MICA GATEWAY RESIDENCE

BALTIMORE, MARYLAND

SCOTT MOLONGOSKI

SENIOR THESIS

STRUCTURAL OPTION

ADVISOR:

PROFESSOR SUSTERSIC

PRESENTATION OUTLINE

BUILDING INTRODUCTION

EXISTING STRUCTURE

THESIS CHALLENGE

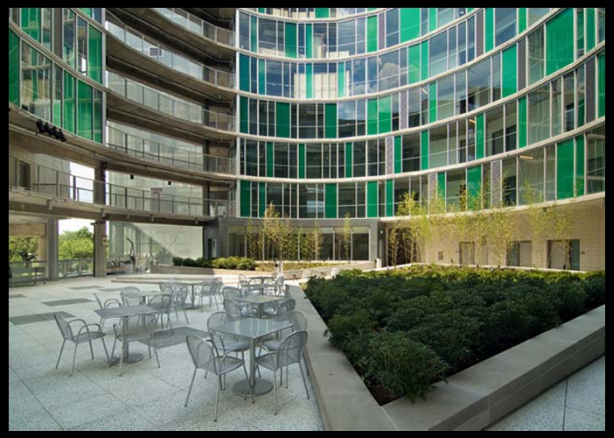
PROPOSED SOLUTION

GRAVITY SYSTEM DESIGN

LATERAL SYSTEM DESIGN

ARCHITECTURAL BREADTH

CONCLUSION



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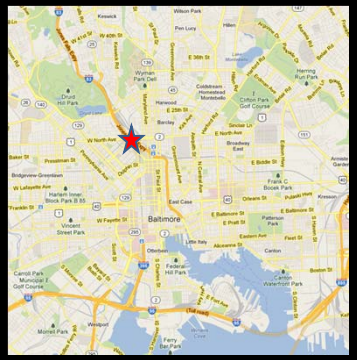

BUILDING INTRODUCTION

OWNER: MARYLAND INSTITUTE COLLEGE OF ARTS
ARCHITECT AND ENGINEER: RTKL ASSOCIATES
CIVIL ENGINEER: KCW ENGINEERING TECHNOLOGIES
GENERAL CONTRACTOR: WHITING TURNER
LANDSCAPE ARCHITECT: HIGGINS LAZARUS

- 122’ TALL
- 9 STORIES PLUS MECHANICAL PENTHOUSE
- 108,000 SQFT
- 64 APARTMENTS
- MULTIPURPOSE “BLACK BOX” THEATER
- COURTYARD
- CAFÉ
- STUDIOS

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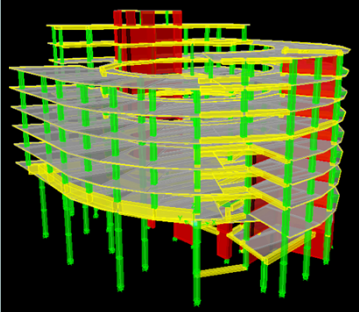
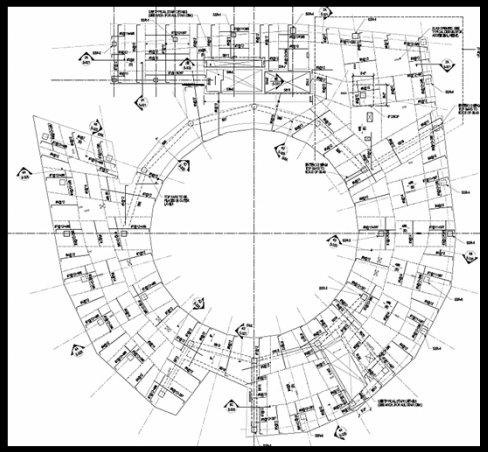


