ADMINISTRATION BUILDING

Justin Purcell
Structural Option
Advisor: Dr. Hanagan

PRESENTATION OUTLINE

- Building Background
- Existing Structural System
- Proposal
- Proposed Structural System
- Cost and Schedule Analysis
- Electrical Redesign
- Conclusions
- Questions and Comments

PROJECT BACKGROUND

BUILDING INFORMATION

- Owner: Confidential Client
- Location: Pennsylvania
- Building Type: Office and Specialty Amenity Spaces
- Size: 311,905 S.F.
- Stories: 5/4 Above Grade
- F-F Height: 20’ For Ground Floor, 13.33’ For Floors 1-5
- Building Height: 87’
- Construction Dates: 10/22/01-7/24/03

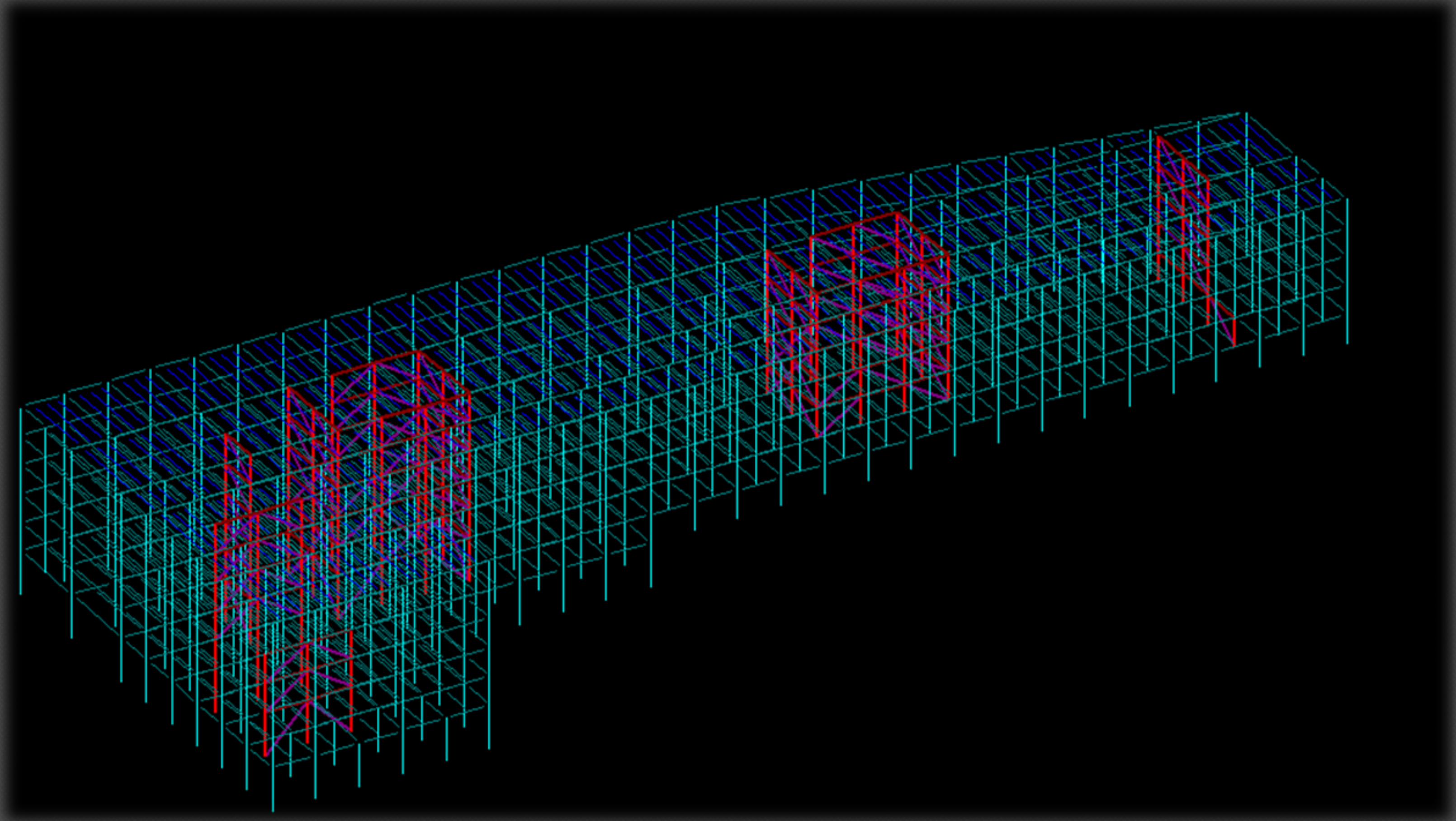
KEY PLAYERS

Architect: KlingStubbins

CM: Skanska

Engineer: KlingStubbins

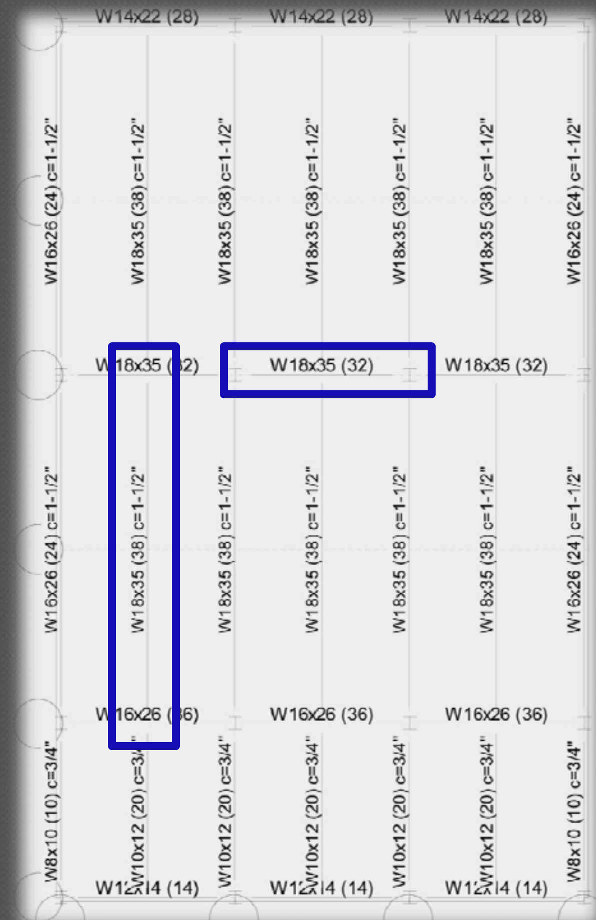
EXISTING STRUCTURAL SYSTEM



GRAVITY SYSTEM

- 3 ¼ " Lightweight Concrete Slab,

  4,000 PSI Concrete Strength
- 3" Composite Metal Deck
- W18x35 Composite Beams-40'
- W18x35 Composite Girders-20'
- W12x96 Columns-13.33'

