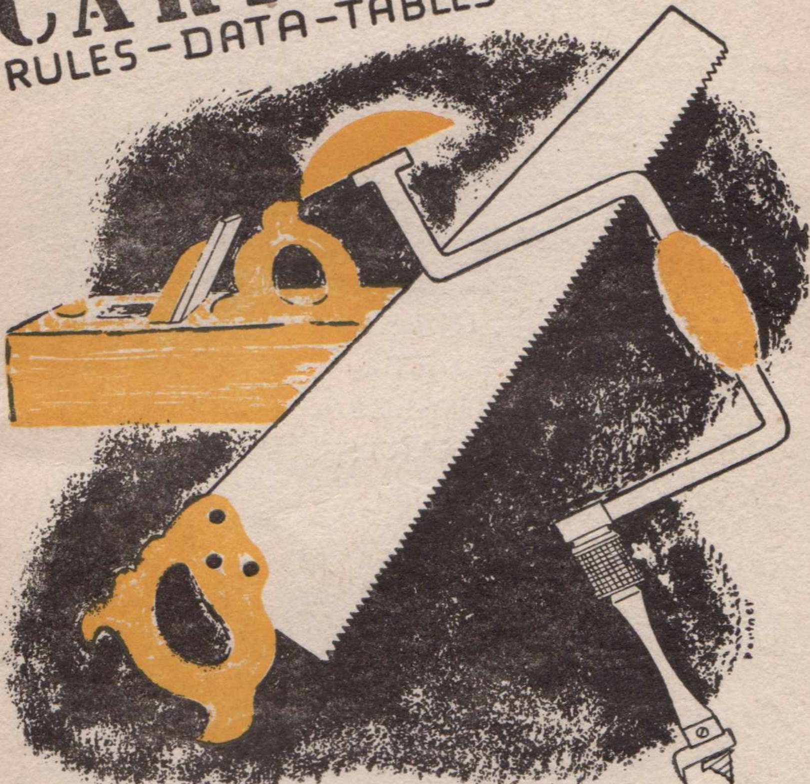
E. R. O'DARE:

CARPENTER'S

RULES – DATA – TABLES – CHARTS – ETC.



HANDBOOK

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CARPENTER'S HANDBOOK.

A Practical Handbook

Containing

RULES

DATA

TABLES

CHARTS

etc.

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GEOMETRY

Angles. Fig. 1.

Are formed by the meeting of two straight lines. They are measured by degrees, which are obtained by dividing the circle into 360 equal parts by means of radii, each part being an angle of one degree.

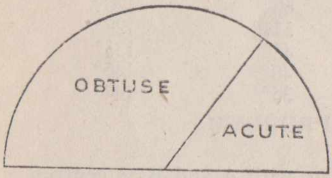


Fig. 1.

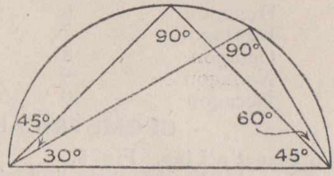


Fig. 3.

Common Angles. Fig. 2.

The most common angles are:

$\frac{1}{4}$ of a circle	equals	90°
$\frac{1}{6}$th	"	"	60°
$\frac{1}{8}$th	"	"	45°
1/12th	"	"	30°
1/24th	"	"	15°

Other angles are easily obtained from these.

The Triangle. Fig. 3.

The sum of the angles of any triangle equals 180°, and the sum of any two of the angles, subtracted from 180°, will give the third angle.

The Circle. Fig. 4.

The circle and its different parts are often used in marking out and solving problems; therefore it will be of great help to get a good understanding of its composition.

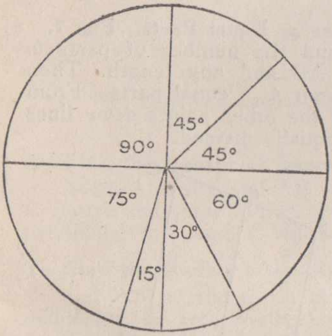


Fig. 2.

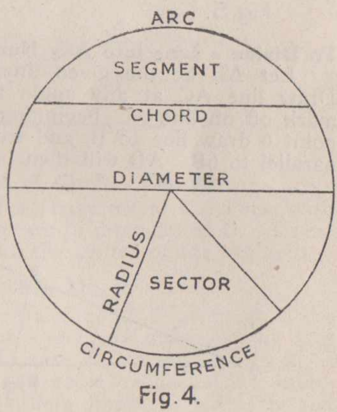


Fig. 4.

A Polygon

Is a plane figure bounded by more than four straight sides, and may be either regular or irregular. The following are the most common polygons:

NAME	No. of sides	Angle at centre.	Angle at circumference.
Pentagon	5	72°	100°
Hexagon	6	60°	120°
Heptagon	7	51½°	128°
Octagon	8	45°	135°
Nonagon	9	40°	140°
Decagon	10	36°	144°

GEOMETRICAL PROBLEMS

To Bisect a Line. Fig. 5.

Let AB be the given line. Then, with A and B as centres, and any convenient radius, describe arcs to intersect at C and D. A line from C to D will bisect and also be perpendicular to AB.

To Bisect an Angle. Fig. 6.

Let ABC be the given angle. Then with B centre and any convenient radius, strike arcs at D and E. With D and E centres, strike arcs to intersect at F. A line from F to B bisects angle ABC.

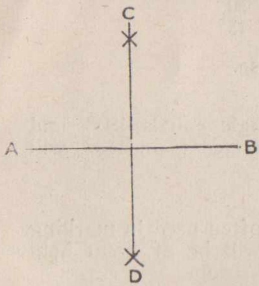


Fig. 5.

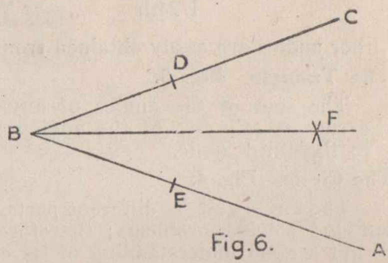


Fig. 6.

To Divide a Line into Any Number or Equal Parts. Fig. 7.

Let AB be the given line, and the number of parts 6. Draw line AC at any angle to AB and any length. Then mark off on line AC beginning from A, 6 equal parts. From point 6 draw line to B, and from the other points draw lines parallel to 6B. AB will then be equally divided.

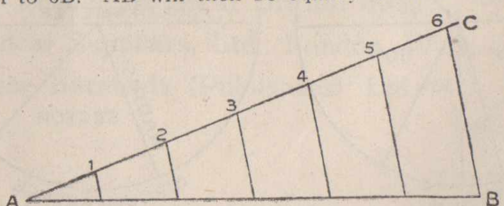


Fig. 7

To Construct an Angle of 60°. Fig. 8.

Draw line AB any length. Then with A centre and any radius, describe arc CD. With D centre and same radius, intersect arc at E. A line from E to A makes 60° angle EAD. To get a 30° angle, bisect arc ED.

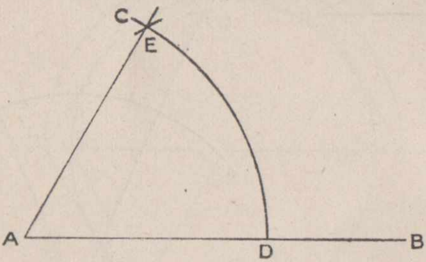


Fig. 8.

To Reproduce a Given Angle. Fig. 9.

