901 NEW YORK Avenue

TIMOTHY H PARK – STRUCTURAL OPTION

Presentation Outline

- Building Summary
- Current Systems
- Proposal Description
  - Gravity
  - Lateral
  - Other Structural Factors
- Breadth Options
  - Construction Management
  - LEEDS Certification
- Conclusion
  - Questions

Building Summary

- 130'-0" Full Height
- 580,000 Square Ft. Total
- 11 Stories Above Grade, 4 Levels Below Grade
- Multi-use Facility
  - Office, Retail, Parking
- Part of Revitalization of central Washington, DC
- Est. $54 million
- Completed in 2004

Owner: Boston Properties
Architect: DCS Design
Structural Engineer: SK&A Engineers
Contractor: Clark Const.

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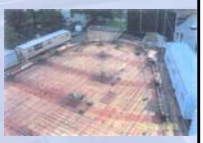
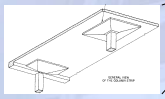
Existing Conditions

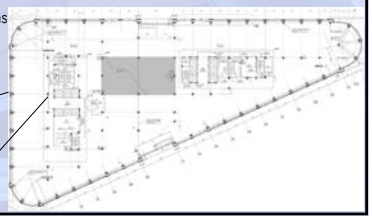
Gravity System
- 2-way Cast-in-Place Concrete
  - 11" thick @ 5,000 psi
  - 20' by 40' bays
- Post-tensioning (to minimize deflection)
- Optional slab penetrations



Lateral System
- Moment Framing
  - 4,000 - 8,000 psi Columns
  - 26" Square Columns

Foundation
- Spread Footings





Existing Conditions

Issues with Current System

- 2-way Cast-in-Place Concrete with PT
  - Shallow slab: issues with draping tendons
  - Anchor slab <1" throughout
  - Imbedment complications
    - PT jack, P/C panels, curtain walls
  - Slab Penetrations

- Just under 1 year to construct structure and shell
- Shape and Location of Building
- Cost
  - PT system is expensive
  - Concrete system is 150% typical price (RS Means)

Proposal

Why the current system was chosen:
- Steel composite assumed to create too thick of a floor thickness
- Shear walls were unnecessary

Is concrete moment framing the best solution?

- Test alternative structural systems
    - Gravity: Steel composite
    - Lateral: Shear walls
- Effects on architecture
- Effects on construction
    - Time
    - Cost
    - Feasibility
- Possible LEEDS Certification

Alternative Gravity System

Steel Composite System

Loads

Dead Load:	Deck	2 psf
	Concrete Slab	62.5 psf
	MEP	15 psf
	Floor Finishes	5 psf
Live Load:	(as specified from current system)	100 psf
	Center Lobby	220 psf

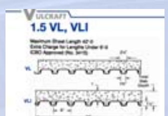
All floors have above typical loads
Composite action is useful on all areas except corners
Steel system lighter than concrete; wind controls over seismic

Alternative Gravity System

Steel Composite System

Column Layout

Based on using an unshored system
Deck taken from Vulcraft Catalog



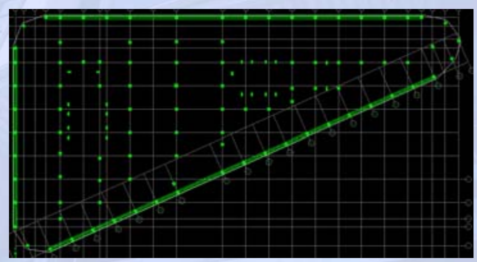
(N=9) NORMAL WEIGHT CONCRETE (145 PCF)

