

SOUND & COMMUNICATIONS

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A TALE OF FOUR CATHEDRALS

BY JIM STOKES

**Systems
Designed to
Accommodate
the Liturgy, Not
a Textbook.**



Figure 1 – The soaring Gothic arches of St. Joseph's (R.C.) Cathedral in Buffalo, New York.

Four East Coast Roman Catholic cathedrals had sound problems where intelligibility was poor. After an acoustical analysis and evaluation of each house of worship, Monte Brothers Sound Systems (Dobbs Ferry, New York) designed and installed an effective distributed sound system for each sanctuary that gave excellent intelligibility and high fidelity reproduction for both speech and music.

The three New York cathedrals are St.

James Basilica in Brooklyn, St. Agnes in Rockville Centre, and St. Joseph's in upstate Buffalo. St. John the Baptist in Paterson, New Jersey is the fourth cathedral under discussion.

An acoustical study of those houses of worship points out the need to consider their inherent structures, RT-60 (reverberation time) data and the mobility of the clergy and choir during services as factors in determining the design of good sound systems.

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Steve Minozzi and Bob Pelepako, partners at Monte Brothers explain the similarities and differences among the cathedrals with respect to sound quality. Their observations and comments are served with a generous helping of common sense. "All of our business is by recommendation," says Minozzi. "We evaluate and correct. In most cases that requires a change in the design of the existing sound system."

Listening and Analyzing

Minozzi explains that meeting with various people at the church, including such key elements as the music ministry, the clergy and the business manager, is part of the process in determining the solution to the problem. "We listen to their complaints, listen to the sound system, and make notes."

Room measurement and analysis is done on a combination of the TEF, Klark-Teknik and White Model 200 analyzers. The most helpful data gathered are the RT-60 profiles. "In most cases, we find the complaints are related to the design of the system – that someone didn't really pay attention to what the parishioners wanted."

The Past Is Prologue

The cathedrals are large churches, each with a past. "Many previous attempts had been made in all four cathedrals to put in different systems," says Minozzi. "St. John's had a central cluster. St. James Basilica had recessed speakers cleverly hidden in the ceiling. St. Agnes had speakers cemented in the walls. And St. Joseph's had numerous attempts at distributed systems, using inefficient speakers." He notes that adding speakers in the Buffalo cathedral compounded the sound problems. "We ended up putting in fewer speakers at the end of the project."

It wasn't that the sound systems in the cathedrals were antiquated and ready for an upgrade. They were mainly four to six years old. It's just that they weren't designed to accommodate the actual activities and ceremonies that were being performed in the cathedrals.

Variety of Shapes, Sizes, Seating

The four cathedrals are diverse in regard to their sanctuary shapes, sizes

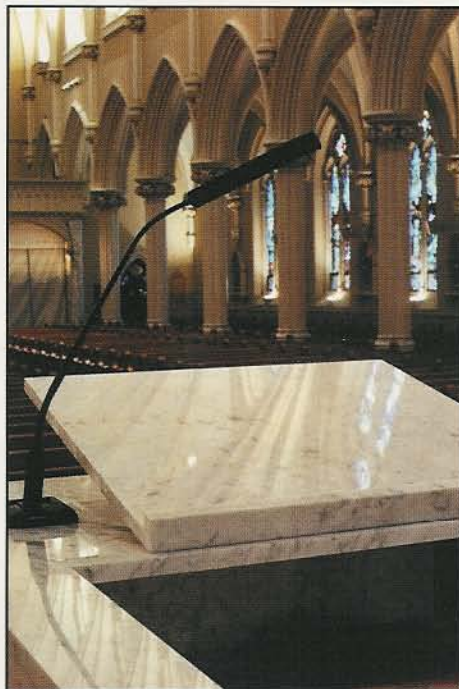


Figure 2 – A gooseneck-mounted electret microphone serves at the marble lectern.

and seating. Minozzi notes that St. John's is the largest of the four. It seats 1,400 with the sanctuary in the center of the church. St. Agnes, which seats 1,200, has a different shape with very small transepts and a long nave. The 600-seat St. James Basilica is the smallest of the group, but has a very high reverberation time, as discussed below. This Basilica has large transepts that are about the same size as the broad nave. St. Joseph's is a cruciform Gothic cathedral that seats 1,200.

According to Minozzi, here is how Monte Brothers RT-60 profiles correlated with the sanctuary layouts. (Refer to RT profile graphs.) At St. John's, the largest cathedral, the overall reverberation time (RT-60 seconds) is 2.763 seconds. The highest reverberation time in the building is 3.550 at 1,000Hz (1kHz) "The profile is important. This is a difficult reverberation pattern because it goes from 2.428 at 160Hz to 400Hz (cumulative low frequencies), then jumps up to 3.348 cumulative from 500Hz to 1.6kHz (midrange), then back down to 2.396 from 2kHz to 5kHz (high). That's a difficult reverberation curve in a big building. You lose too much high end and not enough low end. And it makes intelligibility very difficult."

