# RSMeans

## Business Solutions

Reed Construction Data®

# BASF Corporation
## Time & Motion Study
## November 2006

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**November 2006**

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## *1.0 EXECUTIVE SUMMARY*

Residential building contractors are under increasing pressure to provide higher performance homes at lower cost and in shorter construction time. BASF Corporation is one of the largest multi-national chemical manufacturers in the world, with a portfolio ranging from chemicals, plastics, performance and agricultural products, to crude oil and natural gas. They supply the adhesive used to join the foam to the OSB, the resins in the OSB, and the foam core used in structural insulated panels (SIPs).

As the leading cost consultant and supplier of construction cost information in North America, Reed Construction Data/RSMeans provides third party validation of labor and productivity savings available to manufacturers. BASF needed an analysis of the cost benefits and efficiencies associated with installing SIPs, and commissioned the RSMeans Business Solutions team to design and perform a Time & Motion Study that would quantify the insulation productivity differences between using SIPs and conventional framing.

The research objective was to evaluate the installation time and cost associated with SIPs, as compared with conventional framing comprised of 2 x 6 framing, and oriented strand board (OSB) sheathing, to which thermal insulation and an air barrier are added. SIPs are load-bearing components that form structural exterior wall assemblies, complete with sheathing, insulation, and air barrier. It was expected that because SIPs eliminate a few steps in the building process, it would speed up construction job site time.

Specifically, the Time & Motion Study would quantify the following productivity differences of conventional framing vs. SIPs panels:

a. Labor and cost savings
b. Greater efficiencies and ease of use over conventional framing methods
c. Productivity differences for residential framing and electrical rough-in

The scope of the study is summarized in Table 1.

Prior to the date of data collection, a representative of the RSMeans company visited the PANEL PROS facility and an SIPs installation job site in order to compile an activity list. This activity list would be the basis for the actual installation tasks to be measured.

**Table 1: Project Scope**

| Product | Installation Task | Dates Observed |
|---|---|---|
| SIPs-Wall | 1408 S.F. (Square Foot) Wall, 6.5" thick | 10/17, 10/18, 10/23 and 10/24 |
| SIPs-Roof | 1728 S.F. Roof, 8.5" thick | 10/23 and 10/24 |
| SIPs-Dormers | 222 S.F. Wall and 384 S.F. Roof | 10/23 and 10/24 |
| SIPs-Electrical | 32 wiring devices and 3 lighting fixtures | 10/28 |

On October 17, 18, 23, 24, and 28, 2006, RSMeans representatives performed two time and motion studies at a residential construction site in Tilton, NH. For the first, productivity data was collected on the installation of SIPs wall and roof panels/dormers. For the second, similar data was collected for rough wiring of the house.

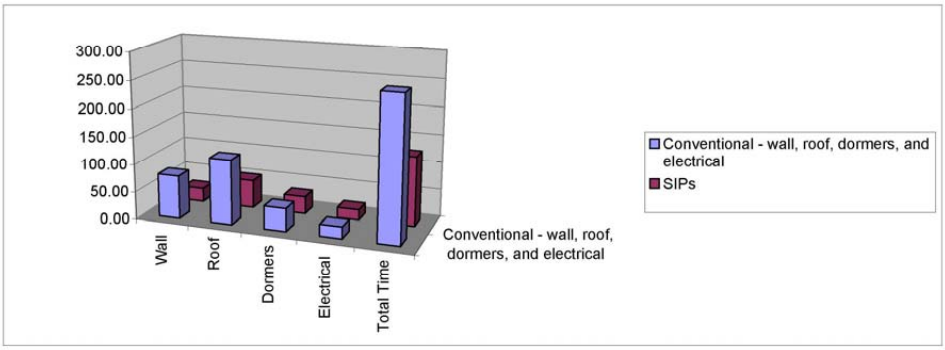
The subject of the study was a two-story, three-bedroom 42' by 28' cape style home with three dormers on a 12/12 pitch roof. The general contractor for the project was Bull Construction, LLC. The 12/12 pitch roof SIPs were fabricated and erected by PANEL PROS, Inc. of Keene, NH. The wiring contractor was Giguere Electric, Inc. of Laconia, NH.

RSMeans cost data was used to benchmark the time and cost for erecting conventionally framed stud walls, roofs, and dormers using exterior sheathing and fiberglass batt insulation. Rough wiring costs were benchmarked in a similar manner. (Benchmark Reference: *Means CostWorks 2006, Residential Cost Data, 3rd Quarter 2006.)*

The following report contains details on the tasks measured in the studies, as listed in the activities time charts. *(See Appendix, Figure 2: Work Measurement, and Figure 3: Recapitulated Work Measurement.)* Significant overall findings are discussed and analyzed, and recommendations made in the following sections of the report.

The data generated from the Time & Motion Studies showed that utilizing SIPs reduced installation time for this project by 130 labor hours. When compared to RSMeans labor hours for a conventionally framed home, this is equivalent to time savings of approximately 55 percent.

Figure 4: Chart for Actual Installed Time Comparison (hours)




(Exhibit P1.2)

The volatility of material costs can vary greatly by the project size, geography, and market. For these reasons, the material cost is not included in the summary of costs within this report. *(See Appendix, Figures 1, 1A, 1B, and 1C for Cost Analyses.)*

Increasing energy efficiency is a key factor in improving home performance and minimizing heat loss/gain, which is a high priority for many new home buyers. It is worth noting that when finished, this house will be Energy Star Qualified, owing to the superior performance of SIPs.

Although it was not within the scope of the Time & Motion Study, the RSMeans Business Solutions team feels that the use of SIPs will reduce life cycle costs. RSMeans suggests a life cycle cost analysis as a potential topic of future investigation. It is also noted that the SIPs wall thickness and performance levels differ from standard home construction.

## *2.0 METHODOLOGY*

### 2.1 Installing Structural Insulated Panels

An RSMeans Engineer recorded activities based on a list of SIPs installation tasks, using five-minute intervals. This is referred to as Group Timing Technique (GTT). The observer records the start and finish times for each task. At the end of data collection, the amount of time spent on each task is determined by subtracting the start time from the finish time. Tasks correlate to those listed in the activities time charts. *(See Appendix, Figure 2: WM1.1, WM1.2, and WM1.3)*

GTT was also used to determine the crew productivity in rough-wiring the house. *(See Appendix, Figure 2: WM1.4)*

The crew installing the SIPs was responsible for rough-framing the entire house. The exterior walls, roof, and dormers were constructed using SIPs. For other tasks, more conventional materials and techniques were employed. Activities unrelated to SIPs installation, such as framing the floors and installing lally columns (a trade name for a concrete-filled pipe column), were not included in the Time & Motion Study.

However, non-installation activities related to SIPs erection were incorporated. These tasks included time to read plans, give and receive instructions, sort panels to facilitate the erection process, and move tools and materials needed for the main task. When the panels arrived on site they were removed from the truck and placed in the staging area using a crane. They were then unwrapped and sorted. *(See Appendix, Figure 2: Work Measurement.)*

Installing SIPs involves some tasks that are not part of conventional wall and roof framing. The work proceeded in the following order:

(1) Cutting: the shop-fabricated wall, roof, and dormer panels have to be cut and labeled to fit their destinations. Likewise, the rough openings for doors and windows must be framed to fit the panels. *(A typical window opening is shown in Photo 2.)* Framing lumber was also installed in the sides of the panels to help form the joint between them. Rough wiring was done as well. Wire chases were drilled and spaces for outlets and switch boxes were routed in the panels. (The SIPs were then wrapped with a protective plastic sheet and shipped to the site for erection.)

