

**A Campus Project
Northeastern US**

**Garrett Schwier
Construction Management**



**Penn State AE Senior Capstone Project
Garrett Schwier | Construction Management
Advisor | Craig Dubler**

A Campus Project Northeastern US

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- I. Project Background
 - A. General Information
 - B. Buildings Overview
 - C. Unique Features
- II. Analysis I – Structural Redesign
 - A. Overview
 - B. Breadth 1 - Structural Redesign
 - C. Results
 - D. Recommendations
- III. Analysis III – Workforce Management
 - A. Overview
 - B. Site Specific Plan
 - C. Cultural Analysis



- IV. Analysis IV – Foreign Worker Safety
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*Not Discussed: Analysis II: Bid Package
Redesign & Mechanical Breadth*

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Size: 308,000 SF Total
136,500 SF of Buildings
150,900 SF Underground Parking Garage

Location: Northeastern US

Cost: \$69.5 million + \$20 million allowance

Contract: GMP

Schedule: Sept. 2012 to Sept. 2014

Owner: Identity Withheld

CM: Balfour Beatty Construction

US Architect: Fentress Architects

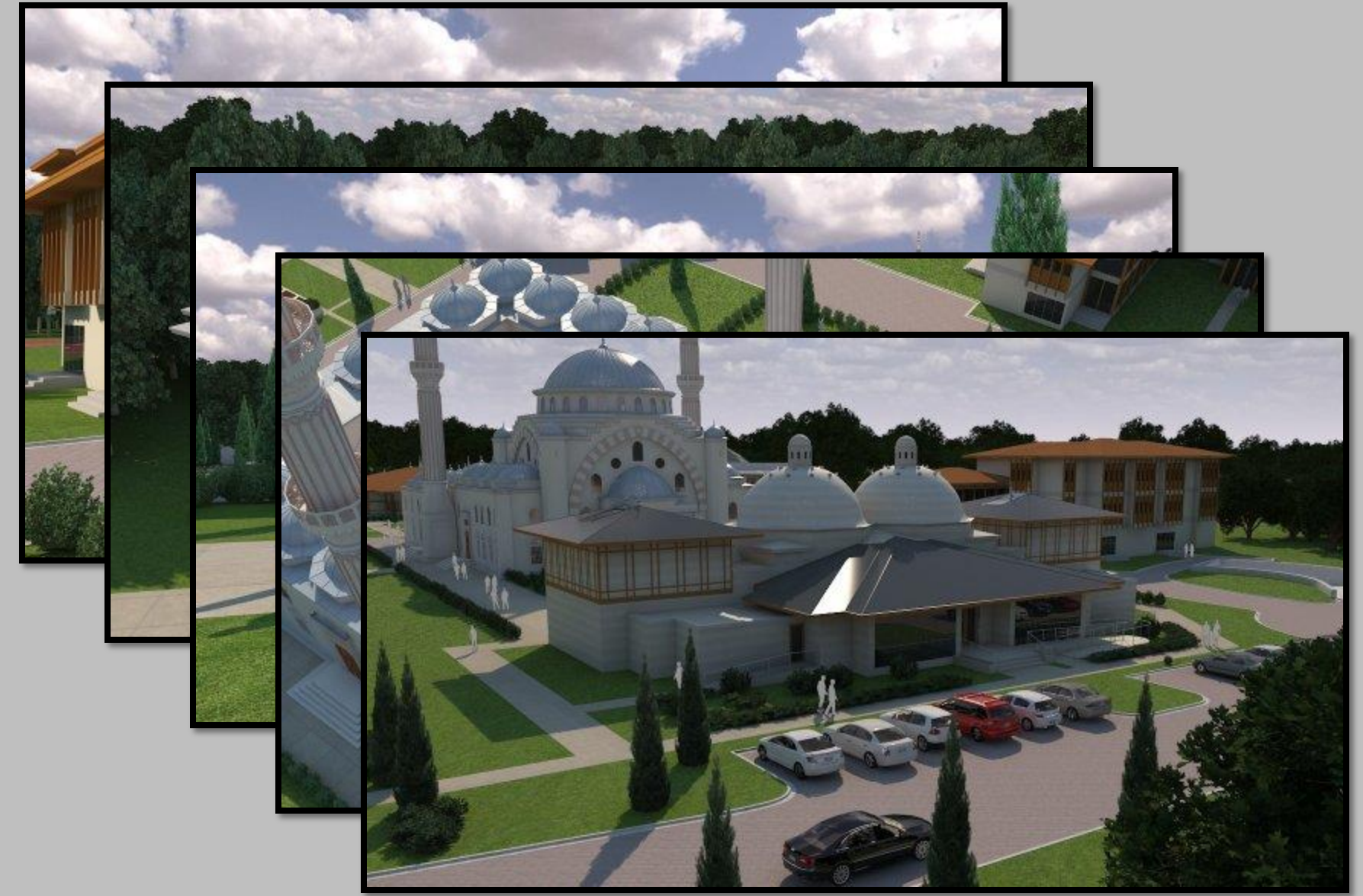
Foreign Architect: Hassa



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- Convent/Monastery
- Cultural Center
- Fellowship Hall
- Mosque
- Turkish Bath





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Finishes, Details, and Ornaments Completed by Foreign Workers

Workers will complete these finishes as part of the cultural objectives of the project.

Include:

- Stained Glass Windows
- Wood Trim
- Detailed Stone Work
- Ornamental Metals



Images courtesy of <http://www.hassa.com/en>.

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Problem Statement:

- Fellowship Hall and Convent/Monastery are only buildings to have a mostly steel structure.
- Does not take advantage of worker affinity to concrete operations.

Potential Solution:

- Design the structure of these buildings to be concrete rather than steel.



