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Vanaja Hall Verkatehdas, the new cultural center for Hämeenlinna, Finland

H. Möller, T. Ilomäki, J. Auvinen and A. Ruusuvuori

Summary. Hämeenlinna is a city of about 80000 inhabitants, approximately 100 km north of Helsinki. Traditionally the city is more know for its medieval castle and its ice hockey team than as a cultural city, but it does have a city theatre, music education facilities and a small city orchestra.

The Verkatehdas complex is an old factory complex more or less in the city centre. The whole complex is redeveloped to hold different kinds of cultural related activities. In the first phase, described in this paper, includes the building of a new concert/multipurpose hall as well as a cinema multiplex. The second phase will include facilities for music education and general arts education. In the future, it is the plan that the city theatre will move to a refurbished hall in the complex.

This paper describes the acoustic design of the Verkatehdas Hall in Hämeenlinna, Finland.

Key words: room-acoustics, multipurpose hall, concert hall

Project outline and design brief

The project was started by an architectural competition in 2003. In the architectural brief for the competition, a shoebox-style concert space with one or two side balconies was called for. The brief also called for a width of 17-19 m and a minimum height of 16 m., with full height in the whole space. The principal uses of the hall were defined as:

- Reinforced music, including “rock” and popular music
- Classical music (acoustic music, from large symphony to recital)
- Conference
- Music theatre and opera
- Drama theatre
- Others shows and community uses, such as circus, banquets, etc.

Compare to most other Finnish cultural houses [3], which traditionally has been designed mainly for acoustic music, in this case it was decided that acoustics of the hall should be designed for a full orchestra as long as it did not jeopardize the other uses. It should be noted the city of Hämeenlinna only has a small city orchestra so the full size orchestra comes from a wish to accommodate visiting orchestras. In general the brief called for the "next generation" Finnish Cultural Centre.

A major concern was to both achieve the acoustics goals and incorporate the necessary theatre mechanical systems and logistics. Essentially this meant that it was decided to have all visible lighting bridges and more or less uniform height of the hall. It was also clear that large surfaces of changeable acoustic treatment would be needed.

The architectural competition was won by JKMM Architects from Helsinki and the design was begun in 2004 and the complex is to be completed by June 2007.

Preliminary "thumb-nail" acoustical results

From the design brief of approximately 750 seats plus the dimensions listed, an approximate room length of 35 m was estimated, along with the room having a maximum volume in the range of from 9,500 m3 up to around 11,500 m3. This range was based upon the knowledge that a larger than normal volume would be needed to allow for attaining the balance between Tocc and Go, achieved, essentially, by a ceiling height approaching 18 m. Taking into account the existence of a rear balcony and two shallow side box balconies, the first calculations used V = 10,000 m3 which for 750 seats is Vs = 13.3 m3/seat, normally considered to be a high value.

Another reason for using this volume was based upon the design philosophy of Kahle, a collaborator on this project, and the choice of a minimum volume depending upon the size of the largest acoustic performance, in this case being a 100 musician orchestra. The theory applied here suggests a minimum volume of 100 m3/musician, where the assumption is that in smaller rooms, there would be at least 10 patrons/musician, and each patron would require a minimum of 10 m3.

The preliminary acoustical criteria were chosen as Tocc = 2.0 sec, Go $\leq$ +6 dB. Using the thumb-nail calculations, previously presented in [1], it is found that the design parameter β for this type of hall is known to be in the range of β = 5.5. Given Vs = 13, 3 m3, T0 can be estimated to 2,7 s and G0 to 7,5. Achieving the preliminary acoustic criteria, would require the addition of approximately 270 m2 (metric Sabines) of absorption to the space. Adding this absorption to the full occupancy condition yields a revised Tocc = 1.56 sec. which is significantly lower than accepted reverberation criteria for symphonic uses. I.e. it was necessary to make a compromise and to it possible to add or remove fixed absorption during the tuning period.

Acoustical design development

The winning entry from the architect competition had a basic shoebox layout, with a width of 17 m and 3 levels of side balconies. The design was investigated by computer modelling [ODEON] with the following principal results:

- The overall width of the hall should be increased to about 18 m, both for stage acoustic reasons but also for better balance of the early reflections.
- A two side balcony layout was acoustically favourable compared to a three level side balcony layout, because the height between the balconies could be increased, thus minimizing shadow effects and as the width was increased, more seating could be achieved. Also the modelling showed that the lateral efficiency and early reflection pattern would still be appropriate.
- The modelling clearly showed the need to acoustically narrow the hall near the ceiling.
- Some (variable) absorption would be necessary to reduce early reflections from the front parts of the side wall for some circumstances.
- The model also indicated that it would be desirable to add (variable) absorption around the orchestra in some cases.