EXISTING STRUCTURE

SLABS:
- TWO WAY FLAT PLATE
- 8” THICK

COLUMNS:
- TWO CONCENTRIC RINGS
- 12”x12” – 24”x24”
- CIRCULAR EXTERIOR
- 36” DIAMETER

UNIQUE CONDITIONS:
- BLACK BOX ROOF
- 41’ SLENDER COLUMNS



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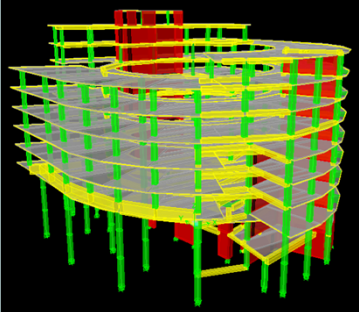
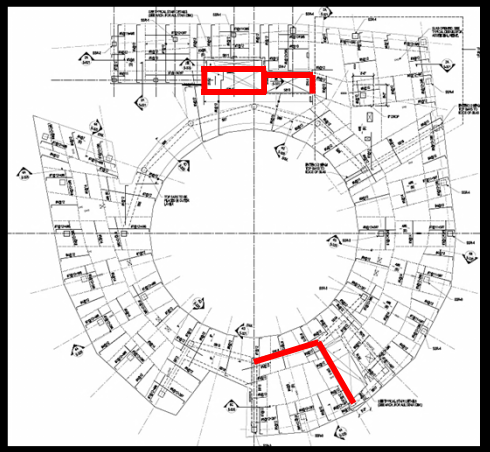


EXISTING STRUCTURE

CONCRETE SHEAR WALLS

DRILLED CAISSONS

360º CURTAIN WALL FAÇADE



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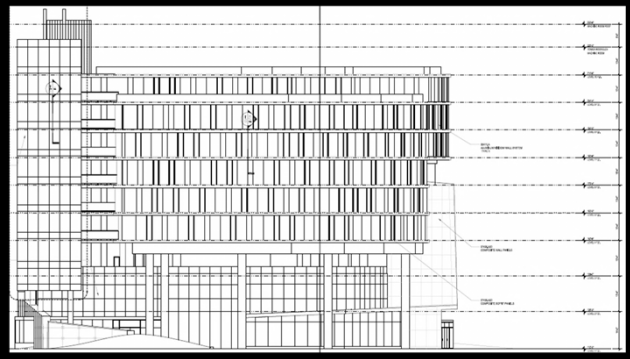
THESIS CHALLENGE

CHANGE USE TO MUSUEM

BENEFITS:
- CIRCULAR FLOOR PLAN
- ARCHITECTURAL SIGNIFICANCE
- OTHER APPROPRIATE SPACES

DETRACTIONS:
- LOW DESIGN LIVE LOADS
- LOW FLOOR TO FLOOR HEIGHT
- POOR SUNLIGHT CONTROL



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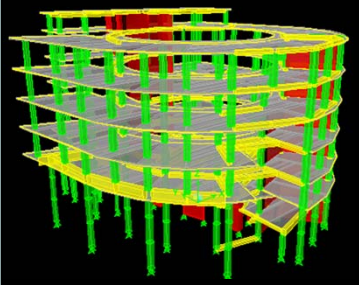


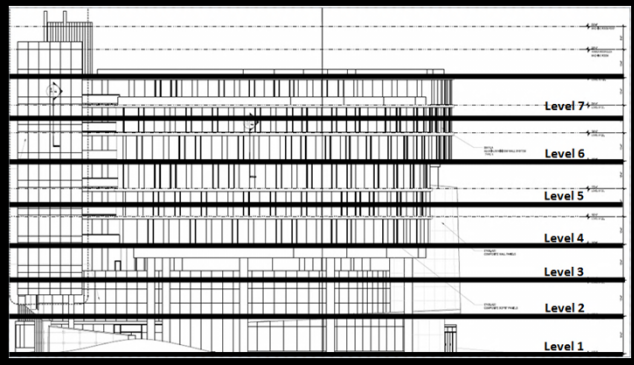
PROPOSED SOLUTION

INCREASE LIVE LOAD:
- 40 PSF – 100 PSF

INCREASE FLOOR TO FLOOR HEIGHT:
- 10 FEET – 15 FEET
- LEVEL 4 – LEVEL 7
- ELMINATE LEVELS 8, 9

DECREASE SUNLIGHT EMITTED INTO BUILDING:
- USE SOLID PANELS
- USE REFLECTIVE/ABSORBANT GLASS

ARCHITECTURAL CHANGES:
- FLOOR PLAN
- CIRCULATION



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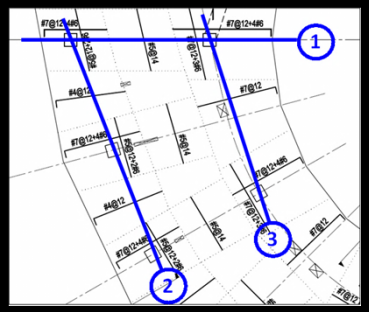


