

Lafayette Tower

801 17th St. NW, Washington D.C.



Justin Wingenfeld
Construction Management
Dr. David Riley

Senior Thesis Presentation 2009
The Pennsylvania State University

Presentation Outline

Project Overview

Column-Free Perimeter

Structural Redesign

Solar Implementation

Conclusions

Questions



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General Building Data

Building name: Lafayette Tower
Location and Site: 801 17th St. NW, Washington D.C.
Building Occupant Name: Louis Dreyfus Properties
Occupancy or Function Types (type of building): Office / Corporate
Size (total square feet): 328,00 SF
Number of stories above grade: 11
Primary project team:
Construction Manager: [Clark Construction Group, LLC](#)
Owner: [Louis Dreyfus Property Group](#)
Architect: [Kevin Roche John Dinkeloo & Associates, LCC](#)
Structural Engineer: [Tadler-Cohen-Edelson & Associates, Inc.](#)
MEP Engineer: [Tolk, Inc.](#)
Civil Engineer: [Edwards & Kelcey](#)
Dates of construction: August 2006– December 2009
Building Cost: \$47 million
Project delivery method: GMP ([Guaranteed Max. Price](#))

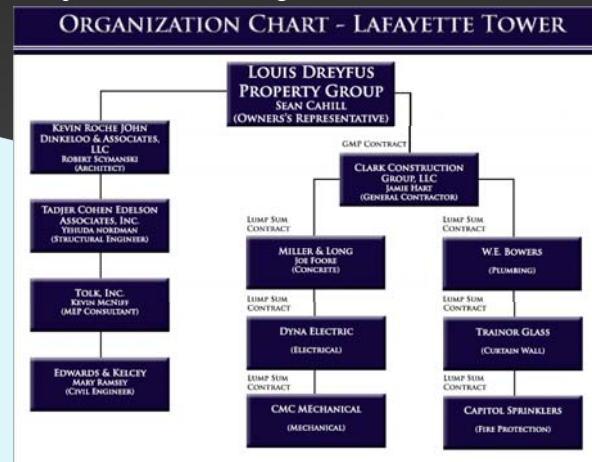
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Project Delivery Method



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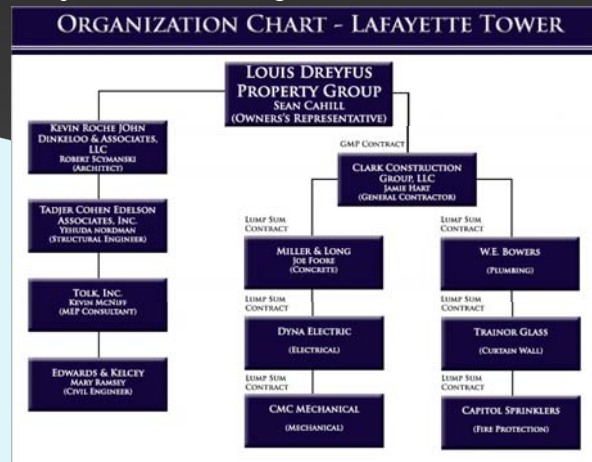
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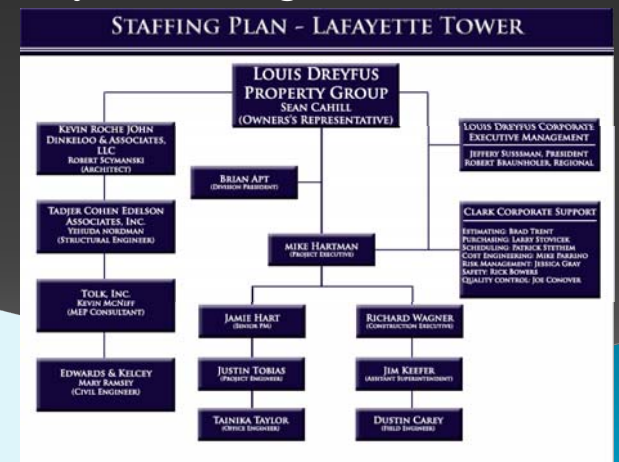
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Project Delivery Method



Project Staffing



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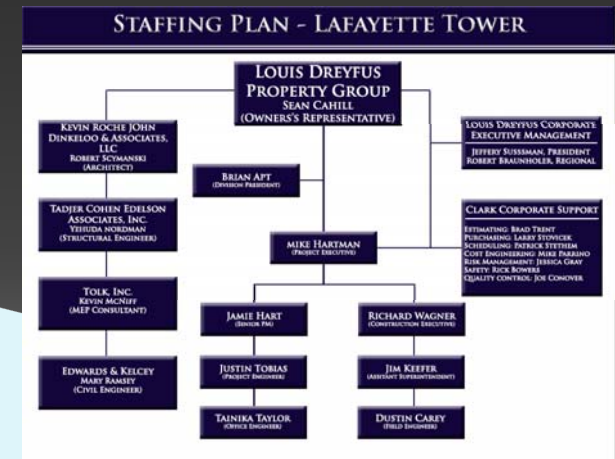
Questions



