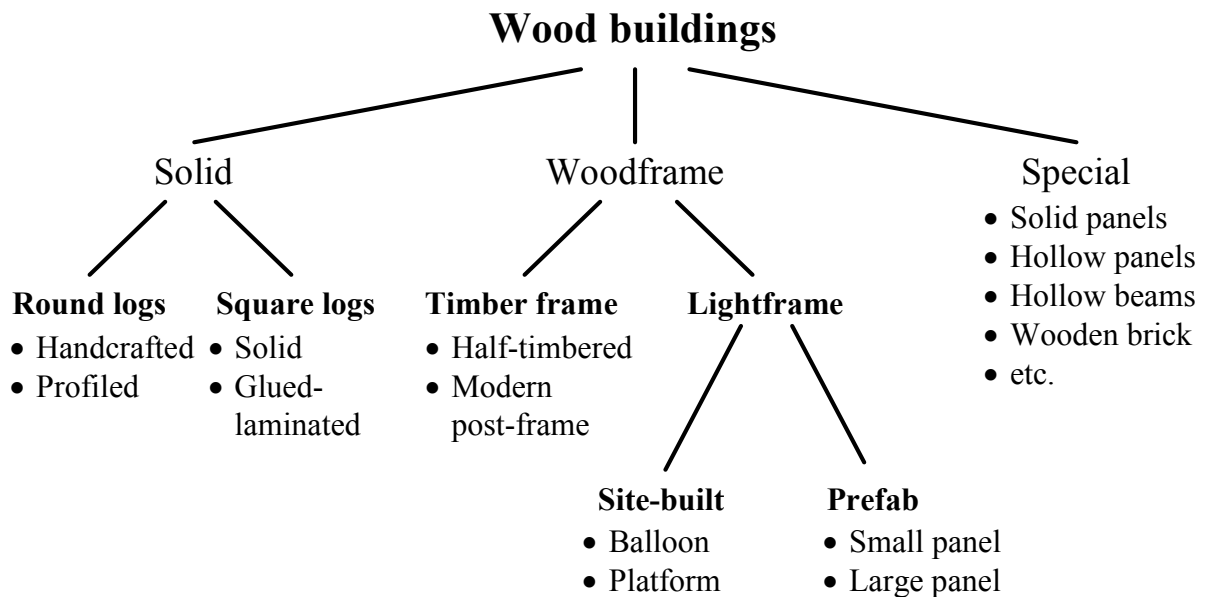


Wood based building systems

Classification:



1. Handcrafted log houses

Made of natural logs, handcrafted individually.

- Advantage: each house is unique – “the real log house”
- Drawback: requires excellent raw material, a lot of work hours and time.
- Challenge: logs cannot be dried out completely – shrinkage!
- Rarely used in Europe

Technology:

- Log shipping – in the bark
- Debarking: by hand, using a drawknife
- Natural pre-drying
- Log selection, shaping and assembly at the plant:
 - Corners
 - Counter-profiling

- Sealing
- Ceiling beams

- Roof

- Disassembly, packaging, shipping
- Reassembly on site

2. Profiled log houses

- Technology developed based on the handcrafted house
- Logs are profiled to a uniform and regular cross-section
- Not as unique-looking as handcrafted houses but still nice
- Major advantage: much faster, cheaper and less work-intensive!

Technology:

- Planning
- Log profiling (special moulders), end-jointing
- Counter-profiling
- Creating corners, joints, etc. and vertical drillholes
- Pre-assembly, marking, disassembly, packaging, shipping
- Re-assembly on-site
 - Waterproofing
 - Starter logs / half logs
 - Sealing

 - Erection

 - Inside walls
 - Ceilings
 - Roofs

- Shrinkage! – Requires a lot of practice and attention!

3. Square log houses

- Similar to profiled round logs, but are square in shape
- May also be partly squared (e.g. D-profile)

Advantages:

- Simpler to build
- Planar surfaces (easier to furnish.)
- Logs are easier to connect (no counter-profiling)
- Simpler joints
- May be made of glued-laminated material!

Solid logs:

- Very similar to round logs, except:
- Simpler cross-sectional profiling (no special moulders required)
- Drip profiles may be necessary
- Corners are simpler. May use corner post.
- Also prone to shrinkage

Glulam logs:

- Made of 2 or more layers. May be laminated horizontally or vertically
- Advantages:
- cheaper
- defects are better distributed
- raw material may be dried – less shrinkage.
- may also be round – rarely used (difficulties in manufacturing)

Some considerations about log houses:

Physical properties

- Thermal insulation: not very effective by itself
 - Regulations – increasingly stringent! Log houses cannot comply... except:
 - Compensation – no heat bridging
 - The effect of windows – much more significant!
- Heat storage: better than lightframe / worse than concrete or brick
- Humidity control: wonderful!

Improving the thermal properties – combining with thermal insulation:

- Insulation on the inside: problematic...
- Insulation on the outside: loss of distinctive appearance / rarely done.
- Insulation in the middle (double layer wall) – difference in shrinkage!

Mechanical properties

Wall must support the weight of the building. The higher the building, the thicker the wall:

- Single-storey: 80 mm
- Single-storey with loft: 100 mm
- Two-storey: 140 mm
- Two-storey with loft: 180 mm

(In reality, the wall is seldom thinner than 160 mm, for thermal insulation.)

