BUILT UP
ENGINEERS

# LIMITED STRUCTURAL INSPECTION

6678 River Road
Fuquay-Varina, NC

*June 6, 2024*

Mahmood Sayed

## SCOPE AND BACKGROUND

At your request, a limited structural inspection of the above property was performed on May 14, 2024. The report that follows has been prepared based on that inspection. The inspection was performed by Sean Casady, PE of Built Up Engineers, PLLC.

No tests, measurements, or calculations have been made except as described in this report. We have not investigated for toxic materials or wastes, or examined public records regarding this property. The scope of the inspection does not assure that the property conforms to any regulations, restrictions, or building codes that may be in effect at its location.

The scope of this project was limited to the inspection and evaluation of the floor system within the sanctuary of the above church building. Per our understanding, the potential owners wished to determine the capacity of the floor system if only repaired to current standards and then also wished to determine what modifications would be required to bring the floor systems to the current live load requirements per the 2018 NC Building Code.

The report is intended to cover only those premises that may be examined visually without excavation, removing surface materials, and disassembling components.

## DESCRIPTION

The subject portion of the church building was originally constructed in 1871 per Harnett County Real Estate Tax Records. The building is constructed on a masonry pier and curtain wall foundation, with wood timber framing. For purposes of this report, all directions (left, right, rear, etc.) are taken from the viewpoint of an observer standing in front of the building and facing it.

Upon our arrival, the crawlspace area was inspected. No interior access was provided as a part of the inspection. The information presented in this report is gathered from the conditions visible at the site as they existed at the time of the inspection.

Should there be any questions or concerns regarding this report, contact us at sean@builtupengineers.com or 919-817-9915. Our mailing address is 7283 NC HWY 42 STE 102-148, Raleigh, NC, 27603. Our website is Builtupengineers.com

## OBSERVATIONS

1. The subject portion of the sanctuary space is approximately 40 feet wide by 50 feet deep. includes an entrance foyer, and two small storage closets immediately to the right and left of the entrance (one space appears to be utilized for audio-visual needs). The space then includes the main gathering space, with a choir loft on the right side and the stage, and a pulpit located in the middle. The space includes a dropped acoustical ceiling (vaulted hip style).
2. Beyond the sanctuary, classroom spaces are present. Additional classroom areas are present to the right in an additional building (not included in the scope).
3. The existing floor system below the church is generally comprised of round wood joists (approximately 8" in diameter), spanning left to right, supported on a central 10x10 timber girder supported on masonry and dry stacked stone piers spaced approximately 5 to 10 feet on center.
   a) On the right and left perimeter of the building, 10x10 timber band girders are present, supported on masonry piers at approximately 12-feet on-center.
   b) Two additional drop girders, consisting of 6x6 timber girders supported on masonry piers at 6'-0" on-center are installed at the midspan of the joists spanning left to right (drop girders located approximately 7 feet and 9 feet from the central 10x10 girder respectively).
4. Note that we prepared an additional report (dated January 11, 2024) providing recommendations to repair various damages to the floor system below the sanctuary.

## DISCUSSION

Per our calculations, in its existing condition, the floor framing appears to be generally adequate for approximately 40 pounds per square foot, which is the design load for most residential applications per current code requirements. Some components of the framing are undersized per our calculations, and these include the drop girders and the perimeter band girders. Note that these components typically are overstressed in bending which per design values includes a safety factor. Further note that due to the significant age of some of the wood components (some greater than 100 years old), reference design values are difficult to quantify, and at best the provided calculations are an estimate. Lumber utilized in wood framing is typically visually graded, and by this process, the design values are estimated based on tabular data, which is based on qualitative testing. For wood of this age, these reference values are likely greater (old-growth wood is typically stronger) which would render the floor system stronger than our calculations show. Nonetheless, for the purposes of calculations and providing a conservative estimate of the floor framing capacity to the ownership, we have assumed values generally based on NDS tabular data.