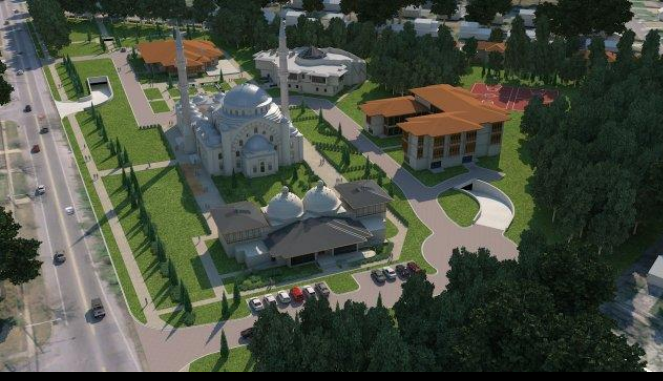
Volume of Concrete: 25,000 CY

Total Cost: \$15.5 million

Concrete Strength: 5000 psi

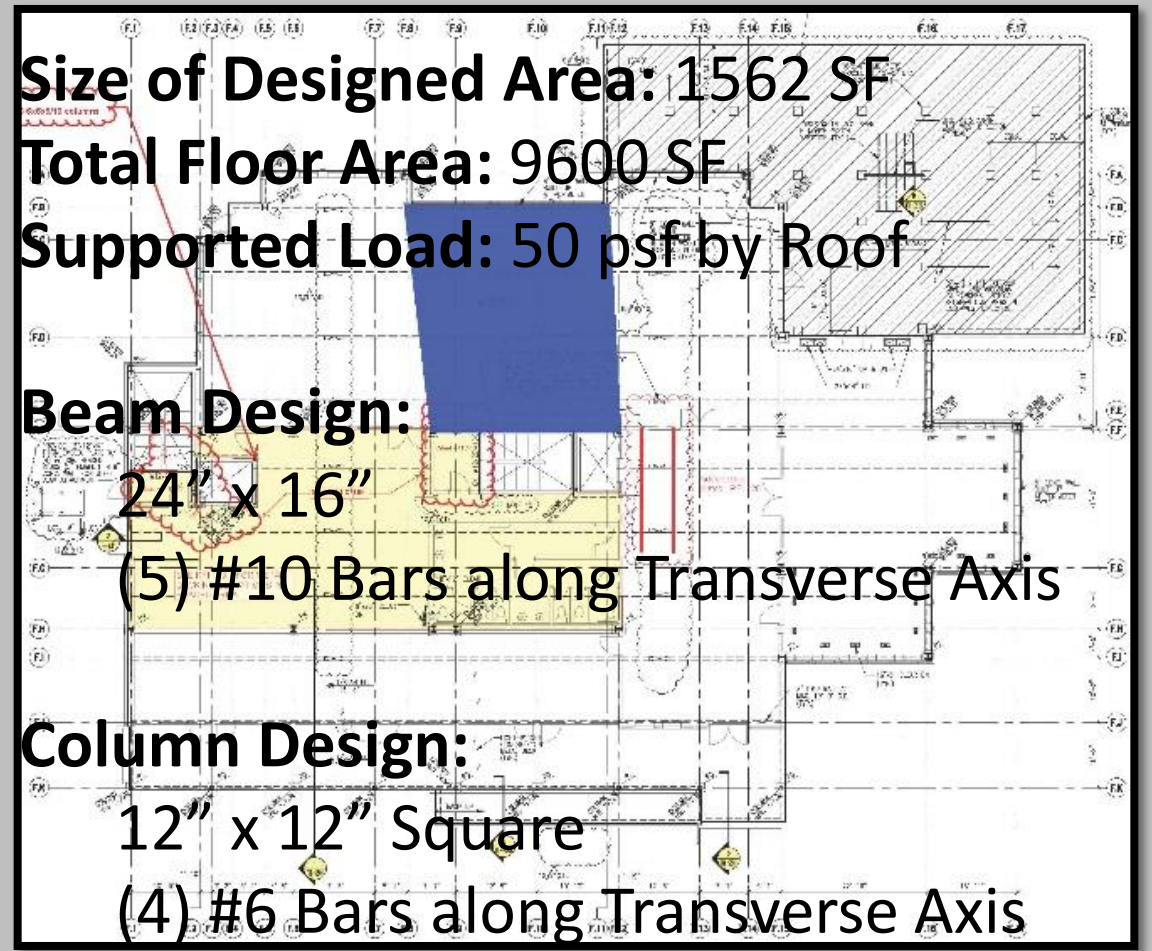
Typical Dimensions Used on Site:

Structural Element	Dimension
Beams	12"x18" --- 12"x30" --- 18"x30"
Columns	12"x24" --- 16"x24" --- 30"x30"
Slabs	8" --- 10" --- 12"

