Cost, Schedule and Coordination Analysis

Cost, Schedule and Coordination Analysis:

Cost Assumptions

The pricing of the structure was completed using several methods in order to best apply available information to each system. Only the structural systems of each option were considered in the cost estimate and included several assumptions. Materials included in the estimate include all gravity framing members, (beams, girders, columns, deck, double-tees, etc.) all lateral members, (frames or shear walls) foundation retaining walls, footings, and roof framing. Pricing for non-structural items are not included, as well as for many items which are left unchanged. Specific connection prices are not included; these would increase the cost of the structure, but do not exhibit an extreme difference in price between the systems.

Comparison of Costs

The original steel system cost was estimated using ICE 2000. All included materials are entered as drawn in provided structural design documents in the unit of measure required. The values of this system may be seen below:

Original Steel Structure Pricing	
note: Member prices include installation costs	
Values as reported from ICE, available in Appendix	
Material	**Total Price**
Masonry	
Mortar	$45,217.29
Block / Reinforcement	$235,343.74
Waterproofing	$11,843.88
Metals	
Structural Steel	$442,378.16
Metal Deck	$115,291.44
Fireproofing	$1,828,686.62
Concrete	
Slab on Deck	$157,673.32
Foundations	
Concrete	$31,491.99
Formwork	$22,406.77
Slab On Grade	
Concrete / Installation	$55,733.42
Roof	
Wood Trusses	$55,050.88
Wood Sheathing	$25,303.73
Accessories	$7,262.45
Total:	**$3,033,683.69**

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Boyds Bear Country
Pigeon Forge, TN

The pre-cast concrete redesign was priced using specific piece costs for all pre-cast as provided by a sample supplier, High Concrete Structures. These costs are specified per member and additional costs are included for installation. This installation value is reduced for rural conditions as the site for Boyds Bear Country is expansive and allows for a great deal of on site storage. It is also estimated that each piece will be picked twice as they may all be stored on site for ease of shipping. Foundation costs are scaled by volume as previously determined, in this case approximately a 15% increase. No changes are made to the original roof framing system. The values of the system may be seen below.

Pre-Cast Concrete Structure Pricing				
note: Member prices do not include crane installation costs				
Member	**Measurement**	**Quantity**	**Unit Price**	**Total Price**
Double Tees				
15DT34-128S	45 ft	35	$5,457.00	$190,995.00
15DT34-168S	45 ft	33	$5,500.00	$181,500.00
15DT34-208S	60 ft	22	$6,931.82	$152,500.04
15DT34-248S	60 ft	16	$7,000.00	$112,000.00
Girders				
12LB36-118S	30 ft	32	$5,881.00	$188,192.00
24IT36-228S	30 ft	30	$5,250.00	$157,500.00
Columns				
18"x18" CHE	36 ft	32	$7,560.00	$241,920.00
24"x24" CHI	72 ft	14	$15,120.00	$211,680.00
Installation Costs				
Rural Location	Picks/Pc	Quantity		
Open Storage	2	214	$1,200.00	$513,600.00
Shearwalls				
30'x14" Panels	18.75 cwt	32	$59.69	$35,814.00
Foundation Walls				
Concrete	27.16 cuyd	16	$79.59	$34,586.63
Steel	352 cwt	1	$59.71	$21,017.92
Formwork	17360 sf	1	$11.73	$203,632.80
Foundations				
Concrete				$36,215.79
Formwork				$22,406.77
Slab On Grade				
Concrete / Installation				$55,733.42
Roof				
Wood Trusses				$55,050.88
Wood Sheathing				$25,303.73
Accessories				$7,262.45
Total:				**$2,244,938.39**

The engineered wood redesign was priced using a combination of RS Means 2002, ICE 2000, and manufacturer supplied cost information. These costs are specified in various units of measure, and input values of each member or material type is adjusted accordingly. All prices include the expenses of installation. Foundation costs are scaled by volume as previously determined, in this case approximately a 25% decrease. No changes are made to the original roof framing system. The values of the system may be seen below.

Wooden Structure Pricing				
note: Member prices include installation costs				
Member	**Measurement**	**Quantity**	**Unit Price**	**Total Price**
Floor Plank				
2"x6" T and G	160.1 MBF	1	$2,450.00	$392,245.00
Tubular Steel Trusses				
30" TJM	66000 sf	1	$4.10	$270,600.00
30" TJH	21600 sf	1	$4.32	$93,312.00
Girders				
10.5"x22" PSL	22.5 ft	24	$41.25	$22,275.00
10.5"x28" PSL	22.5 ft	103	$56.88	$131,819.40
Columns				
7" x 7"	8 ft	53	$14.20	$6,020.80
12" x 12"	17.7 ft	53	$38.32	$35,947.99
14" x 14"	17.7 ft	34	$55.00	$33,099.00
16" x 16"	17.7 ft	36	$71.84	$45,776.45
18" x 18"	17.7 ft	28	$90.92	$45,059.95
20" x 20"	17.7 ft	30	$112.25	$59,604.75
Shearwalls				
30'x12" Panels	16.07 cwt	16	$59.69	$15,347.49
20'x12" Panels	13.45 cwt	16	$59.69	$12,845.29
Foundation Walls				
Concrete	27.16 cuyd	16	$79.59	$34,586.63
Steel	352 cwt	1	$59.71	$21,017.92
Formwork	17360 sf	1	$11.73	$203,632.80
Foundations				
Concrete				$23,618.99
Formwork				$22,406.77
Slab On Grade				
Concrete / Installation				$55,733.42
Roof				
Wood Trusses				$55,050.88
Wood Sheathing				$25,303.73
Accessories				$7,262.45
Total:				**$1,612,566.71**

