Post and Beam Construction

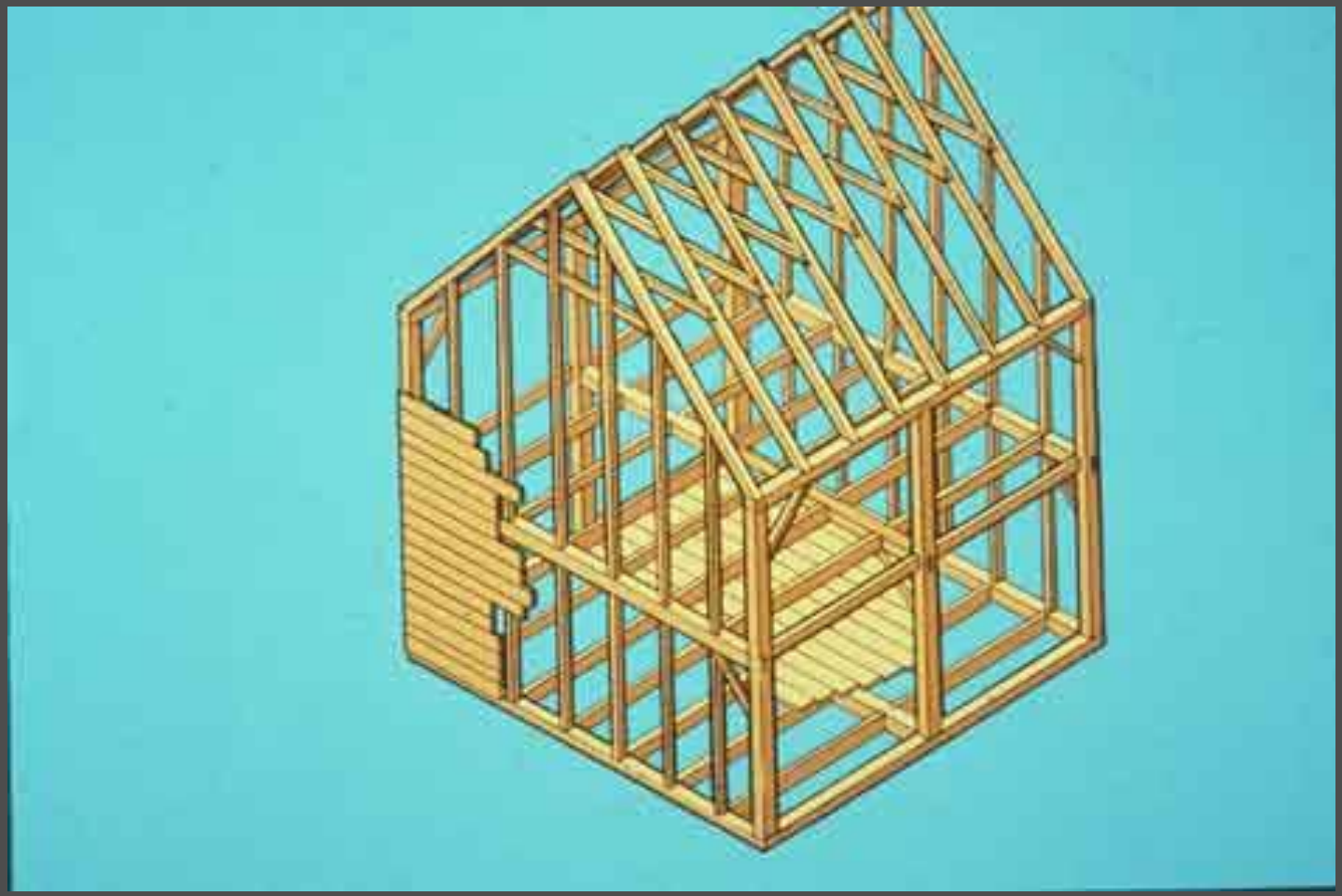
A Presentation

By the

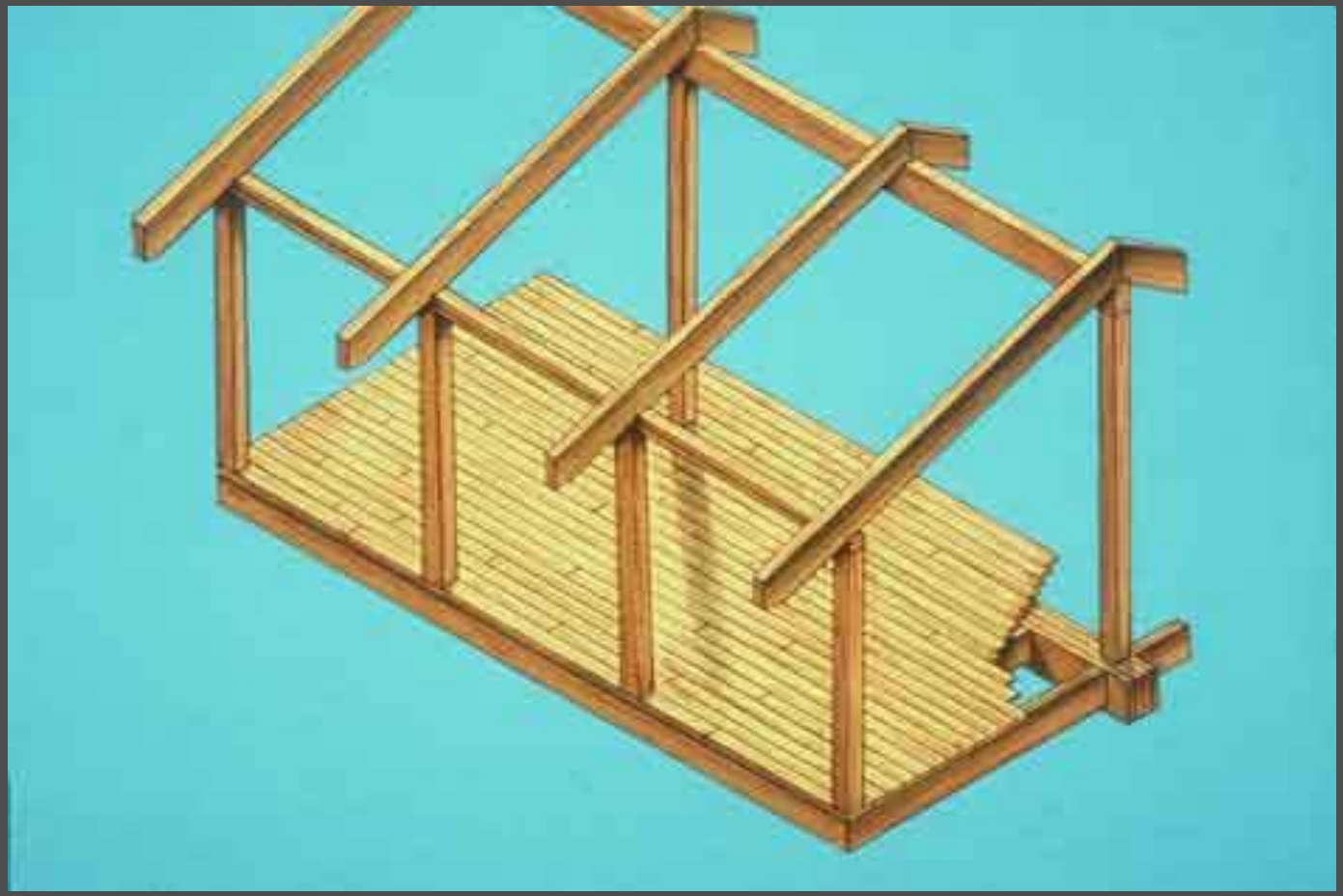
Canadian Wood Council

Canadian Wood Council | Conseil canadien du bois

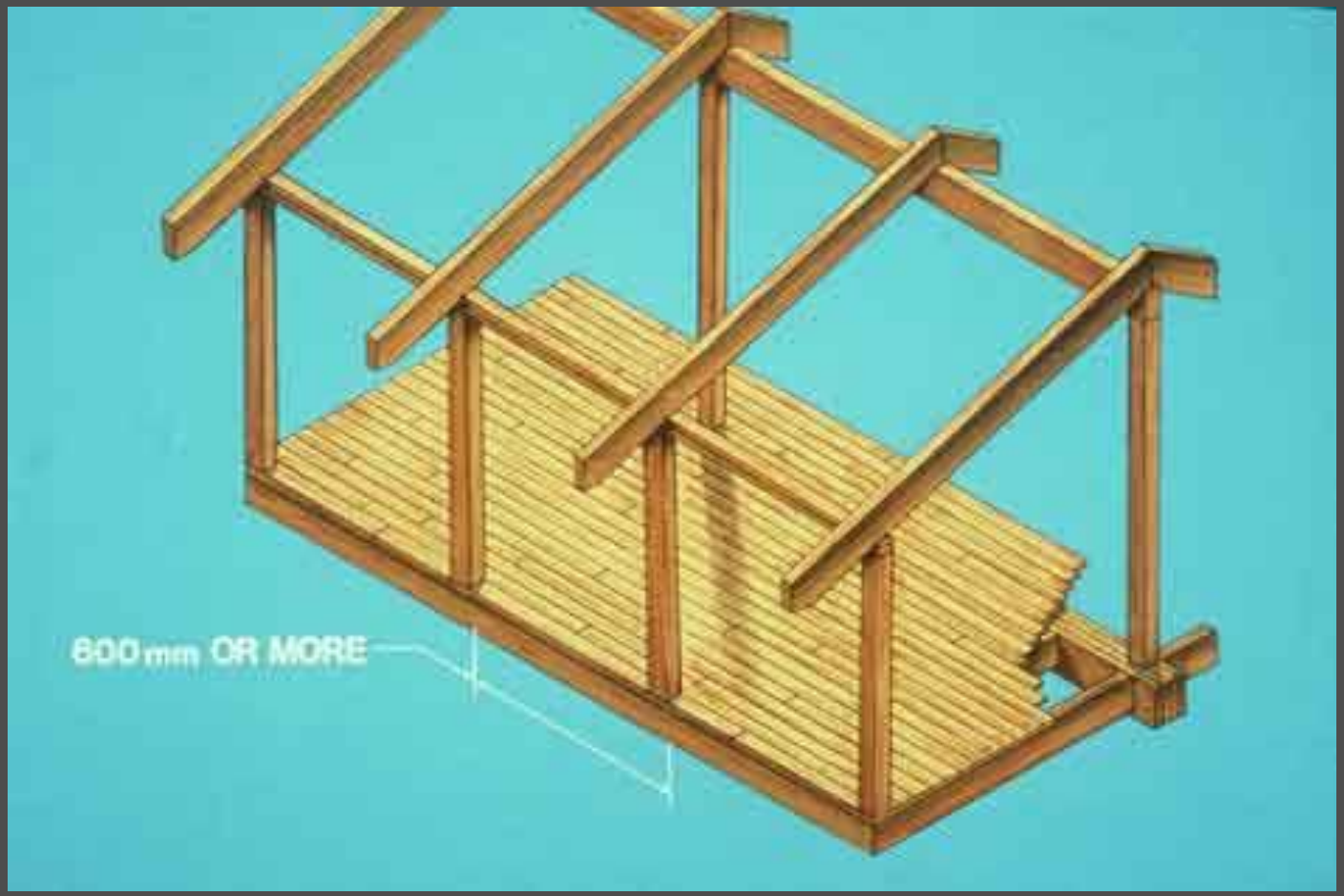
Early settlers introduced the concept of post and beam construction in North America although the system dates from the earliest buildings of Greece.



