EuroPHit

D5.1.5a Wall_/_roof_junctions

INTELLIGENT ENERGY – EUROPE II

Energy efficiency and renewable energy in buildings

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EuroPHit

[Improving the energy performance of step-by-step refurbishment and integration of renewable energies]

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Technical References

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1 Stepwise retrofit of wall-roof junction for solid construction

- Placement: Roof, Facade
- Type of building: Residential or Non Residential
- Climatic conditions: Cold, warm

1.1 Description:

Connection kits adapted to step by step retrofit for frequent roof typologies and wall insulation measures. These kits can also help standardizing roof/wall retrofit in one shot.

Kit for eave connection to sarking pitched roof makes uses of flexible insulation to adapt to different eave geometries.

Kit for eave connection to ceiling insulation prescribes projected insulation to fill spaces that are difficult to access and projected airtightness material to avoid complex moves to cut and seal. Alternatives to projected airtight layer are butyl based deformable membrane openings, grommets for rafters.

Kit for parapet connection focuses on low thermal bridges for coping and guardrail, as well as integration of PV.

1.2 Demands:

- Roof stability
- Protection against rainwater infiltrations
- Thermal bridge free installation
- Continuity of airtightness layer
- No risks of condensation buildup inside components
- Frsi25> 0,7 (building physics criteria)

1.3 Advantages:

- Good step by step functionality - stepwise upgrade
- No need to cut roof structure
- Preserve original roof depth
- Possibility to insert fire retardant insulation materials, which is advantageous especially for multi-family housing.

1.4 Risks:

- Condensation next to rafters
- Electrical shocks when installing and operating PV
- High thermal losses in parapets

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1.5 New products:

- Eave and ridge retrofit kits for : exterior insulation and roof sarking insulation, exterior insulation and ceiling insulation, exterior insulation and flat roof insulation
- Advanced PV integration in highly insulated standards

1.6 Eave retrofit kit for exterior insulation

The junction kit is based on an adjustable plywood soffit, which can be extended in width and length by pre-drilled fixation slots. Parts can be added with adjustable angle to prevent rainwater to damage roof structure and wall insulation.

Case with sarking insulation:

Composition of the eave kit:

For step 1 (airtight connection to the airtightness layer of walls after external insulation of walls):

- Soffit panels (plywood or plastic, composite material with high tensile strength and moderate thermal conductivity)
- Fascia panels
- Variable angle steel connectors between soffit and fascia
- Pre-taped airtightness membrane for wall with plaster-in sealing tape
- Watertight and airtight impregnated sealing tape (5 mm thickness) to seal soffit to external insulation panels.

For step 2 (airtightness and insulation of eave and roof):

- Punctual brackets to fix extending rafters to fascia
- Flexible insulation rolls, width min 15 cm, lambda max 0.04 W/m.K, possibly integrating airtightness membrane on interior face.
- Airtight dowels to fix flexible insulation to existing structure.
- Linear brackets to attach flexible insulation to soffit
- If not integrated to insulation roll, airtightness membrane + airtight tape and mastic for connections to soffit and rafters.