Note that per visual inspection of the interior, the floor appeared to be solid, without indications of deflection (bounce) under foot traffic. Considering the age of the building and general framing standards, we consider the building well-constructed, although some components of the building structure are undersized per our calculations. Note that the term "well-constructed" does not refer to a specific floor capacity due to the numerous variables noted above. The owners should understand that the building is of significant age and that building codes have largely come into use since the building was originally constructed. It is also worth acknowledging that the building has stood for over 100 years, and does not exhibit significant indications of structural distress from the inside, despite framing damage below which has been identified.

We have provided recommendations to repair the sanctuary floor to a 40 PSF capacity (generally matching original conditions) and also additional recommendations to increase the floor capacity to 100 PSF (per current building codes). Note that increasing the floor capacity would include an extensive amount of additional structural work from below.

Further note, only gravity loads are considered in the analysis. We have not considered the effects of wind or earthquake loading on the building.

No areas of the structure were reviewed other than those explicitly described in this report. The review used a standard of care consistent with other local design professionals limited by the scope and budget. This report was at a flat rate and has a liability limitation of 10 times the fees collected. It represents the best judgment of the staff of Built Up Engineers, PLLC given the information available at the time of writing. No review of organic growth, mildew, or any other building science issue was performed except as noted. All opinions are subject to revision based on new or additional information. No responsibility will be taken for conditions that could not be easily seen or are outside the scope of this review. Any use that a third party makes of this report, or any reliance upon, decisions made in response to or in any way influenced by this report are the responsibility of the such third party. Recommendations are provided to address structural-related issues, and may not rectify cosmetic issues.

## RECOMMENDATIONS

*If there are any questions or concerns about the specified recommendations, contact the engineer prior to construction.*

*Note, the below recommendations are assuming repairs will be completed per our previous report. The following recommendations are provided in addition to the framing repairs noted in our previous report.*

### 40 PSF Floor Capacity

1. We recommend installing 8x16 solid grouted CMU block piers on 20''x20''x10'' thick concrete footings below the midspan of the perimeter girders on the right and left sides. Provide pressure-treated blocking or flashing between non-treated wood members.
2. We recommend installing a 16x16 solid grouted CMU block pier on a 24''x24''x10'' thick concrete footing below the 10-foot span of the central girder. Provide pressure-treated blocking or flashing between non-treated wood members.
3. Install a new 3-2x8 drop girder supported on 8x16 solid grouted CMU block piers on 20''x20''x10'' thick concrete footings at 7'-0'' on-center below the midspan of the joists below the foyer at section at the front-right corner where the existing drop girder terminates. Connect the joists to the girder with Simpson H2.5a hurricane ties at each joist, alternating sides.

### 100 PSF Floor Capacity

1. We recommend installing 8x16 solid grouted CMU block piers on 20''x20''x10'' thick concrete footings below the midspans of the perimeter girders on the right and left sides. Provide pressure-treated blocking or flashing between non-treated wood members.

2. We recommend installing 8x16 solid grouted CMU block piers on 20''x20''x10'' thick concrete footings below the midspans of the 6x6 drop girders on the right and left sides. Provide pressure-treated blocking or flashing between non-treated wood members.
3. We recommend fully sistering (bearing point to bearing point) **all joists** with 2x8 pressure-treated members on **both** sides. Attach the new joists to the round member with 4'' long Simpson SDWS screws at 16'' on-center. At the bearing points of the new joists at the girders, provide 2x4 pressure-treated ledgers below the joist with (3) 16d nails below each joist. Note, that the carpet should also be removed, and the subfloor nailed to the top of the joists with 10d nails at 12'' on-center.
4. Install a new 3-2x8 drop girder supported on 8x16 solid grouted CMU block piers on 20''x20''x10'' thick concrete footings at 7'-0'' on-center at the following locations: Connect the joists to the girder with Simpson H2.5a hurricane ties at each joist, alternating sides.
   a) Below the midspan of the joists below the foyer.
   b) Below the section of joists at the front right corner where the existing drop girder terminates.
   c) At the midspan of the floor framing in the rear classroom areas.
5. Install (2) 8x16 solid grouted CMU block piers on 20''x20''x10'' thick concrete footings at the rear of the inset pulpit/stage area (see diagram).
6. We recommend installing a 16x16 solid grouted CMU block pier on a 24''x24''x10'' thick concrete footing below the 10-foot span of the central girder. Provide pressure-treated blocking or flashing between non-treated wood members.

