




AMBRIDGE AREA HIGH SCHOOL

AMBRIDGE, PENNSYLVANIA


BRANDON MCKEE
CONSTRUCTION MANAGEMENT
AE SENIOR THESIS 2007
PENN STATE UNIVERSITY
APRIL 17, 2007

AMBRIDGE AREA HIGH SCHOOL



PRESENTATION OUTLINE

- PROJECT OVERVIEW
- ANALYSIS 1 - GREENING SCHOOLS
- ANALYSIS 2 - PRECAST BRICK FAÇADE
- ANALYSIS 3 - STRUCTURAL STEEL ERECTION SEQUENCE
- CONCLUSIONS
- Q & A



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AMBRIDGE AREA HIGH SCHOOL

PROJECT OVERVIEW

PROJECT OVERVIEW

ANALYSIS 1 - GREENING SCHOOLS

ANALYSIS 2 - PRECAST BRICK FAÇADE

ANALYSIS 3 - STRUCTURAL STEEL ERECTION

CONCLUSIONS

Q & A


TOTAL COST:
\$39.2 MILLION

SIZE:
245,325 SQ. FT
3 STORIES
LOCATED ADJACENT TO EXISTING SCHOOL

SCHEDULE:
24 MONTHS
SEPTEMBER 2005 - SEPTEMBER 2007



FACILITIES:
TELEVISION STUDIO, GYMNASIUM, CAFETERIA, AUDITORIUM, JROTC SHOOTING RANGE, LARGE GROUP INSTRUCTION (LGI) SPACE

FUNCTION:
PUBLIC HIGH SCHOOL FOR GRADES 9-12 (APPROXIMATELY 900 STUDENTS)



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PROJECT OVERVIEW

DELIVERY METHOD:
TRADITIONAL - DESIGN - BID - BUILD W/ 25 MULTIPLE PRIME CONTRACTS

PROJECT OVERVIEW

ANALYSIS 1 - GREENING SCHOOLS

ANALYSIS 2 - PRECAST BRICK FAÇADE

ANALYSIS 3 - STRUCTURAL STEEL ERECTION


CONCLUSIONS

Q & A

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graph TD
    Owner[OWNER  
AMBRIDGE AREA SCHOOL DISTRICT  
DR. KENNETH VOSS] --- 25[25 PRIME CONTRACTS]
    AE[ARCHITECTS/ENGINEERS  
FOREMAN ARCHITECTS  
ENGINEERS] --- 25
    CMA[CONSTRUCTION MANAGEMENT AGENCY  
FOREMAN PROGRAM & CONSTRUCTION MANAGERS] --- 25
    25 --- GC[GENERAL CONTRACTOR  
KUSNICK CONTRACTING INC.]
    25 --- OTC[OTHER PRIME CONTRACTORS]
    25 --- IC[INTERIORS CONTRACTOR  
J.J. MORRIS & SONS]
    25 --- EC[ELECTRICAL CONTRACTOR  
R.C. YATES ELECTRIC INC.]
    25 --- HVAC[HVAC CONTRACTOR  
WAYNE CROUSE INC.]
    25 --- PL[PLUMBING CONTRACTOR  
VRABEC PLUMBING CO.]
    
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--- COST + FEE
—— LUMP SUM
..... CM AGENCY



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AMBRIDGE AREA HIGH SCHOOL

PROJECT OVERVIEW

SYSTEMS OVERVIEW:

STRUCTURE:

 AUGER CAST PILES, PILE CAPS, GRADE BEAMS
 STRUCTURAL STEEL FRAME, PRECAST CONCRETE SLABS

FACADE:

 NON-LOAD-BEARING CMU WALLS W/ BRICK
 ALUMINUM WINDOWS AND CURTAIN WALL

ARCHITECTURE:

 RED/GRAY BRICK TO MIRROR EXISTING SCHOOL
 STEEL ENTRANCE BRIDGE

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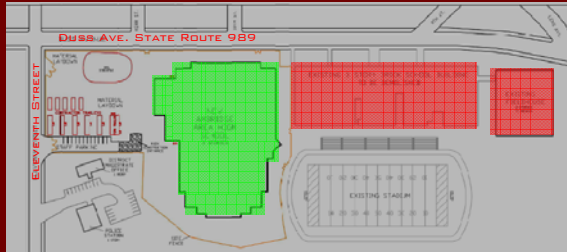
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PROJECT OVERVIEW

SITE LOGISTICS:

PROJECT OVERVIEW
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EXISTING SCHOOL AND FIELD HOUSE
 NEW SCHOOL BUILDING

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PROJECT OVERVIEW

FINISHED PROJECT:




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ANALYSIS 1 - GREENING SCHOOLS CONSTRUCTION MANAGEMENT DEPTH



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GREENING SCHOOLS - DEPTH

PROBLEM:

- MAKE GREEN BUILDING MORE FEASIBLE ON PUBLIC SCHOOL PROJECTS
- DELIVERING PROJECTS AT LOW FIRST COST WITH MORE EFFICIENT OPERATION COSTS

GOAL:

- IDENTIFY BARRIERS
- DEVELOP TOOLS TO EDUCATE

METHODOLOGY:

- INTERVIEW SCHOOL DISTRICTS, DESIGNERS AND INDUSTRY MEMBERS
- UNDERSTAND KNOWLEDGE OF LEED
- DEVELOP EDUCATIONAL TOOLS

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GREENING SCHOOLS - DEPTH

RESEARCH:

- INTERVIEWS WITH SCHOOL DISTRICTS, ARCHITECTS AND CONTRACTORS
- QUESTIONS PERTAINING TO LEED BASED ON PROJECT TYPE AND GOALS
- CONSULT EXISTING RESEARCH

FINDINGS:

- LACK OF KNOWLEDGE
- PERCEPTION OF ADDITIONAL COSTS

EXISTING RESEARCH:

- LEED SHOWS INCREASE IN HEALTH AND TEST SCORES
- ~ +2% COSTS - PAYBACK TIME 2-7 YEARS
- REDUCTION IN NEGATIVE EFFECTS ON ENVIRONMENT

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GREENING SCHOOLS - DEPTH

TOOLS:

- PRESENTATION DETAILING :
 - BUILDING INDUSTRY FACTS
 - GREEN BUILDINGS & LEED
 - BENEFITS OF LEED - CASE STUDIES

PROJECT OVERVIEW
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Building Industry Facts

- Each year buildings are responsible for:
 - Sending 136 million tons of waste to landfills
 - Only 30 - 35% of waste is recycled
 - Average person - 2.8 pounds/day

Green Buildings in Our Area

Green Saving Summary

Green schools costs on average 2% more initially than traditional schools.
 Let us look at the payback period on this investment from only water and energy savings on our school.

Cost to go green: \$38,846,057 x 0.02 = \$776,921

Energy savings: \$93,100 / Year
 Water savings: \$4,710 / Year
 \$97,810 / Year total potential savings

Payback period: \$776,921 / \$97,810 annually = 7.9 Years

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GREENING SCHOOLS - DEPTH

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GREENING SCHOOLS - DEPTH

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TOOLS:

- **WEBQUEST:**
 - REINFORCES MATERIAL
 - ALLOWS ADDITIONAL RESEARCH
 - TESTS KNOWLEDGE & UNDERSTANDING
- **GROUP PROJECT:**
 - REINFORCES MATERIAL
 - EMPHASIZES CREATIVITY
 - SPREADS ADDITIONAL AWARENESS

LEED® & GREEN BUILDING WEBQUEST

Name: _____
 Date: _____

Objective: After an 18% increase in the building sector, LEED certification has become a major factor in green building. Research the following questions and answer them.

Directions: _____

1. What is LEED? _____

2. What are the goals of LEED? _____

3. What are the benefits of LEED? _____

4. What are the challenges of LEED? _____

5. How can we make a building green? _____

6. How can we make a building sustainable? _____

7. How can we make a building energy efficient? _____

8. How can we make a building water efficient? _____

9. How can we make a building healthy and productive? _____

10. How can we make a building resilient? _____

LEED® & GREEN BUILDING GROUP PROJECT

Name: _____
 Date: _____

Objective: To gain a better understanding of the LEED certification process and the benefits of green building. Research the following questions and answer them.

Directions: _____

1. What is LEED? _____

2. What are the goals of LEED? _____

3. What are the benefits of LEED? _____

4. What are the challenges of LEED? _____

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GREENING SCHOOLS - DEPTH

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CONCLUSIONS:


- TWO BARRIERS TO GREEN SCHOOLS
 - LACK OF KNOWLEDGE
 - PERCEPTION OF ADDED COSTS
- LEED IS GROWING IN POPULARITY
- EDUCATING YOUTH BENEFICIAL TO SPREADING AWARENESS
- ONCE BENEFITS ARE REALIZED, LEED WILL BECOME MORE PREVALENT

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ANALYSIS 2- ARCHITECTURAL PRECAST FAÇADE MECHANICAL/STRUCTURAL BREADTH



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PRECAST BRICK FAÇADE - BREADTH

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- **PROBLEM**
 - INCREASE THERMAL VALUE OF WALL
 - ALLOW ENCLOSURE TRADES TO BEGIN EARLIER
 - REDUCE SITE CONGESTION
- **GOAL**
 - EXAMINE USING PRECAST IN PLACE OF TRADITIONAL MASONRY

