Analysis 2: SIPs Panels

About Structurally Insulated Panels

SIP panels are a fairly new type of construction that consists of wall framing and insulation in one combined panel. These panels are typically straighter and stronger than regular stick built stud framing. Since the panels do not require studs interior work like drywall and millwork can be installed quicker and easier without searching for studs or flat surfaces.

SIP panels are not only structurally better but they are also more energy efficient too. The current plans call for 2 x 6 wood studs 16" o/c with R-19 Batting. This type of construction yields an R value of about 13.7, whereas the 6" SIP panel has an R-value of 24.7, making it approximately 58% more efficient. This allows less heat transfer through the walls creating less energy usage in both winter and summer.

As for electrical and plumbing fit outs, with the SIP panel's standard chases we can eliminate conduit material in exterior walls because these chases act like conduit. These chases shown on the right allows us to cut cost for electrical conduit and time from installation.

Reasons for Analysis

There are a lot of reasons to use SIP paneling over traditional stick built. First, I am interested in making this hotel more structurally sound, and with SIP panels we can assure that the building will be stronger, straighter, and quieter. The second reason is to try and cut schedule time and labor cost. SIP panels are prefabricated off site which cuts construction time because they only need to be tilted up and connected. Finally, since the SIP panels are more energy efficient, the owner will be able to save money on his heating and cooling bill and the building will be more environmentally friendly.

SIP Issues

Although, this sounds like a great alternative to the typical stud framed walls some issues have occurred. After speaking with Barry the construction manager of DRK Associates, he has informed me that his crew has not worked with this type of construction yet creating a learning curve delay. In addition, he mentioned that they were bidding a SIP panel project that decided not to move forward with SIP panels due to budget issues, which insists that this process will be initially more expensive. With that being said, the SIP panels must be that much more energy efficient and stronger to continue with this approach.

SIPs Application

For this analysis I will be looking at applying 6" SIP panels to the exterior walls of all three floors of this new addition instead of the typical 2 x 6 stud framed walls. This is approximately 15,274ft^2 of surface area. The interior walls will remain 2 x 6 stud framed walls because energy efficiency is unaffected by interior wall construction.

Cost Analysis

To do the cost analysis we must take a few things into consideration. First of all, the SIP paneling consists of sheathing and insulation and does not need lumber. The 2 x 6 construction must include material costs for the 2 x 6 lumber, the R-19 Insulation and the 3/8" sheathing on both sides. In addition since the time of construction for the SIP panels is shorter than the stud construction, labor is approximately 30% cheaper for the SIP panels. Below is a cost breakdown of material and labor needs for both constructions. Costs were taken from R.S. Means 2009 and the SIP supplier.

Description	2" x 6" Stick Built	Quantity	Total Cost	6 1/2" SIP Panels	Quantity	Total Cost
Material	$520/M.B.F.	21.84 M.B.F.	$11,357	$3.30/SF	15,274 SF	$50,404
R-19 Insulation	$0.52/SF	15,274 SF	$7,943			
3/8" Plywood	$0.40/SF	30,548 SF	$12,220			
Labor	$640/M.B.F.	21.84 M.B.F.	$13,978	$0.64/SF	15,274 SF	$9,784
Total Cost			$45,498			$60,188

As you can see from the table above the initial cost of the SIP panels is about 33% more expensive than the traditional stick built. This was expected and hopefully the energy efficiency increase will help payback this initial cost fairly shortly.

Schedule Analysis

Currently the schedule suggest that it will take 8 days to frame and sheath the first floor, 8days for the second floor, and 10 days for the third floor, taking 26 days to construct all three frames with 2 x 6 stick built construction. After speaking with SIP suppliers who told me the same crew could install the SIP panels 50-70% faster and Barry the construction manager from DRK, I have concluded that the crew would take about 5 days for the first floor, 5 for the second floor, and 7 for the third floor compared to the 8-10 days per floor. The reason the schedule was not cut 50-70% was because Barry explained that his crew was inexperienced in the construction, and also the supplier is trying to sell me a product and will only tell me the best possible situation in order to sell their product. The construction manager explained that if the SIP construction was similar to a prefabricated 2 x 6 stud wall already combined with the insulation and sheathing (which it is) his crew could most likely cute each floors duration by about 3 days. Therefore I went with the 5-7 day per floor installation duration which means we will cut 9 days off the total schedule. An updated schedule can be found in the conclusion section.

