



University of
Salford
MANCHESTER

ROOF CONSTRUCTION

TECHNOLOGY 1

BUILT ENVIRONMENT



ROOF CONSTRUCTION

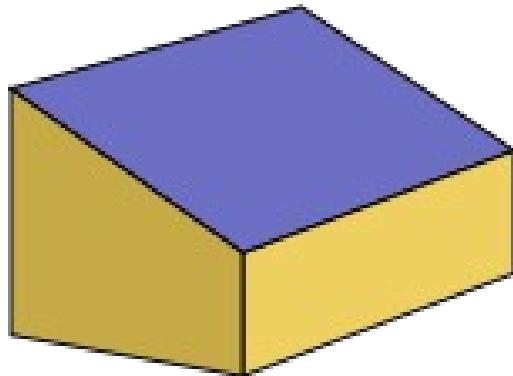
Considerations:

- Span
- Materials
- Strength
- Durability
- Moisture resistance
- Fire resistance
- Stability
- Insulation
- Appearance
- Usage





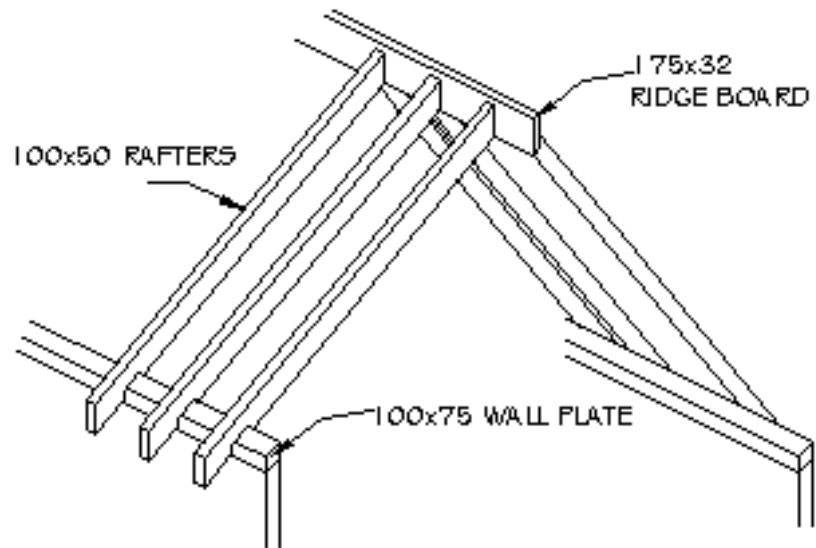
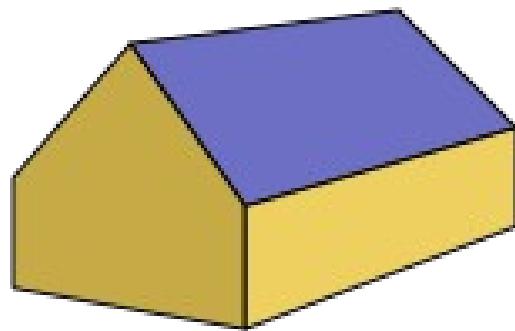
PITCHED ROOFS



