Life Cycle Assessment Report

Clear Lake Iowa Fire Station

June 14, 2010

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Executive Summary

The intent of this report is to provide the City of Clear Lake, Iowa with a Life Cycle Assessment (LCA) of a new 15,888 sq-ft Fire Station proposed to be located in the City of Clear Lake, Iowa on the corner of 2nd Ave North and North 8th Street. This assessment will allow the citizens of Clear Lake to make an informed decision regarding which building assemblies will best serve their needs throughout the life of the building. This LCA compared two building types, one that is designated as the "Baseline Building" which uses a masonry wall system assembly and the other that is designated as a Fabricated Engineered Structure (FES – Metal Building) that uses a metal roof and wall system assembly.

What is a life cycle assessment (LCA)?

Life Cycle Assessment (LCA) is a technique for compiling and evaluating the inputs and outputs and the potential environmental impacts of a building throughout its life cycle (ISO, 1997). Essentially, LCA is a procedure whereby the environmental burdens associated with the building are measured and evaluated by quantifying energy, raw material usage and environmental releases over its expected life-cycle. There are two international standards specifically related to the application of LCA:

ISO 14040:2006 Environmental Management – Life Cycle Assessment – Principles and Framework,
ISO 14044:2006 Environmental Management – Life Cycle Assessment – Requirements and Guidelines

These standards have been integrated into a software system tool call the Athena Impact Estimator, it is a software that takes the inventory data of the proposed building assemblies and applies the ISO standards and then generates reports that allow design teams to make quantitative decisions in a timely manner regarding the environmental impacts of the building over the entire life cycle of the building.

Procedure

The assemblies for the foundations, roofs, walls and floors were entered into the Impact Estimator and designated as the Clear Lake Fire Station - Masonry Wall System this is considered to be the "Baseline Building". A comparative project labeled Clear Lake Fire Station – Fabricated Engineered Structure (FES – Metal Building) was also entered into the Impact Estimator. These two types of buildings used the same foundation assemblies, floor plan, and site plan which are described in the drawings included in this report in Appendix A. These drawings also describe the walls for the baseline building. The difference between the Baseline Building and the FES – Metal Building is described below:

- The wall assembly for the Baseline Building was a brick exterior cladding followed by an air space, extruded polystyrene insulation, (minimum R 26), concrete masonry unit and either gypsum wall board or painted concrete masonry unit interior wall finish.
- The wall assembly for the FES – Metal Building was a 22 gage pre-finished metal wall panel supported by an engineered long span metal structural rigid frame with a minimum batt insulation of R25. It included a vapor barrier and 26 gage pre-finished metal liner panel or painted gypsum wall board as the interior wall finish.
- The roof assembly for the Baseline Building was a double tee concrete roof deck and a PVC roof membrane using tapered rigid insulation with a minimum R value of 35. The drawings indicate a steel open web joist system with steel decking and an EPDM roof membrane using tapered rigid insulation with a minimum R value of 35. A change to the type of roof system was made after the attached drawings were submitted, the current plan is to use a double tee concrete roof deck and PVC roof covering system after funding for the construction of the project occurs. The drawings will be revised during the next phase of the project.
- The roof assembly for the FES – Metal Building was a long span engineered structural support system with a 22 gage pre-finished standing seam metal roof panel, unfaced fiberglass insulation over purlins, one inch thermal block and faced fiberglass between purlines with minimum R value of 35.

Energy to operate the buildings using comparable building types in this location were estimated to be as follows:

Baseline Building: 177,000 Kwh electric consumption per year and 914,000,000 Btu Gas Consumption per year using ASHRAE 90.1 2004. This equates to an Energy Use Intensity of 53.6 BTU/sq-ft/yr

FES – Metal Building: 210,000 Kwh electric consumption per year and 990,000,000 Btu Gas Consumption per year using ASHRAE 90.1 2004. This equates to an Energy Use Intensity of 56.81 BTU/sq-ft/yr

After the building assemblies for each type of building, (except for interior wall assemblies, these were the same for both buildings), were entered into the Impact Estimator reports were generated. As output, the Impact Estimator produces a detailed life cycle inventory for an entered design. It also generates a set of summary impact indicators in graphical and tabular form based on US EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts.