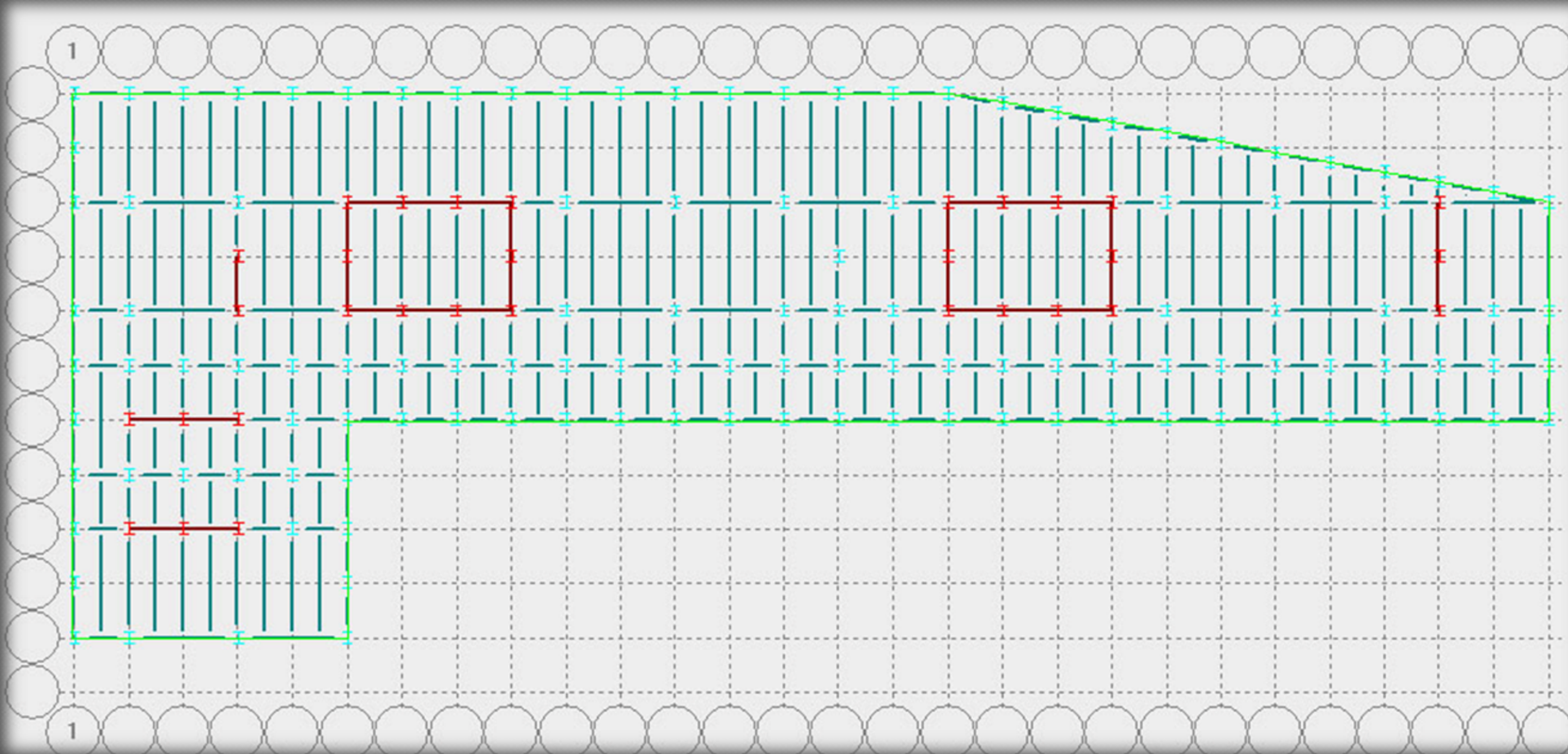


GRAVITY DESIGN LOADS

LIVE LOAD	
FLOOR:	100 PSF
ROOF:	150 PSF

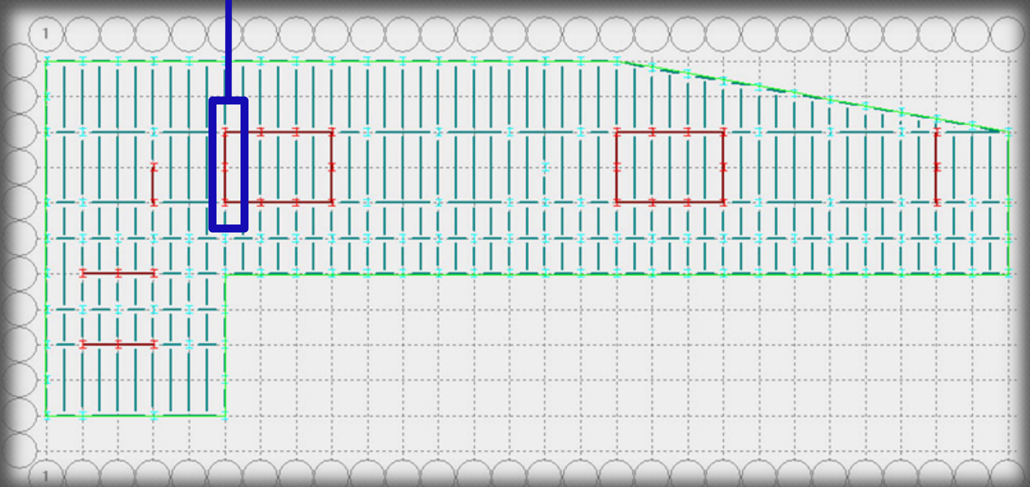
FLOOR DEAD LOAD	
CONCRETE SLAB:	35 PSF
SUPERIMPOSED:	30 PSF
STEEL STRUCTURE	15 PSF
EXTERIOR BRICK TRUSS PANEL	40 PSF

