The Impact on Environment and Decision Making Between Similarity of Design and Materials Difference through BIM

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Abstract

The purpose of this study is to comparison between two buildings have same design but the material entries are different in design stage. Considers Green Building Information Modeling (GBIM) is an effective method for materials analysis and to study impact the materials on environment like Mass, Acidification, Global Warming, Ozone Depletion, Smog Formation, Eutrophication and Primary Energy Demand. This study includes documentation regarding Building Information Modeling, Green Building Information Modeling. The primary case study will be two virtual buildings were considered in this report by using Revit software created two virtual buildings (3D) it has same design but the material entries are different and how can we assess the environmental impact of building materials early and make decision in the design process.

1- Introduction

A Building Information Model is a digital representation of the physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward. A basic premise of the model is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the modeling process to support and reflect the roles of that stakeholder. The model is a shared digital representation founded on open standards for interoperability. The model may be a database made up of a set of interrelated files and not just one entity.

The concept of Building Information Modeling is to build a building virtually, prior to building it physically, in order to work out problems, and simulate and analyze potential impacts. The creation of a building information model begins with the first thoughts of the project. From that point forward the model is used as the authoritative source for information about the building. The demonstrated some obstacles and barriers that could face the adoption of BIM, since some of them lacked the objectivity to evaluate the problem, they ignored obstacles that could hinder the adoption of BIM like the legal factor (Azhar, 2011).

The integrated and coordinated database that is contained within the building elements provides a significant support to sustainability assessment by enabling capturing of the required information during different design stages as required (Bank et al. 2010). Other studies like (McGraw, 2010) and (Journal of BIM, 2009) considered the financial crisis as a drive to implement BIM in order for companies to find new areas of competition.

Opposition can be expected from clients and developers to spend extra money to implement the new approach. BIM has many characteristics that make it a successful substitute to the traditional methods, especially with the robust of sustainable design.

- Objectives of the Study

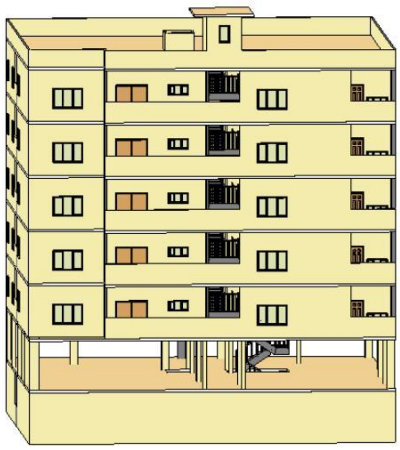
Study of the quality of materials used in the construction process in the design phase and assist in the decision-making stage to support of health environments.

Use of green building information modeling (GBIM) will give a positive development towards less polluted environment, which is integrated with other elements to ensure a healthy environment in the construction industry.

2- Description Case Study

After development software that deal with construction industry , we began to get more information about areas , locations, sites, designs (2D, 3D) and many documents, also many dimension as (4D, 5D, 6D) represent time, cost, lifecycle, facilities management about each project. All this information is called Building Information Modeling (BIM). The result is Life Cycle Assessment (LCA) on demand, is an important layer of research design for decision-making within the same time frame, pace, and environment that building designs are generated. This is especially useful for understanding the impact materials have on the environment. In this studying will take virtual buildings A and B, using Revit software to create (3D) model.

Building (A)



Building (B)

The BIM package in present case is Autodesk Revit. For the creation of the building levels are to be identified for each floor. These levels are then given in the elevation and are created. Next step depends on details in columns, beams, doors, windows and the other details. Families are prepared which should be loaded in each step of project. After creating the levels and families group create individual grid lines in each level and start placing the walls, stairs, etc. as per the tools in the BIM.

3- Results

The results represent Life Cycle Stages (itemized by CSI Division, itemized by Revit Category, CSI Division itemized by Tally™ Entry , CSI Division itemized by Material, Revit Category itemized by Family , Revit Category itemized by Tally™ Entry , Revit Category itemized by Material). The study includes all the building details such as (Concrete, Precast Concrete, Masonry, Openings and Glazing, Metals, Wood/Plastics/Composites, Thermal and Moisture Protection, Roofing and Finishes).