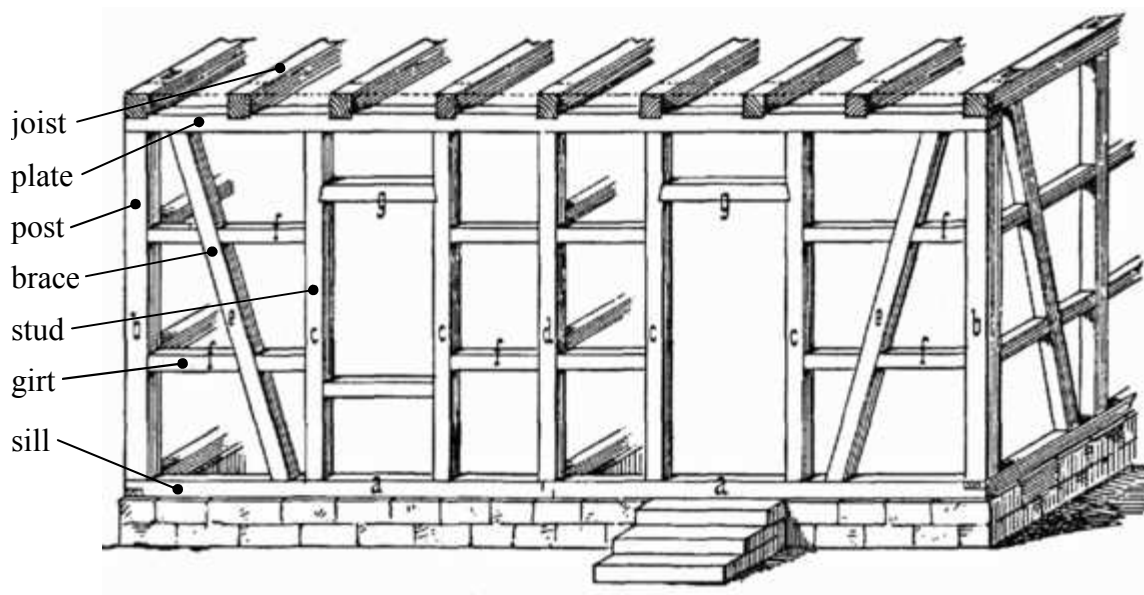
4. Half-timbered houses

One of the most ancient building systems (going back to the 6th century.)

Characteristics:

- framework visible on the outside
- framework bears all of the loads
- framework elements are loaded in compression. Stress design based on experience.
- vertical element spacing is 80-120 cm
- typically with traditional carpenter's joints
- bracing with slanted braces or cross-bracing (71-75°)
- Raw material: usually softwood. Beech or oak for sills.
- Infill: brickwork, wattle and daub, etc.

Structure:



- the sill is anchored to the foundation
- the plate supports the joists and the next storey (platform frame)
- the second storey may be flush with the first or is jettied
- problem: thermal insulation! (Extra insulation is typically added on the inside.)

5. Modern post-frame houses (skellettbau)

A modern engineered system based on the traditional half-timbered construction

Characteristics:

- Elements have larger cross-sections (may be solid or glued-laminated)
- Spacing is much farther away (4.5 – 8 m)
- Framework is responsible for all load-bearing – walls are freely variable!
- Typically no girts or wooden braces.
- Multi-storey houses – various frame types

Advantages:

- Walls are freely variable
- Large glass surfaces are possible
- Good fire safety
- Wall panels may be prefabricated

Disadvantage: thermal insulation

6. Special building systems

There are many other building systems that cannot be placed into any of the above categories. Some of these are full systems, and some are partial solutions.

Here are some examples – there are probably many more...

6a. Cross-laminated solid panels (CLT, KLH)

3-17 layers

Advantages:

- High degree of variability – no studs, simple corner connections, etc.
- Very precise prefabrication
- Easy to assemble and modify on-site
- Relatively thin walls
- Humidity control, fire-resistance (depending on thickness and structure)
- few connections – simple on-site assembly, good air-tightness

Depending on the application, typically combined with heat or sound insulation. May also include ventilation gap.

Electrical wiring – may be recessed parallel with the face layer orientation.

Curved elements may also be manufactured.

6b. Hollow solid wood panels

Contains holes and channels.

Advantages:

- Gaps for insulation materials
- Deeper cross-sections → better for bending
- Less material

Has one main load-bearing direction, but contains perpendicular layers as well.

Elements offered:

- ceiling elements – bottom surface ready, top surface may be open or closed.
- roof elements
- horizontal elements with shear connectors (for wood-cement composite structures)
- wall elements and structures
- facades and hanging ceiling panels
- acoustic surfaces, etc.

6c. Modular „wooden brick” system

Smaller building blocks that fit together like bricks.

Characteristics (Steko building system):

- hollow bricks with vertical studs inside, horizontal spacers, and vertical cladding on the outside.
- $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and whole blocks in two heights
- vertical connections are made using hardwood dowels. Corners are interlocking.
- creating walls like laying brickworks – consecutive rows of blocks are overlapping
- the hollow interior may be filled in with cellulose insulation, and can accommodate ducts and wiring
- Includes bottom starter, top finish and side „reveal” elements for aesthetics, enclosure and for load bearing.
- Additional insulation and cladding may be added.

6d. Other systems

There are several other systems, including:

- Stress-skin panels (popular in the US; structural design and fire safety issues in Europe)
- Agepan woodfibre panels and building system
- Lignatur floor and roof elements
- etc.