West View of IRMC


# Cody A. Scheller

## Structural Option

AE Senior Thesis 2012

## Indiana Regional Medical Center
## Indiana, PA

Southeast View of IRMC

West View of IRMC


## Presentation Outline

**Introduction**
**Existing Structure**
**Thesis Goals**
**Structural Depth**
**Lighting Breadth**
**Conclusion**
**Questions & Comments**

Southeast View of IRMC

## Presentation Outline

# Introduction

Existing Structure

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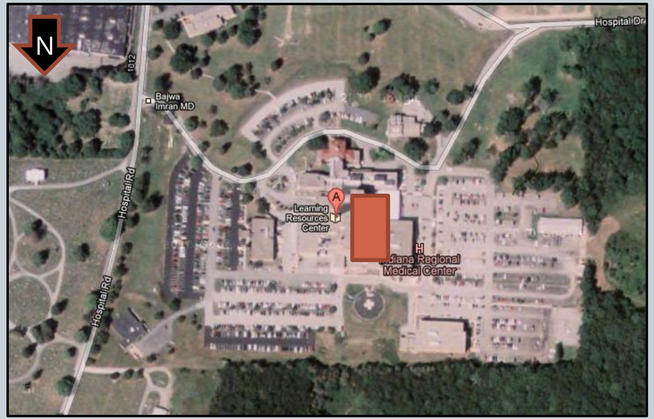
Arial View of IRMC




## Project Information

- Location: Indiana, PA
- Occupancy Type: Full-Service Medical Center
- Size: 140,000 SF
- Height: 97 Feet

## Presentation Outline

# Introduction

Existing Structure
Thesis Goals
Structural Depth
Lighting Breadth
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Arial View of IRMC


## Project Information

- Owner: Not Released
- Architect: Rea, Hayes, Large, & Suckling
- Engineer: Rea, Hayes, Large, & Suckling
- Tenant: Indiana Regional Medical Center

## Presentation Outline

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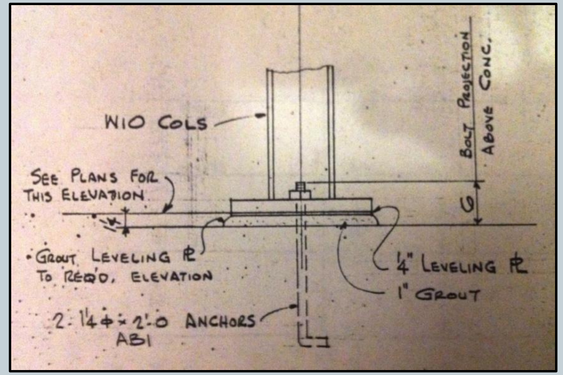
## Existing Structure

Foundation

- T-Shaped Foundation
  - 16-inch concrete footings
- Concrete Piers
  - 32-inch
  - Corners of foundation
- Anchor Bolts

Example Anchor Bolt



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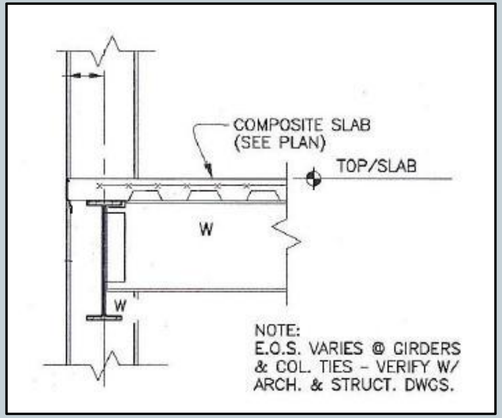
## Existing Structure

Gravity System

- Bay Size: 26’-0” x 16’-0”
  - Completely Symmetrical
- 5 ½” Composite Floor Construction
- W16x50 Fill Beams
- W14x38 Girders
- W14 Columns
  - 78 to 111 lb/ft

