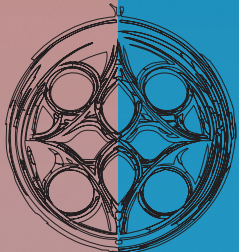


DESIGN STUDY OF

**CATHOLIC
CHURCH
ARCHITECTURAL
FORM AND
MATERIAL
COSTS**

BY JEREMY RIVARD



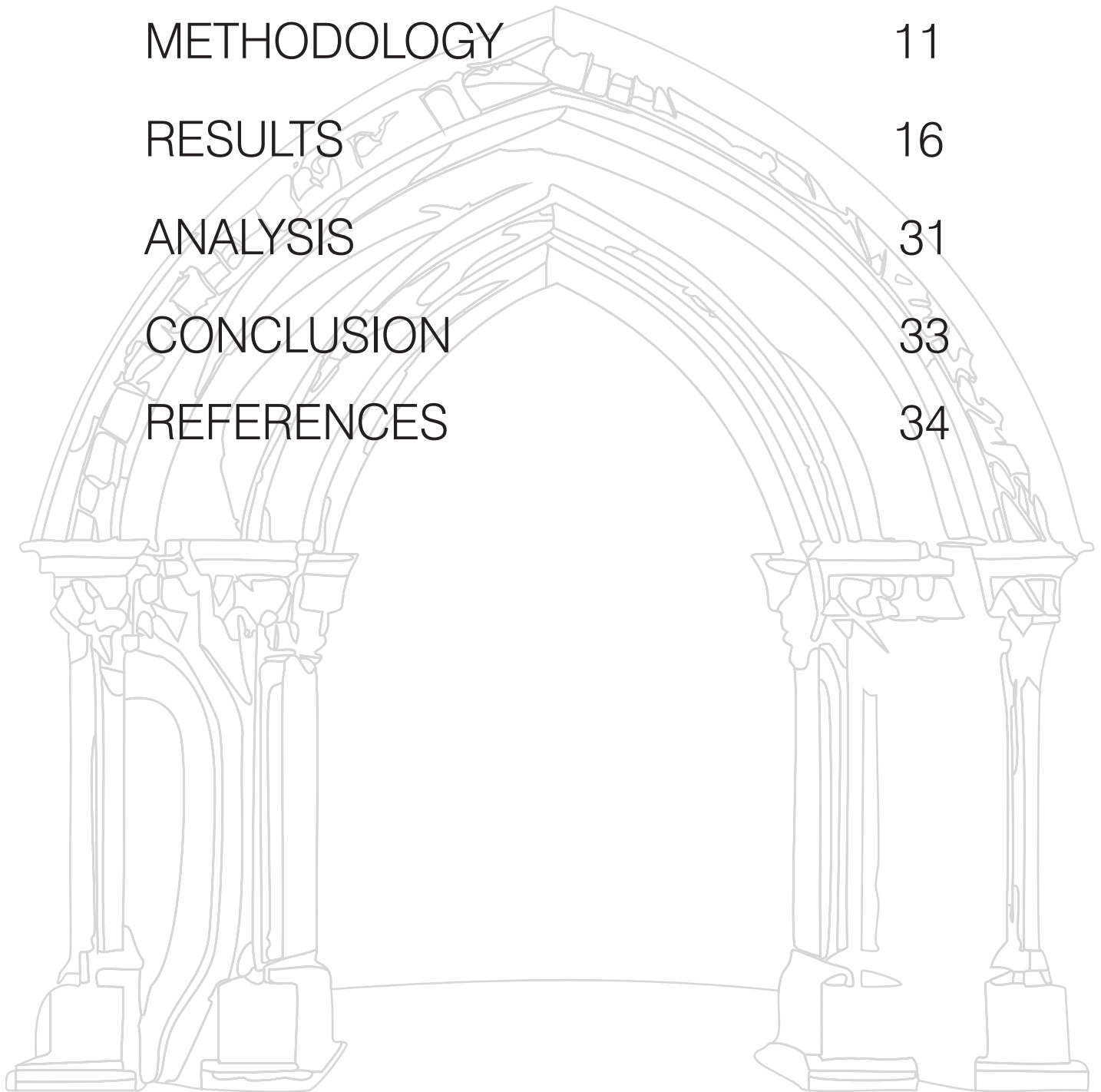
They are to make a sanctuary for
me, that I may dwell in their midst.

According to all that I show you
regarding the pattern of the tabernacle
and the pattern of its furnishings, so
you are to make it.

- Exodus 25:8-9

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INTRODUCTION

The architecture of Catholic churches has an intrinsic connection with the liturgy, theology, and tradition of the Church. Creating sacred spaces to engage in the worship of God has been an essential part of Catholic life since the earliest days of Christendom, but sacred architecture has undergone many notable shifts over the last century. These design changes in modern sacred architecture have partly stemmed from liturgical reform within the Church, but also from societal turmoil from without. This has resulted in many churches built over the last 70 years that fail to live up to their potential, through a lack of architectural beauty, shoddy construction, and tawdry materials. The era of the beautiful Catholic church building had stopped.

The questions this research seeks to address are as follows: How can the beauty of a contemporary church building signify the unchanging solemnity of Catholic worship and aid in the search for the Divine, and how can this beauty be returned to new churches in an economical way through modern construction methods? How can these ideals be applied to design a transcendent sacred space for a small parish with limited resources?

This research project examined designs for a new Catholic church building through the lens of each of the following four categories:

- Form
- Liturgy
- Structure
- Cost

The goal of this research was to find the optimal combination of the above categories for a new church construction project, in order to create a sacred space appropriate for the Catholic liturgy in a cost-effective manner. Variations in form were explored in multiple ways, with the vesica piscis shape serving as the proportioning system for the floorplan shapes and changes in verticality throughout building elements. The progression of possible forms were digitally modeled and the material costs for each were estimated, with the focus being on how each iteration affects the estimated construction costs. The desired outcome will be a joint architectural form and structural method that provides a sanctuary that expresses the four transcendentals of Catholic theology: truth, goodness, beauty, and unity, and does so in an easily constructible way that is financially accessible for small parish communities.

BACKGROUND

The role of sacred architecture in worship is one of high significance. The church building can and should embody signs and symbols of the Catholic faith. The United States Council of Catholic Bishops, in the document *Built of Living Stones: Art, Architecture and Worship*, wrote:

Because the church is a house of prayer in which the Eucharist is celebrated and the Blessed Sacrament is reserved, a place where the faithful assemble, and a setting where Christ is worshiped, it should be worthy of prayer and sacred celebration, built in conformity with the laws of the Church, and dignified with noble beauty and intrinsically excellent art. (2000, p.9)

The church building serves not only as a space for the congregation to gather, but it also serves as a meeting point between God and man. Sacred architecture in the Christian tradition is a physical representation of the Incarnation in which God became man, and as such holds immense value in the Church for its ability to facilitate a sacramental encounter with God.



ST. JOHN THE EVANGELIST CATHOLIC CHURCH, WAYNESBORO, VA

There has been much debate about the proper and correct way to design a church throughout the twentieth century, and especially after the conclusion of the Second Vatican Council in 1965. Architectural interpretation of the results of the council has varied widely, and many Catholic churches constructed in the United States since the conclusion of this council have strayed from the precedent of centuries of sacred architecture in efforts to make the practice of the Catholic faith and liturgy more accessible to lay people. This has resulted in contemporary Catholic churches being constructed in a plethora of architectural styles and forms. While this has allowed sacred

architecture to express the universality of the Church through a variation of styles and forms, it has also led to many churches that completely eschew many traditional design elements and liturgical symbolism. However, over the last decade or two, there has been a significant movement within the Catholic Church in America that has seen a return to more classical forms of sacred architecture in many new parish building projects.

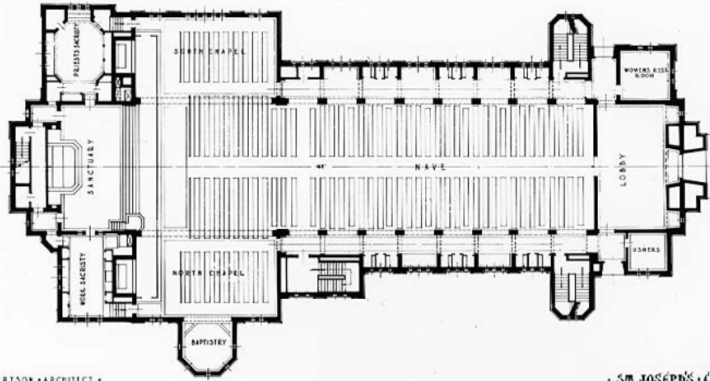
Sorting through the numerous styles and forms of Catholic church architecture in the pursuit of a building methodology that captures the transcendental nature of the sacred liturgy in an attainable design is a valuable exercise due to the relevance of the questions this process seeks to answer. New parish churches are constructed regularly as communities and congregations ebb and flow and old structures fall into disrepair or become too expensive to maintain. Having a church in which the faithful can come and worship God has always been a priority for the Catholic community and will continue to be so in the future.



