ELECTROACOUSTIC CORRECTION OF AUDITORIA WHICH HAVE POORLY COUPLED SPACES USING A SIAP SYSTEM, A CASE STUDY

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1. SUMMARY

The increasing demand for more seating capacity in auditoria leads to more and larger balconies. However, the acoustic coupling of the spaces under and above the balcony to the main volume is usually a problem. This makes for difficulty in selling seats in these areas. Improving the acoustic coupling is generally difficult. This paper describes an electro-acoustic solution which has been applied to a theatre where the overall seating capacity was tripled just by moving the back wall, thus increasing both the balcony and the under balcony areas considerably.

2. BACKGROUND

The Royal Dutch Theatre in Antwerp (Belgium) was a normal sized traditional drama theatre constructed in the sixties. In 1994 the theatre was sold to a private company which redeveloped the theatre for large scale, open end, musical productions, ballet, concerts etc. However, to make a profit, the seating capacity of about 800 seats was not sufficient.

To improve the seating capacity, it was decided to increase the depth of the hall by moving the backwall (fig.1). This resulted in a seating capacity of just over 2000. As a result the balcony (24 rows, about 1000 seats) and the under balcony area (12 rows, about 400 seats) became excessively large.

The problems of these large areas, which would be poorly coupled to the main volume, were recognized by the acoustic consultant. As about 70% of the total seating capacity of the theatre is in this area, the need for an appropriate solution was of the paramount importance. In addition the natural acoustics of the hall would not be of the standard normally expected in a leading performance venue but without any advanced delay systems a reinforced sound would have little flexibility.

Evaluating these problems, the application of a SIAP system was recommended, as this would not only realize the desired acoustic qualities for opera and concerts [1,2,3], but also could solve the problem of the coupled spaces.

3. IMPLEMENTATION OF THE SIAP SYSTEM

The working principles and implementation of a SIAP system are extensively described in a previous paper [3], figure 2 gives the loudspeaker and microphone positions applied for the Royal Dutch Theatre. Within the SIAP system approach loudspeakers are carefully allied to the audience areas to obtain an even sound distribution.

As there is no orchestra shell available, the system in the Royal Dutch Theatre also comprises a stage system to improve foldback and the stage acoustics for both speech and music performances.

Figure 3 gives the reverberation times for the SIAP system off and three of the eight available settings.

4. RESULTS

After the completion of the project, the sound distribution has been measured from two source postions. At each source position measurements were taken at system off and SIAP settings 1 (Speech), 4 (Symphonic music) and 6 (Choir with orchestra). The results are reproduced in figures 4 and 5. From these graphs it can be seen clearly that the natural acoustics result in a very poor signal level at the back of the hall. Due to the fan shape of the hall and its low ceiling there is no proper development of reverberant sound. With the SIAP system the level flattens out as would be the case if a proper reverberant field was developed. This is even the case at setting 1 where there is no significant increase of the natural reverberation time. From this it can be seen that the flattening is not just a result of creating more reverberant sound but - mainly - from a better distribution of the acoustic energy over the space.

5. CONCLUSIONS

Using a SIAP system, the overall acoustic performance of a theatre was improved. Not only the obvious modification of reverberation time was achieved, but also a better sound distribution over the entire volume, including poorly coupled spaces like balconies and under balcony areas. Also the absence of an orchestra shell can be fully compensated when a SIAP system is applied. Reports from the Flanders Royal Philharmonic Orchestra confirm the latter.

