FAITH & FORM

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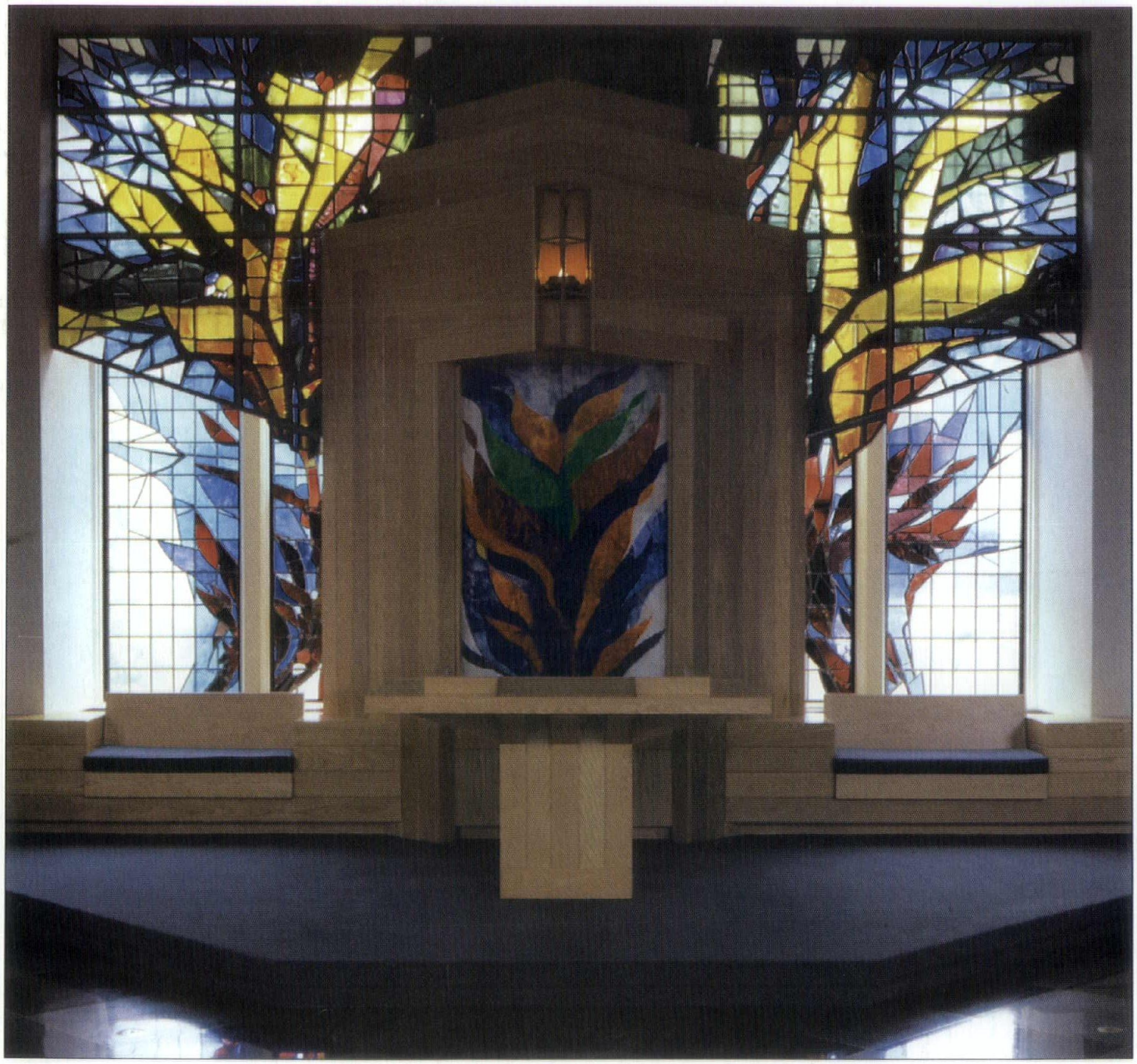

SPECIAL CONTINUING EDUCATION ISSUE

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Manuscript Submission: The editor is pleased to review manuscripts for possible publication. Any subject material relevant to art and architecture is welcome. Text should be double spaced on 8-1/2 x 11 paper. Manuscripts and photos will not be returned unless specifically requested and a return envelope with sufficient postage is included. Good visual material is emphasized.

SPECIAL CONTINUING EDUCATION ISSUE

Earn AIA Learning Units for the three articles checked below (*):

Contents

Features

Departments

About the Cover

"The light of learning illuminates the Temple of wisdom."
—Thomas Jefferson

The stained glass for the Jewish Theological Seminary of America is titled "The Burning Bush" by artist Jean-Jacques Duval of Saranac, New York; Gruzen-Sampton, architect. Duval is well-known for his glass projects in both secular and religious communities. Born in France, he is the recipient of commissions in Europe and the Orient as well as the United States. Cover photo by Marjorie Gersten.

Advertisers' Index

Notes & Comments

Northeast Region/IFRAA Meets

The Northeast Regional Group of IFRAA *met at the Church of the Covenant in Boston on September 14 to present a program, "Renewing Fabric: Building Faith" with Cecilia Lewis, chair, presiding.*

Church of the Covenant steeple.

The Church of the Covenant, a Neo-Gothic structure originally designed by Richard Upjohn, Jr., is going through a remarkable restoration and renovation. The audience was fascinated as it was led through the church's history and the building process by Tom Green, FAIA, principal of Benjamin Thompson and Associates. This landmark church was closely tied to the history of Boston itself.

Sitting in the sanctuary, it was easy to imagine the difficulties of restoration that Green pointed out. At one time, when a demolition developer offered to buy the church for $800,000 the congregation was sorely tempted to accept and move to another location. But looking at their numerous Tiffany windows and a magnificent chandelier, the church members voted to press on in spite of economic problems. To them, this structure was more than beautiful architecture or historical significance; it was their place for worship.

The next presentation was by Pamela Hawkes, vice president of Ann Beha Associates, whose restoration work has received awards from the Massachusetts Historical Association, the National Trust for Historic Preservation and IFRAA. Hawkes's slides helped us understand the technical and aesthetic problems the architects faced. Jean Carroon, AIA, spoke on the special challenge of the tower and spire. Oliver Wendell Holmes once called the steeple the most perfect in Boston.

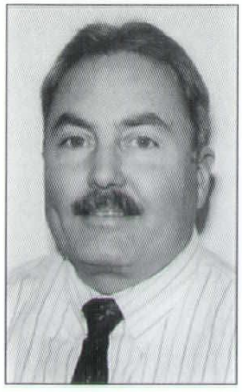
It was the third speaker, Lucy Williams, chair of the Building Committee and a professor of law at Northeastern University, who convinced us that the restoration was a case of the impossible becoming possible. As generous as the members of the congregation were, they could not fund more than a fraction of the money needed. It was Lucy Williams and her committee who created ways to raise over a million dollars to save the church.

Participants sensed that these four presenters had put more than their professional selves into this unique project. Green is a member of the church and a seminary graduate as well as an accomplished architect; Pamela Hawkes introduced the committee to historic preservation contacts when they had exhausted their sources; and Lucy Williams and Jean Carroon are still at work on the lengthy project.

IFRAA's next Northeast Region program, in the spring of 1998, will feature the Young Israel Synagogue of Brookline, Mass., designed by Graham Gund and Associates.—*Cecilia Lewis*

Chairman's Message

By *Douglas* R. *Hoffman*, AIA



Welcome

Some of you will pick up this magazine and recall the days when you received it free just for being an AIA member. Others may have had a subscription but let it lapse when you were not designing any more churches or synagogues. Still others will read this issue for the first time and wonder why you were never aware that *Faith & Form* existed. Whatever your first thoughts as you peruse this complimentary copy, we hope you will be impressed enough to consider becoming a regular subscriber.

Faith & Form has just celebrated its thirtieth anniversary of continuous publication. In its infancy (1967 to 1969), we were able to distribute free copies to AIA members (there were fewer members then, and magazines were much cheaper to produce). However, rising costs forced us to ask for subscriptions around 1970, and since then we have aspired to provide informative, insightful articles on issues affecting religious art and architectural design. Currently, we publish three issues a year at a subscription cost of $26.00. Starting in 1998, if you belong to the IFRAA (Interfaith Forum on Religion, Art and Architecture) PIA, you automatically will receive a complimentary subscription.

This is a *special issue* for us, and we hope a special issue for you! We are offering you the opportunity to earn continuing education credits for several of the articles in this issue. Similar to the format of *Architectural Record*, you will be presented with an article of substance on a particular facet of architectural design, introduced by a set of learning objectives and followed by several questions that test your comprehension and knowledge of the materials presented. The answers to the questions posed at the end of the article are included on another page for your reference and to compare your responses. To earn credit for the exercise, complete the AIA/CES Self-Report Form on page 29, and return it to the address shown.

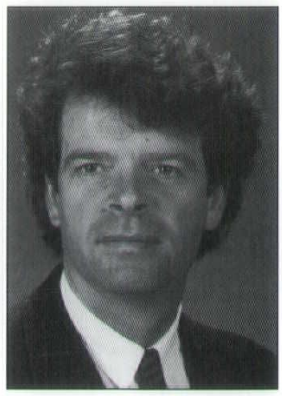
Since we determined this issue would be devoted to educating designers for religious buildings, the articles cover a wide range of topics. Thomas Barrie sets the tone with "The Context of Sacred Architecture," a thought-provoking discussion on the relationship of architectural form to the realm of the sacred. Richard Vosko clarifies the role of the liturgical consultant in religious facility design. Practical guides on key elements of the experience of worship are offered by Robert Betty's "Preparing for a Pipe Organ" and Crosby Willet's "Stained Glass Primer." Jeff Lewis discusses the finer points of design for seating and pew construction, and Dawn Schuette provides an excellent in-depth look at worship space acoustics. Finally, our editor Betty Meyer reviews a recent exhibition of art and craft objects designed for use in spiritual settings. She reminds us that unless we insist on excellence of design and furnishings for the interiors as well, we have not fulfilled our challenge and responsibility.

Contributors to this issue are recognized leaders in their respective fields, but as anyone who has designed a space for worship knows, there are no set solutions that can respond to the vast diversity of religious faith and practice in this country. We encourage you to learn from the wisdom of our writers and challenge you to exercise your innate creativity in the design for any house for worship. Our magazine is devoted to design excellence, and we would welcome the opportunity to publish your unique solution to the timeless quest for crafting sacred space. □

DOUGLAS R. HOFFMAN, AIA, *is the chair of the* IFRAA PIA *and manages the publication of* FAITH & FORM *magazine. Formerly the denominational architect of the United Methodist Church, Hoffman currently maintains a practice in State College, Pennsylvania, and is on a fixed term appointment as an assistant professor of architecture at The Pennsylvania State University.*

THE CONTEXT OF SACRED ARCHITECTURE

By Thomas Barrie



Sacred architecture is never devoid of content. It is not a rational, inanimate object, or a neutral "universal" space, but an animated and dynamic setting that is charged with meaning. Enchanted natural places are typically points of confluence, where disparate elements dramatically meet—the edge of the sea; mountain heights; great waterfalls. Often these were recognized as sacred ground, places where the gods had been or were present, and consecrated as such. The environmental setting of the Greek sacred site at Delphi is such a place; its location on the slopes of the foothills of Mt. Parnassus is subject to capricious and often violent weather. It was here that the sun god Apollo supplanted the earth goddess Gaia, and where the Delphic Oracle served as his inscrutable intermediary. The ancient Greeks believed it was the center of the world and marked this point with the sacred *omphalos* stone located in the inner sanctum of the Temple of Apollo.

According to Mircea Eliade, the sacred was traditionally a place apart; a center separated from the infinite and formless profane world. Often it was revealed by a "sacred hierophany" or appearance of the gods. Its boundaries were then symbolically and physically established, and it was entered by means of thresholds and gateways. Sacred architecture, from a simple enclosure to a complex architectural setting, is basically an elaboration of this essential theme. It was, and still is, an artifact built to delimit sacred ground. In time it came to symbolize the meanings and to accommodate the rituals of the religion it was built to serve.

The sacred has always awakened us to the joy, power, enormity and tragedy of life. This is still the case, though our desacralized age makes the understanding and creation of the sacred difficult. We have lost our way along the paths to the sacred that our ancestors so assiduously established, but if we pause and become still and silent, they often reveal themselves. I can recall moments of peace, agitation, transcendence and epiphany at some of the numerous sacred sites I have visited and researched: an afternoon in the candlelit shadows of the Church of the Holy Sepulchre watching streams of pilgrims retrace the steps of generations; passing the outstretched hands of beggars as I climbed up steep steps to a mountainside stupa in Kathmandu; a day when I prayed for understanding in a parish church in Devon, which arrived at its own pace in the weeks of travel that followed; in the humid heat of August, walking the approach path over and over of a Japanese Zen Buddhist Temple, noticing its textures, shifting views, sounds, smells and my emotions; and a sunny, spring morning recently watching shadows cast by the conical burial mounds at the center of an ancient earthwork enclosure in Southeastern Ohio, as well as inmates inside the razor-wire fence of an adjacent Federal Correctional Institution.

