

The Pennsylvania State University
Department of Architectural Engineering

TWO LIBERTY CENTER



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Construction Management
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PRESENTATION OUTLINE

- *Two Liberty Center Introduction*
- Research Topic
- Façade Construction Analysis
- Mechanical System Analysis
- Conclusions



CLIENT INTRODUCTION

Client Introduction

Two Liberty Center

Research Topic

Façade Sequencing

Mechanical System

Conclusions

Questions

- The Shooshan Company
 - Full service real estate development firm
 - Washington, DC and surrounding areas
 - Build, market, lease and manage
 - Long-term investment in properties
 - Focus on building relationships



BUILDING INTRODUCTION

Client Introduction

Two Liberty Center

Research Topic

Façade Sequencing

Mechanical System

Conclusions

Questions

- Two Liberty Center
 - 180,000 SF Class-A office building
 - 8,600 SF ground-level retail spaces
 - Structured underground parking, 1 space per 580 SF
 - Detailed pre-cast concrete and glass façade
 - Architectural glass tower at southwest corner
 - Part of a sophisticated mixed-use development



BUILDING INTRODUCTION

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Conclusions

Questions

- Liberty Center Development
 - Commercial, retail, and residential development
 - Central urban park with adjoining retail
 - One Liberty Center
 - 330,000 SF office building built 2002-2005
 - Residences
 - 530,000 GSF residential
 - 21-story, 234 luxury condominiums
 - 20-story, 235 luxury apartments



BUILDING INTRODUCTION

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Questions

■ Construction Details

- December 2005 – September 2008 (planned)
- Modified design-bid-build delivery
- General contractor negotiated during design
 - Cost-plus-fee with a guaranteed maximum price
- Subcontracts competitively bid after design
 - Selected on lowest cost with most reliable scope



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RESEARCH TOPIC INTRODUCTION

Client Introduction

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Conclusions

Questions

- Critical Industry Issue
 - PACE Roundtable discussion
 - Rising energy costs
 - MEP decision making – building efficiency
 - Two Liberty Center
 - Building driven by business model
 - Tenants benefit from efficiency



RESEARCH GOALS

Client Introduction

Two Liberty Center

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Conclusions

Questions

- Research impacts of energy trends on development market
- Relate impacts to types of development
- Identify methods for managing these impacts
- Predict future changes to development market



ENERGY TRENDS

Client Introduction

Two Liberty Center

Research Topic

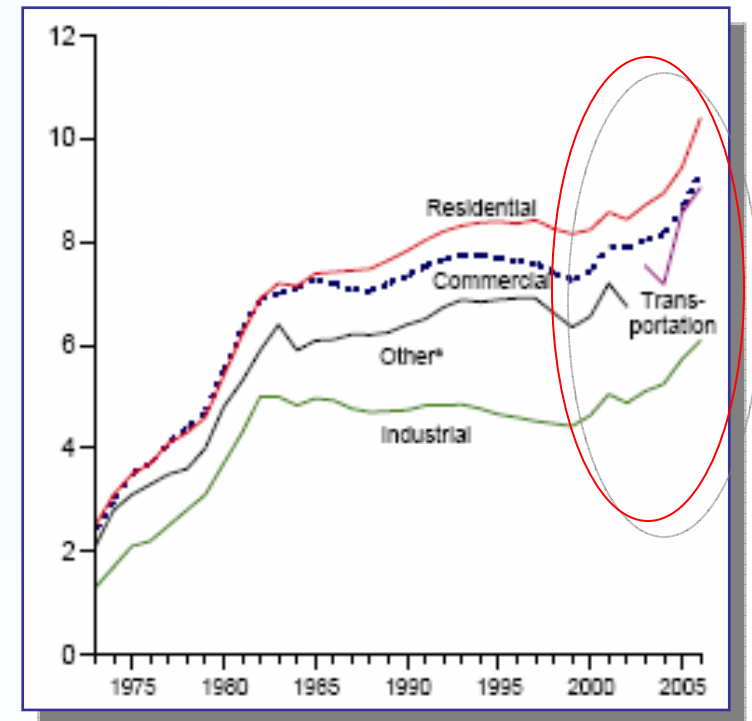
Façade Sequencing

Mechanical System

Conclusions

Questions

- Cost of electricity
 - 25% increase since the year 2000
 - Residential and Commercial sectors are highest





