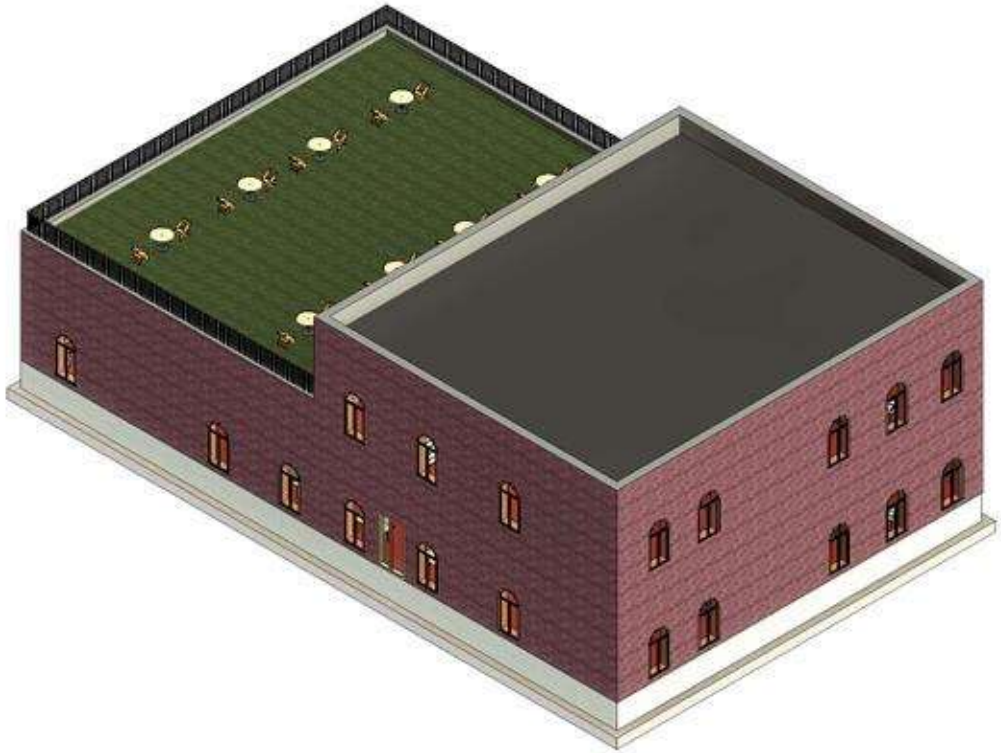
KEYSTONE LIBRARY RENOVATION

BY OM PATEL



1 3D RENDERING

Autodesk Revit

www.autodesk.com/revit

Project Lead The Way

Keystone Center

No.	Description	Date

TITLE PAGE

Project number	Project Number	A-0
Date	Issue Date	
Drawn by	Author	
Checked by	Checker	Scale

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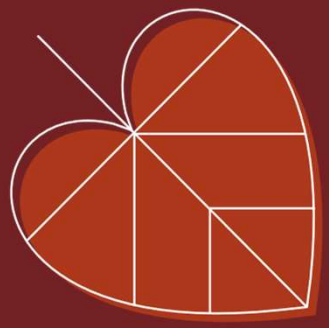
PROJECT DESCRIPTION



For this project, one must renovate abroken-down building into apubliclibrary that incorporatesuniversal design elements, suchas an elevator and handicap-accessible bathrooms, a secondfloor, and a publicly accessible green roof, all of which must follow the ordinancesand building codes of Noblesville, Indiana. These ordinancesinclude having two exits, due to the building's occupancy, andbeing builtof non-combustible materials all of which are stated in section 303.4 following the

assembly A-3 group regulations. Additionally, thebuilding must haveappropriate grading and stormwatermanagement. The library must include a vestibule, a mechanicalroom, a history room, two meeting rooms, a staff restroom, a staffbreak area (that includes a kitchenette), a head librarian office,public restrooms, room for open stacks and computers, achildren's help desk, a children's area, and a front desk.On the second floor,there must be public bathrooms and open area for bookstacks.

LAND USE AND DEVELOPMENT REGULATIONS

I researched the local code of ordinances and building codes to obtain important information needed to redesign the Keystone Building.

2. The model code the building the is based is the International Building Code, 2012 Edition, First Printing and ANSI A117.1 Accessible and Usable Buildings and Facilities, 2009 Edition, First Printing

3. Assembly A-4

4. For each of the four types of construction its species the fire-resistance rating requirements for exterior walls based on fire separation distance.

- Type 1 and 2, are made up of noncombustible materials

- Type 3 is a type of construction where the exterior walls are made of noncombustible materials and the interior elements are any material permittable by the code.

- Type 4 construction is Heavy Timber exterior is noncombustible and interior building elements are of sold or lamented wood.

- Type 5 construction is structural elements, interior/exterior walls are of any material from the code.

The keystone library should be type 1 or 2 because it is the most fire resistant.

5. The least restrictive construction type for the keystone library would be type 1 because the height of the area is unlimited.

6. For the Keystone library's walls it would be beneficial to use metal studs and wooden gypsum wallboard. For the floor commercial carpet, vinyl, and/or tile. I think carpet would be the most effective as it makes the space feel lighter and helps with noise control.

7. The occupant load is 304.

8. The stairs must be at least 39.3 inches wide.

9. The minimum number of exits required is 2.

10. The library lays in the Planned Business Zone.

11. The planned business zone encourages well planned business uses and helps plan infrastructure. (1263 Table V. Zoning Map Changes)

12. The minimum lot size needs to be 20,000 sq. feet, meaning the library meets the regulations as the library has 290,545.2 sq. Feet.

13. For a 2-story building the maximum height is 30 feet.

14. Some information that is helpful when building the library is that the building's front should have access to the street and the dimensions of the library cannot change.

15. Yes, it is permitted to be built on the property.

16. The plan is needed for any improvement to the landscape.

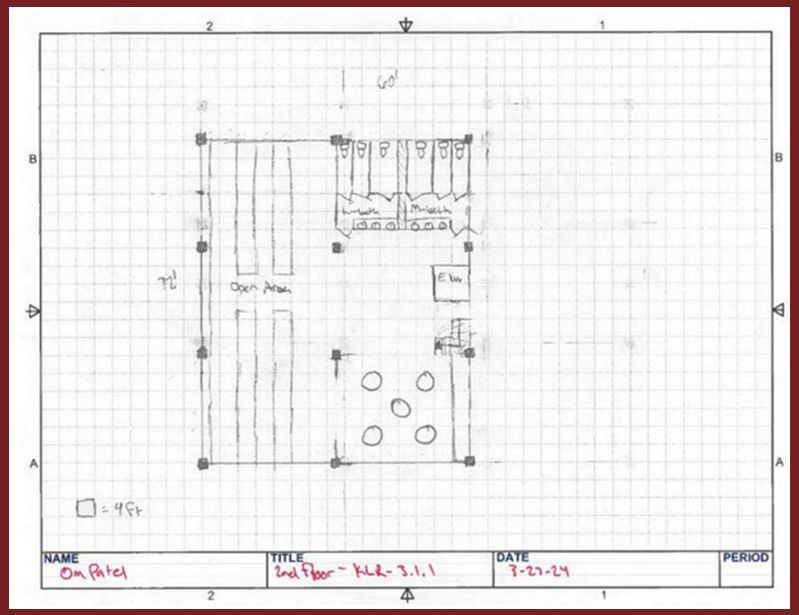
17. There needs to be a landscape plan for parking lots, building bases, screening.

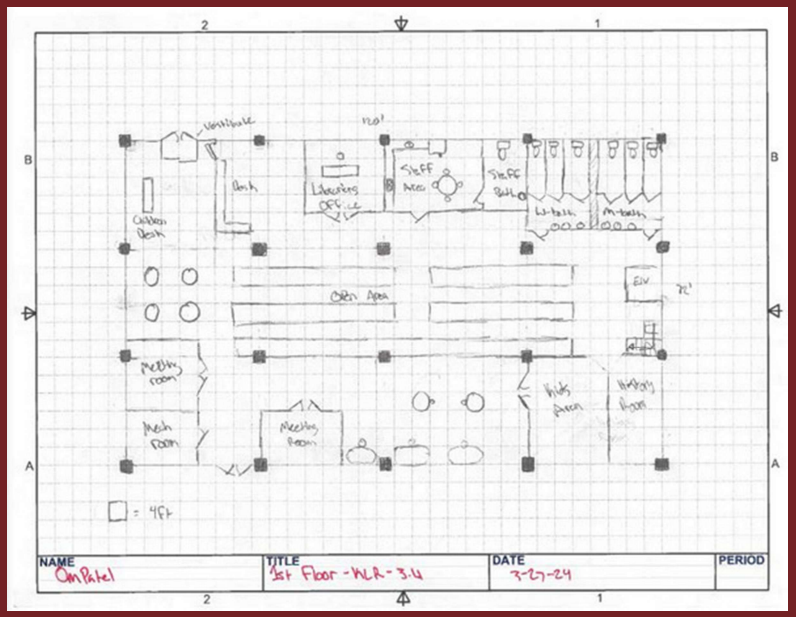
Conclusion:

1. It is important to research building codes as knowing the basic requirements helps the design meet the requirements in the preliminary stages of building the home.
2. Building codes provide safety for people, via egress and staircase requirements, which allows the flow of traffic to not be congested in emergencies.
3. Local ordinances control development as the cities and towns add more codes that a developer must follow.

SKETCHES

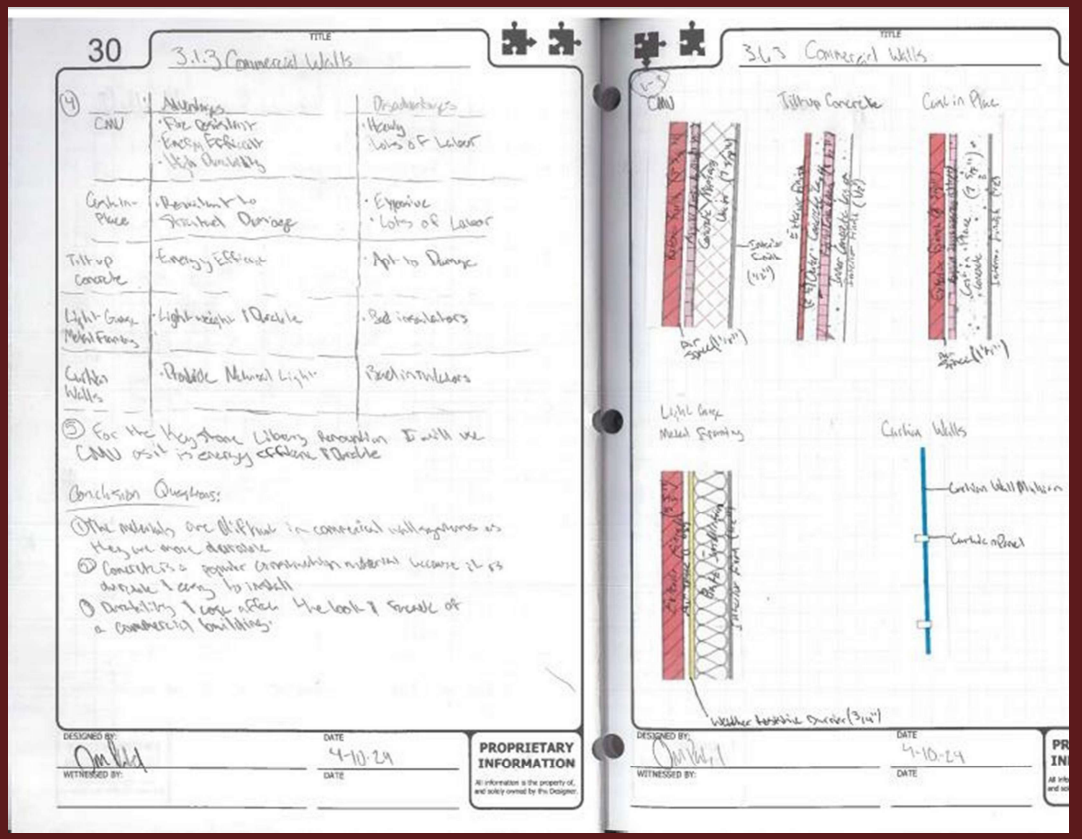
Before I remodeled the library, I created sketches of the first and second floor that incorporate the necessities and follow the constraints given for this project.