Sacred architecture was, and still is, an artifact built to delimit sacred ground.

Symbolism, Mythology and Architecture

The use of symbols has played an important role in the unique human need to define our place in the world. Most commonly, symbols have been used to express what otherwise might have been inexpressible religious and mythological themes. According to Carl Jung, "Because there are innumerable things beyond the range of human understanding, we constantly use symbolic terms to represent concepts that we can't define or fully comprehend. This is one reason why all religions employ symbolic languages or images."

Myths are particularly potent symbolic vehicles because of their ability to weave symbols into a narrative. In sacred architecture, however, we find the most potent use of symbolism, because here symbols are not only representational, but spatial and temporal as well. Consequently, the totality of the architectural experience is a powerful synthesis of the various media used to communicate symbolic themes. In essence, the symbolic content is represented by the orientation, plan, surfaces, geometry, form and spaces of the architecture. Moreover, it is not a static activity, such as viewing art, nor a passive one, such as listening to a folk tale, but a dynamic experience—the inexpressible expressed three-dimensionally and experienced totally.

THOMAS BARRIE *is a practicing architect and associate professor of architecture at Lawrence Technological University, Southfield, Michigan. He is a scholar of sacred architecture whose research has brought him to sacred sites around the world. He has published numerous articles and lectured extensively on his subject area. He is the author of* Spiritual Path, Sacred Place: Myth, Ritual and Meaning in Architecture *published by Shambhala Publications* (1996). *He holds a master of philosophy degree in architectural history and theory from the University of Manchester, England, and a master of architectural design from Virginia Tech.*

A Setting for Ritual

Rituals traditionally have reenacted mythical events—Easter pilgrims carrying their crosses on the Via Dolorosa in Jerusalem recapitulate Jesus' journey to apotheosis—a mimesis of the god's original deed. By participating in a ritual one returns to this sacred time and can approach and perhaps commune with the divine. To be effective, however, ritual needs to be performed within a sacred setting because without this it has no context and thus loses its meaning.

Religious beliefs are often symbolized through ritual and typically there is a close correspondence between the rituals and the architectural setting. This correspondence is not simply functional, but operates at a deep symbolic level in which belief, ritual and architecture are firmly interwoven. In other words, religious architecture is fundamentally "built myth," which symbolizes a culture's belief systems of its time and accommodates and facilitates the enactment of shared rituals.

Spatial Sequence and Symbolic Narrative

A rich spatial sequence and symbolic narrative that symbolizes the spiritual path and its goal typically have been central to sacred architecture. The Way, the spiritual path, the sacred journey—these are all terms that describe the process of spiritual development. They not only describe a psychological setting, but often a physical one as well. In this way its peregrination is a recapitulation of the spiritual quest—a symbolic journey from the profane outer world to the sacred inner world. It is analogous to the "hero's journey" described by Joseph Campbell, including the three stages of the finding of the path, the journey with all its twists and turns, and the attainment of the sacred place.

The architecture often symbolizes the religious quest through enclosures, thresholds, gateways, spatial sequence and a clearly articulated inner sanctum. The entry path of medieval in Japanese Zen Temples, for example, often symbolized the pilgrimage path to the Zen master's bucolic hermitage. The journey is often a sensory, kinesthetic experience that subtly manipulates one's perception and sense of time. It recognizes the profound role that our bodies play in meaningfully interacting with our environment, something that should not be underestimated today.

The lower portion of the Sacred Way at Delphi passes by numerous monuments and treasuries of intercity wars before finally arriving at Apollo's temple. It was a complex spatial sequence, a symbolic journey from the hubris of man to the dwelling of the god. The Doric temple, a pure object set against the surrounding mountains, expressed Apollonian virtues and addressed the unresolved conflict between humans and nature—reason and intuition. Pilgrims traversed the Sacred Way to consult with the oracle, hidden within the inner sanctum, as did the participants of the Pythian Games that took place every four years in the stadium above.

Context

When studying and designing sacred architecture one cannot ignore its social, political, historical, mythological and liturgical context. Religious edifices were rarely benign and often served the political and social agendas of the organized societies that built them. Their full context is essential to plumbing the depths and designing with substance and integrity. It is of necessity complex and subject to multiple interpretations, its meanings often occult and hidden in cipher. Like great literature and religious texts, however, it has and still can provide thresholds to understanding what in varying degrees are accessible to all.

The myth, according to Joseph Campbell, is the "spontaneous eruption of the psyche." Architecture as built myth is similarly linked to the psyche and its need for spiritual orientation, wholeness and transcendence. Much of what our ancestors built was perhaps not rational or intentional, according to our current understanding of these terms. Their simple shrines and great monuments were more "spontaneous eruptions" of their spiritual needs. They need to be understood in this context.

Ultimately, even though the creation of a sacred place involves the careful composition of materials and light, it is not about rational technique, but rests firmly in the ineffable. At the onset we need to abandon rational thought; to have the "beginner's mind" so eloquently described by the Zen monk Shunrya Suzuki.

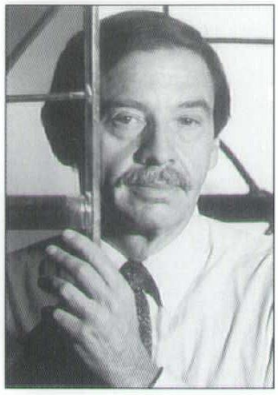
Designing sacred architecture has little to do with "the program" and functional efficiency. As a mediator between humans and their gods it is about a matrix of meaning communicated by the materials and articulation of the architecture. To be attuned to its religious and cosmological context it needs to include a broad context that transcends the confines of the project site. Our ultimate goal is to discover the sacred through a deep understanding of its specific environmental and religious context.

We must remember that religion is a natural and enduring human need, and sacred places have always been auspicious settings where it was believed contact with the divine was possible (though direct access was sometimes limited to the initiated or the powerful). As Thomas Moore argues, the soul has an "absolute, unforgiving need for regular excursions into enchantment," a role that sacred settings have always played. Clearly, there is a need for a "re-enchantment" of our daily lives and a call to re-vivify our built environment. Even though the study of sacred architecture is limited to the places and structures of specific religions and rituals, attuned, sincere, and sensitive architecture of many uses can awaken the sacred within us.

Finally, before we can understand or create sacred places our personal context must be grasped and integrated. We need to examine our beliefs and discover the places that we hold sacred. Otherwise, our understanding will be based on prejudices, and we risk blindly building our superficial desires and neuroses. Too often the content of contemporary architecture is superficial, the result of an inability to consider the context of both the past and the present with equanimity. The creation of the sacred is one of discovery, of uncovering what is hidden, a hierophany where the gods are revealed and rarely if ever the product of personal invention.

The fecund tapestry of the world's religious traditions and the architecture built to serve them, both ancient and modern, provides a rich compendium that can initiate us into the realm of understanding the sacred. We need to discover new ways of expressing the sacred that are appropriate to our time but that also touch the past. Sacred space was always seen as liminal, a bridge between the human and the divine. Today, it might serve as a threshold to a more substantial understanding of the world's religious traditions. The thresholds we pass and the paths that we walk have the potential to lead us to a sacred place and a better understanding of who we are—our own specific context of sacred architecture. □

STAINED GLASS PRIMER



By E. *Crosby Willet*

Part I: History

Over the centuries people have been fascinated with the power of light and color to transform inanimate religious structures into spiritual spaces that create a sense of awe for both believer and non-believer.

For more than 1,000 years stained glass has been a major adjunct to religious architecture, magically conditioning light from the Romanesque period with its two-dimensional ornament and primitive figurative design of iconic influence, strikingly illuminated with glorious primary color palettes, to the pinnacle of stained glass in the magnificent cathedrals of the Gothic Era (1200-1450). It still can be viewed at Canterbury, Yorkminster, Chartres, Bourges, Notre Dame and Ste. Chapelle in Paris, and countless other churches in western and central Europe.

AIA Continuing Education Series

This article offers 2 AIA *Learning Units* (LUs) *to* AIA *members. Use these objectives to focus your study, complete the questions at the end of the article and check your answers on page* 28. *Then fill out the Self-Report Form on page* 29 *and return it to* AIA.

Learning Objectives

To acquaint architects with the use of stained glass in religious buildings with

1. A brief historical overview of stained glass from its origin to modern times;
2. A review of the most used techniques and materials; and
3. A methodology for architect/artist collaboration and a listing of sources for information about stained glass artists, studios and restoration consultation.

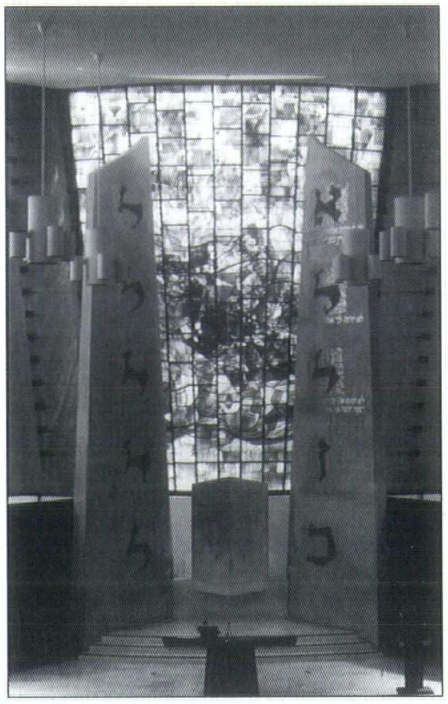
Bryn Mawr Presbyterian, Bryn Mawr, Pa., chapel window, 4'x10'. Designed and made by Louis Tiffany Studios, 1900.

During the 15th century there began an eclipse in the art of stained glass. While it advanced technically with the advent of staining and etching, it became relegated mainly to creating heraldic medallions or copies of Renaissance paintings. This three-century span gained the medium the title of the "Lost Art." It was "rediscovered" in the mid-19th century when Viollet le Duc, a French architect, was commissioned to restore a number of medieval churches including Notre Dame in Paris. His writings about his work helped foster Neo-Gothic movements in England led by William Morris and in the United States by Boston architect Ralph Adams Cram whose credo was "the only valid architectural style for a religious building is Gothic."

At this time, the first truly American stained glass movement, the opalescent School of Glass led by John LaFarge and Louis Comfort Tiffany, was in full swing. During the Victorian Age, they created exceptional decorative and pictorial work in semi-opaque glass that was up to three layers thick to get the subtle nuances of the paintings they were animating in glass. With church architecture turning to the neo-Gothic, a new group of artists including Charles Connick, Otto Heinigke, William Willet, Nicolo D'Ascenzo and Wright Goodhue, led a protest that still exists today between the extremes of muted pictorial "Art Glass" and the vibrant jeweled stained glass of medieval heritage.

Modern stained glass evolved in this same period; Frank Lloyd Wright's ornamental Mondrian-like patterns were integrated into all aspects of his buildings. German artist Jan Thorn Prikker was the guru for the most significant modern movement. After World War II it was led by Georg Meistermann, Ludwig Schaffrath and Johanne Schreiter whose architectonic linear compositions of generally monochromatic palettes spawned thousands of disciples in much of the

E. CROSBY WILLET *is a third-generation glass craftsman. For* 47 *years he has been associated with the* Willet Stained Glass Studios *of Philadelphia, Pa., founded by his grandparents in* 1898. *Notable studio commissions include The National Cathedral, Washington,* D.C.; *The Cadet Chapel, West Point,* N. Y.; *Saint Mary's Cathedral, San Francisco, Calif., Temple Beth Zion, Buffalo,* N.Y.; *Second Baptist Church, Houston, Texas; National Presbyterian Church, Washington,* D.C.



Temple Beth Zion, Buffalo, N.Y. bimah window, 34'x45', from a painting by Ben Shahn. Translation into leaded stained glass by Willet Studios; Benoit Gilsoul, designer, 1967; Harrison and Abramovitz, architect.

Lovers Lane United Methodist Church, Dallas, Texas, section of nave window wall, 100'x50', leaded cathedral and antique glass. Rambusch Decorating Inc.; David Wilson, designer; Robert Rambusch, liturgical consultant, 1978.

world particularly the United States, Canada, Japan and Australia.

