THE RIKO HOUSE - TECHNICAL PRESENTATION

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Due to our achievements and development we are recognized as one of the most promising economic societies in the region. In a short period of time we have grown from a Greenfield investment into an internationally recognized and successful company which constantly offers employment possibilities to the local population.

Development is our perspective. In order to improve our product we regularly and closely cooperate with numerous scientific and educational institutions (Faculty of Architecture - University of Ljubljana, Faculty of Civil Engineering and Geodesy, Biotechnical Faculty - University of Ljubljana, ZRMK Institute in Ljubljana, and Otto Graf Institute in Stuttgart).

Numerous domestic and international certificates confirm the quality of Riko solid wood house (Ü mark, European patent - EU Patent Office München, The best environmental product in Slovenia for 2002, Energy ID - ZRMK Institute). However, the best proof is our success on the EU market where we are increasingly recognized for setting up the criteria for high-quality ecological construction.

The Riko Houses company is a socially responsible firm which provides a motivating working environment and successfully achieves its mission. We aim to increase the standard of living, to encourage new achievements in living-space design and to raise awareness of the importance of ecological materials, the value of healthy living and environmentally friendly construction.

We also invest in the region we come from (Handball Society Riko Houses, Triathlon Ribnica, Ribnica Swimming Club etc.) and include the local tradition of wood design and processing, our source and inspiration into our image trying to be the ambassadors of such a precious inheritance.

about us

Business system

Being a part of Riko Group, the company Riko Houses passes common values to all fields of its activity with commitment and care. We actively participate in several economic groupings that strengthen international business relations and support establishment of new business contacts. As members of the Slovenian Society of Slovenian Producers of Prefabricated Houses, the Passive House Consortium and the Institute for Wood Processing and Sustainable Development, we aim at and strive for raising of operating standards and popularization of wooden construction.

Riko group joins companies that:
- incorporate business initiatives in engineering,
- promote designer brands (such as Starck with Riko),
- bring forward environmental- and energy-saving living (wooden Riko houses),
- support different social activities and associations with regard to culture and art (the Škrabec homestead, the Riko art collection, the Friar Stanislav Škrabec Foundation) and act on the basis of common values and philosophy.

The founder of Riko Group and its leading companies is Janez Škrabec, Slovenian entrepreneur and philanthropist, patron of art and culture.
Nature endowed us with the possibility to dream and it also inspires us when we transform our dreams into plans. However, we are not prepared to do that at any cost. Life is too short to spend precious time on lengthy and wearisome construction work, which too often destroys the confidence and deprives us of the most cherished and irreplaceable ingredients of life. We had all of you and us in mind when we began designing and making RIKO houses - healthy, economical homes, adjusting perfectly to nature and gratefully accepting the rich tradition of using wood as a building material.

Our main aim and motto is a life in natural, healthy surroundings which is accomplished by every construction and house individually. It is our belief that living should be excellent. We appreciate the environment and wish that you too could enjoy life secure and carefree, in a healthy, natural ambiance. Furthermore, we respect the demands and needs of all to whom the contemporary life style dictates an equally contemporary living environment - loving, pleasant and beautiful.

Therefore, in case you have decided to spend the best time of your life constructing inter-personal and family relations and not building a house visit us as soon as possible. We will put up a RIKO house for you in a few months and then only wish you all the best - may the energy caught up in the wood help you create personal and family happiness. We consider this to be our mission and we try to fulfill it with effort, precision, by being kind and at your service as all those who believe that a person deserves a true home.

This is the place where you can let your dreams guide you. We will be more than happy to help you when you decide to make them true.

Wood is not only a building material typical for Slovenia but it also represents a special traditional value stemming from our past. Wood has always been intricately included into the life of Ribnica region where Riko houses are made today. It provided warmth and facilitated daily chores while representing as well a significant method of earning. The inhabitants of Ribnica made products from wood, the so-called dry goods, primarily for their needs only but also started to sell them around the world after obtaining Cesar’s patent in 1492, thus spreading the word about themselves as people who work the wood with love, dedication and experience. The tradition, lasting longer than 500 years, is certainly a heritage that few can boast.

Wood as a material was not only used for manufacturing household products but it greatly influenced and shaped the Slovenian scenery due to its availability and extremely good construction characteristics. Valvasor wrote about houses made of wood which dominated the regions of Gorenjska, Dolnenjska, Kočevsko, Bela krajina as well as Prekmurje in the 17th century. So why did brick houses begin to prevail when the wooden were present for centuries? One of the lesser known but important reasons is the minor ice age climaxing in the 18th century. Due to low temperatures, the heating season was prolonged to the detriment of the houses. Therefore, the government started to encourage other types of construction. The changes were certainly additionally provoked due to the development of the construction materials industry as well as due to the use of wood in commerce, mining and production. We in fact believe that today the wood as a construction material is faced with a true renaissance.

