

Student Checklist (1A)

This form is required for ALL projects.

1. a. Student/Team Leader: _____ Grade: _____
Email: _____ Phone: _____
b. Team Member: _____ c. Team Member: _____
2. Title of Project:
Comparing the Effects of a Building's Glass Type, Size, and Location on Its Average Annual Energy Usage Through BIM Software
3. School: _____ School Phone: _____
School Address: _____

4. Adult Sponsor: _____ Phone/Email: _____
5. Does this project need SRC/IRB/IACUC or other pre-approval? ☐ Yes ☒ No Tentative start date: _____
6. Is this a continuation/progression from a previous year? ☐ Yes ☒ No
If Yes:
a. Attach the previous year's ☐ Abstract **and** ☐ Research Plan/Project Summary
b. Explain how this project is new and different from previous years on
☐ Continuation/Research Progression Form (7)
7. This year's laboratory experiment/data collection:

Actual Start Date: (mm/dd/yy) _____ End Date: (mm/dd/yy) _____
8. Where will you conduct your experimentation? (check all that apply)
☐ Research Institution ☐ School ☐ Field ☒ Home ☐ Other: _____
9. List name and address of all non-home and non-school work site(s):
Name: _____
Address: _____

Phone/
email _____
10. Complete a Research Plan/Project Summary following the Research Plan/Project Summary instructions and attach to this form.
11. An abstract is required for all projects after experimentation.

Research Plan

1. a) Rationale:

Buildings are a major contributor to global energy usage. With the issues of climate change and the rise in population, building professionals have been looking towards sustainable solutions and simulating building performance before construction to make design decisions and optimize energy savings.

My research will potentially support building professionals to understand various effects on a building's energy usage. Also, the world-scale study will hopefully contain results that can be used by policymakers around the world to make regulations and guidelines towards more energy-efficient buildings.

b) Research Questions:

- How does a building's distance from a large body of water affect its energy consumption?
- How do a building's size, location, and glass type affect its annual energy usage intensity (EUI)?

Hypothesis:

The ten-story building will have the greatest EUI compared to the twenty and thirty-story buildings in the same locations. This is based on the idea that buildings with a larger surface area to volume ratio are more responsive to fluctuating temperatures and weather conditions.

c) Procedure:

1. Create a list of cities from around the world that have a human population of 1 million people or more to include in the research.
2. Model a typical thirty-story office building in the Autodesk Revit program.
3. Make ten and twenty-story variations of the building.
4. In each building, identify the function of each room in Revit.
5. Make duplicates of three buildings for each of the locations.
6. In each Revit file, identify the location, generate an energy model, and export the file to Autodesk Insight.
7. For each building, adjust the glass type of each side of the building in Autodesk Insight and collect the building's annual energy unit intensity (EUI) in kBtu/sq.ft.

For each building, this must be done four times for the four glass types: Single Clear, Double Clear, Double Low-E, and Triple Low-E glass.

8. Enter the data into a Google Spreadsheet.
9. Calculate the difference in EUI between using different glass types.
10. Create graphs based on different relationships such as the effects of a building's size, glass type, location, and latitude on its EUI.
11. Observe the relationships found in each graph.
12. Record the findings.
13. Write a research paper describing past research in the field, the methodology, results, limitations, future research, discussion, and conclusion.

Risk and Safety:

There are no potential risk and safety precautions needed to conduct this research.

Data Analysis:

1. Organize specific data into different Google Spreadsheets.
2. Create graphs for the different organized data.
3. Determine if the data supports my original hypothesis.
4. Interpret the findings of each graph and think about why this was found and what it means on a larger scale.

d) Bibliography:

- The Journal of Energy and Buildings
- The Journal of Building and Environment
- The International Symposium on Automation and Robotics in Construction
- Energy Procedia

2. Not applicable for this research

3. Addendum

The original list of locations that the buildings were planned to be simulated in using Autodesk Revit contained 154 cities. However, the software had trouble generating data with these 13 locations: Quito, Ecuador; Lagos, Nigeria; Kano, Nigeria; Ibadan, Nigeria; Kaduna, Nigeria; Dar es Salaam, Tanzania; Kumasi, Ghana; Luanda, Angola; Lusaka, Zambia; Harare, Zimbabwe; Antananarivo, Madagascar; Khartoum, Sudan; and Kampala, Uganda. As a result, these locations were removed from the study, and the buildings were only digitally analyzed in 141 locations.