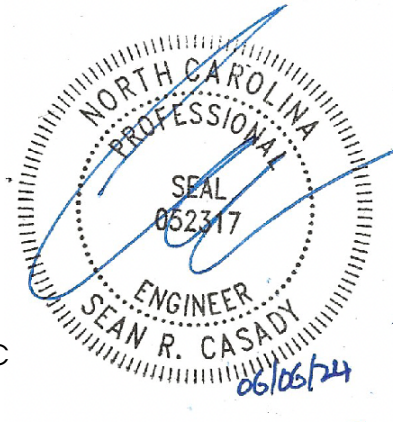
**General Notes:**

- Wood 2x pressure-treated blocking utilized shall be sufficiently dried out to help reduce shrinkage due to the evaporation of excess moisture over time. Alternatively, kiln-dried pressure-treated lumber may be utilized.
- The contractor should verify all dimensions prior to ordering materials.
- If the contractor has any questions or concerns regarding the method of construction or if conditions vary from what is described below, the engineer should be consulted.
- Likewise, if any changes to sizes or modifications to the structure are desired other than what is explicitly described below, the engineer should be consulted.
- All construction and workmanship shall adhere to the 2018 NC Building Code, Residential Code.
- All new lumber should be SPF or SYP No.2 or equivalent. All lumber exposed to concrete/masonry or weather must be pressure-treated.
- Contractor to confirm minimum soil-bearing capacity of 2000 psf. All footings shall be installed a minimum of 12'' below grade and in no case less than the frost depth.
- All new concrete is to have a minimum 28-day strength of 3000 psi.
- All new metal hangers/ties/clips are to be installed per manufacturer specifications.
- All fasteners/connections are to be installed per table R602.3 of the 2018 NC Building Code, Residential Code.
- With any structural changes, finish material cracks and minor movements are typical and expected. These are associated with settlement generally observed after the construction of an addition or significant remodel.