Monopitch



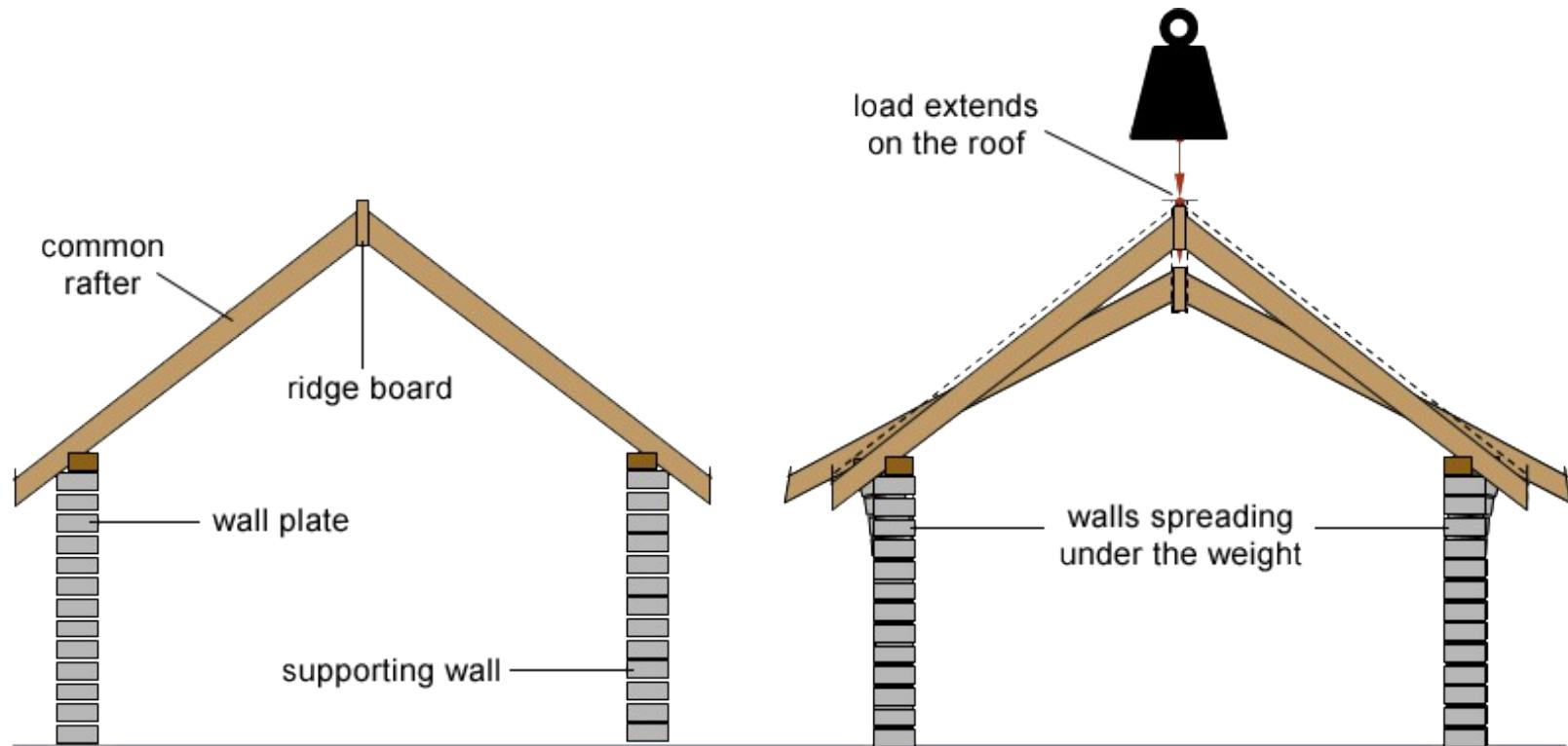
PITCHED ROOFS



Duopitch = couple roof



PITCHED ROOFS

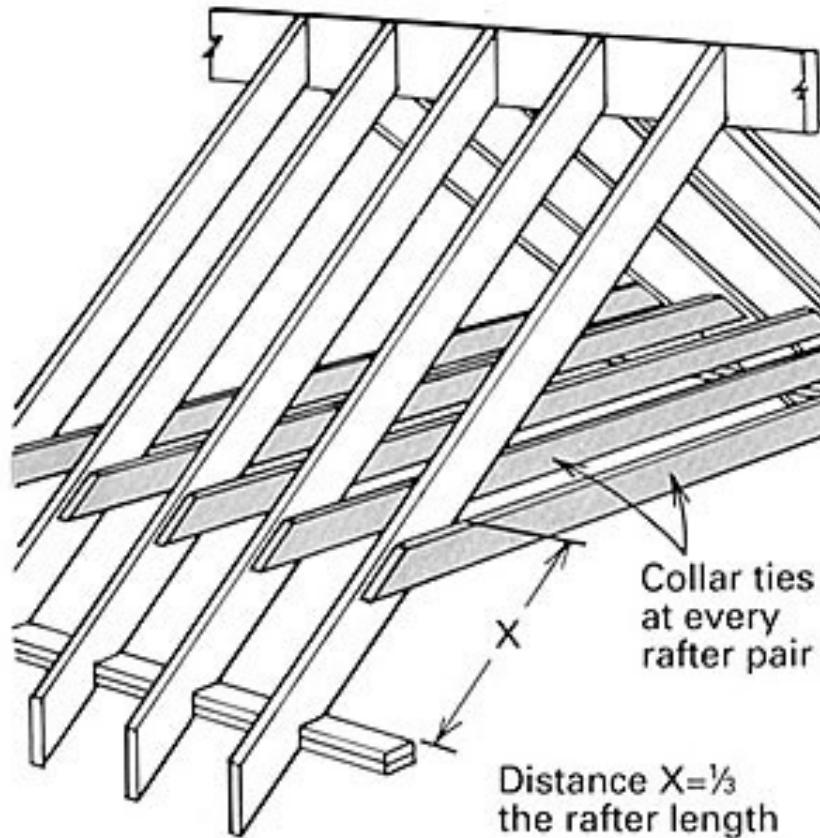


Couple roof – maximum span 3.5m



PITCHED ROOFS

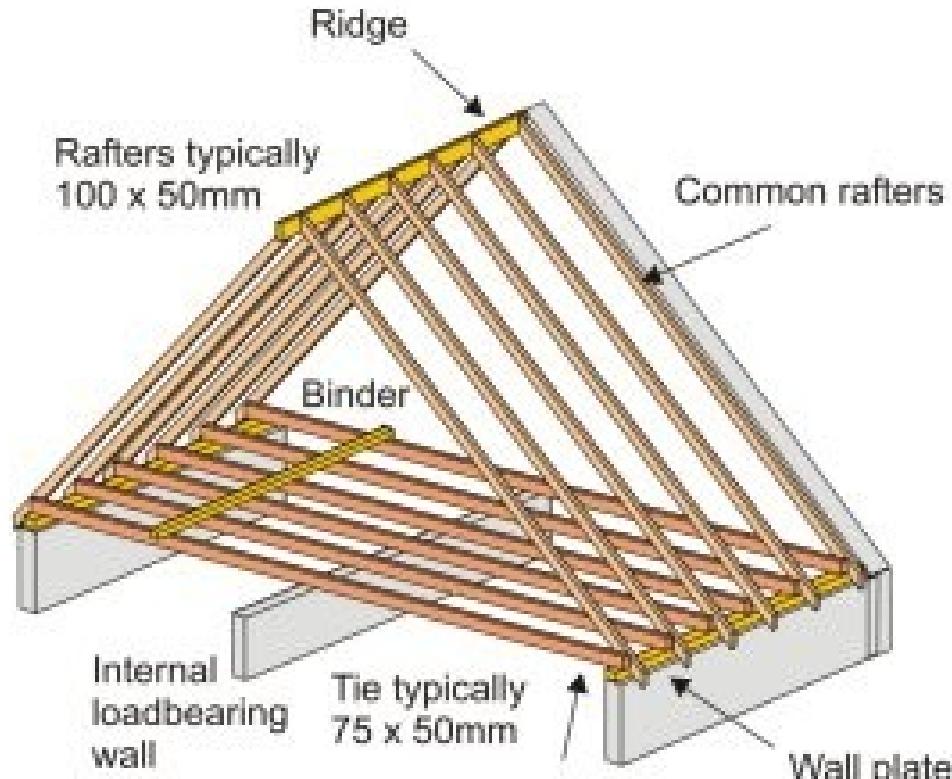
Collar roofs –
Maximum
Spans up to
4.5m





PITCHED ROOFS

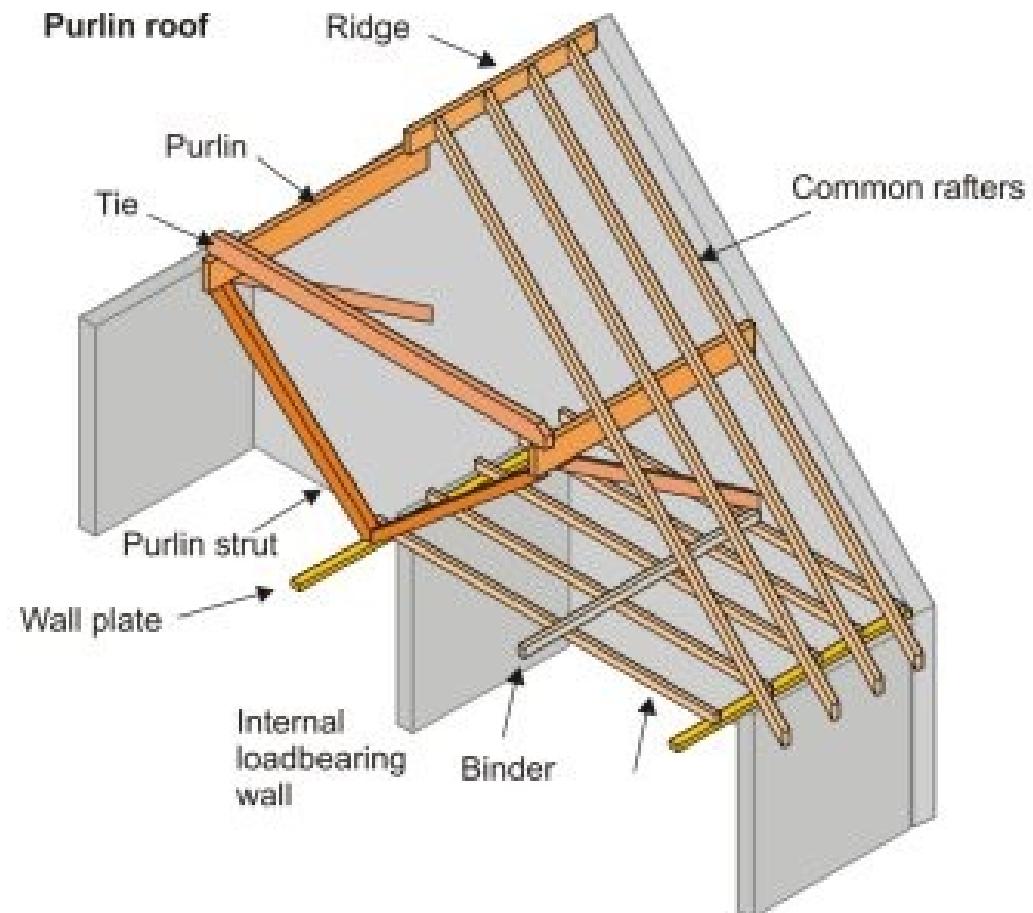
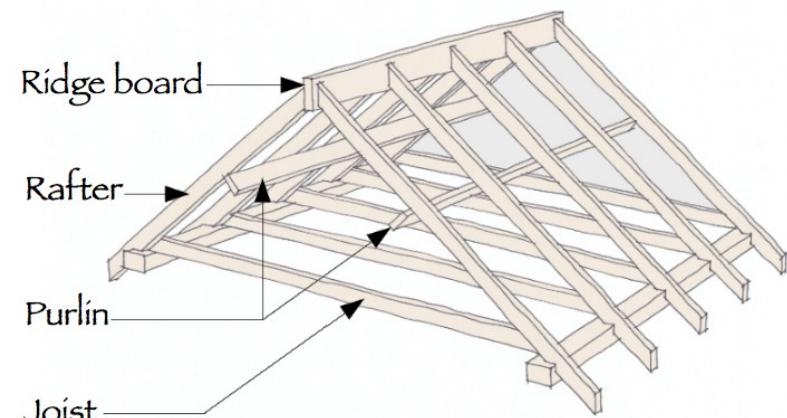
Closed couple roof



