TVET CERTIFICATE III in CARPENTRY

JOINTS CONSTRUCTION

CAPCJ301

Construct joints

Competence

Credits: 10

Learning hours: 100

Sector: Construction

Sub-sector: Carpentry

Module Note Issue date: OCTOBER, 2020

Purpose statement

This module describes knowledge and skills required to construct joints. It describes the skills, knowledge and attitudes required for the trainee to construct lengthening joints, construct widening joints and construct framing joints.

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INTROUCTION

Joinery is a part of woodworking that involves joining together pieces of wood or lumber, to produce more complex items. Some wood joints employ fasteners, bindings, or adhesives, while others use only wood elements. The characteristics of wooden joints - strength, flexibility, toughness, appearance, etc. - derive from the properties of the materials involved and the purpose of the joint. Therefore, different joinery techniques are used to meet differing requirements. For example, the joinery used to construct a house can be different from that used to make puzzle toys, although some concepts overlap. In British English usage it is distinguished from carpentry which relates to structural timber work.

Both of these types of construction utilise a combination of woodwork joints, adhesives, and fittings such as nails and screws.

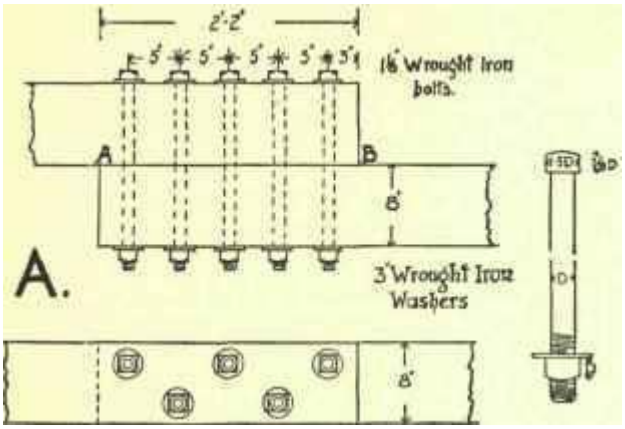
Learning Unit 2 Construct lengthening joints

LO 1.1 Identify types of lengthening joints

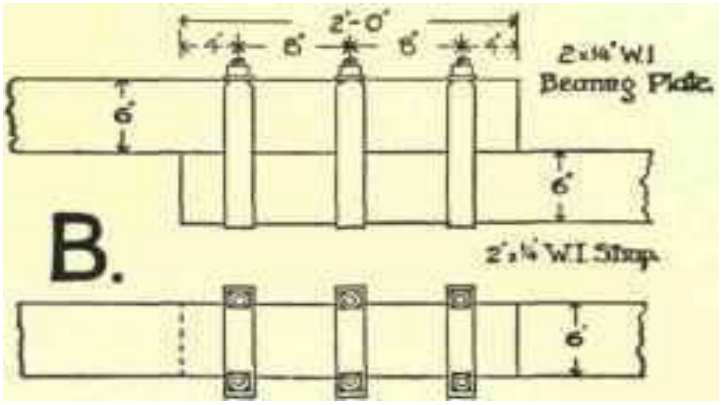
1 Types of lengthening joints

1.Lapped Joint. - This joint is of a very clumsy appearance, and is only used in work of a temporary nature or in small timber framings hidden from view. It is formed by overlapping the ends of two pieces of timber, and fixing them by means of nails or bolts as at A, or by straps as at B, Fig. 1. Nails are used when the timbers are small. It has been found also in practice that a bolted joint is more suitable for resisting a tensile stress than a strapped joint, the latter being a more satisfactory joint when the timbers are in a state of compression.

Fig1.



Labbed Joint Botted.



2 Scarfed joints

In this method of uniting timbers corresponding portions are cut away from the ends of each, and the remaining portions are overlapped and fitted together. This joint is used when appearance is the main object, for which reason great care should be taken in its designing and cutting, so that it may be as imperceptible as possible.

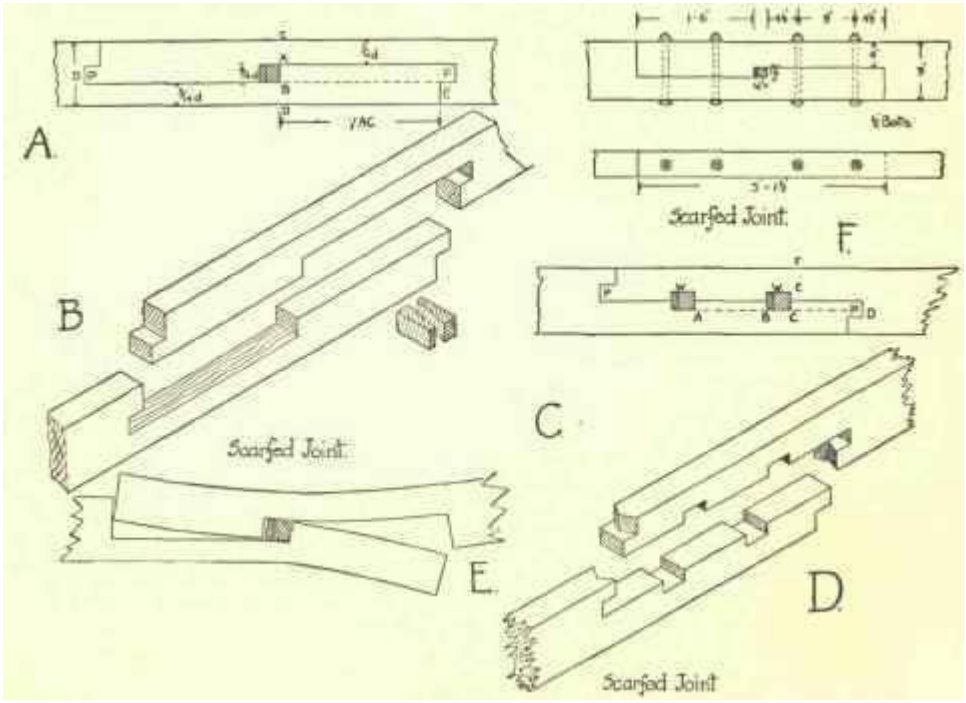


Fig. 2.

3. Fished Joints

When it is desirable to join two timbers without reducing their section to the extent shown in Fig. 3, a joint known as a Fished Joint, and formed as shown in Fig. 3, is used. The simplest form of fished joint is that shown at A, Fig. 3. It is formed by butting the ends of the timbers and bolting wooden fish-plates on to two parallel sides.

