WIKIHOUSE CHASSIS SYSTEM

Version 4.2.1 **A Guide for Designers**

A brief introduction to the latest WikiHouse structural system, and how to get started using it.

IMPORTANT

As always – all information is shared under the licences & terms of the **WikiHouse constitution**. All information is shared 'as is', and without any kind of liability or guarantee, and will not be appropriate for all uses & contexts without modification and/or testing. Make sure you consult an engineer and/or other relevant experts, and comply with all local legislation - as you usually would.

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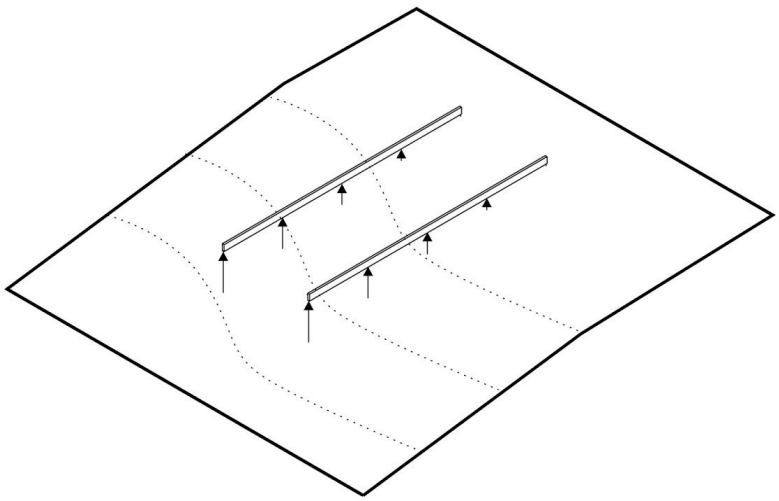
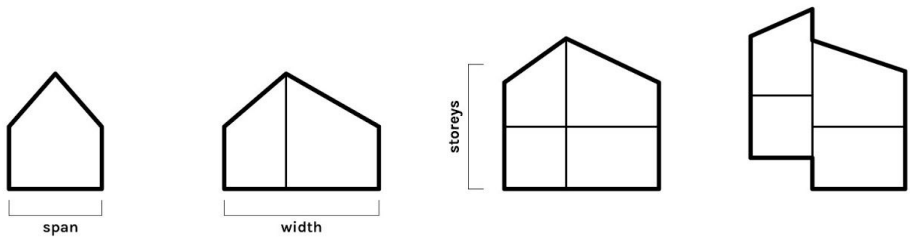
1. SITE & FOOTINGS



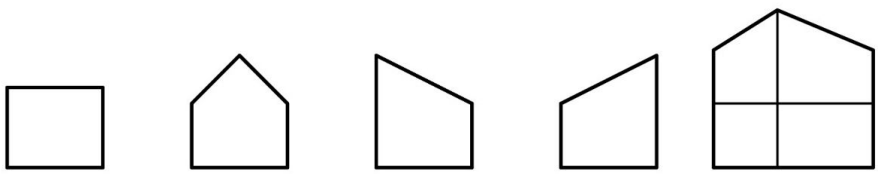
The WikiHouse chassis system can be used on more or less any site, including sloping sites, however the site must provide 2 or more 'rails' (usually timber joists) which are parallel and level. These 'rails' can be supported by almost any kind of foundation type (eg screw piles, concrete trench foundations, adjustable pads etc.) They can also 'step' down a hill if required. The chassis can then be assembled onto those rails, and bolted to them using steel brackets.

2. FORM

Begin by deciding on the form of your structure. This form can vary over the length of the house, providing all the connection points line-up. The rules are:

