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Holy Spirit Catholic Church

Bowling Green, KY
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I. INTRODUCTION

This report is intended to present the design concepts, layouts, modeled simulations of the predicted performance associated with the sound system as well as a description of the acoustical environment of the church.

II. SOUND SYSTEM LOUDSPEAKER CONFIGURATION

The sound system will consist of two (2) Axys Intellivox model DC430 mounted on the brick columns on the wall behind Sanctuary. There will also be one (1) EAW LS832 line array loudspeakers mounted on first column on either side of the sanctuary. Refer to the sound system floor plan and elevation looking toward Sanctuary for locations and mounting heights. A power switch for the sound system is provided in the Working Sacristy 248 behind the Sanctuary.

Low frequency augmentation for the contemporary music portion of the service will be provided by subwoofers mounted in the walls as shown on the sound system floor plan. The subwoofer which has been chosen is the Macpherson LFE12. These subwoofers are very slim in design and pose less of a problem to mount in the desired locations than most other models available.

There are also loudspeakers with volume controls provided in the Choir Practice-241, Family 204, Cana-212 and Narthex-203. The Daily Chapel-246 has been provided with its' own sound system and volume control. A feed to the Church sound system from the outside fire pit service area has also been included in the system.

III. SOUND SYSTEM MODELING

Below are mapping simulations of the systems' predicted speech intelligibility and direct sound (SPL) coverage. The mappings were performed using the acoustic model shown in figure 1 and factory supplied data files for the line array loudspeakers, we will present the acoustical analysis later in this report. While the acoustic model is simplified it does offer enough resolution to accurately assess the room acoustics and system performance. Real world results may vary somewhat from the predictions shown, but these predictions do provide us with a very good reference from which to intelligently determine the best combination of loudspeaker type and placement for space.

Figure 2 shows the predicted direct sound coverage at 1,000Hz. While figure 3 shows the predicted speech intelligibility of the system at 1,000Hz in percent Alcons. Percent Alcons is a measurement of the percentage of consonants lost in speech. Numbers below ten are considered very good, while numbers between sixteen and eleven are considered average. When the numbers become greater than **sixteen,** speech becomes much more difficult to understand. As can be seen in Figure 3 all of the seating areas exhibit very good speech intelligibility.