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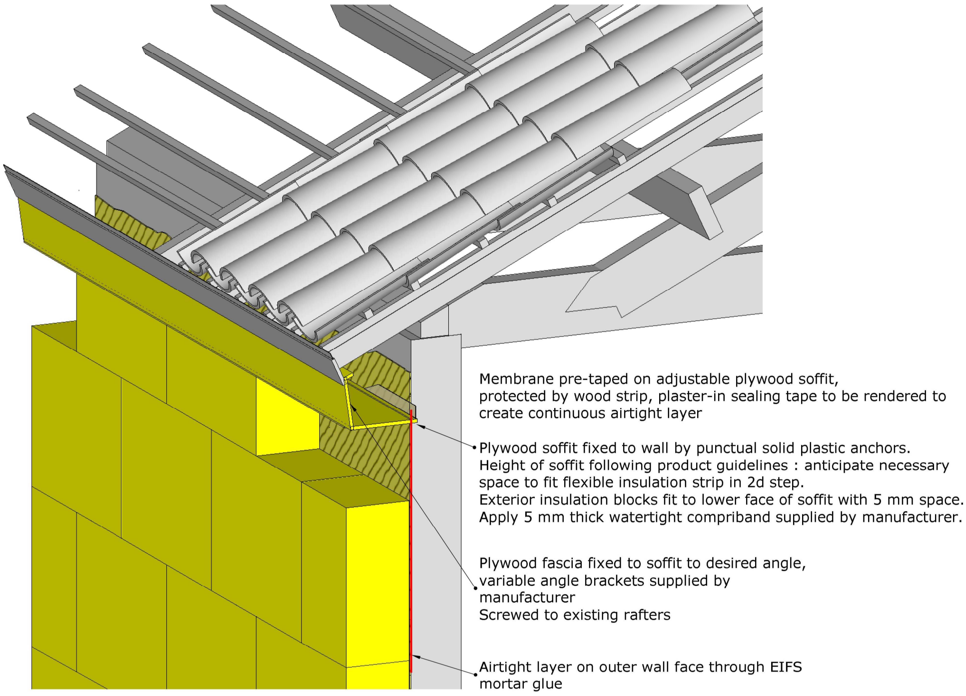
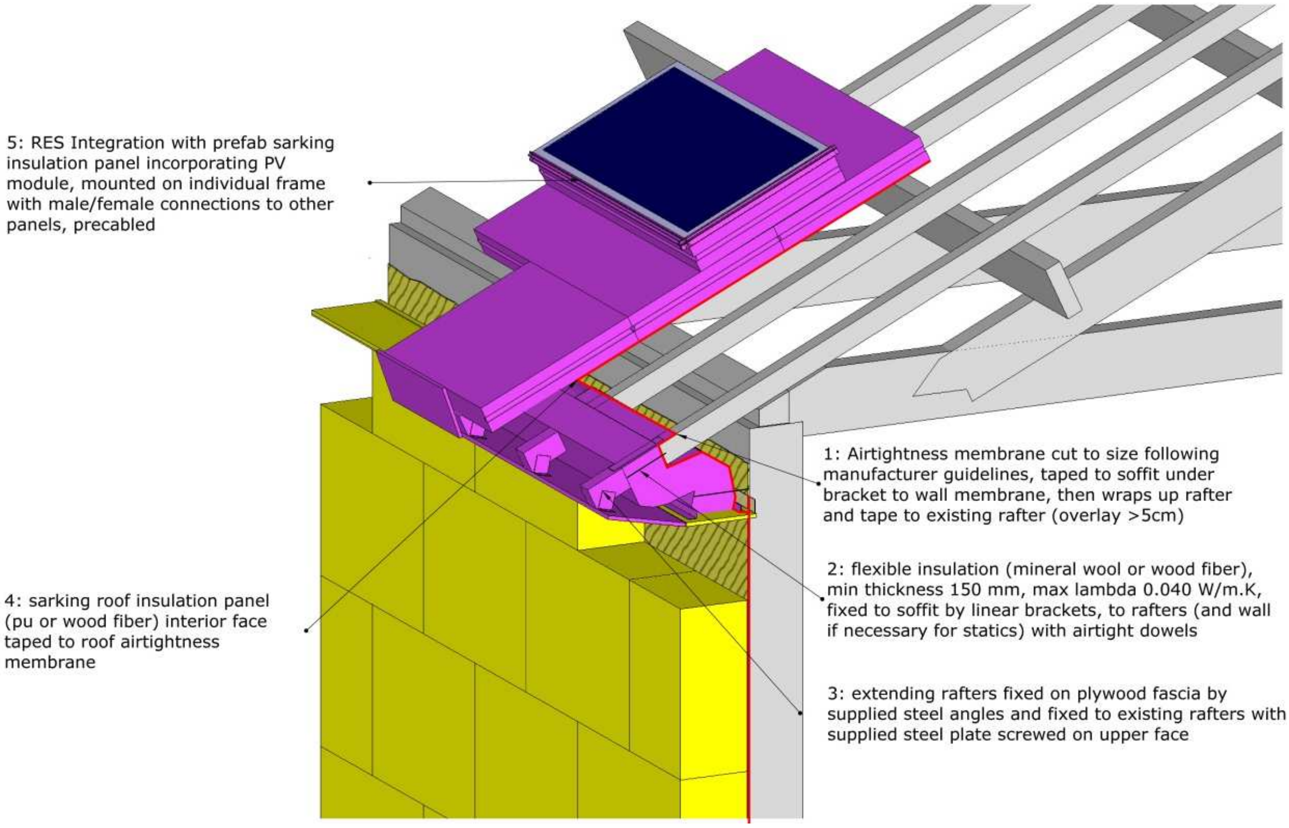
Step 1: Soffit and fascia, airtight connection to airtightness layer of walls:



Step 2: airtightness and insulation of eave and pitched roof



For airtight connection of roof membrane to existing rafters, mastic may be necessary to get the necessary level of adherence.

This solution offers a low thermal bridge connection (below simulation with flexible insulation 15 cm 0.032 W/m.K). Impact of temperature variation at rafter end should be investigated.

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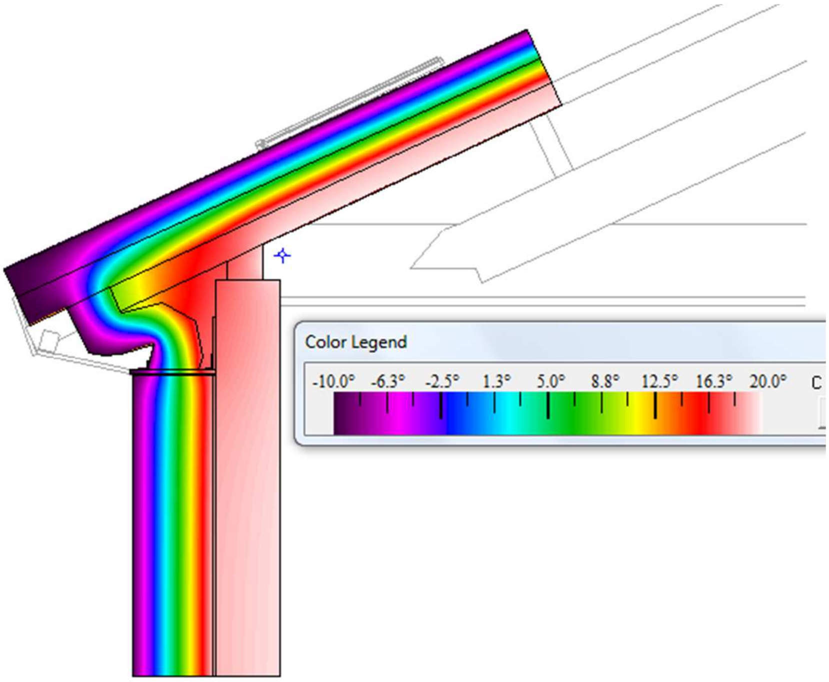
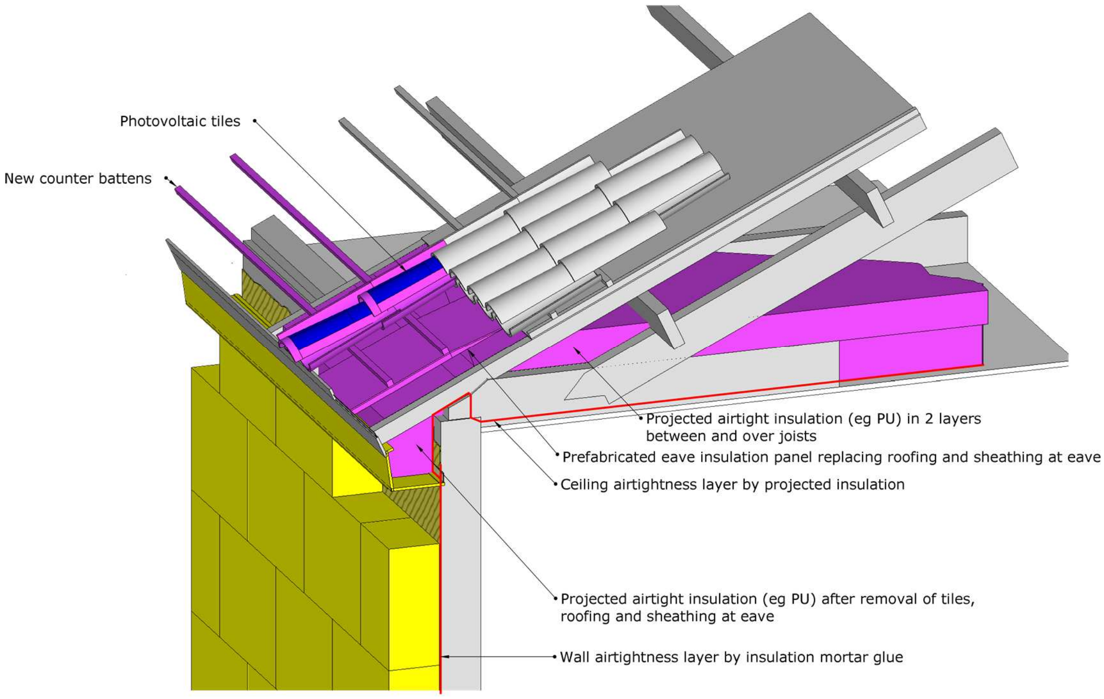