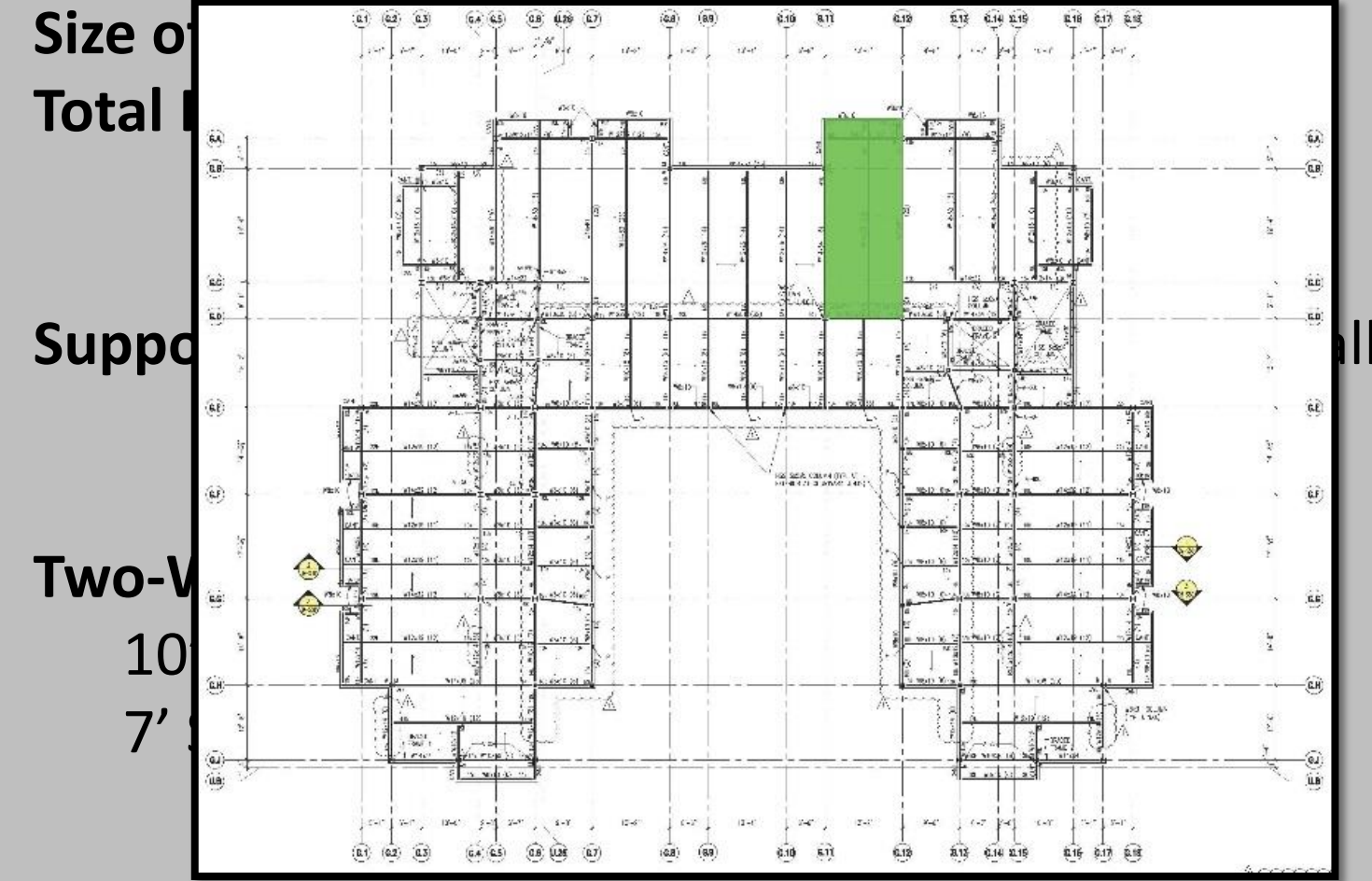


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Fellowship Hall



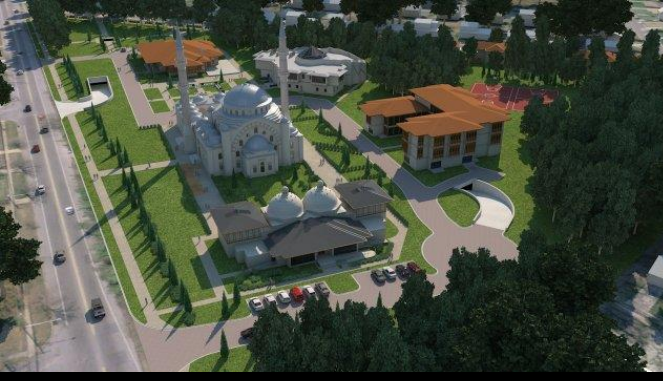
Convent/Monastery



Beam Design:
 16 ½" x 36" Joist-Band
 (10) #11 Bars along Transverse Axis

18" x 12"
 (4) #8 Bars along Transverse Axis

Column Design:
 20" x 20" Square
 (4) #9 Bars along Transverse Axis



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Fellowship Hall

Size of Designed Area: 1562 SF
Total Floor Area: 9600 SF

Cost of Designed Area: \$52,000
Extrapolated Cost: \$321,000

Original Steel Cost: \$318,995
Difference: +\$2,005

	Original Structure	Concrete Redesign	Difference
Total Structural Cost	\$826,758	\$828,763	+\$2,005
Masonry	\$128,670	\$128,670	\$0
Concrete	\$215,000	\$536,000	+\$321,000
Steel	\$318,995	\$0.00	-\$318,995
Roof Truss	\$164,093	\$164,093	\$0
Duration	36	116	+80

Original Duration: 36 days
New Duration: 116 days
Difference: +80 days

No architectural assessment required because of high ceiling height



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Size of Designed Area: 1312 SF per Floor
Total Floor Areas: 27000 SF

Cost of Designed Area: \$109,928
Extrapolated Cost: \$754,079

Original Steel Cost: \$581,950
Difference: \$172,129 + \$80,000
allotment for remaining steel