**CONCLUSION**

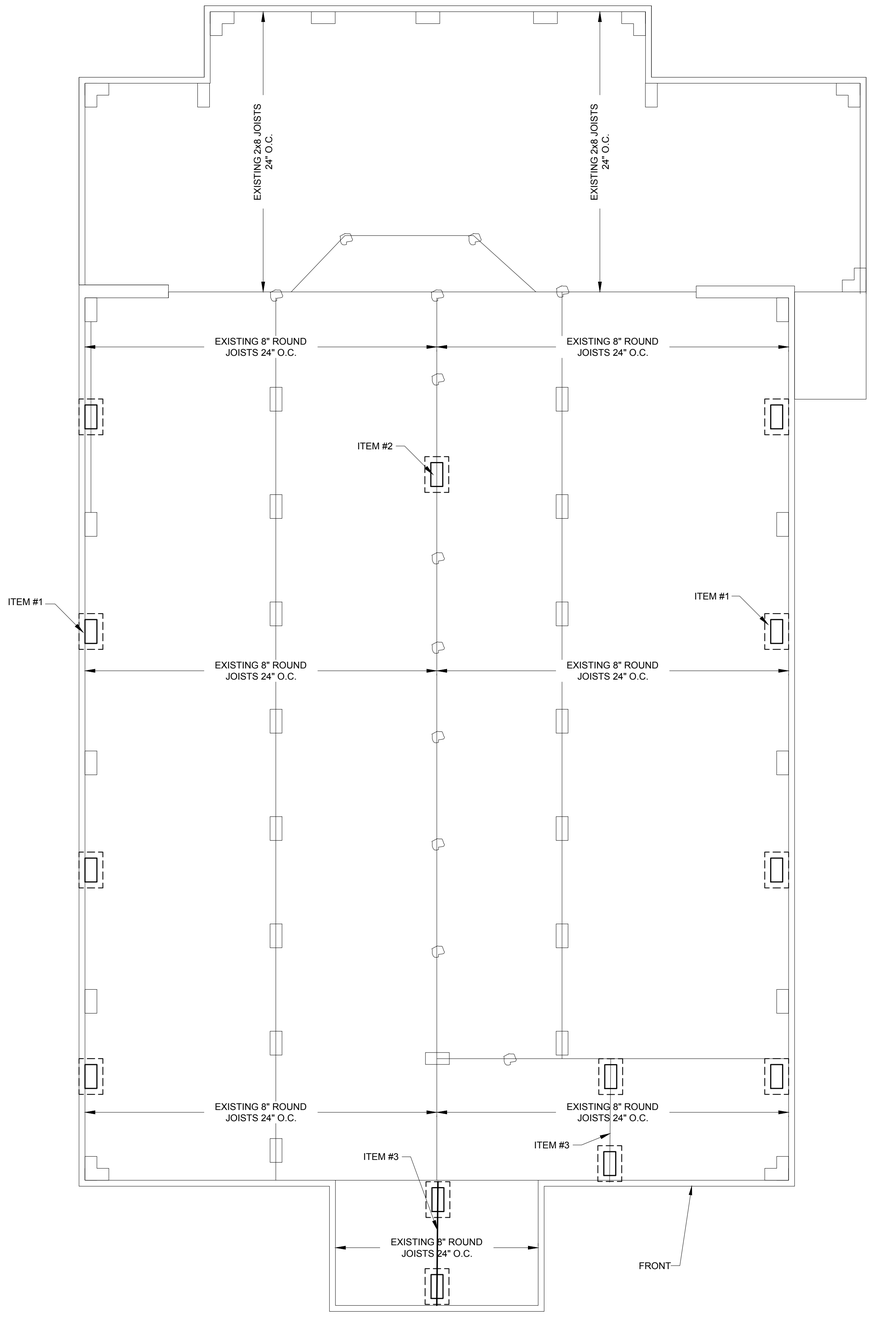
We trust that this report provides the information you require. Please contact us at 919-817-9915 if you have any questions. Thank you for the opportunity to be of assistance to you.

