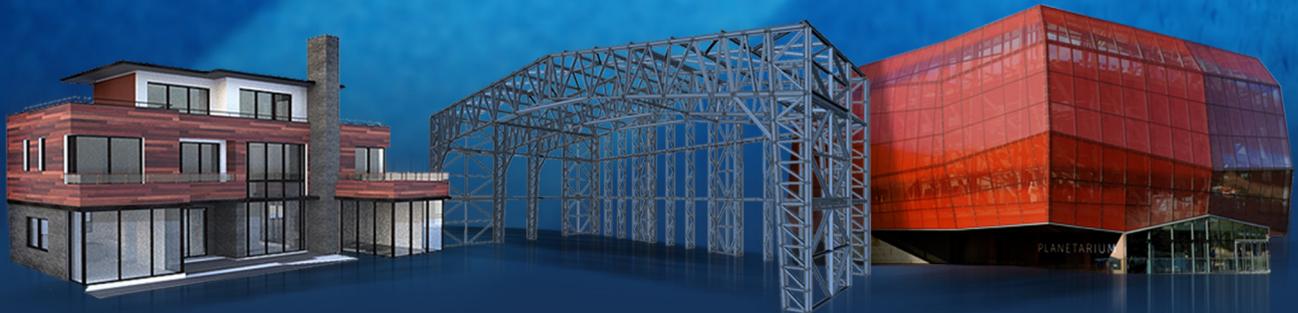


GRZYWKAGROUP

STEEL . CONSTRUCTIONS . LIFESTYLE

Guidelines for Architectural and Structural Design of Buildings with use of the Spatial Steel Frame System

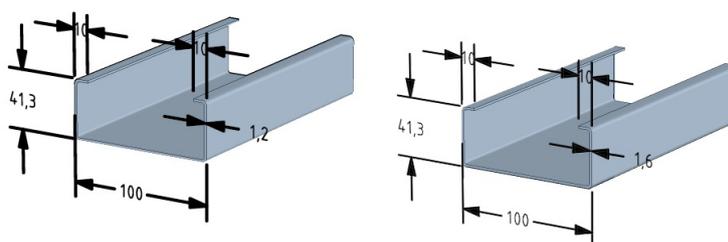


STEEL . CONSTRUCTIONS . LIFESTYLE

Guidelines for Architectural and Structural Design of Buildings with use of the Spatial Steel Frame System

Structural member base dimensions

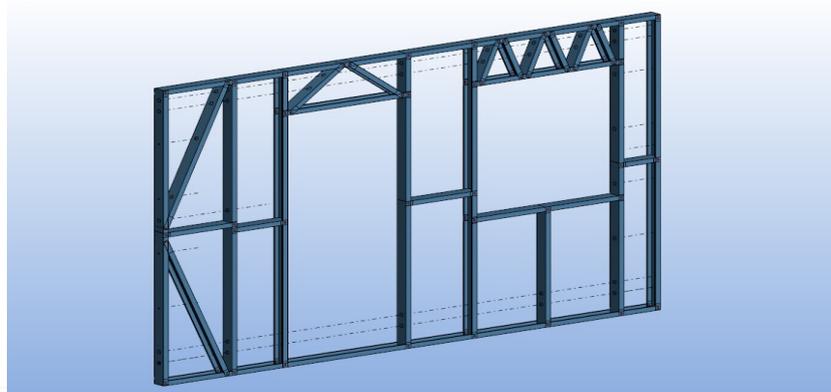
Frame steel structures covered by this document are structurally designed mainly with use of one cold formed section shape (channel section with lips strengthened, overall dimensions 100x41.3 mm differing the thickness of base steel material). The use of sections with equal external dimensions provides unification, makes design process simpler and efficient and lets costs optimization.



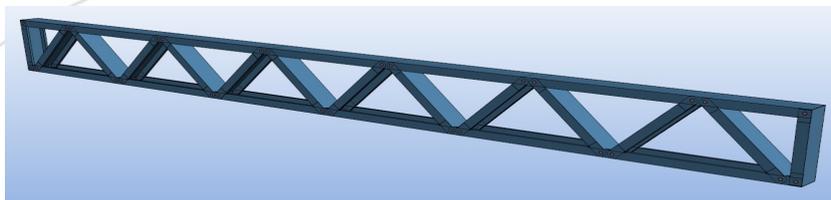
Structural system main elements

There are four base element types:

- wall panels



- floor beams



- roof trusses and roof panels



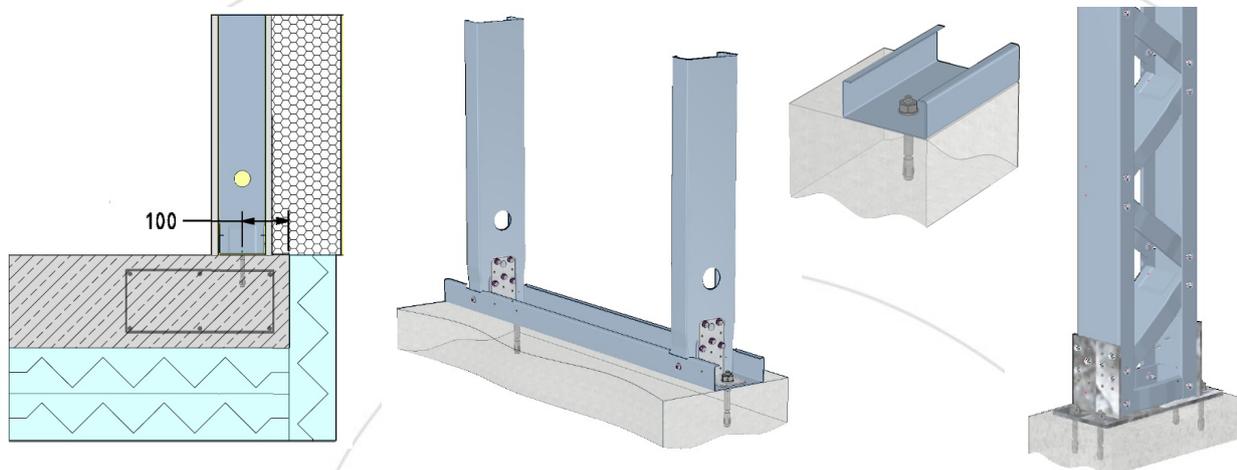
The shop manufactured elements are designed and produced individually according to particular design requirements.

Foundations

For building objects erected using this structural system usually the best and most common solution for supporting is using a spread, reinforced concrete slab foundation. This approach lets almost mean distribution of vertical loads going from supporting walls into the ground independently from the arrangement of the vertical structural elements as walls and columns. Using mentioned type of foundation is not necessary, the kind of settlements as direct strip or indirect pile foundations may be designed, as well, according to underlying local soil geotechnic conditions.

In case of any reinforced concrete foundation its upper surfaces acting as direct support for steel structural elements has to be formed in a way to achieve the offset between the supported element external plane and the external edge of concrete which should be not less than 50mm. Fastening of steel structures to the foundations is executed with use of mechanical anchors provided by leading suppliers. The linear distances between mounting points are designed adequately to particular requirements and commonly not grater than 0.50m. In some special cases the connections are enforced with use of additional cold formed or hot rolled zinc coated sections (usually angles and plates). For vertical, column alike steel elements the bases are designed and made with welded, zinc coated plates thickness 6÷10mm.

The walls structure



The structural thickness of steel wall frames is 10cm. The common spacing of acting as columns in wall panels, the vertical steel profiles is not greater than 60cm due to common cladding plasters limitation. When it is required according to structural strength requirements, the mentioned distance may be smaller adequate to particular structural design. The other method to achieve adequate strength of wall frames is based on use couples of cold formed channel sections adjacent with webs and connected structurally along their lengths. The vertical sections acts also as supporting substructure for cladding plasters.

The lintels above windows and doors openings as girders and beams are in form of truss like longitudinal system elements with overall height not less than 25cm. Typical heights for lintel trusses are in range 25÷40cm. It is recommended to take the axial in plane walls dimensions based on the module equal to 60cm. The same adopted module use is advised in arrangement of openings and its horizontal dimensions.

The recommended limits of the storey heights are:

- for one storey buildings up to 450cm
- for multi storey buildings 330 cm

Maximum axial length of the wall segment between two perpendicular, adjacent vertically supporting structural walls should not be greater than 12.0 m. The wall structural frame panels should be connected to upper surface of reinforced concrete foundations with preserving the minimum clear distance between their vertical outside planes and supporting foundation external edge not less than 50mm.

The external walls

The finished external walls consists of 3 layers:

- internal finishing layer
- structural layer
- external cladding layer

The internal finishing layer

The most often the OSB, CETRIS, G-K (gypsum plasterboard), FARMACELL plasterboards are used. The total thickness of overall layer depends of the number of contained sub layers and their thicknesses. For the design purposes its recommend to undertake the common thickness 2.5÷3.0cm (two plasterboards with steam insulation).