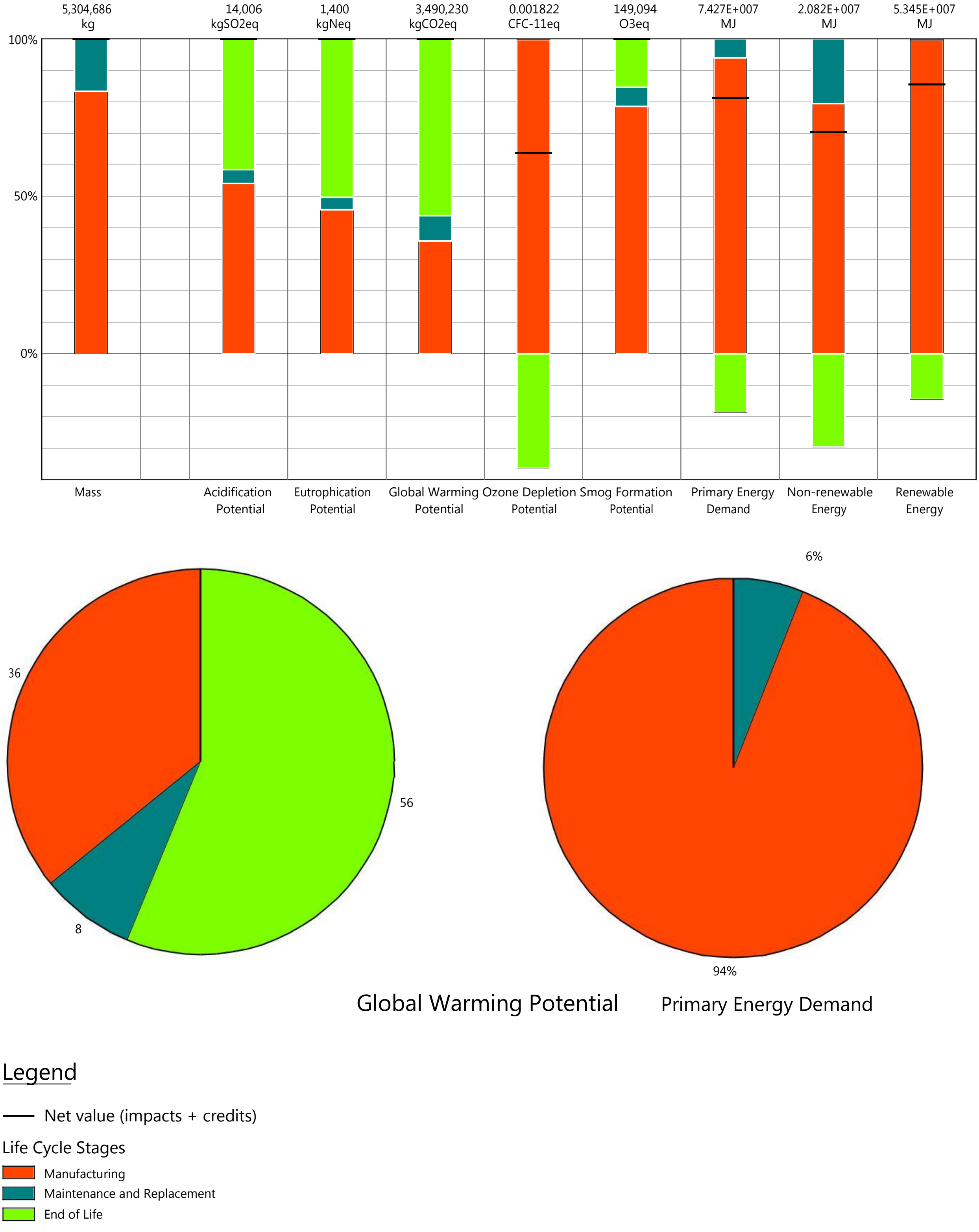


Figure 1: Building (A) Life Cycle Stag