Sincerely,



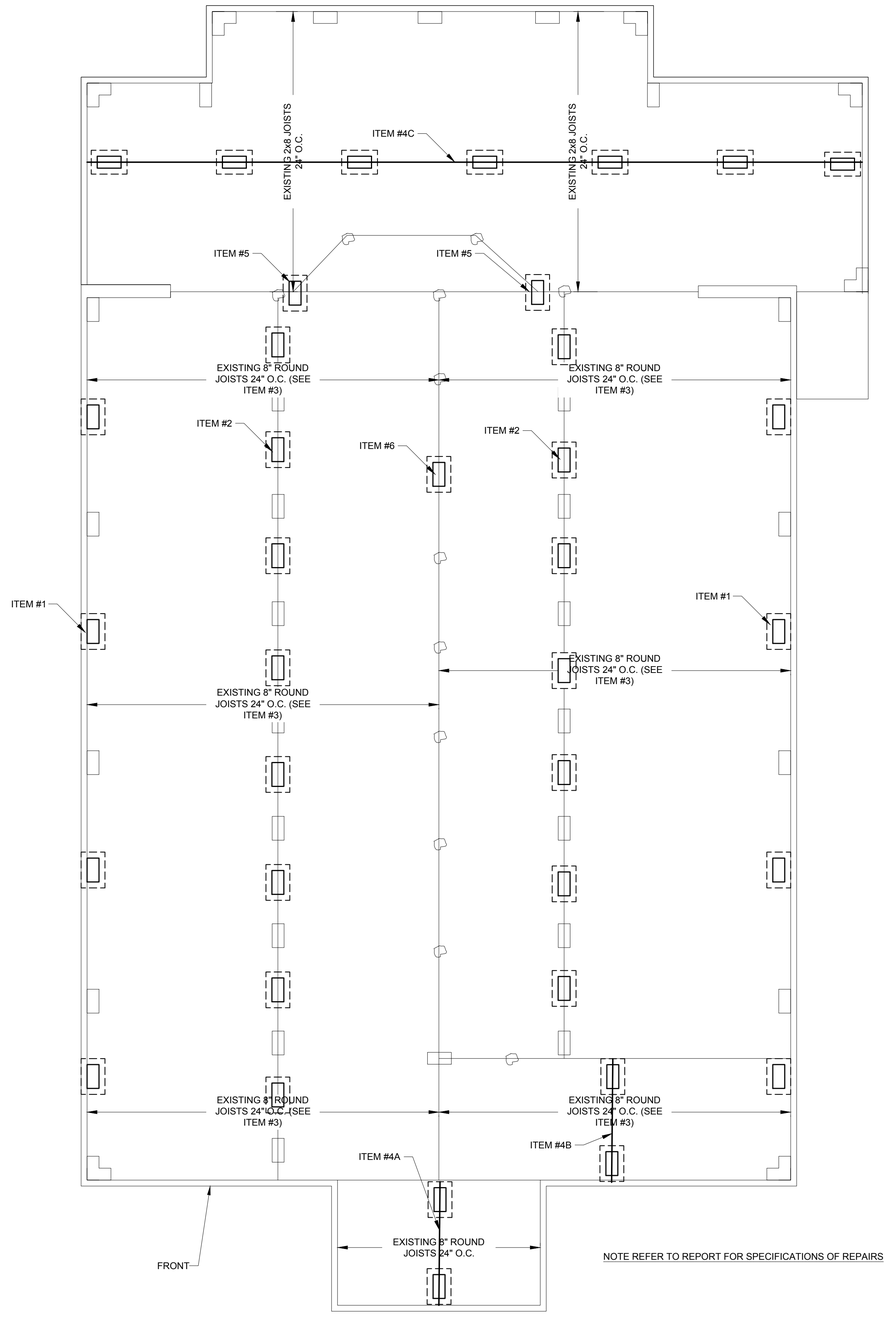

Sean Casady, PE
Project Engineer
Built Up Engineers PLLC
NC Lic. No. P-2664

Enclosed: Repair diagram




## STRUCTURAL SUPPLEMENTAL PLAN - 40 PSF

SCALE: 1/4" = 1'-0"




NOTE REFER TO REPORT FOR SPECIFICATIONS OF REPAIRS

## STRUCTURAL SUPPLEMENTAL PLAN -100 PSF

SCALE: 1/4" = 1'-0"


NORTH CAROLINA PROFESSIONAL SEAL 052317 ENGINEER SEAN R. CASADY
06/06/24

BUILT UP ENGINEERS
7283 NC HWY 42 W STE: 102-148 RALEIGH, NC 27604,
P: 919-917-9915
NC LICENSE NO. P-2664


# STRUCTURAL UPFIT DIAGRAM
# 6678 RIVER RD FUQUAY VARINA, NC

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 0 | 06.06.2024 | FOR CONSTRUCTION |

| | |
|---|---|
| SCALE: | AS SHOWN |
| REVIEWED BY: | SRC |
| DRAWN BY: | SRC |
| DATE: | JUNE 6 2024 |

| | | | | |
|---|---|---|---|---|
| **Client:** | | **Date:** | Jun 6, 2024 | |
| **Author:** | Seaan Casady | **Job #:** | | |
| **Project:** | 6678 river rd | **Subject:** | **central girder** | PASS |
| **References:** | NDS 2018 (ASD) | | | |

## Summary

| | | |
|---|---|---|
| 0% | Allowable Compression | $C' = 47\,400$ lb |
| 0% | Allowable Tension | $T' = 49\,600$ lb |
| 79% | Allowable Bending Moment | $M' = 10\,100$ lb · ft |
| 0% | Allowable Shear | $V' = 9930$ lb |
| 79% | Combined Compression / Bending | $\text{Int}_C = 0.788$ |
| 79% | Combined Tension / Bending | $\text{Int}_T = 0.788$ |

