MONTANA STATE UNIVERSITY

An architectural stained glass window and processional cross problem
by Les Keith Kinzell

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF APPLIED ART
Montana State University
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Abstract:
The project presented in" this "'document' is in partial fulfillment of the requirements for the degree of Master of Applied Art at Montana State College in Bozeman, Montana, With the need for a building design for Christ the King Episcopal Church in Palmdale,"California, the parish members and vicar of that group were convinced that the esoteric and aesthetic forms of detail" concerned with liturgical architecture were far more important than an impressive structure alone. The church design itself was temporarily abandoned along with several of the details that were to go with it in favor of a simple parish hall church. What resulted were the detail decorations for that building, Details of the ideas, research and work procedures for a stained glass window-wall and a processional cross that belong- to the parish hall are written into the body of this paper. Also contained are impressions and visions for probable continuation of this manner of art.

Materials and ideas dealt with in this paper are as follows: 1. Class that is heavy enough to become a wall structure through its own thickness. By laying pieces of this material near one another with arranged colors the author was able to let the viewer’s eye blend the composition into one continuous, softly-changing pattern.

2. A plastic, that will bond"a vitreous material like glass" so that it becomes" stronger "than", the glass itself, yet have the physical properties that are required of glass.

This was Epoxy Resin.

3. Combinations and method's of handling of more" common materials in better"creative forms so that they will become a springboard for further projects in liturgical art.

# AN ARCHITECTURAL STAINED GLASS WALL AND PROCESSIONAL CROSS PROBLEM

by

LES KIETH KINZELL

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree

of

MASTER OF APPLIED ART

Approved:

Head, Major Department

Chairman, Examining Committee

Dean, Graduate Division

MONTANA STATE COLLEGE
Bozeman, Montana

August, 1962

# ACKNOWLEDGEMENTS

Mr. Cyril H. Conrad and the staff of the School of Art at Bozeman, Montana

The Reverend Father Keith Landis of Christ the King Church, Palmdale, California

Members of the parish of Christ the King Church

Mr. James R. Fetridge, Architect, Palmdale, California

Judson Stained Glass Studios, Pasadena, California

My wife, La Moyne, who has helped me continually through this project

TABLE 1. fig. 1 window-wall.

fig.2

fig. 3

# ABSTRACT

The project presented in this document is in partial fulfillment of the requirements for the degree of Master of Applied Art at Montana State College in Bozeman, Montana.

With the need for a building design for Christ the King Episcopal Church in Palmdale, California, the parish members and vicar of that group were convinced that the esoteric and aesthetic forms of detail concerned with liturgical architecture were far more important than an impressive structure alone. The church design itself was temporarily abandoned along with several of the details that were to go with it in favor of a simple parish hall church. What resulted were the detail decorations for that building.

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1. Glass that is heavy enough to become a wall structure through its own thickness. By laying pieces of this material near one another with arranged colors the author was able to let the viewer's eye blend the composition into one continuous, softly-changing pattern.
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3. Combinations and methods of handling of more common materials in better creative forms so that they will become a springboard for further projects in liturgical art.

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# INTRODUCTION

This problem originated in 1960, with the need of Christ the King Episcopal Church in Palmdale, California for ideas and designs that could be used in and for a 300-seat mission church. Father Landis, the vicar, wanted the church to incorporate modern features that would not become sterile in concept and yet hold to the idea of traditional serenity and inspiration. No amount of money for the construction of the church was specified. A free-standing altar, or one that stood away from the rear wall of the church and also a Christus Rex figure that could be installed above the altar in place of the traditional altar cross usually seen in Episcopal churches were desired features.

Many physical factors had to be taken into consideration in designing a structure such as this. Palmdale lies almost directly over the San Andres earthquake fault. It is on the Mojave Desert with extremes of wind, cold, heat and sunlight along with some blowing sand.

With these elements in mind the author spent one summer designing and constructing several models of churches, incorporating the Christus Rex and free-standing altar in each. A portion of the designs are located on Table 2.

Soon after the designs for the church were completed a parish member offered to donate money for a processional

cross that could be used in the services of the church as a memorial to a member of the family. The problem of designing and execution of the cross was given to the author, who will explain the aesthetics and technical problems in the body of the thesis. Three of the crosses shown on Table 3 have been completed or are in stages of completion at the time of this writing. Color photos showing more detail can be seen on Table 1.

