

The Effect of Modular Acoustics on a Performer's Perception in Multiple-use  
(symphonic and operatic) Concert Halls

by

Jennifer DeBoer

Submitted to the Department of Mechanical Engineering in Partial Fulfillment of the  
Requirements for the Degree of

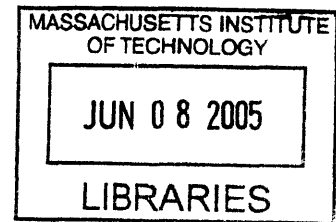
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ADJUSTABLE ACOUSTICS AND THEIR EFFECT ON  
INSTRUMENTAL AND VOCAL MUSICIANS

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ABSTRACT

This thesis studies the varying degrees in a performer's perception of the difference in the adjustable acoustics of a specific performance hall, namely, what is the difference between the opinions of instrumentalists and vocal musicians? Reverberation times in the Rogers Center auditorium in Andover, MA were taken onstage with the hall's acoustical curtains either hidden or exposed. Performers in the school musical and in a local symphony group were given surveys after doing two rehearsals in the hall, one in each configuration.

The results from the reverberation time measurements show a clear difference between reverberation times perceived onstage. Performer surveys, however, show that neither group of performers noticed a strong contrast between different configurations of the curtains. They did, however, respond strongly when acoustics were changed that affected reflective surfaces directly surrounding them.

Thesis Supervisor: Carl Rosenberg

Title: Lecturer, Department of Architecture

## **I. Background**

Architectural acousticians must try to define what makes one performance space better than another. The judgment is, however, initially instinctual and subjective, so it is difficult to compare one performance space to another in objective terms. One of the biggest challenges today is the demand for high-quality performance spaces that can service a wide variety of performance genres; people want multi-purpose rooms that will yield a lovely symphonic sound and then allow for a clear, easily-understood speech the next day.

Opera or musicals present a unique problem for the acoustics architect. While the instrumental and vocal musicality fall under the common heading of "concert" or "classical" music, the sung or spoken words that are not part of a song but instead advance the plot are vital to the audience comprehension of the story. Thus, it is important that they be heard and understood. Speech comprehension is determined by the reverberation time of the room and its high-frequency absorption (Cowan, 30).

One of the simplest ways to provide for varying demands on a performance space is to give it adjustable acoustical properties—surfaces like curtains or walls that can be changed to absorb or reflect more or less sound. Adjustable acoustics offers an inexpensive method of quickly changing the acoustical properties of a space. More reflective surfaces increase the reverberation time of the space, while additional absorptive surfaces do the opposite. Increased reverberation time is often thought of as beneficial to classical (instrumental) performance, while less reverberation time allows speech to be more intelligible.

Historically, architectural acoustics was approached differently from modern practice. During the Baroque, Rococo, and Classical periods, when opera was coming into the broad public domain and opera houses were built for every little town, composers wrote their music not only for the specific performance hall but sometimes even for a specific performer. They created music to be optimized by the performers' voices and the space more for their own commercial benefit (opera was a large market at this time) than for the art itself. The music was therefore tailored to suit the established capabilities of the spaces and the singers. This project, however, attempts to do the opposite—to find how best to tailor the performance space to the music.

Opera encompasses a wide variety of acoustic elements: musical instruments accompanying voices, highly skilled and trained vocalists singing words that must be comprehensible, and the theatrical element which raises the concerns of movement around a stage and complementary props. There are many types of opera, each with slightly different acoustical needs. Some involve the spoken word, some involve large choirs, and some require few instruments in the pit. All are separated from other vocal or symphonic performance by the mixture of these many aspects into a veritable acoustical challenge. Variable acoustics would be ideally suited for adjusting the acoustics to suit each type of opera. These different types of opera have different acoustical demands on the performers and the space. There is as much of a difference in the acoustics needs of a crisp, intricate Baroque piece and a thickly orchestrated Romantic piece as there is between the needs of a lecture hall and a concert space. This project will have to take this into account and incorporate modularity between types of operatic performances as well as between opera and symphony.

The adjustments made to a hall's characteristics shapes the sound the audience hears. But what affect does it have on the sound received by the performers? And, more importantly, how do they respond to these changes? It has been shown that operatic singers adjust their singing with a fine tuning to be able to project over their accompanying orchestra (Prodi, 771). In this manner, other musicians adjust their own playing based on the feedback they receive in real time. The most immediate control on the nature of a performance is the control in the hands of the performers. They cannot control the reverberation time or the availability of reflective surfaces in the performance space. They can, however, change their delivery to suit the properties of the hall. This project will delve into the difference in a hall's acoustical properties as perceived by the performers. It will concentrate on the property of reverberation time, the time it takes for a sound's intensity to be reduced by 60 dB after the source of sound is stopped. This property is directly proportional to the room's volume and inversely proportional to the absorption in the room, both of which can be controlled using adjustable acoustics.

## II. HYPOTHESIS

I am trying to correlate the quantifiable difference in onstage reverberation time in a hall with adjustable acoustics and the perceived difference from the point of view of the performer in that space. From what I have read and drawn from my personal experience as a musician, I believe that the performers, whether instrumentalists or vocalists, will enjoy their sound more with the absorbent curtain wall removed, when their sound will ring for longer and their high frequencies will have a brighter tone. I believe the singers will not notice as much of a difference in their intelligibility as may be expected with the absorbent curtains, and I think they will not want to sacrifice the heightened sound quality for the sake of audience comprehension when they can control this aspect themselves, through more enunciated diction.

Performance halls are designed to fit the acoustical needs of the performances within them. Multi-purpose halls must cater to the demands of different types of performances. They therefore often employ certain types of adjustable acoustics. One of the most widely used is a movable curtain wall that dampens the sound in the hall. It can be opened or closed to encompass the audience's space and change the reverberation time of the hall. The distinction is usually made between musical performances and lectures; the curtains are open for the musical performance to allow the sound to ring in the hall, and they are closed for lectures to dampen the sound as much as possible and make the speaker easily understood. Many other halls use acoustical shells to change the direction or behavior of the sound as it is reflected. But what if the musical performance includes sung text—musical words?

I would like to make the distinction between acoustics adjusted for instrumentalists and acoustics adjusted for singers. And more importantly, I would like to know if the subtle difference between music with sung text and music that is purely instrumental manifests itself in the performers' perception of the adjusted acoustics. Can they tell the difference when the space is changed? How do they adjust their performance to fit the different acoustical properties? Do they react differently to the changed environment? I will be looking for properties of the hall that performers seem to respond to more and noting general trends in their preferences.

### **III. PROCEDURE**

#### **A. Location**

The Rogers Center is a 600-seat auditorium located on the campus of Merrimack College in Andover, MA. It is used for student and community events such as concerts, lectures, and theater and dance performances. To adjust the acoustical properties of the hall to fit the type of performance, the Rogers Center is equipped with 6 curtains that can be exposed or hidden along the side and rear walls to control reverberation in the audience area (see Figure 1). The distance from the stage to the rear wall is 120 ft. The stage is effectively 40 ft. wide and the face is 18 ft. tall. From the stage curtain, the greatest distance on the floor is 12 ft. towards the audience and 33 ft. to the stage rear.



**Figure 1 View of the Rogers Center auditorium with the acoustical curtains hidden.**

Also, the stage is equipped with vertical acoustical shells. There are shells that can be moved into position at the rear of the stage, at the side, and above the stage itself.



Interestingly, the curtains on both of the side wall panels run in front of the wooden slats (see Figure 2), while the curtains on the rear wall run behind the grill of wooden slats (see Figure 3).



**Figure 2** The curtains in the hall when closed. Note the side wall curtains pass in front of the wooden grill while those on the back pass behind the wooden grill.