Let ABC be the given angle. Draw line DE any length, and with D centre, and BA radius, describe arc FG. With F centre and AC radius, intersect arc FG, and from point of intersection draw line to D. This makes angle FDG, equal to ABC. With variations, this method can be used to reproduce almost any figure.

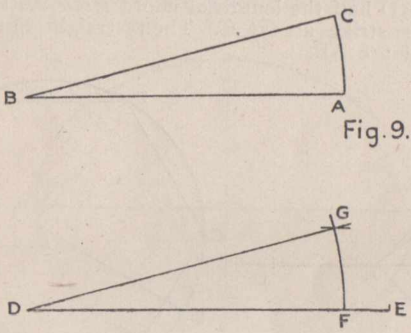


Fig. 9.

To Find the Centre of Segment of Circle. Fig. 10.

With A centre and AB radius, strike arc at C. Then, with B centre and same radius, strike arc to intersect at C. A perpendicular line from C will strike the centre of the segment.

To Find the Radius of an Arc. Fig. 11.

Let AB be the given arc. Make point C at roughly the middle of the arc. With A centre and any radius, strike arcs at D and E. With centre and same radius strike arcs at F and G. Then, with C centre and same radius, strike intersecting arcs at DEF and G. Where lines through DE and

FG intersect at H, will be found the point from which arc AB was described. This method is also used to describe an arc through any three points not in a straight line, with AB and C representing the points.

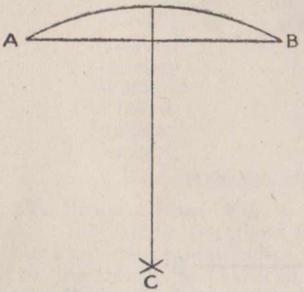


Fig. 10.

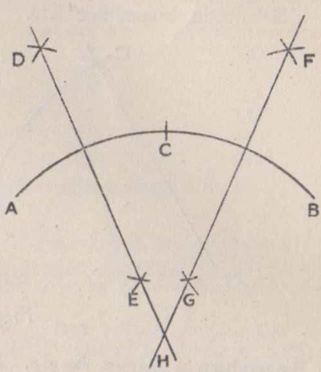


Fig. 11.

To Find a Straight Line Equal in Length to an Arc. Fig. 12.

Let AB be the given arc. Then find the radius of the arc (Fig. 11) and from the centre O draw line to A. Then draw line AC at right angles to OA. Draw chord BA and prolong to D, making AD half the length of chord BA. With D centre and DB radius strike arc at C. Then straight line AC will equal length of arc AB.

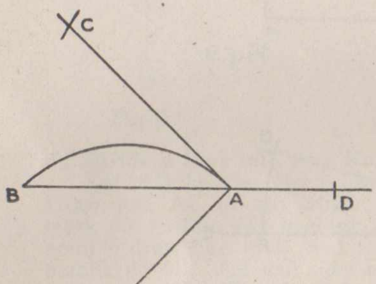


Fig. 12.

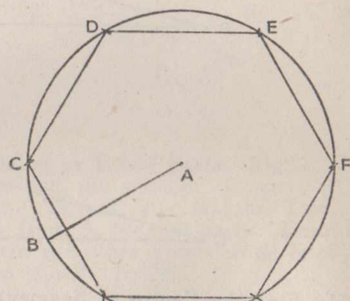


Fig. 13.

To Inscribe a Hexagon within a Circle. Fig. 13.

With radius of circle AB, make points C D E F G H. Draw lines from point to point to form hexagon.

To Describe a Hexagon about a Circle. Fig. 14.

Draw line AB to pass through the centre of circle at C, and circumference at E. With E centre and EC radius, cut circumference at F. Draw chord EF, and a line from C through F. Draw line HG parallel to chord EF. With C centre and CH radius, describe outer circle. Then hexagon formed within outer circle will also be described about inner circle.

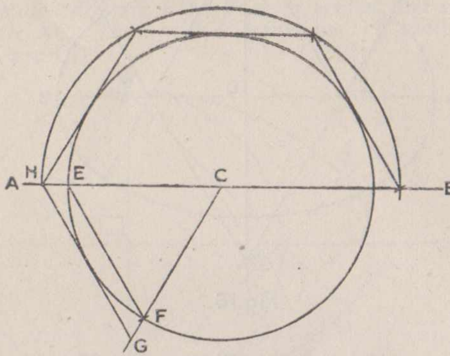


Fig. 14.

To Construct an Oval. Fig. 15.

Draw major axis AB, and minor axis CD. Draw line CA. With E centre and EC radius cut AB at F. With C centre and FA radius, cut CA at G. Bisect GA and draw line through to cut minor axis line at H, and major axis at J. JA then gives radius for end arcs, and HC gives radius for side arcs of oval.

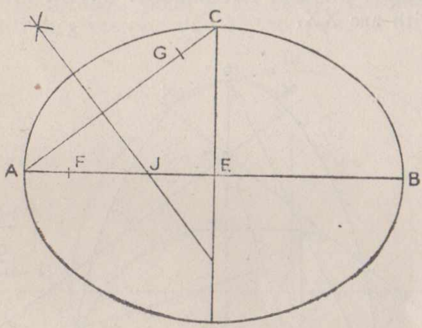


Fig. 15

To Construct an Oval with only Major Axis Given. Fig. 16.

Divide major axis AB into 4 equal parts at C D E, and draw minor axis line through D. With E centre and EC radius, cut minor axis at F and G. Draw lines from F and G through E and C. With E and C centres and CA radius, describe end arcs XX and HH. Then, with F and G centres and FH radius, complete oval with side arcs HX.

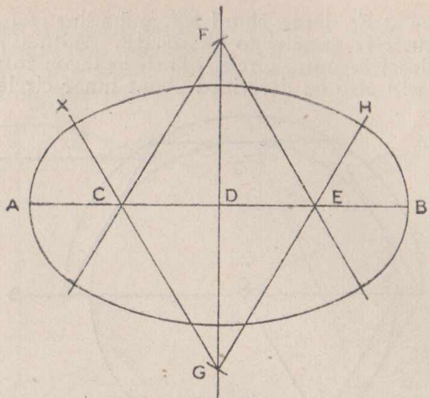


Fig.16.

To Construct an Oval of Egg Shape. Fig. 17.

Draw major axis AB. Then with A centre and half the minor axis as radius, strike point E. Draw minor axis CD through E. With E centre and ED radius, describe a three-quarter circle from D through A and C to F. Draw a line from D to B and erect a perpendicular from F to strike DB at G. Then from G draw a horizontal line to strike DE at H. With B centre and DH radius, strike point at J, and draw line from J to H. Bisect JH, and project bisecting line to K. KD then gives radius for arcs DX and CX. With J centre, complete oval with arc XX.

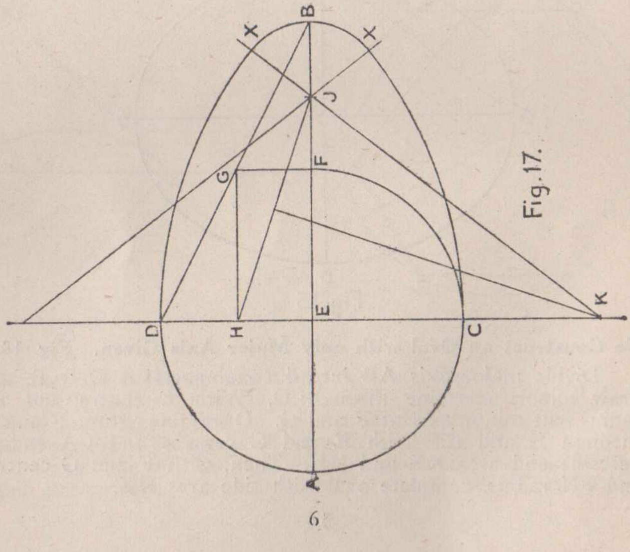


Fig. 17.