(2) Beginning Wall Erection: a sill plate was installed on the rough-framed floor deck. The sill was held in place with construction adhesive and nails. Lifting plates *(as shown in Photo 3)* were then attached to the panels, corner screws started, and the panels moved by a crane. In some cases, the crane placed the panels on the sill. In others, the panels were laid on the floor deck and rotated into place by the crew. Adhesive was applied to the panel seams prior to erection. (Conventional construction adhesive was used for wood to wood contact while specially formulated adhesive was used for wood to foam or foam to foam connections.)

(3) Completing Wall Erection: once standing, the SIPs were aligned horizontally and vertically and the corners screwed together. In some cases a "come-along" was used to help pull the panels together. Temporary bracing was used to hold panels in place until enough panels were erected to make the wall self-supporting. The final step in the wall erection process was to nail all panel edges to the lumber at the sill and between the panels.

(4) Sealing the SIPs joints to reduce leakage and enhance insulating properties: insulating foam is used on the interior seams; a bituminous-based caulk is used on the exterior roof seams; and a tape membrane is used on the interior roof joints. (*Photo 4 shows taped roof joints and Photo 5 shows the caulked roof seams.)*

The second floor deck was erected after the first floor walls were in place, using the same order of procedures as for the first floor walls. Then a ridge beam, supported with interior columns, was installed in the beam wall pockets.

Preparation of the roof panels included attaching the lifting plates, starting screws on the top and bottom edges, attaching cleats, and applying adhesive. The roof SIPs were then hoisted and maneuvered into position and aligned with adjacent panels. Come-alongs were used as needed to help align the panels. Once in place, the panels were screwed to the ridge beam and to second floor wall panels.

The dormers were added as part of the roof installation process. The dormer faces were attached to a sill plate on the second floor using adhesive, nails, and screws. Sidewalls or cheeks were hoisted into place and attached to the roof panels using adhesive and screws. Small dormer roofs were shop-assembled. The larger dormer was assembled in the field and hoisted into place. Dormer roofs were placed as a unit on the face and side walls and attached with adhesive and screws.

After all of the SIPs were in place and secured with screws and nails, the joints were sealed. Wall panel interior joints were sealed with foam. Roof joints were taped on the inside and caulked on the exterior.

## 2.2 Estimating Stick-Built Construction Costs

The subject of the Time & Motion study was a 42′ by 28′, two-story cape style dwelling with a 12 pitch roof. To estimate costs associated with constructing a conventional, stick-built house, RSMeans used the quantity take-off method. In addition, shop drawings were reviewed to ensure that the costs of all labor were included in the final estimate.

In the SIPs house, the first floor deck is constructed on a double sill plate supported by the concrete foundation. The double sill and first floor deck is 1′-3 5/8″ high. The first floor walls are 6 ½″ thick, erected on top of the first floor deck. The walls are 9′-0 5/8″ high on the exterior face. The top of the wall panels are chamfered to support the roof panels. The total height from the top of the concrete foundation to the bottom of the roof is 10′-4 ¼″. The second floor deck is connected to the wall panels using joist hangers. The second floor deck is 1′-0 5/8″ high to provide a rough framed ceiling height of 8′-0″. The second floor gabled end walls are 28′ long and 14′ high. They are erected on the second floor deck with the tops of the walls supporting the edges of the roof. Roof panels are 8 ¼″ thick. No plywood sheathing is used.

SIPs wall and roof panels are fabricated off-site and trucked in for erection. For SIPs wall panels, RSMeans calculated a total of 624 square feet of door and window openings, cut-off corners at the gable ends, dormer face and cheek cut-offs, and angle cut-off waste on the front and back walls, which is not included in RSMeans estimated quantity of 1,408 square feet.

The SIPs roof panels totaled 1,728 square feet, excluding the dormer cut-outs and the squared corners of the dormer roof panels, which are discarded. (For example, for 24-foot long panels at least 3 feet of each panel were cut off for dormer roof openings.)

The estimate for the stick-built house is based on conventional framing with 2″ x 6″ wall framing and 2″ x 10″ rafters. Floor deck costs are not included in the estimate, but it was assumed that the conventional house used the same floor decks as the SIPs house to provide dimensional consistency. The stick-built house has an 8′-0″ stud wall erected on the first floor deck. The second floor deck is supported on the first floor wall. Rafters are supported by the floor and rim joists directly over the exterior walls. Plywood sheathing, ½″ CDX, is placed on the exterior to cover the 8′ high first floor wall, the second floor wall, and the ends of both floor decks.

The estimate for the conventionally constructed house is based on the assumption that the house is to be built on site. For instance, the two header pieces for a 3′ door opening are cut from an 8′ long piece of lumber, the remainder to be discarded. Roof rafters are cut from 22′ long pieces and the excess considered waste. In addition to the waste caused by differences between actual dimensions and standard lumber dimensions, 10 percent is added to the estimated quantities to account for material lost due to damage, incorrect cuts, etc.

RSMeans quantity take-off for the main house roof is 1,728 square feet. The dormer roof is 384 square feet for roofs framed using stick-built methods. Lumber is figured to the nearest length greater than 2 feet increments, and plywood is figured to the full sheet size of 32 square feet (based on 4′ x 8′ sheet).

It can be seen that the square footage of the roof, whether for a conventional house or for the SIPs dwelling, is identical (1,728 square feet.) Applying the quantity take-off methodology thus allows an accurate comparison of construction costs for this two-story cape style building.

## *3.0 COLLECTION AND ANALYSIS OF DATA*

None of the parties involved in the data collection had any influence on the outcome of the construction process, and every effort was made to insure the results of the studies were fair and impartial. A description of the tasks measured and analysis of the data generated in the installation of structural insulated panel walls and roofs follows. *(See Appendix, Figures 1–6.)*

### 3.1 Observation/Study Control Guide

An RSMeans Senior Engineer reviewed the erection process to determine the productivity metrics that needed to be evaluated. A Study Control Guide was then developed to define the discrete process times to be measured. The observer recorded time and work measurement data at five minute intervals.

### 3.2 Data Collection

The house used for the studies was a two-story, three-bedroom, 42' by 28' cape style home with three dormers on a 12 pitch roof. An Engineer was on site to observe the construction of the SIPs walls and roof and to record the data as defined in the Observation Study Control Guide.

Wall panel installation took place on parts of October 17 and 18, 2006. Roof construction started on October 19 and finished on October 23 and 24, due to a rain delay. Panel joints were sealed on the 24th. In addition, PANEL PROS framed the floors and support columns on these days. However, all tasks unrelated to SIPs erection are excluded from this study.

The electrical wiring rough-in for SIPs was observed on October 28, 2006. It was completed in 9 hours. (Interior walls were conventionally framed, and as the electrical rough-in was also conventional, no data was collected.)

### 3.3 Recapitulated Work Measurement

Data was compiled on SIPs walls, roof, dormers, and electrical rough-in wiring. *(See Appendix, Figure 3: Recapitulated Work Measurement (R1.1) for SIPs walls, roof, dormers* and *Figure 3: Recapitulated Work Measurement (R1.2) for electrical rough-in wiring.)*

### 3.4 Productivity Analysis

Field erection of structural insulated panels is faster than for conventional framing. A conventionally framed and insulated house of similar size and design would take approximately 122 percent longer to erect. Wall erection was the most efficient task, taking about a third of the time that it would take to build and insulate a conventionally framed wall. *(See Appendix, Figure 4: Actual Installed Time Comparison.)*

#### *3.4.1 Walls*

The first floor SIPs walls were erected in approximately half a day. The on-site crew initially had five people, with the foreman and two crew members erecting the panels and two additional crew installing lally columns in the basement. (Lally column installation is a conventional framing task and the time is not included in this study.) At mid-morning one crew member left the site and another joined the wall erection crew. The foreman supervised the work, operated the crane, and also helped with the panel installation.