After much deliberation and consultation about the proposed church, Father Landis and Mr. Carleton Winslow, a California architect, concluded that it would not be feasible to go on with the church at present because of the parish finances. It was decided instead that an all-purpose structure could be used temporarily for services and later become the parish hall.

As a result of the decision to curtail the church and Christus Rex project, the only tie with the original idea was the processional cross commission. The job of designing the parish hall was given to Mr. J. R. Fetridge, an architect in Palmdale, California. Mr. Fetridge had tentative drawings made by April of 1960 and then consulted about any changes or additional detail for the proposed building.

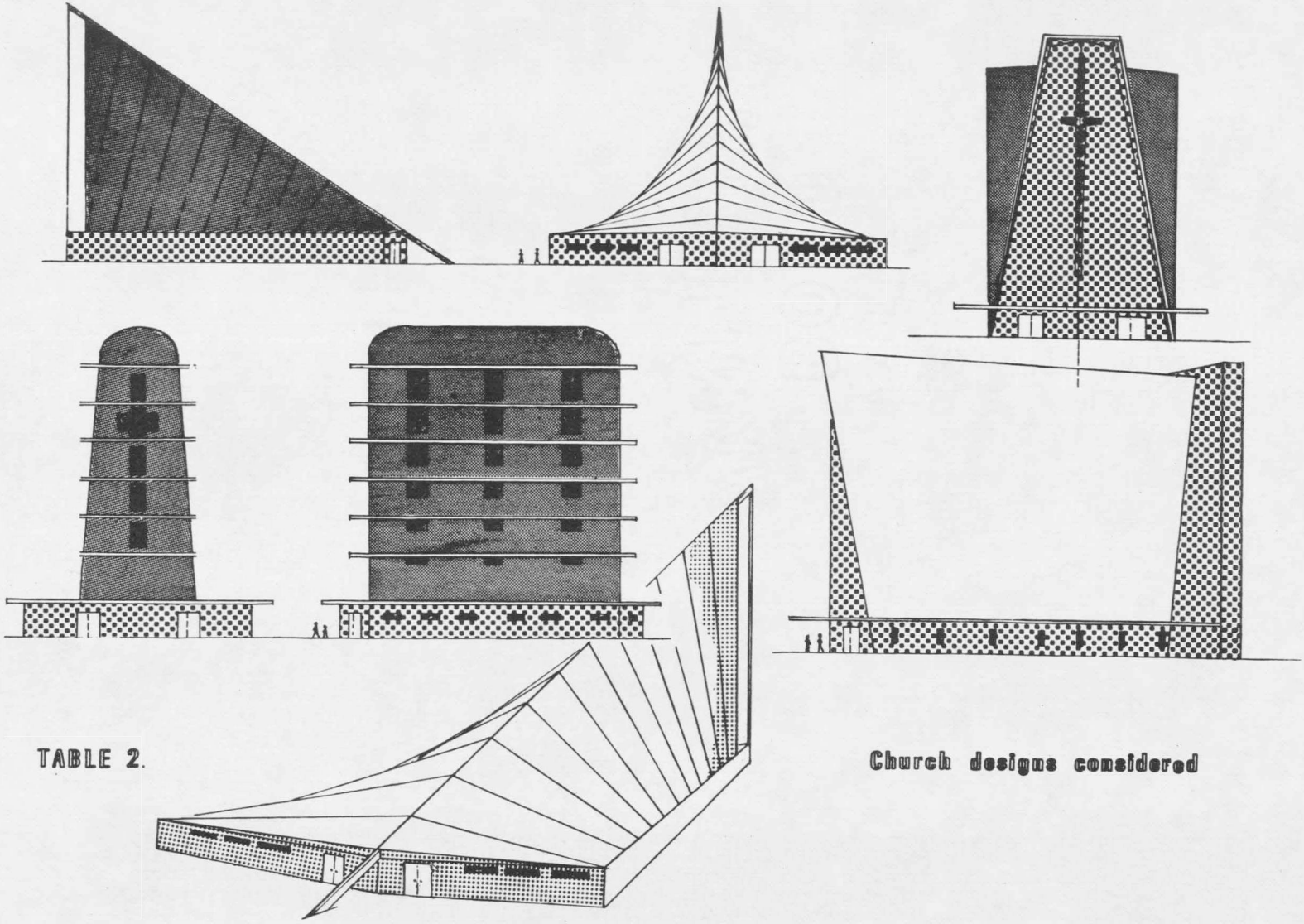

TABLE 2.

