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Subject: All Pilgrims Church, Seismic Evaluation/Upgrade

Parie,

The following report presents a summary of our observations and recommendations regarding the Seismic Evaluation/Upgrade of All Pilgrims Church located in Seattle, Washington.

Introduction

All Pilgrims Church is an active church located at the corner of Broadway and Republican in the Capitol Hill neighborhood of Seattle. Originally constructed in 1906, the church underwent a major addition in 1928 and numerous tenant improvement projects in subsequent years. The church has roughly 27,000 square feet of occupied space. It is currently being used for religious assembly, administrative purposes and limited evening uses. The church does not house any full time child or adult care programs. A formal change of occupancy is not expected at this time.

As part of ongoing long range planning, the church retained P.A. Opsahl Structural Engineers (PAO) to develop a plan for structural and seismic improvements. The first step in developing seismic improvements is to perform a limited seismic evaluation of the facility. M.A. Wright, llc, as a subconsultant to PAO, conducted this seismic evaluation.

It is important to note that as long as the code occupancy of the facility does not change and any improvements are limited to ongoing maintenance and typical tenant improvements, the City of Seattle most likely will not require a mandatory seismic upgrade. This is important, as any seismic improvements will be classified as voluntary, which will allow the Church to set the seismic performance objective to one that meets their performance goals and budget limitations. If, however, the City considers the improvements to significantly extend the economic lifetime of the facility, the improvements would be considered a significant alteration and hence trigger the mandatory seismic upgrade requirements. Typically the City considers replacement of the major mechanical, plumbing and electrical systems as extending the economic lifetime of the building.

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The seismic evaluation was limited to touring the facility, reviewing the available documentation and making recommendations based our experience with seismic retrofits of similar structures. Our recommendations focused on cost effective improvements that will enhance the seismic performance of the facility as opposed to bringing the facility up to a life safety standard. This is discussed in more detail in the Seismic Evaluation Methodology section.

Scope of Work and Limitations

This report represents our opinions based on our on-site observations and our review of the limited original construction documents. The documents available for review included: incomplete structural drawings from the 1929 addition by Schack, Young, and Myers, 1952 bell tower modifications by Lamont Fey and 2001 earthquake repair sketches by IL Gross.

Engineering judgment based on experience with similar structures was used in determining the structural characteristics of the building. No in-situ testing or destructive probing of the existing structure was performed.

Investigation of the non-structural components, such as interior partitions, architectural finishes, decorative façades, etc. was not part of the scope of work.

Formal design of a seismic upgrade is not part of this effort and would be required if the owner desires to go forward.

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This evaluation does not represent a warranty or guarantee on the part of M.A. Wright, llc that other problems, such as material decay, do not exist. M.A. Wright, llc professional services are performed using the degree of skill and care ordinarily exercised under similar circumstances by structural engineers practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional opinions contained in this report.

Description, Condition, and Past Seismic Performance

The church can be divided into five distinct areas consisting of: the original 1906 sanctuary and adjoining chapel, the 1906 bell tower, the 1906 courtyard entryway, the 1928 fellowship hall and the 1928 classroom wing. Figure 1 shows the building plan layout. Existing conditions at each level are shown in Figures 2 through 5.

1906 Sanctuary and Chapel

The sanctuary and area now occupied by the chapel were constructed in 1906. The sanctuary is laid out in a Latin Cross plan of approximately 4500 square feet; the adjoining two-story chapel is approximately 21 ft by 40 ft in plan. Overall height to the peak of the gable roof is roughly 40 feet. There are exposed masonry gable end walls on the south and west sides of the building that extends above the roofline. The north side contains a smaller gable end wall due to the configuration of the altar area. The east gable end wall originally abutted an adjacent building and is now incorporated into the roof/attic of the 1928 addition. See Photos 1 and 2.

The sanctuary and chapel are best described as masonry bearing wall structures with flexible wood roof and floor diaphragms. The gable roof structure consists most likely of tongue and groove decking spanning to timber beams which in turn are supported by clear span heavy timber trusses that bear directly on the exterior bearing walls. The trusses are laid out uniquely at the center of the sanctuary as they span in the diagonal direction as opposed to perpendicular. See Photo 3. The south and west entry and the north altar area are most likely ship lap decking on 2x joists spanning to either wood beams or bearing walls.

The chapel was originally a two story classroom space with 2x floor joists and hardwood flooring. The altar area appears to be 2x over framing above the sanctuary floor. The first floor framing is most likely hardwood over decking supported by 2x joists spanning to either wood beams or bearing walls. There is a built up steel beam located at the centerline of the sanctuary floor supported by steel columns that allows for the large open space in the basement level hall below. The basement floor is concrete slab on grade and the foundations appear to be conventional spread and strip footings.

The exterior walls of the structure consist of varying thicknesses of unreinforced clay brick and partial height concrete walls at the basement. The interior partition walls consist of wood stud framing with lath and plaster covering.

The sanctuary and chapel are in fair to good structural condition. The floors appear reasonably level. There are signs of water infiltration at various locations on the exterior walls. This most likely will lead to the discovery of wood rot at the roof deck that would most likely be repaired at the next re-roof. The amount of rot is difficult to determine without removing the roofing. The repair will most likely consist of replacement in-kind.

The entry area at the southwest corner of the sanctuary appears to have settled, as the floor is sloped in this area and there is cracking in the brick exterior. At this time the settlement is more a of a nuisance issue requiring repair of finishes. If the church desires, the settlement could be minimized by underpinning the exterior wall with helical or pin piles attached to the concrete footing.

To the best of our knowledge this portion of the church performed adequately in the 1949 Olympia and 1965 SeaTac earthquakes. The 2001 repair documents by IL Gross show some damage from the 2001 Nisqually earthquake where the roof beams frame into the exterior west wall above the original west entrance. The repair consisted of adding anchors to the beam at the wall and adjacent truss connections.