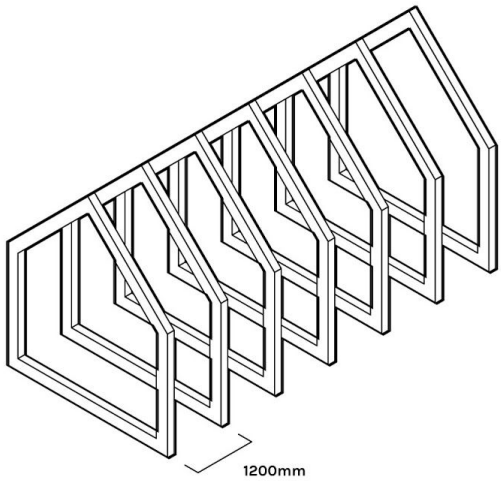


- **Max room span** (generally max 3.6m for a single storey stucture is a good rule of thumb, however this will vary with loads (eg wind, snow etc), size, beam depth, materials and for two-storey designs. Engineers may be able to work out solutions for a range of possible spans and heights, including up to 4.8m, but this is not yet fully codified into general rules.
- **Overall width** (how many spans) is theoretically unlimited (within reason)
- **Overall height** Maximum number of storeys so far is 2. Ultimately the target is 3 storeys, but more development work is needed to achieve this.

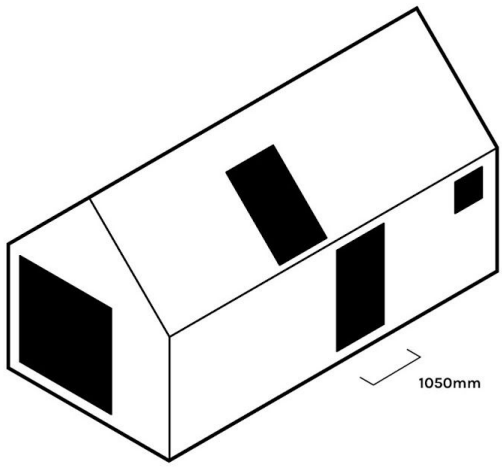


- **Roof Profile** Can be more or less any shape in section, but cannot include curves (currently) and cannot slope along the *length* of the house, only the width. Where very unusual shapes of roof are used, you may need to introduce an extra supporting wall or horizontal section as a tie (consult an engineer).

3. OPENINGS



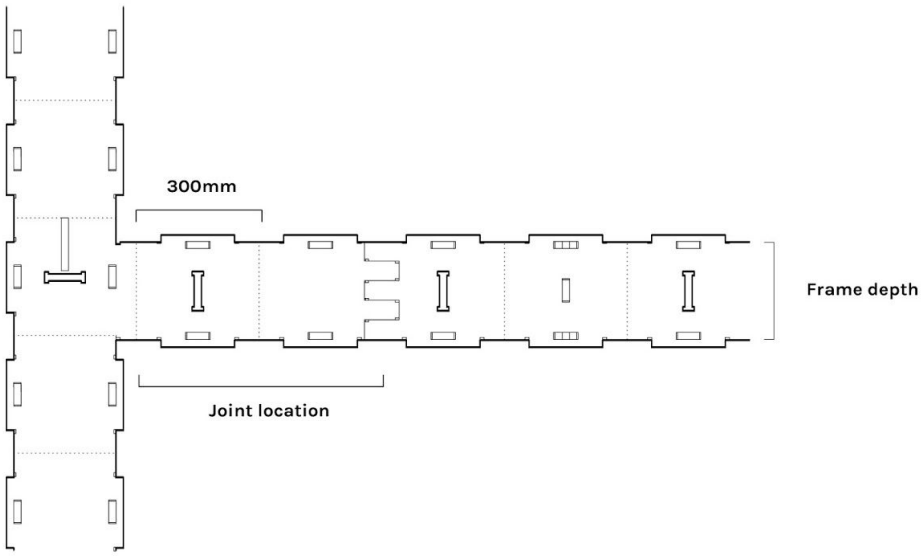
Box frames are repeated every 1.2m by default.



This leaves a clear opening size of 1050mm for windows and doors along the side walls, roof and floor. Within these rules, openings can be positioned more or less anywhere in the design.

