





Waynesburg Central High School

Waynesburg, Pennsylvania



Robert Owen Brennan
The Pennsylvania State University
Construction Management

 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p>	 <p>Waynesburg Central High School</p>  <p>Project Overview LEED Certification Analysis Recycling and Waste Management Energy Savings Analysis (Breadth) Structural Redesign (Breadth) Construction Scheduling Acknowledgements Conclusion</p>	
---	---	--



Waynesburg Central High School

Waynesburg, Pennsylvania



Robert Owen Brennan
The Pennsylvania State University
Construction Management



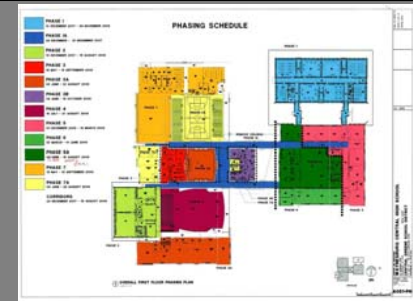
Project Overview








Project Overview




- Owner:** Central Greene School District
- Construction Manager:** Foreman Program and Construction Managers
- Architect and Engineers:** Foreman Architects and Engineers
- Estimated Project Cost:** \$17,000,000
- Size, Addition:** 24,000 square feet
- Renovation:** 154,000 square feet
- Number of Stories:** 2
- Delivery Method:** CM Agency, with Multiple Primes




 Waynesburg Central High School Waynesburg, Pennsylvania  Robert Owen Brennan The Pennsylvania State University Construction Management	 LEED Certification		
	Introduction	Results of Research	Solution
Problem: Public high schools often have a hard time deciding whether or not it is worthwhile to pursue LEED certification.			
Goal: Create a guide for school districts in western Pennsylvania that would help them decide if LEED certification is worth pursuing.			



Waynesburg Central High School
Waynesburg, Pennsylvania



Robert Owen Brennan
The Pennsylvania State University
Construction Management




LEED Certification

Introduction
Results of Research
Solution
Conclusion

Common Survey Responses

- Points depend to much on location
- Paperwork is a hassle
- Contractors unfamiliar with the process and not organized enough
- LEED certification does not focus on the correct areas (energy)



Results of Research

Cost Results

- Costs an average of 2% more then conventional
- Estimated net saving to be \$71 per square foot

Energy Emissions	\$9
Water and Wastewater	\$1
Increased Earnings	\$49
Asthma Reduction	\$3
Cold and Flu Reduction	\$5
Teacher Retention	\$4
Employment Impact	\$2
TOTAL	\$74
COST OF GREENING	(\$3)
NET FINANCIAL BENEFITS	\$71



Waynesburg Central High School

Waynesburg, Pennsylvania



Robert Owen Brennan
The Pennsylvania State University
Construction Management

LEED Certification



Solution



Introduction Results of Research Solution Conclusion

LEED Checklist

Yes	No	Points	Prerequisite
Project Total (Prerequisite Released) 79 Points			
LEED 2009 20 points			
LEED 2009 30 points			
LEED 2009 47 points			





Yes	No	Points	Prerequisite
Sustainable Sites 16 Points			
Yes		1	Prerequisite 1
		1	Prerequisite 2
		1	Prerequisite 3
		1	Prerequisite 4
		1	Prerequisite 5
		1	Prerequisite 6
		1	Prerequisite 7
		1	Prerequisite 8
		1	Prerequisite 9
		1	Prerequisite 10
		1	Prerequisite 11
		1	Prerequisite 12
		1	Prerequisite 13
		1	Prerequisite 14
		1	Prerequisite 15