**Figure 3** The passage for the acoustical curtains. Note this wall is on the side of the theater and the curtains pass in front of the wooden grill.

## **B. Reverberation tests**

To be able to compare performers' reactions to the changed reverberation time due to the curtains, I needed to first measure the onstage reverberation time. I did so using a speaker projecting pink noise as a sound source and a RION receiver. (Pink noise is white noise, sound that contains every frequency, which is filtered to make a sound wave with equal energy at every octave.) The RION receiver measured the decibel level in the hall at 9 different frequencies. It took samples every 2 milliseconds for 4 seconds at 16 Hz, 31 Hz, 61.5 Hz, 125 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, and 8 kHz. I first measured the reverberation time in the hall with the curtains opened and closed from the center of

the third row of the audience. I did this to have a base measurement to which I could compare my subsequent measurements.

To determine the quantitative characteristics of the stage's acoustics, I recorded the reverberation time in various positions with various stage configurations. The first measurements were done with the hall acoustics fully open, that is, the curtain walls were all stowed away. The hall was empty and the stage shells were pushed to the rear for floor space sufficient for the musical. The first test was done to establish a baseline for the hall's reverberation time. It was done sitting in the third row in the audience with the speaker in the center of the stage. For the second and sixth test, the speaker was in the center of the stage and the receiver was on the right (A) and the left (B). For the third and seventh test, the speaker was on one side of the stage and the receiver was on the same side (A) and the opposite side (B). For the fifth test, the receiver was in the center of the stage and the speaker was on the right (A) and the left (B). These three configurations create a thorough picture of the reverberation environment onstage. The following diagram and description outline the exact configurations for each test. These various configurations simulate the different positions the performers of a musical or a multiple-person instrumental group may be in and the different ways they may hear their or their compatriots' sounds. These tests were all repeated with the acoustic curtains drawn (the two panels on each side wall and the two panels in the rear) (Figure 2).

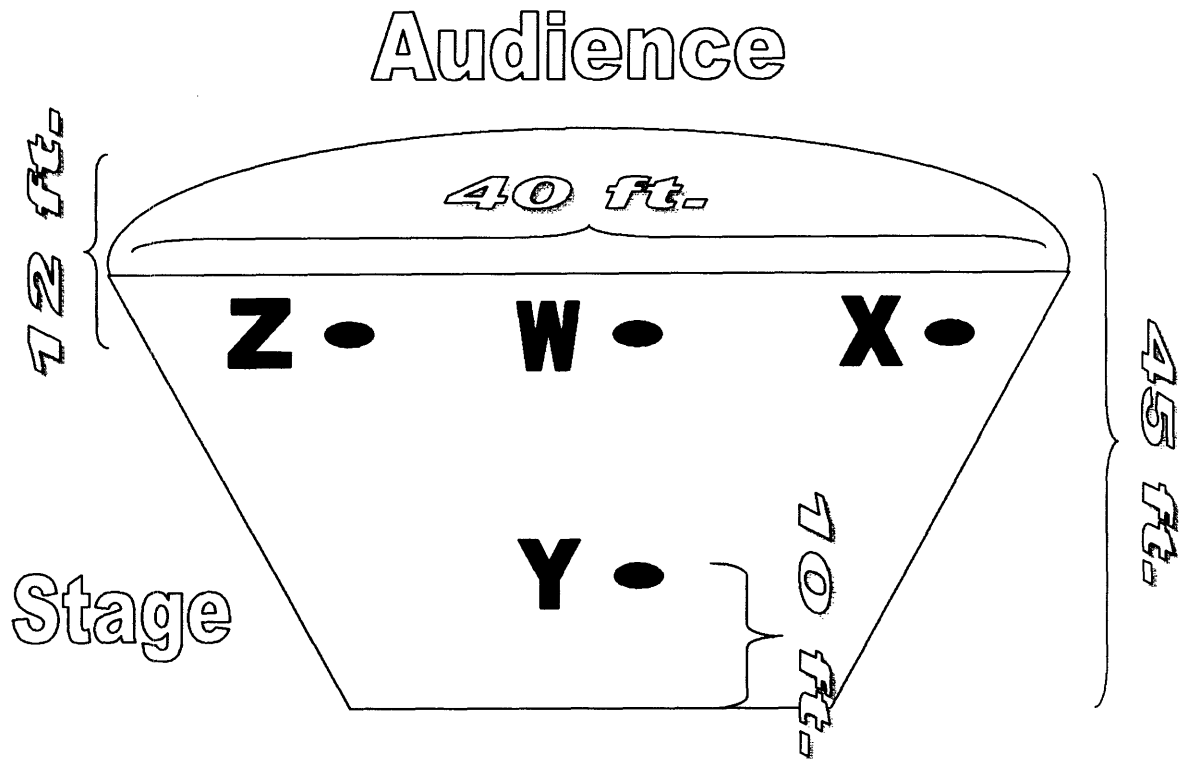


Figure 4 Diagram of placement of speaker and receiver. This diagram is not to scale.

Measurements were taken at various locations onstage to canvas the area for different reverberation times. Tests 1a and 1b were run with the speaker in position W in the center of the stage and the receiver in the center of the third row in the audience. This measurement was made for reference to be able to compare the perceived reverberation time for the performers onstage as compared to that of the audience. Tests 2, 3, and 5 were run with the curtains hidden. Tests 2a and 2b were run with the speaker in position W and the receiver at positions X and Z, respectively. Tests 3a and 3b were run with the speaker in position X and the receiver in positions X and Z, respectively. Tests 5a and 5b

were run with the speaker in positions X and Z, respectively, and the receiver in position Y. Tests 6 and 7 were run with the curtains exposed. Tests 6a and 6b were run with the speaker in position W and the receiver in positions X and Z, respectively. Tests 7a and 7b were run with the speaker in position X and the receiver in positions X and Z, respectively.



**Figure 5 Speaker in the center of the stage (position W).**

The following chart gives the specifics of the equipment used in the reverberation tests.

<i>Equipment</i>	<i>Specifications</i>
Speaker	Electovoice SX A100 loudspeaker
Sound control	Neutrik Minerator MR-1 white noise generator
Receiver	Rion NA 27, 1/3 octave band sound level meter, with calibrator

**Figure 6 Specific information on equipment for reverberation time measurements.**

### **C. Performer reactions**

To elicit reactions from vocal and instrumental performers, two different musical groups were chosen. Both used the Rogers Center at different times. After an initial rehearsal in the space with the acoustics in one configuration, the participants in each group were given a survey to fill out after a second rehearsal in a different configuration. The survey requested reactions to how different the space sounded and how the performers changed their delivery to suit the new sound. The questions were worded so as to solicit initial reactions as well as more in-depth assessments. The surveys asked similar questions with different phrases to pull out the nuances of the performers' preferences.

The student musical was *How to Succeed in Business Without Really Trying*, a musical in English with several lead roles and a small pit orchestra. For this production, all of the soloists were miked and the band in the pit also had microphones. The set was simple and varied between a larger open space and a space that was forward and closed off on the stage. The first dress rehearsal, the first of the two rehearsals referred to in the survey, was the first one in which the soloists were miked.

The Merrimack Valley Philharmonic Orchestra, conducted by George Monseur, is the symphonic group in residence for the Rogers Center. They are a full 50-piece concert orchestra. They were rehearsing a Prokofiev symphony and a Brahms concerto for three rehearsals in a row. For the first rehearsal the acoustic curtain was exposed. For the second and third rehearsals the acoustical shells were moved up on the stage and the curtains were hidden.

