New Middle School

Geneva, Il

Greg Kemerer

AE Senior Thesis 2006 – CM Option

Presentation Outline

Background
Analysis 1
Analysis 2
Analysis 3

- **Background**
  -Building, project, and site information
- **Analyses**
  -In depth discussion of each analysis
- **Questions**
  -A little Q & A

Background

Owner Information

Currently overseeing:

- 5 elementary schools
- 1 middle school
- 1 high school

Chief concerns:

- space, cost, durability, safety, schedule

The Building

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The Building

Background
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Size: 196,000 sq ft

Construction: 5/16/05 – 8/29/06

Hard Cost: $28,800,000

Delivery Method: Design-big-build, CM Agent

The Team

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Owner: Geneva Community Unit School District #304

Architect: Larson and Darby Group

Construction Manager: Bovis Lend Lease

Consultants: Rempe-Sharpe and KJWW

The Systems

Mechanical

HVAC: (2) 300 ton air cooled chillers, 6 AHUs, dust control system

Heating: 2-pipe heated water system, (2) 250 BHP boilers, individual fan coil units throughout

Additional Heating: 2,340 linear feet of radiant ceiling panels

The Systems

Electrical

Supply: 2732 KVA 480/277 line

Main Distribution: 4,000 A, 480/277, 3 Phase

Transformers: (2) 500 KVA, (1) 225 KVA

Generator: 250 KVA, 480/277, cross-linked to existing middle school

Fire Protection

4 zone, wet system

smoke detectors and alarms

The Systems

Structural

Unit A/C: Single story. 12” CMU load bearing masonry on concrete strip footings

Unit B: Two story. Structural steel with combination architectural precast and face brick. Flooring is 12” hollow core precase with 3” poured slab topping. Basement utilizes step footings to match CMU coursings.

The Site Plan

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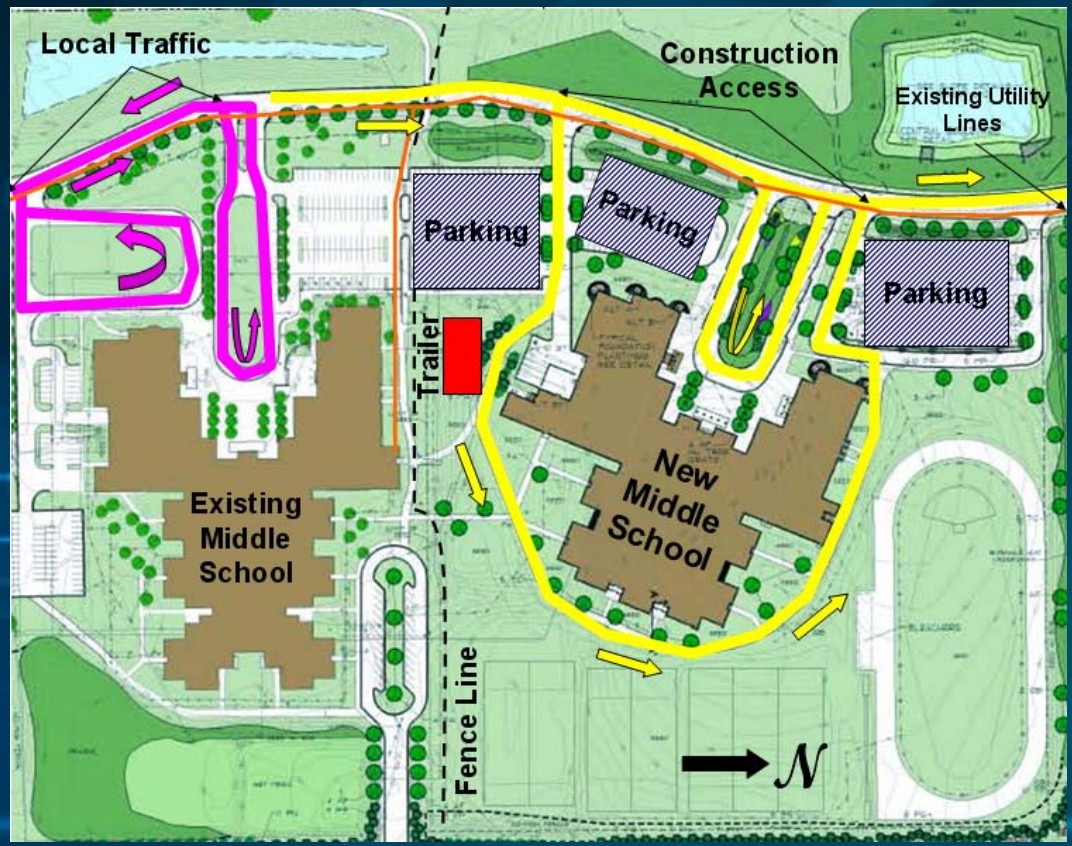

Analysis 1

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Interior Wall System, Building B

Intent

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Building B Interior Wall Type

