RESEARCH REPORT

KAITLYN KANE
ARCH 771
DR. GANAPATHY MAHALINGAM
NORTH DAKOTA STATE UNIVERSITY

THE METHODOLOGY OF CALCULATING THE CARBON FOOTPRINT OF A BUILDING

INTRODUCTION

The thesis research topic I chose is the methodology of calculating the carbon footprint of a building. I chose this topic because I care a lot about our environment and sustaining it. How can I take a site and not wipe it clean and start with my own ideas and design, but to sit back and look at how the site itself can guide my design? I've been working on studying different types of building materials and calculating their individual emissions. I will further research how to adapt or change those materials to reduce carbon emissions. I think it is important to realize that we are first and foremost integrating into nature and not throwing up a build and then going back to integrate nature back within the site. I was at a hunting cabin a couple of weeks ago and they told the story of how they built the cabin and they had said that each tree that was cut down for the location of the cabin was planned out and used for the structure and finishes. Materials that belong on the site are used on the build. I really want to work towards being more aware of the existing site and working more on my perspective of existing elements and how important they are. Destroying existing elements within a single site is “small” & “unimpactful” is not the way to think while designing architecture because the Earth is our site. The more we ruin and destroy individual sites will result in destroying our Earth. I started researching how to calculate a buildings carbon footprint and struggled to find enough information to realistically find out results. This thesis topic intrigued me to study a deeper way to be able to understand the carbon footprint of a design before it is built and how to reduce an existing building’s carbon emissions.

METHODOLOGY

My first plan off attack was to "simply" figure out how to calculate the carbon footprint of a building. I found out that this was not so simple. I was able to find a lot of websites that businesses can pay for and use to find out their results; but this didn't help me. I wanted to know HOW to calculate, not just the results. So, first things first, what makes a carbon footprint? This is the question that needs to be defined before anything else. This is the problem, so I need to fully understand what the problem is before trying to solve it.

CARBON FOOTPRINT

What is a carbon footprint? It is spoken about worldwide. The term is used to specify a problem; seems like a big problem at that. Nobody seems to use this term in joyful way. The definition of carbon footprint it "the total amount of greenhouse gas emissions caused by an individual, event, organization, service, place or product, expressed as carbon dioxide equivalent". So, this led to further investigating. With guidance from Professor Ganapathy Mahalingam, I was introduced to Building Transparency's EC3 tool. This was the start to it all.

EC3 TOOL

Building Transparency is a website that fosters a better building future by addressing embodied carbon's role in climate change. It allows you to create an account and import Revit models in. You can also upload multiple models to be able to compare them. This site also allows to explore many different material types and learn about each of those material's emissions. EC3 is a great tool for my thesis. It has really allowed me to learn in so much detail about material choices and carbon emissions.

TALLY

I found the Tally extension through Building Transparency website. They provide Tally as a sister software. Tally is a Revit extension that allows the flow of data from Revit to the EC3 tool. This software was game changer. It plugs right into Revit and is easy to learn. It takes all of your components on your model (floor, doors, windows, roof etc.) and allows you to choose a specific material to define it. Once all of the components are defined, you are then able to convert it over to EC3 to collect your results.

RESULTS

Throughout researching, I have found a way of using multiple software that can be used together to calculate existing data. I have created a YouTube video that allows anyone to see the process I used to covert a Revit model to the EC3 tool. I have included all of my slides that make up my video. These slides capture the majority of what I have learned while researching the methodology of calculating the carbon footprint of a building.

CONCLUSIONS & PROJECTIONS

From here I will go on in the spring semester to pick an existing building and create a model of it in Revit. Then I will insert the current materials that are being used. I will then run it through EC3 and figure out the starting carbon emission data. Then I will go back into Revit and Tally and choose different materials and work to reduce the carbon emission for an end result.

I am very proud of where I am at this point. I hope that this process that I have went through will benefit not only the way we design but also the Earth. I hope to find additional ways to help reduce carbon emissions in the future to help do my part to help our world.

YOUTUBE VIDEO

I am including the link to my YouTube video for ease of access.

https://www.youtube.com/watch?v=sfgvYCzDcmo

Below are my slides of my video, but they are missing the audio so make sure to check out the full video with audio.

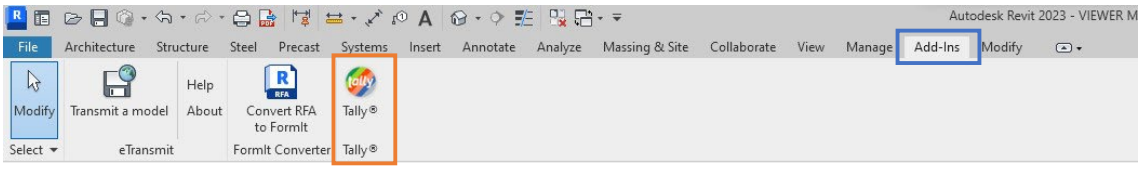
Converting Revit Model to EC3 Tool

Created By: Kaitlyn Kane
Guided By Professor Ganapathy Mahalingam

Software Needed

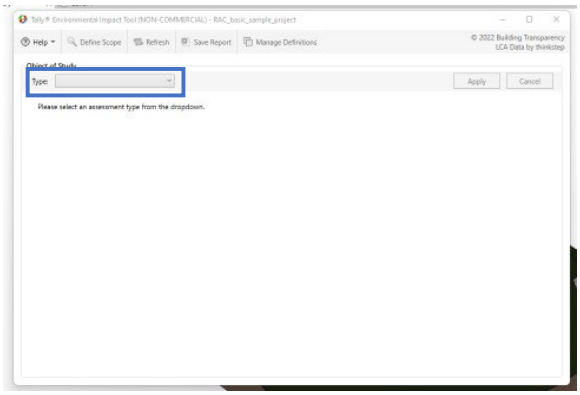
Step 1:
User left click on "Add-Ins

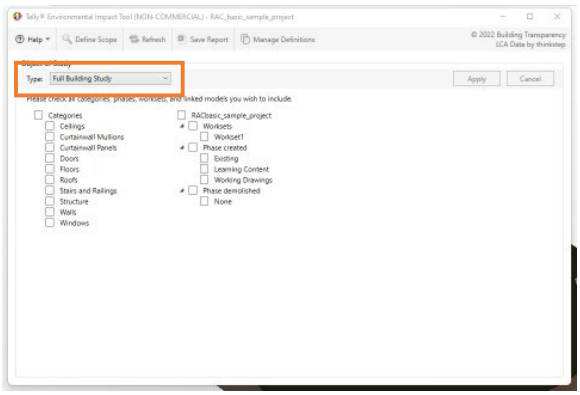
Step 2:
User left click on “Tally”



Step 3:
User left click on “Type” dropdown box

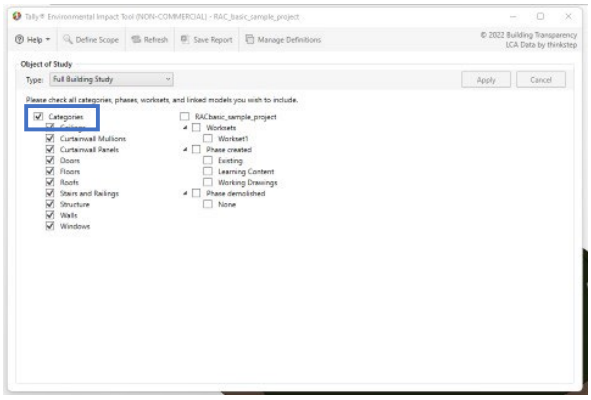
Step 4:
User left click on "Full Building Study"





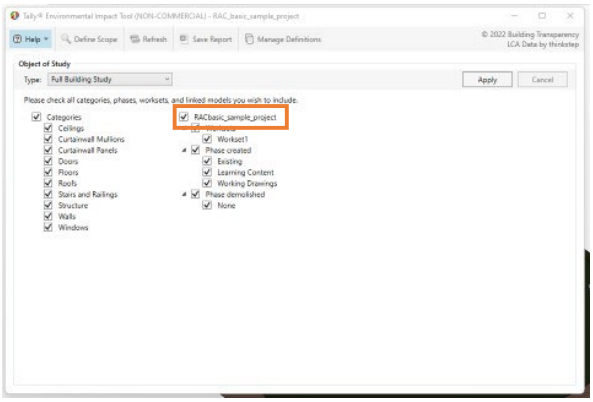
Step 5:

User left click on "Categories" box



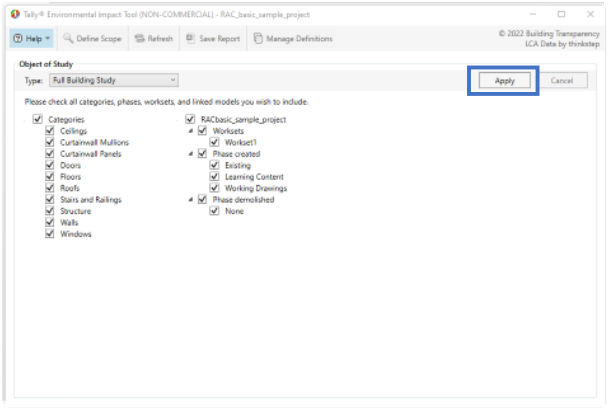
Step 6:

User left click on the current project box (RACbasic_sample_project)



