

**ROOF SHEETS**  
profile steel sheets 600 x 2400 mm

**CEILING PANELS 600 x 2400 x 50 mm**  
- PVDF-coated steel sheet + polyurethane insulation

**FRAME**

**H-columns and beams (HEB 140)**  
- galvanized steel  
- spacing 2400 mm

**Roof trusses**  
- galvanized steel  
- h=600 mm, chords 100x100 mm, members 50x50 mm

**Bracing**  
- in all directions with diagonal stiffening bars

**Connections with bolts**

**FLOOR PANELS 600 x 2400 x ~90 mm**

**BASEMENT**  
- steel skids, SPACING 2400 mm

**TERRACE**  
- galvanized steel frame  
- terrace boards recycled plastic boards  
- fences with steel posts, wires and handrails

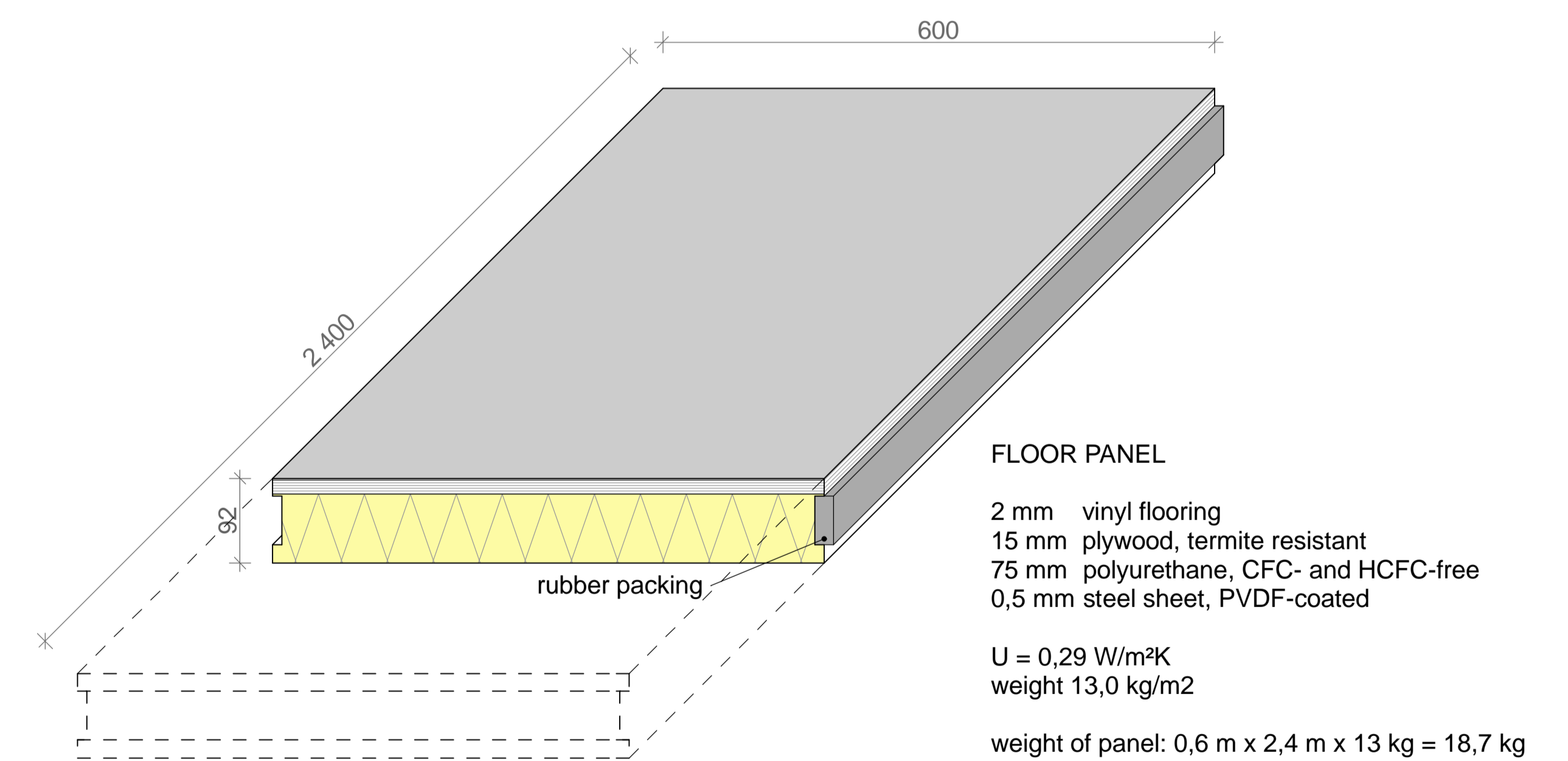
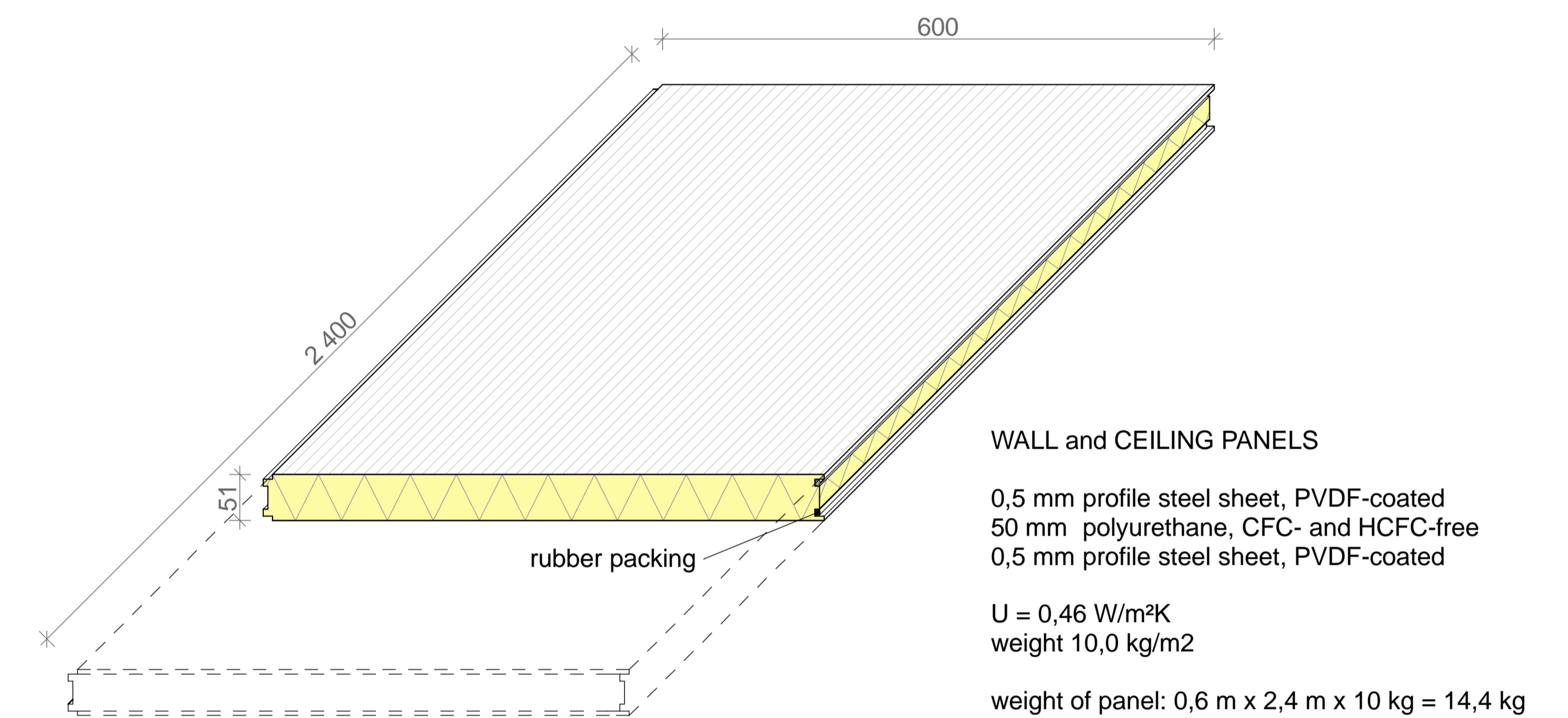
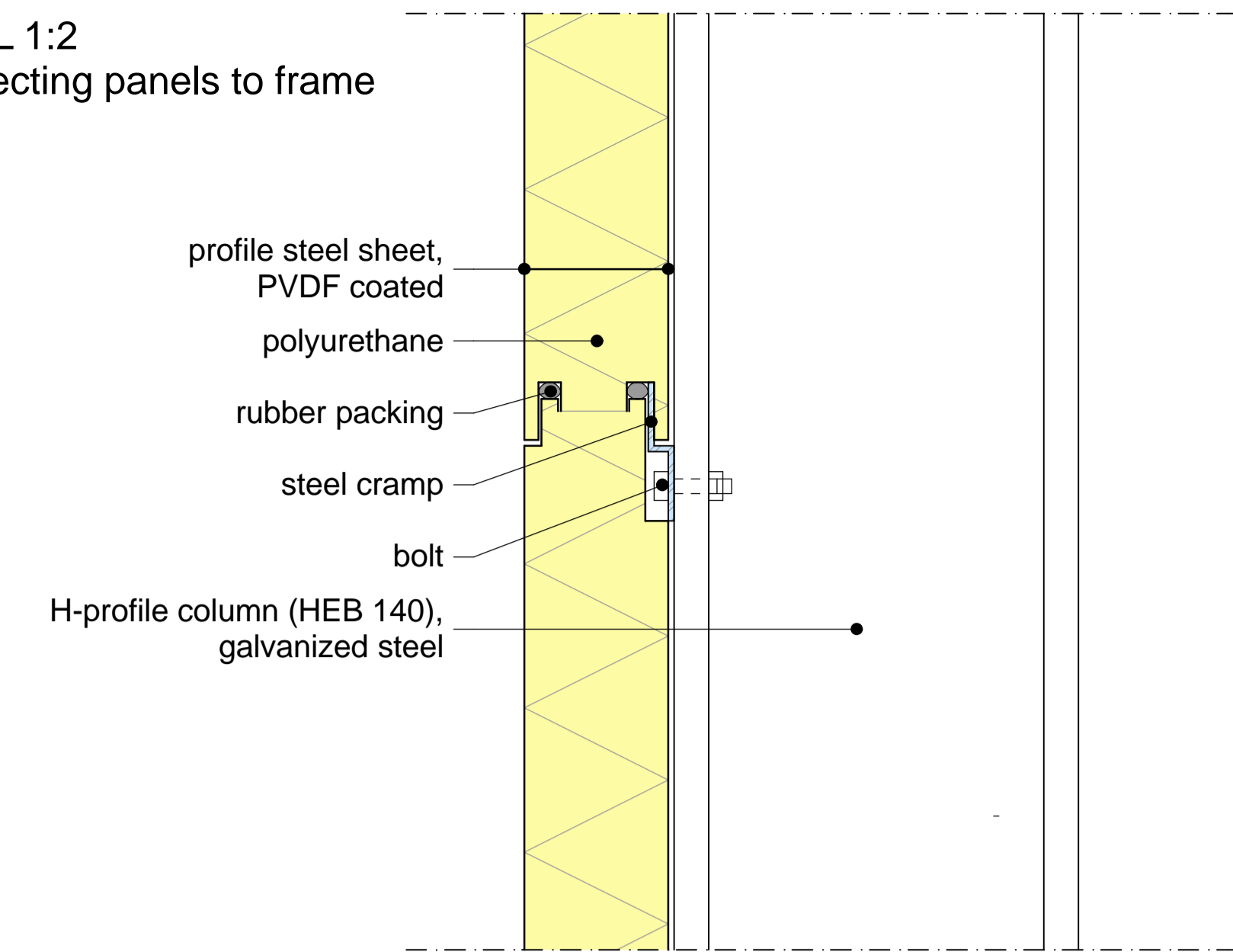
**RAMP**  
- adjustable angle (hinge joint to terrace frame)