Owner / GC Relations

- Had prior relationship that run dry
- This project was a good opportunity for the two companies to reestablish that relationship
- Reestablishing the relationship would lead to:
 - Continued work between LD and Clark
 - Both parties making \$\$
- This added additional pressure on both companies staffs to make this project successful

Project Staffing



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Site Location

801 17th St NW
Washington, DC 20006



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Site Logistics

801 17th St NW
Washington, DC 20005



Site Location

801 17th St NW
Washington, DC 20005



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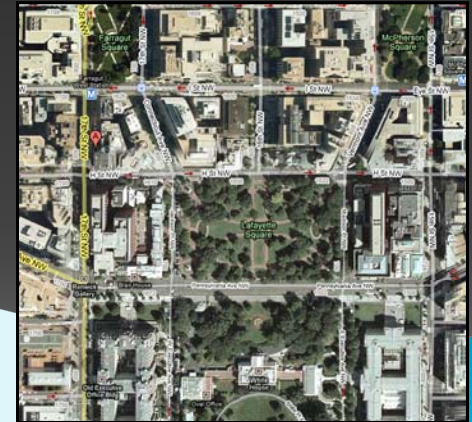
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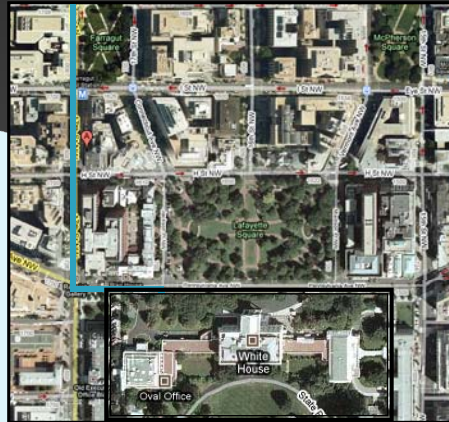
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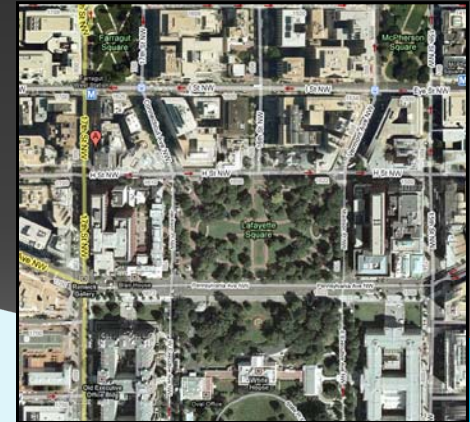
801 17th St NW
Washington, DC 20005



Presidential
Motorcade
Route

Site Location

801 17th St NW
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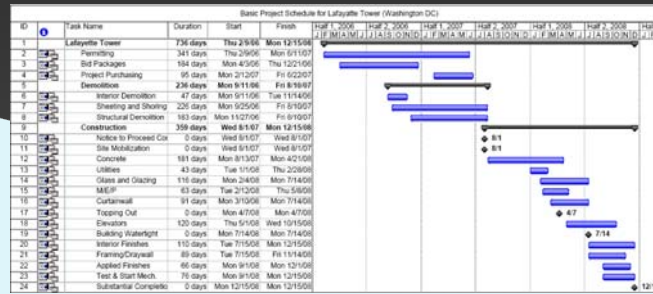
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Schedule



Demolition (9.11.06 – 8.10.07)



Superstructure (8.13.07 – 4.7.08)



Finishes (4.8.08 – 12.15.08)



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Column-Free Perimeter Depth

Problem:

The column-free perimeters are an exciting feature for potential tenants because of the increased square footage of window space they provide on the North, West, and South faces of the building but they greatly increase the difficulty of construction due to the incorporation of detailed fall protection plans and cantilevered slabs.

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Column-Free Perimeter Depth

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The column-free perimeters are an exciting feature for potential tenants because of the increased square footage of window space they provide on the North, West, and South faces of the building but they greatly increase the difficulty of construction due to the incorporation of detailed fall protection plans and cantilevered slabs.

Solution:

I agree that the views to the South side of the building are worthwhile due to the fact that they overlook The White House. However, I don't feel the views to the West and North are worthy of the extra time, money and energy needed to incorporate this feature. Therefore, I propose to remove this feature on these sides of the building.