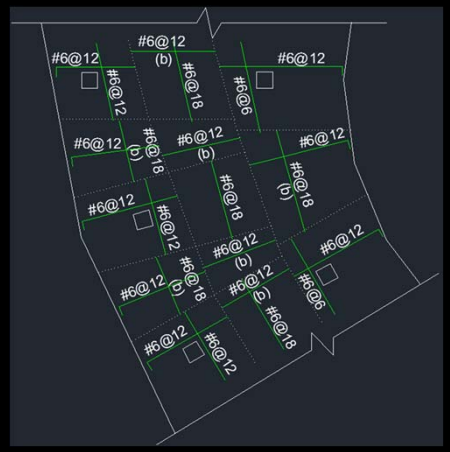
GRAVITY SYSTEM DESIGN

SLAB ANALYSIS:

- EQUIVALENT FRAME METHOD
  - FLEXURE
  - PUNCHING SHEAR
  - DEFLECTIONS

SLAB DESIGN:

- 12” THICK
- #6 USED FOR FLEXURE
- #5 @ 12” BOTTOM MAT
- #4 @ 3” FOR SHEAR



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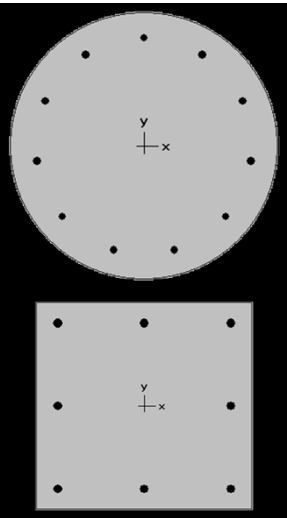
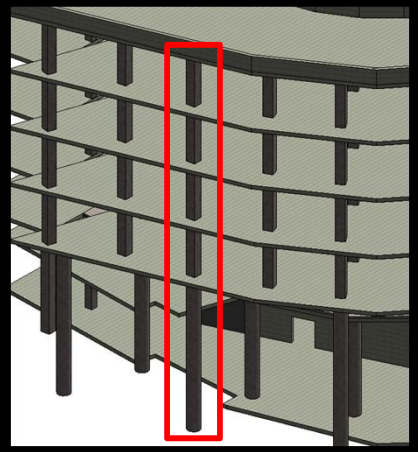


GRAVITY SYSTEM DESIGN

COLUMN ANALYSIS:
- 41’ TALL SECTION
- STANDARD 15’ TALL SECTION
- spCOLUMN
- SLENDERNESS CHECK

COLUMN DESIGN:
- 36” – 42” DIAMETER EXTERIOR
- 11 #10’s
- SLENDERNESS CHECK OKAY
- 24”x24” – 30”x30” INTERIOR
- 8 #10’s
- CONTINUOUS SIZE LEVEL 4 - ROOF



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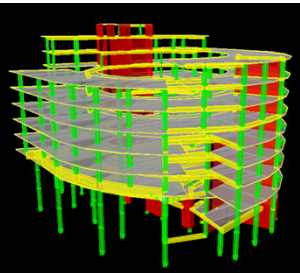
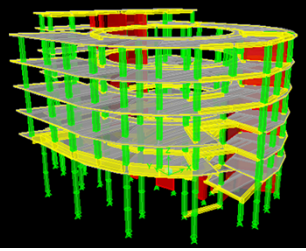
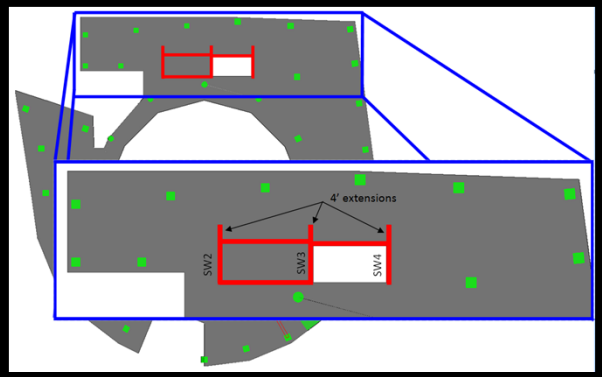