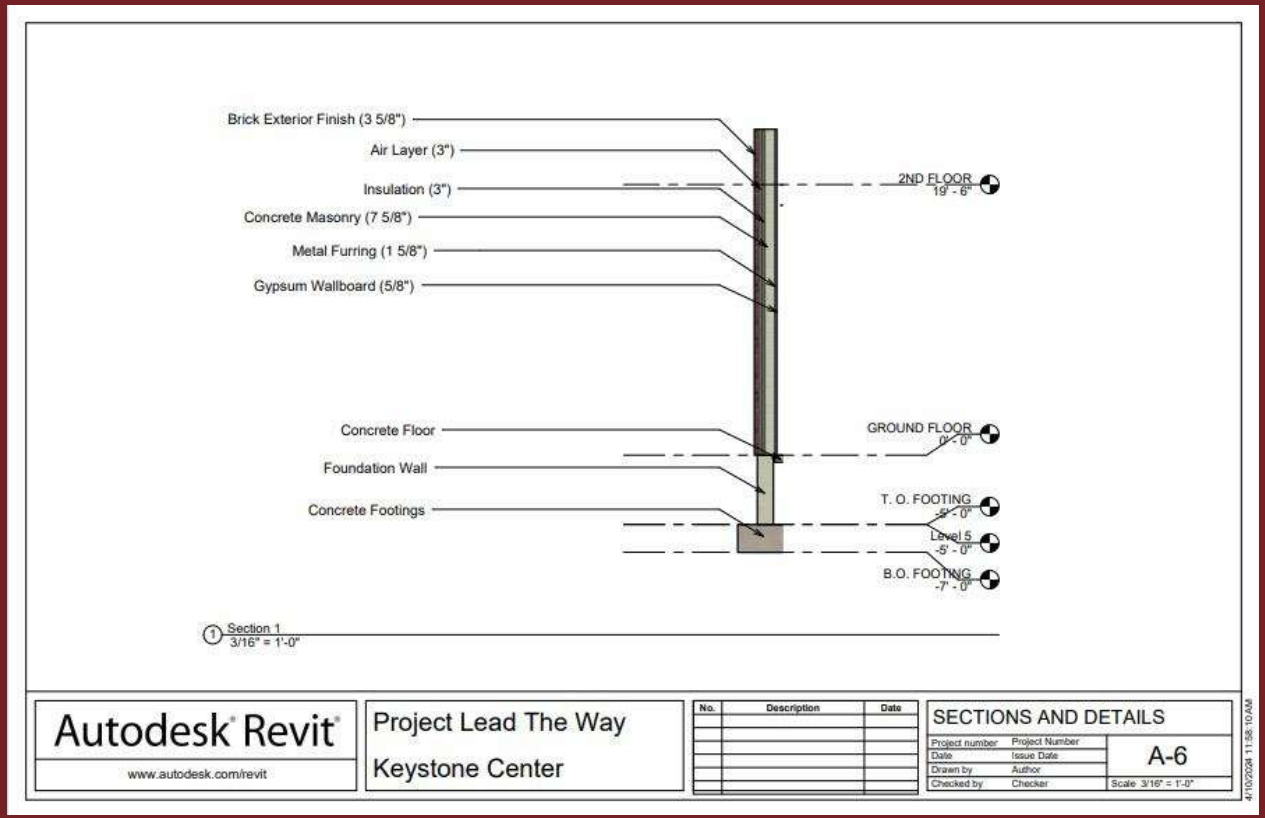


COMMERCIAL WALL SYSTEMS

I examined the different parts that make up various commercial wall systems, integrating the best wall system, CMU wall, for the Keystone Library's purposes.



COMMERCIAL WALL SYSTEMS



COMMERCIAL ROOF SYSTEMS

I researched the necessary requirements to make a low-slope roof acceptable for human traffic and for use as a green roof. From my research I selected and integrated EDPM roofing material and a granular drainage system.

I would use EDPM roofing as it has been proven to be long lasting and lower energy costs. Furthermore, it is eco-friendly, cost effective and fire resistant.

3)

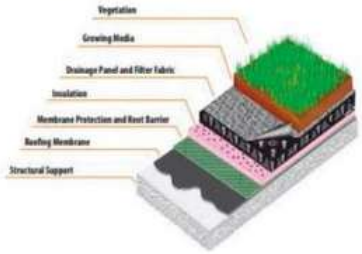
Granular Drainage System

- Does not require instant vegetation
- Biodiversity
- Average water retention
- Low maintenance
- Cost Effective

Figure 4-4:
Typical layers of a multi-course roof system with granular drainage layer.

Monolithic Platform System

- Does not require instant vegetation
- Biodiversity
- High water retention
- Low maintenance
- Allows for later installation of solar

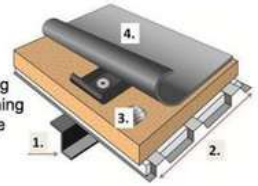


I will use a granular drainage system as it is more cost effective then the monolithic platform system.

2)

EDPM Roofing

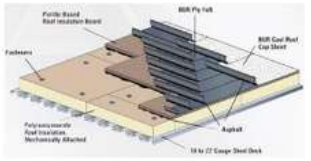
- Tough material that can withstand heavy foot traffic
- Often used as a recreational deck
- Energy Efficient



1. Roof Beams
2. Structural Decking
3. Insulation/Sheathing
4. EPDM Membrane

Built Up Roof (BUR)

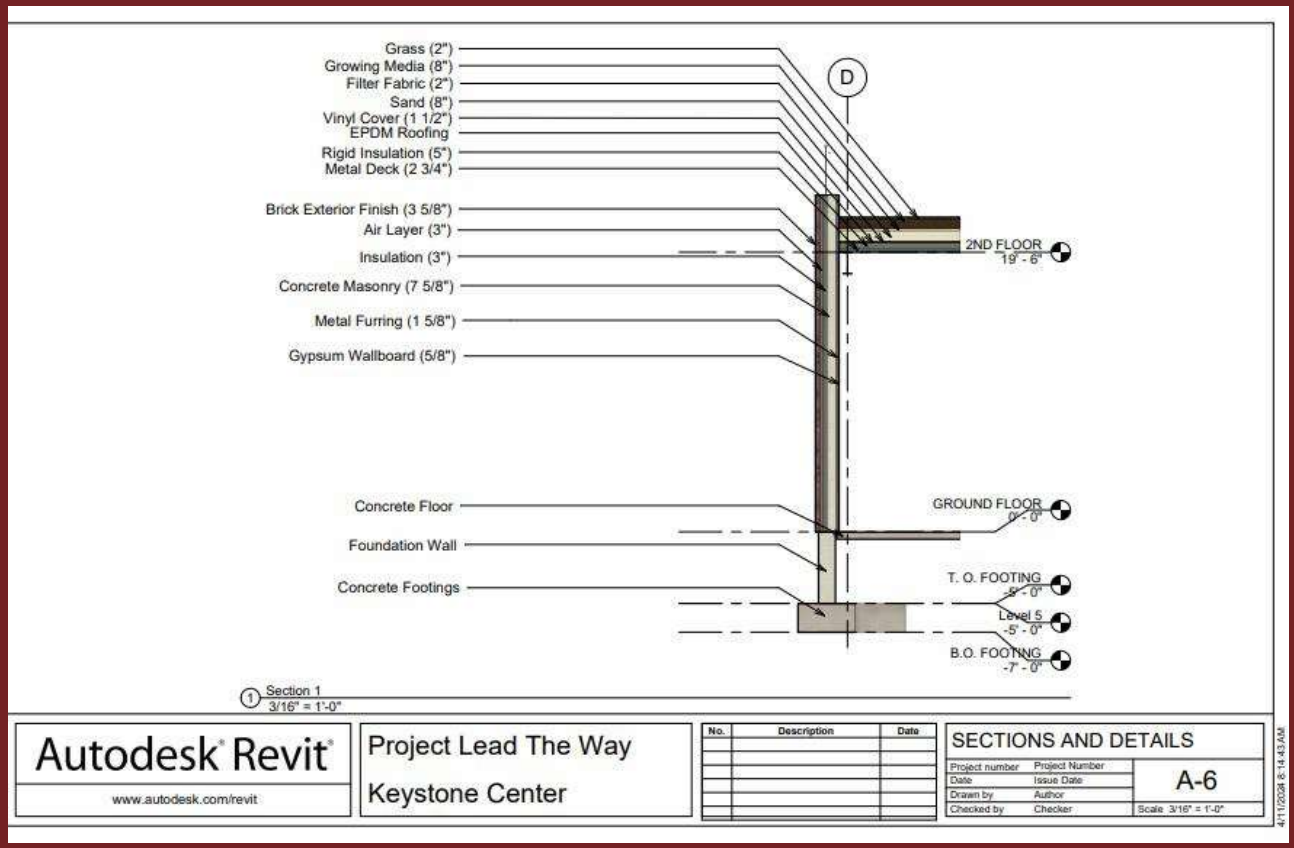
- Alternating layers of asphalt and reinforcing fabric
- Efficient use of space and waterproofing
- Not aesthetically pleasing



PVC Sheeting Materials (Vinyl)

- Low maintenance water proofing
- Resists pedestrian damage
- Problems occur with age and climate

COMMERCIAL ROOF SYSTEMS



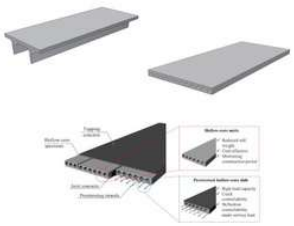
COMMERCIAL FLOOR SYSTEMS

I researched two potential elevated concrete floor systems for the Keystone Library Project and incorporated a composite slab design due to its durability and cost effectiveness.

