HTETCO a Pre-Engineered Metal Building (PEMB) Using RSMeans

TABLE OF CONTENTS
Section 1: Introduction
Section 2: Types and Methods of Measurements
Section 3: Factors that may Affect Take-Off and Pricing
Section 4: Labor, Material, Equipment, Indirect Costs
Section 5: Special Risk Considerations
Section 6: Ratios and Analysis
Section 7: Miscellaneous Information
Section 8: Sample Sketch
Section 9: Sample Estimate
Section 10: Glossary / Terminology
Section 11: References
SECTION 1: INTRODUCTION

Description
This paper is written to detail the process of performing an estimate of a pre-engineered metal building (PEMB) using RSMeans Online Data costing software. Although these structures are used in many locations, the installation location will affect the design criteria and ultimately the overall cost. This paper will focus on a PEMB being erected in the continental United States.

A PEMB may look similar to a conventional steel structure however unlike the conventional system, the PEMB is designed by a metal building supplier utilizing computer based design software. Ultimately this software allows for less steel being utilized, thus lowering costs. PEMB’s have many advantages over the conventional steel structure, the largest being reduced costs and shortened design duration along with a shortened construction schedule. The main parts of a metal building start with the primary framing system which includes the columns and beams. This is followed up with the secondary framing system which include the wall girts and roof purlins. Exterior walls and roof surfaces include metal panels systems. In addition to these, there are many options that may or may not be included. For example, the building may include soffits, closure and trim pieces, gutters and downspouts, thermal insulation, skylights, windows, doors, roof hatch and access ladder, and many other items. Exterior panels may be upgraded to include integrated insulation. For this paper, a base estimate will be illustrated along with the parameters utilized. Options will be delineated and included in the estimate.

SECTION 2: TYPES AND METHODS OF MEASUREMENTS

In order to get a complete estimate utilizing the RSMeans software, the estimator will need to quantify the following list of items:

Overall Floor Area (interior) in SF, Eave Height in Feet, and Number of Spans and Span Distance in Feet
RSMeans provides square foot pricing for the basic PEMB based on the three criteria listed above. Typically the architectural floor plan will include the dimensions needed to calculate the overall square footage of the building area. It may be as simple as taking the length of the building from exterior corner to exterior corner and multiplying by the width of the building in the same manner. The eave height is the vertical distance between the floor level and the intersection of the top edge of the exterior wall and the horizontal roof line. This dimension can be found on an exterior wall section of the architectural plans. Depending on the use of the building the end user may want a clear span structure. It would not be pragmatic for an aircraft hangar housing multimillion dollar aircraft to have interior columns within the interior of the structure. Note that depending on the desired clear span, the cost of a clear span building can be excessive due to the increased sizes of the primary steel components necessary to carry the structural load across the span. In contrast, it may be acceptable to have interior columns in a warehouse structure where the design can accommodate interior columns. Once the above criteria have been identified, you simply match the criteria to the applicable RS Means line item for the square foot pricing and multiply this times the total building floor area.

Eave and Rake Length in LF
The eave is the horizontal edge of the roof and the rake is the edge of the roof that is on a slope. Both dimensions can be measured off the architectural roof plans. When measuring these lengths, also make note of the length of roof overhang. These lengths will be needed to calculate and price any desired trim pieces, gutters and soffits.

Individually Counted Items
Several items will need to be individually counted including, entrance canopies, doors, windows, skylights and downspouts. When counting these items one must delineate the different sizes.
SECTION 3: PROJECT SPECIFIC FACTORS TO CONSIDER IN TAKE OFF AND PRICING

Geographical Location

Where the project structure is being built will have many effects on the subsequent cost. Different regions have unique conditions that will alter the actual design of the metal building. For example, areas subject to hurricanes will need to be designed to withstand designated wind speeds and pressures based on regional criteria. Other geographic areas may be subject to seismic activity which will also have an effect on the design of the structure. Proximity to coastal salt environments will have an impact on the materials that will need to be specified. The closer to the ocean, the more likely the standard materials included in a basic PEMB will suffer corrosion and need to be replaced more readily than in an inland environment. There are upgrades available that include painted aluminum core roofing panels in lieu the standard zinc-aluminum coated steel, however they will more than double the cost of the roof. Also, any exposed fastener will need to be stainless steel, again adding more costs. If the building is being erected in a location subject to snow, this will increase the design loads which in turn increase the steel member sizes and ultimately increase the cost. In addition to material cost increases, location also has an effect on labor costs. Larger more populated areas with higher costs of living like Chicago or San Francisco will have much higher labor rates than Harrison (Arkansas). According to RSMeans Reference Items, San Francisco is 158.5% higher than the national average, while Harrison is 58.9% lower than the national average. The larger metropolitan areas are also more likely to be subject to union participation which also increases the labor rates.