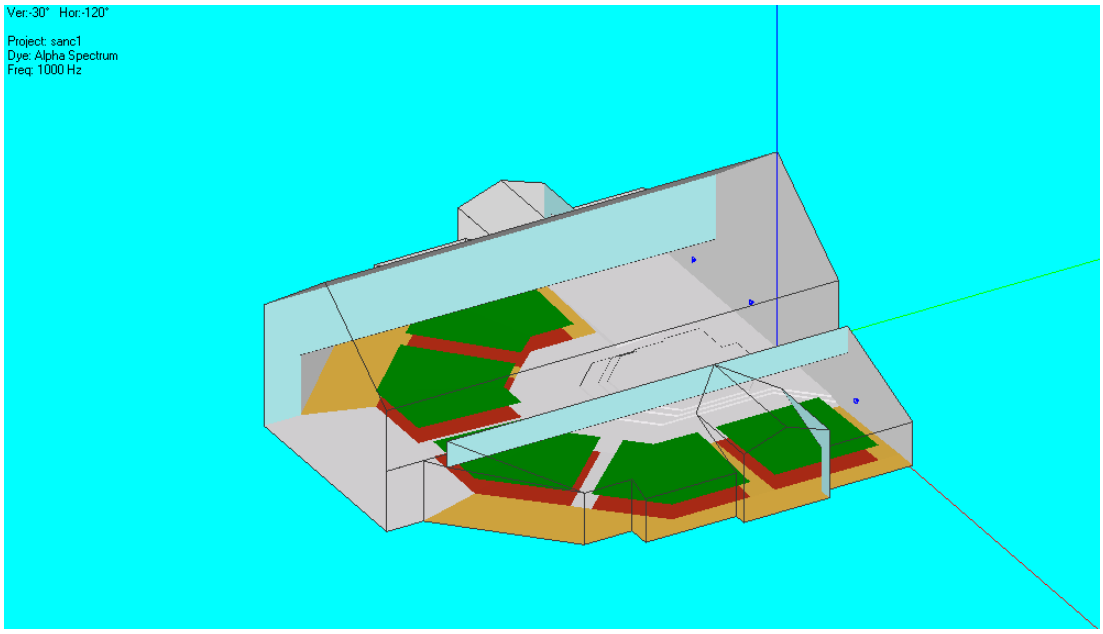


Figure 1 - Acoustical model used for simulations and acoustical analysis

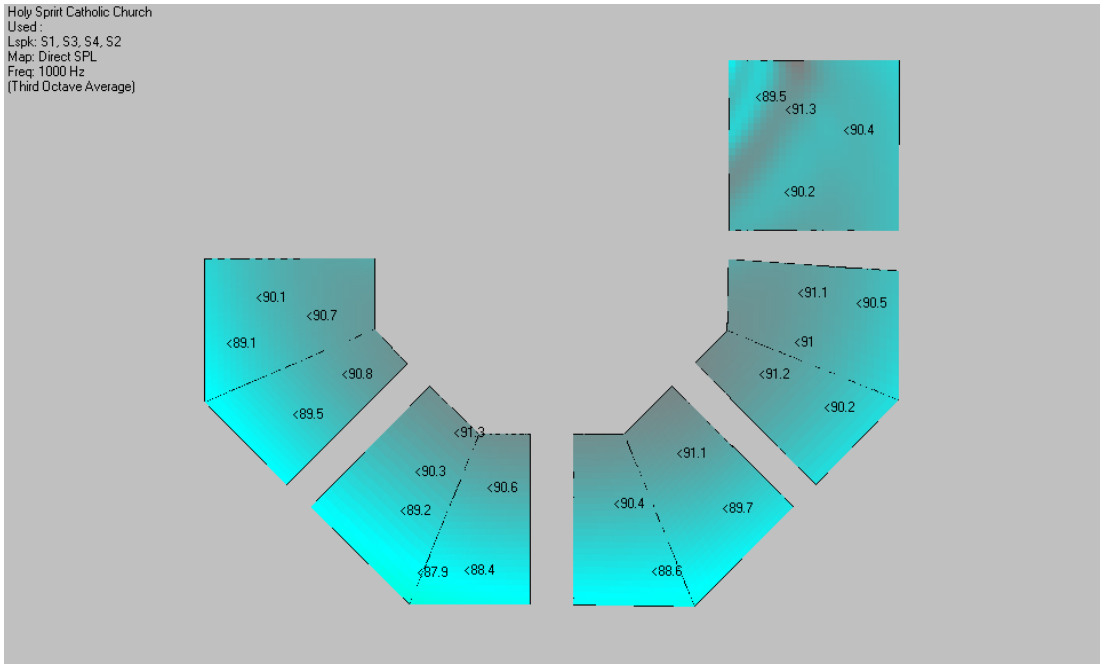


Figure 2 - Direct Sound Coverage (SPL) @ 1,000Hz

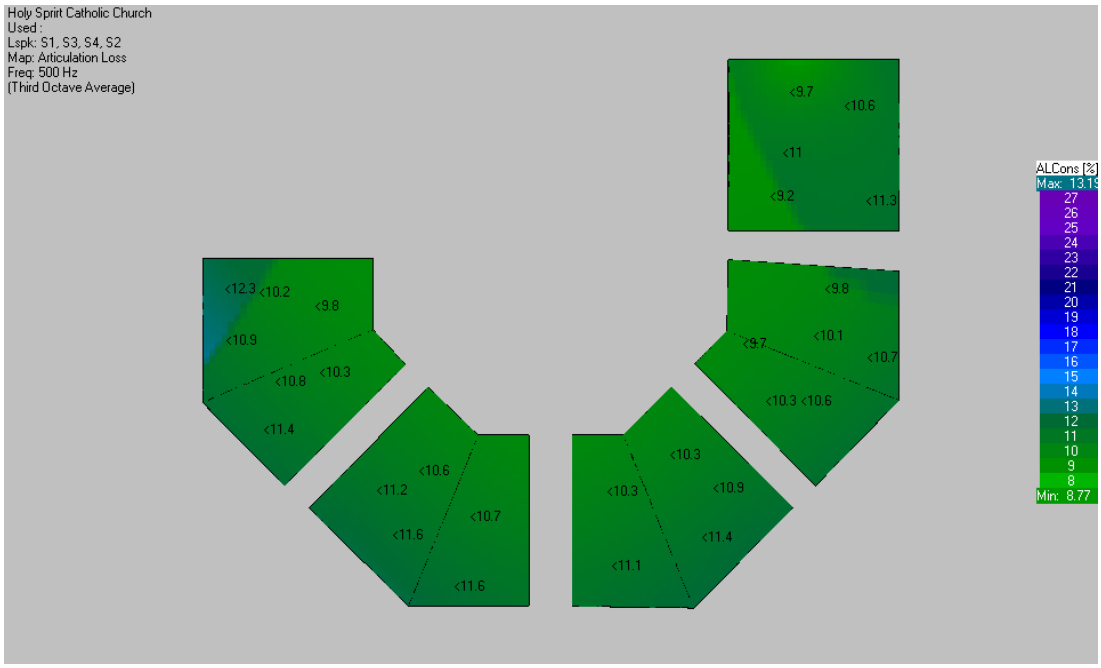


Figure 3 - Speech Intelligibility (%Alcons) @ 1,000Hz

IV. MICROPHONES AND MIXING

Four wireless microphone systems in the main church and one for use in the day chapel will be provided with the sound system. Earset microphones have been provided for use with the wireless microphone systems. Earset microphones are strongly recommended for use in this space as they will provide the most reliable sound quality and the least problem of feedback. Handheld dynamic microphone transmitters have also been provided for use with two of the main church wireless systems. Two of the wireless systems, with earset microphones only, are dedicated for priest use and will operate via an automatic mixing system for times when an operator is not present. While the other two wireless systems, with the handheld and earset microphones, will operate via the musician's system.

Other microphones and accessories include four Earthworks Flexwand choir microphones, six dynamic Shure Beta 58, 2 condenser instrument microphones. These numbers have been used for estimating the systems but may be adjusted some as the project moves forward.

Mixing for the daily pastoral system will be provided via an automatic mixing system. This system will provide the required gating on/off of the main speech microphones, i.e. two wireless, ambo, altar and chair microphones, allowing unattended operation of the sound system for a traditional service.

The mixing of the musician's instruments and microphones will be accomplished via a 32-channel Yamaha LS9 digital mixer although there is a 16-channel option which would

offer a savings of $4,000.00. The mixer will also be provided with an Aviom interface card to allow the implementation of Aviom personal monitor mixers and In-Ear monitoring systems. In addition to In-Ear monitoring a stand mounted powered Hot Spot monitor and powered floor monitor will be provided which may also be driven from an Aviom personal monitor mixer. Six Aviom personal monitor mixers and five wired In-Ear monitor systems will be provided. The In-Ear monitors are planned for use by the Keyboard, 2 guitars, bass and drummer while the additional personal mixer will drive the floor monitor for the singers. At this point none of the In-Ear systems are planned as wireless units though this could be adjusted if desired.

