

IBSEN/PEER GYNT IN A STONE QUARRY, WHO NEEDS AN ACOUSTICIAN?

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1. INTRODUCTION

This paper will give the acoustic experiences of an outdoor theatre in a stone quarry, highly acclaimed for its excellent speech acoustics. The reason for the good acoustics is not an "arkestra" platform like the old greek amphi- theatres, but massive stone walls at the rear of the huge "stage". This theatre gives the actors the possibility of adjusting the voice and the direction of head in a very elegant manner, and use echoes as an effect in the performance. The acoustic measurements indicate that one should not use omni-directional loudspeakers when measuring details of theatre acoustics.

2. ABOUT THE SITE

Fjaereheia is an outdoor theatre in a stone quarry in the south of Norway, near the small town Grimstad, where Ibsen in his early days spent some unlucky years as a chemist's apprentice.

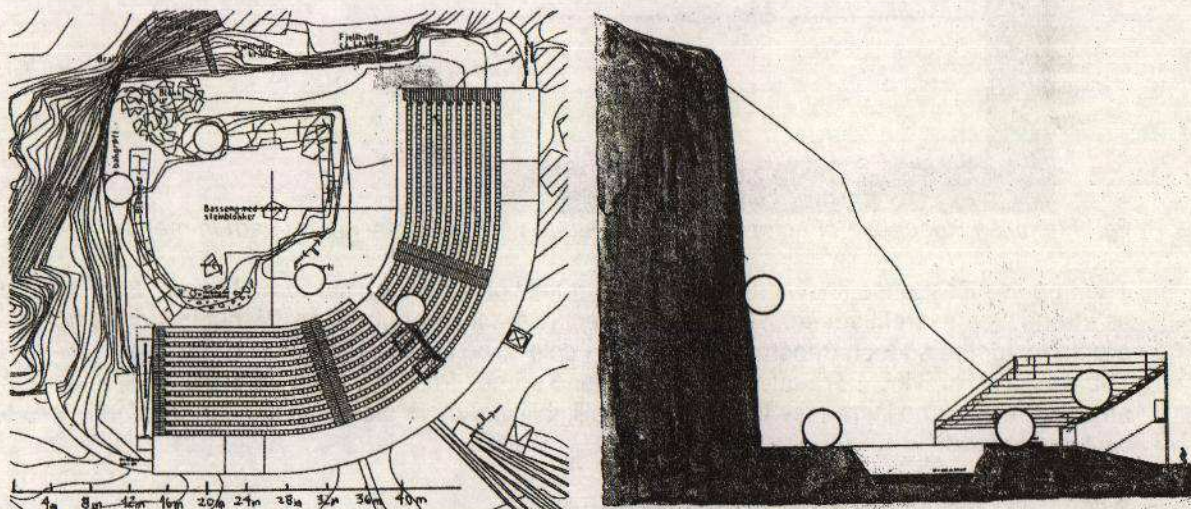


fig. 1+2 Plan and Section of the outdoor theatre

The outdoor theatre is run by Agder Theatre, a regional theatre situated in Kristiansand, the closest city. The site has been used for theatre performances for some years, with a temporary amphi made of wood. I did acoustic measurements for this situation and experienced the performance of Ibsen: "Peer Gynt", 1998, and assisted that new amphi, made of concrete in 1999, secured the natural good acoustics. (The theatre reports that the new amphi has even better acoustics, for the 99-season of the same performance).

"Peer Gynt" was done totally without electronic amplification (except for effects and the music playback), even if the distance from the most remote actors position is more than 45m. The most surprising experience was that the actors speech, at the longest distances, was by all means the "clearest". The close reflections from the stone back wall should be a good exercise for all students of scenography.

If our measurements had been taken with an omni-directional loudspeaker, one would have stated that most of the positions for actors should be impossible. Some of them are problematic, but most of them are quit satisfactory, due to the directivity of the mouth and the actors possibility to change the direction of his head. The close reflections from the stone walls will of course give coloration (see [1] and [2]), but as this coloration appears natural for the site, this does not give any problems for the listener, and increases the speech intelligibility.

All the figures in this paper are given with a time axis as "meters" travelling distance ($c=343$ m/s). All measurements are taken with MLS-equipment, and a small, non-omni-directional loudspeaker (Fostex SPA-11), in order to somewhat simulate the directional properties of the human mouth. The receiver microphone was an omni-directional AKG.

(Due to practical reasons, the signal level is not the same for all the source positions. A comparison of sound levels from the different positions would be very interesting, but is therefore not possible.)

