections

Contract No.: 633477

Specifications of the design process (D5.2)

H2020-EE-2014-1-PPP (EE-01-2014)

This project has received funding from the European Union's H2020 framework programme for research and innovation under grant agreement no 633477.

Table of content

1 Introduction

The objective of work package 5 is the testing, pilot implementations and demonstration in a number of settings:

- real settings, in demonstration projects: renovation of a complete building or parts of a building
- industrial settings: demonstration of the production
- real life learning lab (RLLL) settings: to do in deep testing on small scale building

The aim of these testings is to collect information on the performances in practice of the solutions, developed by the industrial partners in MORE-CONNECT. Therefore the developed solutions are first of all tested in the geo-clusters where these have been developed. The testing and demonstration concern the experiences in mounting and assembling and the performances in practice in terms of energy and building physics.

The testing and demonstration in practice will be organised on six locations:

- Czech Republic (RLLL setting for in deep testing): experimental setting at the UCEEB lab, Bustehrad
- Denmark (full real setting): Korsløkkeparken, Odense
- Estonia (full real setting): Akadeemia tee, Tallinn
- Latvia (full real setting): Saules iela 4a, Cesis
- The Netherlands (full real setting):
    - Graaf Jan straat, Zoetermeer
    - Kruiskamp, Breda
    - Presikhaaf, Arnhem
- The Netherlands RLLL setting for in deep testing: Breitnerstraat 23 and 28, Heerlen
- Portugal (partial real setting, renovation of facades): Edifício Professor Doutor Mota Pinto, Vila Nova de Gaia

The work package comprises 6 tasks of which this deliverable presents the results of Task 5.2 - Preparation of technical documentation. As the type of deliverable for D5.2 is ‘Demonstrator’ this note is composed by drawings and details of the several components in the pilot projects, developed during the design processes.

2 Task 5.2 - Preparation of technical documentation

The preparation of technical documentation within each country varies according to the actual needs for each pilot project. It may consist of a subset of the following activities:

- construction drawings in 3d BIM (walls, roofs, installations),
- production engineering documentation of the integral proposition,
- cost calculation, price/performance calculations
- tendering documents.

The work within this task carried out for each of the above pilots are described below, country by country.

3 Czech Republic (RLLL setting for in deep testing)

The pilot in the Czech Republic will take place in an experimental setting at UCEEB.
The detailed technical documentation and preliminary budget estimation for the Czech pilot has been prepared. There is plan to build a mock-up of a section of a typical building – corner including details of walls with windows, plinth and connections to roof structure. Vertical structures will be made of bricks, horizontal structures will be made of concrete. The testing modules will be applied on the mock-up.

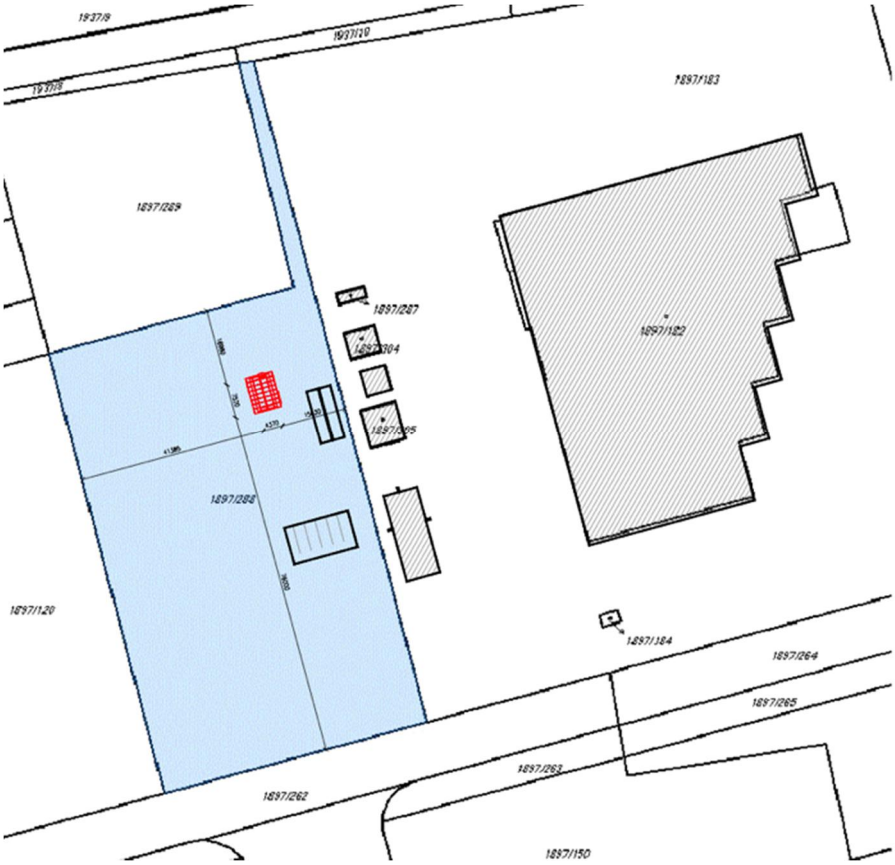


Figure 1: Location of the Czech mock-up (red) on the plot for experimental structures (light blue).

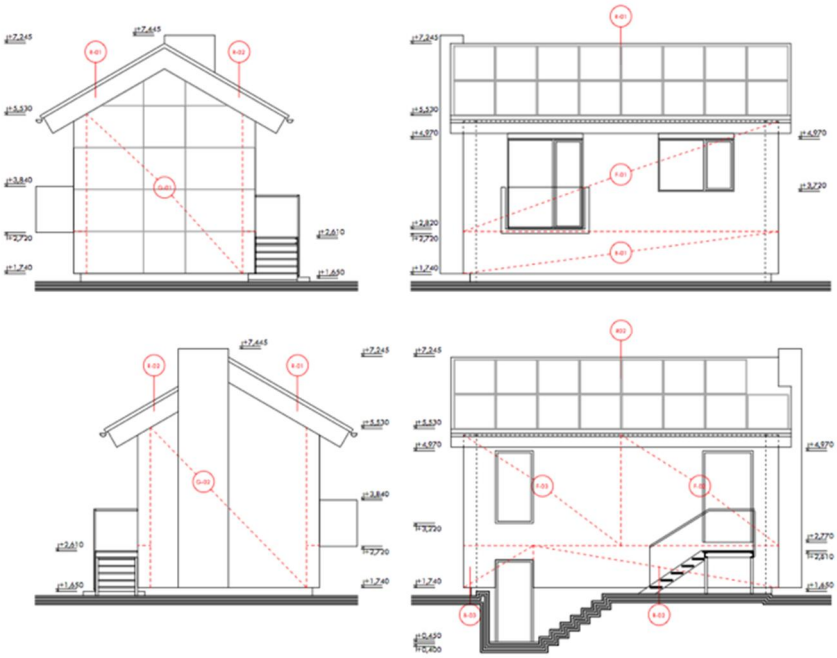


Figure 2: Views of the mock-up building.

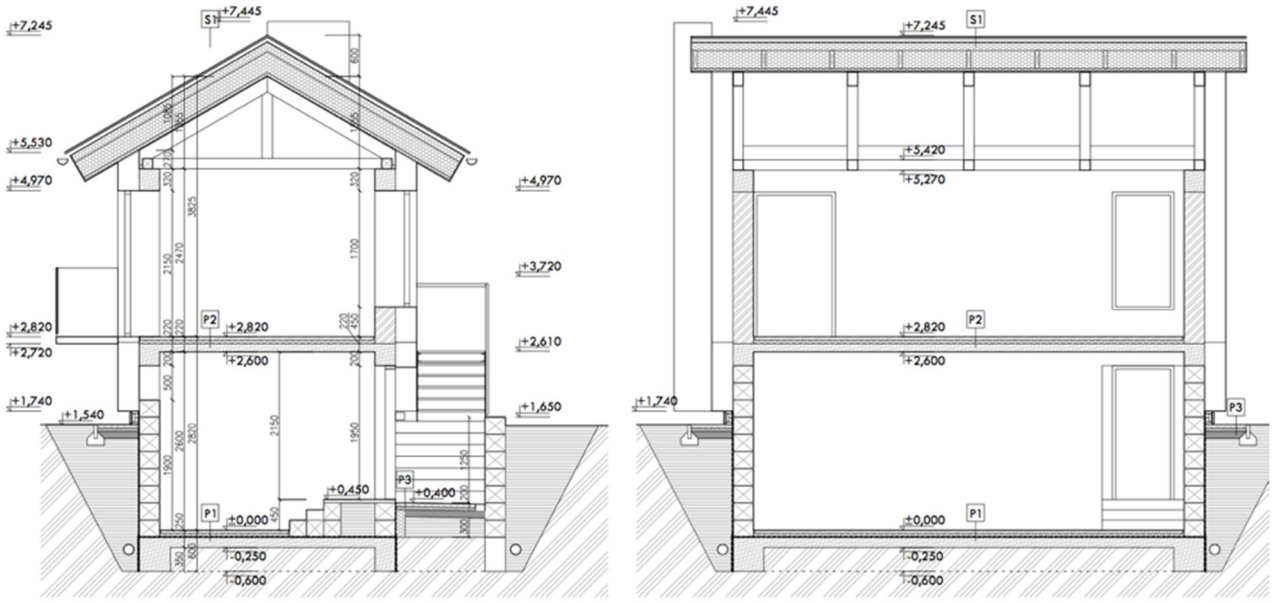


Figure 3: Cross sections of the mock-up building.

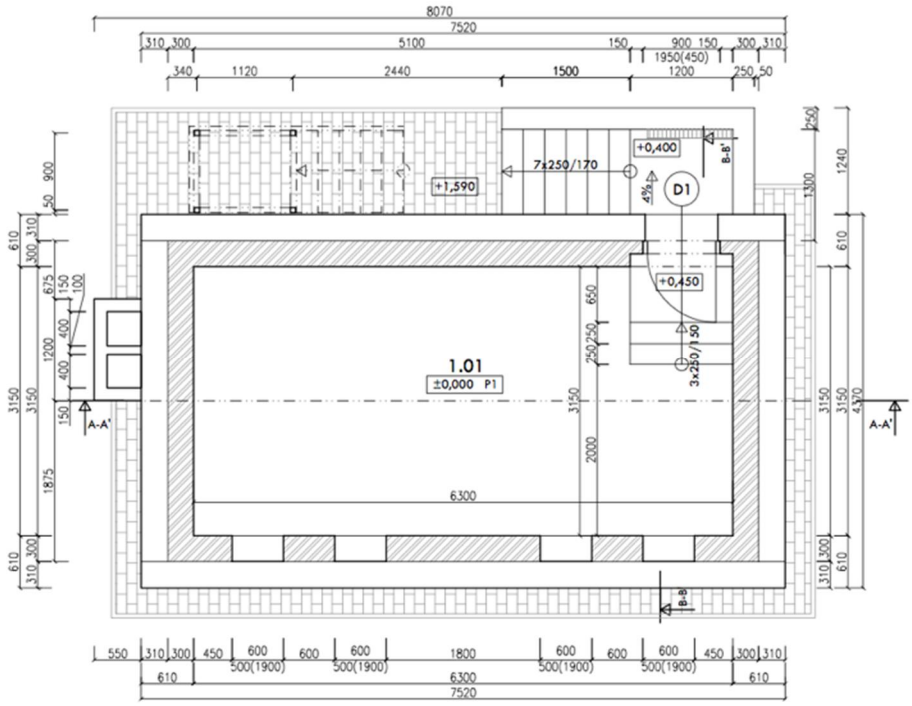


Figure 4: Layout of 1st floor.

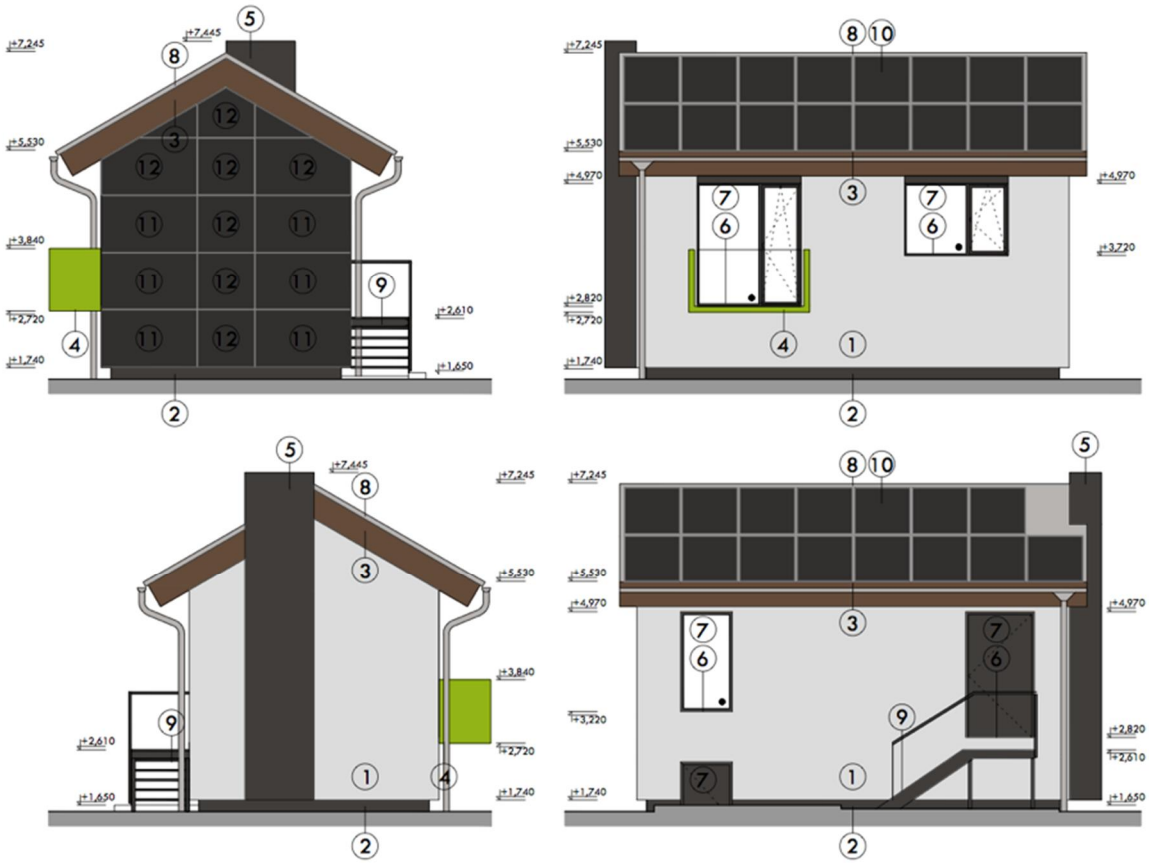


Figure 5: Side views with installed modules.

4 Denmark

Figure 1: Architectural sketch of the façade after renovation

WINDOWS

Figure 2: Whole building façade after renovation

Figure 3: Design drawings of different window combinations for the façade and gable walls.