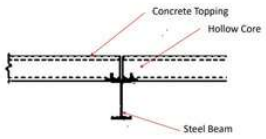
Research

Cast-in-Place
- Formed on site
- Can be shaped as needed

Hollow Core Precast
- Created off site
- Transported to site
- Installed into the structure

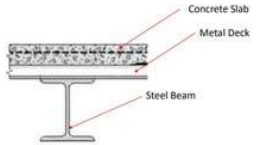


Hollow core precast concrete floor panels



- 24' span length
- 4" panel width
- 8" slab thk.
- 7.5" No. & size of reinforcing strands

Composite Slab Design (cast-in-place concrete on metal decking)



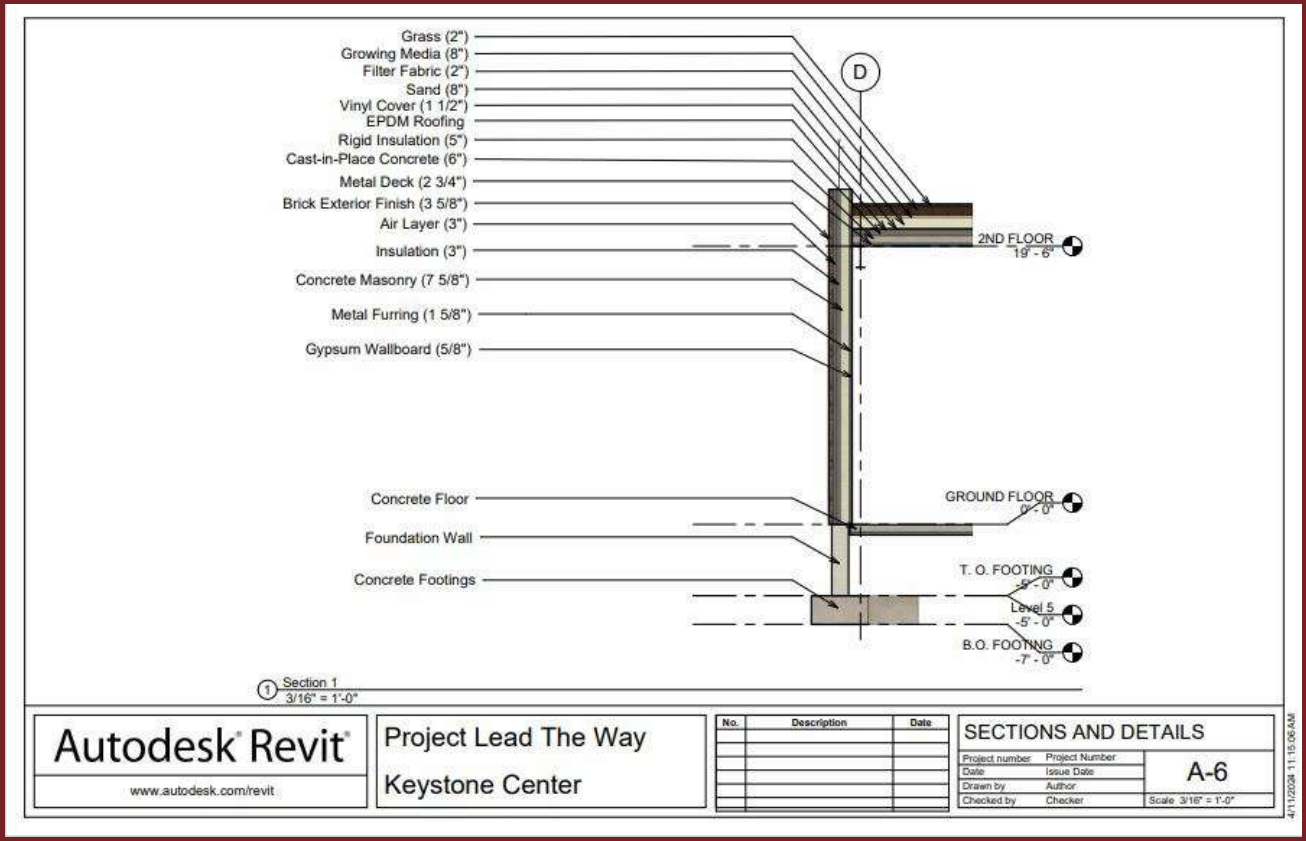
- Normal Weight Concrete
- Type 1.5 CF Composite Floor Deck
- 3-span
- 12' span length
- 6" slab thk.
- 20 deck Type
- W2.1xW2.1 WWF
- 7-4 allowable unshored clear span

Question 6

- I would use Composite Slab Design as it simple, efficient, and durable

Conclusion

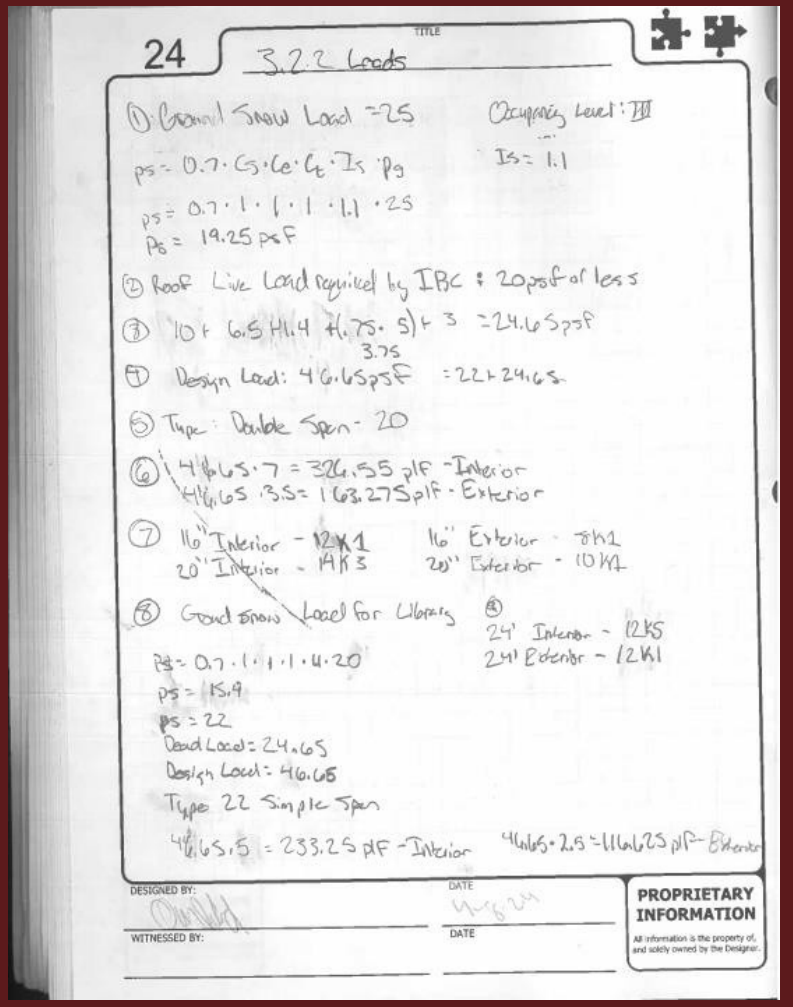
1) The materials used in a residential floor system are different from a commercial system as they have to be more durable and fire resistant.
2) The advantages of using precast concrete floor components are that they are more durable and higher quality.
3) Factors you should consider when designing a system for a building design is cost and durability.
4) To add more strength to a concrete floor they can change the span length and thickness of the floor. Additionally, engineers can use rebar to add more strength to a floor.