Total Slab Depth	Deck Type	SDI Max. Unshored Clear Span 1 Span	2 Span	3 Span	Superimposed Live Load, PSF Clear Span (ft.-in.) 5'-0	5'-6	6'-0	6'-6	7'-0	7'-6	8'-0	8'-6	9'-0	9'-6	10'-0	10'-6	11'-0	11'-6	12'-0
5 1/2"	1.5VL22	4'-4	5'-9	5'-10	400	400	388	348	314	285	260	238	219	202	187	173	160	149	139
	1.5VL21	4'-9	6'-5	6'-6	400	400	400	367	332	301	275	252	232	214	198	184	171	159	148
	1.5VL20	5'-1	6'-10	6'-11	400	400	400	383	346	315	287	263	243	224	208	193	179	167	156
(t=4")	1.5VL19	5'-7	7'-7	7'-8	400	400	400	400	374	340	311	286	263	243	226	210	196	183	171
	1.5VL18	6'-1	8'-3	8'-4	400	400	400	400	399	363	332	305	281	260	241	225	210	196	183
57 PSF	1.5VL17	6'-7	8'-9	9'-0	400	400	400	400	399	363	332	305	281	260	242	225	210	196	184
	1.5VL16	7'-1	9'-2	9'-6	400	400	400	400	400	361	330	303	279	259	240	224	209	195	183

Alternative Gravity System

Steel Composite System

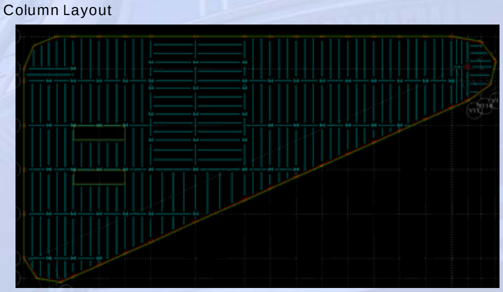
Column Layout



Alternative Gravity System

Steel Composite System

Column Layout



Alternative Gravity System

Steel Composite System

Column Layout

Alternative Gravity System

Steel Composite System

Lateral Framing: Moment Connections

Resist Primarily Wind Loads
Moment Framing across Perimeter of Building

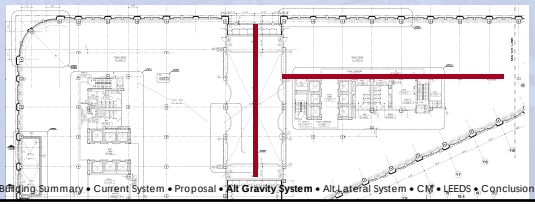
Total Drift: 1.76" < 3.25"

Alternative Gravity System

Final Design

- Bays are 21' by 36'
- Unshored increases contruction speed but requires smaller spans
- 1.5VL deck from Vulcraft (1.5") + 5.5" slab + 8" = **15" total depth**
  - 1.5" + 5.5" + 18" = 25" total depth
  - 1.5" + 5.5" + 30" = 37" total depth

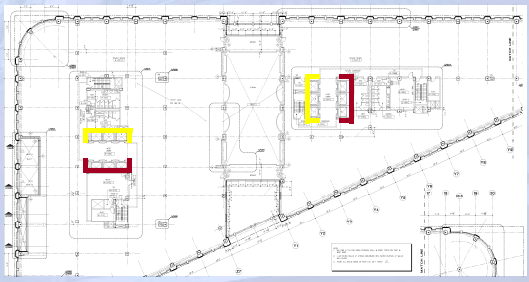
- Max allowable (to maintain 9' ceiling): 32"



Alternative Lateral System

Shear Wall System

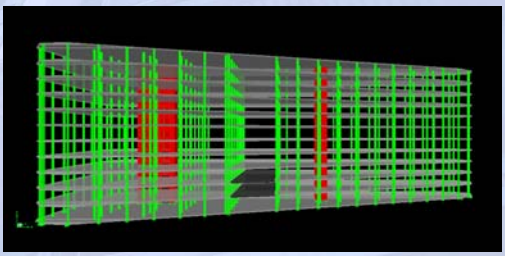
Shear Wall Location



Alternative Lateral System

Shear Wall System

Shear Wall Location



Alternative Lateral System

Final Design

Columns Re-sized to 16" Square Columns
All Columns 5,000 psi instead of 4,000-8,000 psi
Shear walls 10" thick with #5's @ 12" o.c. (both sides)