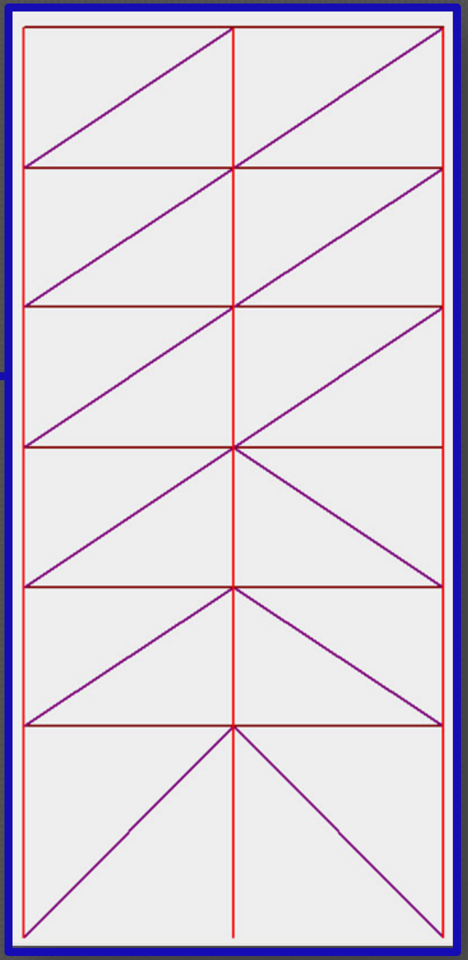
TYPICAL FLOOR



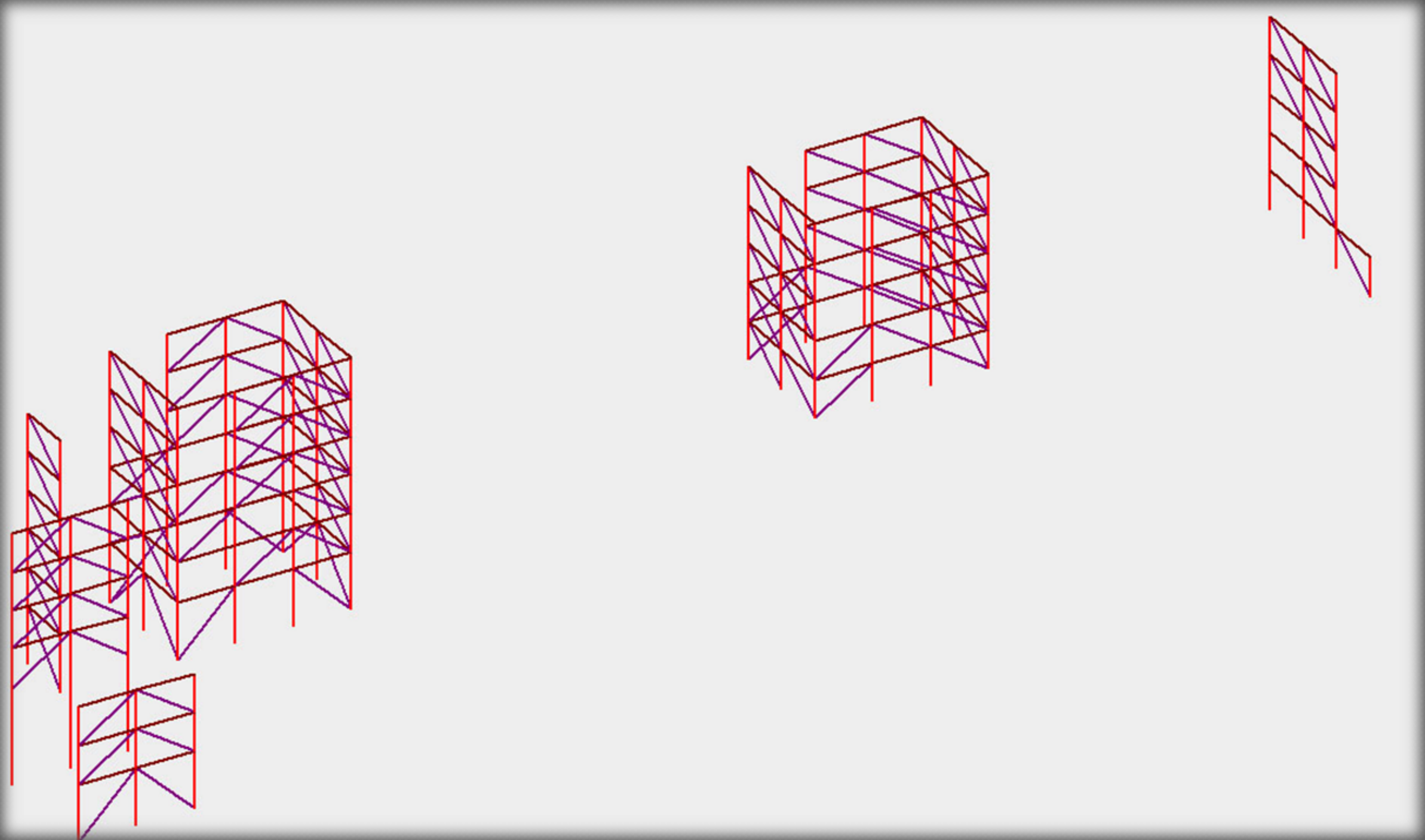
LATERAL SYSTEM

- Braced Frames (Frames in Red)
- HSS 8x6x½ Braces
- Coordinated With Mechanical Distribution





BRACED FRAMES



PROPOSAL

GOALS

- Change Existing Structural System To A One-Way Slab, CIP Concrete System
- Estimate Cost Of Existing And Proposed Structural System
- Estimate Schedule Of Both Systems