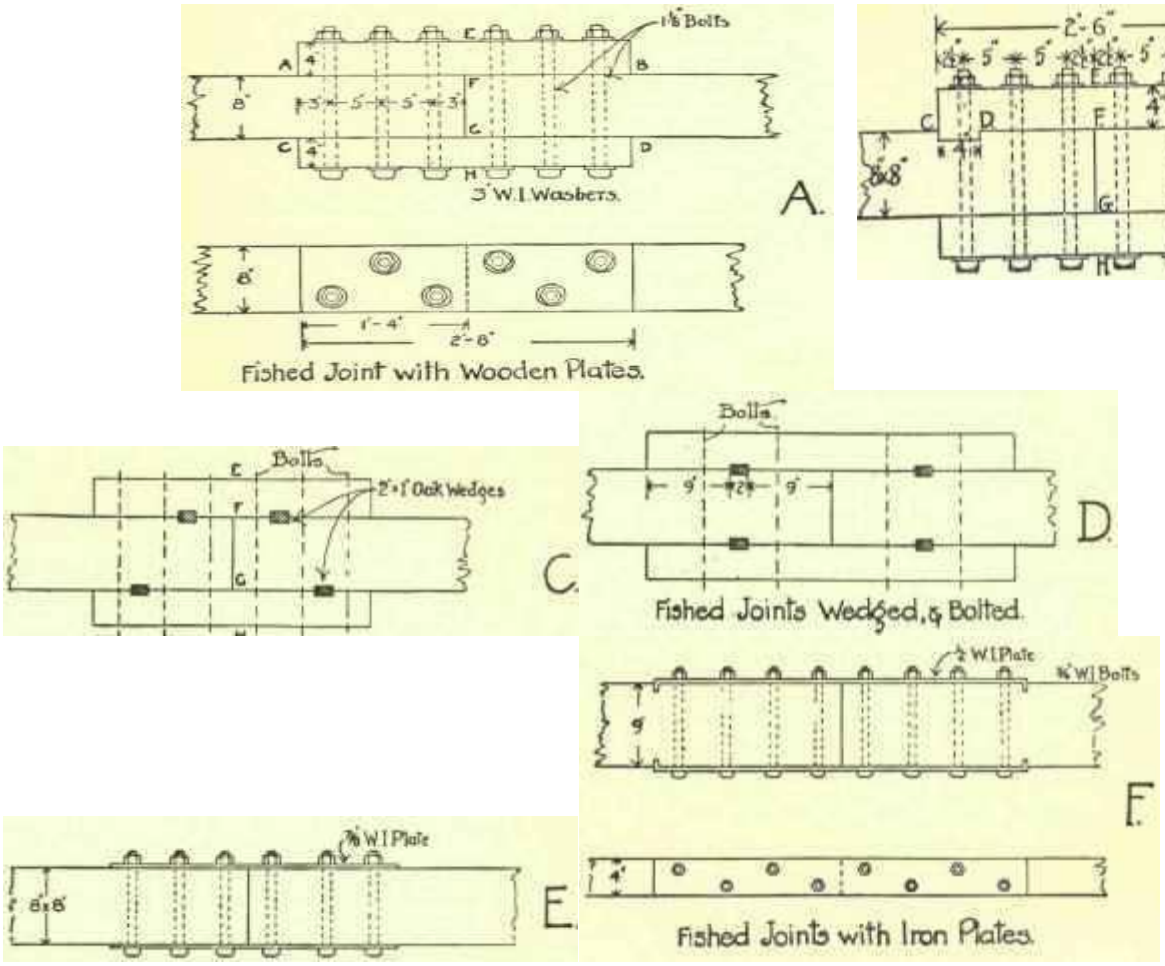


Fig. 3.

4. Joints for Lengthening Wall-Plates

1.Screwed Joint

A very useful joint is formed by butting the ends of the plates and securing them by means of a hand - rail screw,

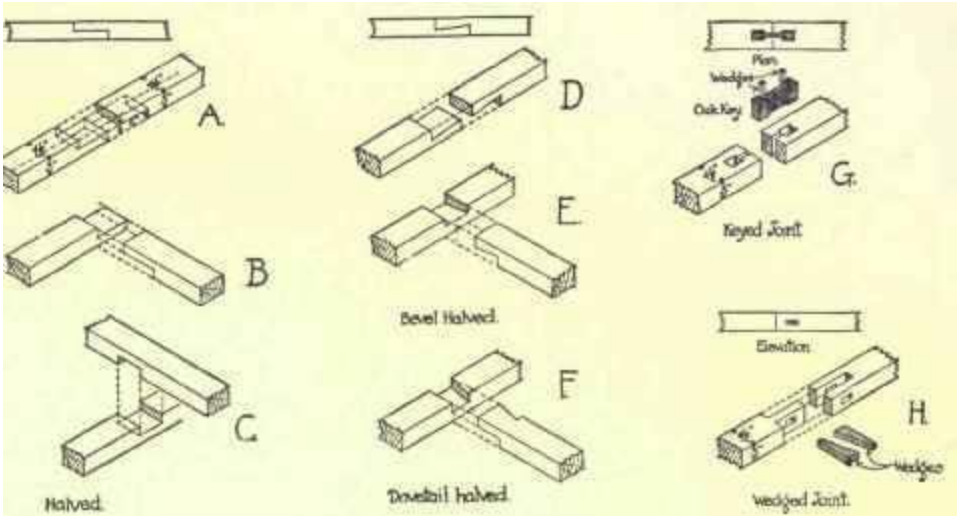
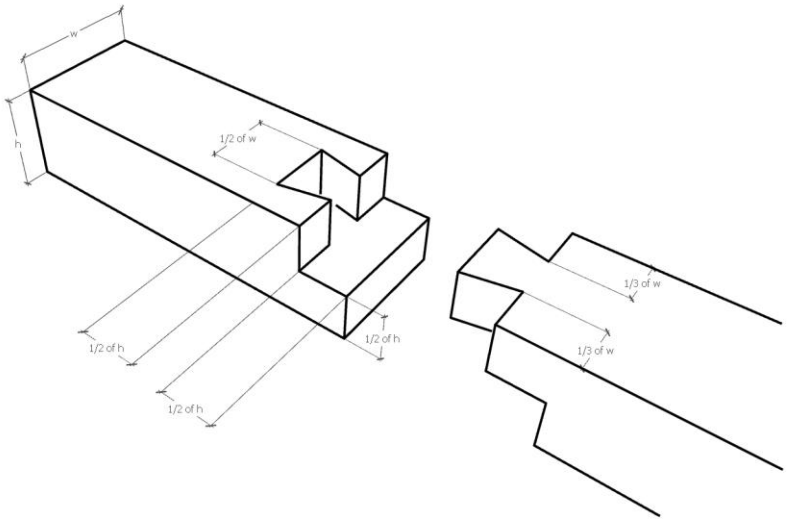


Fig. 4

2.DOVETAILED SCARF JOINT



This connection type is basically a simple half lap joint with an additional dove tail. It is very practical and effective.

It plays an important role statically and simplifies the process of erecting.

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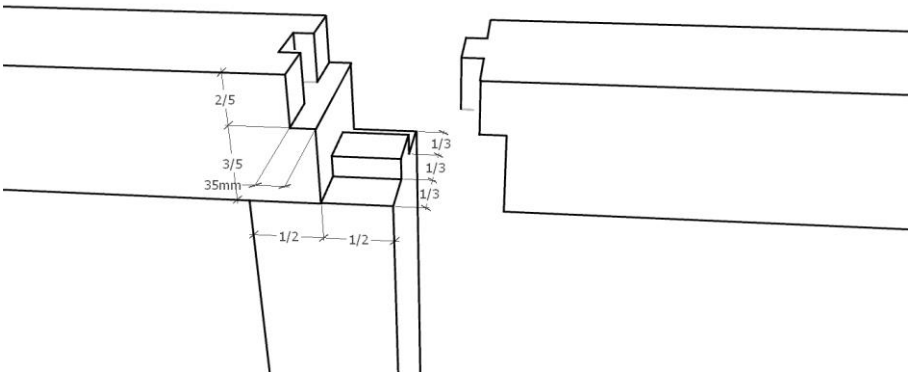
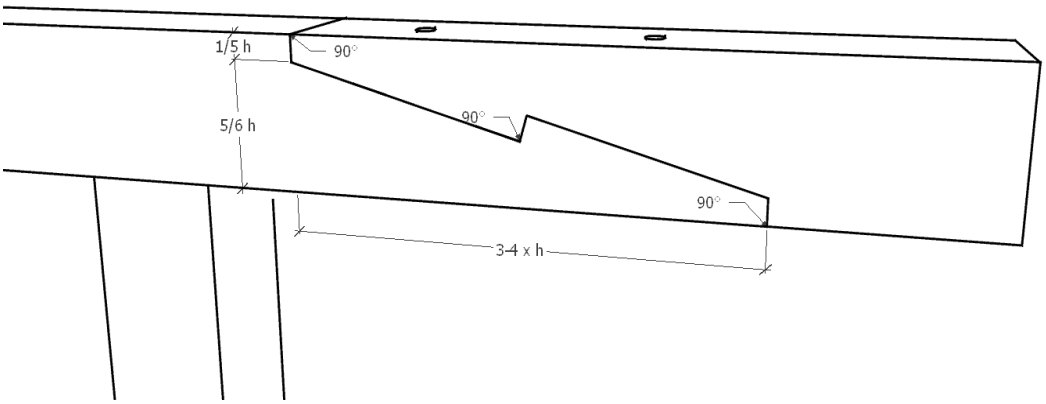
3. RABBETED STUB TENON