V. VIDEO SYSTEM

The video system consists of two 12'x9' electric video screens and two 5800 lumens Sanyo projectors mounted on the second beam approximately 46' from the Sanctuary wall. The projectors were selected for their high output and ability to project at extreme angles from the screens. The screens to be used are Draper Targa screens. The screens were selected to fit between the columns. This will be a close fit since the screens case measures 151" overall and the width between the columns is a total of 152". See attached elevation for locations.

We have also included two Sony EVID70 remote pan/tilt camera with controller and video switcher, a pair of DVD/VHS player/recorders and an Edirol LVS400 video switcher. The camera locations are not on the cross sections.

System control and signal distribution to the projectors is accomplished via Crestron QuickMedia system with an 8-button keypad.

VI. SOUND AND VIDEO SYSTEM COST ESTIMATES

The current estimated costs of the main Church sound system are as follows:

- Church sound system with Yamaha LS9-32 (32-channel digital mixer) and full Aviom monitoring system - $133,000.00 - $137,000.00

- Church sound system with Yamaha LS9-16 (16-channel digital mixer) and full Aviom monitoring system - $129,000.00 - $133,000.00

- Church sound system reusing the existing Yamaha O1V96 and full Aviom monitoring system - $123,000.00 - $127,000.00

- If the Aviom Personal monitoring system is not desired, deduct $7,000.00 from the above totals.

- The cost of the Chapel system is estimated at - $3,000.00 - $4,000.00

The estimated costs of video systems are as follows:

- Projection/presentation system with Crestron control, 2 projectors, 2 electric screens and less computer (owner supplied) - $56,000.00 - $58,000.00
- Video camera system with switcher, Pan/Tilt/Zoom controller and 2 remote Pan/Tilt/Zoom cameras - $10,000.00 - $12,000.00

The above estimates are calculated using manufacturer suggested retail prices less 15% plus a 30% integration, or installation, cost. Under actual bidding these costs are sometimes lower. We would suggest bidding the systems as a base bid for the main Church and Chapel sound systems and alternates for the new digital mixing, Aviom monitoring, projection and video cameras. This way the owners may rank order the items and make a decision based on actual bid costs.

VII. ACOUSTICAL ANALYSIS

Room Acoustics: Room acoustics are commonly described by reverberation time because it is an item that can be expressed by a number. However, it actually is only a part of what makes up the acoustics of a space. Reverberation time is determined primarily by the volume of the room (cubic feet) and the amount of sound absorbing surfaces in the room. One square foot of perfect (unity) absorption is known as a Sabin. The shape of a room and the location of the sound absorbing surfaces also effect the reverberation time. People are the primary source of sound absorption in a space where reverberation is desired. Figure 4 shows the calculated reverberation times at the various frequencies with the church totally occupied. Figure 5 shows the calculated reverberation times with no occupancy. Figure 5 is based on there being pew cushions and commercial carpet in the areas defined on the attached floor plan. Partial occupancy will range between these two extremes.

