ENERGY AND BUILDINGS
2021 – 2022

Thermal zoning and geometry creation

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Practical info

Installation file

Google doc for questions:
https://docs.google.com/document/d/1PrbHYNKNaYRuopPOKa5YK-MYZ2CjoabTDx8nm5rcyZY/edit

Questions and answer meeting on Thursday 14:30, Seminar room (ex Fisica Tecnica)

Information about the report in moodle. After the practical lectures there will an in-depth explanation of the report

Software

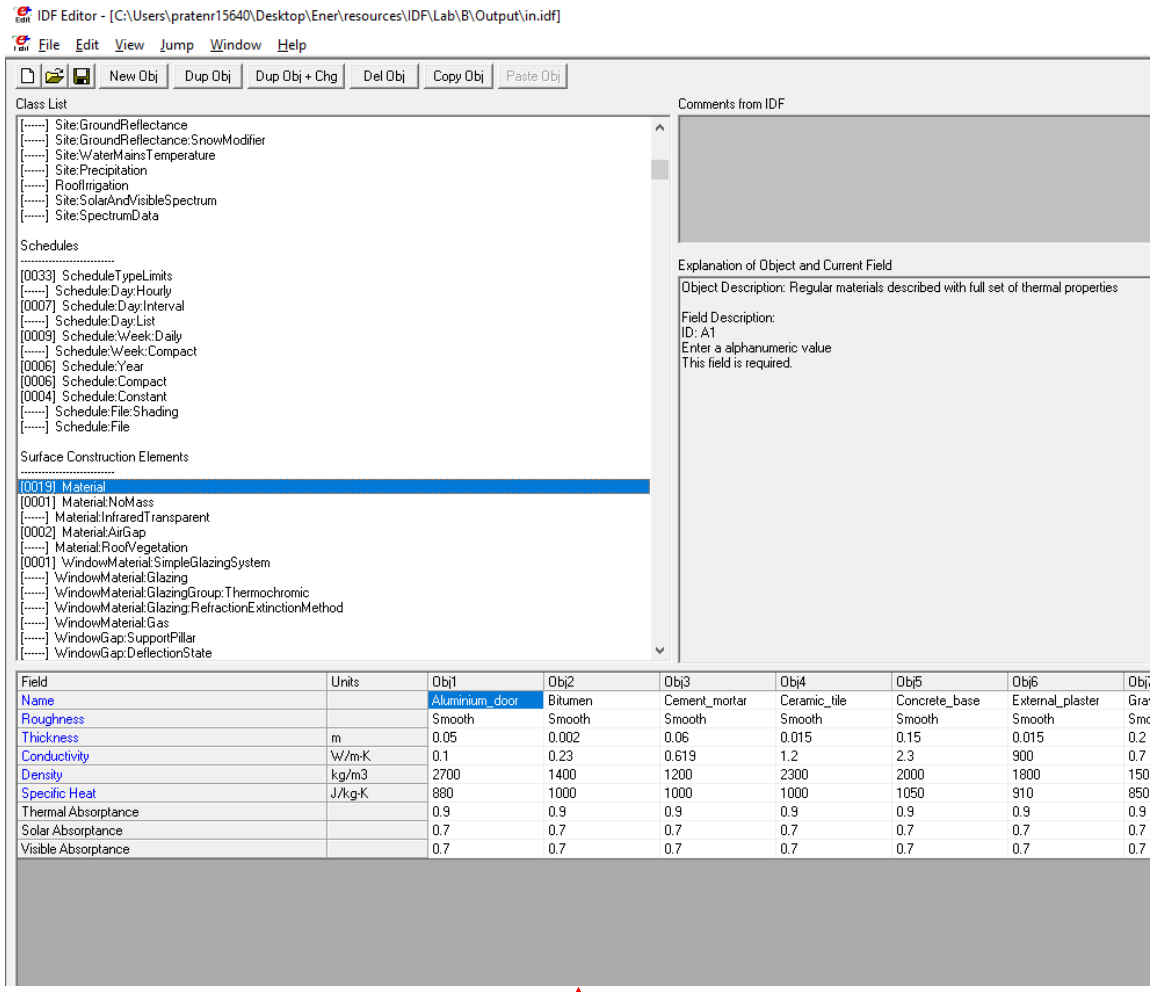
Installation of the tools

1. SketchUp
2. OpenStudio
3. EnergyPlus

Everything ok?

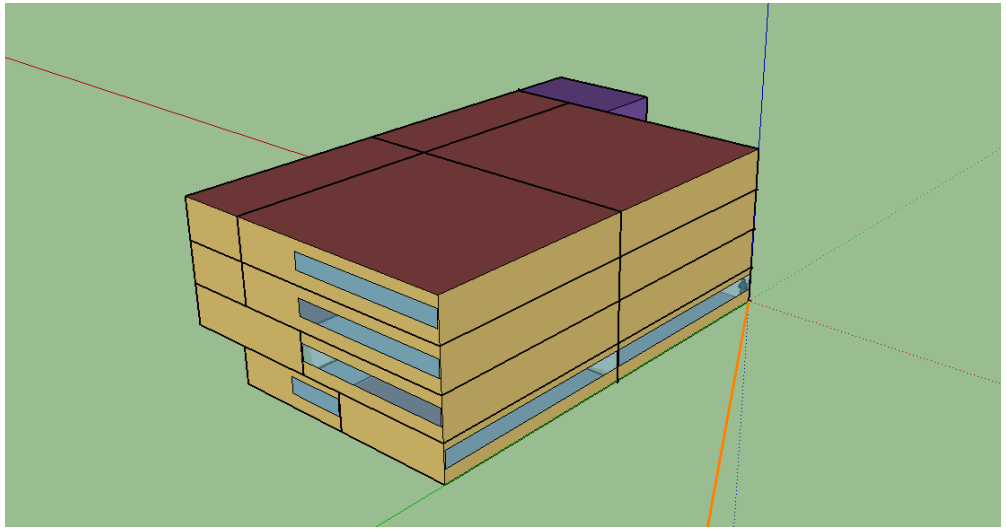
What is EnergyPlus?

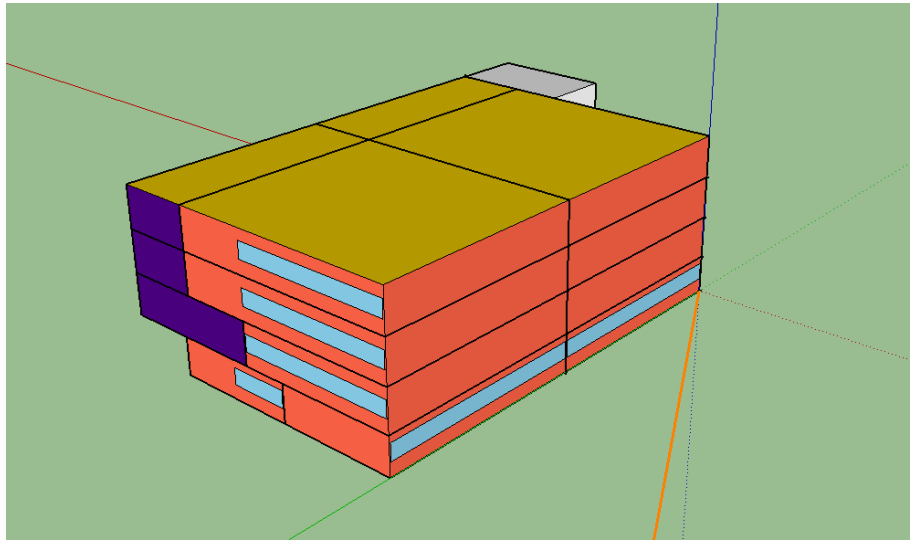
1. Open source Building Energy Simulation tool
2. Very detailed (new Standards are moving towards an hourly calculation)
3. All the internal models are quite complex
4. Very powerfull! Plenty of features supported: HVAC system, IEQ, photovoltaic production, daylighting, ...
5. Useful for LEED and other certificates
6. **Not user-friendly**! Only a solver not a GUI