In the 1930s, A. Labourret, a French artist, created panels of thick slabs of glass in concrete that were later refined into "faceted glass," widely used in American churches since the 1960s.

The 1960s' new church building boom in the United States helped the modern glass movement, which was led by large atelier-type studios that combined talented artists and craftsmen to create windows sympathetic to a variety of architectural needs. Among the larger studios were Rambusch, Durhan and Rohlf, New York City; Hiemer, New Jersey; Daprato, Chicago; Connick and Burnham, Boston; Jacoby and Frei, St. Louis; Hunt, Pittsburgh; Cummings, San Francisco; Judson, Los Angeles; Schmitt and Pickel, Milwaukee; and Willet in Philadelphia. Gabriel Loire in France and Roger Darricarre in Los Angeles were the leading exponents of the faceted glass techniques that soon became a mainstay of the American studios.

Interest in stained glass reached unprecedented heights from the 1970s on. Thousands of people learned "how to do it" in three easy lessons. Today, Tiffany lamp shades are imported from Taiwan and at least one full color book on every aspect of stained glass is published each month. Stained glass is on the World Wide Web. For the architect doing religious building in the 1990s there are more artists and studios available in every section of the United States than ever before. Since our stained glass is aging, restoration is becoming a major aspect of the field. Restoration specialists can be located nationwide (see Sources).

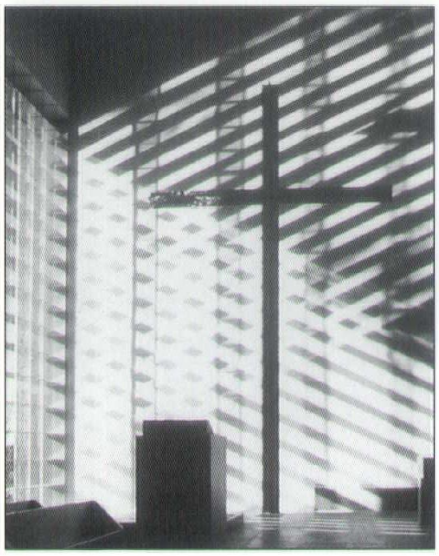
Part II: Materials

Stained glass today is a broad generic term covering all types of glass used in a decorative manner. Some of the varieties of the glass available are:

- *Cathedral and opalescent glass*: Machine-made rolled glass in a broad range of color and textures. Cathedral is more transparent, opalescent semi-opaque. Made in the United States by a number of manufacturers.
- *Antique glass*: Mouth-blown glass found in hundreds of colors and textures and used exclusively by many artists for its transparency, shading and handmade look. Sheet sizes are limited (24" x 36" the largest). The thickness varies, giving color shading and a thin opalescent coating for light diffusion. It is manufactured in Europe and the United States.
- *Dalles*: one-inch thick glass slabs cast 8" x 12", made in hundreds of colors and manufactured in the United States, Germany and France.
- *Commercial glasses*: normally clear or tinted in large size and a variety of mechanical-appearing textures.
- *Bevels and jewels*: cast or handmade from U.S.A., Germany and Asia.
- *Dichroic glass*: super thin layers of metallic oxides allow both transmitted and reflected color from opposite ends of the spectrum at the same time. Manufactured in small sheets in the United States. Good in windows where views from exterior and interior are of and where reflective light is needed.

Part III: Techniques

- *Leaded stained glass*: traditional, representational symbols of figures. Can be painted and fired for light control, more labor intensive, but adapts well to abstract design with beautiful variations of hand-blown antique and mechanical glass textures. Varying glass densities with a variety of lead widths make it unique, particularly where fine detail is desired.
- *Faceted glass*: more contemporary, less expensive than most leaded glass by as much as 50 percent. Limited in detail, lettering, shapes. Faceting glass surface results in added play of light. Rich color to pastel tints are available. Requires fewer frames and reinforcing.
- *Sandcarved, beveled clear and opaque whites*: Good for interior screens and artificially lit windows, or in a place where high transparency to view exterior is desired.
- *Protective glazing* in glass and plastics is widely used but often incorrectly. It should always be vented to allow moisture to dissipate.



Christian Seminary, Indianapolis, Indiana, dichroic window wall, 10'x30'. Designed and made by James Carpenter, 1985-87; Edward Larrabee Barnes, architect.

Part IV: Architectural Philosophy

The architect as planner for religious structures is in the best position to envision how they will want to condition light entering the building and the colors needed to create the proper environment for worship. If the glass artist/studio is selected early into the project, they can be of great help on structure, materials and consultation with the client in developing iconography, design style and cost. Stained glass guidelines suggest that after interviews, the client select one artist/studio to work with on the project. Should they fail to provide the proper solution, they should withdraw and the client be free to choose another artist.

Part V: Sources

1. The Stained Glass Association of America (SGAAA), PO Box 22642, Kansas City, MO 64112, 800-888-7422, fax: 816-361-9173. More than 400 members of studios, artists and individual practitioners on an international basis. It publishes a magazine four times a year. Free for architects is their annual 84-page *Source Book*. It contains the names and addresses of all members plus a wide variety of artists and studio members' work. The *Source Book* also contains specifications, a glossary of stained glass terms, and a bibliography of stained glass books.

Restoration Information: The SGAA publishes *The Standards and Guidelines for the Preservation of Historic Stained Glass Windows* (21 pp.) and its Restoration Committee is working on an accreditation program for restoration studios. This guideline and lists of restoration consultants are free and can be obtained by calling or faxing the SGAA Administrative offices (#1 above).

2. *The Guild*, an annual publication, lists artists and craftsmen by category in all types of architectural arts including glass. It has more than 100 artists listed in architectural glass and the work of many is portrayed by excellent color photographs. A large percentage are not SGAA members. Free copies for qualified architects may be obtained by calling or faxing their corporate headquarters: Kraus Sikes Inc., 931 East Main St., Suite 106, Madison, WI 53703, 800-969-1556; fax: 608-256-1938.

3. *Faith & Form*, published three times a year by the AIA as part of its PIA for Religious Architecture. It lists stained glass artists, studios and restoration studios as well as advertisements by a number of stained glass studios. For membership/subscription information, contact: IFRAA PIA, Jean Barber, 1735 New York Ave, NW, Washington, DC 20006, 202-626-7305.

4. Publications dealing with stained glass as well as blown (hot) glass (but tend to be more technical) include:

- *Glass Craftsman* (bimonthly), 28 South State St., Newtown, PA 18940, 215-860-9947; fax: 215-860-1812.
- *Glass Art* (bimonthly), Travin, Inc., 9771 S. Spring Hill Place, Highland Ranch, CO 80126, 303-791-8998; fax: 303-791-7739.
- *Glass* (quarterly), Urban Glass, 647 Fulton St., Brooklyn, NY 11217, 718-625-3685.
- *Neues Glass* (quarterly, in both German and English), New Glass German Language Publications, Inc., 153 S. Dear St., Englewood, NJ 07631. □

AIA/FAITH & FORM Continuing Education Series Instructions

- Read this article, "Stained Glass Primer" (pages 11-13), using the learning objectives provided to focus your study.
- Complete the questions below, then check your answers (page 28).
- Fill out the Self-Report Form on page 29 and submit it to receive two AIA Learning Units for this article.

Questions

1. The earliest stained glass dates to Medieval times. Identify the approximate dates and list three places where it can still be viewed.

Answer 1. _____

2. The Victorian era of stained glass in America was dominated by two personalities. Name them and describe their work.

Answer 2. _____

3. Major influences on modern 20th century stained glass include a number of French and German artists. Name two and give a brief description of their work.

Answer 3. _____

4. Name two major types of stained glass currently used in religious buildings in the United States and briefly describe the characteristics of each.

Answer 4. _____

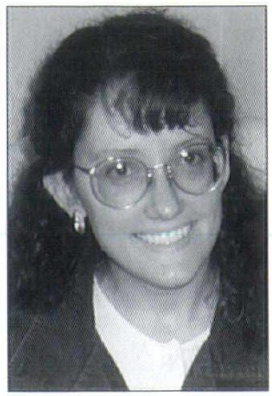
5. What is considered the best way for architects and stained glass artists/studios to collaborate with their client?

Answer 5. _____

6. There are two sources available free of charge to architects seeking more information on stained glass or locations of artists/studios on a nationwide basis. Name two and describe what benefits each gives.

Answer 6. _____

GOING BEYOND THE VISUAL



By Dawn R. Schuette, AIA

Imagine walking into a brilliantly renovated Gothic church, looking at the carefully coordinated cluster of loudspeakers hanging at the transept and not being able to understand a word that is said. . . .

Imagine sitting in an elegant, intimate new chapel—when a rainstorm on the metal roof disrupts all that is said or sung. . . .

Or imagine going into a large, visually uplifting space with plush carpet, padded pews and beautiful sandstone walls—only to experience sound that is distant and dry rather than soaring.

When architects receive a charge to design or renovate a worship space, their first thoughts often go to the grandeur of the new space, the transition/preparation tone set by the building entry, or the message to be conveyed with the building exterior. This is normal for architects, who by nature are visual people. As an architect myself, I can relate to this.

A worship space, however, whether a large cathedral, small synagogue or intimate meeting house, goes far beyond the visual in serving its wide range of functions. For every service it may act as a lecture hall, concert hall, gathering space, recording studio and rehearsal room. The visual character and inviting quality of the building must be considered, but the major functions of any worship building relate most closely to the sense of hearing. The message presented should be heard clearly, whether it be a sermon or wedding service. The music should impart a message, stir emotion, or invite the listener's participation. Many churches broadcast their services, so listeners will only *hear* the events occurring without any sense of the visual, but they are participants as well.

With or without knowledge of it, every architect working on such a building is shaping the nature of the congregation and its liturgy for the following decades. Just as the highly reverberant Gothic cathedrals resulted in the slow chanting liturgy of the 1400s, so too the architecture of today will affect (though maybe not to that extreme) how people participate in the service, whether the spoken word can be subtle or must be loud to be heard, and what type of music best suits the room and service. The challenge to architects is to expand beyond the visual and incorporate a sense of sound into their design.

To incorporate sound into the design, there are a few basic guidelines that should be in the back of every architect's mind. Although it is advisable to bring an acoustics consultant into the design as early as possible, all architects should be aware of and incorporate these criteria and principles from the beginning of any new building design or renovation:

- The room's volume and construction materials should be evaluated to provide the necessary reverberation time for the intended liturgy.
- Surfaces in the room should be shaped to provide support to unamplified words and music.
- Background noise should not interfere with intelligibility and meditation.
- Proper isolation should be provided from the exterior and adjacent spaces to limit disruptions.

Reverberation Time

Reverberation is the term attributed to the sustainment of sound within a room. A technical definition for reverberation time (RT) is the length of time it takes for a sound to reduce 60 decibels after the source (speech or music) is stopped. As an aid to understanding this quality, imagine a past experience of listening to the final chord or last note in a piece of music. If the sound died away almost instantly, the RT in the space was short. If the sound hung in the air for a time, the RT was long.

Reverberation times for worship spaces vary widely depending on the liturgy or desired acoustic quality. The typical range is from 1.2 seconds for a

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Learning Objectives

1. Inform architects about the practice of acoustics to remove some of the mystery about the science.
2. Give architects general guidelines about room shaping and surface treatments that will allow for informed design decisions when beginning work on a space for worship.
3. Provide an understanding of factors other than visual elements (shape and surface treatment) that influence the acoustics of a space, such as background noise from building systems and the need for isolation from adjacent spaces or the exterior.

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small space to as much as 8 seconds for a large cathedral. For music, longer reverberation allows for a blending of successive tones and adds to a sense of being enveloped in the music. Although ideal reverberation for pure lecture rooms is around 1.0 second to prevent overlapping of syllables, speech can work in a reverberant worship space if it is well supported by the room and there are no disturbing echoes. It is critical in a room designed for a long reverberation time to have a sensitively designed speech reinforcement system that works with the room's acoustics rather than against it (such as a cluster at the transept of the reverberant Gothic church).

Factors that affect reverberation are the available volume in a room, the geometry of the room, the construction materials of the walls, ceiling and floor, and interior finishes and furniture.

To generate a long reverberation time, sound energy must be held within a space for 2 to 8 seconds. Thus, construction materials must be chosen carefully to sustain all sound frequencies. A single layer of gypsum can be set into vibration easily with a tap of one's fist. It is similarly set into vibration by middle and low frequency sound energy, resulting in absorption of that energy. However, gypsum will easily reflect high frequencies. The sound in a room where the walls and ceiling are constructed of one layer of gypsum would profoundly lack low frequency energy. It is the low fundamental tones that give warmth to music and speech; without them the room would sound harsh and brittle. A grout-filled CMU wall with a directly applied plaster skin coat will not vibrate significantly when struck by a fist or by sound energy. A room with massive walls such as this would be characterized as having a warm, full or rich sound. Not all spaces can afford construction as heavy as 12" masonry, but the maximum weight for walls, floor and ceiling should be the goal for any space where music is critical.