Case with ceiling insulation:

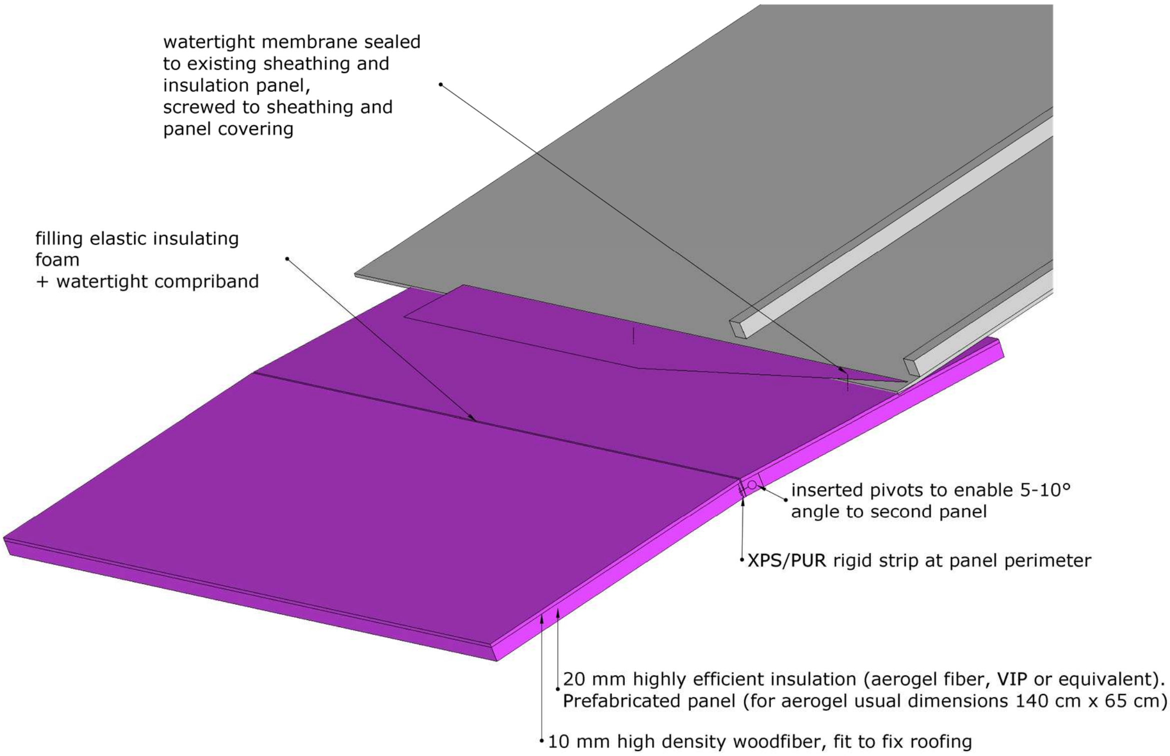
When the aim is to insulate the ceiling on unheated attic, a quick option is to project insulation and/or airtightness.