The love of wood inherent in the life of the Ribnica region is presently being fulfilled in the Riko Houses company. We have woven this rich tradition into our work and, through our knowledge of wood and the construction of wood houses which is more detailed today, we have offered to those desiring only the best for their home a true product.
Wood fibre is an excellent insulator during the winter as well as during the summer. The main advantages of wood-fibre insulators are as follows:

- Excellent protection from cold - decreases the heating costs
- Excellent heat protection - decreases the cooling costs
- Good sound insulation - provides peace indoors
- Natural ability to receive and emit humidity from the air - positive impact on the atmosphere indoors
- Vapour permeability (vapour diffusion-open construction) - positive impact on the atmosphere indoors
- No overheating (phase shift) - comfortable indoor temperature

Much research and expert opinion of confirms that living in houses made of wood is especially recommendable for persons prone to allergies.

Stefan Schimpf, MD from Salzburg, dedicated to preventive medicine and immunotherapy, claims that, due to its ability to breathe and absorb, wood functions as a biological filter. The air filled with harmful bacteria, viruses and fungi is purified inside wood pores and returns as such into the living space. Such clean air positively influences the immune system thus contributing to the improvement of health in general.

Wood is a universal, natural, permanent, traditional and resilient material used for construction that combines excellent physical and mechanical characteristics. It also represents the healthiest living environment and has a positive impact on peoples’ psychological and emotional well-being. In addition, it is a material with outstanding building and insulating characteristics.

Although inflammable, wood endures stronger fire than steel or concrete. A thin carbonated layer is created on the surface of burning wood thus preventing influx of oxygen and the dispersion of fire.

Wooden construction is safe from earthquakes as it is very resilient to compression, tension and bending. Due to the balance between its weight and load capacity wood can also be used for buildings on soil with a lower load capacity.
System of construction of wooden Riko houses is different from any previous systems and represents an important step forward. This technology corresponds to strict requirements concerning the environment and energy consumption. Riko houses are distinguished, besides for their naturalness and economy, also for individuality, better quality of living and advanced architectural solutions.

Two basic building systems have been developed by the Riko Houses Company:

- SOLID TIMBER WALL - LMS
- TIMBER FRAME WALL - ROS

Large wall prefabricated units are assembled on the building site. During the production process the walls are insulated, have been fitted with built-in doors and windows, and come with prearranged façade. Due to prefabricated elements, the construction period is short and moving in is fast.

THE RIKO HOUSE

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<th>NEIGHBOURHOODS</th>
<th>CUSTOM DESIGN</th>
</tr>
</thead>
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<tr>
<td>RESIDENTIAL BUILDINGS</td>
<td>HEALTHY ECOLOGICAL HOUSE</td>
</tr>
<tr>
<td>PUBLIC BUILDINGS</td>
<td>LOW ENERGY HOUSE</td>
</tr>
<tr>
<td>TIMBER FAÇADES</td>
<td>GUARANTEE 30 YEARS</td>
</tr>
<tr>
<td>WOODEN CEILINGS</td>
<td>QUALITY CRAFTSMANSHIP</td>
</tr>
</tbody>
</table>

SOLID TIMBER CONSTRUCTION

- solid timber wall LMS
- thermal and sound insulation
- timber substructure
- air layer
- timber cladding

TIMBER FRAME CONSTRUCTION

- sheathing
- timber sub-construction (inst. plane)
- foil (vapour barrier)
- plywood
- timber frame wall-thermal insulation
- finishing insulation layer
- rendered façade
An insulated solid wood wall 22.5 cm thick is fire proof for as long as 60 minutes. The testing of RIKO outer wall resilience was undertaken at the Slovene Institute for Civil Engineering - Department of Construction Physics / Fire Laboratory.

We took part in the research project concerned with the increase of seismic safety of prefabricated wood buildings in co-operation with the Faculty of Civil Engineering and Geodesy, Department for Testing Materials and Constructions. The project is still in progress and our goal is to increase the seismic safety of RIKO houses by participating in it. Thus, we also provide the construction of objects in the region of Posočje and actively participate in the rebuilding of that region struck by earthquake in 2004.

Considering the EU directive which indicates that construction of low-energy houses will be compulsory by 2020, Slovenia passed Regulations on energy efficiency in houses called »PURES (Official journal »Uradni list« 52/2010) that sets the highest allowed thermal conductivity for solid structures at 0,28 W/m²K and at 0,20 W/m²K for timber-frame structures.