To Construct an Egg-shaped Oval, with only Minor Axis Given. Fig. 18.

Draw minor axis AEB, and with E centre, and EA radius, describe circle. Draw major axis line XX of indefinite length. Draw lines AD and BC through F. Then, with A centre and AB radius, describe arc BD. With B centre, and same radius, describe arc AC. Then, with F centre and FC radius, complete oval with arc CD.

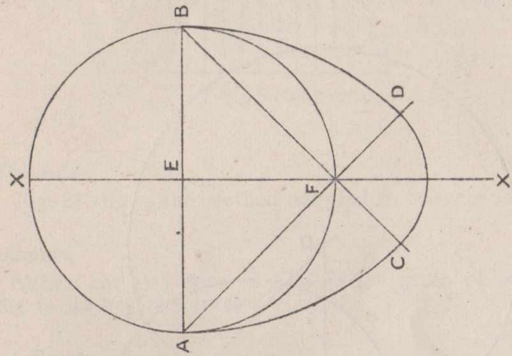


Fig. 18.

To Inscribe a Regular Polygon of Any Number of Sides within a Given Circle. Fig. 19.

Within the given circle draw two diameters AB and CD at right angles. Divide CD into as many equal parts as the polygon has sides (eight here, as an example). With A centre and three-quarter of length AO as radius, strike point E. Draw line from E through point 2 to strike circumference at F. Chord FD then gives one side of the required polygon.

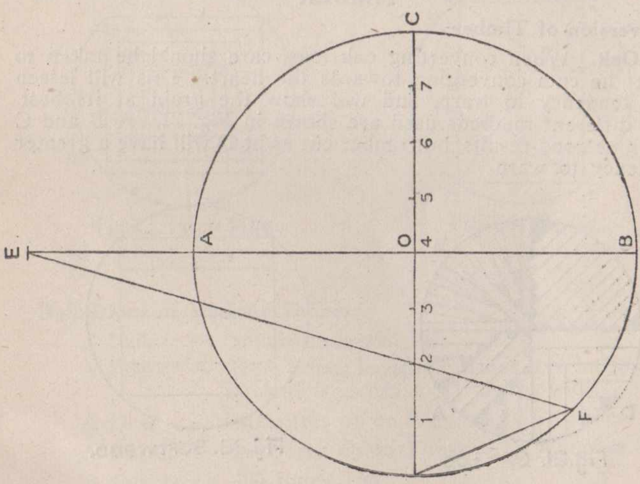


Fig. 19.

To Construct a Polygon with One Side Given. Fig. 20.

Let AB be the given side. Then, with B centre and BA radius, describe semi-circle, making diameter ABC. Divide semi-circle into as many equal parts as the polygon has sides (eight here, as an example). From B draw line to point 2. Bisect AB and B2 bisecting lines to intersect at D. With D centre and DA radius, describe circle within which the polygon is constructed.

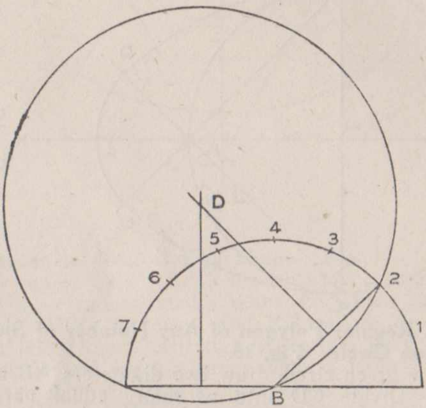


Fig. 20.

TIMBER

Conversion of Timber.

Oak. When converting oak logs, care should be taken to have the cuts converging towards the heart. This will lessen any tendency to warp, and will show the grain at its best. The different methods used are shown in Fig. 21. A B and C will give good results, but timber cut as at D will have a greater tendency to warp.

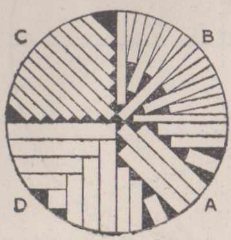


Fig. 21. Oak Log.

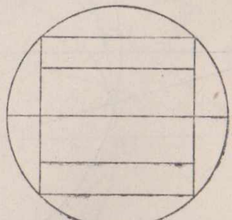


Fig. 22. Softwood.

Other Hardwoods.

Hardwood logs are often halved and cut into boards as shown at Fig. 25. This, no doubt, saves time at the expense of quality.

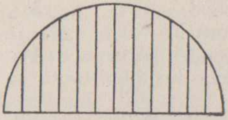


Fig. 25. HARDWOOD.

Softwoods.

Fig. 22 shows the method adopted to convert softwood logs.

Pitchpine.

When cut as shown at Fig. 23 the grain of pitchpine will show to its best advantage.

Best Beams.

Fig. 24 shows how to cut the best beams. Draw the diameter AB, and divide it into three equal parts at C and D. From these points draw lines to the circumference at E and F, and join the four points EAFB to obtain the best beam.

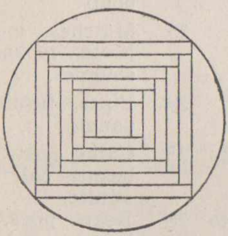


Fig. 23. PITCH PINE.

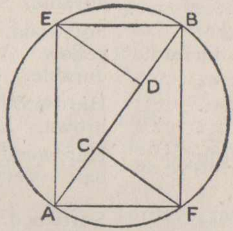


Fig. 24. BEAM.

Definitions of Various Timbers.

A Balk — roughly squared log.

A Plank — from 8 foot length, 2 inches to 6 inches thick, and 9 inches to 11 inches wide.

A Deal — measures up to 9 inches by 4 inches.

A Batten — measures up to 7 inches by 4 inches.

A Square — 100 Super feet.

Characteristics of Various Timbers.

Here are the different English and Foreign timbers, arranged in alphabetical order for easy reference.

Timber.	Characteristics.	Weight per cub. ft. lbs.	Chief uses.
Alder.	Hardwood. Light nut brown.	33	Clogs, turnery, Plywood.
Ash.	Hardwood. Brown. Not very durable.	44	Sports goods, tool handles, motor body work.
Balsa.	Hardwood. White to pale brown. Extremely light.	2½ to 24	Aircraft, ships.
Basswood.	Softwood. Yellow brown.	30	Interior building.
Beech.	Hardwood. Brown flecked. Not very durable.	46	Turnery, furniture, flooring.
Box.	Hardwood. Pale yellow. Fairly durable.	60	Turnery, inlay, drawing instruments.
Canadian Birch.	Hardwood. Pale red brown. Tough and durable.	44	Plywood, aircraft, coach building, interior work.
Canary Whitewood.	Hardwood. Light to dark brown. Not very durable.	28	Furniture, turnery, interior work.
Cedar Honduras.	Hardwood. Resembles mahogany. Fairly durable. Scented.	30	Cigar boxes, panels, boats.
Cedar Port Orford.	Softwood. Pale yellow. Very durable. Scented.	33	Matches, joinery, boats, roofing shingles.
Cherry.	Hardwood. Red brown. Durable.	39	Pipes, furniture, panels.
Chestnut.	Hardwood. Resembles oak. Very durable.	35	Gates, posts, beams, oak substitute.
Cypress.	Softwood. Yellow to pink. Very durable.	28	Boats, piles, bridges and building work.
Douglas Fir. (Oregon Pine). (B.C. Pine).	Softwood. Red brown. Strong scent.	33	Bridges, piers, flag poles, plywood, building work.
Elm.	Hardwood. Red brown. Very durable under water.	35	Piles, coffins, agricultural vehicles.
Gaboon.	Hardwood, resembles mahogany, not very durable.	25	Plywood, panels, mahogany substitute.

