

# AC Hotel Philadelphia

## (Notebook Submission B)

Jesse Bordeau

Structural Option

Thesis Advisor: Heather Sustersic

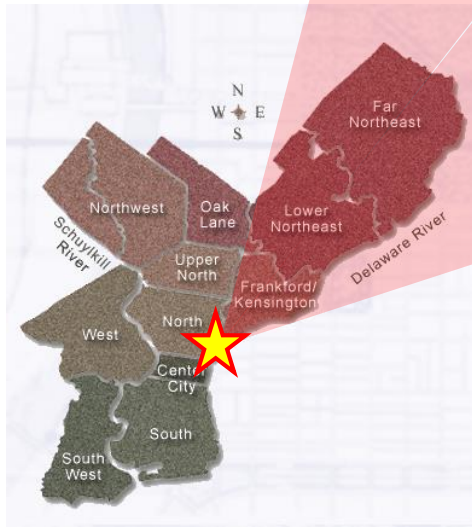
# Overview

- ▶ Site Location & Building Information
- ▶ Existing Structural System
- ▶ Typical Bay & Spot Checks
- ▶ Alternative Systems & Comparison

# Site Location - 230 North 13<sup>th</sup> St, Philadelphia, Pa



- ▶ Northwest of Center City
- ▶ Enclosed by Clarion St., Florist St. and 13<sup>th</sup> St.



# Building Information

- ▶ Prior use
  - ▶ NFL Film Studio
  - ▶ Warner Bros. Distribution Center
  - ▶ Big Brothers Big Sisters' National Headquarters (most recent)
- ▶ Height: 192' above grade
- ▶ Size: 107,680 sq.ft.
- ▶ Occupancy: Residential transient hotel
- ▶ Features
  - ▶ Valet parking via car elevator
  - ▶ 150 guest room units
  - ▶ Restaurant, fitness center & indoor pool
  - ▶ Green Roofs (Intensive & Extensive)