1906 Bell Tower

The bell tower attached to the southwest corner of the sanctuary is approximately 18 ft by 18 ft in plan with an overall height of 55 ft.

The bell tower is a brick masonry bearing wall structure with four levels of horizontal wood diaphragms resisting lateral loads. The original construction of the bell tower included a masonry cupola structure approximately 20 ft in height that was significantly damaged in the 1949 Olympia earthquake. The cupola as well as most upper exterior ornamental parapets and cornices were subsequently removed. At some point the entrance through the tower changed from the south side to the west side. The tower rests on concrete foundation walls. See Photos 1 and 2.

In 1995 the bell tower underwent a voluntary seismic upgrade which consisted primarily of wall anchors at the intermediate floors and a new sloped roof. Given the age and extent of the upgrade, it is our opinion that it does not meet current seismic upgrade standards and would most likely be classified as a minimum bolts-plus type seismic enhancement (see seismic evaluation methodology section for definition). The 1995 improvements could be incorporated into a full life safety upgrade if the church chooses that option.

While we did not observe the interior condition of the bell tower, the exterior appears to be relatively free of cracks. Some signs of water infiltration were observed through the foundation walls in the basement below the tower. In general the bell tower appears to be in good to excellent condition with no obvious signs of settlement or structural distress.

As noted above, the upper portion of the bell tower was damaged in the 1949 Olympia earthquake. To the best of our knowledge there was no damage from either the 1965 SeaTac or 2001 Nisqually earthquakes.

1906 Courtyard Entryway

Also included in the original 1906 structure is a small courtyard entryway structure adjacent to the south side of the chapel between the 1906 sanctuary and 1928 fellowship hall. It is approximately 30 ft by 8 ft and consists of unreinforced brick entryway arches and wood trellis over brick paving. See Photo 4.

The courtyard entryway area shows signs of ongoing soil settlement. The courtyard entryway structure appears to be in poor to fair structural condition.

To the best of our knowledge this portion of the church performed adequately in the 1949 Olympia, 1965 SeaTac and 2001 Nisqually earthquakes.

1928 Fellowship Hall

The 1928 fellowship hall is located east of the 1906 sanctuary and consists of a large two story open area with an attached two story east wing. The second story of the attached east wing serves as a balcony overlooking the hall. There is another small lighting balcony on the south side of the hall. The fellowship hall is approximately 40 ft by 70 ft in plan with the adjoining two-story east wing approximately 10 ft by 70 ft in plan. The structure is best described as a light wood framed structure with flexible wood roof and floor diaphragms.

The overall height to the peak of the fellowship hall gable roof is roughly 40 feet. The fellowship hall's gable roof structure consists of OSB on skip sheathing supported by 2x rafters on wood beams spanning to custom steel trusses. The trusses span the width of the two story hall and are in turn supported by steel columns embedded in the wood framed walls. The barrel shaped plaster ceiling is suspended from the trusses. The steel columns are supported by a concrete foundation wall on the west side and by a concrete beam on the east side located between the fellowship hall and the attached east wing. The floor consists of hardwood over diagonal sheathing supported by 2x joists spanning to wood beams and columns or directly to the foundation walls. There is a large open unfinished basement crawl space below the hall with approximately 7 feet of headroom. The perimeter walls of the crawl space have infilled windows. The foundations appear to be conventional concrete spread and strip footings. See Photos 5 and 6.

The east wing attachment has a flat roof approximately 25 feet in height. The roof structure consists of OSB on skip sheathing supported by 2x joists spanning to a wood beam on the west side and to a bearing wall on the east side. The upper floor of the east wing consists of hardwood over diagonal sheathing supported by 2x joists spanning to wood beams and columns or to bearing walls. The lower floor of the east wing is an elevated concrete slab spanning from a concrete beam on the west side to the exterior concrete wall on the east side. There is a shared large open unfinished basement crawl space below. The foundations appear to be conventional concrete spread and strip footings.

The exterior walls of the structure consist of wood studs and sheathing with brick veneer. The basement level consists of concrete exterior walls with stucco and plaster above grade. The interior partition walls consist of wood stud framing with lath and plaster covering. Fire separation walls at various locations are double tongue and groove.

The fellowship hall is in good to excellent structural condition. There are no obvious signs of settlement or earthquake damage. The crawl space was moist and appears to lack ventilation which is most likely related to the infilled windows. Deterioration of the brick veneer mortar was observed at the southwest corner. This should be re-pointed as part of an ongoing exterior maintenance program.

To the best of our knowledge this portion of the church performed adequately in the 1949 Olympia, 1965 SeaTac and 2001 Nisqually earthquakes.

<u>1928 Classroom Wing</u>

The 1928 classroom wing is a two story structure with a full basement approximately 41 ft by 90 ft in plan. It is attached to the north side of the fellowship hall and 1906 sanctuary. The overall height to the peak of the shared gable roof is roughly 40 feet.

Similar to the fellowship hall, the classroom wing is best described as a light wood framed structure with flexible roof and floor diaphragms. The gable roof structure consists of OSB on skip sheathing supported by 2x rafters spanning to walls below.

The first and second floors appear to be hardwood on diagonal sheathing supported by 2x joists spanning to interior or exterior bearing walls. The basement floor is slab on grade and the foundations appear to be conventional spread and strip footings.

The exterior walls consist of wood studs and sheathing with brick veneer. The basement level consists of concrete exterior walls with stucco and plaster above grade. The interior bearing and partition walls consist of wood stud framing with lath and plaster. The only exceptions are the concrete walls surrounding the basement boiler room, the 2x laminate walls enclosing the two stairways, and the double tongue and groove fire separation walls. See Photos 7 and 8.