References

[1] W. PRINSSEN, 'System for Improved Acoustic Performance', Dutch Acoustical Society Journal no. 109 (1991)

[2] W. PRINSSEN AND M. HOLDEN, 'System for Improved Acoustic Performance', Proceedings of the Institute of Acoustics, Vol. 14: part 2 (1992)

[3] W. PRINSSEN AND B. KOK, 'Technical innovations in the field of electronic modification of acoustic spaces', Proceedings of the Institute of Acoustics, Vol. 16: part 4 (1994)

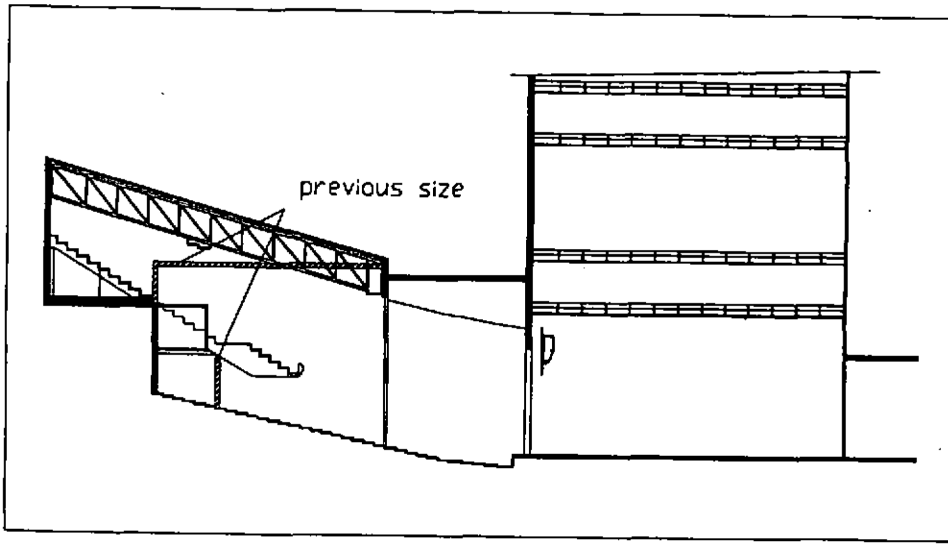

Figure 1. Royal Dutch Theatre in Antwerp (Belgium)