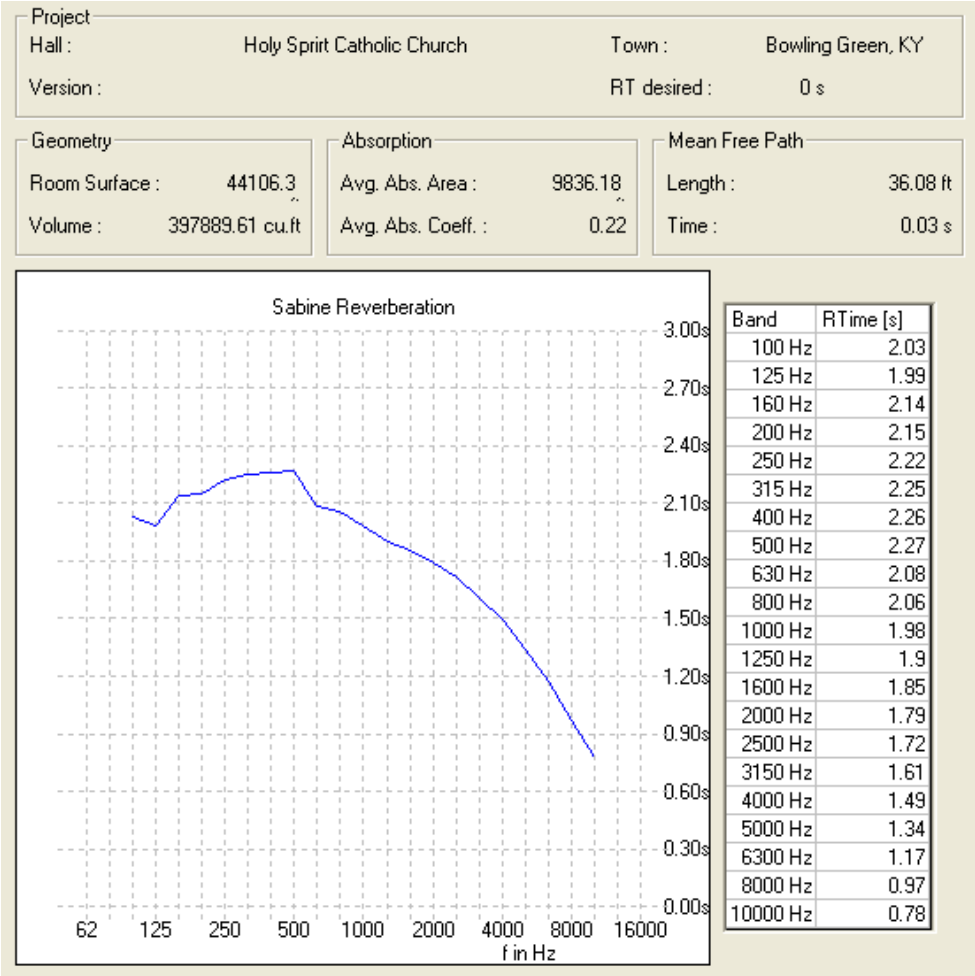
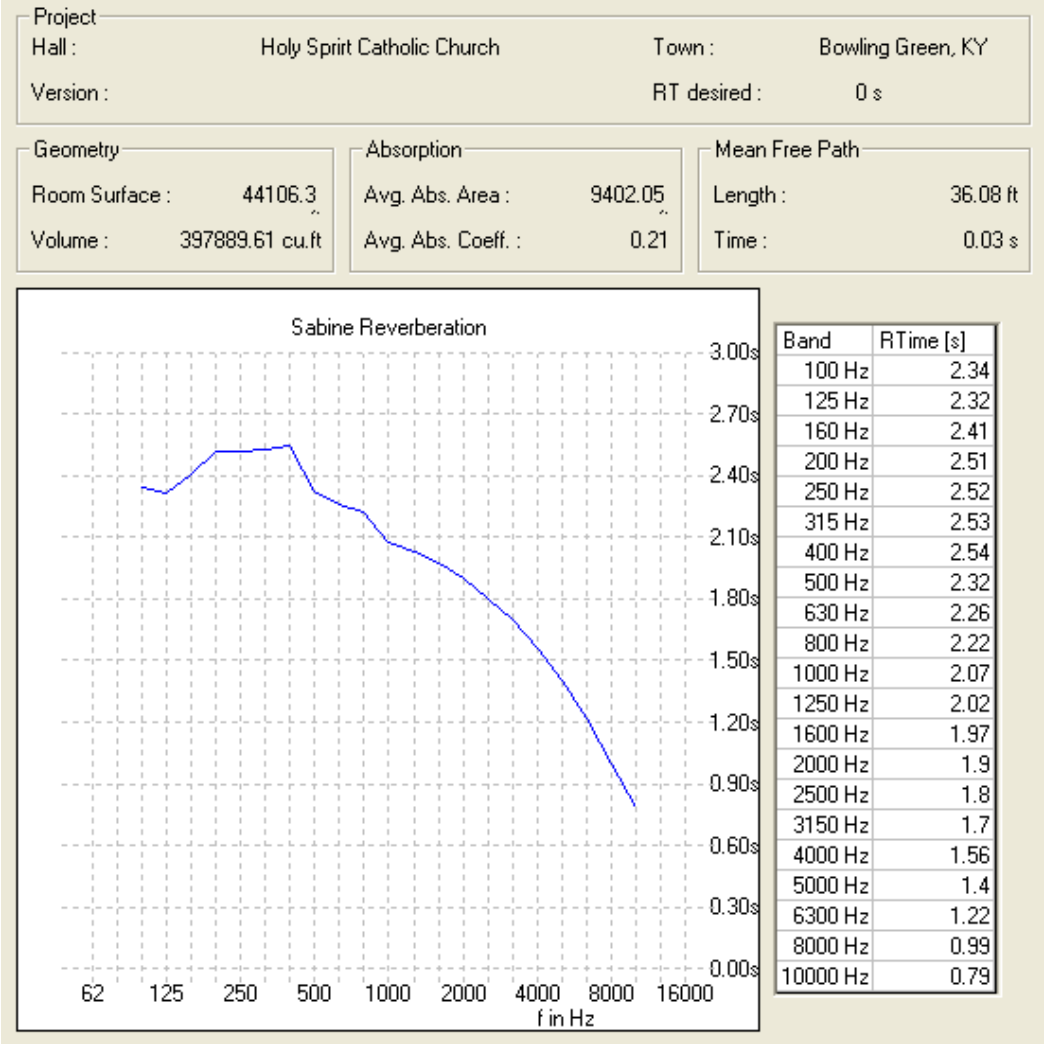