Close Couple roof – maximum span 5.5m



PITCHED ROOFS

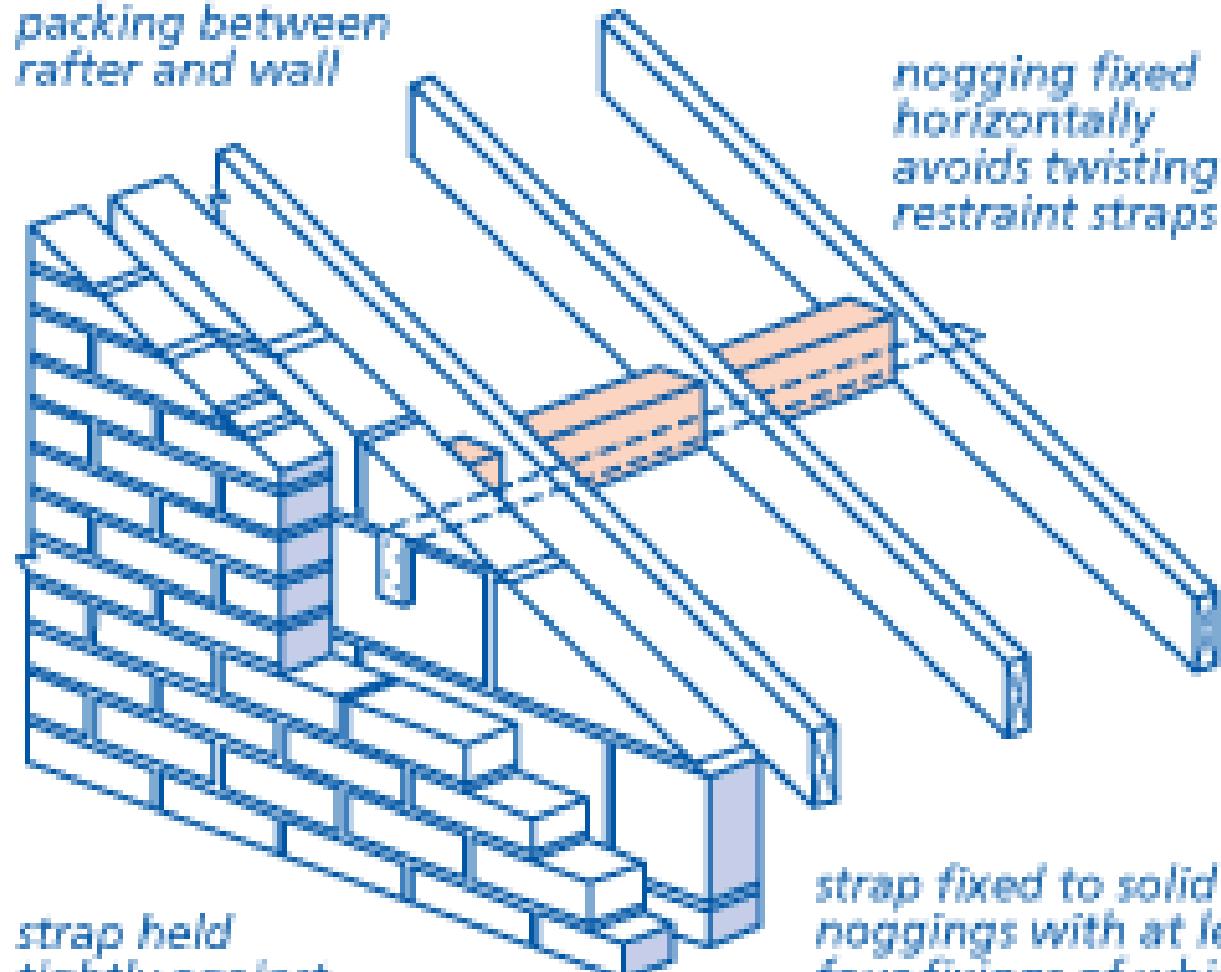


Purlin roof – Spans up to 8m



PITCHED ROOFS

*packing between
rafter and wall*



*nogging fixed
horizontally
avoids twisting
restraint straps*

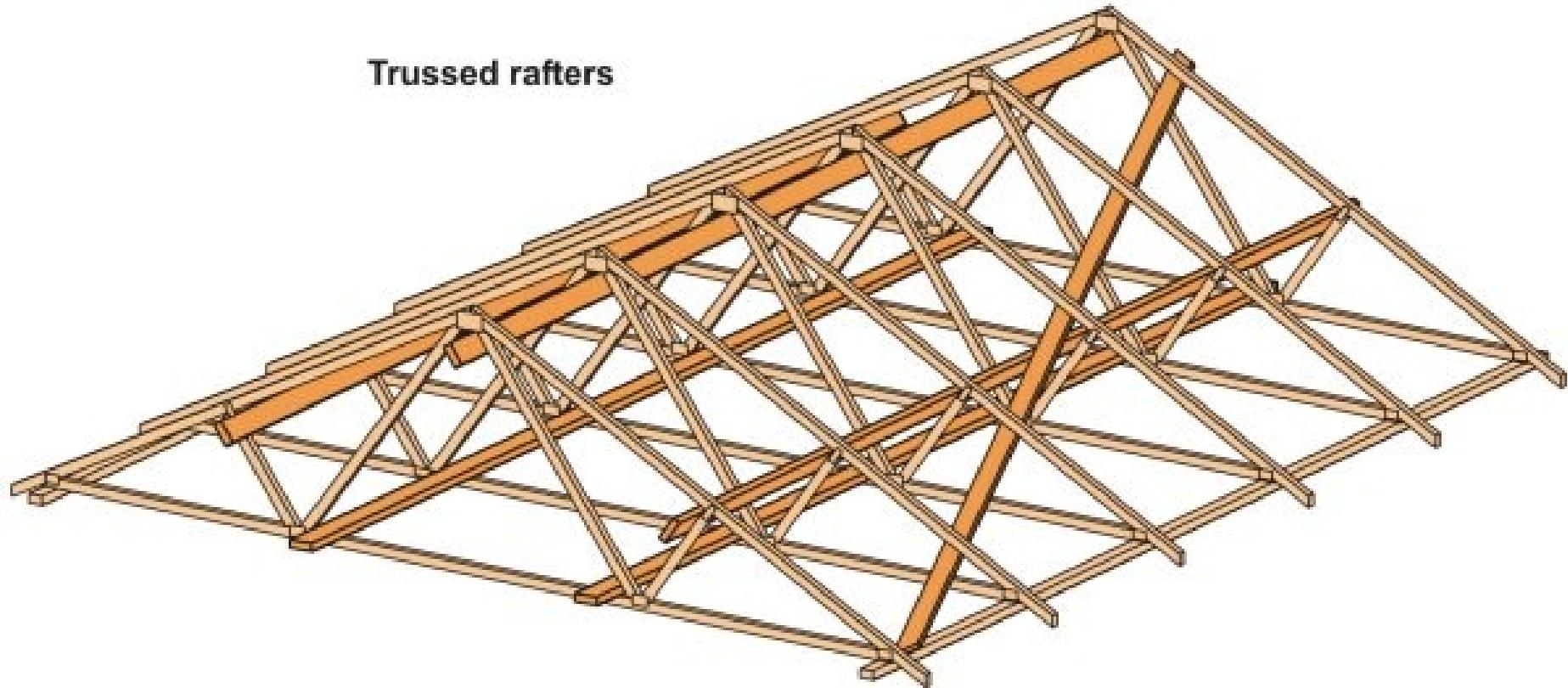
*strap held
tightly against
block inner leaf*

*strap fixed to solid
noggings with at least
four fixings of which
at least one to be in
the third rafter*



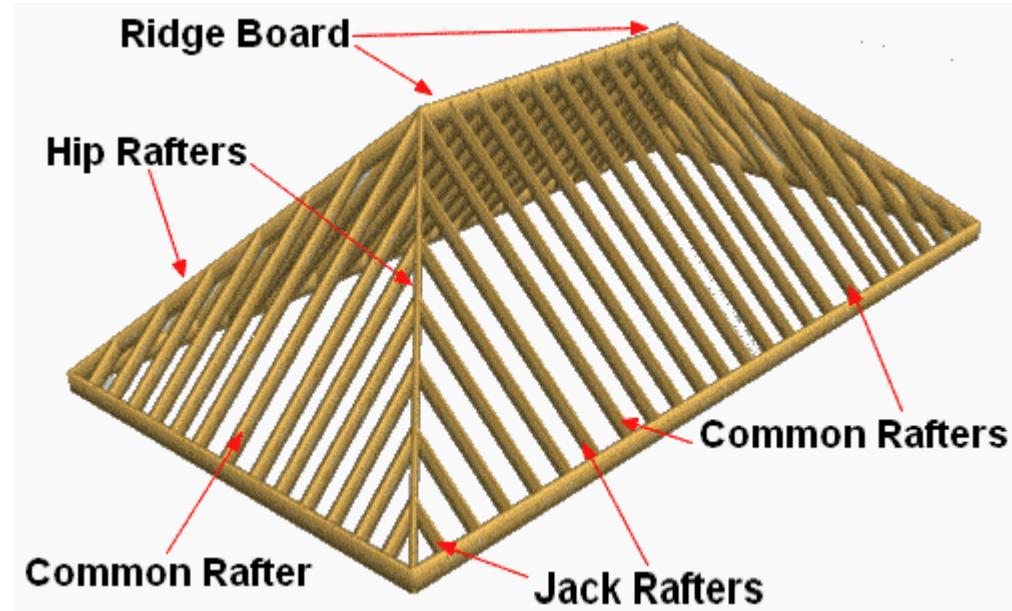
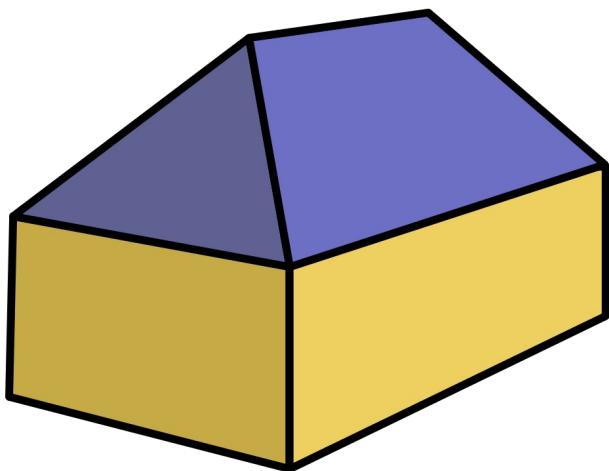
PITCHED ROOFS

Trussed rafters





PITCHED ROOFS

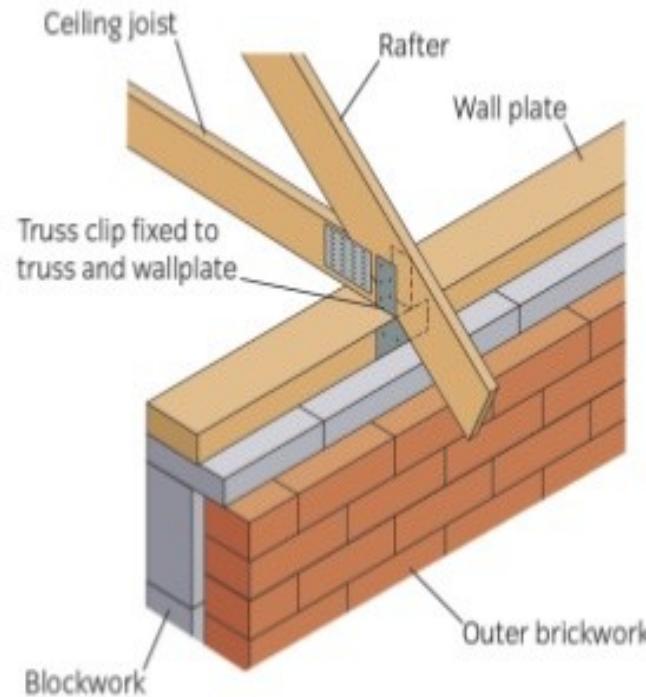
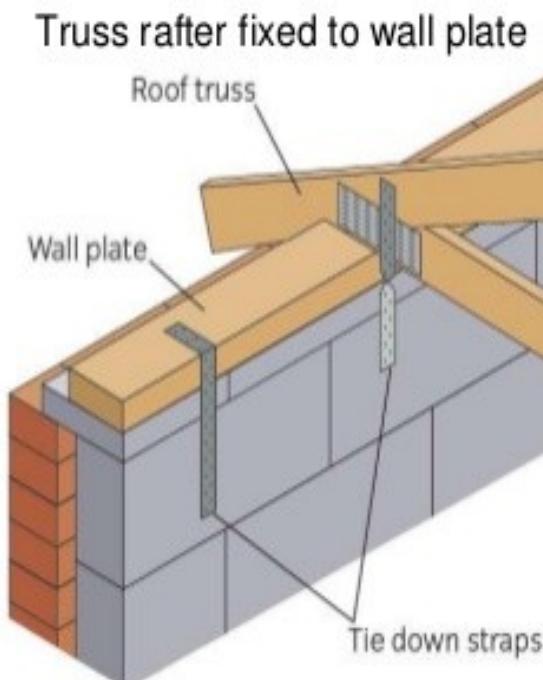


Hipped roof



WALL PLATES

Restraint straps fixed at maximum 2.0m from the centre.