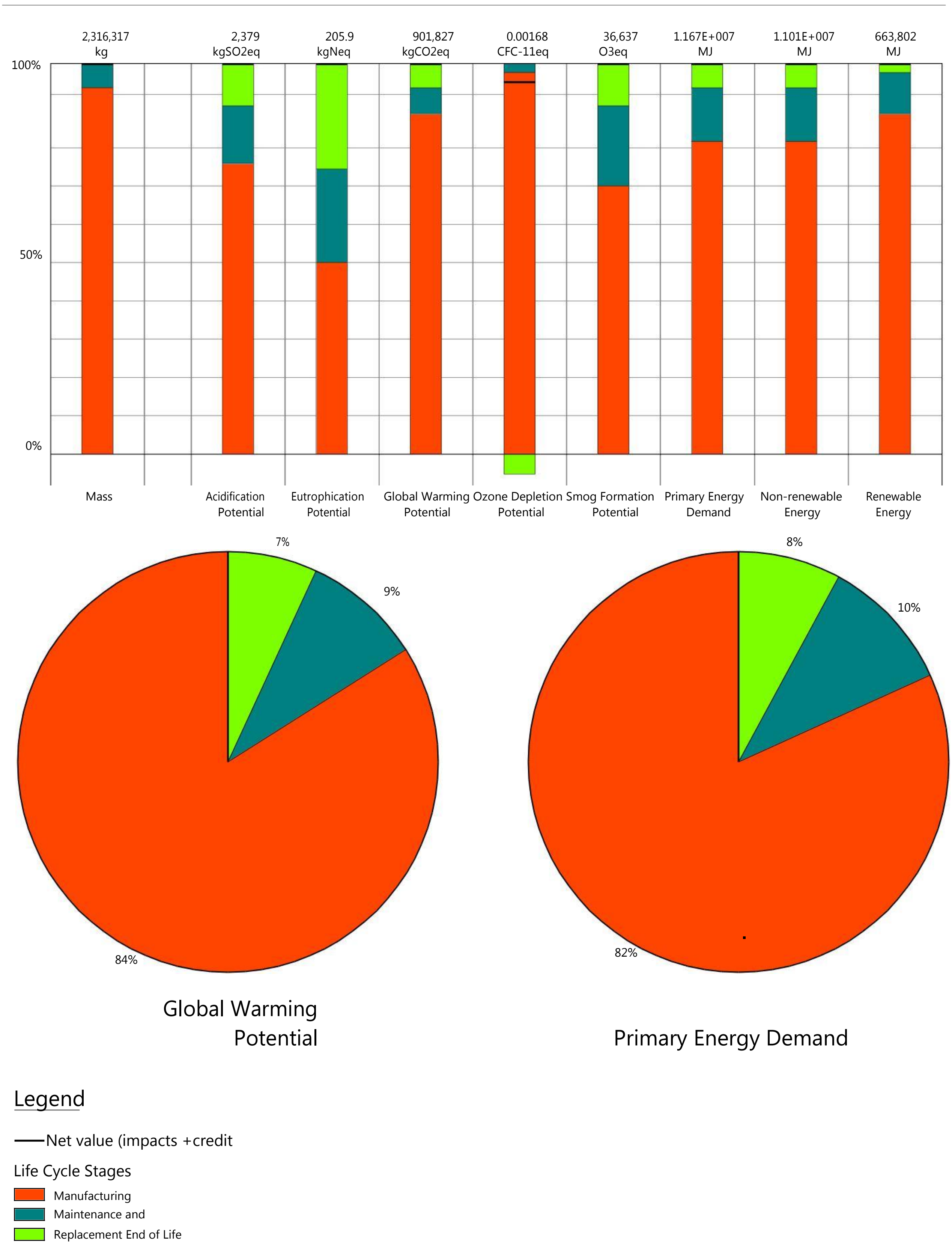
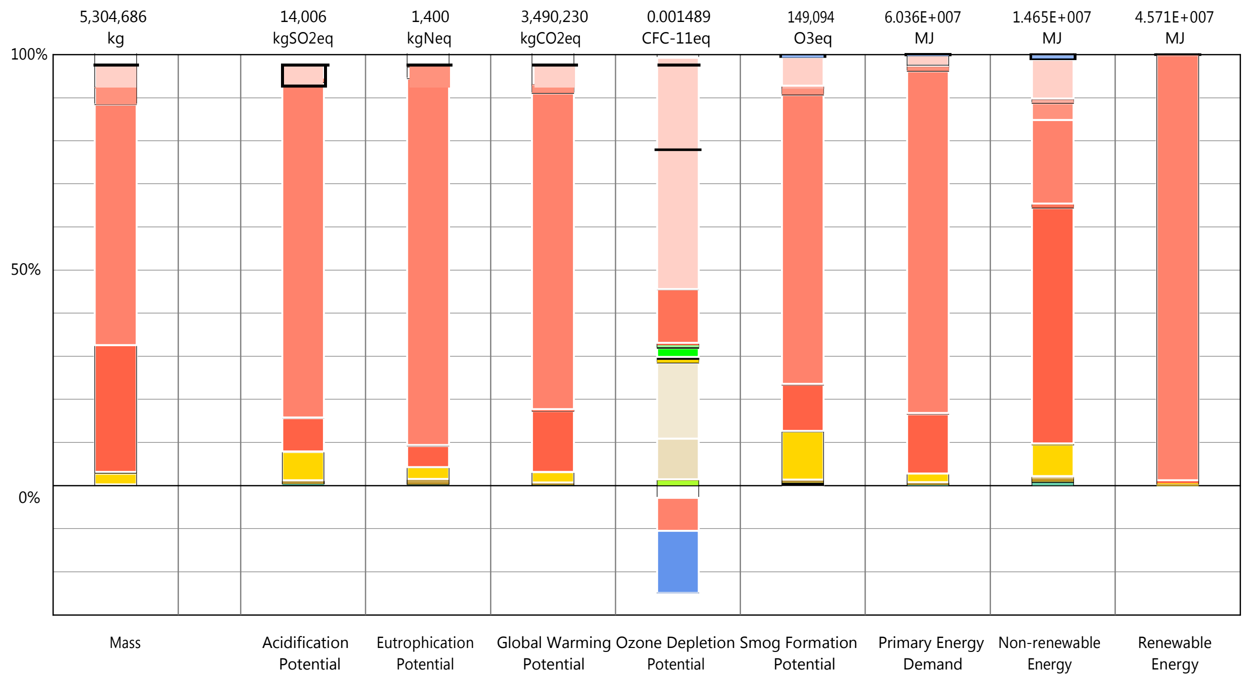