- Redesign Electrical System To Limit The Number Of Transformers

STRUCTURAL REDESIGN

DESIGN PROCEDURE

- ASCE 7-05
- ACI 318-02
- CRSI 2002 Design Manual
- E-TABS
- Unit Strip Method
- PCA Slab And Column
- Hand Calculations

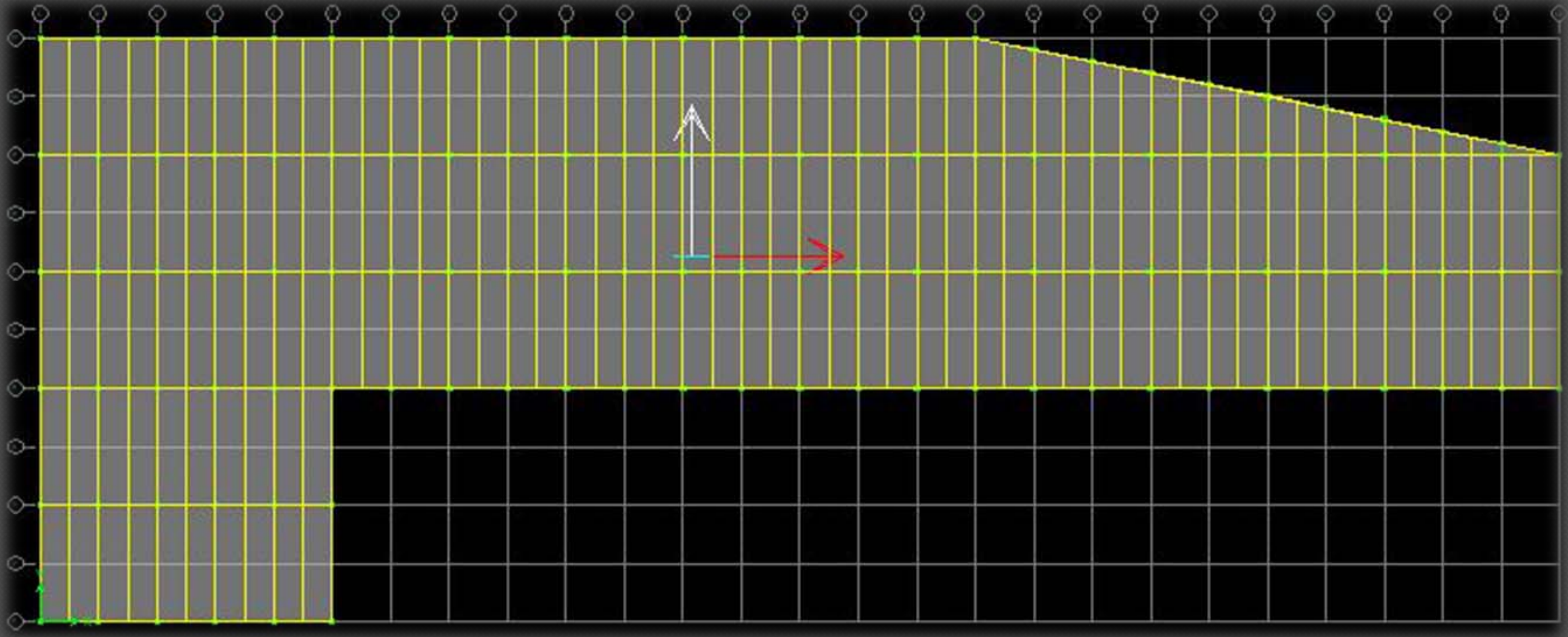
STRUCTURAL OVERVIEW

- 6" Normal Weight Concrete Slab-CIP
- 16" x 28" CIP Beams
- 20" x 26" CIP Girders
- 20" x 30" CIP Columns
- Moment Frames
- Design Floor And Roof Loads:

DESIGN LIVE LOAD	
FLOOR LOAD:	100 PSF
ROOF LOAD:	150 PSF

DESIGN DEAD LOAD	
CONCRETE SLAB:	88 PSF
SUPERIMPOSED:	30 PSF

TYPICAL FLOOR



SLAB DESIGN

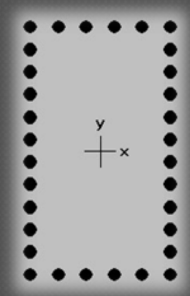
- 4000 PSI Concrete, 60 KSI Steel Reinforcing
- Minimum 5" Thick Concrete Slab Based On ACI
- 6" Thick Concrete Slab Was Used
- Pattern Loading Considered To Find Critical Moments
- Steel Reinforcing
  - Bottom: #3's @ 8" O/C (Positive)
  - Top: #4's @ 12" O/C (Negative)
  - T-S: #4's @ 15" O/C

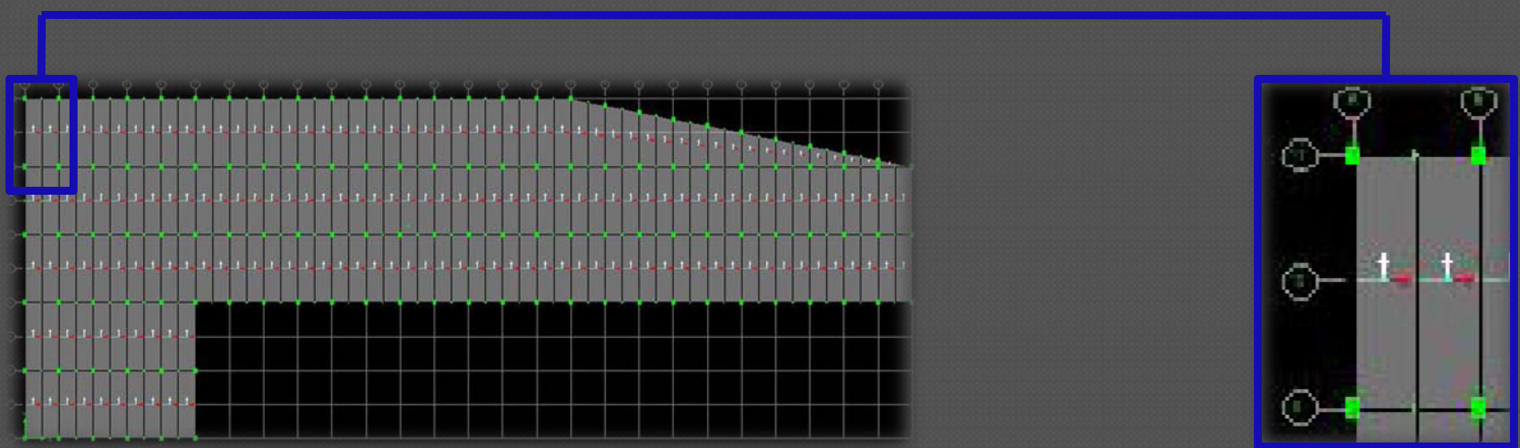
COLUMN DESIGN

- Designed For 1300 Kips and 750 K-FT
- Gravity and Lateral Loads
- Slenderness Considered Based On ACI For Lateral Loads
- 4000 PSI Concrete
- # 3 Ties

COLUMN DESIGN

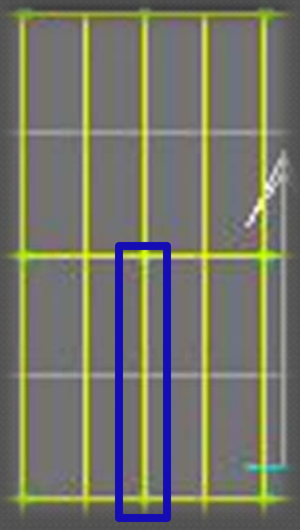
- 20" x 30" CIP Column
- 32 #10 Bars
- Oriented So That The 30" Depth Handles The Larger Wind Force In The Long Direction





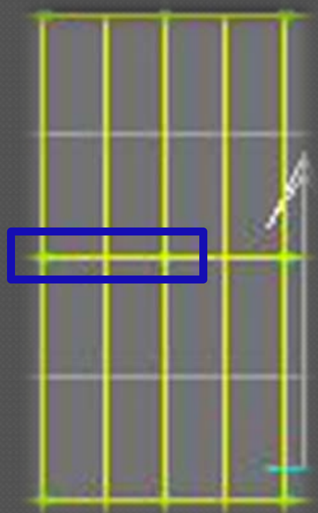
BEAM DESIGN

- Moment and Shear Coefficient Analysis
- 16" x 28" Beam
- Steel Reinforcing
  - Bottom: 2 #11's
  - Top: 2 #11's
  - Stirrups: #5's
- L/370 Deflection Ratio



GIRDER DESIGN

- Moment and Shear Coefficient Analysis
- 20" x 26" Girder
- Steel Reinforcing
  - Bottom Bars: 3 #11's
  - Top Bars: 4 #14's
  - #5 Stirrups
- L/706 Deflection Ratio