Example Floor System Diagram



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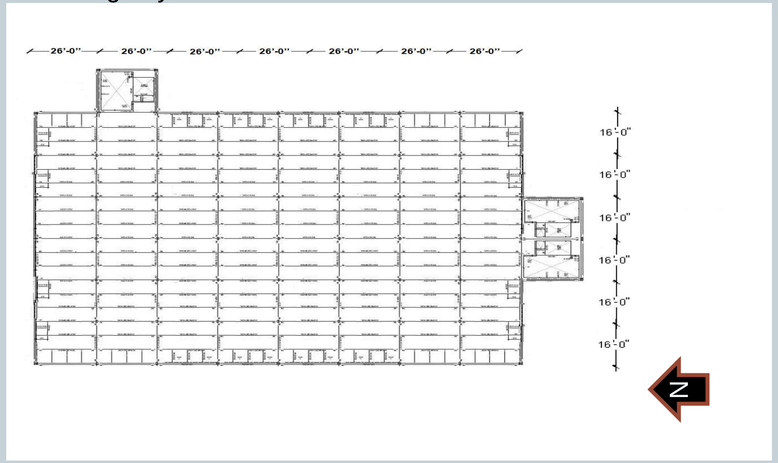
## Existing Structure

Lateral System

- Braced Frame
- Steel Moment Frame

Existing Layout



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## Thesis Goals

Structural Depth

- Redesign building with concrete
- Retain current floor plan
- Design for additional renovations

Lighting Breadth

- Determine effect on lobby/waiting room
- Redesign basic lighting system

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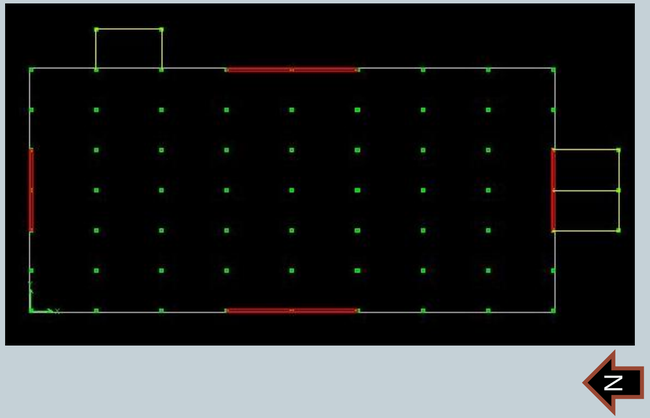
## Structural Depth

Design Process

- Initial Plan Layout
- Gravity System Design
- Lateral System Design

ETABS Model



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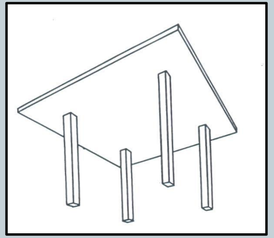
## Structural Depth

Slab Design Alternatives

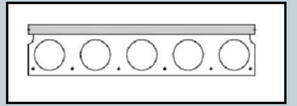
- Two-Way Flat Plate System
- Two-Way Post-Tensioned Slab
- Precast Hollow Core Planks

Two-Way Post-Tensioned

Two-Way Flat Plate



Hollow Core Planks



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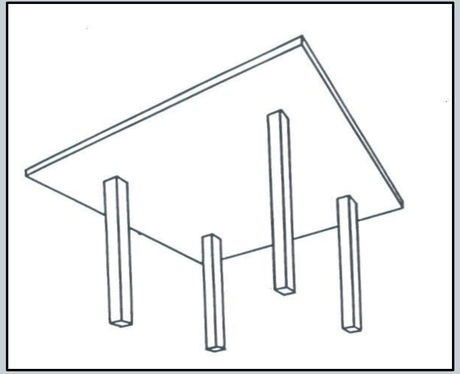
## Structural Depth

Two-Way Flat Plate Design

- 9” uniform Slab Thickness
  - L/h = 33
- Typical span length of 26’-0”
- 80 psf Live Load
- 30 psf Superimposed Dead Load
- Roof Slab = 12” thickness
- No Drop panels or interior beams