The Energy Act (Official journal »Uradni list« 118/2006) determines compulsory energy certification of buildings and that is why acquisition of energy certificates that indicate information on thermal characteristics of buildings has been compulsory in Slovenia since 2008.

We are aware of importance of sustainable development and that is why low-energy RIKO houses include thicker insulation of external construction, energy efficient windows and doors, good airtightness, forced ventilation with heat recuperation and use of renewable energy sources.

It is also important to underline constant internal auditing and developing activities in cooperation with different institutions which result in receiving different types of quality certificates:

- ISO 9001 - Quality Management Systems,
- FSC certificate
- The best environmental product in Slovenia for 2002
- Offsite Award for the Carmarthen Place - The Wood Awards 2007
- Energy Identity Card (ID) for Individual Building 2004 - ZRMK Institute

The most important international certificates we have are:

- European Patent - EU Patent Office München,
- Certificate of Conformity - DIN 1052 given by FMPA Stuttgart,
- Bescheinigung B - Certificate for Qualified Gluing of Bearing Wooden Constructions according to DIN 1052,
The external walls not only limit and define the inner space but also serve as the primary sheathing and structural element of the building. In keeping with contemporary demands for safe and comfortable homes they also have a number of key structural qualities such as thermal permeability, diffusion stability, sound insulation, fire resistance, and seismic activity resistance to list just a few. Two basic building systems have been developed by the Riko Houses Company:
- SOLID TIMBER WALL - LMS
- TIMBER FRAME WALL - ROS
Both types of walls are available in a wide range of dimensions according to the structural stability and construction requirements of the house and the needs of the customer.

Facade is the exterior layer of the building, which as well is serving an aesthetic role also plays a key protective function. Façade protects against certain mechanical and weather related strains such as wind, rain, snow, frost or the sun’s radiation. The choice of the correct façade, treated in the appropriate way, is an important step in the achievement of lasting satisfaction. In general, façade can be divided into three groups:
- ventilated façade: wooden, metal, stone, or artificial (synthetic) fibres.
- non-ventilated façade: glass
- contact façade: thick layered and thin layered
Ventilated timber façades and contact thin layer rendered façades are the most suitable for making timber prefabricated large wall units.

The interior wall is a vertical structural unit used for the division of different areas of the living space. Interior walls can also be used in load capacity or sound insulation functions and further prepare the house for housing installations such as heating and hot water, electrical wiring, water and sanitary installations, etc. Interior partition walls can be produced from laminated solid timber panels (LMS) or from timber frame construction (ROS).

Columns and beams have a load-bearing function and together with exterior walls they ensure the structural stability of the building. These various load-bearing structures (beams, lintels, columns) made of glued wood, must be of prepared to the required dimensions. In addition to the key role these structures play in terms of structure, they are as well visually appealing. In cases of large spans or heavy strain, metal structures can as well be used.

The floor structure construction is a horizontal structure which divides the building into individual floors. The vertical division of interior space can be done in the following ways:
- with solid timber panels of various thicknesses
- with ceiling joists of various diameters
- with ceiling structures

The balcony and terrace are elements that connect the interior and exterior space.

The roof is the uppermost finishing structure which joins and holds the building together. It protects it from the weather and keeps the building warm while providing an additional barrier against external noise. Due to its aesthetic effect the roof is treated as ‘the fifth façade’. Several factors influence the shape of the roof, however, among them geography and building code restrictions are the most important.
The roof is composed of several layers. Cladding covers the roof structure and protects the most exposed part of the building. A layer of air is left between the external layer of roofing material and the roofing underlay (vapour permeable foil) and together they enable a breathable roof structure. The thermal insulation is composed of several overlapping layers which are placed above or between the rafters depending on the type and form of the roof. The interior of the roof structure can be finished with exposed wood panelling, or alternatively gypsum-fibre panels or plywood, etc., however only wood can be laid above or under the roof structure (standard or visible roofing).
The structural properties of the roof define the individual types:
- standard roofing
- visible roofing
- combined roofing
- roof elements