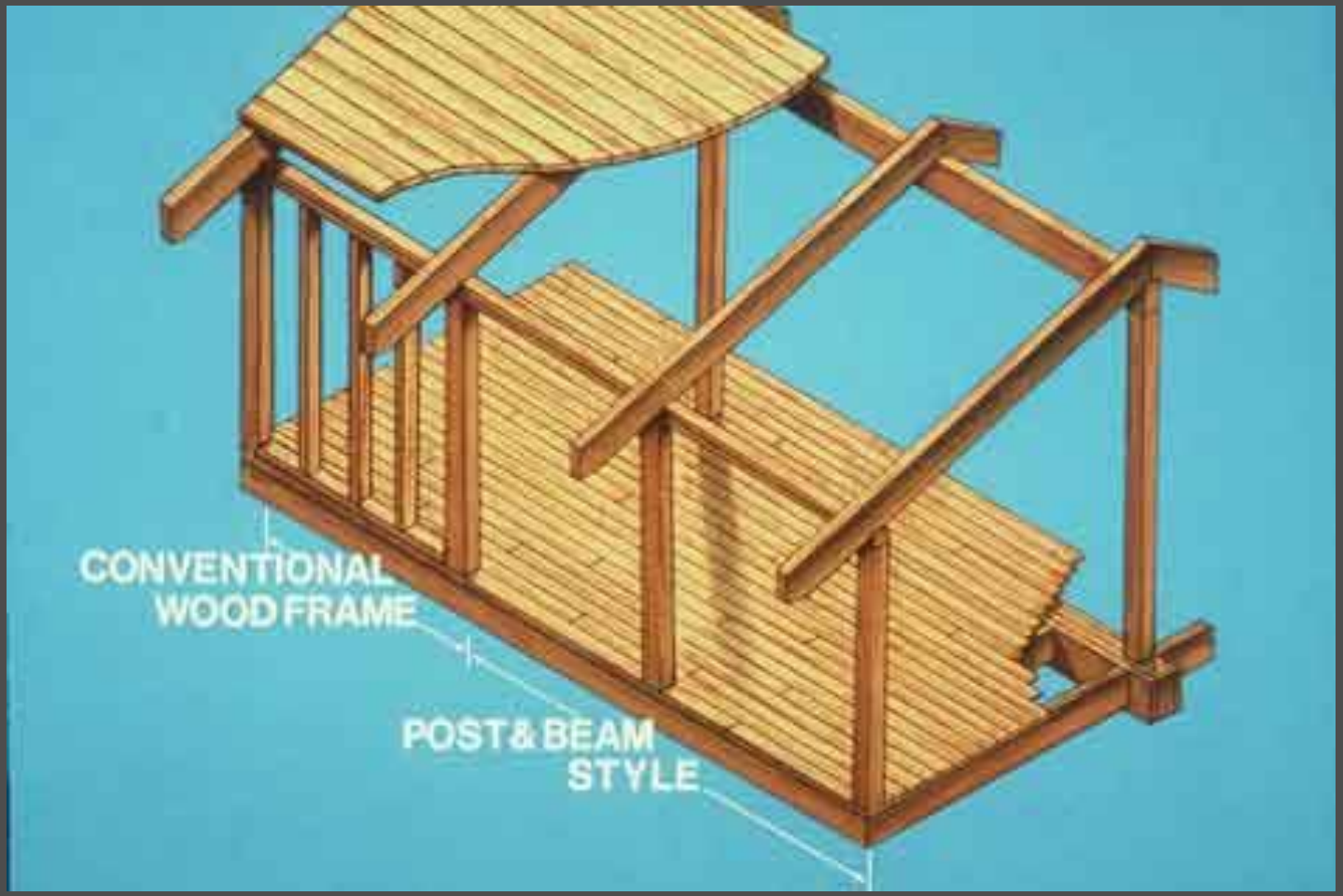
Basically, the post and beam system is a skeletal framework of decking, beams and posts supported on a foundation. It is suitable for any location in Canada.



The posts and beams are usually spaced well apart; more than 600 millimetres by definition, but usually 1200 millimetres or more. The National Building Code of Canada requires engineering design of all structural members spaced more than 600 mm apart.



Wood decking is often used for the floors and roofs, spanning between beams. Conventional wood-frame construction, however, can also be used between the posts and beams, with studs, joists and rafters supporting the sheathing and sub floor.

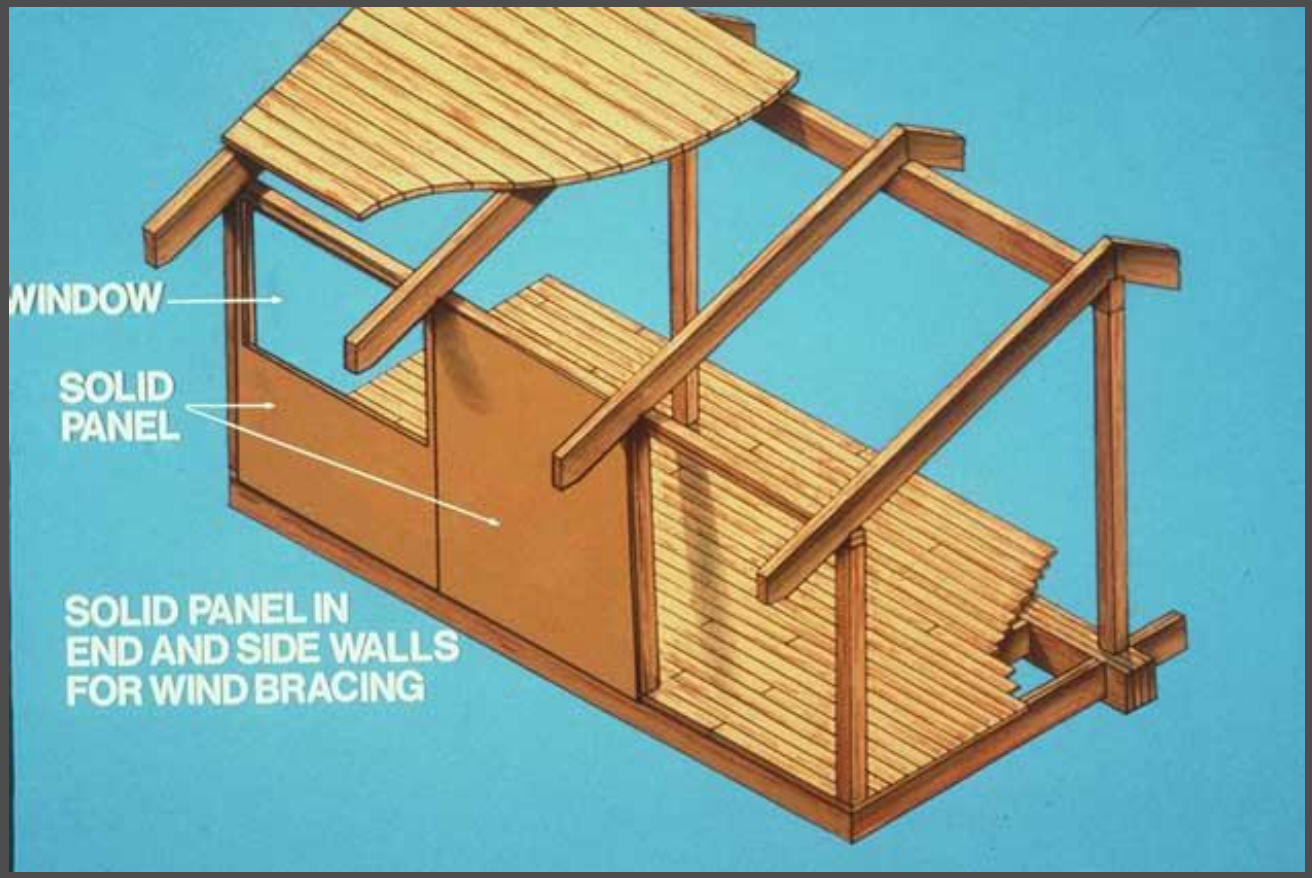


In fact, post and beam construction is sometimes combined with conventional wood-frame construction. Small members are used at close spacing in wood-frame construction; ie. no more than 600 millimetres apart and sometimes at 300 but, more often, 400 millimetre spacing.

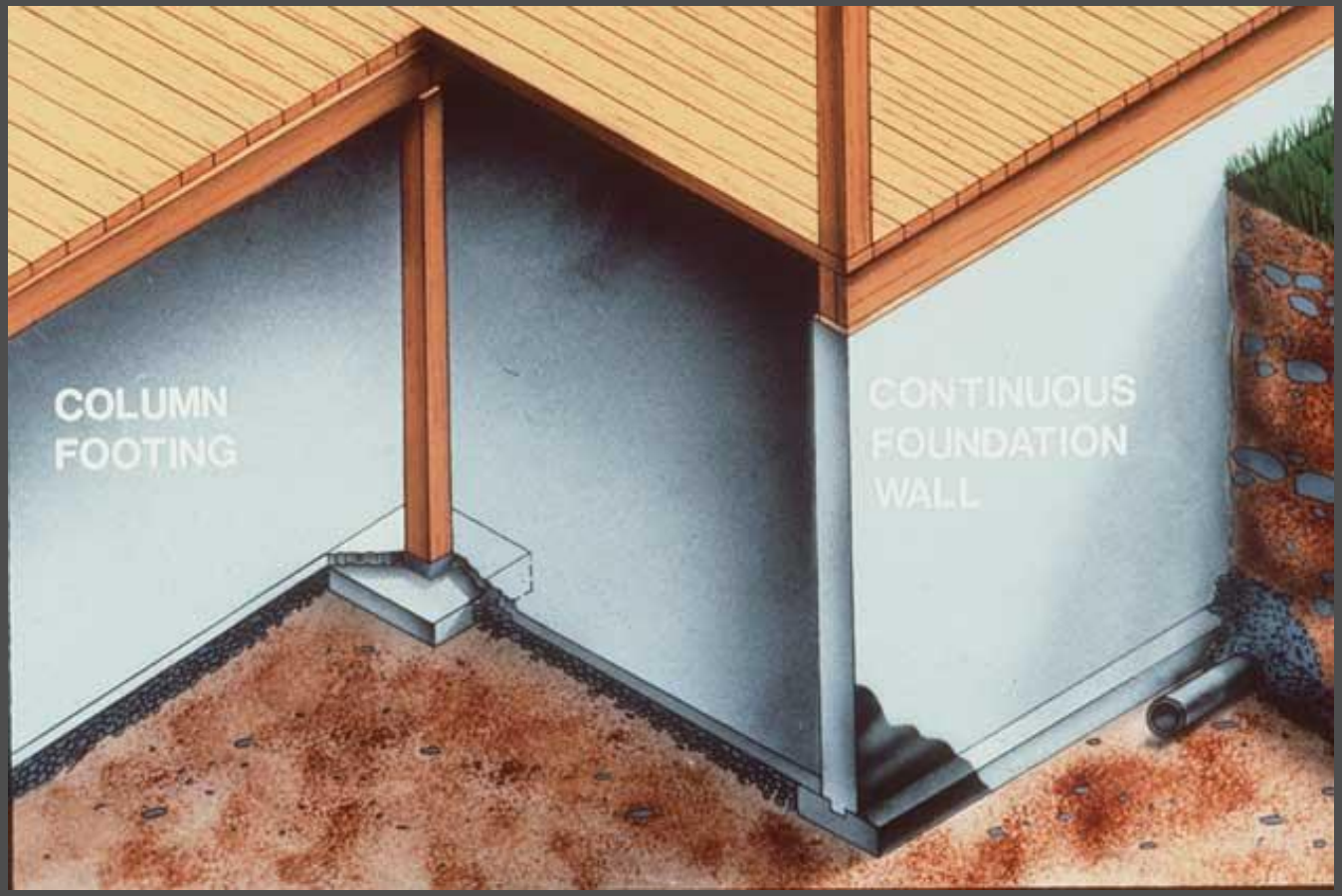
Fast erection is another feature of post and beam construction. Since there are few members and joints, the framework is simple to precut and assemble. Infill panels can be fabricated in the shop and inserted quickly into the framework.

All structural members should be designed to carry the imposed loads: snow, wind and live and dead loads. Strength and deflection limits established by building codes, or known by experience to be good practice, must be observed.

Special attention must be paid to wind bracing and uplift because there are few framing members in post and beam construction. Walls or partition panels can be provided at appropriate intervals, connected to the main framing and made rigid by diagonal bracing or sheathing to give adequate racking resistance. They can be designed to act as shearwalls.



Post and beam framing can be supported on footings or continuous foundation walls, designed to carry the imposed loads. Adequate air spaces should be left around the wood members for ventilation. If decay conditions cannot be avoided, the wood should be pressure treated.



Poles can also be used to support post and beam structures, with the end of the pole extending into the ground to act as a pile. The poles are designed as round columns in accordance with CSA 086. If fronting on water, the piles can extend to support below water level. The poles, of course, must be pressure treated according to CSA standards to prevent decay.

The poles can be extended up into the building to serve as the posts, but they must be designed to carry all imposed loads. Pole construction is especially effective on hilly or otherwise unusable sites, or where high water in spring, or floods, could cause problems.

In addition to homes, many agricultural buildings are built using pole construction, in the post and beam style.