Original Duration: 39 days
New Duration: 984 days
Difference: 945 days

Convent/Monastery

	Original Structure	Concrete Redesign	Difference
Total Structural Cost	\$1,497,202	\$1,669,331	+\$252,129
Masonry	\$0	\$0	\$0
Concrete	\$728,000	\$1,482,079	+\$754,079
Steel	\$581,950	\$80,000	-\$501,950
Roof Truss	\$187,252	\$187,252	\$0
Duration	39	984	+945

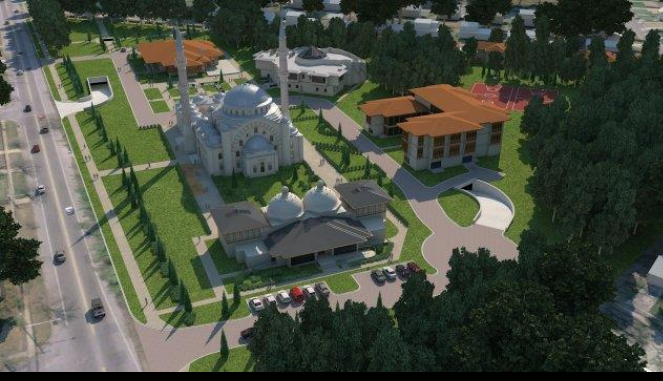
Architectural Assessment

Steel Structure:

2' ¾" to 2' 6¾" of clear space in ceiling
21 SF of area occupied by columns per floor
8" x 8" columns

Concrete Structure:

8¾" to 1' 6¾" of clear space in ceiling
118 SF of area occupied by columns per floor
20" x 20" columns



Final Recommendations

Convent/Monastery: Not recommended

- Increased schedule duration.
- Increased cost.
- Negative effects to architecture.

Fellowship Hall: Possibly recommended.

- If schedule can afford the extended duration or if the duration can be reduced.

Fellowship Hall



Convent/Monastery



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**III. Analysis III – Workforce
Management**

A. Overview

B. Site Specific Plan

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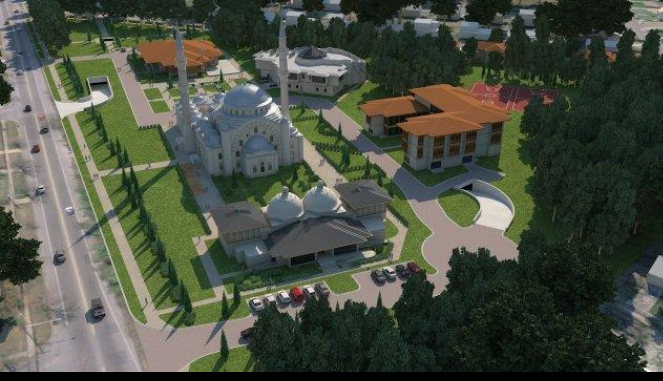


Problem Statement:

- Multiple buildings create the opportunity to operate construction in multiple locations across the site.
- More challenging to manage the site and ensure productivity.

Potential Solution:

- Develop a Workforce Management Plan to enable strategies to improve productivity.
- Include suggestions to motivating the foreign workforce.