ST. MICHAEL THE ARCHANGEL CATHOLIC CHURCH, PAWCATUCK, CT

CASE STUDIES

One method of understanding the diverse and varied approach to Catholic sacred architecture in the United States over the last century is to examine several churches that typify prominent forms and structural systems found in churches. The following case studies are all Catholic parish churches built around the United States that each exhibit one of the general floorplan forms or structural systems that were incorporated into the methodology of this research. Their seating capacities, dates of construction, and geographical region vary, giving a further glimpse into the immense variety of design directions that have been pursued.



• A. ALBERTSON • ARCHITECT •
 • JOSEPH WILSON PAUL RICHARDSON •
 • ASSOCIATES •

MAIN CHURCH FLOOR PLAN
 SCALE IN FEET

• ST. JOSEPH'S CHURCH •
 • SEATTLE • WASH. •



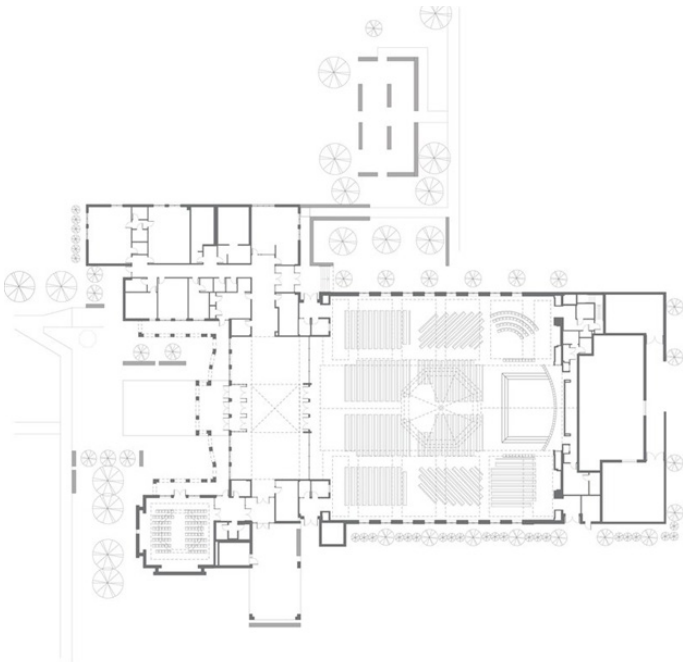
ST. JOSEPH

SEATTLE, WA

1929

ABRAHAM H. ALBERTSON

St. Joseph's Catholic Church represents the traditional Latin cross plan served as the primary arrangement for Catholic places of worship for centuries, dating back to the early Christian churches built in Rome. The long rectilinear form, stretching from the narthex forward to the sanctuary serves to represent the journey from the world to the heavens. The pews are arranged in two columns, directly facing the sanctuary and the altar. The transept formed by the cross holds 2 additional columns of pews, side chapels, and 2 sacristies for preparing for the Mass. The main doors of the church are on the central axis and lead into the narthex, which is flanked by restrooms and stairwells. The longitudinal emphasis of the plan helps focus attention forward and emphasizes the preeminence of the altar, while the verticality of the nave and steeple help inspire the mind heavenward.



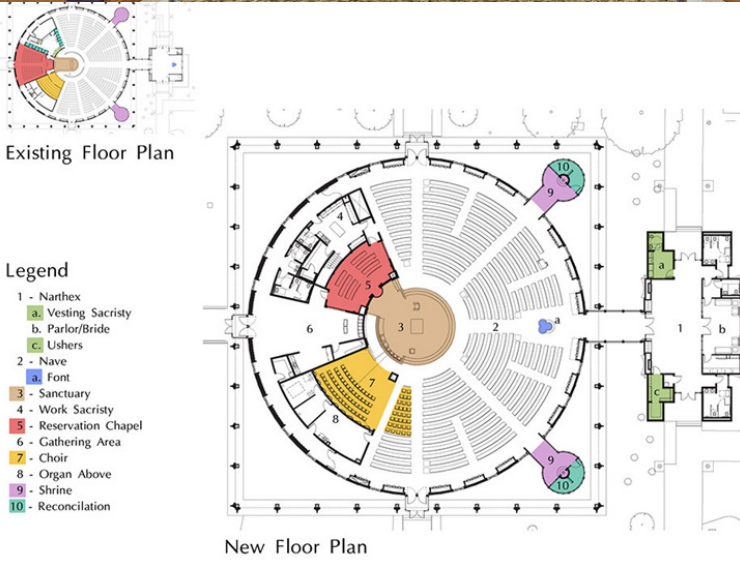
ST. MARY MAGDELENE

RALEIGH, NC

2016

CANNON ARCHITECTS

The Church of St. Mary Magdelene is an example of a contemporary Catholic church building that is designed around a large rectilinear nave and sanctuary space. This serves as the center of the grid-like floorplan, with the secondary and circulation spaces organized around it. The nave has four columns of pews primarily arranged perpendicular to the central axis formed by the tabernacle, altar, and central aisle. The sanctuary space is demarcated by a raised floor, physically and visually elevating the altar. The design also includes a large narthex space at the back of the church to serve as a space for parishioners to mingle.



ST. MONICA

DALLAS, TX

1962, RENOVATED 2013

THOMAS E. STANLEY, FISHER HECK ARCHITECTS

A distinct example of a “church in the round”, St. Monica’s Catholic Church is clear result of the liturgical shifts of the second half of the second half of the 20th century. The plan of the whole building radiates out from the hub of the altar, with the curved pews arranged in the semicircular nave. The seating for the choir, pipe organ, and adoration chapel are placed directly behind the sanctuary, with the other secondary and functional spaces arranged next to these, freeing up the walls at the back of the nave for stained glass windows, helping to flood the building with natural light.



ST. MICHAEL THE ARCHANGEL

PAWCATUCK, CT

REBUILT 2020

GEDDIS ARCHITECTS

The Church of St. Michael the Archangel is a historic nineteenth century church that was rebuilt in 2020 utilizing a new heavy timber truss roof structure for the nave and sanctuary. The trusses are arched hammerbeam style, with powder coated steel tie rods and joinery, constructed by Vermont Timber Works. The trusses rest on steel columns, built on new concrete foundations. The walls were also rebuilt, using steel framing. The interior features a simple and yet colorful paint scheme, with the white ceilings highlighting the exposed timber. The exterior of the church features traditional New England clapboard siding and modest ornamentation, capped by a towering spire.



ST. JOHN THE EVANGELIST

WAYNESBORO, VA

2021

HARRISON DESIGN

St. John the Evangelist's Catholic Church is an example of a new build church building that uses a steel superstructure throughout the entire building. The structure is comprised of steel columns, single span steel beams, and steel purlins supporting the roof deck. The structural system is entirely concealed in the finished building. The exterior is clad in a fieldstone masonry veneer, giving the church a traditional look that matches the classical Latin cross form. The interior is similarly designed in a traditional style, with a exposed wooden rafter beams supporting a vaulted ceiling hiding the superstructure above. The nave and sanctuary have a dualtone paint finish, as the walls are painted in light earth tones while the ceiling is painted blue, symbolizing the blue of the skies above the earth.

METHODOLOGY

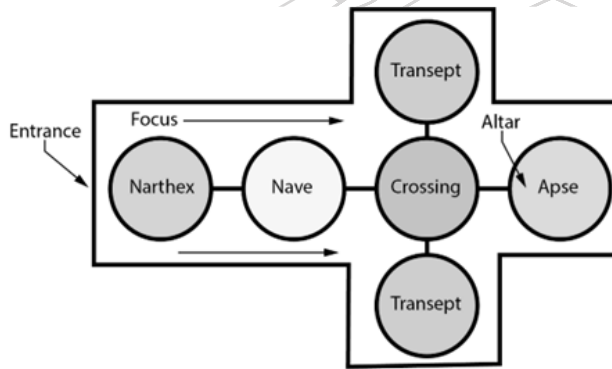
The methodology of this research consisted of the following stages:

1. Three distinct building forms were chosen, determined by systems of geometrical proportioning for sacred spaces, existing case studies, and Catholic liturgical guides.
 - a. The geometry of each floorplan was based off of the shape of the vesica piscis. Consisting of overlapping circles, this shape has deep theological symbolism and has been used in the design of churches in for centuries. The size of the building was determined by a seating capacity of 250 people for each form.
 - b. The case studies were used as a basis for the overall shape and proportioning of each floorplan, and for the structural materials.
 - c. Each church layout was designed around the main function of the space, the Catholic liturgy. Each space consists of a nave with space for seating 250 congregants, a sanctuary with altar and tabernacle, confessional, entry space, sacristy space, restrooms, and secondary storage spaces.
2. Each floorplan design was modeled in Revit and was built into a potential three dimensional building form, with floors, walls, windows, doors, roofs, structural columns, and the main structural trusses each building necessitated.
 - a. A common steeple design shares between each iteration
 - b. Each floor type was modeled as structural floor, with the intention of adding a basement underneath
 - c. A brick on steel stud wall type was used for all exterior walls, and a 6" partition wall type was used for all interior walls.
 - d. The timber roof trusses are 6 panel scissor trusses and the steel roof beams are steel I-beams
3. The material cost for the modeled elements of each floorplan iteration was estimated using RSMeans software databases.
4. The costs for each element were compared throughout the iterations, and an estimated cost per square foot for each design was determined.