The classroom wing is in good to excellent structural condition. There are no obvious signs of settlement or earthquake damage.

To the best of our knowledge this portion of the church performed adequately in the 1949 Olympia, 1965 SeaTac and 2001 Nisqually earthquakes.

Seismic Evaluation Methodology

The first step in performing a seismic evaluation is to determine the seismic performance objective. The seismic performance objective defines the level of damage the facility undergoes during a specific earthquake. For new construction and mandatory seismic upgrades in the City of Seattle, the seismic performance objective is life safety under an earthquake with a 475 year return period. For comparison purposes the earthquakes in 1949, 1965 and 2001 had a return period of 25-50 years. Life safety performance means the damage will be such that there are no life-threatening injuries. It does not mean the facility will be economically viable to repair or continued use.

Typical life safety upgrades in a building such as All Pilgrims Church involve the installation of numerous concrete shear walls or steel braced frames as well as improvements to the connection of the floor and roof to the load bearing walls.

Enhanced seismic performance is typically reserved for historic structures or buildings with economic limitations. It is the standard most typically used in Seattle for voluntary upgrades of older historic structures with economic limitations. The goal of the upgrades is to minimize life threatening damage such as preventing portions of brick walls from falling off the building onto public pedestrian walkways. Another way of describing this is the improvements activate the full existing strength of the structure but do not increase the strength like a typical life safety upgrade. Some people refer to these types of upgrades as a “Bolts Plus” upgrade since the improvements typically take on the form of improving the attachment of floors and roofs to load bearing walls (wall anchor bolts) and bracing parapets and chimneys (plus).

For this evaluation we focused on enhanced seismic performance improvements. Our approach involved touring the facility, reviewing the available documentation, and limited probing to determine the age, style of construction and general structural condition. Then using our past experience with similar structures along with resources such as ASCE 31-03 *Seismic Evaluation of Existing Structures* and ASCE 41-06 *Seismic Rehabilitation of Existing Structures* we developed schematic cost effective improvements that enhance the seismic performance. No structural analysis was performed to determine the extent of new lateral elements (such as concrete shear walls or steel braced frames) that would be required for a full life safety upgrade.

Probable Seismic Performance As-Built Condition

Based on our limited observations, document review, and previous experience with similar structures, as well as the documented performance in the 1949, 1965 and 2001 earthquakes, we offer the following qualitative opinions regarding the probable seismic performance of the church in it's as built condition (without any seismic upgrades) during a code level earthquake.

It is important to note that while the building performed reasonably well (with the exception of damage to the bell tower cupola in the 1949 earthquake and the west entry in the 2001 earthquake) in the 1949, 1965 and 2001 earthquakes, none of these events produced the level of ground shaking the current codes specify for seismic evaluation or new design. In fact, the ground motions at the site were roughly 1/3 of that currently predicted for a 475 year return event. This is mainly due to the distance of the site from the earthquake epicenters.

<u>1906 Sanctuary and Chapel</u>

The 1906 sanctuary and chapel portion of the church is an unreinforced masonry (URM) bearing wall structure with flexible roof and floor diaphragms. Previous earthquakes have shown that without a seismic upgrade, this type of building performs poorly in large earthquakes. This portion of the church is particularly susceptible due to the fact that the walls are thin relative to their height and poorly connected to the roof and floor. This causes the walls to become susceptible to falling away out-of-plane, which may lead to localized or total collapse of the roof and floor, creating a life safety issue. Additionally, the heavy timber trusses that bear directly on the four corners of the exterior unreinforced masonry walls further increases the potential risk of roof collapse due to the concentration of roof loads in this relatively weak area.

<u>1906 Bell Tower</u>

The bell tower is a URM bearing wall structure with flexible diaphragms. Damage from the 1949 Olympia earthquake lead to the removal of the cupola (which supported the bells) as well as most of the upper exterior ornamental parapets and cornices. We are not aware of any damage from the 1965 event. In 1995 the bell tower underwent a seismic upgrade. This upgrade can be described in today's terms as an enhanced performance upgrade similar to a "Bolts Plus" upgrade described in the methodology section. To the best of our knowledge the bell tower performed adequately in the 2001 Nisqually earthquake.

In the event of a large code level earthquake, the main concern with the bell tower is having unanchored brick veneer courses fall above the primary exits. This is a life safety issue as the majority of injuries in a major earthquake caused by this type of structure result from falling debris along public pedestrian walkways. A structural collapse of the bell tower is unlikely due to the geometry and amount of solid walls at its base; however, there would most likely be significant cracking of the masonry piers.

1906 Courtyard Entryway

The courtyard entryway is a URM bearing wall structure with no diaphragm. It is in poor condition and would most likely collapse in the event of a large earthquake. Although the courtyard appears to be a seldom used area, the structure poses a potential hazard of collapse onto the public pedestrian walkway nearby.

1928 Fellowship Hall

The fellowship hall is a combination of steel trusses supported by steel columns surrounded by conventional wood stud construction with masonry veneer. There are numerous openings around the perimeter of this portion of the church. The exterior walls consist of plaster on studs with horizontal wood sheathing behind the brick veneer. The exterior walls along with the roof and floor diaphragms form the earthquake resisting system.

This portion of the church is probably the most susceptible to damage during the event of a large earthquake due to the low stiffness and seismic strength of the walls in conjunction with the relatively heavy veneer system.

In the event of a large earthquake, the steel columns supporting the steel roof trusses will most likely protect the main hall from collapse. The surrounding wood stud construction will likely experience large lateral deflections which may cause unanchored brick veneer to fall as well as produce significant damage to the interior finishes. The south gable end wall is very tall and slender making it susceptible to shedding unanchored brick veneer onto public pedestrian walkways below, which is a life safety issue.