For a given species and grade of beam, sizes will depend on length of span, spacing between beams, magnitude of imposed loads and deflection limits. Deflection limits will depend on intended use of the building or member and appearance requirements. For example, if easily cracked surfaces such as gypsum and plaster are supported by the beam, allowable deflection should be less than for wood decking. The National Building Code of Canada provides design guidelines.

Posts and beams can be made of:

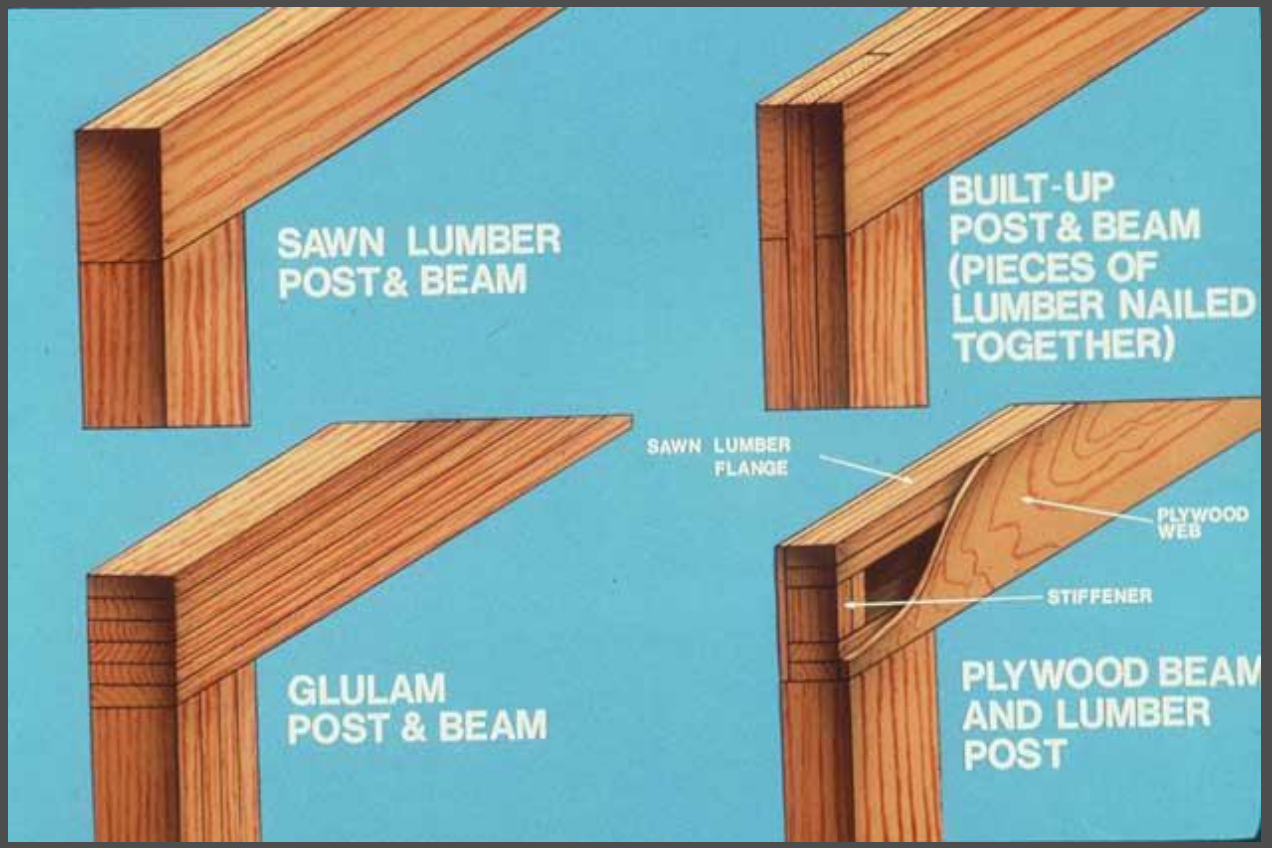
-1 sawn lumber,

-built-up members made from pieces of lumber, nailed together,

-glued-laminated timber,

-plywood and lumber, or

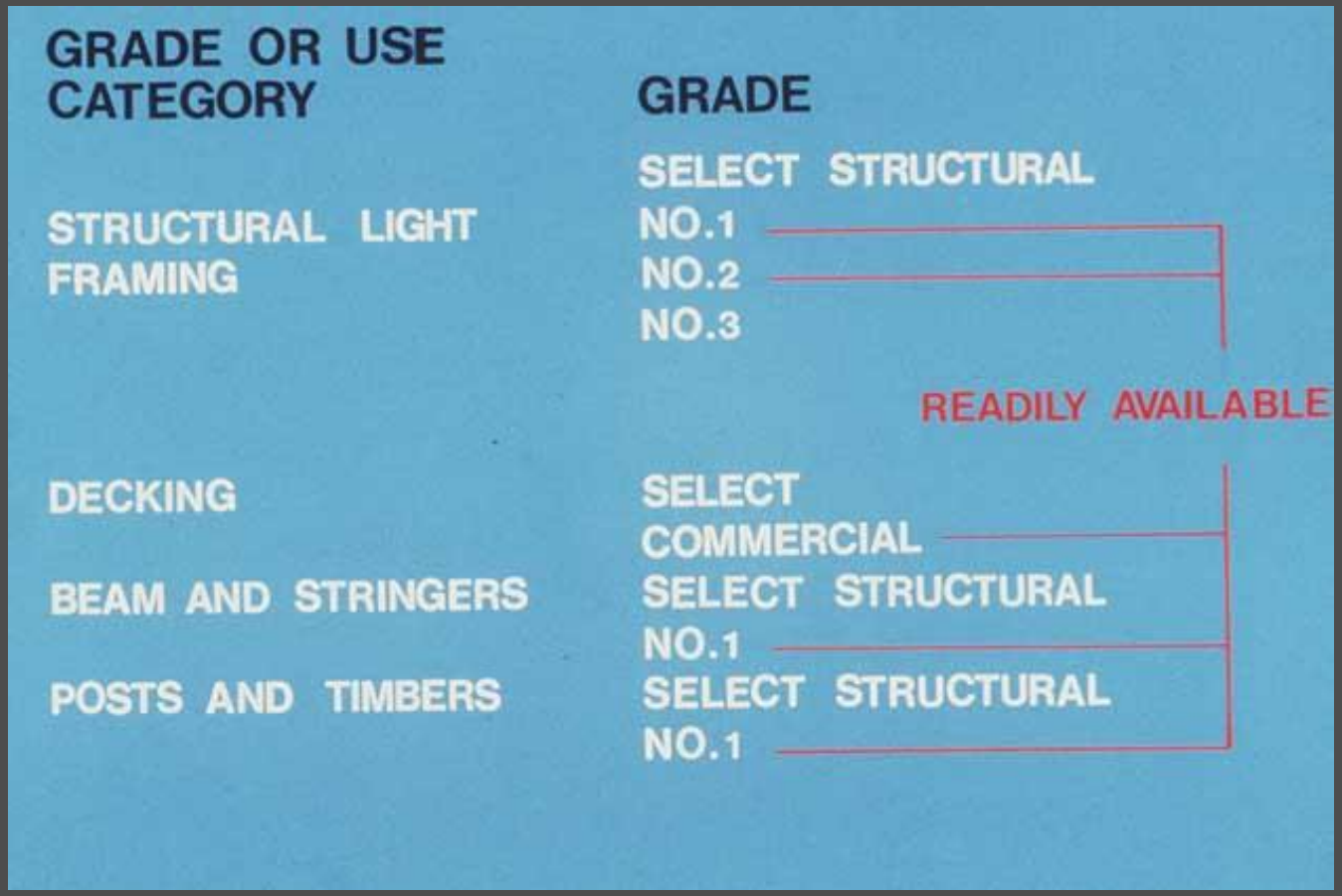
-poles



Lengths of lumber available will depend on species and location. Generally, lumber in western Canada is readily available in lengths up to 6.10 metres; in eastern Canada, in lengths up to 4.88 metres. Longer lengths can be obtained on special order, but unit costs may increase.

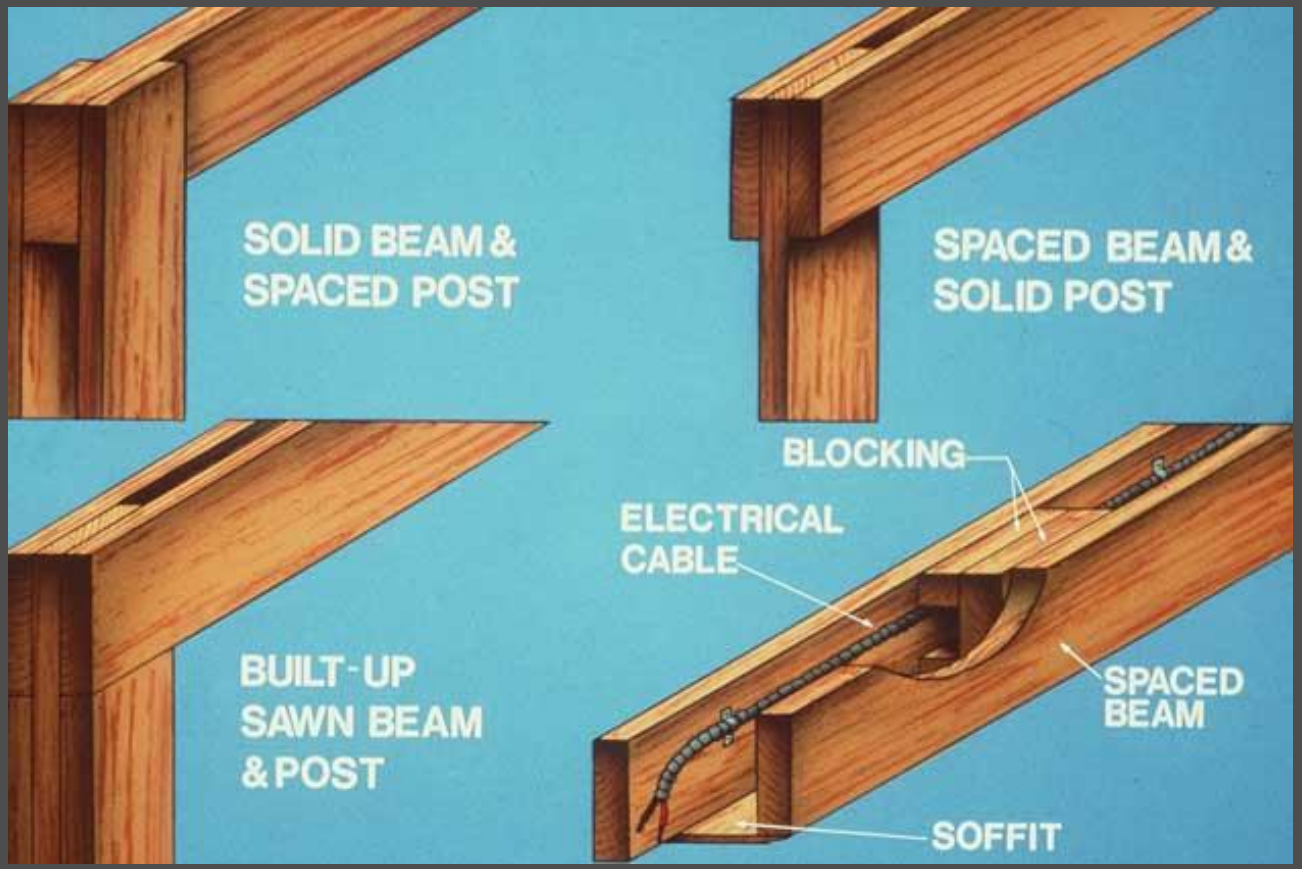
For smaller sizes, any species of lumber can be chosen, but for larger sizes it may be necessary to select a western species, such as Douglas Fir, Western Larch or Pacific Coast Hemlock. Trees from the west generally grow larger and taller than those in the rest of Canada. They yield larger sizes of lumber, but are sold across Canada.

Designers should specify a grade of lumber that is readily available. The top grade may not be stocked at retail lumber yards and some grades such as select structural, are not often graded by manufacturers. Structural light framing is often sold as No.2 and Better, a mix of No. 1 and No.2 grades. A minimum of sizes and grades will minimize confusion at the job site.