ENERGY TRENDS

Client Introduction

Two Liberty Center

Research Topic

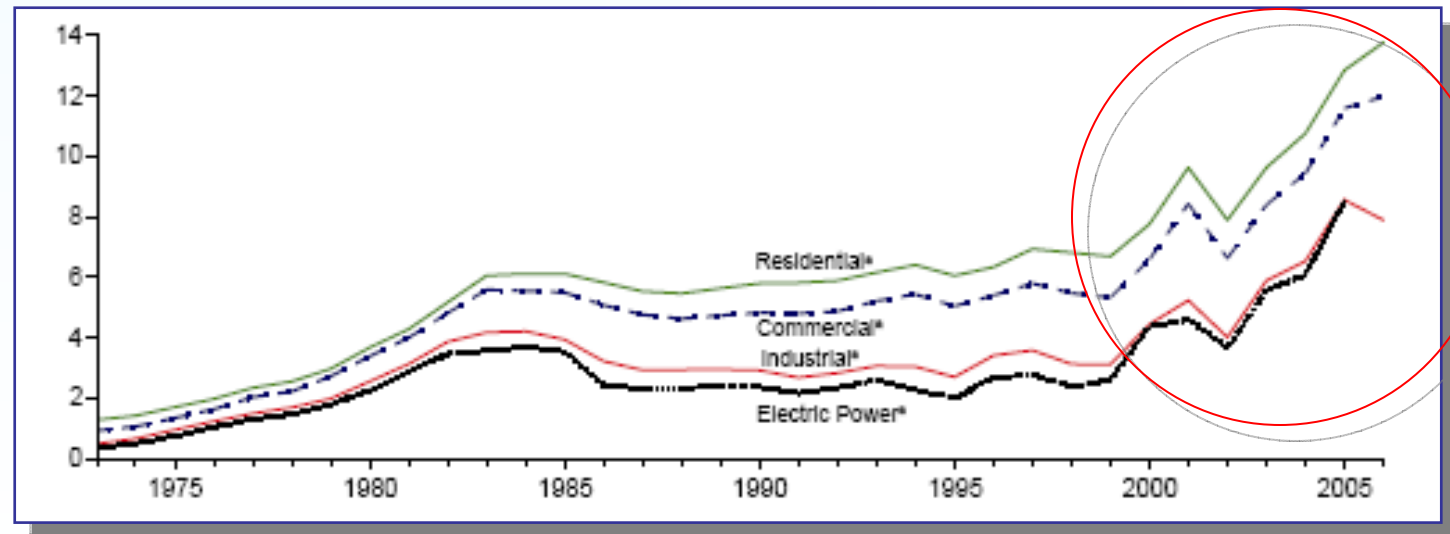
Façade Sequencing

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Conclusions

Questions

- Cost of natural gas up 100% since 2000
- Residential and Commercial sectors highest





DEVELOPMENT TYPES

Client Introduction

Two Liberty Center

Research Topic

Façade Sequencing

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Conclusions

Questions

- Types of development considered
 - Commercial / Office space
 - Multi-family residential
- Utility cost responsibility
 - Triple-net: tenant pays for everything
 - Full-service: all costs included in rental rate
 - Hybrid



BUSINESS OF BUILDING EFFICIENCY

Client Introduction

Two Liberty Center

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Conclusions

Questions

- When tenants are responsible for utilities:
 - Efficient buildings are in higher demand
 - Vacancy rates below averages
 - Higher rental rates can be offset by savings
 - Profits increase for building owner
 - Maintain higher resale values



BUSINESS OF BUILDING EFFICIENCY

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Questions

- When owner is responsible for utilities:
 - Lower rental rates offset by savings
 - Vacancy rates below averages
 - Maintain higher resale value
 - Profits increase for building owner



MARKETING

Client Introduction

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Conclusions

Questions

- Sustainable Design Aspects
 - Day-lighting and Air Quality
 - Improved employee productivity
 - Higher job satisfaction
 - Reduced absenteeism
 - Efficient Systems
 - Lower operating costs for tenants
 - Status symbol



FUTURE OF DEVELOPMENT

Client Introduction

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Conclusions

Questions

- Developers are continuing to make decisions based on the same business model, but the outcomes are changing
- Marketability factors will push for a change in the business models
- Lowering prices of new technologies will allow for more efficient and sustainable designs



CONCLUSIONS

Client Introduction

Two Liberty Center

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Conclusions

Questions

- Developers can profit from building efficient and sustainable buildings
 - Proper marketing can offset additional costs
 - Efficient technologies becoming more affordable
 - More valuable buildings at resale
- More responsible development



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FAÇADE SEQUENCING

Client Introduction

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Conclusions

Questions

- Problem Statement
 - Priority placed on occupancy schedule
 - Phased turnover by floor
 - Tenant fit-out following turnover
 - Earlier occupancy leads to earlier payback
 - Façade re-sequencing offers acceleration



FAÇADE SEQUENCING

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Conclusions

Questions

- Façade Construction Details
 - Architectural pre-cast concrete panels
 - Aluminum framed windows
 - Architectural details
 - Glass curtain wall systems
 - Retail store-fronts
 - Glass tower



FAÇADE SEQUENCING

Client Introduction

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Conclusions

Questions

- Existing Sequence

- Complete erection of each face in sequence
- Mobile crane utilized
- Window installation begins during installation of the fourth and final face of panels
- Windows installed per floor – bottom to top