3. ACOUSTIC MEASUREMENTS

3.1 Actor close to the stone wall

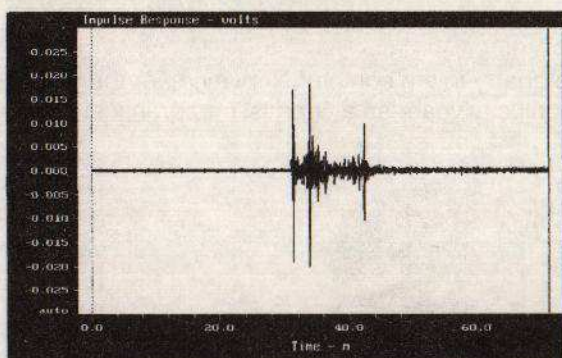


fig. 3 Impulse Response of actor close to the stone wall. (x-axis = sound path in meters)

The Impulse Response shows a strong, close reflections from the stone wall (within 3 m) This reflection is as strong as the direct sound. Such close reflections will give coloration [1], but this does not give any problems for the speech transmission, and the coloration appears "natural" in this site.

The reflection arriving 12 m after the direct sound comes from the opposite stone wall, and does not give any clear echo, and increases the speech intelligibility. Actors placed at this far positions were extremely well understood.

3.2 Actor at centre - stone- position

Impulse Responses for actors facing the amphi and facing the rear stone-wall is given in fig. 4 a+b.

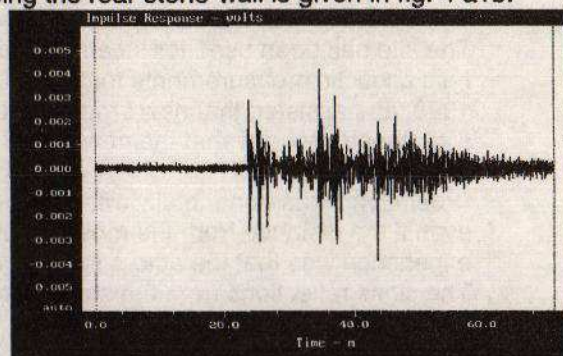
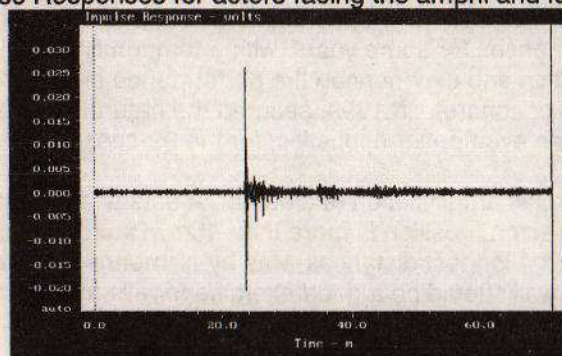


fig. 4 Impulse Response from "centre" a)=Facing amphi

b)=Facing stone walls

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Facing the audience, the actor does not get much acoustical "help". When facing the stone walls, in fig 4b) we see strong reflections 10m after the direct sound, from the stone walls, that will increase the speech intelligibility. After some 20m we get the reflection from the corner between these stone walls. These last reflections give echoes. These effects were carefully used by the actors in their performance.