This is a much more detailed connection.

Many measurements are necessary to get this joint done.

4. OBLIQUE HOOKED SCARF JOINT

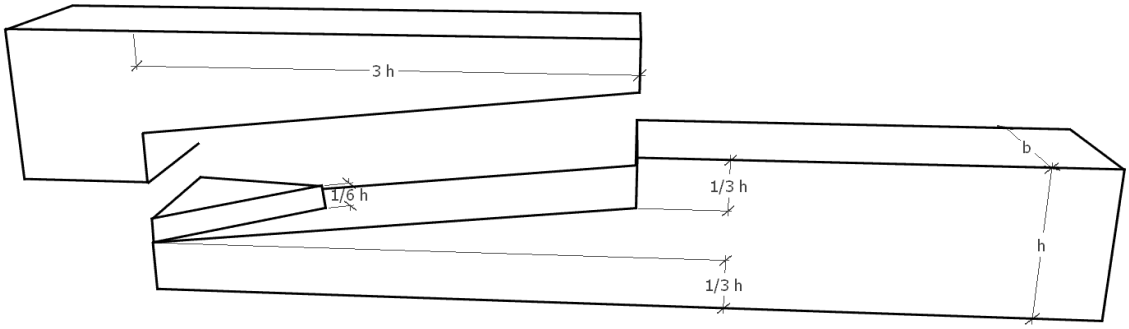


The hooked scarf joint is a very resiliant lengthening joint, it can handle both tension and compression forces.

These joints are common for the construction of timbered houses as well as in normal house construction.

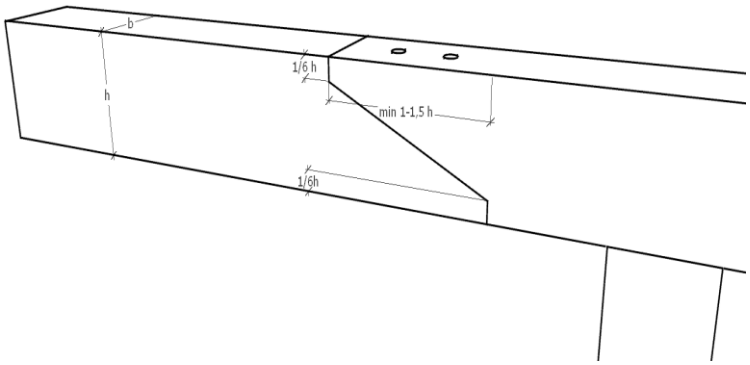
There are different possibilities to recreate this connection, although it is not quite easy. You can find further help in my e-Book.
For more detailed information to this scarf joint look up this article.

5. OBLIQUE SCARF JOINT WITH HIDDEN HOOK



This joint is made almost like the hooked scarf joint. It is also quite similar to the pinned oblique scarf joint.

6. OBLIQUE PINNED SCARF JOINT



This lengthening joint is used for joining two timbers with larger cross-sections to form one longer piece. Examples are center purlins, ridge purlins or girders.

The main advantage of this joint is that the complete cross-section can be taken into account for bearing the load. For a simple half-lap joint this is not possible.

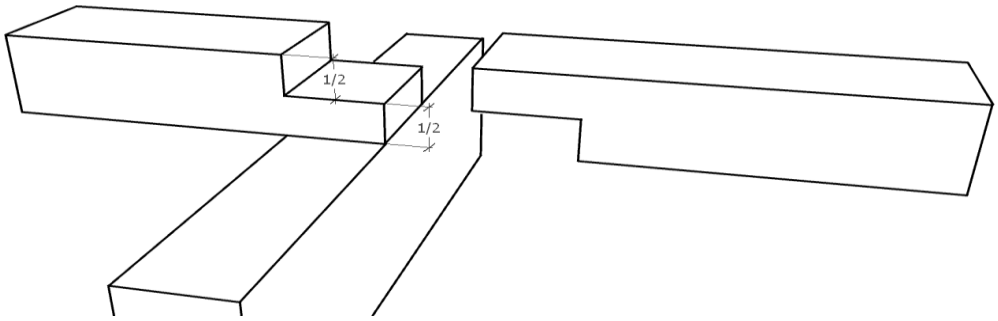
When drafting it must be remembered that the upper beam should rest on the bearing point and the lower beam is fixed underneath. The other way around it would lead to cracks.B oltsare used to secure against lateral movement and hold both pieces toge

LO 1.2 Construct lengthening joints

- **Procedures of constructing: lengthening joints:**

-**Read sketches**: the practice should start according to the readable sketch with scale, dimensions, sections and use actual size.

1. HALVED SCARF JOINT



- Prepare timber to the required size: by marking**,** ripping, planning, squaring and cutting

- **Identify the tools required**: tools used to make lengthening joint are divided into two groups

Which are hand tools and wood working machines

Hand tools: ex: pencil, tape measures, saw clamp, try square, planer, chalk line, screw drivers, hand drill, bevel, work bench, bit, axe…etc

Wood working machine: ex: surface planer machine, thicknesses machine, panel saw, mitre saw, etc….

- Identify sides and edges Cutting joints to size: there are two sides and two edges that used to work in lengthening joints real side and off side start with real side and real edge.

LO 1.3 Assemble part of lengthening joints

- **Types of assembly used in lengthening joints**

- **Assembling test**: non-permanent) is the assembly made by joiner or carpenter without adhesive or another kind of materials for fastener.

- **final assembling: (permanent)** Traditional construction features permanent fixing with glue and also a mechanical fastening such as screws, pins or nails. When a more decorative finish is required, glue is used in combination with a more sophisticated joint.

More modern furniture with manufactured boards will use knock-down fittings so that parts can be easily replaced or flexibility in the modular construction and aesthetic of the items.

Glue is a chemical mixture that bonds wood surfaces together. The most common version of this is PVA (Poly Vinyl Acetate). It is very easy to apply and easy to clean off with water and there are other glue as follows: animal glue, contact glue…….

Pins are a metal fastening that is driven into two pieces of wood to connect them. The pins can be hammered or driven below the surface of the wood so that they can't be seen.

Nails are a thicker version of pins. They typically have a large striking surface so that it can be driven into the material.

Screws, like nuts and bolts, are a metal fastening that connects two bits of material together. Screws do this by carving a thread into the material that holds them secure. Unlike nails and pins, screws can be easily removed.

