ChristophorusHaus

A highly active passive house.

BBM Procurement Service of MIVA, 4651 Stadl-Paura, Austria

In full responsibility

The world is under constraint of saving energy. An ecological turn is urgently called for. The Kyoto-Protocol passed in 1997, an agreement of the United Nations that codifies binding objectives concerning the reduction of the output of greenhouse gases, complies with this need to act. The EU member states have agreed on an 8% reduction of the greenhouse gas emissions in the period of 2008 - 2012, compared with the state of 1990. Austria has set itself the exemplary goal of a 13% reduction. The EU-Life-Programme supports such projects like the ChristophorusHouse.

Since 1997, environmental protection projects are being implemented in the South by BBM (Procurement Services of MIVA), a service provider in development cooperation. One of its priorities is the refurbishment of hospitals as to renewable energy and waste management, water supply and water treatment, including biological sewage plants. The lasting effect of this work is ensured by corresponding training courses.

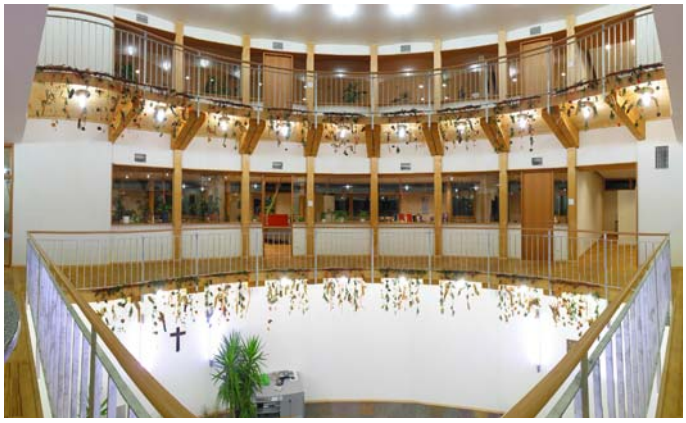
In 2003, a credible sign of environmental protection was given also in the North by the "ChristophorusHouse" project. The ChristophorusHouse, a multifunctional building with a useable area of 2.096,07 m^2, located in Stadl-Paura, Upper Austria, was constructed in wood as an energy-saving passive house. It was designed by BBM as a showpiece project and it is supposed to have an exemplary effect nationally as well as internationally. Under the direction of BBM, experts of most different fields worked together. The least possible energy consumption and the use of ecologically renewable building elements were main items of the planning, respectively of the implementation.

ChristophorusHouse

"ChristophorusHouse" was the name of the vision right from the start. The name refers to Saint Christopher, the patron saint of the travellers in the Catholic Church. MIVA is a Catholic relief organization that aims at supporting the pastoral and social work of the Young Churches in the poor countries of the world by means of transportation: lorries, motorcars and off-road vehicles, bicycles and motorcycles, but also boats, agricultural equipment or - depending on the requirements - living carriers of burden like elephants, donkeys or mules. The "Procurement Services of MIVA" or "BBM" is responsible for the technical and logistic handling of MIVA projects. In addition, it offers its know-how to other relief organizations and it is very involved in technical large-scale projects.

For example Matany, a big hospital in the Karamoja region in the northeast of Uganda: Without the hospital of Matany and its outstations, the Karamojong, a nomadic tribe of herdsmen, would be basically without medical care. But to the blessing, a threat was added. One by one, the trees within a wide radius around the hospital were cut down, because the hospital's laundry needed firewood for hot water. In the arid region of Karamoja, this soon became a problem. Were the trees retreated, the aridity expanded. In addition, the laundry represented a constant danger of infection and dissemination of germs. So under the direction of BBM, also this hospital was adapted to an environmentally sound operation.

Multifunctionality



The construction was a challenge for all the people involved. Because besides all ecological conditions, it also had to combine a multitude of functions: offices for MIVA and BBM, a logistics centre with warehouse for the aid shipments of BBM, a car-wash, premises for events and seminars, a world-shop, exhibition areas and a catering kitchen should all find room under one roof. Under the abbreviation CHH, the ChristophorusHouse will also offer specific international events from the subject areas of MIVA and BBM.

In its effort towards expressing everything at the same time, the official description of the project sounds a bit unwieldy: the ChristophorusHouse is a "multifunctional office and administration building with logistics and cultural centre according to passive house standards in sustainable wood construction".