**PREFABRICATED WALL PANELS 600 x 2400 x 50 mm**  
- PVDF-coated steel sheet + polyurethane insulation

**WINDOWS 600 x 2400 mm**  
- aluminium frame

**DOORS 1200 x 2400 mm**  
- aluminium-steel

**DETAIL 1:2**  
- connecting panels to frame



**Frame and Cladding System, Prefabricated Panels**

The construction of teaching unit is based on modular unit of 600 x 2400 mm. Building can be extended or shrunk with module dimension of 2400 mm. Facades, roof, floor and partition walls are made of prefabricated panels of this size. Also windows and doors are part of modular system, so their placement is flexible. Panels are connected to the frame with hooks and bolts, and connection between panels are tongue-and-groove joints, that have elastic packing stripe between.

The framework is made of galvanized H-profile (HEB) steel columns and beams, and galvanized steel trusses, that are connected to each other with bolt joints. All parts of framework are prefabricated and cut-to-size. Framework is braced with diagonal bracing beams on each directions of the building, making the framework work as a rigid box, that makes it more durable for example in case of earthquake.

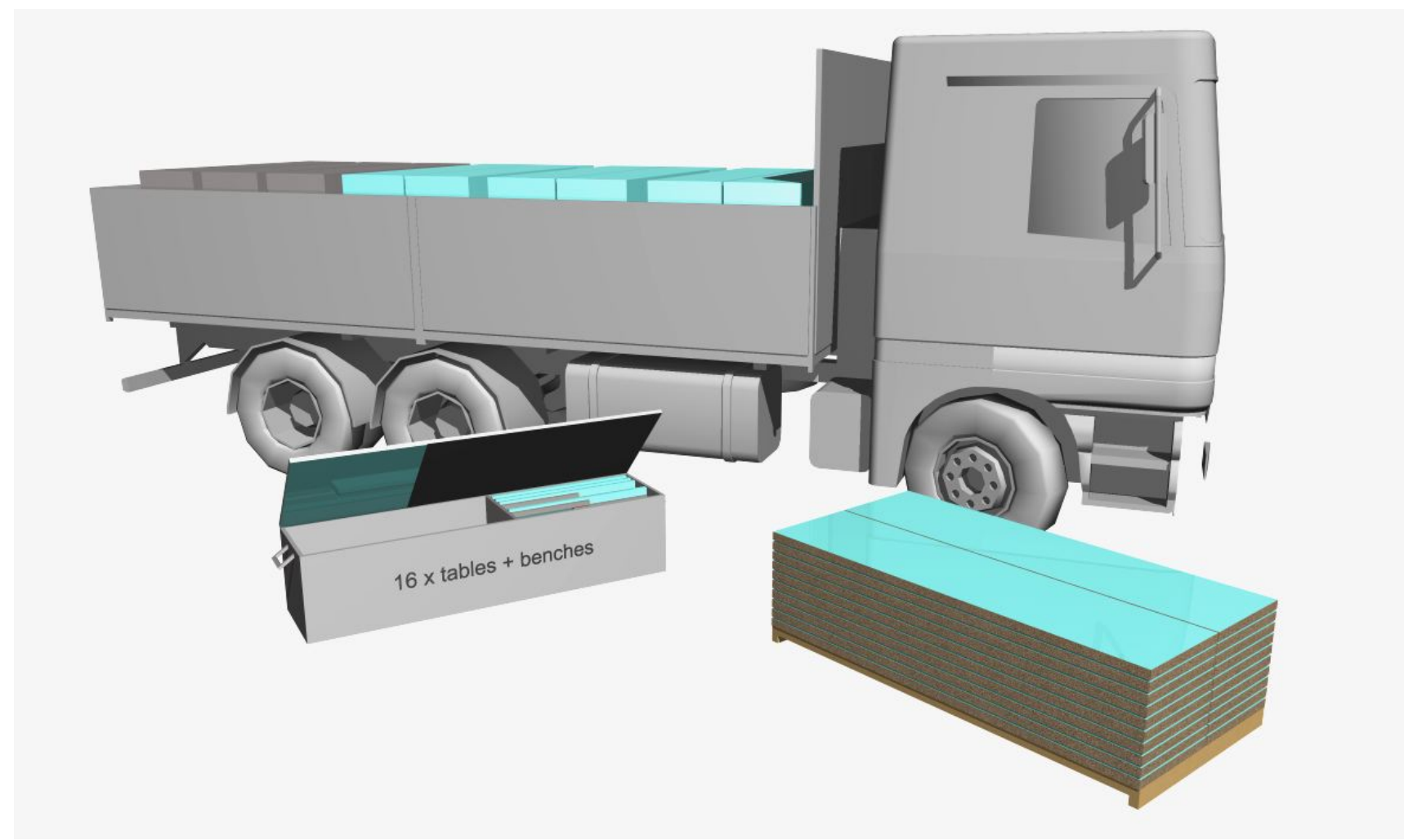
Teaching unit is based on steel skids, that are haunched on the ends, which allows moving teaching unit small distances by tractor without deconstructing and constructing building again. To minimize the damages of standing or streaming water caused by heavy rains, the ground underneath the building should be raised comparing to surrounding area.