After the first floor walls were erected, the second floor deck was installed. This task was considered to be conventional framing and was not included in this study. However, it took the rest of the day and part of the next.

When the floor deck was finished, the wall panels for the house's gable ends were hoisted to the second floor and assembled on the deck. The

walls were then rotated onto the sill plates and aligned. (Since this is a cape style house there are no front and back walls on the second floor.)

A total of 1408 square feet of SIPs walls were installed in 24.8 labor hours, door and window openings not included. *(See Appendix, Figure 2: Work Measurement* for a detailed list of tasks and associated time spent on individual activities.)

A comparable conventionally framed wall would use 2′ x 6′ studs with ½ inch CDX sheathing on the outside and 5 ½ inch fiberglass batt insulation between the studs. The average construction time for a conventional 2′ x 6′ wall would be 78.12 labor hours, or 0.055 labor hours/square foot.

(*Note:* Based upon the shop drawings there was a total of 624 square feet of door & window openings, cut-off corners at the gable ends, dormer face and cheek cut-offs, and angle cut-off waste on the front and back wall. If we add this number to the current figure in our estimate (1,408), the sum is 2,032 square feet, which is very close to the 2,064 square foot number provided by the wall manufacturer. Allowing for the panel size as it comes from the factory and including the dormer outs and squaring off the corners of the dormer roof panels, the quantity calculated (2,343) is slightly less than the wall manufacturer's number of 2,480 square feet. This quantity is allowing for 24-foot-long panels where at least 3 feet of each panel is being cut off and thrown away. Similar conditions exist for the dormer openings and rectangular-shaped roof panels. The quantity, which has been changed to 1,728 and 384 square feet (main house and dormer roofs, respectively, represent the roofs as they would be framed using stick-built methods. Lumber has been figured to the nearest greater 2′ increment and plywood has been figured to full sheets of 32 square feet.)

### *3.4.2 Roof and Dormers*

The roof and dormers were installed on the next two working days, along with some unrelated framing tasks not included in this study. The crew size was increased to six people, one foreman and five workers, in an unsuccessful attempt to finish the roof before heavy rain forced a delay in the construction process.

Once the walls were constructed the ridge beam was installed. Then the roof panels were hoisted into place, aligned, and secured. Dormers were installed in sequence with the roof panels. Roof and dormer installation tasks were timed separately so that the data from this study could be applied to roofs that either did not have dormers or had different numbers of dormers.

1,728 square feet of roof SIPs were installed in 50.8 labor hours. The resulting productivity is calculated at 0.029 labor hours/square foot.

Dormer walls totaled 222 square feet and dormer roofs totaled 384 square feet. Dormer productivity is based on the total wall and roof area because of their relatively small size and slightly more complicated alignment. SIPs dormers took 31.33 labor hours to erect, or 0.052 labor hours/square foot to install.

A comparable conventionally framed and insulated roof would take an average of 117.48 labor hours to build, and it would take an additional 41.87 labor hours to add stick dormers. *(See Appendix, Figure 4: Actual Installed Time Comparison.)*

Some of the panels forming the roof dormer interface were not fabricated correctly in the shop, which forced some downtime and extra work for the field crew. The crew members who were in position to receive and install the components were forced to wait for the ground crew to field-adjust each piece of the dormer assembly. The downtime was not included in the erection time for the roof, but the extra work was included. Had all the panels been properly prefabricated, roof and dormer installation would have been more efficient than it appears to be in this study.

It was not possible to accurately determine how much of a task's time was due to necessary work and how much was "extra" needed to cope with a problem. However, dealing with problems and minor errors is a part of the field work on any project, and including this time gives a more realistic measure of the installation time for SIPs than a problem-free installation would have.

### *3.4.3 Sealing*

The final half-day on site was devoted to sealing the SIPs joints. Although joint sealing was left until all panels were installed, aligned, and secured

as final structure, the time was recorded and included as appropriate with wall, roof, or dormer erection.

### *3.4.4 Electrical*

The house was wired in one day by a crew consisting of one foreman and six electricians. The exterior walls were SIPs and the interior walls were conventionally framed with 2" x 4" studs. The time needed to do the electrical rough-in for interior walls was not included in this study. Tasks associated with rough-wiring receptacles, switches, and fixtures in the panels are included. The house was also wired for telephone and cable television, but this work required only one box in the SIPs for the external connection to service providers.

The electricians installed boxes for 7 switches, 25 receptacles, and 3 external light fixtures in 18.76 labor hours. Installing these fixtures in conventionally framed exterior walls would average 21.11 labor hours. The average time for installation in SIPs is 0.54 labor hours per wiring device or fixture, while the average for conventional walls is 0.60 labor hours per wiring device or fixture.

## 3.5 Cost Analysis

Erecting prefabricated structural insulated panels is much faster than building a comparable house using conventional framing. SIPs installation requires the use of a crane, which adds to construction costs and partially offsets the savings from reduced labor. In this example, the cost of erecting the SIPs house was $35,622, including the cost of the crane, while the conventionally framed house would cost an average of $21,197. Field erection demonstrated that using SIPs is faster, yet the total cost is approximately 68% greater. *(See Appendix, Figure 5: Installed Cost Comparison.)*

Rough-wiring installation proved less expensive than for a conventional house. Labor costs for wiring were $870 for the SIPs house compared to an average of $979 for a conventional house. A cost savings of $109 would be realized in this example.

### *3.5.1 Walls*

A total of 1,408 square feet of SIPs walls (door and window openings excluded) was installed with a labor cost of $1,372. A comparable conventionally framed wall would use 2" x 6" studs with ½ inch CDX sheathing on the outside and 5 ½ inch fiberglass batt insulation between the studs. The average labor cost for a conventional 2' x 6' wall would be $3,331. Labor costs for a 6 ½ inch SIPs wall are $0.97/square foot, while a conventional wall is expected to have a labor cost of $2.37/square foot.

Clearly, SIPs installations enjoy a significant savings in field labor costs. The costs associated with the crane are included in the labor costs, as is the cost of sealing the wall joints.

### *3.5.2 Roof and Dormers*

1,728 square feet of SIPs roof panels were installed with a labor cost of $2,816, or $1.63/square foot. Dormer walls totaled 222 square feet and the dormer roofs totaled 384 square feet. Dormer productivity is based on the total wall and roof area because of the relatively small size and slightly more complicated alignment issue.

SIPs dormers had a labor cost of $1,735 per 606 square feet or $2.86/square foot. A comparable conventionally framed and insulated roof would take $4,498 in labor to erect, and the labor for the dormers would cost an additional $1,765. Corresponding unit labor costs are $2.60/square foot for the roof and $2.91/square foot for the dormers. The added cost of the crane made the SIPs roof and dormer slightly more expensive than walls to install. (The costs associated with sealing the wall joints are included in the labor costs for the roof and dormer, but material costs are not.)

### *3.5.3 Electrical*

Electricians installed and wired boxes for 7 switches, 25 receptacles, and 3 external light fixtures for a labor cost of $870. Installing these fixtures in conventionally framed exterior walls would average $979 for labor. Labor cost savings for rough wiring in SIPs is $3.12 per device.

## 3.6 Benchmarking Cost Analysis

*Means CostWorks 2006, Residential Cost Data, 3rd Quarter 2006* was used to obtain benchmark costs for the framing, insulation, and wiring of the house. Crews required are also defined in this source. Labor, material, and equipment costs were included as appropriate. National average costs and productivity rates were used for conventional construction, and national average labor and equipment costs were used *with observed productivity data* to define costs for SIPs construction.