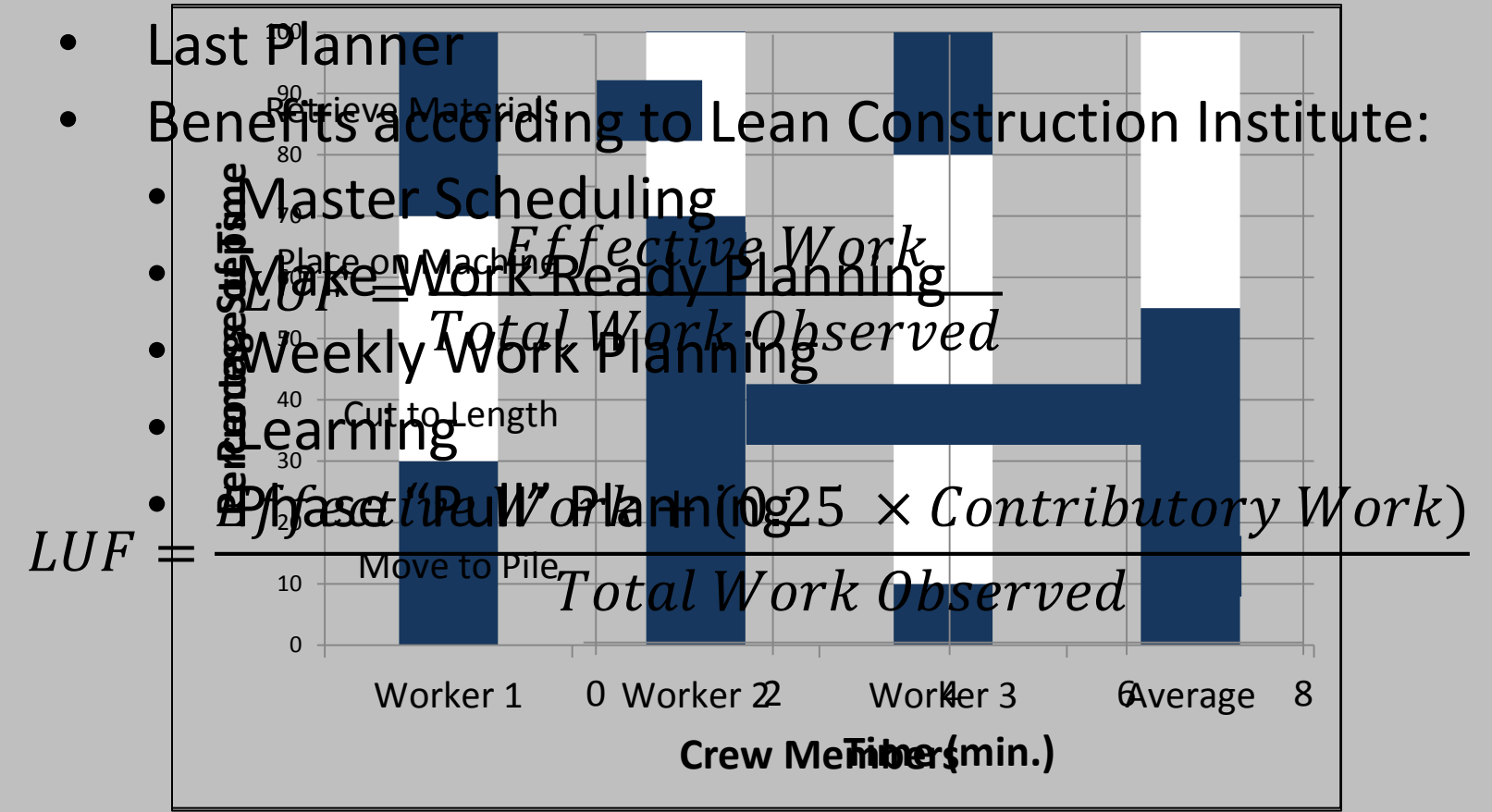
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Management Structure:

- Divide the site/buildings among separate superintendents.
 - One – Parking Garage, Mosque, Fellowship Hall
 - Two – Cultural Center, Convent/Monastery, Turkish Bath
- Overall site superintendent to manage these superintendents.
- Requires effective and frequent communication, cooperation, and coordination.

Management and Planning Tools:

- Last Planner
- Benefits according to Lean Construction Institute:



Production Analysis:

- Information collected through site observation, video, and pictures.
- Crew Balance Charts to identify waste in crew size.
- Process Charts to identify waste in process steps.
- Labor Utilization Factors to identify slow or fast progressing activities.



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Background of Foreign Workers:

- Most are uneducated or come from farming.
- Patriarchal society.
- Authoritarian leadership style.
- Higher expectations of management.

Motivational Techniques:

- Clearly defined disciplinary system.
- Inspirational group speeches.
- Recognition of individual effort and achievement.

Leadership Techniques:

- Avoid ambiguity.
- Give clear and directive instructions.
- Management work longer hours – arrive earlier, stay later than laborers.