Yes	No	Points	Prerequisite
Energy & Environmental Performance 17 Points			
Yes		1	Prerequisite 1
Yes		1	Prerequisite 2
Yes		1	Prerequisite 3
Yes		1	Prerequisite 4
Yes		1	Prerequisite 5
Yes		1	Prerequisite 6
Yes		1	Prerequisite 7
Yes		1	Prerequisite 8
Yes		1	Prerequisite 9
Yes		1	Prerequisite 10
Yes		1	Prerequisite 11
Yes		1	Prerequisite 12
Yes		1	Prerequisite 13
Yes		1	Prerequisite 14
Yes		1	Prerequisite 15
Yes		1	Prerequisite 16
Yes		1	Prerequisite 17
Yes		1	Prerequisite 18
Yes		1	Prerequisite 19
Yes		1	Prerequisite 20
Yes		1	Prerequisite 21
Yes		1	Prerequisite 22
Yes		1	Prerequisite 23
Yes		1	Prerequisite 24
Yes		1	Prerequisite 25
Yes		1	Prerequisite 26
Yes		1	Prerequisite 27
Yes		1	Prerequisite 28
Yes		1	Prerequisite 29
Yes		1	Prerequisite 30
Yes		1	Prerequisite 31
Yes		1	Prerequisite 32
Yes		1	Prerequisite 33
Yes		1	Prerequisite 34
Yes		1	Prerequisite 35
Yes		1	Prerequisite 36
Yes		1	Prerequisite 37
Yes		1	Prerequisite 38
Yes		1	Prerequisite 39
Yes		1	Prerequisite 40
Yes		1	Prerequisite 41
Yes		1	Prerequisite 42
Yes		1	Prerequisite 43
Yes		1	Prerequisite 44
Yes		1	Prerequisite 45
Yes		1	Prerequisite 46
Yes		1	Prerequisite 47
Yes		1	Prerequisite 48
Yes		1	Prerequisite 49
Yes		1	Prerequisite 50
Yes		1	Prerequisite 51
Yes		1	Prerequisite 52
Yes		1	Prerequisite 53
Yes		1	Prerequisite 54
Yes		1	Prerequisite 55
Yes		1	Prerequisite 56
Yes		1	Prerequisite 57
Yes		1	Prerequisite 58
Yes		1	Prerequisite 59
Yes		1	Prerequisite 60
Yes		1	Prerequisite 61
Yes		1	Prerequisite 62
Yes		1	Prerequisite 63
Yes		1	Prerequisite 64
Yes		1	Prerequisite 65
Yes		1	Prerequisite 66
Yes		1	Prerequisite 67
Yes		1	Prerequisite 68
Yes		1	Prerequisite 69
Yes		1	Prerequisite 70
Yes		1	Prerequisite 71
Yes		1	Prerequisite 72
Yes		1	Prerequisite 73
Yes		1	Prerequisite 74
Yes		1	Prerequisite 75
Yes		1	Prerequisite 76
Yes		1	Prerequisite 77
Yes		1	Prerequisite 78
Yes		1	Prerequisite 79
Yes		1	Prerequisite 80
Yes		1	Prerequisite 81
Yes		1	Prerequisite 82
Yes		1	Prerequisite 83
Yes		1	Prerequisite 84
Yes		1	Prerequisite 85
Yes		1	Prerequisite 86
Yes		1	Prerequisite 87
Yes		1	Prerequisite 88
Yes		1	Prerequisite 89
Yes		1	Prerequisite 90
Yes		1	Prerequisite 91
Yes		1	Prerequisite 92
Yes		1	Prerequisite 93
Yes		1	Prerequisite 94
Yes		1	Prerequisite 95
Yes		1	Prerequisite 96
Yes		1	Prerequisite 97
Yes		1	Prerequisite 98
Yes		1	Prerequisite 99
Yes		1	Prerequisite 100





Yes	No	Points	Prerequisite
Materials & Resources 11 Points			
Yes		1	Prerequisite 1
Yes		1	Prerequisite 2
Yes		1	Prerequisite 3
Yes		1	Prerequisite 4
Yes		1	Prerequisite 5
Yes		1	Prerequisite 6
Yes		1	Prerequisite 7
Yes		1	Prerequisite 8
Yes		1	Prerequisite 9
Yes		1	Prerequisite 10



