Fall 2013

# Life Cycle Assessment American Center, Rangoon, Myanmar

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## Introduction

This LCA looks at the cradle to grave operations of a building, quantifying the environmental impacts of the materials, production process, transportation, operating use, deconstruction, and disposal. There are several environmental categories that can be identified for evaluating global impacts including global warming, ozone depletion, eutrophication, acidification, smog formation, particulates, and fossil fuels. According to the International Organization for Standardization, there are four phases for performing LCA of a building: goal and scope definition, life cycle inventory (LCI), impact assessment and analysis of results. The goal and scope defines the intent of the LCA (cradle to gate, cradle to grave) and the limitations. The LCI is a data collection process that quantifies the materials being used and their energy inputs and outputs. The impact assessment looks at the LCI damage it may have on the environment.

## Methods

This LCA was conducted in Tally, in accordance with LEED and the life cycle assessments they reward points for. All of the data set comes from Tally. Materials were selected by YGH and input to Tally within Revit. The base LCA study was conducted on the American Center base Revit model provided by YGH. The building is two stories and 2400 m2. It has an information center, library, offices and conference room. The building is designed to teach children in Myanmar about the United States. The LCA data collected from this data was compared to the same building using a mixture of metal stud and concrete with wall assembly types constructed of only wood and only concrete. The environmental impact categories calculated in the life cycle assessment of the American Center were global warming potential and primary energy demand. The research focused on these two LCA categories in particular and focused further on the wall assemblies and how they impacted both
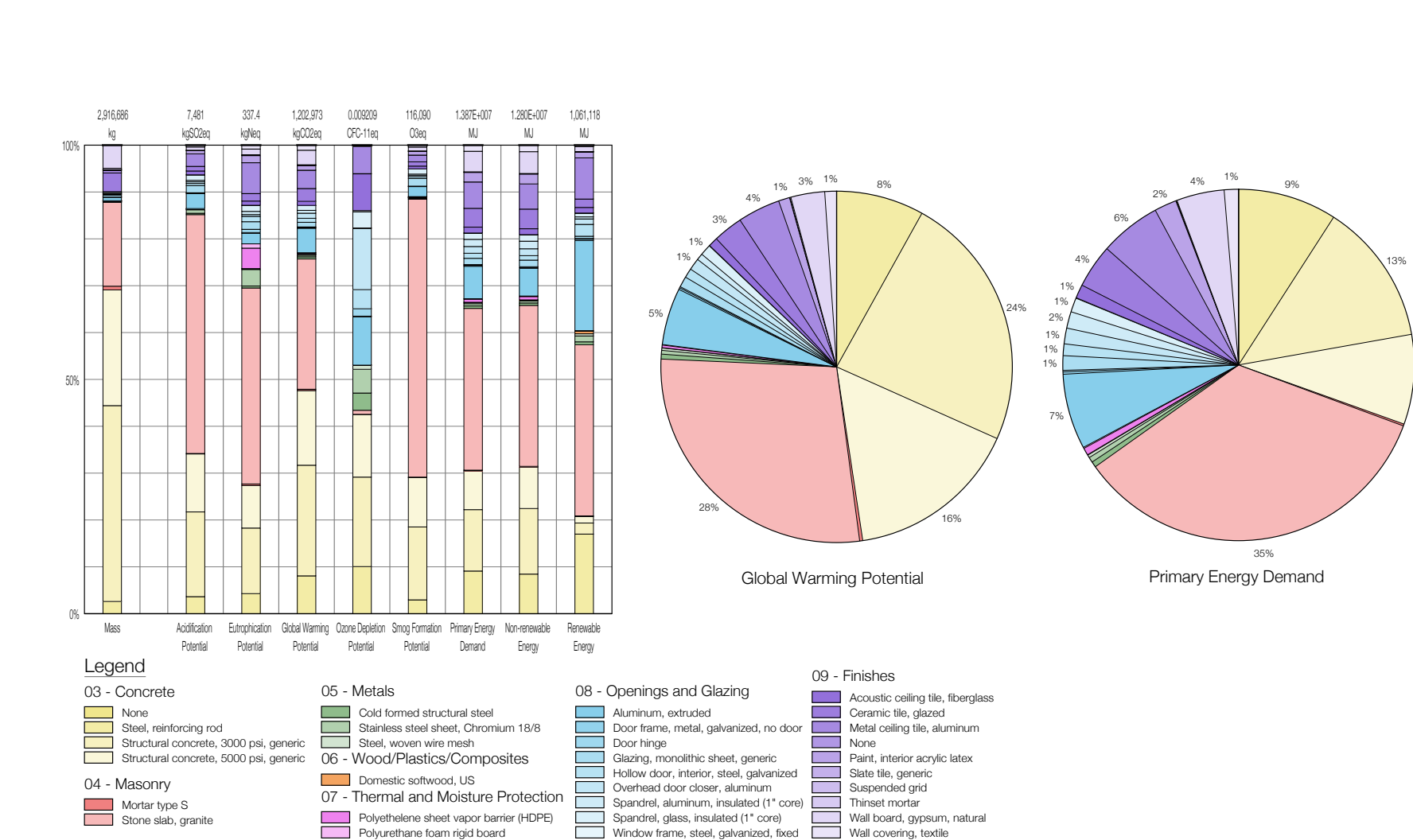
primary energy demand and global warming potential. Global warming potential is the measurement of gas emissions that are causing an increased greenhouse effect. Primary energy demand is a measurement of the total energy drawn from the earth. It is energy demand from non-renewable resources and renewable resources.