## *4.0 KEY FINDINGS*

RSMeans Business Solutions team was engaged to determine cost savings and efficiencies associated with installing SIPs.

Key findings that emerged from the Time & Motion Studies:

- The use of prefabricated Structural Insulated Panels resulted in significant time and labor cost savings. Erection of the SIPs walls, roof, and dormers took 45% of the labor hours expected for conventional construction.
- Rough-wiring the electrical appurtenances in the SIPs walls took 89% of the labor hours expected for rough wiring in a conventional house. (Hourly rates for the electricians were the same for both types of construction, so the labor cost savings matched the labor hour savings.)

Other advantages for SIPs include:

- SIPs eliminate the need to install exterior sheathing, thermal insulation, and housewrap separately. The SIP sandwich panels come preassembled, which reduces installation time.
- Precut openings: with door and window openings already cut, there is less labor required on the job site to install SIPs.

The following observations made in the field may be helpful to contractors using SIPs:

- Optimum crew size: a foreman who can double as the crane operator, two carpenters, and one helper. For rough-in wiring, three electricians will save coordinating time.
- SIPs installation requires the use of a truck-mounted crane and a qualified operator. Such equipment and training is not typical for a residential framing crew.
- Panels need to be carefully checked to make sure they fit before they are shipped to the job site.
- Plans should be checked to be sure the panels and openings are correctly dimensioned.
- Field-cutting panels should be avoided whenever possible, as errors could result, causing long delays waiting for replacements to be shipped.

## *5.0 CONCLUSIONS AND RECOMMENDATIONS*

The RSMeans Business Solutions team concluded that not only does using prefabricated SIPs save significant time on site, it reduces labor costs. In addition, rough-in wiring with prefabricated wire chases further increases these savings.

Although life cycle costs were not part of this study, it should be noted that SIPs installed to meet Energy Star requirements offer significant savings in energy use. A typical 2' x 6' wall with fiberglass batt insulation has an R value of 19 while the comparable SIPs wall is rated at R 22.3. In addition to the higher R values, the sealed joints between the SIPs reduce air leakage (drafts) and energy loss.

Energy efficiency is a very attractive selling point with many potential buyers, despite the higher material costs of SIPs, because they minimize heat loss/gain in a new home, increase comfort, and save money in the long run.

BASF may wish to evaluate labor and materials differences between equivalent wall configurations (i.e. a 2 x 4 wall compared to a nominal 4 inch SIP wall.) Similarly, an R-19 SIPs wall could be compared to a "high performance" 2 x 6 conventionally framed wall.

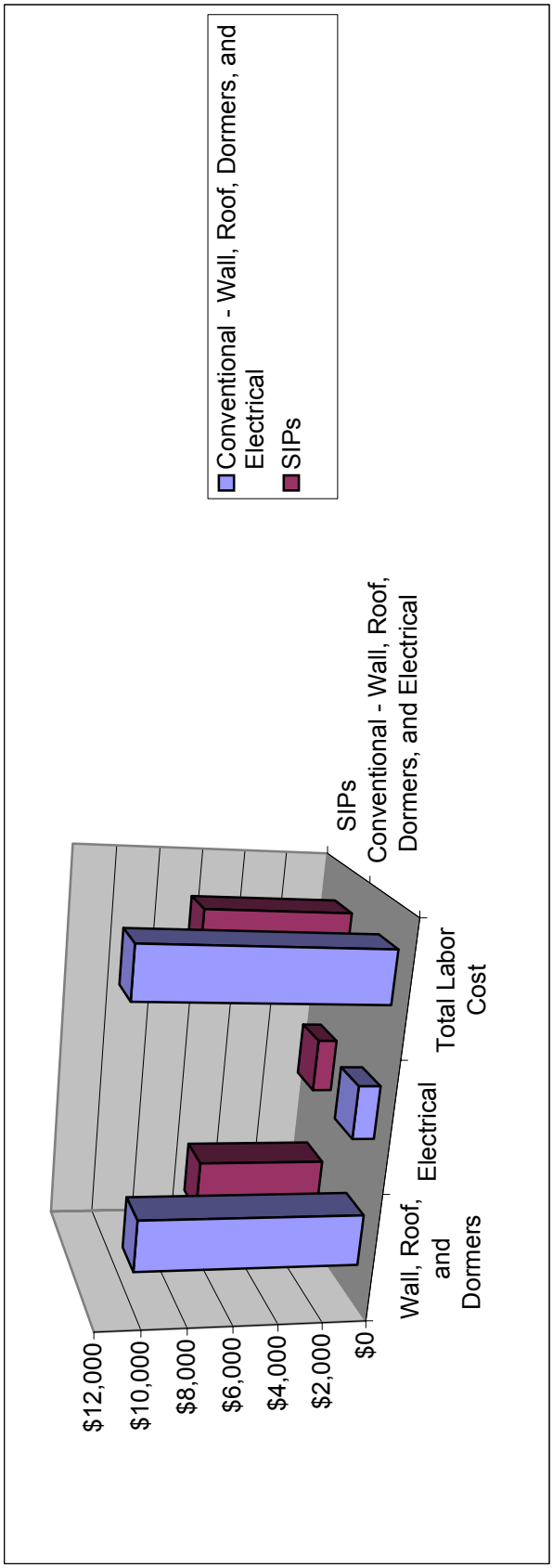



Figure 1: Chart for Overall Cost Analysis (Dollars)

## Figure 1: Overall Cost Analysis

| Application | Wall Labor Cost | Roof Labor Cost | Dormers Labor Cost | Subtotal Cost | Delta % for Column E |
|---|---|---|---|---|---|
| Conventional - wall, roof, and dormers | $3,331 | $4,998 | $1,765 | $10,094 | |
| SIPs - wall, roof, and dormers | $1,372 | $2,816 | $1,735 | $5,923 | -41% |

| Application | Electrical Labor Cost | | Subtotal Cost | Delta % for Column C |
|---|---|---|---|---|
| Conventional - Electrical rough-in | $979 | | $979 | |
| SIPs - Electrical rough-in | $870 | | $870 | -11% |

### Summary of Total Labor Cost Comparison

| Application | Wall, Roof, & Dormer Labor | Electrical Cost | Total Labor Cost | Delta % for Total Cost |
|---|---|---|---|---|
| Conventional - Wall, Roof, Dormers, and Electrical | $10,094 | $979 | $11,073 | |
| SIPs | $5,923 | $870 | $6,793 | -39% |

Note: For Delta % by using Conventional time as denominator

### Figure 1A: SIP Wall Cost Analysis

| Application | Wall Labor Cost | | Subtotal Cost | Delta % for Column E |
|---|---|---|---|---|
| Conventional - Wall | $3,331 | | $3,331 | |
| SIPs - Wall | $1,372 | | $1,372 | -59% |

### Figure 1B: SIP Roof Cost Analysis

| Application | Roof Labor Cost | | Subtotal Cost | Delta % for Column E |
|---|---|---|---|---|
| Conventional - Roof | $4,998 | | $4,998 | |
| SIPs - Roof | $2,816 | | $2,816 | -77% |

### Figure 1C: SIP Dormer Cost Analysis

| Application | Roof Labor Cost | | Subtotal Cost | Delta % for Column E |
|---|---|---|---|---|
| Conventional - Dormer | $1,765 | | $1,765 | |
| SIPs - Dormer | $1,735 | | $1,735 | -2% |