After several iterations of drawings were completed, the hall volume became V ≈ 9,500 m3, β ≈ 5.6, and the number of seats totalled NT = 715. As this would give a T0 of about 2,7 s at mid-frequencies, it was decided to add 100 m2 (metric Sabines) of fixed absorption, resulting in Tocc = 1.82 sec. which is still within acceptable limits for symphonic works.

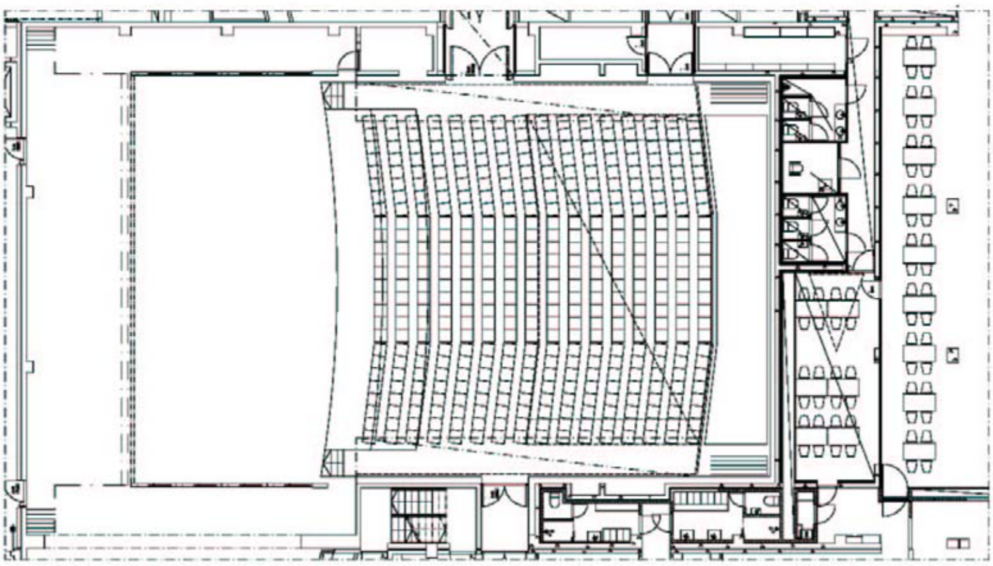


Figure 1. Plans of the Vanaja Hall, first floor

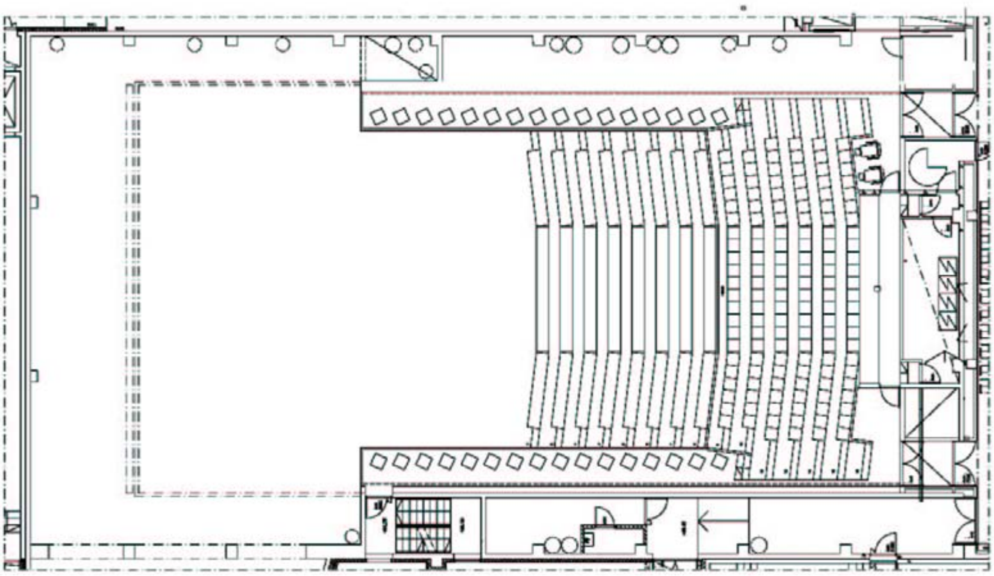


Figure 2. Plans of the Vanaja Hall, second floor

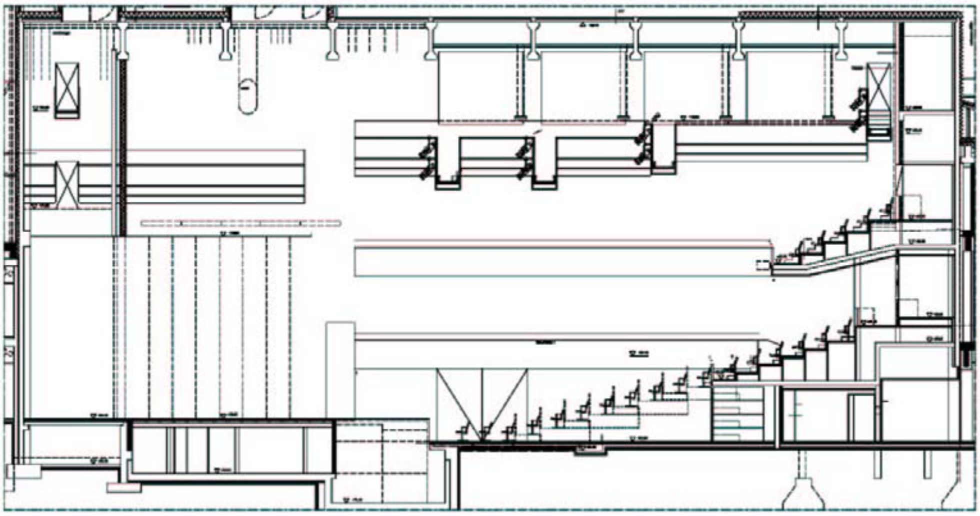


Figure 3. Length section of the Vanaja Hall

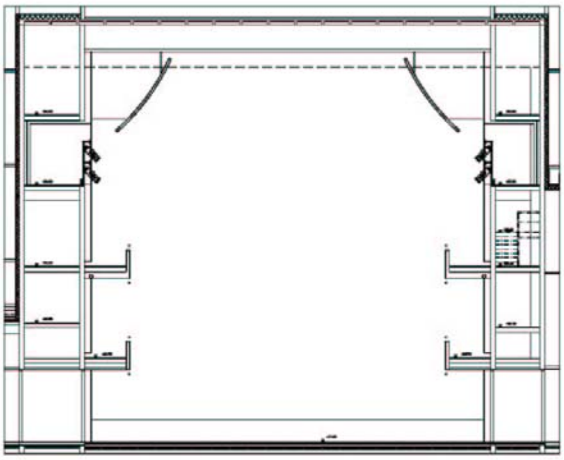


Figure 4. Cross section of the Vanaja Hall

Description of the hall

The final design is basically a shoe-box with two side box balconies and rear-balcony. Furthermore there is a third technical balcony. The length of the hall is approx 34 m, the width 18 m and the height 18 m above front floor, (17 m above the stage). The stage is in normal setting 18 m wide and 9 m deep (162 m2) and can be extended by a further 4 m into the audience. The orchestral pit is 4 m deep and 14 m wide and has a nominal depth 1.4 m below the front floor.

The seating consists of 416 on the main floor with movable risers, a fixed back floor with 140 seats, four side box balconies, with 16 seats on the lower and 17 seats on the upper balconies, and a rear upper balcony with 125 seats, yielding a total count of 715 seats.

The lower front floor riser can be configured to an extension for the upper floor seating, as is shown in the length section in Fig. 2, it can be configured to give a “half” rise with wider platforms for raised table seating, or it can be retracted to give a flat floor for banquets etc.

Both side and back wall are covered with “acoustic detailing” varying in depth from about 250 mm on the side walls and about 150 mm on the back wall. These are made of 20-30 mm MDF-boards, with an uneven surface.