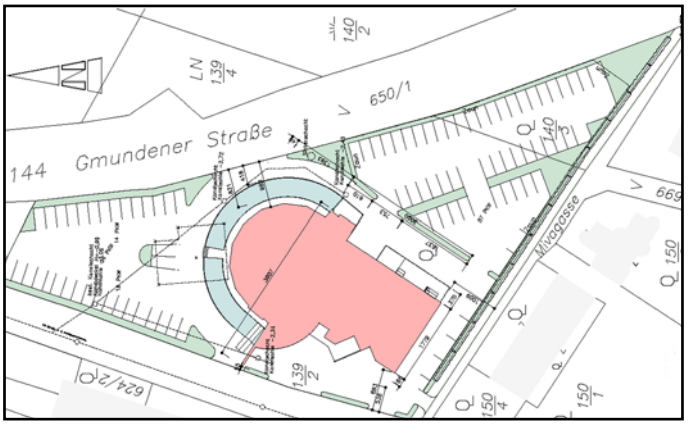
The fact, that there actually exists now a building in Stadl-Paura that meets all these demands, is due to a meticulous planning - and the willingness for constant interchange between all the persons involved (builder-owner, architects, companies involved in the construction and advisory organizations). Only through the persistent team work and constant discussions, the building could get optimized in all its planning and building phases to become a real showpiece project today. The ChristophorusHouse is the first round, three-story wood construction in passive house standard in Austria.

Integral planning of the building

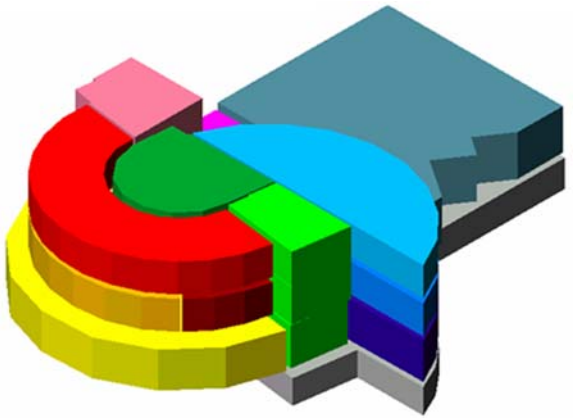
The integral construction planning combines all aspects to create the utmost comfort and highest ecological acceptability at concurrently defined general economic conditions. From the energetic point of view, the integral planning processes treat and optimize the interaction between the building, the user and the provision of comfortable work conditions (temperature, air, light, work makeshifts, etc.).

The experience showed very clearly that such innovative construction projects have a need for a "responsible energy coordinator". This person not only handles the building services as in conventional planning processes, but also has the overview of all energy relevant areas and is the link between the individual groups (builder-owner, architect, house services' planner, electrical planner, structural engineer, building physicist, site management, etc.)

A further prerequisite for the implementation were the weekly building coordination meetings with all persons involved in the project and the executing companies. So even during the implementation phase, there were still optimizations possible. This teamwork contributed to having the project finished after only just one and a half years of construction time without having any substantial corrections to be carried out afterwards. The results are analysed in a measuring evaluation, lasting 2½ years. First evaluations already showed that the monitor data tally very well with the simulation data.