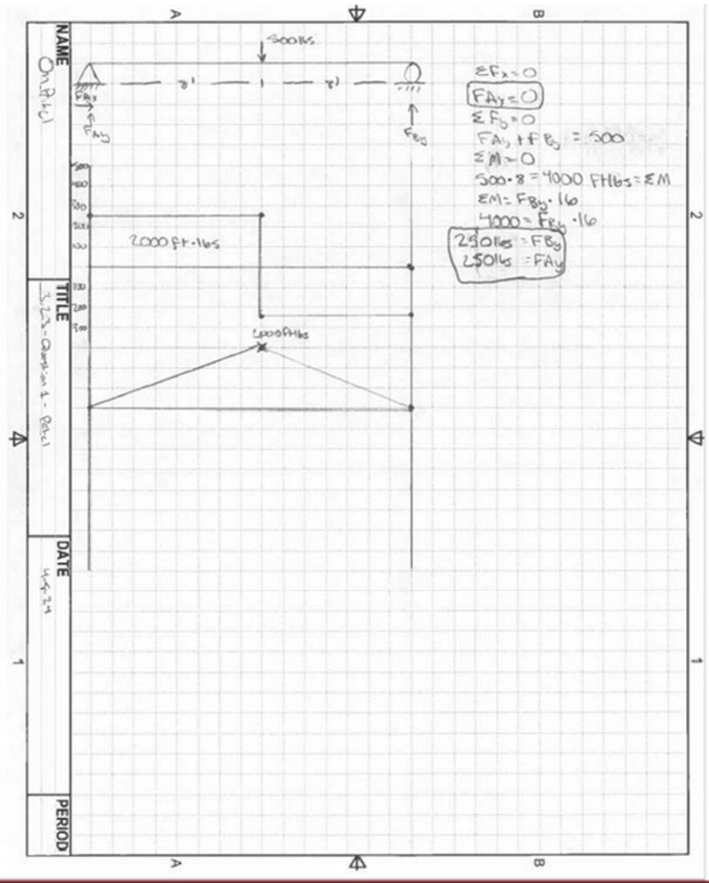


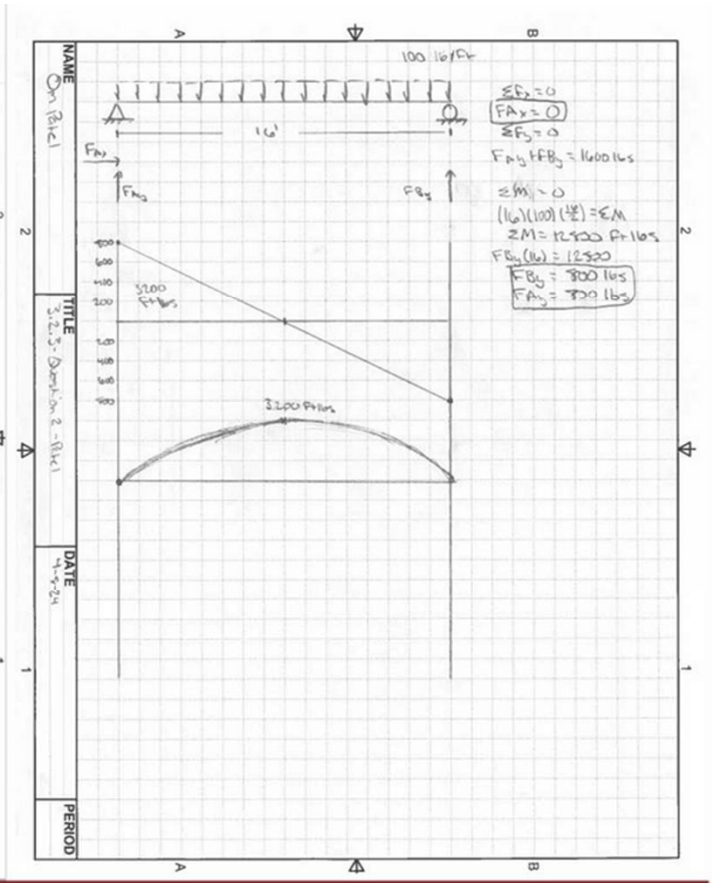
COMMERCIAL FLOOR SYSTEMS

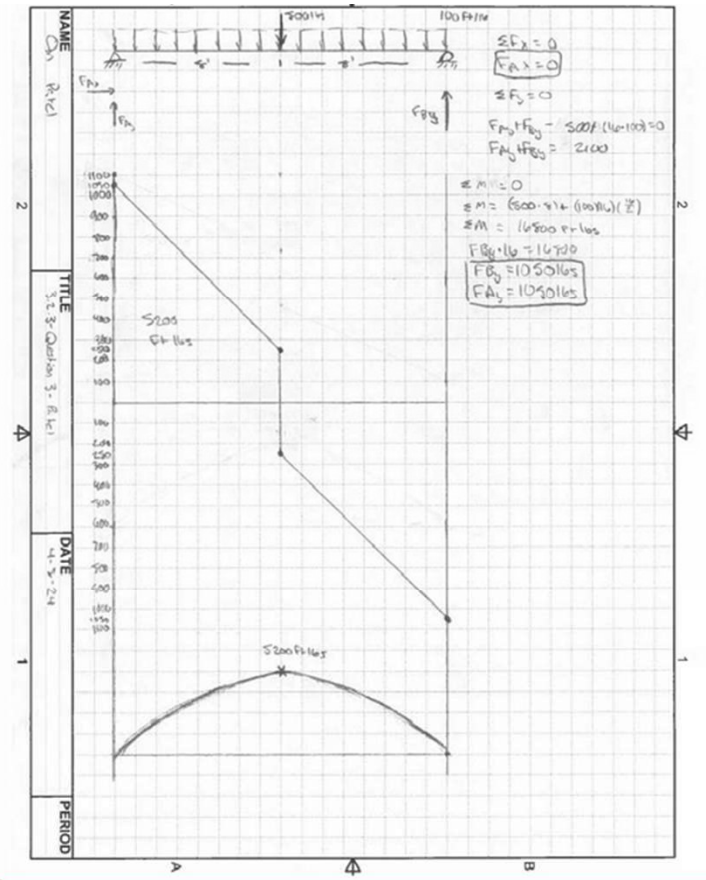
LOADS

Identified the design loads for each structural element in the Keystone Library to select structural elements such as roof decking and steel joists.



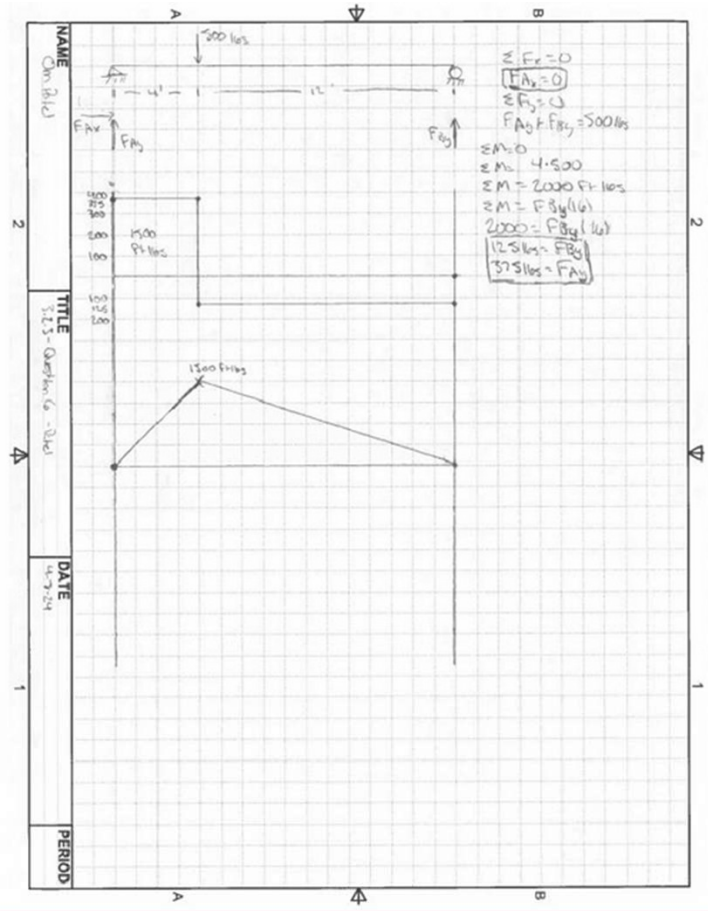


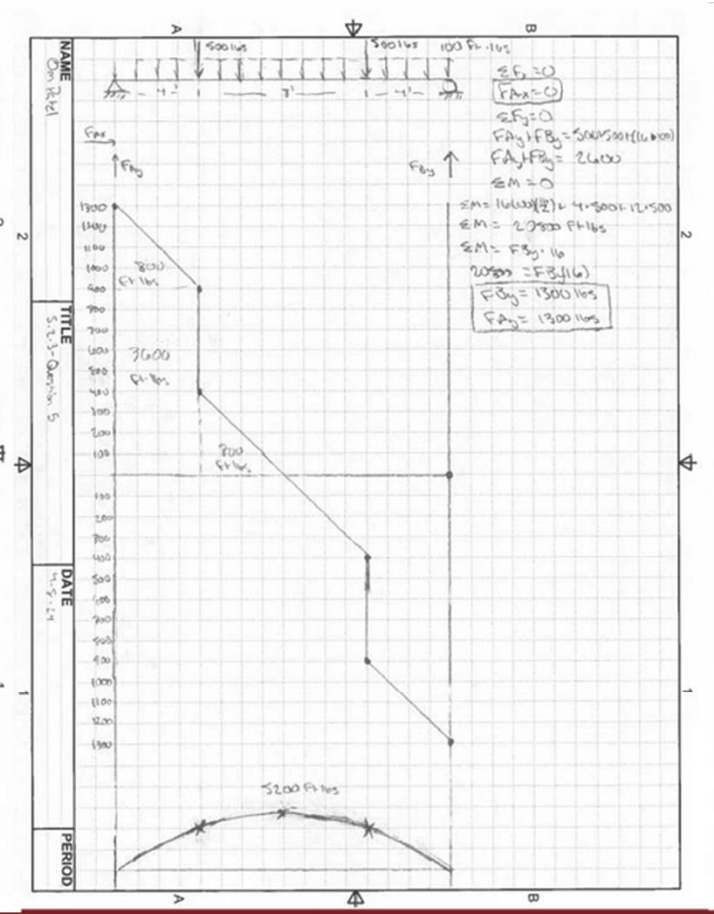


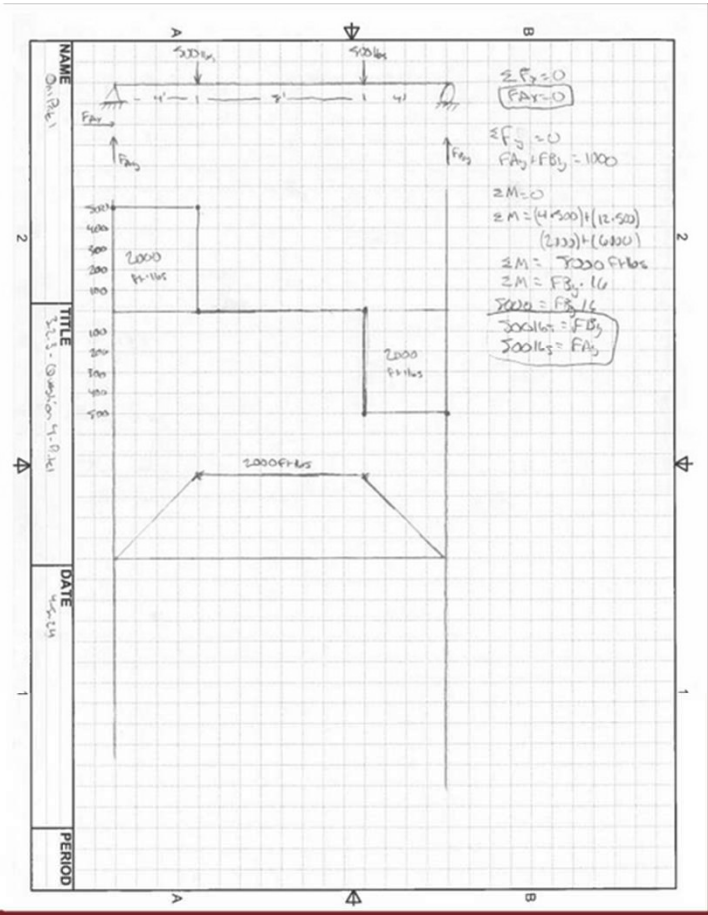


BEAM ANALYSIS

I analyzed beams to determine the beam strength necessary to resist the applied loads and then created shear and moment diagrams to visualize the beams distribution of mass, allowing for optimization and prevention of design failures.