Windows and doors are built in into the exterior wall during production. They are a part of the sheathing and given that their basic function is to provide the enclosed space with light and air they have considerable impacts on the quality of living within that space. Both of these key functions must be harmonized in a way that meets the customer’s desires or needs and at the same time adhere to building codes and regulations. In terms of windows and doors the following properties have been given increased attention in recent times: thermal transmittance, sound insulation, safety, light permeability, the quality of sealing, mechanical strain, durability and maintenance, etc. Window frames and doors can be produced from various materials such as timber, aluminium, a combination of timber and aluminium and PVC. There are many types of windows and doors to choose from and selections can be based on the colour and shade of the finishing coating, glasswork, manner of opening, handles, etc.
The solid timber walls LMS is the basic unit of construction in the RIKO system. It is composed of 40 mm thick spruce panels. These wood panels are dried using state of the art technology (kiln dried wood) which produces a humidity ranging from 8 to 11%. The timber panels are glued into the wall unit of appropriate length and height. High quality single component polyurethane (PUR) glue is applied in the process. The glue is made without formaldehyde, does not release poisonous emissions into the environment and is considered to be ‘healthy’ glue. The glue seal is horizontal, for this reason the glued wall does not have a vapour barrier coat and therefore allows the wall to ‘breathe’. The bottom panels in the wall units, which are placed onto a concrete foundational plate, are composed of larch timber due to its greater hardness, density and resistance and additionally protected with hydro insulation. The walls come with prefabricated with drilled holes for electrical installations and openings for doors and windows. In order to achieve even better dimensional stability and structural strength walls can be strengthened with reinforcements that are built into the insulation plain and thus unnoticeable.

<table>
<thead>
<tr>
<th>Type of wall</th>
<th>Thickness of insulation</th>
<th>Thermal transmittance</th>
<th>Total transmittance (through wall)</th>
<th>Sound insulation</th>
<th>Fire resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMS 100</td>
<td>50 x 40</td>
<td>0.27</td>
<td>0.27</td>
<td>49</td>
<td>60</td>
</tr>
<tr>
<td>LMS 100</td>
<td>100 x 40</td>
<td>0.27</td>
<td>0.27</td>
<td>49</td>
<td>60</td>
</tr>
<tr>
<td>LMS 100</td>
<td>160 x 40</td>
<td>0.25</td>
<td>0.25</td>
<td>55</td>
<td>60</td>
</tr>
<tr>
<td>LMS 100</td>
<td>200 x 40</td>
<td>0.25</td>
<td>0.25</td>
<td>55</td>
<td>60</td>
</tr>
</tbody>
</table>
Exterior timber frame wall ROS is a large wall unit, fabricated from timber frame construction and filled with various insulation materials, which can be panels made of wood fibres, mineral wool, Styrofoam etc. Soft insulation can also be used, such as glass, and other types of wools, cellulose flake, to name just a few.

The interior of the frame structure is enclosed with plywood and foil (often referred to as vapour barrier). This inner barrier prevents the intake of moisture into the wall. Onto the barrier is then fixed a vertical timber sub-construction, (installation plane) that is covered by various panelling and sheathing such as: gypsum-fibre, gypsum-cardboard, OSB, plywood.

A finishing insulation layer made of tongue and groove fibres with a thickness from 20 to 60 mm (the thickness varies depending on the type of external façade) is fixed to the outside of the timber frame.

**Exterior wall**

<table>
<thead>
<tr>
<th>Location</th>
<th>Architecture</th>
<th>Year of construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>London, Great Britain</td>
<td>NO-architects</td>
<td>2009</td>
</tr>
<tr>
<td>Cambridge, Great Britain</td>
<td>NBBJ: Chiaki Tomita</td>
<td>2007</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of wall</th>
<th>Thickness of insulation (mm)</th>
<th>Thermal transmittance U (W/m²K)</th>
<th>Heat transfer (through wall) D (h)</th>
<th>Sound insulation Rw (dB)</th>
<th>Fire resistance REI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIKO PLUS 160</td>
<td>160 + 60</td>
<td>0.19</td>
<td>9.1</td>
<td>46</td>
<td>≥ 46</td>
</tr>
<tr>
<td>RIKO PLUS 200</td>
<td>200 + 60</td>
<td>0.17</td>
<td>8.8</td>
<td>46</td>
<td>≥ 46</td>
</tr>
<tr>
<td>RIKO PLUS 240</td>
<td>240 + 60</td>
<td>0.15</td>
<td>8.0</td>
<td>46</td>
<td>≥ 46</td>
</tr>
</tbody>
</table>
In accordance with our general philosophy, Riko houses are built using natural materials whenever possible and for this reason wood fibre thermal insulation is preferred. In addition, wood fibre insulation is solid and has a stability that makes it resistant to settling over time. The greatest advantage of this material, however, is its phase shift which means that in warmer months it serves as an excellent insulator against the heat. Riko offers a wide variety of thermal insulation, which include: mineral wool, Styrofoam, glass wool, and sheep wool. All of Riko’s materials are not only excellent thermal insulators but also provide superior sound insulation and protection against water damage and the degrading effects of time. In places where the threat of moisture damage is a constant concern, an extruded polystyrene, known as Styrodur, can be used to give added protection.