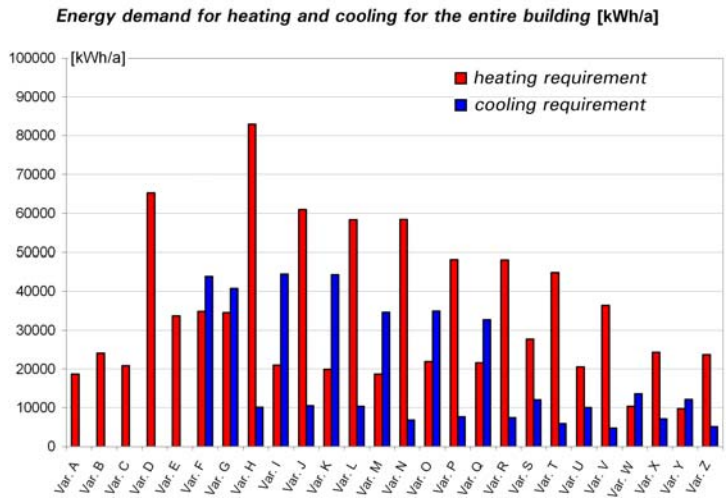
Energetic optimization process



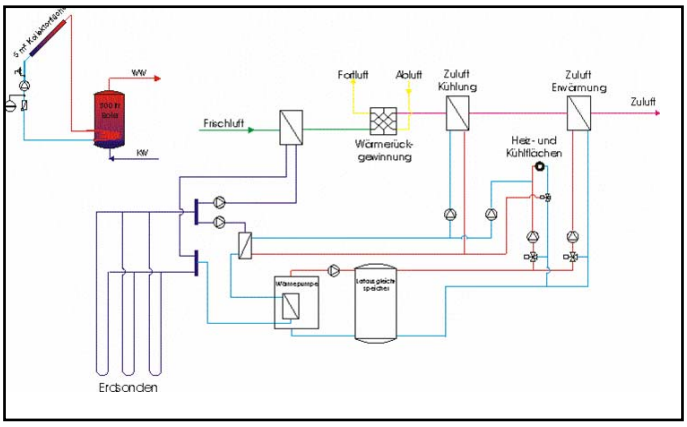
In the course of the planning work for the ChristophorusHouse, an integral planning process was implemented. The "energy responsibility" in this planning process was entrusted to AEE INTEC (in cooperation with the IWT of the Technical University of Graz). The energy planning team chose the simulation programme TRNSYS as a tool for the optimization of the building behaviour at climatic peak loads. For a better overview and analysis of the thermal behaviour, the building was divided into 20 thermal zones during its planning stage.

To improve the rating results of the dynamic building simulation, every single variation (wall structures, storage loads, air change, external loads, internal loads, etc.) was done with two different climates. Once for the one extreme: "heating" and one time for the other extreme: "cooling".

Subsequently, it was the task of the energy planning team, in cooperation with the other experts involved, to ensure the required comfort in winter as well as in summer, at minimum energy consumption, by taking calculated influence on architecture, building physics, loading capacities and equipment. In more than 20 calculi of variations, the building was optimized with regard to comfort and energy requirements. Furthermore, the project was accompanied by the "Passivhaus Dienstleistungs GmbH", Darmstadt during the entire building phase.



CO_2-neutral building services



The gradual reduction of the energy demand for heating and cooling was the pre-condition for the definition of a sustainable and at the same time reasonably priced energy supply system. The earth serves as heat source (heating operation) and as heat sink (cooling operation) and it is activated by 8x100 m long Duplex earth probes (double U-pipes, DN 32). For the heating operation, the earth probes serve as heat source for a heat pump of 43 kW. In summer, the same system is used as heat sink without employment of energy - "direct-cooling". The distribution within the house is carried out by 560 m^2 of heating respectively cooling ducts in the ceilings and floor elements. The cooling system that is based on the earth's coldness is supported by the natural cooling down of the mass of the atrium during the night hours.

The fresh air is supplied by two separately controlled ventilating and ventilation systems with heat recovery through rotational heat exchangers. Amount of heat recovery: 78% respectively 86%. This way, the heat produced by people and equipment in the house is utilized. Furthermore, the heat of the earth (approx. 14°) is used as pre-heater of the fresh air in winter, respectively for cooling in summer, without any additional loads of heating or cooling registers.

To be able to provide the electricity demand for the heat pump, respectively the driving energy of the pumps and ventilators, at a largely CO_2-neutral base in the annual average, a mains-coupled photovoltaic plant with a peak output of 9,8 kW_{peak} was set up.

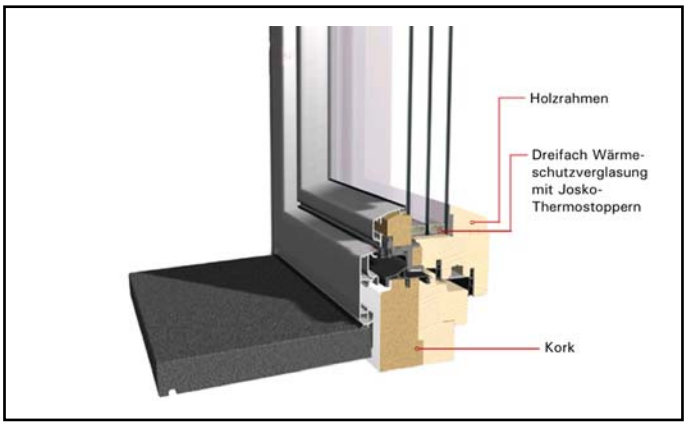
Innovative wood construction

To visibly give preference to renewable building materials, the house was designed as a round wood construction. The building is supported by 51 solid round wood poles - winter-cut pine trunks, tested for their strength by ultrasound scans. The ceilings rest on newly developed high-strength pole carriers. By a special procedure, the glued laminated girder elements were bent, so that from the basically straight wood parts, a rotunda could come into being. The experiences which were gained in ecological and in structural-constructional respect as well as in building physics, give way for a substantial further development of the wood element construction in passive house standard.