In contrast to surface weight, room finishes have significant effects on middle and high frequency reverberation. When sound energy strikes an absorptive material such as carpet, the molecules of air moving through the fibers transform some of the energy into heat. Thin materials, such as carpet or thin tapestries on a wall, will have the greatest effect only on high frequency sound energy. Too much of such materials in a space can have a negative impact on the brilliance

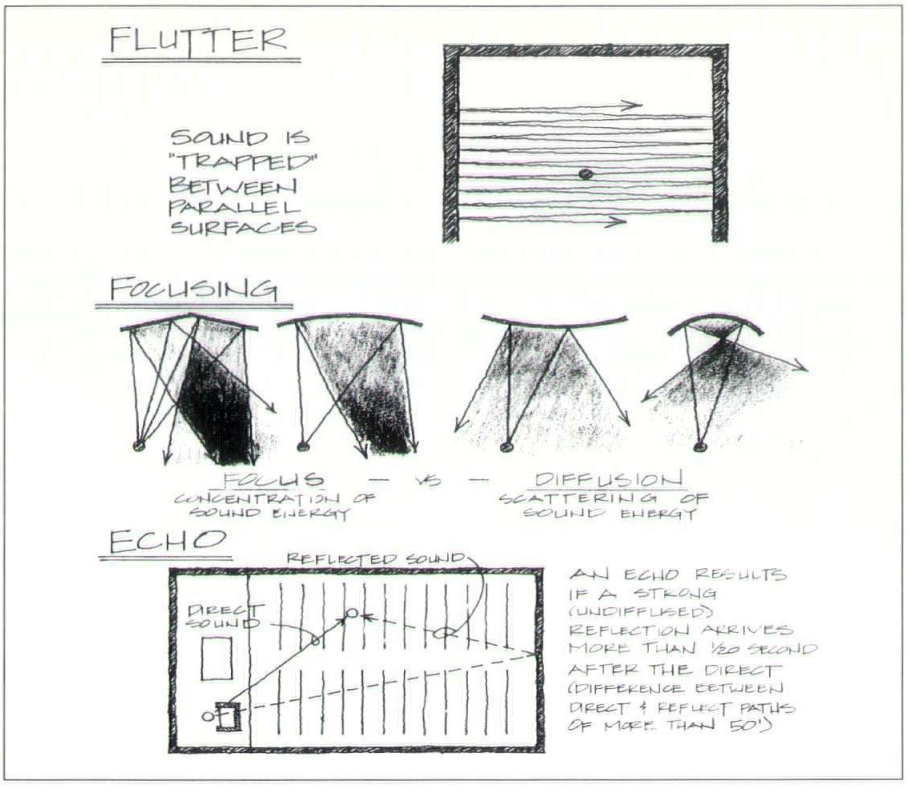


Figure 1. Flutter, focusing, echo.

of sound, but selective use can prevent unwanted acoustic effects of flutter or echoes (described later). A 3" foam pew cushion is thicker and will affect middle frequencies as well as high frequencies. This or similar acoustically thick materials, such as heavy draperies and thick carpet on a pad, will begin to have a significant impact within the range of speech and can reduce communication or intelligibility if used improperly. Similar to thin materials, thicker absorption can be beneficial for preventing echoes, but its use should be limited if the goal is long reverberation.

Everyone can relate to singing at the top of their lungs along with a loud song in the car. We are not afraid to sing in a situation where the individual voice is supported by other music or voices, but the instant the music is turned low, our singing stops. A standing congregation singing a hymn will be looking down into a song book. If the floor is carpeted and the pews are cushioned, a great deal of their sound energy will be absorbed before it has a chance to reach the upper volume of the room where reverberation occurs. Carpet and pew cushions also reduce reflections within the congregation, so timid singers will feel they are singing alone and therefore will sing quietly or not at all. A reflective floor and pews help envelop people in sound, giving them a sense of being supported by a chorus of voices.

Room Shaping

After the massing of the building is set, the interior shape of the walls and ceiling must be addressed. In addition to weight considerations, the orientation of these surfaces or creation of smaller spaces off the main space will have a profound impact on communication for speech, choir, organ and other instruments.

There are three types of acoustic conditions that should be avoided in any space where clarity of speech and music is important: flutter, focus and echo (see *Figure* 1).

Flutter is a condition where sound becomes trapped between parallel walls. This condition is most problematic at the plane of people's ears, so diffusive treatment at lower walls and windows is critical. Flutter is worst for higher frequencies, resulting in lack of clarity for speech and harshness for music.

Focusing conditions are created where concave shapes or angled planes of a ceiling concentrate sound to one location. For some conditions, the focused reflection can be stronger than the direct sound, which will confuse the listener. This also results in "hot" spots where the

acoustic focus occurs and "cold" spots where reflections are absent.

For contrast, a diffusive shape, which is acoustically positive, is also illustrated. A focusing condition is a problem if the focus occurs where people will be affected by the concentration of sound. A tight radius curve that focuses sound 20 feet above people's heads will result in a diffusive condition near the floor as shown.

Echoes are created when a strong reflected sound reaches a listener too late after the direct sound. The late reflection arrives at the listener at the time the sound of the next word arrives, forcing a person to concentrate closely or lose words. The human ear is very sensitive to displaced sounds, such as echoes, so the time difference only has to be 50 milliseconds (1/20th of a second) between direct sound and strong reflection for an echo to interfere.

Note that echoes relate to *strong* reflections. Low-level, late reflections are not echoes but part of the undercurrent of sound that is reverberation. It is particularly important to control echoes when a sound system is to be used in a space because an amplification system generates significantly more energy than the human voice alone. Design for audio must work with the room, and the room must be designed with audio in mind to create a successful combination.

With these basics in mind, the overall shape of the room must be considered as in the following example. If the choir is located in a small chancel or separated from the main space by a small arched opening, it will be more difficult for it to communicate with the congregation than if it were located in an open rear balcony or large, open chancel. The ceiling and walls of a chancel can be shaped to project sound to the congregation, but the limitation will always be the size of the opening that separates the two.

Two plans shown in *Figure* 2 are an example of how two identical shapes can have profoundly different acoustic characters depending on the orientation. The first is a traditional shape for a small church with the altar at one end of a long narrow room. Reflections from the main speaking area across the room to the farthest seat are short enough not to result in an echo for speech although treatment at the rear wall is necessary to prevent an echo from the surface. Slight angling of the side walls may also be required to prevent flutter if these surfaces are not greatly broken up by windows or other architectural elements. The organ and choir are located on the main axis of the room and open to the congregation.

The second plan is the same footprint but with the altar oriented on one of the long walls. Although there is a benefit in having all of the congregation closer to the altar in this example, there is an echo problem due to the extreme width of the room in relation to the presider. Although there may not be a rear wall echo, diffusive treatment at all parallel walls should be considered. The choir is in a corner but is open to the room. The organ is in a bad location as it is removed from the room and does not speak down the long axis. As illustrated, a section of the congregation does not

EFFECT OF CONSTRUCTION MATERIALS ON REVERBERATION

Sound travels at the speed of 1,130 feet per second. The sound someone hears at the end of a two-second reverberation time will have traveled 2,260 feet within the room. Obviously, the sound energy must reflect off the room surfaces in that amount of travel, and in a room 60 feet wide, this would be equivalent to 36 trips between the side walls. There must be enough volume in the room to allow the sound to reflect that many times without interruption, but the construction materials chosen will determine whether there is good or weak sound reflection.

Imagine a sound wave bouncing between walls, floor and ceiling such as in the above example. Each time the sound strikes a surface, a portion of the energy is reflected and a portion of the energy sets the wall into vibration. Some energy is lost in the process of vibration (I know it's getting into physics, but bear with me) and the rest is radiated to the air on the opposite side of the wall surface. Since the energy not lost to vibration is returned to the room, the goal for maximum reverberation should be to prevent vibration of the building surfaces.

For illustration, imagine throwing a ball at a heavy drape hanging in the middle of a room. The drape moves and the ball falls directly to the ground since all energy was lost at impact. The same scenario can be visualized for a ball thrown against a gypsum or concrete wall. With the gypsum, the ball will return with a good amount of the initial energy, although some is lost. With the concrete, almost all of the energy would be retained in the ball. The point being that the greater the mass of an object, the less it will vibrate when a force is applied to it.

With sound, the concept is similar, but the forces affect an entire wall surface at once. Speech occurs in the frequencies between 250 and 4,000 cycles per second (Hertz). At these frequencies, the sound waves vary from 4'-0" to 3" in length. At 3", the sound does not have enough energy to move a single layer of gypsum, so most of the energy will be reflected back to the room. At 4', the sound energy is more significant, so the gypsum partition will move, thus returning only a portion of the energy to the room. Now relate to the frequencies of music by envisioning the sound of a large bass drum. When standing close to such a drum, the sound can be felt in your chest. The sound wave at this 32 Hertz frequency is roughly 32 feet long. Compared to that wave of energy, your body next to the drum is a mere minor disturbance akin to a person standing in the ocean when a wave of water passes by. Similarly, a single layer of 5/8"-thick gypsum is not significant enough to affect a 32-foot sound wave, so most of the energy will not return to the room—even on the first bounce. A 12"-thick CMU wall with stone or plaster applied directly to the surface will vibrate and lose some energy when struck by a 32-foot sound wave, but a significant portion of the energy will be returned to the room.

For music, it is critical to provide as much mass possible to maintain low frequency energy. All instruments, but especially organs, sound best in a room that gives full, rich support rather than one that will make even a Stradivarius sound harsh and brittle. ■

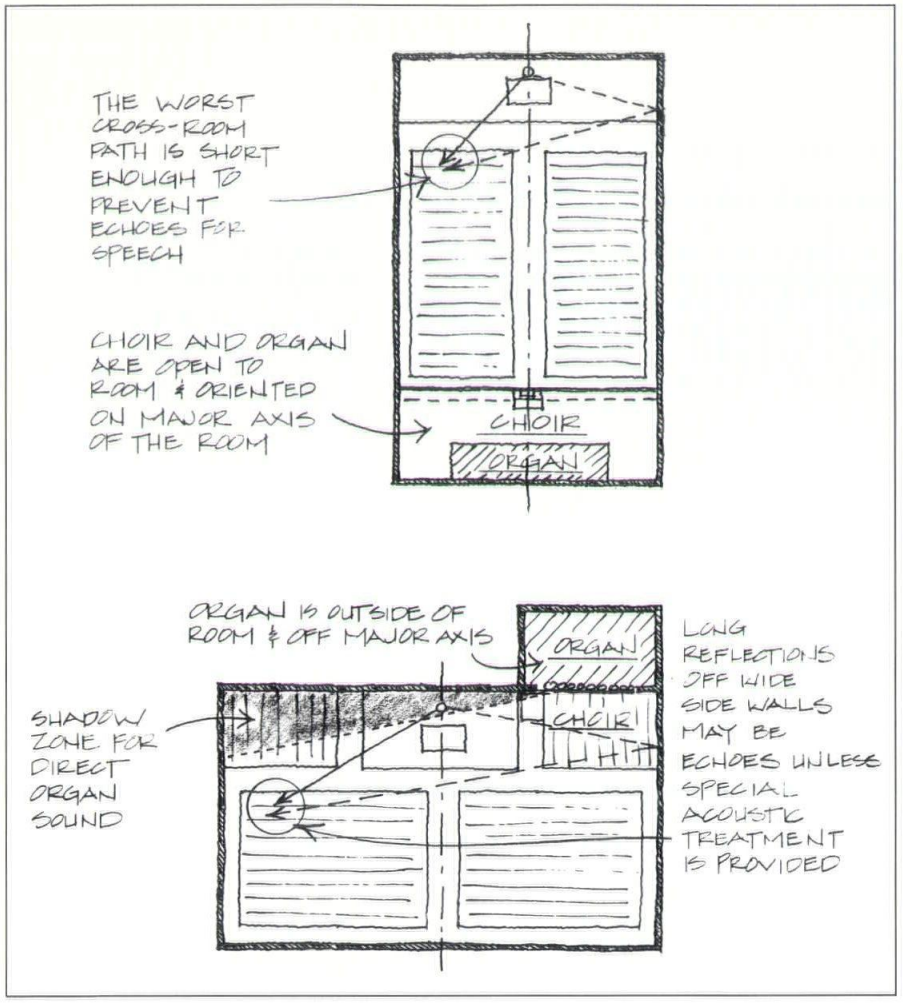


Figure 2. Orientation can affect how two identical shapes can have profoundly different acoustics.