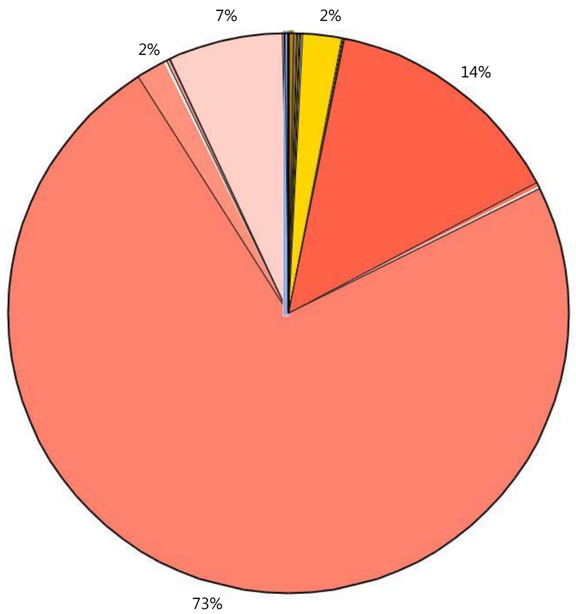
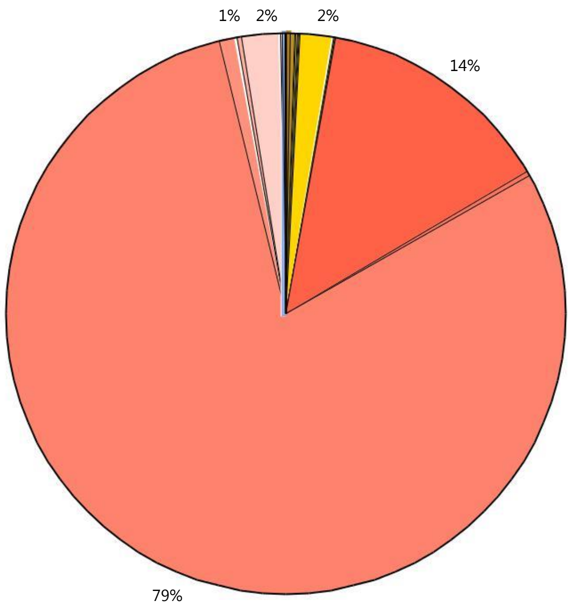


