"PLEASE TELL ME again. Why is it not a good idea acoustically to put carpeting on the floor of a church, even though carpet is often used in the aisles of a concert hall?" A parishioner raised this question during discussions regarding the design of a new church building. Distilled to its essence, the question really is, "What is the difference between church acoustics and concert hall/auditorium acoustics?" The difference is indeed large, distinct, and critically important. In the concert hall or theater, the audience does not participate vocally. In the church, the congregation does have considerable vocal participation. In fact, it is this participation of the assembly in the words and music of hymns, psalms, and liturgy that makes acoustical design a greater challenge in the worship space than in the concert space.

In order to achieve an excellent architectural and acoustical environment for worship, one must first understand the functional needs and practical goals for worship. The key architectural elements involved must also be understood.

A significant and possibly primary amount of content, emotion, and expression is transmitted aurally to and from the worshipers. This is not to say that visual art, color, form, light, shadow, dramatic action, etc. are secondary. Nor is it to say that the perfume of flowers or incense, or the touch of a neighbor's handshake, the flow of water, the texture of the architecture or the taste of bread and wine are secondary. We must acknowledge, however, that the dialogue of liturgical response, the words of lessons and sermon, the verbalized prayers, and the music of hymns, psalms and sacred literature communicate the truths of the faith, and do so for nearly 95% of the time typically spent in worship.

The essential acoustical goals and needs for worship have been consistent over the years, even though specific applications and uses have expanded and changed. These are:

- clear, intelligible distribution of speech (of lessons, prayers, sermon, liturgy) to all worshipers. At one time the source of speech was almost exclusively the province of the pastor, who spoke only from pulpit, lectern, altar or font. Today lay readers, assisting ministers, actors in drama, and others frequently speak to the congregation from many different places in the worship spaces, requiring greater flexibility in the environment.
- the blending of music into good ensemble, enabling all musicians to hear each other.
- balanced, clear distribution of music to all worshipers. Lutheran music has typically been organ and choir oriented. These remain the primary musical forces, but the scope has expanded to include multiple choirs, handbells, various acoustical and electronic instruments, pianos and other keyboards. Musical styles have also expanded from being eurocentric to embracing diverse ethnicities.
- distribution of sound energy within and among the congregation to foster robust participation in hymns and liturgy. The music and liturgy (as sung and spoken by the congregation) now includes not only well-known chorale style hymns, but also various classic, contemporary, ethnic, and ecumenical offerings. This diversity requires greater support for the congregation via musical/instrumental leadership, and in hearing each other well.
- control and suppression of unwanted noise (from external sources, and from internal systems). The "noise of life", sometimes called noise pollution...
has increased over time to include more traffic, motor, and machinery sounds than ever before. Further, the very building systems such as air conditioning or specialized lighting that enhance the environment also have the potential of intruding with noise.

The determinate tools and elements that architects and designers have at hand to achieve these goals include:

- **room size**: the cubic air volume of the room should be generous. Sound travels in air. Therefore, greater air volume brings more potential for good sound distribution. Tall ceilings and wide aisle spaces, for example, are beneficial.

- **room shape**: oblong or shoebox-shaped rooms—those with one longer and one shorter axis—help to distribute sound energy. Round, square, or fan shapes are generally poor, for they do not distribute sound energy evenly.

- **location of elements**: musicians must be together: The choir, organ, organ console, piano, instruments, bells, etc. should be oriented so that all musicians hear each other. This will facilitate good tuning and rhythmic accuracy, and will build musical ensemble. Separations between musical participants of approximately 55 feet or greater may cause accuracy and rhythm to deteriorate. Organ and singers/musicians, must be located to project along the longer axis without obstruction to all worshipers in the room. Speakers and microphones of the sound system require careful placement for good sound distribution and to avoid problems such as feedback.

- **interior materials**: architectural materials and structures absorb sound energy (removing it from the listening environment), reflect sound energy (maintaining its audibility), or transmit sound energy (letting sound either exit or enter the listening environment). Materials with each of these characteristics must be used in proper proportion and ratio for a successful result. The correct relationship of reflecting and absorbing materials in conjunction with room size and shape should be used to achieve a reverberation period of approximately 2.0 seconds. (Reverberation period is the measure of how long a time in seconds sound energy is audible, traveling, blending, and distributing itself within a space.) A reverberation period of approximately 2.0 seconds is generally long enough to enhance music and to foster good hymn singing participation, yet short enough for separate words of speech to remain distinct. Sound absorbing materials, if used in a room, should be kept far from musicians and worshipers. For example, carpeting used in the choir area or under the pews of the congregation will absorb and stifle the sound of choir, organ, instruments, and hymn-singing worshipers, and prevent such music from dispersing and blending in the room. Sound transmitting materials that allow noise from outdoors or from adjoining spaces to interrupt worship should be avoided. Conversely, materials used at organ chamber tone openings must be extremely sound transmitting for good musical clarity.

- **sound system**: in rooms with generous reverberation periods that enhance and encourage music and congregational participation, it is often necessary to clarify speech through the use of an electronic sound system. Speakers should be selected and located to direct sound energy only to seating areas. Intelligibility may suffer if speakers aim at too many reflective building surfaces and not directly at worshipers. Sound systems may also be appropriate for some musical styles and idioms. For the most part, the acoustical architecture, and not a sound system, is the preferred vehicle for carrying sacred music to all listeners.

- **mechanical systems**: the design, type, and placement of mechanical systems in the building (such as heating/air conditioning ducts, fans, electrical motors, plumbing equipment, etc.) must be carefully considered to avoid creating airborne or structure borne noise from interrupting activities in the worship room.

Are concert/theater acoustics different from church acoustics? Indeed! The participation of the concert hall audience is passive receiving the performance. The participation of the worshiper is at times passive (receiving the speech of sermon, or the music of choirs), but the participation of the worshiper is often active (singing and speaking in consort with all the other worshipers in hymns and liturgy). This difference is understood and acted upon in those worship spaces and churches recognized to be excellent throughout the years.