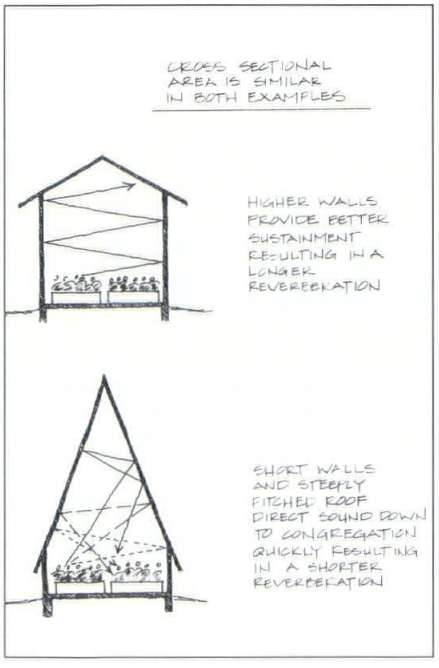


Figure 3. Cross-sectional area is similar in both examples.

hear direct sound from the organ at all.

Another issue is the relationship of height to width of the room. To use increased volume to its full potential for reverberation, raising the side walls and roof together is more useful than maintaining low side walls and creating a steeper roof as shown in *Figure* 3. Taller side walls sustain sound by not directing it down to the absorptive zone of the congregation. The steeper roof quickly directs sound down to the congregation where it will be absorbed, so reverberation time will be lower.

Background Noise

A room can have the perfect shaping, volume and visual character, but if it has a high level of background noise, the congregation will not be happy. Today there are more demands on comfort, and HVAC systems deliver more air than ever before.

The HVAC system, electrical system and plumbing system are hidden and, unfortunately, not always considered carefully for noise control. They are often one of the first places to look for savings when budgets are tight, looking to switch to a cheaper (which typically means noisier) air handler or questioning whether the expensive isolation mounts and hangers are really necessary.

Background noise is generated from direct connection between vibrating equipment and structure, from loud airborne sound exciting the structure, from the fan directly to the room via the ductwork, from restrictions of air flow that regenerate noise in the ducts, and through direct openings in the walls, floor or ceiling between spaces.

It is important to consider good placement of all building equipment and stress inclusion of isolation materials during initial construction. It is not easy to lift a chiller and place the deferred vibration mounts a year after the building is completed.

Isolation

The fourth and final major issue is to provide good isolation of the space from the exterior and from adjacent spaces. Today, most cooling is done via mechanical systems, so there is less problem with noise from open windows than was previously experienced. For any site, evaluation of the traffic noise or noise from adjacent buildings must be reviewed to determine how much isolation is needed in the wall, window and roof structures. Note: Massive surfaces at the interior of the space will help increase sound isolation, so there is an added benefit beyond the rich interior sound.

Special considerations for exterior noise are traffic, rain, airplane flyovers, cooling towers and building transformers for your building or adjacent buildings. I do not include thunder in this list since it is a source that is nearly impossible to isolate without doing major, and often unnecessary, isolation. The worse offenders on this list are typically rain impact noise and street traffic generated by buses—both of which set up direct vibrations in the building structure. As noted in the opening example, rain on a metal roof can stop a service, so use caution when selecting any lightweight material that could act as a drum. To varying extents, all roof structures will be susceptible to rain, but a concrete or heavy wood structure will not vibrate at the higher frequencies that disrupt speech. Bus noise is a problem that may require that the worship space be shielded from

the street by other structures.

Once the exterior skin is established, noise from adjacent spaces must be considered. Isolation at a loud mechanical room is more often considered than the distracting speech that may occur from a fellowship hall located below the sanctuary. A common situation is that ductwork serving the sanctuary may be supplying or returning air at the floor. This ductwork would run within the fellowship hall. Even with good isolation at the floor slab, the walls of the ductwork are thin metal and if exposed within the fellowship hall will easily transmit sound, resulting in an isolation problem. At all penetrations of the slab there will be an opening that, if not sealed properly, will result in an isolation problem. A solution in this case would be to install a heavy gypsum ceiling below the ducts.

There are many rooms around worship spaces that pose special problems, such as cry rooms, toilet rooms, choir warm-up rooms, Sunday school classrooms, and offices with ringing phones. All areas must be reviewed to maintain low noise levels within the sanctuary. There is little worse than hearing a toilet flush during quiet meditation.

There are many books to read on the subject of acoustics, but the one I highly recommended to architects is *Concepts in Architectural Acoustics* by M. David Egan (McGraw-Hill, 1972) as a simple and visually oriented discussion of basic principles.

All architects should be aware of consultants in their area. If a project is tight on budget and fee, consider calling in a consultant for an initial meeting during early design. A few hours of time at this stage can make a large difference.

Ideally, acoustics should be considered by the design team and construction team throughout every step of the building process. Worship spaces are acoustic spaces. Use your ears during their design as well as your eyes. □

Questions for AIA *Continuing Education credit appear on page* 24.

SOURCES OF BACKGROUND NOISE

Background noise in a worship space can result from the following:

• **Direct Structural Vibrations.** Air handlers, pumps, transformers and all other vibrating equipment, if mounted directly to a floor or wall, will transmit their vibration into the structure. This vibration can travel hundreds of feet through slabs and walls throughout the building. The walls, floor and ceiling of the worship space then acts as a drum head, radiating the sound into the room.

One of the most shocking examples of direct vibration can be found in piping systems. Pumps generate a tremendous amount of energy that is easily transferred through the pipes and water they contain. If the pump is not isolated from structure, its noise will be heard through the building. If the pump is isolated but the piping is not, the sound energy will travel within piping and be reradiated within another space by the pipe, any structure to which it is rigidly attached or, worst case, by the relatively lightweight fins of a radiator at the end of the line.

• **Airborne Sound Via Indirect Paths.** All building system equipment generates noise. In addition to general noise, fans, pumps and transformers have a characteristic of generating pure tones related to the speed of the fan or pump or the cycles of electrical current. Both these pure tones and general loud equipment noise can excite a structure into vibration even if the equipment is fully isolated from direct vibration.

For this reason, air handlers in sensitive situations are often housed to reduce this effect. To visualize this effect, compare this to a loudspeaker that is hung in a room. When the sound is at a high enough level, the floor and walls will begin to vibrate even if the loudspeaker is not in contact with these surfaces.

As stated in the sidebar on sound reflection, the lowest frequencies will set structure into vibration first, and it is these low frequencies that are predominant in mechanical equipment rooms.

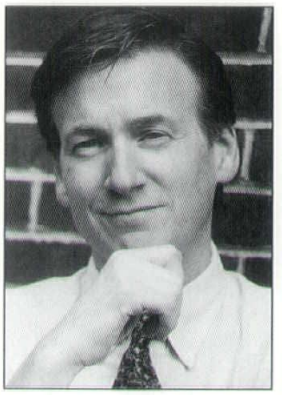
• **Airborne Sound Via Ductwork.** The noise from air delivery fans has an open air path to the occupied space via the ductwork. If it didn't, there would be no air delivery. (Although acousticians do not like the situation, we have learned to respect it.) Sound levels at the fan are typically 90 to 100dB at 500 Hz (an octave above middle C). To be considered quiet, the noise level in the room must be 25 to 30 dB at this frequency. That drop of 65 to 75dB is even more than the 60dB drop used for measuring reverberation. It is a large amount of energy that should be taken quite seriously.

To stop the fan from "talking" directly to the room, internal lining in ducts and sound reduction devices such as oversized plenums and sound attenuators are used. These elements are designed by acoustics consultants and fall within the engineer's realm to incorporate, but architects should be aware that a considerable distance is required to make the 65-75dB reduction discussed above. As a general rule, units should be placed as far from the assembly space as possible, and sufficient room for large duct runs should be allocated.

• **Sound Generated by Air Pressure.** Another noise source in ducts is hiss generated by the diffusers at the end of the run or turbulence noise within a duct. If the air is moving too fast at the diffuser, noise will be generated at high frequencies. This falls perfectly within the range of speech and will result in problems of communication within the assembly space, so speeds as low as 250 feet per minute may be recommended. Convoluted or constricted bends in ductwork should also be avoided as this results in turbulence noise. once the design has taken all the noise of the fan out, space restrictions should not be imposed that will regenerate noise near the room.

• **Airborne Sound Via Direct Openings.** Finally, the most obvious problem is sound traveling through direct openings such as around pipe duct, or conduit penetrations in the wall or floor. Follow the general rule that someone from USG once quoted to me: "Use sealant around everything." ■

COMMUNITY SEATING FOR SACRED PLACES



By Jeff Lewis

Many religious buildings are designed with an emphasis on structure and the challenge of creating the best seating solution coming later. Architects should understand how the space will function for the congregation, *then* design the building. Knowing furniture options from the beginning will help in designing a better worship environment. Will the seating arrangement enhance the spiritual experience and create a sense of belonging? Will the furniture draw inspiration from the architectural elements?

Designing the Building From the Inside Out

Seating is typically the last item installed but the first thing people notice and have direct contact with when entering. Because worship is a participatory experience, seating plays an important role in whether people feel a part of the service or view themselves as mere onlookers. A curved seating arrangement will bring the worship community together. People who must strain to see the clergy or to make eye contact with other worshipers may feel alienated and uncomfortable.

To illustrate, ask ten participants to stand in a straight line. To look at each other, they must lean over and peer forward. But if they are placed in a semi-circle, they are able to make eye contact, while still focusing attention on the front of the sanctuary.

Understanding the Options Available

Many worship areas will best be served by a combination of pews and flexible seating. The seating arrangement in *Figure* 1 fully utilizes the space available in a rectangular building while promoting both unity and hospitality. This seating arrangement allows the congregation to focus forward, toward the altar. At the same time, parishioners are aware of each other. Visitors entering through the main door are greeted by a wide aisle that leads the eye toward the front of the space.

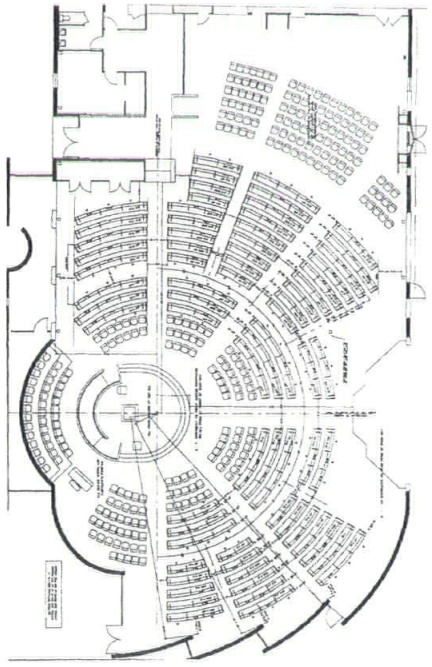


Figure 1. *True radius—perhaps the ultimate seating arrangement in a rectangle-shaped building utilizing a minimum amount of space. Upholstered wood chairs fit well into this arrangement.*

The combination of radius pews and upholstered chairs maximizes floor space while still allowing a portion of the sanctuary to remain open for other uses.

Straight and radius pews are both available. "Straight" pews are available with several options and can either be placed in a straight line or set in a mitered configuration. Mitered pews allow for a simulated radius appearance but compromise seating space at the joints and in aesthetic appearance and comfort.

A radius layout may allow for more efficient seating and greater design flexibility, which is a primary need of many churches. Because of rising construction costs, many congregations are considering multi-purpose facilities that can be used not only for worship but also for fellowship, concerts or dramatic presentations. At the same time, they may want the multi-purpose space to look like a worship area. In designing such space, the architect must consider how to achieve the "feel" of a traditional church while still preserving flexibility. Upholstered wooden chairs can be designed to interlock for pew-like seating, providing flexible yet traditional-appearing seating complete with kneelers and book racks, if desired.

Interlocking chairs can be configured in any seating arrangement—radius or straight—and then can be stacked and stored when not in use. As with pews, chairs can be chosen from standard design specifications or can be custom designed or modified.

An efficient alternative is to specify chairs in double or triple lengths. This allows the architect to maintain flexibility while still providing common, pew-like seating and lowering the initial seating cost per person significantly.

