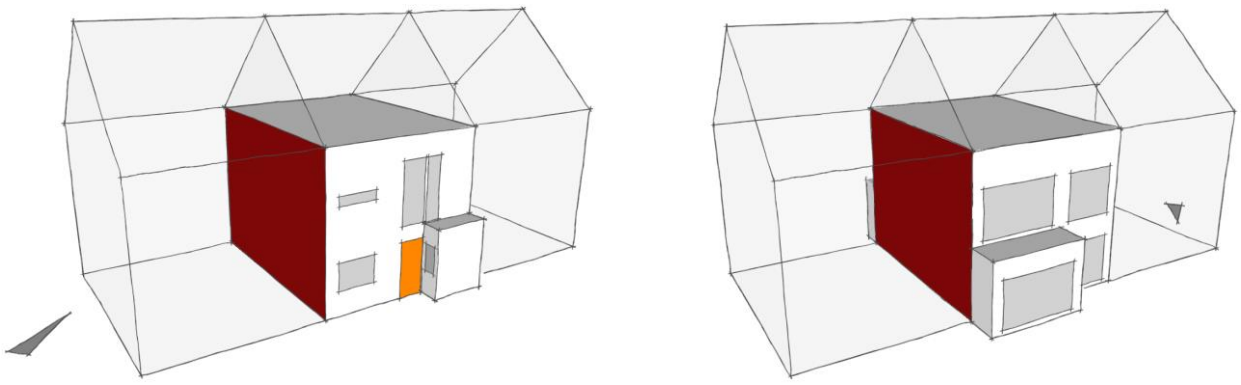
ZEBRA example – mid-terrace (21_07_12)

1 Sketch and task

You have just started to sketch up a design for a client, who is demanding a low energy/carbon home to be built in Stonehaven (Scotland, 56.96°N 2.22°W). They have not vocalised exactly what they mean by that, but have heard of Passivhaus, so that seems a reasonable starting point; you know that embodied emissions are of growing interest too, so you wish to generate no more than current best practice suggests. It has 3 bedrooms, but how many people will live normally here is not clear at all. The external dimensions for the bounding box (excluding protrusions) are 7.75 × 6.00 × 5.77m (length × width × height). The dimensions (extracted from your drawing package; or that formed the basis of your sketching) are given in the descriptions that follow.

Please model the building using 'Complexity Level 1' in a blank copy of ZEBRA.



a) South-East façade (main entrance) b) North-West façade (garden)

Figure 1: Sketches of the house. The arrow on the ground points North. Grey openings indicate glazed openings and orange solid ones. Red walls indicate party walls. Notice the house has a cold roof. Unfortunately, there are no description of the surroundings in these sketches.

2 Geometry

Table 1: General properties

Element	Value	Unit	Comment
External walls	56.09	m²	**Area calculated after the subtraction of openings**.
Party walls	89.49	m²	Adjacent to neighbours.
Ground floor	52.36	m²	Foundation type: slab on grade.
Roof external	5.86	m²	The roof of the protrusions in the ground floor.
Roof cold attic	46.09	m²	Area of the ceiling of the second floor.
Double-pitched roof	62.66	m²	For both tilted sides.
Treated Floor Area (TFA)	71.00	m²	Estimated considering an external wall thickness of 0.45m.
Internal building volume	170.15	m³	Estimated from TFA and floor heights of 2.40m.

Table 2: Openings. These are the dimensions of the hole in the fabric, any glazed areas will be smaller due to frames. You can save data entry time by copying and pasting (using match formatting) the dimensions into ZEBRA. For example the light blue area. The total area of the opaque external door is 2.10×0.90≈1.89m^2.

Group	Façade	Type	Hole height [m]	Hole width [m]
Opaque	South-East	Solid door	2.10	0.90
Glazed	South-East	Window	1.00	1.40
		Window	1.00	0.45
		Window	0.35	1.40
		Window	2.10	0.90
		Window	2.10	0.55
	North-West	Window	1.75	2.80
		Window	1.75	1.75
		Window	1.75	2.80
		Window	1.75	1.75

3 Construction

The client is keen to have high quality low-impact construction based on rammed earth and a timber structure free of thermal bridges. Besides that, there is nothing special known about the construction at this stage, just that it should be high quality in terms of infiltration levels (0.60ach@50Pa), so you plan to use defaults you got from another low energy project.

Table 3: Thermal properties

Element	Value	Unit	Comment
External walls	0.15	W/m²/K	
Opaque doors	1.00	W/m²/K	
Ground floor	0.15	W/m²/K	
Roofs	0.15	W/m²/K	
Windows	0.85	W/m²/K	Triple glazing.
Average frame width	0.20	m	Some openings are big and will need dividers. This is just an estimation.
Glazing g-value	0.45	-	Illustrative value for triple glazing.
Shading	Average	-	You estimate surroundings offer a typical level of shading at the site.

4 Systems

The house is mechanically ventilated with heat recovery (guessed to be 80% efficient) and half of the double pitched roof can be used for a PV system. The client prefers a combi boiler connected to mains gas to provide space heating and domestic hot water (you believe a good boiler might have an efficiency of 90%; as a combi boiler there will be no storage but some distribution losses considering the house will have several bathrooms).

5 Final remarks

Please remember that the task is to model the building in ZEBRA using complexity level 1. Notice that information is not complete because there are just things one does not know at an early design stage. For any unknown bits, follow suggestions and defaults given in ZEBRA. After having completed the task, do play with the model to make it as sustainable as possible.