Church designs considered

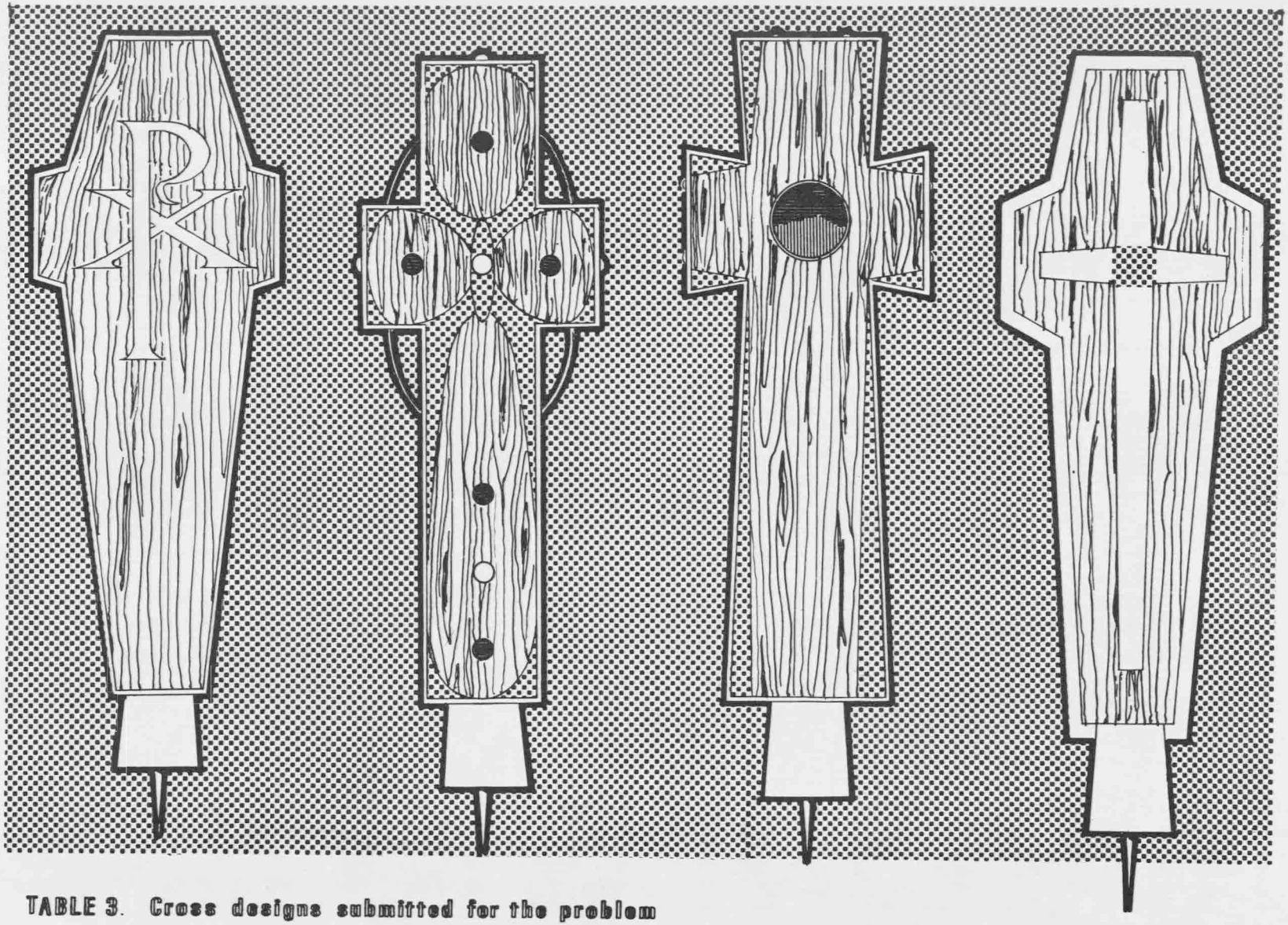

TABLE 3. Cross designs submitted for the problem

After preliminary drawings for the parish hall were completed by the architect the author was given the project of designing and executing a decorative window to be located at the entrance of the building and encompassing the doorway, and further consultation with the architect enabled the author to increase this area three feet in width, an expansion more harmonious with the total wall area. The final size of the glass area was sixteen feet by sixteen feet. Since this was the parish hall, there would be no need for literal or objective design that might change the relationship of the parish hall to the proposed church building, still under consideration. It was assumed that using color blends derived from the locality as motif would sharpen the sense of mystery and reverence for the things that surround us as well as allowing the viewer to associate the colors of the wall with the environment.

In addition to problems of aesthetics, there were problems of engineering: wind pressure, heat and cold variances, and the fact that the window would be at ground level, where it might be dangerous to persons colliding with or falling against it.

Stained glass of the one-eighth inch variety that could be bonded in color areas to clear plate glass was first tried. This attempt failed because the bonding material for the two types of glass was not strong enough to withstand the stresses that would be encountered without discoloring the stained

glass color.

Colored plastic sheets were considered as a possible solution, but they were not resistant to shock and to sand abrasion, nor would they remain fairly constant in size through temperature changes. The cost of this material was also very prohibitive.

In Pasadena, California, the author consulted with the Judson Stained Glass studio's technical advisors, who recommended the use of heavy glass that was over one inch thick. This material had been used in certain situations in Europe and America. Concrete was used as a bonding mortar to hold the pieces together. Judsons were experimenting with a new bonding material that would replace the lead cames and cement mortar that were commonly used with stained glass. This material, plastic resin, called Epoxy, is employed extensively in industry where the ultimate in strength is required. A number of