I. Project Background

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IV. Analysis IV – Foreign Worker
Safety

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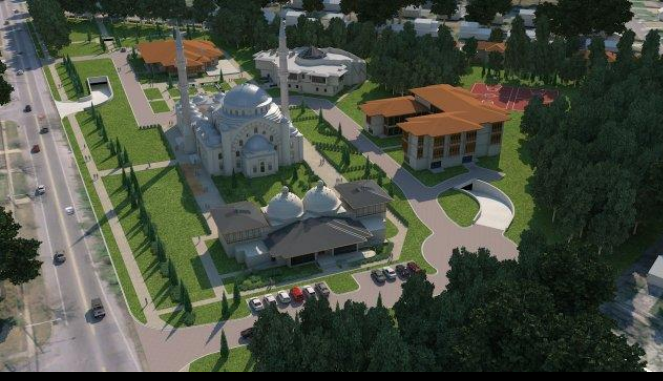
- Crew of foreign workers brought to US to complete details and finishes across the project.
- Workers may not be familiar with US construction practices and regulations.

Potential Solution:

- Develop a Foreign Worker Safety Plan.
- Will present strategies to improve communication and safety on-site despite language and cultural barriers.



Images courtesy of <http://www.hassa.com/en>.



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A. Training Foreign Workers:

- Comprehensive and specific program.
- Learn more about foreign workers.

B. Interpreters and Translators:

- Facilitate communication on-site.
- Foreign workers w/ strong English.

C. Teaching English:

- Provide classes for workers to learn basic English.
- Motivation is key.

D. Worker-Management Communication Methods:

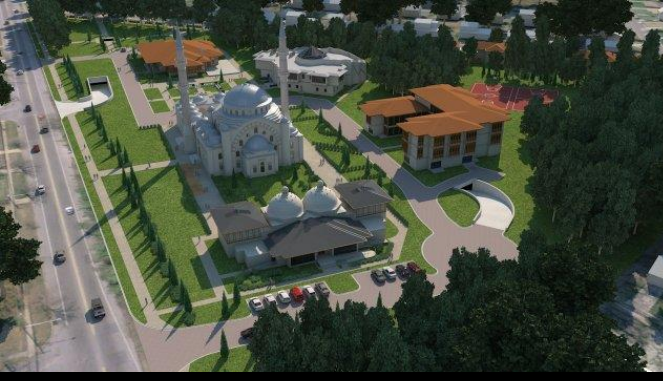
- Additional mediums for communication.
- Bilingual reporting systems.

E. Racism in the Workplace:

- Fight early and actively.
- Schedule site bonding activities.

F. Visual Safety Notification Techniques:

- Communication that can be easily understand regardless of language.
- Colored hard hats, two card system, Talk-Sign.



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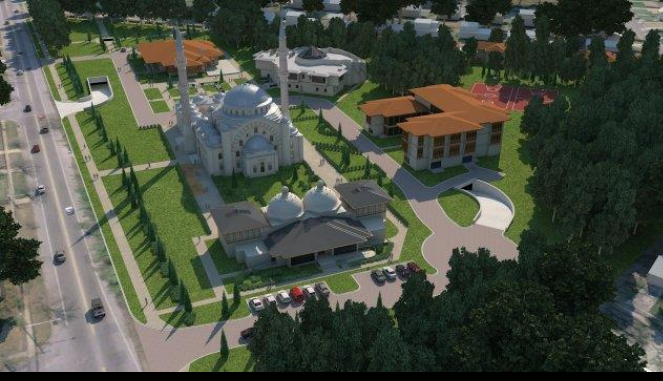
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*Image courtesy of
<https://www.citb.co.uk/>.*



