

SQUARE 320

1199 F Street, NW – Wash, DC



Michael Webb

Charleston, South Carolina

Architectural Engineering
Construction Management
The Pennsylvania State University

Senior Thesis Presentation 2009

SQUARE 320 Project

“Enabling Synergy Among Renovation Teams”



Project Overview

Size

- 485,000 SF; 15 stories

Cost

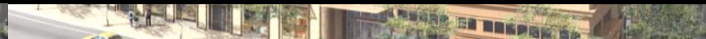
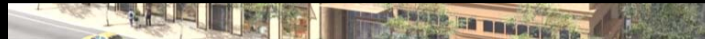
- \$60 million

Schedule

- Dec 2006 – April 2009

SQUARE 320 Project

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Project Background

- Construction of 12-story Class A Office Space
- Renovation of 3 historic buildings
- Rejuvenating the District's East End
- Total Duration: 30 months
- Currently at 85% Leased Tenants

SQUARE 320 Project

“Enabling Synergy Among Renovation Teams”



Major Players

Owner

- Douglas Development

Architects

- Pei Cobb Freed
- Shalom Baranes
- HKS, PC

Construction Manager

- James G. Davis

Centrally Located



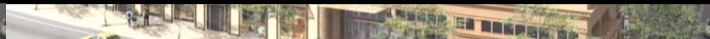
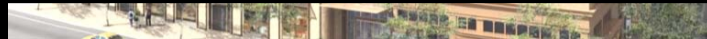
National Mall, Verizon Ctr, White House, DC Convention Ctr

1199 F Street Wash DC, NW



SQUARE 320 Project

“Enabling Synergy Among Renovation Teams”



Project Details

Size

- Class A Office : 350,000 SF
- Retail Shops : 30,000 SF
- Parking : 75,000 SF

SQUARE 320 Project

“Enabling Synergy Among Renovation Teams”



Project Details

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Project Delivery System

- CM @ Risk with GMP

Project Details

Height

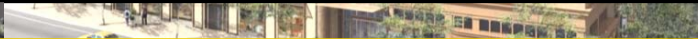
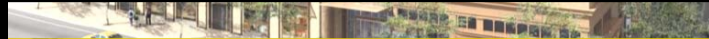
- 12-Stories Above Grade
- 5-Stories Below Grade

Structure

- Renovation
 - Steel Frame w/ Deck
- Tower
 - Post-Tensioned Concrete

SQUARE 320 Project

“Enabling Synergy Among Renovation Teams”



Project Architecture

New Construction

- Office Tower

Historic Renovations

- Barry Whitmore
- Corcoran
- Nordlinger

Office Tower

- Custom curtain-wall, signature design of IM Pei
- Lobby Atrium heavily appointed with granite, marble, copper
- Luxurious bathrooms to attract wealthy tenants

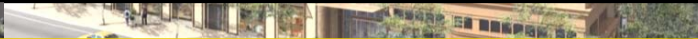
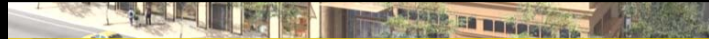


Atrium



SQUARE 320 Project

"Enabling Synergy Among Renovation Teams"



Project Architecture

- New Construction
- Office Tower

Historic Renovations

- Barry Whitmore
- Corcoran
- Nordlinger



1892 - 1899

Historic Renovations

- Re-appoint brick façade
- Restored Granite stonework
- Replace ornamental metal décor at storefront
- Recreate facade of 1892



SQUARE 320 Project



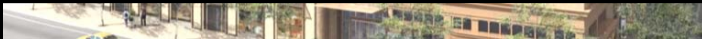
Scope: Renovation Work

Historical Renovations

=> Growing Market

1. Energy cost savings in the name of sustainability
2. Require less capital & incur less risk

SQUARE 320 Project



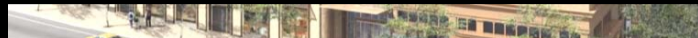
“Enabling Synergy Among Renovation Teams”

Overarching Theme

- Methods that will unlock the potential synergy among renovation teams
- Various parties are united to achieve greater success as a whole



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What is Synergy?