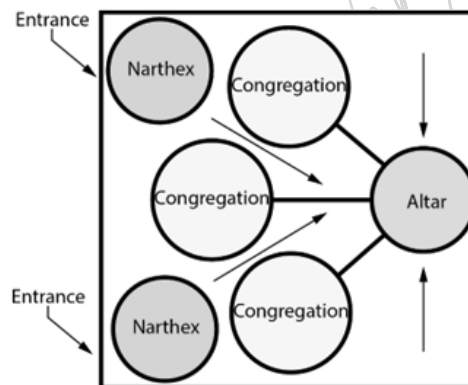


The spatial forms that were analyzed included derivatives of the three spatial configurations outlines below, which represent several of the primary forms found in Catholic church plans today.

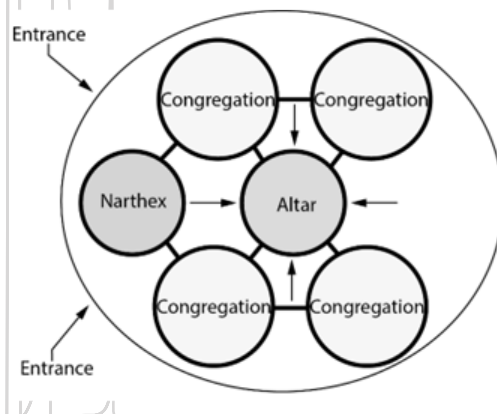
The first option is a traditional Latin cross plan, with a linear nave connecting the narthex to the apse, intersected by a transept. The focus remains on the front of the church and the altar.



The second form is rectangular, with the altar along one of the walls and the seating for the congregation arranged throughout the center of the plan. The focus is directed towards the back wall and angled towards the altar.

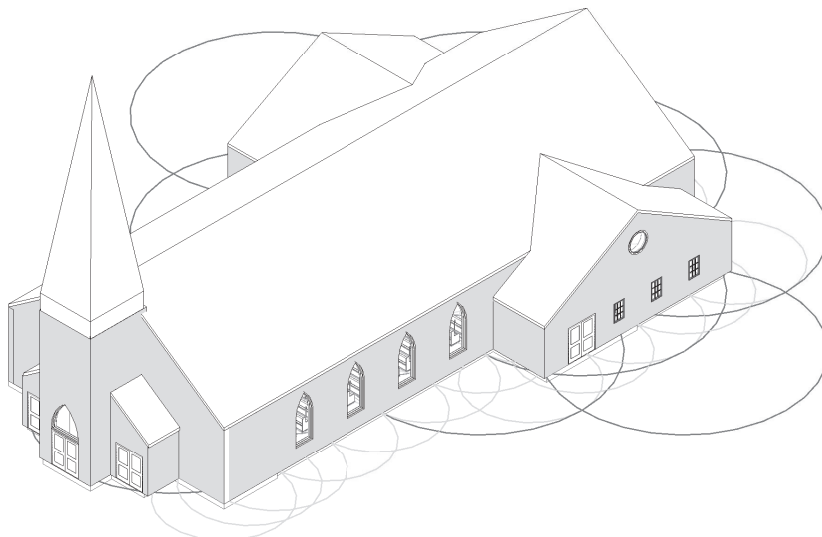
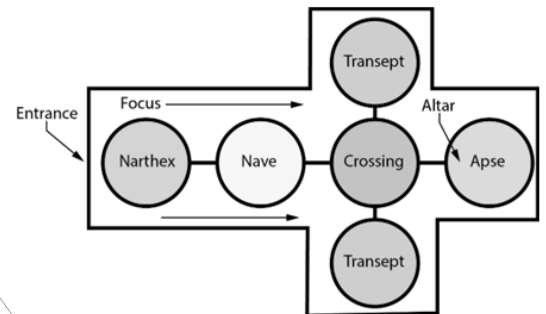
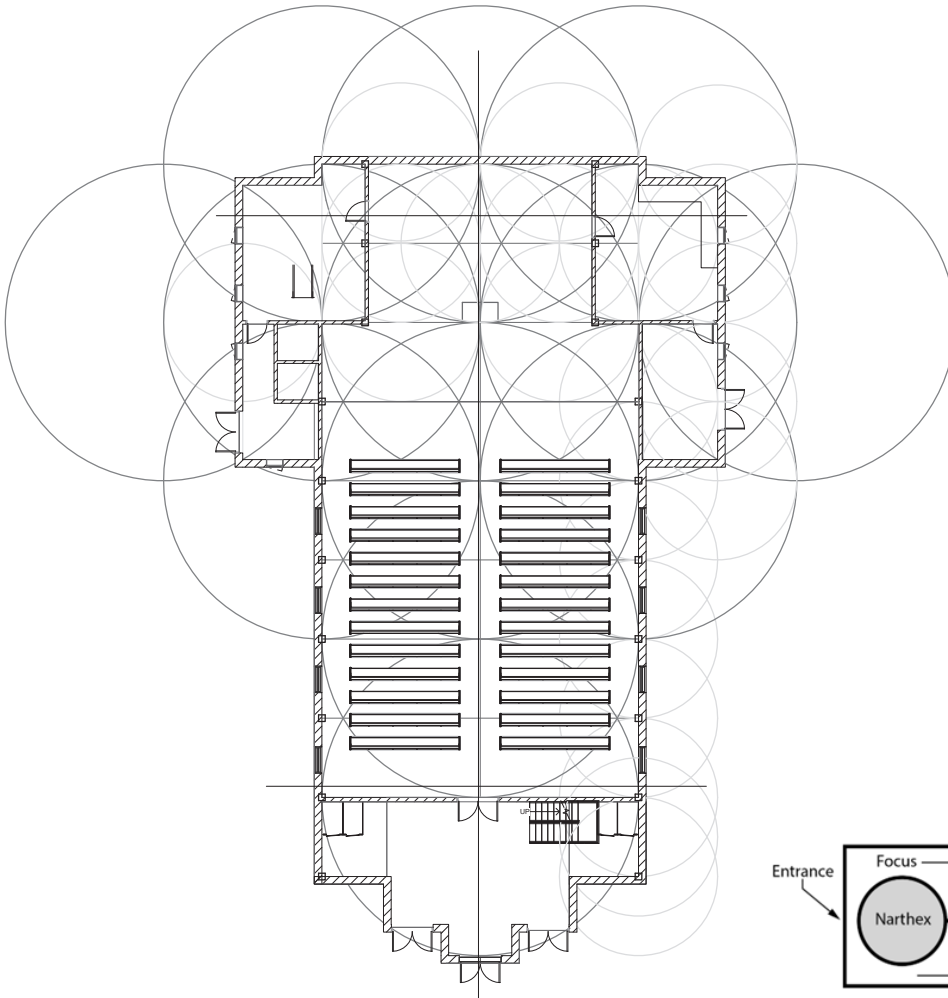


The third design is a radial form arranged around the altar. The congregation all are in close proximity to the altar, with different viewing angles.