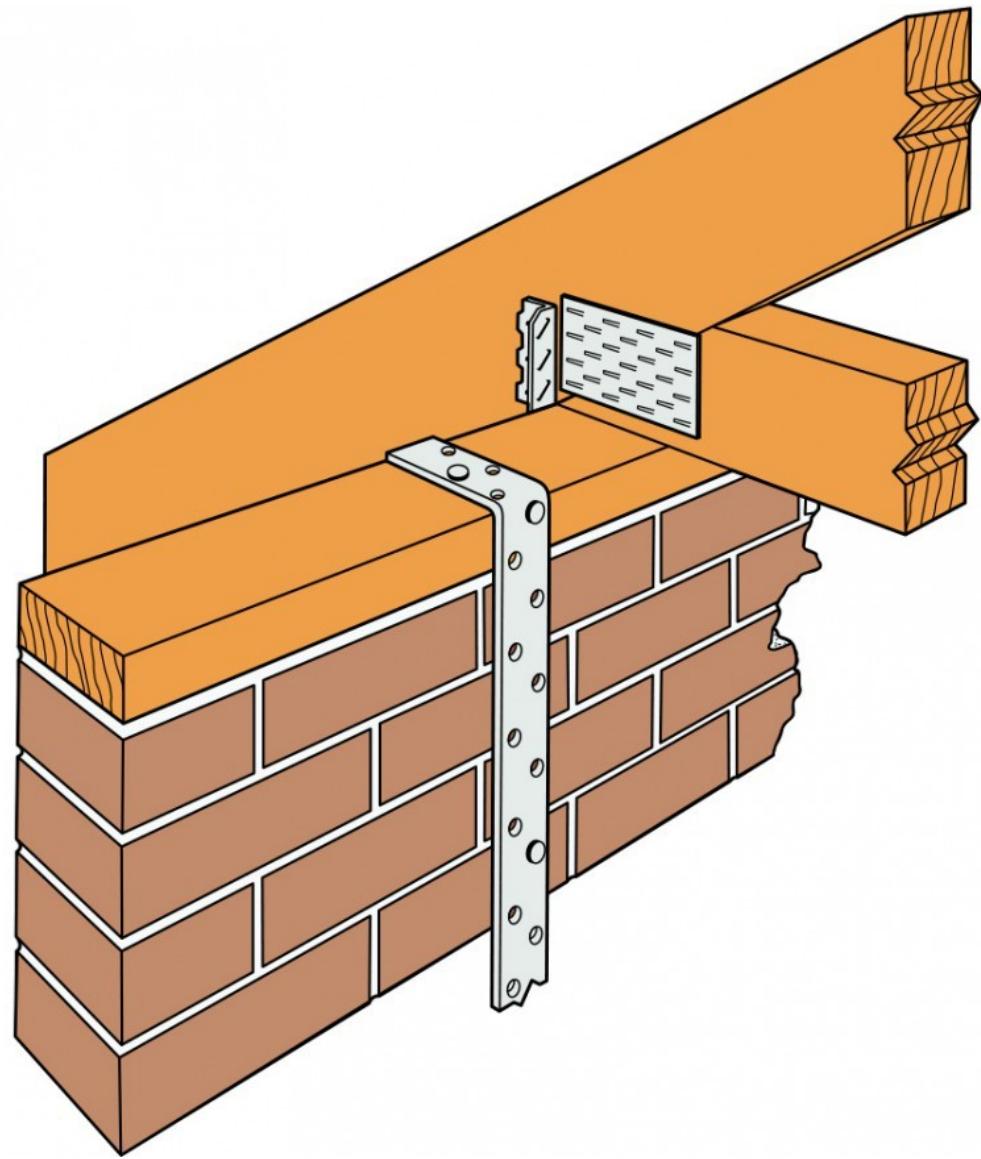
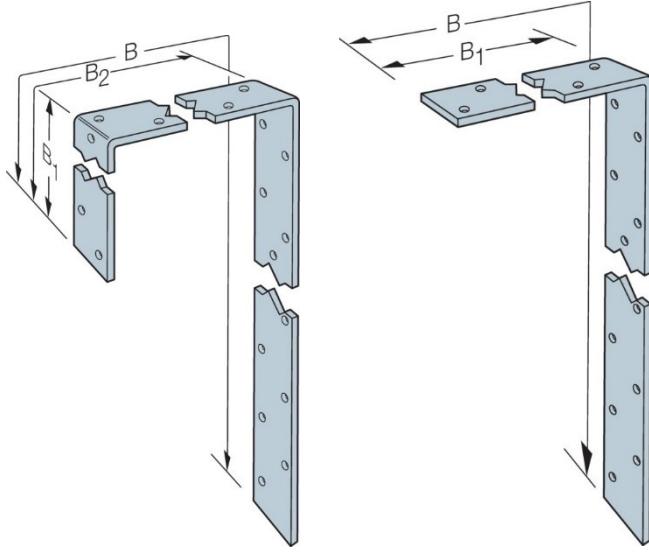
- Provide the bearing and fixing medium for various roof members
- Distribution of loads evenly over the wall
- Bedded in cement mortar on top of load-bearing walls



WALL PLATES

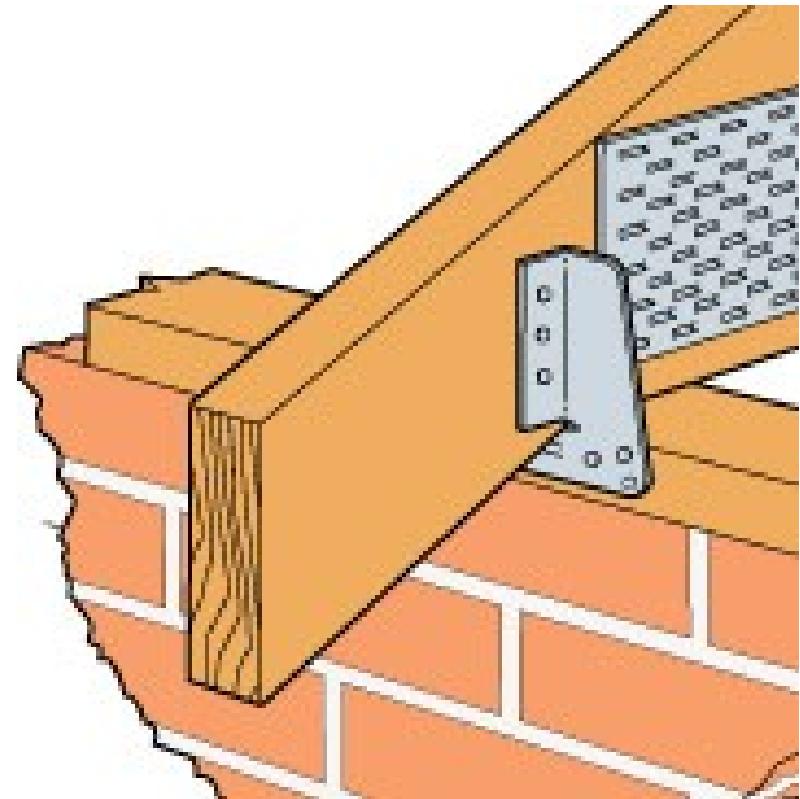
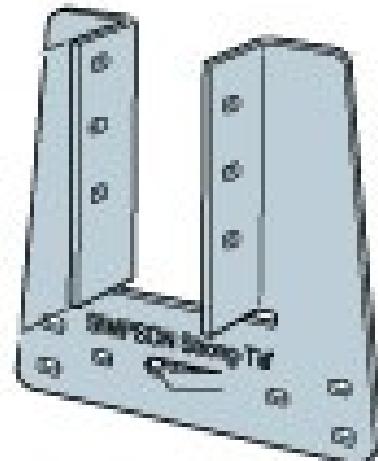
Heavy/light restrain straps