inquiries revealed that Epoxy could be purchased in large quantities and that it was being used on glass in limited cases. After the author consulted with a representative from the plastic manufacturer the company formulated a special slab-glass compound that would be more than adequate for the needs of this project. Technical data on this slab-glass compound is located on Table 6.

After solving the glass and bonding problem the author

and architect decided that the two materials required more lateral strength. A system of structural iron webbing and enclosures was worked out, whereby the window, or wall, as it was now, could be executed in sections of convenient size, thus eliminating a great deal of lateral strain on the materials. Installation of the glass and Epoxy could be executed much more easily. A window constructed in sections could more readily be repaired, should damage occur.

The artistic design of the window area required consideration of glass area; properties, limitations and workability of the medium; the integration of the window to the building itself; and the unity with the surroundings and the proposed continuation of the church building program. After a great deal of drawing, discussion with Father Landis and members of the parish led to the consideration of five of the proposed drawings (more than twenty-five had been submitted). These designs were sent to Mr. Cyril H. Conrad and the staff of the School of Art at Montana State College for further consideration, comment and suggested changes.

Heavy vertical structure lines as main forms that would integrate with the shape around the doorway concealed the structural iron webbing and became part of the total design. The soft blends of the glass colors drawn from the desert lo-

cale form the main color structure, while the darker areas on the outside edges help to enclose and unify the design with the structure. An intense, pure-colored horizontal shape was used to tie the three main divisions of glass together without losing the calculated color balance, otherwise segmented by the irregular juncture lines of the Epoxy.

When the designing of the window-wall was almost complete and the purchase of suitable stained glass slabs arranged, one of the parishoners volunteered to defray most of the cost of the project. Several other parish members volunteered to assist in completing the cutting and fashioning of the glass and Epoxy.