There are also material considerations. Will the sanctuary seating be all wood or a combination of wood and upholstery? Upholstered seats provide additional comfort and a warm hospitable atmos-

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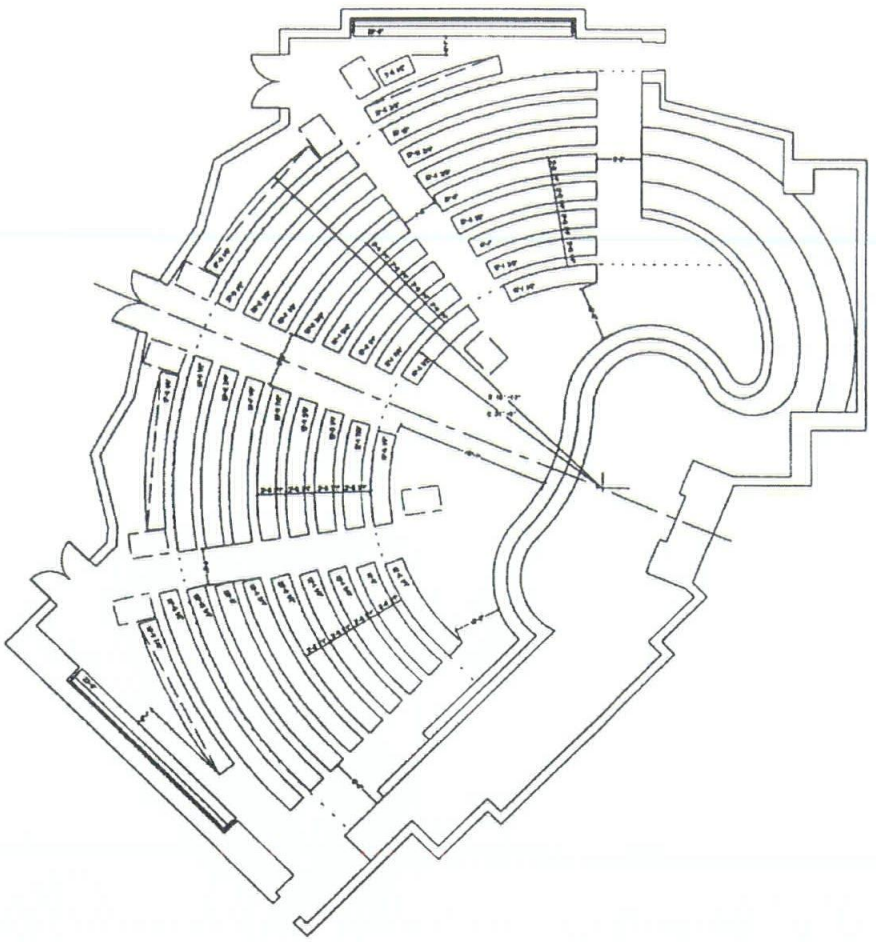


Figure 2. This floor plan illustrates the efficiency and beauty of true radius pews that could not be accomplished with mitered pews. The pew design reflects the imaginative architecture of the building.

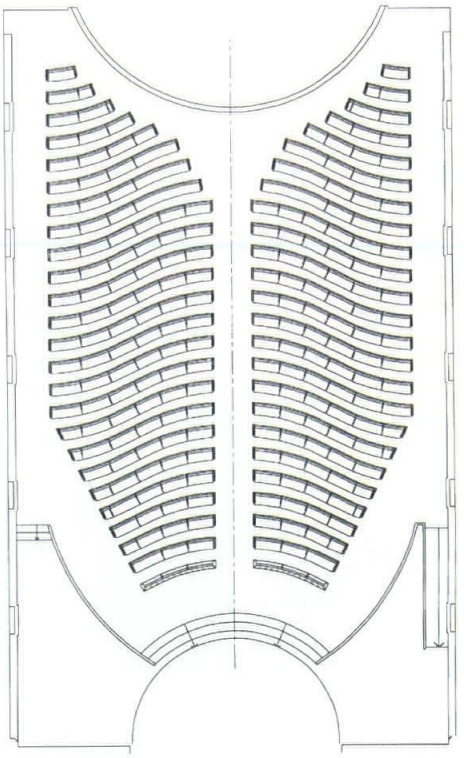


Figure 3. Seating arrangement in Old St. Patrick's Church, Chicago, Illinois.

phere as well as reduce furniture cost. Upholstered furniture can utilize either foam padding or spring seats. Foam padding should be a minimum of 2" thick for seats and 1" for backs; a 4" seat padding, however, provides greater durability and comfort. Spring seats provide more support than foam padding alone; spring seats will not "bottom out" and offer more comfort as well as greater durability. If all wood surfaces are used, does the furniture budget allow for solid wood or veneer construction? While veneer surfaces are less expensive, they may limit both design and in some areas durability.

Designing Furniture That Can Enhance and Complement the Architecture

Whether standard or custom furniture is used, cooperation between the architect and manufacturer is vital. A manufacturer equipped with a computer-aided design (CAD) system will be able to work closely with you to create precisely the right seating configuration.

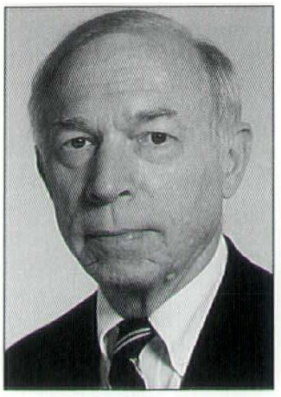
Church furniture should enhance the beauty of the worship area by carrying through motifs and themes of the sanctuary and architecture. Both pews and chairs should be built of wood types that match or complement the wood used throughout the environment. In most cases, solid wood pew ends allow for greater architectural freedom than veneer ends; they provide a wonderful opportunity to carry architectural detail through to the seating area.

Radius pews provide particular beauty and potential to the worship area. *Figure* 2 illustrates a seating plan that reflects the imaginative architecture of the church building.

Custom pews allow the architect almost unlimited freedom in design. For example, the serpentine pews designed and custom built for Old St. Patrick's Catholic Church in Chicago, Illinois (*Figure* 3), provide a more dynamic worship area while still maintaining a traditional look. □

PREPARING FOR A PIPE ORGAN

Robert K. Betty



The complexity of a pipe organ's construction and its physical size (it is the largest of all musical instruments) make a church's preparations for one a formidable task. The pipe organ's success is dependent upon its environment; its proper placement only increases the responsibility of the "planner" as the pipe organ is an instrument without a "sounding board"—an essential part of a piano and other instruments. Encasement of the pipes is of some help, but the pipe organ must gain most of its resonance from the room in which it speaks.

The organ's sound may be activated by a direct mechanical linkage between the console key and the windchests ("tracker action") or by an electro-pneumatic or all-electric action system. The type of action employed affects the relative location of the pipes/windchests and the console and, in turn, their relationship to those who are affected by the instrument.

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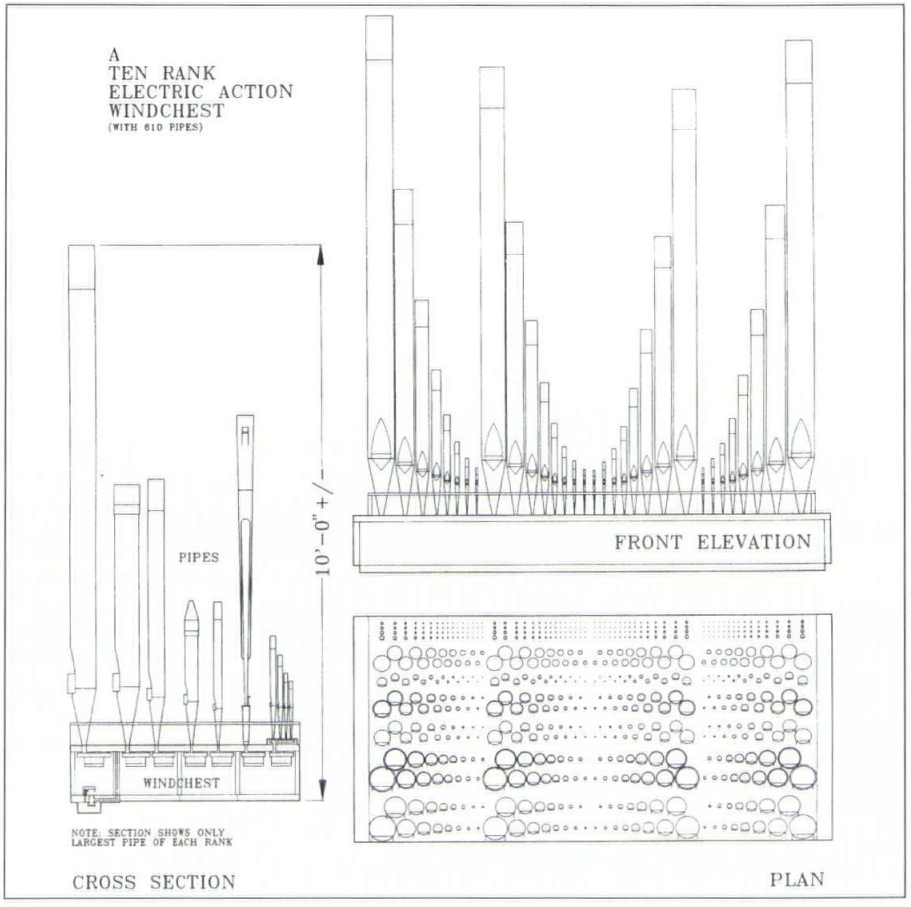
Learning Objectives

1. To learn the basic components of a pipe organ.
2. To understand the factors that are important to the successful installation of a pipe organ.
3. To become an effective "liaison" between the client and the organ builder in the design process.

ROBERT K. BETTY *is a representative of the Schantz Organ Company, Orrville, Ohio, and an organist and choirmaster at All Saints' Episcopal Church, Norristown, Pennsylvania.*

The pipes/windchests of mechanical action organs are usually contained in a wooden case built by the organ builder. This case is attached to, or minimally detached from, the console. Since the consoles of organs with electric action are connected by electric cables, the pipes may be separated into two or more "divisions," some of which may be a considerable distance from the console.

The consoles of these organs may also be placed on casters or platforms to allow their movement for various uses. Divisions of electric action organs may be encased or housed in organ chambers with tonal openings into the church, although pipes in chambers are heard with less "presence," in the same way as an instrumentalist playing in an adjoining room. The standard "rule of thumb" for the dimensions of an organ chamber is that it be "twice as wide as it is deep and as high as it is wide." Tonal openings should be at least two-thirds of the area



Windchest example. From "Planning Space for Pipe Organs" used with permission of Pipe Organ Builders of America.

of the wide side of the chamber and covered with an acoustically transparent material. All surfaces within the chamber must be hard and reflective for maximum sound projection.

Three basic categories of components are common to all pipe organs: pipes/windchests, console and) blower.

Pipes/Windchests

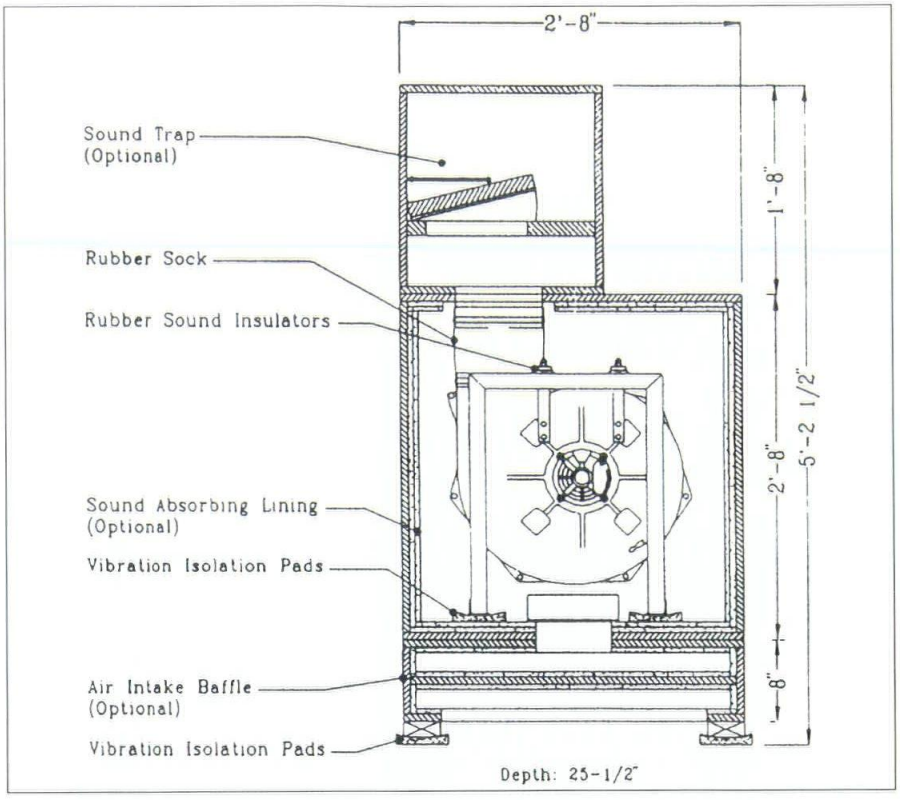
The greatest part of the organ's size and weight is the pipes, windchests and other mechanism. Since this is the "sound-producing" portion, it must be carefully placed within the church if the organ is to be effectively heard. The windchests are the largest and heaviest of the organ's components, approximately 8' to 10' in length and varying in width according to the number of ranks they support. For best sound projection, the pipes and windchests should be located on the central axis of the church without obstacles. As most church organs are used for choral accompaniment, the pipes should be close to the choir.