- Heavy for lateral restraint
- Light for vertical loads





WALL PLATES



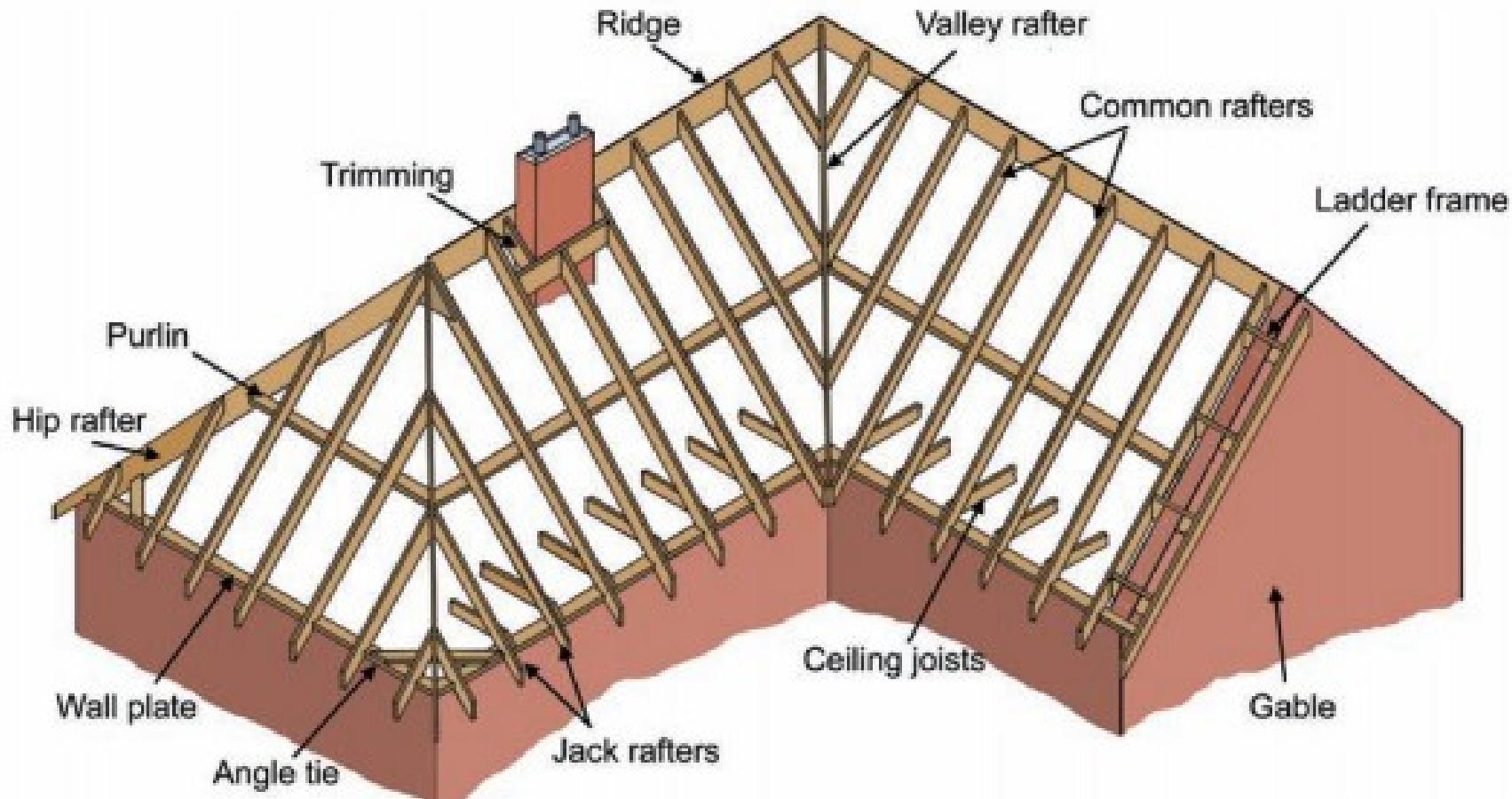
Simpson clip



Any questions?