Courtesy of google images



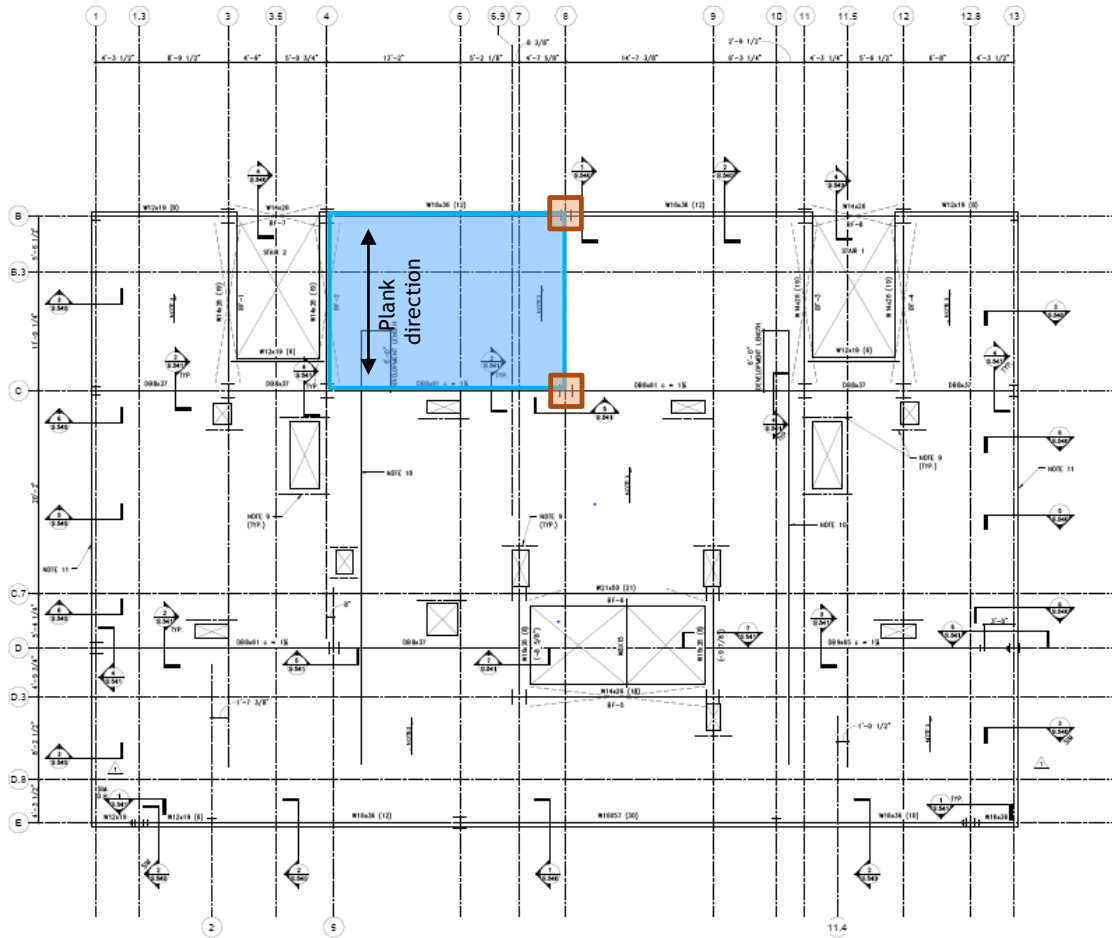
# Historic Building

- ▶ 31' tall
- ▶ Load-bearing masonry walls

# Proposed (New) Structural System

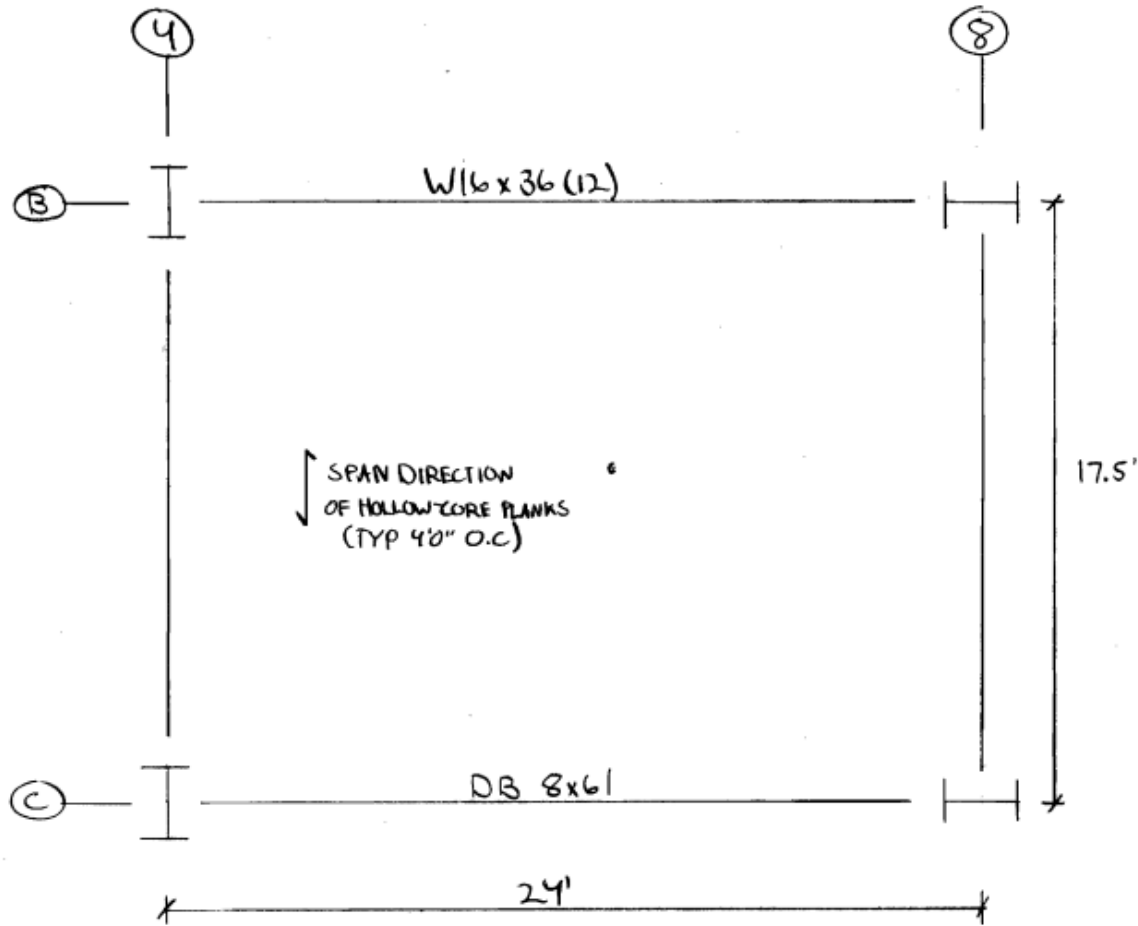
- ▶ Foundation
  - ▶ Mat Slab (varying thickness)
- ▶ Framing
  - ▶ Girder Slab (composite)
    - ▶ Precast hollow-core planks (4'0" typ.) on dissymmetrical beam (D-Beam, DB) girders, wide flange girders at perimeter
- ▶ Columns/Lateral
  - ▶ Lower levels- concrete columns & concrete shear walls
  - ▶ Upper levels- steel (wide flange) columns & concentric braced frames