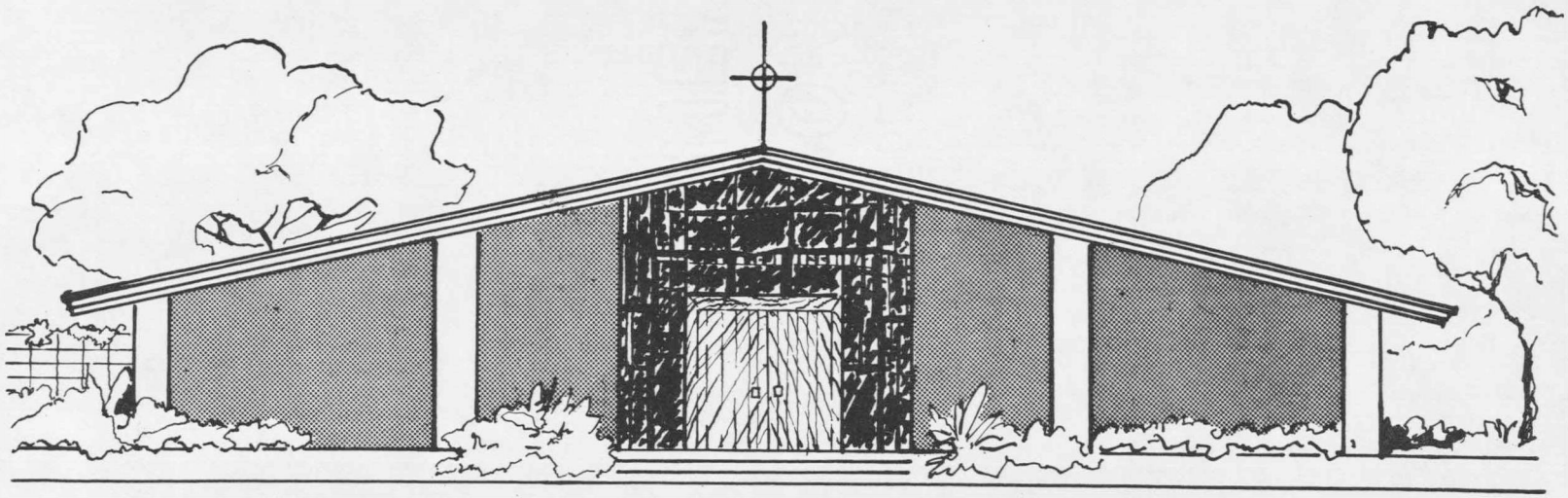

TABLE 4. Window-wall location on structure ( heavy dark area )

## CONSTRUCTION

Patterns for the three main divisions of the wall were enlarged from the design drawing on sturdy pattern paper by means of an opaque projector. Outlines were made around each of the dark Epoxy sections with a well filled felt tip pen so that the ink would bleed through the paper to a certain degree. To make sure that any of the pattern that overlapped onto the other divisions of the total layout were matched on the adjacent pattern required care. This kept the unity of the total area as it was in the original design. There was very little area scale adjustment needed in the enlarging process.

After the laying out of the full-size patterns and the labeling of each color area, the pattern for each division was placed directly over the already constructed iron webbing. Adjustments made on the pattern to conform to any minor differences that might occur between the pattern and the iron webbing eliminated any difficulty that might occur when the plastic and glass sections were set into the framework.

After alterations were made on the face of the patterns they were reversed and the corrected lines were traced through the paper from the face. All work done over the pattern was done from the reverse side so that the glass to be laid out on the pattern would be left smooth to the viewer from the outside of the building and remain true to the design.

Shaping and fitting the glass over the pattern, which was covered by plastic sheeting, was done by laying large-size,

irregularly-shaped pieces over the solid color areas and graduating the size to smaller pieces, intermixed with the color area adjacent, so that a gradual blend was accomplished between the two colors, similar to a mosaic. The glass was cut by scoring and tapping with a glass tool until it broke on the scored line, as average window glass is handled. For complicated internal cuts a special diamond blade saw and water coolant were used. The saw was mounted so that a movable carriage would carry the glass into the blade.

After the glass pieces were fitted into the section according to the colors on the original design with a plastic negative sheet covering the pattern, a one-half inch board dike was carefully constructed around the section so the area would correspond to the iron webbing material. The dike was covered with a greasy negative substance so that the Epoxy would separate from it without difficulty after the hardening process was finished. Each piece of glass was faceted on the back side, or the side facing up, by chipping with an adz-like hammer on all sides to within one-half inch of the face that rested on the pattern. All pieces were then cleaned with denatured alcohol and replaced in their original positions. Faceting each of the pieces was done primarily to pick up more sources of light than would be possible if the glass were flat on both visible surfaces. This gave the glass the quality of gems as well as the translucency and life desired.

