Optimization of Bill of Quantities for Construction of Pre-Engineered Buildings

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Abstract- Steel construction is considered as a process that involves many related activities. Pre-Engineered buildings steel parts are required to be installed in a specific order due to structural safety requirements and to the logical sequence of erection. Garnet shop is being constructed for the sand blasting of bogies. Sand blasting is a process for removing corrosion in iron before painting. In Paint shop painting work in trains after blasting has been done. After painting of bogies wheels will be attached in trains in this building. Bogie shop is the biggest building of the project. It is meant for attachment of shells and shaping it into bogie and after that attachment of bogies into each other of the train. In this shop machines and tools will be fitted in trains Shell store is constructed for the storage of shells brought here from other factories like Kapurthala. Shell means the cover part of the bogies. Transport shop is constructed for transportation purpose after complete finishing of the train. Transporting engine will come here and it will carry out the all new train from the rail coach factory.
Key words: BOQ, Pre-Engineered Building, Rate Analysis.

I. INTRODUCTION

Pre–engineered steel buildings use a combination of built-up sections, hot rolled sections and cold formed elements which provide the basic steel frame work with a choice of single skin sheeting with added insulation or insulated sandwich panels for roofing and wall cladding. The concept is designed to provide a complete building envelope system which is air tight, energy efficient, optimum in weight and cost and, above all, designed to fit user requirement like a well fitted glove. These Pre–engineered Steel Buildings can be fitted with different structural accessories including mezzanine floors, canopies, fascias, interior partitions, crane systems etc. The building is made water-tight by use of special mastic beads, filler strips and trims. This is a very versatile building system and can be finished internally to serve any required function and accessorized externally to achieve attractive and distinctive architectural styles. It is most suitable for any low-rise building and offers numerous.

It is very advantageous over the conventional buildings and is really useful in case of the low rise buildings. Pre-engineered buildings are generally low rise buildings; however the maximum eave heights can go up to 25 to 30 meters.

Low rise buildings are ideal for offices, houses, showrooms, shop fronts etc. The application of pre-engineered concept to low rise buildings is very economical and speedy. Buildings can be constructed in less than half the normal time especially when complimented with other engineeredsubsystems. Good structural design of the building necessitates integration of the structure into a whole physical system. It is necessary to understand the influence of structural design on the architectural design and also vice versa for the development of the subsystems for power, lighting, thermal control, ventilation, water supply, waste handling, firefighting etc. The steel structural systems have come out more popular largely because of their ability to provide flexibility in accommodating these subsystems in the building.

II. REVIEW OF LITERATURE

Banwell (1964), BOQs where primarily devised for tendering allied purpose. He however contended that it should not be there only function. According to him, BOQ could be used for purposes including costing, bonusing, ordering, programming and control. The conventional format of the BOQ was considered by Banwell to be inadequate for such purposes. He however did not propose and alternative.

Nelson (1970), also criticized the BOQ as being inadequate to provide the site management team with the information it needs. According to him, site management team spend a lot of their time seeking information from numerous sources and recalculating dimensions and quantities into units which are required on site. He further criticized the BOQ for lack of coordinated information, aggregation of quantities on a 'similar material' rather than on a operational basis and the measurement of quantities in units which need conversion before they can be used.

Skinner (1979), investigated contractor's use of the BOQ and the utility derived from the information contained in a BOQ during the construction phase. A detailed investigation was conducted into the usefulness of the BOQ using their parameters of bill format, adequacy of information presented and independence in terms of any need to seek additional information to supplement that presented in the bill.

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Kodikera et. al . (1993), investigated the extent of usage of the BOQ for post contract work in building contractors organizations. Using eight case studies, they concluded that the average extent of use of the BOQ for post-contract work was found to be50%.According to them, this 50% of the BOQ requires some form of re-working which needs to be reduced if improved post-contract use of estimating data is to be achieved. They further concluded that information stored in the BOQ should be arranged in a directly usable way and that the key element of the BOQ information that need to be presented in a more meaningful format if the amount of re-work is to be reduced.