- 2 agents acting together such that the whole is greater than the sum of its parts'
- 5 + 5 = 15

Overview of the Research Results

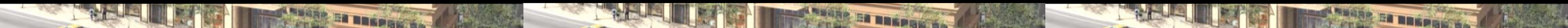
- 3 Distinct Areas that when combined will unlock the potential for success



SQUARE 320 Project

3 Focus Areas

- Cohesion
 - Information-Time-Money Relationship
- Innovation
 - Forward Thinking teams
- Emotional Intelligence
 - Monitoring the project climate & developing working relationships



3 Focus Areas

- ➔ **Cohesion**
 - Information-Time-Money Relationship
- **Innovation**
 - Forward Thinking teams
- **Emotional Intelligence**
 - Monitoring the project climate & developing team relationships

Cohesion

- Information-Time-Money Relationship:

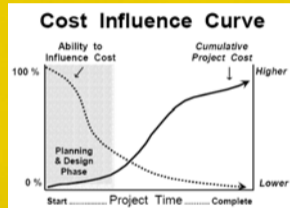
$$(Info)^{-1} = Time + Money$$

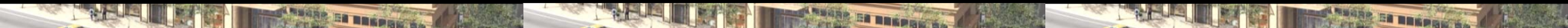
More Information Early

+ Enhances Communication

➔ Efficient Better Quality Work, Less Stress, Happiness & Job Satisfaction

- 3D Laser Surveying (Info) + Major Players Meetings = Teamwork , Unity



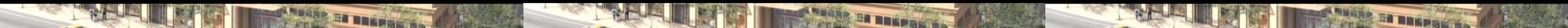


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- ⇒ • Innovation
 - Forward Thinking teams
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Innovation

- Need Cohesive Teams to be Forward Thinking
 - Utilize alternative technology or re-designed systems
- ⇒ [Avoid design decisions that result in severe financial penalties
Potential savings for each party involved]



3 Focus Areas

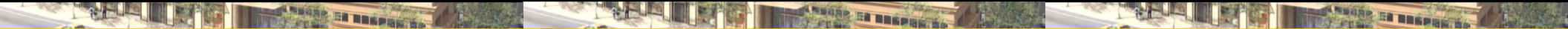
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Emotional Intelligence

- Ability to perceive one's emotions and those in other relationships
- Used as a tool = Monitoring agent that tracks development among people & teams

➔ Insight into each individual & project climate simultaneously
Enables focused efforts at benefiting each individual & project
Allows tailoring project climate to highlight teams strengths

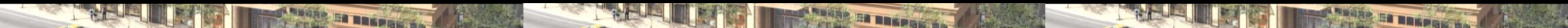
...Ultimately, enabling synergy among renovation teams



What is the Diagnosis?

Square 320 was plagued with many challenges:

- Concealed Conditions - missing or incorrect documents
- Poor communication between all parties
- RFIs lasting 100+ days
- Months of delays
- Additional costs
- Frustrating project climate
- Lack of accountability & job ownership



3 Focus Areas



• Cohesion

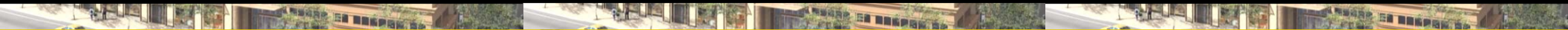
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• Innovation

- Basement Expansion, Financial Perspective, Value of Thinking Forward
- Recouping the Loss through Mechanical & Structural Redesign

• Emotional Intelligence

- Poor Working Climate, EQ Assessment, Office vs Field Dynamic



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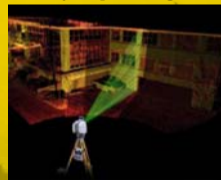
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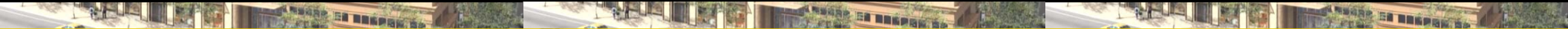
Problems

- Concealed Conditions
- Missing or incorrect drawings
- Lack of Information
- Disconnected Team
- RFIs left open indefinitely

Strategy

- Utilize 3D Laser Surveying
- Selective Demolition
- Accurately map existing conditions





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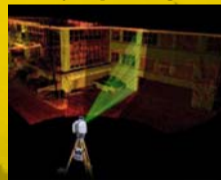
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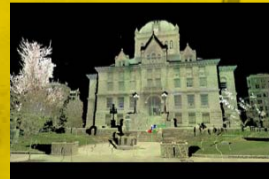
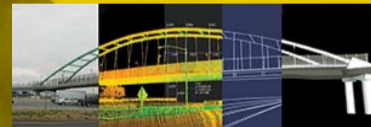
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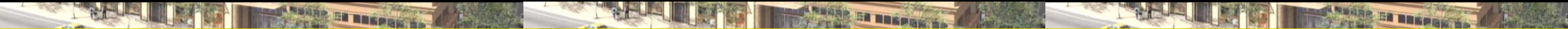
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What is Laser Surveying?