Timber.	Characteristics.	Weight per cub. ft. lbs.	Chief uses.
Greenheart.	Hardwood, colour varies. Extremely durable.	65	Marine work, heavy construction.
Hemlock. (Western).	Softwood. Yellow. Durable.	29	Joinery building work.
Hornbeam.	Hardwood. White. Not durable.	43	Pulleys, bobbins.
Iroko. (African Teak).	Hardwood. Brown. Extremely durable.	41	Joinery, flooring, draining boards.
Ironwood.	Hardwood. Dark red. Extremely durable.	70	Inlay, cabinets.
Jarrah.	Hardwood, resembles mahogany. Very durable.	50	Panels, joinery, flooring.
Kauri.	Softwood. Yellow brown. Not durable.	34	Joinery, turnery.
Larch.	Softwood. Red brown. Very durable.	37	Pit props, piles, boats, building.
Lime.	Hardwood. Pale yellow. Not durable.	35	Turnery, cabinets, musical instruments, toys.
Mahogany. (African).	Hardwood. Red brown. Durable.	35	Aircraft, ships, panels, joinery.
Mahogany. (Honduras).	Hardwood. Red brown. Durable.	34	Joinery, panels, ships, pattern-making.
Maple.	Hardwood. Creamy brown. Durable.	47	Floors, turnery, sports goods, coach work, joinery.
Oak. (American).	Hardwood. Yellow brown. Very durable.	48	Floors, panels, furniture, coach work.
Oak. (English).	Hardwood. Yellow brown. Very durable.	48	Church construction, furniture, ships.
Pear.	Hardwood. Yellow-brown. Durable.	45	Turnery, inlay, drawing instruments.
Pitchpine.	Softwood. Light red. Very durable.	41	Heavy construction, ships, joinery.
Poplar.	Hardwood. White to pink. Not durable.	25	Matches, toys, plywood.
Redwood. (Red Pine).	Softwood. Yellow to red brown. Durable.	32	Building, pit props, telegraph poles.
Rosewood. (Indian).	Hardwood. Light to purple brown. Very durable.	54	Furniture, panels, inlay.

Timber.	Characteristics.	Weight per cub. ft. lbs.	Chief uses.
Satinwood. (Indian).	Hardwood. Golden-yellow. Very durable.	62	Inlay, furniture, interior decoration.
Scots Pine.	Softwood. Yellow white. Durable.	33	Pit props, boxes, building.
Silver Fir.	Softwood. White to yellow. Not durable.	30	Building, telegraph poles, boxes.
Sitka Spruce.	Softwood. Brown. Not durable.	28	Ships, joinery.
Spruce. (Canadian).	Softwood. White. Not durable.	28	Building, musical instruments, oars, ladders.
Teak.	Hardwood. Dark brown. Extremely durable.	42	Heavy construction, ship-building.
Walnut. (African).	Hardwood. Golden brown. Durable.	35	Furniture, panels, inlay.
Walnut. (American).	Hardwood. Light to dark brown. Extremely durable.	38	Furniture, panels, inlay.
Walnut. (English).	Hardwood. Grey brown. Durable.	36	Furniture, panels, gun-stocks.
Western Red Cedar.	Softwood. Pink to brown. Extremely durable.	32.	Shingles, weather-board, exterior work, ships, canoes.
Willow.	Hardwood. White. Not durable.	28	Cricket bats, false limbs, carts.
Yellow Deal.	Softwood. Yellow. Durable.	40	Building, exterior work.
Yew.	Softwood. Golden brown. Very durable.	42	Exterior work.

BUILDING CONSTRUCTION

FLOORS

Floors may be divided into three main classes—single, double, and framed floors.

Single Floors.

Fig. 26 shows the plan of a single floor. These are constructed with common or bridging joists stretching from wall to wall without any intermediate support, except in the case of ground floors, when they may be supported by piers or sleeper walls. Where the span exceeds 8 feet, strutting is introduced to stiffen the floor. Note the details for the trimming of the joists at fireplaces and stair-openings. The trimmers and trimming joists are of extra thickness to carry the added weight of the trimmed joists. Tredgold's rule for the sizes of trimmers and trimming joists:—To the width of the common joists add ⅛ inch for every joist carried by the trimmer. This will give the width of the trimmers.

Double Floors.

Fig. 27 is the plan of a double floor, which is constructed where longer spans are necessary. It consists of common joists supported by binders at intervals of 6 to 10 feet. The common joists may be notched over the binders, to which fillets are nailed for additional support. As the binders carry the whole weight of the floor it is essential for them to be placed over solid masonry and not above opening.

Note the trimming details where common joists run parallel to the fireplace.

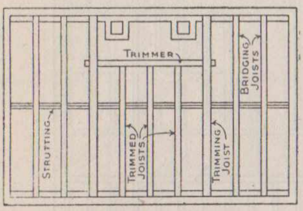


Fig. 26. SINGLE FLOOR.

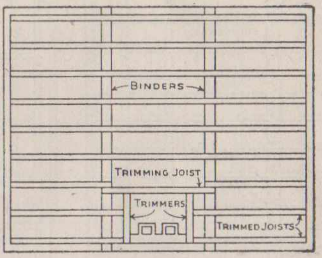


Fig. 27. DOUBLE FLOOR.

Framed Floors. Fig. 28.

In large buildings such as factories and warehouses, where very long spans are necessary, framed floors are used. These consist of wood or steel girders to carry the binders, to which the common joists are fixed in the usual way.

The binders may be tenoned or notched into the girders, but where the maximum strength is required iron stirrups are hung to the girders, and the binders are then dropped into the stirrups. When iron girders are used, the common practice is to fix the joists to wood plates bolted to the girders.

General Data.

Joists should always be placed across the narrowest width of a room, and they will be stiffer if thin and deep, rather than thick and not so deep. Hearths for fireplaces can be supported by fillets fixed to the surrounding joists. When ceiling joists are necessary, they should be about 14 inches apart. With single floors it is often the practice to have every fifth common joist about 2 inches deeper than the rest, and fix the ceiling joists to these.

Floor timbers should never be built into walls, but should have a clear space around the ends to prevent decay. For sizes of floor timbers refer to tables or Tredgold's formulae.

FRAMED PARTITIONS

There are three main types of partitions:—Common; Quarter or Framed; and Trussed.

Common Partitions. Fig. 29.

These generally consist of 4 inch x 3 inch beads, and the construction is as follows:—

The sill is first fixed in position, and if it runs directly over a floor joist, this joist should be of extra depth to prevent sagging. Where a rough underfloor is laid, the sills are fixed to this, and cut away at door openings. The bead is then fixed, with clearance to floor above, so that any sag in the floor will not put pressure on the partition.