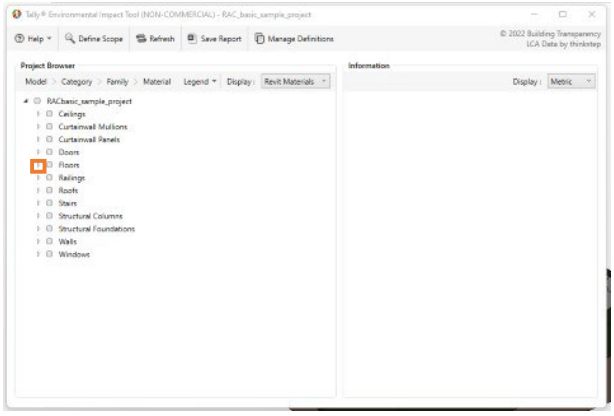
Step 7:

User left click on "Apply"



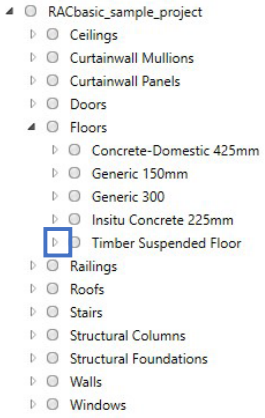
Step 8:

User left click on "Floors" drop down arrow



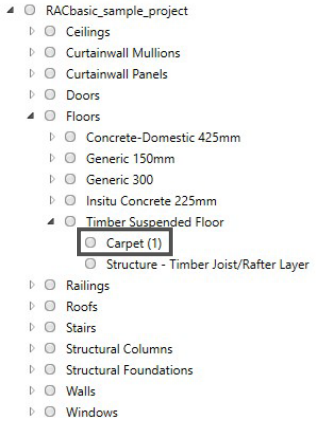
Step 9:

User left click on "Timber Suspended Floor" drop down arrow



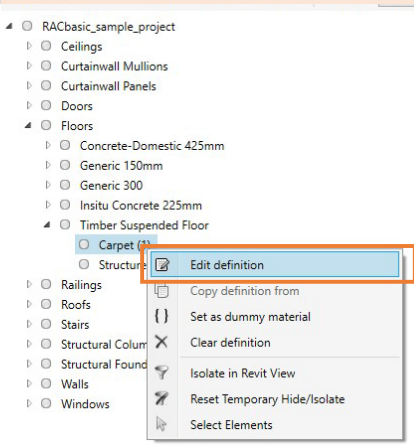
Step 10:

User right click on "Carpet"



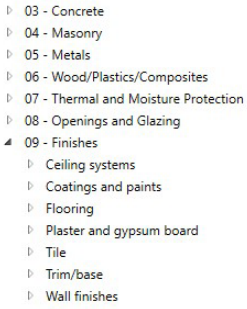
Step 11:

User left click on "Edit definition"



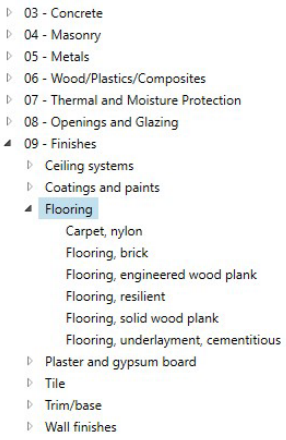
Step 12:

User left click on "Finishes" drop down arrow



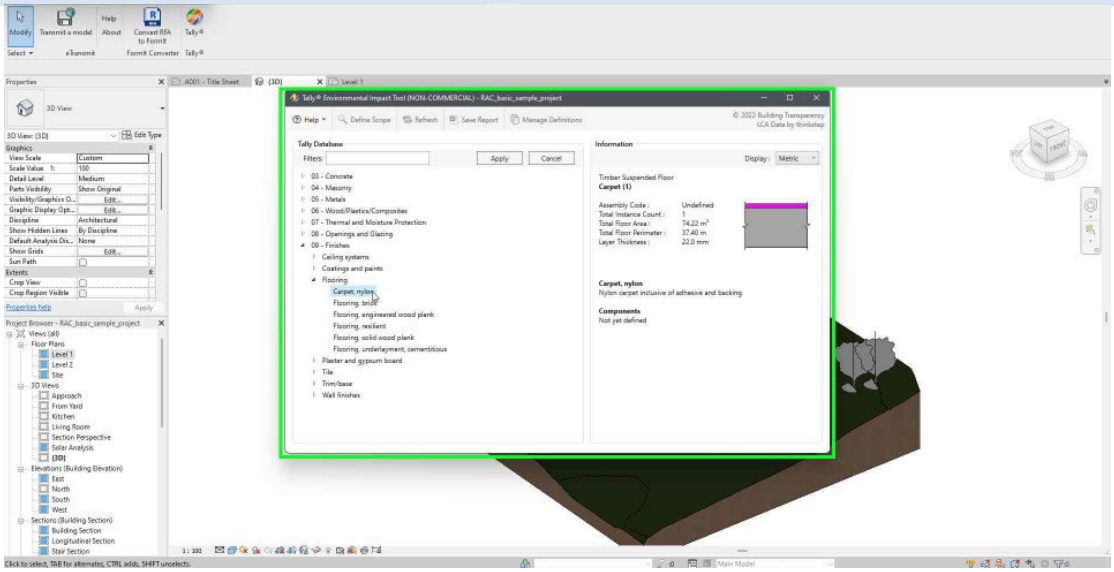
Step 13:

User left click on "Flooring" drop down arrow



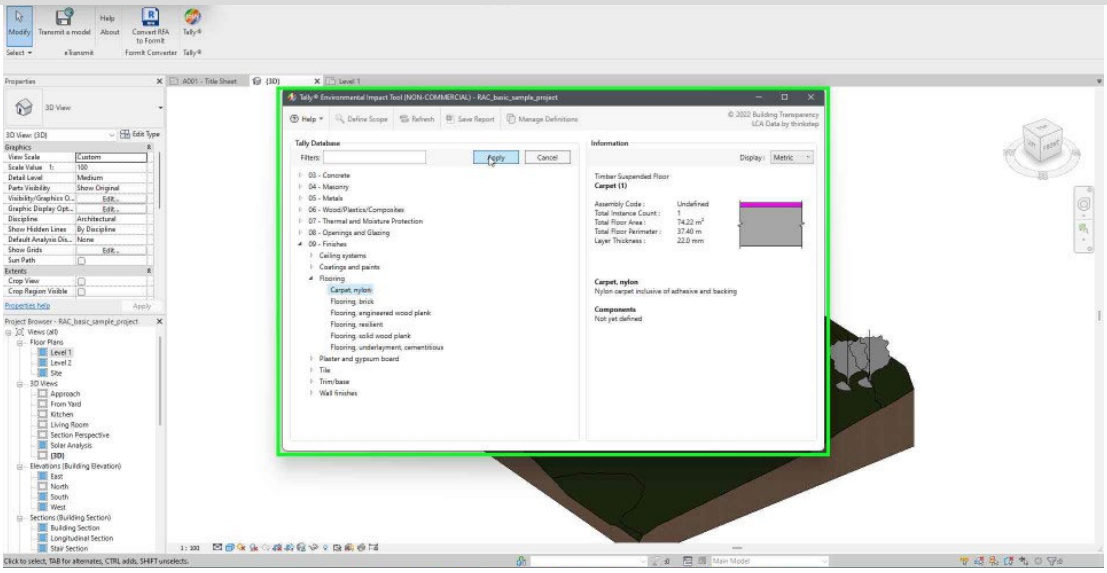
Step 14:

User left click on "Carpet, nylon"



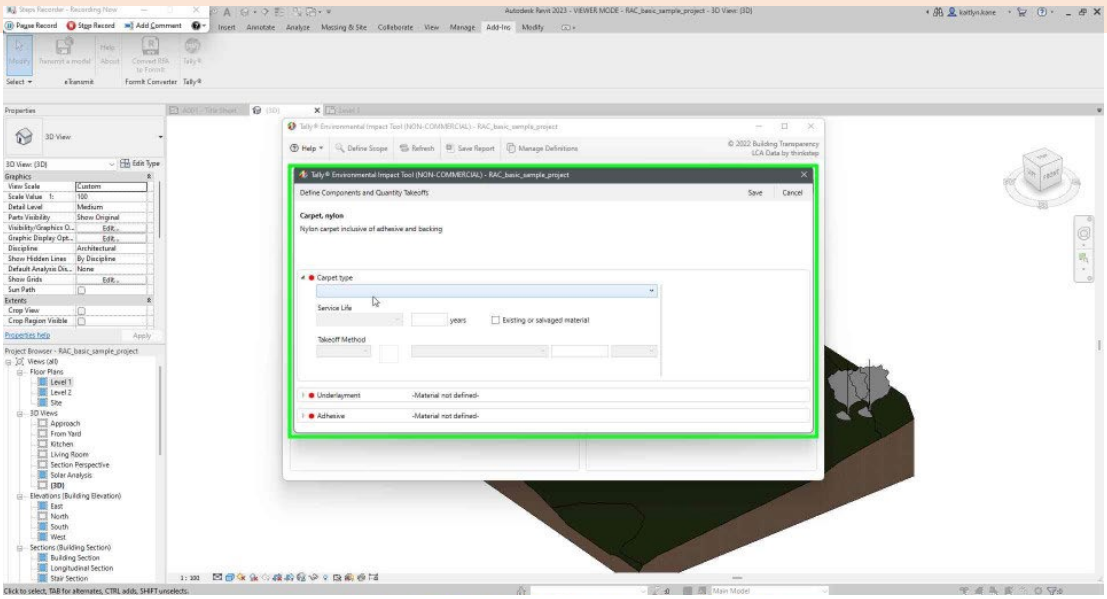
Step 15:

User left click on "Apply"



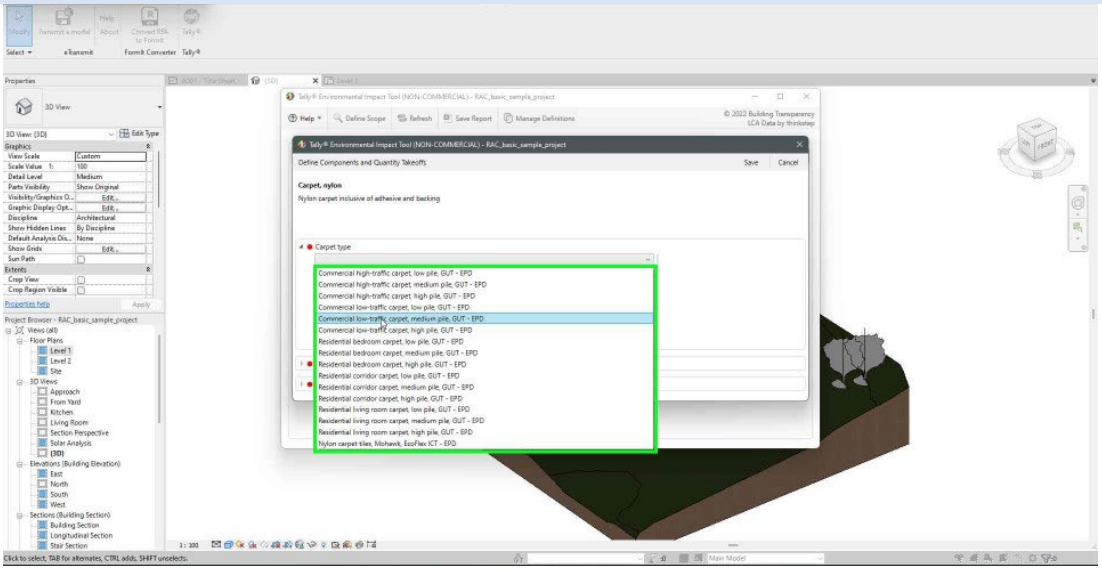
Step 16:

User left click on the material definition drop down for “Carpet type”



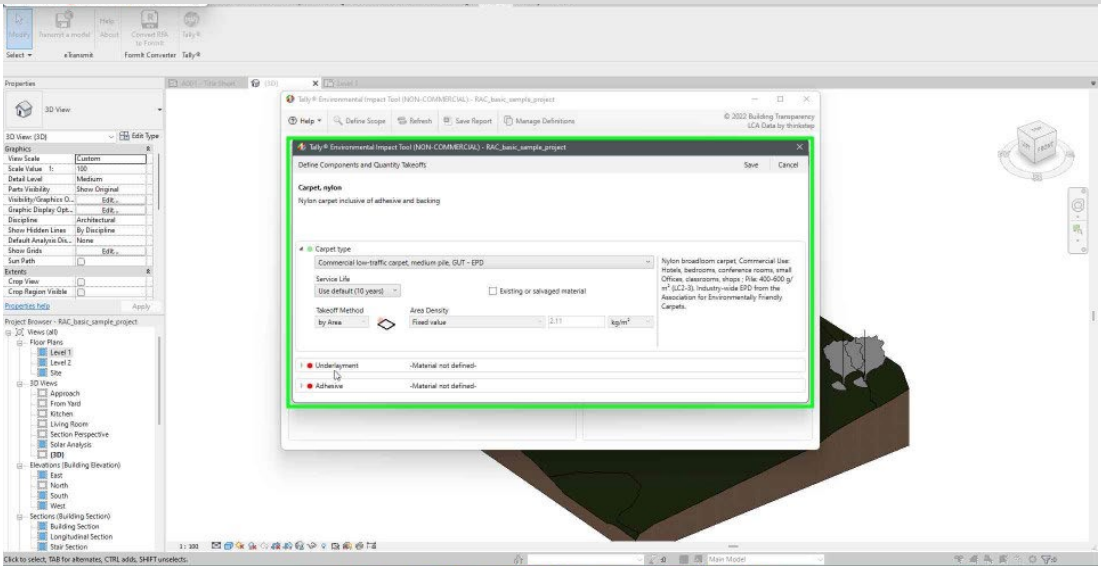
Step 17:

User left click on a specific material type



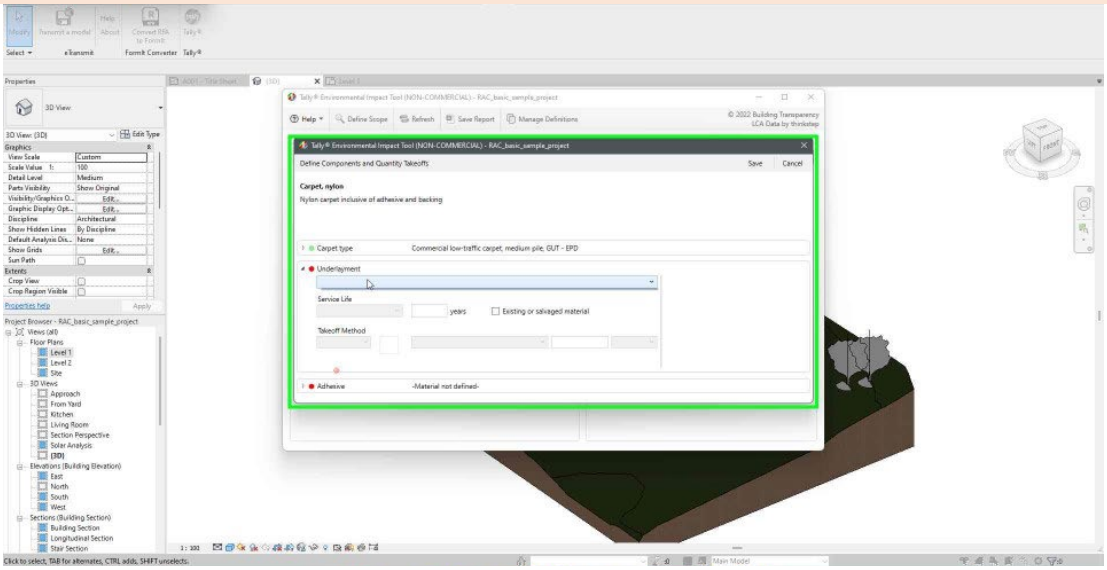
Step 18:

User left click out to allow for default input

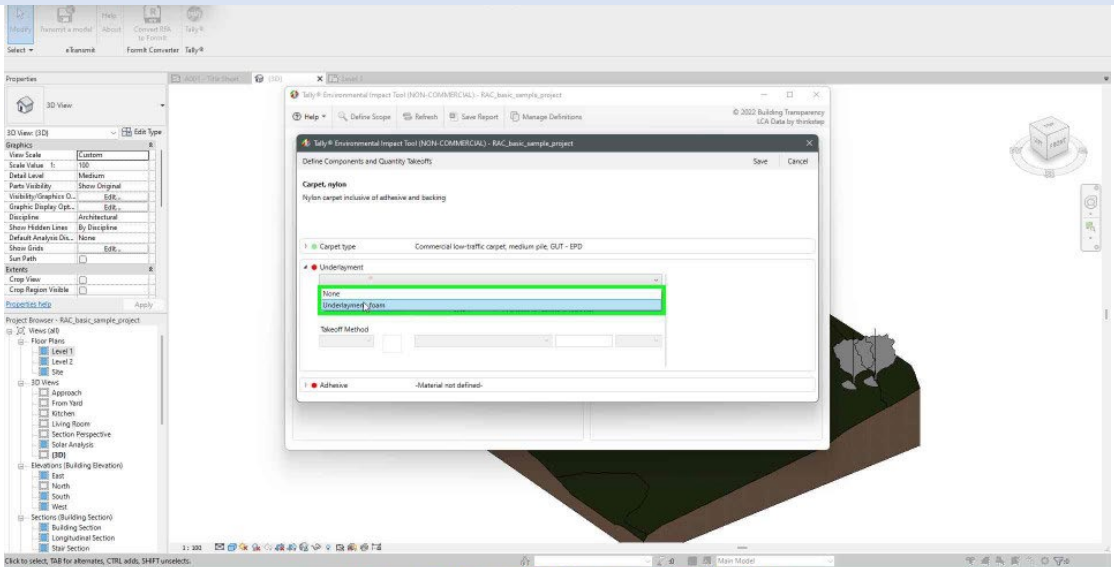


Step 19:

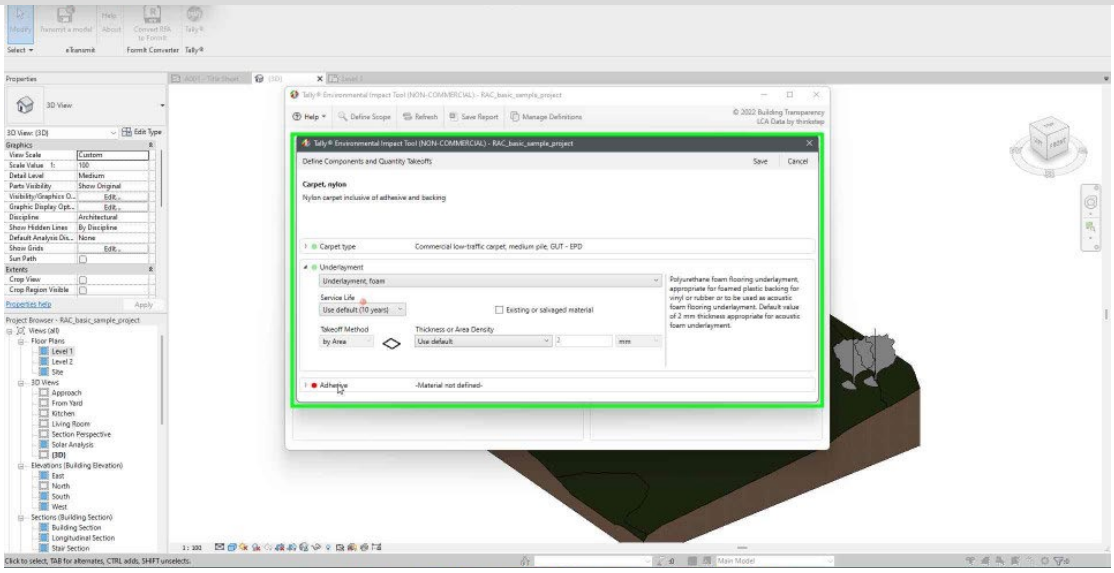
User left click on the material definition drop down for "Underlayment"



Step 20:
User left click on User left click on a specific material type

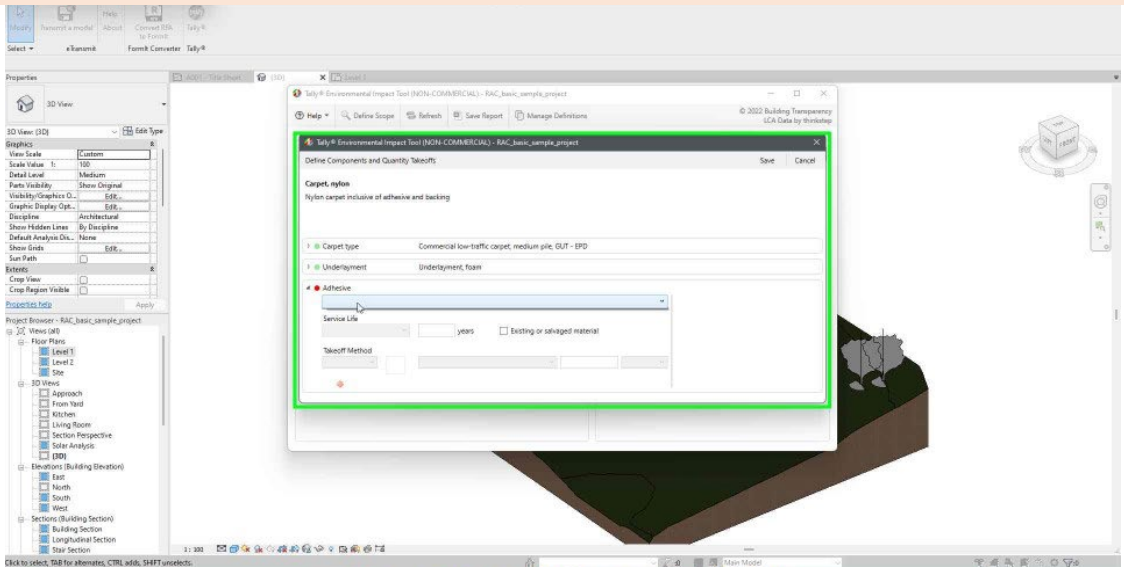


Step 21:
User left click out to allow for default input



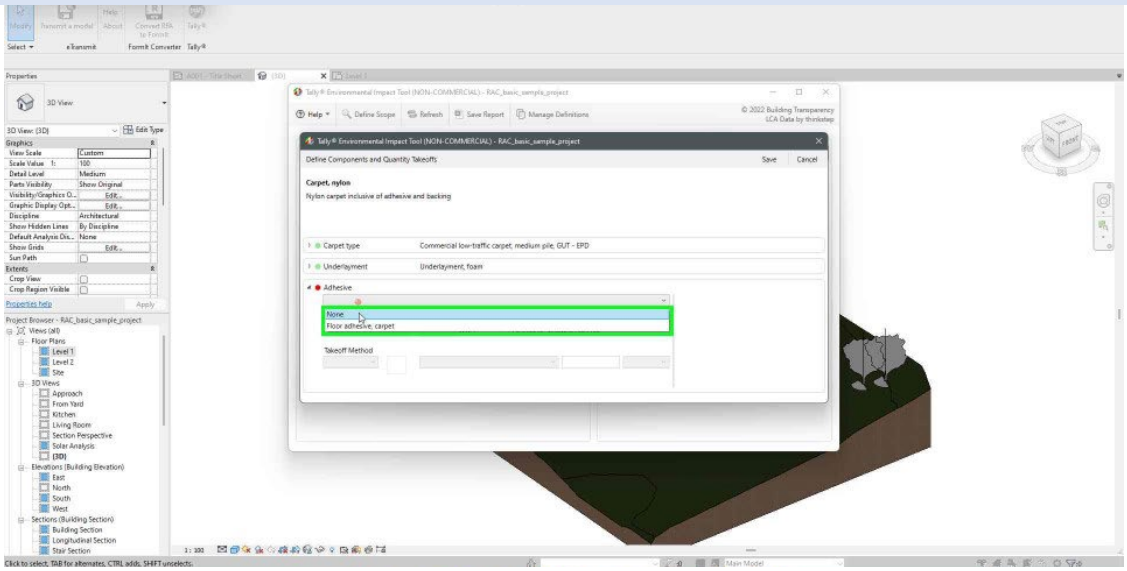
Step 22:

User left click on the material definition drop down for “Adhesive”



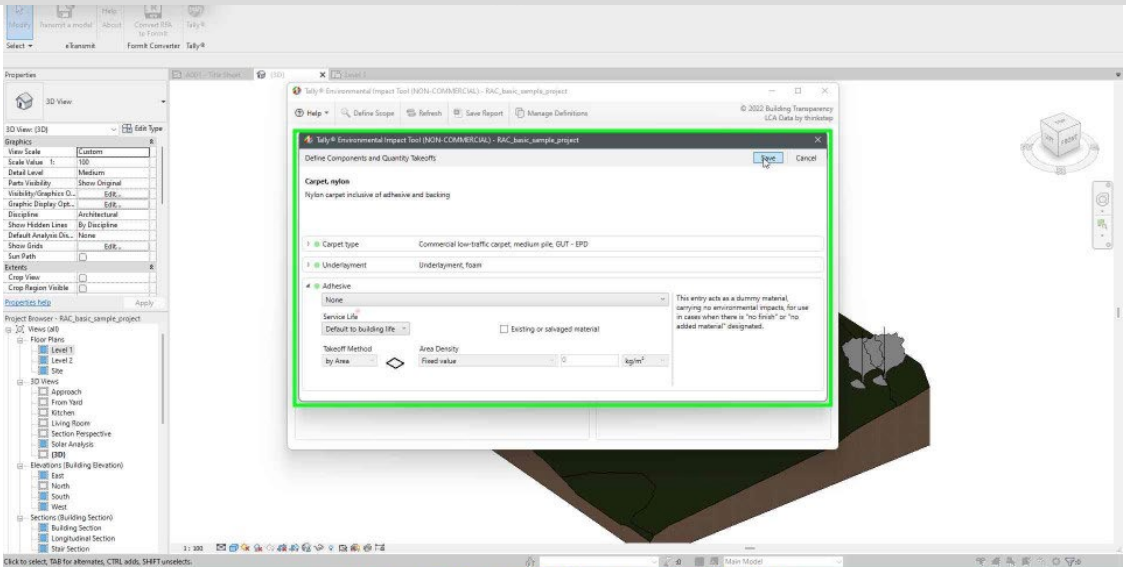
Step 23:

User left click on User left click on a specific material type



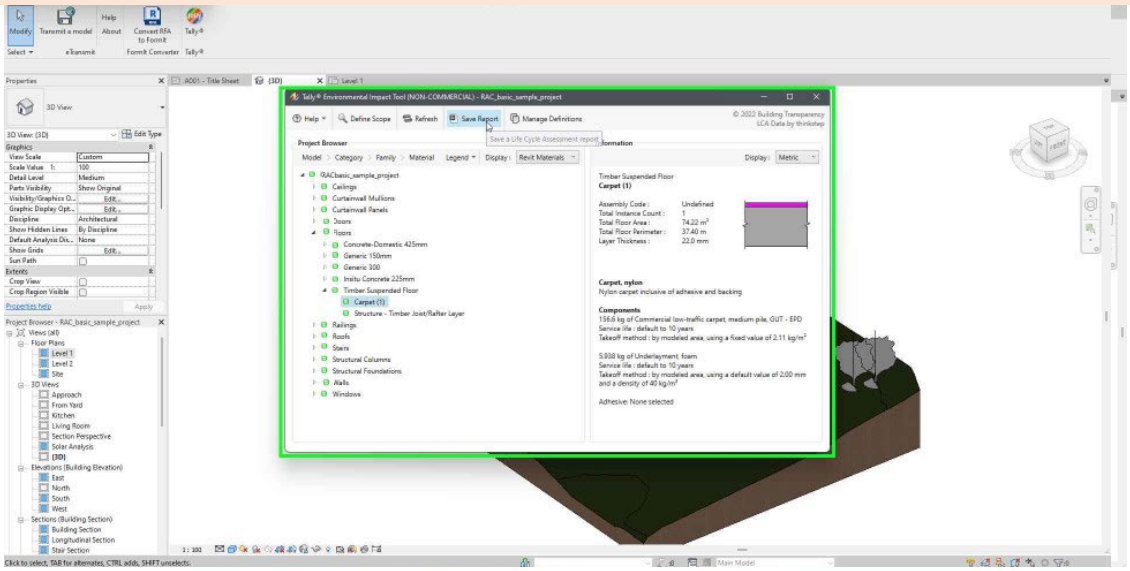
Step 24:

User left click on "Save"

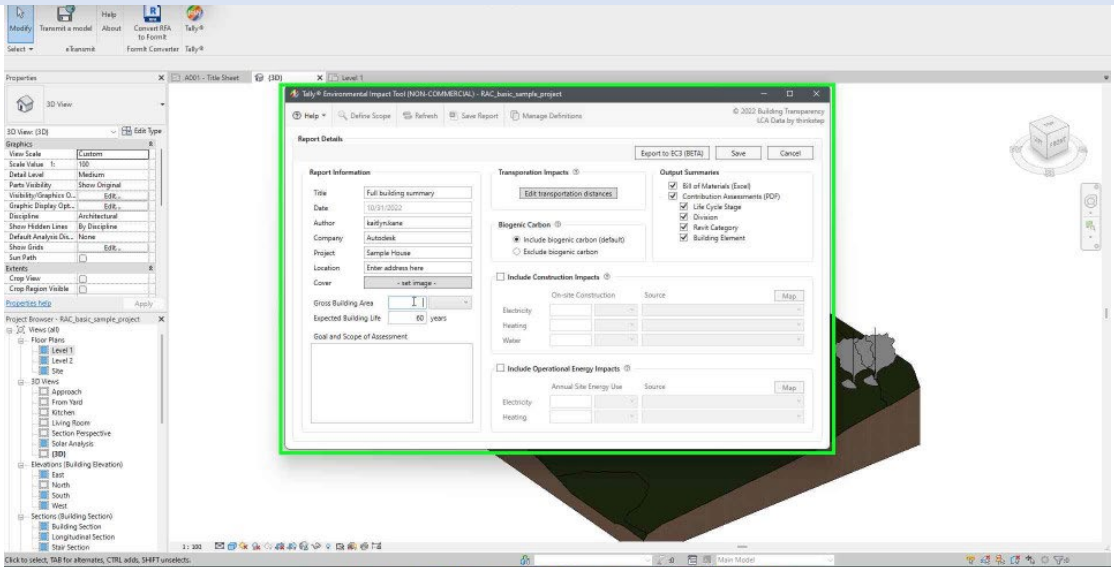


Step 25:

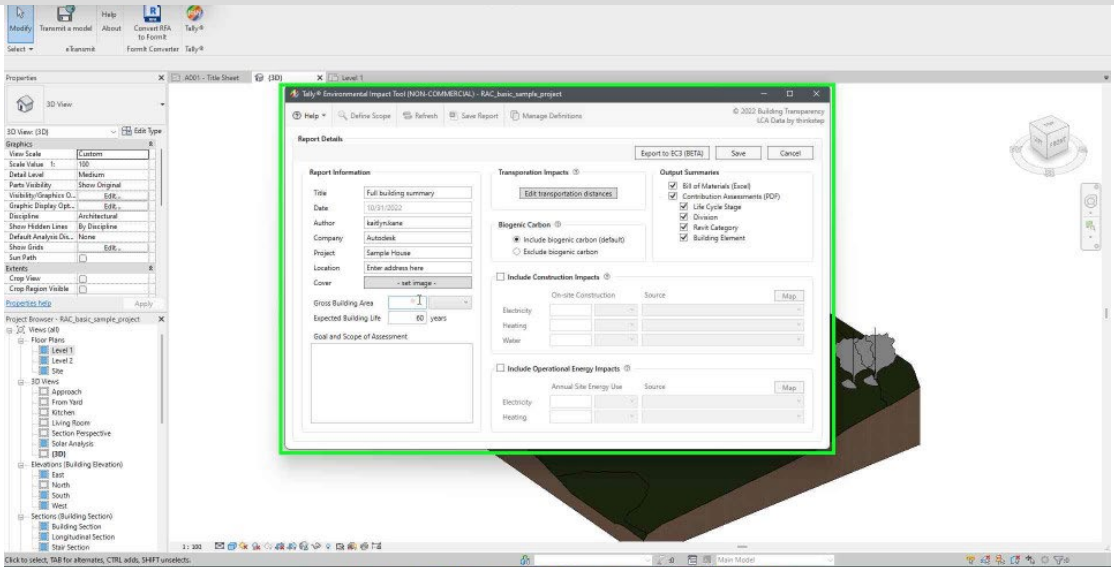
User left click on "Save Report"



Step 26:
User left click the box to the right of “Gross Building Area”

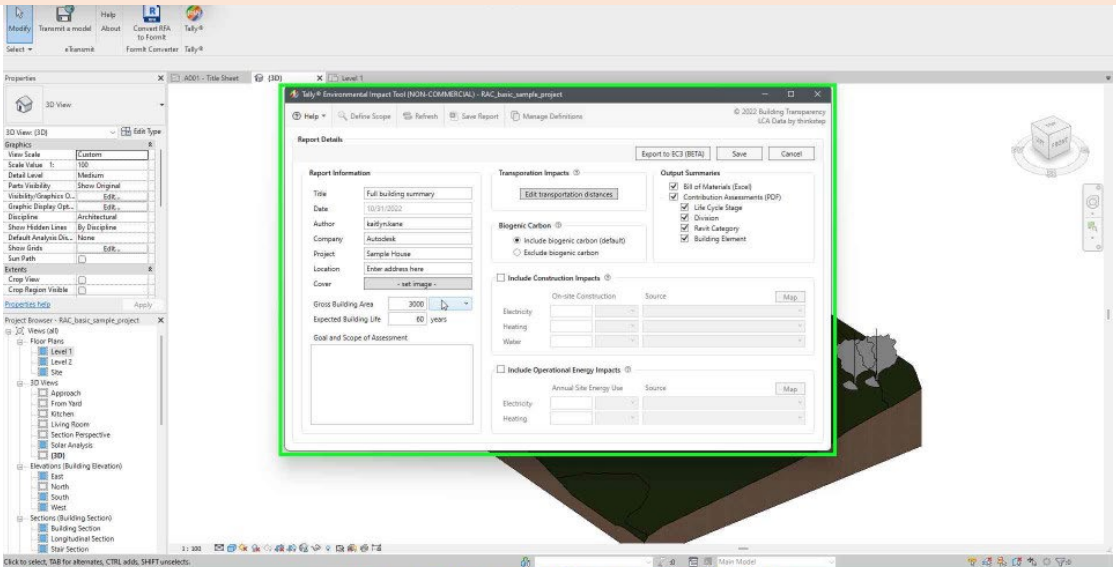


Step 27:
Type the building area amount



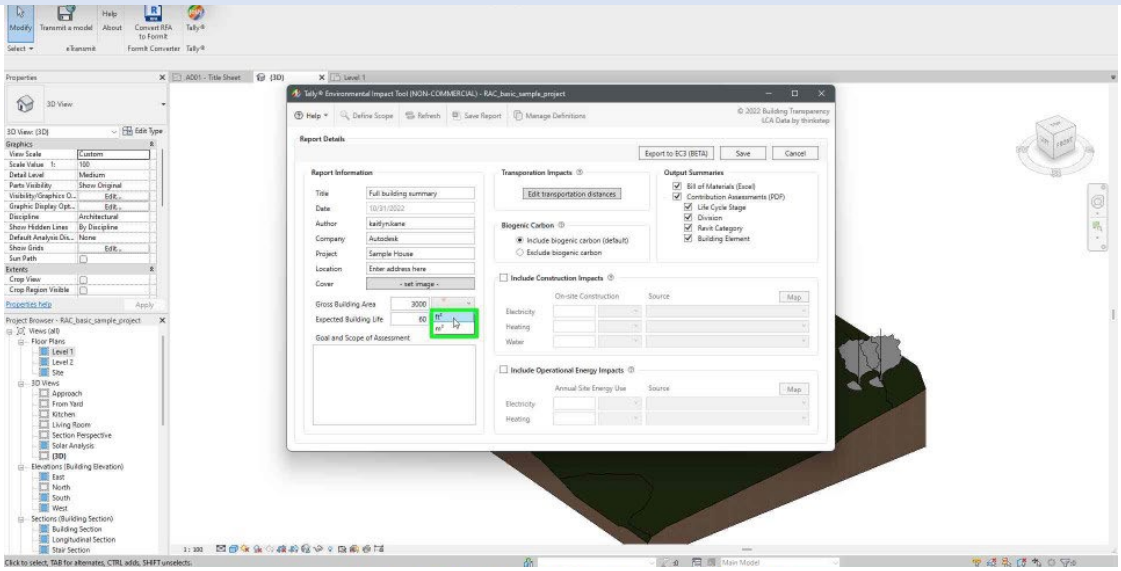
Step 28:

User left click on the box to the right of the building area amount



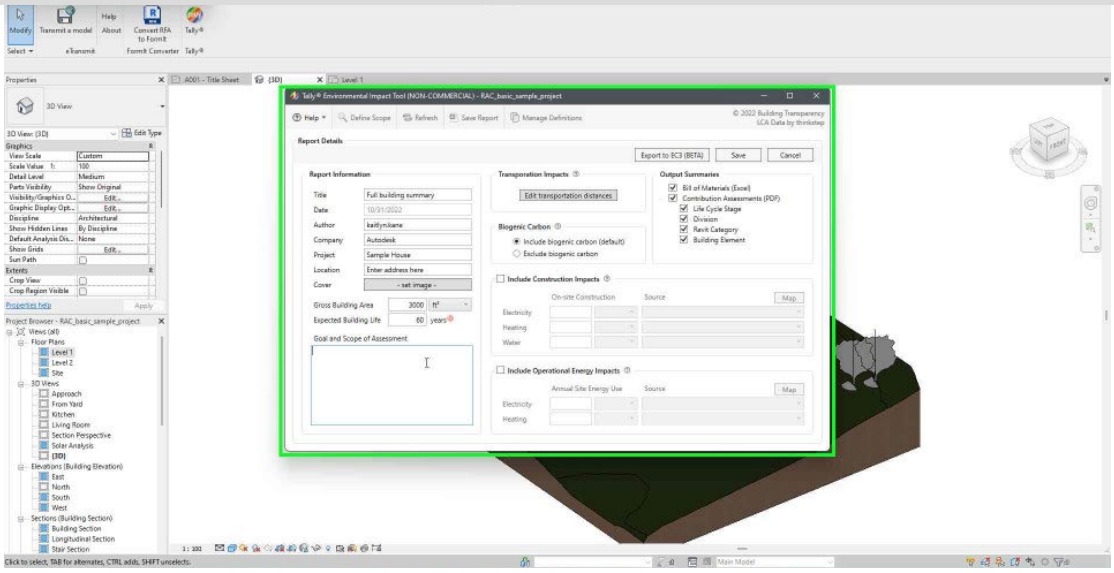
Step 29:

User left click on the desired unit



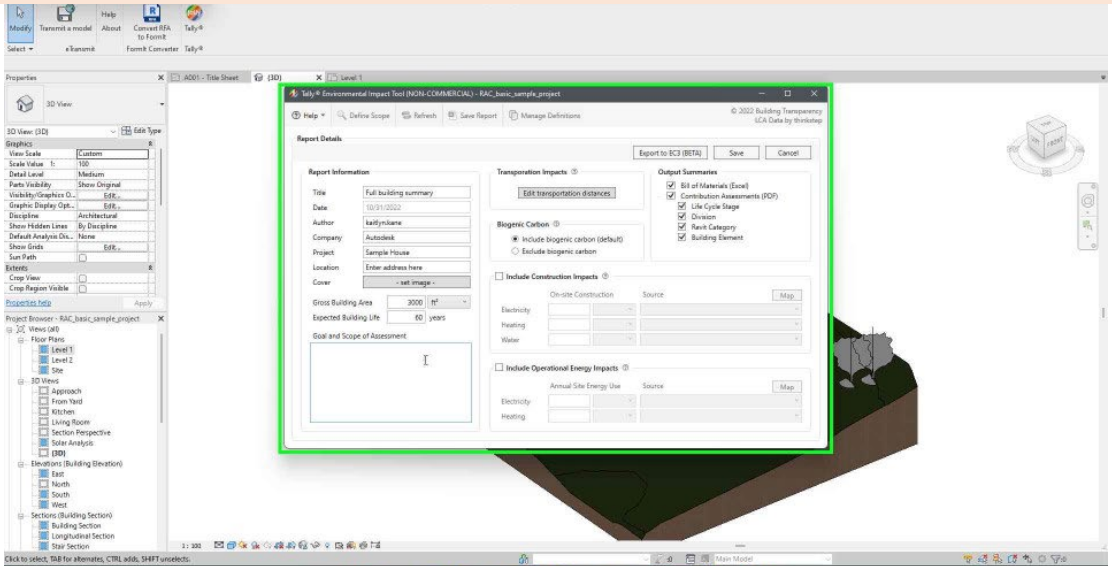
Step 30:

User click on the box below "Goal and Scope of Assessment"

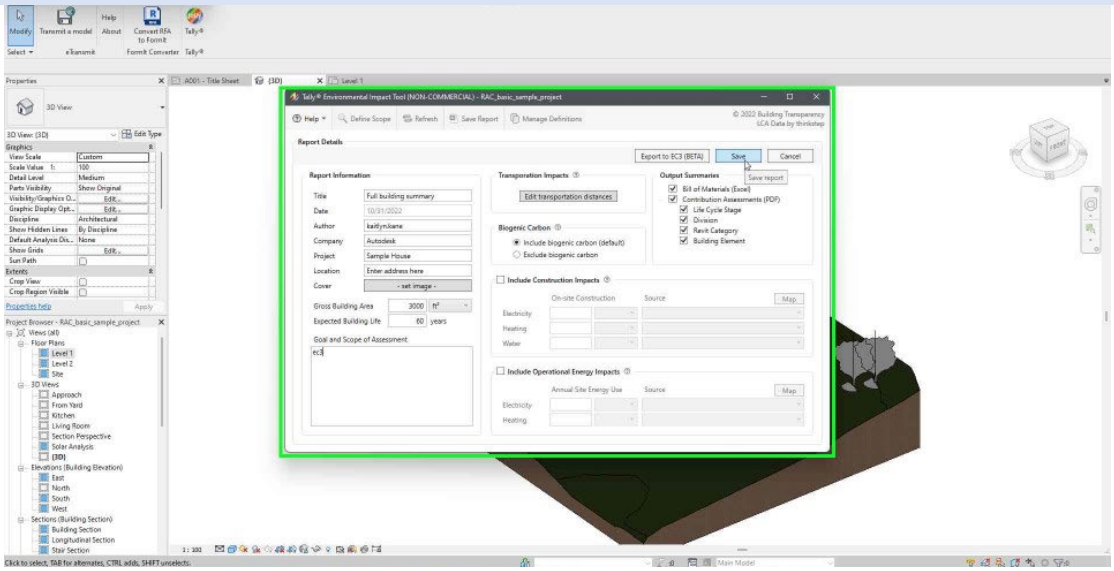


Step 31:

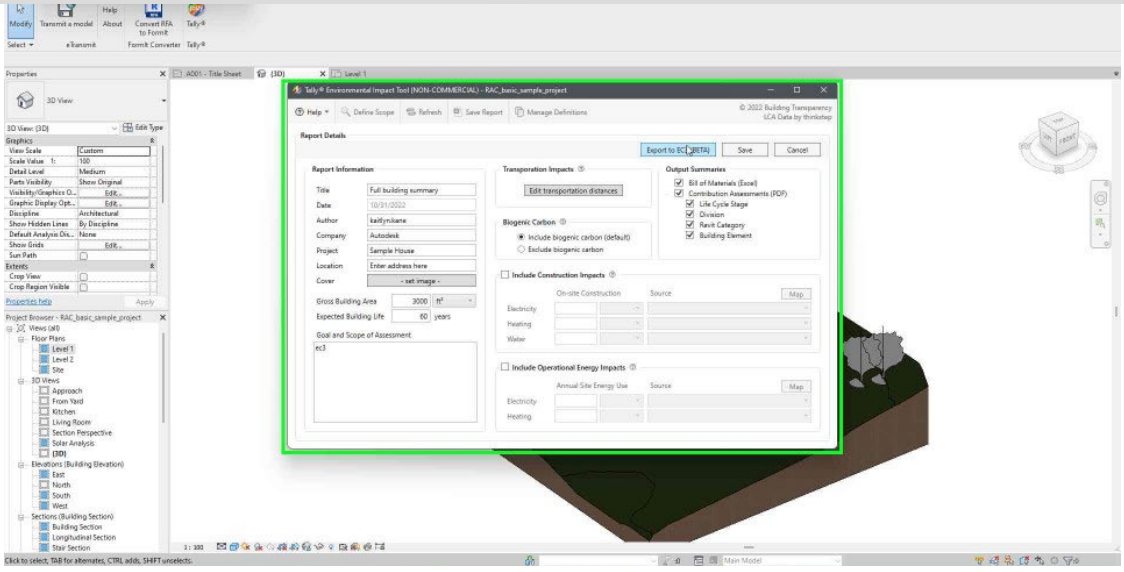
Fill in "Goal and Scope of Assessment" box



Step 32:
Fill out any other information needed to define the project

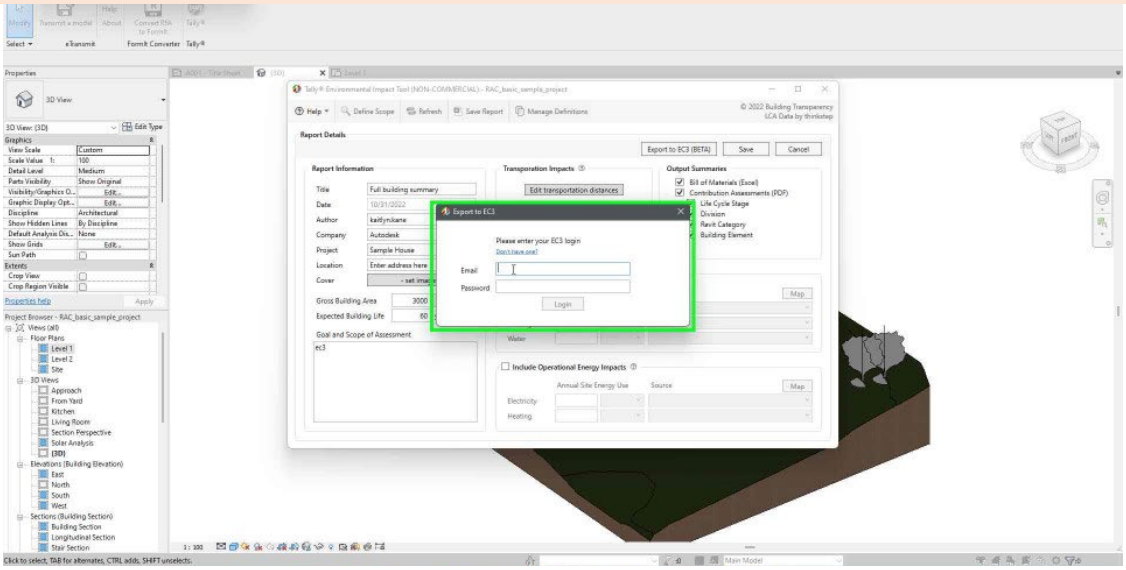


Step 33:
User click on "Export to EC3 (BETA)"