- LIDAR (Light Detection and Ranging)
- Laser pulses reflect and create 3D image
- Scanning maps out 3D point cloud
- Reduces field work & improve efficiency
- 3D Models used in 3D BIM design expedite process
- Frequently used for historical surveying & renovations





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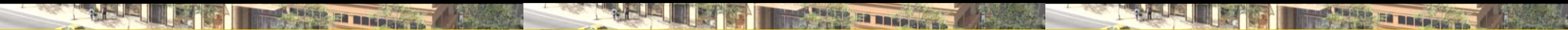
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Will It Work?

- Davis experts say NO!
- Concealed Conditions
- Tenants must keep working
- Technology not used at its full potential

Alternative Strategy

- Utilize 3D laser surveying in Corcoran stair well
- Design process took over a year
- All attention should've been placed there at the start.



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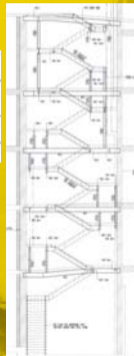
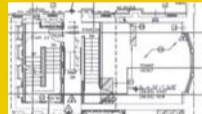
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Corcoran Stair

- Only Stair in Historic Renovations
- Varying landing elevations, risers
- Tight tolerance for glass work
- Goal: Vertical 3D scan

=> model to design from



3 Focus Areas

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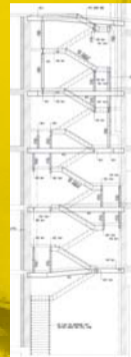
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Corcoran Stair

- Avg Design Time = 16wks
- Corcoran Stair > 52wks

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Cost Comparison

- Time is cut to 1/3rd
- Avg Cost is 3x
- Design time cuts 4wks
- 4 wks @ \$30K = \$120K

Laser Scanning Estimate



Variety of Rough Estimates for Scanning the Corcoran Stair

Company	Location	Conventional Survey	Time	Laser Survey	Scan Time	Data mine
WadeTrim	FL	\$6,000	6 wks	\$15,000	1 day	14 days
Langan Engineering	NY	-	-	\$5,000	1 day	3-5 days
Darling Surveying	AZ	-	-	\$25,000	1 day	7 days
James C. Davis	VA	-	-	-	3 days	10 days

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SQUARE 320 Project

Cohesion

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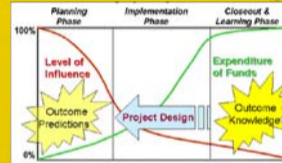
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Cost-Savings Potential

- Kickoff meetings pre-design
- Early problem solving
- Early cohesive communication
- Surveyors are well-versed
- Coordination goes along way to save \$
- Langan Engr Ex: 4000 conflicts avoided = \$500,000 savings



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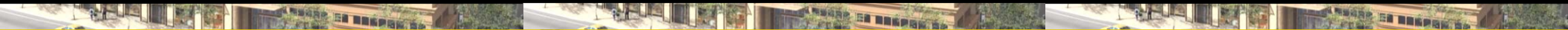


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Conclusion

- Information-Time-Money Relationship
 - More efficient production rates
 - Shorter design time required
 - Fewer delays from RFIs
 - Compressed schedule

=> **Cost Savings: \$120,000 – \$425,000**



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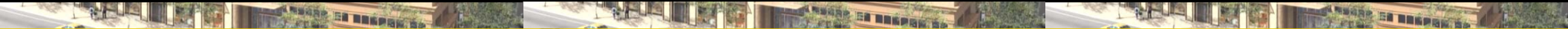
Problems

- Basement Expansion
 - Purpose & Process
- Added Cost
- Schedule delays
- Little benefit

Basement Expansion

- Clark Foundation
- B1 Level – Lower Floor
- Created 2,300 rentable ft²
- 4.25” Excavation
- Heavy Underpinning
- Systematically Jacked Each Column