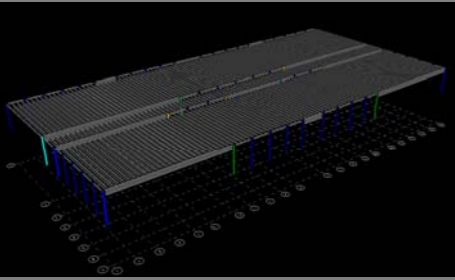
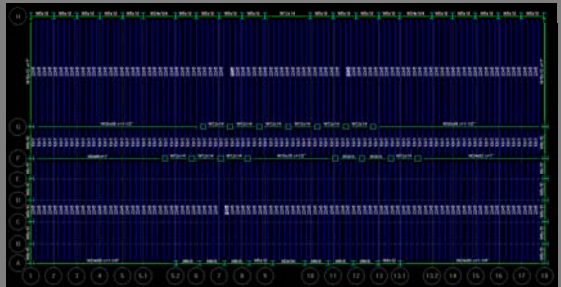
Yes	No	Points	Prerequisite
Indoor Environmental Quality 10 Points			
Yes		1	Prerequisite 1
Yes		1	Prerequisite 2
Yes		1	Prerequisite 3
Yes		1	Prerequisite 4
Yes		1	Prerequisite 5
Yes		1	Prerequisite 6
Yes		1	Prerequisite 7
Yes		1	Prerequisite 8
Yes		1	Prerequisite 9
Yes		1	Prerequisite 10

Yes	No	Points	Prerequisite
Integration & Design Process 8 Points			
Yes		1	Prerequisite 1
Yes		1	Prerequisite 2
Yes		1	Prerequisite 3
Yes		1	Prerequisite 4
Yes		1	Prerequisite 5
Yes		1	Prerequisite 6
Yes		1	Prerequisite 7
Yes		1	Prerequisite 8


 Waynesburg Central High School Waynesburg, Pennsylvania  Robert Owen Brennan The Pennsylvania State University Construction Management	 LEED Certification 		
	Introduction	Results of Research	Solution
Conclusion: <ul style="list-style-type: none">•Green construction costs about 2 % more than traditional•Savings for green schools estimated to be \$74 per square foot•Serious economic benefits to green construction			

 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p>	<p>Recycling and Waste Management</p> <p>Problem: Construction projects produce large quantities of waste.</p> <p>Goal: Implement a waste management plan that promotes recycling resulting in waste reduction.</p>	<p>Recycling and Waste Management</p> <p>Conclusion:</p> <ul style="list-style-type: none"> •Small waste management stations for convenience •One central waste management center •Partner with Waste Management to achieve LEED point   
---	--	---


 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p>	 <p>Structural Redesign</p> <p>Introduction Structural Summary Cost Summary Schedule Summary Conclusion</p> <p>Problem:</p> <p>Precast concrete was chosen as a structural system for Waynesburg Central High School and caused several constructability issues.</p> <p>Goal:</p> <p>Analyze and compare a structural steel system to the implemented precast concrete system, to determine the constructability issues associated with both as well as determining the most economic system, based on both the constructability challenges and construction cost.</p>	
---	--	---

 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p>	<p>Structural Redesign</p> <p>Introduction Structural Summary Cost Summary Schedule Summary Conclusion</p> <p>3D View from RAM</p> 	<p>Structural Summary</p> <p>Redesigned Steel Beam Plan</p> 
---	--	---


 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p>	 <p>Structural Redesign</p> <p>Introduction Structural Summary Cost Summary Schedule Summary Conclusion</p> <p>Original Building Exterior Facade</p> 	 <p>Structural Summary</p> <p>Exterior Façade of Additions</p> 
---	---	--




Waynesburg Central High School
Waynesburg, Pennsylvania




Robert Owen Brennan
The Pennsylvania State University
Construction Management




Structural Redesign





Cost Summary



Introduction Structural Summary **Cost Summary** Schedule Summary Conclusion

Factors for Estimating


- RS Means 2009
- Foundation Assumed to be Same
- Lengths and Sizes of Existing Members Input into RAM Model
- Loads on Members did not Change (self weight calculated by RAM)
- CMU Walls act as Lateral Sheer Walls for Both Systems