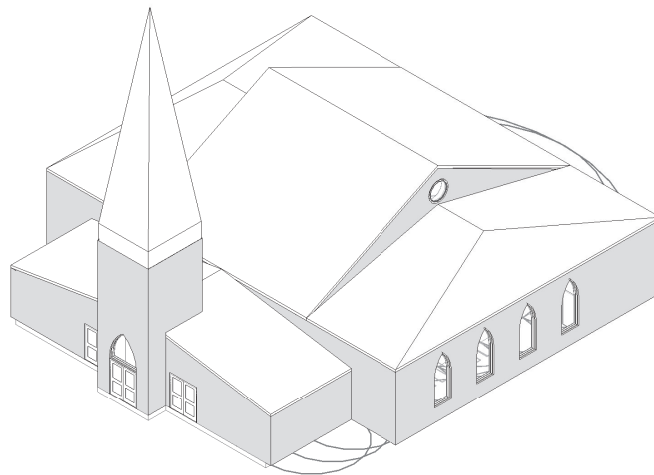
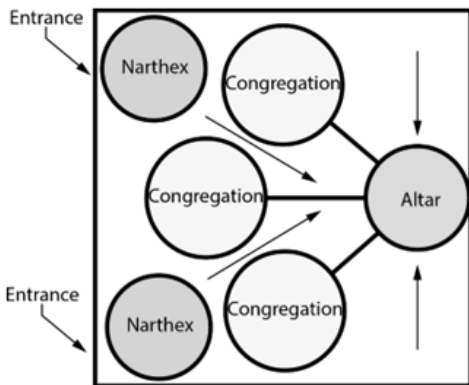
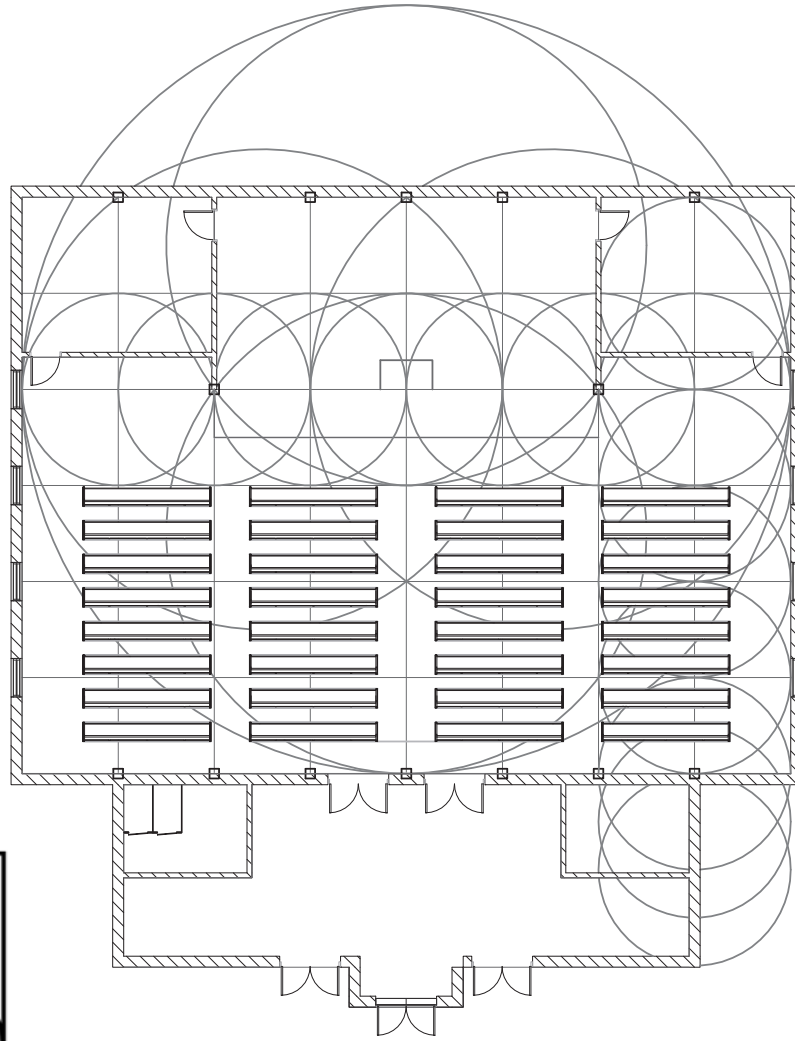
FLOORPLAN 1

The first option is a traditional Latin cross plan, with a linear nave connecting the narthex to the apse, intersected by a transept. The focus remains on the front of the church and the altar. The vesica piscis shape derives from circle 48 feet in diameter. The floor area is 7203 square feet.



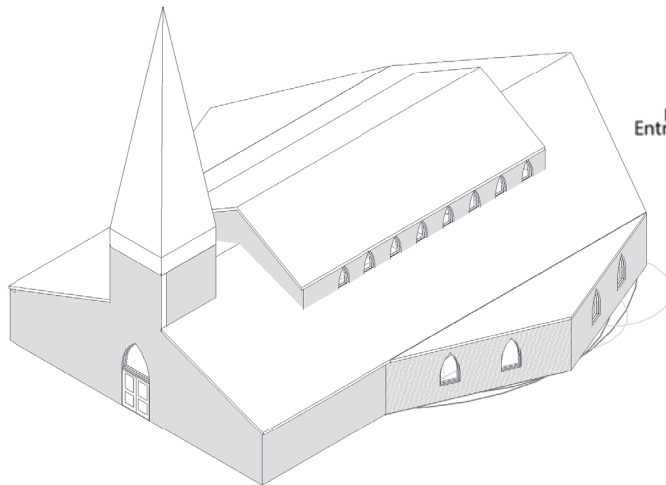
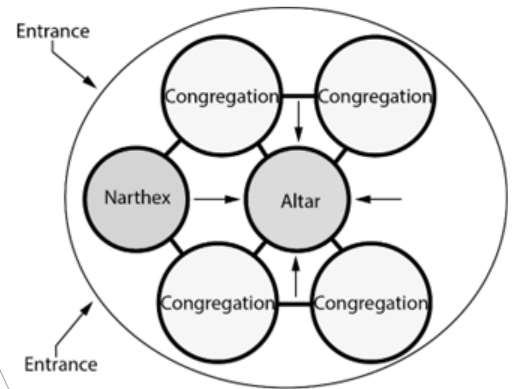
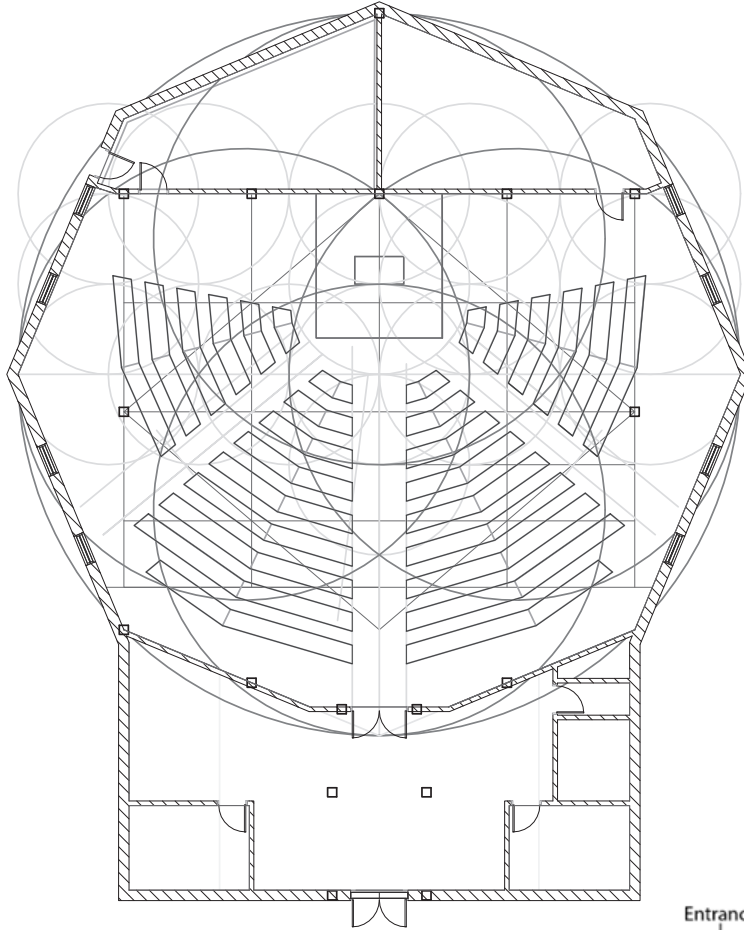
FLOORPLAN 2

The second form is rectangular, with the altar along one of the walls and the seating for the congregation arranged throughout the center of the plan. The focus is directed towards the back wall and angled towards the altar. The vesica piscis is derived from a circle 80 feet in diameter. The floor area is 6503 square feet.



FLOORPLAN 3

The third design is a radial form arranged around the altar. The congregation all are in close proximity to the altar, with different viewing angles. The vesica piscis is derived from a circle with a diameter of 50 feet. The floor area is 6291 square feet.



