ARCHITECTURE

1. Introduction

Spring 1997 the city of Lahti and SAFA announced an open competition for wooden concert hall in the shore of lake Vesijärvi nearby old port of Lahti. The competition sought for a unique architectural solution using wood in a new way.

Competition- phase 1
The aim of the phase 1 was to find out an architectural solution for a congress and concert hall connected to old factory building in the site. Also the use of wood in various ways was encouraged and asked for. The building was to be flexible, multi-purpose usable and it should have made the most of the site.

It was an open competition due 15.08.1997 (29.08.1997 for model).

Competition- phase 2
In the late fall 1997 phase 1 was completed and three entries were recommended to enter phase 2. This phase introduced collaboration with contractors and acoustical consultants in special.

The presence of the contractors (each entry was given a randomly chosen contractor) was to insure that these three entries would meet budget and would be in all aspects possible to be built. Second phase entries were submitted march 1998.

The site
The competition site was placed on the area called Ankkuri next to lake Vesijärvi about 1,5 km away from the city centre. The area had been former industrial heart of the city accommodating wood and glass industry etc. It had very good connections via lake and a canal coming from Vääksy and a railway. These factors made the site one of the busiest wood industry "junctions".

Ankkuri had been abandoned and asleep for several years but for a decade ago Ankkuri was named for a developing coastal site for public services. This project has EU-funding and is co-ordinated by city of Lahti. It aims to bring it all back into life and create local and world wide attraction and to provide people with active places by the lake.

There is an old factory building called "Puusepäntehdas" which has hosted wood industry and also some glass fabrication. It has been nominated for significant cultural and historical building and some parts of it are protected by master plan. The building itself was in a very poor condition been kept cold and empty many years. It is made of bricks and it has several heights and parts.
2. Architectural elements

The aim was to make simple pieces of buildings each of them with individual character still connected to old existing industrial site. It also broke the relatively large program into several parts enabling simultaneous multi-purpose use. One part could accommodate conferences while concert was being performed. A simple industrial approach was selected to give character to each new building member.

Wood was treated in a various ways starting from rough industrial pre-fabricated element surface leading towards warm inviting touch of wood in the places to touch.

An important feature as well is the view or landscape, which we wanted to be exposed in every space of the complex to the visitors. Also organizing the whole building along axis following shorelines direction was to activate interaction between harbour activities and thing happening inside of the building.

Wood

The buildings’ design goals concerning use of wood were influenced by traditional finnish buildings like barns and family houses. We wanted to gain the simple, human, peasant-like atmosphere appearing in the traditional buildings.

The idea was to connect this first larger scale wooden public building to its roots. We have had tradition on this but it has been vanished for about 100 years or so.

We also studied traditional treatments and joints used in log-house tradition. Then we tried to convert this in to modern way of doing it. This also has to do with idea of using tho whole scale of treated wood; from rough to finest carpenters’ hand shaped forms.

It also relates to traditional idea of using wood in different purposes; load-bearing, space shaping and usable furniture. This idea made it possible to use some traditional treatings on furniture and some smaller parts of the building, which take time quite much. Also intruments where some influence to the design on a metaphorical- level

Wooden structures and materials:

The Forest Hall:

A wooden structure with a large scale, which supported by tall wooden pillars made out of glu-laminated spruce, forms the basic structure. The columns support a "foliage", on which the light roof layers are piled. Nine massive wooden pillar hold a structure field sized 11.2x11.2 meters. In order to strenghen the visual appearance the classic enthasis arch is estimated. The foyer levels are supported with heavy wooden glulam beams. The tilted back wall of the concert hall is covered with birch panels.

The Conference wing:

The conference wing is built with similar wooden structures as the conference and concert hall. The massive figure of the glulam structures resembles the appearance of the machinery of the harbour. The walls are finished with white treated pine plywood.
The Concert Hall’s wall structure:

Wood is relatively light material itself, so we had to seek solutions to make massive solid wall out of timber products. The wall has a two way job: it has to absorb all noise from outside (it has to vibrate) and it has to reflect all the sounds coming from the hall back to the concert room (inner core is not allowed to vibrate)

It is a traditional way to have sand in the floors in vernacular architecture in order to prevent sound of footsteps spreading. This led in to idea of having two wooden plates and sand in between. It also had metaphoric idea linking to shore of lake Vesijärvi.

To keep the outside noise away we constructed a multilayer façade. Glass skin supported by hanged horizontal Kerto-beams is to take approximately 37 dB out of the noise coming from outside (estimated to be 85 dBA). The rest is handled by air space of non-symmetrical form Wisa-plywood with additional layer of mineral wool and sand filled massive Kerto-wall. The idea was also to have a façade, which lives by the day with its shadows and highlights

The wooden girders, which stand freely, form the main supporting structure. These glulam structures are very impressively visible in the reverberation chambers, empty spaces like wooden cathedrals. Outside the girders and walls are provided with a glass layer, which is constructed very elegantly with steel and wood. The tilted acoustical wall (21 meters high) is constructed with Kerto-LVL box elements with sand fillings. These elements are very heavy in order to prevent the outside noise and to have good low frequency sound reflection. Kerto-LVL plates are treated with transparent layer of weather resistant varnish.