### III. Results

#### A. Measured Data

Figure 7 shows the reverberation times in different places on stage with a sound source in different places. The numbers show a clear difference between the reverberation times for the curtain being open and it being closed.

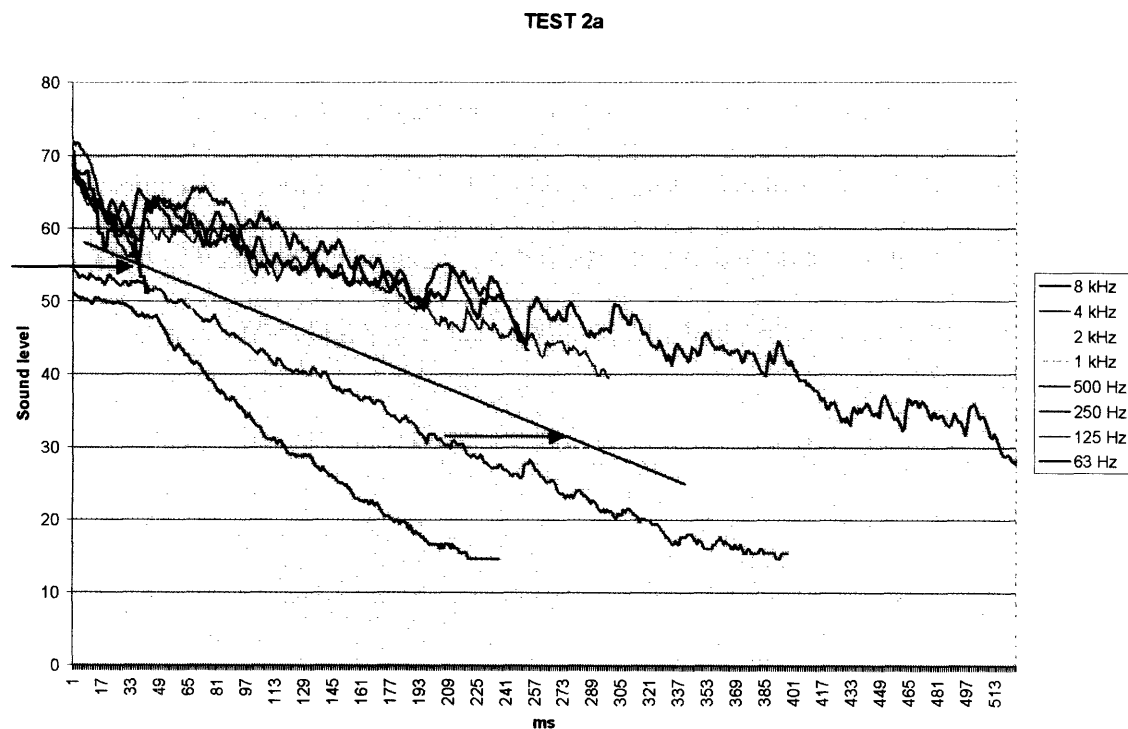
Test Number	Curtains Hidden/Exposed	Reverberation Time (sec)				
		500 Hz	1 kHz	2 kHz	Ave (500 Hz and 1 kHz)	
1a	Hidden	1.46	1.54	1.08	1.50	
1b	Exposed	1.36	1.27	1.20	1.32	
2a	Hidden	1.70	1.49	1.34	1.60	
2b		1.73	1.45	1.61	1.59	
3a		1.45	1.57	1.25	1.51	
3b		1.56	1.55	1.36	1.56	
5a		1.56	1.72	1.34	1.64	
5b		1.44	1.39	1.42	1.42	
6a		Exposed	1.37	1.45	1.37	1.41
6b			1.38	1.35	1.32	1.37
7a	.99		.81	.86	.90	
7b	1.34		1.38	1.22	1.36	

Figure 7 Calculated reverberation times in the Rogers Center.

Data was gathered in octave bands from 16 Hz to 8 kHz, and calculations were made for 500 Hz, 1 kHz, and 2 kHz since these are the generally accepted indicators for sound—tones and articulations—in the human audible range (Beranek, 20). The tests were done in an empty hall with all of the doors shut, the acoustical curtains either completely hidden or completely exposed, and the acoustical shell pushed to the rear of the stage.

### Example Reverberation Time Calculation

To approximate the reverberation for a certain frequency in a particular configuration, we graph the decay curves of a certain test. The graph concentrates on the area where one can identify the time of the sound source stopping and the receiver perceiving a drop in the sound in the room. A best-fit line is made to approximate the slope of the decay (see Figure 8). A beginning and ending point yield two sound levels and times. The times correspond to 2 ms gaps in measurements taken. The resulting slope is then converted to the amount of time it would take such an impulse to decay by 60 dB.



**Figure 8 Sample graph showing calculation method for reverberation time.**

From the data gathered, the time it took for the sound in the hall to decay by 20 dB ( $R_{T20}$ ) was able to be measured. To relate these numbers to a more standard

measurement, however, the data needed to be extrapolated to represent the time for the sound to decay by 60 dB ( $R_{T60}$ ) the standard acoustical measurement for reverberation time. This was done using the procedure described above, and therefore data are not exact. One of the problems encountered in doing this procedure was that the difference between the direct sound from the speaker and the noise floor (the decibel level at which the sound at a certain frequency bottoms out) was not as large as it could be. This measurement is known as the signal-to-noise ratio, and had it been larger, the data for  $R_{T60}$  would have been easier to measure. The signal-to-noise ratio for 1 kHz was approximately 40 dB, which is sufficient for a measurement, but the signal-to-noise ratio for 63 Hz was only 20 dB. As one can see in the graphs of the sound decay (Appendices A and B), the noise floor for low frequencies is rather high, which makes measuring the decay rate very difficult. However, the data for frequencies below 500 Hz were not used to measure reverberation times not only because they were invalid, but because they were unimportant for questions about human articulation. They were included in the graphs to give a complete picture of the sound environment in the hall and on the stage.





**Figure 9** The acoustical shells are shown here at the rear of the stage as they are normally stored.

## **B. Reactions/Discussion**

Of the forty musicians present at the three orchestra rehearsals, eleven were surveyed. They came from all sections of the orchestra (high and low strings, winds, brass, and percussion).

I had problems with feedback from the singers in the musical, and only one vocalist returned a completed survey. I was able, however, to sit in on a debriefing after the first rehearsal to gauge the performers' overall

reactions to the space and the music. Therefore, my discussion here concentrates on the responses of the instrumentalists as a group and the musicians as a whole (including the vocalists) rather than trying to extrapolate significant conclusions solely from the group of vocalists. The responses of the musicians were purposefully subjective; I wanted them to describe their experiences in their words, not mine. Generalizations were made from their positive or negative responses i.e. I noted what each of the musicians responded to and whether or not they were affected in the same way by the same changes. Also, where possible, the numbers of respondents to questions with clear diametrically opposed answers were noted.

Initial reactions point to the tendency of the musicians to disregard the changes caused by the curtain walls. Only two of the twelve performers responded to the curtains being changed. Instead the performers responded more to the changes in acoustics that most directly affected them. Changes made to the reflective surfaces onstage that affected the early reflection time for the performers made the most difference for them. Whether vocalists or instrumentalists, the performers were more aware of differences when the changes were made on stage, in close proximity to their sound production. The strongest response for the instrumentalists (eight of eleven) was concerning the acoustical shells, and the overwhelming response from the vocalist's survey and the comments after the rehearsal for the musical was about the soloists' microphones.

