The Research and Economic Development Center

Erie, Pa

Kristen Eash	Option: Construction Management
Advisor : D. Riley	Date: 4-3-06
Summary Book	

Research and Economic Development Center
Erie, Pa
Kristen Eash

Technical Analysis

Cladding System

There is a problem with metal panel siding in Erie due to the weather swings and construction practices so I proposed to redesign the cladding of the building to increase the construction ease and cost of the building. This will take into account the cost of fixing the system while the building is in its first fifty years of building use. A comparison with brick and glass panel walls was conducted. Research into the initial cost of construction and schedule, research into maintenance costs, a comparative analysis between the systems using cost, and schedule, and a summary are the measurable steps of this analysis.

Background:

At the Pennsylvania State University, Erie, The Behrend Campus, there are now three buildings with metal panel systems. The two previous buildings have both needed work on the metal panel within five years due to leaking at windows, doors, and panel connections. This leaking has been attributed to the climate changes throughout the year causing major expansion and contraction of the panels. Although this expansion was expected, the results on the sealant were not. The weather is harsh on the sealant which gets harder than it would normally. This and the movement with the panels cause cracking in the caulk. These cracks have been causing water damage in the buildings. It is expected that this issue will arise with the metal panel system on the new Research and Economic Development Center as well. There are approximately 3900 square feet of metal siding on the building which will see this damage.

Research and Economic Development Center
Erie, Pa
Kristen Eash

Research Intent:

The intent for this analysis is changing the cladding system to either the glass panels or the brick that the remainder of the building is built with. A comparison between these replacement systems and the existing systems consists of schedule comparisons, cost comparisons and cost of maintenance comparisons. Also it was important to check that the structural system will remain the same or of a similar cost.

I would like to be able to use this research to show the architect and owners of the building which system would be the best to use. The key points of my research are as follows:

- Research into the cost of maintaining the metal panel systems and the length of time between the need for maintenance.
- Cost of systems analysis using RS Means cost data
- Duration of construction of system analysis using RS Means construction duration estimates
- Research into maintaining the proposed systems and the length of time between needs for maintenance.
- A weight of system comparison.
- Structural redesign of curtain wall down to the first floor columns. The structural system at this point and lower should not need to be redesigned due to factors of safety used and because the wall system load should not differ that greatly.
- A chart of the pros and cons of each system was used to identify which system is the best to use. This chart is listed in the conclusion of this section.

I expect that the brick system will end up being the system selected. The metal panel will be the cheapest and shorter to construct but have a high maintenance cost and problems with the construction. The glass system is predicted to be the highest cost second longest construction. It will also have high maintenance cost and issues during construction. Because brick is very traditional, it will have lower cost than glass have less maintenance issues and ease of construction. It will also probably have the longest construction time.

Research and Economic Development Center
Erie, Pa
Kristen Eash

Material Cost:

Name	Cost/ SF
Glass and aluminum supports	$45
Brick	$28.75
Metal Siding and aluminum supports	$9.79

If you were to just look at the total system costs then you could come up with

Name	Cost
Glass	$175,500
Brick	$112,125
Metal Siding	$35,244

But the metal siding will require approximately $85,000 worth of repair work due to caulking issues. This repair work will come every seven years. With the building life being estimated at 49 years this could add significant cost to the metal siding. A present value for this will need to be calculated. I will be calculating the highest interest rate that will be required to choose the higher priced material. The table will show the present value of the maintenance at various interest rates the total column. This number must be higher than the difference in systems or else the original metal siding system will be cheaper.

The equation is $P=i(1+i)^{-n}$ or using interest tables it is P=A(P/F, i, n) for each year payment is made.

i= the interest percentage in decimal
n = the number of years

	Year 7	Year 14	Year 21	Year 28	Year 35	Year 42	Year 49	Total
1%	$79,280	$73,950	$68,969	$64,328	$60,002	$55,964	$52,199	$454,692
2%	$74,001	$64,558	$56,083	$48,824	$42,500	$37,001	$32,215	$355,181
4%	$64,592	$49,088	$37,298	$28,348	$21,539	$16,371	$12,436	$229,670
6.75%	$52,930	$32,963	$20,528	$12,784	$7,965	$5,304	$3,086	$135,558
11.25%	$40,299	$19,108	$9,061	$4,293	$2,040	$969	$459	$76,228

Because the difference between the metal siding and the brick is $76,881 it is cheaper to use the brick so long as the interest rate is lower than 11.75%. It is cheaper to use the glass only if the interest is less than 6.75 % due to the price difference between the two being $140,256. (Although this chart only shows some numbers I solved for many to find the rate that yielded a material choice difference.)

This also assumes that the other systems will not need repaired in this time. Brick is used quite often at this campus and typically need very little work on it. The glass system is untested so although there may indeed be maintenance issues there can be no cost comparison using the maintenance data. Thus it will be assumed that with proper construction practices there will be no need for maintenance on this system.