Console

The console includes the keyboards and stop controls used by the organist to play the instrument. Consoles vary in size in proportion to the size of the organ they control. Electric action consoles, which are detached from the pipes and windchests, will require from 25 sq. ft. to as much as 42 sq. ft. and range in weight from 500 to 1,300 lb.

To maximize the organist's control of the action, consoles of mechanical action organs are most effective when attached to the organ case. Since many organists also direct choirs from the console, it is of great advantage to have a good sight line from console to singers, and both organist and singers should be able to hear the organ in good balance.

Detached console example, St. Bernard's Episcopal Church, Bernardsville, NJ, Schantz Organ Co., Orrville, Ohio



Blower example (1 H.P. *with sound deadening enclosure*).

Standard requirements for organs with electric actions are a 3" empty conduit from the console to each area where pipes are located, a 3/4"-conduit (with wires) from the console to the blower location , and a 3/4"-conduit from an AC source to the console. Organ builders will match console case finishes to church furniture from samples.

Blower

A motor drive, centrifugal blower is required to produce the wind (pressurized air) to the organ's windchests. Depending on the organ's size, the motor will range from 1/4 h.p. to 10 h.p. To avoid mechanical noise in the church, the blower is best located in an acoustically isolated area, but smaller blowers can be accommodated with pipes in a sound deadening enclosure if necessary. Round 24 g. galvanized wind lines, typically from 6" to 12" in diameter, are normally provided by the church from the blower to each pipe location. All seams must be soldered air-tight with lapping the same direction as the wind's travel. Lines running through unheated/uncooled space should be insulated.

The volume of the room the organ serves and the seating capacity of that room dictate the size of the organ. A larger church that seats more singers (choir and congregation) requires a larger organ to "fill" the space for the congregation's listening and to effectively lead them in their singing. Organ size is expressed in number of "ranks" of pipes, each rank consisting of one pipe for each manual or pedal key that plays that rank.

Floor loads of 50 to 100 lb. per sq. ft. must be prepared for in pipe/windchest areas. Organs with "double-decked" divisions on a smaller footprint will have higher weight concentrations.

The accompaniment of church services and the playing of some of the organ literature require that the organist be able to control the volume of a portion of the ranks of pipes. This is accomplished by enclosing these ranks in an "expression box" or chamber with movable wooden strips or "shades" covering the tonal openings. By closing these shades from the console, the organist is able to soften the sound of the pipes inside.

In divisions of pipes where no "expression" is needed, pipes can be exposed to view in various configurations. Their inherent graduation in length and diameter makes them naturally pleasing to the

eye, and they are heard with more clarity in exposed position. A wide variety of natural, flamed and painted finishes on both metal and wooden pipes is available.

Every organ builder knows only too well how much the instrument so painstakingly created is "at the mercy" of its acoustical environment. Pipe organs can fully "blossom" only in rooms where healthy resonance and reverberations (2-3 seconds with the building half occupied) exist. These acoustical properties also promote better congregational singing, as individuals who are dubious about their singing abilities are more confident when they hear their voices only as blending with others. Hard, reflective surfaces, high ceilings and possibly the services of an acoustical consultant are good places to start.

Pipe organ builders are willing and able to provide valuable assistance to architects and their clients in their pipe organ planning. A 16-page booklet, *Planning Space for Pipe Organs*, is available from the Associated Pipe Organ Builders of America, PO Box 155, Chicago Ridge, IL 60415, or from the American Guild of Organists, 475 Riverside Drive, Suite 1260, New York, NY 10115. □

AIA/FAITH & FORM Continuing Education Series Instructions

- Read this article, "Preparing for a Pipe Organ" (pages 21-23), using the learning objectives provided to focus your study.
- Complete the questions below, then check your answers on page 29.
- Fill out the Self-Report Form on page 29 and submit it to receive two AIA Learning Units for this article.

Questions:

1. What are the three main categories of pipe organ components?

Answer 1. _____

2. What type of organ action requires the console to be attached or only minimally detached from the pipes/windchests?

Answer 2. _____

3. What is considered to be a "healthy" reverberation time for pipe organs when the church is half occupied?

Answer 3. _____

4. In addition to the enhancement of organ sound, what is the advantage of an acoustically "live" worship space?

Answer 4. _____

5. Name two advantages of exposed pipes.

Answer 5. _____

_____

6. What determines the size of the organ?

Answer 6. _____

GOING BEYOND THE VISUAL

(*continued from page* 18)

AIA/FAITH & FORM Continuing Education Series

Instructions:
- Read the article, "Going Beyond the Visual" (pp. 14-18), using the learning objectives provided to focus your study.
- Complete the questions below, then check your answers on page 29.
- Fill out the Self-Report Form on page 29 and submit it to receive two AIA Learning Units for this article.

Questions:

1. How does the surface weight of wall and ceiling construction effect the sustainment of sound (reverberation time)?

Answer 1. _____

2. What is the effect of surface finishes on reverberation?

Answer 2. _____

3. This article discusses three room-shaping conditions that can have a negative impact on sound clarity. List and briefly describe these conditions.

Answer 3. _____

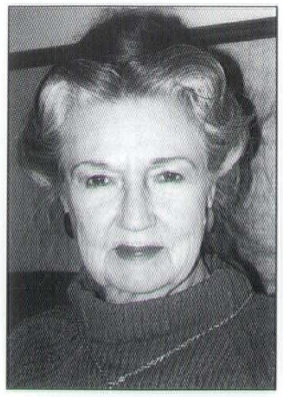
4. Plan dimensions and vertical height of a space can have a profound impact on sound in a room. Based on discussion in the article, what would be the desired plan shape for a space where clarity of unamplified speech from the altar is important? (Hint: Echoes must be eliminated.)

Answer 4. _____

5. Attention to sound isolation is necessary to provide the quiet, distraction-free meditation atmosphere typically desired for worship spaces. What building components and systems typically contribute to isolation problems?

Answer 5. _____

INSPIRING REFORM



By Betty H. Meyer, Editor

"Inspiring Reform" is the theme of a recent exhibit at the Davis Museum and Cultural Center at Wellesley College, Wellesley, Mass., and it does just that: The title refers to the raison d'être of the Boston Arts and Crafts Movement (1897-1997), which is celebrating its centennial this year.

One hundred fifty objects are shown in many media. The exhibit was planned "to explore a complex of aesthetic ideals, historical circumstances, and the social context that defined the movement and propelled it into national significance."

Have you as architects and artists ever deplored the fact that instead of handcrafted objects on your carefully designed altar or bimah, there are ordinary objects ordered from standard publishing houses? This need not be so, if we can convince people of the value of authentic arts and crafts. This exhibit, which has attracted many more viewers than was expected, will travel next to the Renwick Gallery in Washington, D.C.

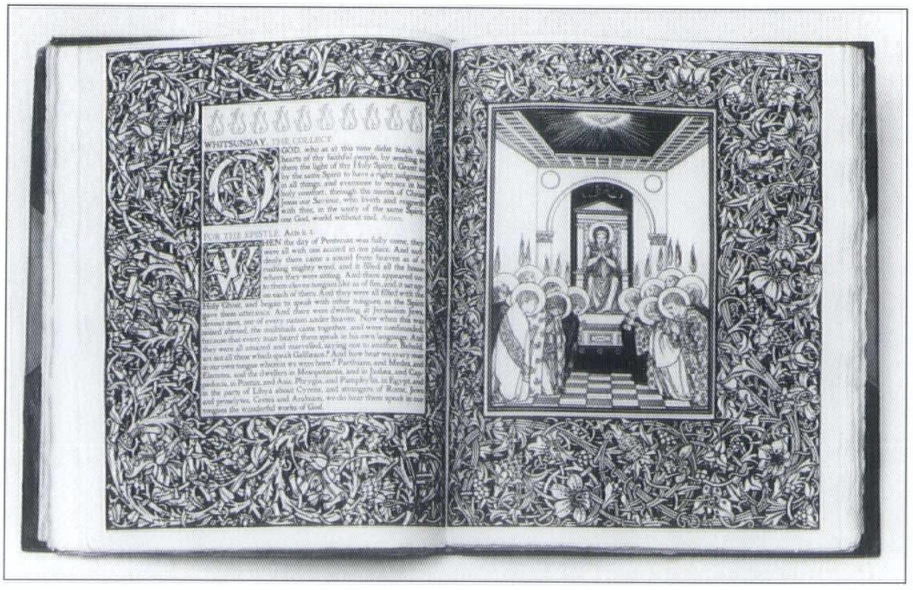
This reform movement actually had its roots in Europe after the Industrial Revolution when all the old skills and methods that had been passed down from generations were swept away, and cheap factory goods had driven away handcraftsmen. A growing movement in England to restore the decorative arts arose and carried over to the states. The Boston Society of Arts and Crafts was the first organized in America though many soon flourished across the country for a number of years. It is now the only one in existence.

Scholars have said that this movement changed the focus of 19th-century Boston from the literary to the visual. The newly arrived president of Harvard, Charles Eliot Norton, established the first American Art History course; the Museum of Fine Arts was founded (1870) as well as the Gardner and Fogg Museums; and Frederick Olmstead began his work on the emerald garden necklace along the Fenway. Schools of architecture and design were established, and architects included Henry Hobson Richardson, Ralph Adams Cram and Bertram Grosvenor Goodhue. Artists included John Singer Sargent, Daniel Chester French, Arthur Dow, Wallace Nutting, Gustav Stickley and Connick Studios in stained glass. John Ruskin and William Morris wrote articles encouraging people to have nothing in their homes that they did not know to be useful or beautiful. Quality hand production, they said, will restore dignity to the maker and the objects of refined and elegant design will re-establish harmony and simplicity in the home.

Enthusiasm for the movement soon expanded into the city at large. The Massachusetts School System incorporated art education into its general curriculum in 1870, thus embracing all social classes. Architects who thought labor had been de-humanized called upon craftsmen in the building trades, benefiting masons, woodworking shops, etc. They also encouraged the immigration of skilled carvers, weavers, painters and other artists.

When numbers of immigrants arrived, schools were set up to teach those who had no skills. Women and children were taught in social settlement houses. Skills taught included wood carving, metal work, ceramics, photography, toy making, painting and posters, silversmithing, furniture, textiles and ecclesiastical design. Experiments were begun in art therapy and in elevating the status of women.

There are large photographs on the walls of this exhibit that show the



COLLECTION OF MARTIN W. HUTTER

"The Altar Book" by Goodhue, Updike and Bell is printed with photo-engraved illustrations and was on display earlier this year at the "Inspiring Reform: Boston's Arts and Crafts Movement" exhibit at the Davis Museum and Cultural Center, Wellesley College.

immigrant families learning a trade from people passionately devoted to arts and crafts. Other walls and glass cases show handmade objects so beautiful you want to hold them in your hand. One becomes re-acquainted with the early Colonial style and the influence of Japanese art.

Naturally, I was interested in two silver chalices by George E. Germer and George J. Hunt that were elegant and original in design, and a pair of altar vases of silver with gold by Arthur J. Stone and Herbert Taylor. Goodhue himself was the designer and decorator of an altar book, and Cora Bailey illuminated the text for Christ's Sermon on the Mount.

COLLECTION OF THE POMFRET SCHOOL

Pair of altar vases, silver with gold, 1915, by Arthur J. Stone and Herbert Taylor.

Photography as an art was in its early stages then, but there are seven platinum prints in their original frames of the head of the Christ (seven last words) that are very moving.

Finally, when I stood before a tableau, "Christmas in Heaven" carved by John Kirchmayer, I was in awe of its artistry. Ralph Adams Cram, who believed that every carved figure ought to be a poem in itself, called him the dean of American carvers. I counted 34 figures!

What a difference it would make today if architects would feel a responsibility to ask that only handmade objects adorn their sanctuaries...if building committees would feel that their job also includes the interior...that clergy would elevate true beauty in the minds of their congregations. To do less than this diminishes not only the overall quality of the work, but the worship experience of all.

If a hundred years ago people working together could inspire such reform, why can't we?