## Figure 2: Work Measurement

**Application: Wall** | **Installation of SIP** | **Dates: 10/17 , 10/18**
**Client: BASF Corporation** | **Building size: 42' x 28' house** | **10/23, & 10/24/2006**
**Contractor: PANEL PROS** | **Location: Tilton, NH**
**Observer: RS Means**

| Work Activity | 10/17 | 10/18 | 10/23 | 10/24 | Actual time |
|---|---|---|---|---|---|
| Non-productivity Time and Breaks (65 min + 5 min) | | | | | 70 min |
| | | | | | |
| Instruction (15 min + 5 min) | | | | | 20 min |
| Reading Plans (20 min) | | | | | 20 min |
| Material Movement (other than panels) | | | | | 215 min |
| (170 min + 45 min) | | | | | |
| | | | | | |
| Small Tools (35 min + 40 min) | | | | | 75 min |
| Moving Dunnage and Clean-up (20 min + 10 min) | | | | | 30 min |
| **Actual Installation:** | | | | | |
| 1. Sole, Shoe, and Sill Installation | | | | | 145 min |
| (85 min + 60 min) | | | | | |
| 2. Unwrapping Panels (20 min + 5 min) | | | | | 25 min |
| 3. Rigging for Panel Bundles (20 min + 50 min) | | | | | 70 min |
| 4. Attach Lifting Plate (25 min + 15 min) | | | | | 40 min |
| 5. Detach Lifting Plate (25 min + 5 min) | | | | | 30 min |
| 6. Crane Operating - Operator (55 min + 40 min) | | | | | 95 min |
| 7. Load in Air Time - Crew (15 min + 10 min) | | | | | 25 min |
| 8. Tag Line (5 min) | | | | | 5 min |
| 9. Panel Placement (10 min + 5 min) | | | | | 15 min |
| 10. Splines (5 min + 10 min) | | | | | 15 min |
| 11. Horizontal Wall Alignment (60 min) | | | | | 60 min |
| 12. Nailing (40 min) | | | | | 40 min |
| 13. Screw Fastening Corner (60 min) | | | | | 60 min |
| 14. Glue Application (25 min + 20 min) | | | | | 45 min |
| 15. Bracing temporarily (15 min + 25 min) | | | | | 40 min |
| 16. Vertical Wall Alignment (20 min) | | | | | 20 min |
| 17. Come Along (10 min) | | | | | 10 min |
| 18. Foam Joints (70 min + 30 min) | | | | | 100 min |
| | | | | | |
| 19. Drill Foam Holes (15 min) | | | | | 15 min |
| 20. Trim Foam Joints (15 min + 15 min) | | | | | 30 min |
| 21. Sort Panels (20 min) | | | | | 20 min |
| 22. Assemble Wall Panels (80 min) | | | | | 80 min |
| | | | | | |

(Exhibit WM1.1)

## Figure 2: Work Measurement

**Application: Roof** | **Installation of SIP** | **Dates: 10/19 ,**
**Client: BASF Corporation** | **Building size: 42' x 28' house** | **10/23, & 10/24/2006**
**Contractor: PANEL PROS** | **Location: Tilton, NH**
**Observer: RS Means**

| Work Activity | 10/19 | 10/23 | 10/24 | Actual time |
|---|---|---|---|---|
| Non-productivity Time and Breaks(140 min) | | | | 140 min |
| | | | | |
| | | | | |
| Instruction (60 min) | | | | 60 min |
| Reading Plans (15 min) | | | | 15 min |
| Material Movement other than panels (45 min) | | | | 45 min |
| Small Tools (50 min) | | | | 50 min |
| Moving Dunnage and Clean-up (5 min) | | | | 5 min |
| **Actual Installation:** | | | | |
| 1. Sole, Shoe, and Sill Installation (5 min) | | | | 5 min |
| 2. Unwrapping Panels (30 min) | | | | 30 min |
| 3. Rigging for Panel Bundles (35 min) | | | | 35 min |
| 4. Attach Lifting Plate (85 min) | | | | 85 min |
| | | | | |
| 5. Detach Lifting Plate (30 min) | | | | 30 min |
| 6. Crane Operating - Operator (170 min) | | | | 170 min |
| | | | | |
| | | | | |
| 7. Load in Air Time - Crew (85 min) | | | | 85 min |
| | | | | |
| 8. Panel Placement (300 min) | | | | 300 min |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| 9. Splines (20 min) | | | | 20 min |
| 10. Lumbering Openings (5 min) | | | | 5 min |
| 11. Horizontal Wall Alignment (10 min) | | | | 10 min |
| 12. Foam Scraping (30 min) | | | | 30 min |
| 13. Nailing (15 min) | | | | 15 min |
| 14. Screw Fastening Corner (180 min) | | | | 180 min |
| | | | | |
| | | | | |
| 15. Glue Application (60 min) | | | | 60 min |
| 16. Bracing temporarily (10 min) | | | | 10 min |

(Exhibit WM1.2)

## Figure 2: Work Measurement

**Application: Dormers** | **Installation of SIP** | **Date: 10/23 & 10/24/2006**
**Client: BASF Corporation** | **Building size: 42' x 28' house**
**Contractor: PANEL PROS** | **Location: Tilton, NH**
**Observer: RS Means**

| Work Activity | 10/23 | 10/24 | Actual time |
|---|---|---|---|
| Non-productivity time and Breaks (70 min + 5 min) | | | 75 min |
| | | | |
| Instruction (15 min + 15 min) | | | 30 min |
| Reading Plans (65 min + 20 min) | | | 85 min |
| | | | |
| Material Movement other than panels | | | 125 min |
| (70 min + 55 min) | | | |
| Small Tools (40 min + 20 min) | | | 60 min |
| Moving Dunnage and Clean-up (130 min + 180 min) | | | 310 min |
| | | | |
| | | | |
| **Actual Installation:** | | | |
| 1. Attach Lifting Plate (25 min) | | | 25 min |
| 2. Detach Lifting Plate (20 min) | | | 20 min |
| 3. Crane Operating - Operator (70 min) | | | 70 min |
| | | | |
| 4. Load in Air Time - Crew (20 min) | | | 20 min |
| 5. Panel Placement (135 min) | | | 135 min |
| | | | |
| | | | |
| 6. Foam Scraping (35 min) | | | 35 min |
| 7. Nailing (155 min + 5 min) | | | 160 min |
| | | | |
| | | | |
| 8. Screw Fastening Corner (150 min + 30 min) | | | 180 min |
| | | | |
| | | | |
| 9. Glue Application (35 min) | | | 35 min |
| 10.Roof Cleats (Cut and Nail) (125 min) | | | 125 min |
| | | | |
| | | | |
| 11. Come Along (5 min) | | | 5 min |
| 12. Align Dormer Roof (160 min) | | | 160 min |
| | | | |
| | | | |
| 13. Assemble Dormer Roof (135 min) | | | 135 min |
| | | | |
| | | | |

(Exhibit WM1.3)