The Impact Estimator determines the life expectancy of a building by evaluating the durability of the bill of the materials included in the assemblies for the respective building. A bill of materials was generated for each of the building types, these numbers take into account the durability of each of the materials used in the assemblies and automatically adds replacement materials for the years of life desired for the building. For example, exterior metal will deteriorate quicker than concrete so if a 100 year life expectancy is desired for a building then the amount of metal

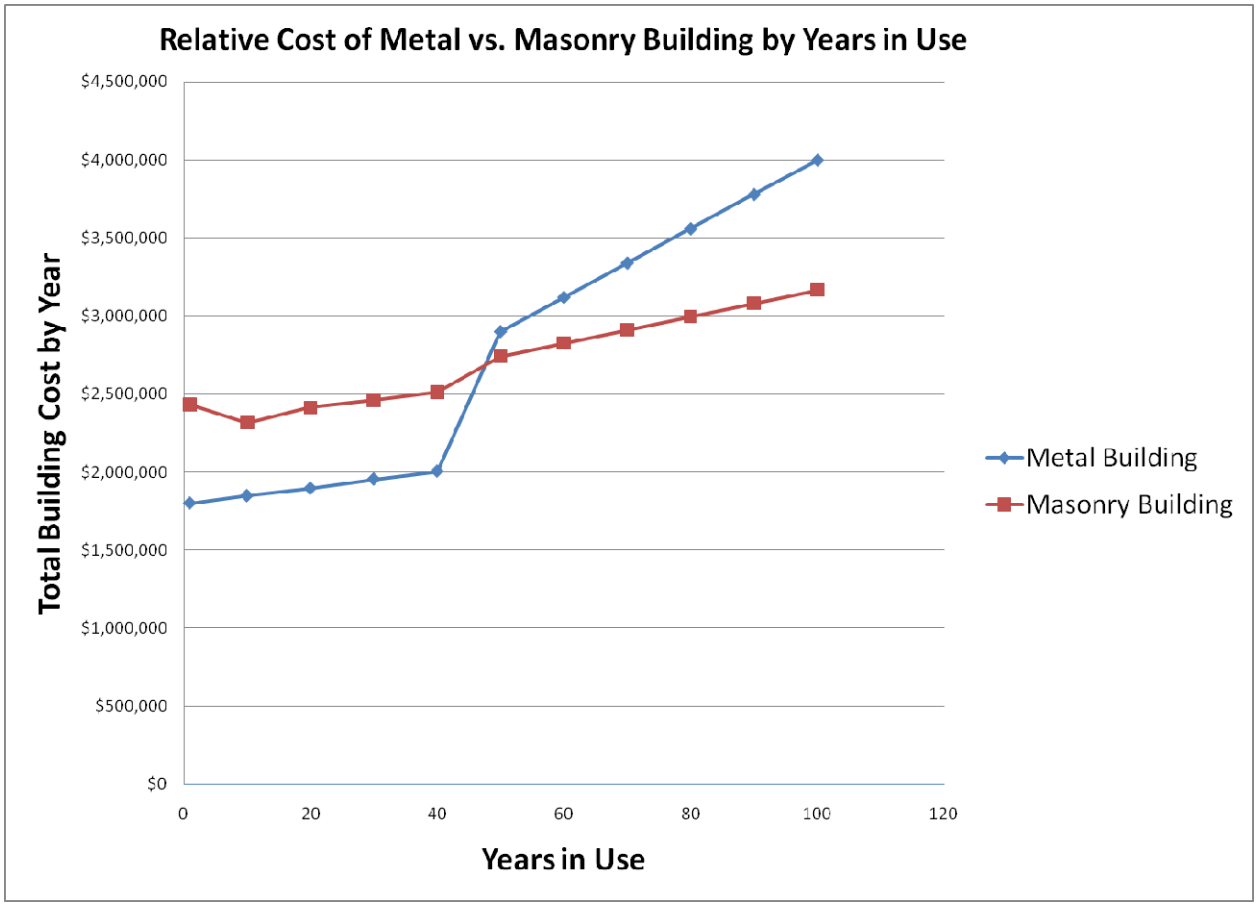
needed for the building will include replacement material for metal after it has deteriorated. This additional material is added to the bill of materials for the respective building type.

A bill of materials was generated for every 10 years for each of the respected buildings, a cost for each of the material was assigned and then a total construction cost estimate was calculated. The cost estimates used in the calculations assumed that inflation costs and investment costs were equal over the 100 years. It is likely that the investment value of the city's financial portfolio, due to their conservative investment opportunities, would not keep up with the cost of inflation, thus the estimate of cost assumptions is considered to be a conserve approach when evaluating the data.

Findings

Life Expectancy Comparison

The following graph represents the life cycle cost associated with sustaining a FSE – Metal Building for 100 years compared to the life cycle cost associated with sustaining a Base Building – Masonry Building for 100 years.



Appendix A

Drawings of Baseline Project