Learning Unit 2 Construct widening joints

Widening Joints are used to make wider boards by joining narrower one edge to edge. Whichever jointing method is chosen, care should be taken to ensure the curve of the **Annular Rings** is reversed on adjacent boards as shown.

As timber dries out, its **Annular Rings** will tend to try and straighten. Reversing their direction in this way minimises the degree to which the widened board will ***cup*** or ***warp***.

Note: Although now almost universally replaced by **MDF**, solid timber window sills would be positioned 'heart side up'. This ensures that if there is any movement as the **Annular Rings** tend to straighten, the sill would 'bow' upwards in the centre rather than 'cup' and hold moisture.

To avoid this problem almost completely, choose boards which have been sliced ***radially*** from across the centre of the tree, and whose **Annular Rings** are therefore close to being at right angles to each face *(these boards are known as **Quarter Sawn** and **Rift Sawn** - they are much sought-after and will be hard to find!)*

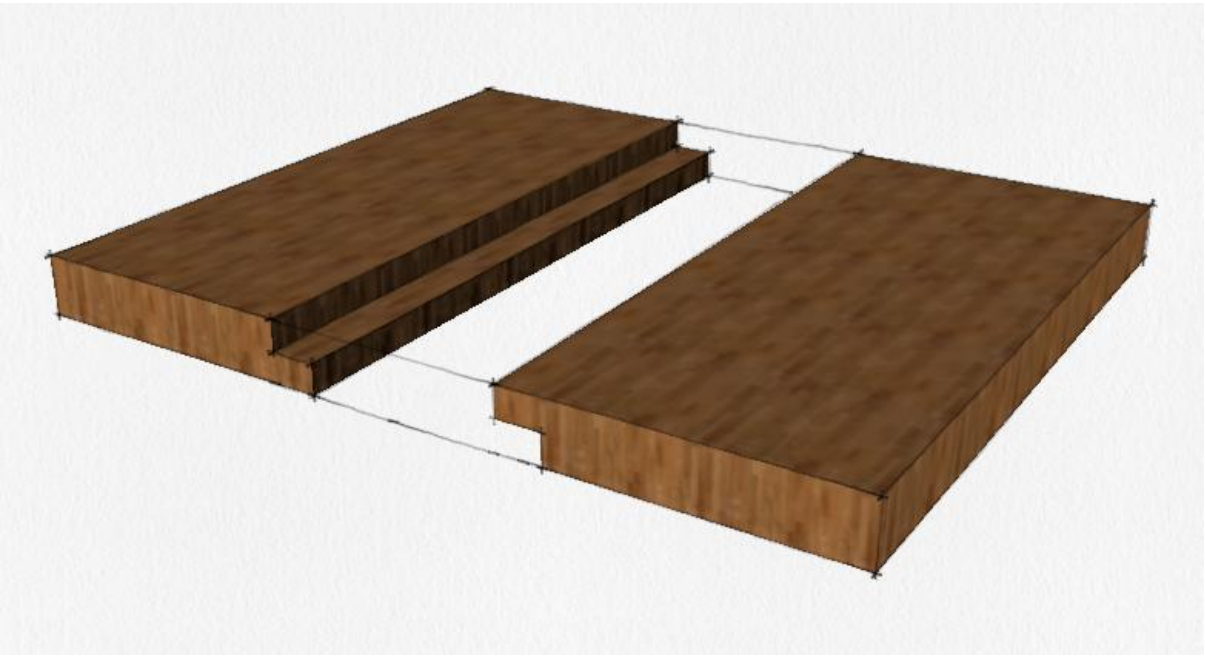
It is important to ensure joining surfaces are straight and **square** and to arrange boards such that their **Grain** goes in the same direction - this is so any subsequent planing and finishing is made easier. Check for **Squareness** by balancing one board on top of another and testing with a straight edge.

Some **planing** will be needed after jointing to ensure the finished boards surfaces are flat, so choose boards somewhat thicker than the required finished size to start with.

LO 2.1 Identify types of widening joints

- **Types of widening joints :**

Rebate Joint
The Rebate joint is sometimes used to widen timber. It is not as strong and requires nails and glue to hold it together losing most of its aesthetic appeal

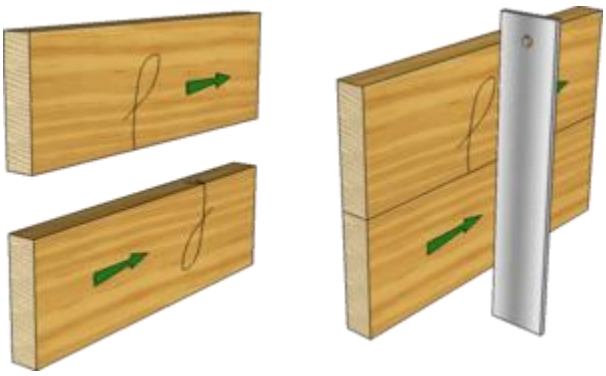


- **Tongue and Groove Joint**

A traditional floor-boarding joint *(now largely superseded by **Chipboard** panels but still a useful and strong method of joining together boards)*. The **Groove** should be approximately one third the thickness of the joining edges and cut with a **Plough Plane** using the nearest width blade. The **Tongue** can be cut to match

in the form of two **Rebates** but shaped and matching blades are available for **Combination Planes** to ensure a close fitting joint. They can also be machined using a **Router**.

- **Edge to edge but joint**: is the simplest Widening Joint but with careful preparation and modern Adhesives can be very strong

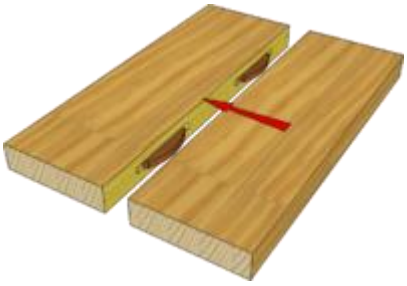


- Prepare the joining edges, **Gauge** their centres, then hold them together with ends overlapping about 12mm as shown.
- Use a **Try Square** to **square** lines across where the screws are to be positioned.
- On one piece only, **square** lines across about 14mm - 16mm to one side of each of the screw centres to mark the ends of the slots.
- Drill pilot holes for the screws in one piece and holes to clear the screw-heads in the second piece 10mm - 12mm deep.
- Drill holes to clear the screw shank, also 10mm to 12mm deep, at the ends of the slots.
- Using a thin **Mortise Chisel** cut the slots through to the screw-head clearance holes to a width equal to the screw shank. *(click on images to enlarge for clarity)*
- Screw a screw into a scrap piece of wood to a depth of 8 or 9mm and use this to cut the screw head grooves by placing it down into the screw-head clearance hole and tapping along the slot with a **Hammer**.
- Use the same scrap of wood, with screw, to set the height of the screw-heads in the second piece of timber.
- Bring the two pieces together and lightly **cramp**, then using a **Mallet**, drive the screws along the slots to bring the timber ends together.
- if required after this *dry run*, take apart the joint, add glue and re-assemble.