## Figure 2: Work Measurement

**Application: Electrical** **Installation of SIPS** **Date: 10/28/2006**
**Client: BASF Corporation** **Building size: 42' x 28' house**
**Contractor: Giguere Electric, Inc.** **Location: Tilton, NH**
**Observer: RS Means**

| Work Activity | Crew Foreman | Crew A | Crew B | Crew C | Crew D | Crew E | Crew F | Total Minutes | SIPS Prorate Minutes |
|---|---|---|---|---|---|---|---|---|---|
| Non-Productive and Breaks | 10 | 10 | 40 | 25 | 55 | 25 | 20 | 185 | 67 |
| Receiving Instruction* | 140 | 50 | 35 | 10 | 20 | | 5 | 260 | 18 |
| Reading Plans | 35 | 5 | 10 | | 5 | 5 | | 60 | 22 |
| Material Movement | 30 | 25 | 25 | 30 | 30 | 15 | 20 | 175 | 64 |
| Small Tools | 5 | | 15 | | | | | 20 | 7 |
| Moving Dunnage and Cleanup | | | | 5 | 50 | 40 | 45 | 140 | 50 |
| **SIPS Actual Installation:** | | | | | | | | | |
| 1. Fishing Wire | | 5 | 20 | 15 | 50 | 10 | | 100 | 100 |
| 2. Pulling Wire to First Floor | 5 | 30 | 30 | 10 | 15 | 5 | 10 | 105 | 105 |
| 3. Pulling Wire to Second Floor | 70 | 65 | | | | | | 135 | 135 |
| 4. Drilling Sole Plate (SIP) | | 10 | 30 | 30 | 10 | | 5 | 85 | 85 |
| 5. Drilling New Wire Chase (SIP) | 5 | 5 | 15 | 15 | | 20 | 20 | 80 | 80 |
| 6. Cut Hole for Outside Outlet | | | | | 5 | | | 5 | 5 |
| 7. SIPs Boxes and Wiring (Interior) | | 60 | 40 | 55 | 75 | 20 | 35 | 285 | 285 |
| 8. Set Outside Box and Wiring (Exterior) | | | 5 | | | 20 | 20 | 45 | 45 |
| 9. Foam (Caulk) | 5 | 10 | 10 | | | | | 25 | 25 |
| **Actual Installation (Not part of Scope)** | | | | | | | | | |
| 1. Rough-in Wiring for Receptacle | 15 | 10 | 15 | 5 | 15 | 15 | 10 | 85 | N/A |
| 2. Rough-in Wiring for Switch | 15 | 20 | 20 | 25 | 10 | 20 | 5 | 115 | N/A |
| 3. Rough-in Wiring for Lighting Fixture | 5 | 20 | 5 | 5 | | 5 | 60 | 100 | N/A |
| 4. Connecting to Main Panel (Inc. Circuit Breakers) | | | | 135 | | | | 135 | N/A |
| 5. Drilling Interior | | 35 | 15 | | 10 | | 20 | 20 | N/A |
| 6. Install Main Panel Box | | | | 30 | 15 | 5 | 5 | 55 | N/A |
| 7. Set Interior Boxes | | 25 | 20 | 15 | 15 | 5 | 10 | 90 | N/A |
| 8. Set Ceiling Boxes | 25 | 20 | 30 | | 10 | | | 85 | N/A |
| 9. Pull Interior Wire | 115 | 75 | 95 | 70 | 85 | 160 | 150 | 750 | N/A |
| 10. Install Conduit | | | | | | 40 | 40 | 80 | N/A |

Note: 1. *260 minutes for receiving instruction is above norm for residential house; for a fair comparison with Means, recast with 30 minutes.

(Exhibit WM1.4)

## Figure 3: Recapitulated Work Measurement

| Work Activity (Installation time in minutes) | SIP Wall | Work Activity (Installation time in minutes) | SIP Roof | Work Activity (Installation time in minutes) | SIP Dormers |
|---|---|---|---|---|---|
| **Non-process Time:** | | | | | |
| Non-productivity Time and Breaks | 70 | | 140 | | 75 |
| Instruction | 20 | | 60 | | 30 |
| Reading Plans | 20 | | 15 | | 85 |
| Material Movement other than panels | 215 | | 45 | | 125 |
| Small Tools | 75 | | 50 | | 60 |
| Moving Dunnage and Clean-up | 30 | | 5 | | 310 |
| **Actual Installation:** | | | | | |
| 1. Sole, Shoe, and Sill Installation | 145 | 1. Sole, Shoe, and Sill Installation | 5 | 1. Attach Lifting Plate | 25 |
| 2. Unwrapping Panels | 25 | 2. Unwrapping Panels | 30 | 2. Detach Lifting Plate | 20 |
| 3. Rigging for Panel Bundles | 70 | 3. Rigging for Panel Bundles | 35 | 3. Crane Operating - Operator | 70 |
| 4. Attach Lifting Plate | 40 | 4. Attach Lifting Plate | 85 | 4. Load in Air Time - Crew | 20 |
| 5. Detach Lifting Plate | 30 | 5. Detach Lifting Plate | 30 | 5. Panel Placement | 135 |
| 6. Crane Operating - Operator | 95 | 6. Crane Operating - Operator | 170 | 6. Foam Scraping | 35 |
| 7. Load in Air Time - Crew | 25 | 7. Load in Air Time - Crew | 85 | 7. Nailing | 160 |
| 8. Tag Line | 5 | 8. Panel Placement | 300 | 8. Screw Fastening Corner | 180 |
| 9. Panel Placement | 15 | 9. Splines | 20 | 9. Glue Application | 35 |
| 10. Splines | 15 | 10. Lumbering Openings | 5 | 10.Roof Cleats (Cut and Nail) | 125 |
| 11. Horizontal Wall Alignment | 60 | 11. Horizontal Wall Alignment | 10 | 11. Come Along | 5 |
| 12. Nailing | 40 | 12. Foam Scraping | 30 | 12. Align Dormer Roof | 160 |
| 13. Screw Fastening Corner | 60 | 13. Nailing | 15 | 13. Assemble Dormer Roof | 135 |
| 14. Glue Application | 45 | 14. Screw Fastening Corner | 180 | | |
| 15. Bracing temporarily | 40 | 15. Glue Application | 60 | | |
| 16. Vertical Wall Alignment | 20 | 16. Bracing temporarily | 10 | | |
| 17. Come Along | 10 | 17. Roof Alignment | 150 | | |
| 18. Foam Joints | 100 | 18. Roof Cleats (Cut and Nail) | 175 | | |
| 19. Drill Foam Holes | 15 | 19. Align Ridge Beam and Posts | 30 | | |
| 20. Trim Foam Joints | 30 | 20. Lumber Roof Panel ends | 620 | | |
| 21. Sort Panels | 20 | 21. Tape Roof Joints Drill Foam Holes (20 | 390 | | |
| 22. Assemble Wall Panels | 80 | 22. Caulk Roof Joints | 155 | | |
| **Actual production time** | **1415** | | **2905** | | **1790** |
| ***Contingency time (5%)** | **71** | | **145** | | **90** |
| **Total installation time (minutes)** | 1486 | | 3050 | | 1880 |
| **Total installation time (hours)** | 24.76 | | 50.84 | | 31.33 |
| **Residential Rate W/Crane & O & P** ($55.40) | $1,372 | | $2,816 | | $1,735 |
| **Total installation square feet** | 1,408 | | 1,728 | | 606 |
| **Installation time per square foot** (hours/S.F.) | 0.0176 | | 0.0294 | | 0.0517 |
| **Installation dollar per square foot** | $0.97 | | $1.63 | | $2.86 |

Note: 1. *Contingency time: Add 5% allowance to actual production for material procurement and mobilization, etc.

(Exhibit R1.1)

Figure 3: Recapitulated Work Measurement

| Work Activity (Installation time in minutes) | SIP Electrical Work |
|---|---|
| **Non-process time:** | |
| Non-Productivity and Breaks | 67 |
| Receiving Instruction | 18 |
| Reading Plans | 22 |
| Material Movement | 64 |
| Small Tools | 7 |
| Moving Dunnage and Cleanup | 50 |
| **Actual Installation:** | |
| **SIP's Electrical Work Actual Installation:** | |
| 1. Fishing Wire | 100 |
| 2. Pulling Wire to First Floor | 105 |
| 3. Pulling Wire to Second Floor | 135 |
| 4. Drilling Sole Plate (SIP) | 85 |
| 5. Drilling New Wire Chase (SIP) | 80 |
| 6. Cut Hole for Outside Outlet | 5 |
| 7. SIPS Boxes and Wiring (Interior) | 285 |
| 8. Set Outside Box and Wiring (Exterior) | 45 |
| 9. Foam (Caulk) | 25 |
| **Actual production time** | 1093 |
| ***Contingency time (3%)** | 33 |
| **Total installation time (minutes)** | 1126 |
| **Total installation time (hours)** | 18.76 |
| **Residential Rate incl. O & P** ($46.38) | $870 |

Note: 1. *Contingency time: Add 3% allowance to actual installation for material procurement.