One of the factors which one initially would think may have caused a large amount of the perceptual differences between the vocalists and the instrumentalists is the use of microphones. Almost all the sound for the musical was amplified, while no microphones were used for the orchestra. The acoustics of the room were adjusted based on the fact that the musical would require almost entirely amplified sound. For the vocalists, however, their comments both right after the rehearsal and in the survey pointed to a need to become accustomed to the amplified sound. According to their director, Dorrie-Lenore Parsons, the performers were told repeatedly not to react to the changes in sound, but they "always do" nevertheless. Their reactions were less different from those of the instrumentalists than one might expect. Both pointed to adjustments in the acoustical architecture that noticeably affected their sound as *they* heard it, not as the audience heard it.

The performers were more perceptive of acoustical factors that more immediately reached their ears. Changes in the hall's reverberation time are made more for the benefit of the audience than the performers. The rear curtain wall is, according to Bond, the most directly linked to the performers' perception of their sound. Generally, the curtains are either wholly deployed or completely hidden, with the exception of the curtains that cover the panel in the rear of the hall. These curtains, according to Philip Bond, the Rogers Center's sound mixer, are "never ever put away." This is to eliminate the effects of echoes from the stage traveling the long distance to the back wall and reflecting directly back to the performers, causing a noticeably delayed reflection to reach the performers' ears and disturbing their performance.

Of the ten instrumentalists surveyed, only two initially responded that they could not tell the difference when the acoustics of the hall were changed. Even in these two cases, the performers responded to later questions with indications that they noticed some sort of difference between the three rehearsals.

However, the major difference for the instrumentalists was the addition of the acoustical shells. There are three-tiered acoustical towers (see Figure 9) that can be moved into place at the rear of the stage to close off unused parts of the stage. Another shell can be flown in from directly above the performers to close off the cavern directly above the stage.

Of the musicians surveyed, five thought that hearing articulation was more important than vibrant sound, four thought they were equally important,

"There shouldn't be a trade-off."

and only one thought that sound was more important. Nevertheless, all but one responded that they preferred the configuration with the walls out and the curtains hidden:

“The less sound absorbent the better.”

For the instrumentalists, the ability to hear each other was paramount, perhaps more important even than the ability to hear themselves. This, too, was a function of the acoustical shell, which, when moved out, surrounds the sides, rear, and ceiling of the stage. It provides closer, smoother reflective surfaces for the musicians to benefit from early reflections and direct the orchestra’s sound outward. Without the shell, instrumentalists complained of

“problems (on Monday) hearing certain instruments”.

With the shell, they noticed

“it [was] easier to hear the other sections and dynamics [seemed] more pronounced”.

Even those two who indicated on their surveys that changing the acoustical properties (walls, curtains) did not make a difference for them noticed that

“sometimes, from where [they were] sitting, the winds [were] heard more clearly when the sound baffles [were] in place.”

Though the use both of the walls and hidden curtains provides more reflective surfaces, ten of the twelve musicians preferred having a more reverberant sound and being able to hear and respond to each other than to have reverberation controlled for them:

“I felt that I did not have to force my sound as much...I prefer to keep the physical arrangements the same and allow the musicians to adjust. It is more difficult to adjust when the staging changes. I do believe, however, that the acoustics should be adjustable to accommodate different performing groups.”

Performers noted that they were constantly adjusting their performance anyways, responding to the varied feedback they got from the reflections:

“Generally without the curtains the sound is fuller and better... We are always adjusting as the hall changes i.e. an audience absorbs much sound so curtains [sic] must be open to compensate... The acoustics are excellent now so don't change it... we all need to hear each other and the shell does this best... The less sound absorbent the better... No real problems because the hall is so responsive.”

Instrumentalists noted not only difficulty hearing but also difficulty playing on the day when the curtains were exposed and the shell was back.

“Curtains and carpeting always ‘suck up’ the sound... greater bow pressure to produce more volume,” one responded. Another wrote, “I had to work harder, play out more to be heard on Monday [when the curtains were exposed].”

The acoustical walls increase the reflective surfaces around the stage, which is exactly what hiding the acoustical curtains in the main hall does. The difference is how much the musicians are able to tell the difference. The acoustical walls change the sound they hear immediately and respond to, while the curtains change the sound that is received by the audience. The more important sound for the musicians is the sound that is closer to them, which is reflected off of the acoustical wall.

#### **IV. Conclusion**

From the calculations of the measured reverberation times onstage, the acoustical curtains in the audience part of the hall do make a difference for the sound on stage. The differences in reverberation times between having the curtains hidden and having them exposed are significant. The performers, however, did not respond enthusiastically to the

changes made in the hall. Changing the curtains did little or nothing that they could notice.

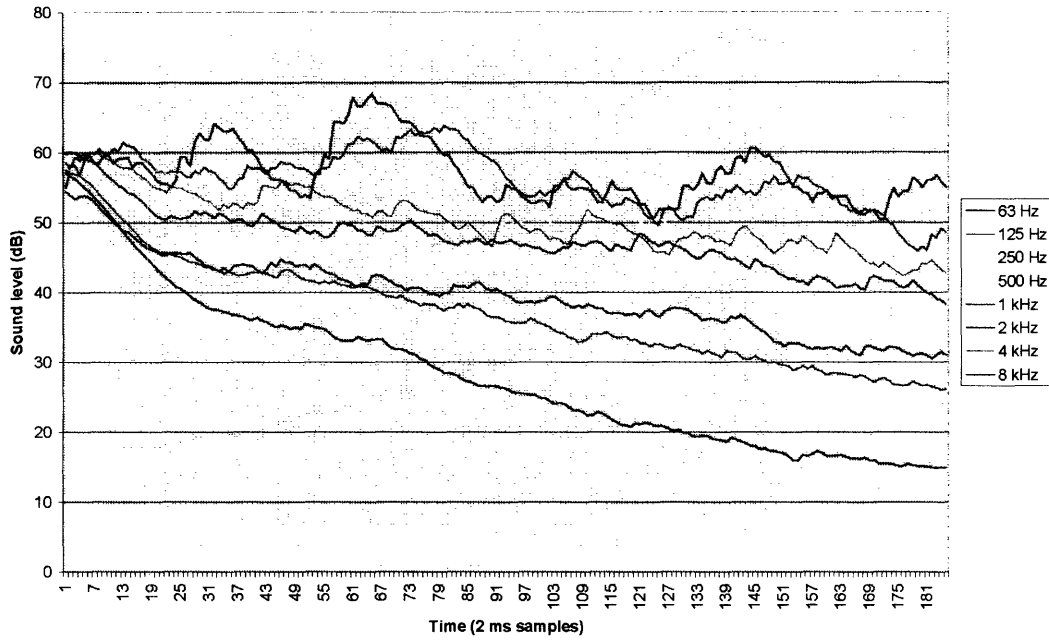
They did respond, however, to changes in acoustic surfaces in close proximity to them since it significantly affected the sound they immediately heard. They liked being able to hear themselves, even if their playing was more blended and articulation was more challenging. They preferred to retain as much control as possible over their own playing or singing.

This thesis only begins to look at the subject area of performer response to real-time feedback of their performance. There are many more tests that can be done to explore this subject further. Since the performers seem to respond much more dramatically to changes in acoustic surfaces that are very present onstage, it would be interesting to delve into the specifics of onstage acoustical changes. Reverberation and early reflection times could be taken onstage with and without musical sets, for example.