FAÇADE SEQUENCING

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Façade Sequencing

Mechanical System

Conclusions

Questions

- Alternative 1
 - Existing methods utilized
 - Façade erection can begin during 8th floor concrete work
 - Floors 1-5 of each face erected
 - Floors 6-9 follow completion of lower floors
 - Window installation starts during final face of lower floors
 - Installed per floor from bottom to top



FAÇADE SEQUENCING

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Conclusions

Questions

- Alternative 2
 - Tower crane utilized
 - Façade starts during 6th floor concrete
 - Each floor of panels installed – bottom to top
 - Window installation can follow each floor of panels
 - Installed per floor from bottom to top



TURNOVER SCHEDULE

	Floor	Existing	Alternative 1	Alternative 2
Client Introduction	1 st	9 August 2007	13 June 2007	30 April 2007
Two Liberty Center	2 nd	24 July 2007	28 May 2007	11 April 2007
Research Topic	3 rd	27 July 2007	4 June 2007	18 April 2007
<u>Facade Sequencing</u>	4 th	1 August 2007	11 June 2007	25 April 2007
Mechanical System	5 th	14 August 2007	18 June 2007	2 May 2007
Conclusions	6 th	17 August 2007	25 June 2007	9 May 2007
Questions	7 th	15 August 2007	2 July 2007	16 May 2007
	8 th	30 August 2007	9 July 2007	23 May 2007
	9 th	8 September 2007	16 July 2007	30 May 2007
		Average Savings:	40 Days	72 Days



4-D ANIMATION

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Questions

View 4D Animations



FAÇADE SEQUENCING

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Questions

- Conclusions
 - Alternative 2
 - Requires second shift work
 - Added construction cost and planning
 - Implement Alternative 1
 - Schedule savings with minimal impacts
 - Accelerated occupancy



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MECHANICAL ALTERNATIVE

Client Introduction

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Conclusions

Questions

- Centralized HVAC for offices
 - Simplified construction
 - Allows for earlier building enclosure
 - Opportunity for schedule and cost savings



MECHANICAL ALTERNATIVE

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Conclusions

Questions

- Centralization of AHU's for offices
 - 8 – 15,000 CFM chilled water AHU
 - Located in core mechanical rooms
 - 2 – 51,500 CFM chilled water AHU
 - Located on rooftop
 - Duct riser through existing mechanical rooms



MECHANICAL ALTERNATIVE

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Questions

Cost Analysis

			Bare Costs		Total Costs	
	Qty.	Size (CFM)	Material	Labor	Base	Including O&P
Existing						
AHU	8	15000	\$88,800.00	\$20,200.00	\$109,000.00	\$128,000.00
Alternate						
AHU	2	51500	\$74,800.00	\$16,350.00	\$91,150.00	\$107,000.00
Duct	1700	N/A	\$646.00	\$5,049.00	\$5,695.00	\$8,500.00
Savings:			\$13,354.00	-\$1,199.00	\$12,155.00	\$12,500.00



MECHANICAL ALTERNATIVE

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Questions

Schedule Analysis

	Qty.	Size (CFM)	Labor Hours	Total	Scheduling Days
Existing					
AHU	8	15000	78	620	78
Alternate					
AHU	2	51500	246	492	62
Duct	1700	N/A	0.084	142.8	18
			Savings:	-15	-2



MECHANICAL ALTERNATIVE

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Conclusions

Questions

- Conclusions
 - Desired conditions still achieved
 - Alternative system offers cost savings
 - Minimal scheduling impacts
 - Construction simplified
 - Allows for building enclosure acceleration



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CONCLUSIONS

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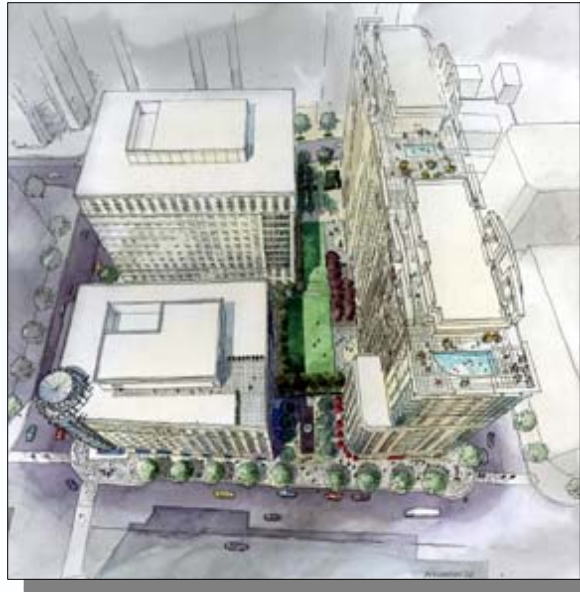
Conclusions

Questions

- Building efficiency
 - Responsible development
 - Profitable opportunities
- Façade Sequencing
 - Opportunity for substantial acceleration
 - Applicable to many projects
- Mechanical Alternative
 - Simplified construction process
 - Reduced upfront costs



QUESTIONS



TWO LIBERTY CENTER

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