SketchUp – 3D Modeling

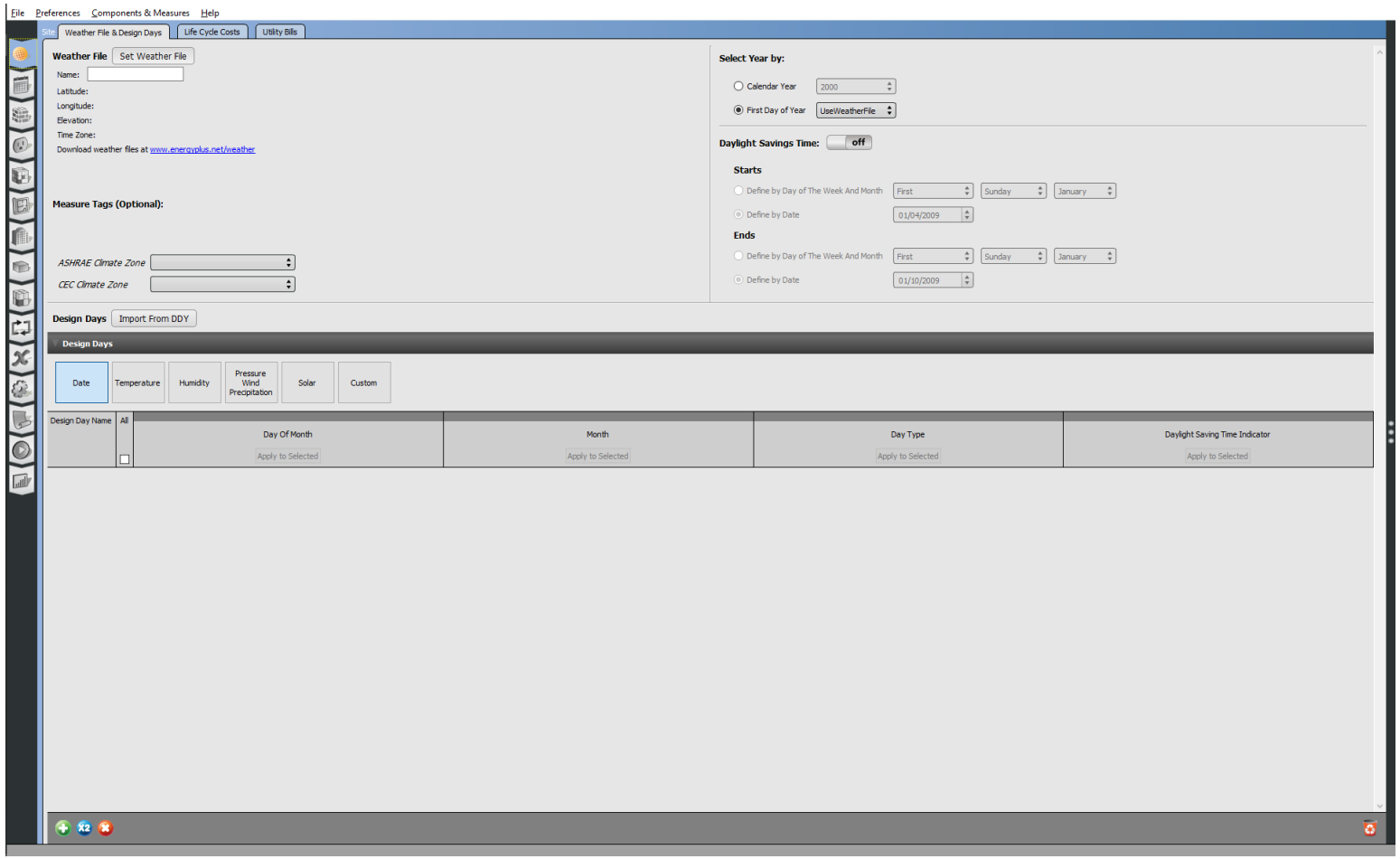
1. Powerfull tool for 3D rendering
2. We will use it for the creation of geometry
3. Creation of thermal zones
4. Assign surfaces boundary conditions and constructions





Openstudio

1. Graphical User Interface of EnrgyPlus
2. Used to create and modify easily the model
3. Linked to SketchUp through the plugin