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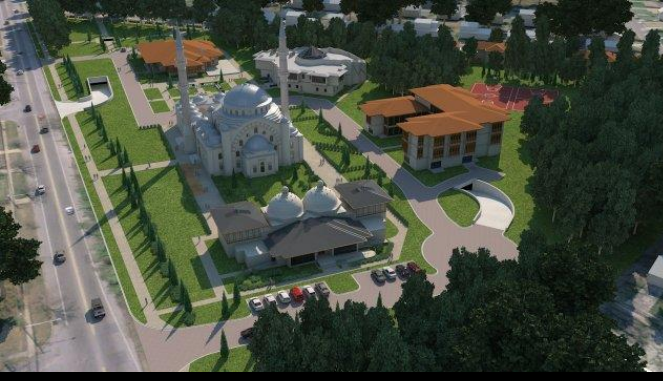
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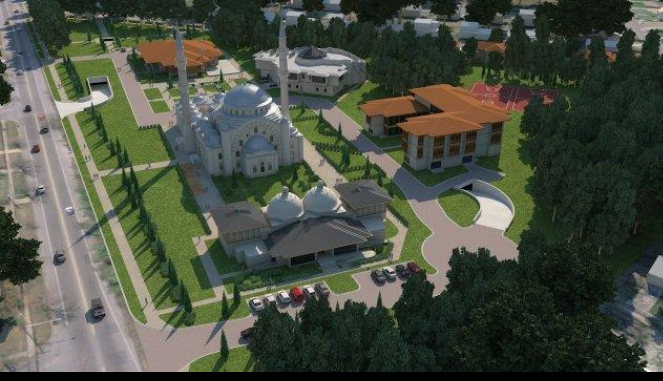
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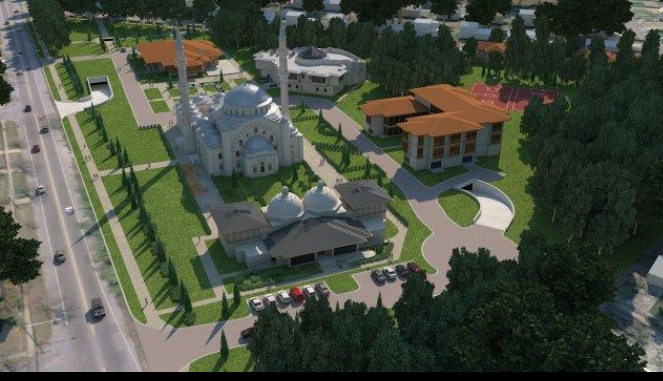
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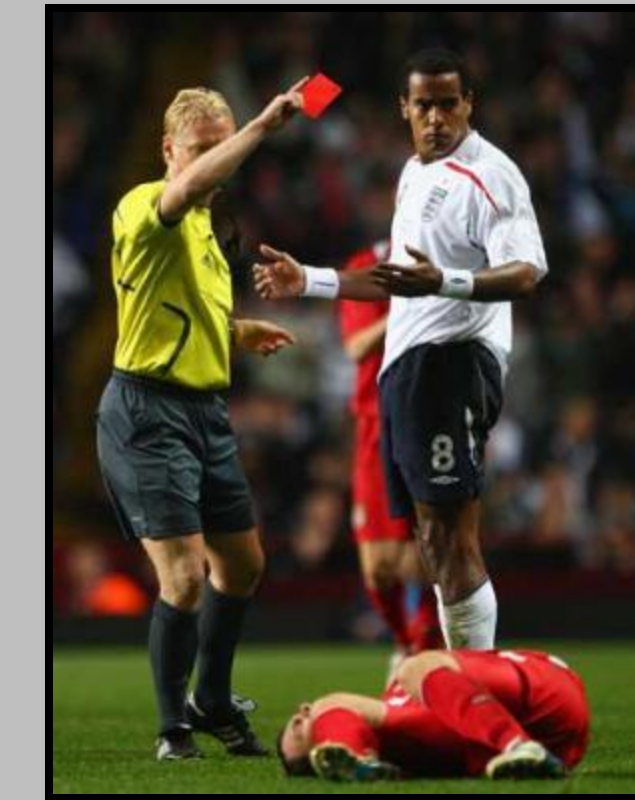


Image courtesy of <https://juicy303.wordpress.com>.



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Analysis I: Structural Redesign

- Convent/Monastery → Not recommended
- Fellowship Hall → Worth Exploring

Analysis III: Workforce Management

- Recommended.
- Manage the workforce and improve productivity.

Analysis IV: Foreign Worker Safety

- Recommended.
- Ensure worker safety and improve the culture on site.



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Thank you:

AE Department and Faculty

Craig Dubler, Advisor

Pelin Gultekin, PSU Graduate Student

Dan Weiger, Alexander Building Construction, Co.

Friends and Family, and Jeff

The logo for Balfour Beatty Construction. The words "Balfour Beatty" are in a large, bold, blue sans-serif font, and "Construction" is in a smaller, blue sans-serif font below it. The logo is set against a white rectangular background.

Bhavin Patel, Project Engineer

Note: All site and building renderings and images are courtesy of Balfour Beatty Construction.

Thank You!



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Questions?