Materials, used in classroom unit, are chosen to be durable, light weight, and safe. As many of the materials as possible are made of recycled material and/or can be recycled. Wall and ceiling panels are 50 mm thick, pvdf-coated steel sheet on both sides and polyurethane insulation between. Floor panels are made of steel sheet, polyurethane insulation, termite resistant plywood and vinyl flooring. Windows and doors are aluminium framed, and are equipped with shutters that protect the windows from storm winds.



**EDUCATIONAL BUILDINGS IN CATASTROPHE AREAS**  
- STUDY AND DESIGN

JENNI LAAKSONEN, May 2010  
Master's Thesis, Degree Programme of Architecture  
Tampere University of Technology  
Instructor: professor Kari Salonen



**Transporting and Relocating**

Modular panels of teaching unit are transported on pallets. The classroom furniture is packed for transport in transport boxes that serve as cupboards when building is in use. Teaching unit can be transported in containers by ship, train, truck or airplane, or the boxes and pallets can be loaded on the back of a lorry. In case of very difficult location by infrastructure, teaching unit can be transported on jeep or even donkey.

Building materials of classroom are light weight, so they are easy to transport and to lift on their place. Teaching unit is also designed to require the minimum construction tools and professionalism of workmen. Teaching unit delivery has also construction kit, with bolts, required tools and manual with instructions of constructing.

When there is not need for classroom in the site anymore, teaching unit can be deconstructed and relocated to new location. Deconstructing and transporting long distances may not be profitable and by ecological reasons not favourable, but for example in case of refugee camp, the teaching unit can be transported to nearby village after camp is taken down.