## Results

Tally breaks all of the materials into percentages of the total buildings GWP and PED, therefore the data will be in the form of overall percentages and how they differed from wall assembly to wall assembly. The base numbers were calculated, with the GWP for building 1 being 501.2 kgCO2eq/m2 and the PED output at 5,778 MJ/m2. An all wood framed wall construction method would drop the buildings GWP to 388.8 kgCO2eq/m2 and the PED output to 4,197 MJ/m2. In comparison, an all concrete wall structure would cause the building to have a GWP of 444.8 kgCO2eq/m2 and a PED of 4,448 MJ/m2.
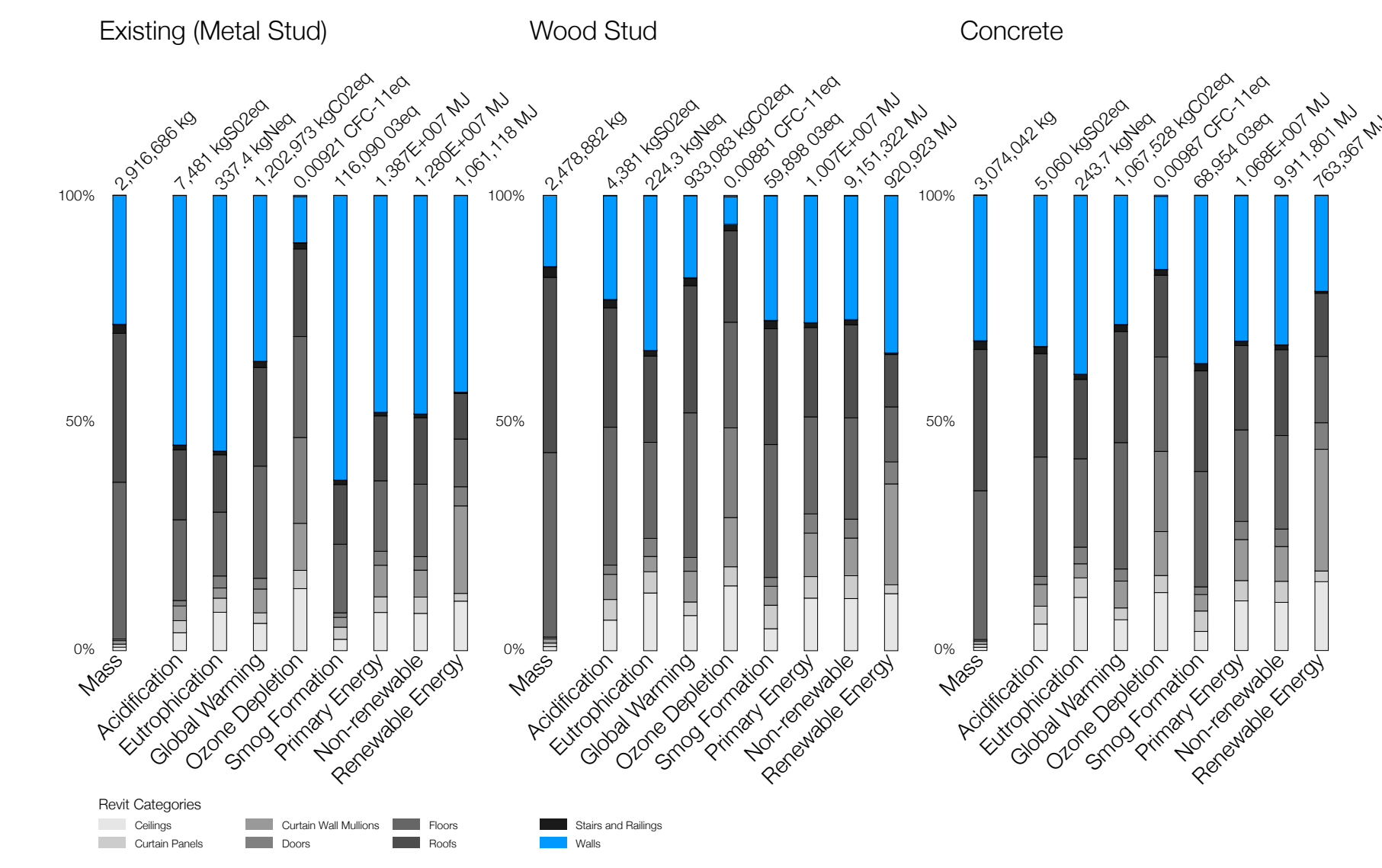
## Modeling Challenges