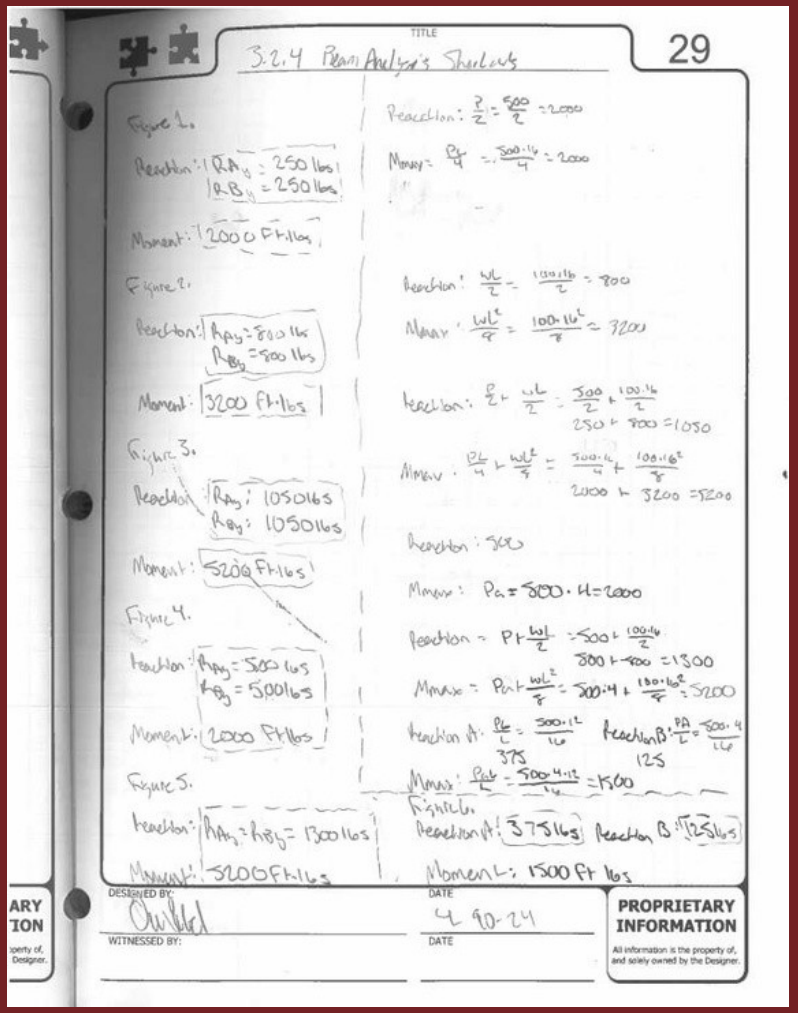


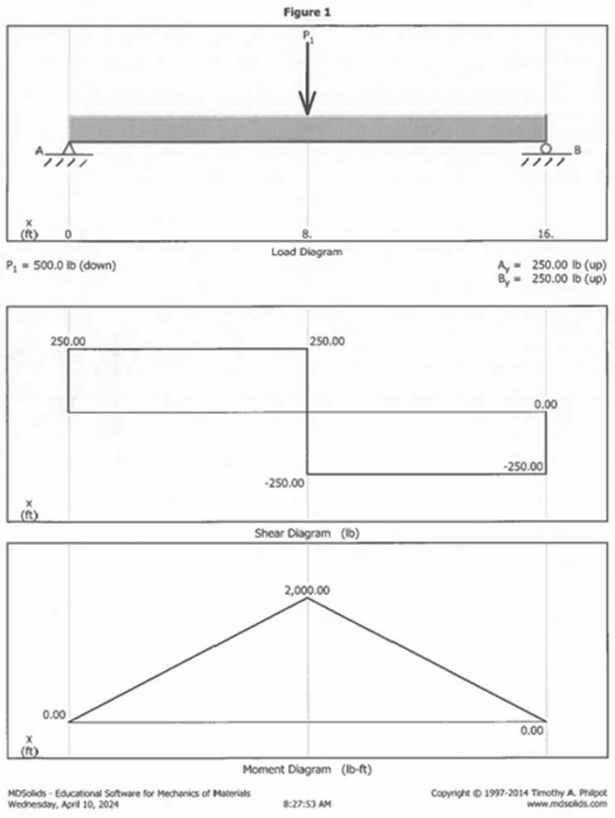


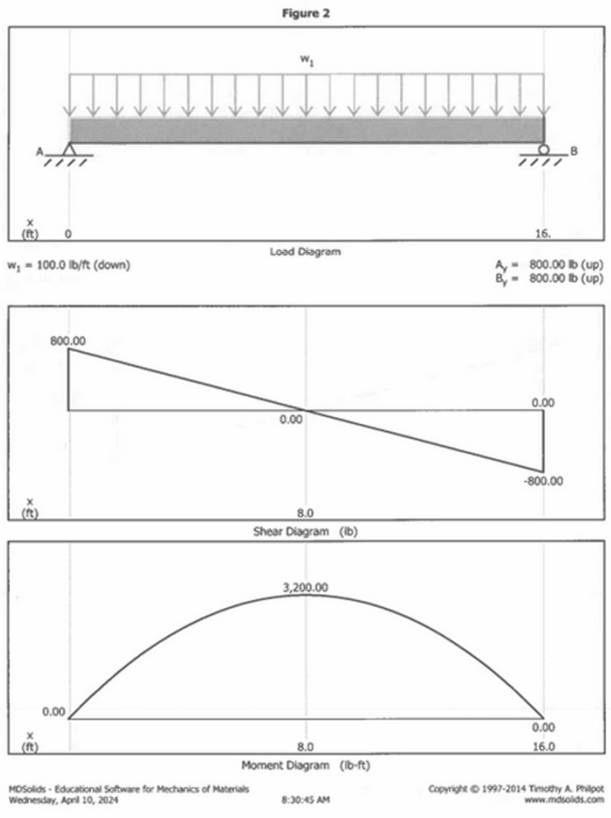
BEAM ANALYSIS

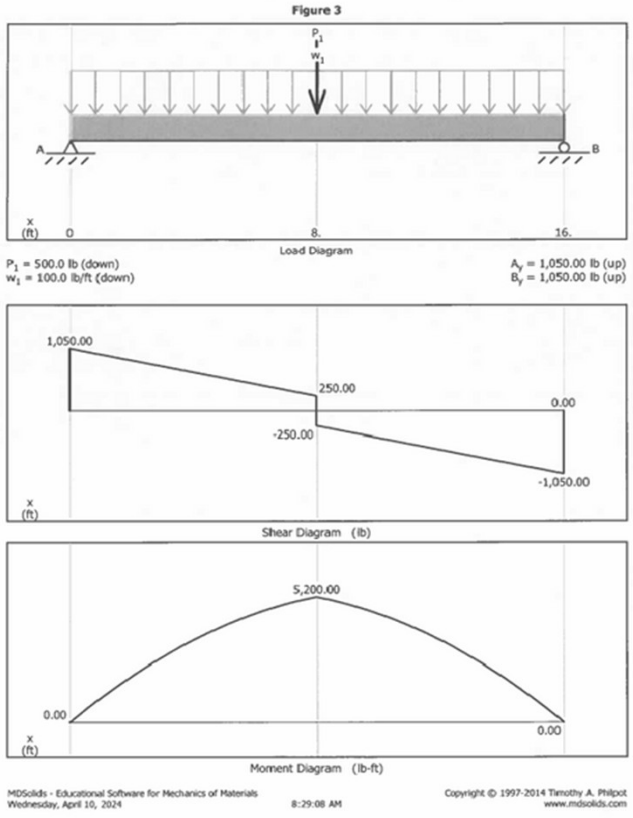
BEAM ANALYSIS SHORTCUTS

I used mathematical formulas to simplify the process of finding reaction forces and maximum moments. I also used MDSolids to create shear and bending moment diagrams that any engineer can analyze.