Design of the model

1 - Geometry definition

2 - Input/Output definition

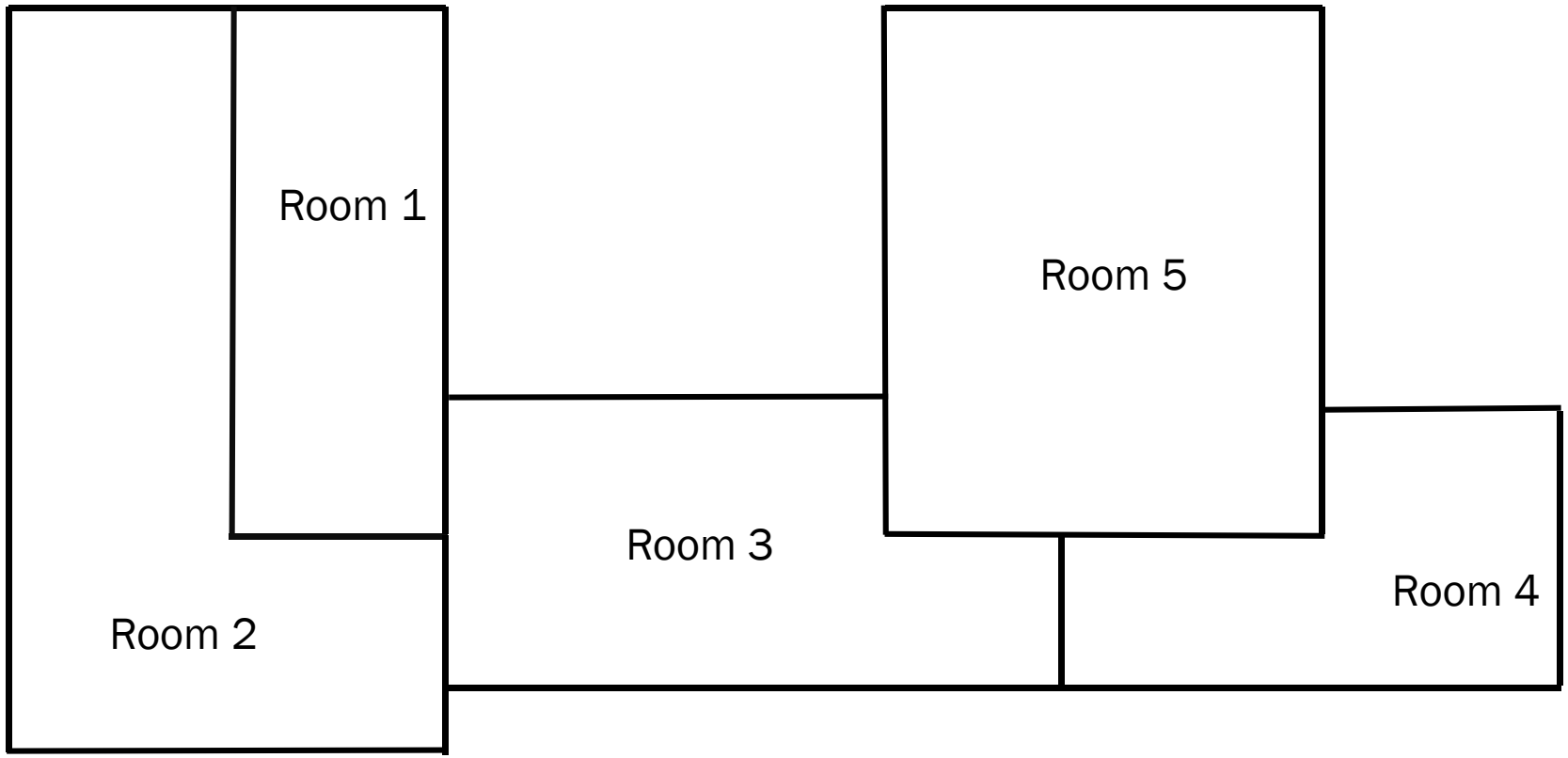
3 - Simulation

4 - Analysis of the results

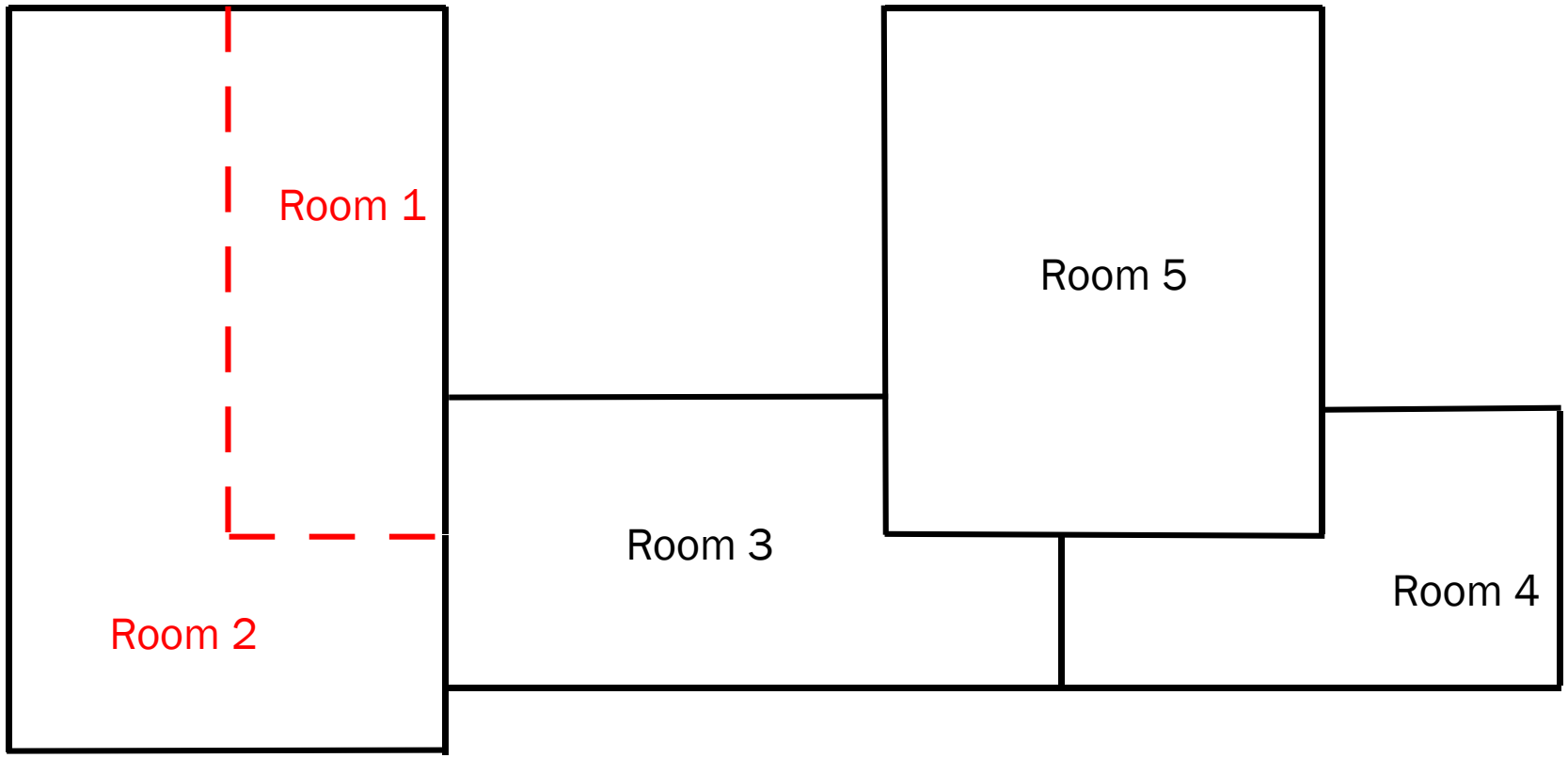
«Zone» the building

1. First thing to assume and think in a Building Energy Simulation
2. **Thermal Zone**: not a geometric concept!!!
3. Thermal concept: the control volume of an energy balance
4. Includes the air volume and the surrounding surfaces
5. Usually the boundaries are real surfaces (adiabatic or heat transfer surfaces)
6. Different criteria to subdivide a building in thermal zones