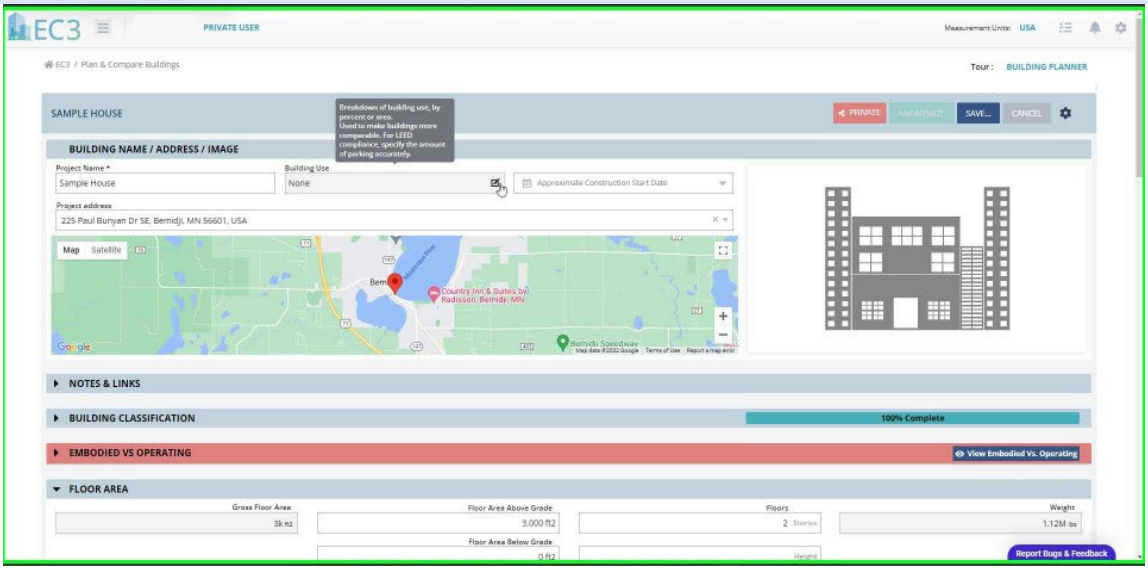
Step 34:

Fill in EC3 account information



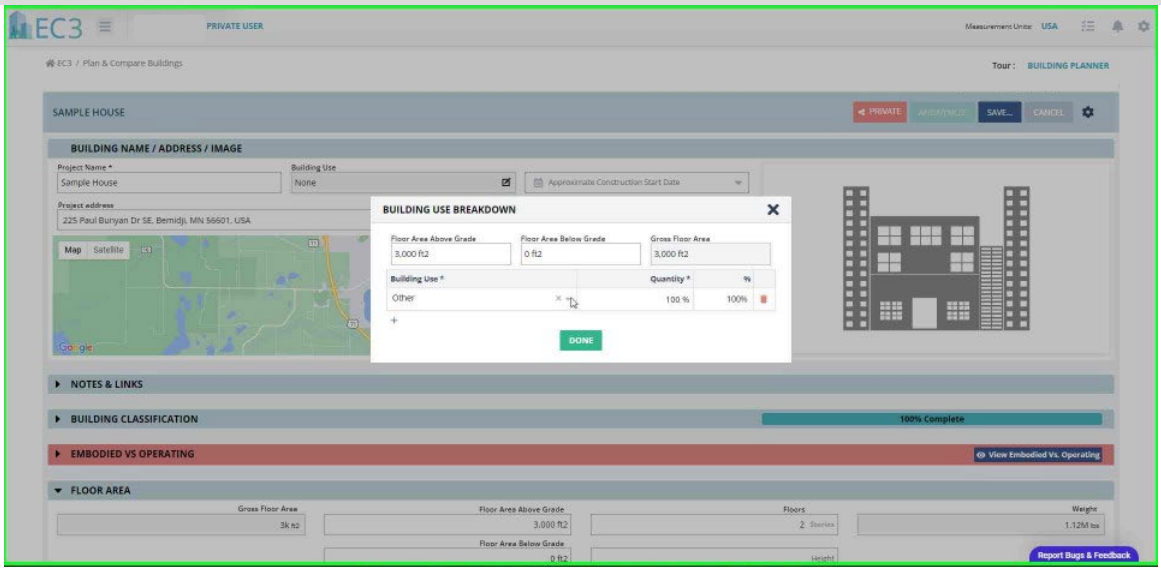
Step 35:

User left click on "Building Use" drop down



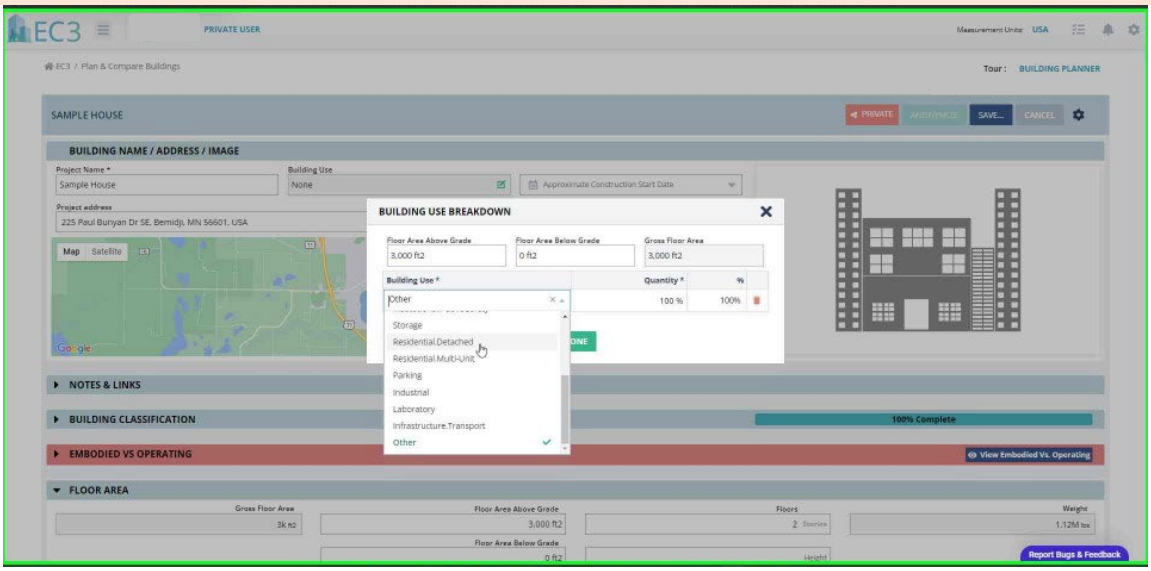
Step 36:

User left click on “Building Use“ drop down

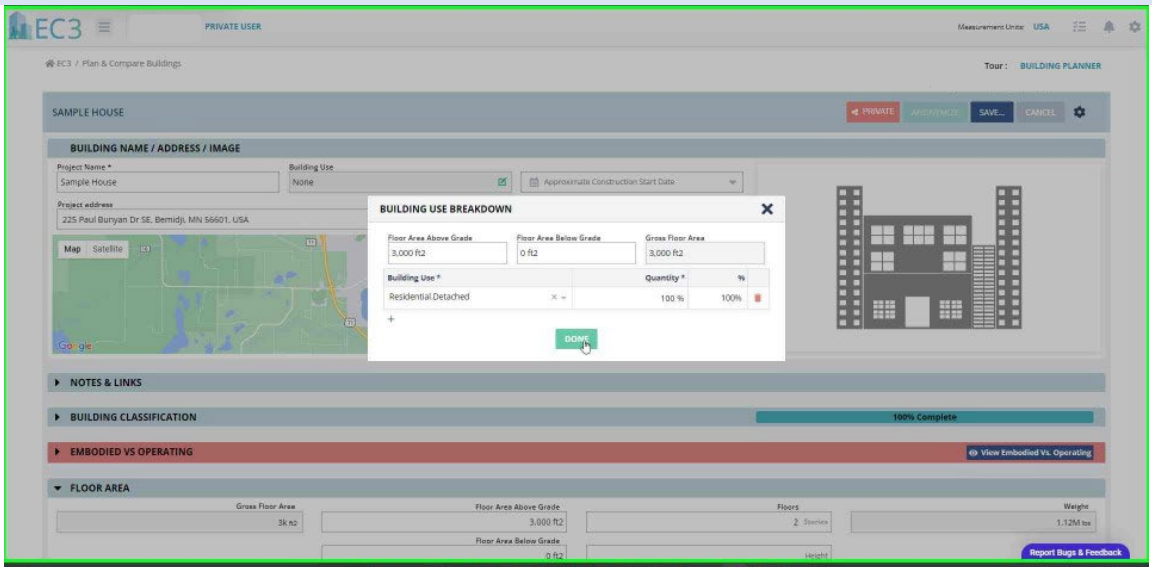


Step 37:

User left click on building use type



Step 38:
User left click on "Done"

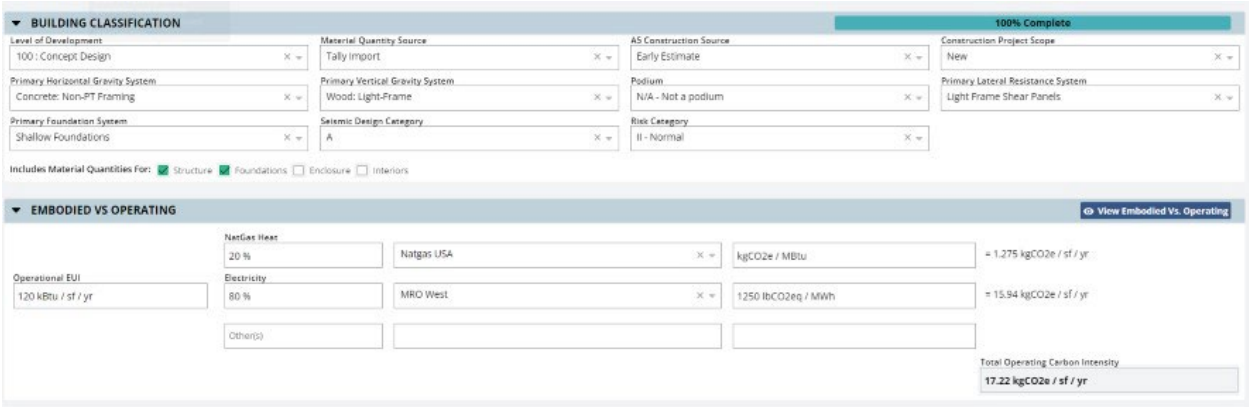


Step 39:

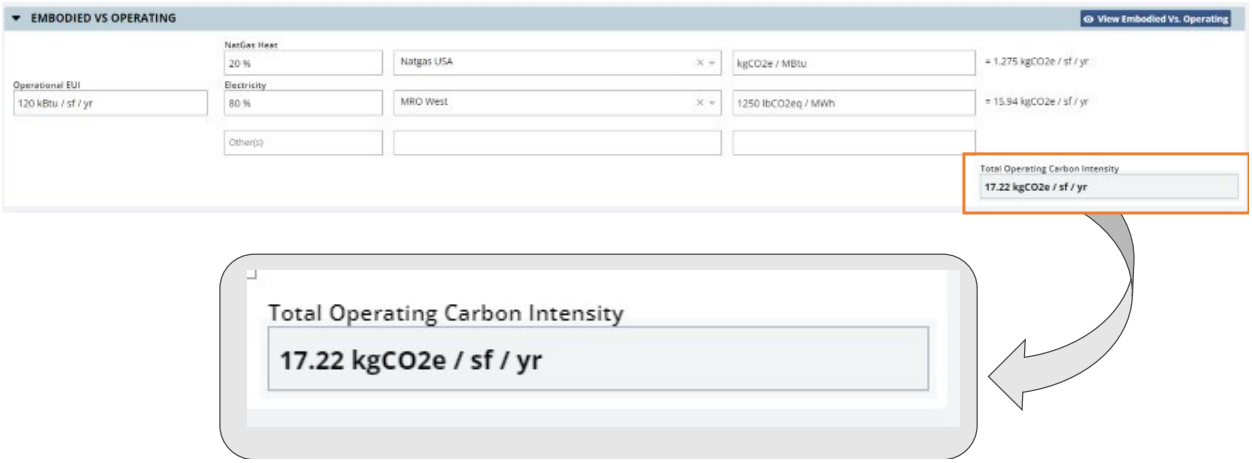
Select the drop down arrow for "Building Classification" and fill out additional building information

Step 40:

Select the drop down arrow for "Embodied vs Operating" and fill out information about the buildings EUI

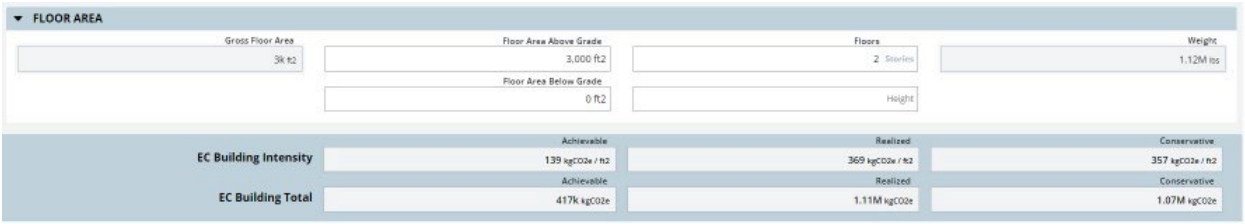


Step 41:
Look at the bottom right of the "Embodied vs Operating" section to find the buildings Total Operating Carbon Intensity

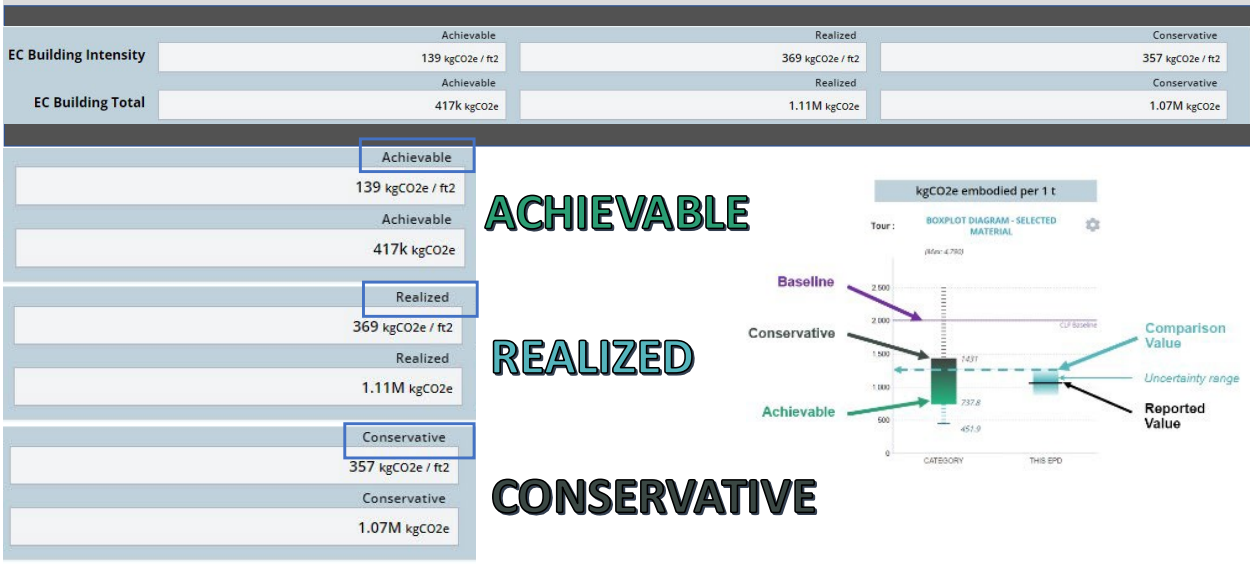


Step 42:

Select the drop down arrow for
"Floor Area" and fill out additional building area information

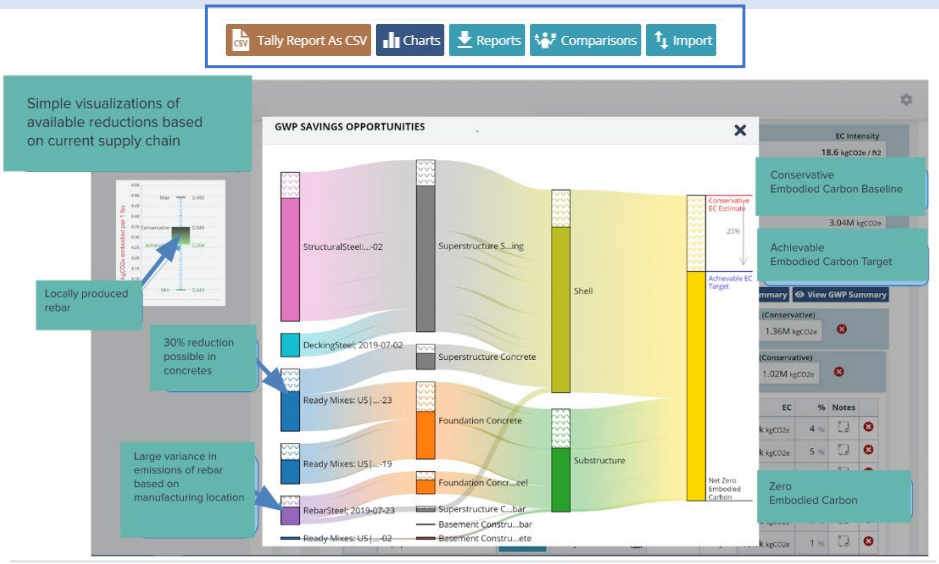


Step 43:
Review emission outputs



Step 44:
Scroll further down to review materials and their properties.

Step 45:
At the top of the materials list, click on the different colored tabs to access many different charts and report information



Review and analyze EC3 data to find out individual material information and emissions along with total building emissions.

Use this information to obtain carbon emissions to set a new goal for improvement.

Visit https://www.buildingtransparency.org/ec3resources/ec3-user-guide/ for more guidance in EC3 Tool