RESULTS

FLOORPLAN 1 COST DATA

| Floor Schedule | | | | | | |
|----------------|------------------------|------------|------------------------|--------------------|-------------------|--------|
| Area | Family and Type | Area value | Structural cost per sf | Finish cost per sf | Total cost per sf | Price |
| 489.88 SF | Floor: Choir loft | 490 | 16 | 7 | 23 | 11218 |
| 252.85 SF | Floor: Entryway | 253 | 16 | 14 | 30 | 7634 |
| 266.84 SF | Floor: Entryway | 267 | 16 | 14 | 30 | 8056 |
| 609.28 SF | Floor: Entryway | 609 | 16 | 14 | 30 | 18394 |
| 3021.67 SF | Floor: Nave | 3022 | 21 | 14 | 35 | 105517 |
| 282.84 SF | Floor: Restroom | 283 | 14 | 5 | 19 | 5365 |
| 1439.25 SF | Floor: Sanctuary | 1439 | 21 | 46 | 67 | 96228 |
| 419.82 SF | Floor: Secondary Space | 420 | 16 | 5 | 22 | 9056 |
| 420.34 SF | Floor: Secondary Space | 420 | 16 | 5 | 22 | 9067 |
| | | | | | | |
| | Total SF: | 7203 | | | Total price: | 270535 |

| Roof Schedule | | | | | | |
|---------------|---------------------------|------------|------------------------|---------------------|-------------------|--------|
| Area | Family and Type | Area value | Structural cost per sf | Roofing cost per sf | Total cost per sf | Price |
| 774.52 SF | Basic Roof: Roof 1 | 775 | 6 | 8 | 14 | 10673 |
| 729.79 SF | Basic Roof: Roof 1 | 730 | 6 | 8 | 14 | 10057 |
| 6775.42 SF | Basic Roof: Roof 1 | 6775 | 6 | 8 | 14 | 93365 |
| 1070.67 SF | Basic Roof: Steeple roof | 1071 | 5 | 8 | 12 | 13030 |
| 70.61 SF | Basic Roof: Entryway roof | 71 | 6 | 8 | 14 | 973 |
| 79.08 SF | Basic Roof: Entryway roof | 79 | 6 | 8 | 14 | 1090 |
| 84.41 SF | Basic Roof: Entryway roof | 84 | 6 | 8 | 14 | 1163 |
| | | | | | | |
| | | | | | Total: | 130351 |

| Structural Column Schedule | | | | |
|----------------------------|--|----------|---------------|-------|
| Cost per ft. | Family and Type | Length | Length in ft. | Price |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 16' - 2" | 16 | 1600 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 16' - 2" | 16 | 1600 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 16' - 2" | 16 | 1600 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| | | | Total: | 30300 |

| Structural Framing Schedule - Timber | | | | | Structural Framing Schedule - Steel | |
|--------------------------------------|-------------------------------------|--------|--------|--|-------------------------------------|--------|
| Cost per ft. | Family and Type | Span | Price | | Cost per ft. | Price |
| 350 | Scissors Truss-6 Panel: Standard | 48 | 16800 | | 600 | 28800 |
| 350 | Scissors Truss-6 Panel: Standard | 48 | 16800 | | 600 | 28800 |
| 350 | Scissors Truss-6 Panel: Standard | 48 | 16800 | | 600 | 28800 |
| 350 | Scissors Truss-6 Panel: Standard | 48 | 16800 | | 600 | 28800 |
| 350 | Scissors Truss-6 Panel: Standard | 48 | 16800 | | 600 | 28800 |
| 325 | Scissors Truss-6 Panel - APSE: Apse | 34 | 11050 | | 600 | 20400 |
| 325 | Scissors Truss-6 Panel - APSE: Apse | 34 | 11050 | | 600 | 20400 |
| | | | | | | |
| | | Total: | 106100 | | Total: | 184800 |

| Wall Schedule | | | | |
|---------------|----------------|--|------------|--------|
| Area | Cost per sq ft | Family and Type | Area value | Price |
| 735.90 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 735.90 | 19869 |
| 6289.56 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 6289.56 | 169818 |
| 1765.41 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 1765.41 | 8827 |
| | | | | |
| | | | Total: | 198514 |

FLOORPLAN 2 COST DATA

| Floor Schedule | | | | | | |
|----------------|------------------------|------------|------------------------|--------------------|-------------------|--------|
| Area | Family and Type | Area value | Structural cost per sf | Finish cost per sf | Total cost per sf | Price |
| 3132.07 SF | Floor: Nave | 3132 | 25 | 14 | 39 | 122652 |
| 1000.00 SF | Floor: Sanctuary | 1000 | 17 | 46 | 63 | 62560 |
| 946.32 SF | Floor: Entryway | 946 | 17 | 14 | 31 | 29506 |
| 333.11 SF | Floor: Secondary Space | 333 | 17 | 5 | 22 | 7328 |
| 333.11 SF | Floor: Secondary Space | 333 | 17 | 5 | 22 | 7328 |
| 258.26 SF | Floor: Restrooms | 258 | 14 | 5 | 19 | 4899 |
| | Floor: Choir Loft | 500 | 16 | 7 | 23 | 11450 |
| | | | | | | |
| | Total: | 6503 | | | Total: | 245724 |

| Roof Schedule | | | | | | |
|---------------|--------------------------|------------|------------------------|---------------------|-------------------|--------|
| Area | Family and Type | Area value | Structural cost per sf | Roofing cost per sf | Total cost per sf | Price |
| 1177.33 SF | Basic Roof: Roof 1 | 1177 | 6 | 8 | 14 | 16224 |
| 2783.54 SF | Basic Roof: Roof 1 | 2784 | 6 | 8 | 14 | 38357 |
| 1425.37 SF | Basic Roof: Roof 1 | 1425 | 6 | 8 | 14 | 19642 |
| 1425.37 SF | Basic Roof: Roof 1 | 1425 | 6 | 8 | 14 | 19642 |
| 1070.67 SF | Basic Roof: Steeple roof | 1071 | 5 | 8 | 12 | 13030 |
| | | | | | | |
| | | | | | Total: | 106894 |

| Structural Column Schedule | | | | |
|----------------------------|---|----------|---------------|-------|
| Cost per ft. | Family and Type | Length | Length in ft. | Price |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 15' - 0" | 15 | 1500 |
| | | | Total: | 21000 |

| Structural Framing Schedule | | | | | Steel structural framing | |
|-----------------------------|----------------------------------|--------|-------|--|--------------------------|--------|
| Cost per ft. | Family and Type | Span | Price | | Cost per ft. | Price |
| 400 | Scissors Truss-6 Panel: Standard | 60 | 24000 | | 600 | 36000 |
| 400 | Scissors Truss-6 Panel: Standard | 60 | 24000 | | 600 | 36000 |
| 400 | Scissors Truss-6 Panel: Standard | 60 | 24000 | | 600 | 36000 |
| | | Total: | 72000 | | Total: | 108000 |

| Wall Schedule | | | | |
|---------------|-----------------|--|------------|--------|
| Area | Cost per sq ft. | Family and Type | Area Value | Price |
| 1234.69 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 1234.69 | 33337 |
| 771.78 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 771.78 | 20838 |
| 1124.45 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 1124.45 | 30360 |
| 754.44 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 754.44 | 20370 |
| 190.00 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 190.00 | 5130 |
| 554.70 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 554.70 | 14977 |
| 178.44 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 178.44 | 4818 |
| 106.75 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 106.75 | 534 |
| 73.33 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 73.33 | 367 |
| 106.75 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 106.75 | 534 |
| 73.33 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 73.33 | 367 |
| 348.82 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 348.82 | 1744 |
| 330.10 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 330.10 | 1651 |
| 348.82 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 348.82 | 1744 |
| 330.10 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 330.10 | 1651 |
| 465.55 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 465.55 | 12570 |
| 465.55 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 465.55 | 12570 |
| 253.37 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 253.37 | 6841 |
| 245.47 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 245.47 | 6628 |
| 218.68 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 218.68 | 5904 |
| 138.66 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 138.66 | 3744 |
| | | | | |
| | | | Total: | 186676 |



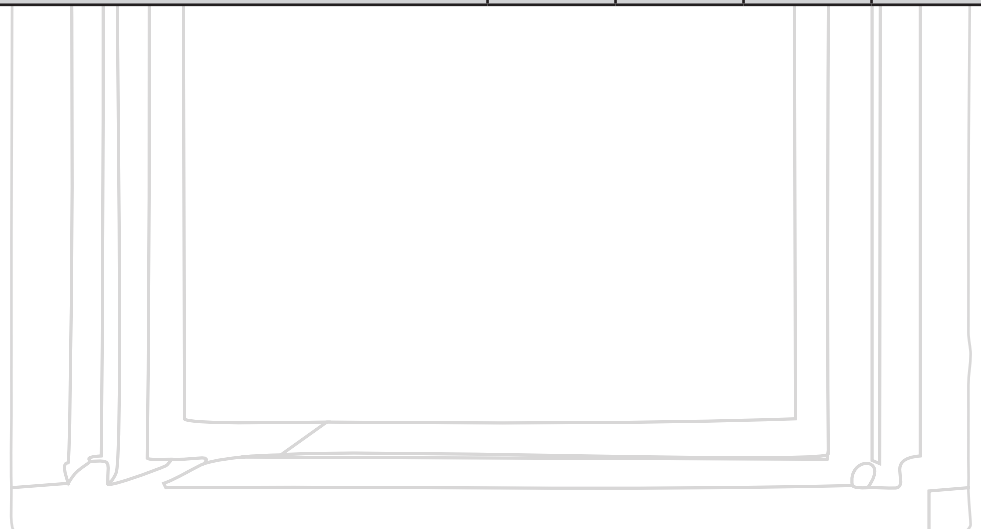
FLOORPLAN 3 COST DATA

| Floor Schedule | | | | | | |
|----------------|------------------------|------------|------------------------|--------------------|--------------------|--------|
| Area | Family and Type | Area Value | Structural cost per sf | Finish cost per sf | Total price per sf | Price |
| 3450.86 SF | Floor: Nave | 3451 | 30 | 14 | 44 | 151182 |
| 223.09 SF | Floor: Sanctuary floor | 223 | 30 | 46 | 76 | 16899 |
| 1041.56 SF | Floor: Entryway floor | 1042 | 19 | 14 | 32 | 33715 |
| 248.93 SF | Floor: Restrooms | 249 | 14 | 5 | 19 | 4722 |
| 826.77 SF | Floor: Entryway floor | 827 | 19 | 14 | 32 | 26763 |
| | Floor: Choir Loft | 500 | 16 | 7 | 23 | 11450 |
| | | | | | | |
| | Total: | 6291 | | | Total: | 244731 |

