

MAJOR BUILDING SYSTEMS

FRAMED STRUCTURES

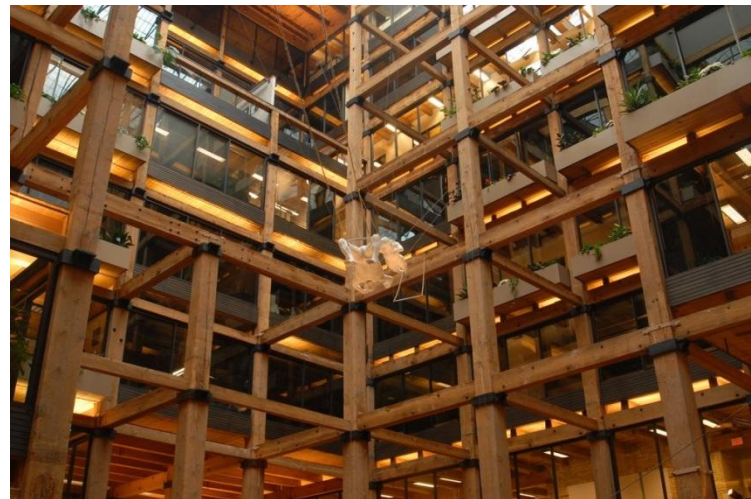
- Framed structures are a collection of horizontal beams (forming each floor level) that transmit forces to vertical columns. These columns in turn provide a pathway through which the forces can travel downwards to the foundations and from there into the ground. The vertical columns may form the walls at the perimeter of the building, or they may be distributed throughout the space. When positioned within the space, two or more columns may be joined to create internal divisions, or they may be left as discrete columns.



- The great benefit of this multi-level framework is that, because the columns are transmitting the loads vertically, solid-wall structures are not needed to support the floors above, and can therefore be omitted (creating large open spaces), or walls can be created using nonstructural materials such as glass.
- Framed structures allow us to build high-rise buildings that are often characterised by facades composed entirely of glass, though the materials used for these curtain walls can be practically anything. Radical architects of the Bauhaus movement in Germany in the 1920s were the first to use of glass in this innovative way. Because of the strength of frames, buildings can be made very tall. It was the development of framed structures in the latter part of the nineteenth century that lead to the first high-rise buildings.



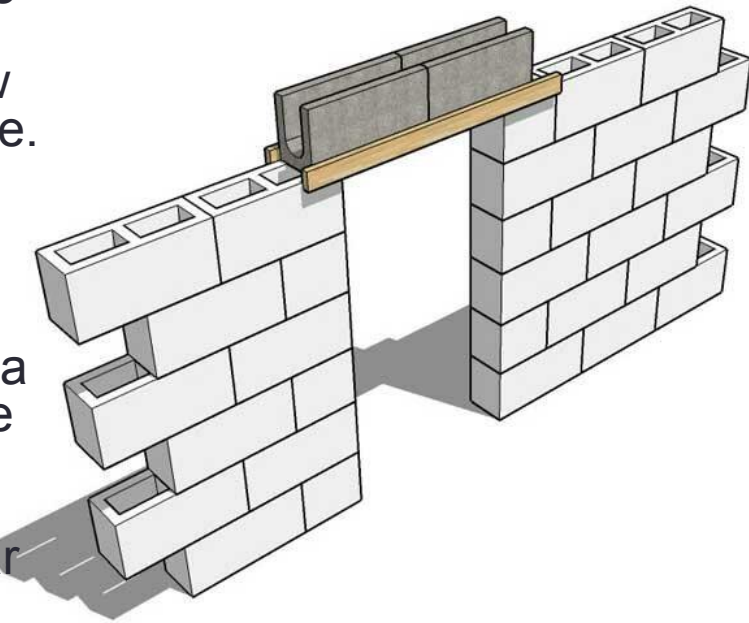
- Lightweight timber frames are a common method of construction in many regions of the world, though the frame is usually invisible under a skin of other materials such as brick. Frames of this type will usually be braced to prevent twisting by the addition of a plywood skin to the outside of the frame. Timber framing of residential developments allows fast and accurate construction by a relatively low-skilled workforce, as it is an easy material to work with. Sections of the frame are often pre-fabricated off site under good working conditions, then brought to the site for rapid assembly.
- Timber frames are also an environmentally-friendly construction method. Highly energy-efficient buildings can be made by inserting insulation between the vertical and horizontal timbers creating buildings that perform extremely well in some of the most extreme climates.