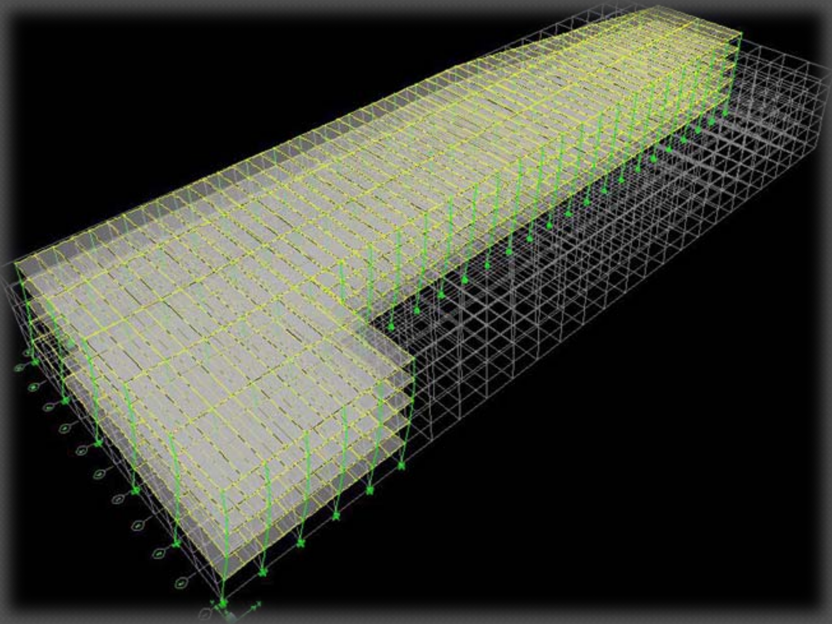


MOMENT FRAMES

- Designed To Resist Lateral Loads In Both Directions
- Achieved From CIP Monolithic Pour At Every Connection
- For Simplicity Of Lateral System And Ease Of Construction, Every Column And Beam Connection Is A Moment Connection
- Forces Distributed By Relative Stiffness
- 32 Moment Frames
  - 6 In The Short Direction
  - 26 In The Long Direction

LATERAL DRIFT

- Combination Of Shear Deflection And Bending Deflection
- Controlled By Wind
- Drift Found To Be Less Than 1" In Both Directions
  - 0.2" In Long Direction
  - 0.15" In Short Direction



ADVANTAGES OVER EXISTING STRUCTURAL SYSTEM

- Floor Depth Savings: 5”
- Beam Deflection Savings: 0.7”
- Girder Deflection Savings: 0.4”
- # Of Column Savings: 76
- Drift Savings: 0.37”

COST AND SCHEDULING

EXISTING STRUCTURAL SYSTEM

- Cost Estimate #1: $8.62 Million
  - Estimate Based On G.C.'s Suggestions And Feedback
- Cost Estimate #2: $7.71 Million
  - Estimate Based On R.S. Means 2008
  - Detailed Estimate Based On Takeoff Per L.F. Of Steel
- Cost Estimate #3: $8.67 Million
  - Estimate Based On R.S. Means 2008
  - Generic Steel Estimate Based On A 3-6 Story Steel Building

EXISTING STRUCTURAL SYSTEM

- Schedule For Estimate #1: N/A
- Schedule For Estimate #2: 5 Months
- Schedule For Estimate #3: 5 Months

PROPOSED STRUCTURAL SYSTEM

- Cost Estimate #1: $13.46 Million
  - Based On R.S. Means 2008
  - Detailed Estimate Based On Takeoff
- Cost Estimate #2: $12.44 Million
  - Based On R.S. Means 2008
  - Generic Estimate Based On CIP One-Way Slab W/Beams and Columns

PROPOSED STRUCTURAL SYSTEM

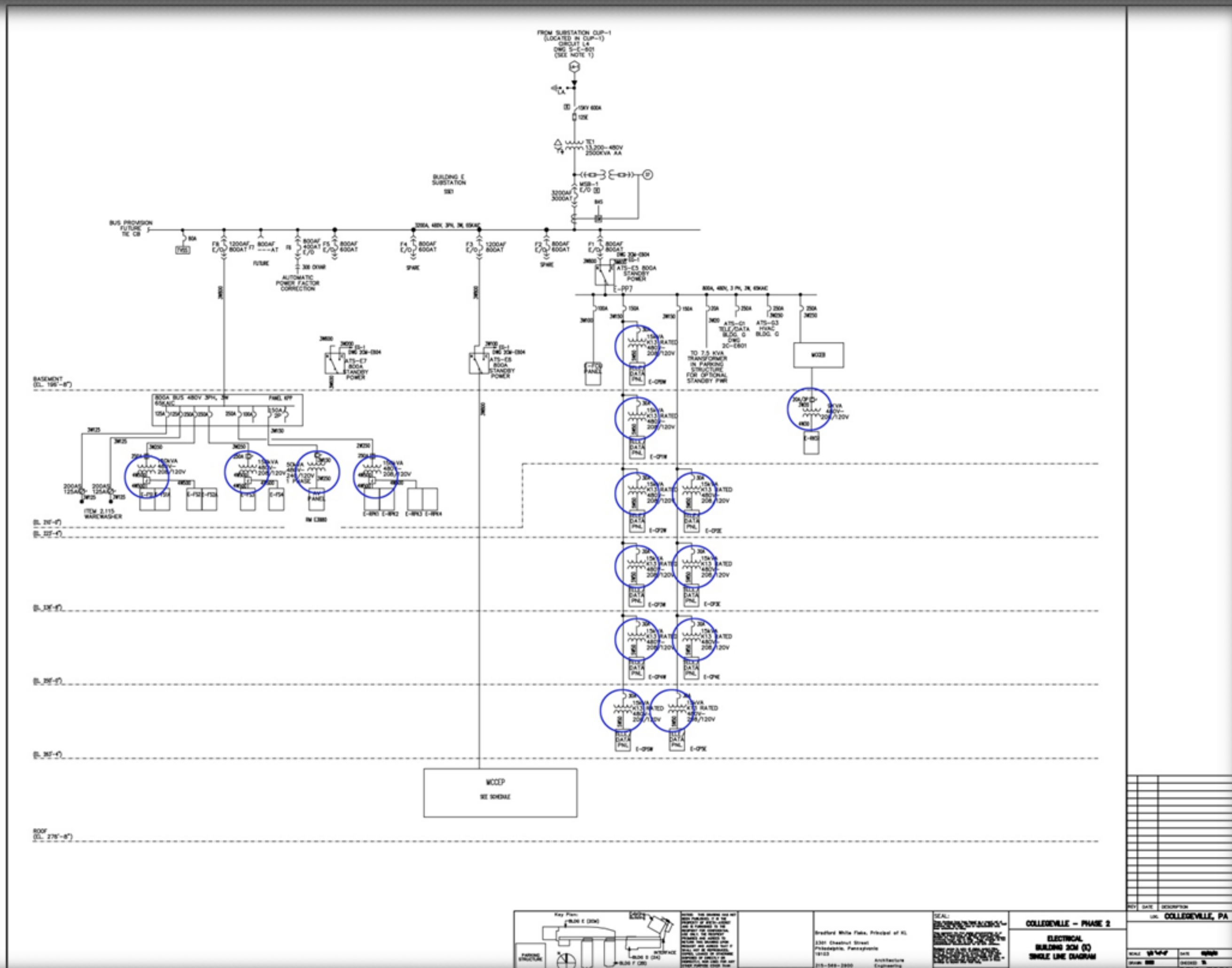
- Schedule For Estimate #1: 15 Months
- Schedule For Estimate #2: 15 Months