| Roof Schedule | | | | | | |
|---------------|--------------------------|------------|------------------------|---------------------|-------------------|--------|
| Area | Family and Type | Area value | Structural cost per sf | Roofing cost per sf | Total cost per sf | Price |
| 1895.27 SF | Basic Roof: Roof 1 | 1895 | 6 | 8 | 14 | 26117 |
| 3992.49 SF | Basic Roof: Roof 1 | 3992 | 6 | 8 | 14 | 55017 |
| 352.43 SF | Basic Roof: Roof 1 | 352 | 6 | 8 | 14 | 4856 |
| 352.43 SF | Basic Roof: Roof 1 | 352 | 6 | 8 | 14 | 4856 |
| 1070.67 SF | Basic Roof: Steeple roof | 1071 | 5 | 8 | 12 | 13030 |
| | | | | | | |
| | | | | | Total: | 103876 |

| Structural Column Schedule | | | | |
|----------------------------|---|----------|---------------|-------|
| Cost per ft. | Family and Type | Length | Length in ft. | Price |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 9' - 2" | 9 | 900 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 10' - 0" | 10 | 1000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 10' - 0" | 10 | 1000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 9' - 2" | 9 | 900 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 9' - 2" | 9 | 900 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 20' - 0" | 20 | 2000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 20' - 0" | 20 | 2000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 9' - 2" | 9 | 900 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 20' - 0" | 20 | 2000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 20' - 0" | 20 | 2000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 10' - 0" | 10 | 1000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 30' - 0" | 30 | 3000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 30' - 0" | 30 | 3000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 30' - 0" | 30 | 3000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 30' - 0" | 30 | 3000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 20' - 0" | 20 | 2000 |
| 100 | HSS-Hollow Structural Section-Column: HSS12X12X3/16 | 20' - 0" | 20 | 2000 |
| | | | Total: | 30600 |

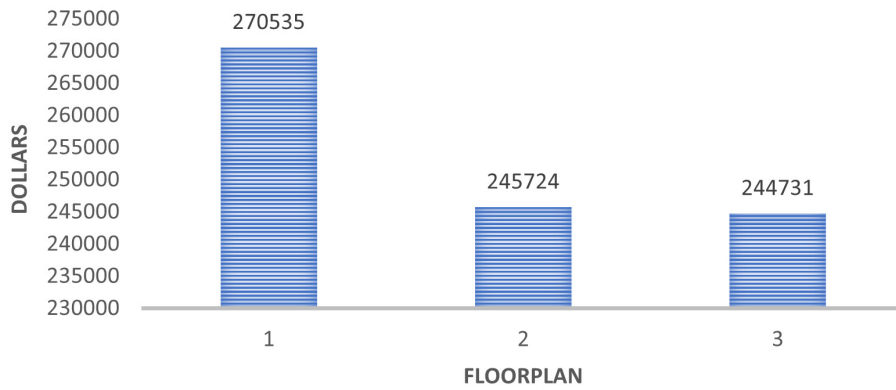
| Structural Framing Schedule - Timber | | | | | Structural Framing Schedule - Steel | |
|--------------------------------------|--|--------|-------|--|-------------------------------------|--------|
| Cost per ft. | Family and Type | Span | Price | | Cost per ft. | Price |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 275 | Howe Gabled Truss-6 Panel: Half Standard | 14 | 3850 | | 600 | 8400 |
| 300 | Scissors Truss-6 Panel: Standard | 28 | 8400 | | 600 | 16800 |
| 300 | Scissors Truss-6 Panel: Standard | 28 | 8400 | | 600 | 16800 |
| 300 | Scissors Truss-6 Panel: Standard | 28 | 8400 | | 600 | 16800 |
| 300 | Scissors Truss-6 Panel: Standard | 28 | 8400 | | 600 | 16800 |
| 300 | Scissors Truss-6 Panel: Standard | 28 | 8400 | | 600 | 16800 |
| 240 | Steel transfer beam W24x70 | 54 | 12960 | | 240 | 12960 |
| | | | | | | |
| | | Total: | 93460 | | Total: | 180960 |



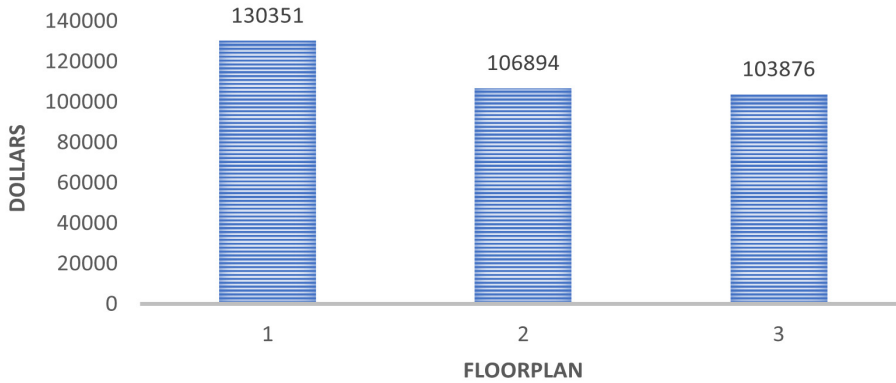
| Wall Schedule | | | | |
|---------------|-------------|--|------------|--------|
| Area | Cost per sf | Family and Type | Area Value | Price |
| 532.62 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 532.62 | 14381 |
| 498.47 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 498.47 | 13459 |
| 288.55 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 288.55 | 7791 |
| 303.65 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 303.65 | 8199 |
| 318.41 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 318.41 | 1592 |
| 318.46 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 318.46 | 1592 |
| 320.01 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 320.01 | 8640 |
| 247.75 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 247.75 | 6689 |
| 876.35 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 876.35 | 4382 |
| 283.46 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 283.46 | 7653 |
| 930.41 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 930.41 | 25121 |
| 271.90 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 271.90 | 7341 |
| 408.55 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 408.55 | 2043 |
| 201.57 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 201.57 | 5442 |
| 266.54 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 266.54 | 7197 |
| 204.10 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 204.10 | 5511 |
| 260.37 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 260.37 | 7030 |
| 14.54 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 14.54 | 73 |
| 18.51 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 18.51 | 93 |
| 156.21 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 156.21 | 781 |
| 149.83 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 149.83 | 749 |
| 119.24 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 119.24 | 3219 |
| 208.96 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 208.96 | 5642 |
| 107.04 SF | 27 | Basic Wall: Exterior - Brick on Mtl. Stud | 107.04 | 2890 |
| 303.69 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 303.69 | 1518 |
| 156.21 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 156.21 | 781 |
| 149.83 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 149.83 | 749 |
| 177.60 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 177.60 | 888 |
| 96.30 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 96.30 | 482 |
| 96.30 SF | 5 | Basic Wall: Interior - 6 1/8" Partition (2-hr) | 96.30 | 482 |
| | | | | |
| | | | Total: | 152409 |