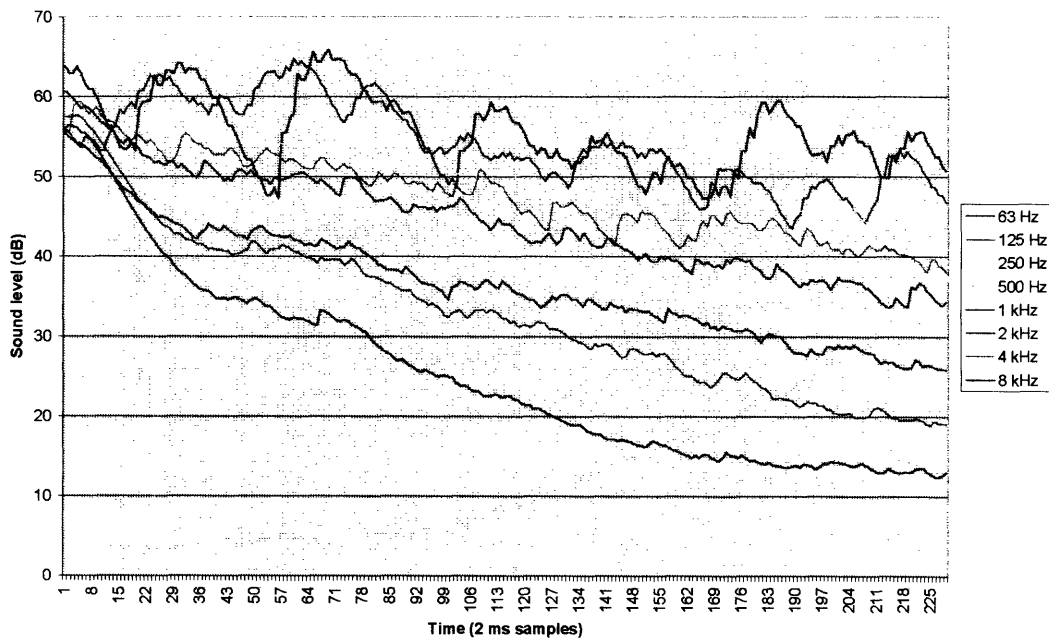
This thesis explored the effects of adjustable acoustics from the performer's point of view. I first measured the reverberation time onstage at a theater with the acoustical curtains either hidden or exposed to determine the onstage difference between the two configurations. I then surveyed performers who had rehearsed in the two configurations to garner their reactions and discern any difference in their reactions to the two set-ups. I found that the performers reacted minimally to the changes to the acoustical curtains, but reacted significantly to changes in acoustics that affected the early-reflection time onstage. They preferred the acoustics to be changed so they remained with what they saw as the most control over their sound.