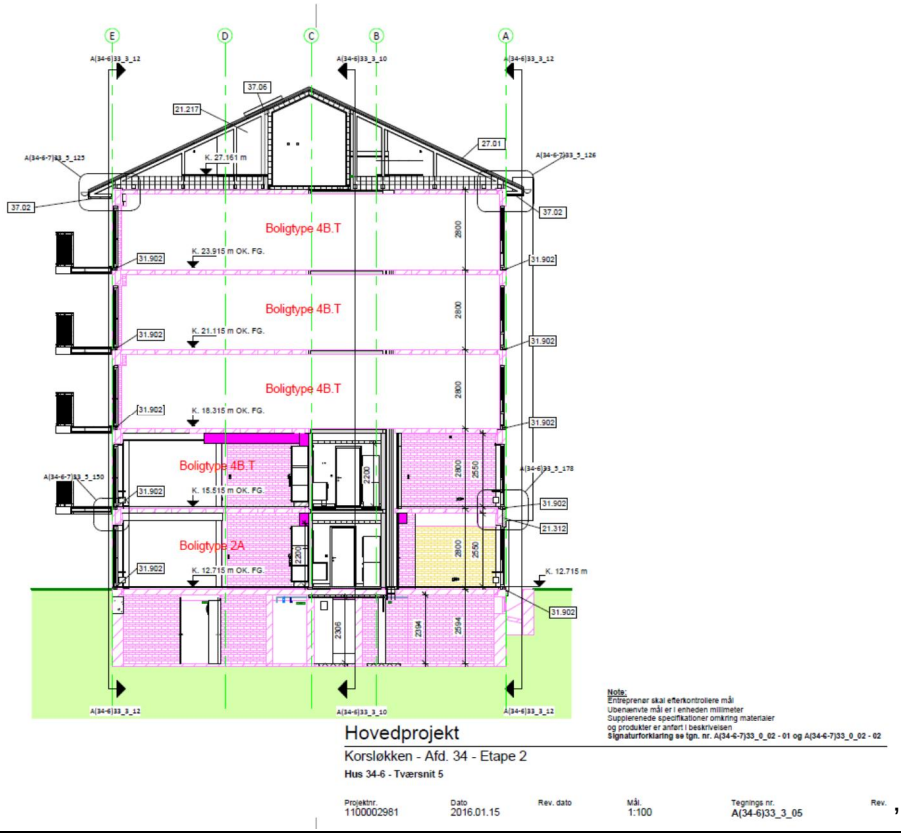


Figure 4: One section of the building – among other things showing the location of the windows

VENTILATION

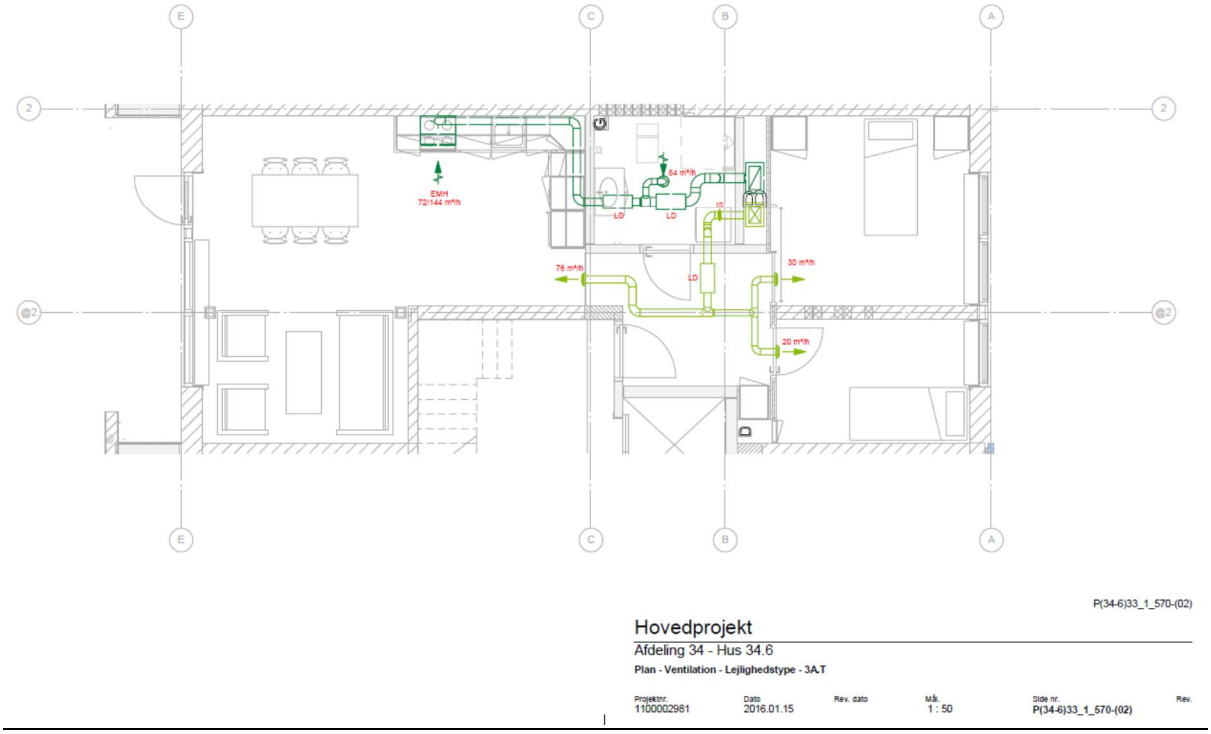


Figure 5: Layout of ventilations system in one of the many apartment types.

SOLAR CELLS

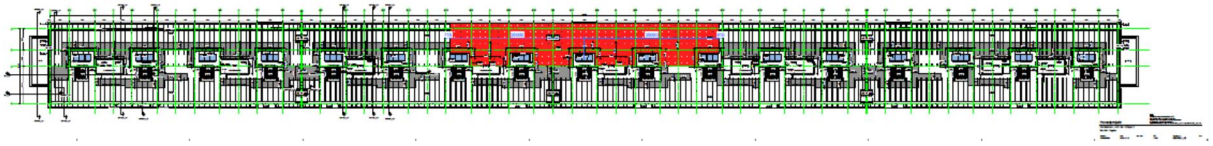


Figure 6: Placement of the Innogie PV roof on the south slope of the building roof.

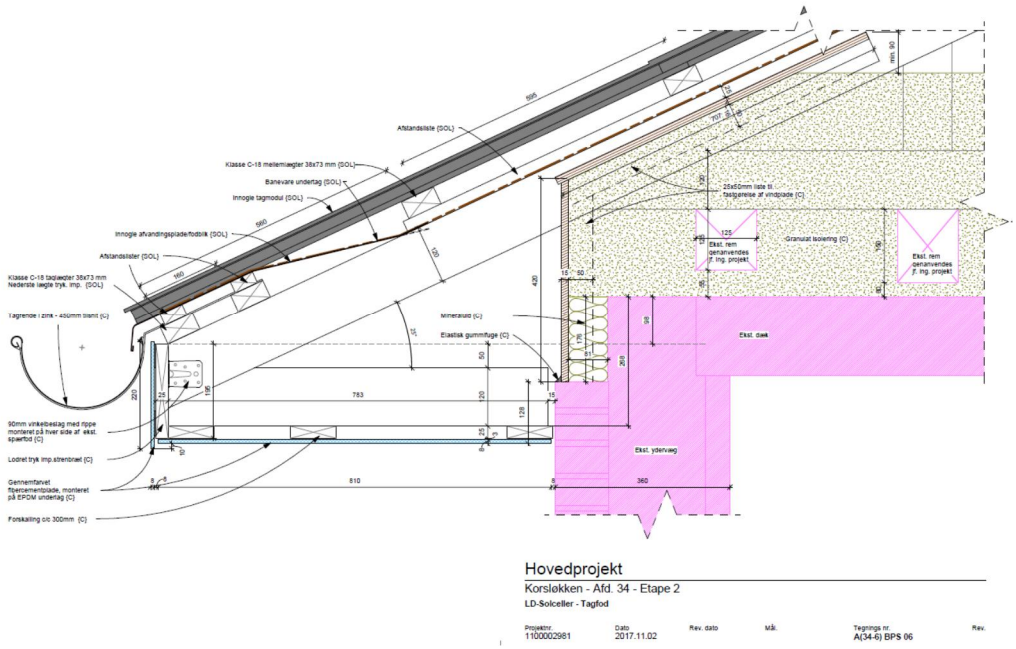


Figure 7: Detail showing mounting of the PV roof at the lowest part of the roof.

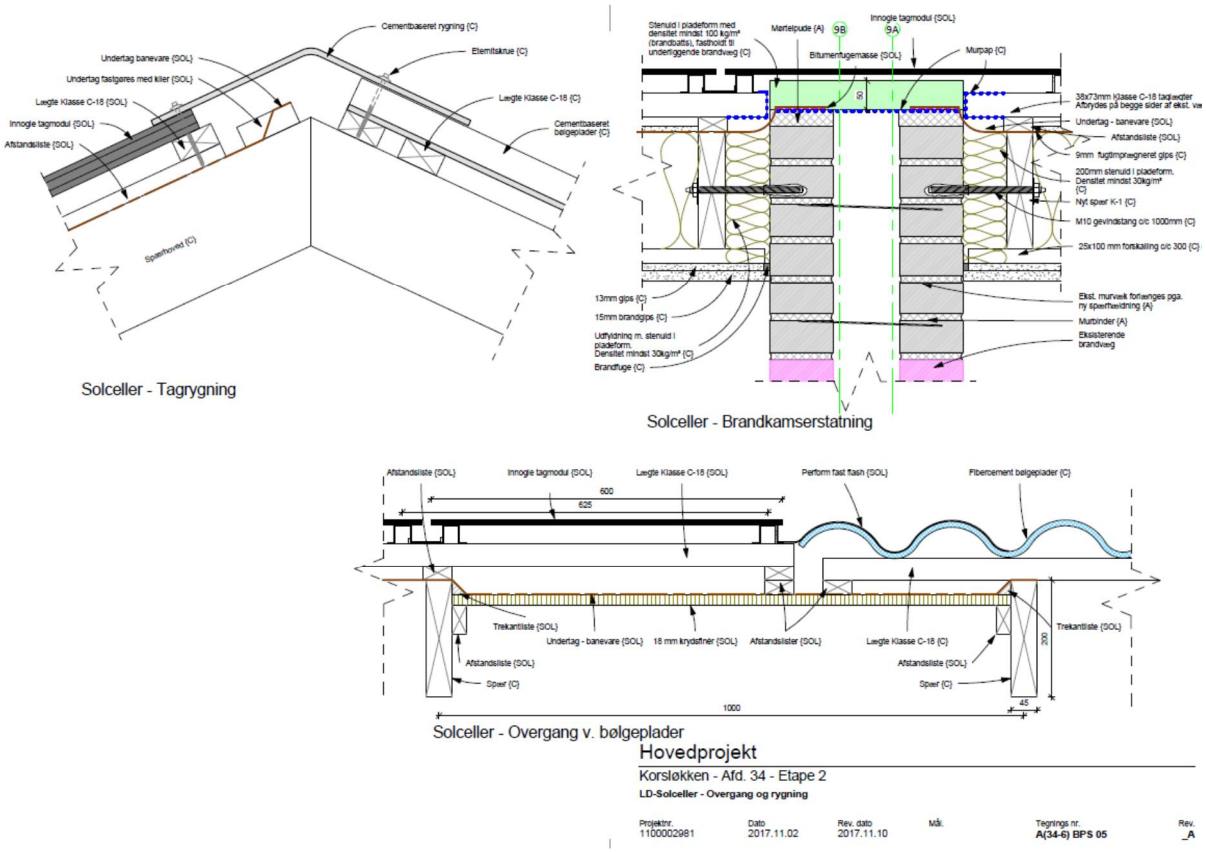


Figure 8: Details showing mounting of the PV roof at the highest part of the roof.

GABLE WALL INSULATION AND DECORATION

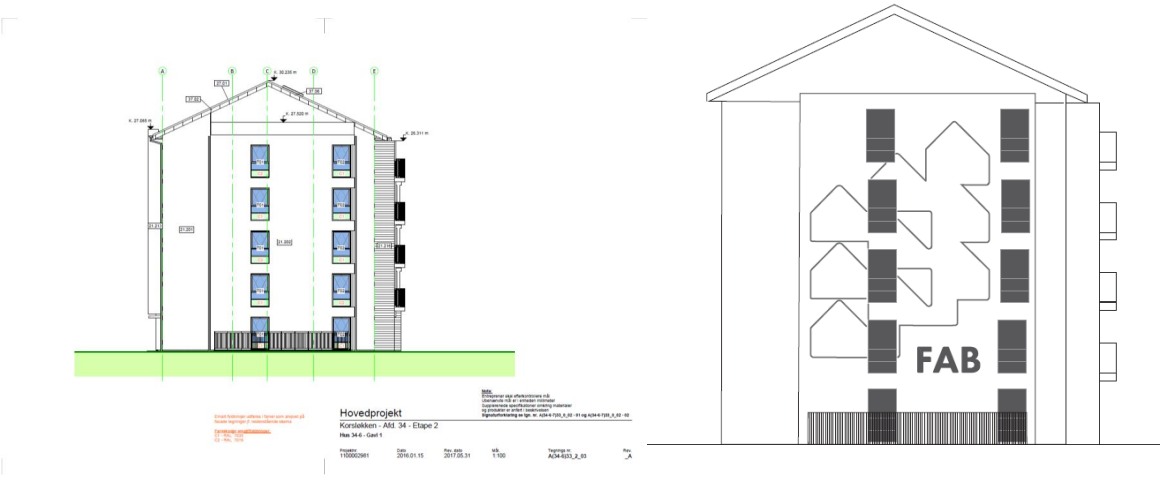


Figure 9: Elevation of one of the gable walls to be insulated and decorated by the Invela robot system. The figure to the right show the logo design of the building association FAB to be 3D printed in concrete on the vertical wall onsite. This will demonstrate the user platform and the precision of the robotc3D-printing for future onsite robotics work.

5 Estonia

Design documentation is ready:
https://www.dropbox.com/sh/puwkyazer4gesow/AADydFbzwA5J8I4jNnIIdrTia?dl=0
On base of the preliminary studies of the pilot building and analysis made, the design of the building envelope and structures (see some examples on Fig.1-Fig.6) and technical appliances (see some examples in Fig.7-Fig.8) of the Estonian pilot was accomplished. Design was accomplished by Estonian design company Sirkel&Mall OÜ.

- Building envelope:
    - Existing concrete large panel elements +
    - Timber frame module panel with
    - Mineral wool as insulation and
    - Mineral wool rigid board as wind barrier,
    - Cement fibre plate for facade,
    - PU-foam and tape for local air/vapour tightening
    - Slope roof module panels
    - Ventilation ducts in the modules
  - Exterior wall (with modular panels): U≤0.11 W/(m^{2}K)
  - Basement wall (ETICS): U≤0.16 W/(m^{2}K)
  - Roof (with modular panels): U≤0.10 W/(m^{2}K)
  - Windows (triple glazing): U≤0.80 W/(m^{2}K)
  - Basement ceiling: U≤0,60 W/(m^{2}K)

Figure 1. Example of designed structural unit of conjunction of existing concrete partition wall, window and modular panel (without existing concrete core)

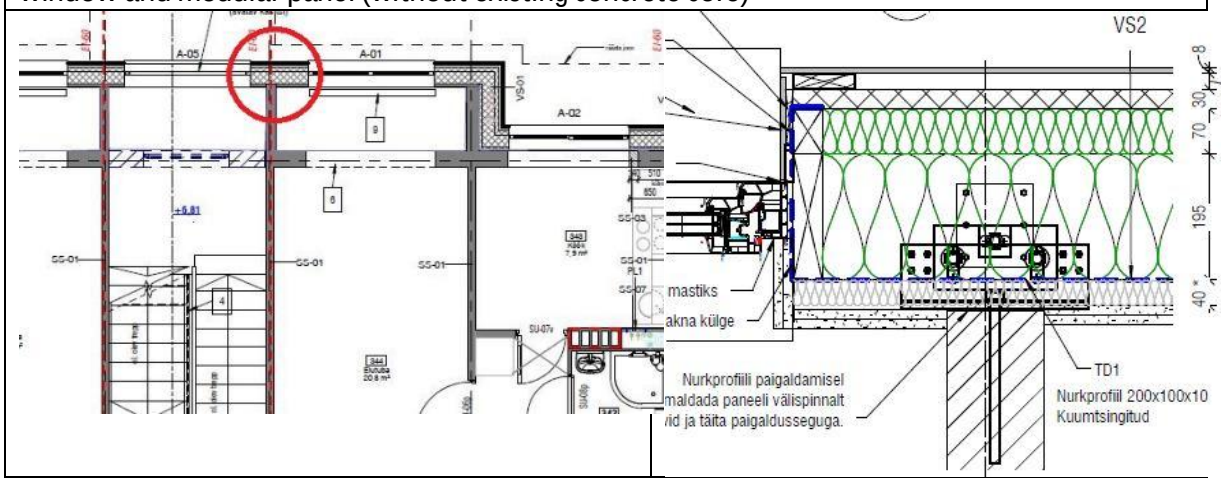


Figure 2. Example of designed structural unit of conjunction of existing concrete partition wall and external concrete wall with modular panel