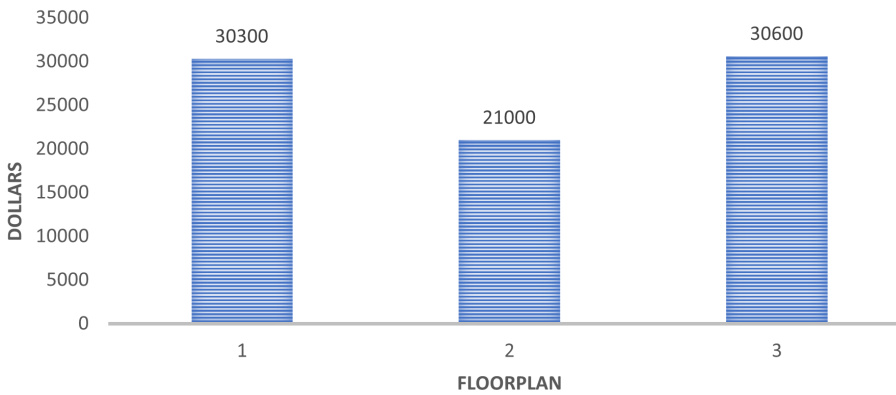
FLOOR STRUCTURE AND FINISHES PRICE



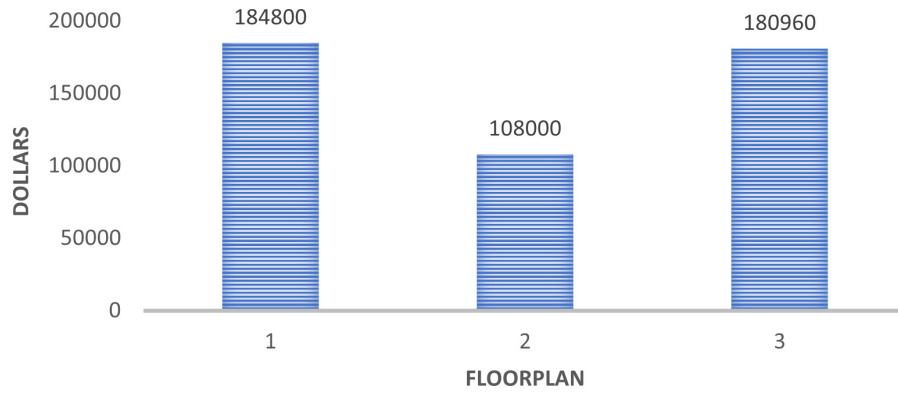
ROOF STRUCTURE AND FINISHES PRICE



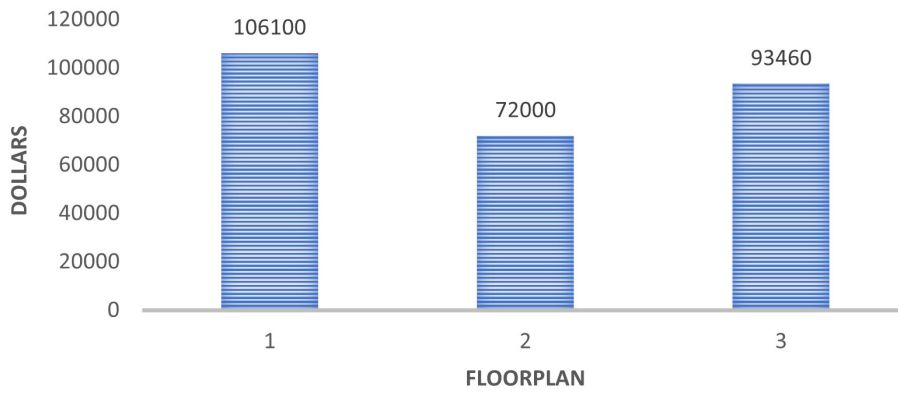
STRUCTURAL COLUMN PRICE



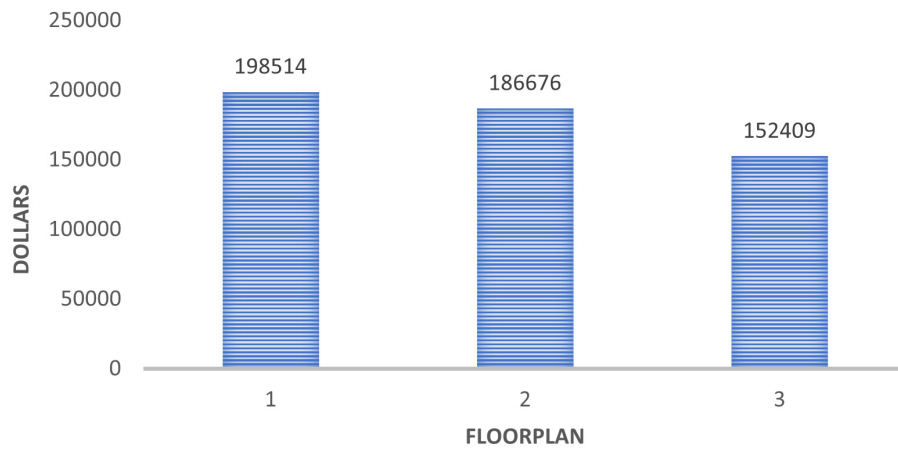
STEEL STRUCTURAL FRAMING COST



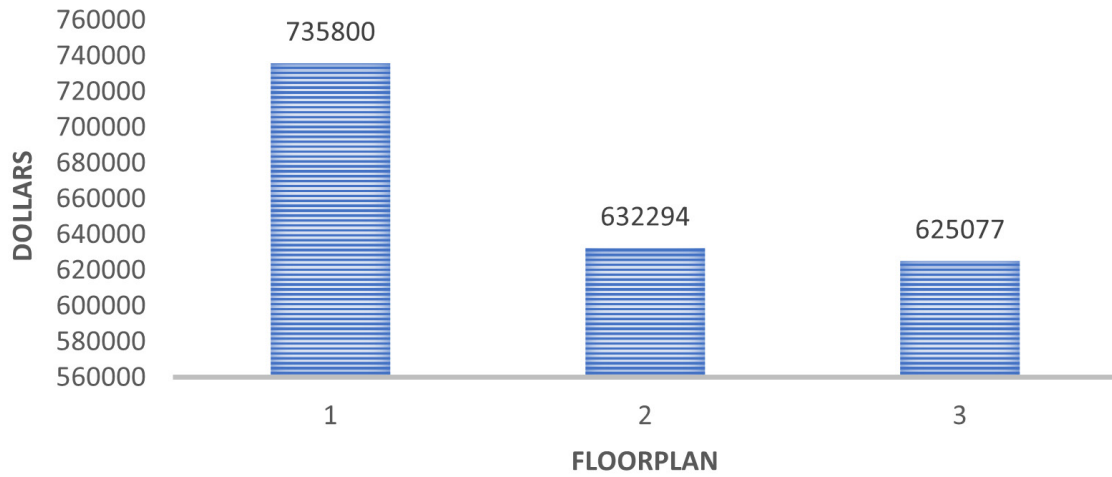
TIMBER STRUCTURAL FRAMING COST



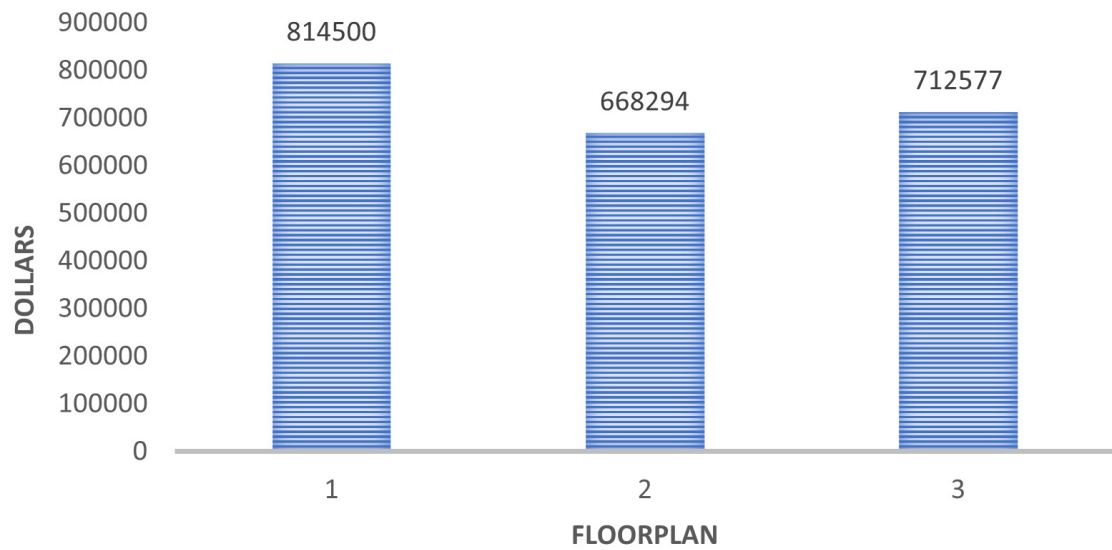
WALLS COST



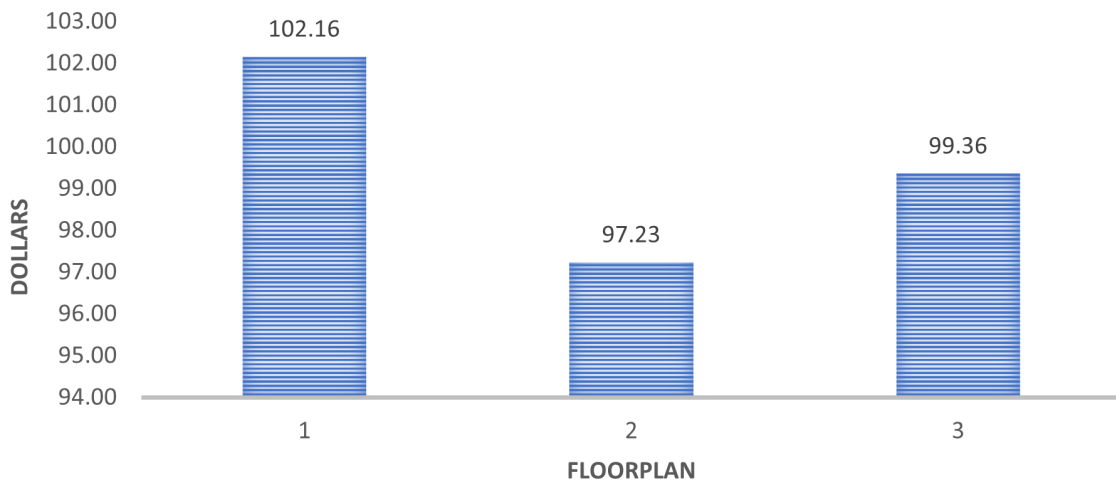
TOTAL COMBINED COST - TIMBER



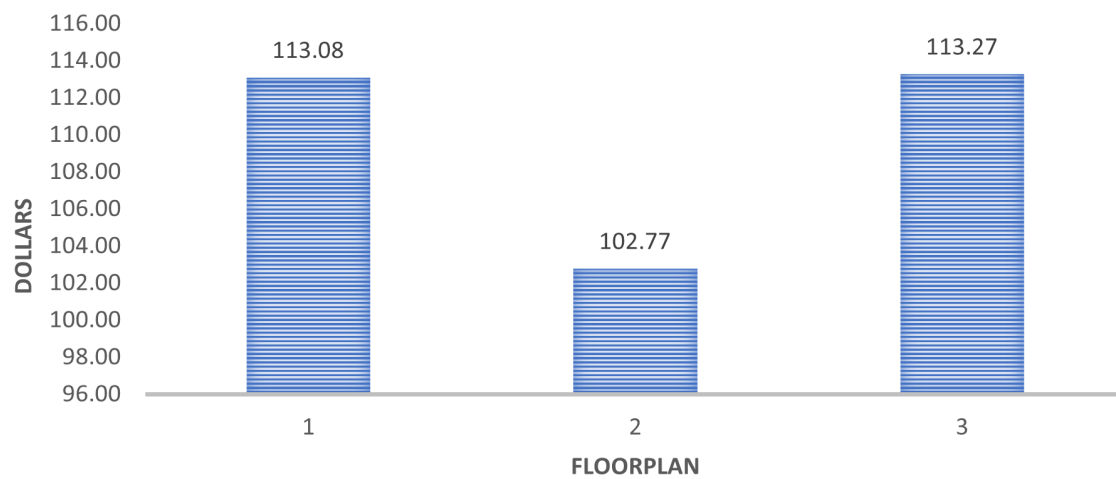
TOTAL COMBINED COST - STEEL



COST PER SQ FT - TIMBER



COST PER SQ FT - STEEL

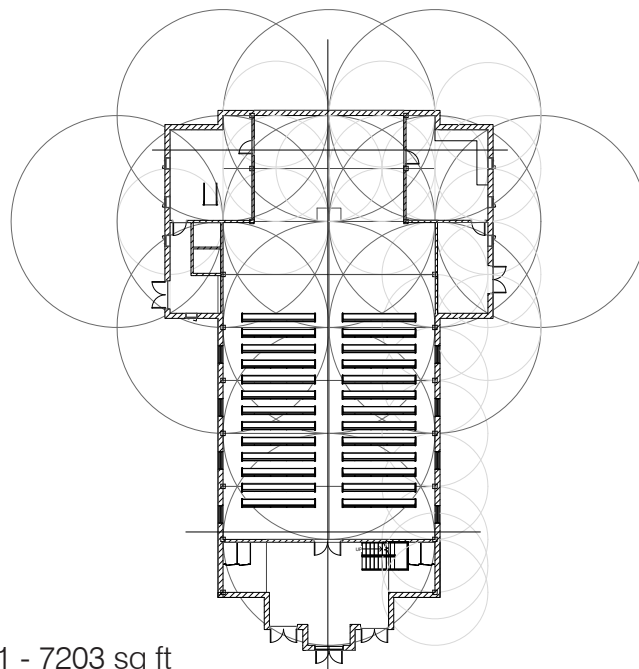


ANALYSIS

After reviewing the data that was collected in this research, it is clear that the shape of the floorplan has significant effects on the building costs of a church building. Each form has different spatial layouts, material considerations, and structural needs. Using the collected data, floorplan 2 would be most affordable to construct, with an estimated cost per square foot of \$97 with a heavy timber structure and \$103 with a steel structure. Floorplan 1 had the highest estimated cost per square foot with the timber structure, at \$102, which is 5% higher. Floorplan 3 had the smallest floor area, at 6291 square feet, but had an estimated cost of \$99 per square foot with the timber structure and was the most expensive per square foot with the steel structure, at \$113. Overall, using a steel structure for the roof system would cost between 6-14% more per square foot than using a heavy timber structure.

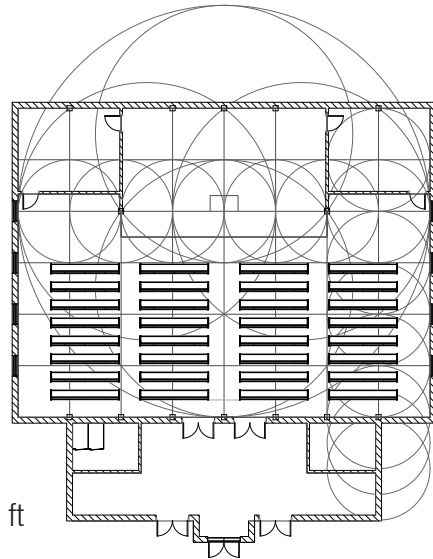
While each building form can be reduced to a number for easy cost comparison, the liturgical appropriateness and potential for beauty of each must also be considered.

In the first floorplan, the Latin cross shape creates a long nave leading forward to the sanctuary, representing the journey from the outer world into the holiness of house of God. The focus of the architecture is on the sanctuary, and the congregation faces the same way during Mass, emphasizing the importance of the altar and the tabernacle.



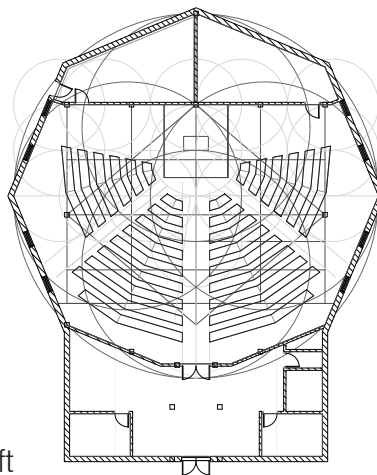