# APPENDIX A: *Sound decay graphs in the audience*

Test 1a

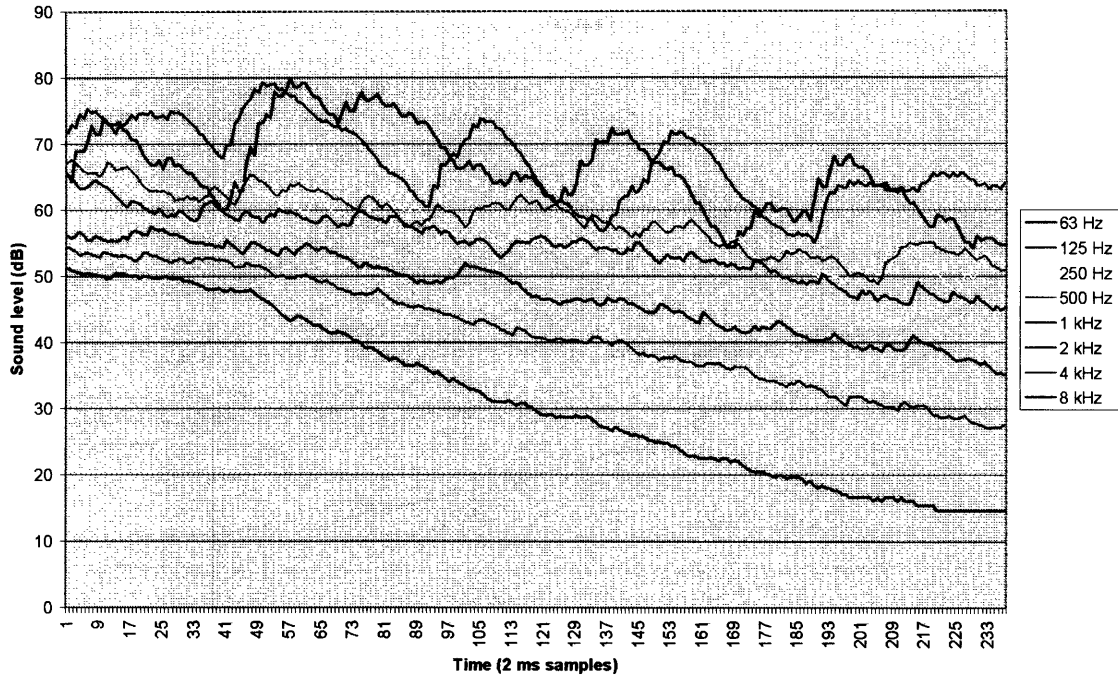


Test 1b

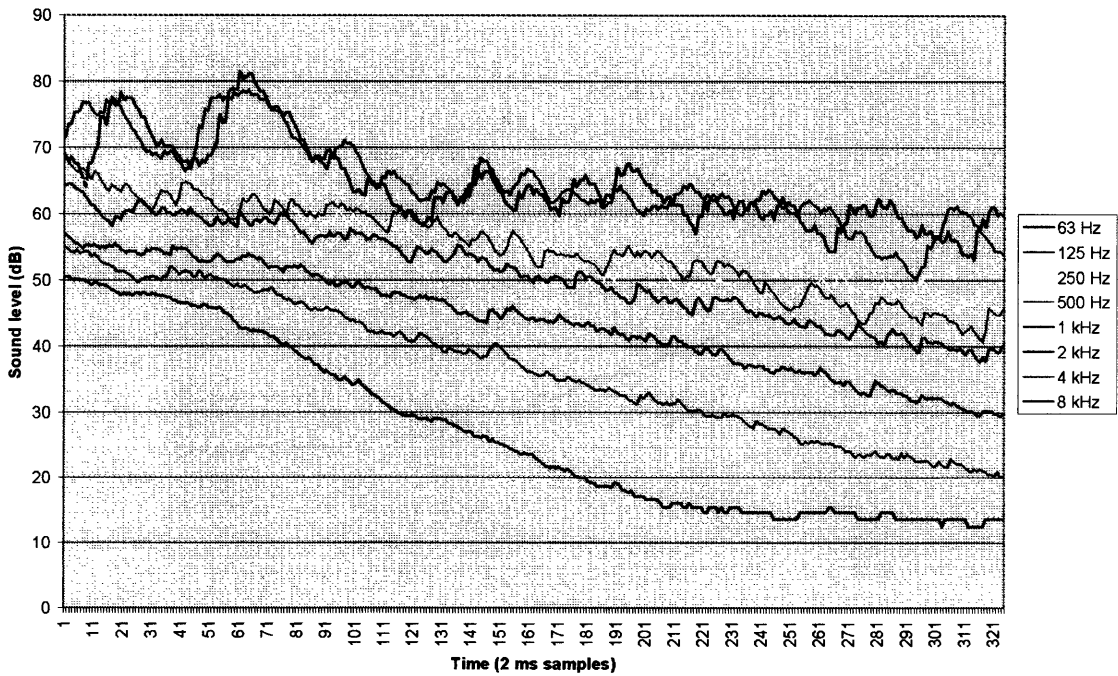


## APPENDIX B: *Sound decay graphs onstage*

Test 2a

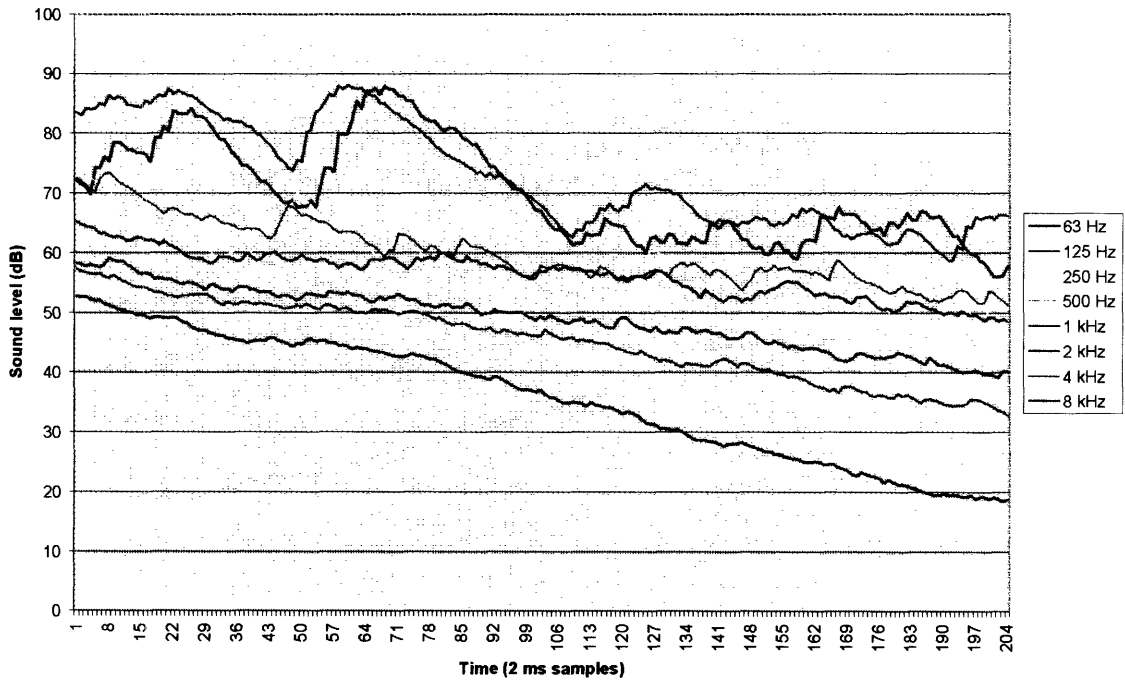


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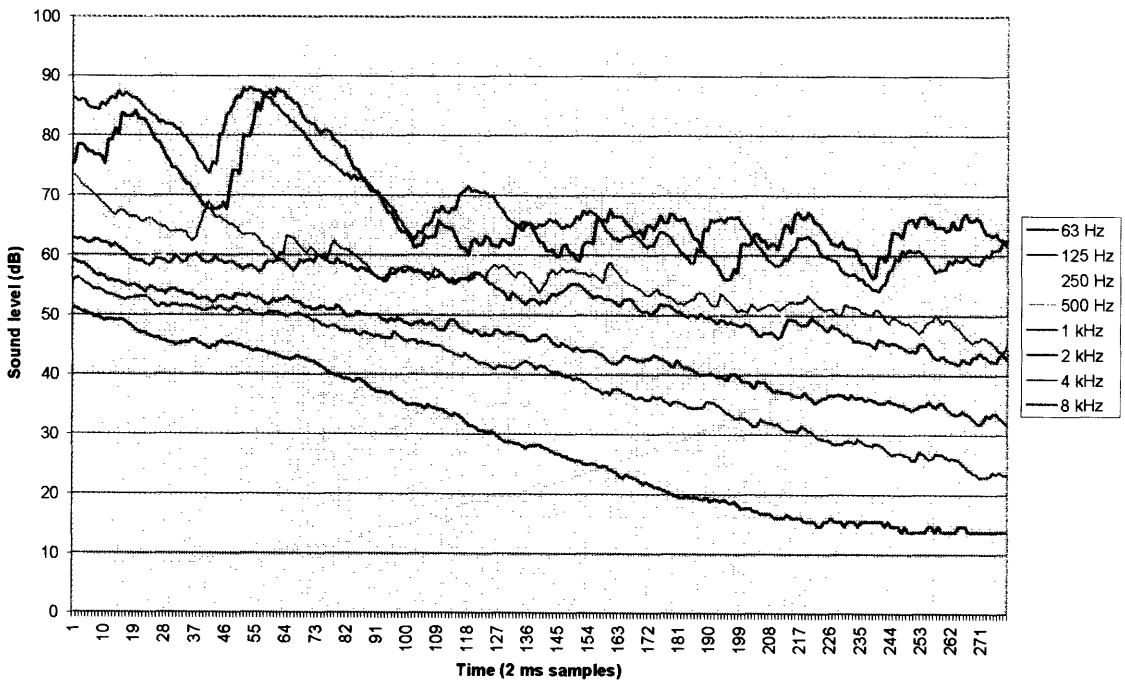