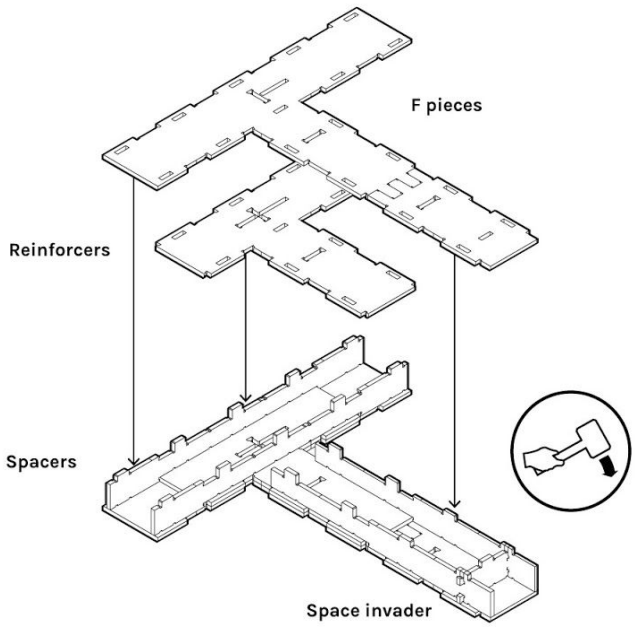
In the end walls, openings can be any size or shape.

4. FRAMES



The frame profile has a set ‘depth’. The default frame depth is 250mm, though it can be lower (min 200mm) for smaller structures or higher for larger ones. Download the sketchup model and turn on ‘hidden geometry’ and ‘colour by layer’. You will see that the frame is quite easy to build in sketchup, since it mostly comprises of a repetitive grammar of 300mm long lego-like modules.

As a rule, joints in the frame should be located at least two modules from a corner. Never locate joints in the middle of a span. And remember, no piece can be larger than 1200 x 2400 overall, or it won’t fit on a sheet. To mistake-proof your design, try to orientate your ‘male to female’ joints in such a way that it is impossible to put parts in the wrong way around).

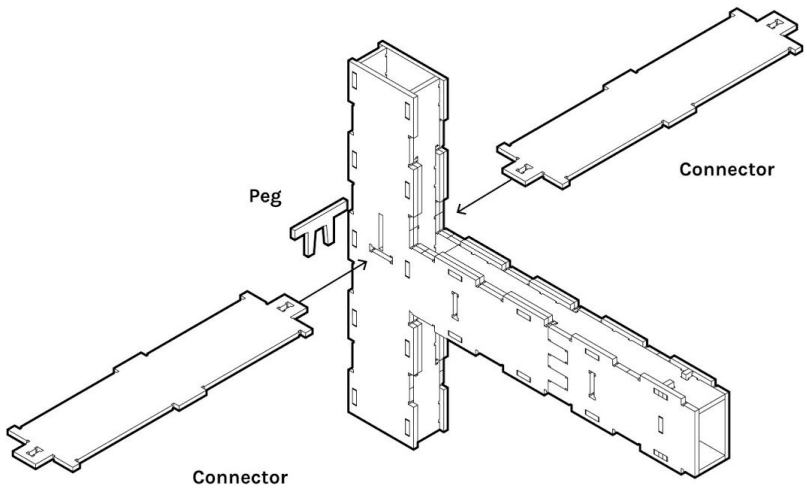


The full box-frames are assembled from four types of part.

'F' pieces The frame or 'F' pieces are the main face of the box frame, and are named F1, F2, F3 etc.
Spacers The long thin pieces. These mallet into the frame. You'll notice that the slots for the spacers don't have 'dog bones' - instead they crush in to form a tight fit.
Space invaders (so-named by the WikiHouseNZ team because of their shape) are the little spacers that keep the frame in a box shape. These only need to be positioned at occasional intervals.
Reinforcers These serve to stiffen the corners, and bridge forces across joints in the spacers. In some cases it will be sufficient to simply add these into the frame, in others it may be necessary to use an adhesive to fix these to the F pieces. This is very much 'in development'. Always work with an engineer to ascertain this.

Frames are assembled on a flat surface first, then raised. At some point during the process insulation needs to be added to the inside of the box frame. This will change depending on what insulation you use.