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Column-Free Perimeter Depth

South Facing Views:



GOOD! 😊

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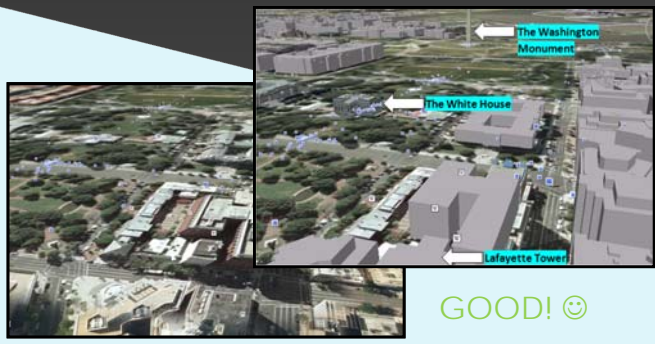
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Column-Free Perimeter Depth

South Facing Views:



West Facing Views:



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Column-Free Perimeter Depth

North Facing Views:



POOR ☹️

West Facing Views:



OKAY 😊

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Column-Free Perimeter Depth

Items to Consider:

- Cost Implications
- Schedule Impacts
- Constructability Variances

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Column-Free Perimeter Depth

Items to Consider:

- Cost Implications
- Schedule Impacts
- Constructability Variances

Main Sources of Information:

- Owners Representative
- Clark Construction Rep.
- Information From Structural Redesign
(obtained in structural breadth)

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Column-Free Perimeter Depth

Important Info From Owner's Rep.:

- The cantilever cost him \$1.00/gsf. With the building sitting at around 228,000 SF, the addition of the cantilever cost approximately ~~\$228,000~~.
- The column-free perimeter increases the value of the rental space somewhere between \$0.25 and \$0.50 per square foot.
- The typical lease period is 15 years.

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- The typical lease period is 15 years.

Cantilever Value Calculator

Floor	Floor Area (SF)	Low \$/SF	High \$/SF	Value Range		Typical Lease	Value Range	
2nd	17,482	\$0.25	\$0.50	\$4,370.50	\$8,741.00	15 years	\$65,557.50	\$131,115.00
3rd	21,156	\$0.25	\$0.50	\$5,289.00	\$10,578.00	15 years	\$79,335.00	\$158,670.00
4th	20,556	\$0.25	\$0.50	\$5,139.00	\$10,278.00	15 years	\$77,085.00	\$154,170.00
5th	21,006	\$0.25	\$0.50	\$5,251.50	\$10,503.00	15 years	\$78,772.50	\$157,545.00
6th	21,006	\$0.25	\$0.50	\$5,251.50	\$10,503.00	15 years	\$78,772.50	\$157,545.00
7th	21,006	\$0.25	\$0.50	\$5,251.50	\$10,503.00	15 years	\$78,772.50	\$157,545.00
8th	21,006	\$0.25	\$0.50	\$5,251.50	\$10,503.00	15 years	\$78,772.50	\$157,545.00
9th	21,006	\$0.25	\$0.50	\$5,251.50	\$10,503.00	15 years	\$78,772.50	\$157,545.00
10th	20,856	\$0.25	\$0.50	\$5,214.00	\$10,428.00	15 years	\$78,210.00	\$156,420.00
11th	21,156	\$0.25	\$0.50	\$5,289.00	\$10,578.00	15 years	\$79,335.00	\$158,670.00
Total							\$773,385.00	\$1,546,770.00

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Column-Free Perimeter Depth

Cantilever Value / Floors Leased					
Floors Leased	Value Range/ Floor		Low Total	Ave. Total	High Total
1	\$77,338.50	\$154,677.00	\$77,338.50	\$116,007.75	\$154,677.00
2	\$77,338.50	\$154,677.00	\$154,677.00	\$232,015.50	\$309,354.00
3	\$77,338.50	\$154,677.00	\$232,015.50	\$348,023.25	\$464,031.00
4	\$77,338.50	\$154,677.00	\$309,354.00	\$464,031.00	\$618,708.00
5	\$77,338.50	\$154,677.00	\$386,692.50	\$580,038.75	\$773,385.00
6	\$77,338.50	\$154,677.00	\$464,031.00	\$696,046.50	\$928,062.00
7	\$77,338.50	\$154,677.00	\$541,369.50	\$812,054.25	\$1,082,739.00
8	\$77,338.50	\$154,677.00	\$618,708.00	\$928,062.00	\$1,237,416.00
9	\$77,338.50	\$154,677.00	\$696,046.50	\$1,044,069.75	\$1,392,093.00
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Column-Free Perimeter Depth

Important Info From Clark Rep.:

- Installation is very similar between a cantilevered slab vs. a traditional PT slab
- As far as installation costs, schedule and constructability, both slabs are very similar therefore no analysis is necessary
- The real differences are apparent when considering safety for the cantilevered slabs
 - Quality Control needs to be monitored much more stringently
 - The associated fall protection plan makes tasks more difficult/time intensive

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Materials Needed for Addition Safety:



In Column Anchor Strap
(2) Per column



Full Body Harness



Retractable Lifeline Cable

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Extra Man Hours Safety Plan Causes:

"The major drawback of this plan is the additional time caused for people who are affected by it. Something that would take an hour would take approximately an hour and a half if it had to be done outside of the cables."