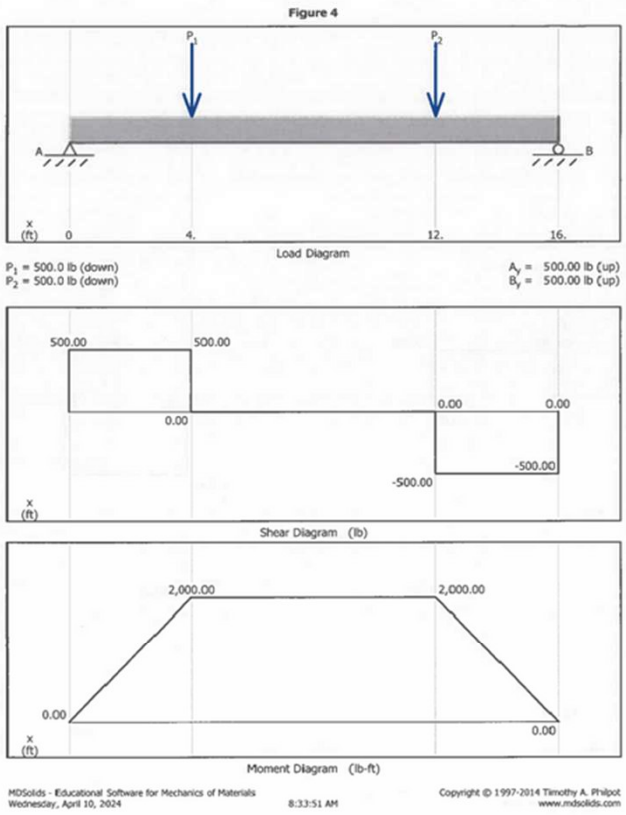


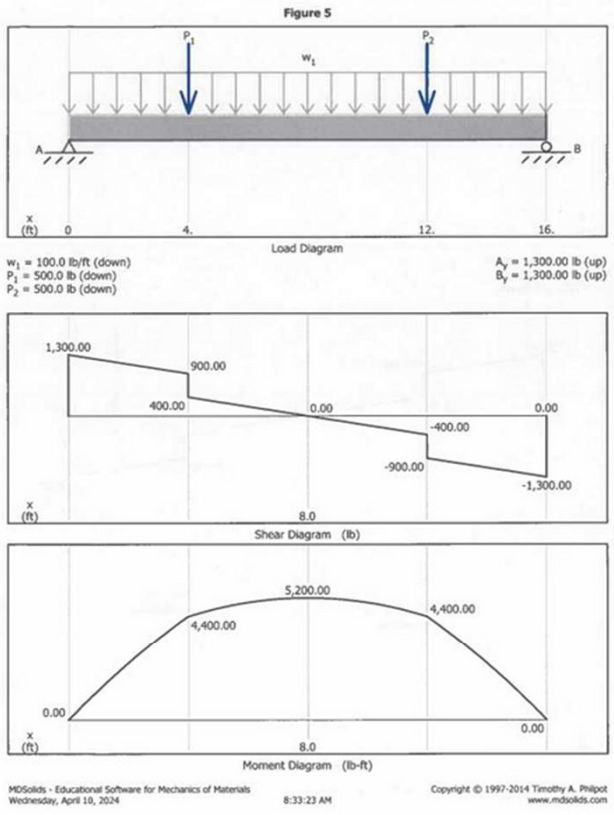


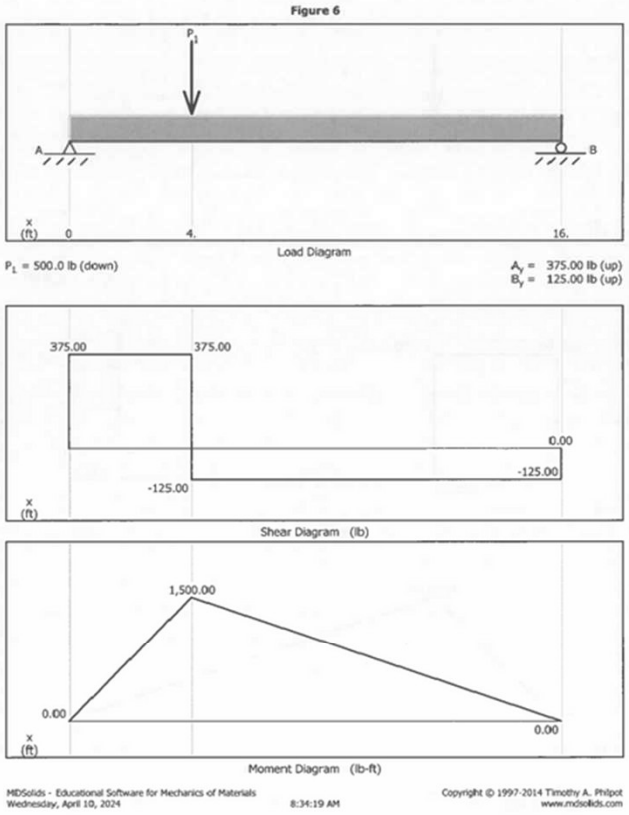




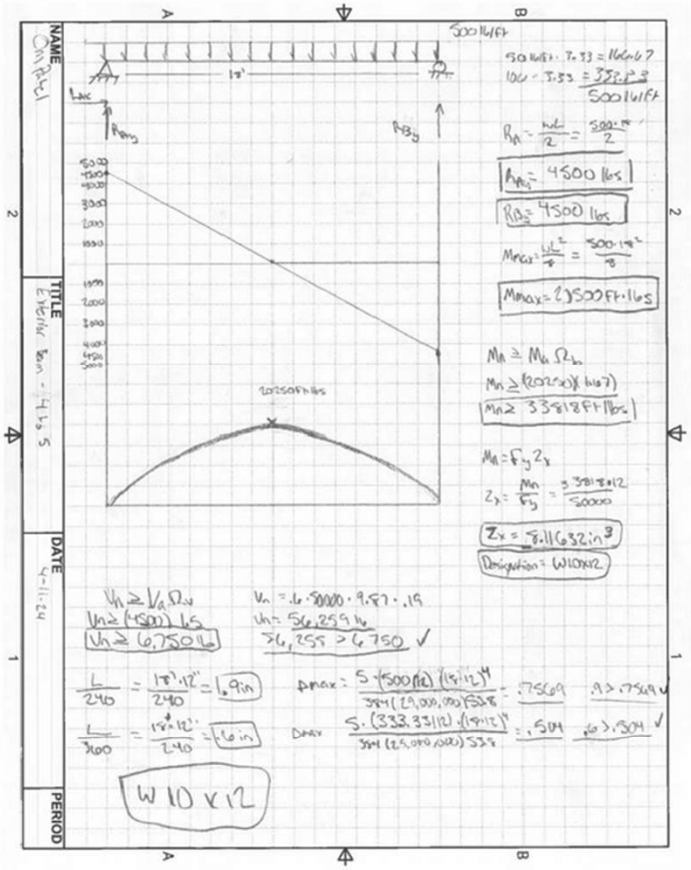
BEAM ANALYSIS SHORTCUTS

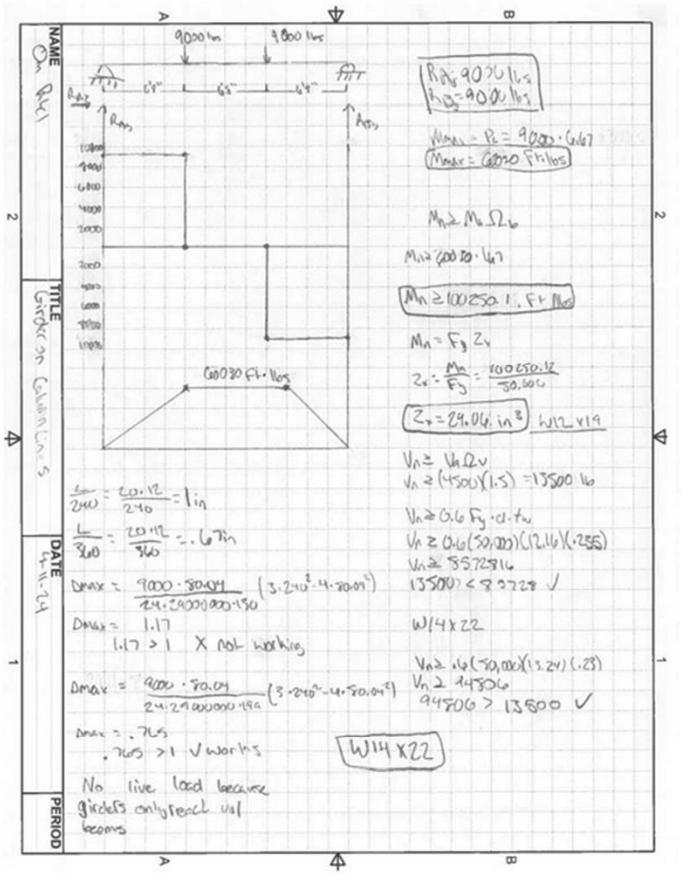


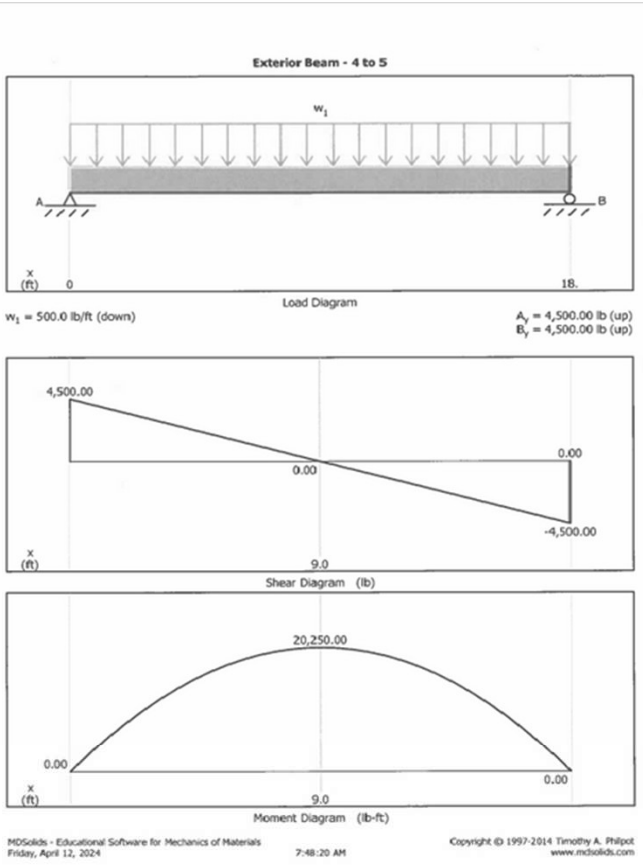




BEAM ANALYSIS SHORTCUTS

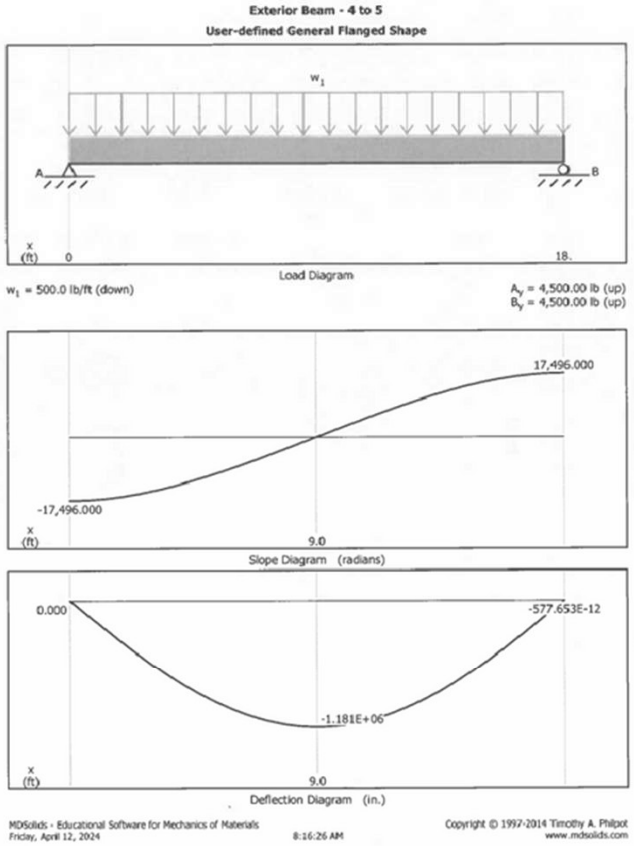






BEAM DESIGN

Selecting a cost-effective beam design that will provide enough shear and bending strength to limit deflection, using beam analysis methods.