The Epoxy resin was mixed carefully and poured from a narrow-spouted container, held high above the work area. This eliminated any bubbles that might weaken the binding quality of the resin. The liquid was carefully poured around each piece of glass so that the level of the Epoxy would not vary above or below the one-half-inch-thickness level. This eliminated any unevenness that might warp the section during its curing process. After applying the Epoxy to the section the piece was left to set up in a constant-temperatured room for twenty-four hours. When the hardening process was complete the section was carefully removed from the mold and reversed to its backside to finish out the curing process, which requires at least five days. The final tempering process eliminated any warpage that might ruin the piece. After curing, all excess Epoxy was removed by chipping and filing. The section was then ready for installing into the supporting web iron.

Each section was installed in the iron framework which was coated inside the flanges with a plastic glazing material that would never harden or become brittle. Upon installation a small strip of angle iron was bolted to the supporting frame to lock the section securely into place as is shown on Table 5.

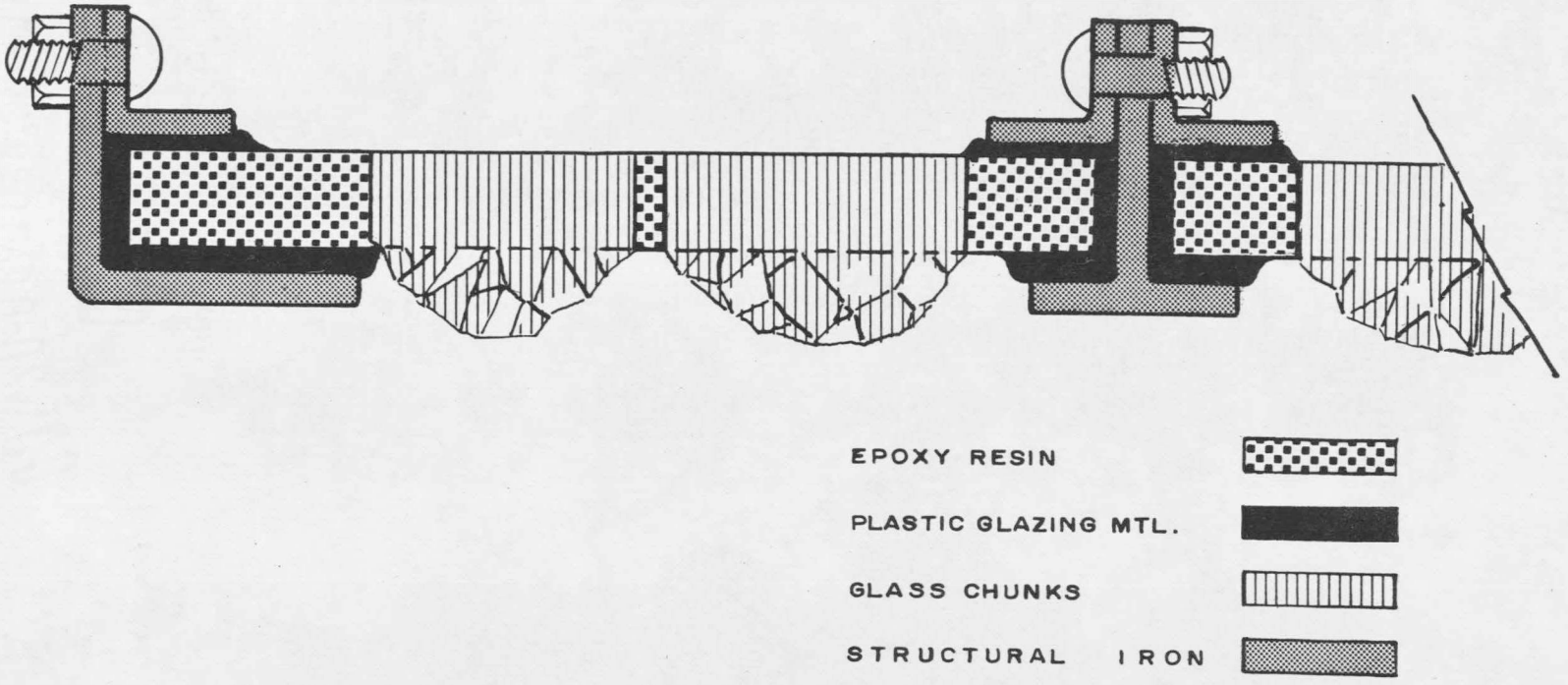


TABLE 5. Cross-section, showing location of wall materials (near normal size)

