

ACOUSTICAL EVALUATION OF TEMPORARY PERFORMANCE FACILITIES

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1. INTRODUCTION

Considerable research has been conducted in understanding as well as designing acoustics of performance spaces of conventional auditoria used for music, drama and speech. However, not much is known about the acoustics of spaces used for temporary performances. Typical examples of such spaces are the large group of venues used for jazz festivals. Large single arena, temporary of course, is used for the jazz festivals in Toronto and Halifax. On the other hand Montreal uses a number of venues, including one large space, for the Montreal Jazz Festival held every July. The acoustics of the three main arenas of Toronto, Montreal and Halifax was investigated. Computer simulations of the three venues were conducted. In addition, simple surveys of the stakeholders of the three venues were undertaken to compare the simulation with audience satisfaction. Complete details of the study can be found in the Master's thesis of Ben Gaum¹. The results of the acoustics of temporary performance facilities will be presented.

2. BACKGROUND

The main phase of the research will consist of a simulation study (objective) and a subjective survey data collection and analysis. The experiment being set up will focus on looking at three different temporary structures that have been erected for the purpose of musical performances for various jazz festivals across Canada and will include: *The Atlantic Jazz Festival*, *The Montreal Jazz Festival* and the *Toronto Jazz Festival*. The three temporary structures used in this study are shown in Figure 1. The details of the three spaces are: (a) Toronto – Main tent 30 m (L) X 45 m (W) with overall height of 8.5 m; seating capacity of 1200; aluminum and steel frames with 21 ounce vinyl fabric roof and sides; (b) Halifax – 60' (L) X 130' (W) with overall height of 27'; seating capacity of 1200; aluminum and steel frames with 21 ounce vinyl fabric roof and sides; and (c) Montreal – Open air/covered stage; Stage 42' (L) X 44' (W) with overall height of 29'; seating capacity open spaced; wood and steel frames with wood panelling for the stage.

The results presented in this paper have focussed on the objective and subjective analysis techniques of Beranek². The study has combined the collection of acoustical data on both the scientific engineering and subjective levels in order to find a connection between architectural form and the subjective interpretation of music. Upon gathering structural and layout information about the spaces themselves, a 3D model was constructed and analyzed using acoustical engineering software, *CATT Acoustics*³. As an additional element of the simulation study, an acoustics survey was also conducted to gather subjective data from the various

venues themselves. In order to maintain a level of consistency for all the surveys, a single song from a single band that has been played in all three venues was used as a base for the survey analysis. The survey was given to individual musicians, technicians and engineers that were directly linked to and involved with the venues in order to obtain an accurate account of what the sound quality and acoustics were like in that specific venue when the specific song was played.



(a)



(b)



(c)

Figure 1. Temporary Performance Facilities – a) Toronto Jazz Venue; b) Atlantic Jazz Festival venue; and c) Montreal Jazz Festival venue.

3. OBJECTIVE ANALYSIS

The objective analysis involved a simulation study of the three venues using *CATT Acoustics*. The simulation model requires information about the specific venues with regards to overall dimensions, layouts, materials and surrounding site conditions. After all the important information was acquired, 3D models were built that included material

attributes for each face that would be able to be read and analyzed in CATT Acoustics. Proper locations for sources and receivers of sound had to be properly placed in the model as well as sound absorbing coefficients for each material used. A typical CATT Acoustics screen for the Halifax venue is shown in Figure 2.

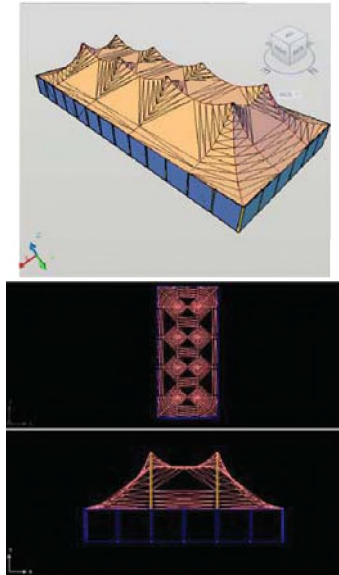


Figure 2. CATT Acoustic rendering of Halifax Venue

Upon completion of the model building for each venue, the models were then analyzed for various acoustic properties, focussing on the *quantitative* properties that would most accurately match the *qualitative* properties that would be looked at in Section 4, the survey study. The quantitative properties that were looked at in the simulation study were: a) C-80 (Clarity); b) SPL (Sound Pressure Level); c) G (Total Sound Level or Loudness); and d) RT (Reverberation time). The quantitative results for the three venues are shown in Table 1 below. It is seen that the four parameters

are well within the acceptable range except the RT for Toronto venue is higher than optimum.

4. SUBJECTIVE SURVEY

The survey being used in this study is largely based on the survey questionnaire of Beranek² for his study. The survey focuses again on the three members of *The New Deal*, as well as other musicians who have played in the venues, technicians and engineers who have worked the venues and manufacturers of the structures themselves. The 10 survey questions are: *Clarity* (1-muddy and 10-clear); *Balance 1* – treble (1-weak and 10-loud); *Balance 2* – bass (1-weak and 10-loud); *Balance 3* – singers (1-weak and 10-loud); *Noise* (1-Intolerable and 10 inaudible); *Overall Impression* (1-poor and 10-excellent); *Reverberance* (1-poor and 10-excellent); *Envelopment* (1-poor and 10-excellent); *Intimacy* (1-poor and 10-excellent); and *Loudness* (1-poor and 10-excellent). The results of the survey were gathered and organized into an easy to read, quantitative format for analysis. In total, 30 surveys were filled out with 10 surveys per venue. The results of the survey are presented in Table 2 below. Toronto and Halifax venues are seen to be in the mid-high acceptance range where as Montreal seems to have many unhappy users due to its open air/closed stage design.

REFERENCES

1. Ben Gaum, “Sound Created Form,” *M.Arch. Thesis*, Ryerson University, Toronto (2009).
2. L. L. Beranek, *Concert Halls and Opera Houses, music, acoustics and architecture*, Springer Verlag, New York (2004).
3. CATT Acoustics. V8.0g(build 2.02) CATT (1998-2007).
4. M. Mehta et.al. *Architectural Acoustics: Principles and Design*. Prentice Hall. (1998)

Table 1. CATT Acoustics results for the three venues .

Factor	Toronto	Halifax	Montreal
C-80 – Average of 500, 1000 and 2000 Hz bands (-1 dB to +4 dB) ⁴	0 dB	5 dB (high)	0 dB
SPL: in 500, 1000 and 2000 Hz	Uniform	Uniform	Uneven
G: 0 to 5 dB acceptable in 500 and 1000 Hz bands ^{2,4}	9 to 10 dB	0 to 5.5 dB	0 dB (low)
RT: acceptable around 1 to 1.2 secs	3.5 secs (H)	1.2 secs	0.8 secs-low

Table 2. Survey results for the three venues.

Factor*	A	B	C	D	E	F	G	H	I	J
Toronto	7.5	5.5	6	7	7	5.5	7	7.5	5.5	7.5
Halifax	8	5.5	5.5	8	7.5	5.5	7.5	7	6.5	7
Montreal	4.5	7.5	7	4	8	5	8	6	4	6.5

*NOTE: A-Clarity; B-Reverberance; C-Envelopment; D-Intimacy; E-Loudness; F-Balance 1; G-Balance 2; H-Balance 3; I-Background Noise; and J-Overall Impression.