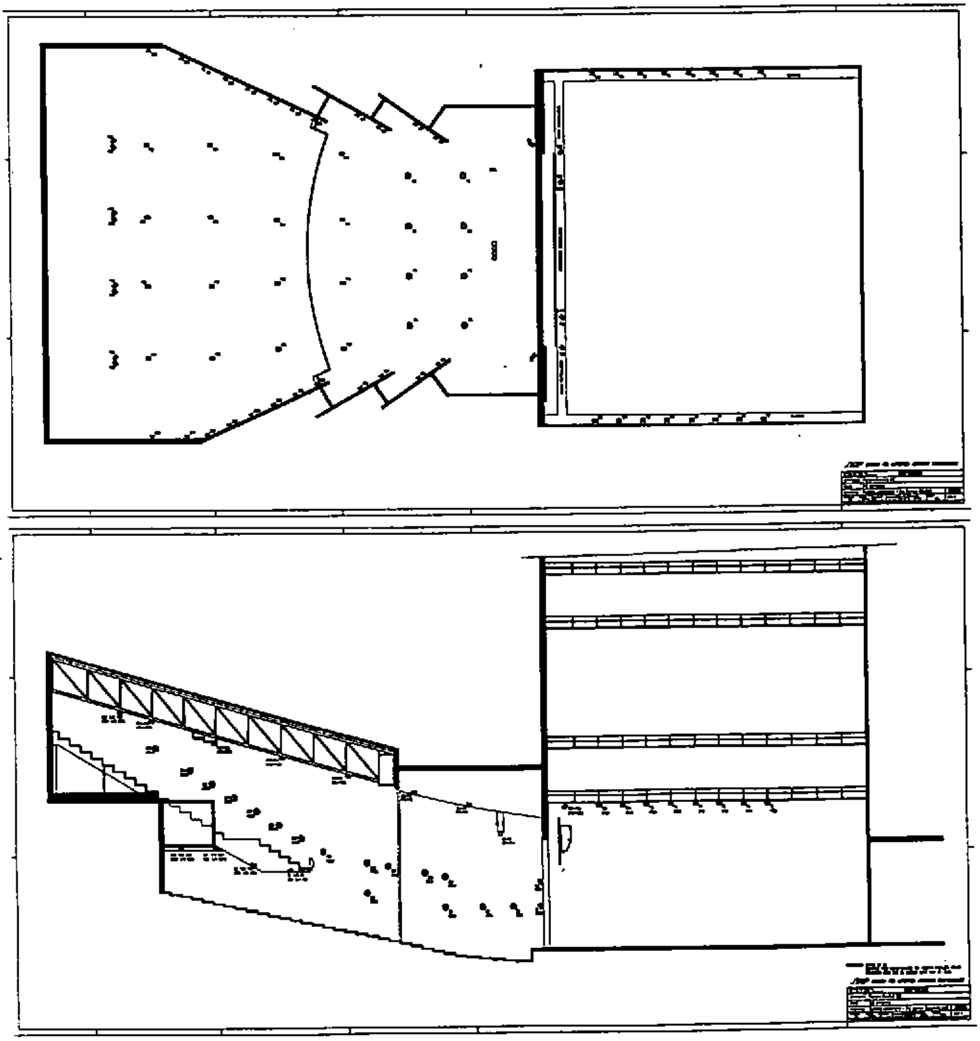

Figure 2. Loudspeaker placement

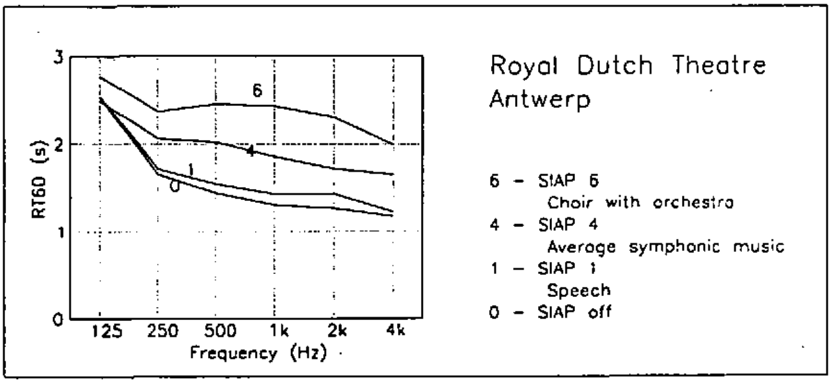

Figure 3. Reverberation time