In contrast, he explains that St. Agnes is "more do-able." The profile chart

shows a total RT-60 of 2.228 seconds reverberation time. The low/mid/high cumulatives are, respectively, 2.303/2.444/1.895 seconds. "Those are better reverberation time," Minozzi points out.

Then the most difficult profile occurs in St. James Basilica. The small cathedral has the hardest surfaces and the largest acoustic reflective problems. "It's very, very difficult," declares Minozzi. The total RT-60 is on the high side at 3.454 seconds. The cumulatives go from lows at 3.016 to a huge mid jump at 4.518 to highs at 2.014 seconds.

St. Joseph's total RT-60 is 2.646 seconds. The cumulative pattern of low/mid/high is smoother at, respectively, 2.512/2.866/2.516 seconds.

Summing up, Minozzi says that longer reverberation times at the mid-range frequencies (500 Hz to 1.6k Hz) can cause difficulties with speech intelligibility. He notes that 20 years of Monte Brothers research bears out that statement from their profiles of many houses of worship, including Christian churches of many denominations as well as Jewish temples. "Oddly enough, most contractors don't log this data!"

Minozzi explains that the critical intelligibility band starts at 2 kHz. "So from 2 kHz to 5 kHz you'd think if reverberation were high, intelligibility would be better. However, if it's lower, it's better. It gives you more control. Too much reflected sound at those frequencies puts a real damper on intelligibility."

Furthermore, he says the richest sound would emanate from a tapered reverberation pattern, which is highest at the low frequencies, lower at the mid range and lowest at the high frequencies. "Therefore, a highly reverberant low frequency range doesn't jump into the way of the spoken word. If you went to the Basilica in Rome or the Sistine Chapel, that's probably the profile we would get."

The System Should Match the Services

Minozzi discussed the cathedrals similar sound problems involving intelligibility as a function of shape and size with relation to reverberation times. The next aspect is the remedy for the sound problems for all four cathedrals. The solution was to provide "personal-

ization" of sound by means of low-Q speakers in a distributed speaker system without delay, using a forward masking concept.

According to Minozzi, "personalization" refers to the voice delivered in a gentle, personal manner to the parishioner and not manipulated. "People want to be spoken to. They want to hear the person (clergy) speaking in a way they it sounds like the person."

The type of distributed system Minozzi recommends and installs allows mobility of the clergy for activities in all parts of the church without feedback, which would have been caused by a central cluster and/or an improperly designed distributed system. Hence, the old idea of "directional realism," prevalent in many writings on systems for worship spaces, doesn't apply. The concern now is with logistics.

There's a need for mobility with cathedrals by virtue of the liturgy. For example, there are Stations of the Cross literally around the sanctuary, baptisms, funeral processions, Holy

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Day ceremonies, ordinations of priests and choirs among other diocesan events and activities requiring mobility. And that's not limited to cathedrals. The advent of wireless microphones has given clergy the freedom of moving from the fixed microphone on the pulpit into the congregation in many churches and temples. Sound systems have to be designed, accordingly, to offer fluidity of movement within the house of worship.

Common Speakers and Microphones

It is beyond the scope of this article to delineate all sound reinforcement



Figure 3 – A floor stand and mini-boom support an electret microphone at the Bishop's chair or cathedra.

equipment installed in the cathedrals. However, there is certain equipment that is basic to the installs. While Minozzi would not promote any specific brand of low-Q speaker, he notes that full range speakers that don't employ crossovers were chosen in the Monte Brothers designed distributed system. Digital equalization is used. "Some of these cathedrals use 1/6-octave, dual filter digital-controlled equalization. St. Joseph's in Buffalo is completely digital electronics."

Audio-Technica microphones are used exclusively. On the hardwired side, he notes that the AT 915 QMR/MLx electret condenser, supercardioid pattern mic is used at the pulpit and the lectern. "It has almost no proximity effect, and it has a generous enough polar pattern that can pick up a variety of voices. You don't have to be right on axis with this mic. And it doesn't pick up a lot of ambience in the cathedral." The mic also suits the members of the congregation participating in the services who aren't professionally trained to read into a microphone.

There's special consideration for miking at the altar of sacrifice. The AT 851 WA or the AT 961 boundary mics are the choice. "They're very effective. They're used at the altar of sacrifice because there can't be any visible microphones."

The hypercardioid AT-873 is used for the choir. "It's very rugged and very pleasing for that application." Since choirs can be located anywhere, there's concern for logistics. "We usually use the 873s, which are an excellent mic in this situation because you can expand the polar pattern for choirs and reduce it for soloists."

Regarding wireless mics, Minozzi points out that the AT 935 QMR/MLx, which is a shorter version of the aforementioned AT 915, and the AT 830 lavaliers are used with Audio-Technica and Lectrosonics wireless transmitters, providing needed mobility.