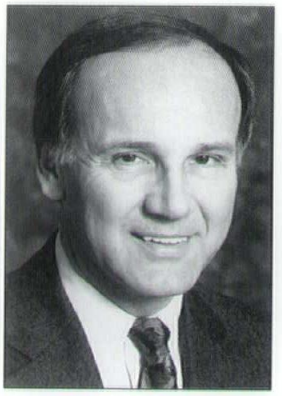
My congratulations are due to Curator Judith Hoos Fox, to Susan M. Taylor, director of the Davis Museum, and to J. Abbot Miller who designed the installation and catalog. I am especially grateful to Peter Walsh, Media Relations, who helped with the material for this article. Harry N. Abrams, Inc., New York, N.Y., is the publisher of an appropriately handsome book on the whole project. □

THE SOCIETY OF ARTS & CRAFTS (1897-1997)

This society was incorporated to promote artistic work in all branches of handicraft. It hopes to bring designers and workers into mutually helpful relations and to encourage workers to execute designs of their own. It endeavors to stimulate in workers an appreciation of the dignity and value of good design; to counteract the popular impatience of law and form, and the desire for over-ornamentation and specious originality. It will insist upon the necessity of sobriety and restraint, of ordered arrangement, of due regard for the relation between the form of an object and its use, and of harmony and fitness in the decoration put upon it.

LITURGICAL DESIGN CONSULTANTS

Who They Are and What They Do



By *Richard S. Vosko*

A Jesuit theologian at Fordham University once remarked to me, "No one of us knows more than all of us." This axiom is relevant to the building professions where experts and consultants are constantly called upon to collaborate with architects and others. In the field of religious art and architecture, "liturgical" design consultants are now considered key members of the professional team along with lighting and acoustical specialists.

Who Are They?

Liturgical designers and artists are not really new to the work of building or renovating religious edifices. Acute interest in religious art and architecture was stimulated in part by the liturgical art movement, which began in the United States in the late 1930s. Over the years, organizations like the Liturgical Arts Society, the Guild for Religious Architecture, the American Society for Church Architecture, and now the Interfaith Forum on Religion, Art and Architecture (the RAA PIA of the AIA) all have promoted interfaith conversations concerned with the quality of religious buildings. The work of the liturgical designer and artist has been instrumental in fulfilling this important mission—the design and adornment of inspiring and functional sacred spaces.

The consultant brings a unique dimension to a religious building project because of his or her knowledge of how worship spaces function and what role they play in the socio-religious landscape. However, their practice is not regulated and their qualifications are quite diverse. At a minimum, a good consultant possesses a solid background in the arts and a thorough knowledge of liturgy (a word used to describe the worship practices of a congregation). Some may be licensed architects or interior designers but most are not. Some may belong to professional organizations like the American Institute of Architects or the newly founded Association of Consultants for Liturgical Spaces but most do not.

Although the backgrounds of liturgical consultants are different and they do not all have the same training, some of the credentials important to the practice are:

- A degree in theology or the study of liturgy
- A degree in the fine arts or architecture
- A degree in the history of religious architecture and art
- A degree or certification in adult education methods and techniques
- The ability to read architectural plans
- The ability to draw.

While professional degrees and certifications are important it should be noted that many consultants are very good at what they do because of their natural talents and lengthy experience. Therefore, a resume full of degrees is not a guarantee that the consultant is fully qualified any more than a license to practice architecture is a guarantee that the architect is competent. A good rule of thumb in searching for a qualified consultant is to see if he or she has a proven record and glowing references.

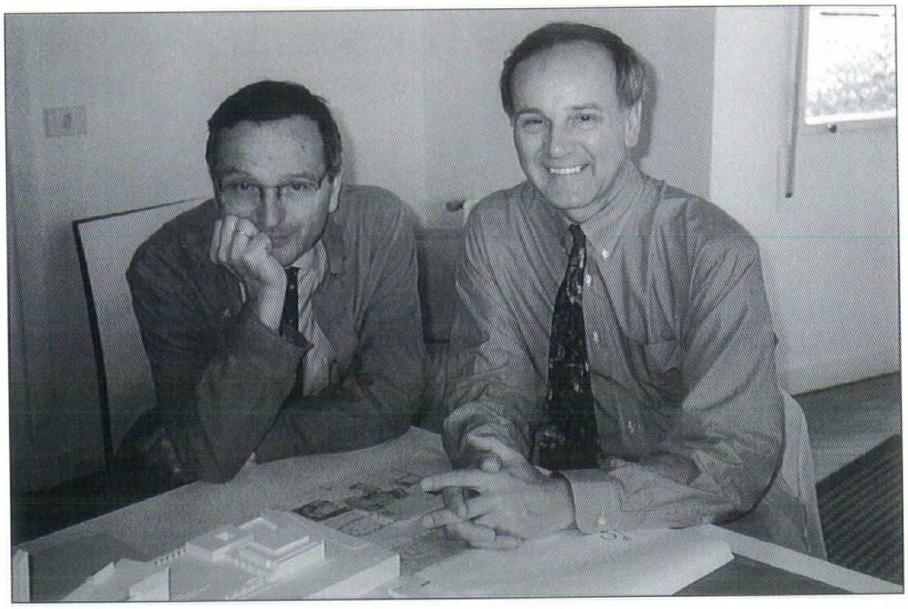
What Do They Do?

Depending on their credentials and experience the services offered will vary. In general, the consultant is someone who acts as a change-agent without threatening the congregation. He or she must be a good teacher, respecting what the members of the congregation already know. The consultant may have to coach the client (and sometimes the architect) but should always be a team player. The ability to be creative is as important as the ability to be practical. Finally, expertise in conflict management will be helpful in any project.

Because many of these services are not governed by state regulations or professional licensing requirements, the qualifications of the consultant should be carefully scrutinized. Specifically, a liturgical design consultant should be able to offer the following services:

- *Organizational development*. Frequently, the consultant is retained by the congregation to facilitate the entire process of building or renovating the worship space. As the first professional hired for the project, the consultant would then coordinate preliminary timetables, the creation of committees and the search for other professionals, as needed.
- *Education*. One of the most important roles is that of an educator, helping the congregation learn how to create an appropriate place of worship according to its own traditions. This may include presenting a series of learning experiences that would include the history of religious art and architecture and the examination of the liturgical design options available to the client.
- *Data gathering and programming*. Once the congregation has completed its educational series it is ready to articulate specific needs and expectations. Some consultants are trained to utilize various data collection tools to help the congregation develop a program to document input from the various groups and committees. This information would then be

RICHARD S. VOSKO, *Ph.D., of Clifton Park, N.Y., has been a designer and consultant for worship environments since 1969. He is a board member of* IFRAA *and the recipient of the 1994 Elbert Conover Award for his contributions to religious art and architecture.*



Dr. Richard Vosko (right) working with Pritzker Award winner Professor Rafael Moneo on the new Cathedral of Our Lady of the Angeles, Los Angeles.

used to create a master plan and stimulate a creative design process with the architects.

• *Selection of other professionals.* If an architect has not been selected the consultant can assist the congregation in searching for one. The participation of the consultant in the search process can help establish an early collaborative spirit. Ideally, the entire professional team is in place at the beginning of the project. However, this may not be possible if the congregation is not sure of what it wants or needs to do.

• *Architectural process.* Throughout the architectural process the consultant works closely with the architects and all other design professionals such as acoustical and lighting experts to assure that the liturgical components of the project are thoroughly considered. During the schematic phase the consultant may also prepare conceptual sketches of what the worship space could look like. Some consultants who are architects will take the project only up through the completion of the schematic phase. A local architect would then finish developing the designs. Other consultants who are architects will guide the project from start to finish.

• *Artwork, furnishings and appointments.* Many consultants are talented artists and may design and/or make some or all of the furnishings and appointments required in the worship space. Other consultants will help the congregation search for and select appropriate artists and artisans.

The consultant usually oversees the design, fabrication and installation of all liturgical art, furnishings and appointments in a collaborative way.

How Can You Find One?

Liturgical design consultants usually work directly for the congregation. However, if the congregation is not aware that such consultants exist, the architect may suggest that one be retained for the project. There are some sources available for finding the right consultant.

• The Religious Art and Architecture PIA of the AIA (a.k.a. IFRAA) has a directory that identifies the professional practices of the members. E-mail: 44673@t-mail.telescan.com.

• The Federation of Diocesan Liturgical Commissions has a directory of liturgical consultants. Telephone: 202-635-6990.

• The Institute for Liturgical Consultants, a training program for professionals who wish to become liturgical design consultants, has a list of people who have been certified through their program. Telephone: 773-324-8000.

• The newly founded Association of Consultants for Liturgical Spaces has a membership directory. Telephone: 773-486-8970.

• Most local and regional administrative offices of the various faith traditions keep lists of consultants.

• Finally, although not all consultants may have websites, the internet will soon become another useful source. □

AIA/FAITH & FORM Continuing Education Series ANSWERS

Answers refer to the three articles listed below using the learning objectives provided to focus your study. To receive CES credits, fill in the Self-Report Form on page 29.

Article 1: "Stained Glass Primer" by E. Crosby Willet (pp. 11-13)

1. Dates: 1000-1450; Canterbury, Yorkminster, Chartres, Bourges, Troyes, Notre Dame and Sainte Chapelle (Paris).

2. John LaFarge and Louis Comfort Tiffany. They worked in opalescent glass, often plated into three or more layers. Their work reflected pictorial landscapes and figurative scenes.

3. German artists: Thom Prikker, George Meistermann, Ludwig Schafforth, Johannes Schreider. All of the German School specialized in linear architectonic design with monochromatic muted palettes. French artists: A. Labouret and Gabriel Loire developed and popularized the use of one-inch thick or more slabs of glass set into a concrete matrix in place of lead. Now widely used in the United States as faceted glass.

4. (a) Leaded stained glass normally uses thinner types of rolled or blown glasses glazed in lead, and zinc carnes or copper foil. It can be painted and fired. Used where fine details, shading for light control are particularly desired. Requires more structural framing. (b) Faceted glass (dalle de verre) uses one-inch dalles in a matrix of epoxy resins. Ideal for bold concepts and abstract designs but can be detailed to portray symbolism and figures. Particularly good for application needing strong structure or requiring low budgets. Requires minimal framing questions.

5. The architect is in the best position to establish the light and color influence he or she will want in the new or remodeled religious structure. The earlier a stained glass artist/studio can be brought in to collaborate the better as they can advise on window details, structure, and suggest the proper type of glass

for each window/light area. They can also work with the client to determine themes, design style and budget.

6. (a) Stained Glass Association of America, a clearinghouse for general information on stained glass, annually publishes an 84-page Sourcebook, which lists all 400 members geographically, has color photos of artists'/studios' work and restoration guidelines. (b) The Guild annually publishes a large, well-illustrated book of all types of architectural arts, which contains sections on architectural glass as well as religious glass and comprehensive lists of artists/craftsmen internationally and descriptions of their work.

Article 2: "Going Beyond the Visual" by Dawn Schuette (pp. 14-18)

1. Wall surfaces with a low mass (density) will vibrate when struck by sound energy with the result that reverberation will lack low frequency energy and sound harsh or brittle. Heavy mass, such as 12" of concrete, will resist vibration and allow all frequencies to reflect back into the room and maintain low frequency reverberation.

2. Room finishes have the most profound affect on middle and high frequencies. Minimizing absorptive surfaces will maximize reverberation at these frequencies. Absorptive surfaces, such as carpet, pew cushions and tapestries will reduce reverberation.

3. Flutter is a condition when sound is trapped between parallel surfaces, resulting in harshness to sound and lack of clarity. Focus is a condition when concave surfaces or angled planes concentrate sound, resulting in strong "hot" spots that are often confusing to listeners. Echo is a condition when strong reflected sound arrives at a listener too late after the direct sound, resulting in overlapping of successive notes/words that is confusing to listeners.

4. The best plan layouts will have (a) narrow walls, particularly near the front of a room, to eliminate side wall echoes; (b) diffusion at any parallel surfaces to prevent flutter; and (c) attention to proper diffusion at the rear wall to prevent echoes or focusing conditions.

5. Vibrating and loud equipment (air handlers, pumps and transformers) result in structure-borne noise. Air delivery systems can result in loud background noise from fans or diffuser hiss. Ductwork is a common short-circuit in isolation between spaces. Lightweight construction may not sufficiently isolate noise from the exterior or adjacent spaces. Openings around wall penetrations result in direct, open air paths between spaces.

Article 3: "Preparing for a Pipe Organ" by Robert Betty (pp. 21-23)

1. Pipes/windchests, console, blower.
2. Mechanical ("tracker") action.
3. 2-3 seconds.
4. Greater congregational singing is encouraged.
5. (a) The pipes speak with more clarity and presence. (b) They are visually attractive.
6. The volume of the church and its seating capacity. ☐

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