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PRECAST BRICK FAÇADE - BREADTH

OVERVIEW

- PRECAST WITH INSET BRICK FROM HIGH CONCRETE
- INITIAL COST - \$1,435,298 MORE
- FAÇADE COMPLETION - 63 DAYS EARLIER
- MINIMAL REDUCTION ON HEAT LOSS/GAIN
- WEIGHS MUCH MORE BUT ADEQUATELY SUPPORTED

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COST IMPACTS

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| SYSTEM | UNIT COST | TOTAL COST |
|-----------|------------|-------------|
| BRICK/CMU | \$35.89/SF | \$2,137,162 |
| PRECAST | \$60.00/SF | \$3,572,460 |



59,541 SF REPLACED
 180 TOTAL PANELS
 \$1,435,298 MORE EXPENSIVE

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SCHEDULE IMPACTS

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| SYSTEM | UNIT COST | TOTAL SCHEDULE |
|-----------|--------------|----------------|
| BRICK/CMU | 700 SF / DAY | 85 DAYS |
| PRECAST | 8 / DAY | 21.9 DAYS |



59,541 SF REPLACED
 180 TOTAL PANELS
 6-8 WEEK LEAD TIME
 ~63 DAYS SHORTER DURATION

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MECHANICAL IMPACTS

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Summer Heat Gain

| System | Area (SF) | U-Value | ΔT | Heat Gain | |
|---------------------|-----------|---------|----|-----------|-----------------|
| | | | | F | (BTU/hr) (Tons) |
| Traditional Brick | 59541 | 0.050 | 30 | 600000 | 5AC |
| Precast Panel | 59541 | 0.054 | 30 | 607000 | 5D7 |
| Difference | | | | 7000 | 0.01% |
| Chiller Load | | | | 20000 | 0.00% |
| Difference % | | | | 0.00% | |

Winter Heat Loss

| System | Area (SF) | U-Value | ΔT | Heat Loss | |
|---------------------|-----------|---------|----|-----------|----------|
| | | | | F | (BTU/hr) |
| Traditional Brick | 59541 | 0.050 | 30 | 595410 | 5AC |
| Precast Panel | 59541 | 0.054 | 30 | 607000 | 5D7 |
| Difference | | | | 11590 | 0.00% |
| Boiler Load | | | | 600000 | 0.00% |
| Difference % | | | | 0.00% | |

NEGLIGIBLE HEAT LOSS/GAIN
 MINIMAL MECHANICAL BENEFITS

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STRUCTURAL IMPACTS

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| SYSTEM | WEIGHT (PSF) | TOTAL WEIGHT (TDN) |
|-----------|--------------|--------------------|
| BRICK/CMU | 45 | ~1340 |
| PRECAST | 100 | ~2980 |

GRAVITY LOADS TO FOUNDATION
 LATERAL CONNECTION UNCHANGED
 PRECAST WEIGHS MORE THAN DOUBLE
 FOUNDATION CALCULATIONS SHOW ADEQUATE DESIGN

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PRECAST BRICK FAÇADE - BREADTH

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- **CONCLUSIONS & RECOMMENDATIONS**
 - REDUCES SITE CONGESTION
 - PRODUCED IN CONTROLLED ENVIRONMENT
 - INITIAL COST - \$1,435,298 MORE
 - FAÇADE COMPLETION - 63 DAYS EARLIER
 - MINIMAL REDUCTION ON HEAT LOSS/GAIN
 - ADEQUATE STRUCTURAL SUPPORT

PRECAST IS A FEASIBLE OPTION

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ANALYSIS 3 - STRUCTURAL STEEL ERECTION SEQUENCING

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STRUCTURAL STEEL ERECTION

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- **PROBLEM**
 - ALLOW OCCUPANCY TO OCCUR AT BEGINNING OF SCHOOL YEAR
 - 24 MONTH SCHEDULE DELAYED INITIALLY
- **GOAL**
 - REDUCE OVERALL SCHEDULE
 - REVISE STEEL ERECTION SEQUENCE
 - OVERLAP FAÇADE AND STEEL ERECTION

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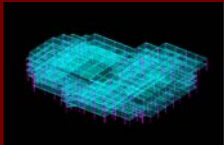
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STRUCTURAL STEEL ERECTION

- OVERVIEW
 - ALLOWS FAÇADE COMPLETION EARLIER
 - NO ADDITIONAL COSTS
 - NO OVERALL PROJECT DURATION CHANGE

PROJECT OVERVIEW
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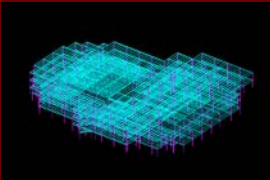
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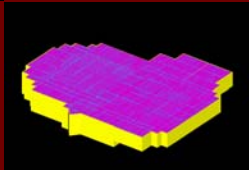
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STRUCTURAL STEEL ERECTION