Zoning Example - 1/4

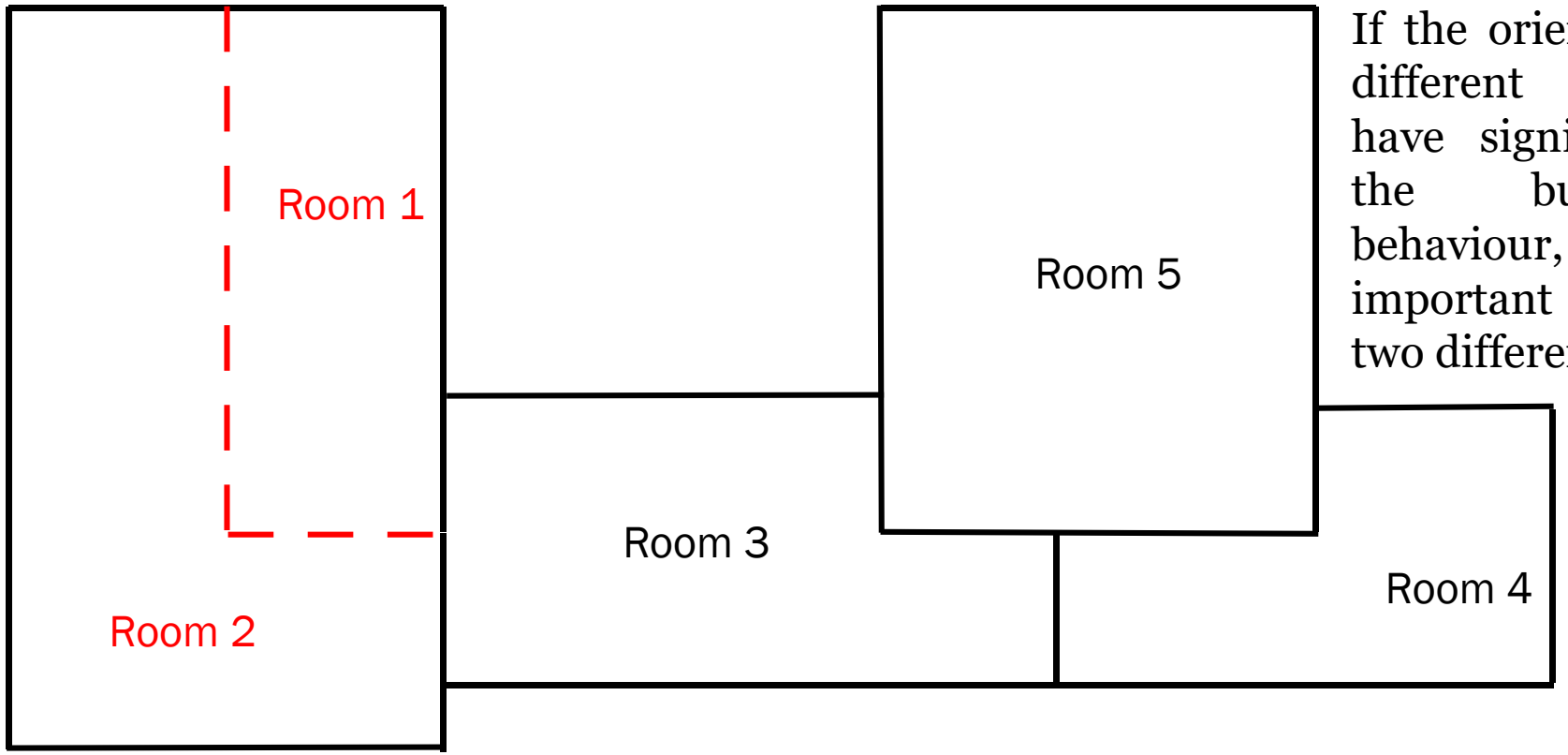


Zoning Example - 2/4



Room 1 and 2 are served by the same system at the same temperature; in general they can be defined as a single zone.

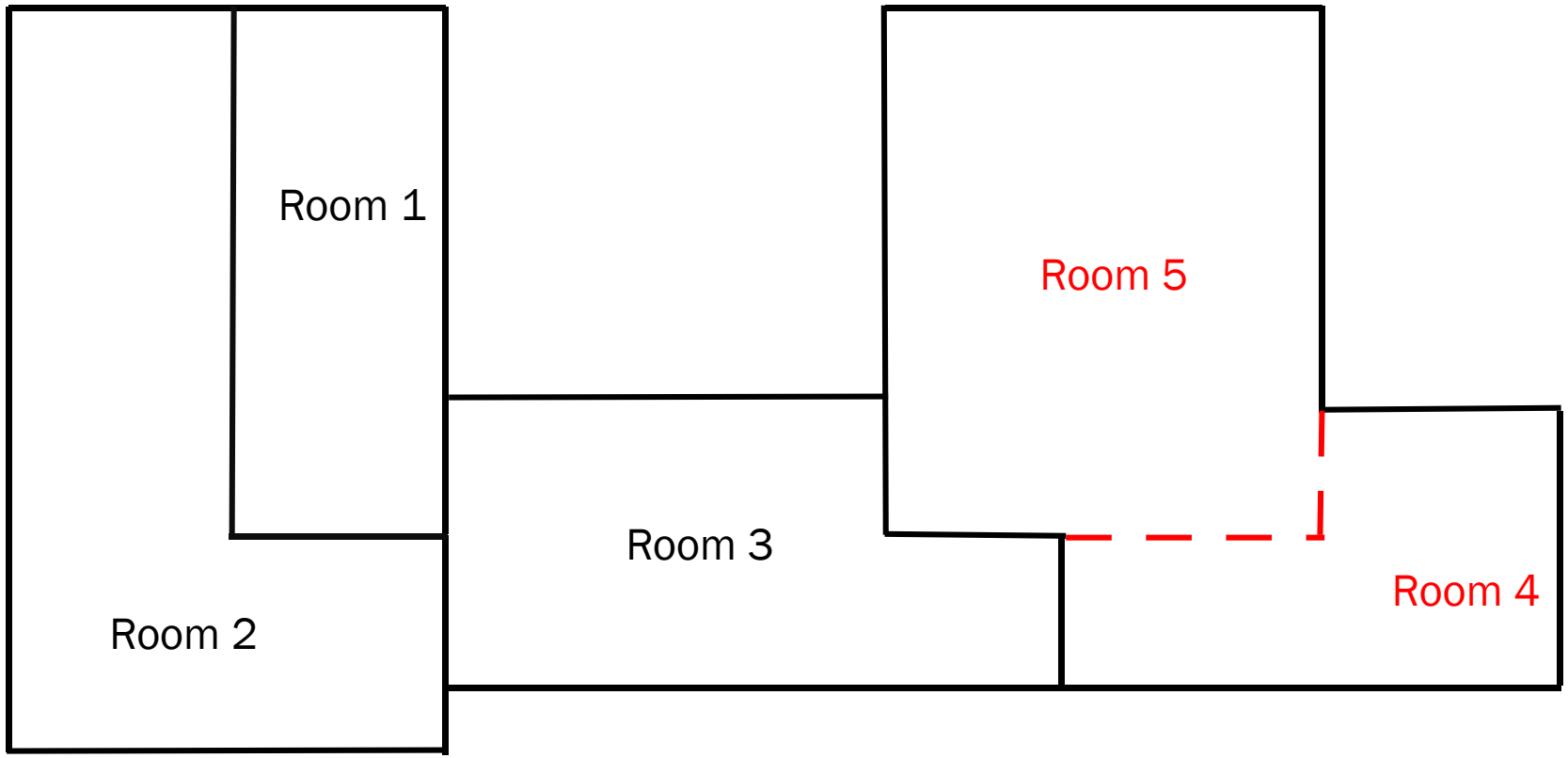
Zoning Example - 3/4



If the orientation is defined, different solar gains may have significant impact on the building energy behaviour, and it becomes important to split them in two different zones

Room 1 and 2 are served by the same system at the same temperature; in general they can be defined as a single zone.