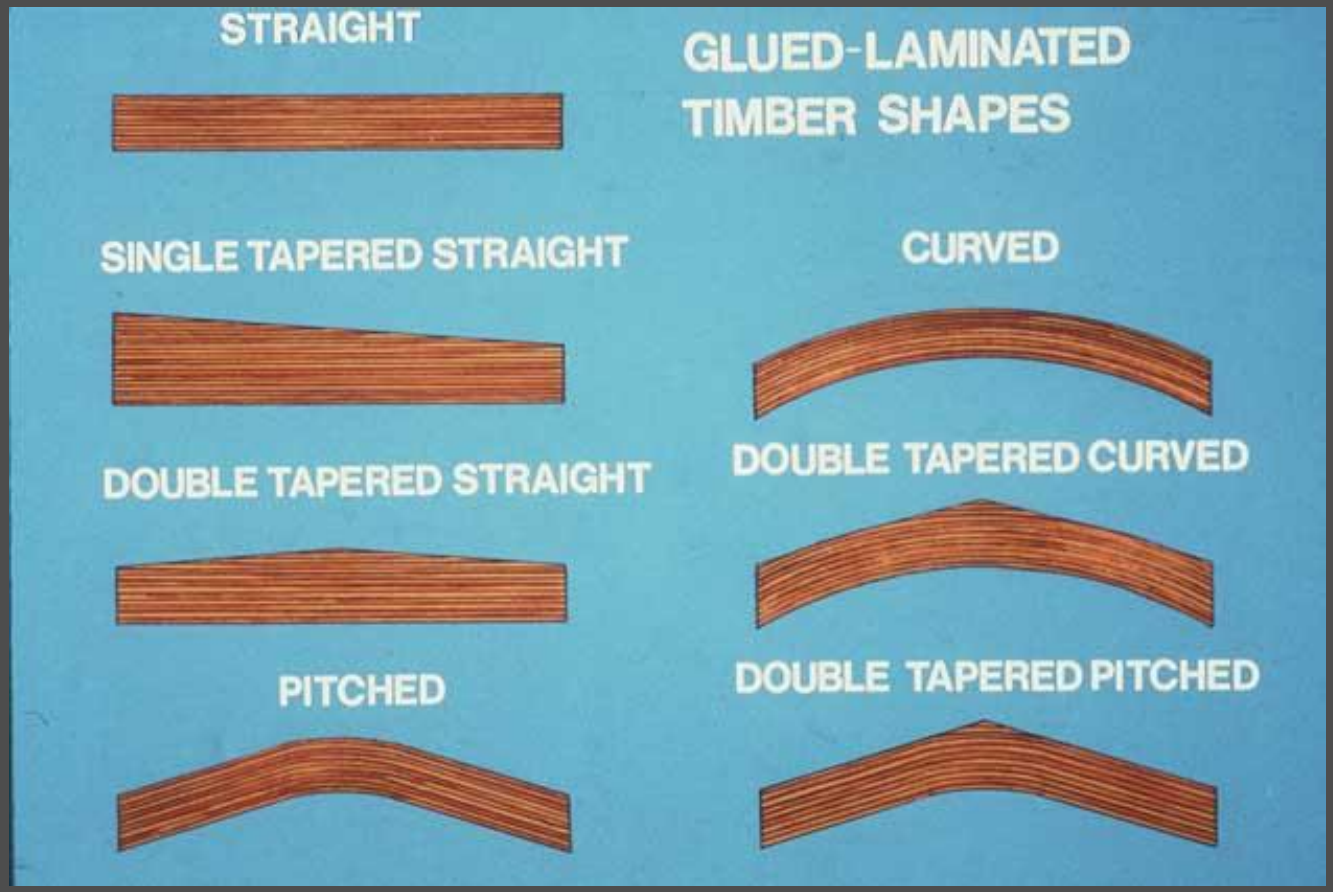
If stored outside, lumber should be stacked properly, with spaces for air circulation between layers and a cover over the pile. Unseasoned members should not be used in a building that is closed in quickly and heated. Too quick drying can result in development of checks or splits. Large sizes of lumber are always manufactured unseasoned and drying takes place after manufacture. These large members should be seasoned slowly to minimize checking and twisting.

In some cases, it may be desirable to build up beams or posts using small, readily available dimension lumber, nailed or bolted together. Certain design guidelines must be closely followed, but present no problem. This method of assembly also permits the use of spaced beams and posts with good interlocking joints between members. Smaller pieces of lumber are easy to handle and easy to obtain seasoned. Services, such as electrical wiring, can be placed between members of spaced beams.



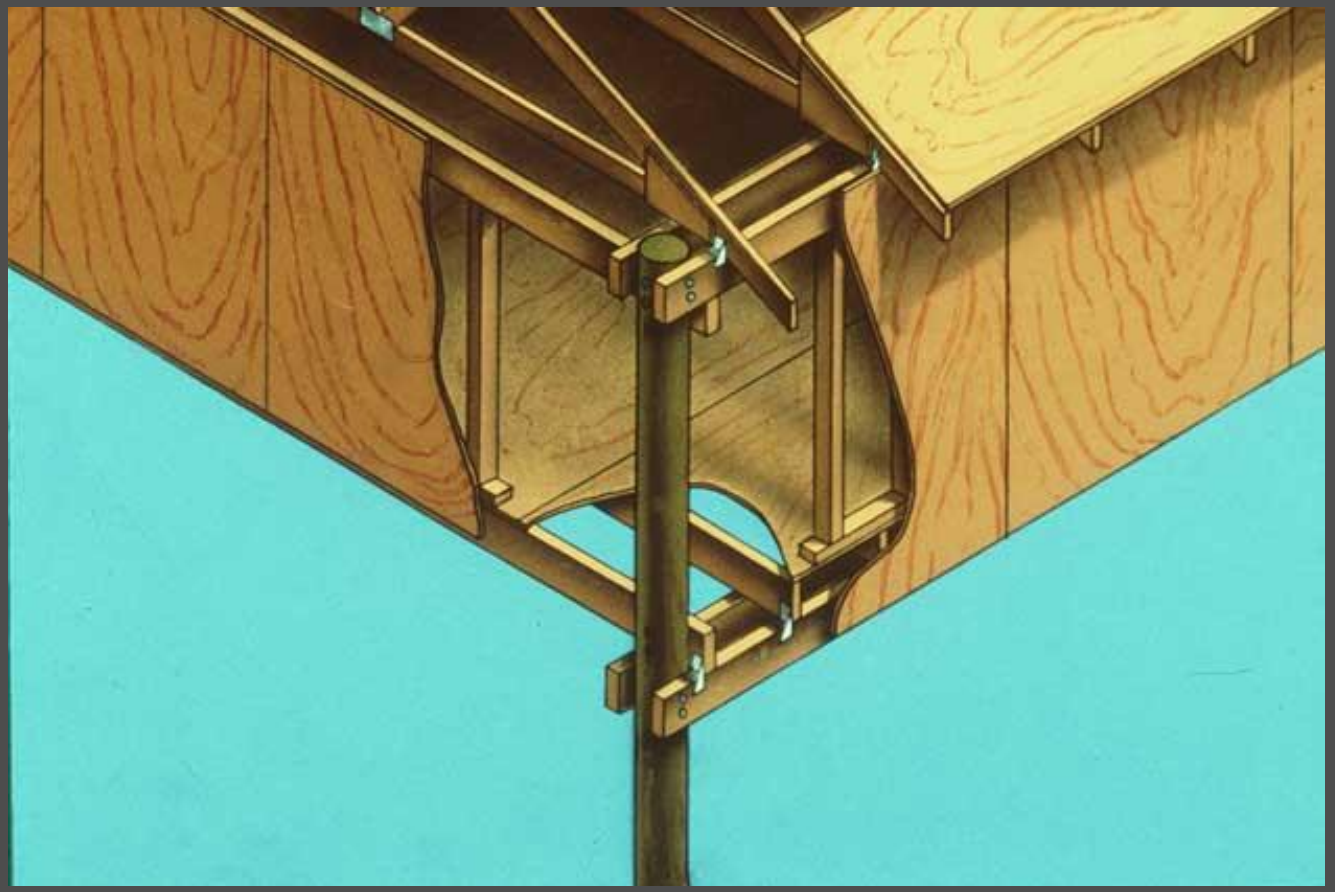
Manufacture of glued-laminated timber takes place in the shop under specially controlled temperature and moisture conditions to ensure that the glue bond is at least as strong as the wood itself. A system of quality control, conducted in accordance with CSA standards, helps ensure that a structurally reliable and durable end product is provided. Here, a worker is checking the moisture content of the glulam stock prior to manufacture.

Glued-laminated timber can be fabricated in curved, tapered or straight shapes, and in many sizes and lengths. Most members are custom made for specific jobs so will need to be ordered in advance. Generally, laminated members cost more than equivalent size sawn lumber members, although they are also stronger, resulting in longer spans.



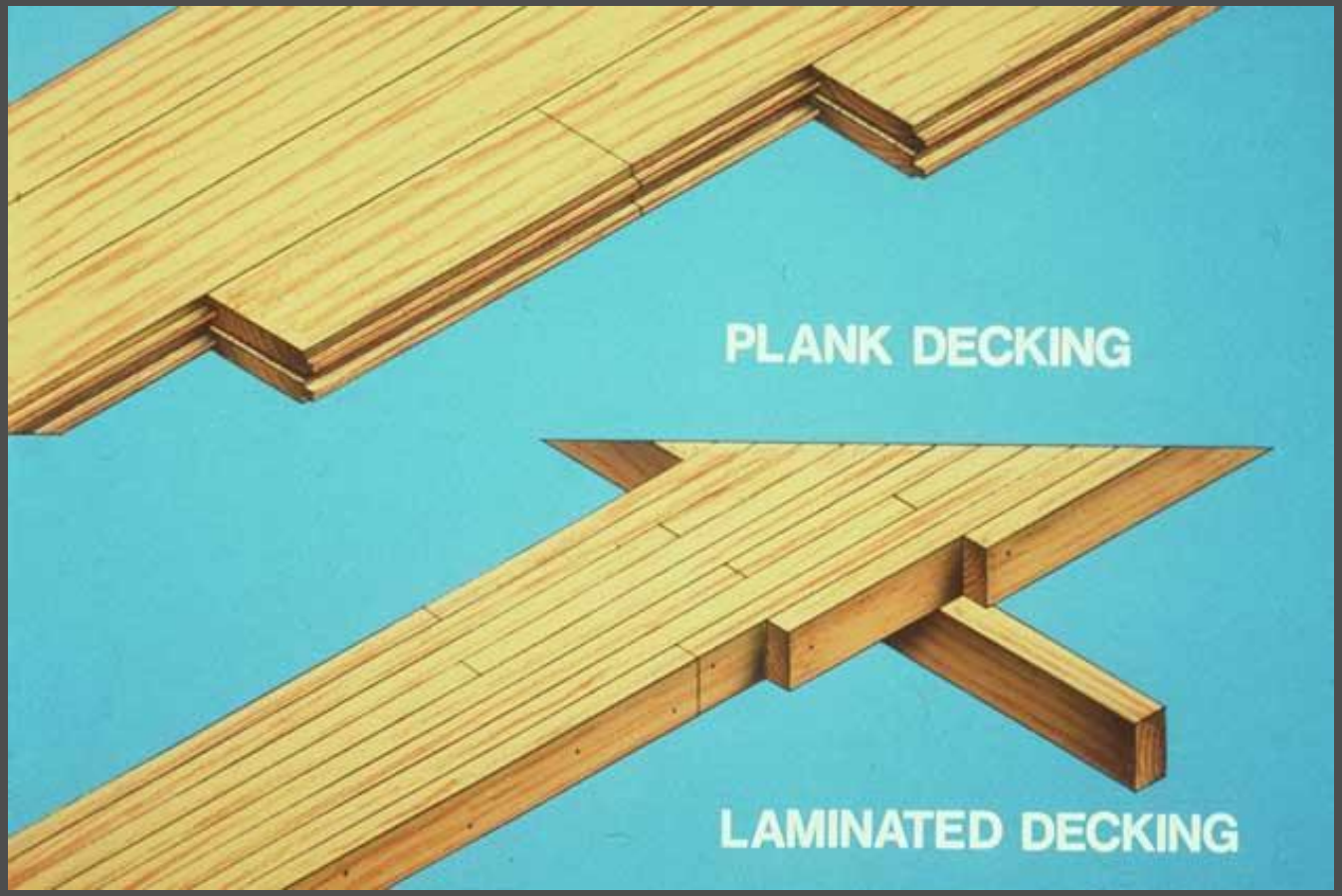
Plywood, in conjunction with lumber, can be used to build plywood web beams, either in a box or I-shape. Plywood web beams are light, efficient and made of readily available material. Beams may be assembled with nails or glue, or both, and may be made either on-site or in a factory. Gluing must be carried out under closely-controlled conditions to ensure that the glue bond is at least as strong as the wood.