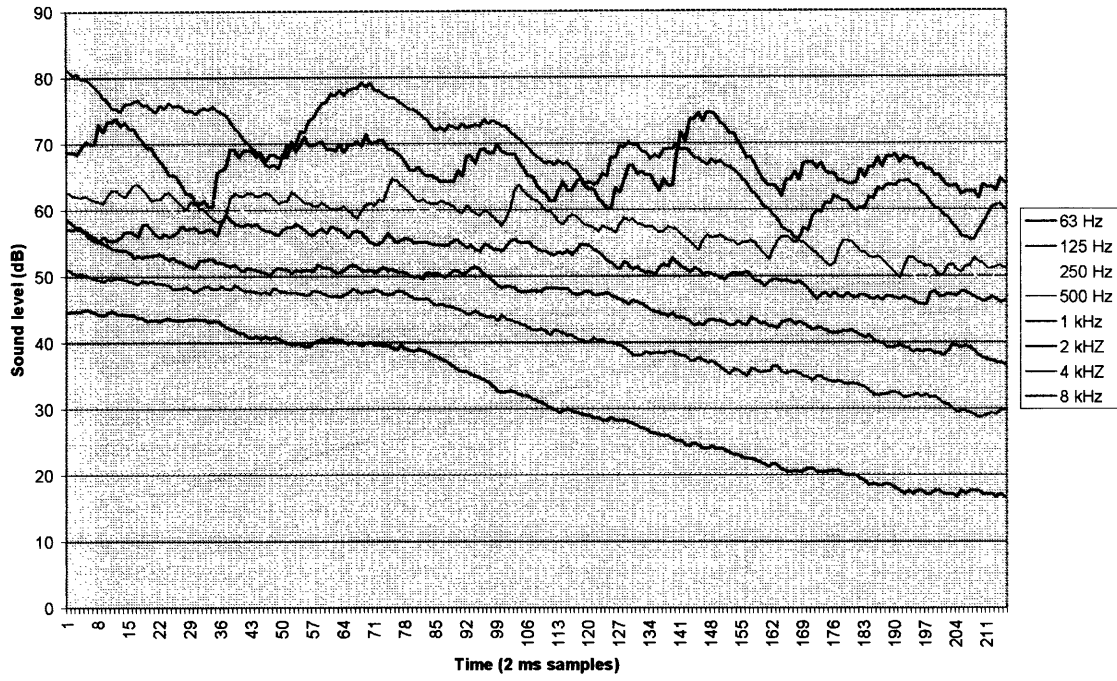
Test 3a



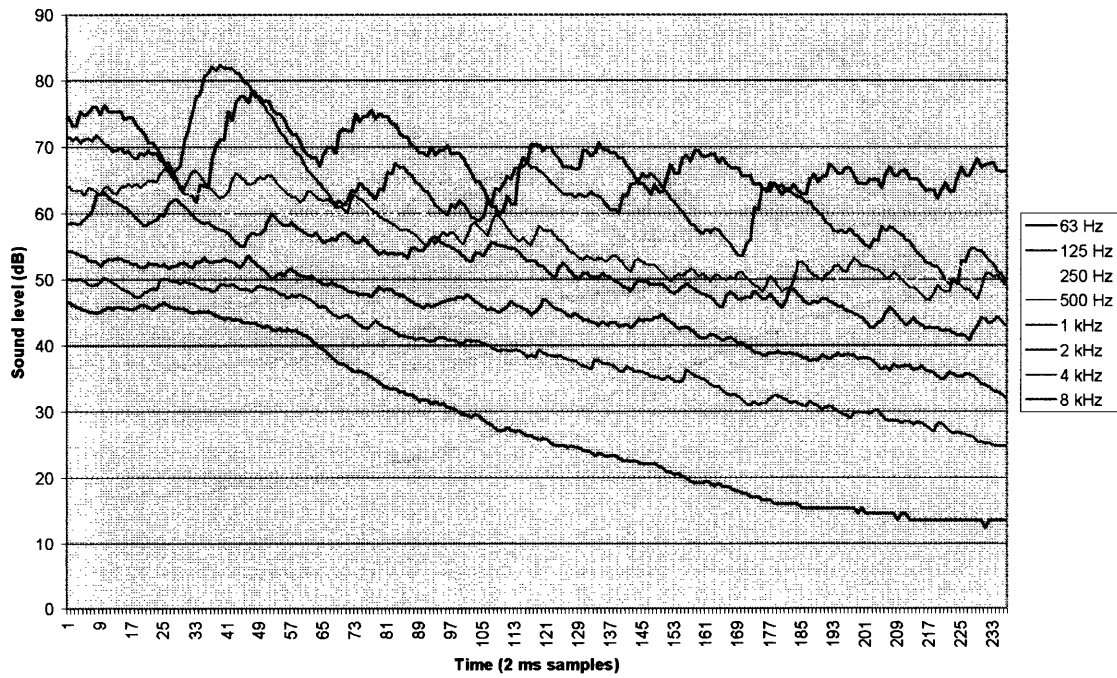
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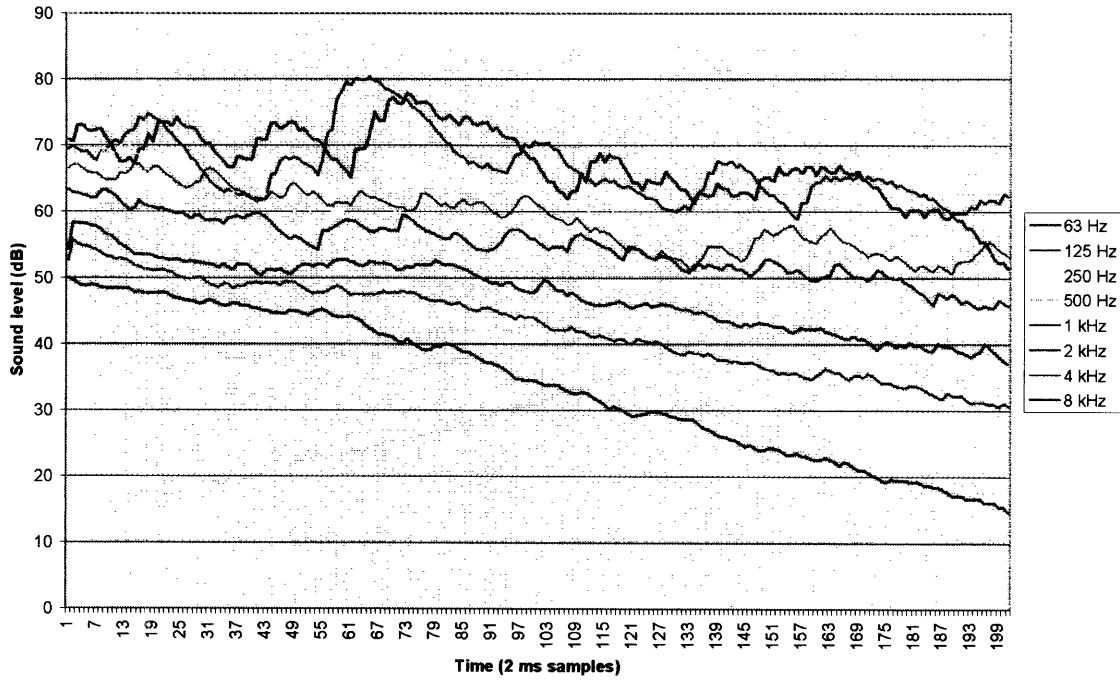
Test 5a