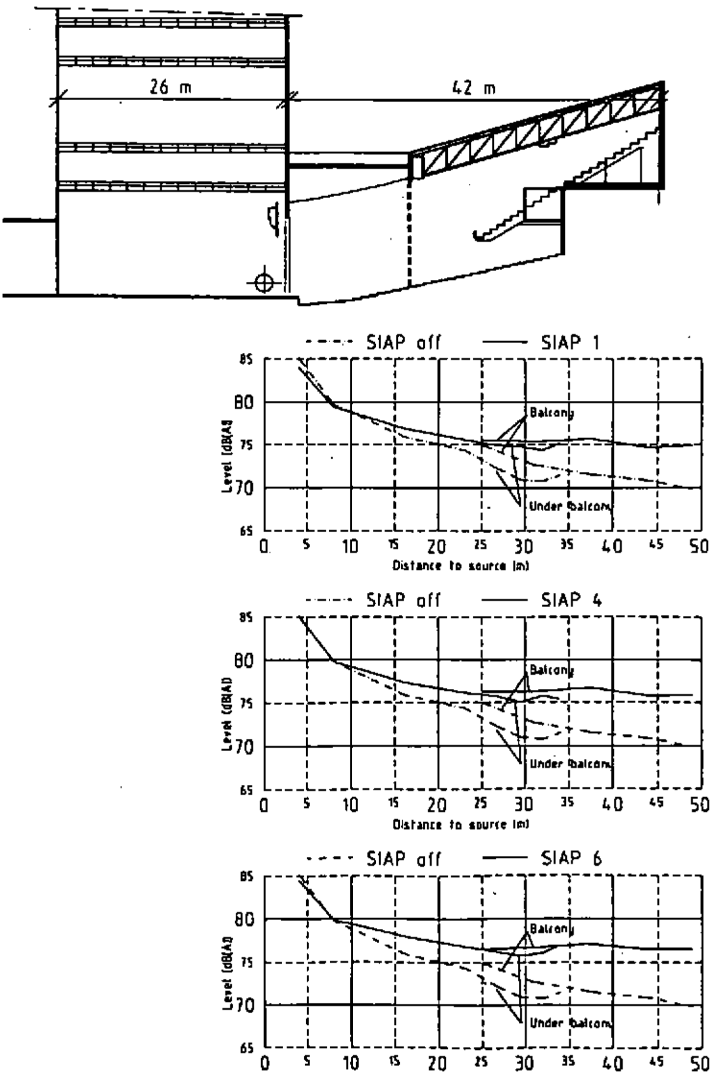

Figure 4. Level vs distance, source front of stage

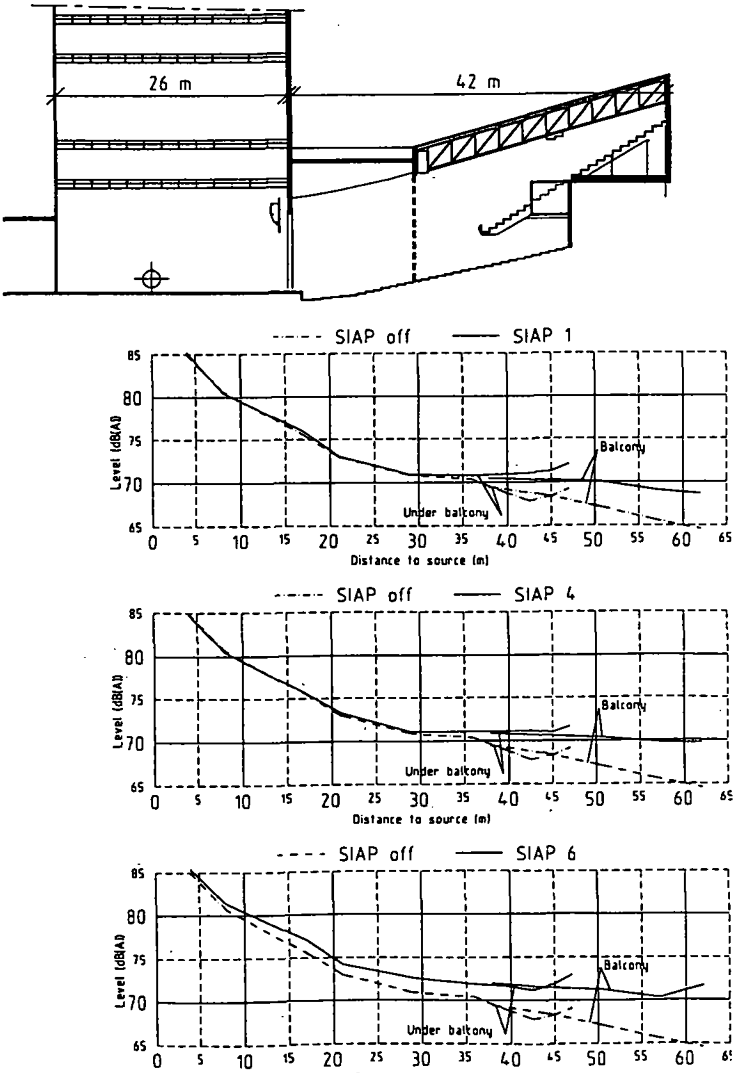

Figure 5. Level vs distance, source rear of stage