5. CONNECTORS

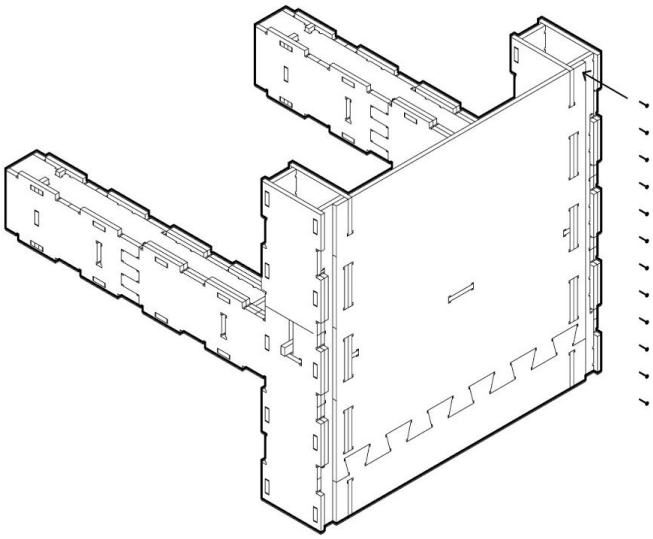


Connectors are generic; generally there are only two types. 'Primary' connectors slot in during the barn-raising, and are pegged into place. 'secondary' connectors just slot into place after the frames have been raised. Generally you only need connectors at the corners, but you will also need to put them in to support floor panels etc.

Sometimes it may be useful to make a special connector, name it with a *, and change the size of the slot-part at the end. That way, no one will ever be to put it into the wrong location (a bit like a key).

6. PANELS

The panels are an integral part of the structure, providing rigidity to the frame. They slot onto the 'grips' and must be screwed onto the box frames at regular intervals (we suggest every 150mm).



Note the ‘zip’ seams where two panels meet, transferring forces along the skin of the structure.

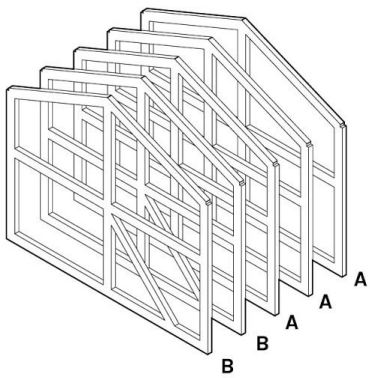
During assembly, fit the external panels first and add the panels as you go, forcing the frame gradually into precise alignment (usually some encouragement with a screwdriver or by ‘donkey kicking’ the frame is needed)

7. LATERAL WALLS

Once you have a complete assembled chassis, internal and end walls are separate ‘stud’ wall kits which are simply screwed into the frame at the appropriate location. This also means they can be positioned anywhere, and changed during the life of the building.

8. NAMING YOUR PARTS

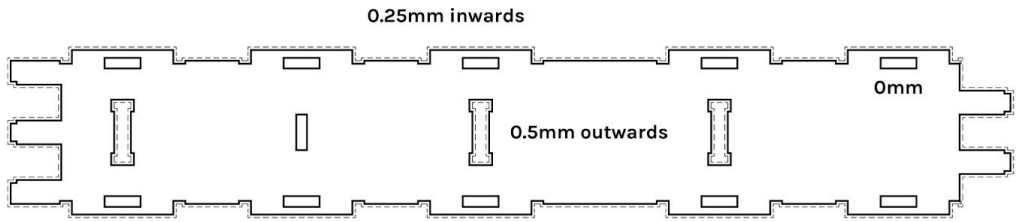
In the sketchup model, open ‘Entity Info’ and click into individual parts to find their names. There is a whole naming system to adopt, based on which type of part it is. Frame (F), Spacer (S), Connector (C),External panels (EX), Internal panels (IN) and lateral walls (L). This helps understanding and using the parts on site. Without their names cut into them, the parts are essentially useless.



Each complete box frame has a letter, eg a house might have several type ‘A’ frames, a few type ‘B’ frames etc. The order of these can be understood like a DNA chain along the house. eg. A, A, B, B, A. So the first F piece in frame type A would be called **‘A/F1’** for example.

9. CREATING YOUR CUTTING FILES

Parts can be laid out onto cutting files manually in sketchup (you will need sketchup pro to export a dxf file) or use CNC software such as V carve. Free tools to make this process easier are currently in development.



Parts need to be ‘offset’, to give the structure some tolerance. Without these tolerances, the frame will be almost impossible to assemble. As a general rule, outer edges of parts should be offset inwards by 0.25mm (to make the parts smaller). Slots in parts should be offset outwards by 0.5mm (to make the slots larger). However, this does not apply to the ‘crush’ holes for spacers, which need to be tight.

Check the guide cutting file (.dxf) in this folder, to view the layer names etc. In fact you might want to use it as a template.

