

Acoustical Modeling and Auralization as a Design Tool for a University Concert Hall Renovation

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Crowell Concert Hall
Center for the Arts - Wesleyan University
Middletown, CT

OBJECTIVES:

- **Make Crowell into a world class facility for:**
 - Teaching**
 - Performance**
 - Recording**

- **Enhance Crowell's value as an important asset to Wesleyan University and the entire community.**

Crowell Concert Hall

Areas needing improvement

- **Hall background noise level**
 - **Essential to all facets of hall use:**
teaching (ensemble)
Performance (audience)
Recording
- **On-Stage communication**
 - **Critical for good ensemble playing**

Crowell Concert Hall

More areas needing improvement

- **Hall aesthetics (quality of sound)**
 - **Stage projection**
 - **Hall reverberation and echo**
 - **Essential for audience perception clarity, intimacy and envelopment**

Crowell Hall Study Results

- **Background noise studies**
 - **Extensive tests for background noise levels**
 - **Major noise sources identified**
 - **Design solutions devised, budgeted**
 - **Noise level (NCB 30 to 40) too high for concert hall**

More Crowell Hall Study Results

- **Reverberation time (RT) studies**
 - **RT tests conducted using impulse & continuous sources**
 - **RT good in mid-frequencies for large orchestra, somewhat too high for chamber music**
 - **RT very high in low frequencies**

More Crowell Hall Study Results

- **Listening tests - Wesleyan Orchestra**
 - **Listened in audience seating and on stage**
 - **House sound (audience) muddy, although warm**
 - **Audience lack of clarity and envelopment, marked lack of spatial width and intimacy**
 - **Cross-stage communication very poor: No cues between cellos/2nd violins or between 1st violins/violas**
 - **Small orch wind section ensemble ok,**

but unbalanced sound

More Crowell Hall Study Results

- **More Listening tests - Wesleyan Orchestra**
 - **Bass strength good**
 - **Very late on-stage (ceiling & back wall) reflections degrade overall ensemble playing, particularly with large orchestra**

More Crowell Hall Study Results

- **Performer evaluations**
 - **Student orchestra concert - Beethoven**
“they survived“
 - **Large pro jazz ensemble**
Drummer “can’t hear” vibraphonist
Bassist stated sound “very muddy“
 - **Small renaissance group**
“liked sound“

More Crowell Hall Study Results

- **Computer modeling studies**
 - **Built CATT-Acoustics CAD model of existing hall, based on architectural drawings, site measurements**
 - **Calculated RT good agreement with test**
 - **Auralization similar to hall sound, overall reverberance and flutter echoes are well modeled**

pictures

Renovation design study objectives

STAGE

- **Improve early reflection density**
- **Reduce/eliminate disturbing late reflections**
-ceiling, back wall
- **Eliminate on-stage flutter**
- **Retain more energy on-stage**
-improve dispersion/diffusion

Renovation design study objectives

HOUSE

- **Improve projection from stage**
- **Improve early reflection density**
- **Improve lateral reflection energy**
- **Eliminate flutter and other echo anomalies**
- **Enhance sense of intimacy/envelopment
-side and rear reflections**

design sketches

Renovation design auralization examples

- **Stage source to mid-house listener**
 - existing hall model
 - renovated hall model
- **Stage source to stage listener**
 - existing hall model
 - renovated hall model

CONCLUSIONS

Crowell Concert Hall Renovation

- **Model of existing hall good diagnostic tool to identify causes of aesthetic problems**
 - **Reflection time history**
 - **Objective parameters**
 - **Auralization**
- **Model essential tool for design solution**
 - **use both objective and subjective results to make design decisions**

CONCLUSIONS

Crowell Concert Hall Renovation

- **Renovated hall universally well received
- faculty, community, performers**
- **Solutions achieved by harmonizing
Art, Science and Technology**