Exterior Beam - 4 to 5
User-defined General Flanged Shape
w1
A
B
x (ft)
0
18.
Load Diagram
w1 = 500.0 lb/ft (down)
Ay = 4,500.00 lb (up)
By = 4,500.00 lb (up)
17,496.000
-17,496.000
9.0
Slope Diagram (radians)
0.000
-577.653E-12
-1.181E+06
Deflection Diagram (in.)
MDSolids - Educational Software for Mechanics of Materials
Friday, April 12, 2024
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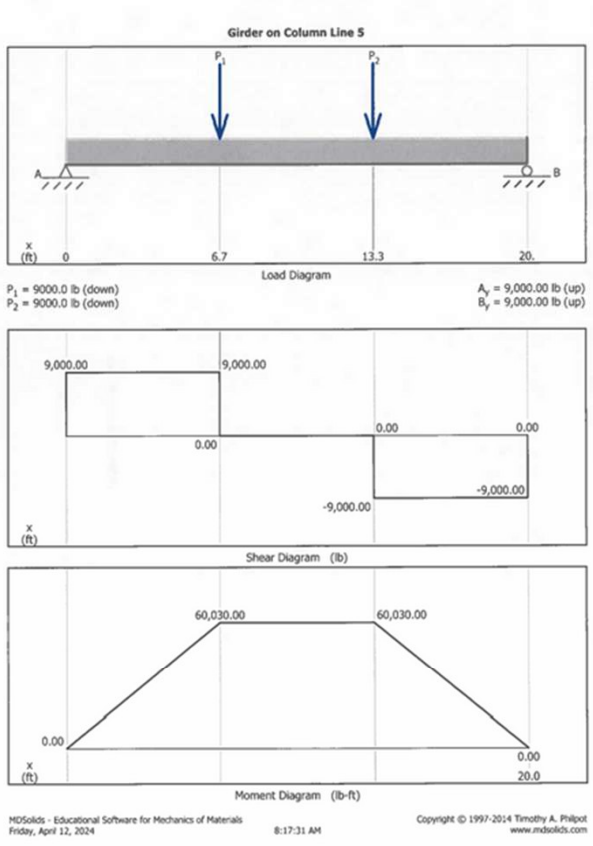
Girder on Column Line 5
P1
P2
A
B
x (ft)
0
6.7
13.3
20.
Load Diagram
P1 = 9000.0 lb (down)
P2 = 9000.0 lb (down)
Ay = 9,000.00 lb (up)
By = 9,000.00 lb (up)
9,000.00
9,000.00
0.00
0.00
0.00
-9,000.00
-9,000.00
Shear Diagram (lb)
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60,030.00
0.00
0.00
Moment Diagram (lb-ft)
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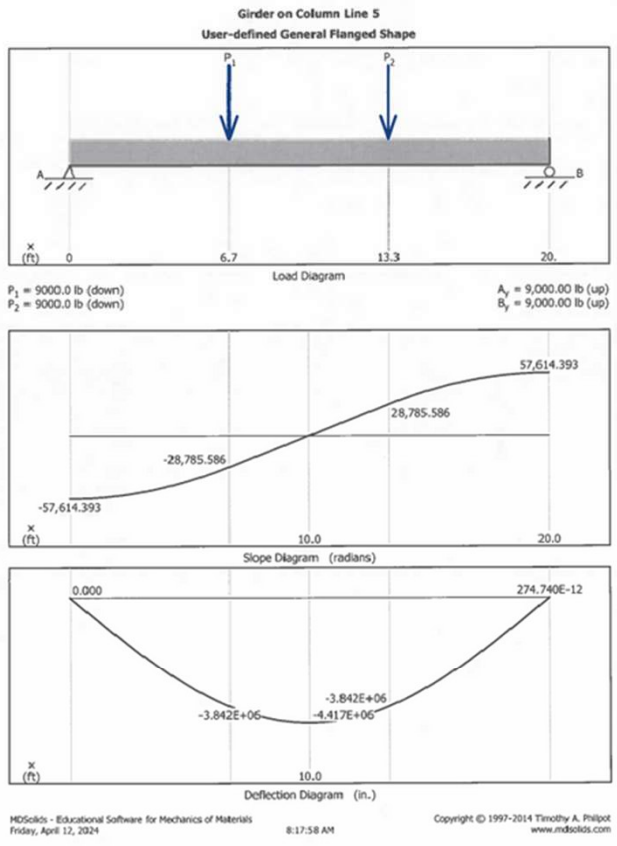
Girder on Column Line 5
User-defined General Flanged Shape
P1
P2
A
B
x (ft)
0
6.7
13.3
20.
Load Diagram
P1 = 9000.0 lb (down)
P2 = 9000.0 lb (down)
Ay = 9,000.00 lb (up)
By = 9,000.00 lb (up)
57,614.393
28,785.586
-28,785.586
-57,614.393
10.0
20.0
Slope Diagram (radians)
0.000
274.740E-12
-3.842E+06
-3.842E+06
-4.417E+06
Deflection Diagram (in.)
MDSolids - Educational Software for Mechanics of Materials
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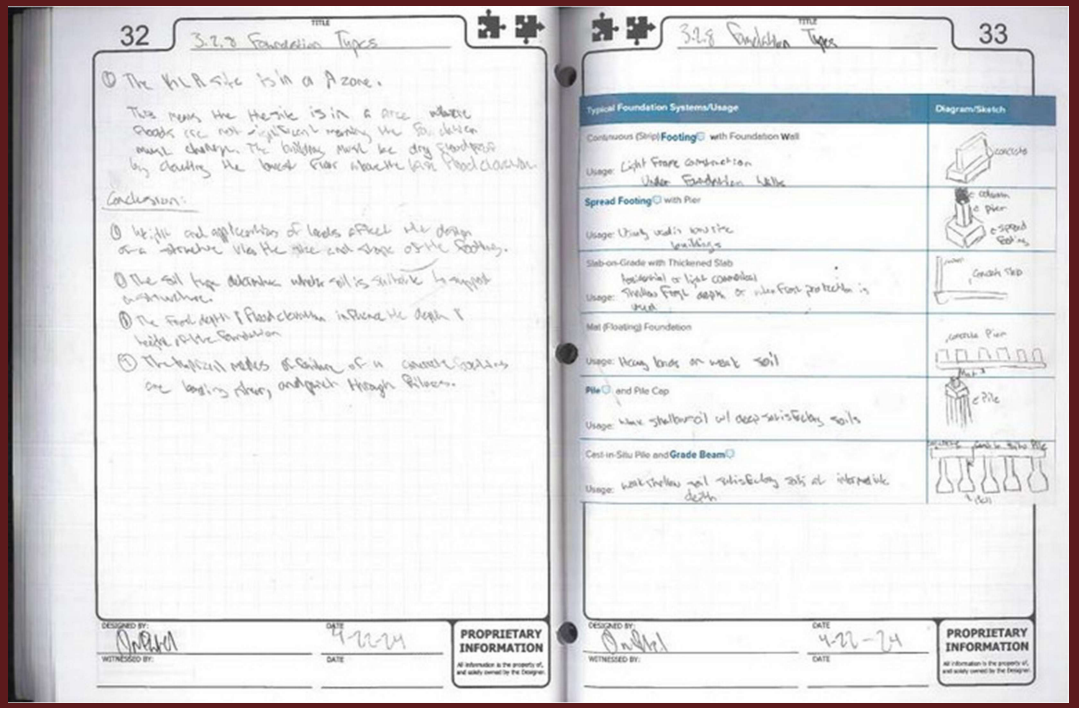
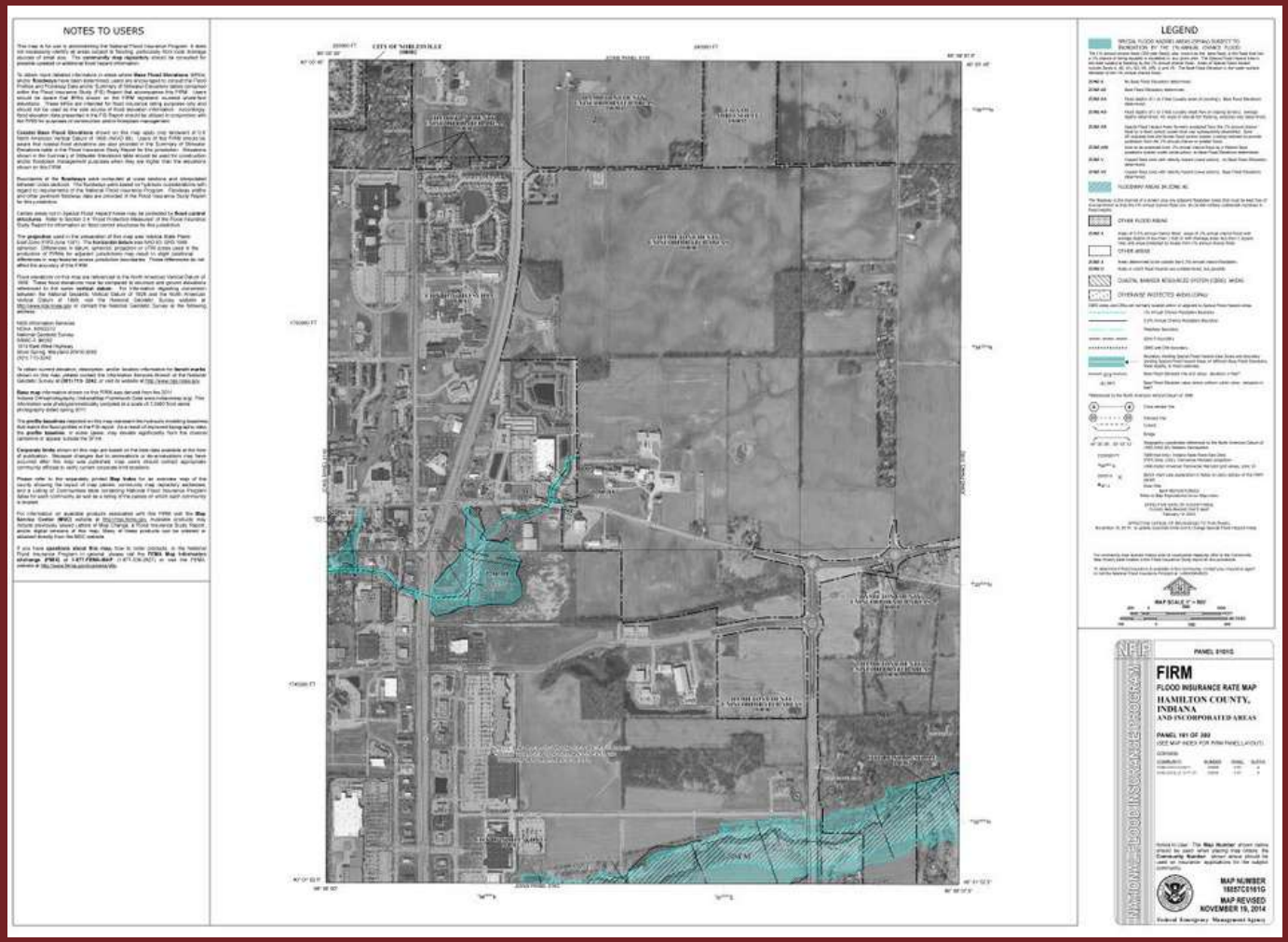
BEAM DESIGN

FOUNDATION TYPES AND CONSIDERATIONS

Investigated soil and environmental conditions for a site to provide the information necessary to select one of the many foundation types

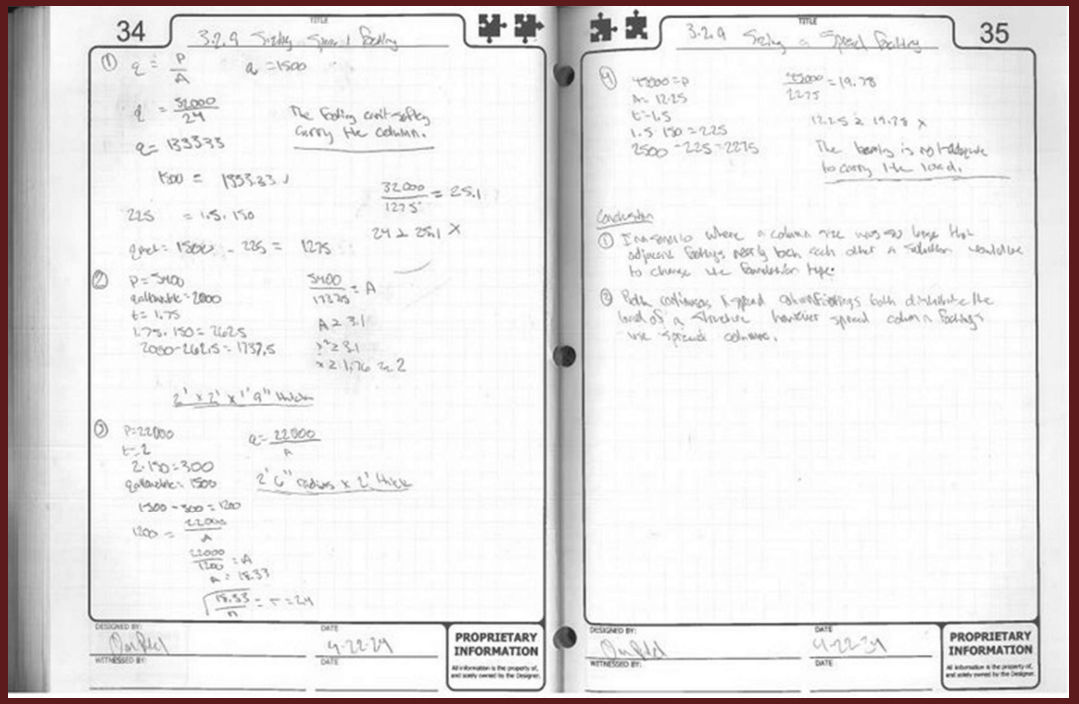


FOUNDATION TYPES AND CONSIDERATIONS



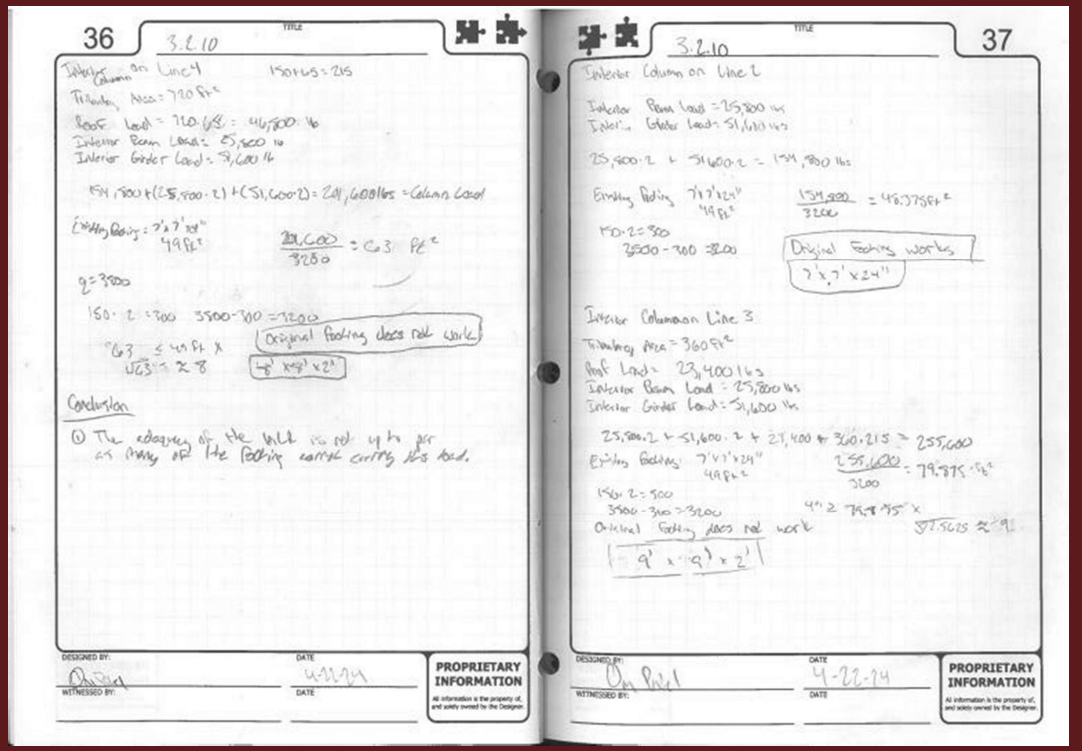
SIZING A SPREAD FOOTING

I used the site-specific soil information to size spread footings for several different buildings