The fellowship hall is also poorly attached to its foundation and may slide horizontally off the basement walls in the event of a major earthquake. This may lead to broken gas lines and subsequent fires which in past earthquakes have been more of a life safety issue then damage from the structure itself.

1928 Classroom Wing

The classroom wing is a wood stud bearing wall structure with masonry veneer. It is poorly attached to its foundation and has two gable end walls that are tall and slender. In the event of a large earthquake, the classroom wing would likely perform better than the fellowship hall; however there may still be significant damage to interior finishes and shedding of unanchored brick veneer from the gable end walls. The tall narrow chimney above the flat roof would likely collapse onto the roof, potentially penetrating the roof structure. Movement of the structure off its foundation could lead to localized failure and broken gas lines which may cause fires.

Ranking each area of the church relative to the others in order of highest risk to lowest may be helpful in deciding how to proceed with a seismic upgrade. Our qualitative ranking would be as follows:

1. 1906 Courtyard Entry
2. 1906 Sanctuary
3. 1928 Fellowship Hall
4. 1928 Classroom Wing
5. 1906 Bell Tower

Enhanced Performance Seismic Upgrade Recommendations

The first step in any seismic upgrade would be to perform the upgrades related to the enhanced seismic performance objective. These upgrades would be designed to meet the requirements of a full life safety upgrade so that they would not need to be redone when a full life safety upgrade is performed. Another way of stating this is the enhanced performance upgrade would serve as the starting point of the full life safety upgrade.

Based on our limited observations, document review, and previous experience with similar structures, our seismic upgrade recommendations for enhanced seismic performance are as follows.

<u>1906 Sanctuary and Chapel</u>

1. Remove roofing to add ½" plywood/OSB sheathing and replace roofing.

2. Install new in-plane anchors at the roof.

3. Install new out-of-plane anchors at the roof.

4. Install new truss to beam connections.

5. Provide additional column shoring consisting of thru-bolted exterior and interior steel plates at four (4) main truss bearing locations. See Figure 3-A.

6. Inspect for rot damage to wood beams and roofing near location of walls showing signs of water infiltration.

7. Install new in-plane anchors at the floor.

8. Install new out-of-plane anchors at the floor.

9. Provide continuity ties at girder to column connections at the first floor.

10. Verify brick veneer anchorage above all primary exit locations.

1906 Bell Tower

1. Verify brick veneer anchorage above primary exit location.

2. Inspect the interior of the bell tower for signs of earthquake damage or water infiltration and rot.

1906 Courtyard Entryway

1. Consider removal of the entry archway damaged from ongoing settlement and weathering.

2. If removal is not a reasonable option, repair both the wood roof and masonry arches and columns to restore the entryway to its original condition.

1928 Fellowship Hall

1. Install cold form stud framing with plywood sheathing “strong backs” at inside face of south gable end wall between the roof and lighting balcony level.

2. Verify brick veneer anchorage at gable end wall.

3. Verify brick veneer anchorage above all primary exit locations.

4. Install new out-of-plane anchors at south balcony to gable end wall connection.

5. Provide continuity ties at girder to column connections at the first floor.

6. Provide additional sill plate anchor bolts at top of concrete foundation walls.

1928 Classroom Wing

1. Infill skylights located at the flat roof with wood joists and sheathing.

2. Provide additional bracing at existing brick masonry chimney at the flat roof.

3. Install ½” plywood at inside face of north and east gable end walls in the attic.

4. Verify brick veneer anchorage at gable end walls.

5. Verify brick veneer anchorage above all primary exit locations.

6. Provide additional sill plate anchor bolts at top of concrete foundation walls.

7. Provide flexible attachments to boiler connection and gas lines.

The proposed seismic upgrades are shown as in red on Figures 2 through 5.

Based on our limited analysis we would estimate this upgrade to have a construction cost in the range of $150,000 to $250,000.

Life Safety Seismic Upgrade Recommendations

1906 Sanctuary and Chapel

Includes all the upgrades listed in the enhanced performance upgrade as well as concrete walls or steel braced frames on each of the four sides of the sanctuary. The new walls or frames will most likely require new foundation elements.

1906 Bell Tower

Includes all the upgrades listed in the enhanced performance upgrade as well as concrete walls or steel moment frames at the first floor in the area of the doors and windows. The attachment of the intermediate floor would most likely also need to be upgraded to current standards.

1906 Courtyard Entryway

Complete disassembly of the masonry structure, to be rebuilt with new steel frame core covered with the original brick, which would act as a veneer. This will also require significant foundation work.

1928 Fellowship Hall

Includes all the upgrades listed in the enhanced performance upgrade, and removal of the majority of the interior plaster finishes, allowing new plywood shearwalls to be installed.

1928 Classroom Wing

Includes all the upgrades listed in the enhanced performance upgrade, and removal of the majority of the interior plaster finishes, allowing new plywood shearwalls to be installed.

Based on our limited analysis, we would estimate this upgrade to have a construction cost in the range of $1,000,000 to $1,500,000.

If you have any questions please do not hesitate to contact me.