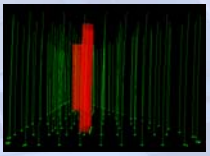
Total Building Drift: 0.38"

Cost Difference due to Shear Walls

Rebar:		- $89,500.00
Concrete:		- $371,000.00
Total:	save	$461,000.00

Cost of Shear Wall

Rebar:		+ $19,100.00
Concrete:		+ 78,800.00
Total:	spend	$98,000.00



Total Savings of ~$363,000.00

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Construction Management

Primary Issues:

- **Cost**
- Site Layout
- Schedule
- Feasibility (in summary)

Construction Management

Current Cost: $54 million

$93.10/square foot

Shear Wall Savings: $363,000.00

Steel Estimates: (excludes mech/elect/interior finishes)

RS Means Concrete: $62.40/square foot

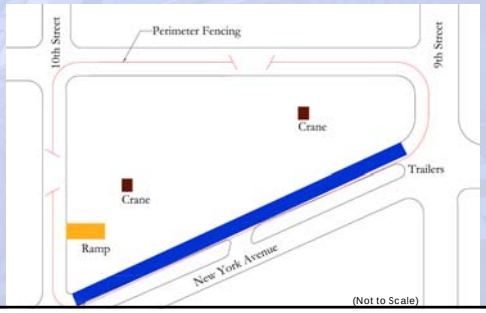
RS Means Steel: $65.83/square foot
or $38.2 million

(does not include connections, studs, etc.)

Construction Management

Site Layout

For Alternate Design: crane, **lay down area**, etc.



Construction Management

Site Layout

Steel

- Can use same crane locations
- No room for layout (small site outside perimeter of building)
- Can't layout anything during rush hour
  - 7-9 a.m. and 3-5 p.m. daily

Shear Wall

- No effect on site

Construction Management

Schedule

Current Schedule

- Start: August 19, 2002
- Finish: October 29, 2003
- **Total Time: 1 year 2 months**

Shear Walls

- No effect on schedule

Construction Management

Schedule

Steel

- Floor column erection and placement: ~2 days
- Floor beam erection and placement: ~2 days
- Composite deck installation: ~4 days
- Concrete pour: ~1 day

Total: **54 days** (about 1 floor/week)

- Start: August 19, 2002
- Finish: ~November 11, 2002

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LEEDS Certification

Leadership in Energy and Environmental Design

"for the design, construction, and operation of high-performance green buildings"

Feasibility of 901 New York Avenue for LEEDS Certification

1 Bryant Park

7 WTC

SALA Building

LEEDS Certification

Point System

Certified:	32-39 points
Silver:	40-47 points
Gold:	48-63 points
Platinum:	64-85 points

Points Division

Sustainable Sites	5 points	
Water Efficiency	1 point	
Energy and Atmosphere	4 points	
Materaisl and Resources	0 points	
Indoor Environment Quality	14 points	
Innovation, Quality, Upgrades, & Maint.	0 points	**24 points total**

LEEDS Certification

Suggestions for Points

- Carpool Parking Spots
- Rainwater Collection System
- Recycling
- DOAS system
- Adjacent Parking Lot Re-Design

Possible Rating: up to 50 points (Gold Certification)

- Issues
  - Graywater, DOAS system complications
  - Adjacent Parking Lot not owned by Boston Properties

Summary

Alternatives

Steel:

- Cheaper than current system
- Little space for steel layout (requires extremely tight scheduling for layout areas)
- Cost does not reflect studs, other composite additions

Shear Walls:

- No effect on schedule or site layout
- Savings of $363,000 (or more)

LEEDS:

- Up to Gold certification possible
- Depends on owner about feasibility

Questions ? ? ?

Acknowledgments

DCS Design	Chris Garwood Elizabetth Espino Kathy Barcus
Clark Construction	
SK&A Structural Engineers	Nasser Meamarian
Boston Properties	Steve Morken
Faculty Consultant	Prof. Ali Memari
Thesis Instructor	Prof. Kevin Parfitt