There were limitations to the data calculated and LCA has been a retroactive tool in most cases. The information found can act as general guidelines on what materials have a greater impact on the environment around them, but are in need of greater specificity. Tally produces the necessary baseline information to make informed decisions on material selection and their affects on the earth, but is limited in the amount of detail. The materials selected for each wall, floor, ceiling and other systems were generalized. The building is currently in the design development stage and did not

have the material detail necessary for pinpointing exact materials within specific wall types that are leading to higher GWP and PED.
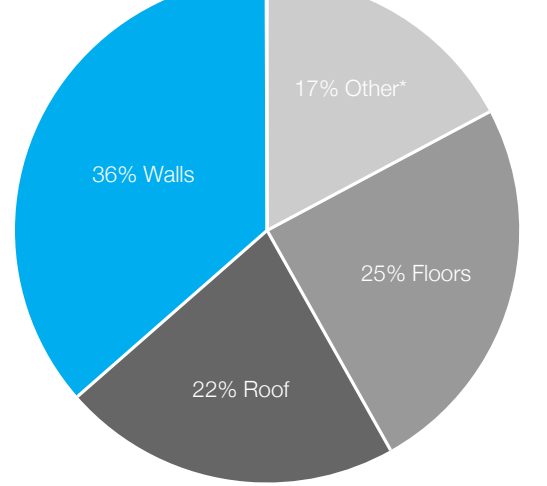
## Conclusions

As architects we need to design buildings with greater knowledge of the global warming potential, primary energy demand, as well as other environmental impact categories that were not calculated such as acidification potential and nonrenewable energy. A major step in reducing the impact of buildings from cradle to grave is to run life cycle assessments early in the design phase to help inform material selection. Source materials locally to limit the travel impact, reduce the amount of materials that require extensive amounts of energy to produce such as steel, or insure that the materials have a high-recycled content.

> A major step in reducing the impact of buildings from cradle to grave is to run life cycle assessments early in the design phase to help inform material selection.

### Results per CSI Division, itemized by Material



Legend

03 - Concrete
None
Steel, reinforcing rod
Structural concrete, 3000 psi, generic
Structural concrete, 6000 psi, generic

04 - Masonry
Mortar type S
Stone slab, granite

05 - Metals
Cold formed structural steel
Stainless steel sheet, Chromium 18/8
Steel, woven wire mesh

06 - Wood/Plastics/Composites
Domestic softwood, US

07 - Thermal and Moisture Protection
Polyethelene sheet vapor barrier (HDPE)
Polyurethane foam rigid board

08 - Openings and Glazing
Aluminum, extruded
Ceramic tile, fiberglass
Door frame, metal, galvanized, no door
Door hinge
Glazing, insulated, sheet, generic
Hollow door, interior, steel, galvanized
Overhead door closer, aluminum
Spandrel, aluminum, insulated (1" core)
Spandrel, glass, insulated (1" core)
Window frame, steel, galvanized, fixed

09 - Finishes
Acoustic ceiling tile, fiberglass
Ceramic tile, generic
Metal ceiling tile, aluminum
None
Paint, interior acrylic latex
Slate tile, generic
Suspended grid
Thread mortar
Wall board, gypsum, natural
Wallpaper, textile

Global Warming Potential

Primary Energy Demand

### Existing (Metal Stud) / Wood Stud / Concrete (bar charts)



Revit Categories
Ceilings
Curtain Panels
Curtain Wall Mullions
Doors
Floors
Roofs
Stairs and Railings
Walls

### Global Warming Potential
Results Per Revit Category



1,202,973 Kg CO2 eq.    933,083 Kg CO2 eq.    1,067,528 Kg CO2 eq.