Zoning Example - 4/4



Even though Room 4 and Room 5 are physically separated by walls, if:
1. the envelope materials are similar
2. they have similar end use (similar setpoints and internal heat gains) → They can be considered as one
3. They have the same supplying system

OBJECTIVE of the report:

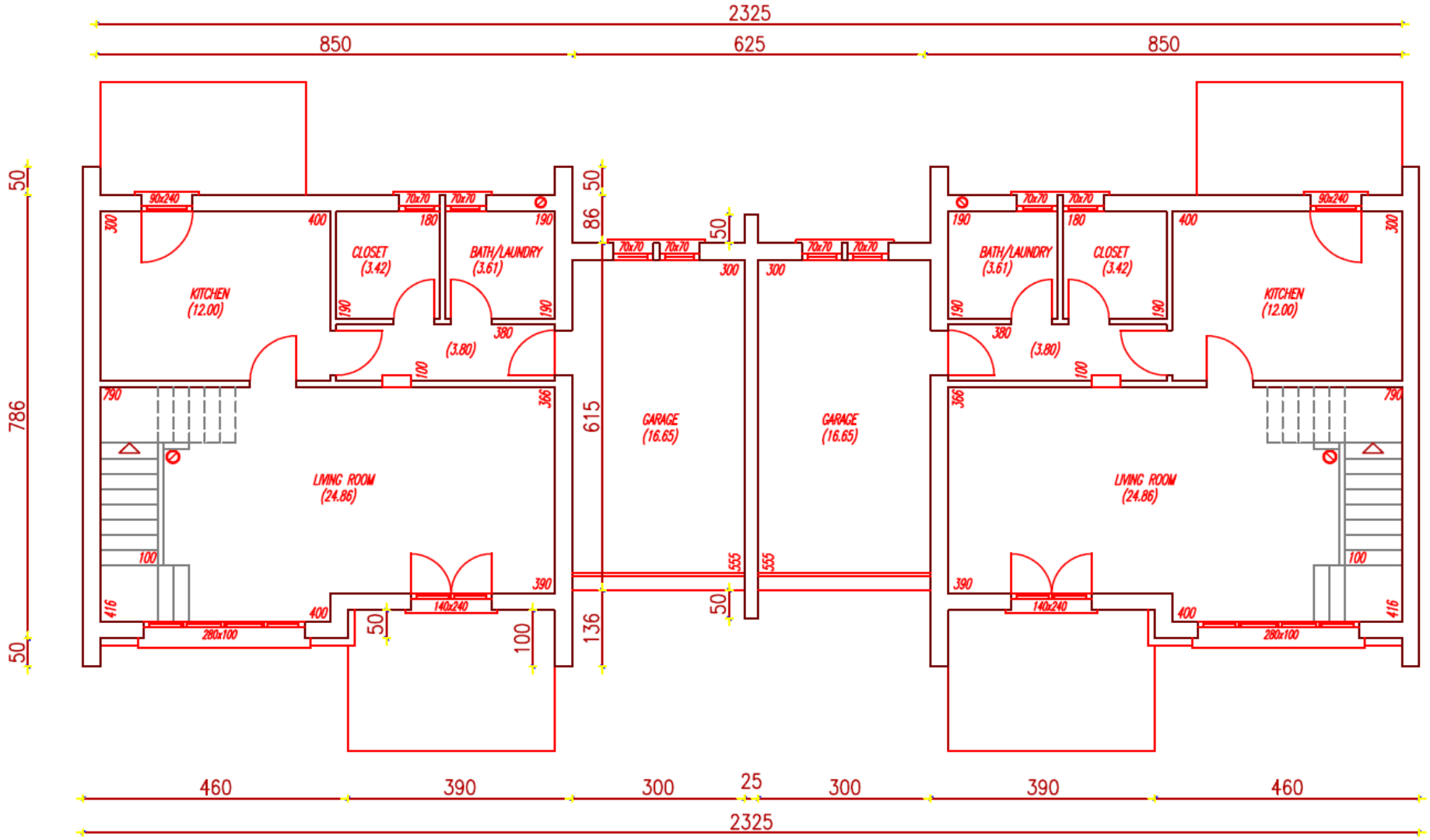
The objective of this project is to define the **DETAILED MODEL** of your house/apartment. Therefore, the zoning part is fundamental because according to the end-use you may have different input values.

Some suggestions:

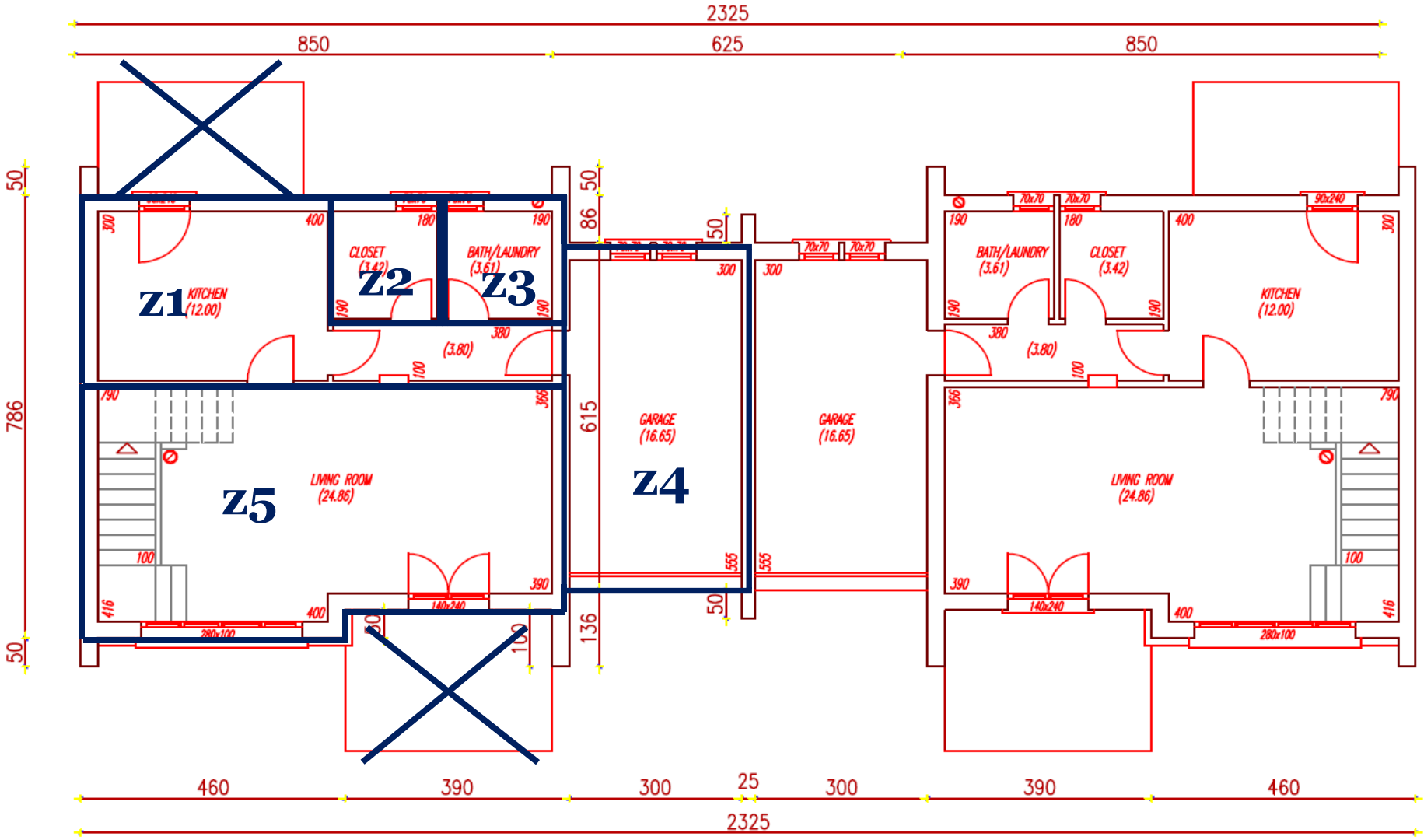
- If you have adjacent bedrooms, you can consider them as a unique thermal zone.
- If laundry and toilet are adjacent, this can be a unique thermal zone too.
- If you can reduce the number of zone and simplify your model, do it! This will help you in having a lighter, fast, and easy model.
- Depending on your house, the number of thermal zones should be between 3 and 10

