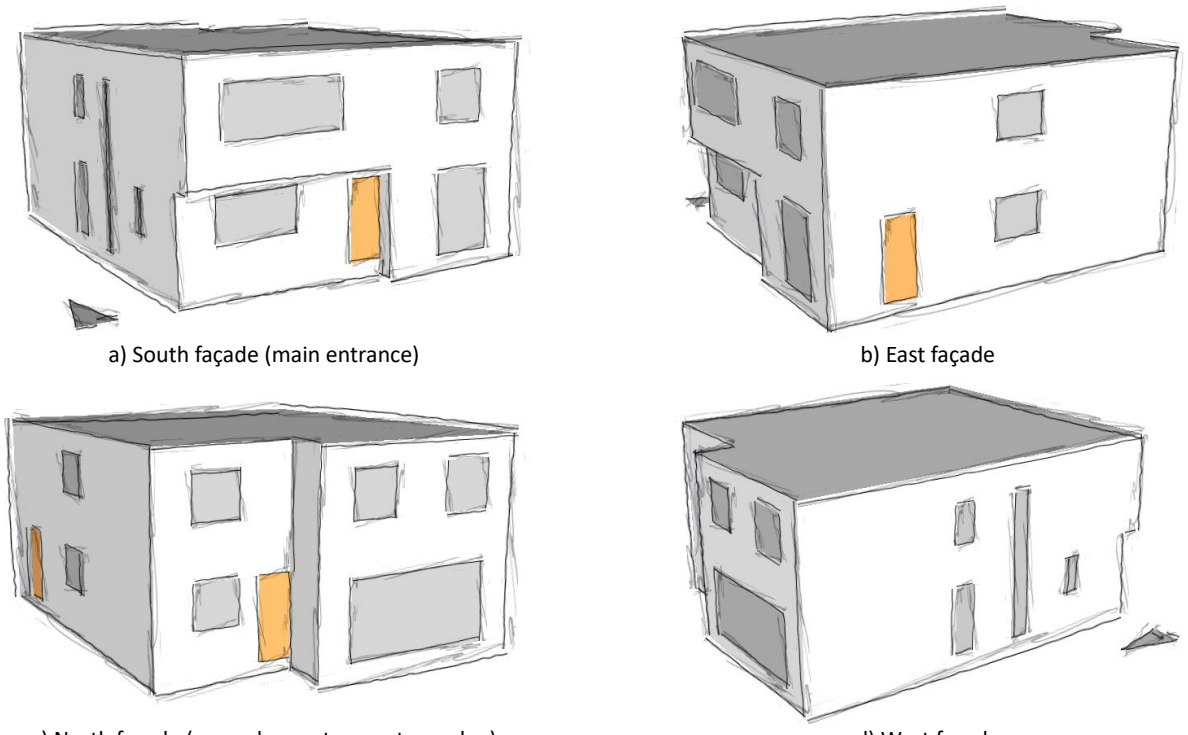
ZEBRA example – detached (21_07_12)

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 not far from London (approximately 51.366°N, 0.005°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 6 bedrooms to allow for big family gatherings and summer parties, but how many people will live normally here is not clear at all and might change over time. The external dimensions for the bounding box are 12.3 × 10.1 × 6.0m (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 façade (main entrance)

b) East façade

c) North façade (secondary entrance, to garden)

d) West façade

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

2 Geometry

Table 1: General properties

Element	Value	Unit	Comment
External walls	227.25	m^2	**Area calculated after the subtraction of openings**.
Ground floor	116.39	m^2	Foundation type: slab on-grade.
Roof	119.29	m^2	Flat roof at least 50% suitable for PV panels.
Treated Floor Area (TFA)	196.98	m^2	Estimated considering an external wall thickness of 0.45m.
Internal building volume	472.75	m^3	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 opaque external doors is 3×(2.25×0.90)≈6.08m^2.

Group	Façade	Type	Hole height [m]	Hole width [m]
Opaque	East	Solid door	2.25	0.90
	South	Solid door	2.25	0.90
	West	Solid door	2.25	0.90
Glazed	North	Window	1.20	1.20
		Glazed doors	2.25	4.30
		Window	1.35	1.35
		Window	1.35	1.35
		Window	1.35	1.35
	East	Window	1.20	1.50
		Window	1.20	1.50
	South	Window	1.20	2.30
		Glazed doors	2.25	1.70
		Window	1.35	3.20
		Window	1.35	1.35
	West	Window	2.10	0.60
		Window	1.20	0.60
		Window	4.60	0.60
		Window	1.20	0.60

3 Construction

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. The client fancies masonry-like external aesthetics, like the one given by lightweight brick slips. The house will feature a timber frame structure.

Table 3: Thermal properties

Element	Value	Unit	Comment
External walls	0.14	$W/m^2/K$	
Opaque doors	1.00	$W/m^2/K$	
Ground floor	0.12	$W/m^2/K$	
Roof	0.10	$W/m^2/K$	
Linear thermal bridge	0.04	W/m/K	Top perimeter of each storey (44.80m/storey) has a thermal bridge. There are no point thermal bridges as you plan to use plastic wall ties and fixings.
Windows	0.85	$W/m^2/K$	Triple glazing
Average frame width	0.20	m	Some openings are big and will need dividers. So 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 at least half of the roof area can be used for a PV system. The client welcomes the idea of having a conventional heat pump for space heating (you have found one with an average efficiency of 1.5 for heating mode); but in addition wants a combi boiler connected to mains gas to provide domestic hot water so that occupants can take as many showers as they want during the day (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.