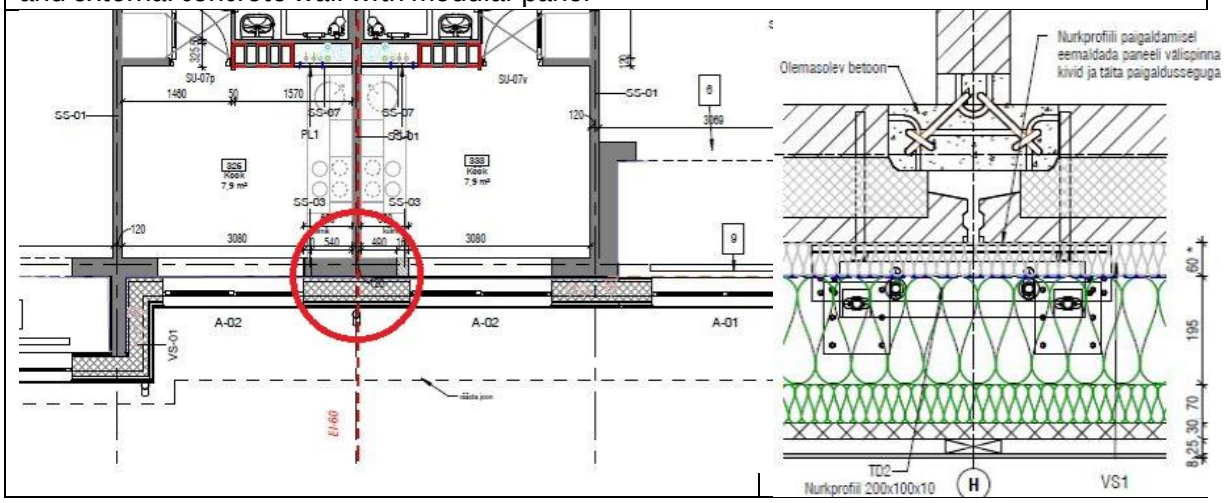


Figure 3. Example of designed structural unit of conjunction of external wall corner and modular panel (with existing concrete core)

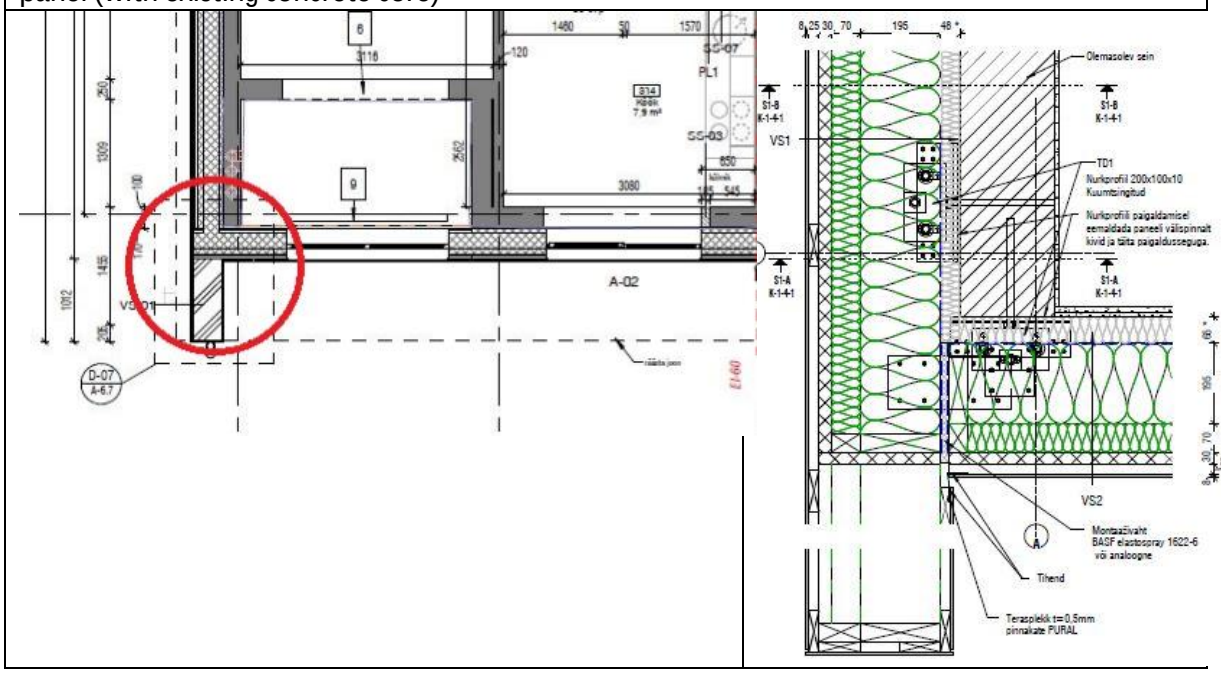


Figure 4. Example of designed structural unit of conjunction of existing external concrete wall and external concrete wall with modular panel with ventilation ducts in it

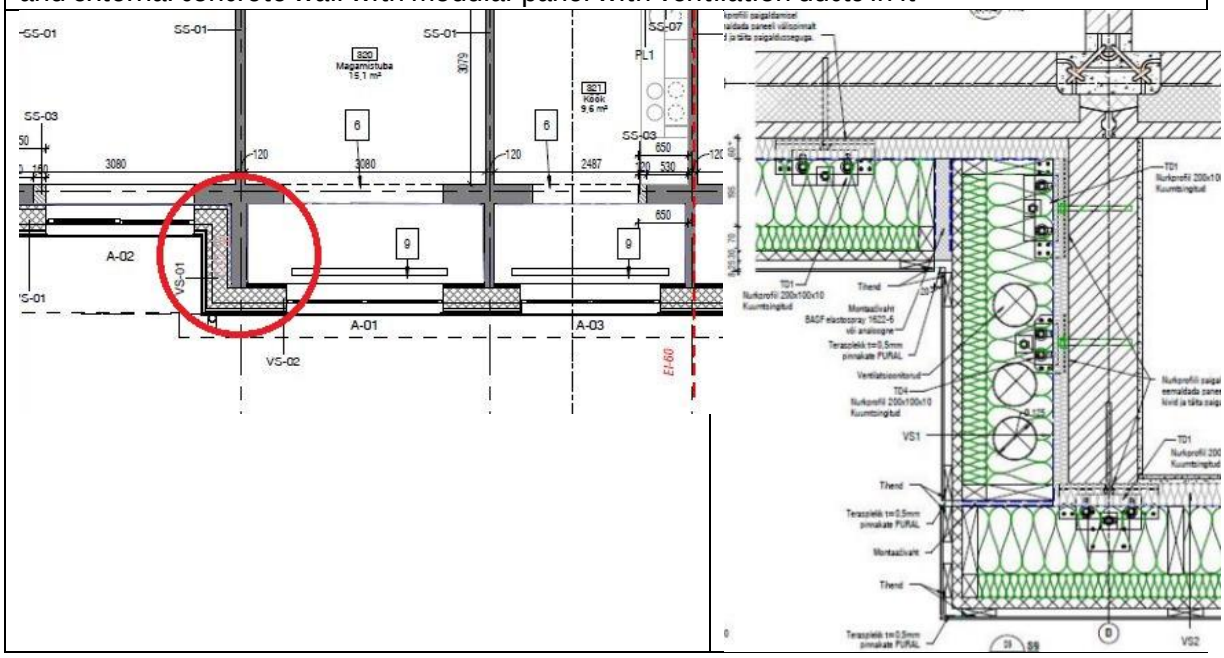


Figure 5. Example of designed structural unit with consideration of unevenness of existing concrete large panel surface and with importance of placement and joists of vapour control layer

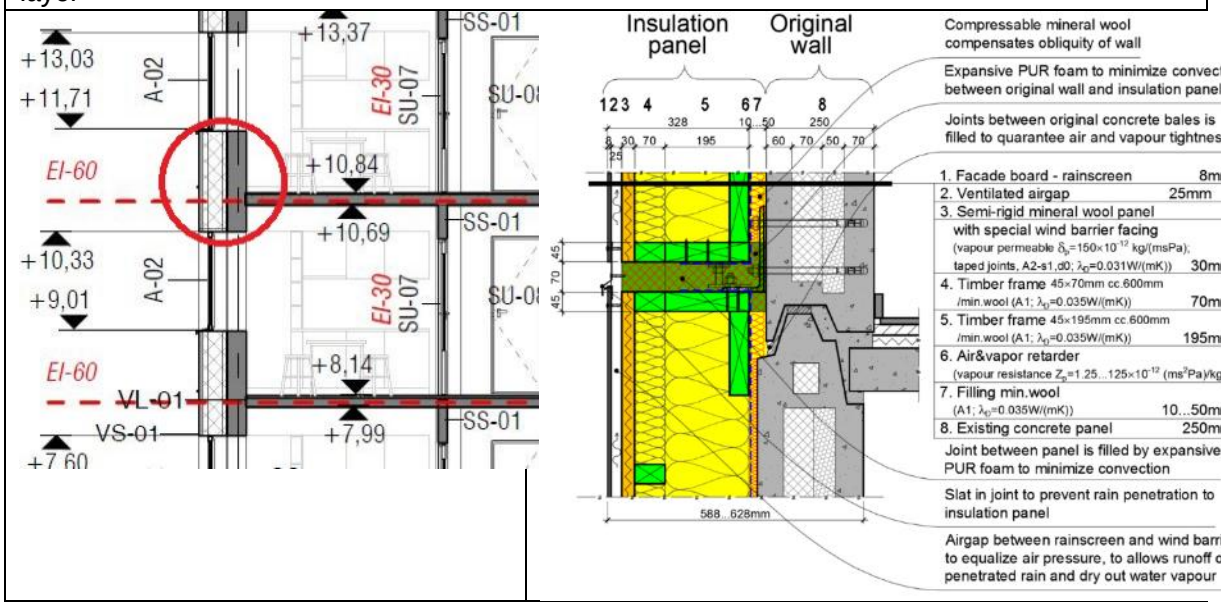
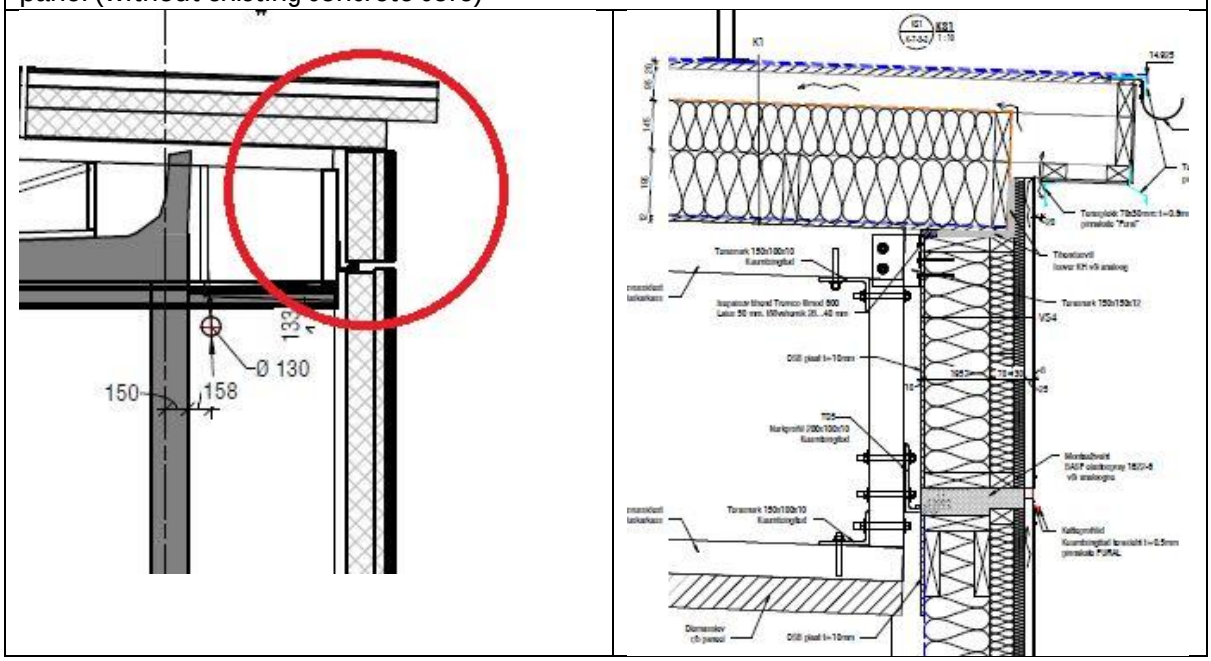


Figure 6. Example of designed structural unit of roof modular panel and external wall modular panel (without existing concrete core)



- Ventilation: balanced ventilation with HR in each apartment
- Heating: radiators, thermostats, renovation of heat centre
- Solar collectors: for DHV on roof
- Solar panels: for electricity on roof
- MC „engine“: in apartment (half building) and in roof (half building)

Figure 7. Example of designed ventilation system

- half building based balanced ventilation units with VHR
  - „engine“ on roof
  - ducts in modular panels
- half of apartments are with balanced ventilation units with VHR
  - „engine“ in locker-room

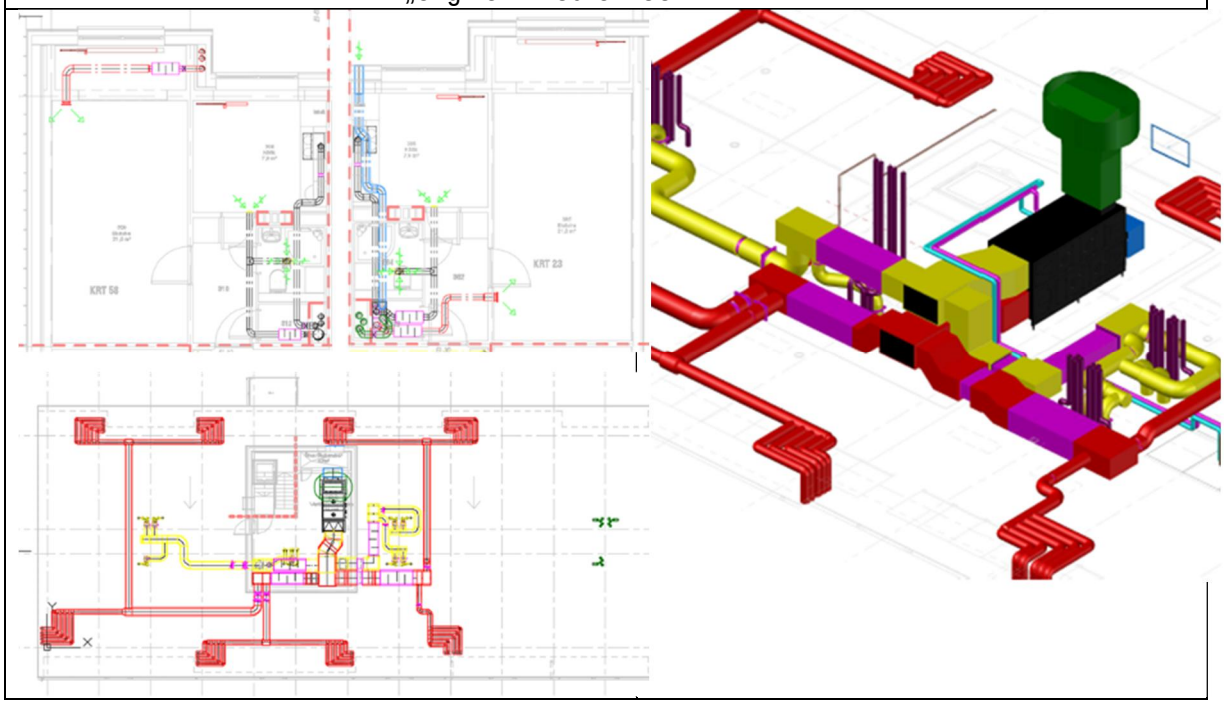
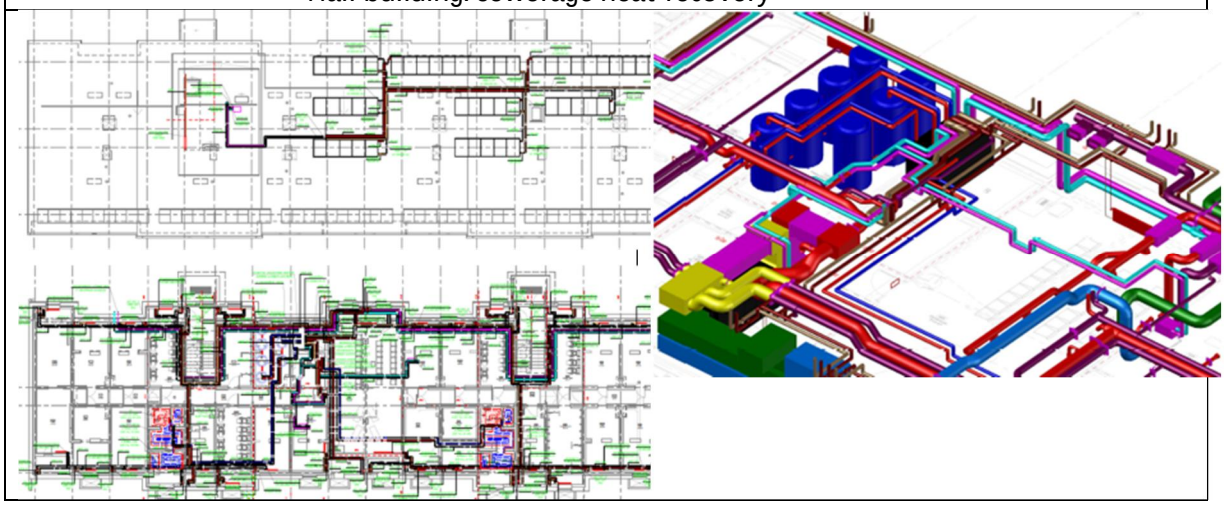


Figure 8. Example of designed hot water and heating system and placement of PV and solar panels on the roof

- Half building: solar collectors on the roof
- Half building: sewerage heat-recovery



6 Latvia

Negotiation with architectural company has been started. The design work was finished on January 2017. The final construction permit was received on February 20107.
Design work was performed by RTU spin-off design and construction company LTD PLACIS. More information on LTD PLACIS is available here http://www.rtu.lv/lv/universitate/struktura-un-vadiba/kapitalsabiedribas/sia-placis
Total design cost according to agreement is was 3455.60Euro including VAT 21%.