LATERAL SYSTEM DESIGN

ETABS MODEL:
- UPDATED SLABS AND COLUMNS
- UPDATED FLOOR TO FLOOR HEIGHT
- SHEAR WALLS - MESHED SHELLS
- LATERAL AND GRAVITY

1ST ANALYSIS:
- SEISMIC IN Y DIRECTION CONTROLLED
- SHEAR WALLS INADEQUATE IN FLEXURE
- INCREASED LENGTH 4’



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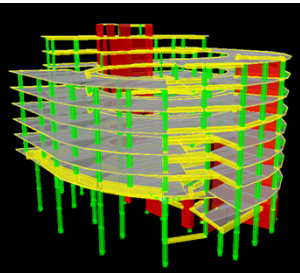
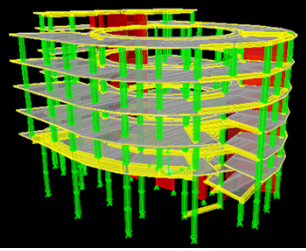


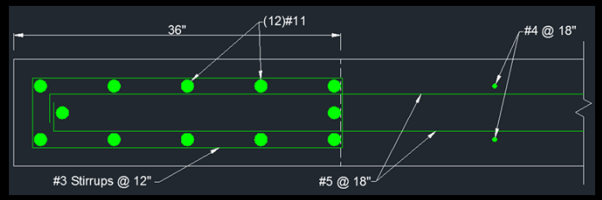


LATERAL SYSTEM DESIGN

2ND ANALYSIS:
- ACCEPTABLE DEFLECTIONS AND STORY DRIFT
- CHECKED OVERTURNING MOMENT

SHEAR WALL DESIGN:
- 36” BOUNDARY ELEMENT
- 12 #11’s WITH #3 TIES @ 12”
- #4@18” VERTICAL SHEAR
- #5@18” HORIZONTAL SHEAR

FOUNDATION DESIGN:
- SHEAR WALL CAISSONS
- CRSI 2008 HANDBOOK
- ADEQUATE SHAFT AND BELL SIZES



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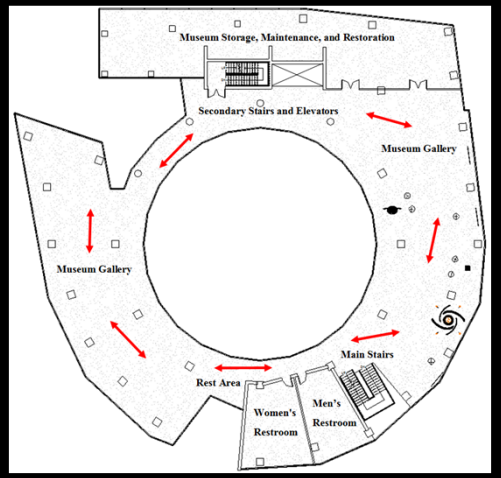
DESIGN ASPECTS:
- LARGE VIEWING SPACES
- OPEN GALLERIES
- CIRCULATION
- SUNLIGHT CONTROL
- REST AREAS

DESIGN CHANGES:
- APARTMENT REMOVAL
- MUSEUM STORAGE AND MAINTENANCE
- RESTROOMS
- ART ALCOVES



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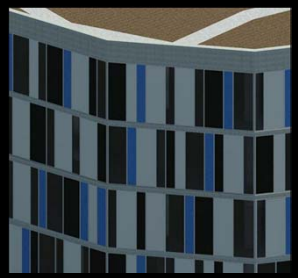
FAÇADE CHANGES:

- CONTROL SOUTH SIDE
- INCREASED USE OF SOLID PANELS
- REFLECTIVE AND ABSORBENT GLASS



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CONCLUSION

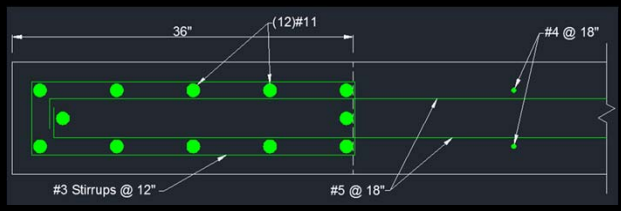
COULD HAVE BEEN DESIGNED AS MUSEUM

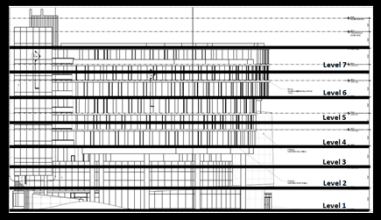
SYSTEM TYPES FEASIBLE

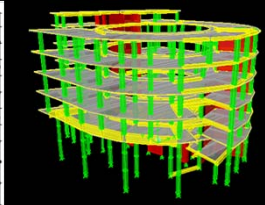
SIGNIFICANT STRUCTURAL STRENGTHENING

SIGNIFICANT ARCHITECTURAL CHANGES

INCREASED MATERIAL AMOUNTS = HIGHER COST







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ACKNOWLEDGEMENTS

MARYLAND INSTITUTE COLLEGE OF ARTS

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- BOB KNIGHT
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- PROFESSOR HEATHER SUSTERSIC
- PROFESSOR KEVIN PARFITT
- PROFESSOR BOB HOLLAND

FRIENDS AND FAMILY

QUESTIONS AND COMMENTS

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MATERIAL INCREASE:
- SLAB CONCRETE: 27%
- COL. CONCRETE: 26%
- COL. STEEL: 21%

DEVELOPMENT LENGTH:
- 6’ BEYOND IN FRAME 1
- 5’ BEYOND IN FRAME 2
- 7’ BEYOND IN FRAME 3
- BOT. BARS CONT.

HOOKS:
- 90º
- 6” BOT. BARS
- 9.8” TOP BARS

APPENDIX

Story Drift and Displacement (Seismic in the Y Dir. With -X ecc.)

Story	Story height (ft)	Displacement (in)	Story Drift (in)	Allowable Drift (in)
Tower Roof	113	0.9814	0.0892	1.695
Roof	103	0.8922	0.1363	1.545
7	88	0.7559	0.142	1.32
6	72	0.6139	0.1392	1.08
5	56	0.4747	0.113	0.84
4	41	0.3617	0.1255	0.615
3	27	0.2362	0.0968	0.405
2	14	0.1394	0.1394	0.21

Overturning Moment

Story	Height (ft)	Story Force (k)	**Moment (k-ft)**
Tower Roof	113	40.9	**4622**
Roof	103	207.2	**21342**
7	88	193	**16984**
6	72	156.9	**11297**
5	56	119.2	**6675**
4	41	90.7	**3719**
3	27	80.3	**2168**
2	14	27.2	**381**
		Total=	**67187**

Caisson Design

	M_{over} (k-ft)	P_{axial} (k)	Total Load (k)	Shaft Dia. (ft)	Bell Dia. (ft)	Vertical Reinf.	Ties
SW 1	34424	504	1399	13.5	4.5	9- #10	#4@ 18"
SW 2	11467	246	942	11	4	7- #10	#4@ 18"
SW 3	11467	246	942	11	4	7- #10	#4@ 18"
SW 4	9829	246	825	10.5	3.5	7- #9	#3@ 18"
SW 5	20697	390	1095	12	4	7- #10	#4@ 18"
SW 6	20697	390	1095	12	4	7- #10	#4@ 18"
SW 7	16093	390	927	11	4	7- #10	#4@ 18"
SW 8	9700	270	523	8.5	3	7- #8	#3@ 16"