Estimate Summary Table


Redesigned Structural Steel Estimate	
Adjusted Total Cost of Structural System:	\$ 383,259.93
Adjusted Total Cost of Brick Piers:	\$ 20,432.86
Adjusted Total Cost of Redesigned Structural System w/ Brick Piers:	\$ 403,692.78

Original Structural System Estimate	
Adjusted Total Cost of Structural System:	\$ 527,378.24


Savings for Structural Steel System	
Difference Between Structural Systems:	\$ 123,685.46




Waynesburg Central High School
Waynesburg, Pennsylvania




Robert Owen Brennan
The Pennsylvania State University
Construction Management




Structural Redesign






Schedule Summary




Introduction Structural Summary Cost Summary **Schedule Summary** Conclusion

Similarities in Structural Systems







Column anchor system to foundation







Precast column on base plate anchored to foundation

System Comparison

Precast Concrete	Structural Steel
<ul style="list-style-type: none"> •Same Day Erection •Bolted Connections •Beams Over top of Columns •Prefabrication time of a month 	<ul style="list-style-type: none"> •Same Day Erection •Bolted Connections •Beams Set Column to Column •Prefabrication time of a month

 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p>	 <p>Structural Redesign</p> <p>Introduction Structural Summary Cost Summary Schedule Summary Conclusion</p> <p>System Change Benefits</p> <ul style="list-style-type: none">•Estimated Cost Savings of \$123,000•Familiarity with System Construction Sequence•Potential to Keep Same Exterior Façade as Original Building <p>Structural steel has many advantages to precast concrete and would be more beneficial to be used on this project.</p> 	
---	---	--

 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p>	 <p>Construction Scheduling</p> 	
	<p>Introduction Schedule Impacts Revised Site Plans Conclusion</p> <p>Problem:</p> <p>Multiple Phase construction projects create a need for elaborate schedules, resulting in congested work sites.</p> <p>Goal:</p> <p>To compare the site plans and phasing sequence that exist with what is necessary for a LEED certified project, and create a modified schedule and series of site plans incorporating necessary changes for LEED as well as a steel structure.</p>	



Waynesburg Central High School

Waynesburg, Pennsylvania



Robert Owen Brennan
The Pennsylvania State University
Construction Management



Construction Scheduling

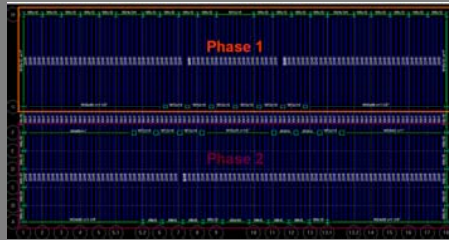


Schedule Impacts



Introduction Schedule Impacts Revised Site Plans Conclusion

Steel Erection Sequencing



Waynesburg Central High School Detailed Steel Schedule			
Task Name	Duration	Start	Finish
1.0 Steel Design	30 days	Mon 1/12/09	Thu 2/19/09
2.0 Steel Procurement	30 days	Mon 1/12/09	Fri 3/1/09
3.0 Building #1	4 days	Mon 2/2/09	Mon 2/16/09
3.1 Erect Steel Columns 1	1 day	Mon 2/2/09	Mon 2/2/09
3.2 Erect Connections Columns 1	1 day	Mon 2/2/09	Mon 2/2/09
3.3 Erect Steel Beams 1	1 day	Mon 2/2/09	Mon 2/2/09
3.4 Erect Steel Columns 2	1 day	Mon 2/2/09	Mon 2/2/09
3.5 Erect Connections Columns 2	1 day	Mon 2/2/09	Mon 2/2/09
3.6 Erect Steel Beams 2	1 day	Mon 2/2/09	Mon 2/2/09
3.7 Erect Connections Beams 2	1 day	Mon 2/2/09	Mon 2/2/09
3.8 Building #2	4 days	Tue 2/3/09	Thu 2/19/09
3.9 Erect Steel Columns #2	1 day	Tue 2/3/09	Tue 2/3/09
3.10 Erect Connections Columns #2	1 day	Tue 2/3/09	Tue 2/3/09
3.11 Erect Steel Beams #2	1 day	Tue 2/3/09	Tue 2/3/09
3.12 Erect Connections Beams #2	1 day	Tue 2/3/09	Tue 2/3/09
3.13 Building #3	4 days	Tue 2/3/09	Thu 2/19/09
3.14 Erect Steel Columns #3	1 day	Tue 2/3/09	Tue 2/3/09
3.15 Erect Connections Columns #3	1 day	Tue 2/3/09	Tue 2/3/09
3.16 Erect Steel Beams #3	1 day	Tue 2/3/09	Tue 2/3/09
3.17 Erect Connections Beams #3	1 day	Tue 2/3/09	Tue 2/3/09