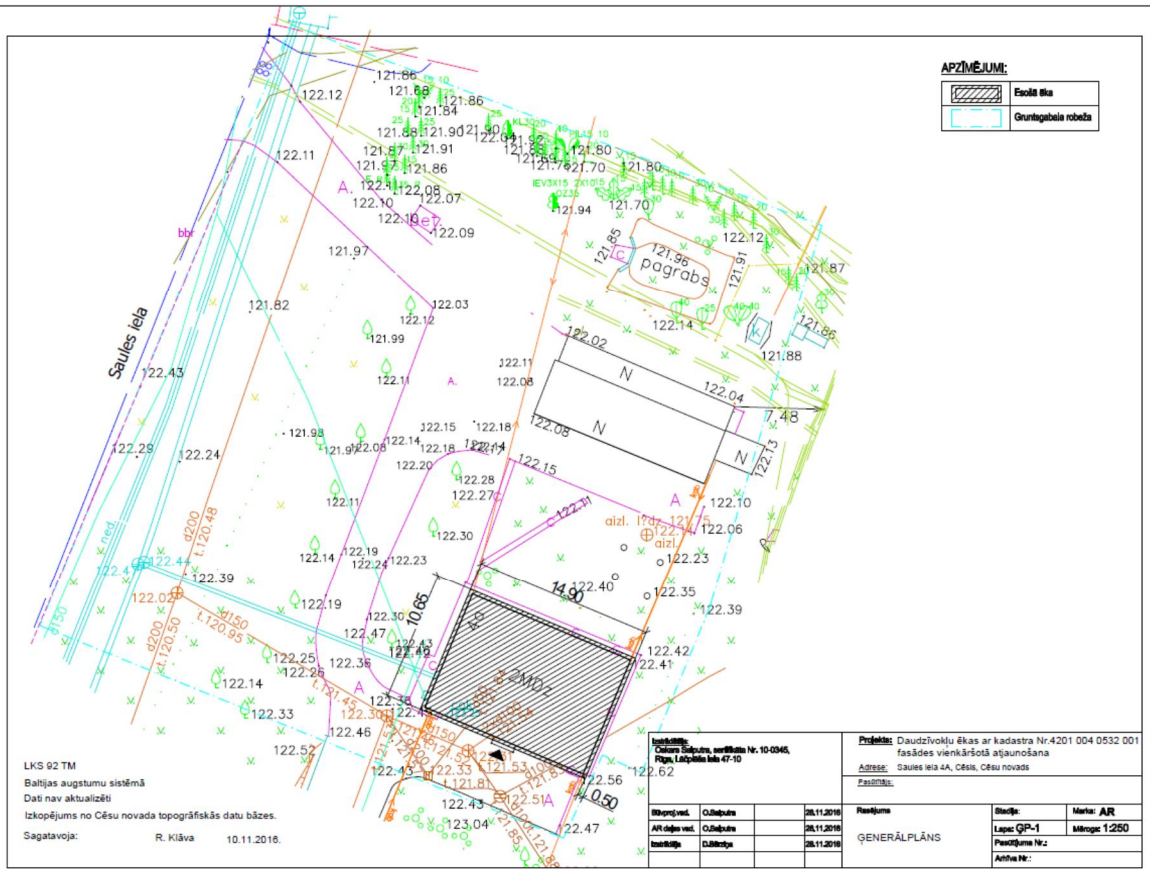


Fig. 1 General plan

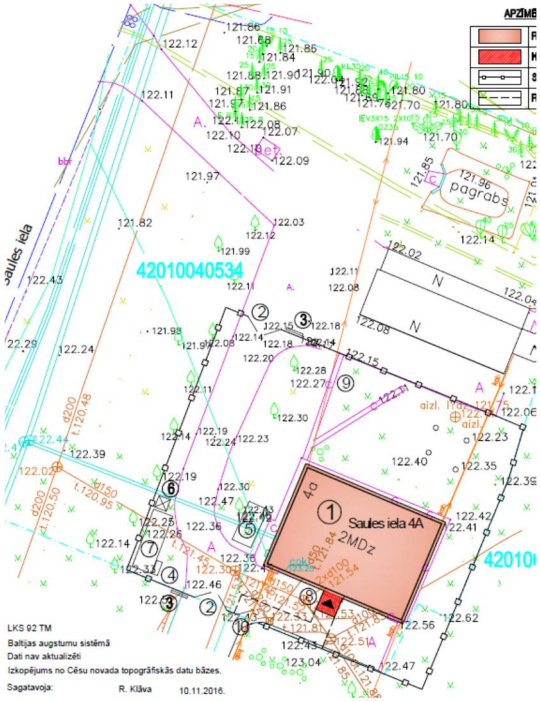


Fig. 2 Organization scheme of construction work

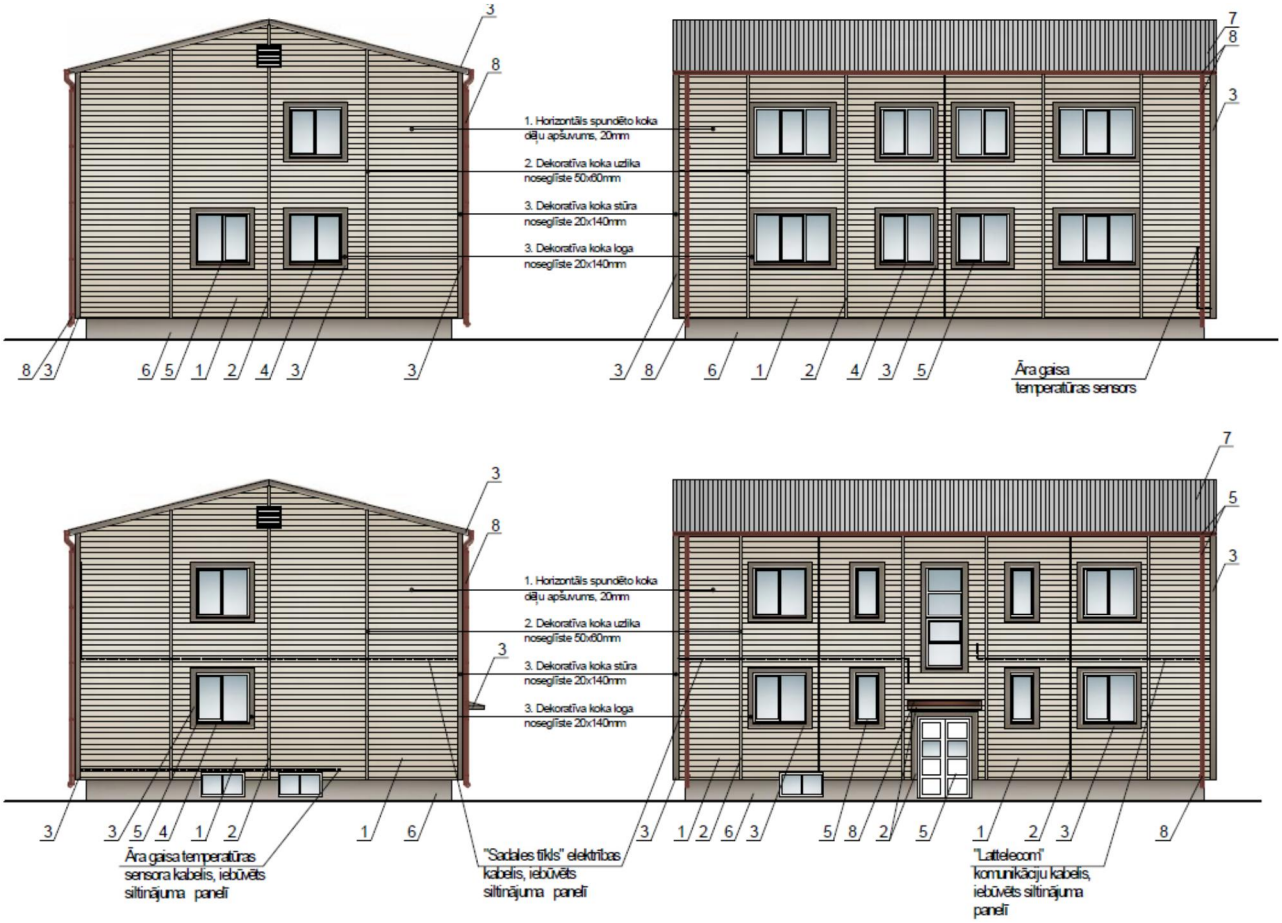
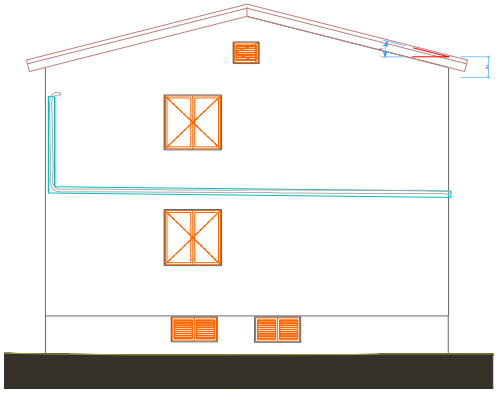
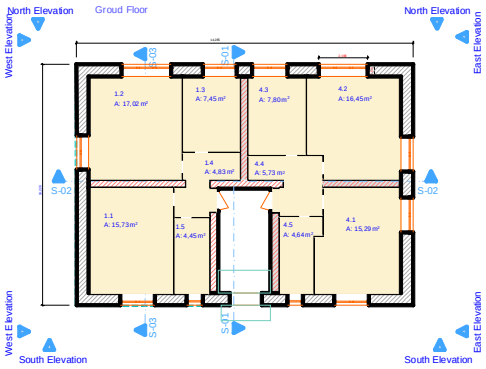


Fig. 3 Facades layout



a) wire placement on the façade



b) floor plan

Fig.4. Building model preparation for design

Fig. 5 Integration of existing wires

Fig. 6 Panel layout on the main façade

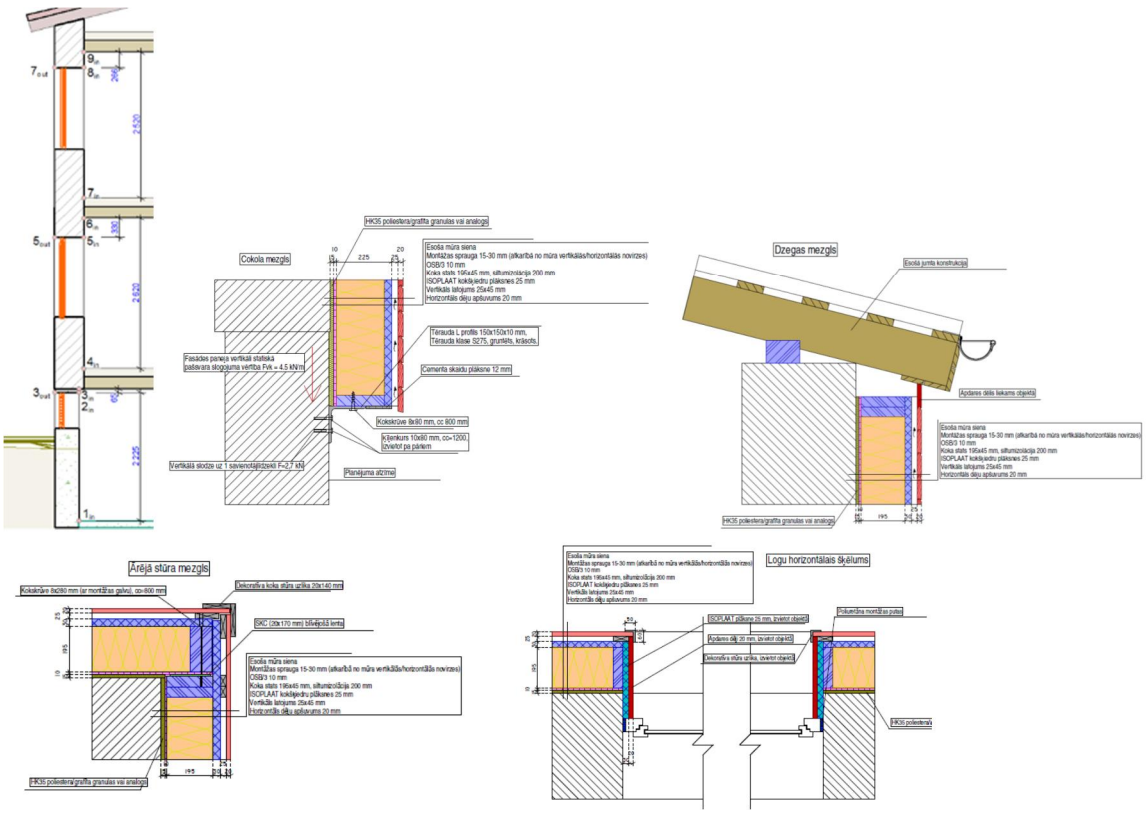


Fig. 7 Vertical cross-section and connection elements

7 The Netherlands

Preparation includes integral proposition construction drawing in 3d BIM (walls, roofs, installations), production engineering of the integral proposition, cost calculation, offering. Price/performance improvement was the focus of the engineering/R&D/innovation teams. In the Netherlands three pilot projects will be implemented:

- Zoetermeer
- Presikhaaf
- Kruiskamp

7.1 Zoetermeer project (Webo and BJW)

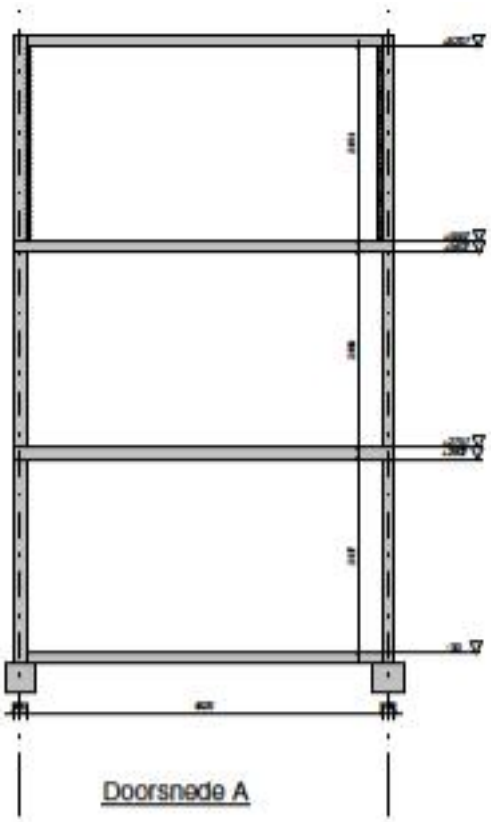
Graaf Jan straat Zoetermeer

PRivate
NOM renovation in 10 days
Build in 1974
Energy overshoot

Airtighness Qv10< 0,3l/s.m2
Brine heatpump water-water
PV-cellen and
Heatwatercollector
WTW and boilerbuffer 150l
Rc roof 7, Rc wall, 5 Rc vfloor 5

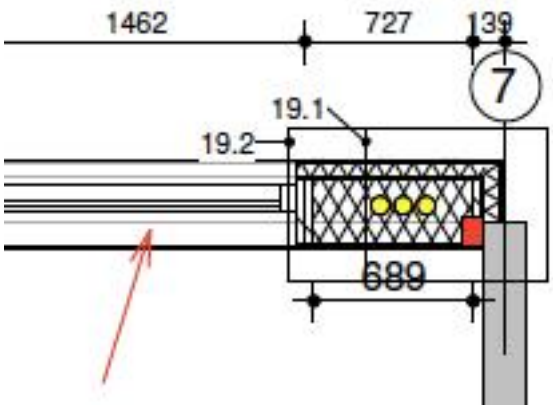
Opening november 2015 by minister Blok

Conclusion on pilot Zoetermeer has been; with support of subsidization BJW/Webo will build and reap a lot of experience in all aspects of the pilot realizations.



