



Duquesne University

Vickroy Hall



Donna Kent
Structural Option
Advisor: Dr. Boothby



Presentation Outline



Vickroy Hall

- **Building Introduction**
- **Redesign Goals**
- **Depth Study**
- **Breadth: Scheduling Impact**
- **Conclusions and Recommendations**



Building Introduction



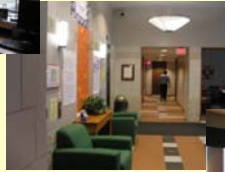
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Building Use:

Occupancy: Living/Learning Center



Double Suites with Adjoining Bathroom



Lounges, laundry rooms, work areas



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Building Introduction



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Building Statistics

Completed: July 1997

Height: 105'

Floors: 8

Floor Area: 77,000 sf



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Building Introduction



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Current Structural System

- **Superstructure: Steel Moment Frames**
- **Roofing System: "Screen Wall" Standing Seam Metal covered frames**
- **Floor System: Composite metal deck with WWF reinforcement**
- **Foundations: Grade beams bearing on caissons**



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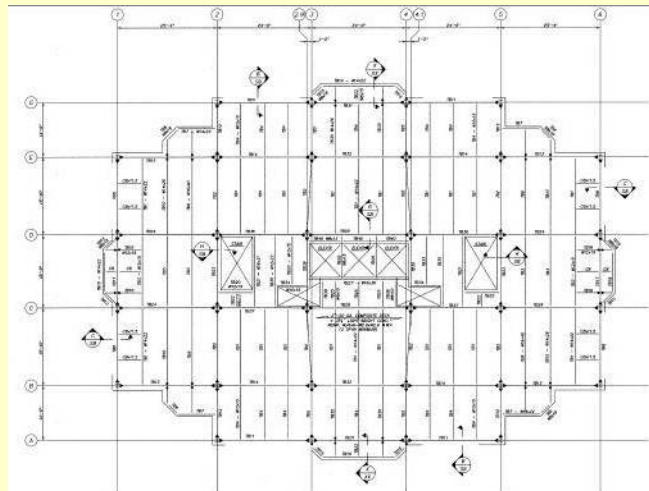


Building Introduction



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Current Typical Floor Plan



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Redesign Goals



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Redesign to a more typical construction for the type and occupancy of building

• **Generally:**

- **Load bearing masonry**
- **Light gauge metal studs/ wood studs**
- **Cast in place or pre-cast concrete floor systems**



- **Determination of Masonry Bearing Walls vs. Moment Frames (scheduling)**

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Depth: Structural Redesign



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• **Redesign System Requirements:**

- **Exterior and select interior walls as bearing walls**
- **Shear walls to replace moment frames**
- **Pre-cast planks to replace composite floor**

• **Methods of Redesign:**

- **Empirical Design Method (non-reinforced)**
- **Allowable Stress Design**

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Depth: Structural Redesign



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Masonry System Design and Calculations

- Floor loading: LL= 55 psf, SDL= 40psf
- Most planks laid parallel to long direction of building
- Exception: 2nd floor
- Bearing walls placed perpendicular to long direction
- Shear Walls placed as needed

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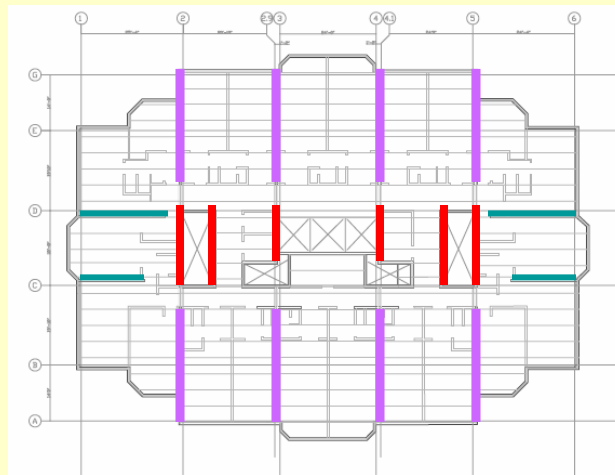


Depth: Structural Redesign



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Redesigned Typical Floor Plan