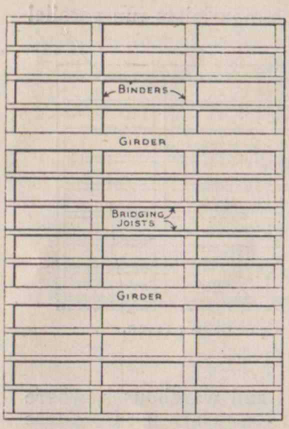
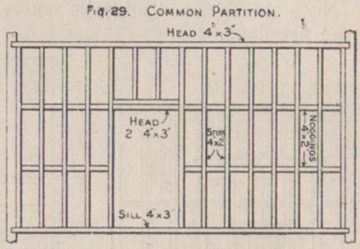


Fig. 28. FRAMED FLOOR

Fig. 29. COMMON PARTITION.



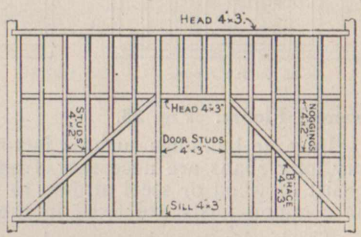


Fig. 30. QUARTER PARTITION.

The studs are next erected, spaced 12 to 18 inches apart. Door studs and door head should either be doubled or of extra thickness. The horizontal noggings are finally cut into position and fixed at about 3 foot intervals.

As these partitions are usually covered by wall board or plastic board, it is well to fix studs and noggings according to the size of the covering.

Framed or Quartered Partitions. Fig. 30.

These are similar to common partitions, but have braces introduced into the construction. These run from the base of the walls at an approximate angle of 45° towards the centre of the partition.

Braces are also used over door heads.

The ends of the sill and head should bear on the wall plates, thus reducing the floor load. The principal idea of using braces is to transmit as much weight as possible to the walls.

Trussed Partitions. Fig. 31.

This type is framed with a truss formed either by a King Post in the centre, with the diagonal braces as the principals, or where an opening occurs, with a Queen Post truss. These partitions as a rule, are required to assist in carrying the floor above, thus the sizes of timbers is increased.

Figs. 36 and 37 show simple King and Queen Post trusses.

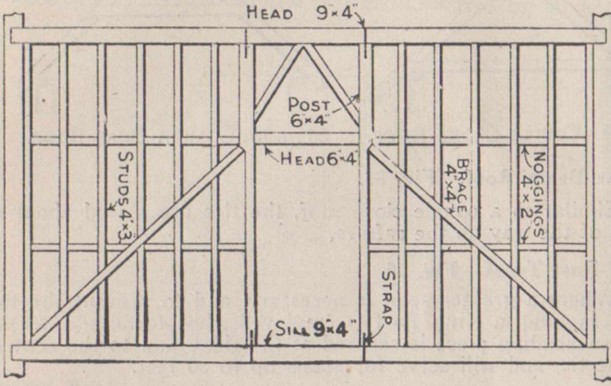


Fig. 31 TRUSSED PARTITION

General Data.

Should a common partition be required to run between joists, bearers are fixed at about 3 foot intervals. Some very fine and elaborate trusses are found in churches and old buildings, but in modern building steel trusses are usually employed, especially for roof work.

ROOFS

Lean-to or Single Span Roof. Fig. 32.

This simple roof consists of rafters laid from one level to a lower level. and is used mostly for outbuildings or annexes.

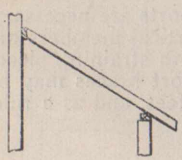


Fig. 32. LEAN-TO-ROOF.

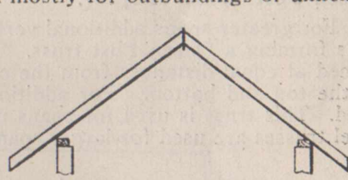


Fig. 33. COUPLE ROOF.

Couple Roof. Fig. 33.

This is also known as a double span roof. The rafters meet at the ridge, and the feet are notched and nailed to wall plates.

For a small span a couple roof is satisfactory, but there is a tendency to spread and push outwards.

Couple Close Roof. Fig. 34.

This is constructed as a couple roof, but to check the outward thrust, ties are introduced at the feet of the rafters.

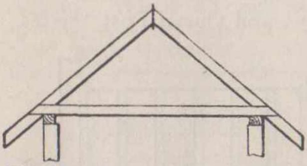


Fig.34. COUPLE CLOSE ROOF.

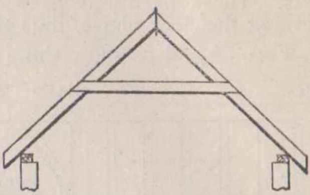


Fig.35. COLLAR BEAM ROOF.

Collar Beam Roof. Fig. 35.

Similar to a couple close roof, the ties are placed about a third of the way up the rafters.

King Post Truss. Fig. 36.

Where a greater span is necessary, and to prevent the tie from sagging, a King Post is employed, thus forming a truss. The suspending piece is secured at the ridge and to the centre of the tie, and will serve for spans up to 30 feet.

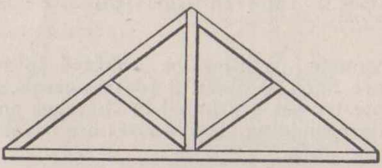


Fig. 36. KING POST TRUSS.

Queen Post Truss. Fig. 37.

For greater spans additional vertical supports are necessary, thus forming a Queen Post truss. These vertical members are placed at equal distances from the centre, with straining pieces at the top and bottom. For additional support braces may be used. This truss is used for spans up to 45 feet, and as a rule, steel trusses are used for larger spans.

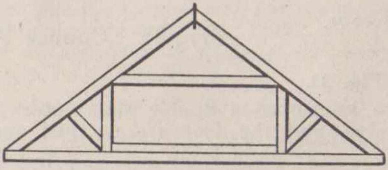


Fig.37. QUEEN POST TRUSS.

Hipped Roof. Fig. 38.

This is the roof which is generally constructed in modern building, the gable ends being eliminated by the slopes of the roof meeting at an angle, thus forming a hip. An abutment from a hipped roof, such as a dormer, will bring calley rafters into use. Jack rafters are those that run from hips and valleys. The outward thrust of the hip rafter at the angles, is counteracted by a dragon-beam, which is secured by an angle tie.

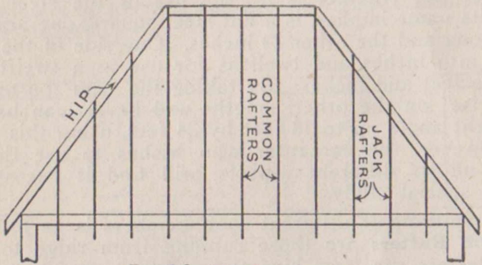


Fig.38. HIPPED ROOF

Mansard Roof. Fig. 39.

Where it is desired to utilise the roof space a mansard roof is usually constructed. This is actually a form of couple close roof for the upper part, the ties and rafters being secured to purlins; from these the lower rafters run to the wall plates.

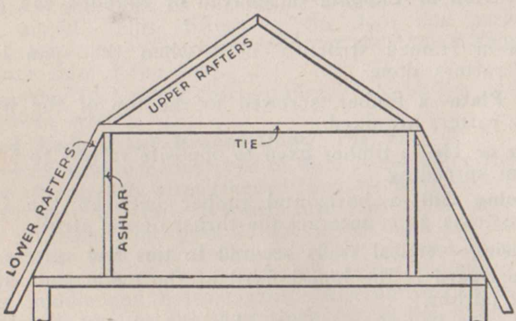


Fig.39. MANSARD ROOF

General Data.