Structural layer

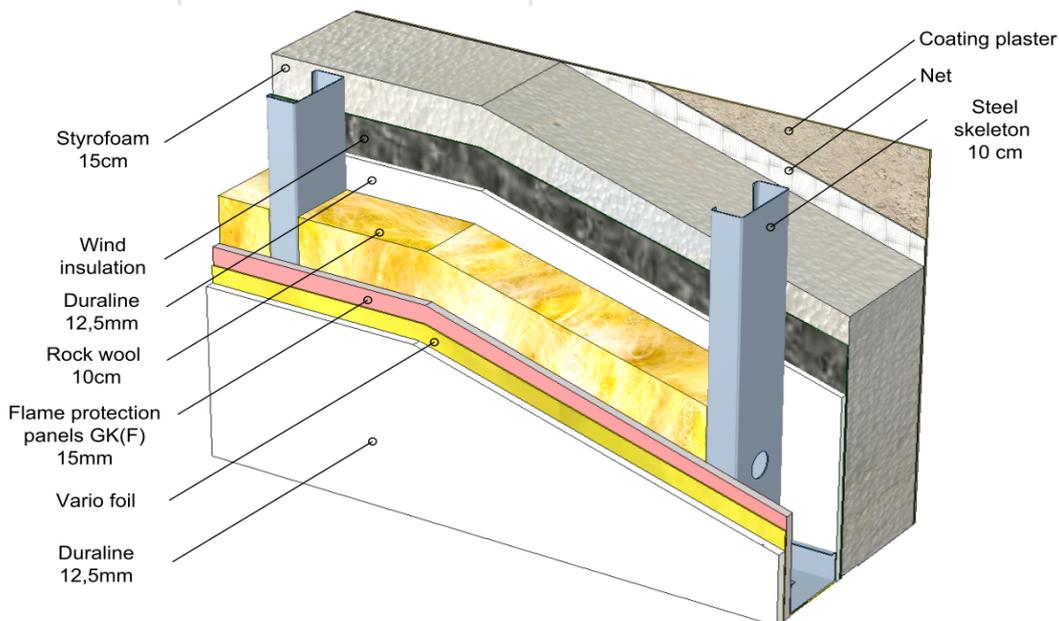
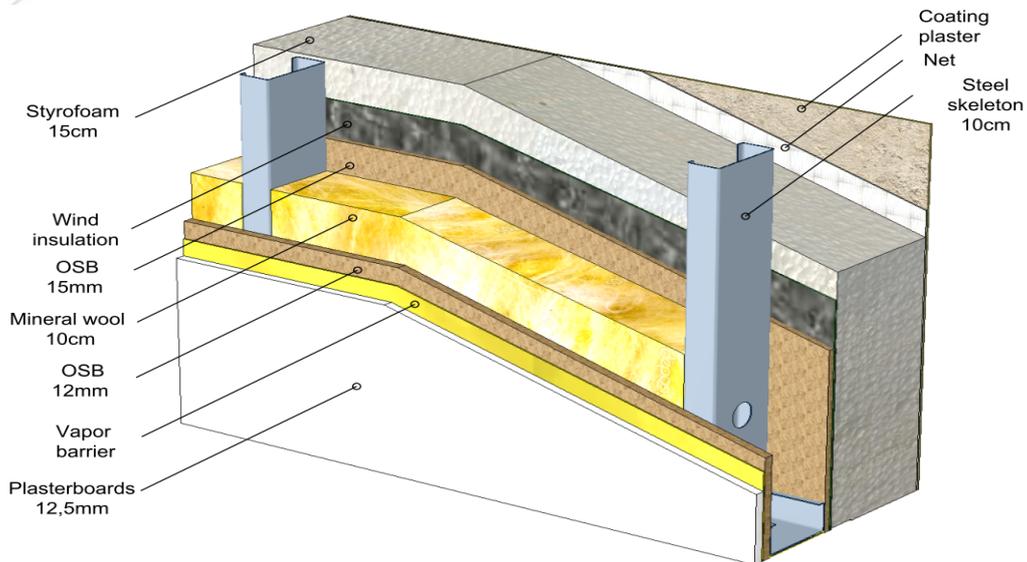
The structural layer thickness as its composed with prefabricated panels with use of system sections is equal to 10.0cm. The free spaces between steel elements are filled with thermal insulation as rock wool or PIR/PUR foam.