## Key Properties

| | | |
|---|---|---|
| Member | | 10x10 SYP No. 2 |
| Size and Grade | | 10x10 SYP No. 2 |
| Total Member Length | $L =$ | 8 ft |
| Bracing Condition | | Fully Braced |

## Design Loads

| | | |
|---|---|---|
| Positive Design Moment | $M^+ =$ | 7980 lb · ft |
| Negative Design Moment | $M^- =$ | 0 lb · ft |
| Design Shear | $V =$ | 0 lb |
| Design Axial Compression Load | $C =$ | 0 lb |
| Design Axial Tension Load | $T =$ | 0 lb |

## Member Properties

| | | |
|---|---|---|
| Section Modulus | $S =$ | 143 in$^3$ |
| Base Allowable Shear Stress | $F_v =$ | 165 psi |
| Base Allowable Bending Stress | $F_b =$ | 850 psi |

## Tension Design (NDS 2018 Cl 3.8)

| | | |
|---|---|---|
| Adjusted Tension Strength | $F_t' =$ | 550 psi |

## Compression Design (NDS 2018 Cl 3.7)

| | | |
|---|---|---|
| Fully Braced Compression Strength - Pure Axial Loading | $F_c^* =$ | 525 psi |
| Governing Slenderness - X-axis | $(\ell_e/d) =$ | 0 |
| Governing Slenderness - Y-axis | $(\ell_e/b) =$ | 0 |
| Adjusted Compression Strength (X-axis) | $F_{c,x}' =$ | 525 psi |
| Adjusted Compression Strength (Y-axis) | $F_{c,y}' =$ | 525 psi |

## Bending Design (NDS 2018 Cl 2.3)

| | | |
|---|---|---|
| Governing Duration Factor in Bending | $C_{D,b} =$ | 1 |
| Size Factor | $C_{F,b} =$ | 1 |
| Incising Factor | $C_{i,b} =$ | 1 |
| Beam Stability Factor | $C_L =$ | 1 |
| Adjusted Bending Strength | $F_b' =$ | 850 psi |

## Shear Design (NDS 2018 Cl 3.4)

| | | |
|---|---|---|
| Governing Duration Factor | $C_D =$ | 1 |
| Adjusted Shear Strength | $F_v' =$ | 165 psi |

| | | | | |
|---|---|---|---|---|
| **Client:** | | **Date:** | Jun 6, 2024 | |
| **Author:** | Seaan Casady | **Job #:** | | |
| **Project:** | 6678 river rd | **Subject:** | **perimeter girder** | PASS |
| **References:** | NDS 2018 (ASD) | | | |

## Summary

| | | |
|---|---|---|
| 0% | Allowable Compression | $C' = 47\,400$ lb |
| 0% | Allowable Tension | $T' = 49\,600$ lb |
| 66% | Allowable Bending Moment | $M' = 10\,100$ lb · ft |
| 0% | Allowable Shear | $V' = 9930$ lb |
| 66% | Combined Compression / Bending | $\text{Int}_C = 0.659$ |
| 66% | Combined Tension / Bending | $\text{Int}_T = 0.659$ |

## Key Properties

| | | |
|---|---|---|
| Member | | 10x10 SYP No. 2 |
| Size and Grade | | 10x10 SYP No. 2 |
| Total Member Length | $L =$ | 10 ft |
| Bracing Condition | | Fully Braced |

## Design Loads

| | | |
|---|---|---|
| Positive Design Moment | $M^+ =$ | 6680 lb · ft |
| Negative Design Moment | $M^- =$ | 0 lb · ft |
| Design Shear | $V =$ | 0 lb |
| Design Axial Compression Load | $C =$ | 0 lb |
| Design Axial Tension Load | $T =$ | 0 lb |