# Typical Bay



- ▶ Bay sizes vary
- ▶ Typ. Bay
  - ▶ 17.5'x24' (420 sq.ft.)
- ▶ 8" hollow-core planks w/ 2" topping
- ▶ D-Beam girders at interior
  - ▶ DB: 8x37, 8x61
- ▶ Wide flange girders at perimeter
  - ▶ W: 12x19, 16x36, 16x57
- ▶ Spot Checks
  - ▶ Bay- Column Lines: 4-8, B-C
  - ▶ Columns: B8 & C8

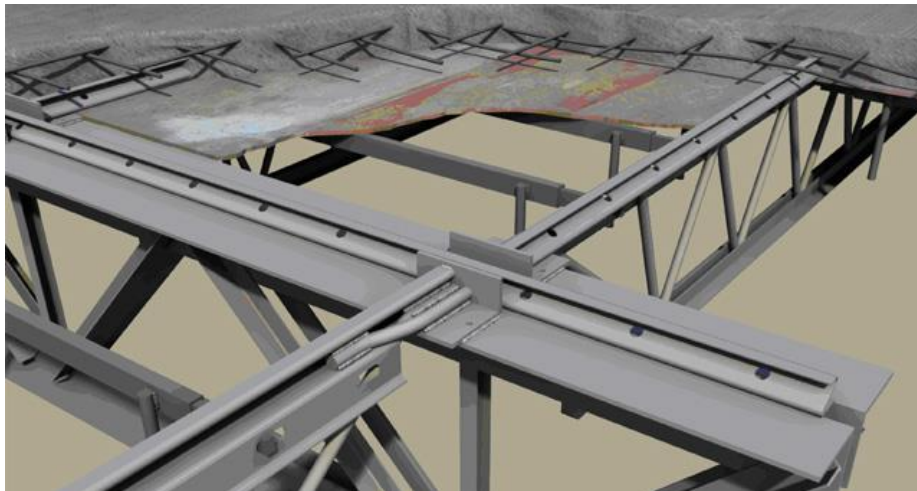
# Typical Bay Spot Checks



- ▶ Existing floor system checked for
  - ▶ Strength
  - ▶ Deflection
  - ▶ Camber
- ▶ Columns
  - ▶ Effective length - 10'6" (Steel Manual)
- ▶ Existing system met all requirements

# Alternative Systems

- ▶ Alternative 1: Non-Composite Steel Framing
- ▶ Alternative 2: Composite Steel Framing
- ▶ Alternative 3: Hambro D-500 Composite Girder



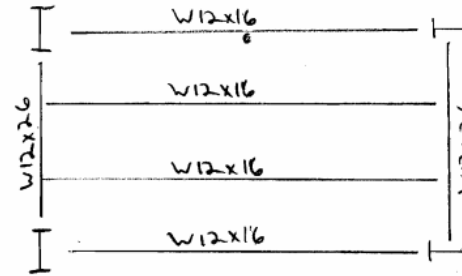
Courtesy of google images



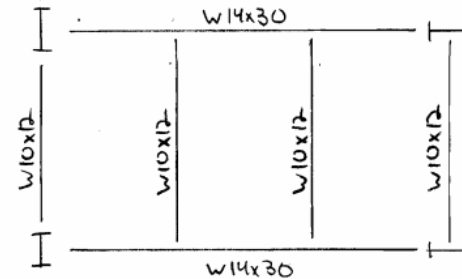
# Alternative 1: Non-Composite Steel

- ▶ Beam & girders checked for:
  - ▶ Strength
  - ▶ Deflection
- ▶ Explored two options (both 3 span):
  - ▶ Spanning beams long direction
  - ▶ Spanning girders long direction
- ▶ Chose option 1
  - ▶ More steel
  - ▶ Beam & girder depth same
  - ▶ Total deck thickness = 4"
  - ▶ Beams - W12x16
  - ▶ Girders - W12x26
  - ▶ Total depth = 16"