3.3 Actor in front of the amphi

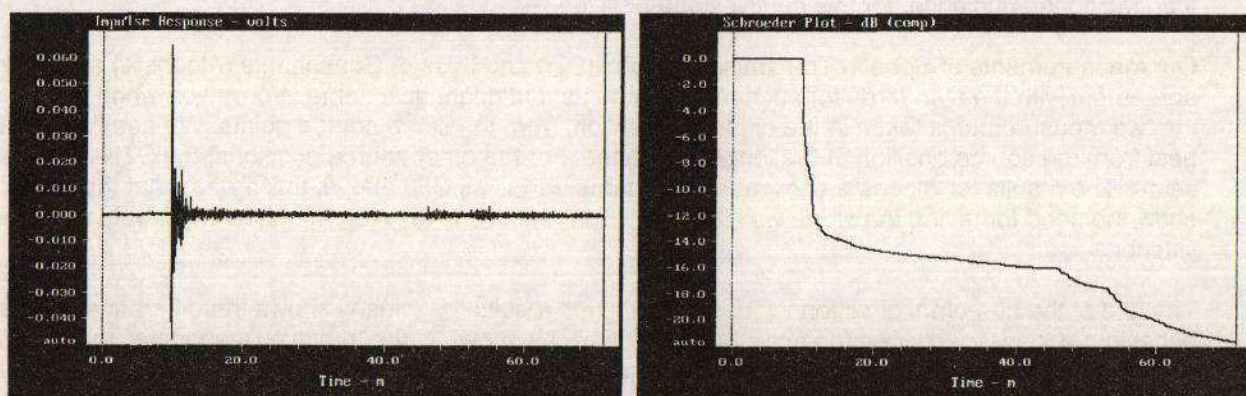


Fig. 5a+b, Impulse Response and Schroeder-curve for Actor Facing the audience

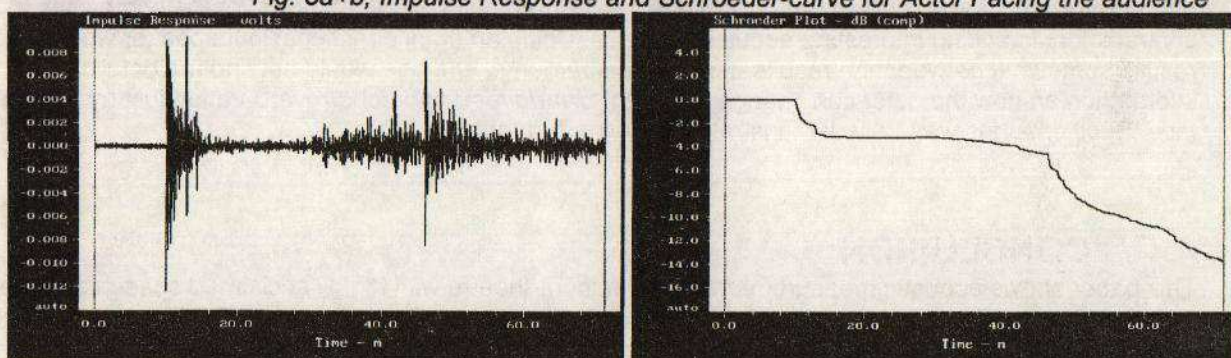


Fig. 6a+b, Impulse Response and Schroeder-curve for Actor Facing the stone wall

The theatre had the experience that the front positions of the actors were in fact the most problematic with respect to speech, even though they are placed very close to the amphi. This is because these positions do not get any close reflections, because of the massive absorption in the ranked audience amphi. On the other hand, strong "outbursts" from this position, facing the stone wall was very dramatic. The actor has the possibility to change between "close/near" and "broad/reverberant".

It is also interesting to notice that actions on the front stage gives broad "stereo"-reflections from the stone walls. This was very well used in the big "wedding" scene of Peer Gynt, which was sonically magnified and broadened due to these reflections. Happily, such reflections also appear for the audience applause.

3.4 Discussion/Acoustic Parameters (1000 Hz)

	C50	"STI"	"Alcons"	EDT	RT (-5, -25 dB)
<u>Close to Stone Wall</u>	10.8	0.7	2.9	0.2	1.1
<u>On Centre Stone</u>					
Towards audience	4.5	0.6	5.3	1.1	1.1
Towards stone wall	-0.4	0.6	7.3	0.6	1.1
<u>In front of Audience-Amphi</u>					
Towards audience	8.0	0.9	1.9	1.7	1.0
Toward Stone Wall	-1.6	0.6	5.6	1.2	0.9

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The measured C50 corresponds very well with the experiences from the performance. The source position close to the stone wall is extremely clear, (it also has high volume/strength at the listener position). For the position on the centre stone, we see that the C50 is reduced when facing the stone wall, compared to facing the audience. This is because of the reflections after some 20m etc, giving echo etc., discussed above. However, in practical use, with trained actors, the benefit of extra volume/strength more than compensates this lack of clarity, so that as a total, the direction of the actor facing the stone walls is better than facing the audience, for this centre-stone-position.

Our measurements of Speech Transmission Index (STI) and Loss of Consonants (Alcons%) are not in agreement with the standards for such measurements, but might give some information when comparing the two measurements taken in the different direction, from the same source points. We see that STI is best from the source position at the longest distance. For the other source positions, the STI is about the same. The results for Alcons% show about the same trends as C50 above, this means that they do not show the need for facing the stone wall to get enough reflections to give enough strength/volume at the listener.

The use of the non-omni directional loudspeaker gives results that clearly shows the difference in reflection behaviour experienced when the actor turns his head. As shown in the Impulse Responses, the sound decays are often far from linear, and the measured reverberation times give only a slight indication of the acoustic environment. In standardised room-acoustic-measurements, omni directional loudspeakers are often preferred, in order to give reproducible results. Reproducibility might, however, be somewhat contradictory to finding interesting acoustical results. Using an omni directional loudspeaker would give results somewhat between the results of our measurements, and one would not find the detailed information on how the actor can change between "clear/direct" and echo/reverberation just by turning his face. Such changes was truly demonstrated in the performance.

4. CONCLUSION

This paper shows acoustic measurements in an outdoor theatre with highly acclaimed speech acoustics. In order to investigate the acoustics, one must watch the Impulse Responses in detail. The nuances of this outdoor theatre could not have been judged by measurements with an omni directional loudspeaker, investigating the common room acoustic criterias alone.

References:

- [1] Tor Halmrast: *"Orchestral Timbre, Combfilter-Coloration from reflections"*
Journal of Sound and Vibration, sp.ed Opera Hall Acoustics 99 (in print)
- [2] Tor Halmrast: *"Measurements of orchestra acoustics.*
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