Always cut a test piece first with the material and the machine you are going to use, and adjust the tolerances accordingly. It should be reasonably easy to assemble, but tight when assembled.

10. MATERIALS

The WikiHouse chassis system is designed to use any structural panel material (usually structural plywood), of size **1220mm x 2440mm x 18mm** (or 1200mm x 2400 x 18mm in Europe). However there are some other factors to consider:

Tolerance Even though the stated thickness may be 18mm, within the pallet thicknesses can vary. Parts need to fall within +/- 0.5mm - in other words, **17.5mm-18.5mm**. Any sheet outside this range should only be used for external panels.

Keep dry! Do not let the parts be exposed to prolonged moisture, humidity or hot direct sunlight. This causes them to expand or shrink and can make them unusable.

Structural performance There are various existing standards for panel products, but they may be tested to varying degrees. If in doubt, consult an engineer. We have found that WISA structural spruce plywood is a good bet.

Sustainably-sourced Always use FSC (or equivalent) certified timber. Obviously.

Off-gassing
Adhesives used in wood products can off-gas chemicals, which don't make for healthy environments. While the industry is improving on this, always look for plywood or OSB which is formaldehyde-free.

11. CNC MANUFACTURING

WikiHouse parts can be cut on any 3-axis (or more) 4x8' CNC machine, which range in price from a Blackfoot, a Marchant Dice, a ShopBot through to more expensive industrial-grade CNC machines which in some cases can even auto-feed. You can also find a local CNC workshop and ask them to quote the cost of cutting it for you.

Different machines will do the job at different speeds, and this matters, because this is the potential bottleneck. Assume you'll need 5-6 sheets per m2 of floor area and approx 30 mins per sheet).

We strongly recommend you use a CNC with a vacuum-bed and a highly effective dust extract to keep the pace up. Always wear ear protection, goggles and dust masks.

12. TOOLS

Include several Wiki-mallets ('persuaders') and 'Stepups' in your cutting files. They're very, very useful for all kinds of things, from making a level surface, to safe working above your head, to getting in and out of the house during the construction process, or simply for sitting on when you have a tea break!

13. OTHER BUILDING ELEMENTS

The system is designed to be as 'product agnostic as possible', allowing you to use almost any kind of cladding, internal lining, services, insulation, footings, doors, windows etc as possible. However, some solutions work better than others. It's worth investigating other projects as they emerge to learn lessons.

Particularly important elements include:

Breather membrane
The chassis should be wrapped in a breather membrane (such as Tyvek Supro or similar).

Insulation
Solutions include soft-fill insulation (we suggest sheep's wool or other recycled products, fibreglass insulation is horribly itchy and volunteers will hate it!), expanded polystyrene (must be pre-cut) or blow-in cellulose (a key element of this is the cost of blowing in. Can anyone invent or source a low-cost / hireable blower that will allow self-builders to do this for themselves?).

SHARE YOUR DESIGN & DOCUMENTATION

Please do share lessons, design files, photos, and costings from your project. There are number of ways you can share them.

The WikiHouse Commons.
The community google drive, join and create a folder for your project here.
The WikiHouse google groups
here.
Twitter
Tweet to @WikiHouse.

NEED MORE HELP?

Book a workshop

If you and your team would like a workshop introducing you the WikiHouse system, kickstarting your project, or reviewing the project you already doing, they're now available to book through an extremely handy online booking process. A member of the Foundation team will join you (in person or online) for half-a-day workshop, giving you a full, up-to-date intro to the WikiHouse system. By the end of half a day, you'll know everything about the building system we do. Book one here.

Donate

We work for everyone. The WikiHouse system is open source, and WikiHouse Foundation is a non-profit dedicated to growing the commons and supporting the community. If you have derived value from using the WikiHouse system (or just want to help it succeed faster), please make a donation to the WikiHouse Foundation, either on a one-off basis or, even better, as a monthly stipend.

Interested in becoming a certified WikiHouse provider?

If after you have built a project using WikiHouse your company would like to (and are able to) provide services using the WikiHouse system (design, manufacturing, engineering, contracting, certification, warranties, tools, materials) as a certified provider etc, please email enquiries@wikihouse.cc. This is something we will be working towards (hopefully with you) over the coming year.