Existing (Metal Stud)    Wood Stud    Concrete
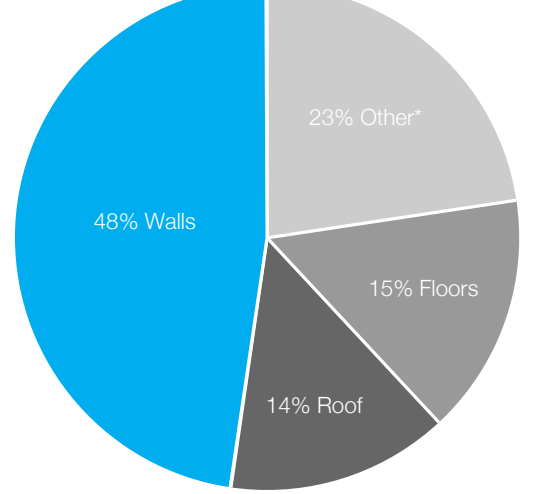
*Ceilings, Curtain Panels, Curtain Wall Mullions, Doors, Stairs, Windows

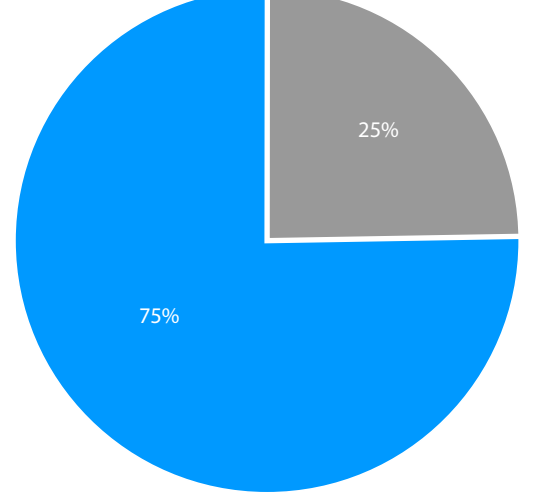### Primary Energy Demand
Results Per Revit Category



1.387E+007 MJ    1.007E+007 MJ    1.068E+007 MJ

Existing (Metal Stud)    Wood Stud    Concrete

*Ceilings, Curtain Panels, Curtain Wall Mullions, Doors, Stairs, Windows

### Global Warming Potential
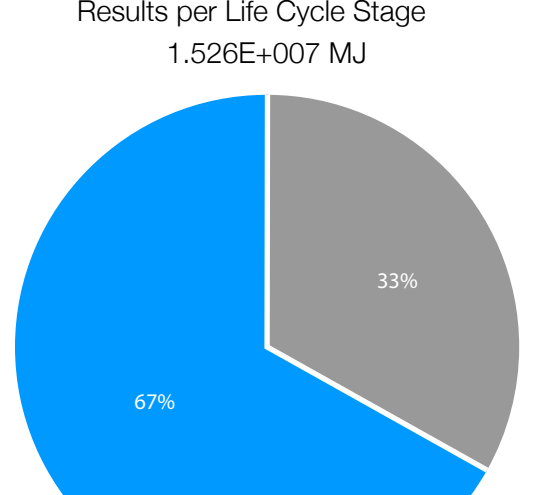Results per Life Cycle Stage



1,323,661 Kg CO2 eq.    1,042,742 Kg CO2 eq.    1,172,827 Kg CO2 eq.

75%    82%    85%
25%    18%    15%

Existing (Metal Stud)    Wood Stud    Concrete

Legend
Life Cycle Stages
Manufacturing
Maintenance and Replacement

### Primary Energy Demand
Results per Life Cycle Stage



1.526E+007 MJ    1.154E+007 MJ    1.186E+007 MJ

67%    73%    76%
33%    27%    24%

Existing (Metal Stud)    Wood Stud    Concrete

Legend
Life Cycle Stages
Manufacturing
Maintenance and Replacement