Best regards,

Michael A. Wright, SE
Structural Engineer

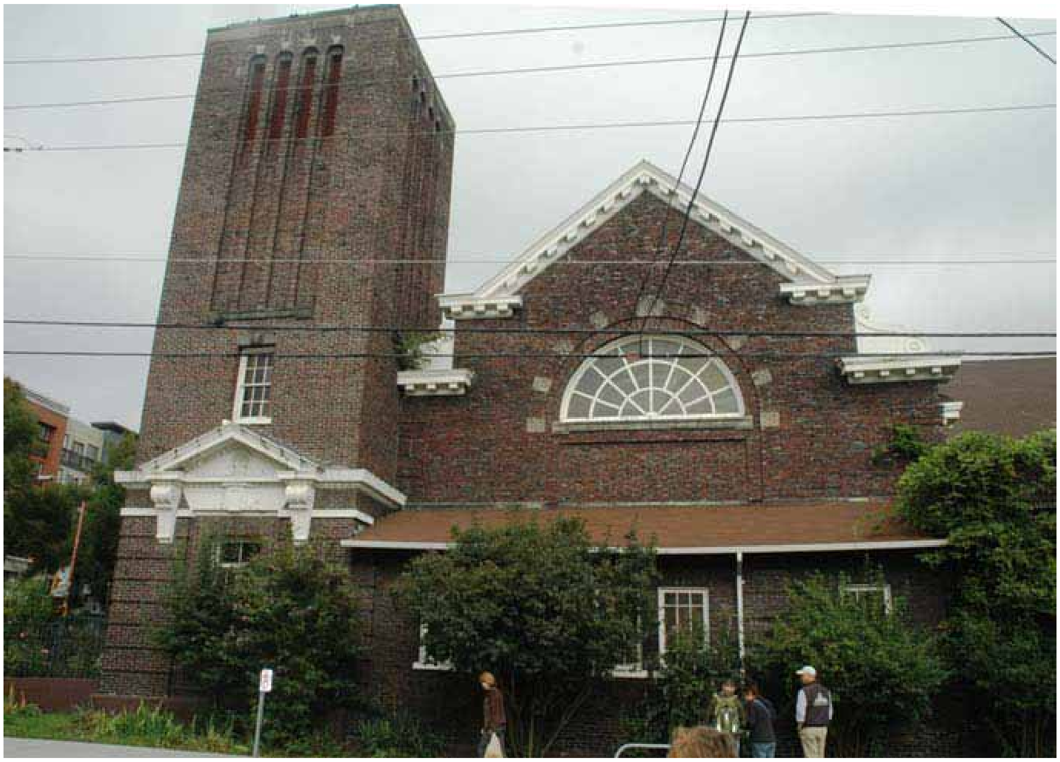

Photo 1: 1906 Sanctuary and Bell Tower – South Elevation

Property of Museum of History & Industry, Seattle

Photo 2: 1906 Bell Tower with Original Cupola – Southwest Elevation

Photo 3: 1906 Sanctuary – Roof Framing

Photo 4: 1906 Courtyard Entryway – South Elevation