Framing the various members of a roof is not difficult provided the main principals are thoroughly understood. First of all the "rise" and "run" of the common rafter, generally known as the "pitch" of the roof, must be ascertained. The "rise" is the vertical height measured from the highest part of the rafter to the level of the wall plates. The "run" is the horizontal distance from the outside edge of the wall plate to a point directly below the ridge. Therefore it will be seen that the "rise" and "run" and the common rafter, form a triangle, of which the hypothenuse is the length of the common rafter, and when the "rise" and "run" are known, the length of the common rafter can be found by solving the equation C^2 equals A^2 plus B^2.

To eliminate the trouble of working out the length of the rafter for different pitches, roofing tables have been compiled, and reference to these will be of great assistance. Another method for roof framing is by the use of the steel square, which, as its name implies, is a flat steel square, one arm being 18 inches long and the other 24 inches. One side of the square is divided into inches and twelfths for use as a twelfth scale to calculate feet and inches. By taking the "run" on one arm, and the "rise" on the other, lengths and bevels can be found for any right angle up to 18 feet by 24 feet, using this twelfth scale. However, the carpenter who wishes to use the steel square in all its different aspects, will find it necessary to make it a special study.

The definitions of different roof members is as follows:—

Common Rafters are those running from ridge to eaves.

Jack Rafters run from hips and valleys to eaves.

Principal Rafters are the inclined rafters of a truss, supporting the purlins.

Purlins are rafter supports running parallel to the walls, equally spread between ridge and wall plates.

Ridge—the board at the apex of the roof, to which the rafters are screwed.

Ridge Roll or Capping—a splayed or rounded cap to the ridge.

Truss—a framed structure used when the span is too great for rafters alone.

Wall Plate—a timber, screwed to the top of the wall to which the rafters are fixed.

Collar or Tie—a timber fixed to opposite rafters to prevent them from spreading.

Straining Sill—a horizontal timber between the Queen Posts of a truss, to counteract the thrust of the struts.

Ashlaring—vertical studs secured to ties and rafters.

Barge Board is the board fixed at the gable ends, to the projecting purlins.

Finial—usually a decorative piece secured to the barge boards where they meet at the apex.

Verge is the part of the roof that projects beyond the gable.

Eaves—where the rafters project over the walls.

Soffit is a board fixed to the underside of the rafters at the eaves.

Fascia—the gutter board fixed to the splayed ends of the rafters.

Sprocket—a piece fixed to the foot of a rafter when the roof is steep, to reduce the pitch into the rain-water gutter.

Tilting Fillet—an alternative to a sprocket.

Dragon Tie—screwed to a hip rafter and the wall plates, to check the thrust of the hip.

Dormer Window is a window which abuts from the roof.

DOORS

Ledged Door. Fig. 40.

This door is suitable for sheds or light interior use, and consists simply of tongued and grooved boards secured to three horizontal ledges.

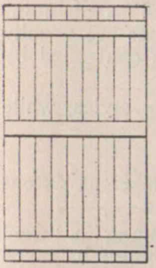


Fig. 40. Ledged Door.

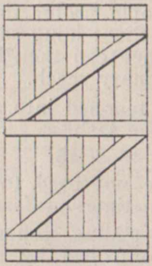


Fig. 41. Ledged and Braced Door.

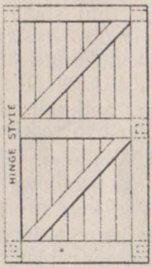


Fig. 42. Framed Ledged and Braced Door.

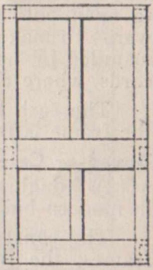


Fig. 43. Framed and Panelled Door.

Ledged and Braced Door. Fig. 41.

This is the same as the simple ledged door, with diagonal braces added. This stiffens up the door and prevents the sagging tendency. The lower ends of the braces should be at the hinge side of the door.

For the little extra cost entailed, the addition of braces is well worth while.

Framed, Ledged and Braced Door. Fig. 42.

For exterior use this type of door is recommended. Being framed it is greatly strengthened to resist warping. The frame consists of three rails tenoned into two styles, the top rail being the same thickness as the styles, and the middle and bottom rails half the thickness. The top rail is rebated to receive the ends of the boards, which are nailed to the face of the middle and bottom rails. Alternatively both top and bottom rails may be the same thickness as the styles, and both rebated.

Framed and Panelled Door. Fig. 43.

For better class interior work this door is generally used. The panels are inserted in grooves in the inside edges of the frame, while to avoid large panels, a centre style or mounting is tenoned into the rails. The approximate sizes for the frame are:—

Styles, mounting and top rail 4½ inches wide, middle and bottom rails 9 inches wide by 2 inches thick.

General Data.

Although there are many kinds of doors, they are mostly constructed on the same principals as described here. In the framing up of a door, the wider rails are double tenoned with haunches, and the styles are cut longer than the finished size. This prevents splitting when wedging the joint, the projecting ends being cut off after the door is framed up and glued.

WINDOWS

There are two main types of windows—solid or casement, and boxed or cased.

Solid or Casement Windows. Fig. 44.

These windows are hung in solid frames, the edges of which may be square, moulded, or chamfered. They are usually made to open outwards, but some people prefer them to open inwards to make cleaning easier. Pivot hung sashes are usually installed in large buildings, as they can then be controlled by cords, where they are out of ordinary reach.

The sash bars and rails are tenoned into the styles, while the frame is rebated to receive the sash.

Boxed or Cased Windows. Fig. 45 & 46.

Although these windows are not used to a great extent in modern building, they are sometimes preferred.

The construction consists of sliding sashes hung in boxed frames, the movement being controlled by counter-balanced weights running over pulley wheels. The boxes contain the weights and consist of pulley styles rebated into inner and outer linings, with a parting slip to separate the weights.

The pulley wheels are fitted flush to the styles, the weights hang inside, and a pocket piece is fitted to provide access to the interior of the casing. The sliding sashes are kept apart by a parting bead. Fig. 46 gives an idea of the construction.

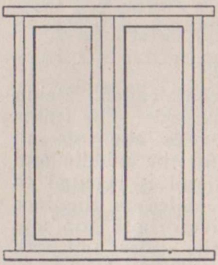


Fig.44. Solid or Casement.

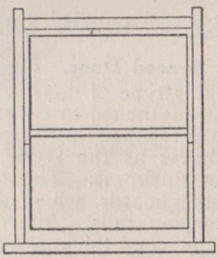


Fig.45 Boxed or Cased.

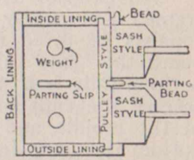


Fig.46. Boxed Frame Detail.

General Data.

With mass produced joinery and metal frames being so much cheaper than workshop made joinery, window making is becoming less necessary. But as one may be called upon to repair or install a sliding sash, a knowledge of the construction is essential.