- **Edge dowel joint**: Dowels provide a convenient means by which to strengthen a Butt Joint *(or **Rubbed Joint**)* but great care has to be taken to ensure accurate location of the Dowels in each piece to be joined. Choose a Dowel diameter approximately one third the thickness of the joining edges

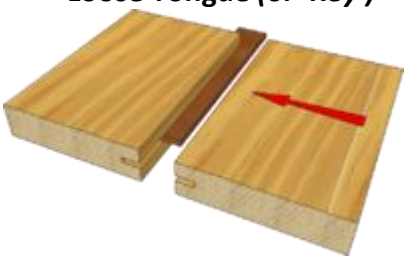
- Prepare the joining edges, **Gauge** their centres, then hold them together in a **Vice** for example.
- Use a **Try Square** to **square** lines across where the **Dowels** are to be positioned.
- Drill holes for the **Dowels** 20mm - 25mm deep in one piece only,
- Insert **Dowel Centres** into the drilled holes and press the two halves of the joint together such that the **Dowel Centres** mark the hole positions on the second piece.
- *(an alternative is partially to drive panel pins into one half, snip off their heads and use these to mark centres on the second piece)*.

Biscuit Joint



Butt Joints can be reinforced by inserting dried and compressed wooden **Biscuits** into pre-cut slots or **Grooves**. The use of **Biscuits** is gaining popularity in preference to using **Dowels** because they are more forgiving and less marking out is needed *(i.e. the **Biscuit Jointer** or **Router** used has stops and fences to ensure correct positioning and often only a centre line is needed to mark the positions for the **Biscuits**)*.

- **Loose Tongue *(or 'Key')***



Very similar to a **Tongued and Grooved Joint** but requiring only **Grooves** to be cut into each of the joining edges thus simplifying construction. The **Tongue** is made from solid timber or **Ply** and fitted into the **Grooves** which are cut to a suitable width *(e.g. the nearest standard **Ply** thickness to approximately one third the timber thickness)*. If **Tongues** are made from solid timber, the **Grain** should be either diagonal or go across the width for strength.

(line space)

LO 2.2 – Construct widening joints

- **Procedures of constructing widening joints:**

Read sketch

- Prepare timber to the required size: by marking**,** ripping, planning, squaring and cutting

- **Identify the tools required**: tools used to make lengthening joint are divided into two groups

Which are hand tools and wood working machines

Hand tools: ex: pencil, tape measures, saw clamp, try square, planer, chalk line, screw drivers, tenon saw, back saw, hand drill, bevel, work bench, bit, axe…etc

Wood working machine: ex: surface planer machine, thicknesses machine, panel saw, mitre saw, morticing machine, tenoning machine, spindle moulding machine etc….

- Identify sides and edges Cutting joints to size: there are two sides and two edges that used to work in lengthening joints real side and off side start with real side and real edge.

(line space)

LO 2.3 – Assemble parts of widening joints

- **types of widening assemble:**

- assembling test: (non-permanent) is the assembly made before final assembly to verify if the joint is well done.

- final assembling: (permanent) permanent fixing with glue.

More modern furniture with manufactured boards will use knock-down fittings so that parts can be easily replaced or flexibility in the modular construction and aesthetic of the items.

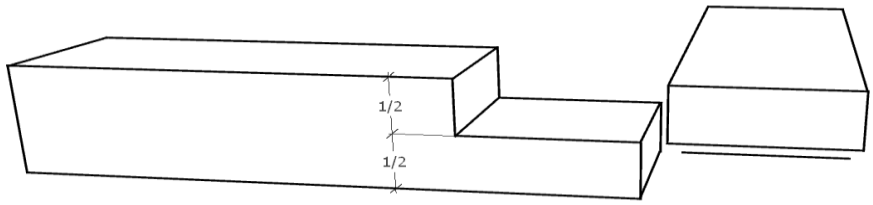
Glue is a chemical mixture that bonds wood surfaces together. The most common version of this is PVA (Poly Vinyl Acetate). It is very easy to apply and easy to clean off with water. And use other glue as follow: contact glue, synthetic resin glue……

Learning Unit 3 – **Construct framing joints**

LO 3.1 – Identify types of framing joints

- Types of framing joints

1. HALF-LAP JOINT

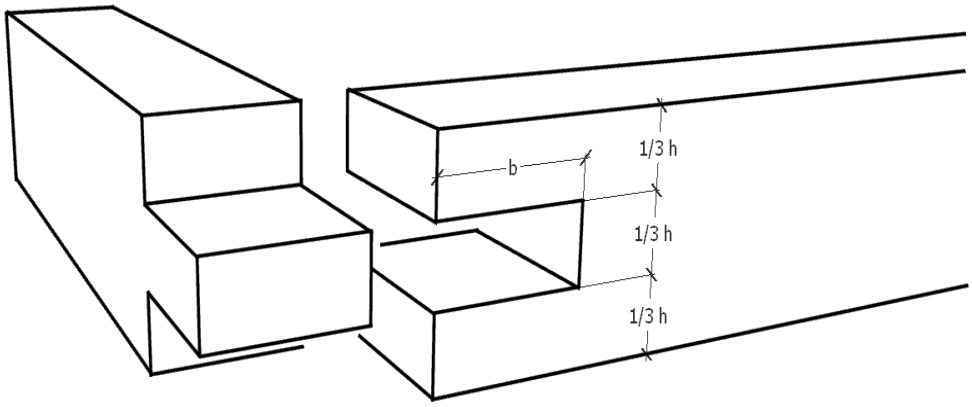


Similar to the halved scarf joint half of the beam width is cleared away. When joining the parts the surfaces are at one level.

The joint becomes stable when reinforcing it with screws or sheet metal parts.

It is the simplest connection and can be done in a short time.

2. BRIDLE JOINT



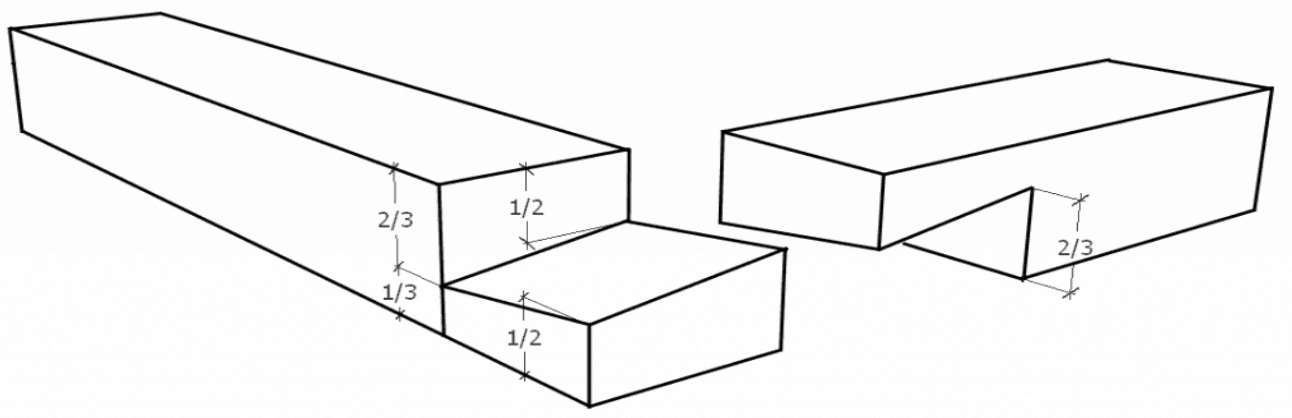
This joint requires time in making since it is more difficult in detail.

First the front end of the first timber is divided into three parts to cut out the tenon.

Then a mortise is cut into the front end of the corresponding second timber.

These joints are very useful for constructing door and window frames.