Photo 5: 1928 Addition Fellowship Hall – Southeast Elevation

Photo 6: 1928 Fellowship Hall – Roof Framing

Photo 7: 1928 Addition Classrooms – North Elevation

Photo 8: 1928 Classroom Wing – Roof Framing

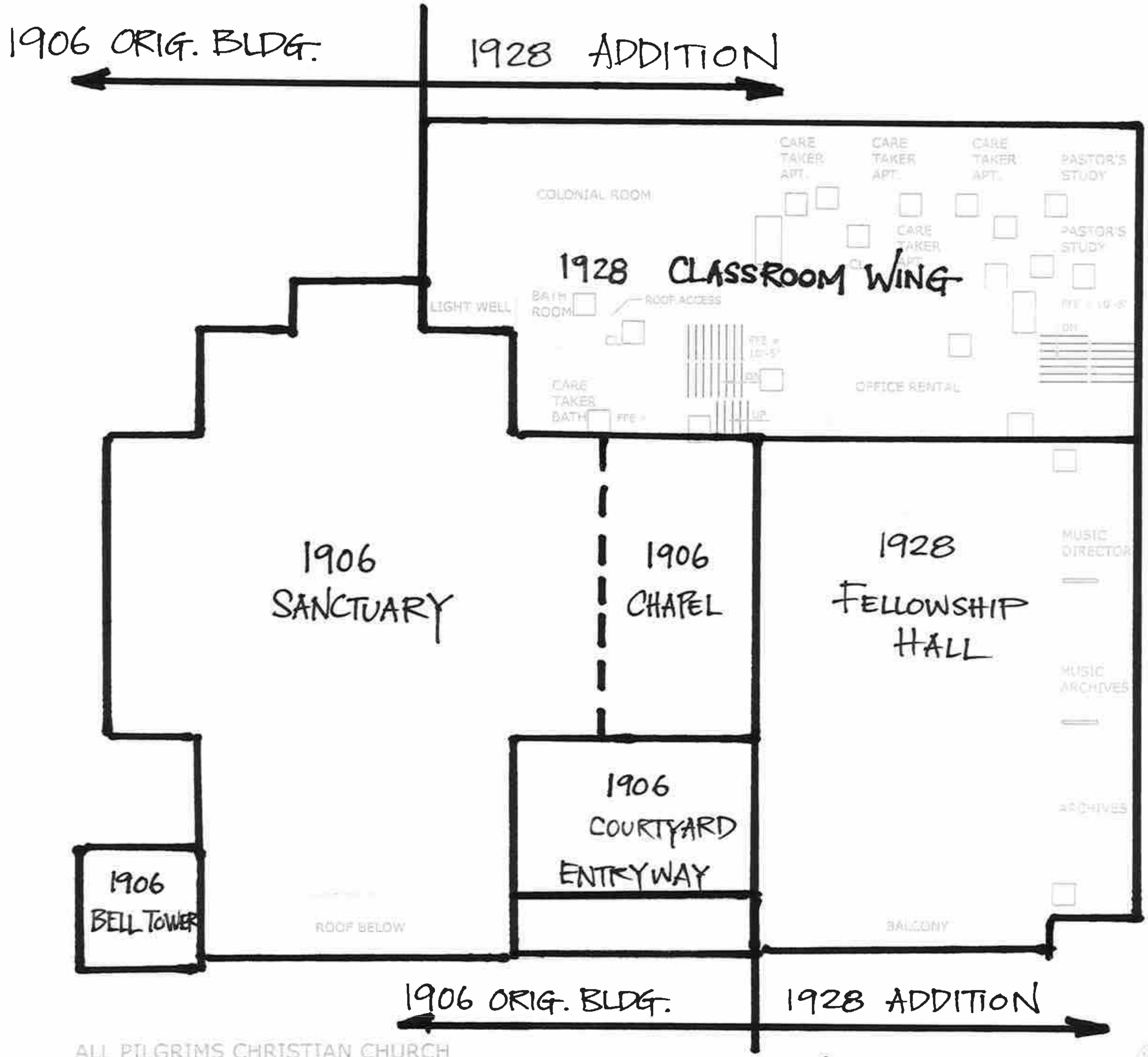

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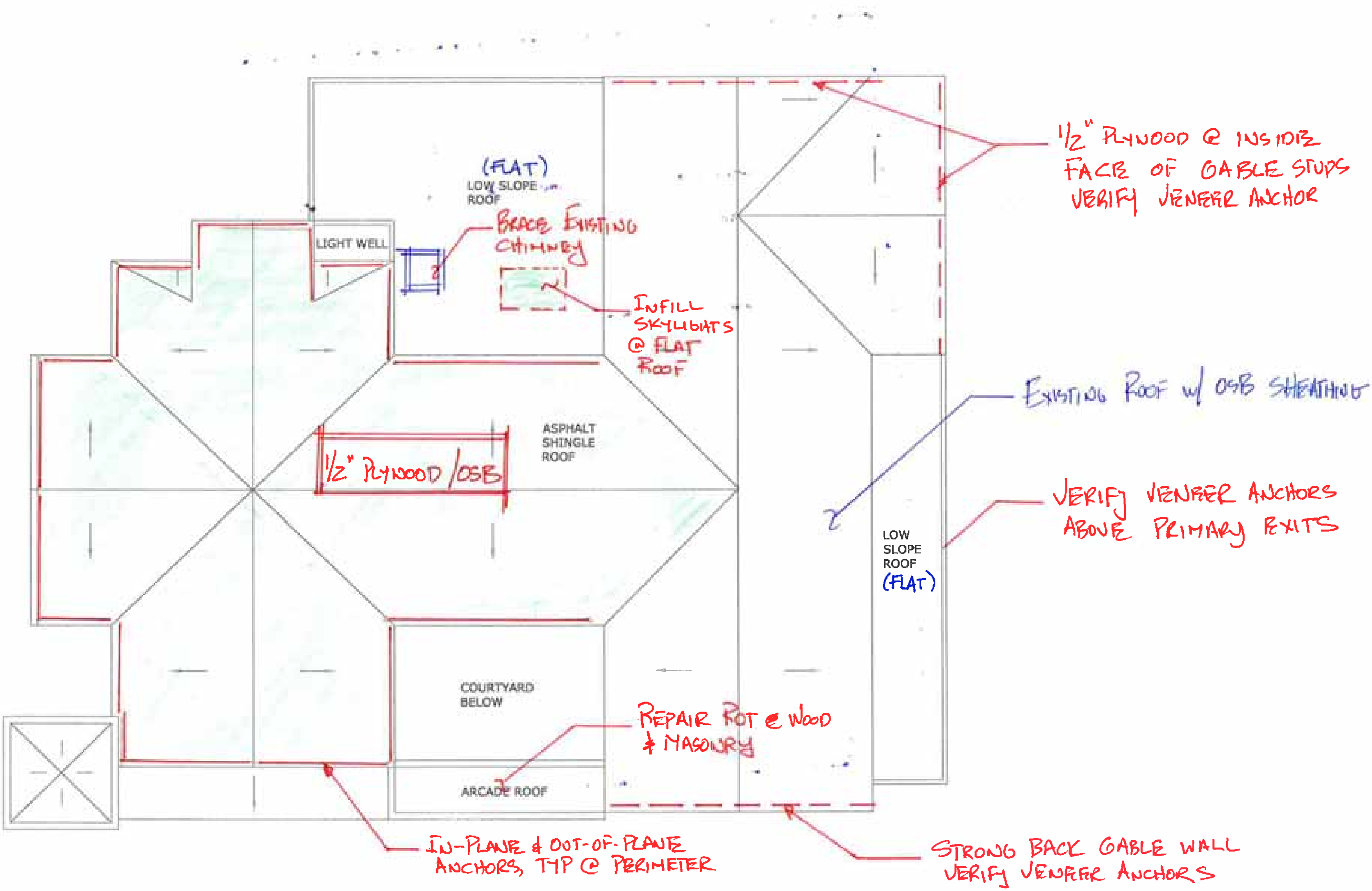
FIGURE 1 BUILDING PLAN LAYOUT



