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THE ACOUSTIC SITUATION AT THE ST. STEPHEN´S CATHEDRAL IN VIENNA

Maria Fellner, Franz Graf [1]
Gerhard Graber [2]
Johannes Egger, Thorsten Rohde [3]

[1] JOANNEUM RESEARCH Forschungsgesellschaft mbH
Steyrergasse 17, A-8010 Graz, Austria
Phone: +43 (316) 876-1637, Fax: +43 (316) 876-91637
maria.fellner@joanneum.at, franz.graf@joanneum.at

[2] Technical University Graz
Inffeldgasse 12, A-8010 Graz, Austria
Phone: +43 (316) 873-7435, Fax: +43 (316) 463697
graber@tugraz.at

[3] rohde-jegger acoustics
Weidweg 9, A-8051 Graz, Austria
Phone: +43 (316) 672153, Fax: +43 (316) 913485
j.egger@jegger-acoustics.at , office@rohde.at

Abstract: *During history the acoustic itself as well as the music performance at the St. Stephen´s cathedral in Vienna has changed a lot. In the presented work extenxive acoustic measurements were made and a model for room acoustic simulations was built. This is the basis for a better scientific understanding of the present acoustic situation and will help to develop a proposal for optimization of the musician´s situation.*

Key words: room acoustics, church acoustics

1. HISTORY AND PRESENT SITUATION

The St. Stephen´s cathedral in Vienna (see figure 1) was built during the Romanesque and the Gothic period. At this time the music and its performance was completely different to now (see [1] and [2]). Additionally there were some architectural changes which had an impact on room acoustics, too.

Table 1 shows a list of typical positions for music performance. Figure 2 shows this positions within the ground plan of the cathedral.

The aim of the presented work was to get a better scientifc understanding of the acoustic situation in this large room because there have no detailed measurements done before. On basis of these measurements and additional room acoustic simulations proposals for an optimization of the musician´s situation should be made.

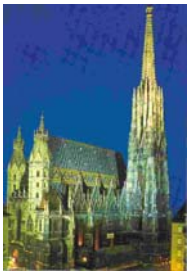

Fig.1. St. Stephen´s cathedral in Vienna

Position Nr.	Name
1	Füchselbaldachin
2	Orgelfuß
3	Neue Orgel
4	Friedrichsschiff
5	Altar Wr. Neustädter Schiff
6	Volksaltar

Table 1. Typical positions for music performance at the St. Stephen´s cathedral in Vienna

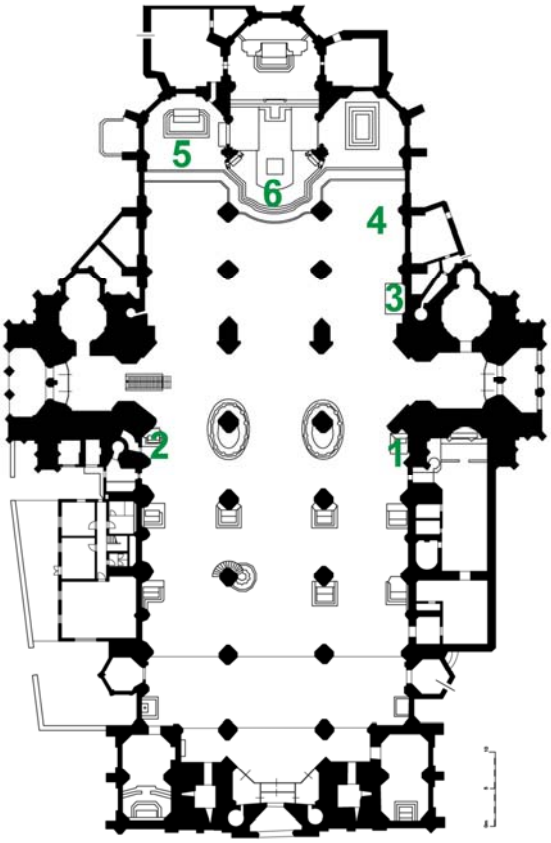

Fig.2. Ground plan of the St. Stephen´s cathedral in Vienna with typical positions for music performance (1-6)

2. MEASUREMENTS

The measurements were done with a Norsonic dodecaeder and AKG studio microphones, a PC, an 8-channel professional soundcard and the software WinMLS2000, which works with maximum length sequences.

Source positions of the dodecaeder were at position 3, 4, 5 and 6 (see fig. 1). There were in total 213 microphone positions all over the room. Figure 3 gives an impression of the measurements at the cathedral.

Fig.3. Measurements at the cathedral: the source was located at the Volksaltar and the microphones are in the Hauptschiff

For the analysis of this huge amount of measurement and simulation data a special tool for visualization was programmed. With the aid of this tool a 2-dimensional display of different user-defined parameters was possible (which is not possible within the software WinMLS).

Results of the measurements for the reverberation time T30 are shown in figure 4.