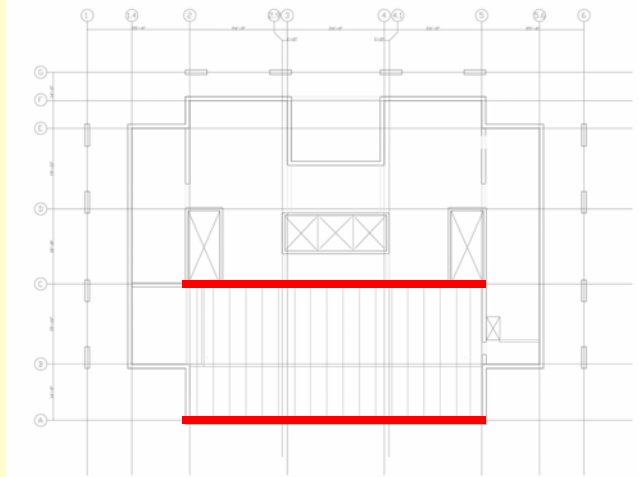
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Depth: Structural Redesign

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Redesigned Second Floor Plan



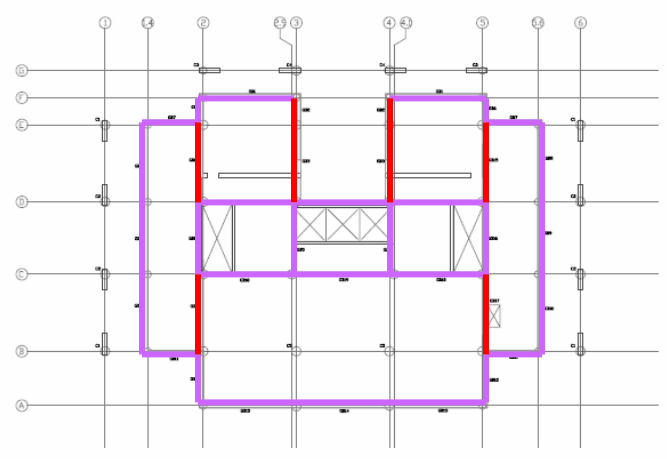
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Depth: Structural Redesign

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Redesigned Foundation Floor Plan



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Depth: Empirical Design



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Results and Commentary

- **Interior Bearing Walls**
 - Large loads and stresses accumulated to the ground floor
 - Ground floor: 3 wythes of 10" grouted blocks
 - Masonry vs. Steel (W14x193): 30" vs. 15.5"
- **Exterior Bearing Walls**
 - Ground Floor: 12" grouted blocks
 - Non-bearing walls designed the same for constructability
- **Lateral System**
 - No reinforcement, all criterions met

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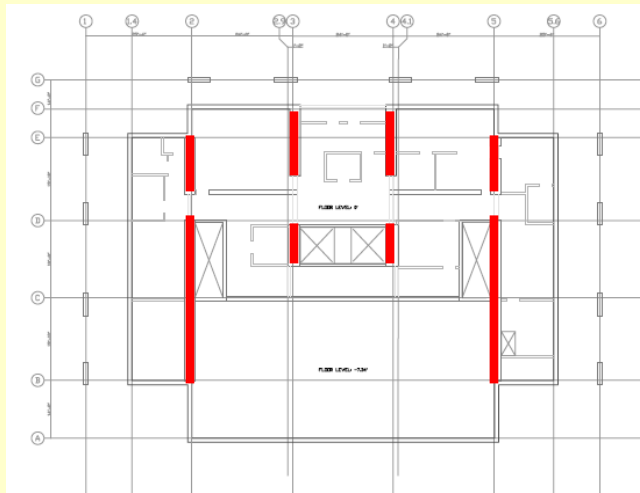


Depth: Empirical Design



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EDM Ground Floor Plan



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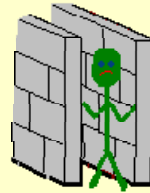
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Depth: Empirical Design



Results and Commentary

- **Not an economical use of materials**
- **Decreased living/working space**
- **Not an acceptable design**