Fall Protection Labor Cost					
Employee Classification	Hours/Day	Multiplier	Duration (days)	Wage (\$/hr)	Cost (\$)
Engineer	6	0.33	56	32	\$3,548.16
Helper	6	0.33	56	23	\$2,550.24
Engineer	4	0.33	75	32	\$3,168.00
Helper	4	0.33	75	23	\$2,277.00
Sub-Total					\$11,543.40
25% increase					\$2,885.85
Total					\$14,429.25

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Total					\$14,429.25

Effect on Curtain Wall Sub-Contractor:

Curtain Wall Total Cost = approx. \$4 million

Total Labor Cost (%15) = approx. \$600,000

Production Rate Reduction = approx. 20%

Increase in Labor Cost = approx. \$120,000

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Information From Structural Redesign:

This study involved redesigning the column layout in order to create an optimal plan that kept the column-free design on the South face of the building but incorporated a more typical layout for the columns on the West and North faces while keeping it as close to the original design as possible.

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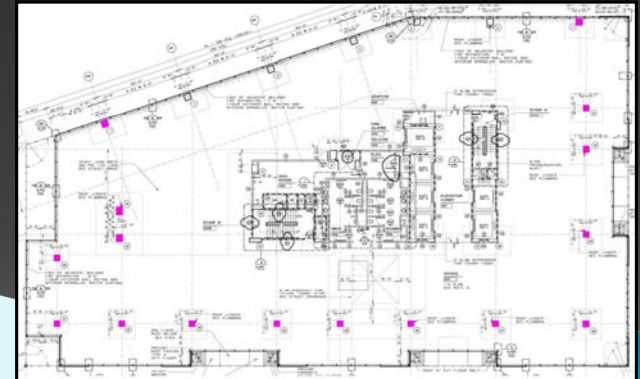
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Original Column Layout



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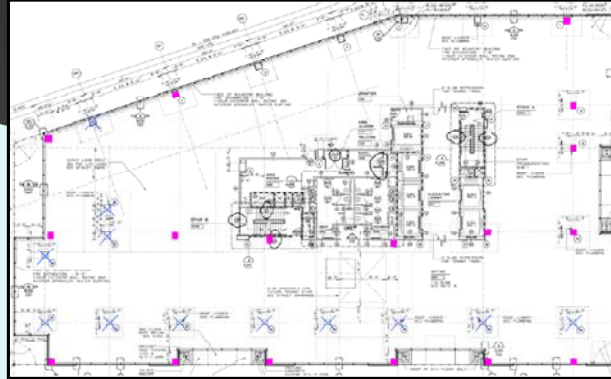
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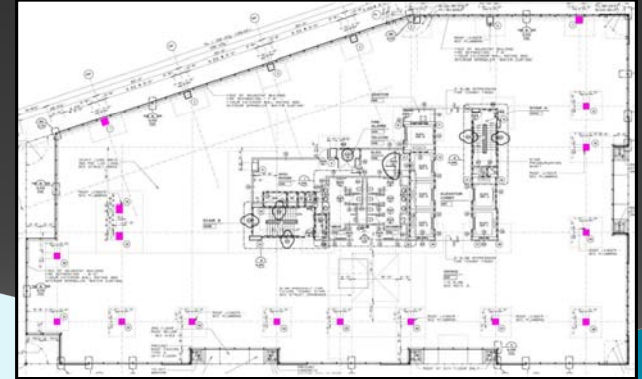
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New Column Layout:



Original Column Layout:



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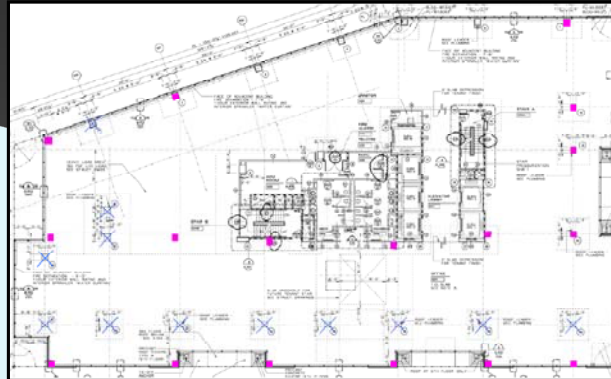
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New Column Layout:



Results:

- New design is structural stable with little changes to original slab and reinforcing designs
- 70% removal of the cantilevered slabs
- Original cost of cantilever, \$328,000, is reduced to \$98,400
- The new design will retain between approx. 50-66% of the original increased rental value

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Pros vs. Cons

Means of Tabulation:

Original Design:

- The total value of the scenario can be found by taking the average value the column-free exterior brings to the building per floor and subtract the cost of the cantilever
- There will be a different values depending on the number of floors being leased

New Design:

- All of the benefits (money saved from fall protection materials and extra labor for both the GC and curtain wall company) will be compiled
- The average value per floor that the column-free exterior brings to each floor will be adjusted by the percentage determined by the cantilever's partial removal analysis
- The cantilever cost will be adjusted to correspond with the percentage of cantilevered slab remaining in the new design

All of the inputs for each scenario will be summed and the highest value for each number of floors being leased will be indicated.

