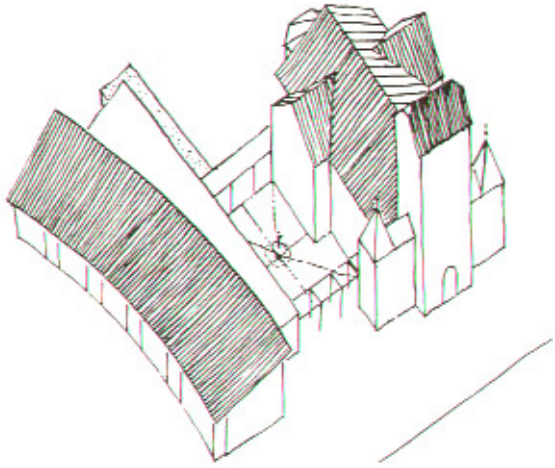
Play in Passivhaus

Timber and earth building for children

Dipl. Ing. Olaf Reiter
Architektengemeinschaft Reiter und Rentzsch
Moritzburger Weg 67, 01109 Dresden
Tel. (+49) 351 / 88505-0, E-Mail: architekt@reiter-rentzsch.de

1 The cloistered kindergarten

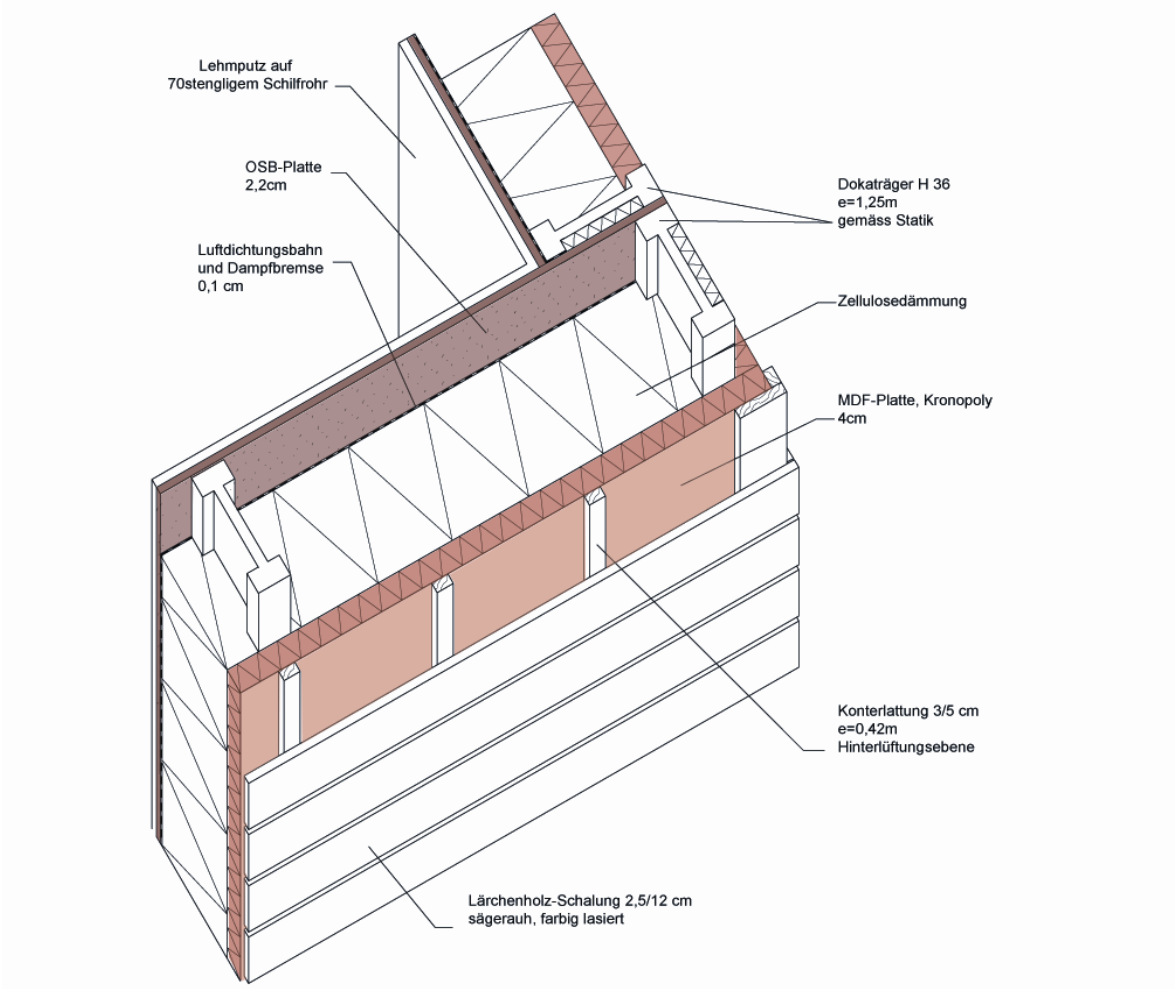


Directly by the Jakob Church in Döbeln the Lutheran church commissioned a new kindergarten. Similar to a monastery the original kindergarten St. Florian, was intimately connected to the church by the means of a cloister. However, due to the severe flooding of 2002 a replacement kindergarten was required and an architectural competition was run. Architects Reiter Rentzsch won the competition, with the concept of recreating the cloister and the inherent relationship with the church. It was immediately apparent that a modern timber building would require sensitive treatment when placed beside a 19th century church.

When entering the enclosed kindergarten from the street into the foyer, your gaze is immediately drawn towards the church via an expanse of north facing glazing. A curved earthen wall, polished carmine red, with built in wardrobe, separates the circulation space from the south facing group rooms. Stepping through the doors with large glazed elements the children enter their play space complete with timber galleries and bathrooms. From the group rooms it is possible for the four groups of 68 nursery and kindergarten children to access directly the garden. The building has the pleasant aroma of natural building materials, timber and earth, this combined with the controlled mechanical ventilation results in fresh and healthy air quality. The

ventilation and heat recovery unit, located above the north wing of ancillary rooms, is expressed and visible though a glass wall. The ecological and Passivhaus concepts have been very well received by the children and clients.

2 Timber frame construction with engineered beams



Passivhaus-External wall build up