Burnished face CMU

- durable, attractive, high fire rating
- expensive, heavy, coordination issues

Metal stud wall

- lightweight, inexpensive, fewer coordination issues
- less durable, thermal bridging, sound transmission

Methods

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Wall takeoff

Calculate unit weight of different wall types

Calculate total weight difference

Re-size structural steel members

Calculate cost savings for steel and new wall type

Weight Savings

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Existing System:	1,050,742 lbs
Stud Wall System:	128,848 lbs
Savings:	921,894 lbs

Total Difference of 461 Tons

-or-

18.43 psf of dead load

Structural Steel

- Background
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BEAMS

Original Calculations

	PSF	X-Section	PLF	KLF
Live Load	80	6.5	520	0.52
Dead Load	113	6.5	734.5	0.7345

Length	34.66

	M LL	M DL	M Max
M Max	124.9368	176.4733	301.4101

Z Req	80.37602	Beam Size = W 21 x 44
		Z = 95.8

Check:	Foot Kips	Inch Kips	
M Max	307.3501	3688.201	
Phi Mn		4311	OK

Re-Calc

	PSF	X-Section	PLF	KLF
Live Load	80	6.5	520	0.52
Dead Load	95	6.5	617.5	0.6175

Length	34.66

	M LL	M DL	M Max
M Max	124.9368	148.3625	273.2993

Z Req	72.87981	Beam Size = W 18 x 40
		Z = 78.4

Check:	Foot Kips	Inch Kips	
M Max	278.6993	3344.392	
Phi Mn		3528	OK

Original Calculations

	PSF	X-Section	PLF	KLF
Live Load	80	6.5	520	0.52
Dead Load	113	6.5	734.5	0.7345

Length	27.33

	M LL	M DL	M Max
M Max	77.68061	109.7239	187.4045

Z Req	49.97452	Beam Size = W 18 x 35
		Z = 66.5

Check:	Foot Kips	Inch Kips	
M Max	193.3445	2320.134	
Phi Mn		2992.5	OK

Re-Calc

	PSF	X-Section	PLF	KLF
Live Load	80	6.5	520	0.52
Dead Load	95	6.5	617.5	0.6175

Length	27.33

	M LL	M DL	M Max
M Max	77.68061	92.24572	169.9263

Z Req	45.31369	Beam Size = W 16 x 31
		Z = 54

Check:	Foot Kips	Inch Kips	
M Max	175.3263	2103.916	
Phi Mn		2430	OK

Cost Impact

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Wall Cost Savings

Original						
Glazed Concrete Block	**Mat.**	**Lab.**	**Equip**	**Total**	**O&P**
Double Face 8x16" - 6" Thick	**$ 11.25**	**$ 4.13**	**$ -**	**$ 15.38**	**$ 19.10**
	$ 15,986.25	$ 5,868.73	$ -	$ 21,854.98	$ 27,141.10
Double Face 8x16" - 8" Thick	**$ 11.75**	**$ 4.40**	**$ -**	**$ 16.15**	**$ 20.00**
	$ 255,268.75	$ 95,590.00	$ -	$350,858.75	$434,500.00
Total	$ 271,255.00	$101,458.73	$ -	$372,713.73	$461,641.10
New					
Metal Studs & Track	**Mat.**	**Lab.**		**Total**	**O&P**
3 5/8" Stud - 24" OC	**$ 0.22**	**$ 0.30**	**$ -**	**$ 0.52**	**$ 0.74**
Total	$ 5,092.12	$ 6,943.80	$ -	$ 12,035.92	$ 17,128.04
Delta	**$ 266,162.88**	**$ 94,514.93**	**$ -**	**$360,677.81**	**$444,513.06**

Cost Impact

- Background
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Structural Steel Cost Savings

Original Steel Members		Mat.	Lab.	Equip.	Total	O&P
W 21 x 44		$ 46.00	$ 2.96	$ 1.42	$ 50.38	$ 57.50
		$ 124,384.00	$ 8,003.84	$ 3,839.68	$136,227.52	$155,480.00
W 18 x 35		$ 36.50	$ 3.28	$ 1.58	$ 41.36	$ 47.50
		$ 25,951.50	$ 2,332.08	$ 1,123.38	$ 29,406.96	$ 33,772.50
W 18 x 40		$ 42.00	$ 3.28	$ 1.58	$ 46.86	$ 53.50
		$ 20,661.48	$ 1,613.56	$ 777.27	$ 23,052.31	$ 26,318.79
	Total	$ 170,996.98	$ 11,949.48	$ 5,740.33	$188,686.79	$215,571.29
New Steel Members						
W 18 x 40		$ 42.00	$ 3.28	$ 1.58	$ 46.86	$ 53.50
		$ 113,568.00	$ 8,869.12	$ 4,272.32	$126,709.44	$144,664.00
W 16 x 31		$ 32.50	$ 2.42	$ 1.59	$ 36.51	$ 41.50
		$ 23,107.50	$ 1,720.62	$ 1,130.49	$ 25,958.61	$ 29,506.50
W 16 x 31		$ 32.50	$ 2.42	$ 1.59	$ 36.51	$ 41.50
		$ 15,988.05	$ 1,190.49	$ 782.18	$ 17,960.73	$ 20,415.51
	Total	$ 152,663.55	$ 11,780.23	$ 6,184.99	$170,628.78	$194,586.01
	Delta	$ 18,333.43	$ 169.25	$ (444.67)	$ 18,058.01	$ 20,985.28