Two-Way Flat Plate System



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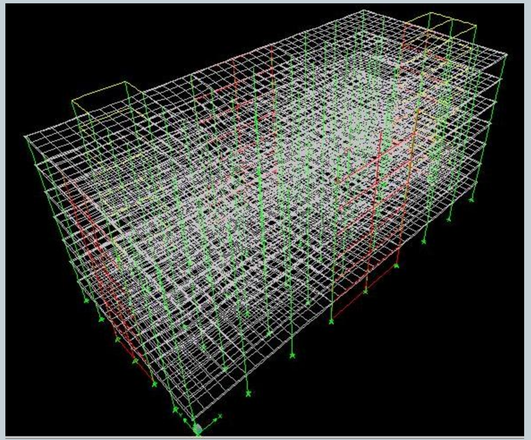
## Structural Depth

Two-Way Flat Plate Design

- 8 spans at 26’-0” each in N/S Direction
- 6 spans at 16’-0” each in E/W Direction
- Slab Reinforcement
  - Top Bars = Negative Moments
  - Bottom Bars = Positive Moments

ETABS Model



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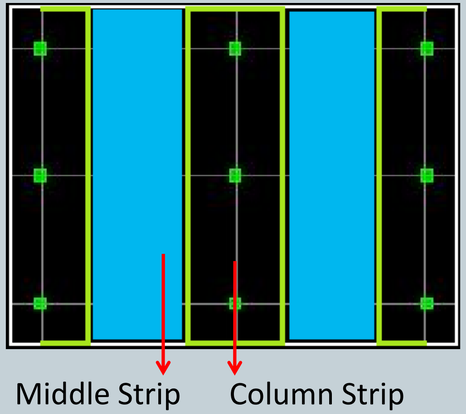
## Structural Depth

Slab Reinforcement – Frame B

- Column Strip – 8 ft width
  - 12 - #6 Top Bars - @ 10.6” o.c.
  - 6 - #6 Bottom Bars - @ 12” o.c.
- Middle Strip – 18 ft width
  - 12 - #6 Top Bars - @ 15.4” o.c.
  - 12 - #6 Bottom Bars - @ 15.4” o.c.

Frame B – 26’-0’’ Span



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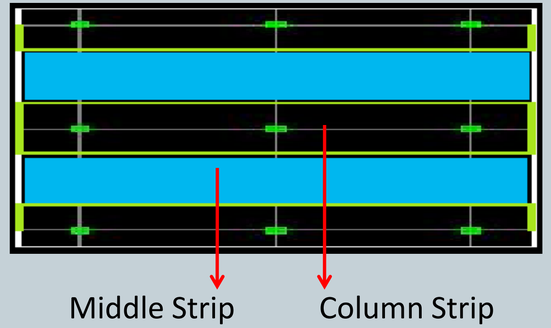
## Structural Depth

Slab Reinforcement – Frame A

- Column Strip – 8 ft width
  - 8 - #6 Top Bars - @ 6.86” o.c.
  - 6 - #6 Bottom Bars - @ 12” o.c.
- Middle Strip – 8 ft width
  - 6 - #6 Top Bars - @ 12” o.c.
  - 6 - #6 Bottom Bars - @ 12” o.c.

Frame A – 16’-0’’ Span



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## Structural Depth

Column Design

- Uniform Size throughout building
  - 20” x 20” columns
- Column Height: 13’-0” to 14’-0”
- Reinforcement:
  - 8 #9 bars vertically
  - #3 ties every 16”

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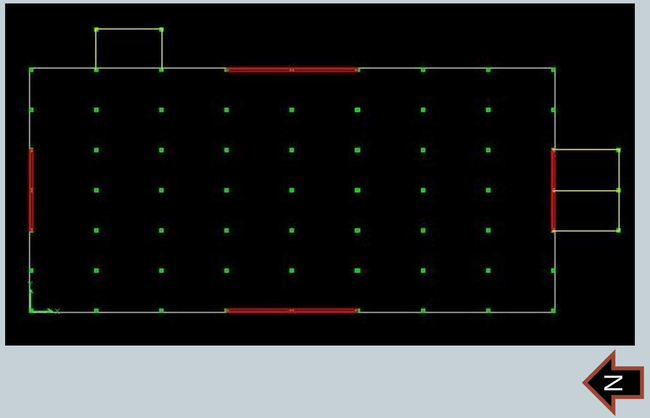
## Structural Depth