All external walls and roof are of timber frame construction utilising engineered timber i-beams (360mm Doka), stiffened with OSB panels. An u-value of 0.11 is achieved by filling between the timbers with cellulose insulation. Additionally 4cm of wood fibre board encloses the structure to achieve 30 minute fire resistance and to ensure the construction is free of thermal bridges. This is vital for Passivhaus construction as thermal bridges must be minimised; this is particularly difficult at the corners of timber construction (see illustration). The floor plate is of warm construction and is insulated on the underside (u-value 0.13). Additionally, the the whole of the timber frame is raised on foam glass footings which protects the construction and minimises the thermal bridging.

Timber frame on foamglass footing

The internal walls of the group rooms are of timber frame construction with solid timber joists. The children and parents were then capable of building the infill elements of unfired clay bricks. Over this was installed areas of wall heating tubes and straw as a key for the clay plaster, which was then finished in breathable (casein based) natural paint. The earthen construction provides high thermal mass for the building, this regulates not only the temperature swings but also the internal moisture levels.

Unfired clay brick internal wall

The gallery and ancillary rooms ceilings are solid glue laminated timber. For the glazed facades a Passivhaus glazing system (u-value 0.85, g-value 55%) was installed onto the load bearing timber elements. The external cladding consisted of painted larch timber cladding for the walls, a rear ventilated green roof and timber window complete with material blinds for solar shading. The application of a vapour barrier or waterproof membrane was intentionally excluded, therefore allowing for the walls and roof to be breathable, which is highly desirable for healthy construction. A blower door test achieved the air tightness n50 requirements of a Passivhaus (0.5 internal volume air changes per hour at 50 pascals).