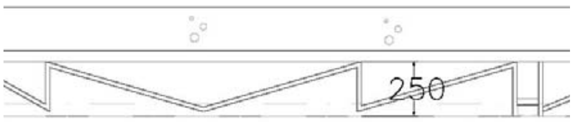


Figure 5. Side wall treatment, horizontal cut

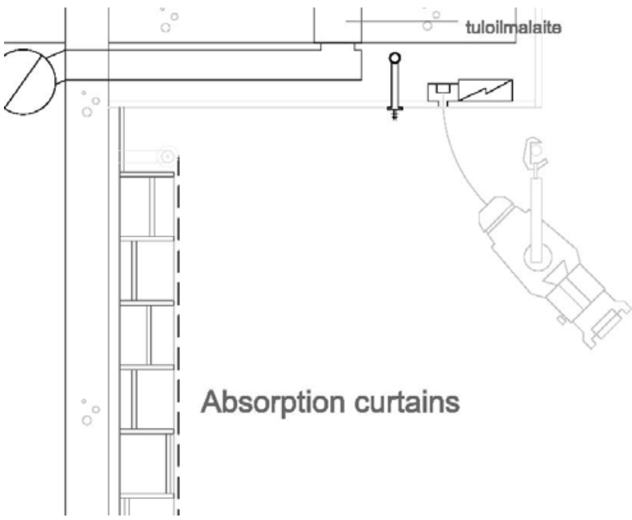


Figure 6. Side wall treatment, vertical cut

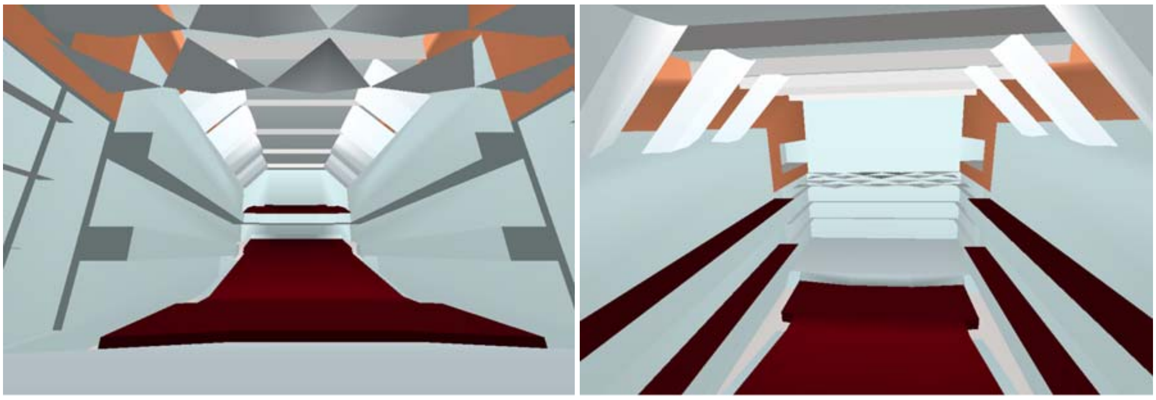
On the upper part of the side wall, there are four reflectors on either side. These are made from multilayer gypsum boards and are curved and tilted. The fixed additional absorption is place on the wall surfaces behind these reflectors.

The variable acoustics in the audience chamber are implemented by curtains. The main curtains are four double curtains which extend from the ceiling 3 m down over the whole width of the hall. It is intended that these curtains will be the primary tools of adapting the acoustic of the hall to different performances as well as to add additional damping for rehearsals.

Furthermore there are curtains which can cover most of the side walls. These curtains are rolled down approx 100 mm in front of the wall surface and are retracted into the balcony construction when not used. The curtains are operated in several groups, which for instance will make it possible to use the lower front curtains to reduce the strength of the first reflections of the orchestra.

The stage has an acoustic enclosure with a diffusing surface similar to the structure on the side walls. The side elements are moveable, they can be parked in the backstage area, and the back wall element can be hoisted, thus revealing the back and side stages. There are areas with variable absorption on the stage back wall. Furthermore the side wall elements can be moved to "vent" the stage or in other words provide more absorption on the stage.

A reflector cloud, and from approximately 1 m2 large elements can be hung above the stage, and can at the most cover 40-45% of the stage area. The reflectors are hung from the standard fly bars and are either stored vertically above the stage or removed and placed in storage.



From stage towards audience   From rear balcony towards stage

Figure 4. 3D view of Verkatehdas Hall with the ODEON program.

Conclusions

Due to building process delays, it has not been possible to make final acoustic measurements in the hall. Preliminary measurements do however indicate that the reverberation time is somewhat shorter than expected. The first orchestral rehearsals in the hall was however quite positive.

Acknowledgement

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H. Möller, T. Ilomäki, J. Auvinen and A. Ruusuvuori
Insinööritoimisto Akukon Oy
Kornetintie 4 A
00380 HELSINKI
henrik.moller@akukon.fi