ELECTRICAL DESIGN

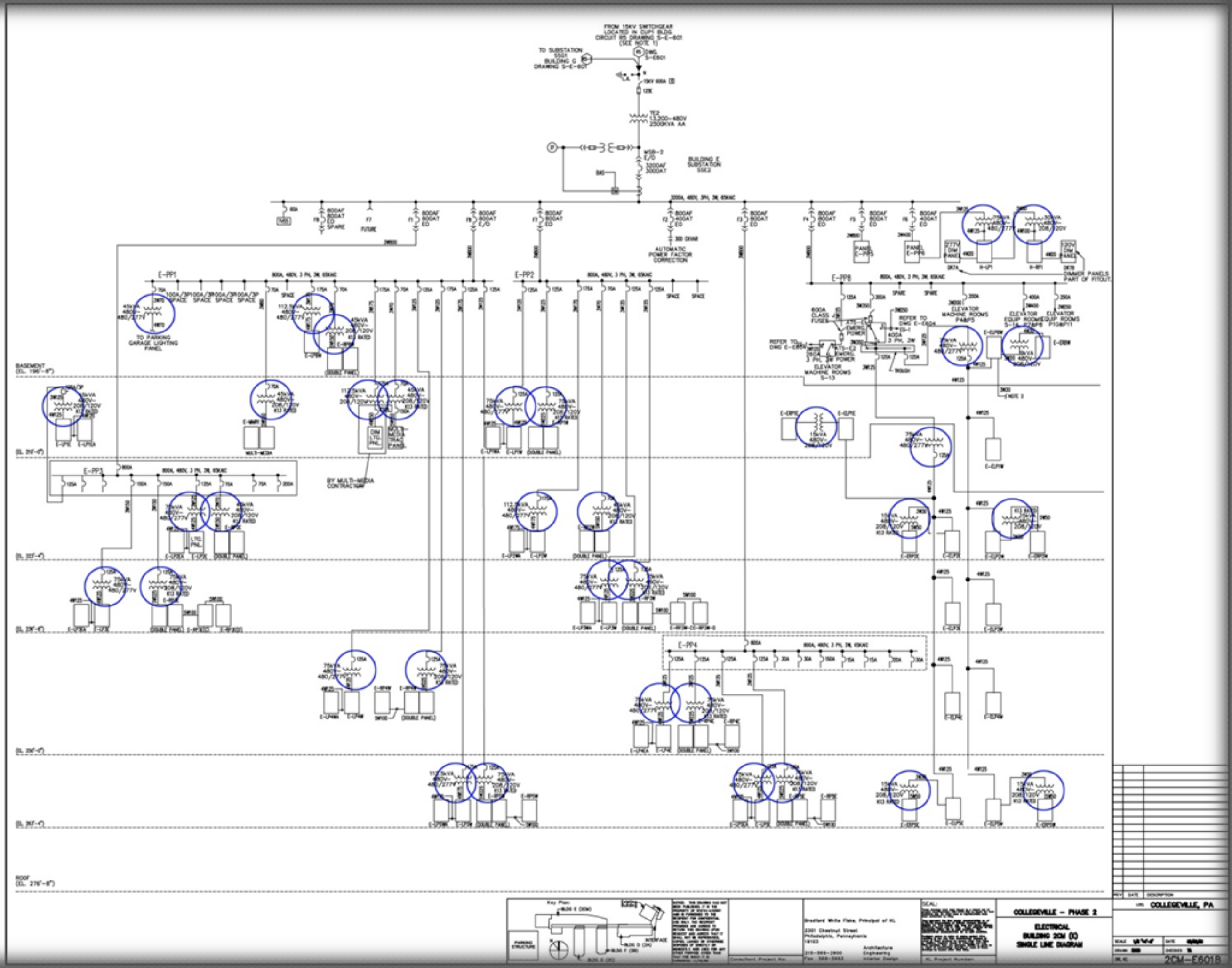
PROBLEM STATEMENT

- There Is An Excessive Amount Of Transformers
- Currently There Are 50 Transformers
- GOALS:
  - Reduce Number Of Transformers
  - Resize The Feeders