If pole construction is employed for the foundation, the poles can be extended into the house to act as the posts, or they can be stopped at the superstructure. The poles must be pressure treated with preservatives in accordance with CSA 080 to prevent decay.

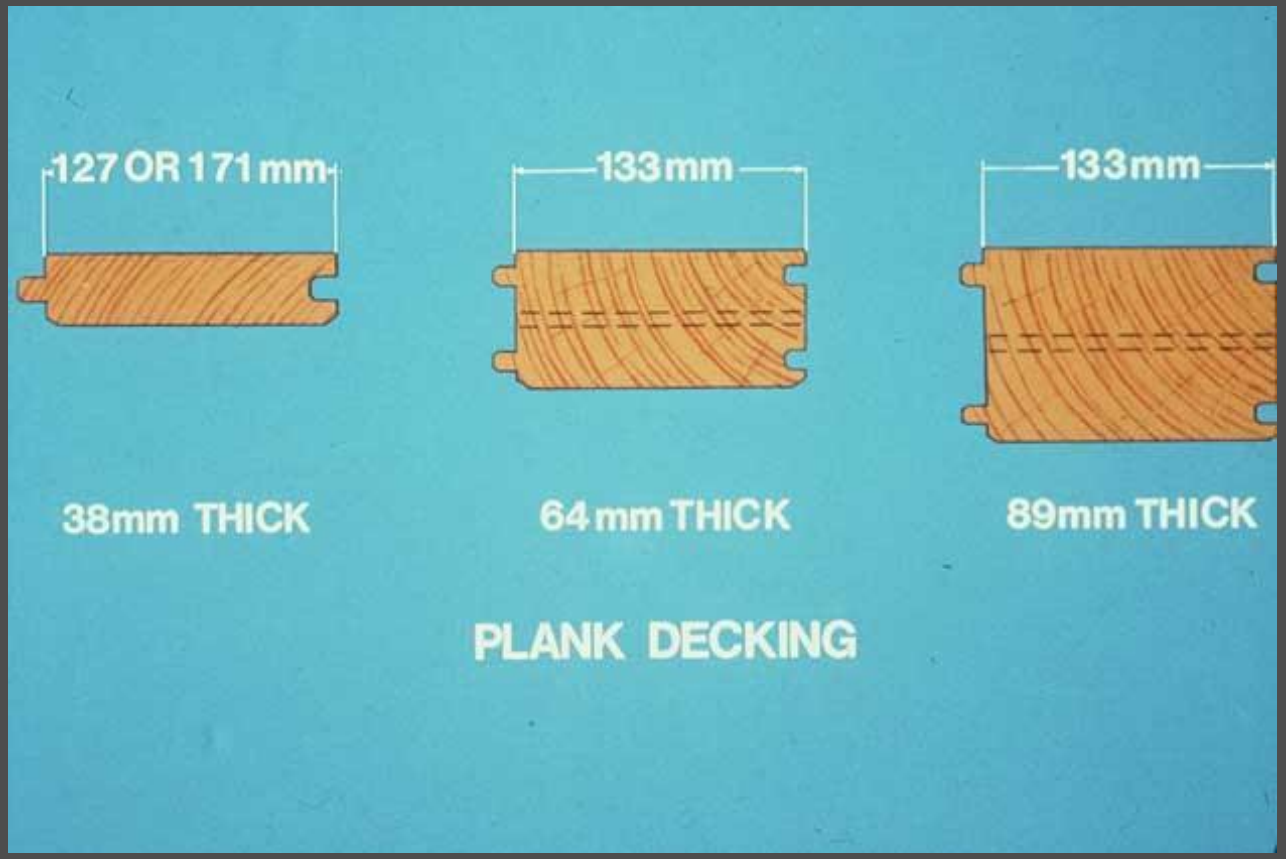


Roofs and floors can be built using exposed decking or conventional sheathed joist and rafter construction with a finished ceiling. The exposed decking, however, lends itself best to post and beam construction since it is so attractive.

Structural lumber decking can either be tongue and groove plank decking, with the wide face laid horizontal, or laminated decking, made of dimension lumber laid on edge and spiked together. Both types of decking are commercially available in a wide range of species and sizes.

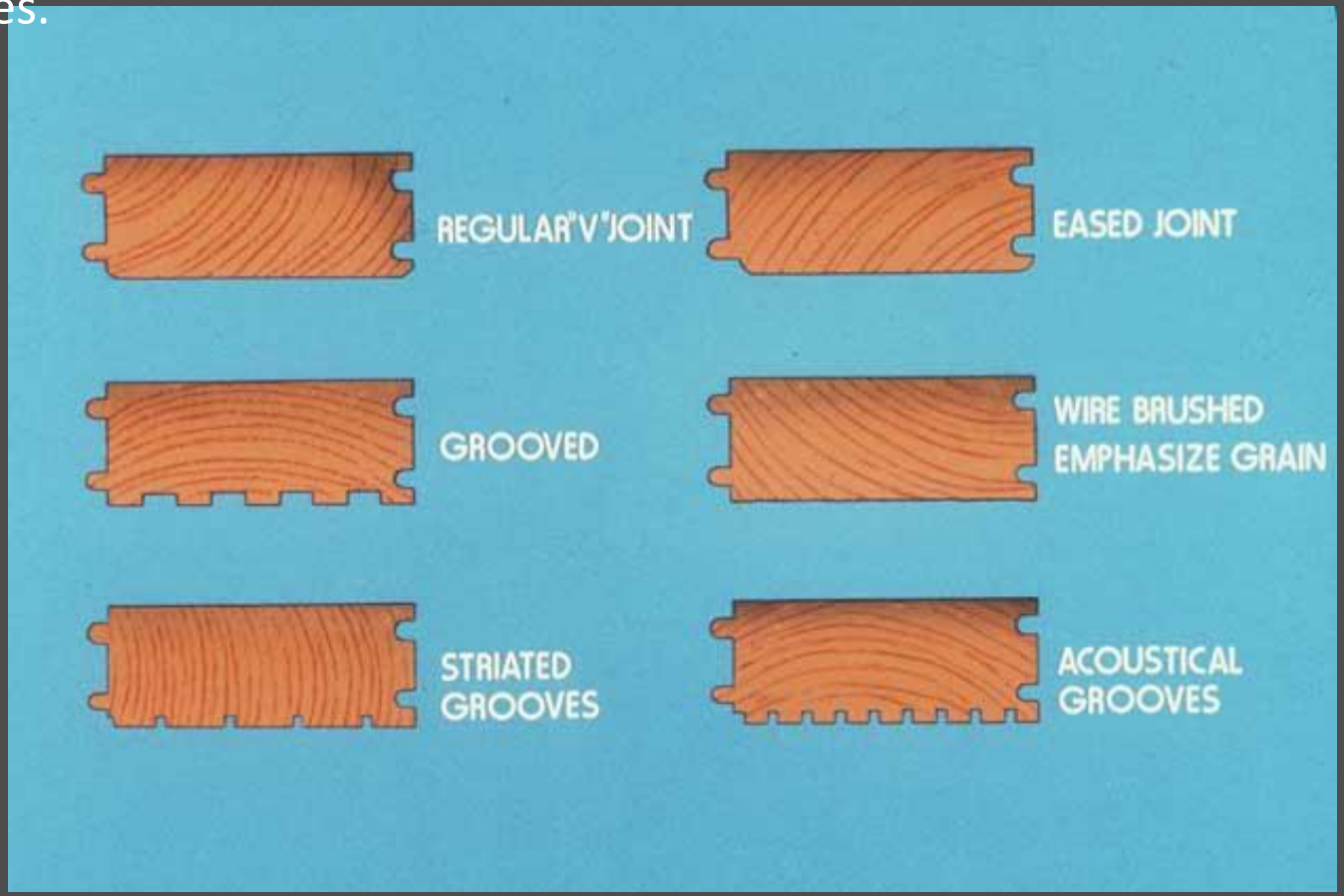


Plank decking is available in three thicknesses, 38, 64 and 89 millimetres. The 38 mm thick decking has a single tongue and groove to transfer loads between planks. The 64 and 89 mm decking has a double tongue and groove because of the heavier loads to be shared by the pieces, the material with a double tongue and groove is predrilled with lateral 6 mm diameter holes 750 millimetres on centre. This allows each piece to be nailed to the adjacent one with 200 mm spikes.



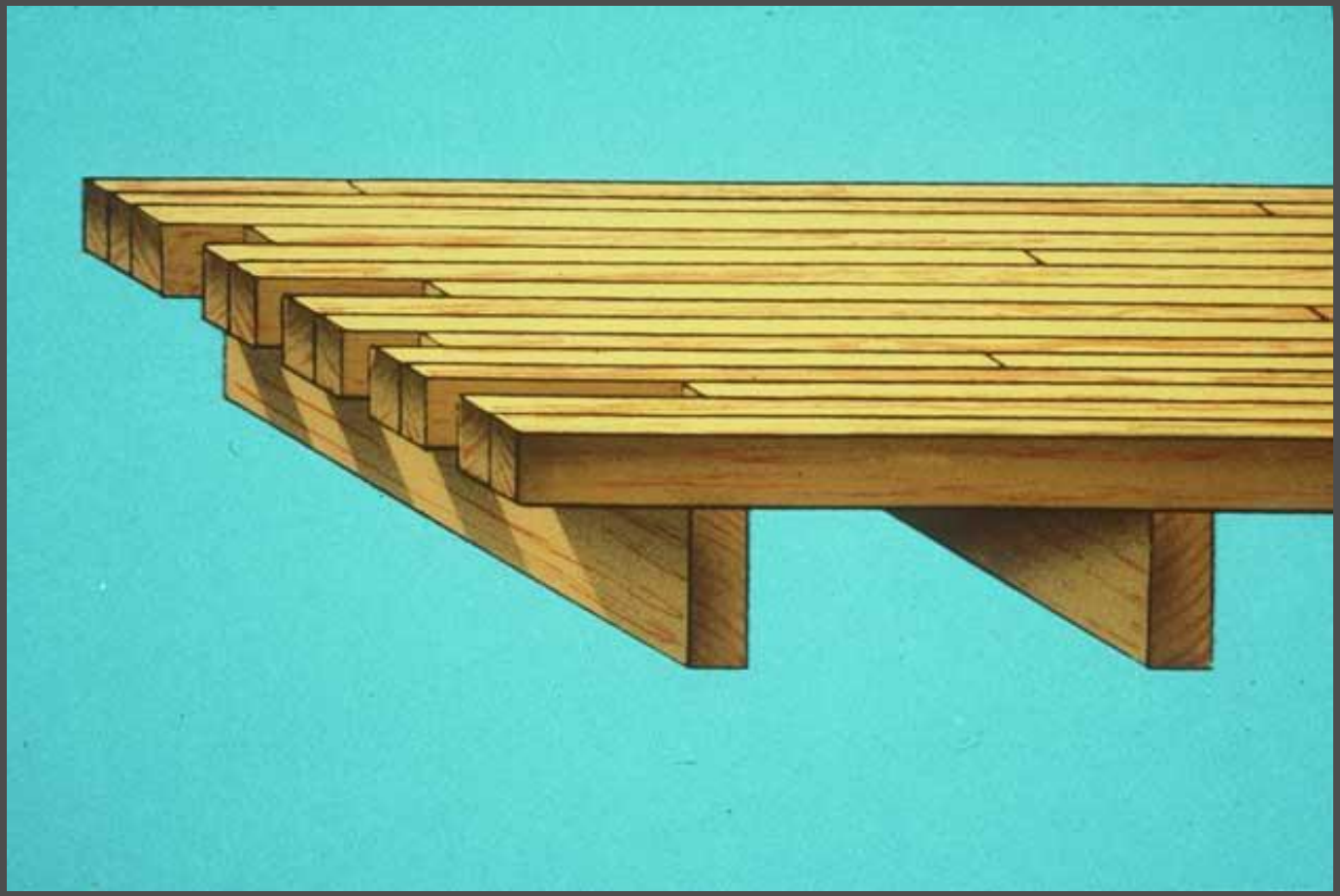
Tongue and groove end joints or metal spline joints can be used at end joints to improve load transfer at that location.

The underside of plank decking is usually left exposed, with a regular "v" joint. Other patterns are available for 64 and 89 mm planks, however, such as grooved or striated finishes, rounded or eased joints, wire brush finishes that emphasize the grain, or acoustical grooves.