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Depth: ASD



Results and Commentary

- **Ground Floor:**
 - **Short Interior Bearing Walls: 12" block fully grouted**
 - **Short Exterior Bearing Walls: 12" block grouted at 24" o.c.**
 - **Long Interior Bearing Wall: 8" ungrouted**
 - **Long Exterior Bearing Wall: 10" ungrouted**
 - **Masonry (12") Vs. Steel (15.5")**
- **Lateral System**
 - **Shear reinforcement not needed**

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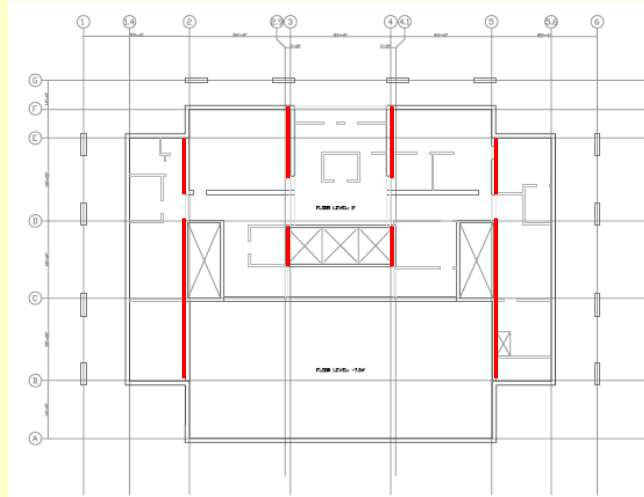


Depth: ASD



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ASD Ground Floor Plan



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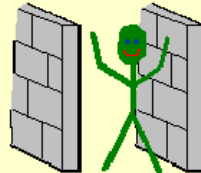
Depth: ASD



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Results and Commentary

- **Economical use of material**
- **Living space not impeded by multiple wythes**
- **Overall good design method**



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Redesign Impact



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- **Empirical Design not suited for building design**
- **Allowable Stress Design well suited for design**
 - **Wall size generally the same size**
- **Masonry system much heavier**
 - **Redesign of foundations**
 - **Larger members, greater number**
 - **Redesign of exterior columns**
 - **Affected architectural aesthetics**
 - **W-shapes and Angles as lintels**
 - **Pre-cast concrete would not hold loads unless very large**

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Breadth: Scheduling



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Scheduling Goals and Criterion

- **Goal:**
 - **Determine time impact of new design**
- **Criterion:**
 - **Using Structural components only**
 - **Foundation excavation and utility tunnel reroute not included**
 - **Stair and elevator shafts, roof system not used**
 - **No scheduling of finishes, partitions, etc**

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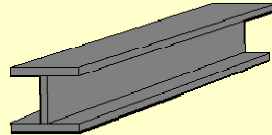
Breadth: Scheduling



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Steel Moment Frame Schedule

- Critical Path Items
 - Foundations
 - Columns, Girders, floor materials
- Expected Erection from Caissons to completed brickwork: 51 weeks



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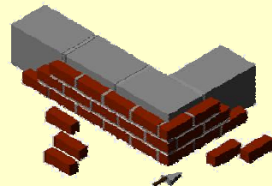
Breadth: Scheduling



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Load Bearing Masonry and Pre-cast Plank Schedule

- Critical Path Items
 - Foundations
 - Bearing wall block work, planks
 - Columns/beams for 2nd floor support
- Expected Erection from Caissons to completed brickwork: 50 weeks



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Breadth: Scheduling



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Results and Commentary

- Scheduling time was very close
 - 51 weeks (steel) vs. 50 weeks (Masonry)
 - Moment frames vs. grouting
 - More manpower required for masonry
- Time impact was not a deciding factor for structural system
- Economic comparison may have been more wise
 - Location
 - Availability of materials

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Conclusions



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Existing Structure vs. Redesign Structure (ASD)

Pros:

- Wall size relatively the same width (15" vs. 12")
- Living/working space not impeded
- Time to construct structural system very close



Cons:

- Heavier System
 - Increased foundation size
- Exterior Columns modified
 - Affected architectural aesthetics



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Recommendations



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- **Masonry bearing walls with hollow core planking is a sensible option**
- **Further analysis of a cost impact would be wise**



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Acknowledgements



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Duquesne University

- **Gust Flizanes**
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AE Faculty and Staff

- **Thanks for your complete understanding during difficult times**
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Mentors of the AE Program

Family, boyfriend, and friends

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