Conclusion

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Use Metal Stud Wall System

Analysis 2

Background
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Exterior Wall System, Building B

Intent

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Building B Exterior Wall Type

8” CMU, 3” rigid foam insulation, face brick

Alternative Systems

Tilt-up concrete with Nitterhouse brick façade

Precast concrete with face brick

Smith Midland Slenderwall

Tilt-up Problem

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Cost & Schedule Impact

- Background
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Existing Wall Type		
	Total Cost	Total Weeks
CMU, normal weight, 8"	$187,450.00	12
3" Rigid Insulation, R 13	$ 80,270.00	6.3
1" Air Space		
Face Brick	$242,190.00	7.6
	$509,910.00	**25.9**

Insulated Precast Concrete with Face Brick		
	Total Cost	Total Weeks
4" Precast, 2" polystyrene	$529,460.00	6
1" Air Space		
Face Brick	$242,190.00	7.6
	$771,650.00	**13.6**

Tilt Up Construction w/ Face Brick		
	Total Cost	Total Weeks
Tilt-up conc. panels, 5.5"	$192,740.00	5.5
3" Rigid Insulation, R 13	$ 80,270.00	6.3
1" Air Space		
Face Brick	$242,190.00	7.6
	$515,200.00	**19.4**

Slenderwall		
	Total Cost	Total Weeks
Slenderwall	$621,000.00	0.8
R13 Batt Insulation	$ 80,270.00	2.9
5/8" Gypsum Board	$ 27,140.00	4.8
	$728,410.00	**8.5**

Energy Impact

- Background
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R-Values

Existing Wall Type	
	R
CMU, normal weight, 8"	2.02
3" Rigid Insulation, R 13	13
1" Air Space	0.91
Face Brick	0.43
	16.36

Precast Concrete, Insulated with Face Brick	
	R
4" Precast, 2" polystyrene	10.4
1" Air Space	0.91
Face Brick	0.43
	11.74

Tilt Up Construction w/ Face Brick	
	R
Tilt-up conc. panels, 5.5" thick	0.67
3" Rigid Insulation, R 13	13
1" Air Space	0.91
Face Brick	0.43
	15.01

Smith Midland Slenderwall	
	R
Slenderwall	0.2
R13 Batt Insulation	13
5/8" Gypsum Board	0.56
	13.76

Energy Impact

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Existing Wall BTU/Year

BIN	DB Temp.	BTU/hr	Total BTU
13	85.8	107132.07	1392716.932
38	87.9	123434.78	4690521.573
62	84.6	97816.239	6064606.84
97	82.5	81513.533	7906812.682
199	79.5	58223.952	11586566.45
245	76.8	37263.329	9129515.674
323	75.8	29500.136	9528543.825
426	73	7763.1936	3307120.474
372	70.5	-11644.79	-4331862.029
433	68.6	-26394.86	-11428973.62
334	67.1	-38039.65	-12705242.65
328	64	-62105.55	-20370620.01
291	60.9	-86171.45	-25075891.65
280	58.6	-104026.8	-29127502.39
251	57.8	-110237.3	-27669574.63
247	55.8	-125763.7	-31063642.87
239	52.9	-148277	-35438202.46
273	50.1	-170013.9	-46413805.58
299	48.2	-184764	-55244438.3

sum cool
53,606,404.45

sum heat
1,579,855,700.44

Energy Impact

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Energy Cost Impact

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Annual Energy Cost Impact

	Heating Cost	Cooling Cost	Total Cost	10 Yr Delta
Existing Wall Type	$22,420	$1,409	$23,829	0
Precast	$24,635	$1,548	$26,183	$23,540.69
Tilt-up	$23,731	$1,491	$25,222	$13,932.25
Slenderwall	$24,861	$1,562	$26,423	$25,942.80

Conclusion

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Stay With Initial Wall System

Analysis 3

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Obstacles to Building Green Schools

Intent

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To better understand why more schools aren't being built green and find the obstacles that are allowing this to happen

Benefits:

- **Reduced Energy Bills**
- **Smaller Environmental Impact**
- **Better Student Performance**

Methods

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Online research

Phone interviews

More phone interviews

The Way Schools Build

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Funding from tax dollars or referendum

Community Involvement

referendum, forum, SC had no requirement

projects were at various states or preparation

Hired Outside Architects

Geneva had an in-house architect

Findings

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Schools and districts generally unaware of benefits of green design. Also unaware of government green incentive programs.

Architects always suggested the green design

had to do “some convincing”

Non-Green Schools

various excuses

insisted green was still on their minds

Conclusion

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No green buildings without green design

Owner and community education

Government incentives

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Questions

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