The LMS is insulated solely with hard insulation panels because they maintain dimensional integrity over time, they do not settle and are therefore able to prevent a thermal bridge. Soft insulations, however, can be used in the insulation of ceilings and roofs and in areas in which the insulation is laid horizontally because the effects of settling are not a concern.
Timber façade is suitable for family houses as well as public buildings and it can be fitted to any exterior wall, to a new as well as existing building. It is usually fitted to a timber substructure, which is attached to a load bearing structure through thermal insulation.

The quality of the timber façade is determined by the correct choice of wood, the precision with which it is installed and professional execution of the details. Through careful consideration of the principles of structural protection and the fact that it must be ventilated, there is no concern for the durability of timber façade. In Riko constructed houses, larch timber is most commonly used due to its high level of natural resistance.

The floor structure joint of timber façade can be fitted with aluminium flashing or timber batten, which runs around the building and functions to protect against water penetration into the structure. The floor structure joint can also be done by creating overlapping façade.
Types of timber façades differ in form. Several basic types of timber façade can be chosen that offer a variety of possibilities for installation (horizontal, vertical, diagonal).
The corner trim is chosen depending on the type of façade used. The corner trims in horizontal façade close the timber facing while with vertical façades their function is to bind them around the corner.
Rendered façade is fitted directly onto the exterior layer of the insulation. Thin layer rendered façade is divided into basic and final layers. Basic Layer - two coats of adhesive mortar with mesh and pre-coating are completed in production. All of the finishing trim for windows, doors and corners is also completed during the production process. Final Layer is a silicon-silicate render in various shades of colours and granulations, which is completed on the building site. Such façade render is elastic, water proof and highly vapour permeable. The thickness of all layers of rendered thin layer façade is from 6 to 10 mm.

The floor construction joint is done with a dilation gap into which the dilation rubber is inserted. This rubber expands and contracts and prevents the intake of water into the structure.
The solid timber partition wall is made of glued spruce panels and is planed on both sides to provide a quality and attractive finish. The thickness of an interior partition LMS wall is 95 mm while the height and length may vary. Holes for electrical installations are drilled during the production process, however, the number of drilled holes is limited due to the need to maintain structural stability (maximum 9 drill holes).

The frame partition wall is composed of timber studs of various dimensions, to which gypsum, timber and other varieties of panels are fitted. The timber frame can be filled with various insulation materials and thus the acoustic and thermal properties are enhanced. The thickness of the frame structure is determined according to its function or the specific requirements of the customer.

The sound insulation wall is a timber frame construction composed of 60/140 mm timber studs with 60 mm thermal insulation fitted between them. This structure is enclosed on either side with double layered panels. Within the enclosure there is a wooden substructure which is on the inner side fitted with sound insulating tape.

### Type of Wall

<table>
<thead>
<tr>
<th>Type of Wall</th>
<th>Thickness of Construction</th>
<th>Sound Insulation</th>
<th>Fire Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>RNO 60/100 (non-load bearing wall)</td>
<td>60/100</td>
<td>43</td>
<td>30</td>
</tr>
<tr>
<td>RNO 100/60 (load bearing wall)</td>
<td>100/60</td>
<td>43</td>
<td>30</td>
</tr>
<tr>
<td>RNO 140/60 (sanitary)</td>
<td>140/60</td>
<td>43</td>
<td>30</td>
</tr>
<tr>
<td>RNO 2x100/60 (sound insulation/fire resistant wall)</td>
<td>2x 100/60</td>
<td>52</td>
<td>180</td>
</tr>
</tbody>
</table>
Primarily, glued timber beams of various diameters and dimensions are used depending on load and stability demands. In the case of extreme spans and loads metal bearers various profiles and dimensions are also used, in accordance with stability calculations. Metal beams can be exposed or covered with panelling of various kinds such as timber or plaster.

Timber columns of various dimensions and forms are the basic type of column, and in the case of greater loads metal ones are used. Metal columns can also be employed based on the individual needs of the customer or investor.

For additional structural strength steel suspension cables or metal reinforcements can be used.
Floor structure panels are composed of attractive glued solid spruce panels. The thickness of these panels varies between 100 and 160 mm, the largest width being 1250 mm. The panels are laid onto walls or load-bearing structures. The panels are joined with overlapping joint. On the upper side of panels the finishing coating is subsequently done together with sound insulation while the bottom side remains visible.

Ceiling joists are glued timber beams of varying dimensions, covered with spruce panelling. The entire floor structure is subsequently constructed onto these ceiling joints. Ceiling joists can be visible (covered with an attractive panelling) or closed with various other types of panels (plaster or timber panels). The dimension of ceiling joists and the spacing between them are individually calculated for the stability of each house.