2. Residential Rate incl. O&P is $46.38, based on 3rd quarter 2006 Means Residential Cost Data.

(Exhibit R1.2)

Figure 4: Actual Installed Time Comparison (hours)

| | Column A | Column B | Column C | Column D | Column E |
|---|---|---|---|---|---|
| **Application** | **Wall** | **Roof** | **Dormers** | **Total Time** | **Delta % for Column A+B+C** |
| **Conventional - wall, roof, and dormers** | 78.12 | 117.48 | 41.87 | 237.47 | |
| **SIPs** | 24.76 | 50.84 | 31.33 | 106.93 | -55% |

| | Column A | Column B |
|---|---|---|
| **Application** | **Electrical** | **Delta % for Column A** |
| **Conventional - Electrical rough-in** | 21.11 | |
| **SIPs** | 18.76 | -11% |

**Summary of Actual Installed Time Comparison**

| Application | Total time | | Delta for Time | Delta % for Total Time |
|---|---|---|---|---|
| **Conventional - Wall, Roof, Dormers, and Electrical** | 237.47 + 21.11 = | 258.58 | | |
| **SIPs** | 106.93 + 18.76 = | 125.69 | -132.89 | -51% |

Note: For Delta % by using conventional time as denominator

(Exhibit P1.1)

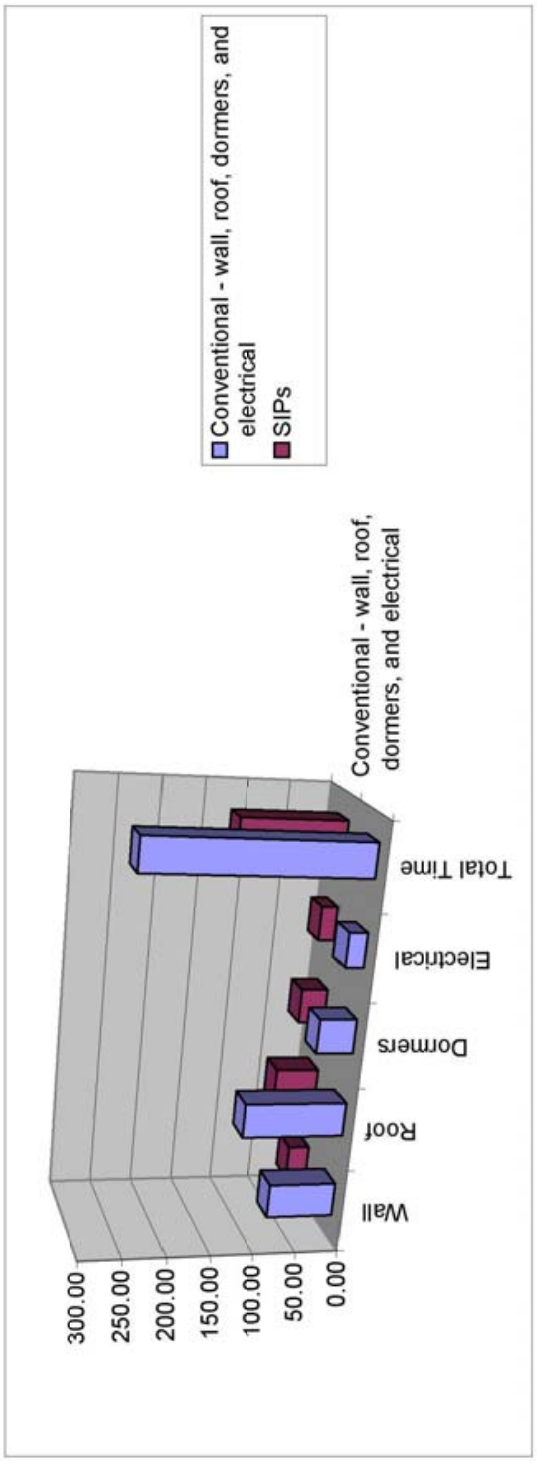



Figure 4: Chart for Actual Installed Time Comparison (hours)

(Exhibit P1.2)

Figure 5: Installed Cost Comparison

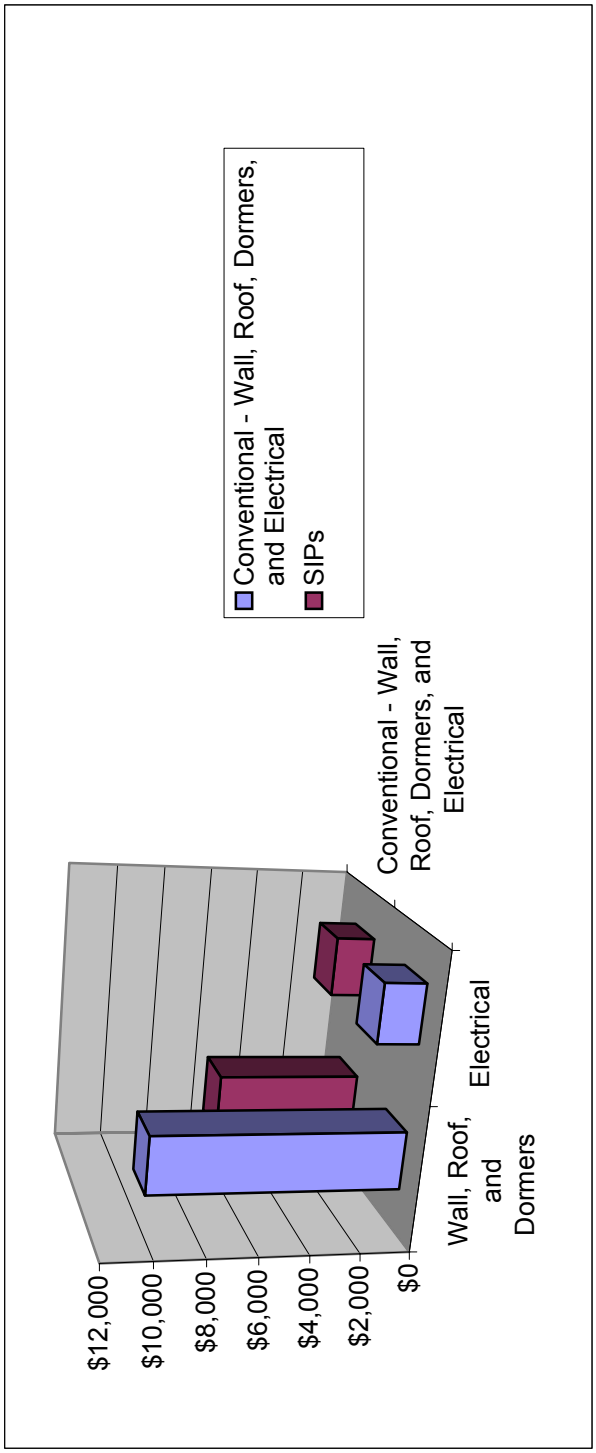
| | Column A | Column B | Column C | Column E | Column F |
|---|---|---|---|---|---|
| Application | Wall Labor Cost | Roof Labor Cost | Dormers Labor Cost | Subtotal Cost | Delta % for Column E |
| Conventional - wall, roof, and dormers | $3,331 | $4,998 | $1,765 | $10,094 | |
| SIPs - wall, roof, and dormers | $1,372 | $2,816 | $1,735 | $5,923 | -41% |

| | Column A | | Column C | Column D |
|---|---|---|---|---|
| Application | Electrical Labor Cost | | Subtotal Cost | Delta % for Column C |
| Conventional - Electrical rough-in | $979 | | $979 | |
| SIPs - Electrical rough-in | $870 | | $870 | -11% |