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Boyds Bear Country
Pigeon Forge, TN

In comparing the three system prices, a great deal of savings can be seen in the two new systems. The pre-cast concrete system shows a savings of over $78,800, while the engineered wood system shows a savings of over $1,420,000. The substitution of concrete for masonry block in the retaining / foundation walls of the structure exhibits a savings of more than $33,000, included in the price difference above.

Schedule Assumptions

Making any comparison of schedules between a new method of construction and the original is difficult due to extraneous site conditions. The original construction schedule of the building was set to run from November 2004 to April 2005, a 6 month time period. In reality the construction process lasted into July 2005, adding an extra 3 months, or 50% to the planned schedule.

In reviewing conference notes from the duration of the construction, only 8 days are noted to be lost due to weather conditions. A large portion of time was included in the coordination of trades, during which one set of contractors were delayed by the work of another, or in the worst case scenario, the work of some contractors was inadvertently destroyed by others. Because of these issues, among others, it becomes difficult to create an accurate set of schedules for the project.

Comparisons of Schedules

Several general comparisons may be made amongst the systems. In general the pre-cast concrete members themselves will be able to be more quickly installed. The number of pieces which must be placed and connected is decreased dramatically. Every piece of pre-cast concrete installed replaces approximately two pieces of steel. This simple piece count difference creates a savings in both crane use and connection time. The connections of members in the re-cast system are generally completed with simple welds or grouting; the concrete used to cover these connections is already used on site in foundation work. These connection differences are likely to also reduce construction time, eliminating the need for bolting and shear stud installation.

The engineered wood members are more numerous than the concrete members used in the original structure; however the installation techniques are simpler. Instead of requiring an experienced crew to relocate to the site to complete steel construction, local contractors may be used to complete construction. These local contractors are more likely to be able to adapt to the requirements of local weather and site conditions, thus reducing the potential for lost time.

On of the largest time saving factors in both redesign options is in the replacement of all masonry work with either cast-in-place or pre-cast concrete. The installation and construction of these can be completed much more quickly, especially once including the considerations of the height of these items. The labor required to install a short concrete wall and an high concrete wall are fairly similar, where in the case of installing masonry, a 17 foot high wall requires a great deal of labor.

Overall, both systems show a general decrease in construction time; however specific site and contractor conditions have a great impact on the actual construction of the building. A schedule representing the time actually spent on the construction of the structure of Boyds Bear Country is located in the appendix.

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Analysis of Coordination Issues

In the original construction is complicated by the number of materials used in the building. Completing the construction of a building becomes more complicated with the use of numerous materials. This requires the attainment and coordination of many contractors. With the addition of each contractor and each supplier, the required amount of coordination and the potential for error increases.

The breakdown of included materials in the original steel building is large and can be listed as follows:

Steel
- Hot rolled structural members
- Metal decking
- Shear studs
- Bolted / welded connections
- Light gauge steel framing

Concrete
- Cast-in-place elevated slabs
- Lightweight cast-in-place elevated slabs
- Cast-in-place slab on grade
- Shallow foundations

Masonry
- Normal CMU block
- Ivany (high strength) CMU block
- Structural Piers

Wood
- Manufactured trusses
- Timbers

Variety of Finish Materials
- Gypsum board
- Plywood, etc….

The breakdown of included materials in the pre-cast building can be listed as follows:

Steel
- Welded member connections
- Light gauge steel framing

Concrete
- Pre-cast concrete members
- Member toppings
- Cast-in-place retaining / foundation walls
- Cast-in-place slab on grade
- Shallow foundations

Wood
- Manufactured trusses
- Timbers

Variety of Finish Materials
- Gypsum board
- Plywood, etc….

The breakdown of included materials in the wooden structure can be listed as follows:

Steel
- Member connections

Concrete
- Pre-cast concrete shear walls
- Cast-in-place retaining / foundation walls
- Cast-in-place slab on grade
- Shallow foundations

Wood
- Manufactured floor trusses
- Laminated structural members
- Floor planks
- Manufactured roof trusses
- Stud wall framing

Variety of Finish Materials
- Gypsum board
- Plywood, etc….

By switching the structural system to either of these options, the amount of materials and contractors can be decreased. In accomplishing this goal, the likelihood of problems during construction decreases. A schedule may be clearer with fewer subcontractors required to be on site at varying times. If fewer materials are involved, there is a decreased opportunity for a clash between material interface and contractors. Overall, both of these systems decrease the required amount of work to be completed on site, and the number of subcontractors required in coordination.