All front and back walls removed .

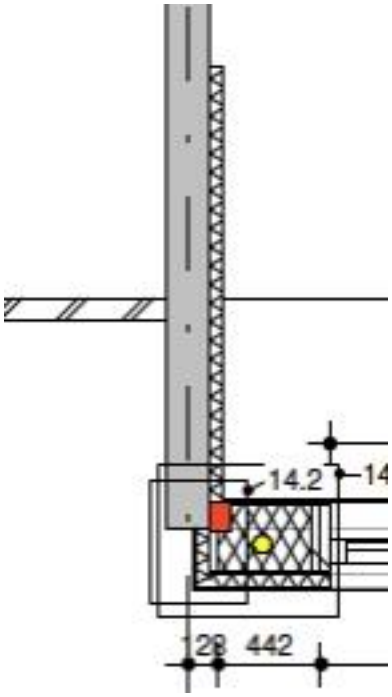
Bare base construction as basis for all new front and back walls.



Air ducts for ventilation and heating (yellow)

Attachment beam for both attachment from inside and airtightness.

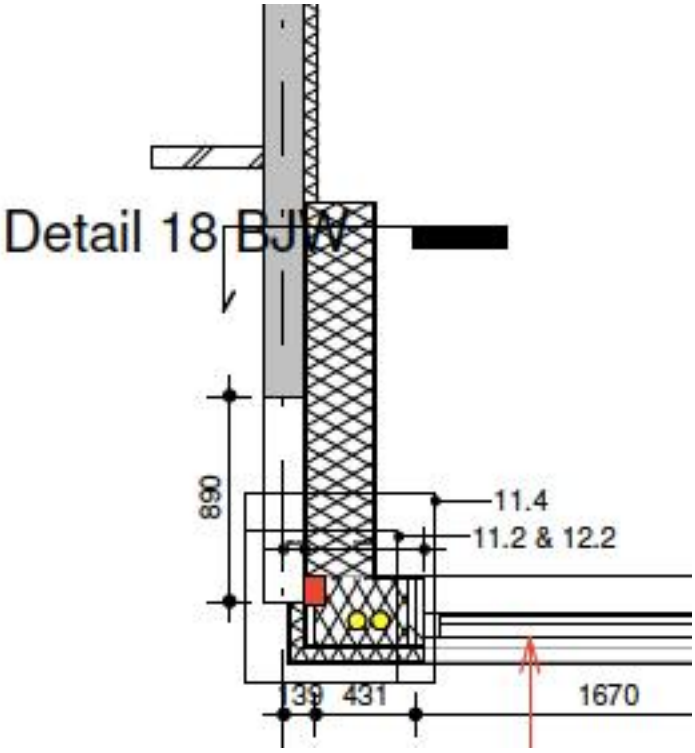
Width of windows is adjusted to allow air ducts.

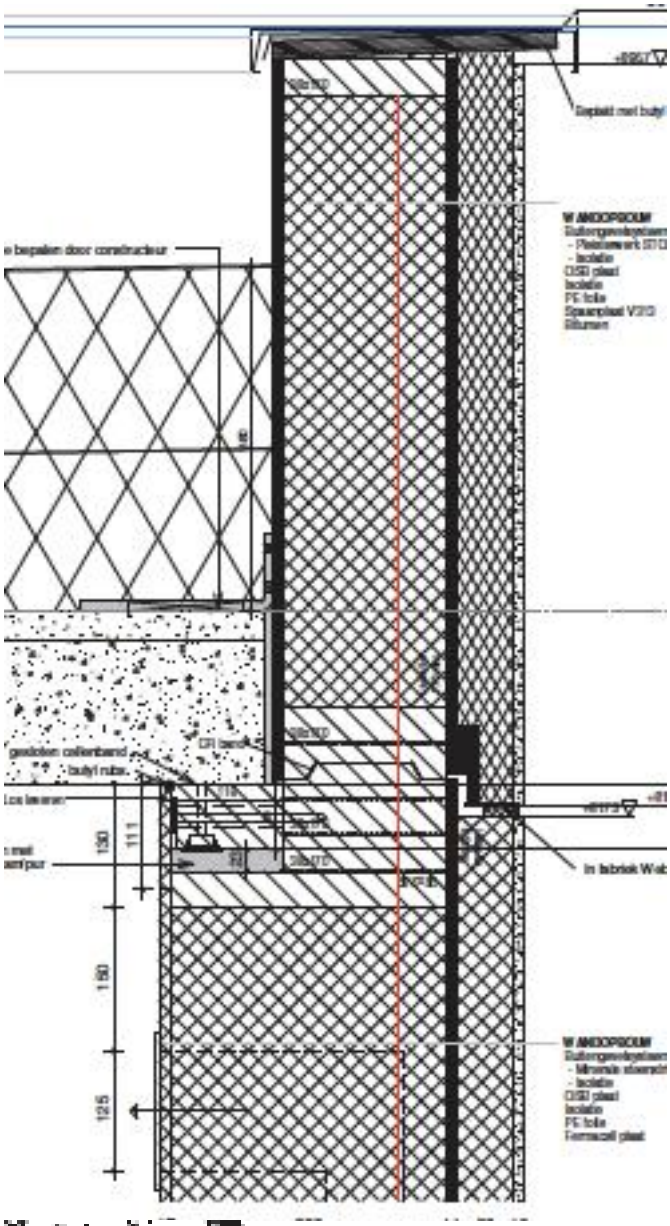


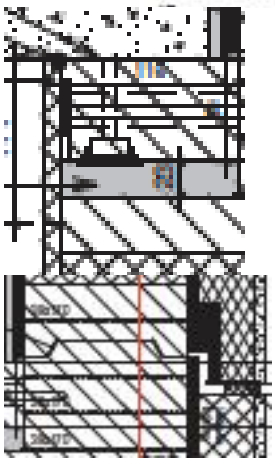
Insulation layer attached because of not-insulated wall of neighbours

Insulation layer attached because of not-insulated wall of neighbours .

Living room space added.



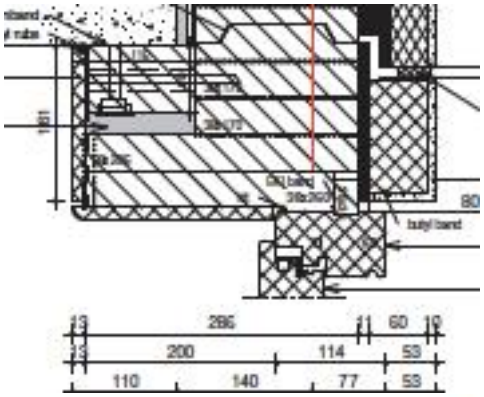




Klick&Span patented connection

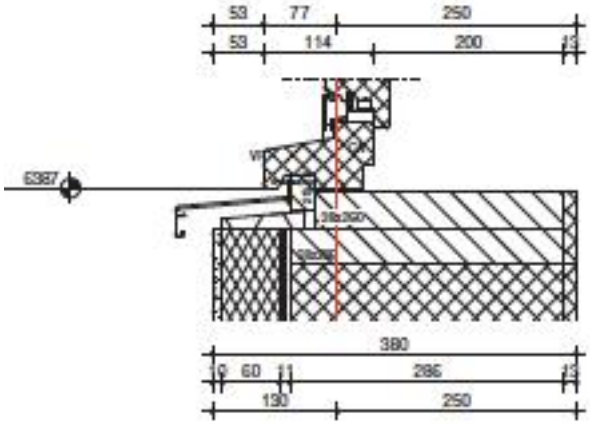
Seeker/finder connection for mm accurate placing

Watertight connection between walls at the level of outside insulation and putz.

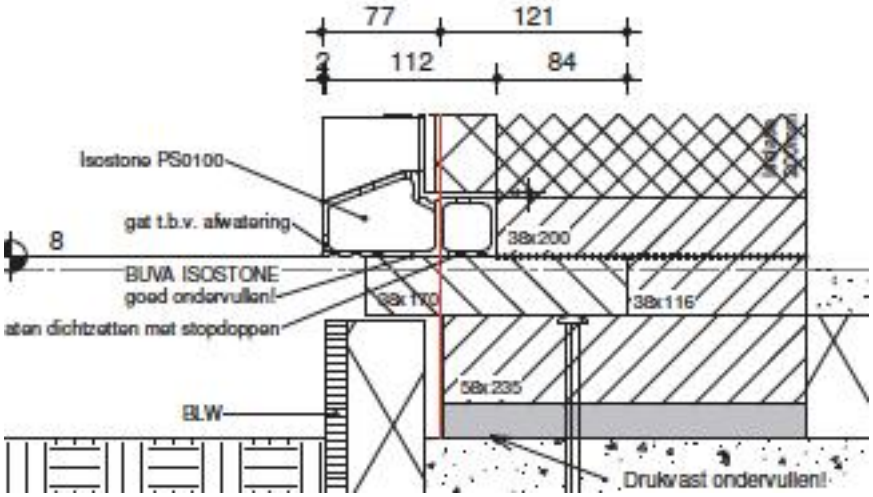


Airtight assembly of window frames.

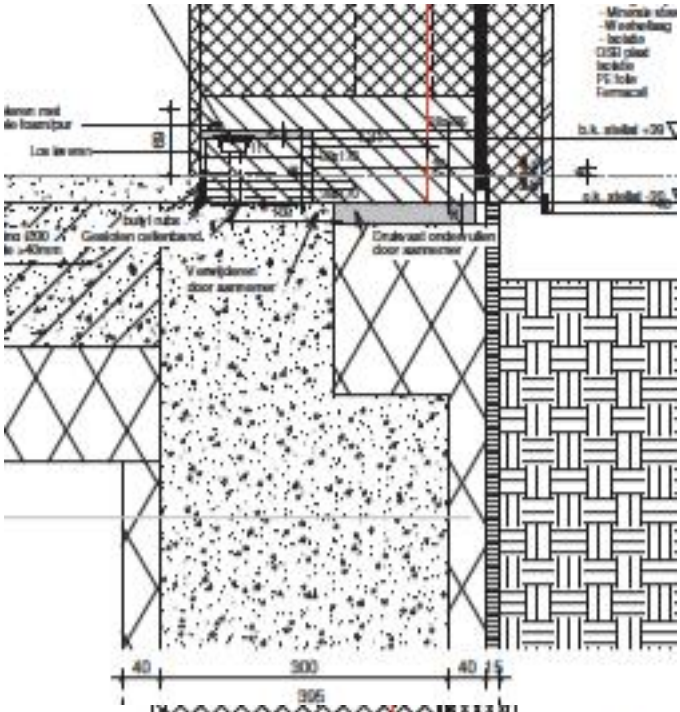
Details of inside wall finish.



Airtight assembly of window frames.

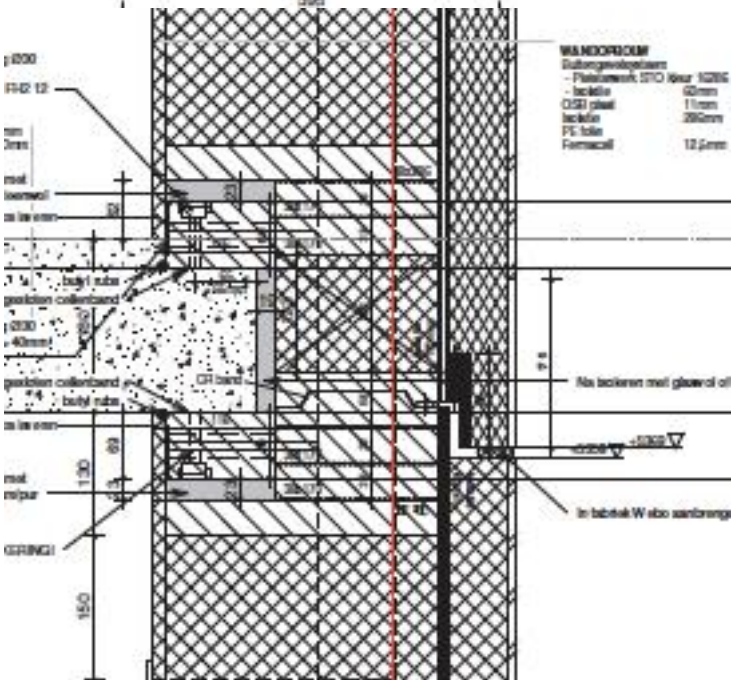


Detail of connection of door frame.



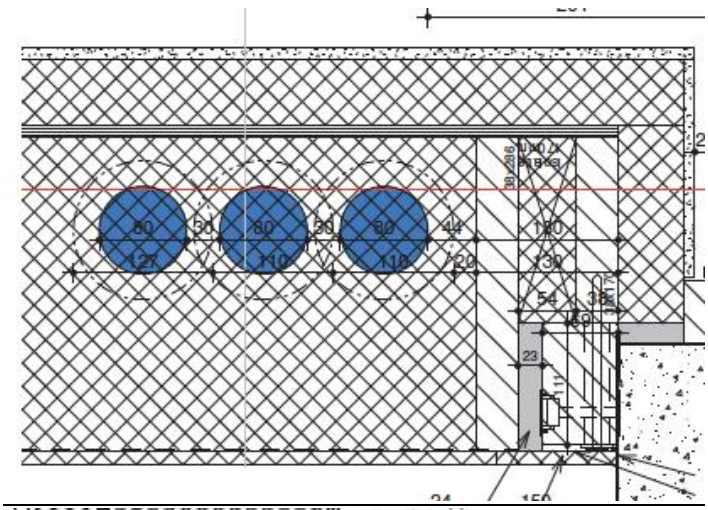
2 walls connected and attached to floor.

- finder / seeker
- Klick &Span



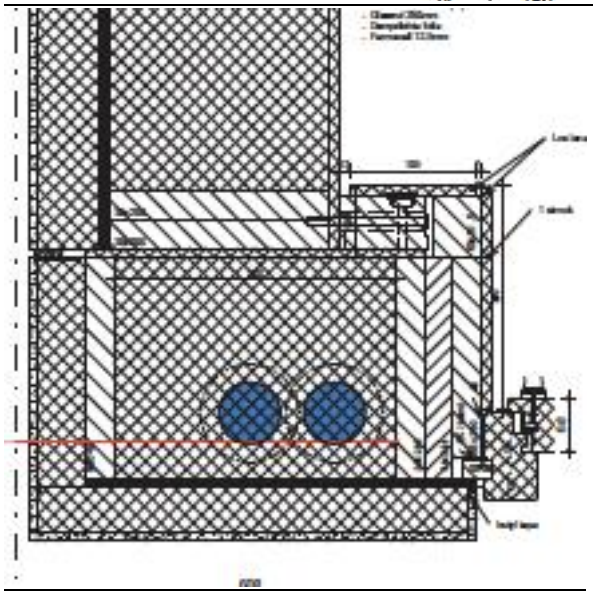
Wall connection to ground floor and foundation.

Insulation of foundation below earth level.