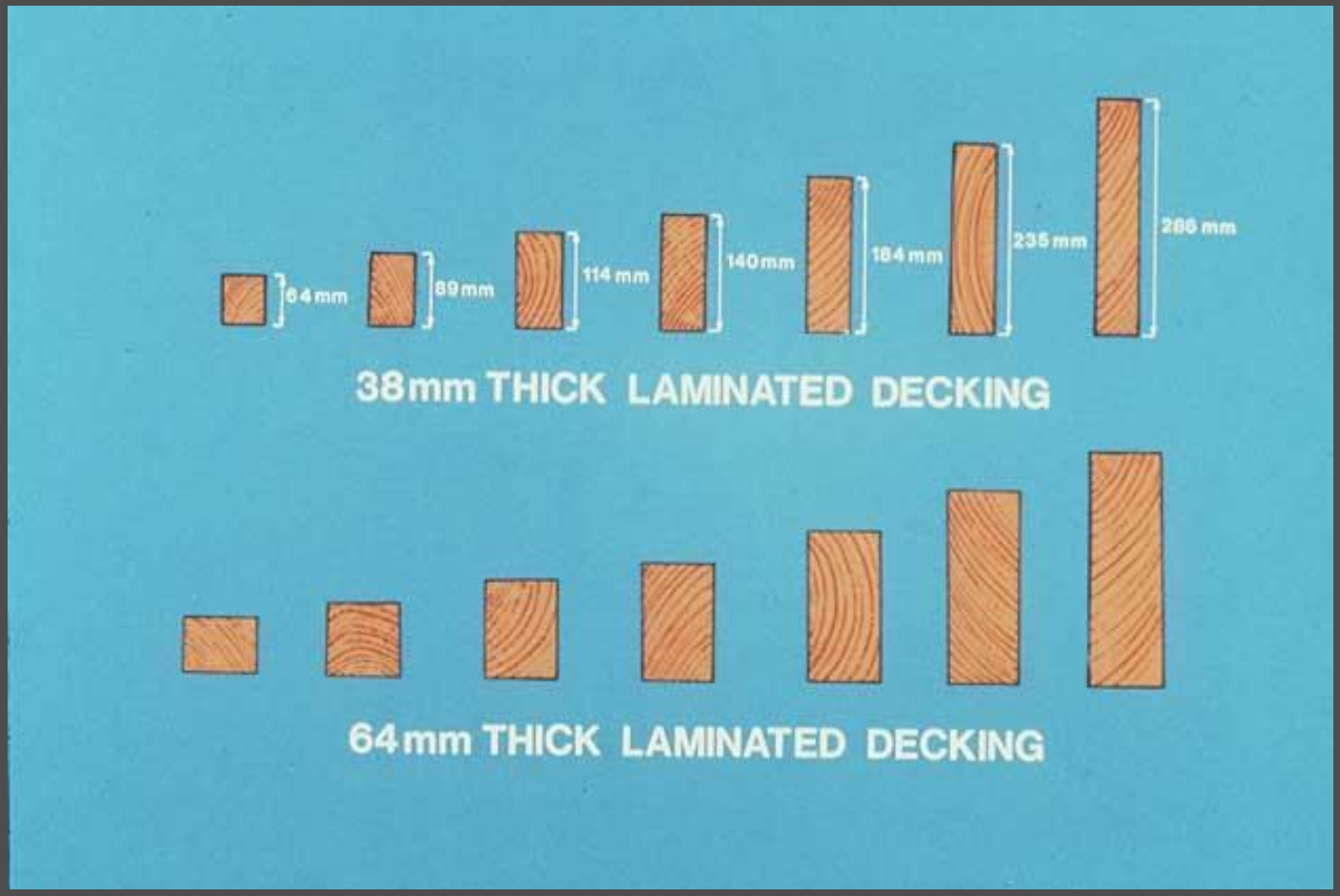


Only two grades of plank decking are manufactured, select grade and commercial grade. Select grade is only about 10 to 20% stronger and stiffer than commercial grade, but has a better appearance. Therefore, select grade is usually used in high class construction where good strength and fine appearance are desired, such as homes, schools, restaurants and churches. Commercial grade is often used in warehouses, service stations or structures with a ceiling underneath.

Laminated decking is often used for heavily loaded floors in industrial and storage buildings and for ramps, wharves and bridges. When appearance is not a factor, it is popular for standard floor and roof construction.

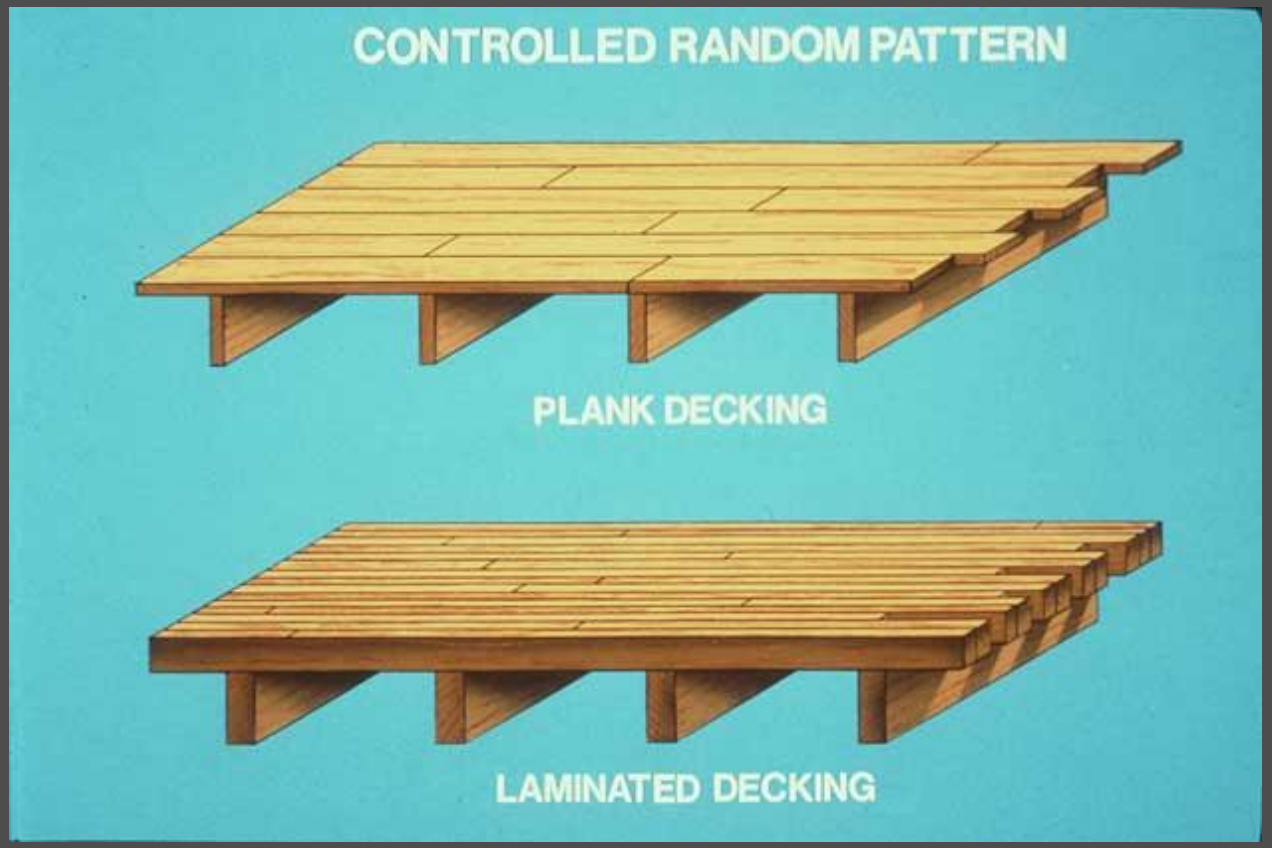


Dimension lumber for laminated decking is generally 38 mm in thickness with widths varying between 64 and 286 mms. Occasionally, 64 mm thick lumber is used. This lumber need not be kiln dried, unless so specified, because shrinkage is less critical than for plank decking.

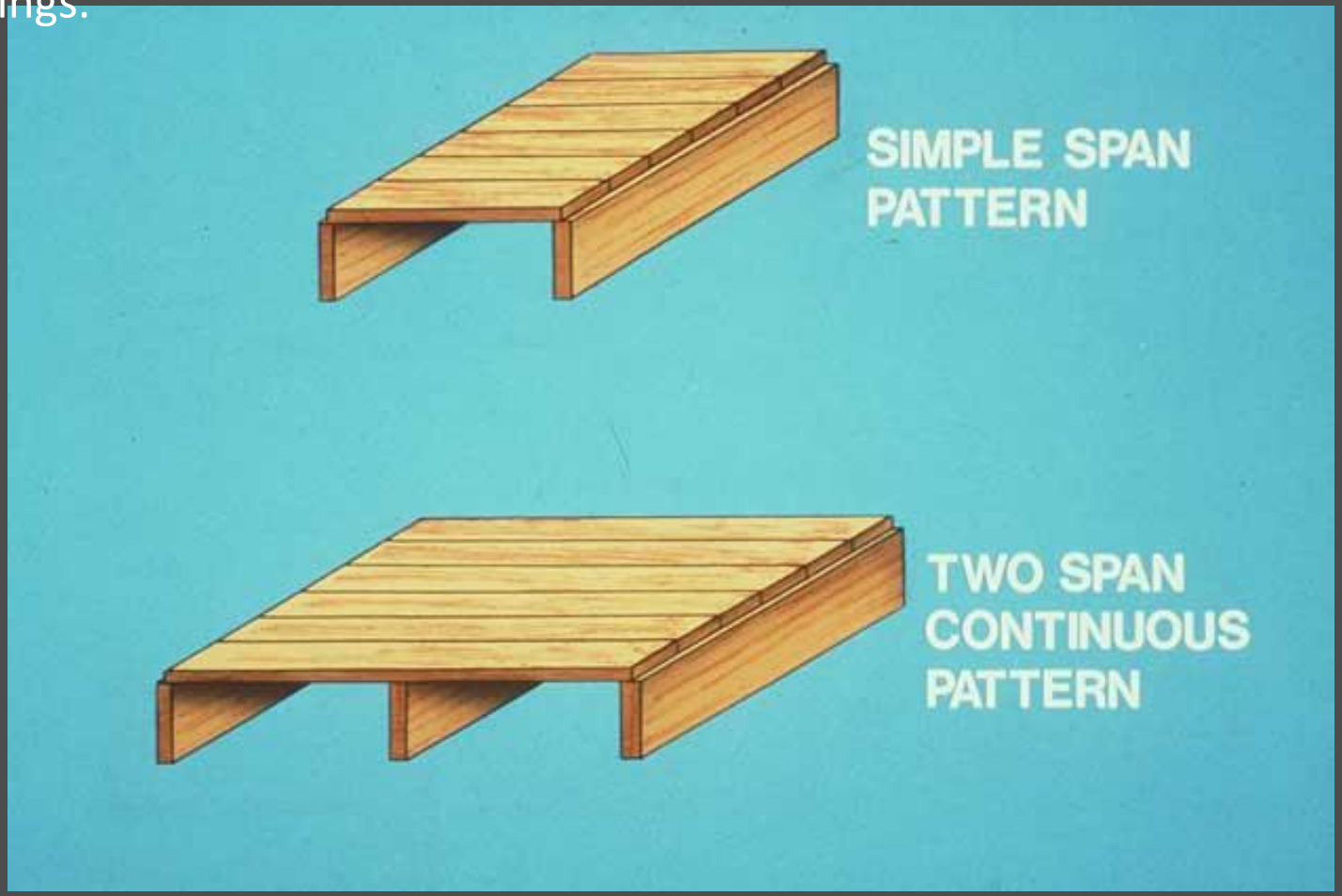


Laminated decking is nailed together at maximum spacings of 450 mm and maximum end distance of 100 mm, with a minimum nail length of twice the plank thickness. Decking lengths are usually provided in random odd or even lengths. Specific lengths can be ordered, but delivery time will probably be longer and the unit price may be higher.