Lateral System Design

- Shear Wall Design
  - Thickness: 16”
  - Placed according to braced frames

ETABS Model



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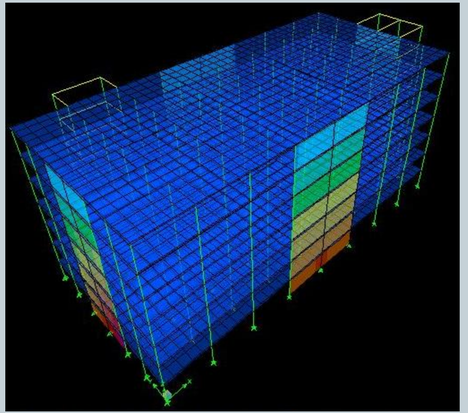
## Structural Depth

Overturning

- Building Weight: 26,000 kips
- Seismic Base Shear: 650 kips
- Wind Base Shear N/S:  519.18 kips
- Wind Base Shear E/W: 969.54 kips
- Seismic Load: 2.5% of Dead Load
- Wind Load: Overturning Moment is less than Resisting Moment



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## Structural Depth

Lateral System Deflections

- Seismic Controlled in North/South
- Wind Controlled in East/West
- Drift
  - E/W Drift Due to Wind = 0.95”
  - N/S Drift Due to Seismic = 0.113”

Lateral System Deflections Continued

- Max. Allowable Seismic Story Drift
  - 0.14” – 14 ft floor height – $0.010h_{sx}$

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## Lighting Breadth

Current Design

- Lobby/Waiting Room
- Room Dimensions: 20’-0” x 30’-0”
- Room Height: 11’-0”
- Recessed Fluorescent Lighting

New Design Changes

- Room Height: 12’-0”
- LED Lighting

Recessed Fluorescent Luminaire

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## Lighting Breadth

Design Criteria

- Target Illuminance: 10 fc – 20 fc
- CCT: neutral & warm
- CRI: 70 or higher
- Specific Tasks
- Aesthetics
- Light Distribution: Direct

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## Lighting Breadth

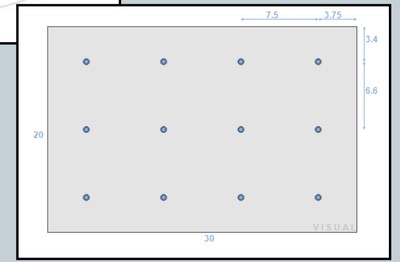
Luminaire Selection

- 6” LED Downlight
- One 31 Watt Lamp Fixture
- Installed in ceiling cavity

Lumen Method

- 14.2 footcandles with LLFs
- 12 Luminaires

6” LED Downlight




Luminaire Layout

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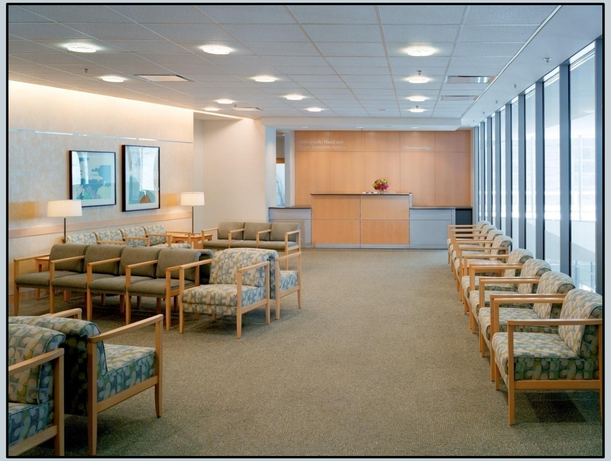
## Lighting Breadth Conclusion

New Design

- Convenience
- Functionality
- Aesthetics

Lobby/Waiting Room Photo



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## Conclusions

The redesign of the structural system from steel to concrete was effective, but not as efficient.

Symmetry of the building plan was preserved.

Foundation system would need redesigned from the effects of the new building weight.

Change in floor-to-floor heights will result in new lighting designs in some areas.

# Acknowledgments


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- Norman Ziemer – Facility Engineer
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- Robert Holland – Professor
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- AE Class of 2012

West View of IRMC


# Questions & Comments

Southeast View of IRMC