A nine day reduction in schedule is not worth the $14,690 increase in initial budget. Therefore, we must now look at how energy efficiency will reduce future heating and cooling bills to determine if this substitution is worth proceeding with.

Energy Efficiency Analysis: Mechanical Breadth

In order to determine the energy savings from the reduced cooling and heating needs I used a SIP energy calculator from r-control.com. The calculator takes into account building location, building size (width, length, and height), the size of the SIP panels used, and the size of the original stud wall with batting rating. Although this is only an estimate and not exact figures we can get a very good idea of annual savings and be able to determine whether the SIP construction is practical. The calculator results for both poor and average leakage, can be seen in Appendix C Figure 1 and Figure 2 respectfully at the back of this assignment. Below is a summary of the SIP energy calculator results.

	Conventional 2 x 6 Construction (Poor leakage)	Conventional 2 x 6 Construction (Average leakage)	6" SIP Construction
Heating (MBTU)	775 MBTU	606 MBTU	257 MBTU
Heating Cost	$9,525	$7,448	$3,306
Cooling (MBTU)	82 MBTU	72 MBTU	40 MBTU
Cooling Cost	$1,008	$885	$492
Total (MBTU)	**857 MBTU**	**678 MBTU**	**297 MBTU**
Total Cost	**$10,533**	**$8,333**	**$3,798**

As you can see from this table the calculator expects the SIP construction to result in a 64%(poor leakage)/54%(average leakage) savings which is a total of $6,735(poor leakage)/$4,535(average leakage) savings annually on heating and cooling bills.

Since this calculation assumes that the roof is also SIP paneling and the cost is not specific to the exact electricity cost of my building, I must do some calculations to determine a more accurate annual savings. First I must add the amount of BTUs needed for heating and cooling for both the conventional and SIP construction but use the conventional roof BTUs for the SIP construction because SIP paneling roofs aren't a part of my analysis. In addition, my project uses electricity for both heating and cooling whereas the calculator uses natural gas for heating. The heating and cooling of the hotel rooms are done by individual electrical heating/cooling units to allow for individual comfort. Finally, they are considering a $0.04/kWh electricity cost whereas my building has a $0.13/kWh electricity cost making the calculators values much lower than the actual.

The conventional construction is estimated to use 775 MBTUs for the heating season and 82 MBTUs for the cooling season for a total of 857 MBTUs with poor leakage. The conventional construction is estimated to use 606 MBTUs for the heating season and 72 MBTUs for the cooling season for a total of 678 MBTUs with average leakage. The SIP construction is estimated to use 257 MBTUs for the heating season and 40 MBTUs for the cooling season for a total of 297 MBTUs. Now that we have the total BTUs I must convert this to kWhs so I can determine the cost using the exact electricity cost for my project. Below are the calculations from BTUs to kWhs.

1 BTU = .000293 kWhs

Conventional Energy Usage Poor Leakage
857,000,000 BTU*(.000293 kWh/BTU) = 251,101 kWh

Conventional Energy Usage Average Leakage
678,000,000 BTU*(.000293 kWh/BTU) = 198,654 kWh

SIP Construction Energy Usage
297,000,000 BTU*(.000293 kWh/BTU) = 87,021 kWh

Now we can determine the cost by using $0.13 kWh which is the electricity cost of my building. Calculations for new cost are below.

Conventional Energy Cost Poor Leakage
251101 kWh*($0.13/kWh) = $32,643

Conventional Energy Cost Poor Leakage
198654 kWh*($0.13/kWh) = $25,825

SIP Construction Energy Cost
87021 kWh*($0.13/kWh) = $11,313

The values I received with the Holiday Inn Express electricity cost were significantly higher than the calculator had originally expected. With these values the SIP panel

construction will save approximately $21,330(poor leakage)/$14,512(average leakage) per year, making the building 65%(poor leakage)/55% (average leakage) more energy efficient. Note that it is likely that the new construction will have an average leakage rather than poor leakage because the construction is new. With that being said we will use the average leakage values to determine the payback period of the SIP installation.

Payback

Even if the annual $14,512 savings is higher than expected, with an initial budget increase of $14,690, the owner will still be able to pay off the difference in 1-2 years. With that being said, the implementation of SIP panels vs. the traditional stick built construction is very practical for the owner.