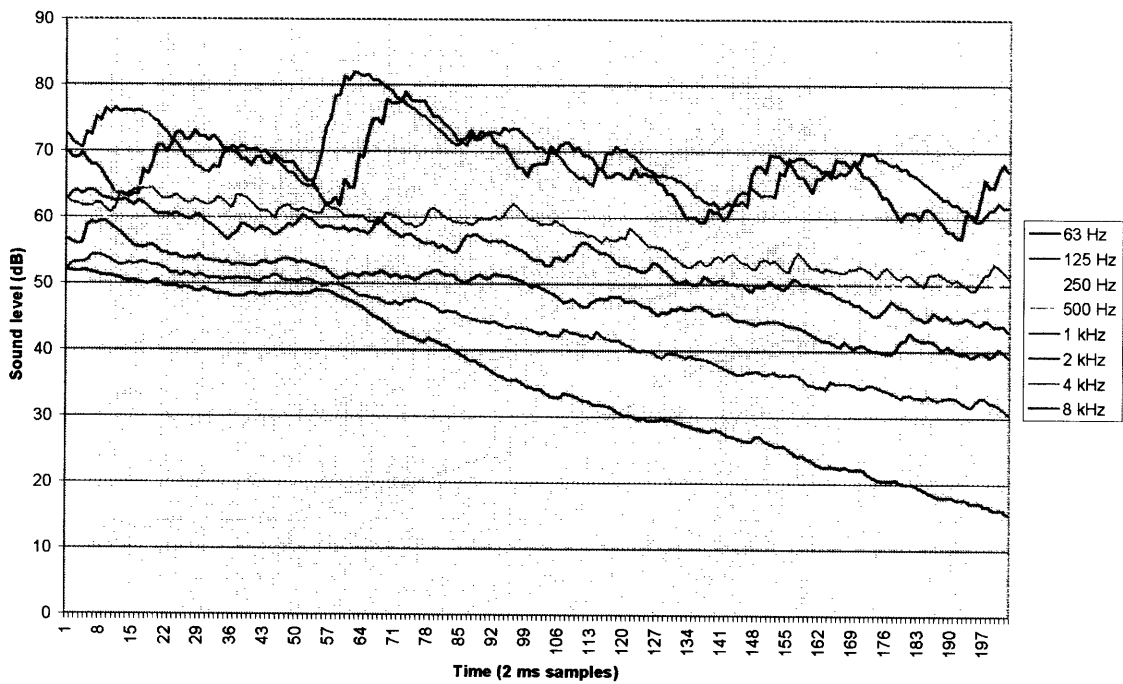
Test 5b



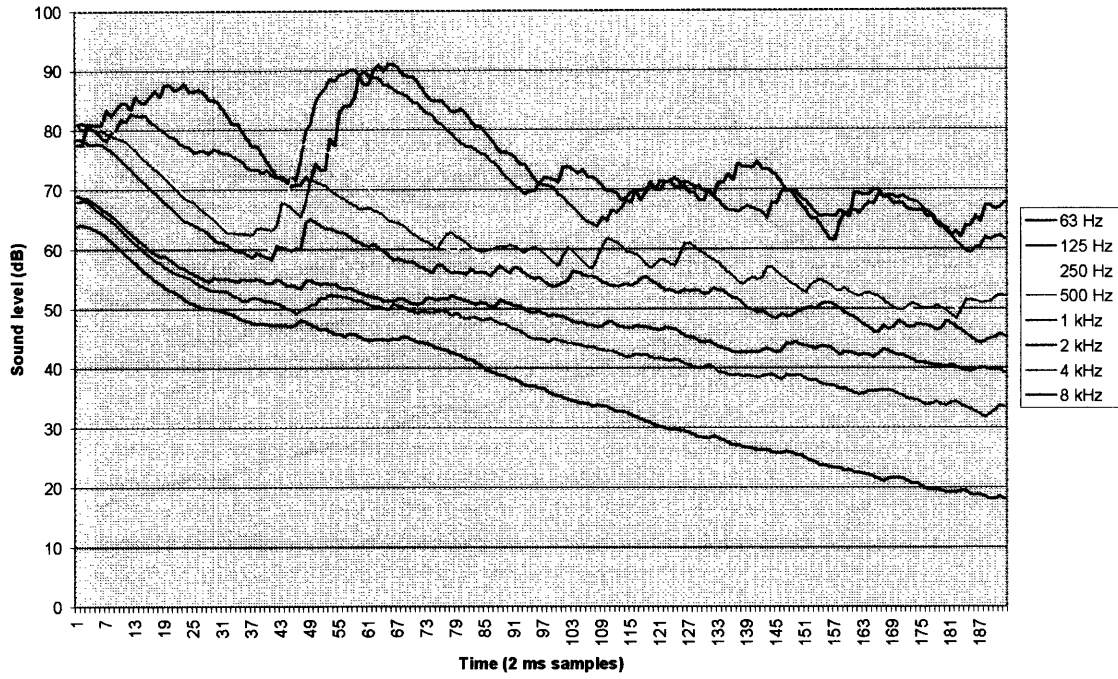
Test 6a



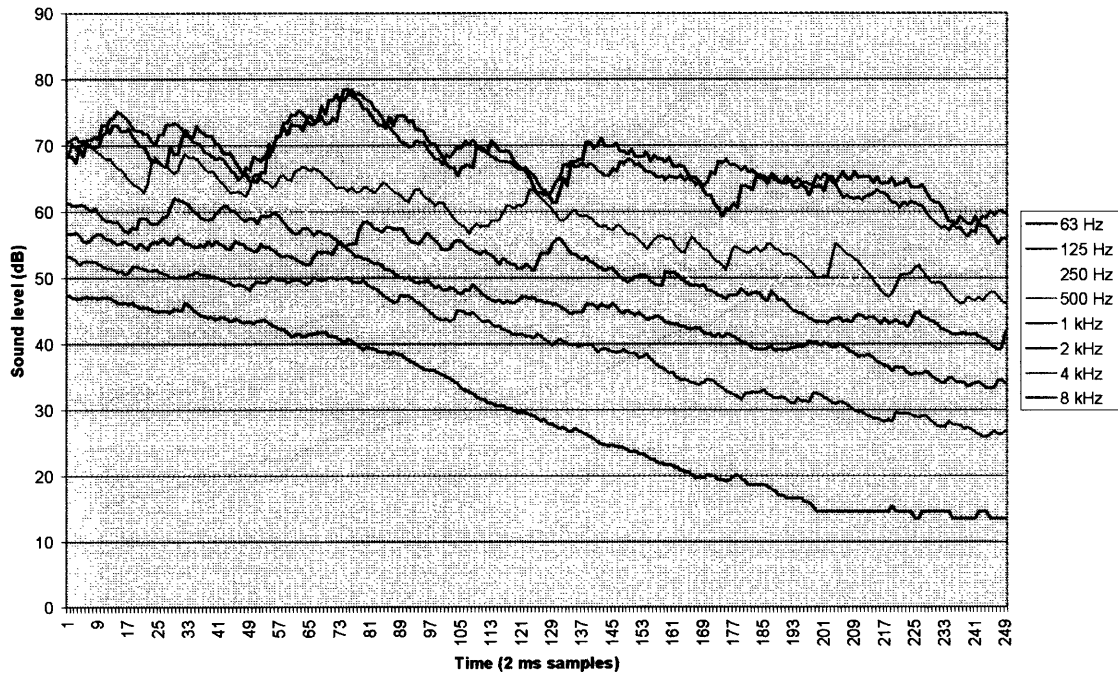
Test 6b



Test 7a



Test 7b



## **APPENDIX C: *Questions for vocalists***

My thesis looks into the difference that performers can notice when acoustics in a performance hall change. Since the Rogers Center has movable curtains to dampen sound, that will be the factor that I will be studying. For Tuesday evening's rehearsal, all of the curtains were open, and for Wednesday's rehearsal, all of the curtains that run along the side and back walls will be out. I am interested in what the performers thought about their sound on each night.

### **APPENDIX A-*Questions for performers***

Could you tell the difference? Please describe it.

How did you adjust your performance to fit the difference in sound?

Do you think the difference is noticeable enough to warrant the use of adjustable acoustics?

When did you most notice the difference? Where were you onstage? Were there other performers onstage?

Where on stage did you sound the best? Where on stage did you think you were most easily understood?

Where on stage did other people sound the best? Where were you standing?

Which night did other performers sound better? Which night were they easier to understand?

Which configuration did you like better/were you more comfortable with?

Was it easier to sing on Tuesday or Wednesday? How?

On which day could you understand yourself better? On which day could you understand the other performers better?

Did you think the quality of the music changed (e.g. warmer one night)?

Do you think is more important for the audience to be able to understand the words or to hear more vibrant music?

If you could pick, which configuration would you perform in?

Have you performed in this space before? Have you heard a performance in this space before?

What problems did you have with the acoustics on Tuesday night that you didn't have on Wednesday? Were there any problems on Wednesday that you didn't have on Tuesday?

Did you notice any differences specifically when you were talking? Were there any problems that only occurred when you were singing?

Were there any problems only when you were miked or only when you weren't? How did you adjust in these cases?

## **APPENDIX D: *Questions for instrumentalists***

My thesis looks into the difference that performers can notice when acoustics in a performance hall change. Since the Rogers Center has movable curtains to dampen sound, that will be the factor that I will be studying. For Monday evening's rehearsal, all of the curtains were open, and for Thursday's rehearsal, all of the curtains that run along the side and back walls will be out. I am interested in what the performers thought about their sound on each night.

### **APPENDIX A-*Questions for performers***

Could you tell the difference? Please describe it.

How did you adjust your performance to fit the difference in sound?

Do you think the difference is noticeable enough to warrant the use of adjustable acoustics?

When did you most notice the difference? Where were you onstage?

Where on stage did you sound the best? Where on stage did you think your expressions were most easily heard?

Where on stage did other people sound the best? Where were you sitting/standing?

Which night did other performers sound better? Which night were they easier to play with?

Which configuration did you like better/were you more comfortable with?

Was it easier to play on Monday or Thursday? How?

On which day could you hear yourself and your articulation better? On which day could you hear the other performers better?

Did you think the quality of the music changed (e.g. warmer one night)?

How important is it that the audience hears articulation as opposed to vibrant sound?

If you could pick, which configuration would you perform in?

Have you performed in this space before? Have you heard a performance in this space before?

What problems did you have with the acoustics on Monday night that you didn't have on Thursday? Were there any problems on Thursday that you didn't have on Monday?

Did you notice any differences in your articulation between the two rehearsals? Were there any problems that only occurred with a specific articulation?  
How did you adjust in these cases?



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