BME Faculty of Architecture Building Constructions 3.
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TUTORIAL OUTLINE

to the 4th workshop exercise of the Building Construction 3. class

Up-to-date Fenestration with Thermal Insulating Glazing and Glued-laminated Timber Frame and Sash

The purpose of the workshop exercise: the introduction of up-to-date windows, doors and entrance doors that have thermal insulating glazing and glued-laminated timber frame and sash.

The workshop exercise discusses a window. The main technical characteristics of glued-laminated timber fenestration:

- The frame and sash material is usually pinewood. The profiles are usually glued together from three pieces of wood, with alternating grain direction to avoid warping. Lengthening of the profiles is possible, which allows the use of smaller pieces of wood, thus reducing the price of the final product. On the other hand, making the frame and sash using unglued, un-lengthened timber pieces is a more expensive manufacturing option.
- The action of the windows may be fixed, top-hung, bottom-hung, side-hung or multi-action. The maximum sash width may be 120 cm, the maximum sash height may be 270 cm. Over-dimensioning the sash is a common architectural mistake that results in the deformation of the window. The weight off the thermal insulating glazing is far more than the weight of regular glazing, therefore the sash and frame of thermal glazed fenestration are larger than those of single glazed fenestration of similar width and height.
- The sash is fixed to the frame by a complex hinge and closure mechanism on several points and there are typically one soft and two rigid connections along their perimeter where they touch. The example in the workshop exercise details fenestration with two soft connections.
- Between the external (rigid) and intermediate (soft) connection, there is a decompression groove which collects water and channels it into the bottom frame peace from where it is discharged through oval holes (see bottom detail).
- Performance data of the workshop exercise example window:
    - Air-tightness, water tightness, Wind-tightness: exceptional
    - Heat transmission coefficient: U_w = 1,1 W/m^{2}K depending on glazing type
    - Airborne sound insulation capacity: 35dB
- The glazing usually consists of three 4 mm thick glass panes with two 16 mm gas filled gaps between them (4-10-4-10-4 mm) and features low-E coating. The heat transmission coefficient of such solution of the glass alone is 0,7 W/m^{2}K. The

overall performance of the window is 1,1 – 1,3 W/m^{2}K. The glazing is supported by wedges and fixed by glazing beads.
- The surface finish of the frame and sash is either in-situ or factory produced glaze or paint with matte or shiny, colored or transparent appearance. Factory finish has better resistance against UV radiation and weather exposures (driven rain, frost etc.).
- The bottom horizontal parts of the frame and sash are the most exposed to precipitation, therefore they are protected by extruded aluminum trims.

The **1st detail** displays a general installation type with silica gel sealing on both sides and polyurethane foam in the middle. The external silica sealing serves water and wind tightness, the internal silica sealing serves as an air and vapor barrier.
Wall plugs are used to fix the window frame to the wall. The window should be positioned and secured by wedges prior to the placement of the wall plugs in order to prevent the movement of the window due to forces in the wall plugs.

The **2nd detail** shows the bottom vertical detail of the window. The external window sill most be waterproof and connected to the window frame in a similar manner, otherwise a separate membrane needs to be applied below the window sill. The internal window sill is glued to the wall.

Alternative installation example with shading system – rollershutter - can be seen on Fig.1. Providing space for both the box of the roller blind and the thermal insulation of the reveal is only possible if frame extension profiles are applied from both sides (it is different from the drawings introduced at the workshop exercise). The reveal must be thermally insulated, if the window is not aligned with the thermal insulation of the wall, in order to avoid thermal bridges. These thermal bridges would otherwise cause capillary condensation, or even condensation of moisture on the structural surfaces.

The detail displays the upper vertical window detail including the box of the roller blind. The size of the box depends on the area of the blind. For a regular 120-150 cm high window 150-160 mm box size is sufficient. For a 210-240 cm high glazed door 170-180 mm box size is required. From the designer’s perspective, however, it is sometimes easier to design this detail placing the largest required box size uniformly throughout the entire building to reduce the number of different details.

The example detail displays a singular window, for which the fixing of the upper frame part is not required. For windows wider than 1,50 m, fixing is required at that connection, too.