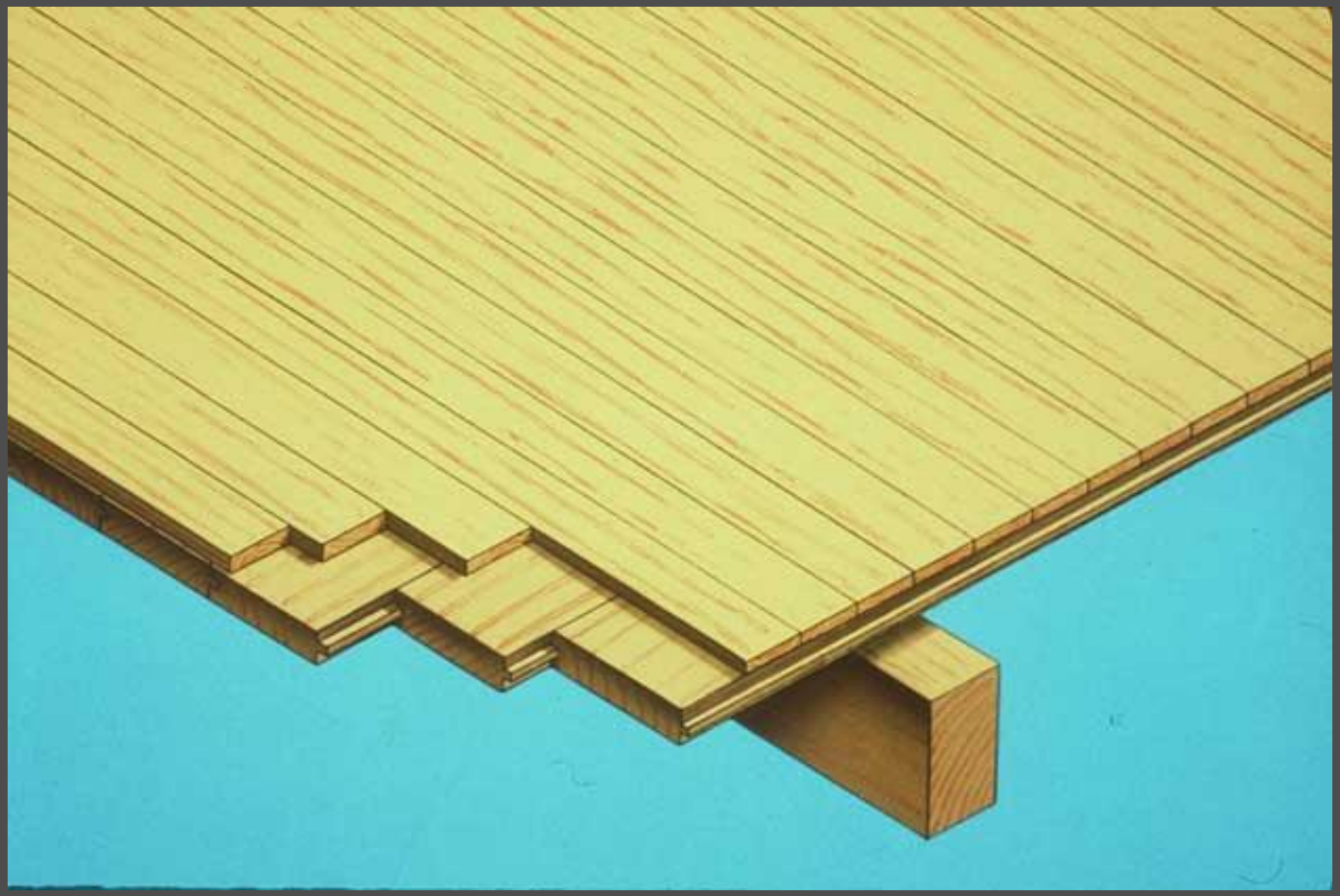
Since plank decking and laminated decking are usually sold in random lengths, a controlled random pattern is normally followed when laying the decking over three or more spans. This is more convenient and economical than using decking of uniform length. The maximum bending moment is the same as for a simple span but the maximum deflection is only about three quarters of the deflection for a simple span. For light loads and long spans, deflection will usually govern.



Decking can also be laid in simple span or two-span continuous patterns, but the lengths will need to be uniform. In addition, beams will have to be spaced to suit the decking length, or the decking cut to suit the beam spacings.

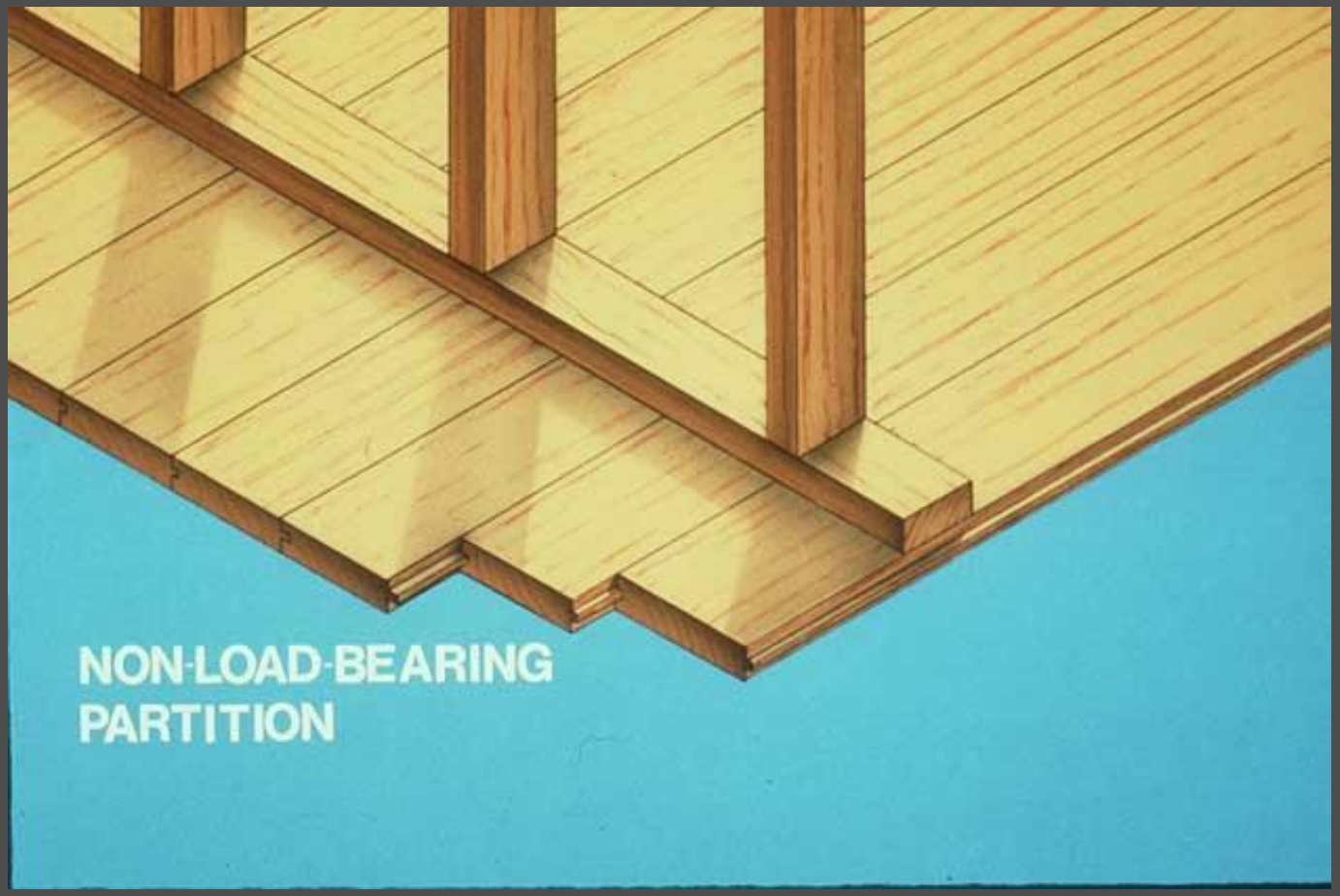


If finish flooring is applied over decking it should be laid at right angles to the decking, using the same procedure as for conventional construction. If heavy concentrated loads occur, additional framing may be needed beneath the planks to help carry the loads to the beams.



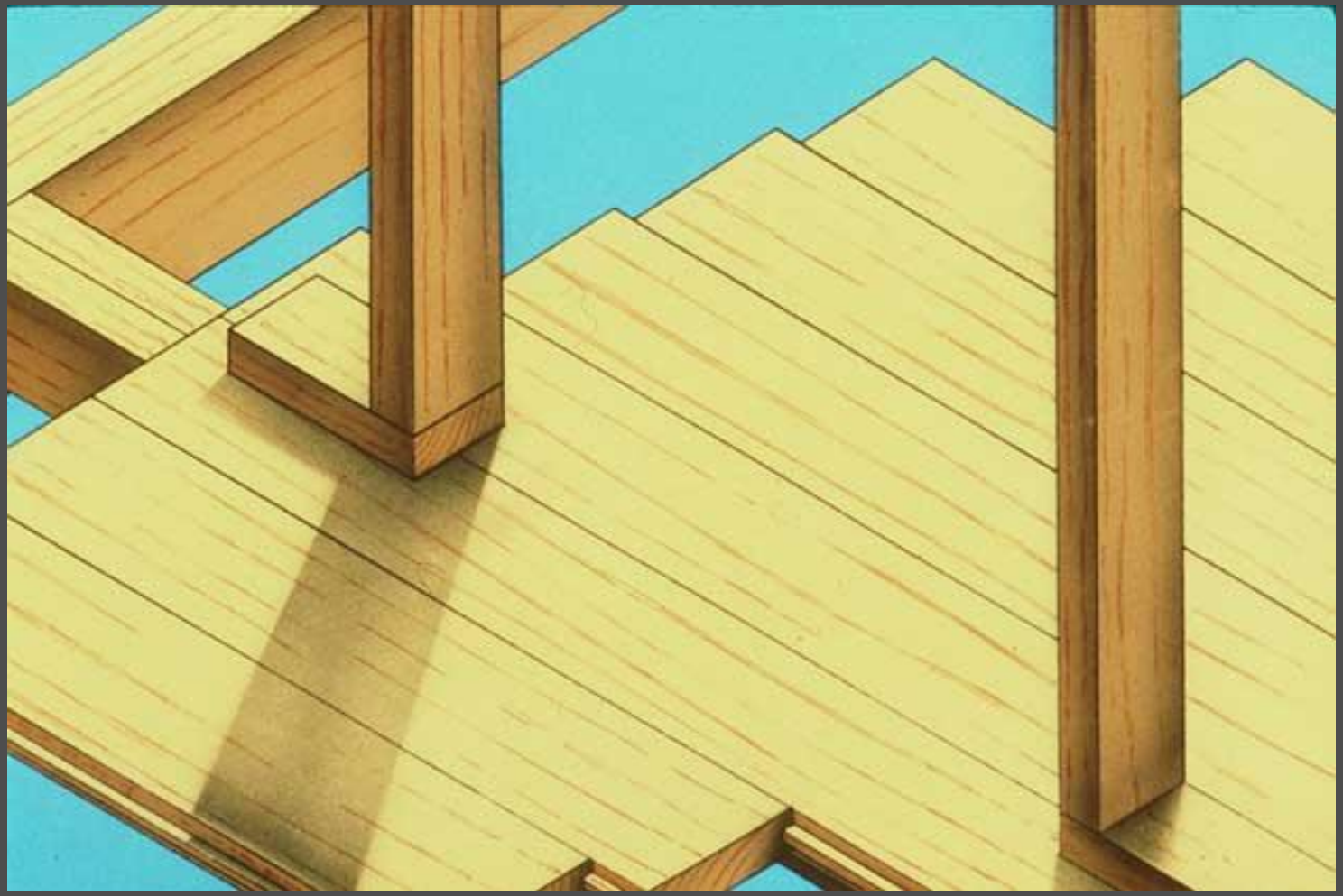
Load-bearing partitions, if they occur, should be placed over the beams and the beams should be designed to carry the loads. Or supplementary beams can be placed in the floor framing arrangement.

Usually, however, partitions are non-load-bearing in post and beam construction. If they are placed at right angles to the decking, no supplementary framing is needed for non-load-bearing partitions if calculations show that the decking will support the dead load of the partition.