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Financial Effects

- \$1M change order
- 4 months delay
- Risk with dangerous procedures

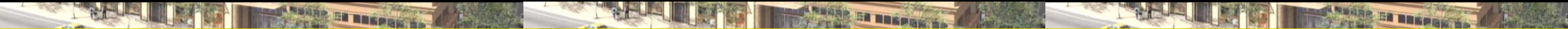
Analysis

- CCIM financial Model
- Annual cash flow of \$71,400
- 23 yr payback
- IRR = 2.22% after taxes

Calculating Project Cost				
Change Order (\$)	Delays (wks)	GCs (\$/wk)	GC Fee (+5%)	Total Cost
\$1,139,000	16	\$30,000.0	\$1,500.0	\$1,620,500

Conclusion

- Not the lucrative decision
 - Little gain with severe financial penalty
 - Space will likely sell for below avg rate – not desirable space
 - Only represents 1.5-2% total office space
 - Would've saved:
 - \$1.6M (2.6% project cost) & 4 months
- => Cut Your Losses**



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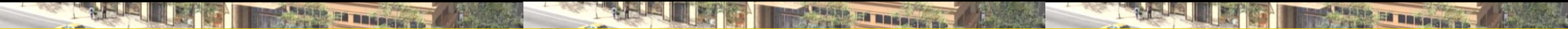
• Emotional Intelligence

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Innovation's Role

- Thinking forward would've prevented the loss
- Alternative ways to recoup the \$1.6M
 - Economic redesign of the structural Jacking system
 - Pursuit of alternative Mechanical system





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Designed based on

- Maximum moment
- Deflection
- Checked for lateral torsional buckling
- Critical bending moment
- Critical buckling load

$$L_b \leq L_p = 1.76r_y \sqrt{\frac{E}{F_y}}$$

$$L_b \leq L_p = 1.76 \left(\frac{2.97}{12} \right) \sqrt{\frac{29,000}{50}}$$

$$L_b \leq L_p = 125.88 \text{ ft}$$

$$L_b = 25$$

$$25 \text{ ft} \leq 125.88 \text{ ft}$$

$$\Phi M_n = \Phi M_p - BF(L_b - L_p)$$

$$0.9 M_n = (0.9)1916.51 - 24.5(25 - 125.9)$$

$$M_n = 4388.26 \text{ kips}$$

$$P_{cr} = \frac{\pi^2 EI_y}{L^2}$$

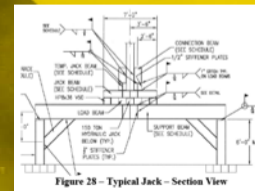
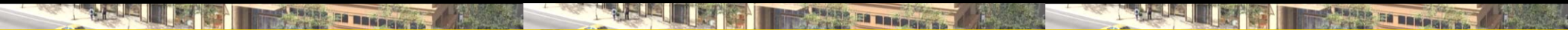


Figure 28 - Typical Jack - Section View



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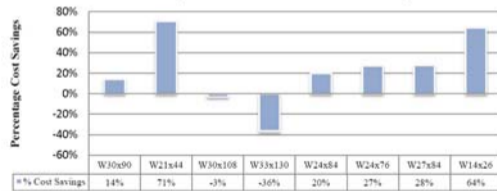
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Structural Jacking System Redesign

- No substantial financial gain
- Only 2 alternative members provide real cost savings

Cost Savings Due To Economical Design



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• **Innovation**

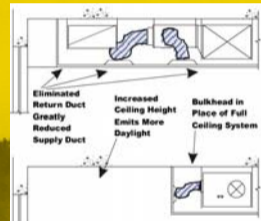
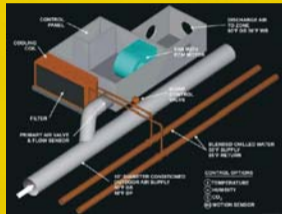
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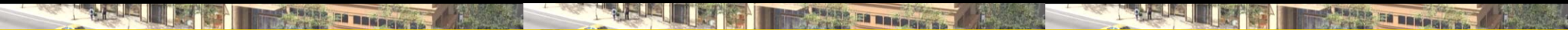
• **Emotional Intelligence**

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Alternative Mechanical System

- Benefits of Fan-Powered Induction Units (FPIU):
 - Increased energy efficiency
 - Superior indoor air quality (IAQ)
 - Increased air circulation & ventilation
 - No RA duct required or VAV units
 - Higher ceilings & Day lighting
 - No need for Mech room per floor
 - Significantly downsize AHU
 - Local mfrs, interchangeable parts
 - Control noise w/ high velocity SA