Seasonal Effect

The time of the year the structure will be erected may play an important role in the overall cost. In certain areas of the country, there may be a defined rainy season which will likely slow down productivity and increase labor costs. Areas subject to heavy snowfall will also affect the productivity. If the inclement conditions are extreme during certain seasons, crews may only be able to work during the less extreme times, thus making these times a premium and subsequently increasing labor costs.

Building Size and Shape

When considering a new building, both the shape and size will impact the cost. A square structure is the most economical shape due to the fact that it minimizes the amount of exterior wall area per square foot of floor area. For example, a 100 foot by 100 foot structure with a 10 foot high exterior wall has 10,000 sf of floor area and 4,000 sf of wall area. In contrast, a 50 foot by 200 foot structure of the same height still calculates to 10,000 sf of floor area however the wall area increases to 5,000 sf. Similarly, the overall size also has an effect on the cost. For example, comparing the same 100 foot structure above to a 50 foot by 50 foot structure yields similar results. The 50 foot structure at 2,500SF has 25% of the floor area of the 100 foot structure, yet has 50% of the wall area or 2000 sf. Also, irregular shapes historically lower efficiencies in both production and erection of the building. The roof on a standard PEMB is typically around 1 in 12 and is considered of the low slope type. As the slope increases, so does the cost.

Special Circumstances

Other considerations due to special circumstances or conditions need to be considered. For example, when working for an airports, depending on whether the project falls within the Federal Aviation Administration (FAA) airside area, there may be additional requirements due to security which will cause an increase in labor costs. The same may be true when working in the public sector, specifically the federal government. There are several labor acts that must be followed when working for the federal government which dictate minimum wage rates paid to employees that are going to be working on the project. Generally these are higher than what the typical employee may be getting paid and thus must be considered when putting together an estimate.

SECTION 4: OVERVIEW OF LABOR, MATERIAL, EQUIPMENT, INDIRECT COSTS AND MARKUPS

APPROACH AND APPROACH TO MARKUPS

For direct costs, as a general rule of thumb, material equates to 50% of the total bare cost, while labor equals 30% and the remaining 20% is for equipment. Typically the range for indirect costs is between 20% and 30% in addition to the bare or direct costs.

Labor Costs

The labor required for installation of a PEMB typically is dependent on the size of the building and the desired construction duration. A typical crew for an average size metal building would include a foreman, 4 steel workers, and a lattice boom type crane with operator. The national average to erect a steel structure for a typical crew is 400 to 500 sf per day. Many factors can affect this production rate, notably eave height. Additional crews can be added if an expedited schedule is desired.

Material Costs

Since steel is a global commodity, material prices can vary on a daily basis and are influenced by numerous factors including, but not limited to natural disasters, strength of the US dollar, and general condition of the world economy.

Equipment Costs

Typical equipment, as indicated above, would include a lattice boom type crane. Additional equipment including some type of fork lift, may be needed for material offloading.

Indirect Costs

Direct costs include the above items, labor, material and equipment. Indirect costs are those costs that are not directly related to the construction of the physical building, however are necessary to incor-
Some of these costs include the subcontractor’s project site costs, partial home office costs, project related insurances, payment and performance Bonds, and profit.

**SECTION 5: SPECIAL RISK CONSIDERATIONS**

All construction projects will have associated risks. These risks can have significant costs associated with them should they actually materialize. The project schedule is typically set at the time of the estimate preparation. The estimator must understand the expected start date and duration of the metal building erection. The project may need the building complete by a certain date and additional costs may need to be included to cover expedited shipping and/or acceleration of the construction schedule. The estimator should thoroughly review and understand the plan notes and specifications. This is where you might find required options that will have associated costs that the estimator will need to include in the estimate. For example, a note may indicate the use of non-tapered or straight columns. A Typical PEMB column will taper; being larger at the base. This reduces the amount of steel and in turn the weight and cost of the column.

**SECTION 6: RATIOS AND ANALYSIS**

Historical cost data can be utilized to provide a check on the estimated cost. It is important to consider all the specific factors included above in Section 3 when comparing to a previously constructed building. Another important factor to consider when using historical data is the date of the data. Historically, construction costs have risen at the rate of 3% per year. Note this is an average and obviously can vary from year to year. Barring any other known special circumstance, one can use this a rule of thumb. If you are comparing to an estimate that was done in 2015, then you would need to add 3% per year for a total of 9% to more accurately represent today’s costs. All other things being equal, a 2015 estimated $250,000 PEMB in 2018 would cost $272,500, or 109% times the previous cost.