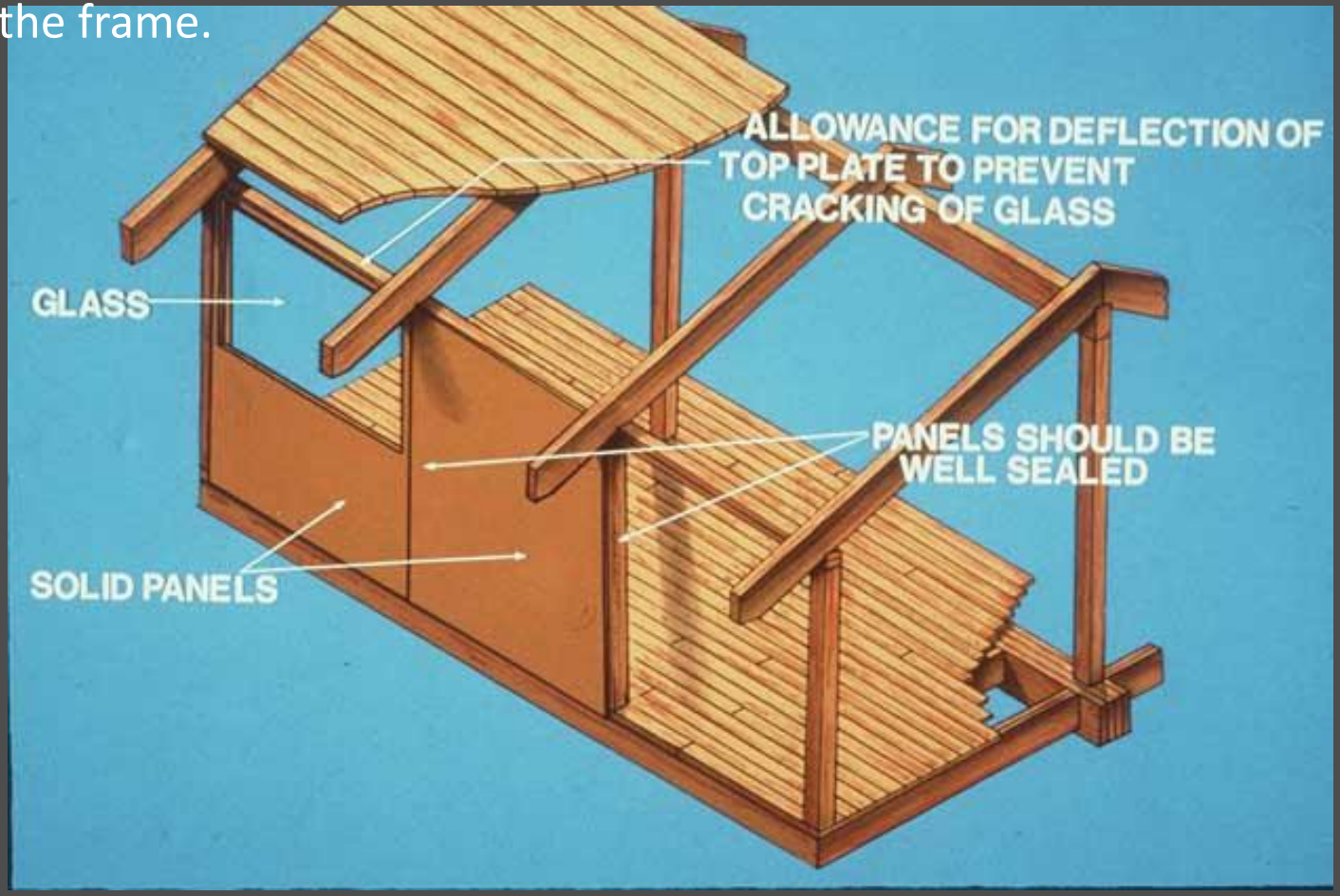


But if they are placed parallel to the planks, they require additional support to carry their weight to the main beams. This can be achieved by placing a beam under the partition, either above or below the decking.

If openings occur in the partition, a beam must always be placed under the decking. The beam can be connected to the main beam by metal hangers.

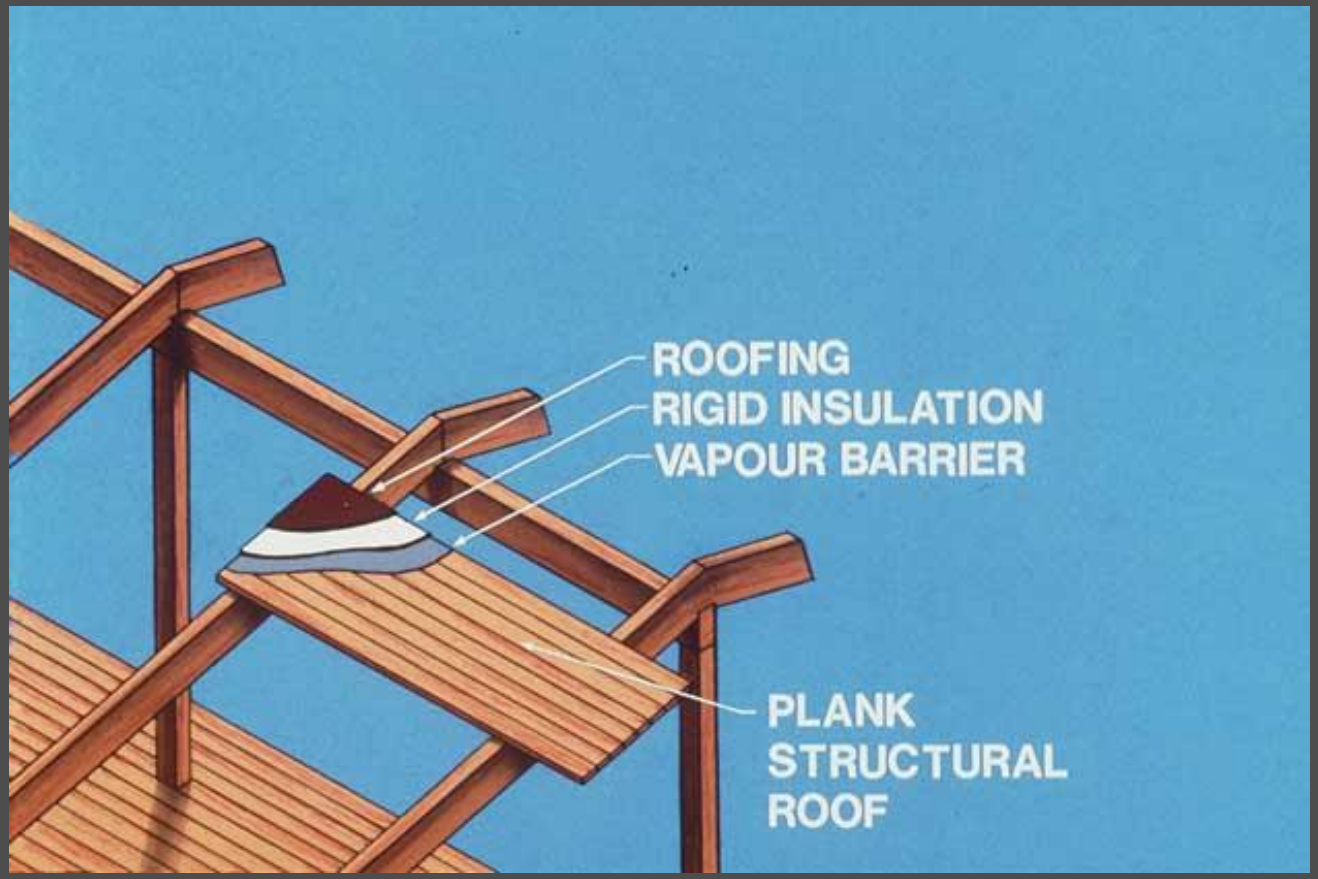


Allowance must be made for movement around the perimeter of the panels, such as beams deflecting at top and bottom of the panel. Frames should be designed to take care of this movement, particularly where there is glass, so that no damage will occur. Joints should be airtight to seal the frame.



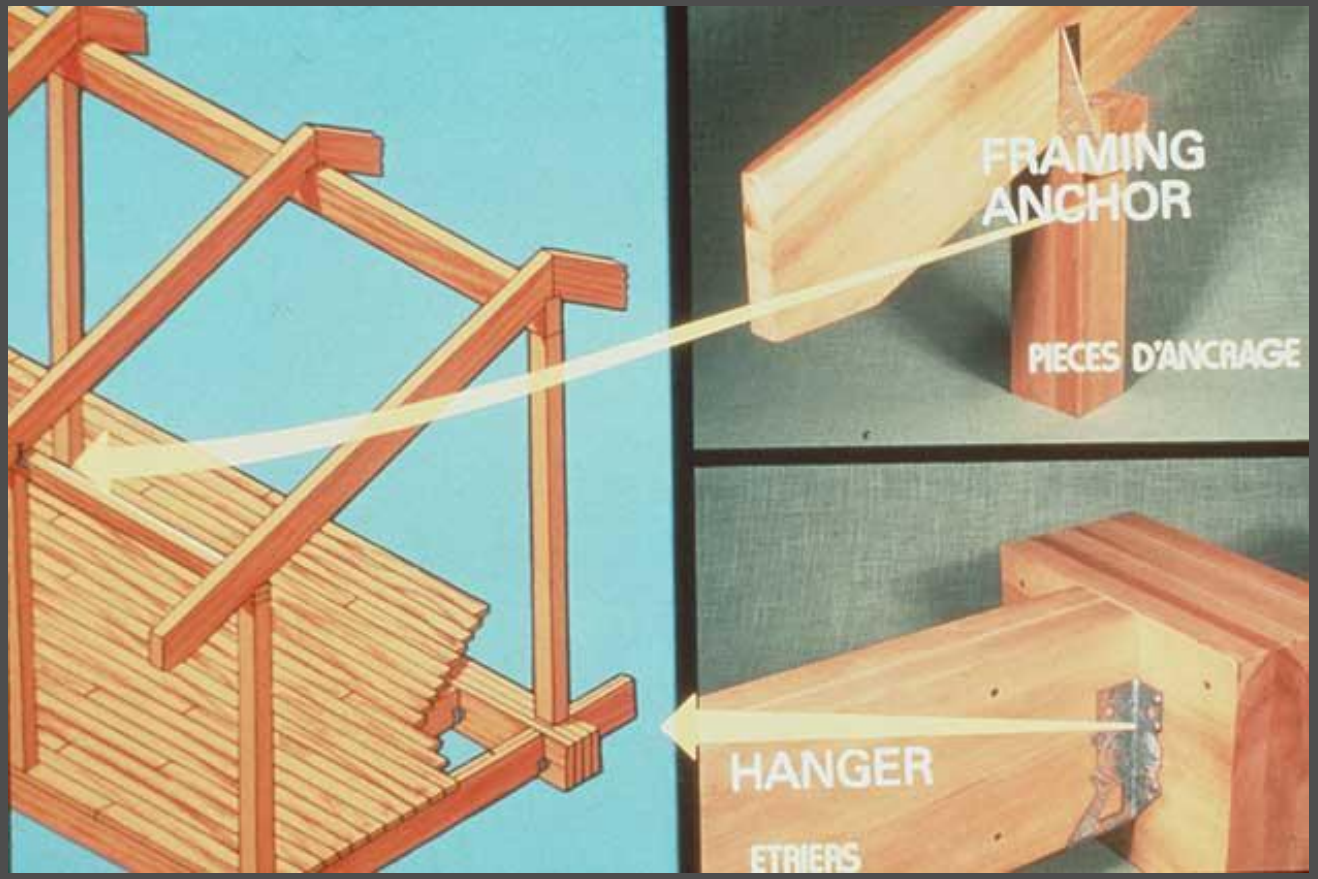
The higher R value can also be achieved by adding rigid insulation to the outside of the studs or posts or by using furring or strapping on the studs or posts and adding additional insulation in the cavity.

Rigid insulation, which is often used with plank decking roofs, is usually laid on the upper side of the deck and bedded in mastic. On steeper roofs, where slope exceeds 3 in 12, the insulation should be held by mechanical fastenings. A vapour barrier is placed at the warm face of the insulation, thickness of the insulation will depend on the "R" value needed for that area.



There is a wide array of metal fasteners for use in wood construction -- nails, staples, screws, light metal connectors, metal connector plates, bolts, lag screws, timber connectors and timber rivets.

There are two main types of light metal connectors -- framing anchors and joist hangers. They are usually used where greater strength and stiffness are needed than can be provided by nails alone, making them ideal for post and beam construction where members are spaced well apart.



But many other metal fittings are used, such as post caps and anchors, straps and nail-on plates, if required to carry design loads, manufacturers recommendations should be followed. Details about other fasteners used in wood construction are given in another audio visual program called “Wood Connections”.