Figure 2: Building (B) Life Cycle Stage





Global Warming Potential



Primary Energy Demand

Legend

Doors

- Door frame, aluminum, powder-coated, no
- door Door frame, wood, no door
- Door, exterior, wood, solid core
- Door, interior, wood, hollow core,
- flush Glazing, double, insulated (air)
- None
- Paint, exterior acrylic latex
- Paint, interior acrylic latex
- Stainless steel, door hardware, lever lock, exterior, commercial
- Stainless steel, door hardware, lever lock, interior, commercial

Windows

- Aluminum turn-tilt window fitting
- Glazing, double, insulated (air)
- Window frame, aluminum, powder-coated, divided operable, insulated

Roofs

- Granite tile
- Steel, reinforcing rod
- Thin set mortar

Curtain Panels

- Glazing, double, insulated (air)

Curtain Wall Mullions

- Aluminum, extruded
- None

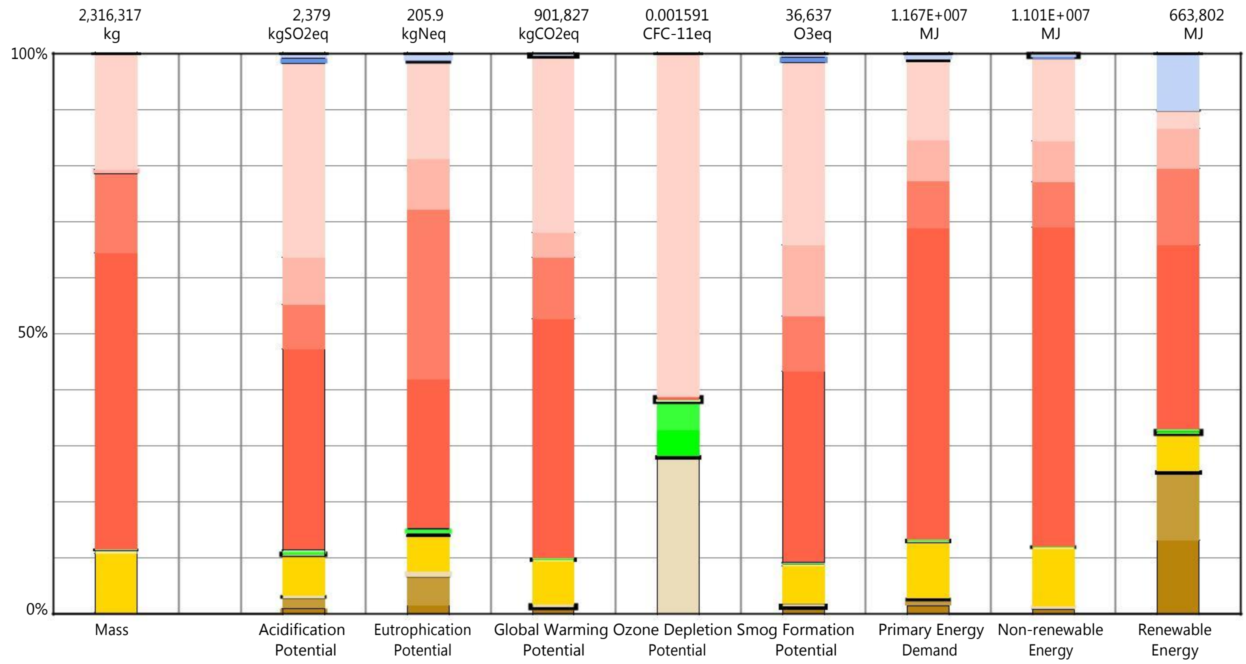
Stairs and Railings

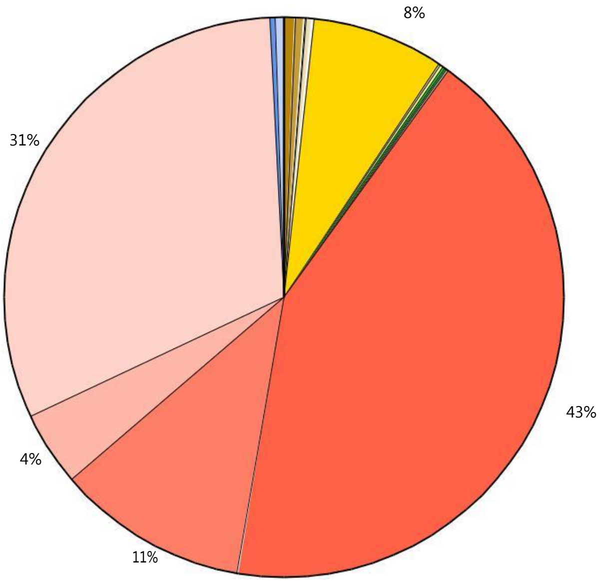
- Cold formed structural steel
- Steel, reinforcing rod
- Structural concrete, 5000 psi, generic