FRACTIONS TO DECIMALS

1/64	·0156	17/64	·2656	33/64	·5156	49/64	·7656
1/32	·0312	9/32	·2812	17/32	·5312	25/32	·7812
3/64	·0468	19/64	·2968	35/64	·5469	51/64	·7968
1/16	·0625	5/16	·3125	9/16	·5625	13/16	·8125
5/64	·0781	21/64	·3281	37/64	·5781	53/64	·8281
3/32	·0937	11/32	·3437	19/32	·5937	27/32	·8437
7/64	·1093	23/64	·3593	39/64	·6094	55/64	·8593
1/8	·125	3/8	·375	5/8	·625	7/8	·875
9/64	·1406	25/64	·3906	41/64	·6406	57/64	·8906
5/32	·1562	13/32	·4062	21/32	·6562	29/32	·9062
11/64	·1718	27/64	·4219	43/64	·6719	59/64	·9218
3/16	·1875	7/16	·4375	11/16	·6875	15/16	·9375
13/64	·2031	29/64	·4531	45/64	·7031	61/64	·9531
7/32	·2187	15/32	·4687	23/32	·7187	31/32	·9687
15/64	·2344	31/64	·4844	47/64	·7344	63/64	·9843
1/4	·250	1/2	·500	3/4	·750	/	/

SQUARE ROOTS

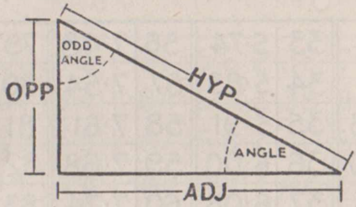
FROM 1 TO 10

1·0	1·00	3·3	1·81	5·6	2·36	7·9	2·81
1·1	1·04	3·4	1·84	5·7	2·38	8·0	2·82
1·2	1·09	3·5	1·87	5·8	2·40	8·1	2·84
1·3	1·14	3·6	1·89	5·9	2·42	8·2	2·86
1·4	1·18	3·7	1·92	6·0	2·44	8·3	2·88
1·5	1·22	3·8	1·94	6·1	2·46	8·4	2·89
1·6	1·26	3·9	1·97	6·2	2·49	8·5	2·91
1·7	1·30	4·0	2·00	6·3	2·51	8·6	2·93
1·8	1·34	4·1	2·02	6·4	2·52	8·7	2·94
1·9	1·37	4·2	2·04	6·5	2·54	8·8	2·96
2·0	1·41	4·3	2·07	6·6	2·56	8·9	2·98
2·1	1·44	4·4	2·09	6·7	2·58	9·0	3·00
2·2	1·48	4·5	2·12	6·8	2·60	9·1	3·01
2·3	1·51	4·6	2·14	6·9	2·62	9·2	3·03
2·4	1·54	4·7	2·16	7·0	2·64	9·3	3·04
2·5	1·58	4·8	2·19	7·1	2·66	9·4	3·06
2·6	1·61	4·9	2·21	7·2	2·68	9·5	3·08
2·7	1·64	5·0	2·23	7·3	2·70	9·6	3·09
2·8	1·67	5·1	2·25	7·4	2·72	9·7	3·11
2·9	1·70	5·2	2·28	7·5	2·73	9·8	3·13
3·0	1·73	5·3	2·30	7·6	2·75	9·9	3·14
3·1	1·76	5·4	2·32	7·7	2·77	10·0	3·16
3·2	1·78	5·5	2·34	7·8	2·79	··	···

SQUARE ROOTS
FROM 10 TO 100

10	3·16	33	5·74	56	7·48	79	8·88
11	3·31	34	5·83	57	7·54	80	8·94
12	3·46	35	5·91	58	7·61	81	9·00
13	3·60	36	6·00	59	7·68	82	9·05
14	3·74	37	6·08	60	7·74	83	9·11
15	3·87	38	6·16	61	7·81	84	9·16
16	4·00	39	6·24	62	7·87	85	9·21
17	4·12	40	6·32	63	7·93	86	9·27
18	4·24	41	6·40	64	8·00	87	9·32
19	4·35	42	6·48	65	8·06	88	9·38
20	4·47	43	6·55	66	8·12	89	9·43
21	4·58	44	6·63	67	8·18	90	9·48
22	4·69	45	6·70	68	8·24	91	9·53
23	4·79	46	6·78	69	8·30	92	9·59
24	4·89	47	6·85	70	8·36	93	9·64
25	5·00	48	6·92	71	8·42	94	9·69
26	5·09	49	7·00	72	8·48	95	9·74
27	5·19	50	7·07	73	8·54	96	9·79
28	5·29	51	7·14	74	8·60	97	9·84
29	5·38	52	7·21	75	8·66	98	9·89
30	5·47	53	7·28	76	8·71	99	9·94
31	5·56	54	7·34	77	8·77	100	10·00
32	5·65	55	7·41	78	8·83		

ROOF FRAMING BY TRIGONOMETRY.



OPP = RISE OF ROOF.
HYP = LENGTH OF RAFTER.
ADJ = RUN.

PARTS KNOWN	TO FIND THESE PARTS — HYP.	OPP.	ADJ.	ANGLE	ANGLE
ADJ. AND ANGLE	$\frac{\text{ADJ.}}{\text{COS.}}$	ADJ. × TAN	. .	. .	90° − ANGLE.
ADJ. AND OPP.	$\sqrt{\text{AOJ}^2+\text{OPP}^2}$			TAN. OPP. ÷ ADJ.	COTAN OPP. ÷ ADJ.
ADJ. AND HYP.	. .	$\sqrt{\text{HYP}^2-\text{AOJ}^2}$	. .	COS. AOJ. ÷ HYP.	SINE ADJ. ÷ HYP.
OPP. AND ANGLE	OPP ÷ SINE	. .	OPP. × COTAN	. .	90° − ANGLE
OPP. AND HYP.	. .	. .	$\sqrt{\text{HYP}^2-\text{OPP}^2}$	SINE OPP. ÷ HYP.	COS. OPP. ÷ HYP.
ANGLE AND HYP.	. .	HYP. × SINE	HYP. × COS.	. .	90° − ANGLE

TRIGONOMETRICAL RATIOS.

SINE $= \frac{O}{H}$ TANGENT $= \frac{O}{A}$ SECANT $= \frac{H}{A}$

COSINE $= \frac{A}{H}$ COTAN $= \frac{A}{O}$ COSECANT $= \frac{H}{O}$

FRAMING TABLE FOR HIP AND VALLEY RAFTERS

Pitch of Roof.	Angle of Vertical Cut.	Angle of Seat Cut at Wall Plate.	Length of Hip or Valley per Foot of Run of Common Rafter.	Angle of Side Cut.	Angle of Backing of Hip	'Drop' of Hip with no Backing
INS.	° ′	° ′	INCHES	° ′	° ′	INS.
3/4	43-20	46-40	24·72	34-30	53-50	7/8
17/24	45-0	45-0	24·00	35-20	54-50	3/4
2/3	46-40	43-20	23·31	36-00	55-30	3/4
5/8	48-30	41-30	22·64	36-50	56-30	11/16
7/12	50-30	39-30	21·99	37-40	57-30	5/8
13/24	52-30	37-30	21·37	38-20	58-40	5/8
1/2	54-50	35-10	20·78	39-10	59-50	9/16
11/24	57-10	32-50	20·22	40-00	61-30	1/2
5/12	59-30	30-30	19·69	40-50	63-10	7/16
3/8	62-10	27-50	19·21	41-30	64-50	7/16
1/3	64-50	25-10	18·76	42-10	67-00	3/8
7/24	67-30	22-30	18·36	42-40	69-10	5/16
1/4	70-30	19-30	18·00	43-20	71-30	5/16
5/24	73-40	16-20	17·69	43-50	74-10	1/4
1/6	76-40	13-20	17·43	44-10	77-00	3/16
1/8	80-0	10-0	17·23	44-30	80-10	1/8
1/12	83-20	6-40	17·09	44-50	83-20	1/8
1/24	86-40	3-20	17·00	45-00	-	1/16