Ceiling elements are constructed of glued timber beams that are joined into a frame. Thermal insulation is fitted between the beams and enclosed on one side with a foil that acts as a vapour barrier and timber substructure for suspended ceiling, on the other side with plywood.
The **balcony** is a fenced platform that functions as an extension of the interior space. In addition to the aesthetic qualities of the balcony it must fulfill the need for safety and stability. The structure of the balcony can be separate (supported or bound to a bearing structure), anchored (onto or between load-bearing walls) or built into the house (loggia). A balcony can be insulated or non-insulated depending upon its position on or in the building. It must be built in such a way as to protect against the elements (cold, water, moist…) to ensure that they do not transfer into the building. Wood balcony fences are made of larch timber. There are two types of fences in the Riko assortment: Riko Classic and Riko Basic. In addition to timber fences, RF type stainless steel fences are as well an option for French balconies.

The **terrace** is a paved space that is a part of the building or beside it. Because of its size, it is usually constructed at ground level but it can be built into above ground floors or on the roof of a building. In cases of the latter, it must be properly thermally insulated and water proofed. A terrace can be covered (as a veranda or in combination with a pergola) or open (simply a paved platform).
Standard roofing is also called hidden roofing since the structure of the roof itself is not visible; from the bottom side it is fitted with paneling. In such cases the insulation is laid between the rafters. Planks are fixed to the truss followed by a layer of vapour permeable foil. Finally the battens for the air layer and roof shingles are then placed.

Visible roofing has an exposed roof structure. The rafters are covered with exposed spruce roof paneling. On top of the paneling a foil against moisture damage (vapour barrier) and hard insulation in the form of panels is placed. Over this, vapour permeable foil is placed which plays the role of secondary cladding as well. The placement of battens follows, which ensures the ventilation of the roof structure. Roof battens are fixed horizontally to ventilation battens and serve for the placing of roof cladding.

Combined roofing is a combination of standard and visual roofing. From the outside it has the appearance of a standard roof.
Roof elements are used for both flat and angled roofs. With regard to composition, they can be divided into ventilated or non-ventilated roof structures.

The base of the roof element is solid glued timber load-bearers, which are assembled into a frame. Into this frame thermal insulation is inserted along the entire element. This thermal insulation is closed on the bottom side with a vapour barrier and on the top with a vapour permeable foil. The angled substructure with OSB panels, which is protected with hydro insulation (done in production or on site) is fitted onto the roof element of a flat roof.

A ventilation channel runs in the area of the angled substructure. With non-ventilated roof elements the entire space must be filled with thermal insulation and therefore the space left within the angled substructure is also insulated.

The roofing elements can be laid onto solid panels or rafters and ceiling joists respectively. It can also be constructed as a load-bearing structure which is finished on the bottom side with a timber substructure for lowering the ceiling and also with ceiling paneling (gypsum, wood paneling, etc.).
The windows and doors that are built into Riko house are of the highest quality, they are made in accordance with DIN standard No. 68 121 and have the certificate of quality RAL GÜTEZEICHEN. The quality of these products is controlled internally and externally as well. When installing windows and doors into a solid timber wall the openings are finished with timber interior trim and timber ledges. In the case of installation into exterior frame walls the inner edges are fitted with the same panels as on the interior walls and the ledges can be made of various materials. The shape, size and installation of the exterior trim depend on the type of façade that has been used, the thickness of the thermal insulation, the position of windows, a number of more detailed factors, etc. The exterior ledges is made of aluminium and screwed into the bottom cross beam. The incline of ledge is minimum 5 degrees. The ledges are finished with end fittings which prevent intake of water behind the shelf. Before the installation of windows, the frames are filled with insulation materials and taped from both sides with sealing tapes. The parts of the structure in which a thermal bridge could potentially occur due to the activity of the timber, are taped with an expandable sealant.

Windows and doors are the weakest link in the sheathing of the house so the highest attention must be paid to their installation to ensure that it is completed with precision and professionalism. Timber windows and doors built using glued pieces taken from a variety of trees, consisting predominantly of larch. The maximum thermal transmittance of glass is 1.1 W/m²K, and the entire Uwert wooden window has from 1.3 to 1.5 W/m²K thermal transmittance. It is also an option to install a window with better thermal properties (0.7 or 0.5 W/m²K glass, insulation layer in window profile...).

To provide shading or to dim direct sunlight various types of shades including brise-soleil, blinds, shutters and sliding panels. In addition to simply regulating to amount of light these shades have other functions as well: the reduction of heat transfer to the interior of a building, the feeling of comfort and privacy, and safety. Shades come in a variety of materials, colours, forms and are engineered to provide customized ease of use.