ALL PILGRIMS CHRISTIAN CHURCH ROOF PLAN

FIGURE 2

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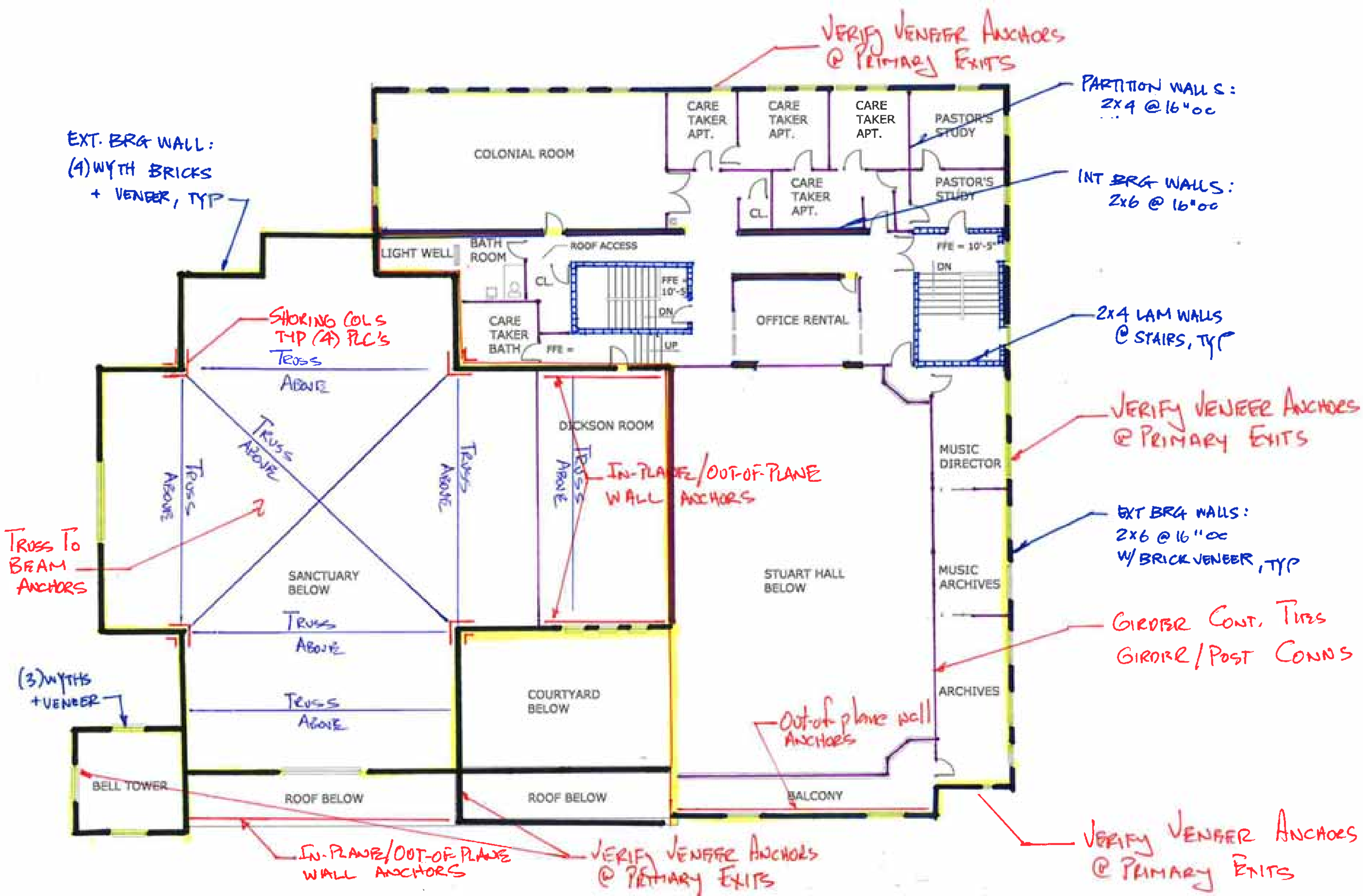

ALL PILGRIMS CHRISTIAN CHURCH SECOND FLOOR

FIGURE 3

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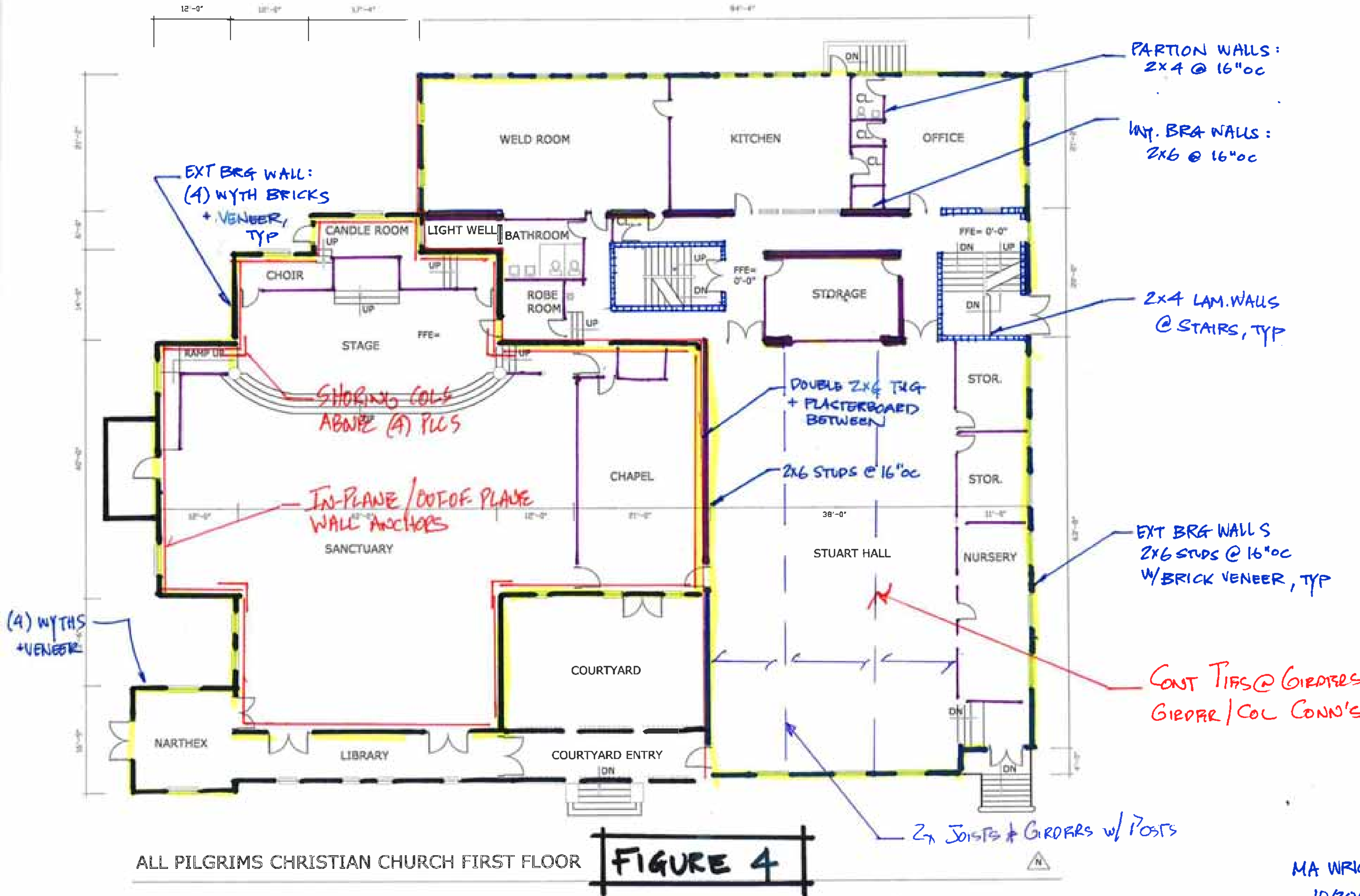