## Member Properties

| | | |
|---|---|---|
| Section Modulus | $S =$ | 143 in$^3$ |
| Base Allowable Shear Stress | $F_v =$ | 165 psi |
| Base Allowable Bending Stress | $F_b =$ | 850 psi |

## Tension Design (NDS 2018 Cl 3.8)

| | | |
|---|---|---|
| Adjusted Tension Strength | $F_t' =$ | 550 psi |

## Compression Design (NDS 2018 Cl 3.7)

| | | |
|---|---|---|
| Fully Braced Compression Strength - Pure Axial Loading | $F_c^* =$ | 525 psi |
| Governing Slenderness - X-axis | $(\ell_e/d) =$ | 0 |
| Governing Slenderness - Y-axis | $(\ell_e/b) =$ | 0 |
| Adjusted Compression Strength (X-axis) | $F_{c,x}' =$ | 525 psi |
| Adjusted Compression Strength (Y-axis) | $F_{c,y}' =$ | 525 psi |

## Bending Design (NDS 2018 Cl 2.3)

| | | |
|---|---|---|
| Governing Duration Factor in Bending | $C_{D,b} =$ | 1 |
| Size Factor | $C_{F,b} =$ | 1 |
| Incising Factor | $C_{i,b} =$ | 1 |
| Beam Stability Factor | $C_L =$ | 1 |
| Adjusted Bending Strength | $F_b' =$ | 850 psi |

## Shear Design (NDS 2018 Cl 3.4)

| | | |
|---|---|---|
| Governing Duration Factor | $C_D =$ | 1 |
| Adjusted Shear Strength | $F_v' =$ | 165 psi |

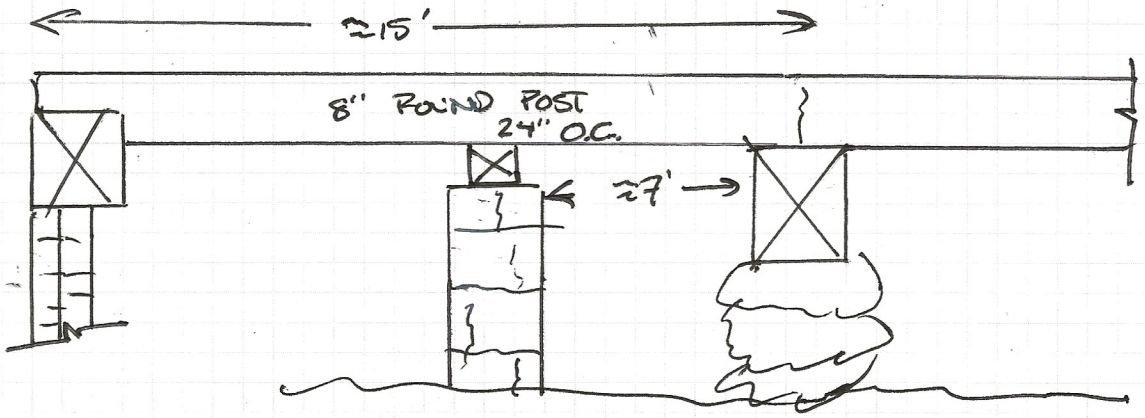
BUILT UP
ENGINEERS

6698 RIVER RD
FUQUAY - VARINA

PROJECT

DATE

# ROUND JOIST CALCS




MAX MOMENT = -1711 FT-LBS (40 PSF) ; -3686 (100 PSF)

USE $F_b$ = 500 PSI (CONSERVATIVE

$A = 44.18\ in^2$

$I = 155\ in^4$

$S = 155/3.75 = 41.33\ in^3$

$\sigma = \frac{M}{S} = \frac{1711 \cdot 12}{41.33}$ in FT-LBS

$= 496$ PSI → 40 PSF

OK

$\Delta = \frac{5wl^4}{384\ EI}$

$\Delta$ 40 PSF ≈ 0.06 in

$\Delta$ 100 PSF ≈ 0.13 in > BOTH OK

100 PSF

→ 1070 PSI > 750 PSI

NG