Brook (2008), the BOQ has two primary uses. One is at the pre-contract stage where it assists the contractors in the formulation of their tenders. The other is at the post contract stage where the BOQ assists contractors and quantity surveyors in the valuing of progress payment and variations among others. For more than 40 years, a lot of work had been done to examine the suitability of the BOQ in these two key phases of construction.

III. MATERIAL AND METHODS

Pre-engineered steel buildings are those which are fully fabricated in the factory after designing, shipped to site in CKD condition; and all components are assembled and erected at site with nut-bolts, thereby reducing the time of completion.

Pre-engineered means, generally speaking, is any part of a structure that is manufactured prior to arrival on the building site. The concept of the pre-engineered building (PEB) is one where the fabrication is completed in a controlled environment with the latest technology, and then subsequent erection is carried out.

Though initially only off the shelf products were available in these configuration aided by the technological development tailor made solutions are also made using this technology in very short durations.

The designs were ready-made but the building components were either ready-made or 'pre-engineered' into standard sizes, spans, bays and heights, and use standard details for fixing cladding, roofing, gutters, flashing, window, doors etc taking advantage of industrial practices of mass productions of components economically.

A healthy trend in the form of growth in demand for construction works in residential, Commercial, Institutional industrial and infrastructure sectors are being seen over the past decade. Modern structure are much more complex and sophisticated as compared to earlier period. One of the major changes which are being felt by all is that the present structure are taller and thinner.

The benefits may be summarized as under:

- Increased speed of construction, quicker return on investment
- Ensured quality of material, Design and construction
- Unlimited architectural possibilities
- Easy construction, maintenance and refurbishing
- Increased life cycle performance and cost competitiveness
- Environment-friendly structures
- Better value for money
- Sustainability in construction through reuse of most materials

- Suitability for Hilly regions and other geographical difficult areas
- Optimized design of steel reducing weight
- Better Earthquake & wind pressure resistant
- Energy efficient roof and wall system using insulation
- Easy integration of all construction materials
- The building can be dismantled and relocated easily
- Future extensions, expansion modification can be easily accommodated without much hassle.
- Virtually maintenance free
- Single-source responsibility
- System approach' ensures integrity and safety of all building components
- Lighter weight; savings in foundation cost of 10-20 percent
- Insulated from sound and heat, as per the requirement
- Better rainwater harvesting through gutters and down-take arrangements
- Overall economy

Main Components

There are following major components in a pre-engineered building:
- Primary or Main frame
- Gable End framing or wind columns
- Secondary frame or Purlins, girts etc.
- Roof & Wall sheeting
- Bracing system
- Crane system

Rate Analysis

➢ Analysis of rates has been taken from CPWD, Delhi (Vol. I) 2012.

Analysis of rate for steel member:

- Unit- kg
- A> Material
- a> R.S section 1.05 @ 60 = 63 Rs.
- b> Fitness L.S = 5 Rs.
- c> Labour/fabrication L.S = 10 Rs.
- d> T&P L.S = 5 Rs.
- Total (a+b+c+d) = 83 Rs.
- Add CPOH 17.5% = 14.52 Rs.
- Total = 97.52 Rs.
- Say = 98 Rs.