3. BEVEL LAP JOINT



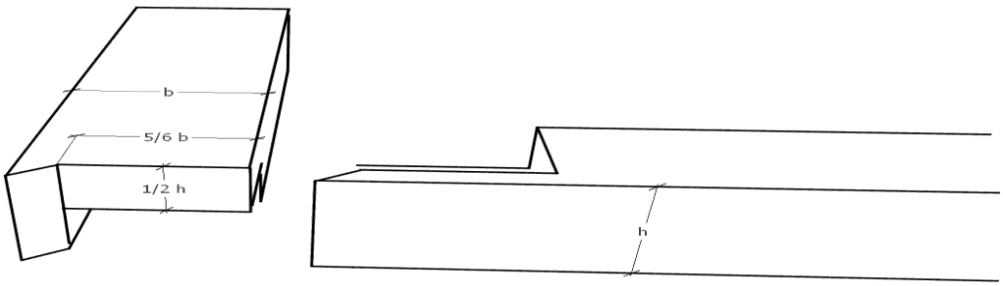
The bevel lap joint is one of the most complex corner joints. Because it has an oblique surface it is not as easy to draft as the half-lap joint.

The main advantage is that not many connectors are needed. By the oblique surface the timbers automatically are held in position.

This corner joint is especially useful for connections which have to carry loads (i.e. carport, truss, canopy and more), but it is time consuming to make them.

In an easier version of this connection only one edge is cut off obliquely.

4. CONCEALED HALF-LAP JOINT



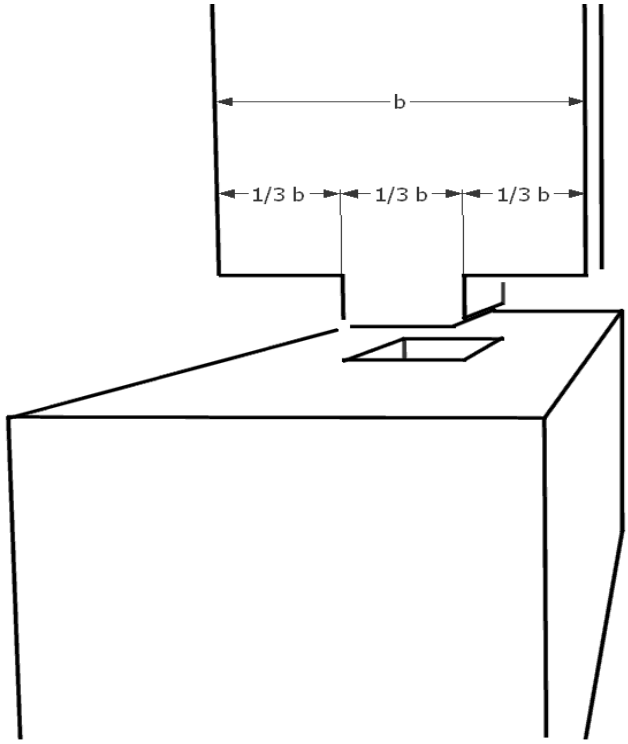
In some cases the end-grain should not be visible, either for weather related reasons or for the look itself.

A concealed half-lap joint serves this purpose. It is manufacured similar to the half-lap joint, just adding some intermediate steps to hide the end-grain.

Did you know?
Woodworking joints became more and more detailed around the year 3500 B.C. Back then tenon and mortise were used.

FRAMING JOINTS
For these so-called junctions two timbers are connected at a right angle. Often tenons and tongue joints are used.

5. STUB MORTISE AND TENON



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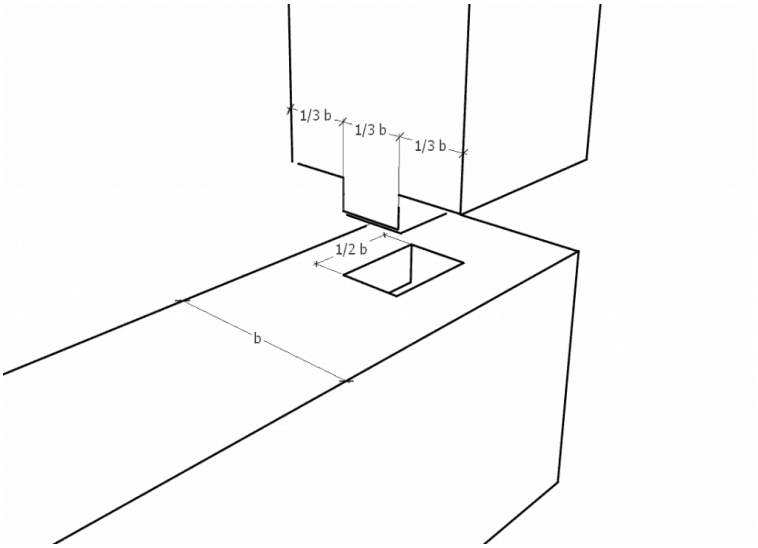
There are different sorts of tenons. A stub tenon is chiseled out over the whole width of the beam.

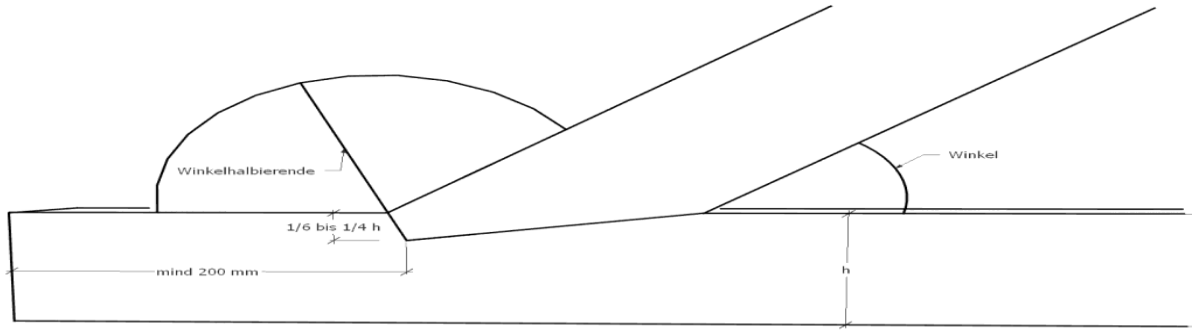
6. HAUNCHED TENON



When some beams have to be mounted at an angle haunched tenons are used.

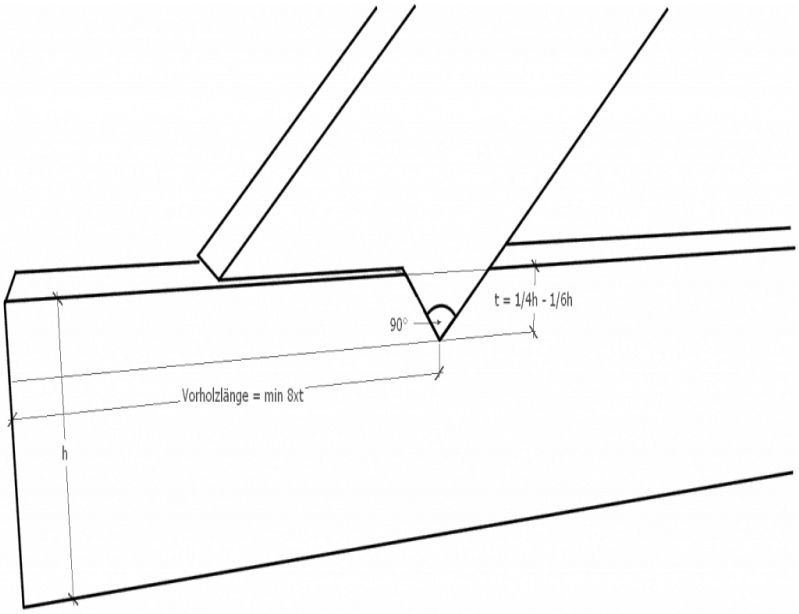
The advantage lies in an easy and fast erecting, lateral shifting is also prevented.