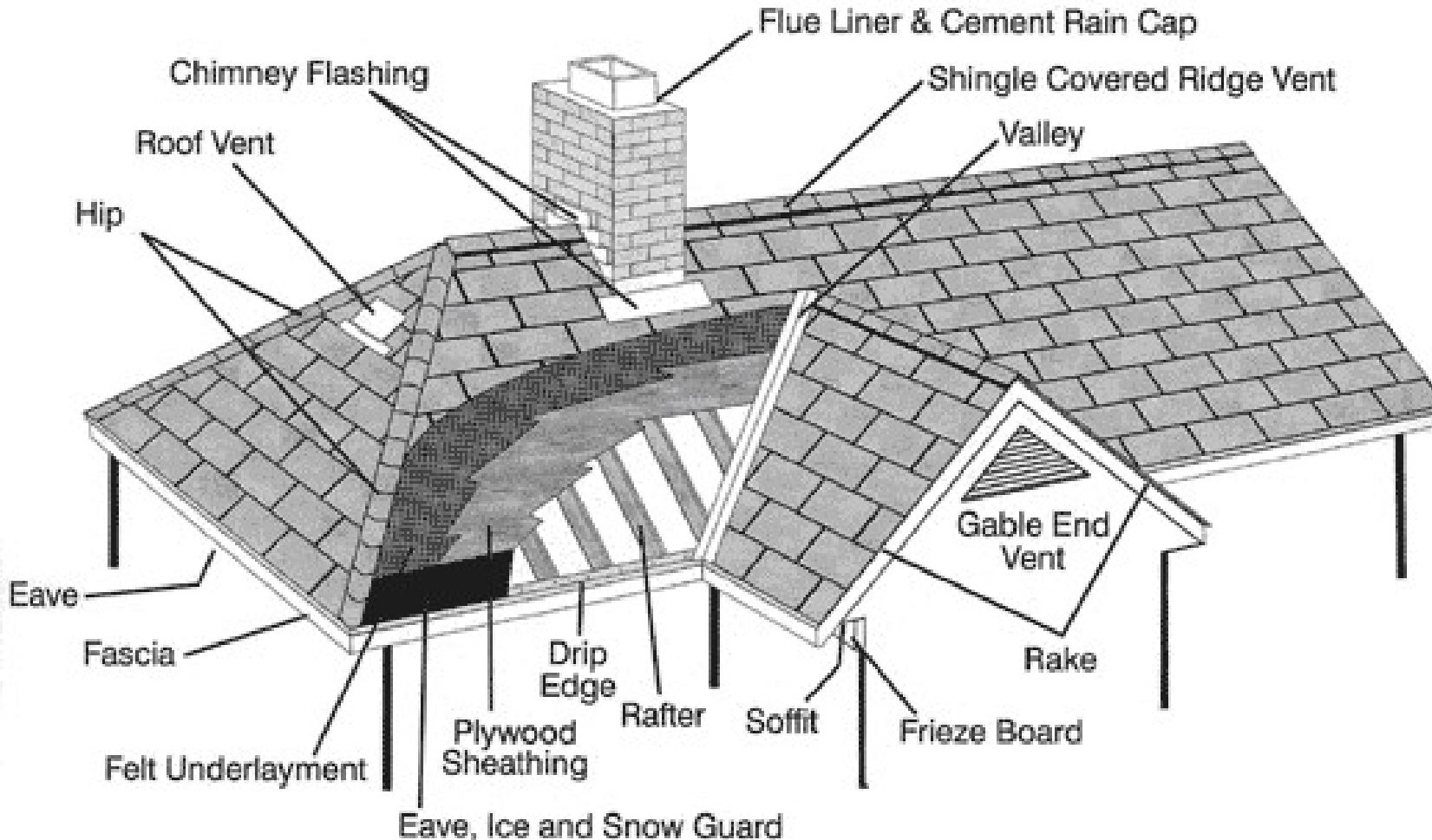


TERMINOLOGY





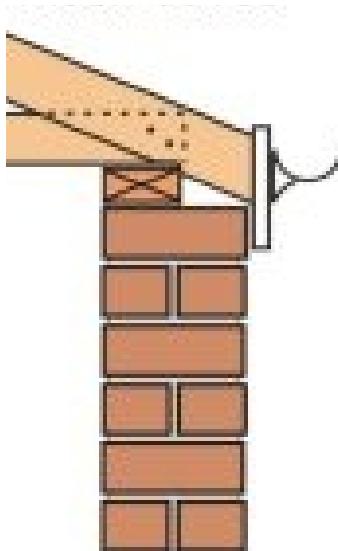
TERMINOLOGY





PITCHED ROOF EAVES

CLOSED EAVES



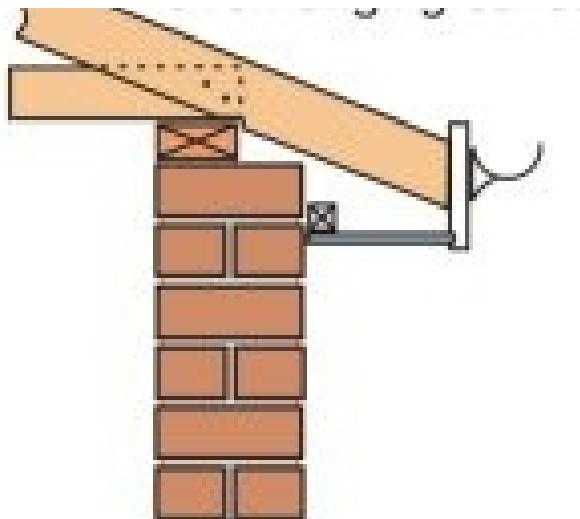
Flush eaves



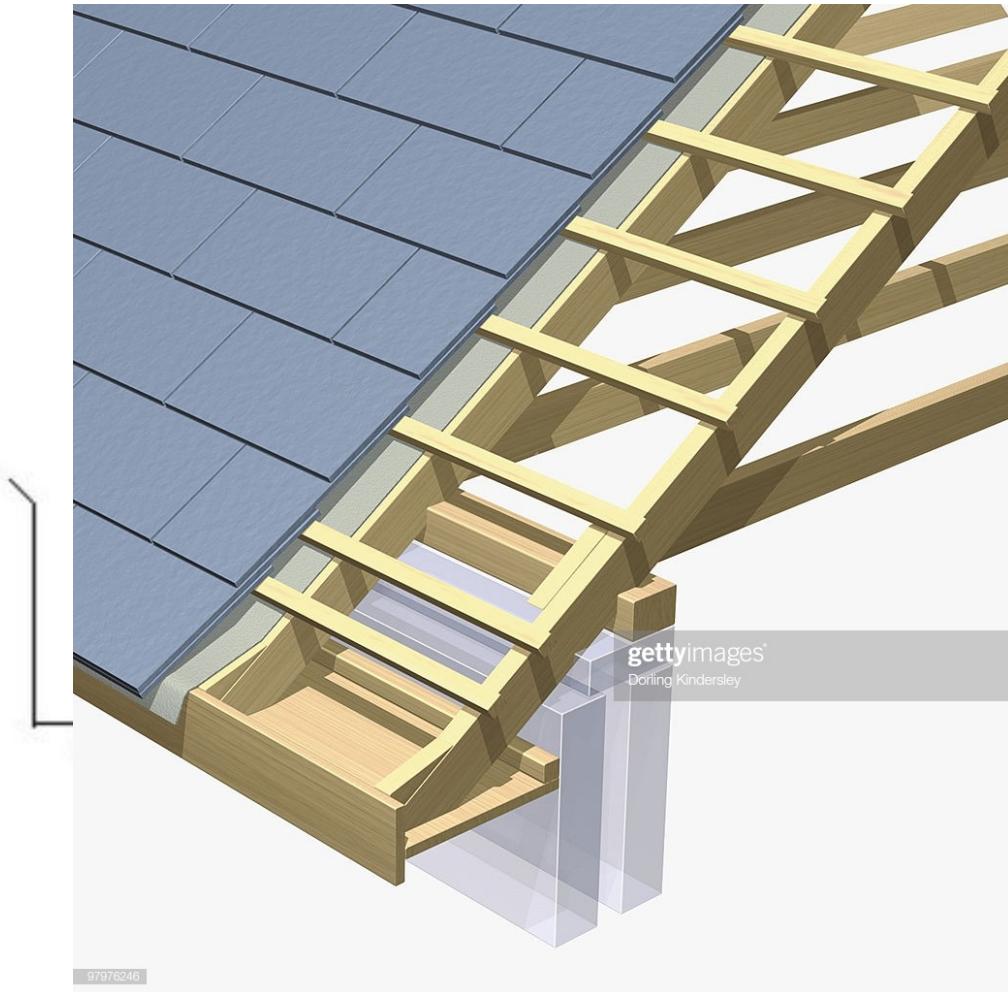


PITCHED ROOF EAVES

CLOSED EAVES



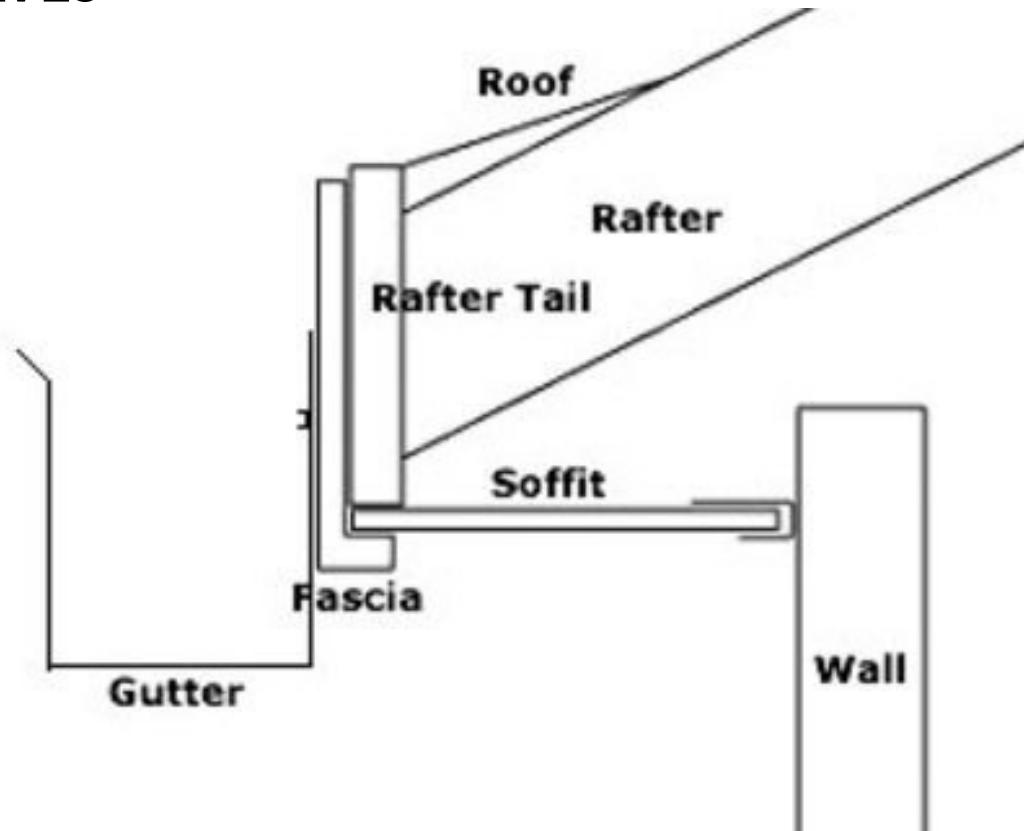
Soffit eaves





PITCHED ROOF EAVES

CLOSED EAVES

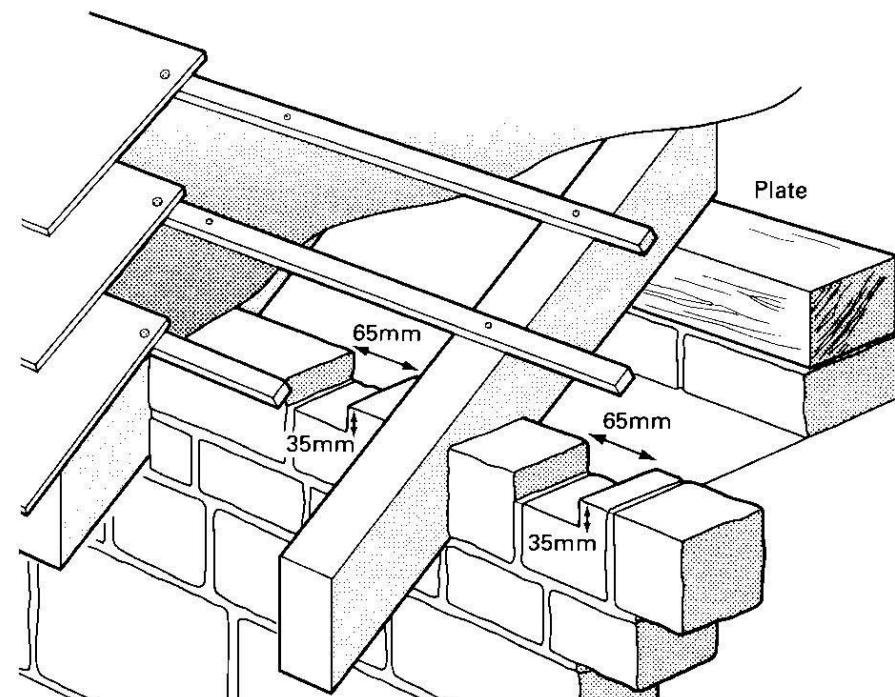


Soffit eaves



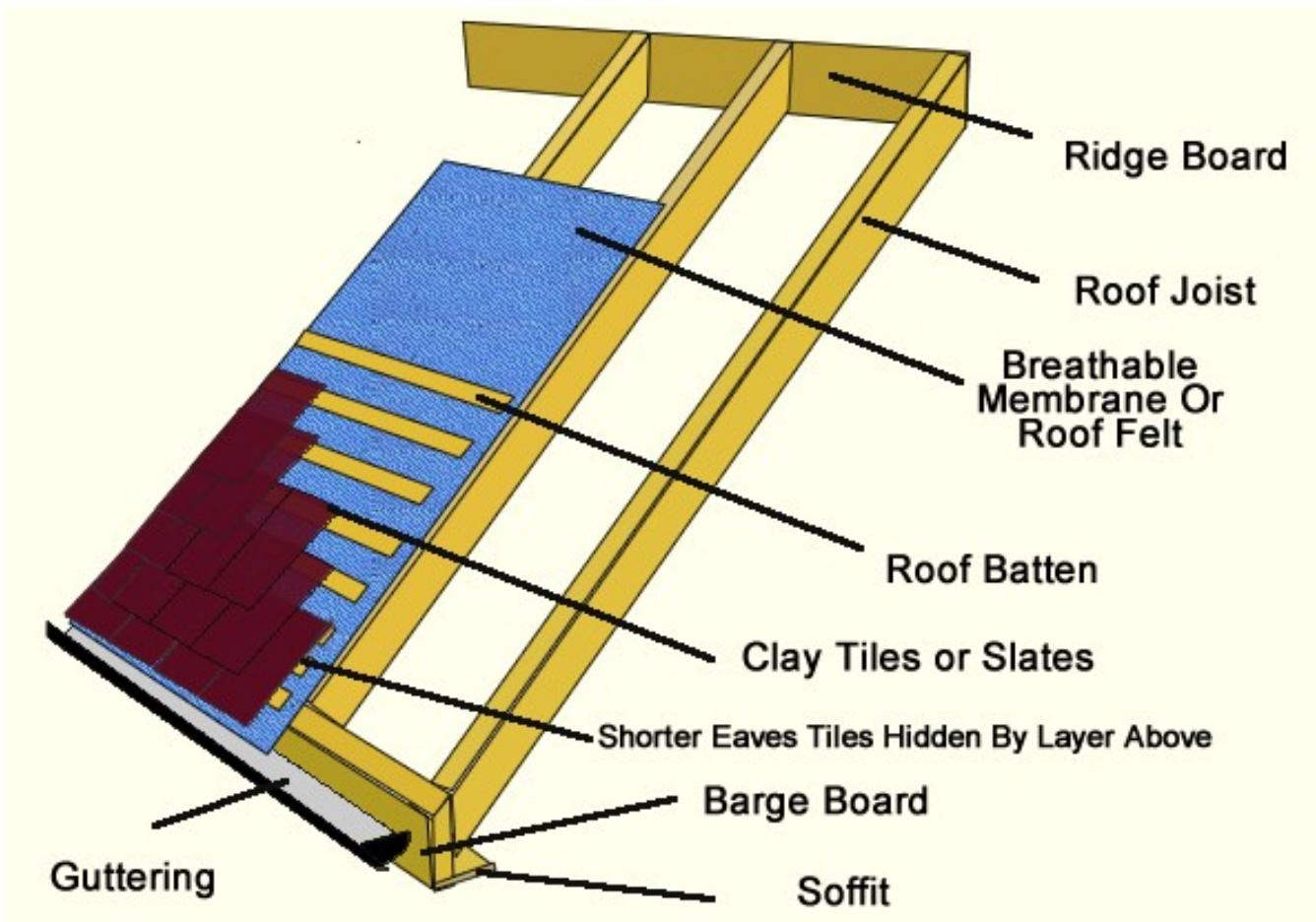
PITCHED ROOF EAVES

OPEN EAVES





ROOF COVER



Where do we put insulation?