Analysis of rate for puf panel roof sheet

- Unit- sqm
- A> Material
- a> Puf panel roof sheet 1.05 @ 1300 = 1365 Rs.
- b> Fitness L.S = 5 Rs.
- c> Labour/fabrication L.S = 10 Rs.
- d> T&P L.S = 5 Rs.
- Total (a+b+c+d) = 1385 Rs.
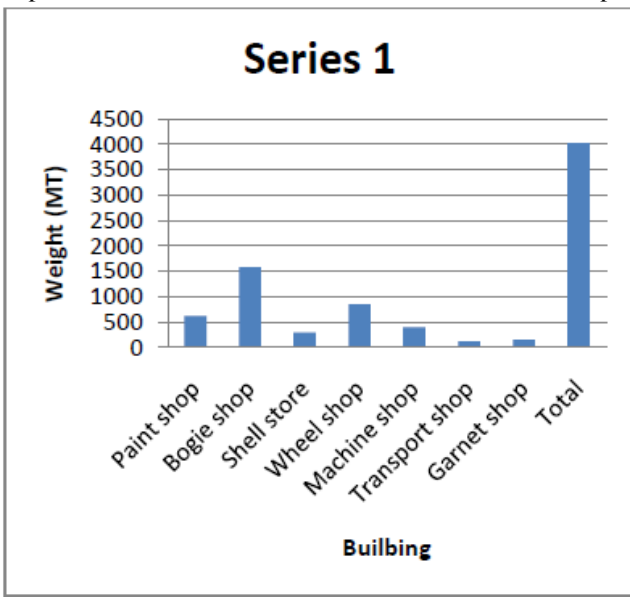- Add CPOH 17.5% = 243 Rs.
- Total = 1628 Rs.

Analysis of rate for polycarbonate sheet

- Unit – sqm
- A> Material
- a> Polycarbonate sheet 1.05 @ 1100 = 1155 Rs.
- b> Fitness L.S = 5 Rs.
- c> Labour/fabrication L.S = 10 Rs.
- d> T&P L.S = 5 Rs.
- Total (a+b+c+d) = 1177 Rs.
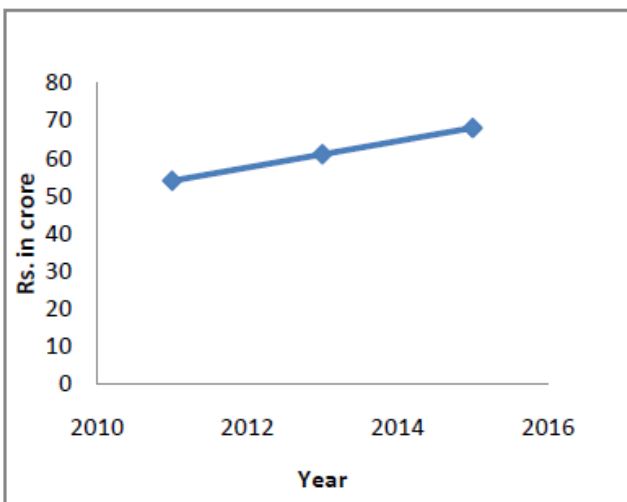- Add CPOH 17.5% = 206 Rs.
- Total = 1383 Rs.

IV. RESULT AND DISCUSSION

Following result come after completion of project.

Graph 1 show how much material is used in different shops

Graph 2 Variation in cost for PEB

removing corrosion in iron before painting. Material required for construction of this shop 147.977MT.

2. Paint shop- It is meant for painting work in trains after blasting has been done. Material required for construction of this shop 618.680MT.

3. Wheel shop- After painting of bogies wheels will be attached in trains in this building. Material required for construction of this shop 852.62MT.

4. Bogie shop- This is the biggest building of the project. It is meant for attachment of shells and shaping it into bogie and after that attachment of bogies into each other of the train. Material required for construction of this shop 1580.61MT.

5. Machine shop- In this shop machines and tools will be fitted in trains. Material required for construction of this shop 399.872MT.

6. Shell store- As the name indicating, it is being constructed for the storage of shells brought here from other factories like Kapurthala. Shell means the cover part of the bogies. Material required for construction of this shop 296.834MT.

7. Transport shop- This building is being constructed for transportation purpose after complete finishing of the train. Transporting engine will come here and it will carry out the all new train from the rail coach factory. Material required for construction of this shop 128.275MT.

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V. CONCLUSION

In this section conclusions are drawn from the discussion and given for further work to deepen the knowledge within the field of bill of quantities for construction of pre-engineered buildings.

1. Garnet shop-This building is being constructed for the sand blasting of bogies. Sand blasting is a process for