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All of the inputs for each scenario will be summed and the highest value for each number of floors being leased will be indicated.

Column-Free Exterior Value Calculator for Original Design

Cantilever Value / Floors Leased				
Original Design				
Floors Leased	Value/ Floor	Ave. Total	Cantilever Cost	Total Value
1	\$116,007.80	\$116,007.80	\$328,000	-\$211,992.20
2	\$116,007.80	\$232,015.60	\$328,000	-\$95,984.40
3	\$116,007.80	\$348,023.40	\$328,000	\$20,023.40
4	\$116,007.80	\$464,031.20	\$328,000	\$136,031.20
5	\$116,007.80	\$580,039.00	\$328,000	\$252,039.00
6	\$116,007.80	\$696,046.80	\$328,000	\$368,046.80
7	\$116,007.80	\$812,054.60	\$328,000	\$484,054.60
8	\$116,007.80	\$928,062.40	\$328,000	\$600,062.40
9	\$116,007.80	\$1,044,070.20	\$328,000	\$716,070.20
10	\$116,007.80	\$1,160,078.00	\$328,000	\$832,078.00

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New Design Benefits:

	Material	Labor	Total \$\$
Safety Plan	\$11,830	\$14,430	\$26,260

	Original Value	Multiplier	New Cost
Cantilever	\$328,000	30%	\$98,400
Curtain Wall Labor Savings	\$600,000	20%	\$120,000
New Value / Floor	\$116,008	58%	\$67,285

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Column-Free Exterior Value Calculator for New Design

Cantilever Value / Floors Leased					
New Design					
Floors Leased	Value/ Floor	Ave. Total	Benefits	Cantilever Cost	Total Value
1	\$67,284.52	\$67,284.52	\$146,260	\$98,400	\$115,144.52
2	\$67,284.52	\$134,569.05	\$146,260	\$98,400	\$182,429.05
3	\$67,284.52	\$201,853.57	\$146,260	\$98,400	\$249,713.57
4	\$67,284.52	\$269,138.10	\$146,260	\$98,400	\$316,998.10
5	\$67,284.52	\$336,422.62	\$146,260	\$98,400	\$384,282.62
6	\$67,284.52	\$403,707.14	\$146,260	\$98,400	\$451,567.14
7	\$67,284.52	\$470,991.67	\$146,260	\$98,400	\$518,851.67
8	\$67,284.52	\$538,276.19	\$146,260	\$98,400	\$586,136.19
9	\$67,284.52	\$605,560.72	\$146,260	\$98,400	\$653,420.72
10	\$67,284.52	\$672,845.24	\$146,260	\$98,400	\$720,705.24

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Design Value Comparison

FLOORS LEASED	OLD DESIGN	NEW DESIGN
1	-\$211,992.20	\$115,144.52
2	-\$95,984.40	\$182,429.05
3	\$20,023.40	\$249,713.57
4	\$136,031.20	\$316,998.10
5	\$252,039.00	\$384,282.62
6	\$368,046.80	\$451,567.14
7	\$484,054.60	\$518,851.67
8	\$600,062.40	\$586,136.19
9	\$716,070.20	\$653,420.72
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1	\$67,284.52	\$67,284.52	\$146,260	\$98,400	\$115,144.52
2	\$67,284.52	\$134,569.05	\$146,260	\$98,400	\$182,429.05
3	\$67,284.52	\$201,853.57	\$146,260	\$98,400	\$249,713.57
4	\$67,284.52	\$269,138.10	\$146,260	\$98,400	\$316,998.10
5	\$67,284.52	\$336,422.62	\$146,260	\$98,400	\$384,282.62
6	\$67,284.52	\$403,707.14	\$146,260	\$98,400	\$451,567.14
7	\$67,284.52	\$470,991.67	\$146,260	\$98,400	\$518,851.67
8	\$67,284.52	\$538,276.19	\$146,260	\$98,400	\$586,136.19
9	\$67,284.52	\$605,560.72	\$146,260	\$98,400	\$653,420.72
10	\$67,284.52	\$672,845.24	\$146,260	\$98,400	\$720,705.24

Presentation Outline

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Structural Redesign

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Design Value Comparison

FLOORS LEASED	OLD DESIGN	NEW DESIGN
1	-\$211,992.20	\$115,144.52
2	-\$95,984.40	\$182,429.05
3	\$20,023.40	\$249,713.57
4	\$136,031.20	\$316,998.10
5	\$252,039.00	\$384,282.62
6	\$368,046.80	\$451,567.14
7	\$484,054.60	\$518,851.67
8	\$600,062.40	\$586,136.19
9	\$716,070.20	\$653,420.72
10	\$832,078.00	\$720,705.24