OPTION 1:



OPTION 2:



## WEIGHT OF STEEL

BEAMS LONG DIRECTION:

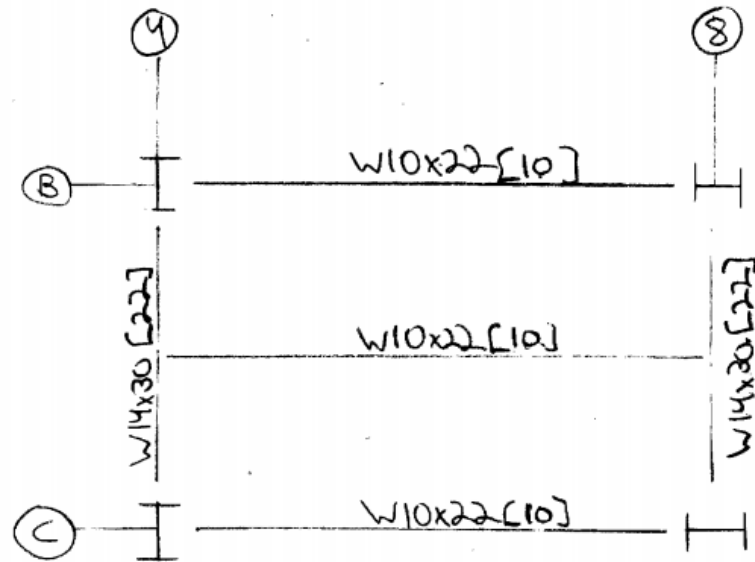
$$(4 \text{ BEAMS})(16 \text{*/FT})(24') + (2 \text{ GIRDERS})(26 \text{*/FT})(17.5') = 2446 \text{ #}$$

BEAMS SHORT DIRECTION:

$$(4 \text{ BEAMS})(12 \text{*/FT})(17.5') + (2 \text{ GIRDERS})(30 \text{*/FT})(24') = 2280 \text{ #}$$

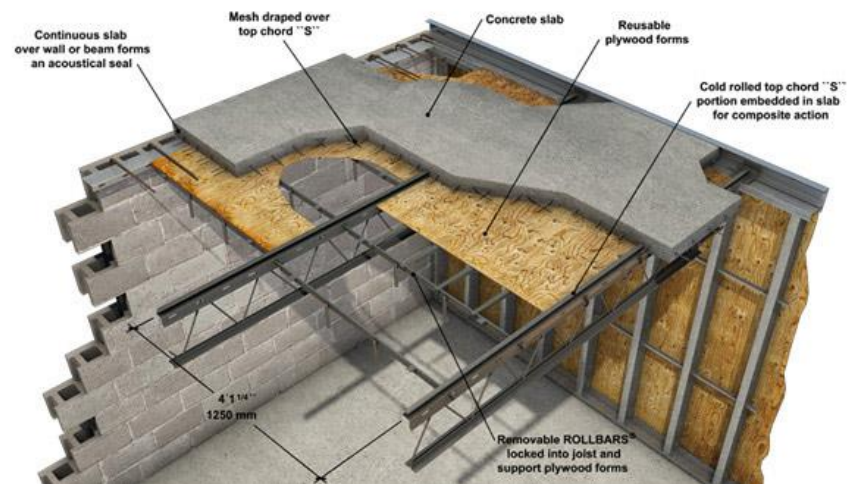
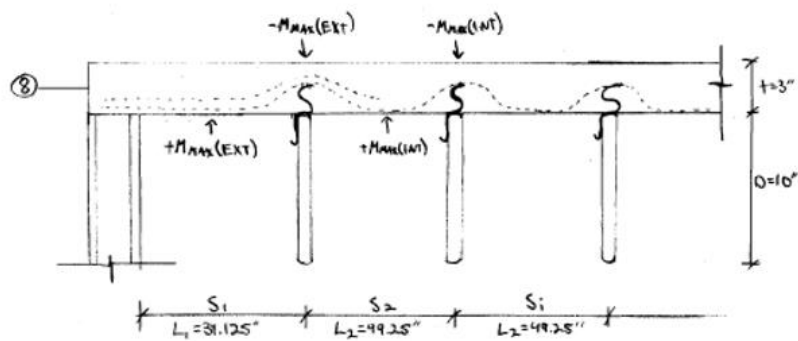
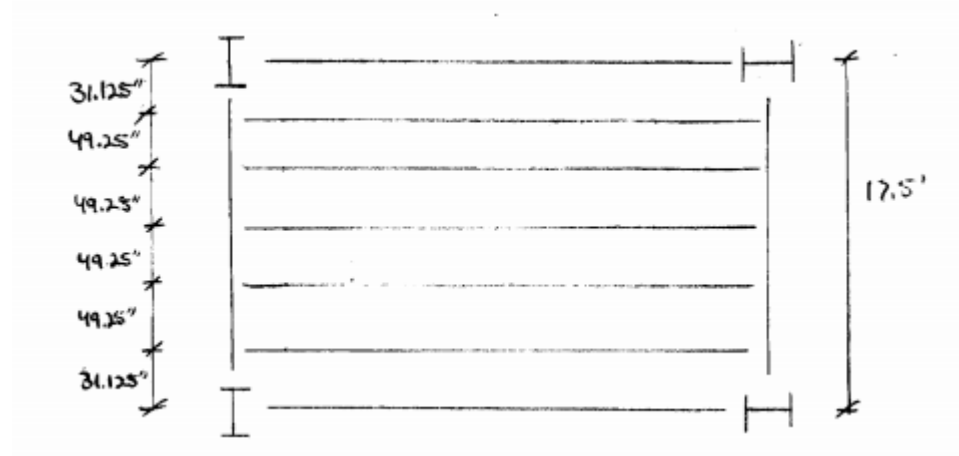
# Alternative 2: Composite Steel