For protection against insects window screens are often used and can be installed on the exterior of windows.

<table>
<thead>
<tr>
<th>WOOD</th>
<th>U glass (W/m²K)</th>
<th>U frame (W/m²K)</th>
<th>U window (W/m²K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASSIC - INO</td>
<td>1.1</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>PLUS - INO</td>
<td>0.7**</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td>PASSIVE - INO</td>
<td>0.5**</td>
<td>2.1</td>
<td>0.8</td>
</tr>
<tr>
<td>WOOD - ALUMINIUM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASSIC - INO</td>
<td>2.5</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>PLUS - INO/AIR</td>
<td>0.7**</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td>PASSIVE - INO/AIR</td>
<td></td>
<td>2.1</td>
<td>0.8</td>
</tr>
</tbody>
</table>

* - aluminium window spacer
** - stainless steel window spacer
**Housing installations** are an important part of a building because they enable heating, fresh water, the disposal of waste water, access to electricity, telephone, internet and many other services. In order to ensure the appropriate choice of installations a professional should be consulted, whose presence is also preferable during both the planning and installation phases. Modern installation systems demand awareness and knowledge of new technologies and the use of suitable materials, tools and procedures. With the appropriate choice of installations we can ensure that housing systems will be durable and operate safely and reliably. When installed correctly with suitable capacity to fulfil the requirements of the system, installations are enabled to provide the undisturbed performance of the building.

For the installation of electrical wiring, holes are drilled into LMS in accordance with pre-approved plans. If the customer wishes, holes for electrical sockets and switches can be installed. Frame walls can be prepared for electrical installations. Wiring for other related installations can be done subsequently onto or into the walls.

**Screed** is installed after the assembly of the building has been completed. They are roughly divided into classical (cement) screed and dry assembled floor structures (dry floor screed). Dry assembled floor systems are more in accordance with our concept of building. In addition to quick installation, there is no drying phase; the final floor finish can be fitted at once. Smaller surface imperfections can be levelled with self levelling floor screed and the bigger ones with dry filler (for example silica sand) which can be used as an insulation layer as well.

For optimum quality of living the installation of a floating floor is recommended (screed on the insulation layer) which controls noise transfer through the structure. During installation attention must be paid to ensure that the floor structure is separated from all other parts of the house (walls, ceilings, installation systems...).

Onto both types of screed the finishing flooring can be laid, such as: timber, ceramics, linoleum, rubber, and various kinds of carpeting made from a wide range of materials.
The façade of any building is subjected to weather elements such as rain, hail, snow or sun rays and for this reason it needs to be properly protected. Surface treatment of timber façade is determined by the natural resistance of the material.

**Larch** has high “self-protection” properties and it does not require additional chemical protection. On the surface of larch timber an oxidation layer is formed, which gives it effective protection against weather elements. With time larch timber forms a grey patina which alters the visual appearance of the façade but has no influence on its functionality or life span.

**Spruce** is not among the more resistant types of wood and has to be chemically protected. The first coating is a penetrating primer that is used to prolong the durability of the spruce wood and protect it against rotting, mould and putridity. After the application of primer three thin layer coatings of stain are applied, which come in a number of shades.

**Cedar** is an exclusive and durable type of wood that does not require any specific maintenance. When faced with elements this type of façade becomes grey in colour.

The inner visible side of laminated solid timber wall LMS is planed. Installed timber is kiln dried and therefore no additional protection is required. Coating the wall for aesthetic and practical reasons thus depends solely on the consumer. With coating the natural colour of the wood can be accentuated and enriched, or changed completely.

Further, colouring changes can be controlled, the surfaced layer strengthened and resistance to mechanical harm enhanced. The coated surface is more resistant to dirt and dust and suitable for wet wiping.

The selection of the coating agent depends on the desired effect. Use of coatings based on waxes, natural oils and other eco-friendly agents that do not close the pores and enable the wood to breathe are recommended. In this way the optimal effect is achieved and a healthy living environment created.
Towards a passive house

For a while now the term passive house has been appearing. The passive house has been described as a “rational house” since in the area of housing construction an optimal balance price and effectiveness is achieved, which translates into the saving of energy. The central idea behind the concept of a passive house is to decrease the level of thermal loss and optimize thermal gain.

The values which are characteristic of a passive house are:
- annual needed heat for heating < 15 kWh/(m²a)
- total annual usage of primary energy < 120 kWh/(m²a)
- annual use of electrical energy < 18 kWh/(m²a)
- thermal loss < 10 W/m²
- air tightness n50 < 0.6 h⁻¹
- Uwert windows < 0.8 W/m²K.