Other significant characteristics:
- The thermal insulation behind the roller blind box is soft mineral wool that fills the gap completely
- The proper sealing of the connection gap between the window frame and the wall hole is the most important!
- 8 cm gap must be left out, between the end of the roller blind box and the wall hole surface, for thermal insulation, in order to prevent point-like thermal bridges.

Up-to-date window installation in wall with EPS thermal insulating composite system with hidden rollershutter, vertical section

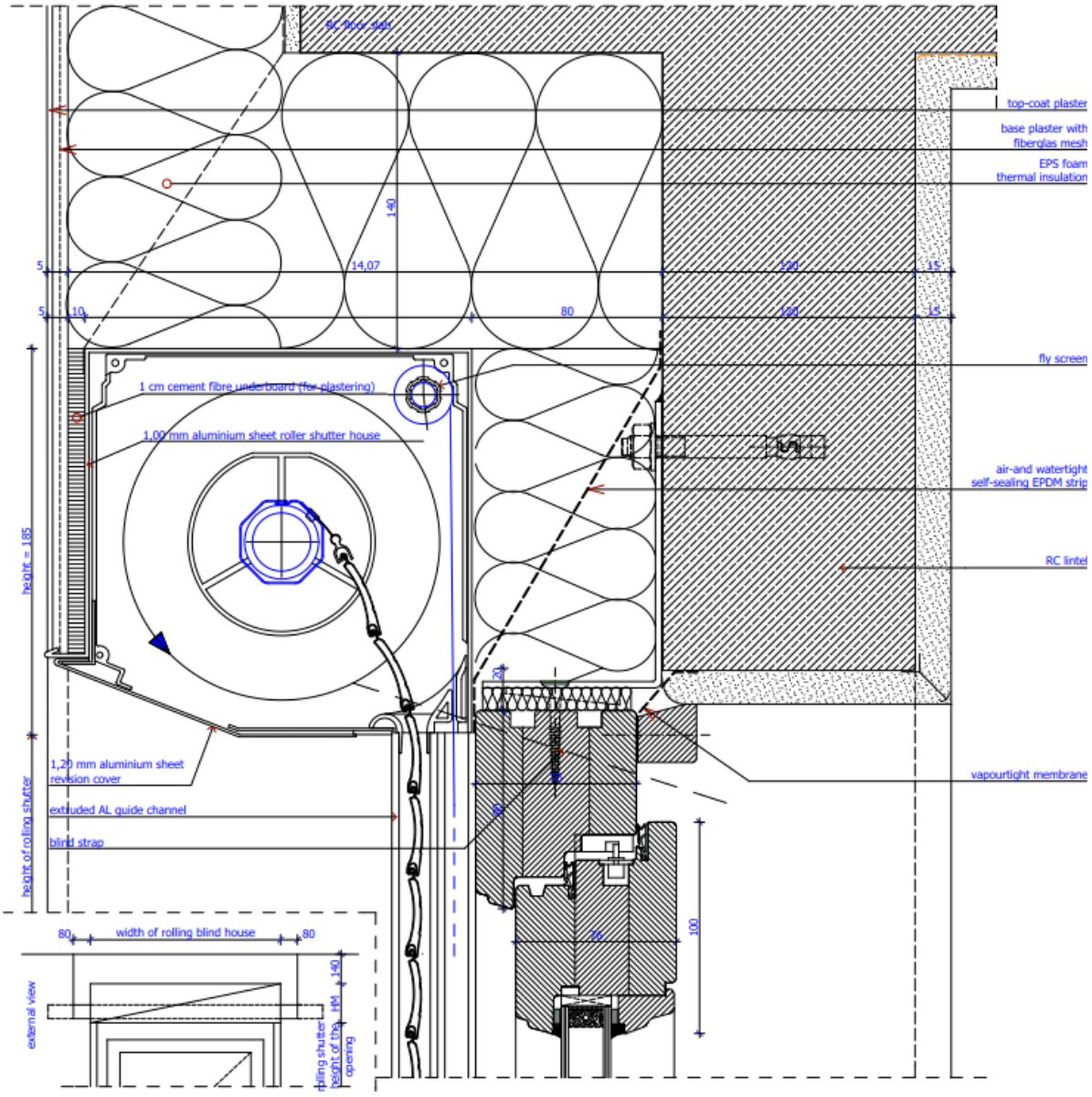

