Variable Acoustics in a Church

Church of the Resurrection Sanctuary with HD Video Screen and 28,5 x 10,5 m (93 x 35 ft) Stained Glass "Resurrection Window"

This Implementation of ACS in a New United Methodist Worship space shows how Passive Acoustic Design which is Integrated with Active Electronic Room Enhancement creates an acoustically versatile Sanctuary.

Acoustics during a Service

To enhance the Architectural achievements of this uplifting and light filled sanctuary, this combined passive and active design allows for unobtrusive changes to the Room Acoustics during Worship with the press of a button on an iPad.

Requirements

Acoustics supporting: Contemporary Music, Speech and Traditional Worship Music including Organ, Congregational singing and Choir.

Conflicting requirements

Architectural goal of having a large space with a soaring sense of majesty **Versus**

An acoustically damped room to support energetic contemporary amplified music.

early reflections will be generated.

There are multiple services each Sunday with different music styles within a service. The acoustics therefore, needs to change during the service. High mid- and late-energy returns are consistent with the church's goal for "lively" acoustics. This supports traditional music and is inviting to the congregation to participate in singing. Contemporary music and speech however require much lower energy returns.

Natural Acoustics

Active Variable Acoustics

each use was evident.

The need for electronic active variable acoustic

enhancement to change the acoustics of the space for

Acoustic Distinctions, responsible for the acoustics

design, had prior experience with Acoustic Control Systems and worked together from the early stages

for the proper application of the technology.

In an ACS electronic-variable acoustic system,

the program material is captured with directional

microphones and manipulated, using advanced digital

signal processing technology

algorithms. As a result late

reflection fields and enhanced

and custom developed

As the starting point the church has well contained natural acoustics with, given the size, low reverberation. It is suited for energetic contemporary amplified music. Technology designer Idribri introduced a high-power, highly directional sound reinforcement system that avoids undesirable energizing of the room what would trigger a surplus of reverberation. Given that many parts of a service are amplified, ACS and PA are often used simultaneously.

Acoustic Design First Priorities

A sense of Majesty

With the sanctuary being a tall vertical space that would draw the congregation upwards

• Acoustics supportive of preaching

Conveying warmth, intimacy and high intelligibility, so that little or no effort is required to hear and understand the message throughout the seating areas

 Acoustics supportive of congregational participation

Encouraged with a vibrant, lively atmosphere to foster alertness. Acoustical visual barriers interfering with the connection between the pastor and those in the room should be avoided.

Additional References

United Methodist -Church of the Resurrection, Leawood https://cor.org/leawood/

Acoustic Distinctions – Acoustics Design https://www.acousticdistinctions.com/

Idibri – Technology Designer https://www.idibri.com/



Positioning of ACS Microphones and Loudspeakers

The relationship between the positions of individual microphones and loudspeakers are established to determine the natural boundary conditions. As a result, a signal is created and sent to a particular loudspeaker, and all speakers together build the desired field of reflections.

This includes taking into consideration the preservation of the natural boundaries within the hall as basis for timing and making sure the generated reflections never arrive before the direct sound.

There are however exceptions, for example if you would like to make a hall sound larger you can manipulate the timing to serve this purpose, you can also virtually create a reflector by reducing the timing of reflections, or mask an echo by filling in slightly differently timed reflections for example to eliminate the sound focusing effects that can be present in a circular construction.

Schematic Floor Plan



Microphones hanging from ceiling

- Microphones hanging above choir loft
- Microphones aimed under balcony
- Main ceiling loudspeakers

Loudspeakerssurrounding the hall Organ chamber loudspeakers Loudspeakersunder PAcluster, aimed to choir

- Loudspeakersabove choir loft
- Balconyface loudspeakers aiming to main floor
 Balconyface loudspeakers aimed under balcony
- Under balcony reverberation fill in loudspeakers

ACS in brief

The system uses:

- 40 microphones
- 40 microphone level inputs
- 124 discrete processed outputs
- 124 power amplifier channels and loudspeakers
- 2x 24 channel Early Reflection matrix
- 2x 24 channel Reverberation matrix



System presets

participate.

6 presets were made available to the user which allowed a reverberation time range from 1.9 sec at system standby up to 4.8 sec at preset 6. The AV Operator can instantaneously switch between presets during the service, the transitions are very subtle and unobtrusive to the congregation. ACS adds energy to the sound reflected by the room, the sound is therefore much more "carried" by the room. As an example, when a member of the congregation starts to sing he or she will notice this will cost little effort and it is heard throughout the church, this will again encourage other members to

Depending on the type of use, different ACS presets can be selected. Preset 1 particularly adds the earlier reflections and can be used to increase the presence of speech.

Presets with more reverberation can be selected for congregational singing, choir, and organ music. Preset 6 with a reverberation of close to 5 seconds still fits very well in this large room and gives it a sound similar to that of a large old church.

The natural acoustics along the sound reinforcement system provides excellent sound quality for the contemporary music program, but also the ACS system can be used when more presence or a higher level of reverberation is desirable for a particular piece.



Measurement Result

Above an energy time curve of a measurement taken near the center of the sanctuary with the electronic system on stand by (in blue) and with the system on preset two - reverberation of 2.4 sec. (in red) we can clearly see the early, mid, and late energies added by the ACS system.

Designers Conclusion

An ACS system is an effective solution when cost or architectural constraints prohibit the room's natural acoustics from supporting the prioritized program of use, and when the acoustical environment that best supports each activity in that space needs to change during the performance; in this case, during a worship service.



Like to know more? Please get in touch!

Speulderweg 31 3886 LA Garderen The Netherlands Phone +31 (0)577 46 22 51 Fax +31 (0)577 46 22 68 e-mail sales@acs.eu