Schedule Changes:

The production for each system component is as follows:

Name	Daily Output
Metal Siding	775 SF/Day
Glass Panels	98 SF/Day
Metal Support	1020 SF/Day
Brick Face Cavity Wall	230 SF/Day

I will be assuming that the Metal Support will begin one day before the glass panels or the metal siding that it would support and then the work would continue concurrently. This means that the schedule for each of these items will have one day added to it for an entire system length.

The system construction length assuming the work area is 3,900 SF is as follows:

Name	Construction Length
Metal Siding	6 days
Glass Panels	41 days
Brick Face Cavity Wall	17 days

The changing from Metal Siding to Glass Panels will result in a 35 Day, or 7 weeks, schedule addition. Like wise changing from the metal siding to the Brick wall will only change the schedule by 11 days, or just over 2 weeks. This will not affect the building enclosure so interior work will be able to proceed. Also since on the CPM schedule the exterior work does finish well before the building does a delay in the schedule will not be a huge problem even though work will end up continuing through early winter.

Research and Economic Development Center
Erie, Pa
Kristen Eash

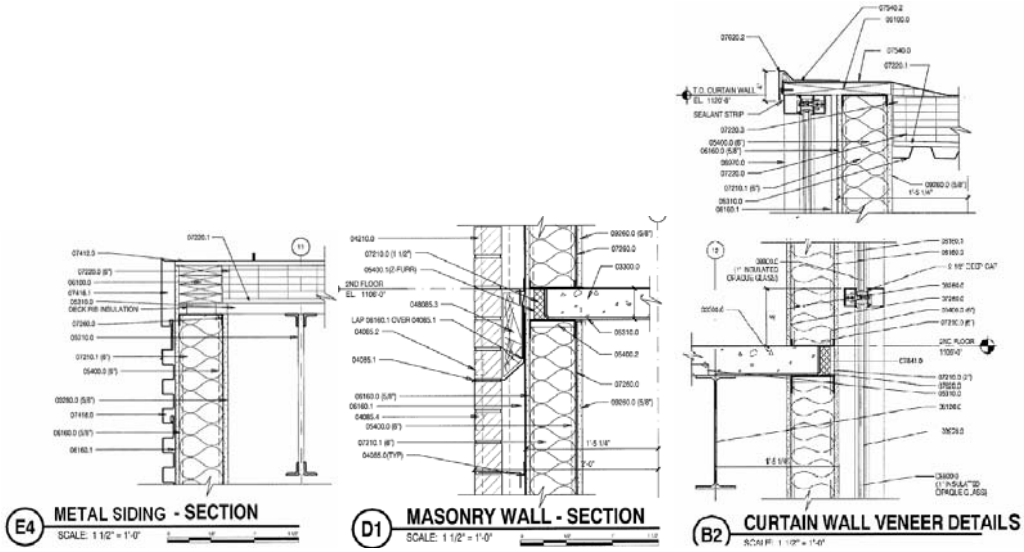
Constructuability:

In Erie, brick is a very common construction material. It also makes up the majority of the building. This will result in a better construction and higher learning curve. The glass is a less common material. In this area the typical use for this material is for strictly window use not cladding. However it is also the second most prevalent material on the building. Because of these factors glass will have a slower learning curve than brick and the construction may be less easy. The metal siding has been used before on buildings in this area but it has had construction issues in the past. It also is the least used material on the building yielding the slowest learning curve.

Structural System:

It was important to find out if the structural system that supports the wall panels would change due to switching the cladding. To do this I found the weight of each wall section. The metal panel weights the least at 12 psf. The glass came next at 30 psf. Coming in at the heaviest was the brick at 55 psf. Next example section of the wall systems that are currently in the building are shown below and will be compared.

By looking at the wall sections it was found that the support system for each wall is the same. This means that the same curtain wall system was used, 6”metal stud wall with bat insulation. Because the same wall supports each system it can be concluded that there will not be a need to change the structural system. This is important to note because there will now be no additional charges due to beefing up the structure.



Research and Economic Development Center
Erie, Pa
Kristen Eash

Conclusion:

Each system must be compared to determine which should be used. Using a chart and ranking the research points, the best system will be chosen.

Research	**Metal Panel**	**Glass**	**Brick**
Lifetime Cost (@ 4%)	$229,670	$175,500	$112,125
Maintenance	$85,000 every 7 years	$0	$0
System	$35,244	$175,500	$112,125
Schedule	6 days	41 day	17 days
Structure	All same	All same	All same
Constructability	Worst	Middle	Best

The ranking of research points are, cost being the most important issue to the University, (especially since the maintenance is paid for by the university while construction is paid by DGS); schedule being second ranked; structure next; finally will be constructability.

Following the criteria importance, brick would be the best system. This is because it is the cheapest and easiest to construct. It may be slower to build than metal panel cladding but due to the construction schedule, the schedule ends up not being important.