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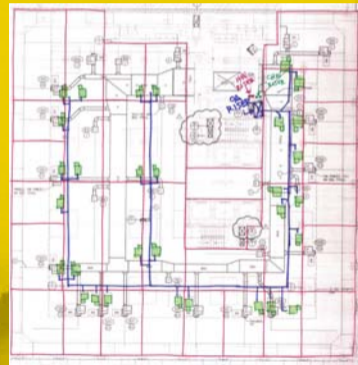
Historic Schematic Design

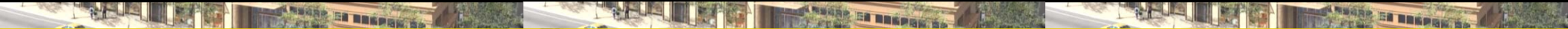
- Determine # units based ft²
- Add SA duct
- Add CHW & HW Pipe
- Requires 6 FPIUs



Tower Schematic Design

- Determine # units based ft²
- Add SA duct
- Add CHW & HW Pipe
- Requires 31 FPIUs
- *Notice: closed loop SA from original design*





3 Focus Areas

- Cohesion
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Determine OA Loads

Benefits of Fan-Powered Induction Units (FPIU):

- Table 6.1 ASHRAE – *Min Vent Rates By Density*
- Determined OA Load for each building
- Sized shaft & ductwork

Determining Basic Outdoor Air Loads					
Floor	# Flrs	Area (ft ²)	Density (#/1000ft)	Outdoor Air (cfm)	Bldg OA (cfm)
Tower			<i>rate: 5 ppl/1000ft</i>	<i>rate: 20 cfm/person</i>	<i>Total Shaft</i>
Typical Floor	12	19000	95	1900	22800
Historical - B1					
B&W	6	2115	11	212	1269
B&W Annex	6	1080	5	108	648
Corcoran	4	1235	6	124	494
Nordlinger	5	6460	32	646	3230
Vault Space - B&W	1	110	1	11	11
Total		11000	55	1100	5652

Determined Water Loads

- Size CHW pipe & HW pipe
- Determined Load to size Chiller
- Sized the boiler as well



Figure 42 - EarthWise CenTraVac Chiller

Sizing CHW Pipe Based On Flowrates for Typical Floor			
Floor	# Units	CHW Flowrate (gpm)	HW Flowrate (gpm)
Tower - Typical Floor		<i>rate: 3 gpm/unit</i>	<i>rate: 0.5 gpm/unit</i>
Perimeter FPIU	19	57	9.5
Internal FPIU	13	39	-
TOTAL	32	96	9.5
x 12 Floors	384	1152	114
Historical - B1			
Perimeter FPIU	6	18	3.0
Internal FPIU	0	-	-
TOTAL	6	18	3
x 6 Floors	36	108	18

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Duct Work Estimate

- Performed traditional takeoffs
- Used DuctCalc software for estimates

Tower

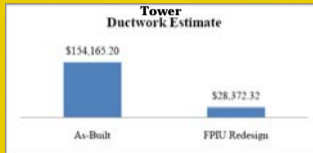
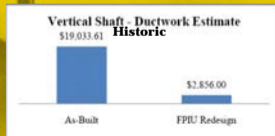
- Supply duct savings=> \$125000 / 82%

Historic

- Supply duct savings=> \$2210 / 73%

Historical Shaft

- Supply duct savings=> \$16177 / 85%

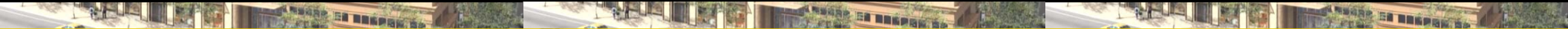


Total Savings For Project

- Savings multiplied by floors
- Total Savings = \$1.5M
- *Excludes cost of added pipe*

Potential Cost Savings From Duct		
Tower - Horizontal	Historic - Horizontal	Historic - Vertical Shaft
\$125,792.88	\$2,209.32	\$16,177.61
	Total	\$144,179.81
<i>x 12 Floors</i>	<i>x 6 Floors</i>	
\$1,509,514.56	\$13,255.92	\$16,177.61
	Total	\$1,538,948