7. OBLIQUE THRUST JOINT / FACE STAGGERED JOINT



A wedge-shaped notch is cut into the load bearing beam. In this notch the compression beam is fitted. Thereby the front face forms the bisector of the obtuse exterior angle.
Usually an additional screw bolt is used to prevent lateral shifting. This bolt should be at the same angle as the front face of the compression beam. The minimum shear plane has to be 20 cm.
Construction wise the oblique thrust joint is not very recommendable. Why?
To guarantee 20 cm of shear plane a lot of timber is wasted.
For more help regarding the oblique thrust joint refer to this article.

8. NOTCHED HOUSING

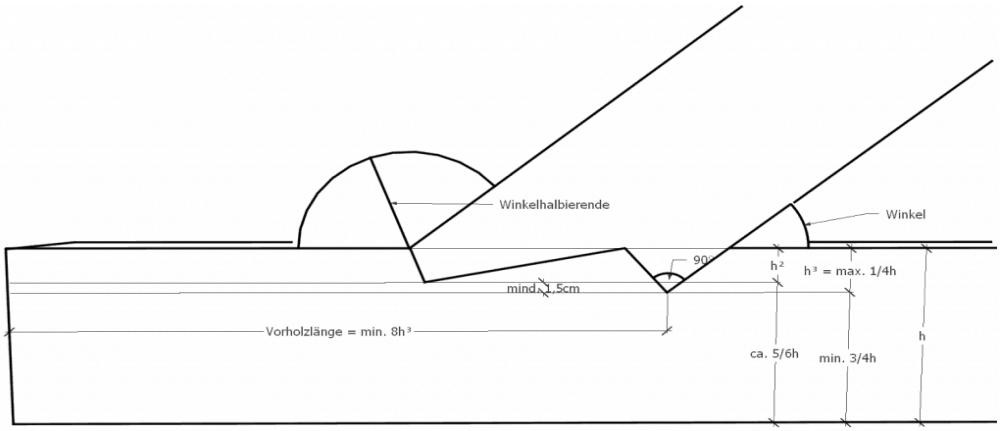


A notched housing should have a debth of 1/4 to 1/6 of the beam height. The beam projection requires a length of 8 times the debth of the notch or at least 20 cm.

Furthermore a gap of 3-5 mm has to be included.

The notched housing saves a few centimeters of the beam and is therefore more recommendable than the oblique thrust joint.

9. OBLIQUE THRUST JOINT WITH NOTCHED HOUSING



Even more stability is gained with this combination of the oblique thrust and the notched housing.

It is important to keep in mind that the notched housing has to be at least one cm deeper than the oblique thrust. Otherwise both shearing planes would clash.

Further important oblique framing joints are covered in this article.

10.CROSS JOINTS AND HALVING JOINTS

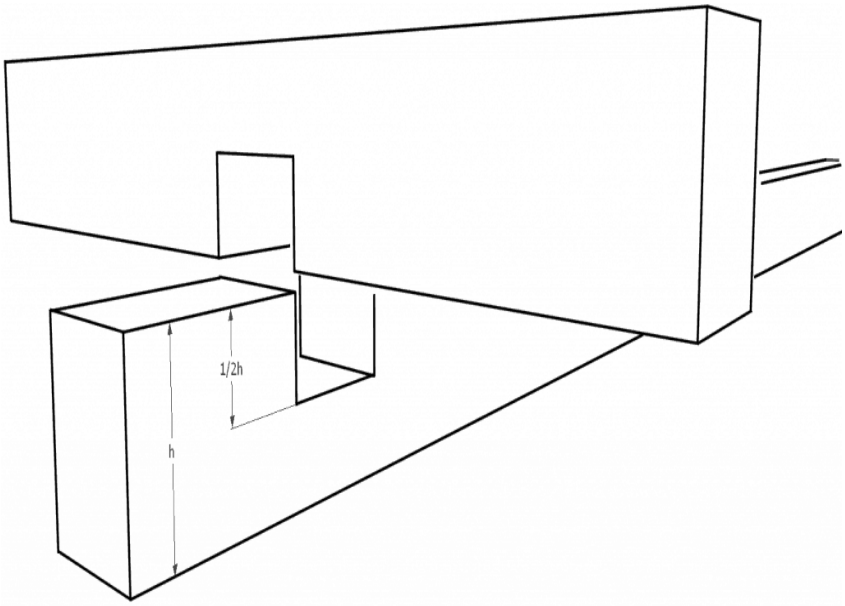
Cross and halving joints are used when two intersecting beams have to be secured.

Examples are tier of beams with binders or window frames with a number of glass panes which need to be seperated.

Product recommendation

Cross joints are best made with a japanese saw. Here you can find a list of the most popular japanese saws.

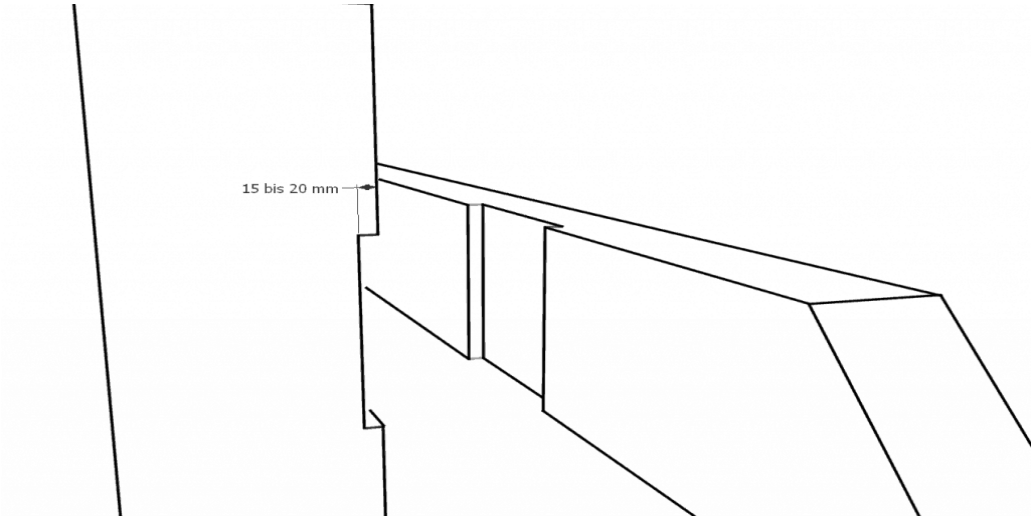
11. HALVED CROSSING JOINT



Any joint in which two pieces of wood are fixed across one another is called a cross joint. When cross-section weakening does not play a role both timbers can be notched up to half of their width.

In case of a load-bearing component like a post this would not be allowed.