The floors and the stage are finished with oiled heat treated birch. The canopy and balcony fronts are made out of Finnish high quality birch plywood. Acoustical doors are constructed out three layers of heavy plywood panels coloured with a tone of a old violin.

3. Locality

Here we had an opportunity to work with local carpenters and builders, which gave to the building more chances to be building for people of Lahti. At the same time they got a show room with a lot of publicity for their skills. So in that way we hoped it would also strengthen local identity.

The buildings’ influences came from the site itself and its’ buildings. The way structures are left exposed and their scale is due to images are used by the site. We wanted to leave the history visible. By using traditional treatments converted to modern we tried to link buildings appearance to its historical ”junction” of industry, railroad, harbour and still create feeling of new public building. Although it is related to traditional warm material wood, we tried to come up with ideas of using it in a new way so that its’ own qualities were the ones to connect it to history, still creating something new to that story.

One wheels comfortable when sensing the roots.
Summary

New techniques of prefabricated elements were used in the walls, ceiling and balcony structures of Sibelius Hall. Materials used were Laminated Veneer Lumber (LVL) products; Kerto LVL Q-board and Kerto LVL S-beams. Heavy wall elements are structural glued box elements with stressed skins and ribs. Assembly is done by screw gluing with Collano Purbond HB 110 one-component polyurethane adhesive (PU). After assembling the elements are filled with sand. Before producing the elements, requirements for successful gluing the following characteristic were determined: adequate surface smoothness of LVL components, right level of moisture content of LVL, screw type, screw space and end distance, right amount of glue spread and glue line thickness.

Additionally the balcony elements had to be tested and modelled for vibration characteristics. After completing the construction verification tests were done.

1. Introduction

Substantial amount of high-class wooden structures was used in Sibelius hall. In Forest Hall (the foyer of concert hall) round glue lam columns are carrying with the three dimensional crown the roof structure. For the erection of massive frameworks of concert hall a functional connection technique had to be developed. Completely a new connection technique was used in the structures of walls, ceiling and balconies. In the following a description of these structural screw glued box elements.

2. Screw glued elements

2.1 Wall element

Concert hall's walls are made out of massive ribbed elements. The width of an element is 9 m, the height 1.8 m and the thickness 300 mm. On the both sides of an element there are Kerto-LVL Q panels; the thickness of inside panel is 69 mm and external 51 mm. The space of 180 mm between the Kerto-LVL Q-boards is filled with sand. The elements are structural glued using Kerto-LVL-S ribs with spacing of 600 mm. The screw gluing was made with Collano HB 110 polyurethane adhesive. It was the first PU adhesive for structural use to be approved by the German authorities. In the wall 10 or 11 sand filled elements are stacked on top of the other. Every element weighs slightly over 7 tons. Due to acoustic reasons the walls are fixed on the slant of 5.7°, which makes the structure more demanding.

Figure 1. Acoustic wall-element
2.2 Ceiling elements
Ribbed panel elements are about 8.3 m long, 1.8 m wide and 560 mm high with 69 mm thick Kerto-LVL-Q panel. Elements are structural glued using the same technique as with wall elements. Extra mass was not needed because the gap of 4 m between ceiling and roof works as a good sound isolation.

Figure 2. Acoustic roof-element.

2.3 Balcony elements
Development of balcony elements was the most demanding part of the project. In addition to gluing technique, the vibration properties of the element had to be tested: the visitor at the concert has to feel the good quality of a floor structure, which is a very important property for the image of wood.

The original element was tested at VTT. The result was that the beams of balconies were reinforced and the bracing of balconies were redesign in a new way, which prevented the longitudinal vibration on the balconies. The height of the elements were increased to reach at least the resonance frequency of 8 Hz. If the resonance frequency would be under 8 Hz, the visitors already sitting at the balconies have felt the late arrival of a visitor as an unpleasant wobbling.

Figure 3. Balcony elements in erecting.

2.4 Development process
Development of elements was conducted as an interaction process during 10 months in the Otawood-group. There were several studies and research work going on simultaneously:

- Development of screw glued Kerto-LVL ribbed Elements with Polyurethane in HUT Laboratory of Wood Technology; Eliisa Kaloinen’s Master’s Thesis [1]
2.5 Conclusion

The Hall of Savonlinna was the next wooden concert and congress hall, where the know-how from Sibelius Hall was utilized. Structurally glued wall element with a sand filling was chosen based on the experience gained from Sibelius Hall.

By gluing wood structurally, it will widen application possibilities and also significantly increase the competitiveness of wood. Architects are able to design imposing constructions, if wood industry provides them facilities to realise the designs reasonably and sustainably.

3. References