Recommendations

The first thing that needs to be said about this analysis is that a good portion of the items that values were found for are subjective and almost, if not, impossible to obtain a 100% value for. That being said, I feel that a fair representation for each scenario has been selected and used to help determine a solution which is:

Construct the building with the partial removal of the column-free exterior

- If less than 8 floors are being leased, then the new design is more valuable the original design over the first 15 years of operation
- Today's economy will make leasing 8 or more floors an extremely difficult, if not impossible, task

Presentation Outline

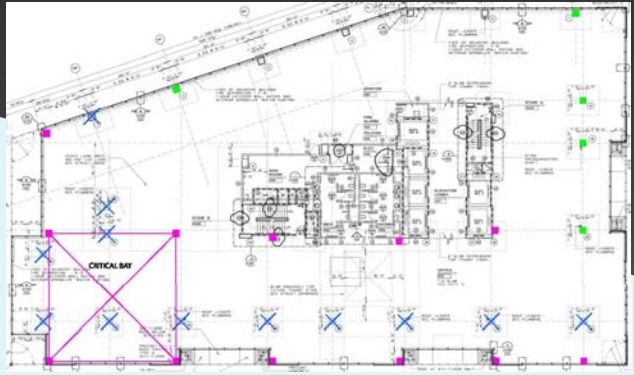
- Project Overview
- Column-Free Perimeter

Structural Redesign

- Solar Implementation
- Conclusions
- Questions



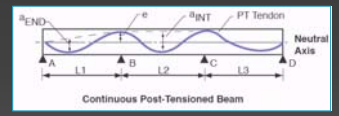
Structural Redesign (Structural Breadth)



Final Design

Final Design
(70) 1/2" 7-Wire Strand Post-Tension Unbounded Tendons
12" Slab depth
42 #7 Reinforcement Bars @ Interior Span spaced $\leq 12"$ OC
42 #7 Reinforcement Bars @ Exterior Span spaced $\leq 12"$ OC
30 #7 Reinforcement Bars @ Interior Supports spaced $\leq 18"$ OC
30 #7 Reinforcement Bars @ Exterior Supports spaced $\leq 18"$ OC

Tendon Ordinate	Tendon (CG) Location*
Exterior Support - Anchor	5"
Interior Support - Top	9"
Interior Span - Bottom	1"
End Span Bottom	1.75"



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Solar Implementation

(Electrical Breadth / Critical Industry Issue)

Problem:

With today's economy in a recession and the growing global awareness of green technologies, saving money and the environment is on everyone's mind. As a soon to be construction manager, both topics are of the utmost importance to me and lead me to the question: *what can I do about it?*

Presentation Outline

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Solar Implementation

(Electrical Breadth / Critical Industry Issue)

Problem:

With today's economy in a recession and the growing global awareness of green technologies, saving money and the environment is on everyone's mind. As a soon to be construction manager, both topics are of the utmost importance to me and lead me to the question: *what can I do about it?*

Solution:

One answer to this question is to do everything in my power to try to incorporate as much sustainable design into my projects as possible. A great way to add sustainable design into Lafayette Tower would be the introduction of photovoltaic panels into the current building systems in order to utilize one of nature's greatest energy sources, the sun.

Presentation Outline

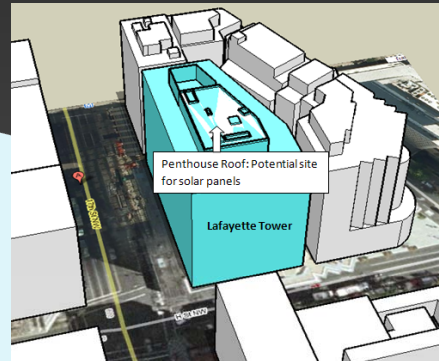
- Project Overview
- Column-Free Perimeter
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- Questions



PV Panel Placement



Presentation Outline

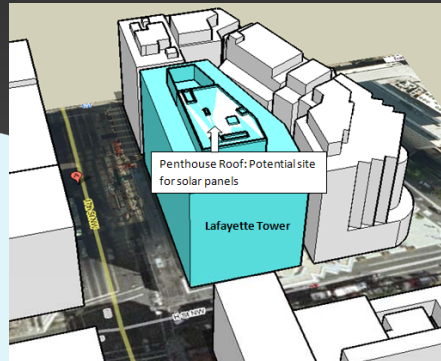
- Project Overview
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Solar Implementation