12. DOUBLE NOTCHED JOINT

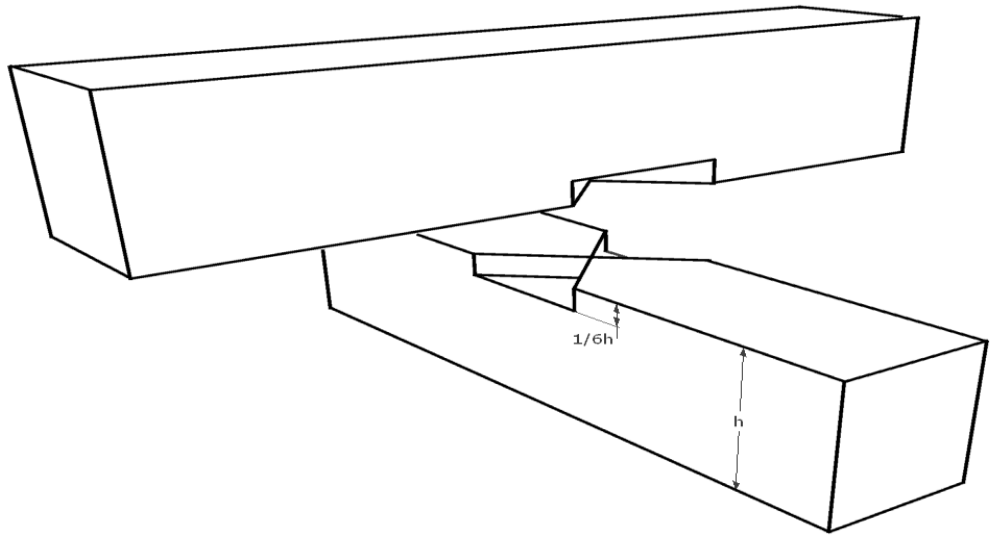


For creating a double notched joint both timbers are cut with notches to receive each other.
The post is cut only as deep as necessary so it can still fulfill its static requirements.
Notches of 1,5 cm to 2 cm are sufficient for this joint. In addition both parts are secured with a screw bolt or a wood screw.

Did you know?

As of the 15th century CE these joints became more and more complex, thanks to the toolmakers. With continually improving axes, hatches and saw blades countless woodworking joints were made.

13. CROSSED TENON JOINT

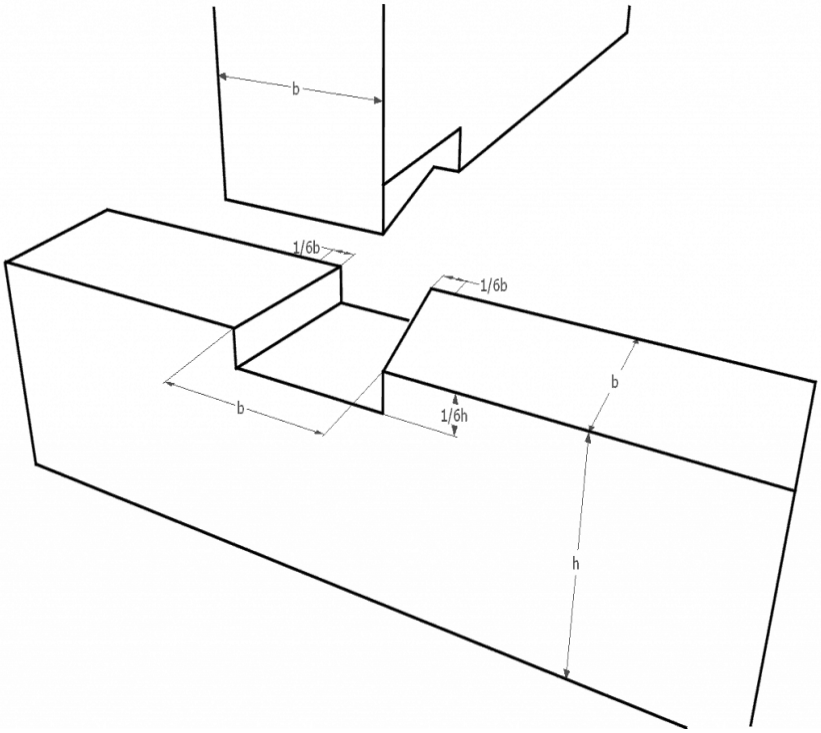


Drafting this joint is easy: By joining the particular timbers and the connecting of the four corners a cross is formed.

1/6 of the height of both parts is removed to create two parts that fit into each other.

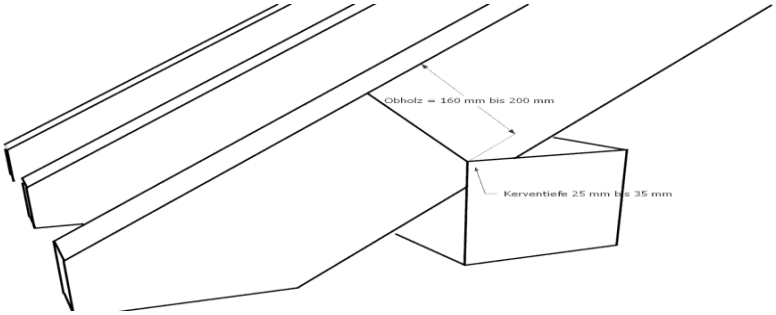
The draft might not require a lot of time, but the execution does. Everything has to be done by hand since the recesses are difficult to reach with mechanical equipment.

14. DOVETAIL LAP JOINT



The dovetail lap joint is a very practical cross joint.
The main advantages are a simple erecting and a high resilience regarding tensile forces.
In comparison to other notched joints drafting is quite easy.

15. BIRDSMOUTH

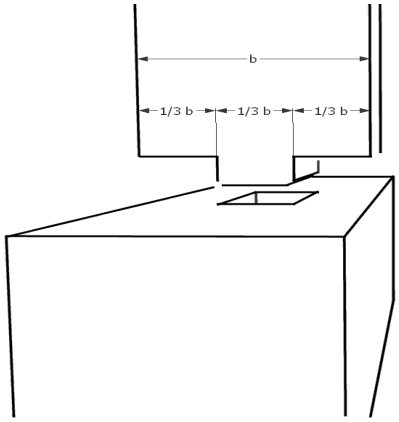


The well-known birdsmouth joint is used when a rafter meets a purlin.
It prevents the shifting of the rafter and helps significantly during the erecting process.
Usually the rafters are fixed with wood screws, rafter anchors or nails.

LO 3.2 – Construct framing joints

- **Procedures of constructing framing joints:**

Read sketch



- Prepare timber to the required size: by marking**,** ripping, planning, squaring and cutting

- **Identify the tools required**: tools used to make lengthening joint are divided into two groups

Which are hand tools and wood working machines

Hand tools: ex: pencil, tape measures, saw clamp, try square, planer, chalk line, screw drivers, tenon saw, back saw, hand drill, bevel, work bench, bit, axe…etc

Wood working machine: ex: surface planer machine, thicknesses machine, panel saw, mitre saw, morticing machine, tenoning machine, spindle moulding machine etc….

- Identify sides and edges Cutting joints to size: there are two sides and two edges that used to work in lengthening joints real side and off side start with real side and real edge.

LO 3.3 – Assemble part of framing joint

- **types of assembly used in framing joint**

- **assembling test**: non-permanent) is the assembly made by joiner or carpenter without adhesive or another kind of materials for fastener.

- final assembling: (permanent) Traditional construction features permanent fixing with glue and also a mechanical fastening such as screws, pins or nails. When a more decorative finish is required, glue is used in combination with a more sophisticated joint.

- Joints can be designed to hold without the use of glue or fasteners; a pinned mortise and tenon is an example of this.
- Glue is highly effective for joining timber when both surfaces of the joint are edge grain. A properly glued joint may be as strong or stronger than a single piece of wood. However, glue is notably less effective on end-grain surfaces. Animal glue is soluble in water, producing joints that can be disassembled using steam to soften the glue.

- Various mechanical fasteners may be used, the simplest being nails and screws. Glue and fasteners can be used together

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