FLOORPLAN 1 - 7203 sq ft

The rectilinear second floorplan is the most cost effective design, however it does not provide the same liturgical focus that the first floorplan offers. While the altar and tabernacle are on the central axis of the space, the nave does not embody the metaphor of the spiritual journey. The pews are all facing the same way, but the outer rows are directed towards blank walls, rather than the sanctuary, distracting from the central purpose of the space as a place for the faithful to encounter God. Ultimately, this form is largely devoid of spiritual symbolism and potential to enhance the liturgy.



FLOORPLAN 2 - 6503 sq ft

In the third floorplan, the octagonal shape calls to mind the traditional 8-sided shape of Catholic baptistries. The arrangement of the floorplan brings the sanctuary and altar to the center, with the nave and pews in close proximity. While this allows the people to be closer physically to the liturgy, it also shifts the focus of the space from emphasizing the sacredness of the sanctuary to creating a more theatrical approach to liturgy. The distinction between the Mass as a divine sacrifice and the Mass as only a gathering of God's people is diminished, limiting the liturgical efficacy of this form.



FLOORPLAN 3 - 6291 sq ft

CONCLUSION

Building a new church is a long, intensive process that relies on the creative input and financial support of many people in a parish. Striking a balance between beautiful design and cost efficiency will always be a challenge for new sacred architecture projects, but the underlying goal should always be to create a worthy space for God to dwell amongst His people. Finding an affordable way to construct such a space will allow many more people to enter into the liturgy in beautiful churches. This can be achieved through many methods, with different building forms, structural types, and materials. Each design choice has the potential to help create a transcendent place to celebrate the liturgy, a place that serves as a physical icon of the beauty of the Catholic faith.



ST. MICHAEL THE ARCHANGEL CATHOLIC CHURCH, PAWCATUCK, CT

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