The timber construction including glazing was completed in two weeks. The clients were impressed by the quality and the finish of the construction. The winter erection of a timber building encounter no problems.

3 60% North facing glazed facade – is that possible?

Foyer with extensive north glazing

With Passivhaus design it is desirable to have the majority of the glazing in a south facing orientation in order to optimise the solar gains. However central to the architectural concept was a strong visual connection between the church and kindergarten, therefore a highly glazed north facade was essential. The first PHPP (Passivhaus Project Package) calculated that the building was a little over the required 15 kWh/m²a heating load. Through the inclusion of a small windowsill and additional insulation on all external allowed the building was able to achieve the Passivhaus standard. After several years of use it has demonstrated that Passivhaus designs can function effectively as inclusions to the urban fabric.

4 Internal Planting to remedy dry air

A child requires a minimum of 15m³/h supply of fresh air. With a relatively high occupation of one child per 2.5m², the group rooms require 300m³/h for the 18 children and one adult. Therefore the group rooms with an internal volume of 185 m³ require 1.6 air changes per hour. In winter this could result in low moisture levels and uncomfortably dry air. To remedy the situation, Reiter Rentzsch Architects worked in collaboration with Mr Frantz from Tübingen Botanical Gardens, to design a scheme that would enable them to use internal planting as a means to providing ideal moisture levels.

For example a 2m high plant (Ficus alii) can increase the moisture levels by transpiring around 1.5litres per 24hours. Two large planting troughs were built directly into the floor plate and to ensure air tightness 20cm of clay was laid. The substrate was a special mix of clay, peat, and clay granules. The natural habitat of the selected plants are tropical rainforests, one trough contains African species and the second Asian. The children water the plants themselves and are fascinated by the rate at which they grow.

5 Environmental Strategy and Servicing

The fundamental concept of a Passivhaus is that heat losses are minimised (high insulation and high tightness) and that passive heat gains (people, lighting, solar transmittance) are optimised so that no active heating system is required in order to achieve thermal comfort. However directly after a weekend or a holiday when the building is 'missing' the heat gains from the occupants and use, the internal temperature can become unsatisfactory. To ensure that the building could deal with these occasions and future energy demands an auxiliary heating system was devised. These additional heating loads are provided by solar thermal collectors in combination with the excess capacity of the existing low temperature gas boiler located in the Jacob Church.

This auxiliary heating is delivered to the group rooms by wall heating; areas of narrow metal tubes laid beneath the clay plaster. As this employs a relatively large area, it produces comfortable radiant heat in addition to removing the need for cumbersome radiators in the space.

Ventilation expressed as visible architectural component

The ventilation system is designed to require a minimum amount of energy, whilst operating at an optimum. Heat recovery is central to this concept, whereby the heat from the stale extract air is recovered by a rotating heat exchange plate which is then transferred to heat the fresh supply air. This ensures that optimal levels of fresh air per person is supplied whilst minimising the heat loss usually associated with ventilation. As mentioned in the previous section, the pre-heating of supply air can result in low moisture levels, however the strategic inclusion of internal planting mitigated this potential problem. Additionally as the incoming fresh air is filtered the air quality is further improved by the removal of fine particles and pollen. The air is distributed via a canal system and is supplied to the group rooms and multiple purpose hall. It is supplied at high level in the galleries above the foyer and extracted from the bathrooms and ancillary areas. This results in Passivhaus buildings having very high air quality air in addition to good hygiene. The project is located in Saxony where the building regulations require natural ventilation in kindergartens. However, because the windows in the buildings are always operable, this allows for the potential natural ventilation in conjunction the mechanical system, this therefore mitigated this regulatory issue.