**SECTION 7: MISCELLANEOUS**

**Exclusions**

Sometimes plans will indicate that certain items need to be provided by the building manufacturer that a typical PEMB would not supply. For these instances, the estimator must clearly note that this specific item is not included in the estimate. Although some PEMB suppliers offer windows and doors, they are limited to what they offer and typically do not match the required specifications.

**Curved or Radius components**

Non-rectilinear components greatly increase costs and need to be confirmed that they can actually be provided by a PEMB manufacturer before an estimator can provide costs.

**SECTION 8: SAMPLE SKETCH**

The oblique sketch below illustrates the typical PEMB primary and secondary steel components.
The following is a floor plan for a maintenance shop (GSE) at Miami International Airport and is specified to be a pre-engineered metal building.

The following are exterior wall elevations and can be used to calculate the exterior siding. This would be needed if the specifications called for something other than standard 26 gauge painted metal panels.
This is the wall section along the plan west elevation. Note the top of steel elevation is at 18'-1" above finish floor. This dimension references the eave height.
The following plan sheet is the structural building foundation plan. This is a good plan to get your exterior dimensions and overall building area. In order to calculate the SF area, the estimator will typically convert the dimensions provided in feet and inches to feet only. The below west and east dimensions converted would be as follows: 1’3-3/4” (x2) to 1.3125’, 14’10” to 14.833’, 14’10-1/2” to 14.875’ which totals 32.33’. The north and south dimensions would be as follows: 1’9” to 1.75’, 16’7” to 16.583’, the 20’ (x2) remains 20’, 17’10” to 17.833 and 6” to .5 which totals 76.667’. The totals can now be multiplied to get the overall building area which is 32.33’ x 76.67’ or 2,479 SF, rounded. Although not easily determined on this plan, the bump out at the north elevation is not part of the metal building. This is apparent when looking at the above elevations.

SECTION 9: TAKE-OFF AND PRICING SHEETS

Note that when starting in RSMeans, there are several options that will affect the pricing. For this estimate, the following selections will be made, “New Construction”, “Open Shop” labor, and location “Miami, FL”.

Welcome to RSMeans Online!

RSMeans Online provides comprehensive, localized, and up-to-date construction costs to help you create reliable estimates in less time. Please set your Preferences now using the panel below. If you are satisfied with your Preferences, select any of the tabs above to continue.
The estimator will then navigate to the proper Sub-Division and code, Subdivision 13 34 19 Metal Building Systems. The building depicted above in the sketches will be used for this estimate. In order to select the proper line number, refer back to the necessary measurements. Note above on the structural foundation plan, there are no interior columns which indicates a clear span structure. The span distance is just over 32 feet, and the eave height is 18 feet.

This will provide the SF erected cost of the base building. The desired options must be added individually. For this estimate, selections will include three 3070 and two 10’ by 10’ framed openings for doors and two 3040 framed openings for windows. These quantities are referenced on the foundation plan and the elevations. Next, trim pieces will include rake, eave trim and gutter. As previously noted, the exterior dimensions are 32.33’ by 76.67’ and this yields an eave length of 154 LF, rounded up, and a rake length of 65 LF. Note the rake does slope and the actual distance would be slightly longer, however because the slope is very low, the amount is negligible. If the slope was greater, the length can easily be calculated using the formula $A^2 + B^2 = C^2$. The actual eave distance for this building would be the square root of $(32.33 \times 32.33) + (4.083 \times 4.083)$ or 32.6 LF rounded. Because of the slope, the actual distance is approximately 3 inches longer than the buildings horizontal dimension. The gutter is shown along the entire length of the building along with 5 downspouts.

The wall sections above show insulation is shown at both the exterior walls (R13) and the roof (R30) and will need to be added to the estimate. To calculate the wall insulation total, the openings will be deducted from the total. The following shows the items selected and the quantities inputted.
HTETCO a Pre-Engineered Metal Building (PEMB) Using RSMeans ... continued

By selecting the estimate action drop down list above and choosing report, the following estimate is prepared by the software. If preferred, the information can be exported to excel and customized.

SECTION 10: GLOSSARY / TERMINOLOGY

Roof Slope
Number of inches a roof rises vertically for every 12 inches it runs horizontally.

Rake
The sloping end lines of a roof.

Eave
The horizontal end lines of a roof

Lattice Boom Type Crane
The lattice boom is a type of boom or arm on a crane. On a lattice boom crane, this type of boom is raised and lowered by a series of guy wires that are powered mechanically.

SECTION 11: REFERENCES

RSMeans from The Gordian Group
30 Patewood Drive, Suite 350
Greenville, SC 29615