Fig.1. Window installation with hidden external roller blind

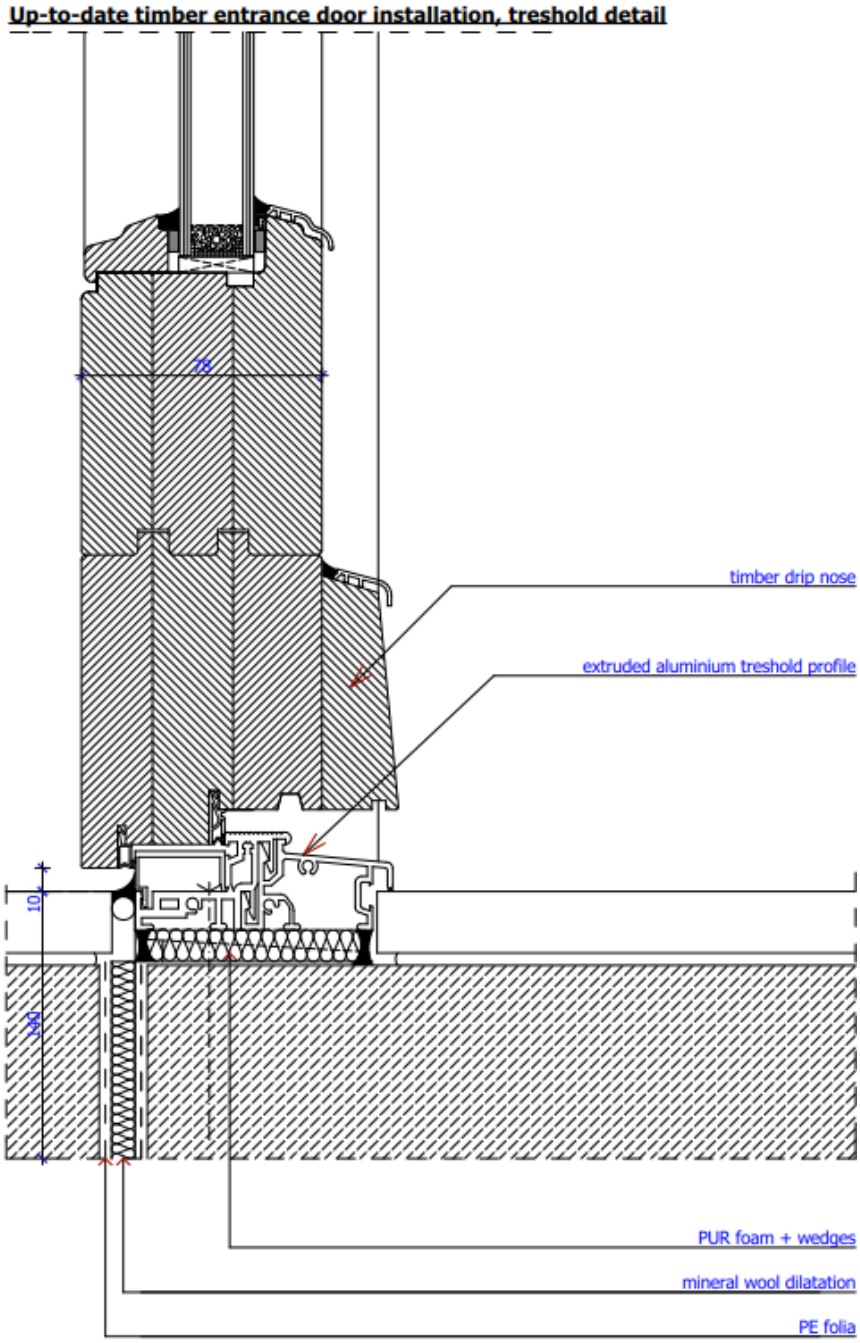

Fig. 2. Treshold detail of an internal (flat-) entrance door

The detail shown on Fig.2. is a glazed entrance door with extruded aluminium flat treshold. This is different from balcony doors; balcony doors are made out of window profiles to achieve the same performance level as the windows. At entrance doors, flat tresholds allow accessibility but have not the same performance level as the threshold of the balcony doors (windtightness, airtightness, watertightness etc.)

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