Each assumption must be clearly explained in the report when you present the zoning strategy

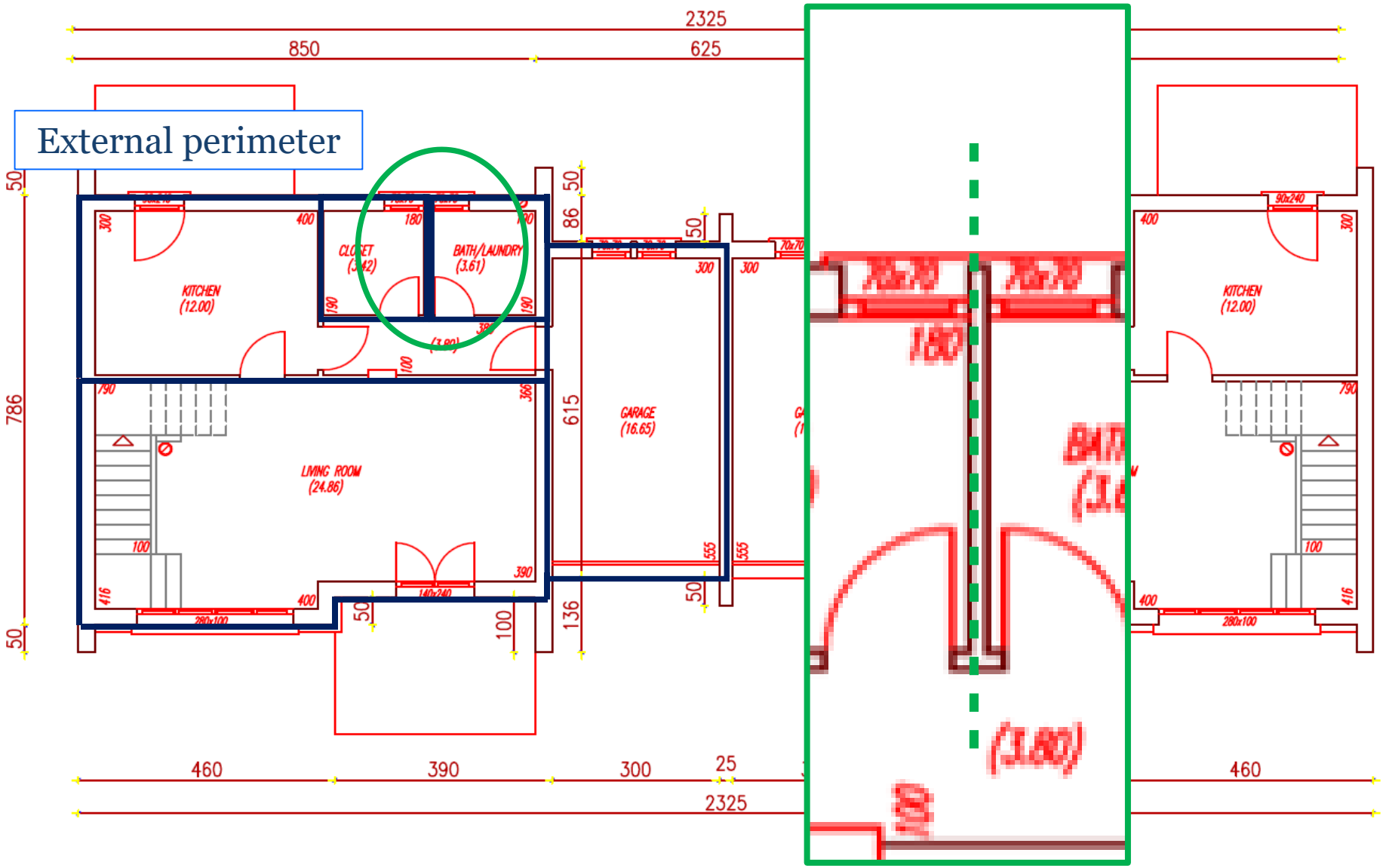
Example Detached House – Ground Floor



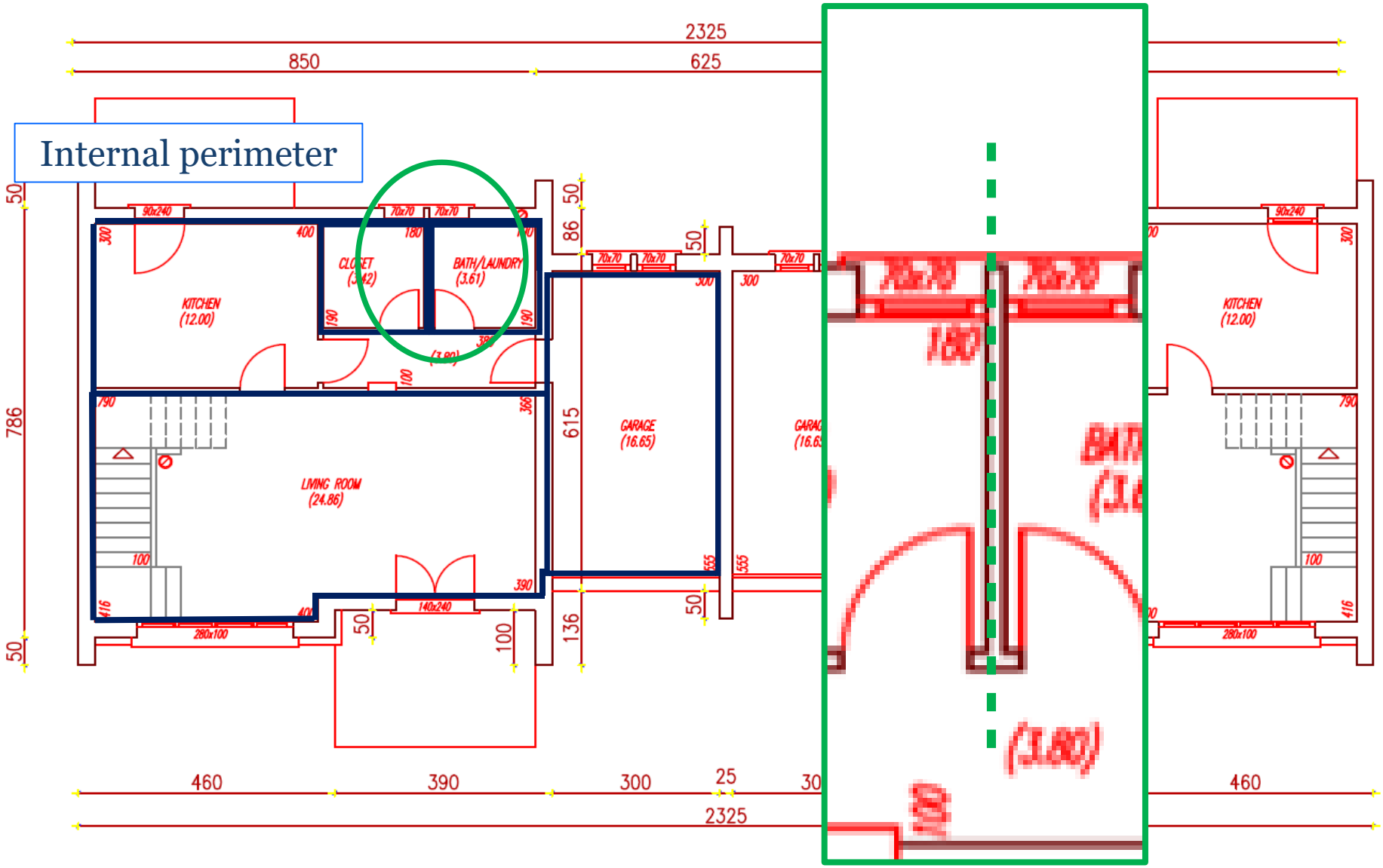
Detached House – Ground Floor



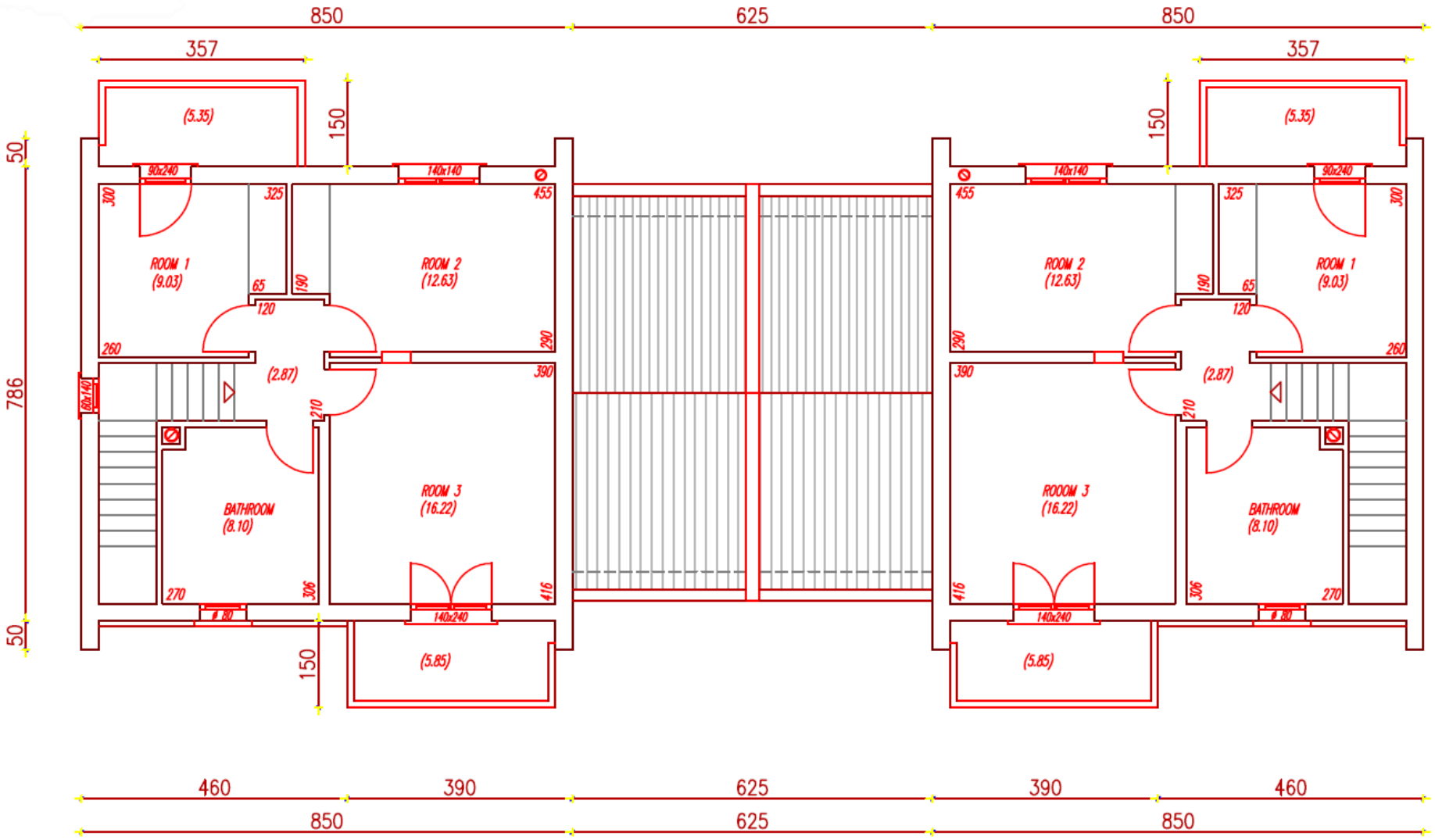
Detached House – Ground Floor



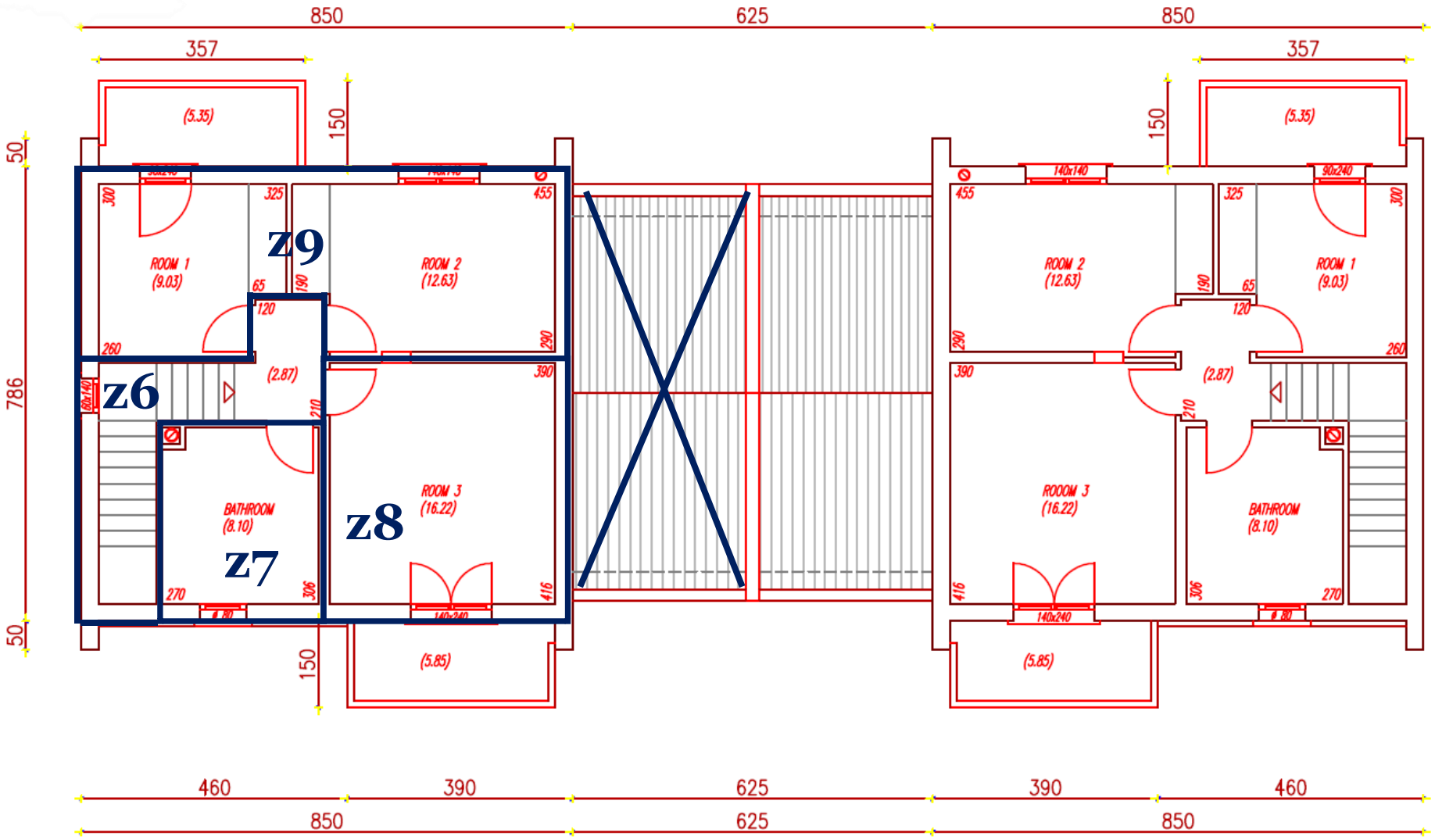
Detached House – Ground Floor



Detached House – First Floor



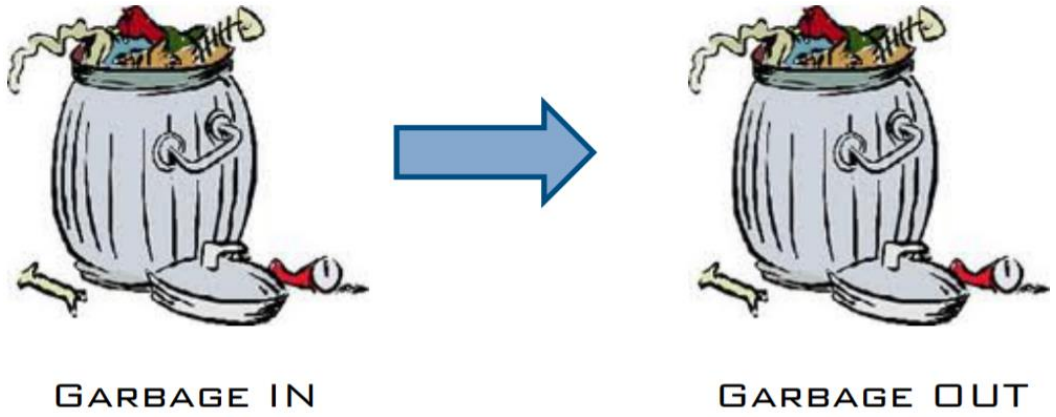
Detached House – First Floor



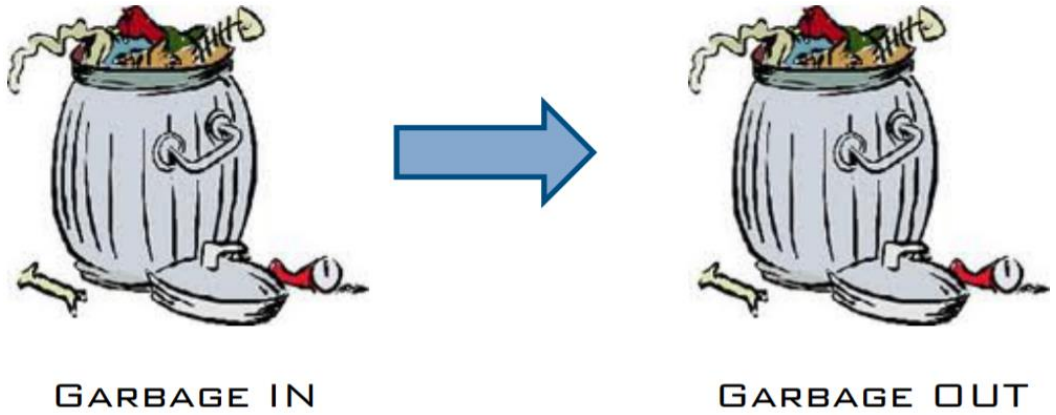
2. Draw the building

- 2D drawing
- Extrusion
- Match
- Add windows

The geometry you're about to start drawing and the input you're entering in SketchUp and Open Studio are the basis of the whole simulation.
Therefore, **if the geometry is not precise, the whole model will be affected by this error**



There are many issues with the geometry creation. **Open zones, surfaces that do not match, non-convex surfaces, non simmetric structures**…