PROBLEM STATEMENT

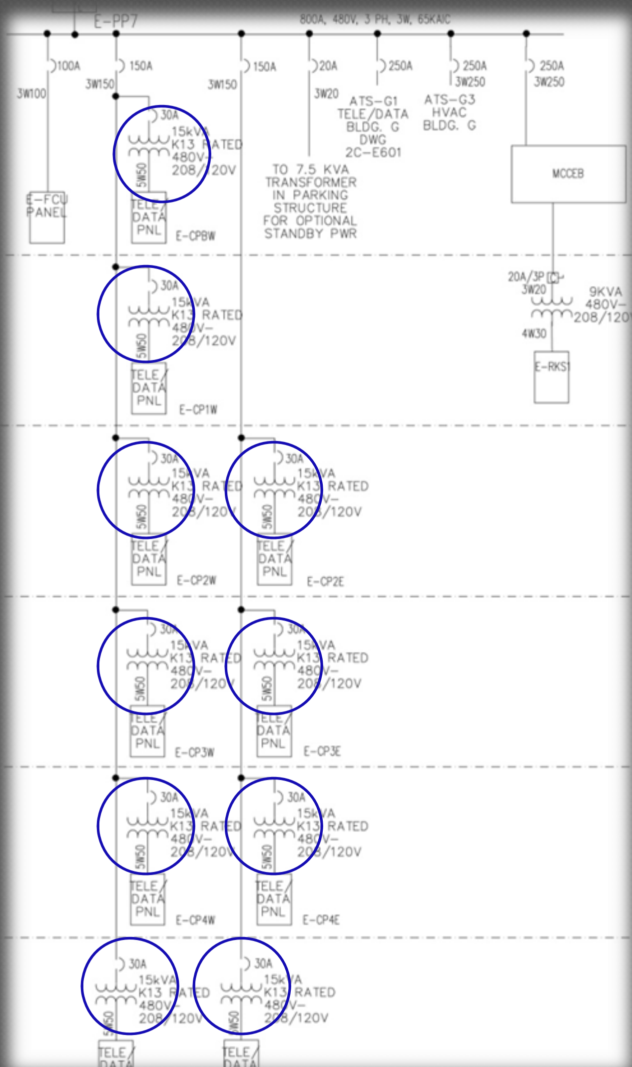


PROBLEM STATEMENT

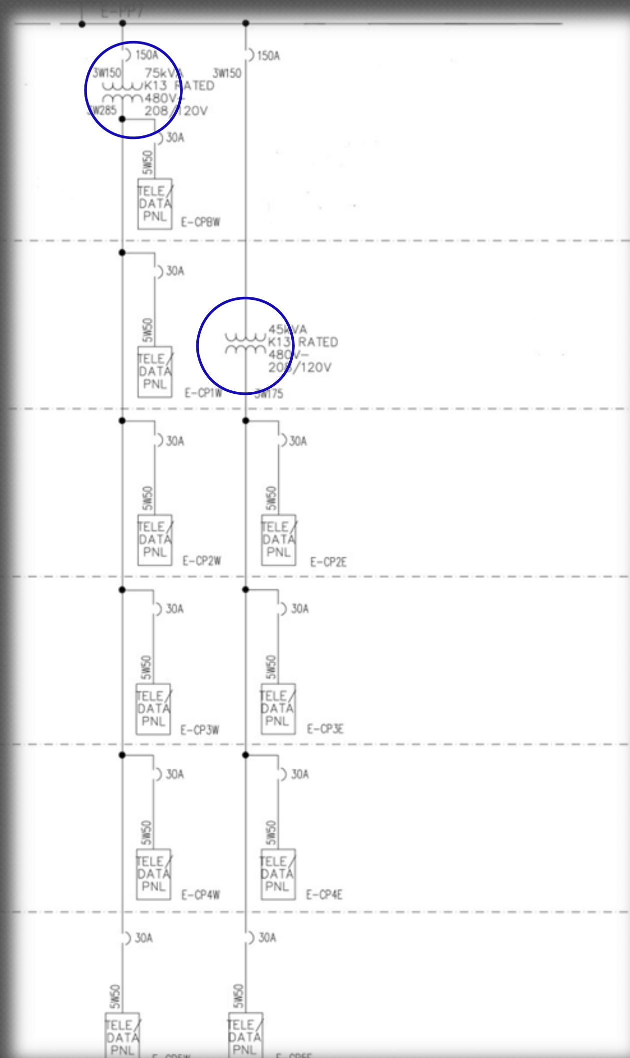


SOLUTION EXAMPLE

BEFORE:



AFTER:



SOLUTION EXAMPLE

LEFT SIDE:

- Transformer Savings: 5
- Connected Load: 53 KVA-Telecommunications
- Replaced With 75 KVA Eaton 480V-208/120V
- Replaced Feeder With 2 Sets Of 4 KcMil Wire

SOLUTION EXAMPLE

- RIGHT SIDE:
  - Transformer Savings: 3
  - Connected Load: 35 KVA-Telecommunications
  - Replaced With 45 KVA Eaton 480V-208/120V
  - Replaced Feeder With 2 Sets Of 4 KcMil Wire

REDESIGN OVERVIEW

- Transformers Before: 50
- Transformers After: 11
- Savings: 39
- Utilized Eaton 480V-208/120V Transformers

RECOMMENDATION AND CONCLUSIONS

RECOMMENDATION

- Keep Structural System As Steel

  Composite System With Braced Frames

  For The Following Reasons:

  - Cost
  - Erection Time

CONCLUSIONS

- Initial Cost Analysis Was Proven Wrong
- Recommend Keeping Existing Structural System
- Able To Reduce The Number Of Electrical Transformers

ACKNOWLEDGEMENTS

- KlingStubbins, Especially Bill Gillespie
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- Pennsylvania State University
- Fellow AE's
- My Family And Friends

QUESTIONS AND COMMENTS