Waynesburg Central High School

Waynesburg, Pennsylvania



Robert Owen Brennan
The Pennsylvania State University
Construction Management

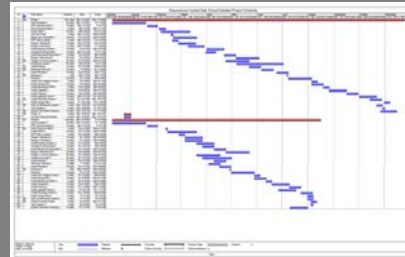



Construction Scheduling




Introduction Schedule Impacts Revised Site Plans Conclusion


Revised Schedule Summary of Phases 1 & 2






Waynesburg Central High School
Waynesburg, Pennsylvania







Robert Owen Brennan
The Pennsylvania State University
Construction Management




Introduction



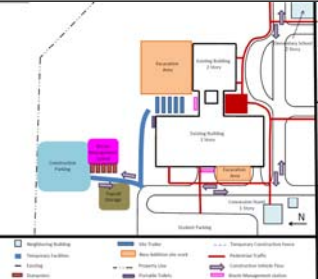
Schedule Impacts



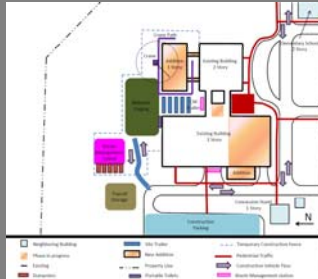
Revised Site Plans



Conclusion



Robert O Brennan
Construction Management
Waynesburg Central High School
Spring 2008
Site Plan
5/27/2009



Robert O Brennan
Construction Management
Waynesburg Central High School
Summer 2008
Site Plan
5/27/2009



Waynesburg Central High School

Waynesburg, Pennsylvania



Robert Owen Brennan
The Pennsylvania State University
Construction Management



Construction Scheduling




Revised Site Plans








Introduction	Schedule Impacts	Revised Site Plans	Conclusion
<p>Robert O. Brennan Construction Management Waynesburg Central High School Fall 2008 1/27/2009</p>			

<p>Robert O. Brennan Construction Management Waynesburg Central High School Summer 2009 3/27/2009</p>			

 Waynesburg Central High School Waynesburg, Pennsylvania  Robert Owen Brennan The Pennsylvania State University Construction Management	 Construction Scheduling 			
	Introduction	Schedule Impacts	Revised Site Plans	Conclusion
Schedule and Site Plan Conclusion <ul style="list-style-type: none">•Construction sequence for systems very similar•LEED could cause several alterations to schedule•Structural system change results in minimal site planning modifications•Differing LEED points would result in varied site plans•Waste management system should be implemented				

 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p> 	 <p>Acknowledgements</p>    <p>Central Greene School District</p>	 <p>Waynesburg Central High School Waynesburg, Pennsylvania</p>  <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p> 
---	--	---

		<p>Waynesburg Central High School Waynesburg, Pennsylvania</p>		
<p>Questions</p>	 <p>Robert Owen Brennan The Pennsylvania State University Construction Management</p>	<p>Comments</p>		