**Technical Systems**

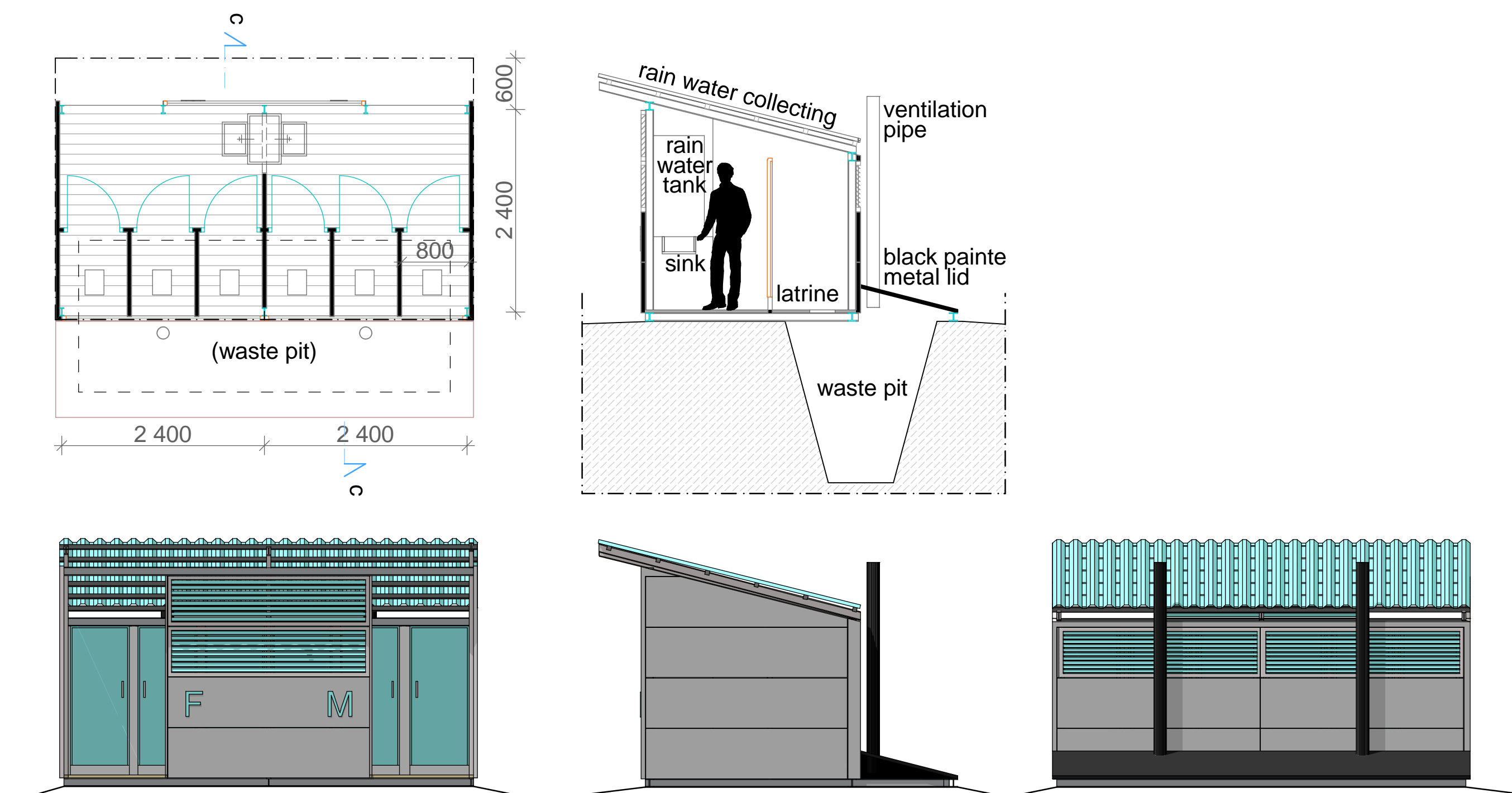
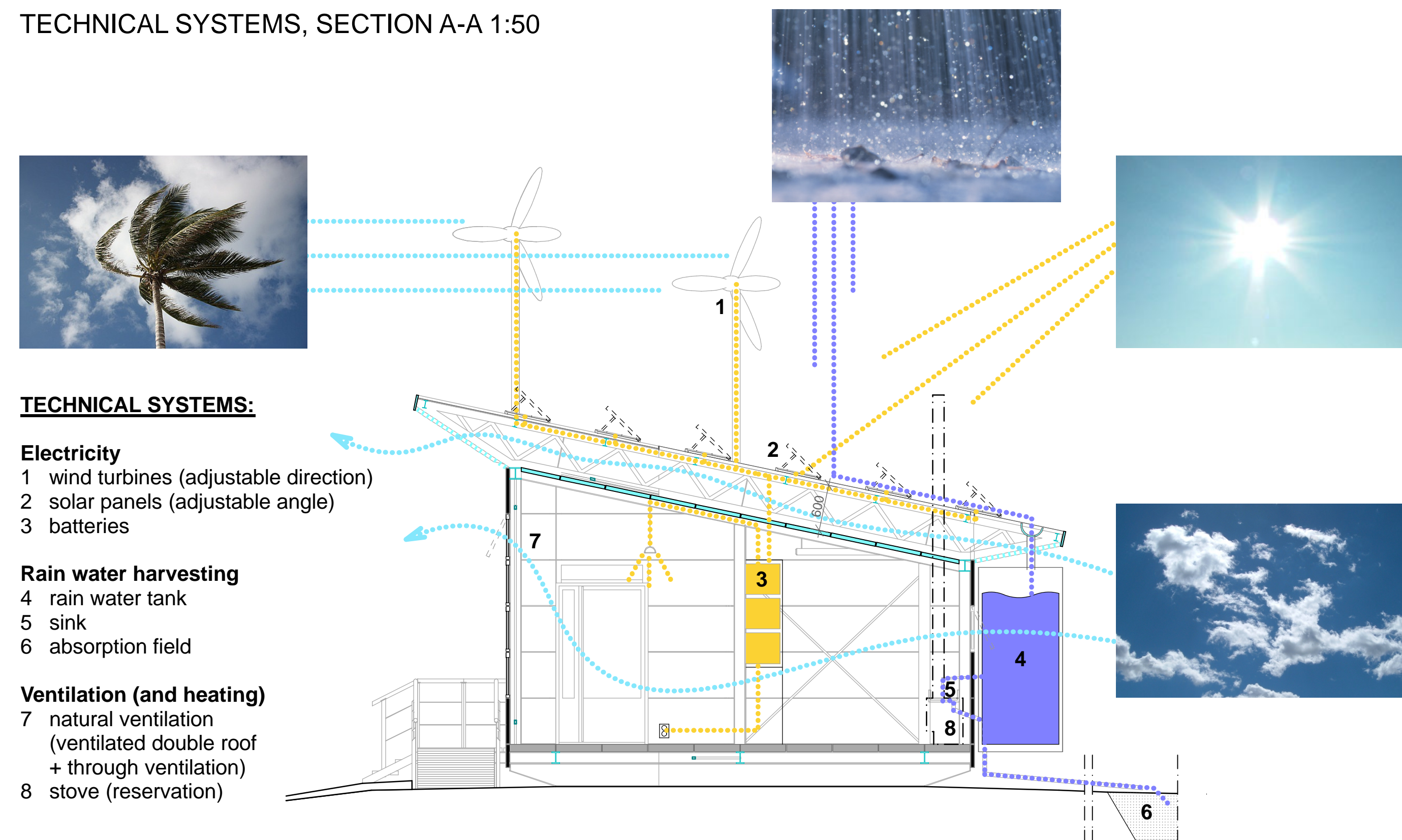
Teaching unit can be implemented independent by power and water supply. It can be equipped with adjustable solar panels and/or windturbines to produce energy for its use - mainly for dark-time lightning and for needs of small electrical equipment like charging mobile phones. Unit can be equipped also with rain water harvesting system.

Ventilation is natural ventilation. Air is designed to flow through classroom, and through ventilation can be intensified in hot climates opening the windows from opposite sides of classroom. Double roof and long overhangs protect the classroom from heat. In cold areas, teaching unit can be equipped with stoves to heat the classroom.

Sanitation is implemented with separate latrine building. Latrine is ventilated pit latrine, which means a pit in the ground and small hut above it. There are separate sides to girls and boys. Latrine building has steel frame, and roof and wall panels are of same size panels as in classroom building. Latrine building can also be extended, with 2,4 m dimension (3 latrine booths). When pit is getting full, hut, that is based on skids, can be dragged over new pit, and old pit can be filled with soil.



**TECHNICAL SYSTEMS, SECTION A-A 1:50**



LATRINE 1:50



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