Timber battens and counterbattens

(BS 5534:2014+A2:2018)

should be of the following species:

a) British-grown

- larch
- British pine
- British spruce

b) imported:

- redwood
- whitewood
- spruce-pine-fir (USA, Canada)
- southern pine (USA)



Timber battens and counterbattens

(BS 5534:2014+A2:2018)

Minimum timber batten sizes

Application	Basic minimum size of batten ^{A), B), C)}			
	Up to 450 mm span ^{D)}		451 mm to 600 mm span ^{D)}	
	Width mm	Depth mm	Width mm	Depth mm
Slates (double-lap):				
• natural: sized or random	50	25	50	25
• fibre-cement or concrete	38	25	50	25
Clay and concrete tiles:				
• double-lap	38	25	38	25
• single-lap	38	25	50	25

^{A)} Tolerances on the basic sizes of timber batten should be: width ± 3 mm, depth $\frac{-0}{+3}$ mm, based on measurement at a reference moisture content of 20% (see [Annex D](#)).

^{B)} These minimum sizes do not apply to battens used to support ridges, hips and valleys.

^{C)} Batten sizes for other slates, tiles and shingles such as timber shingles and shakes and metal tiles, or other proprietary roofing products, should be in accordance with the manufacturer's recommendations.

^{D)} Span is defined as the distance between centres of supports, or the clear distance between the faces of supports plus half the bearing length at each end support, whichever is the lesser. The end-bearing length should be not less than 17.5 mm.

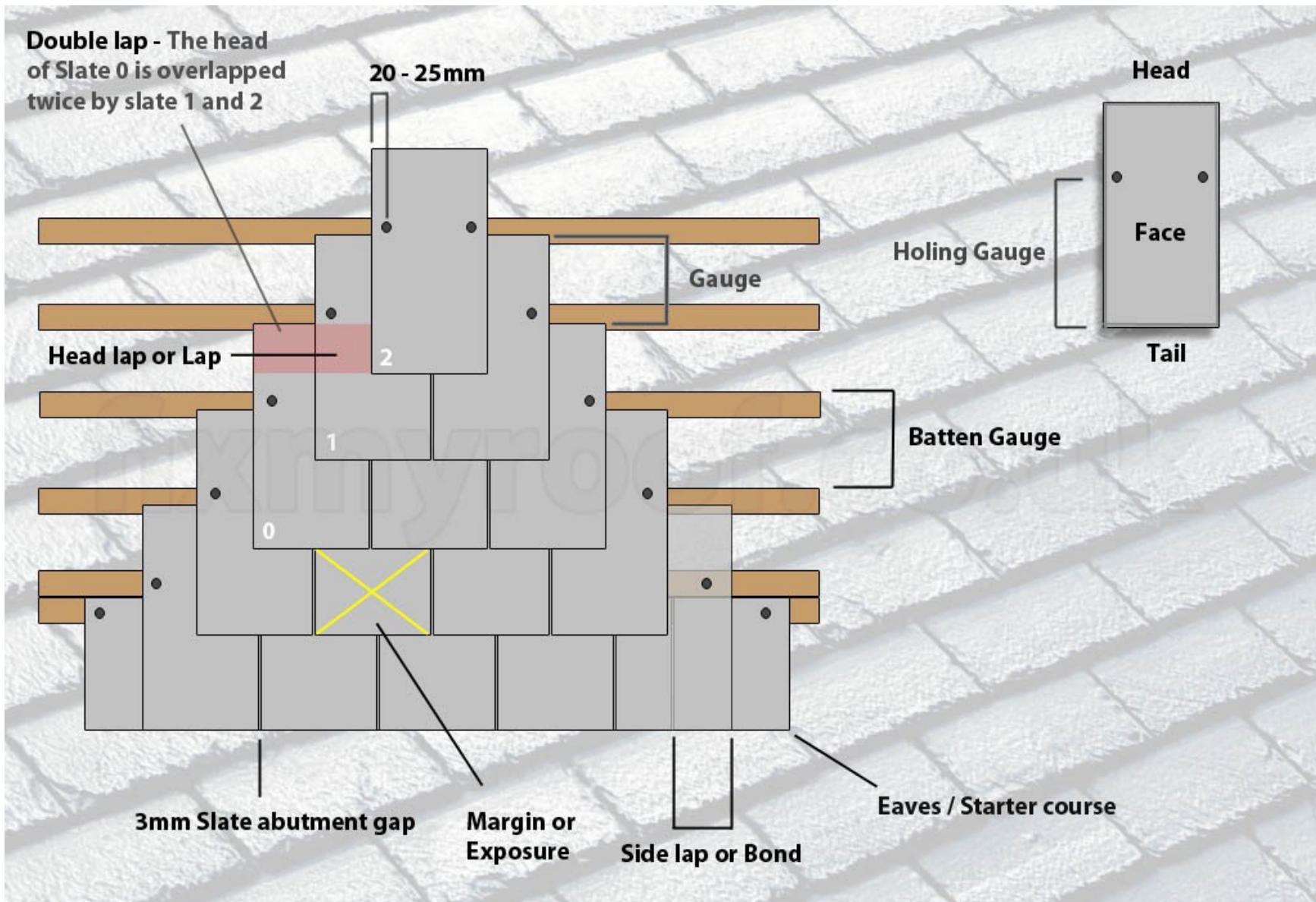


Roof materials

Natural slate shingles

- Long lasting (up to 150 years)
- Fire resistant
- Low water absorption
- Relatively heavy roof
- Common large size 600x300mm
- Quality determined by thickness
 - Best: 4mm thick
 - Medium strong: 5mm
 - Heavy: 6mm
 - Extra heavy: 9mm







Roof materials

Clay

- Long lasting (less than slate)
- Fire resistant
- More porous
- Many shapes (flat or curved)

Roman tiles

15^o- 20^o Pitch



Plain clay tiles

35^o- 50^o Pitch

Hooked over battens and nailed every course
Staggered joints

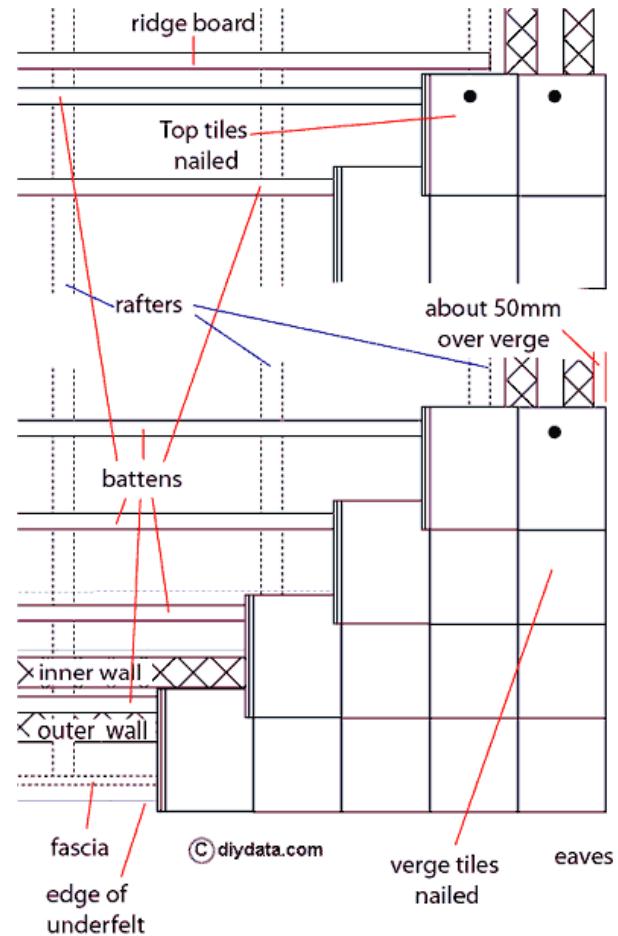




Roof materials

Concrete

- Most common type in the UK
- Much stronger
- Can support weather conditions much better (wind, rain)
- Fire resistance
- Cheaper