To project in the eave zone, eave tiles have to be taken out. Eave tiles can be replaced by photovoltaic tiles (pay attention to watertightness, adequate structure needed).

Below solution for step 2 with projection of PU foam, which creates an insulating and airtight layer. Vapour diffusion is blocked by PU, so projection needs to be continuous to avoid channels for vapour to condense near roof structure.



To limit thermal bridge at eave, where projected insulation has a low thickness, a prefabricated highly efficient panel can be inserted on top of the projected insulation at eave. As shown below, this panel is made of two parts : top part will be fixed to existing sheathing, bottom part will be fixed to eave fascia. Pivots help placing the panel according to roof geometry and insulation thickness. A watertight membrane is sealed to existing sheathing to prevent rainwater infiltrations.



As a variant without PU, mineral wool or cellulose can be projected. Here an additional airtightness layer is needed on the warm side: it can be either a spray (plaster-based) or a membrane.

At ceiling, membrane can be installed on upper face of joists if the thermal resistance of insulation below membrane is < 1/3 of total thermal resistance of ceiling insulation. The highest difficulty is to pass the membrane through the eave. Current solutions consist in cutting, taping and sealing at each penetration. More flexible membranes could include wide butylic strips that can be easily penetrated and moulded to fit rafters and other wood structure components.

1.7 Parapet retrofit kit for exterior insulation

Parapets in solid construction create high thermal bridge effects when insulation is applied on walls and roof. A solution used in new build is to avoid the use of highly conductive material for the parapet, or leave gaps at the parapet base to create periodic continuity of insulation between wall and roof.

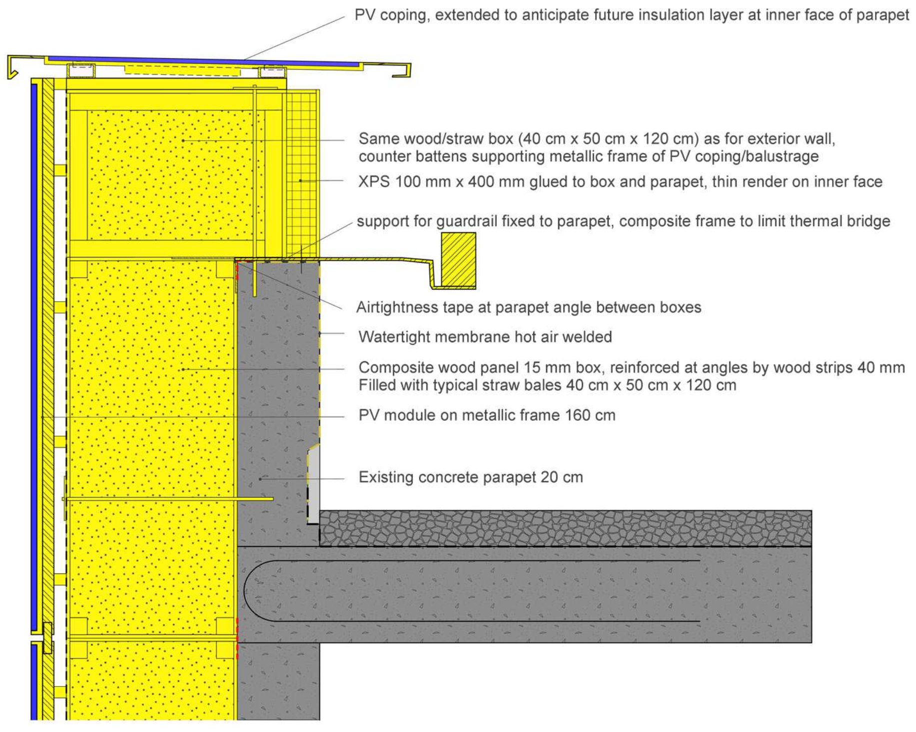
For retrofits, modifying the parapet structure (if in functioning state) is generally too costly. Challenge here is to reach a minimal total cost, and grasp the opportunity to integrate stepwise renewable energy sources.