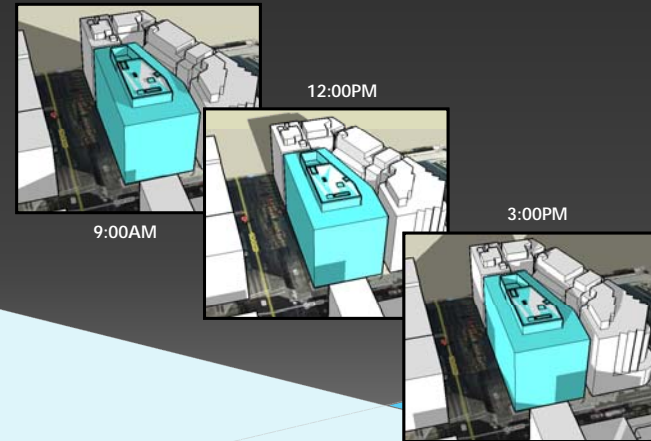
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PV Panel Placement



Shadow Analysis (Winter Solstice - December 21, 2009)



Presentation Outline

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Structural Redesign

Solar Implementation

Conclusion & Lessons Learned

Questions



PV Panel Selection

Selection Criteria:

- Is the company well-known and reputable? Are they on the forefront of technology?
- Is the panel made for large commercial usage?
- Is the panel made for grid tied systems?
- Is there a vender nearby?

Presentation Outline

Project Overview

Column-Free Perimeter

Structural Redesign

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KD210GX-LP

Product Details	
Weight	40.8 lbs
Type (thin-film, poly-crystal, CIGS, CeTe, etc.)	Highly efficient multi-crystal
Connectors	Plug-in
Operating temperature	-40°C to +90°C
Temperature Coefficient (Pmp)	(-)0.40%/°C
Temperature Coefficient (Voc)	(-)0.12%/°C
Temperature Coefficient (Vmp)	(-)0.34%/°C
Temperature Coefficient (Isc)	0.52%/°C
Temperature Coefficient (Imp)	0.19%/°C
Max power current (Imp)	7.90 A
Short-circuit current (Isc)	8.58 A
Rated power at PTC (Pptc)	184.6 W
Durability features	All weather construction
Module Construction/Materials	These cells are encapsulated between a tempered glass cover and a pottant with back sheet to provide efficient protection from the severest environmental conditions. The entire laminate is installed in an anodized aluminum frame to provide structural strength and ease of installation.

THE NEW VALUE FRONTIER
KYOCERA



Presentation Outline

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Inverter Selection

Selection Criteria:

- Is the company well-known and reputable? Are they on the forefront of technology?
- Is the panel made for large commercial usage?
- Is the panel made for grid tied systems?
- Is there a vender nearby?
- Is the inverter compatible with the chosen PV panel?

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Xantrex GT5.0 Inverter

Model	Features	xantrex
GT2.8 Inverter	208VAC Max. Output: 2780W 240VAC Max. Output: 2850W Connection coded per IEC Outdoor Rated NEMA 3R 10 year warranty	 Xantrex GT Series Inverter
GT3.3N Inverter	208VAC Max. Output: 3100W 240VAC Max. Output: 3300W Connection coded per IEC Outdoor Rated NEMA 3R 10 year warranty	
GT4.0N Inverter	208VAC Max. Output: 3800W 240VAC Max. Output: 4000W Connection coded per IEC Outdoor Rated NEMA 3R 10 year warranty	
GT5.0 Inverter	208VAC Max. Output: 4500W 240VAC Max. Output: 5000W Connection coded per IEC Outdoor Rated NEMA 3R 10 year warranty	

Smart choice for power™

xantrex™



Presentation Outline

- Project Overview
- Column-Free Perimeter
- Structural Redesign
- Solar Implementation**
- Conclusions
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Sizing an Array

Determined from EDSGN 498A Exercise
Charts located in Final Report

Criteria	Value
Max. Modules in Series	15
Min. Modules in Series	10
Max. Strings in Parallel	2
Max. Array Capacity	28
W/ Derate Factor	29

# of Modules in Series	1 String		2 Strings	
	#	Pac out (W)	#	Pac out (W)
1	1	168	2	336
2	2	336	4	673
3	3	505	6	1009
4	4	673	8	1345
5	5	841	10	1682
6	6	1009	12	2018
7	7	1177	14	2355
8	8	1345	16	2691
9	9	1514	18	3027
10	10	1682	20	3364
11	11	1850	22	3700
12	12	2018	24	4036
13	13	2186	26	4373
14	14	2355	28	4709
15	15	2523	30	5045
16	16	2691	32	5382
17	17	2859	34	5718
18	18	3027	36	6054

Presentation Outline

- Project Overview
- Column-Free Perimeter
- Structural Redesign

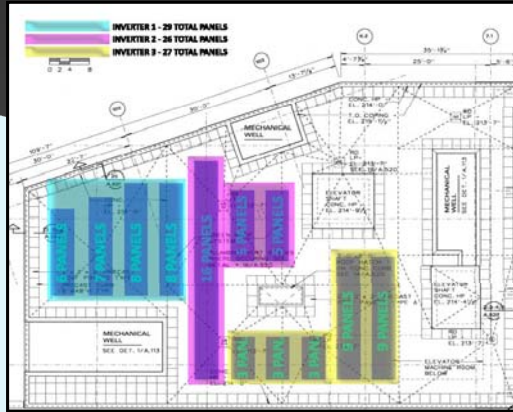
Solar Implementation

- Conclusions
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PV Panel Layout