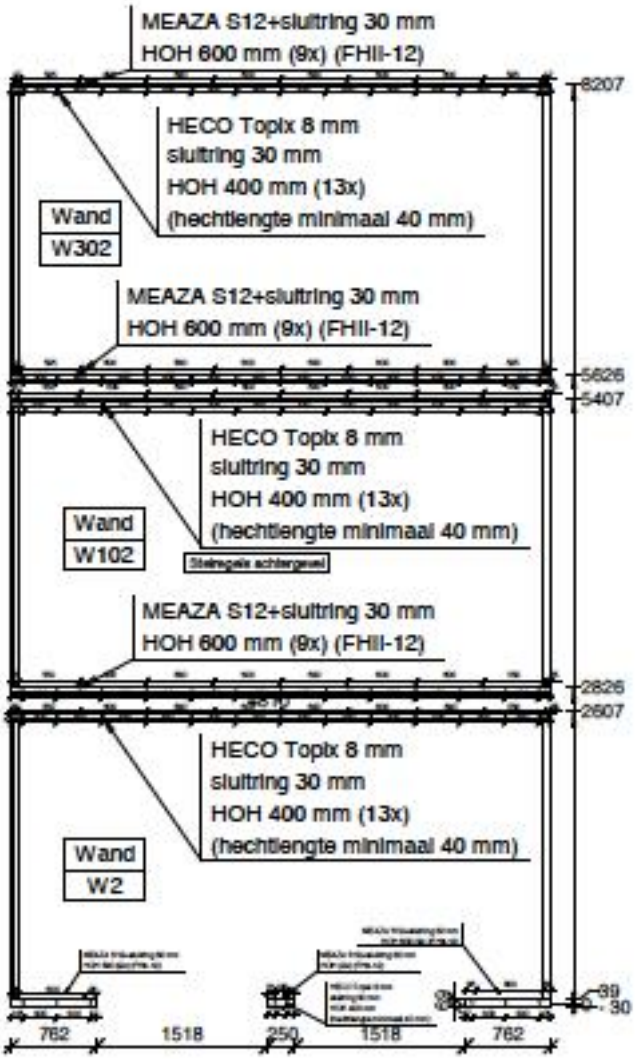


Airducts.

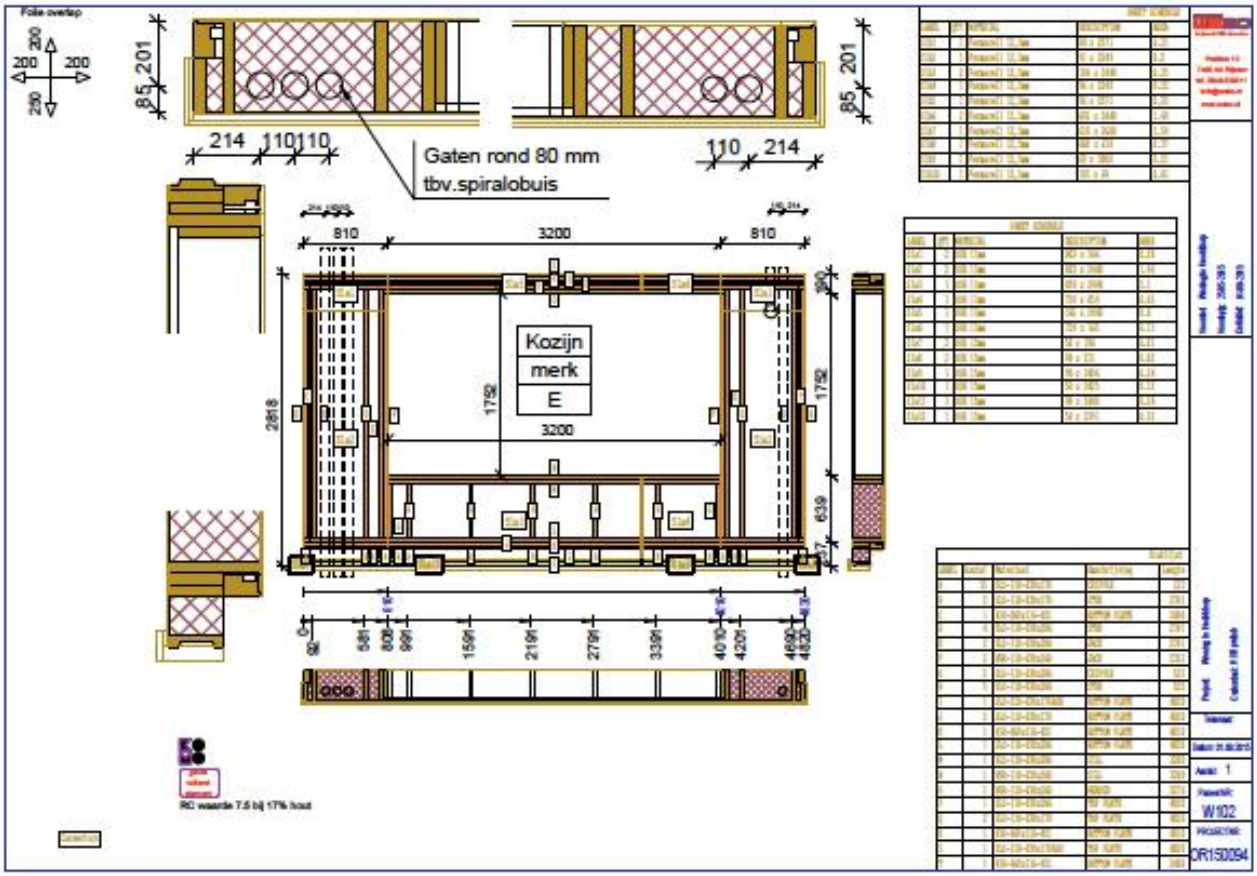
Vertical application of Klick & Span.



Front wall / side wall connection.



Klick & Span connections scheme.



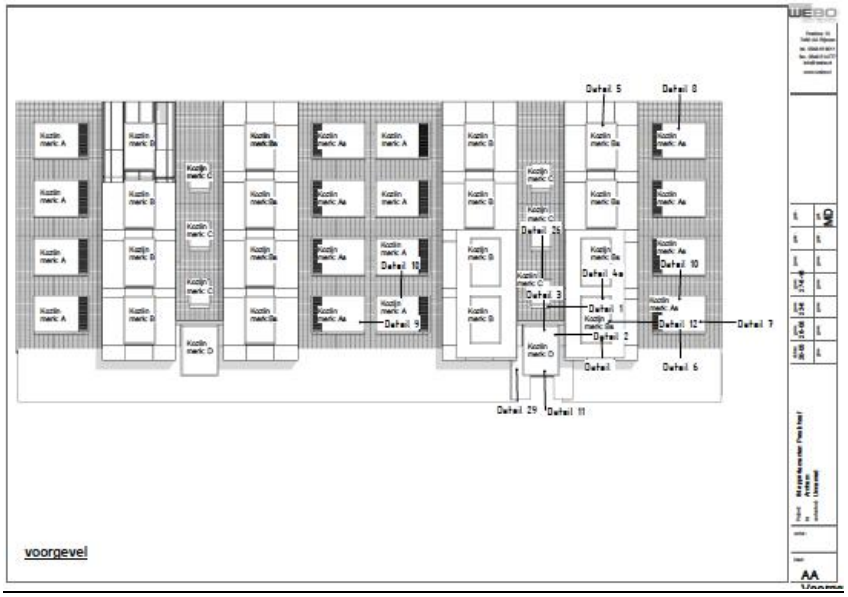
Example of a production drawing
Installations applied are;

- PV
- Heat exchanger combined with ventilation and air heating
- Brine water/water heat pump with boiler buffer

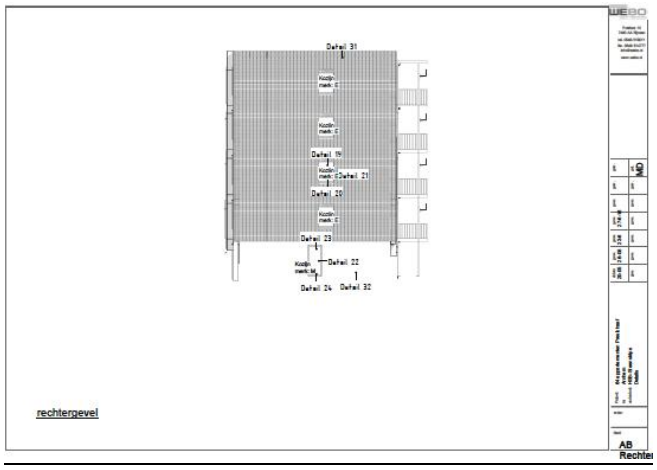
7.2 Presikhaaf project (Webo and BJW)

- Testing and prototyping of walls performance
- Life test of first vertical row
    - Roof construction needed added strength in order to not collapse

        - On the test row the roof collapsed even though construction calculations indicated the renovation approach was sound and would bring no problems.
    - Practical test of insulation results and blower door test.
        - Demands where met after some minor actions
- Assembly of the walls based on the patented 'Click & bolt' attachment methodology
- Testing of all walls
    - Demands met on insulation and airtightness (thermo pictures and blower test)



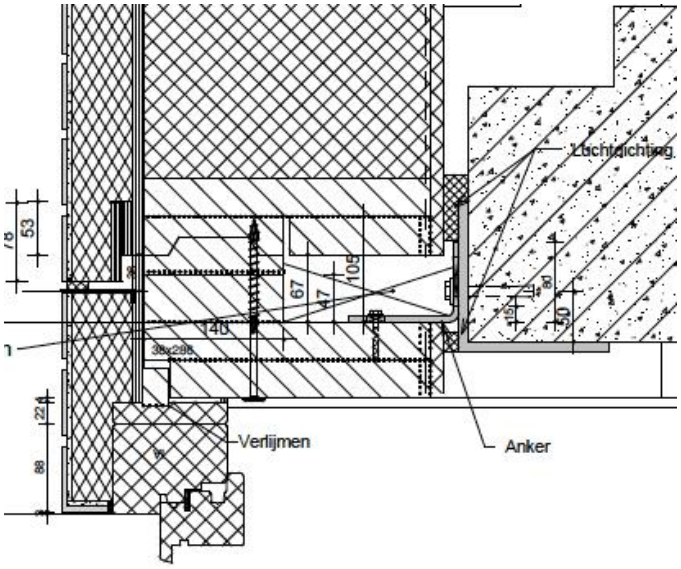
Overview of details front

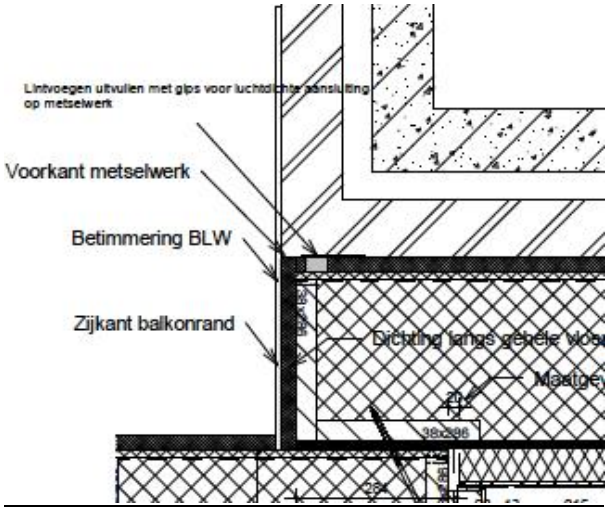


Overview of details side and back

Evolutions compared to Zoetermeer;

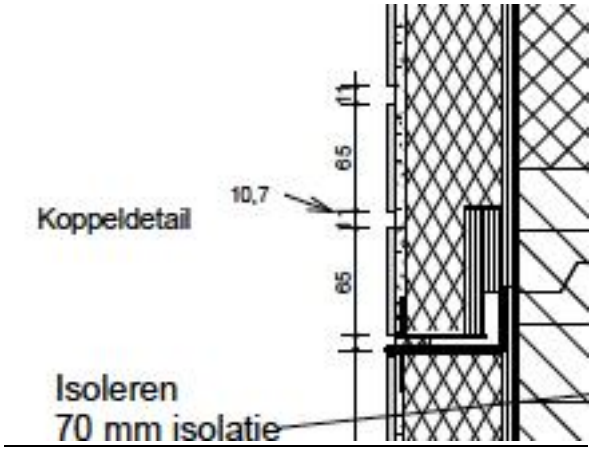
- airtightness still organised on new elements
    - Zoetermeer; wood beam
    - Presikhaaf; steel triangle beam
- Airtightness different compressed band used
- 3e version of Klick & Span
    - still from inside (no scaffold needed)
- connection between elements; different compressable band used (water tightness)



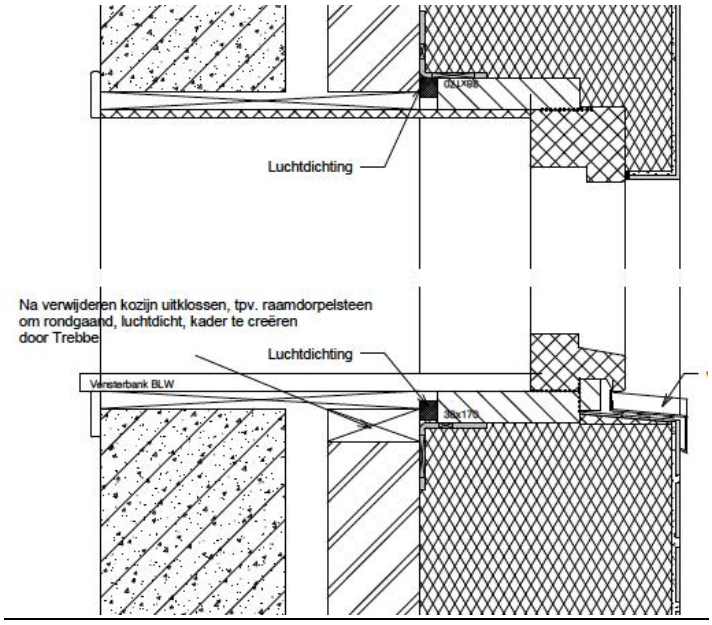


Some preparation done on the existing wall on behalf of airtightness.

Compressible band all around the existing floor edge

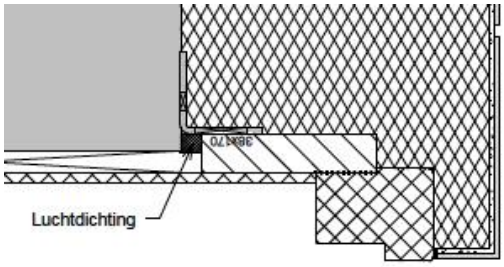


Connection detail; foil on both edges combined with compressible band

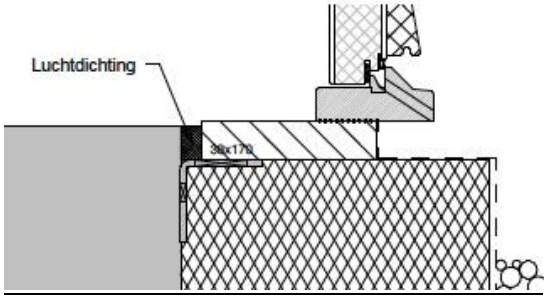


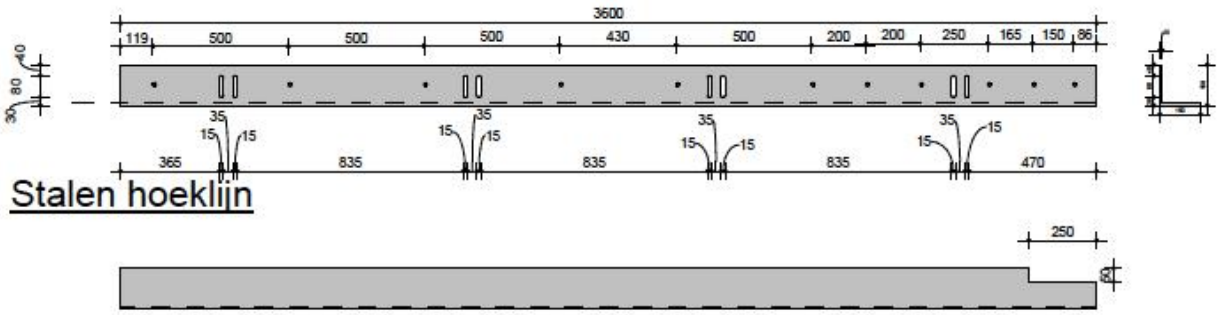
Connections detail window frames

- old frames removed
- new frames in the new wall
- airtightness detail old cavity