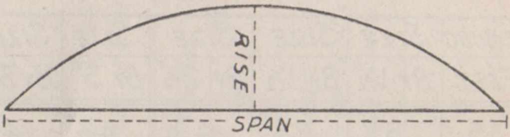
FRAMING TABLE FOR COMMON RAFTERS

Pitch of Roof.	Length of Rafter per Foot of Run.	Angle of Vertical Bevel.	Angle of Side Bevel of Jacks.	Angle of Bevel at Plate.
	INCHES	° ′	° ′	° ′
3/4	21·63	33·40	29·00	56·20
17/24	20·81	35·10	30·00	54·50
2/3	20·00	36·50	31·00	53·10
5/8	19·21	38·40	32·10	51·20
7/12	18·44	40·40	33·00	49·20
13/24	17·69	42·40	34·10	47·20
1/2	16·97	45·00	35·20	45·00
11/24	16·28	47·30	36·20	42·30
5/12	15·62	50·10	37·30	39·50
3/8	15·00	53·10	38·40	36·50
1/3	14·42	56·20	39·50	33·40
7/24	13·89	59·40	41·00	30·20
1/4	13·42	63·30	41·50	26·30
5/24	13·00	67·20	42·40	22·40
1/6	12·65	71·30	43·30	18·30
1/8	12·37	76·00	44·10	14·00
1/12	12·17	80·30	44·30	9·30
1/24	12·04	85·10	44·50	4·50

FLOOR JOISTS
BEARINGS AND SIZES

BEARING FEET	SIZE BY 1½"	SIZE BY 1½"	SIZE BY 2½"	SIZE BY 3"	SIZE BY 3½"
5	5¾"	5¼"	4¾"	4½"	4"
6	6¼	5¾	5½	5	4½
7	7	6½	6	5½	5
8	7¾	7½	6½	6	5½
9	8½	8	7	6½	6
10	9	8¾	7½	7	6½
11	9½	8¾	8	7½	7
12	10	9½	8½	8	7½
13	10¾	9¾	9	8½	8
14	11	10	9½	9	8½
15	11½	10½	10	9¼	8¾
16	12¼	11	10½	9¾	9¼
17	12¾	11½	10¾	10¼	9¾
18	13¼	12	11¼	10½	10
19	13¾	12½	11½	10¾	10¼
20	14¼	13	12	11¼	10¾

TABLE OF RISE FOR BRIDGE SPANS



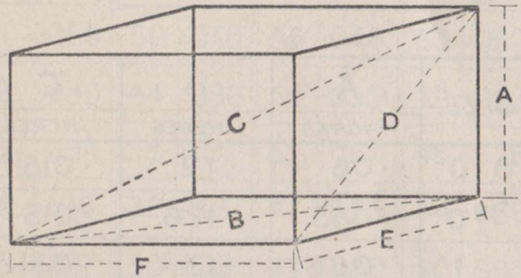
SPAN.	RISE.	SPAN.	RISE.	SPAN	RISE.
30	0·5	120	7·0	280	24·0
40	0·8	140	8·0	300	28·0
50	1·4	160	10·0	320	32·0
60	2·0	180	11·0	350	39·0
70	2·5	200	12·0	380	47·0
80	3·0	220	14·0	400	53·0
90	4·0	240	17·0		
100	5·0	260	20·0		

TABLE FOR RAKING SHORES.

HEIGHT OF WALL.	SIZE OF TIMBER.
15 TO 20 FEET	INCHES 4 × 4 OR INCHES 5 × 5
20 " 30 "	9 × 4½ " 6 × 6
30 " 40 "	12 × 6 " 8 × 8
40 " 50 "	9 × 9 " 8 × 8
50 " 60 "	12 × 9 " 11 × 9

ROOF FRAMING.

TO DETERMINE UNIT LENGTH OF HIP, VALLEY OR COMMON RAFTER.



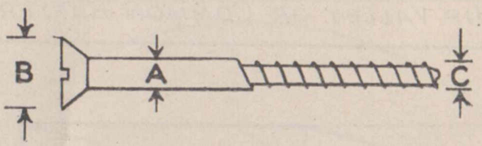
A = RISE OF ROOF
B = RUN OF HIP OR VALLEY
C = LENGTH " " "
D = LENGTH OF COMMON RAFTER
E = RUN " " "
F = TANGENT

WHERE TANGENT = 12", AND RUN OF COMMON RAFTER = 12" THEN RUN OF HIP OR VALLEY = 16·97"

$$C = \sqrt{A^2 + B^2}$$

$$D = \sqrt{A^2 + E^2}$$

STANDARD WOOD SCREWS



SIZE.	A	B	C
	INCHES	INCHES	INCHES
0 0	·06	·12	·015
0	·063	·126	·015
1	·066	·13	·031
2	·08	·16	·046
3	·094	·188	·046
4	·108	·218	·062
5	·122	·244	·078
6	·136	·281	·078
8	·164	·343	·093
1 0	·192	·375	·125
1 2	·22	·437	·125
1 4	·248	·50	·140
1 6	·276	·562	·156
1 8	·304	·608	·187

Standard Wood Screws

Screw Size		Clearance Drill		Root Drill			
				Soft Wood		Hard Wood	
No.	Dia.	No.	Dia.	No.	Dia.	No.	Dia.
1	·066"	50	·070"	56	·046"	55	·052"
2	·080	44	·086	54	·055	52	·063
3	·094	38	·101	51	·067	48	·076
4	·108	32	·116	47	·078	44	·086
5	·122	30	·128	43	·089	40	·098
6	·136	27	·144	40	·098	35	·110
8	·164	17	·173	31	·120	29	·136
10	·192	8	·199	27	·144	22	·157
12	·220	1	·228	20	·161	15	·180
14	·248	G	·261	13	·185	6	·204
16	·276	L	·290	6	·204	1	·228
18	·304	O	·316	1	·228	E	·250
22	·360	V	·377	H	·266	M	·295
24	·388	Y	·404	L	·290	P	·323

USEFUL DATA

PERCENTAGE OF LOSS OF WEIGHT IN SEASONING TIMBER.

OAK	16-25	LARCH	16-25	RED PINE	12-25
ELM	35-40	MAHOGANY	16-30	AMERICAN PINE	18-27

ULTIMATE STRENGTH OF WOODS.

TIMBER	CRUSHING STRAIN PER SQUARE INCH.	TENSILE STRAIN PER SQUARE INCH.
YELLOW PINE	APPROX. 2½ TONS.	APPROX. 5¼ TONS.
BEECH	" 3¼ "	" 5 "
MAHOGANY	" 3½ "	" 9 "
OAK *ENGLISH.*	" 4 "	" 6½ "
ELM	" 4½ "	" 6 "
TEAK	" 5¼ "	" 3½ "
ASH	" 4 "	" 5¼ "

SIZE OF SQUARE-GAUGE BOX TO HOLD 1 CUBIC FOOT OF CEMENT.

DEPTH OF BOX	7"	8"	9"	10"	11"	12"	13"	14"
SQUARE SIDES	15¾	14¾	13⅞	13⅛	12½	12	11½	11⅛

AVERAGE WEIGHT OF 1:2:4 CONCRETE.

COARSE MATERIAL	PER CU. FT.	COARSE MATERIAL	PER CU. FT.
CLINKER.	110 LBS.	LIMESTONE.	140 LBS
BRICK.	125 "	SHINGLE.	150 "

SPECIFIC GRAVITY AND WEIGHT OF WOODS.

TIMBER	SPECIFIC GRAVITY	WEIGHT PER CU. FT.
OAK *ENGLISH.*	·970	61·87 LBS
MAHOGANY	·560	35·00
PITCH PINE	·660	41·25
ELM	·556	34·75
ASH	·760	47·50
LARCH	·544	34·00

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