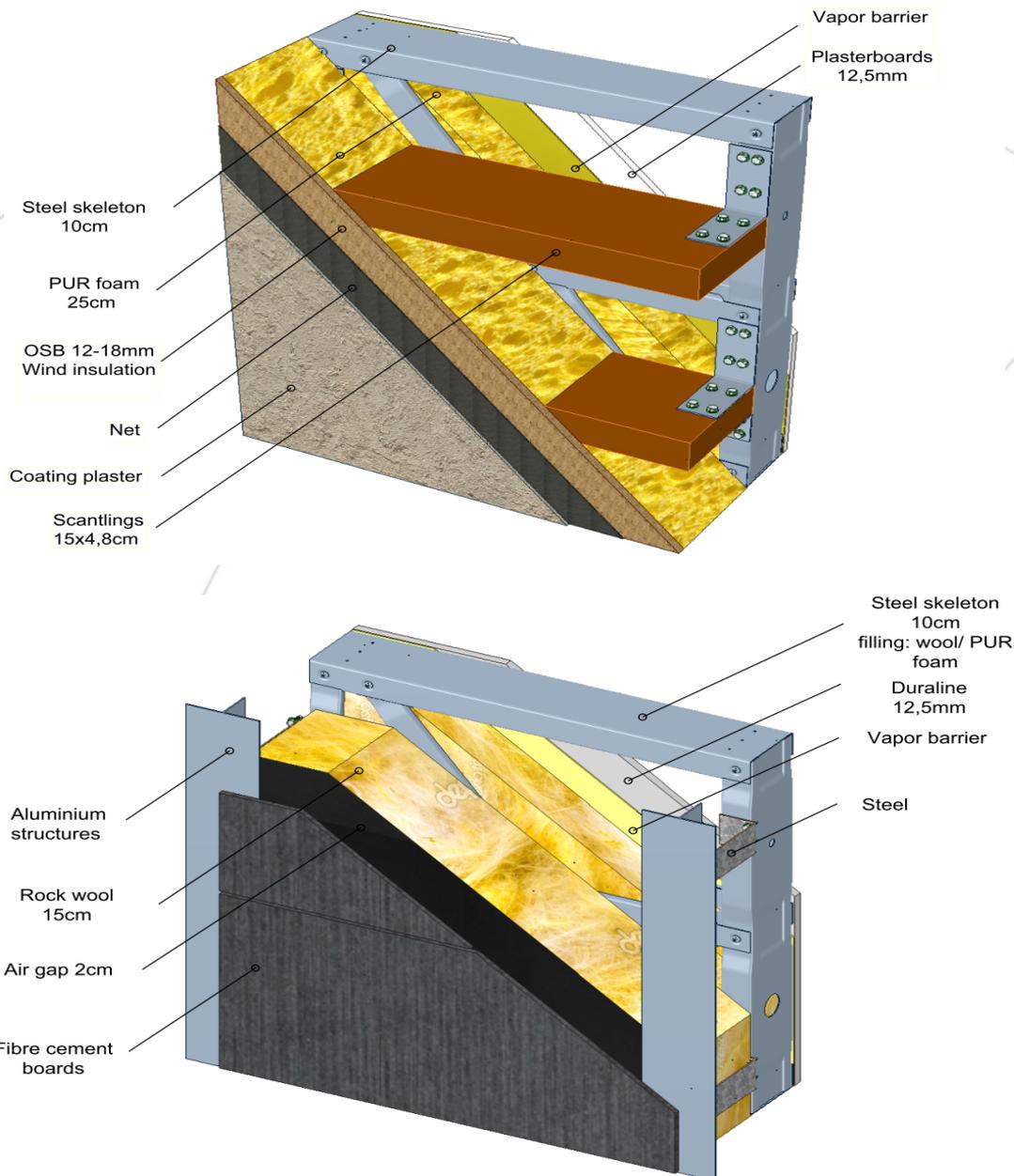
The external layer composition

The first attached directly to structure layer is usually performed with OSB, DURALINE, FARMACELL plasters. The next coating layer is thermal insulation. the typical materials in use are Styrofoam, rock wool or PUR foam. The last external architectural finishing is the mineral or acrylic plaster dressed on the net.

The mean, total thicknesses of the external walls are in the range 29.5÷32cm (assuming thermal insulation total thickness of 25cm). Utilisation of provided our technology lets easy execution of ventilated facades i.e.: with cement fibre or wood finishing. It's possible with use of adequate materials and layers to achieve the REI60 for structural walls requirements.

Example pictures of the external walls composition:



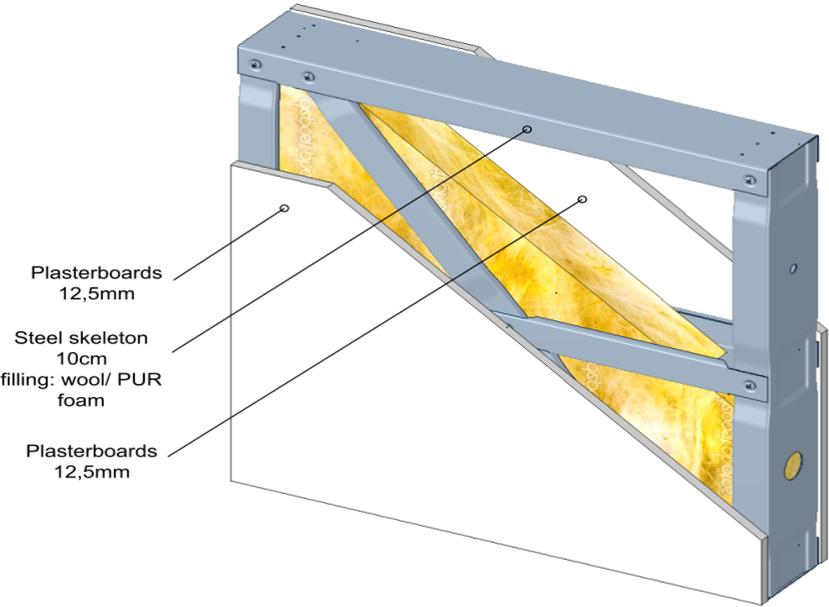
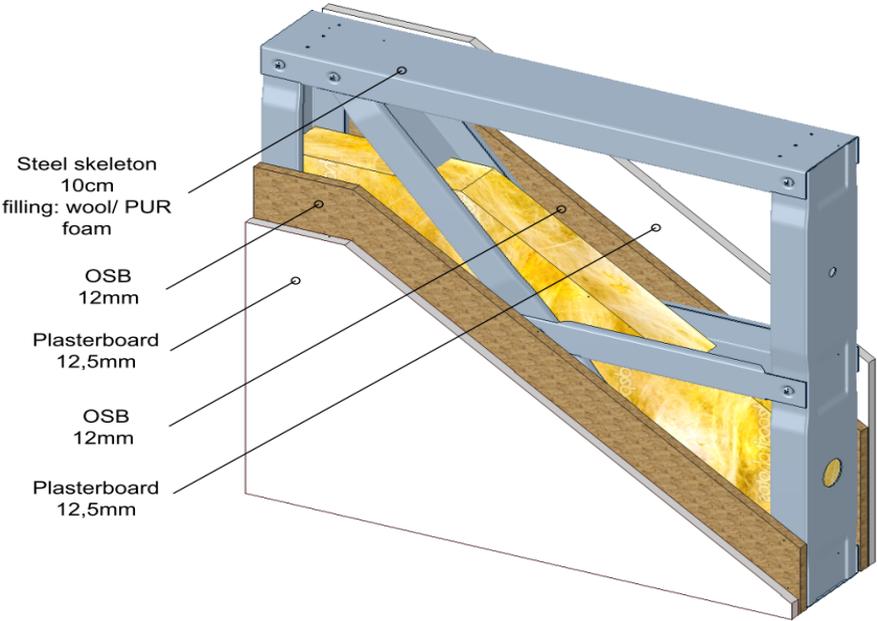