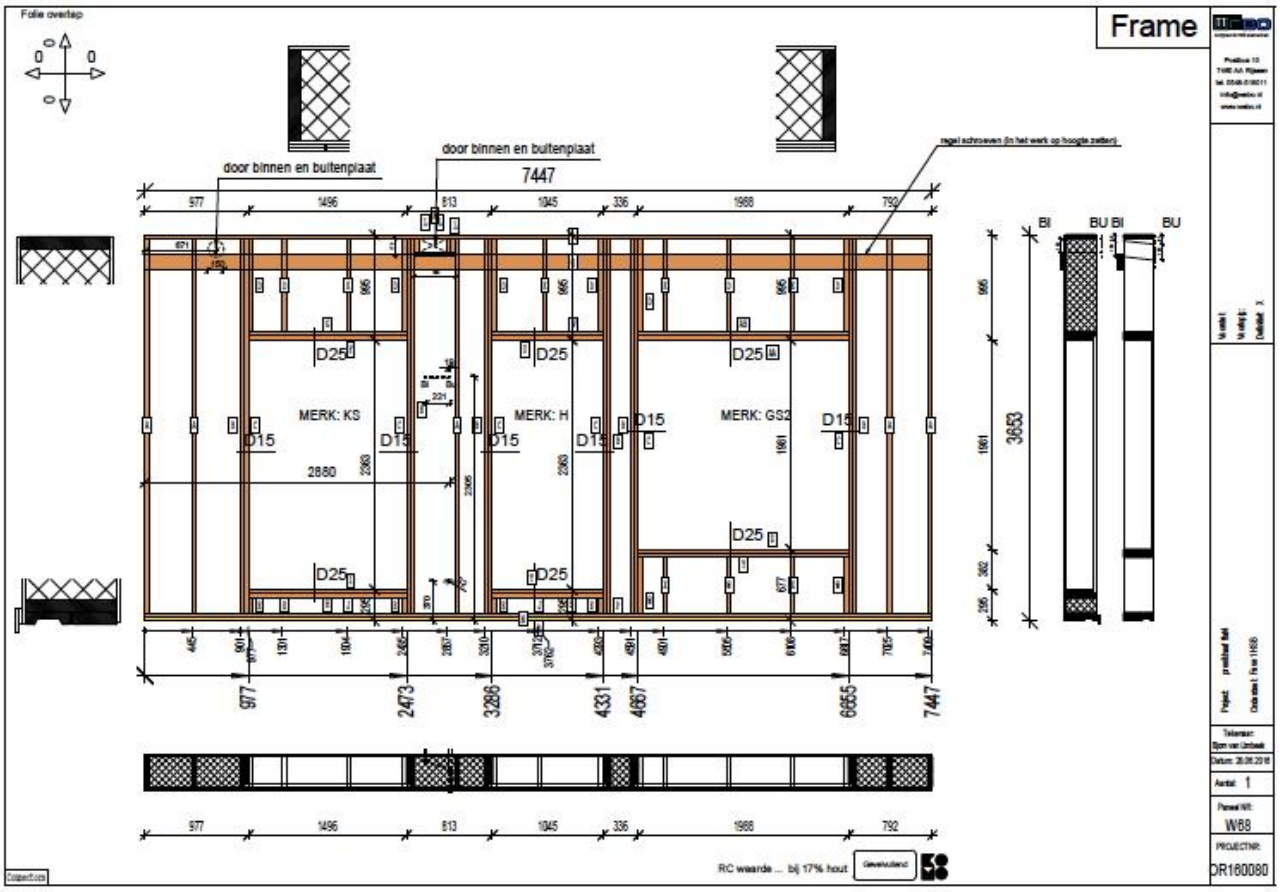


Connections door frame





Steel bearing of walls; all weight directly to the foundation.



7.3 Breda Kruiskamp project (BJW)

Project Kruiskamp is in preparation phase. Production preparation is to be finalised end of 2017.

8 Portugal

Technical project in 3D is done.
Technical specifications of the connection of the modules (module-module and module-building) are in the final phase of development. Preliminary construction drawings in 3D and 2D for some of the connections were developed.
The integral proposition is under development. Technical meetings with all the partners are taking place on a regular basis in order to discuss pilot specific problems and define solutions and further developments. The final design of the renovation work will be completed in November 2016.
Performance and cost calculations are almost all done. Small details are being adjusted as new developments of the renovation are settled. Costs and performance assessments will be ready in November 2016.

Preliminary designs:
Based on the preliminary studies performed for the pilot building, the design of the connections between the modules is already completed.
Figures 1 and 2 present the West view and East view of the building, respectively, in which it is represented the location of the prefabricated modules (P01 to P43). The modules will have the height of the building. The curved part of the building façade (Figure 1) will not be intervened.

Figure 1 – Fixation of the prefabricated modules in the West façade of the building

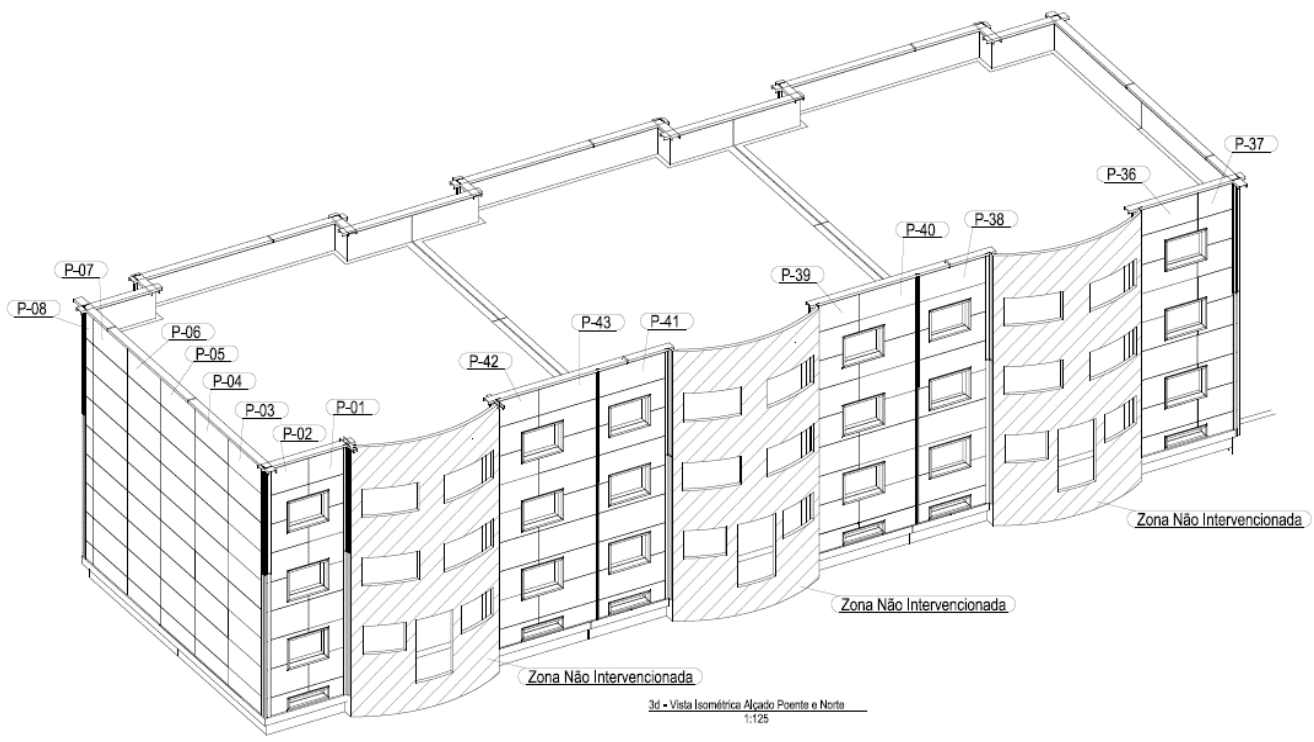


Figure 2 – Fixation of the prefabricated modules in the East façade of the building

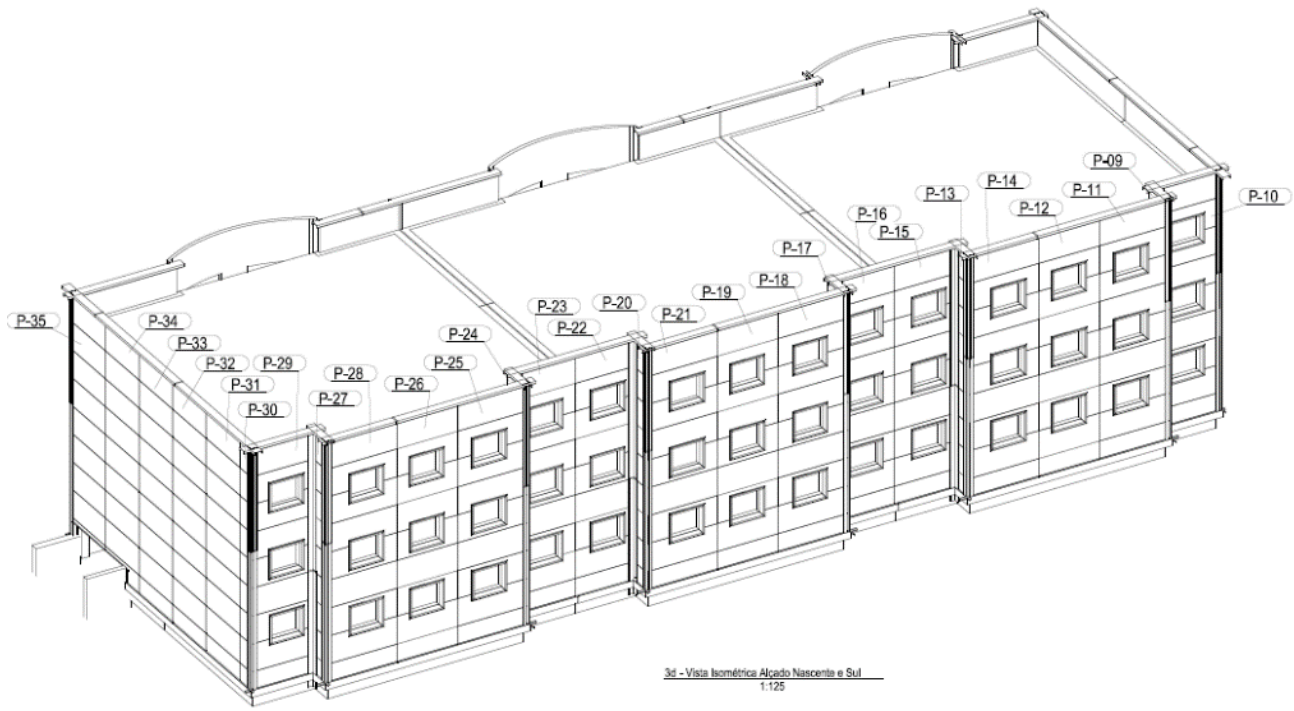


Figure 3 presents different zones of the building which require specific connections between the modules, such as corners of the walls. Figures 4 to 8 present the details A, B and C from Figure 3. Figures 9 and 10 present the linear zone of connection between modules and Figure 11 presents the profile view of the fixation between the module and the façade.

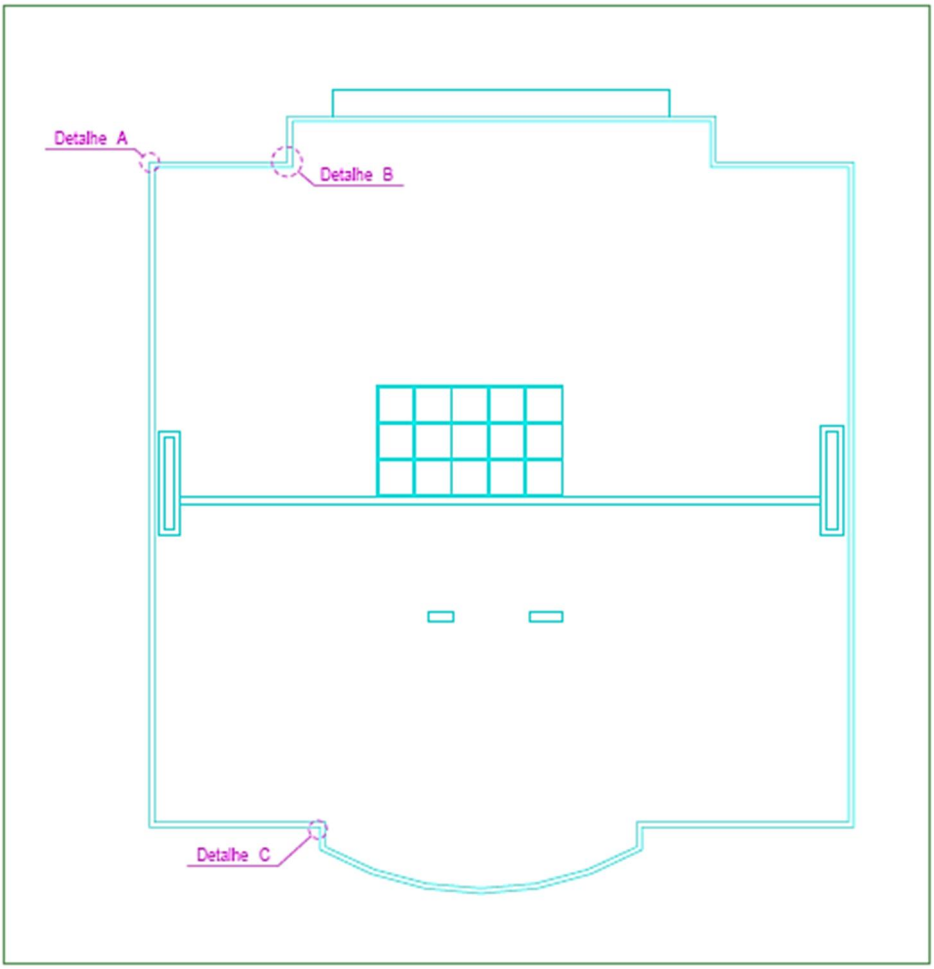


Figure 3 - Scheme of details of the connection of modules in different zones of the building (floor plan)

Figure 4 – Example of designed connection between modules in exterior wall corners (detail A – top view)

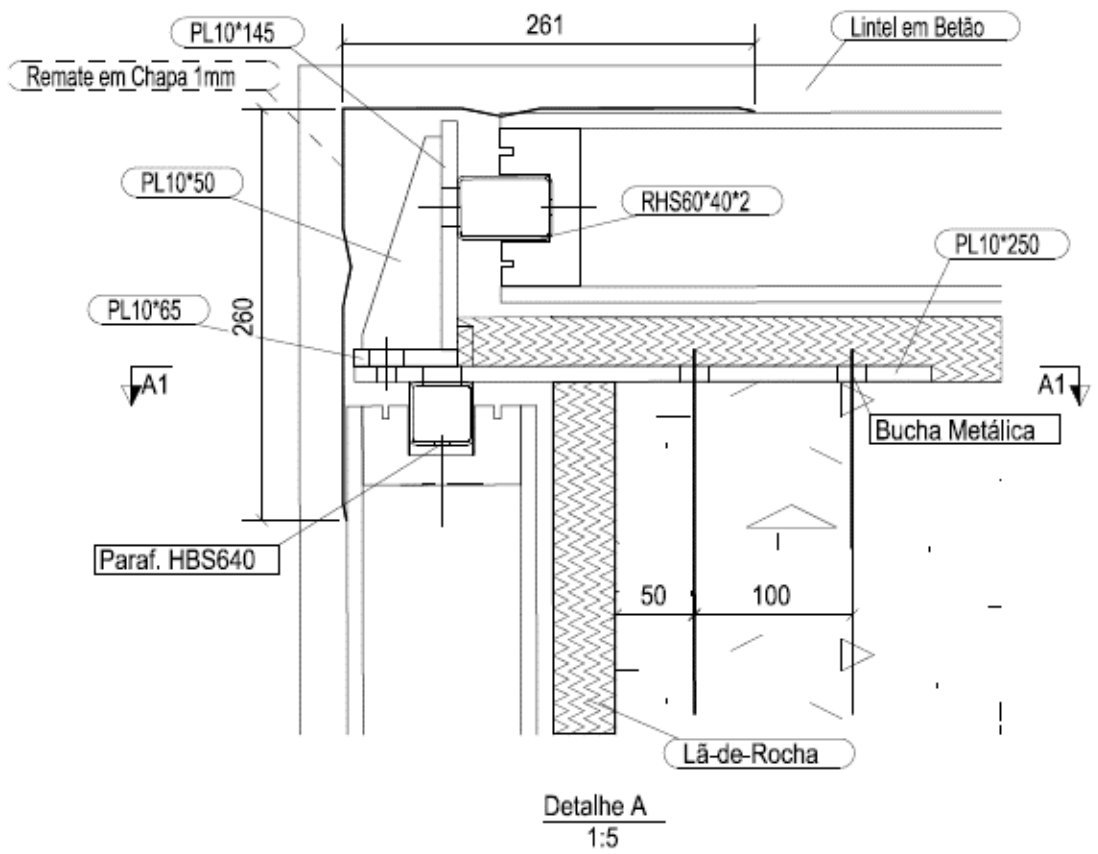
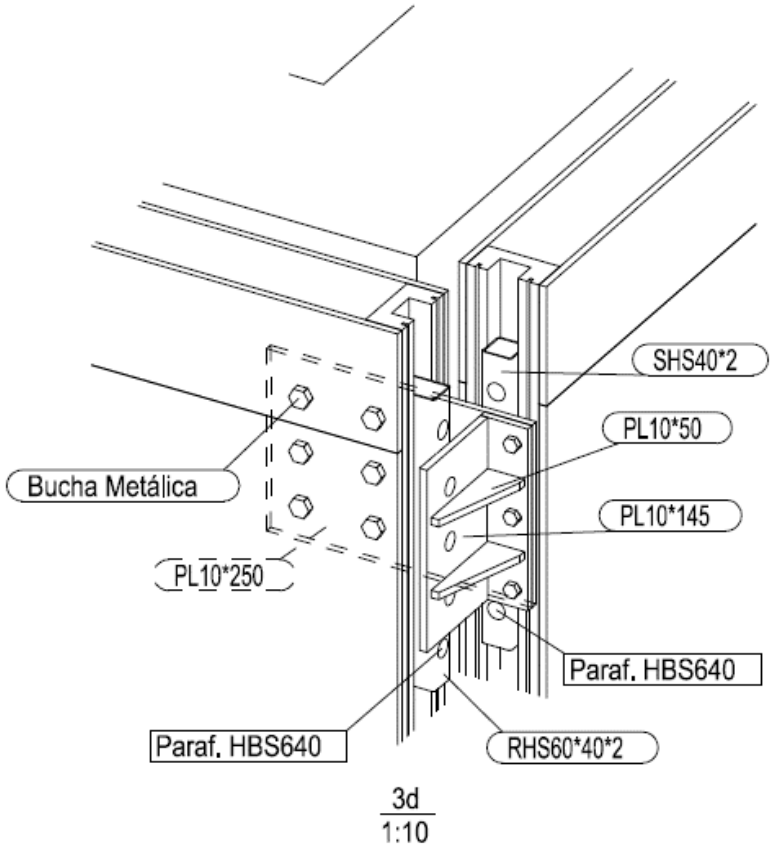