- ▶ Span beams long direction (2 span)
- ▶ Beam & girders checked for:
  - ▶ Strength
  - ▶ Deflection
- ▶ Deck thickness = 4"
- ▶ Beams- W10x22
- ▶ Girders- W14x30
- ▶ Total depth = 18"



# Alternative 3: Hambro D-500 Composite

- ▶ Hambro Composite Floor System Design Guide
- ▶ 1-way concrete slab on open-web joists
- ▶ Joist spacing = 4'11¼"
- ▶ Slab thickness = 3"
- ▶ Joist depth = 10"



Courtesy of google images

# Systems Comparison

| Floor System Comparison |                                                                                                             |                     |                                   |                                                                                                             |
|-------------------------|-------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------|
| Criteria                | Girder Slab (Existing)                                                                                      | Non-Composite Steel | Composite Steel                   | Hambro D-500 Composite                                                                                      |
| <b>System Info</b>      |                                                                                                             |                     |                                   |                                                                                                             |
| Total Depth             | 10"                                                                                                         | 16"                 | 18"                               | 13"                                                                                                         |
| Fire Rating             | 3hr                                                                                                         | 2hr                 | 2hr                               | 2hr                                                                                                         |
| 2 hr Fire Rating?       | yes                                                                                                         | yes                 | yes                               | yes                                                                                                         |
| Lbs/ft <sup>2</sup>     | 83                                                                                                          | 50                  | 46                                | 41                                                                                                          |
| Cost/ft <sup>2</sup>    | \$16.01                                                                                                     | \$11.17             | \$12.04                           | \$8.38                                                                                                      |
| Vibrations              | minimal                                                                                                     | likely              | likely                            | very likely                                                                                                 |
| Formwork                | no                                                                                                          | no                  | no                                | yes                                                                                                         |
| <b>Considerations</b>   |                                                                                                             |                     |                                   |                                                                                                             |
| Pros                    | Rapid construction & assembly (premanufactured), underside can be left unfinished, floor design flexibility | Lightweight         | Lightweight, increased stiffness, | Lightweight, reusable formwork & rollbars, increased rigidity from composite, plenums allow for MEP systems |
| Cons                    | Heavy, expensive                                                                                            | Large total depth   | Largest total depth               | Formwork needed, vibrations                                                                                 |
| Feasible?               | yes                                                                                                         | yes                 | yes                               | yes                                                                                                         |

# Comments/Questions?