During the planning stages, the cooperation of professionals from different fields must be sought. In addition to an architect and construction workers, professionals from the fields of engineering, and housing installation should also be consulted. Without up-to-date knowledge in the field professional planning and proper installation of a passive house are impossible.

The Riko House belongs to a class of energy saving houses in which the best quality materials are used and installed in an optimal way. To be able to ensure the values particular to the passive house we have further developed one feature of the construction of the passive house, which was calculated at the Institute for Researching Materials and Constructions (ZRMK) in Ljubljana.

**THERMAL TRANSMITTANCE**

Thermal transmittance was calculated in accordance with Regulations on thermal protection and efficient use of energy in buildings PURES (UL RS. Št. 93/2008).

Maximum permitted thermal transmittance of the construction:
- exterior walls Umax: 0.20 W/m²K

Calculated value of Riko wall: U = 0.13 W/m²K

The calculated value thus substantially exceeds the demands of legislation and is within the range acceptable for the thermal transmittance of low energy buildings (annual heat consumption 20-25 kWh/(m²a)).

Computer simulations of temperature phenomena with regard to thermal transmittance were performed. The two dimensional state of the wall corner and the joint of the window with this wall, was analyzed.

Edge/threshold conditions:
- temperature of external air: -10 degrees C
- temperature of internal air: 20 degrees C

Simulations of the flow of isotherms in treated cross-sections have shown that thermal bridges do not occur where the exterior wall window joins the wall corner. With windows there are no significant fractures in the flows of temperature curves and the internal part of the window frame and pane is in a warm zone. Results have confirmed that the structure meets professional standards.

**PASSIVE WALLS**

<table>
<thead>
<tr>
<th>Material</th>
<th>Insulation Between</th>
<th>Thickness of Insulation</th>
<th>Thermal Transmittance</th>
<th>Heat Transfer Through Wall</th>
<th>Sound Insulation</th>
<th>Fire Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMS Passive 300</td>
<td>+ 60</td>
<td>0.1</td>
<td>18.2</td>
<td>≥ 46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riko Plus Passive 300</td>
<td>+ 80</td>
<td>0.1</td>
<td>17</td>
<td>≥ 46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FLAT PASSIVE ROOF - ROOF ELEMENTS**

<table>
<thead>
<tr>
<th>Material</th>
<th>Insulation Between</th>
<th>Thickness of Insulation</th>
<th>Thermal Transmittance</th>
<th>Heat Transfer Through Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>I beam 360</td>
<td>+ 60</td>
<td>0.098</td>
<td>18.2</td>
<td>46</td>
</tr>
<tr>
<td>I beam 400</td>
<td>+ 60</td>
<td>0.09</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>
At Riko Hiše we developed a unique system of timber construction, which corresponds to high levels of eco construction and allows clients and architects diverse design solutions. Because of this, these designs have been presented in many domestic and foreign magazine and newspaper articles. It is a fact that when Riko Hiše enters a new market, it rarely goes unnoticed.
Due to the increasing presence in the European market and the demand for timber construction, Riko Hiše presents itself at many prestigious international construction exhibitions. With a unique design oriented way of presentation Riko Hiše promotes the system to construction companies, architects as well as to end customers and this way builds its own network of clients. Attendance at these exhibitions provides Riko Hiše new inquiries and new customers as well as inspiration on new challenges and new trends in the field of construction enabling Riko Hiše to develop and bring the system to new levels.
references

location: Vipava, Slovenia
architecture: Igor Kozinger
year of construction: 2007

location: Podkoren, Slovenia
architecture: Gregor Jiterman + Natasja Kalin
year of construction: 2009

location: Ljubljana, Slovenia
architecture: Zala Kos & Jolanta Kuntar
year of construction: 2004

location: Celje, Slovenia
architecture: Superform, Tonček Žižek & Marjan Poboljšaj
year of construction: 2008

location: Ljubljana, Slovenia
architecture: Janez Rudolf
year of construction: 2007

location: Ribnica, Slovenia
architecture: Boštjan Češarek, Proarhing d.o.o.
year of construction: 2005

location: Vipava, Slovenia
architecture: Igor Kozinger
year of construction: 2007

location: London, Great Britain
architecture: Architects in Residence
year of construction: 2006

location: Zagreb, Croatia
architecture: Renata Petrović
year of construction: 2003

Kindergarten “Petropak”
location: Modena, Italy
architecture: ZPZ Partners
year of construction: 2004

Kindergarten KEKEC
location: Ljubljana, Slovenia
architecture: Jure Kotnik
year of construction: 2010
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