Figure 4 - Reverberation time full occupancy



Band	RTime [s]
100 Hz	2.34
125 Hz	2.32
160 Hz	2.41
200 Hz	2.51
250 Hz	2.52
315 Hz	2.53
400 Hz	2.54
500 Hz	2.32
630 Hz	2.26
800 Hz	2.22
1000 Hz	2.07
1250 Hz	2.02
1600 Hz	1.97
2000 Hz	1.9
2500 Hz	1.8
3150 Hz	1.7
4000 Hz	1.56
5000 Hz	1.4
6300 Hz	1.22
8000 Hz	0.99
10000 Hz	0.79

Figure 5 - Reverberation time no occupancy

All of the modeling data presented here is based on the following surface treatments.

Floors: Commercial carpet under pews is recommended to help stabilize the room in various degrees of occupancy. Also since a more energetic contemporary musical presentation is planned it is recommended that the isles and ambulatory areas also be carpeted. See attached floor plan. Sound reflecting floors are very important near choirs or where sound from the choir must project over these surfaces to the congregation. Therefore the choir area should remain as a hard surface such as tile.

Seating: The pews should be cushioned on the seats.

Walls: The planned limestone walls should be sealed using an appropriate sealant. From an acoustic standpoint, this will make them less absorptive and it will prevent them becoming stained overtime especially near diffuser outlets. This limestone will also supply some high frequency diffusion in the space. The glass at the rear of the Church

should be angled down 5 degrees from the floor to a height of 12’-0” to prevent echo from this surface.

In addition to the above items there is the issue of a “sound lock” between the Sanctuary and the choir practice room 241. Currently the room is shown with one door opening into the corridor feeding directly into the Church. This should be changed to have two doors with a space between so the door to the choir practice room is not opening directly into the corridor feeding the Church. It is impossible to get the needed sound isolation with only one door.

Mechanical System Noise: The mechanical system should be designed to produce maximum RC-25 noise levels. We will review the mechanical engineer’s design as it becomes available.

I hope this answer any questions the Church may have, but David or Stan will be happy to answer any specific questions you may have concerning acoustics for the Church.

Sincerely,
Stan Roller, Acoustics
David Walters, Sound Systems and A/V