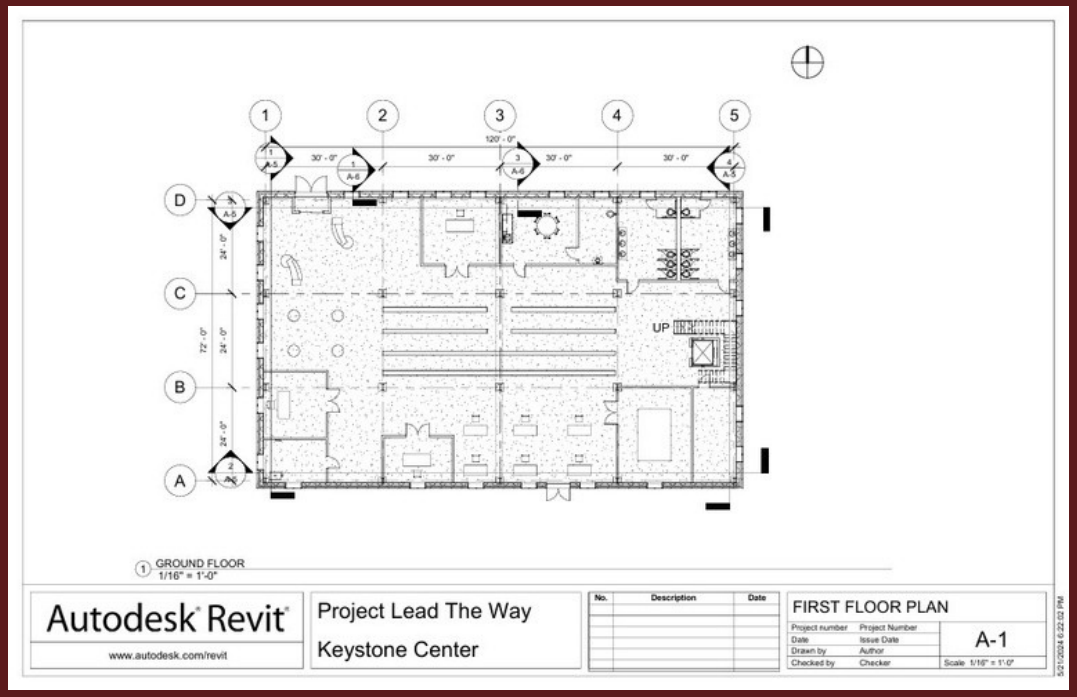


KEYSTONE LIBRARY SPREAD FOOTING ANALYSIS

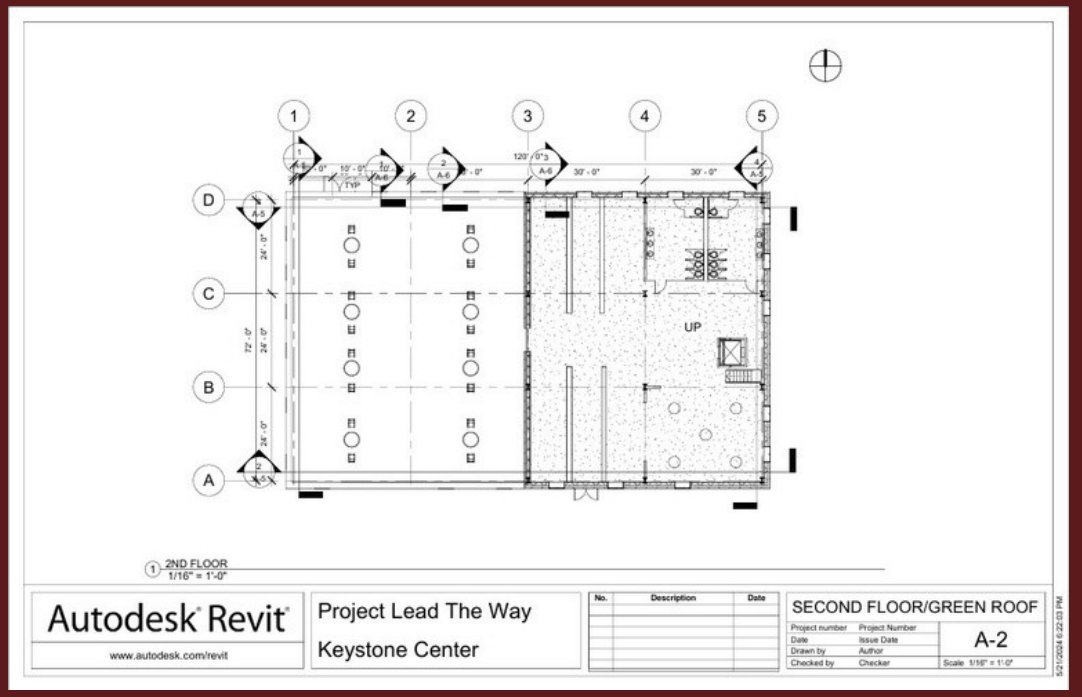
Checked the existing footings on the Keystone Library site, in which I found that many needed to be replaced to adequately support the columns and building.



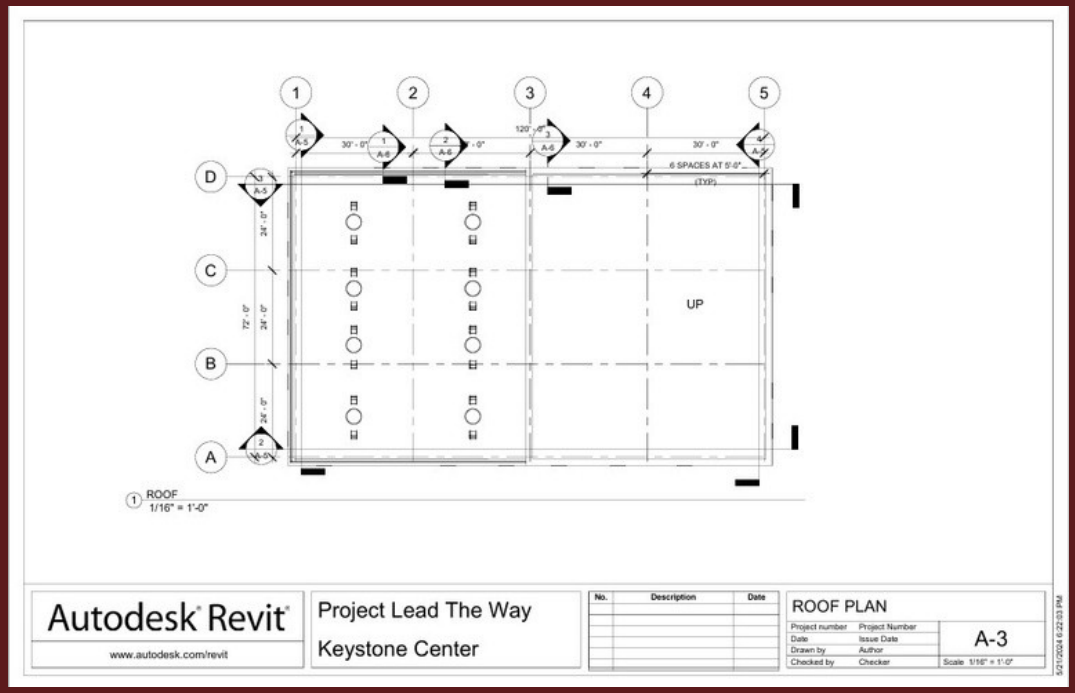
A-1 FIRST FLOOR PLAN



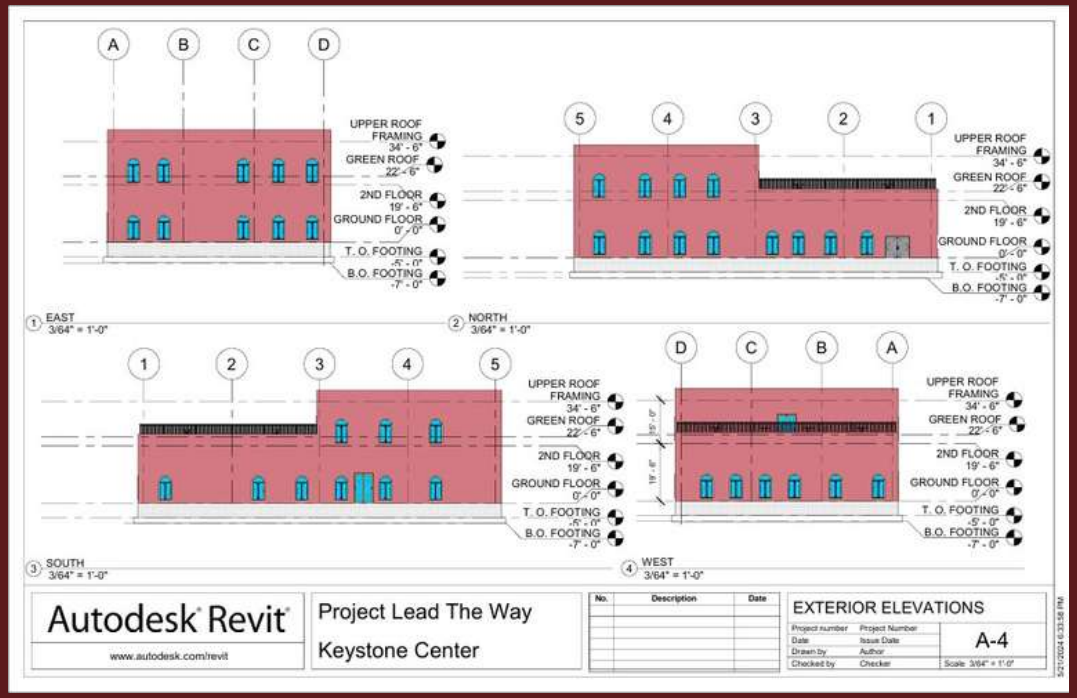
A-2 SECOND FLOOR PLAN



A-3 ROOF PLAN


1
2
3
4
5
D
C
B
A
30' - 0"
30' - 0"
30' - 0"
6 SPACES AT 5'-0"
(TYP.)
UP
1 ROOF
1/16" = 1'-0"
Autodesk Revit
www.autodesk.com/revit
Project Lead The Way
Keystone Center
No.
Description
Date
ROOF PLAN
Project number
Project Number
Date
Issue Date
Drawn by
Author
Checked by
Checker
A-3
Scale 1/16" = 1'-0"

A-4 EXTERIOR ELEVATIONS



A-5 INTERIOR ELEVATIONS

A-6 SECTION VIEWS