# THE PROCESSIONAL CROSS

At the beginning of this project the author considered a cast bronze or brass Celtic-type of cross with inlays of silver. The size was to be approximately eighteen inches high with suitable width. After several drawings and models were made, it was decided that a cross of that form was too traditional in concept for the wants of the parish. Hollow-cast articles are almost impossible to obtain and a solid-cast cross of the size mentioned would be much too heavy for an acolyte to carry during services.

The author approached the problem from a different direction by deciding on a direct-built article instead of a casting. This also gave more feasibility to the physical qualifications. It was decided that something fairly radical in concept might be both mechanically and aesthetically sound. The author had never worked with metal before, and had a very limited supply of materials and tools; consequently, the concept had to be kept simple and direct.

Sheet brass and silver were the only metals available at the time, so they were incorporated into the designs as a basic material along with some wood. The first designs were quite intricate, depending on a strip of sheet brass to enclose any cross design that might be employed. For the strip or band it was first thought that the brass could be shaped around a template in one continuous outline, bending the metal at the junctions. The brass was too heavy to bend properly

so the author used the silver-soldering process learned from Miss Frances Senska of the Montana State College art staff. Each segment of the band was carefully cut and fitted over a template for soldering. This problem worked out so well that the author decided to fabricate all metal parts in the project, including the silver ferrule that would join the staff to the cross.

The use of materials other than the silver and brass evolved out of the continued working and designing process. Numerous experiments with melting colored glass down into controlled patterns were made so that the glass could also be incorporated with beautiful woods. This process of glass additions evolved into the method of making an opening in the center portions of the cross so that the effect of the third dimension would be greatly increased, and also make more of a challenge concerning other possible materials that could be employed into this area of the design. The author cut an outline shape as well as hollowing out the center portion of the cross shown on Table 3, Fig. 4, from brass and sandwiched that between two pieces of wood which formed a secondary shape within the main area. Colored plastic was used to fill in the open area that remained in the center body, thereby increasing the effect of the total unit without detracting from the texture and brilliance of the other materials. These experimental crosses surpassed all demands made of them.

They were light, strong, flexible, beautiful and unique. The most successful crosses are shown on Table 3. To finish out the design of the cross shown on Table 3, Fig. 4, a staff was carved from walnut wood. The staff ends were turned on a lathe to fit the cross ferrule and the base flange, then the remainder was shaved down to a broad, flattened shape similar to a paddle. Being very light in weight, the flattened area made the cross convenient to handle and to keep in a proper position. Furthermore, the flattened shape of the staff added greatly to the scale and magnitude of the total piece.

## MATERIALS USED IN THE WALL

Stained glass: The glass for this project is made by hand and poured into steel molds approximately eight inches square. The resulting pieces are slabs, or more properly, dalles. Colors for this type of glass range completely through the spectrum, with many variations on each main color. Oxides of metal, dyes, chemicals such as vanadium, selenium and rutile - even bits of gold go into making up the colors in this glass. Pink is the most fugitive of the colors as they go through their processing. There are many grades and thicknesses of slab glass. Some French and Italian glasses are over three inches in thickness. They are also very expensive to import; consequently the author used high-quality domestic glass.

Matrix material: Epoxy resin has been used industrially in place of rivets for several years, mainly in bonding aircraft bodies. For use on glass a special formula is made by most manufacturers to fit the needs of lateral strength, weathering, variances of heat and cold, shock resistance and ease of handling. When properly used it becomes much stronger than the glass. Physical properties of a brand called Thermoset 106 are listed on Table 6.

Epoxy is supplied in any color required to blend with either wood or masonry in structures, and various surface textures can be produced by spreading sand or other aggregate over the pattern area before the resin is poured into place.