ALL PILGRIMS CHRISTIAN CHURCH FIRST FLOOR

FIGURE 4

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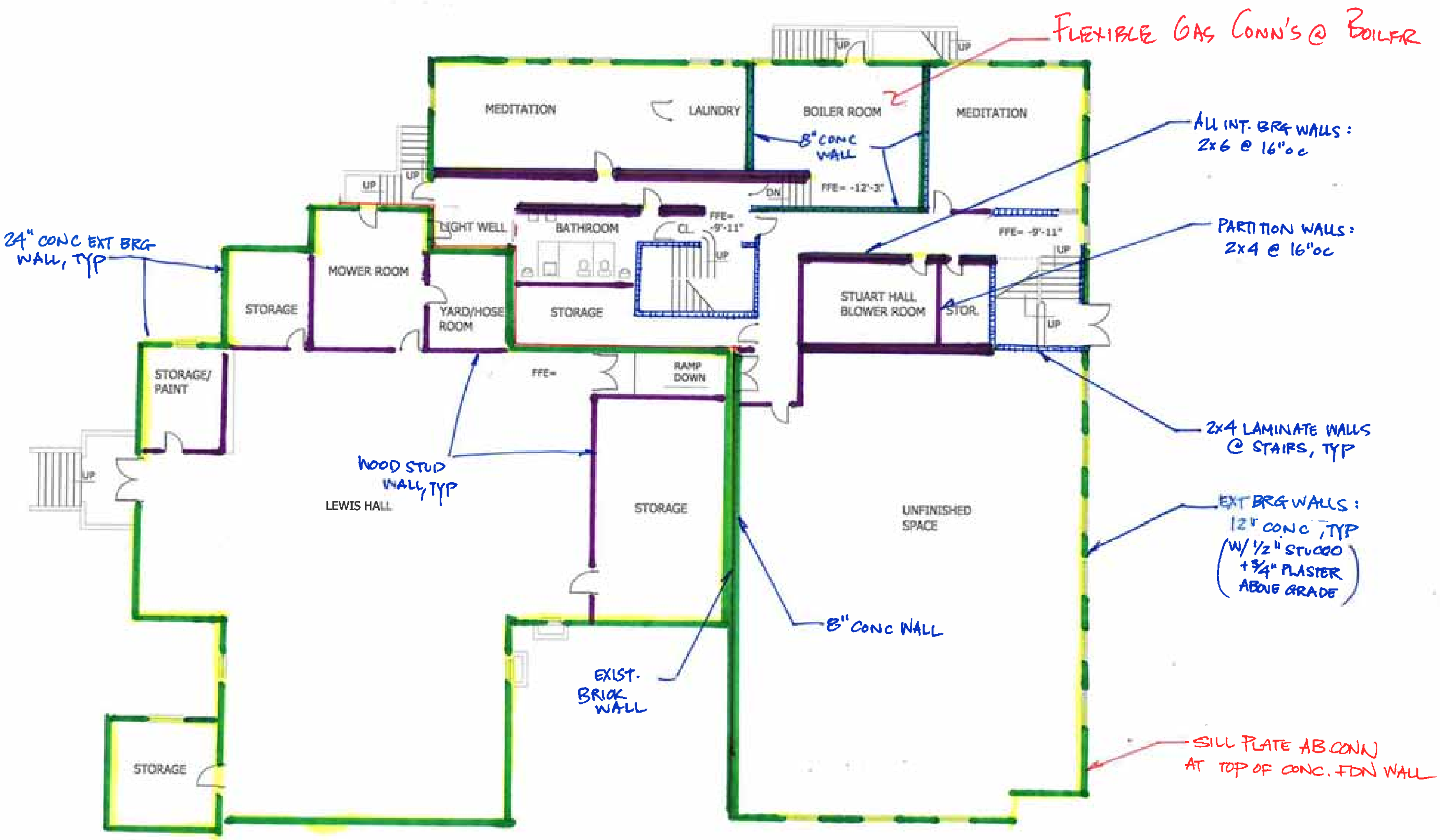

ALL PILGRIMS CHRISTIAN CHURCH BASEMENT FLOOR

FIGURE 5

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