The retrofit kit proposed here is simple: at step 1, wall is insulated on the outside and the box-frame system used to insulate the wall is used also to insulate the parapet, hence simplifying works. A complementary insulation layer can be installed on inner face of parapet to anticipate step 2. At step 2, roof is insulated following warm roof principle, roof membrane is welded to parapet membrane and an additional insulation layer is placed on the interior face of the parapet.

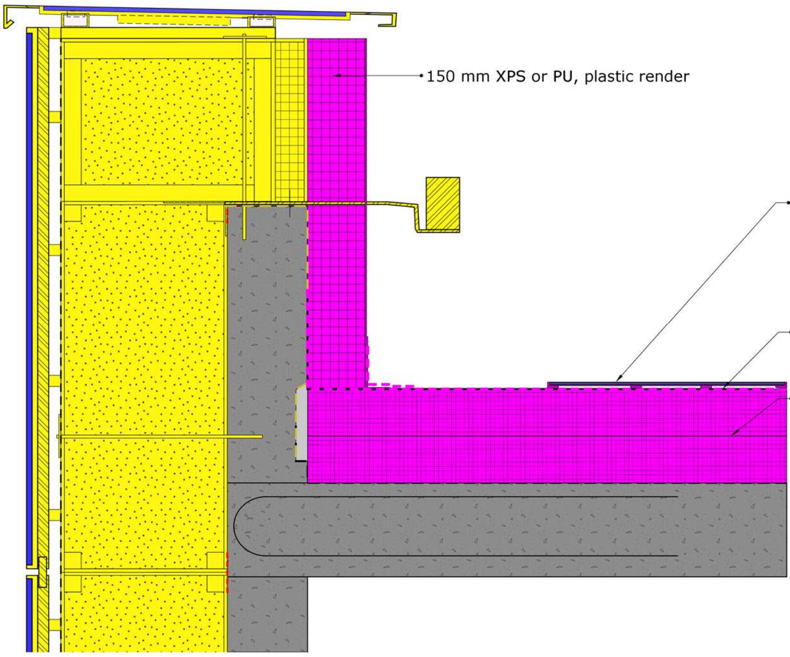
Specificity of the kit:

- Parapet PV coping with adequate size anticipating final parapet insulation.
- Insulation box that can receive PV on facade or parapet, low-carbon material possible
- Low conductivity anchors for insulation box and guardrail on parapet
- (optional) PV modules that can be installed either on facade or on flat roof

Step 1: Wall and parapet insulation, PV integration:



Step 2: Flat roof insulation, PV integration:


150 mm XPS or PU, plastic render
thin film PV modules adhesive linear fixations to membrane, distance to parapet for access and prevent shading
2-layer watertight membrane, welded to parapet membrane
PU 200 mm 0.022 W/m.K