Nearly Covers The Cost Of Basement Expansion



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➔ • Emotional Intelligence

- *Poor Working Climate*, EQ Assessment, Office vs Field Dynamic

Problem

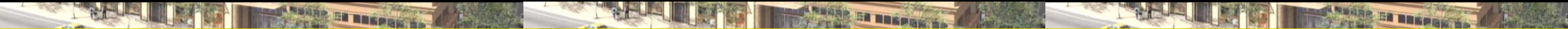
- Poor working climate
- Constant frustration
- High relationships
- Conflicting personalities



“Enabling Synergy Among Renovation Teams”

SQUARE 320 Project

Emotional Intelligence



3 Focus Areas

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Emotional Intelligence is the capacity to recognize one's feelings and those of others, for motivating ourselves, and managing our own emotions and emotions within our relationships.

<p>Intrapersonal</p> <p>Self-regard: "ability to respect and accept oneself as basically good"</p> <p>Emotional self-awareness: Ability to recognize one's feelings and share them appropriately</p> <p>Assertiveness: Ability to express feelings, beliefs, thoughts and to defend one's rights in a constructive manner</p> <p>Independence: Ability to be self directed and free from emotional dependency</p> <p>Self-actualization: Ability for one to realize their potential and to be generally satisfied with their life</p>	<p>Interpersonal</p> <p>Empathy: To be aware of, understand and appreciate the feelings of others</p> <p>Social responsibility: To be a cooperative, contributing, and constructive member of a group</p> <p>Interpersonal Relationships: "Ability to establish and maintain mutually stratifying relationships"</p>
<p>Adaptability</p> <p>Reality Testing: Ability to see the real situation, not being overly optimistic or pessimistic</p> <p>Flexibility: Ability to adjust one's emotions, thoughts and behavior as a situation changes</p> <p>Problem Solving: Ability to identify and solve problems and implement effective solutions</p>	<p>Stress Management</p> <p>Stress Tolerance: Ability to not fall apart when adverse and stressful situations occur</p> <p>Impulse Control: Ability to resist or delay an impulse, drive or temptation to act</p>
	<p>General Mood</p> <p>Optimism: Ability to look on the bright side, maintain a positive attitude, even when faced with adversity</p> <p>Happiness: Ability to feel satisfied with life, to enjoy oneself and others, to have fun</p>

Core Competencies

High

- Assertiveness
- Self-Regard
- Independence

Low

- Emotional Self-awareness
 - Empathy
 - Social Responsibility
 - Interpersonal Relationship Skills
- Chaos**
- High Stress Tol. vs Low Impulse Contr.



“Enabling Synergy Among Renovation Teams”

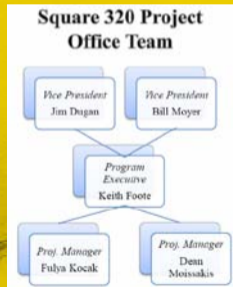
SQUARE 320 Project

Emotional Intelligence

3 Focus Areas

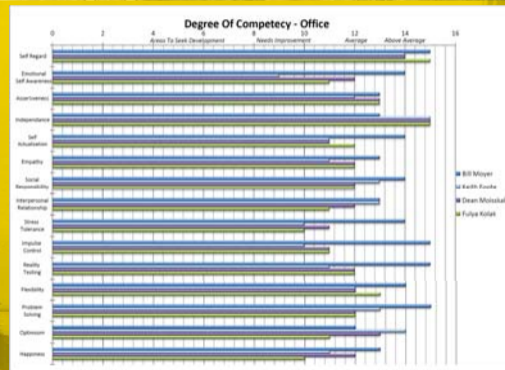
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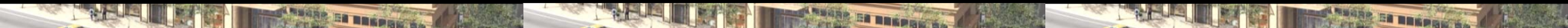
Organizational Structure



Visual Feedback

- Very similar to standard CM profile
- Low**
- Emotional Self-Awareness
- Stress Tolerance
- Happiness





3 Focus Areas

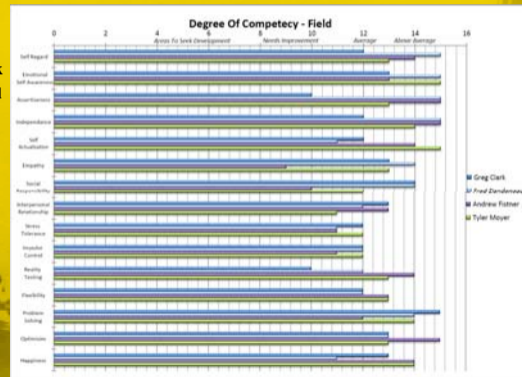
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Observations