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STEEL TOPPED OUT



ERECTION SEQUENCES
MODELED WITH NAVISWORKS

STEEL/FAÇADE COMPLETE

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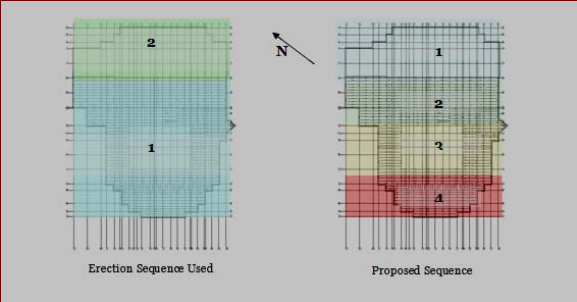
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STRUCTURAL STEEL ERECTION

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STEEL ERECTION SEQUENCES



Erection Sequence Used

Proposed Sequence

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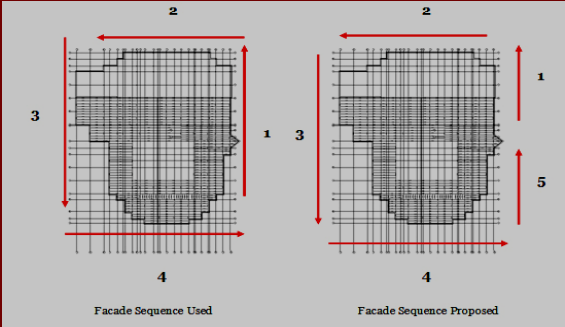
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FAÇADE ERECTION SEQUENCES



Facade Sequence Used

Facade Sequence Proposed

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STRUCTURAL STEEL ERECTION

- SCHEDULE IMPACT**

| | TOPPING OUT | FAÇADE BEGINS | FAÇADE COMPLETE | BUILDING ENCLOSURE |
|----------|-------------|---------------|-----------------|--------------------|
| EXISTING | APRIL 4 | MARCH 1 | JULY 12 | OCTOBER 16 |
| REVISED | APRIL 4 | MARCH 1 | JUNE 16 | OCTOBER 16 |

~ 1 MONTH EARLIER FAÇADE COMPLETION
 INTERIOR TRADES BEGIN EARLIER - NOT MOISTURE SENSITIVE
 OVERALL DURATION UNCHANGED

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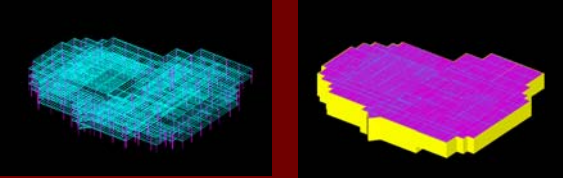
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STRUCTURAL STEEL ERECTION

- COST IMPACT**

SUBCONTRACTOR SCOPE REMAINS UNCHANGED
 NO ADDITIONAL MATERIALS
 NO POTENTIAL GC COST REDUCTIONS



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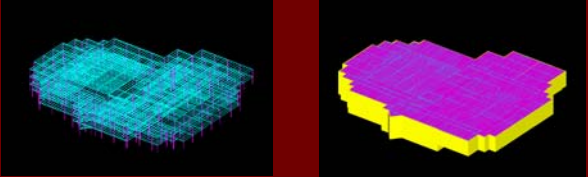
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STRUCTURAL STEEL ERECTION

- CONCLUSIONS & RECOMMENDATIONS**
 - ALLOWS EARLIER FAÇADE COMPLETION
 - NO ADDITIONAL SCOPE OF WORK
 - NO ADDITIONAL COSTS OR COST SAVINGS

REVISED SEQUENCE IS RECOMMENDED



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CONCLUSIONS

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CONCLUSIONS

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- **GREENING SCHOOLS**
 - LESSON EFFECTIVE AT EDUCATING STUDENTS
 - HOPES TO SPREAD KNOWLEDGE AND TEACH OF BENEFITS OF LEED RATED SCHOOLS
- **PRECAST BRICK FAÇADE**
 - REDUCES FAÇADE DURATION
 - REDUCES SITE CONGESTION
 - SLIGHTLY MORE EXPENSIVE
- **STRUCTURAL STEEL ERECTION**
 - EARLIER FAÇADE COMPLETION
 - NO ADDITIONAL COSTS
 - NO OVERALL SCHEDULE CHANGE



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QUESTIONS

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