LOAD-BEARING STRUCTURES

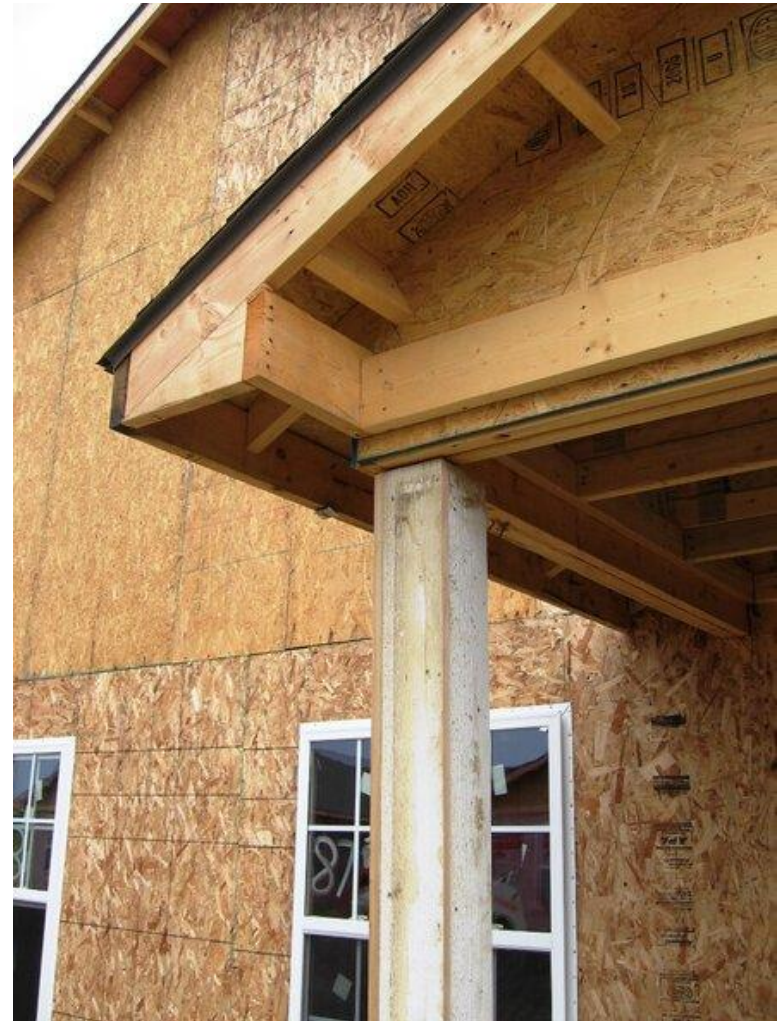
- In a load-bearing structure, it is the masonry construction of the walls themselves that takes the weight of the floors and other walls above. The walls therefore provide the pathways through which forces travel down the structure to the foundations. There is no separate constructional element of the building to do this, as with the frame in a framed structure. Care must be taken when changing existing load-bearing elements of a structure. If changes are made to the structure without adequate precautions, then the structure will collapse.
- If it is desired to move a door or window, or make new openings in a wall, then the loads that are being supported by the wall must be diverted to the sides of the opening to prevent collapse. This is usually achieved by the insertion of a beam or lintel at the top of the opening. This lintel will carry the loads travelling through the wall into the structure at the side of the opening, from where they will travel downwards and so maintain the integrity of the structure. The beam or lintel itself will need to be adequately supported at both ends within the remaining structure.
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- A lintel is a monolithic component and can be manufactured from any suitable material. Timber, stone, concrete (either reinforced or pre-stressed) or steel are the most common. Pre-stressed concrete lintels can span considerable distances, as can rolled steel joists (RSJs), which are often used in renovation work to allow the removal of internal walls.
- If greater distances need to be spanned, it may be more appropriate to construct an arch rather than use a lintel, and this was certainly true before new technologies allowed the use of steel and concrete. Because of their superior mechanical properties, arches can generally support greater loads than lintels. An arch is considered as a single unit, but unlike a lintel it can be composed of a number of components, though it too can be monolithic, like a lintel. Once the individual elements of the arch are in place, the compressive forces (weight) of the building materials above hold them together. The simplest shape of arch is the round or semicircular arch, but there are many variations of form, even flat arches. Arch construction is a very practical engineering solution to the problem of spanning openings that are often treated as decorative elements of a building's facade.



SHEATHING

- Sheathing is the board or panel material used in floors, walls and roofs of both residential and commercial construction. The most basic function of sheathing is to form a surface onto which other materials can be applied. There are several types of sheathing, each having a specific function based on its application.
- *Floor sheathing* is a structural panel that is fastened to the floor structure with nails and glue. It is most often installed after a floor
- frame has been built, and prior to the walls being erected. Commonly called sub-flooring, structural panels are wood products known as plywood and oriented strand board (OSB). Plywood is made from thin sheets of veneer that are adhered together, and OSB is made from wood chips that are adhered together.



- *Exterior wall sheathing* prevents wind and water from entering. There is either non-structural or structural sheathing. Also known as insulating sheathing, non-structural sheathing is installed on an exterior wall to provide added insulation, and in some cases it acts as a radiant barrier. Non-structural sheathing can be applied directly to the exterior wall framing, where diagonal bracing has been installed. It may also be installed on the interior or exterior side of structural sheathing. There are many types of insulating sheathing offering various R-values: plastic, foam, cellulose fiber, paper faced and foil faced boards. Insulating sheathing is a lightweight panel that is easily cut with a knife. The panels are attached with large-headed galvanized nails to exterior wall framing.



- *Structural sheathing* is attached to the exterior wall framing. There are several different types of structural sheathing to choose from; they can be either wood, gypsum or cement based sheathing.
- Wood based structural sheathing includes plywood and oriented strand board. Wood sheathing prevents wall racking in wood framed structures.
- Gypsum based structural sheathing can be paper-faced, glass-mat faced or unfaced core-reinforced sheathing. Paper-faced gypsum and unfaced gypsum/cellulose core-reinforced sheathing are combustible materials and are not moisture resistant. Glass-mat faced gypsum sheathing is non-combustible and moisture resistant.
- *Roof sheathing* provides lateral bracing of roof framing members, and it carries both live and dead loads from above to the rafters and trusses below. Similar to exterior wall wood sheathing, roof sheathing includes plywood and oriented strand board