Walls

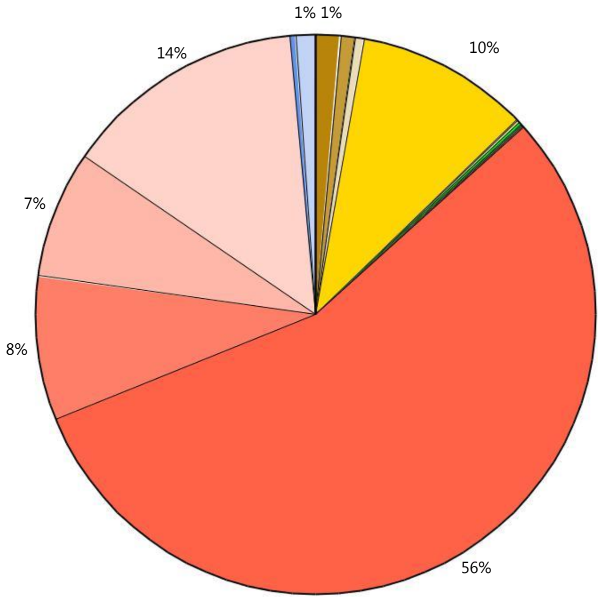
- Brick, generic
- Closed cell, spray-applied polyurethane foam, high
- density Domestic hardwood, US
- Lime mortar (Mortar type
- K) None
- Paint, exterior acrylic latex
- Paint, interior acrylic latex
- Stucco, Portland cement
- Wall board, gypsum, moisture- and mold-resistant

Figure 3: Building (A) Revit Category, itemized by Material





Global Warming Potential



Primary Energy Demand

Legend

Doors

- Door frame, wood, no door
- Door, interior, wood, hollow core, flush None
- Paint, interior acrylic latex
- Stainless steel, door hardware, lever lock, interior, commercial

Roofs

- Ceramic tile, glazed
- Steel, reinforcing rod
- Thin set mortar

Windows

- Glazing, monolithic sheet, generic None
- Window frame, wood, divided operable

Stairs and Railings

- Cold formed structural steel
- Stainless steel, extruded, chromium
- 18/8 Steel, reinforcing rod
- Structural concrete, 5000 psi, generic

Walls

- Brick, generic
- Lime mortar (Mortar type K) None
- Paint, exterior acrylic latex
- Stucco, Portland cement

Figure 4: Building (B) Revit Category, itemized by Material

Table 1: Environmental impacts for buildings A and B

Row Labels	Building A	Building B
Sum of Mass Total (kg)	5304686.374	2316317.323
Sum of Acidification Potential Total (kgSO2eq)	14005.84432	2379.273157
Sum of Eutrophication Potential Total (kgNeq)	1399.613158	205.912107
Sum of Global Warming Potential Total (kgCO2eq)	3490230.227	901826.541
Sum of Ozone Depletion Potential Total (CFC-11eq)	0.001159485	0.001591123
Sum of Smog Formation Potential Total (kgO3eq)	149093.6518	36636.79706
Sum of Primary Energy Demand Total (MJ)	60362477.22	11671720.55
Sum of Non-renewable Energy Demand Total (MJ)	14650572.36	11007918.08
Sum of Renewable Energy Demand Total (MJ)	45711904.85	663802.4677

4- Concluding Remarks

These results in the table 1 were obtained by analyzing the material for models A and B, each model separately. The results represent impact the materials on the environment through values of (Mass, Acidification Potential, Eutrophication Potential, Global Warming, Ozone Depletion Potential, Smog Formation, Primary Energy Demand).

When we compare between two models A and B in sum of mass, building B is better than A because it has least value. If comparison between two models in sum of acidification potential the building B is better than A because the value of building B less than building A .Thus, the comparison is between the buildings on the table for each item as global warming and primary energy demand. But should be noted that primary energy demand is divided into two parts non-renewable energy demand and renewable energy demand, and holds their combination will give us value of primary energy demand.

Primary Energy Demand = (Non-renewable + Renewable) energy demand

After comparison the results for each item in table1, we can make a decision of the building that are more environmentally friendly. The building B is better than building A but it is not perfect because there is little difference between building A and B.

5- Reference

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