Total Components
3 Inverters
82 Panels



Presentation Outline

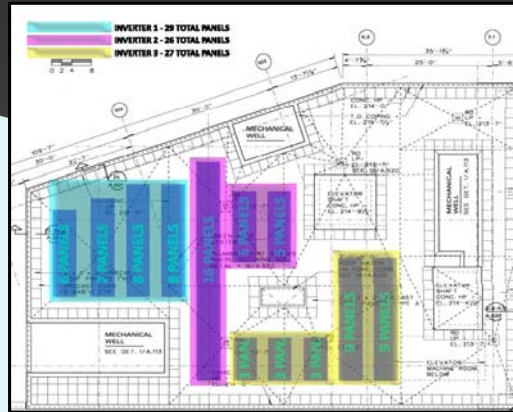
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PV Panel Layout



Total Components
3 Inverters
82 Panels

Cost Analysis



Solar Equipment Estimate			
Material	Cost	# of	Total Cost
Solar Panels	\$874	82	\$71,668
Inverters	\$3,004	3	\$9,012
Mounting Kits	\$46	82	\$3,731
Labor	\$5,000	1	\$5,000
Total			\$89,411

Presentation Outline

- Project Overview
- Column-Free Perimeter
- Structural Redesign

Solar Implementation

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- Questions



Electrical Gains

Determined using PV Watts

Station Identification	
City:	Sterling
State:	Virginia
Latitude:	38.95° N
Longitude:	77.45° W
Elevation:	82 m
PV System Specifications	
DC Rating:	17.2 kW
DC to AC Derate Factor:	0.95
AC Rating:	16.4 kW
Array Type:	Fixed Tilt
Array Tilt:	39.0°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	8.0 ¢/kWh

Results			
Month	Solar Radiation	AC Energy	Energy Value
	(kWh/m ² /day)	(kWh)	(\$)
1	3.59	1888	151.04
2	4.28	1982	158.56
3	4.80	2391	191.28
4	5.34	2477	198.16
5	5.32	2426	194.08
6	5.66	2500	200.00
7	5.46	2434	194.72
8	5.38	2439	195.12
9	5.07	2271	181.68
10	4.72	2253	180.24
11	3.56	1715	137.20
12	3.03	1525	122.00
Year	4.68	26301	2104.08

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Incentives

On February 24th, 2009 the District Department of the Environment (DDOE) announced that DC residents, businesses, nonprofits and private schools may now apply for up to \$33,000 in assistance to install renewable energy systems on their buildings. Up to \$2 million for each of the next 4 years will be available which begins immediately for solar photovoltaic and wind turbine systems. PV incentives are based off of the systems kilowatt rating. It is broken off into 3 tiers.

- \$3 for each of the first 3,000 installed watts of capacity
- \$2 for each of the next 7,000 installed watts of capacity
- \$1 for each of the next 10,000 installed watts of capacity

Lafayette Tower's solar PV system totaled 17.2kW which means it would be eligible for \$30,200 in assistance.

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Payback Period

Initial Cost = \$89,411.00

Expected Incentives = \$30,200.00

Savings / Year = \$2104.08

Total Payback Period = 28 Years

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Payback Period

Initial Cost = \$89,411.00

Expected Incentives = \$30,200.00

Savings / Year = \$2104.08

Total Payback Period = 28 Years

Recommendations

Although a 28 year payback period isn't the best decision financially, I still believe **this system should be incorporated**. There are many benefits to a solar PV system other than \$\$ saved.

- Electric systems generate no emissions of greenhouse gases or other pollutants, thereby reducing our impact on the global climate
- Solar panels provide a visible demonstration of concern for the environment, community education and proactive forward thinking

Not only are these things a responsible person should do, but they could attract potential tenants who are likeminded.

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Conclusions

Column-Free Exterior 😊

- Analysis included fairly subjective material but remained unbiased
- Partial removal of the column-free exterior proved to be financially beneficial in most cases

Structural Redesign 😊

- Proved the proposed layout could be constructed with minimal changes to existing design conditions

Solar Implementation 😊

- Not the best decision financially but still the correct decision as a responsible member of the construction industry

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Questions?



Acknowledgements



Penn State Faculty
Dr. David Riley
Dr. Robert Holland
Dr. Moses Ling



Clark Construction Team
Jamie Hart
Justin Tobias
Dustin Carey
Richard Wagner



Louis Dreyfus Group
Sean Cahill



My Family
Father - John
Mother - Linda
Sister - Emily
Dogs - Lilly & Sophie



My Friends & Fellow AEs