Figure 4 shows the modules and the rock wool which will be placed between the modules and the exterior wall (Detail A). Figure 5 presents the profile view of the same connection.

Figure 5 – Example of designed connection between modules in exterior wall corners (detail A – side view)



Figures 6 and 7 present the design for detail B of the building which represents the connection between modules in interior wall corners.

Figure 6 – Example of designed connection between modules in interior wall corners (Detail B – top view)

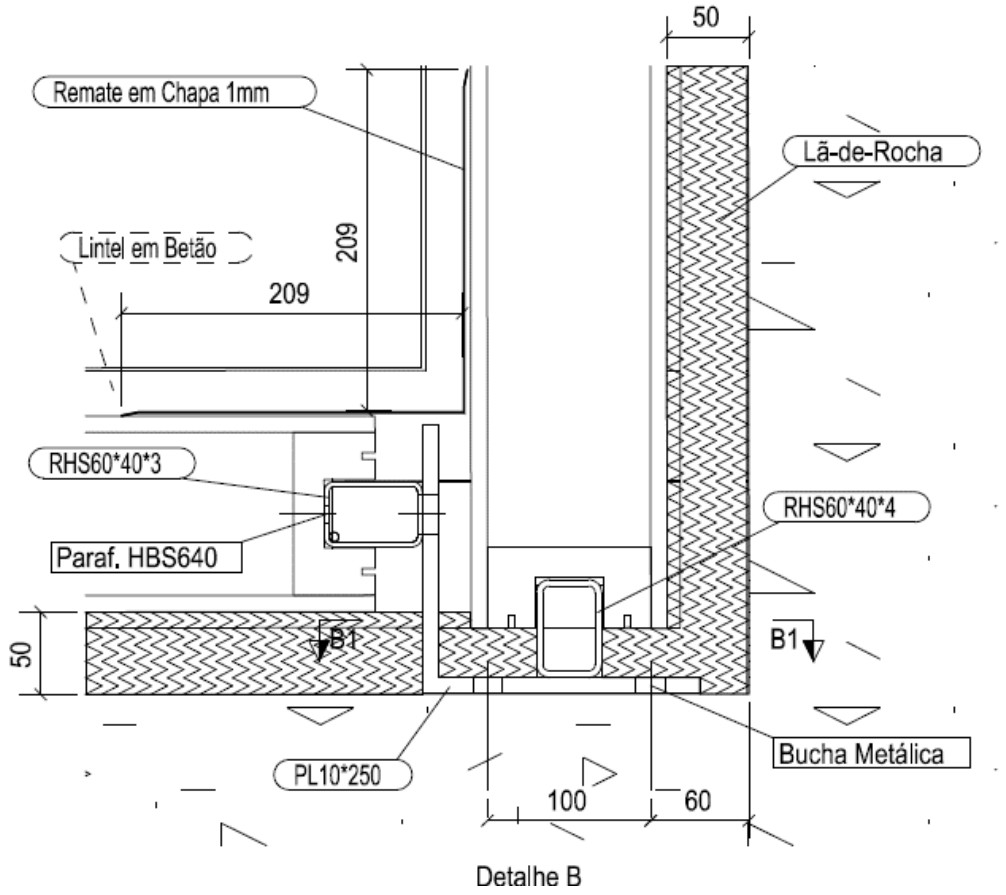


Figure 7 – Example of designed connection between modules in interior wall corners (Detail B – profile view)

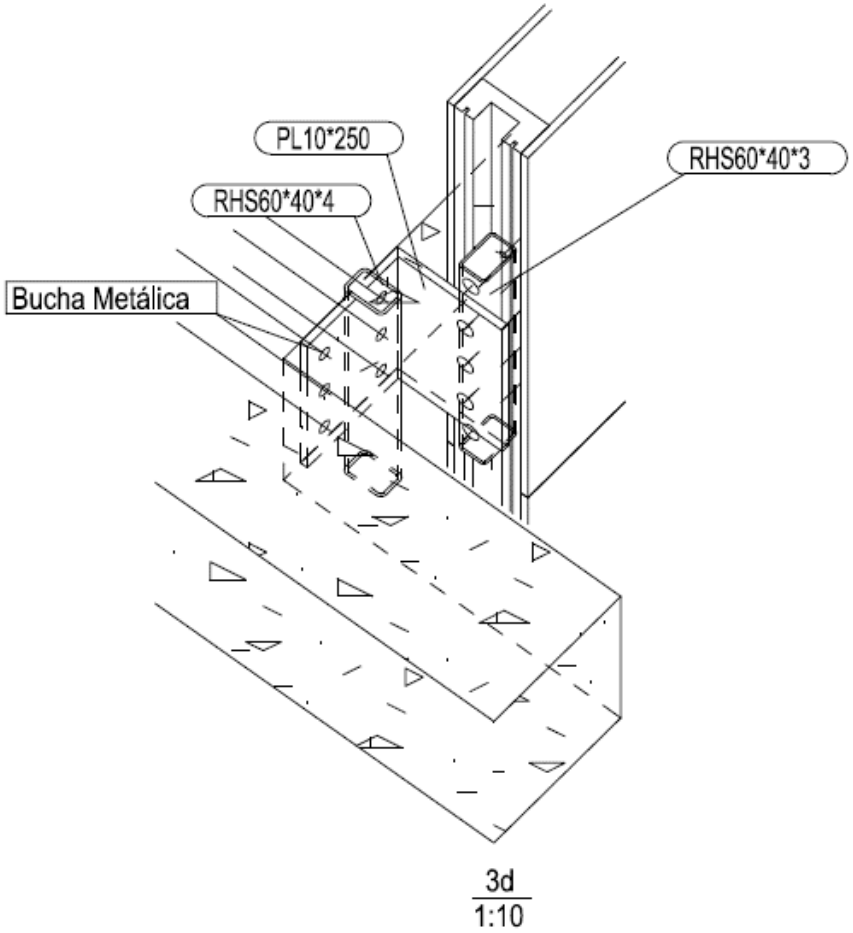
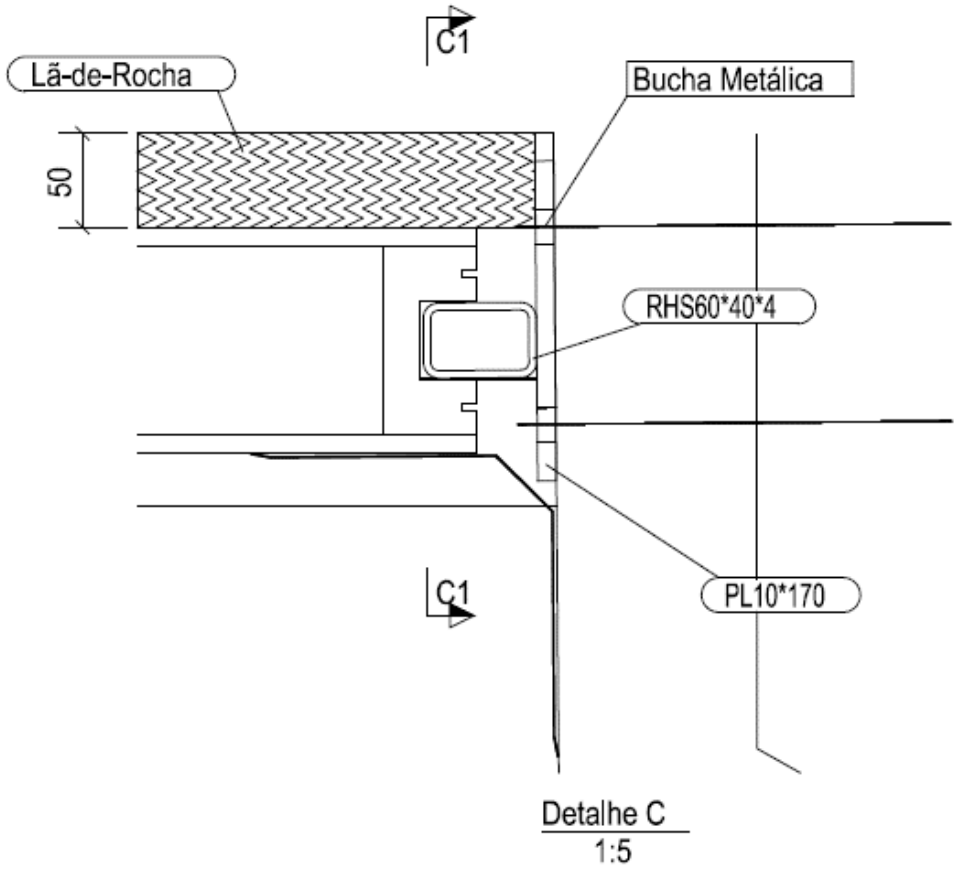


Figure 8 presents the design for detail C of the building which represents the connection between the module and the curved part of the wall.

Figure 8 – Example of designed connection of module with curved wall (Detail C – top view)



Figures 9 and 10 present the top and side views, respectively, of the detail connection between modules in linear zones of the building and their fixation to the concrete slabs.

Figure 9 – Example of designed connection between modules and concrete slabs (top view)

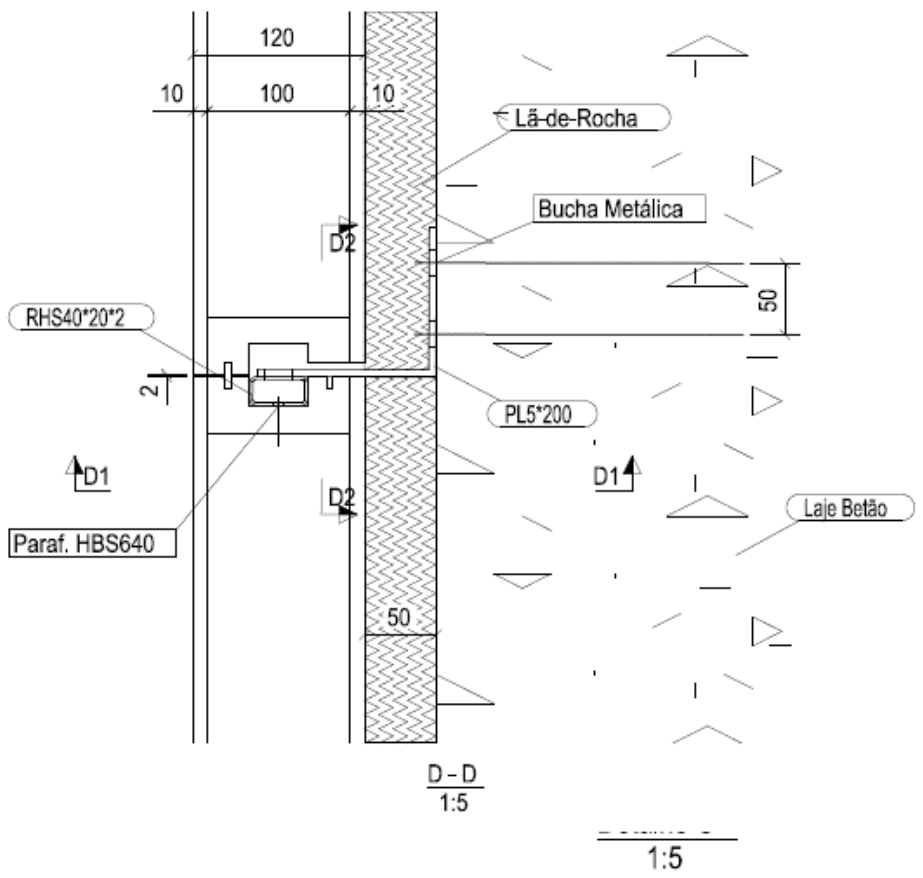


Figure 10 - Example of designed connection between modules and concrete slabs (profile view)

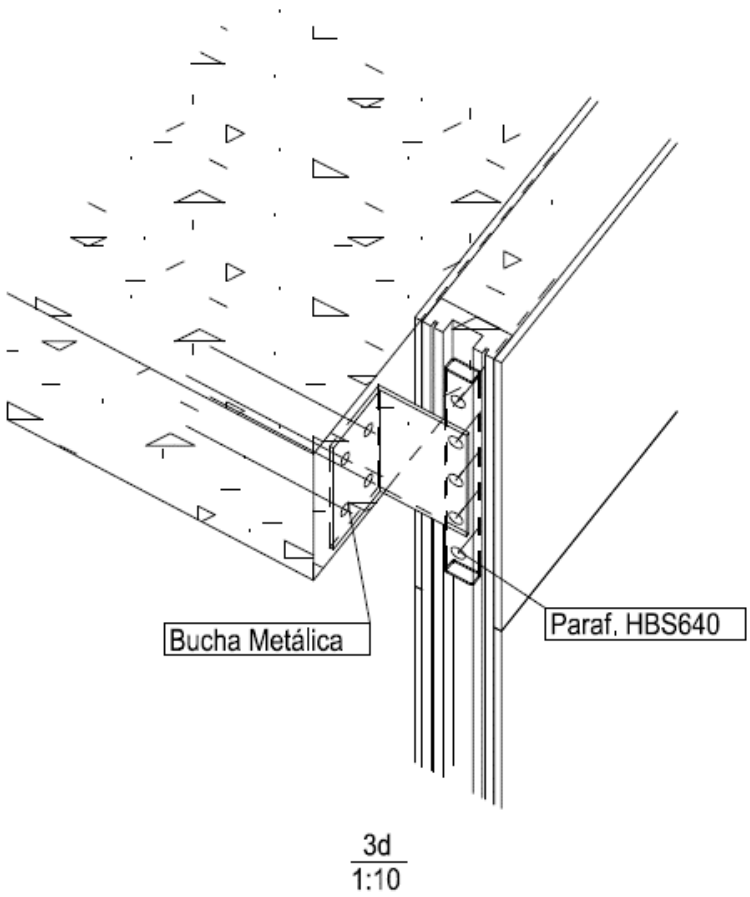


Figure 11 presents the profile view of the fixation of the module to the concrete slab of the façade.

Figure 11 – Profile view of the fixation of the module to the concrete slab of the façade