1. Are you sure you are INSIDE a new space? → NO → Draw a new space!

YES

2. Bug of the tool: right click on the surface → Reverse surface – this should work 90% of the time

YES

It's done!

NO

Assign them manually

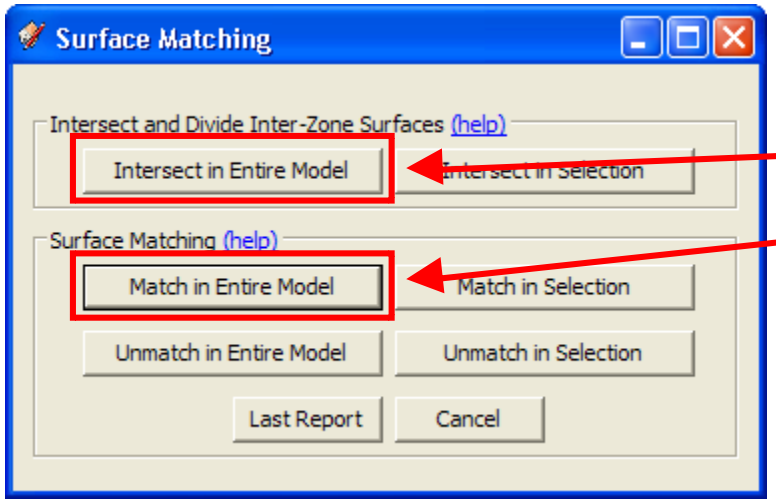
TO DO: Filter the convex/concave external surfaces and either delete them or repair them, otherwise it will appear as an error.

Surface Matching

Try the Intersection of the selection first and let the entire model at the **end**.

If you have multiple floors, do the intersection with the following order:

1. Adjacent vertical walls on the same floor
2. Adjacent slabs on different floors



SAVE THE PROJECT BEFORE CLIKING ON «INTERSECT» OR «MATCH» ENTIRE MODEL

Tips

- Open often the **warning window** to understand if something is going wrong
- Try to use **simple shapes** as rectangles and triangles
- Use the **filter function** to search hidden objects
- **Eventually** delete them opening *model.osm* **as text file**
- Firstly, try to create a simple model, just to understand how SketchUp works; then move to your house

Typical mistakes and errors

- Check if you are inside the space before creating the surfaces
- Control the orientation of the surfaces (darker outside)
- Check non-convex external surfaces
- Check surface matching!
- Again: Check surface matching!
- Check the materials of the structures

SketchUp – Basic Tutorial

https://www.youtube.com/watch?v=VZUMTlTFzFk&list=PL8yXEVRWzpa3pdVB0kgfAEWv1Y1tWra9g – **Part 1**

https://www.youtube.com/watch?v=901ls3NS41A&list=PL8yXEVRWzpa3pdVB0kgfAEWv1Y1tWra9g&index=2 – **Part 2**

https://www.youtube.com/watch?v=rCNpFTyyKuM&list=PL8yXEVRWzpa3pdVB0kgfAEWv1Y1tWra9g&index=3 – **Part 3**

Old but still good

Additional Information

- Google Doc to fill up with **Questions**:
https://docs.google.com/document/d/1PrbHYNKNaYRuopPOKa5YK-MYZ2CjoabTDx8nm5rcyZY/edit

- **Be patient** and remember to **save often**!