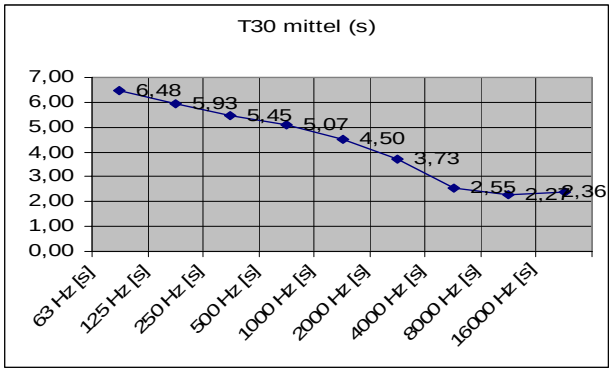

Fig.4. Results for the reverberation time T30 at source position 4 at a height of 3.0 m

Concerning the height of the source position the measurements show a significant better acoustic situation for a height of 3 meters in comparison with 1.5 meters (see figure 5).

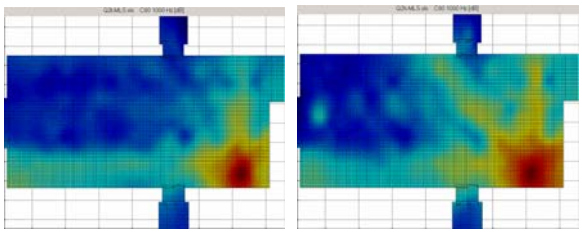

Fig.5. Results for the clarity C80 at source position 4 at 1 kHz at a height of 1.5 m (left) and 3.0 m (right)

An analysis of the hall radius has shown that there are no musical relevant so-called coupled rooms at the cathedral.

3. SIMULATIONS

The room acouctic simulations were done with the software CATT Acoustic. The modell has about 4700 planes, which reaches the limits of the software. Figure 6 shows the modell of the cathedral, figure 7 a view from the west balcony into the room.

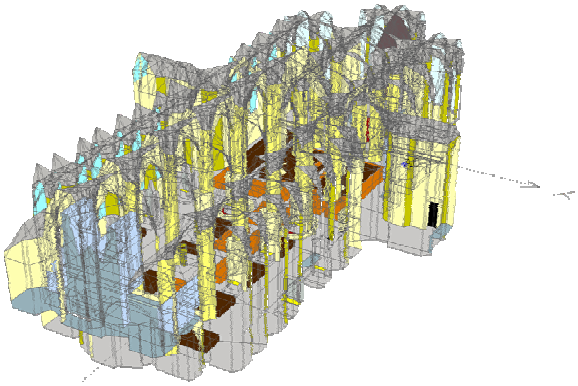

Fig.6. Room acoustic modell of the cathedral

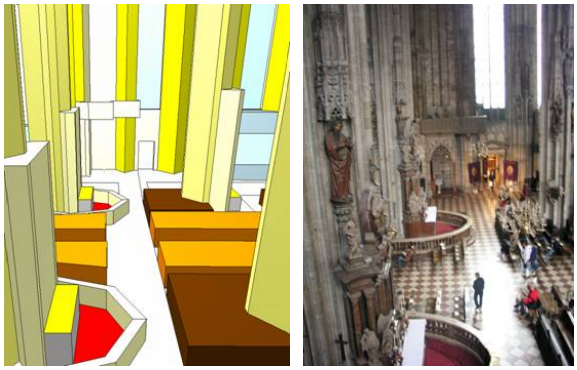

Fig.7. View from the west balcony into the room at the modell (left) and in reality (right)

The optimization of the model showed that the parameter for the air dissipation has an important effect on the calculation results.

4. POSSIBILITIES FOR OPTIMIZATION

Several variations and combinations of walls, reflectors and podiums were simulated for source position 4. These simulations showed that an optimization of the musician´s and listeners´s situation could be achieved by a higher podium and special walls for the musicians as well as reflectors in the Friedrichsschiff and the Hauptschiff for a better sound distribution (see figure 8). The impact of the directivity of musical instruments as analyzed in [3] was studied, too.
Limitations for realizing these actions are liturgical aspects and the protection of monuments.

Fig.8. An example for walls and reflectors for an optimization of the musician´s and listeners´s situation

5. CONCLUSION

In this project the fine structure of the acoustic situation in a Gothic cathedral was investigated. Measurements as well as simulations have shown that there are no so-called coupled rooms at the St. Stephen´s cathedral in Vienna. The position for music performance in the Friedrichsschiff (position 4) is the best one regarding the given liturgical and musical circumstances.

An optimization of the musician´s and listeners´s situation could be achieved by a higher podium and special walls for the musicians as well as reflectors in the Friedrichsschiff and the Hauptschiff for a better sound distribution. Limitations for realizing these actions are liturgical aspects and the protection of monuments.

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