The wood building weighs about 1000 tons, it has a useful area of 2.096,07 m^3 and it consists of about 90 prefabricated elements. The whole wood construction was completed in the workshop halls. The mounting took only 9 days. Also the insulating material for the walls was selected according to ecological criteria. As much as possible, namely 754 m^2 were insulated with hemp, only on the outer walls rock wool had to be used for reasons of fire prevention. In addition, 154 m^3 of cellulose were used as insulating material. A construction free of thermal bridges and an airtight fabric were the prerequisites to achieve the passive house values.

Fabric: U-value 0,11 W/m^2K Blower-door-measuring: n_{50} 0,4 h^{-1}

Passive house windows



The ChristophorusHouse is a passive house and therefore, it has no heating in the conventional sense. So in the planning and during all construction phases, special attention had to be paid to the airproof condition of the building. Windows are of course the critical spots in this respect. Completely newly developed solid wood passive house windows were used for the first time in such a large size passive house and they ensure a maximum of energy preservation in the ChristophorusHouse.

The triply glassed-in windows hardly let any energy escape to the outside, neither in the frame nor in the glass part, but they do lead the heat of the sun towards the interior. (The data: the frame has an efficiency of $U_F = 0{,}77$ W/m²K, the glass: $U_g = 0{,}6$ W/m²K). These values signify a halving of the total energy passage in comparison with conventional windows.

The majority of the materials used for this window consist of raw materials that are growing again naturally, like for example wood and cork. The windows and the wood construction were produced simultaneously. So no natural measurements could be taken. The precise construction according to the plans and the meticulous mounting, were condition for the minimization of a loss of heat. The precise construction (air tightness) was confirmed by a Blower-Door test.

Ecological appreciation

The ChristophorusHouse goes beyond the passive house standard and focuses specially on ecologically acceptable building elements and renewable raw materials. Great importance was attached to energy saving measures.

Through a sustainable water concept, substantial savings in the drinking water consumption could be achieved. All grey water and rain water is clarified by three biological sand bed filter systems and fed to the service water cycle to be used for toilet flushes, car wash and plant watering. In addition, low-flush toilets and waterless urinals are used. For the hot-water supply, a 6 m^2 sized solar system with a solar coverage of approx. 70% was installed.

The natural light is supplied through an optimized daylight guidance, on one hand by a continuous window line on the outside of the building as upper rim of each floor (also when shadowing the windows) and on the other hand, by the glass cupola over the atrium and the glassing-in of the rooms towards the inside of the building. The artificial light can be separately triggered and adjusted by DALI (digital). That way, an individual adjustment depending on the daylight situation is given and only the amount of light necessary for the present viewing task is produced. Energy saving appliances and lamps were employed.

Certification

At its opening on the 18th of October 2003, the ChristophorusHouse received the certificate as quality-proofed passive house by the Passivhaus Dienstleistungs GmbH Darmstadt. According to the certificate, the heat consumption comes to 14 kWh per m^2 of surface and year. The blower-door-measuring of the fabric during the building phase showed a value of 0,4 per hour at a pressure difference of 50 Pascal. The total annual primary energy consumption for heating, hot-water supply, ventilation, auxiliary current and regenerative cooling comes to 49 kWh per m^2.

CO_2-Reduction

The "ChristophorusHouse"- project was realized with the support of the EU Programme LIFE as an energy saving environmental protection project. A reduction of the worldwide CO_2-output is possible. The heating and cooling technique in this project is predominantly CO_2-neutral. In comparison with a conventional office building, the average saving in primary energy is about 275.000 kWh/a. This makes an annual CO_2 saving of 75.000 kg. The chosen wood construction is a further contribution towards this aim. Wood is a reproductive raw material, therefore it is easy on resources and stores CO_2 during its growing phase in the forest. For example, in the ChristophorusHouse, 350 tons of CO_2 are being stored. If 25% of all new buildings would be built according to the concept of the ChristophorusHouse, the Kyoto-objective could be reached for Austria.

The Team

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Energy study: AEE Intec, Gleisdorf

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Energy Globe Oberösterreich
Sonderpreis

Österreichischer Solarpreis

OÖ. Landespreis für Umwelt und Natur

R.I.O. Ressourcen Input Optimierung Innovationspreis

R.I.O. Innovationspreis Aachen
Anerkennung

Best EU-Life-Environment Project

ChristophorusHaus *Das Ökoprojekt*

MIVA *Das Hilfswerk*
B B M *Der Handelspartner*
C H H *Der Veranstalter*

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