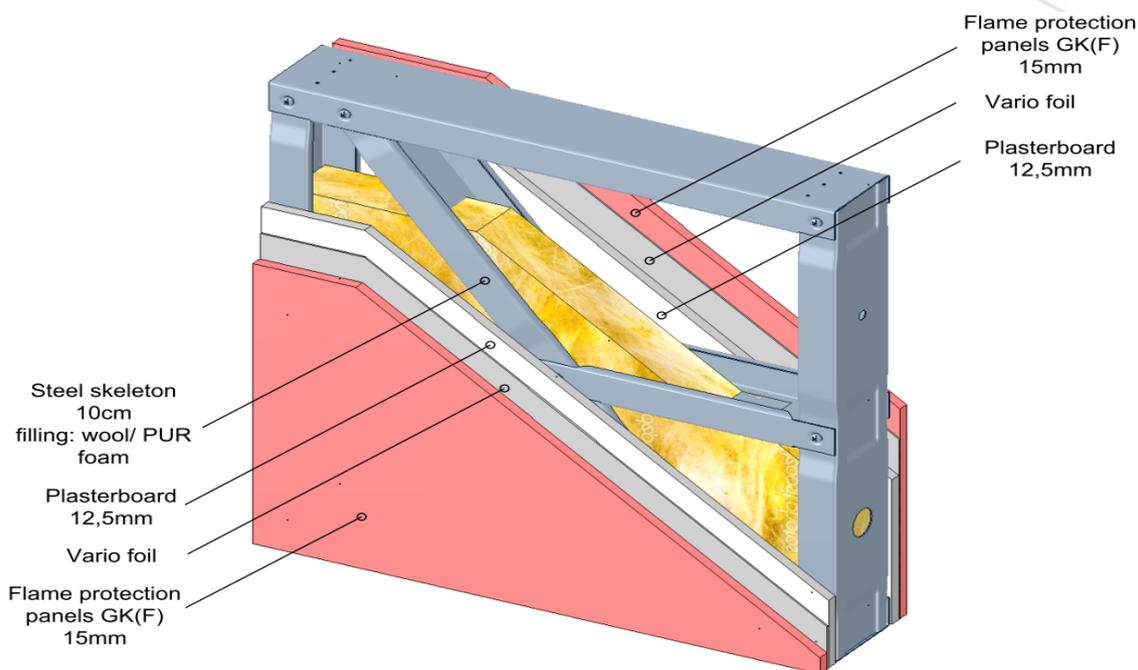
Partition walls

The cladding materials in the partition walls forming are similar as in the case of external walls. The most common is use of OSB, CETRIS, G-K or FARMACELL plasters. The total thicknesses of layers are the result of particular numbers and kinds of used plates. It is recommended to assume for design the total on one side of the structural panel cladding thickness in the range 2.5÷3.0cm. The partition walls does not require the steam insulation.

The factory-made wall panels provides indirect cladding assembly without use of any additional substructures. The partition walls structural panels requires filling with acoustic insulation. The total thickness of partition is at about 12.5cm when one layer claddings on both sides was used or 14.0÷15.0cm with greater number of sub layers.

Following there are illustrations of representatives of mentioned partitions:





Internal installations

Electrical installations

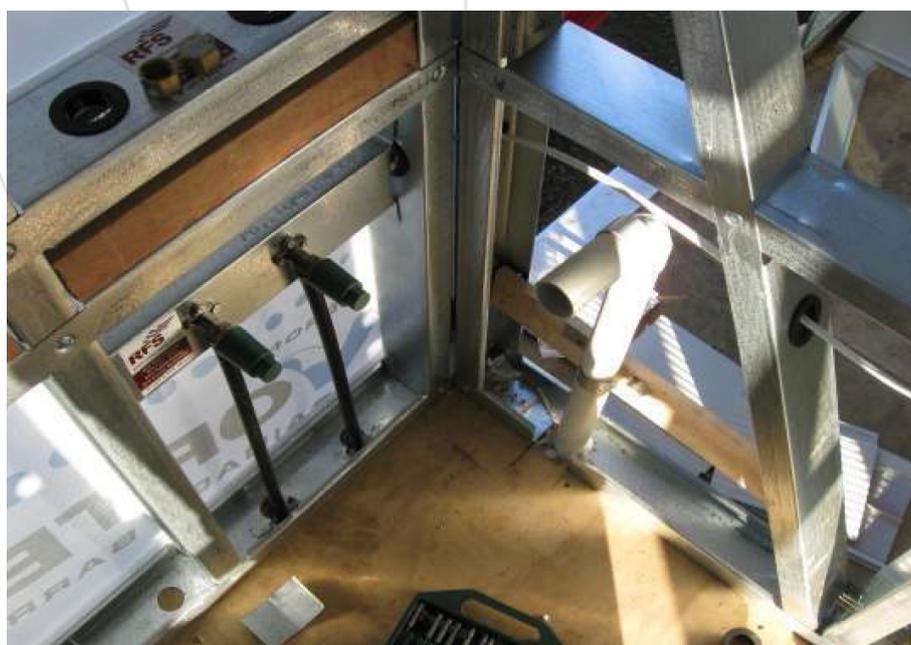
The wiring of the electrical installations in the walls is carried out in the thickness of the steel frames, via the 32mm diameter circular system openings, arranged in the horizontal rows at about 20÷30cm above the floor or under the ceiling. In the ceilings, electrical wires are led in the space above the gypsum ceiling board, with the lead at any point. Electrical installations should be carried out in plastic, corrugated conduit tubes, which protect the conductors from electrical punctures.

Water, sewage and heating installations

The pipes for water supply, sewage and central heating systems are recommended to lead in the thickness of the flooring layers with the exit at the pickup point.

For radiators fixing on walls, under window openings or in other required locations, horizontal steel cold-formed profiles, or wooden patches are used. It can be also perform in wall thickness to lead installations, guiding tube pipes in the system holes 32mm diameter, stamped on posts at 30/40/90/ 110cm height measured from the level of the finished floor.

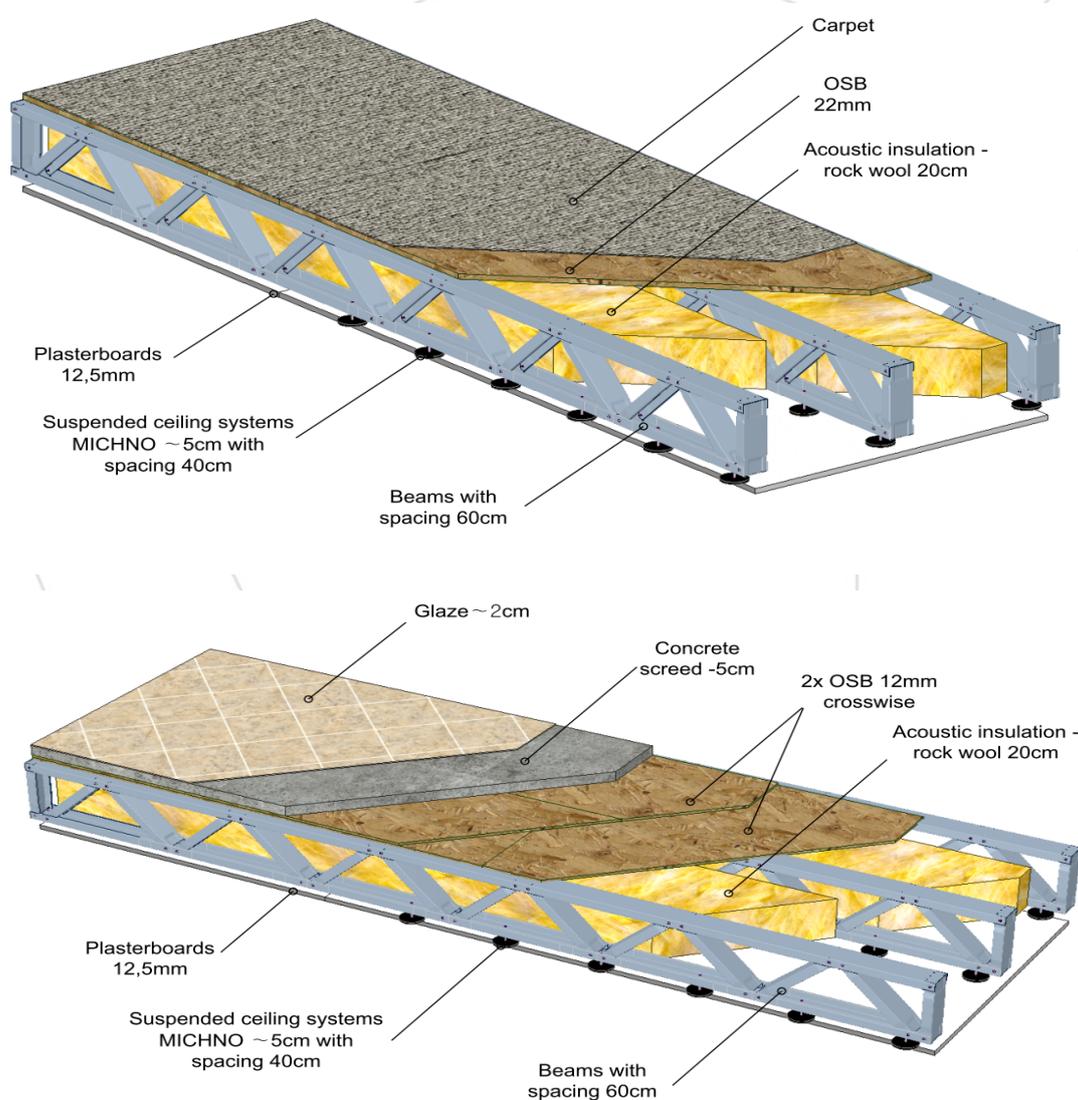
Here are some sample installation photos:

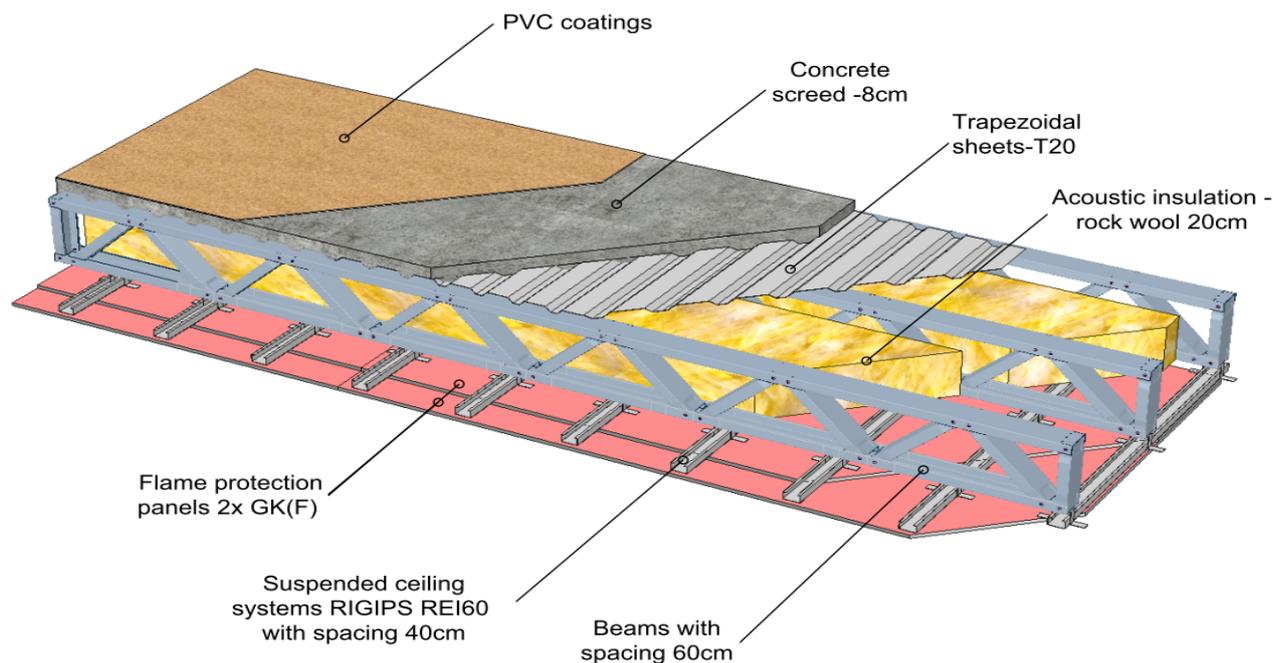


Floors

The designed span of floors in residential buildings should not exceed 12m. The height of the floor beams is on average 25 ÷ 40cm, depending on the span. The most common spacing of the floor beams is 60cm. In special cases smaller span beams are used, eg 40cm. It is recommended to use suspended ceilings for finishing. The total thickness of the suspended ceiling layers together with the substructure is 6-9cm. The most commonly used variant of the upper lining is the use of OSB floor boards (1x22mm or 2x12mm). There is also the possibility of making a concrete floor. Other solutions require consultation with the our design department.

Below are examples of floor sections:





Roof structures

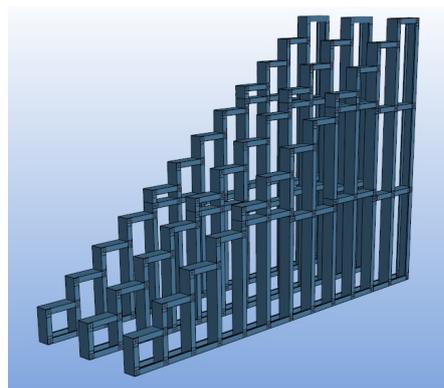
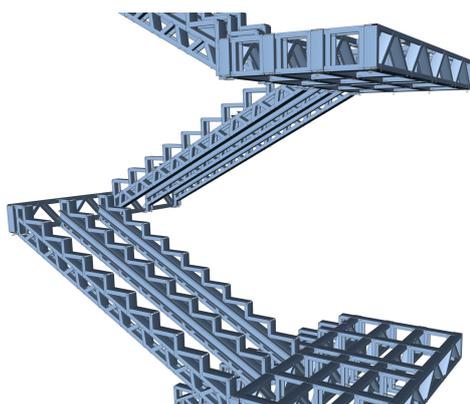
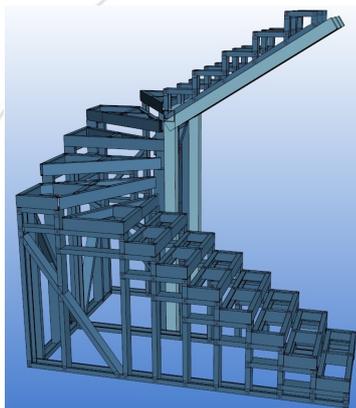
Roofs with a slope of up to 35 degrees can be designed with the use of lattice trusses. In the case of larger falls, it is recommended to adopt a rafter-collar system. General roofing solutions can be used in the same way as in wooden trusses. Wooden rafters are replaced by system trusses, 20-30cm in height and 10cm in width.

Balconies

When designing balconies, it is necessary to use solutions that provide adequate thermal insulation of the partitions and eliminate thermal bridges. Basically, the balconies are designed in the form of a multi-span beam with cantilever. The beams are in form of a system floor truss.

Stairs

Presented structural system can be successfully used for stairs. Two types of stairs are commonly used. The first structural type consists on panels perpendicular to stairways, in arrangement that match the dimensions of the steps. Another way to perform staircase structures is to support the steps on the system lattice beams and to attach the steps on the steps forming on beams upper stripes substructure.



Technical data:

Material

The material from which by cold rolling the sections are made is galvanized steel sheets with the following base steel material strength parameters:

- Yield strength $R_e = 350$ MPa.
- Tensile strength $R_m = 420$ MPa.

It is steel grade S350GD+Z made in accordance with EN 10025: 2002 standard. Corrosion protection is a galvanized coating. The galvanic action of zinc also protects the edges of the elements after the cut. The base thickness of the zinc coating is Z275 which corresponds to 275 g per 1 m².

Sections

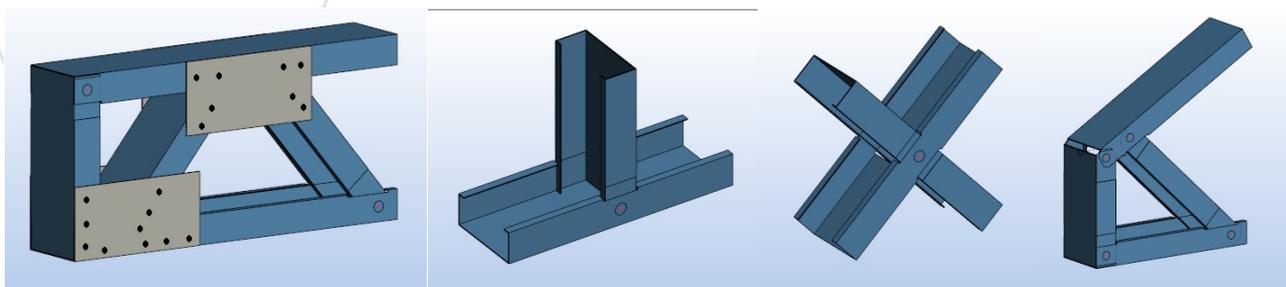
The main steel profiles used in our system are:

- channels C 100x41,3
- trends U 100x51,3

Made of sheet thicknesses of 1.2 and 1.6 mm. Profiles are produced in special machines adapted to operate mentioned structural system. All sections used for construction are in accordance with ITB Technical Approval no. AT-15-9113 / 2013 requirements.

Connections

All component connections are made using sheet metal screws and self-drilling screws. If necessary, the particular connections are reinforced with galvanized sheet plates 1.5÷3.0mm thick. The fixing of the steel structure to the foundations is made using Ø10 mechanical anchors.



Structural design

Structures are designed based on the current standards for structural design "Eurocodes" using specialized software, designed for modelling and strength calculating of thin-walled and cold-formed structures.

Prefabrication

Steel frame system technology, predicts the prefabrication of wall elements into panels, complete roof girders and the of floor elements between storeys preparation in the manufacturing plant. In cases where dimensions of particular assembly unit exceeds the transport capacity, and the division of the such element into smaller structural parts is not structurally indicated (eg very long roof girder for a high panel), prefabricated profiles may be assembled on site.

Assembly of the structure

At the construction site, prefabricated elements are built into the full bearing spatial frame system of the building structure. The anchoring of the structure to the previously prepared foundation also is performed.

Once the wall elements and the plating is installed and fastened, the floor structures and/or roof girders can be installed. All assembly parts of the steel structure are in most cases light enough that the entire assembly process is done manually, without the requirement of use of heavy equipment.

We invite you to contact us:

Grzywka Group

Boguszewska St. 1

01-250 Warsaw

Phone: 22 474 53 80, mob. +48 508 161 319

tel./fax. 22 474 53 81

Technical department: wspolpraca@grzywkagroup.com