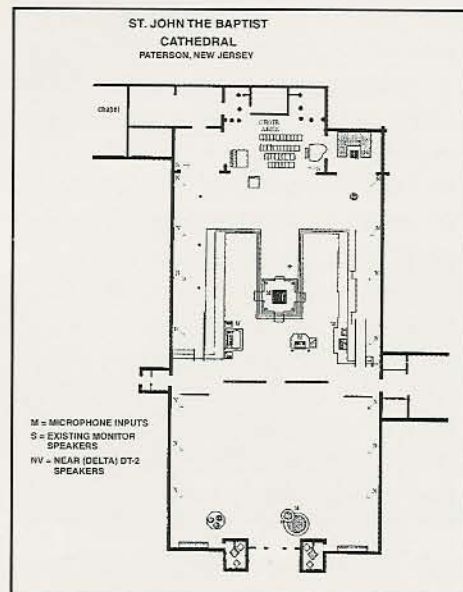


Figure 4 – Floor plan of St. John the Baptist Cathedral in Paterson, New Jersey.

Gating, Pre-Sets and Audio for TV

Biamp Advantage units provide passive gating and pre-sets. Minozzi explains that a passive gating system is used on each of the sanctuary microphones, except the choir mics. "It's done that way because we have accurate equalization, competent signal processing, and competent speaker systems."

Bob Pelepako, who is Steve Minozzi's partner at Monte Brothers, points out that the choir director has the opportunity to control the level of the choir mics with small submixers. Therefore, there are no gates on the choir mics.

Another function of the Biamp Advantage system is the sound level pre-set.

Monte Brothers Sound Systems

Monte Brothers Sound Systems, (Dobbs Ferry, New York), has been in business since 1966 specializing in custom sound systems. For at least the last 20 years, Monte Brothers has devoted about 95 percent of their efforts to houses of worship. There are also special projects that widen the company's scope. For example, in the entertainment industry, there was the unique situation where Monte Brothers provided the needed loudspeaker support for the Universal Studios major motion picture *Meet Joe Black*, so that the cast and crew could hear the director's instructions on the huge birthday party lawn set in the last scene. In addition, the sound company provided a sophisticated Lectrosonics wireless microphone system for the talent. Monte Brothers also does all the custom sound support work for the New York City Police Department's command center.

As an example of the freedom and flexibility of using pre-sets, Pelepako described how they are used for sound level control at St. Joseph's Cathedral in Buffalo. In this case, the Advantage

DRI has a remote keypad with certain pre-sets. "The DRI allows volume to be turned up and down and to change 'scenes' or locations in the church. They hit a button on the keypad and it reconfigures. For instance, the mic may need a volume boost if the cathedral is really crowded. Also, during the week, when the cathedral is really empty, you may want to bring the level down.

"Then for example, the Bishop or a priest may be speaking from the 'Lady Chapel' in the back of the main sanctuary for certain events," says Pelepako. "He hits the pre-set for that area and the system is reconfigured."

The new sound system also provides separate audio feeds for video, such as the live TV broadcasts from St. James in Brooklyn and St. Agnes in Rockville Centre. "All the microphones are split for TV feeds. In order to get room ambience, we hung a mic in the back of the sanctuary that TV people can creatively mix in more ambience. This especially works well on choir and it doesn't sound like the celebrant is talking in an eight by ten room when the services are broadcast."

Rounding Out

Other equipment common to the cathedrals includes such items as White and Biamp equalization. Power amplifiers are mostly Crown with some Crest as well. Summing up all the equipment choices, Minozzi notes that the makes and models selected were reliable and have good perfor-

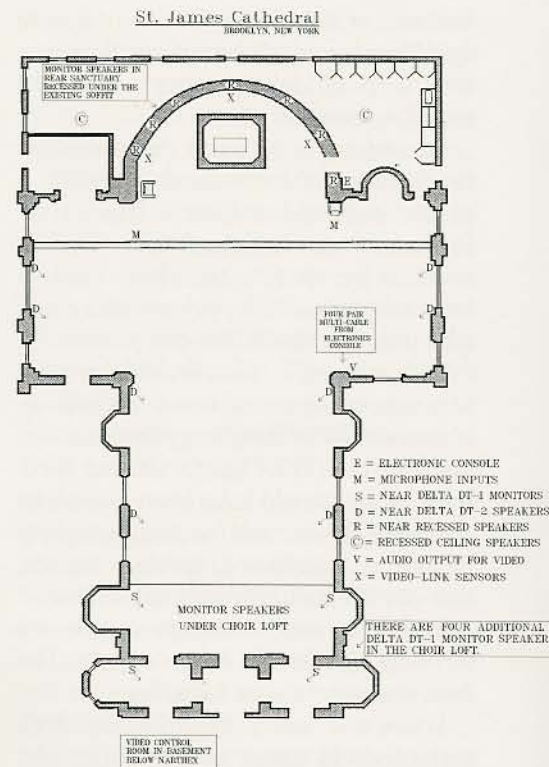


Figure 5 - Floor plan of St. James Basilica in Brooklyn, New York.

mance. "We also select the companies for their support and their willingness to evaluate and help us customize sound systems.

"And clients bring us in because there's no textbook solution to what they need. And this will be true for the years to come. A sound system in a cathedral is not like one in a car or a courthouse, where certain things happen in certain ways every time!"