NATIONAL HARBOR BUILDING M

OXON HILL, MARYLAND

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Structural Option
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INTRODUCTION

National Harbor Building M is a tenant fill out office building in the new National Harbor Development located on the Potomac River in Oxon Hill, Maryland. This five story 73'-4" tall building has a footprint of approximately 14,800 square feet with a typical floor to floor height of 13'-4". A concurrently built parking structure stands parallel to the building rear wall, separated by only a 4 inch expansion joint. The original design calls for Building M to have a structural steel frame and composite floor system supported lateral by steel moment and braced frames as well as masonry shear walls. As determined through analysis conducted in prior technical reports, this design efficiently provides the building with structural integrity without inhibiting its architectural layout or functionality. The structure allows for the encompassment of long spans and open areas crucial for any retail and office based building layout.

Without any major problems in the existing design, the thesis topic for this report was based around achieving the same effectiveness using a different base structure. The structure selected for this investigation was a post-tensioned concrete building. The redesigned system attempted to provide the same architectural and functional freedom allotted by the steel based building without creating any major drawbacks. Along these lines the new system stayed true to the original form of the building, mimicking the exterior dimensions and column layout as closely as possible. If these goals were able to be obtained with the post-tensioned concrete design, the depth of this investigation would be considered a success. Continuing with the idea of maintaining the efficiency of the original design, two breadth topics were also investigated: an architectural façade study and a construction investigation.

During the course of the redesign the CMU masonry shear walls located in the building rear façade became obsolete. While these walls were no longer required for the lateral system, they still provided a barrier between Building M and the adjacent parking structure. This posed the question whether a CMU wall was still the most efficient way to enclose the rear façade. To answer this question the façade study investigated different wall systems and ultimately designed the most appropriate.

To complete the evaluation of the efficiency of the redesigned concrete structure, a construction investigation was carried out. This investigation performed a cost and schedule comparison to the original design. The results would be used to determine if the redesign is also practical from a financial and time standpoint. A concrete structure which performed similar to the existing design, yet required longer construction time and a higher project cost, would be consider not efficient.

CODES/REFERENCES

Design Codes:

- ACI 318-05
- American Institute of Steel Construction (AISC)
  - Steel Construction Manual, Thirteenth Edition (LRFD)
- American Society of Civil Engineers (ASCE)
  - ASCE 7 - 02, Minimum Design Loads for Buildings and Other Structures
  - ASCE 7 - 05, Minimum Design Loads for Buildings and Other Structures
- Building Code Requirements for Masonry Structures, MSJC 2005
- International Building Code, 2003 Edition
- PCI Design Handbook - Precast and Prestressed Concrete, 6th Edition
- RS Means Cost Data 2008, 6th Edition

Additional References:

- Architectural Precast Concrete, Second Edition
- Design of Concrete Structures, Thirteenth Edition
- Masonry Structures Behavior and Design, Second Edition
- http://www.trenwyth.com/vs_fire_ratings.asp
- http://www.mapaprecast.org/precast-wall.asp
- http://www.angelusblock.com/fire.cfm

Computer Programs:

- AutoCAD 2008
- ETABS, Version 9.1.1
- Microsoft Office Excel, 2007
- Microsoft Office Project, 2007
- PCA Column, Version 3.64
- RAM Structural System 11.0
- RAM Concept 2.0
- SAP 2000, Version 11.0.6

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LOADS

Live Loads (Existing and Redesign):

Area	Design Load	ASCE 7-05 Minimum
Lobbies	100 psf	100 psf
Offices	100 psf	50 psf
1st Floor Corridors	100 psf	100 psf
Corridors above 1st Floor	100 psf	80 psf
Future Retail Tenant	100 psf	100 psf

Roof Live Loads (Existing and Redesign):

Item	Design Load	Code Reference
Minimum Roof Load	30 psf + snow drift	
Ground Snow Load (Pg)	25 psf	IBC 2003 1608.2
Snow Exposure Factor (Ce)	1.0 (Exposure D, Partially exposed)	IBC 2003 1608.3.1
Thermal Factor (Ct)	1.0	IBC 1608.3.2
Snow Importance Factor (Is)	1.0	IBC 1608.4
Flat Roof Snow Load (Pf)	17.5 psf + snow drift	IBC 1608.3
Minimum (Pf) used	20 psf + snow drift	

Dead Loads:

Item	Existing	Redesign
Floor	51 psf	100 psf
Composite Roof	35 psf	100 psf (Entire Roof Similar)
Non-Composite Roof	25 psf	--
Superimposed	25 psf	25 psf
Canopies	25 psf	--
8" CMU Wall	80 psf avg,	--
4" Architectural Precast Panels	--	38.3 psf
Additional Loadings	As Noted in Calculations	As Noted in Calculations

Wall Loads (Existing and Redesign):

Item/Location	Design Load (per foot along floor level)
Partition	150 plf
Glass Tower	320 plf
2nd Floor Front Glass	230 plf
3rd Floor Front Glass	150 plf
3rd Floor Architectural Precast	300 plf
3rd/4th Floor Brick	650 plf
5th Floor Front Glass	620 plf
5th Floor Brick	730 plf
5th Floor Architectural Precast	620 plf
Typical Glass Wall	280 plf
Typical Parapet	260 plf
Brick Parapet	260 plf