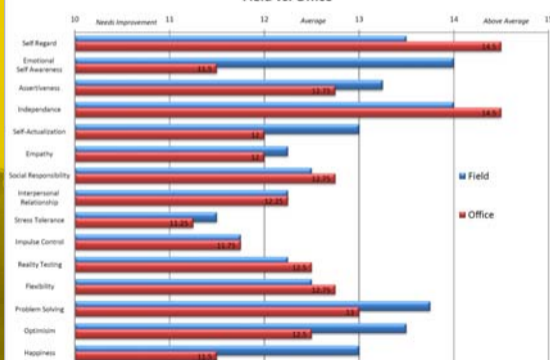
NOTE: Not statistically verifiable, absolute values

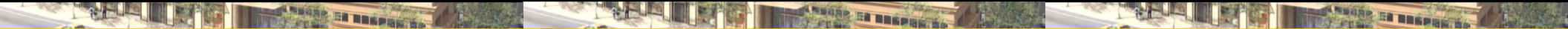
- Low stress tolerance & impulse control + low optimism & self-actualization => **Burnout** profile
- High self-regard, independence & self-awareness, + low empathy & interpersonal relationship skills => **Dysfunctional** relationships
- Office Team
- Empathy, self-awareness, and happiness scores are considerably lower than the field => Poor relationship skills => Strained, frustrated and tired
- Low stress tolerance but Field has higher optimistic & self-aware => Handle stress better

Field vs. Office Dynamic

- EQ is a snapshot of the present, Reflection of the current project climate
- Strained working relationships contrasted w/ proud workers => Industry expects projects to be hard and troublesome
- Office bogged down with comms/relationship problems the project faces + near completion => Feel burnt out
- Field feels like ‘thrown to the wolves’, challenging proj with limtd info and bad comms

EQ Competency
Field vs. Office





3 Focus Areas

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Recommendations

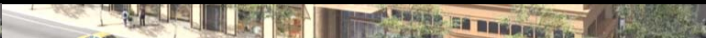
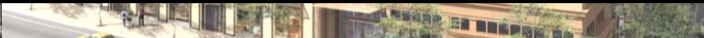
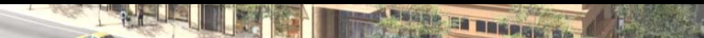
- Surveys & Interview confirm the accuracy of EQ assessment
 - Individuals opportunity to self-monitor their development
 - monitor working relationships & interactions on the job
- Significant potential for gain through periodic monitoring of EQ assessments
 - Improve working conditions, relationships, refocus energies
- Progress Reports: Tasks <=> EQ: Team Synergy
- **Synergy**
= individual collaboration forms a team, accountable to work w/ vested interest in project success



My Proposal

- Remove Tenants Earlier – Demolish Interior – 3D Laser Scan
- Hold Kickoff Meetings Prior to Design Stage (Owner, A/E, CM, Civil)
- Avoid Basement Expansion – Utilize Space for Mech/Elec & Storage
- Replace VAV System w/ FPIUs
- Quarterly EQ Assessments for Key Players: CM Field & Office, Arch, Lead Contractors

⇒ ***Effective Collaboration, Schedule Acceleration,
Cost Savings, Individual & Organizational Growth***



“Enabling Synergy Among Renovation Teams”

Cohesion

More Information Early + Enhanced Communication => Efficient & Better Quality Work
3D Laser Surveying (Info) + Key Player Kickoff Meetings => Teamwork & Unity

Innovation

Need Cohesive Teams to be Forward Thinking
Utilize Alternative Technologies & Redesigned Systems Wherever Sensible
=> Avoid Design Decisions Resulting in Severe Financial Penalties
=> Pursue Potential Savings for Each Party

Emotional Intelligence

Periodic Monitoring = Insight into Individuals & Project Climate Simultaneously
Allows Focused Efforts to Develop Individual & Project
Encourages Tailoring Project Climate to Highlight Teams Strengths

...Ultimately, enabling synergy among renovation teams

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“Enabling Synergy Among Renovation Teams”

SQUARE 320 Project

Closing

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Thank You

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Mom & Dad
ShAdy psU Family

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