

## EnergyPlus Energy Simulation Software

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### 1. Introduction

Living in an area like Duluth, Minnesota, a high fluctuation in the temperature year round is a concern for newly constructed buildings and existing structures. Figure 1 below shows the average temperature throughout the year from the years 1971 to 2000, which indicates that there is approximately 75 degrees Fahrenheit difference between the temperatures in January and the temperatures in July.

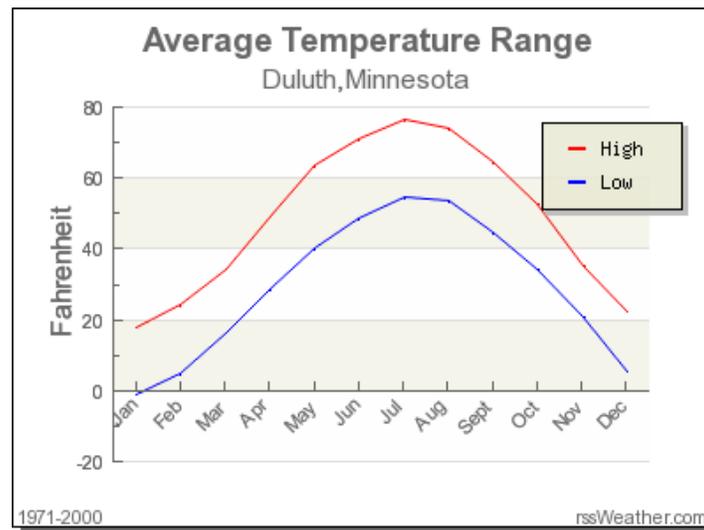


Figure 1: Duluth, MN average temperatures

With this kind of temperature fluctuation, it is important to build structures that have more energy efficient systems for heating and cooling. Numerical simulations of the energy dissipated in a building can be accomplished with the aid of the EnergyPlus Energy Simulation Software. EnergyPlus is a free software program provided by the Department of Energy that simulates thermal loading and analyzes energy usage. There are many older houses in the Duluth area, and it is important to keep updating these properties to maximize energy efficiency and save the home owner money. According to [www.bundle.com](http://www.bundle.com), the median cost of utilities in Duluth is \$156.00 per month, or \$1,872.00 per year. With prices like these it is easy to see why a homeowner would be concerned with energy efficiency.

The purpose of this project was to use the EnergyPlus energy simulation software to model a residential building, and determine the amount of energy consumed by the building. As stated in the project proposal, there will be three different tasks to be completed in this project. These

tasks were to get familiar with the EnergyPlus program, simulate the energy needs of an existing building, analyze these results and make changes to the model to optimize energy efficiency.

## 2. Project Process

To begin this project, research on the EnergyPlus program was performed. The program was installed and the user documentation was read through. This user documentation was very extensive and contained many examples with example input files. These examples were relatively simple and did not really present a lot of information, but they were helpful in getting the feel for the program. However, these files did not show how to create input files, which is where I had the most problems. The Department of Energy also provides information in the form a course syllabus and presentation slides for teaching a course on energy efficiency using the EnergyPlus program. At the beginning of this process, my advisor was planning on using the findings of this project to integrate the program into a structures course, but she left her job at UMD so that portion of the project was never performed. By analyzing this information, a base of knowledge about the program and its capabilities was obtained.

At the beginning of this process, my advisor was planning on using the findings of this project to integrate the program into a structures course, but she left her job at UMD so that portion of the project was never performed. This just left the process of creating a model and simulating the models energy efficiency. The EnergyPlus software contains a few different programs. These include an IDF Editor, EP Compare, an IDF Version Updater, and EP Launch. The program that will be focused on in this research was EP Launch. EP Launch provides a simple way of running simulations using an input file and a weather file. The use of an OpenStudio plug-in for Sketchup aided in the construction of the model, and in the assigning the building materials. This plug-in was designed to make it easier to make a physical model to be used in the simulation. I was able to obtain a set of residential house blueprints from a contractor to be used as a model. It took a while to get used to using the Sketch up program, and creating the model took a lot of time. Once the model was created, it was saved as an IDF file to be used in the simulation. To edit the construction materials, the model had to be opened in Notepad++ and the code of the file had to be edited. The code for these materials was obtained from a Building Component Library, which is a tool provided by the National Renewable Energy Laboratory. A weather file was also placed in the input file. The EnergyPlus website provides weather files for locations all across the world, so it was easy to obtain weather data for Duluth, MN.

After the input file was created, I started running simulations. This is where I ran into problems. I kept getting severe errors that terminated my simulations. The program described what these errors were, but not where they were located in the input file. With over 1,000 lines of code, this was a very difficult task. I spent a lot of time trying to get this model to work. I tried to use the EnergyPlus help desk to fix these errors, but due to time constraints, I was not able to complete a full simulation of the model. I decided to try to create a very simple model in Sketchup to try to get a complete simulation with results, but I ran into the same problem. One of the members of the EnergyPlus support desk informed me that it is very easy to make mistakes when putting information into the input file, and this is probably the reason I had so many problems. I was hoping to be able to get some results from this simple model, and compare different building materials and locations, but due to time constraints, I was not able to do these things. By

comparing these building materials, the most energy efficient system could be identified and implemented. A comparison of building locations would have also be used to compare the costs of energy in different locations.

### 3. Results

As I stated in the project process section of this report, I was not able to complete any simulations to get any results. I made many attempts to perform simulations, but kept getting severe errors that would terminate the simulations. With the help of the EnergyPlus support, I was able to work out some of the errors. However, due to time constraints, the simulation was never fully completed.

### References

U.S. Department of Energy. (2013). *EnergyPlus* 8.1.0. URL: <http://apps1.eere.energy.gov/buildings/energyplus/>

Weather.com. (2014). *Climate for Duluth, Minnesota*. URL: <http://www.rssweather.com/climate/Minnesota/Duluth/>

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