Note: For Delta % by using Conventional time as denominator

(Exhibit C1.1)

Figure 5: Chart for Installed Cost Comparison (Dollars)




(Exhibit C1.2)

## Figure 6: CostWorks Estimate Analysis

***For Stick Built -Walls, Roof, and Dormers***

***Stick Built Walls***

| Qty | CSI Number | Description | L.H./unit | Unit | Bare Labor Total | Total Incl. O&P |
|---|---|---|---|---|---|---|
| 248.000 | 06 11 1040 5246 | Wood framing, walls, studs, | 0.016 | L.F. | $96.72 | |
| 968.000 | 06 11 1040 5167 | Wood framing, walls, studs, 2" x | 0.013 | L.F. | $319.44 | |
| 112.000 | 06 11 1040 5646 | Wood framing, walls, studs, 2" x | 0.024 | L.F. | $67.20 | |
| 92.000 | 06 11 1040 5726 | Wood framing, walls, studs, | 0.026 | L.F. | $58.88 | |
| 290.000 | 06 11 1032 4052 | Wood framing, sills, 2" x 6" | 0.029 | L.F. | $208.80 | |
| 146.000 | 06 11 1040 5045 | Wood framing, walls, plates, | 0.018 | L.F. | $64.24 | |
| 102.000 | 06 11 1040 2007 | Wood framing, walls, headers | 0.037 | L.F. | $93.84 | |
| 122.000 | 06 11 1032 4052 | Wood framing, sills, 2" x 6" | 0.029 | L.F. | $87.84 | |
| 1,600.000 | 06 16 3610 0603 | Sheathing, plywood on walls, | 0.014 | S.F. | $560.00 | |
| 1,440.000 | 07 21 1620 0141 | Wall or Ceiling Insulation, Non-Rigid, fiberglass, kraft faced, batts or blankets, 6" thick, R19, 11" wide | 0.006 | S.F. | $216.00 | |
| | | **SubTotal** | | | $1,772.96 | $3,028 |
| | | **Waste Allowance (10%)** | | | $177.30 | $303 |
| | | **Total** | | | $1,950.26 | **$3,331** |

***Stick Built Roof***

| | | | | | | |
|---|---|---|---|---|---|---|
| 1,728.000 | 06 16 3610 0202 | Sheathing, plywood on roof, CDX, 5/8" thick | 0.012 | S.F. | $535.68 | |
| 1,298.000 | 06 11 1030 5141 | Wood framing, roofs, rafters, on steep roofs, to 4 in 12 pitch, 2" x 10" | 0.032 | L.F. | $1,038.40 | |
| 1,728.000 | 07 21 1620 0201 | Wall or Ceiling Insulation, Non-Rigid, fiberglass, kraft faced, batts or blankets, 9" thick, R30, 15" wide | 0.006 | S.F. | $259.20 | |
| 44.000 | 06 11 1030 5901 | Wood framing, roofs, ridge boards, #2 or better, 2" x 10" | 0.04 | L.F. | $44.00 | |
| 1,800.000 | 06 11 1042 0857 | Furring, wood, on ceilings, 1" x | 0.018 | L.F. | $792.00 | |
| | | **SubTotal** | | | $2,669.28 | $4,544 |
| | | **Waste Allowance (10%)** | | | $266.93 | $454 |
| | | **Total** | | | $2,936.21 | **$4,998** |

***Stick Built Dormers***

| | | | | | | |
|---|---|---|---|---|---|---|
| 403.000 | 06 11 1030 5161 | Wood framing, roofs, rafters, on | 0.038 | L.F. | $378.82 | |
| 403.000 | 07 21 1620 0201 | Wall or Ceiling Insulation, Non-Rigid, fiberglass, kraft faced, batts or blankets, 9" thick, R30, 15" wide | 0.006 | S.F. | $60.45 | |
| 256.000 | 06 11 1040 5726 | Wood framing, walls, studs, installed on second story, 3" x 4", 3' high wall, pneumatic nailed | 0.026 | L.F. | $163.84 | |
| 28.000 | 06 11 1040 2007 | Wood framing, walls, headers over openings, 2" x 6", pneumatic nailed | 0.037 | L.F. | $25.76 | |
| 28.000 | 06 11 1032 4052 | Wood framing, sills, 2" x 6" | 0.029 | L.F. | $20.16 | |

(Exhibit CW1.1)

*(continued)*

Figure 6: CostWorks Estimate Analysis *(continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| 256.000 | 06 16 3610 0603 | Sheathing, plywood on walls, CDX, 1/2" thick | 0.014 | S.F. | $89.60 | |
| 384.000 | 07 21 1620 0201 | Wall or Ceiling Insulation, Non-Rigid, fiberglass, kraft faced, batts or blankets, 9" thick, R30, 15" wide | 0.006 | S.F. | $57.60 | |
| 222.000 | 07 21 1620 0141 | Wall or Ceiling Insulation, Non-Rigid, fiberglass, kraft faced, batts or blankets, 6" thick, R19, 11" wide | 0.006 | S.F. | $33.30 | |
| 384.000 | 06 16 3610 0202 | Sheathing, plywood on roof, CDX, 5/8" thick | 0.012 | S.F. | $119.04 | |
| | | **SubTotal** | | | $948.57 | $1,605 |
| | | **Waste Allowance (10%)** | | | $94.86 | $160 |
| | | **Total** | | | $1,043.43 | **$1,765** |
| | | **Total** | | | $5,929.89 | **$10,094** |

(Exhibit CW1.1)

## Figure 6: CostWorks Estimate Analysis

***For Electrical***

| Qty | CSI Number | Description | Crew | L.H./Unit | Unit | Labor Hours | Bare Labor Total | Total Incl. O&P |
|---|---|---|---|---|---|---|---|---|
| 4.000 | 26 05 9010 4300 | Receptacle devices, resi, decorator style, GFI, type NM cable, 15 amp, incl box & cover plate | 1 Elec | 0.65 | Ea. | 2.60 | 73.20 | |
| 6.000 | 26 05 9010 2110 | Switch devices, resi, single pole, ivory, type NM (Romex) cable, 15 amp, incl box & cover plate | 1 Elec | 0.468 | Ea. | 2.81 | 78.90 | |
| 21.000 | 26 05 9010 4100 | Receptacle devices, resi, duplex outlet, ivory, w/#12/2, type NM cable, 20 amp, incl box & cover plate | 1 Elec | 0.65 | Ea. | 13.65 | 384.30 | |
| 1.000 | 26 05 9010 2150 | Switch devices, resi, 3-way, #14/3, type NM cable, incl box & cover plate | 1 Elec | 0.55 | Ea. | 0.55 | 15.50 | |
| 3.000 | 26 51 1370 2000 | Incandescent fixture, residential, exterior lantern, wall mounted, 60 watt | 1 Elec | 0.5 | Ea. | 1.50 | 42.30 | |
| | | **Totals** | | | | **21.11** | **$594.20** | **$979.00** |
| | | | | **Rate** | | | $ 28.15 | |
| | | | | **Rate w/ O&P** | | | $ 46.38 | |

(Exhibit CW1.2)

**Reed Construction Data**
**RSMeans**
**63 Smiths Lane**
**Kingston, MA 02364**
**1-800-334-3509**