Some of the best practices when working with Epoxy compounds are as follows:

1. Use extreme care in keeping grease or oil off the surfaces of the glass to which the Epoxy compound is to adhere.

2. Never thin Epoxy with solvents. Solvents do not react with this type of resin.

3. Do not cure Epoxy at temperatures below 70° F. It is slow and unreliable.

4. Be sure to mix the resin and the supplied hardening agent thoroughly.

5. Avoid constant or frequent contact of the skin with Epoxy agents. Soap and water are best for cleaning the material from the skin.

Support material, iron: The materials, glass and Epoxy, are very strong but the wall needs some additional agent to tie the pieces or sections together into a compact and flexural unit. Structural iron is not only the easiest to obtain, but is the most successful.

Surrounding each of the three main divisions of the wall is a welded band of one-and-one-half by one-and-one-half inch standard-sized angle iron, with flanges turned inward to form a bedding for the decorative materials. The angle iron was drilled for its mounting on the building by means of lag bolts. T-shaped iron bands, one by one-and-one-half inch in dimension were used to form a webbing across the glass and Epoxy areas.

They also helped in the bedding process for the material. These were welded together where they intersected and converged with the angle iron frame, forming one continuous backing for the decorative material. It was found best to run the T-iron across the whole span of each division in a straight line, from angle iron to angle iron. This insured the ultimate in strength and flexibility, along with providing equal area for each of the enclosed sections.

Each glass-Epoxy section was set into the iron framework and bedded with plastic glazing compound which never hardens. This gives the whole area some flexibility when minor shocks and shifting occur. A strip of five-eighths by five-eighths inch angle iron was fitted and bolted to all framing, which projected above the Epoxy to secure the sections in their final position.

TABLE VI

PHYSICAL PROPERTIES OF THERMOSET 106

| Property | A.S.T.M. No. | Value |
|---|---|---|
| Hardness | D-1706-59T | Shore "D" 89 |
| Tensile strength | D-638-58T | 6,500 psi |
| Initial tensile modulus | D-638-58T | $2.0 \times 10^6$ psi |
| Flexural strength | D-790-59T | 10,500 psi |
| Initial flexural modulus | D-790-59T | $1.7 \times 10^6$ psi |
| Compressive strength | D-695-54 | 12,600 psi |
| Initial compressive modulus | D-695-54 | $0.7 \times 10^6$ psi |
| Izod impact strength | D-256-56 | 0.35 ft. lbs. |
| Water absorption | D-570-59aT | 0.12% |
| Coefficient of linear thermal expansion | | $30 \times 10^6$ in./in. °C. below 50° C.<br>$50 \times 10^6$ in./in. °C. above 50° C. |

Information on this table is given mainly to testify to mechanical stresses and to compare the naterial to architectural standards.

## CONCLUSION

Liturgical art today seems to be increasing in importance, as it did shortly after 1000 A.D. The problem involved in this thesis has been just one of the facets and indications of that trend. Even though Christ the King Church had very little money the congregation was eager to satisfy their various needs with details that were apart from the oversophisticated production line of symbols that are evident in many churches today. Through the aesthetic quality of the decoration that surrounds them they hope to share in man's quest for enlightenment and spiritual awareness.

The artist today has the unique opportunity to help others bridge the gap between the sterile repitition of the mass-produced object and the aesthetic that fosters the spiritual and inner resourcefulness that is so badly needed in our churches today. This work helps the artist also; in making his role in society more valid and useful to his own advancement and maturity.

With the continuation of building for this one parish there will be a great deal more work for the author to do in the field of art, since the building involved in this document was just a beginning. Future plans for the church property include the construction of the main church and a parochial school.

In the Los Angeles diocese alone, present plans call for at least eighty new Episcopal churches. The largest share of

these will embody original designs done by individual artists, instead of the eclectic styles of the past.

The author believes that this project has been fine training and a stimulus to further growth, not only in learning and developing as an artist, but in the implication of future growth in the field of liturgical art. With this hope arises the possibility that the church member, architect and dedicated artist-craftsman will work together for the integrated purpose of serving mankind in his further efforts to find himself.

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| Curtis Life Ins. | |
| Lou Archer | APR |
| 427½ Shoe | 5-21-66 |
| DEN | JUL 13 1966 |
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