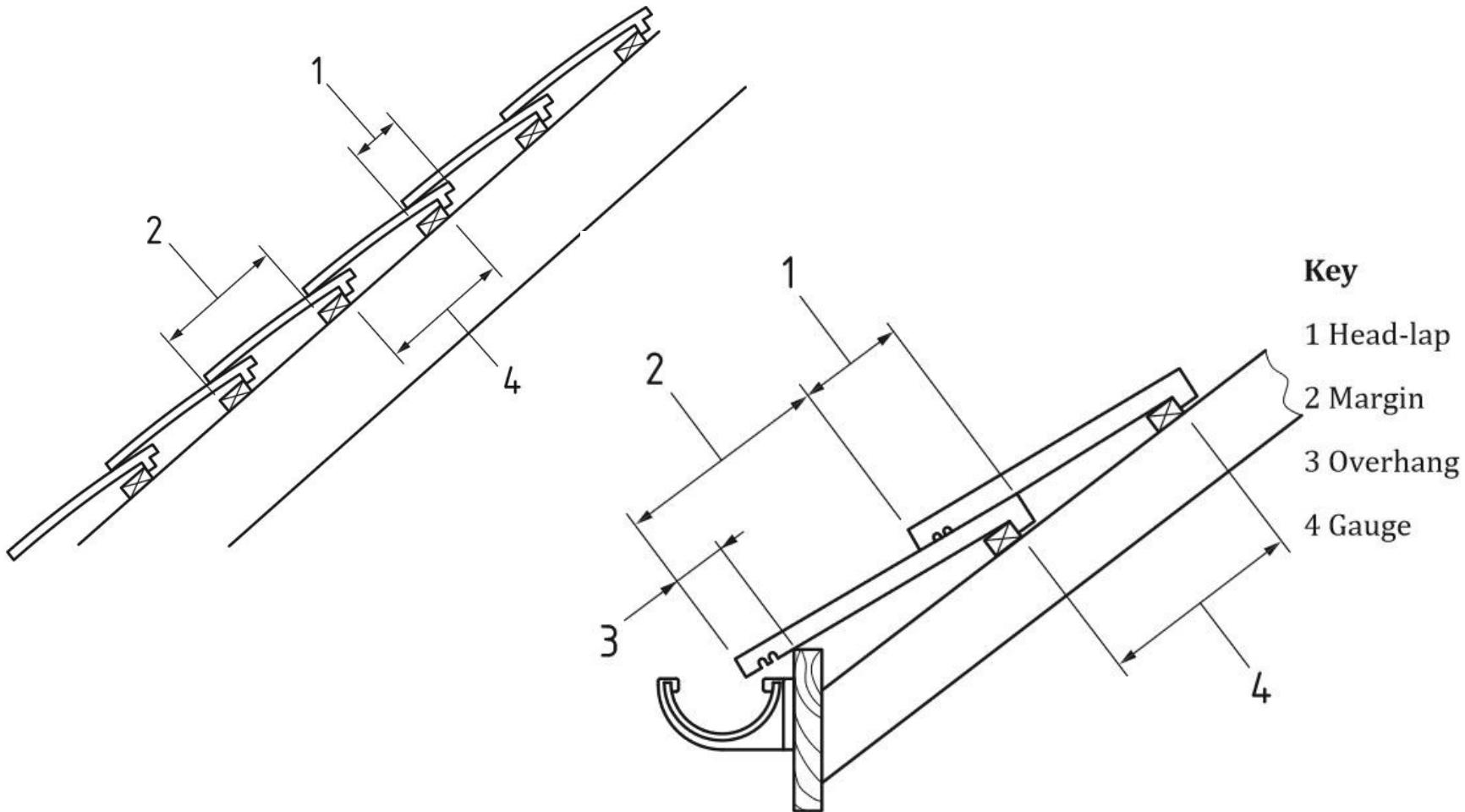


- Less than 12.5, interlocked tiles
- Bigger pitch, tiles hooked over battens, and nailed every 4th row



Single lap, flat tiles

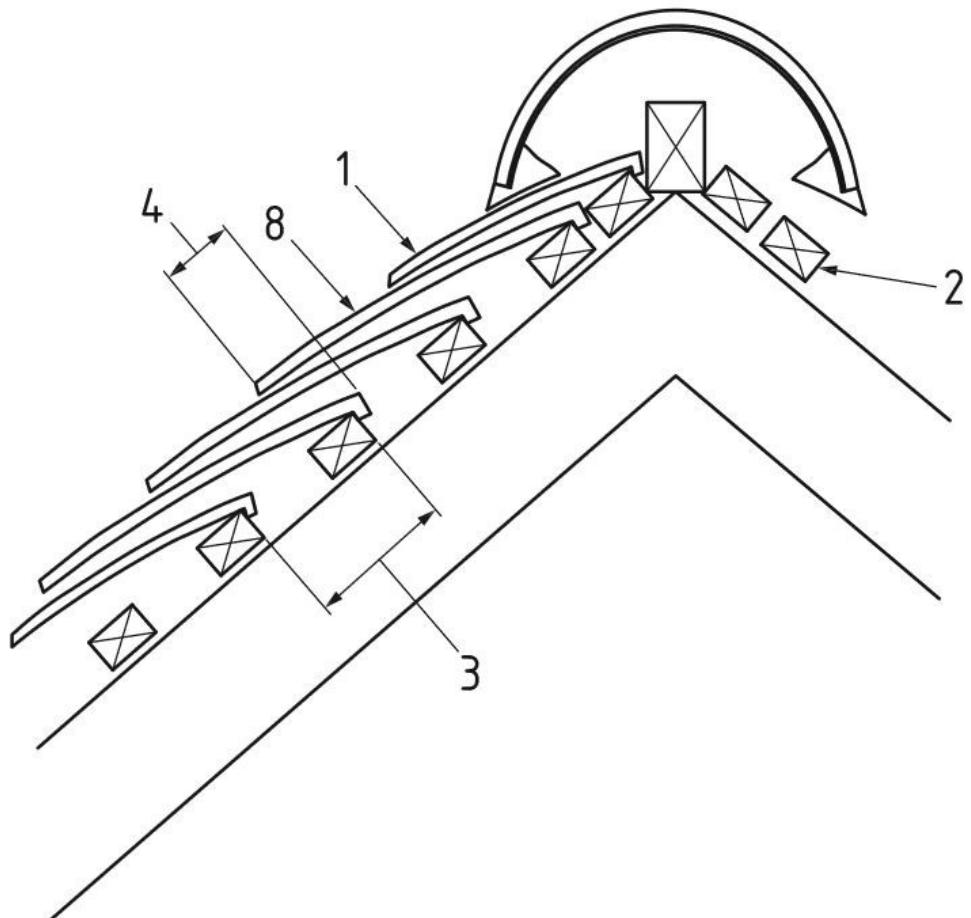
(BS 5534:2014+A2:2018)





Double lap, flat tiles

(BS 5534:2014+A2:2018)



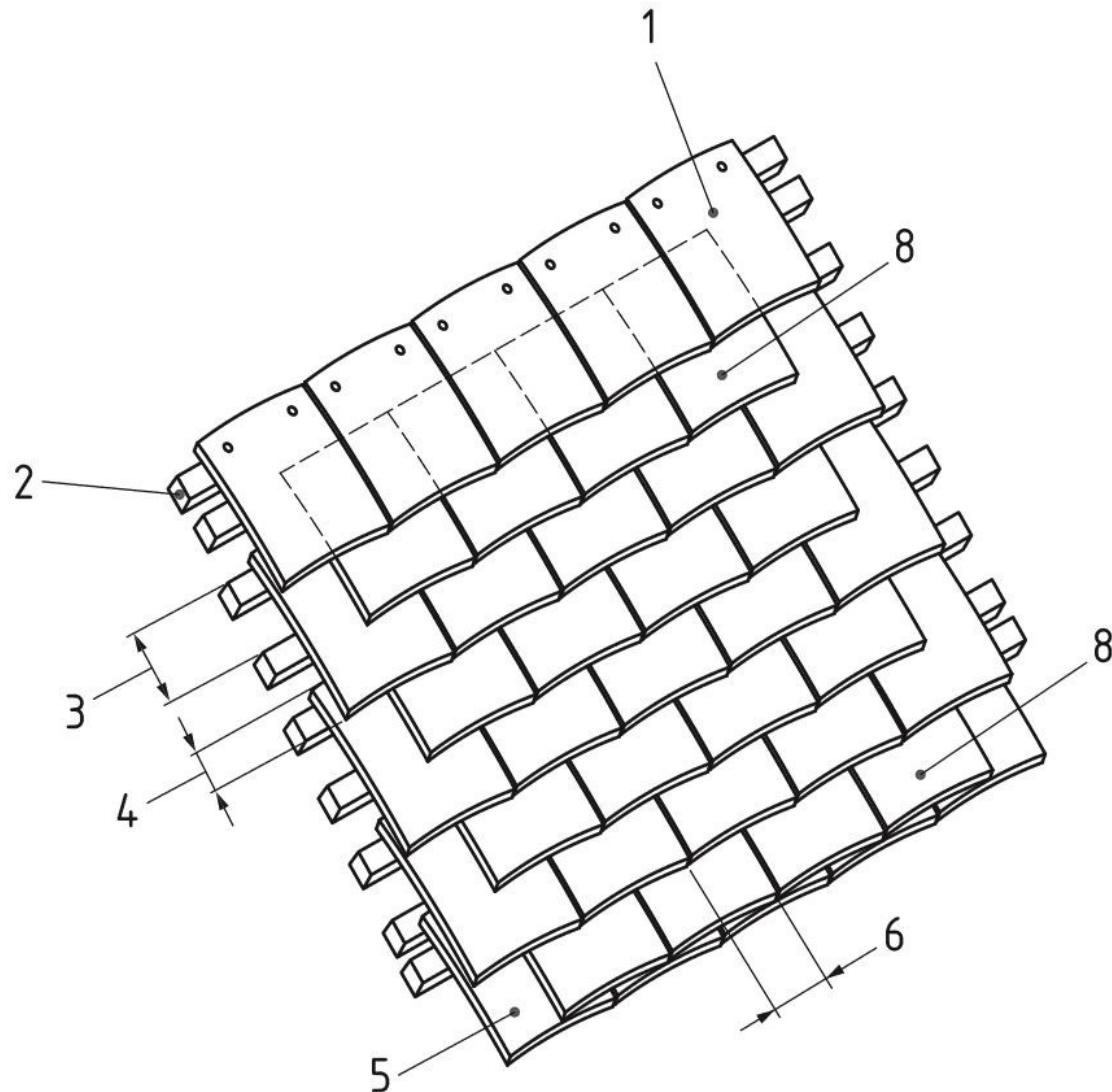
Key

- | | |
|---|-------------------------|
| 1 | Top course tiles |
| 2 | Tile battens |
| 3 | Batten/tile gauge |
| 4 | Tile head-lap |
| 5 | Eaves course tiles |
| 6 | Side-lap |
| 7 | Area of spread of water |
| 8 | Standard tiles |



Double lap, flat tiles

(BS 5534:2014+A2:2018)

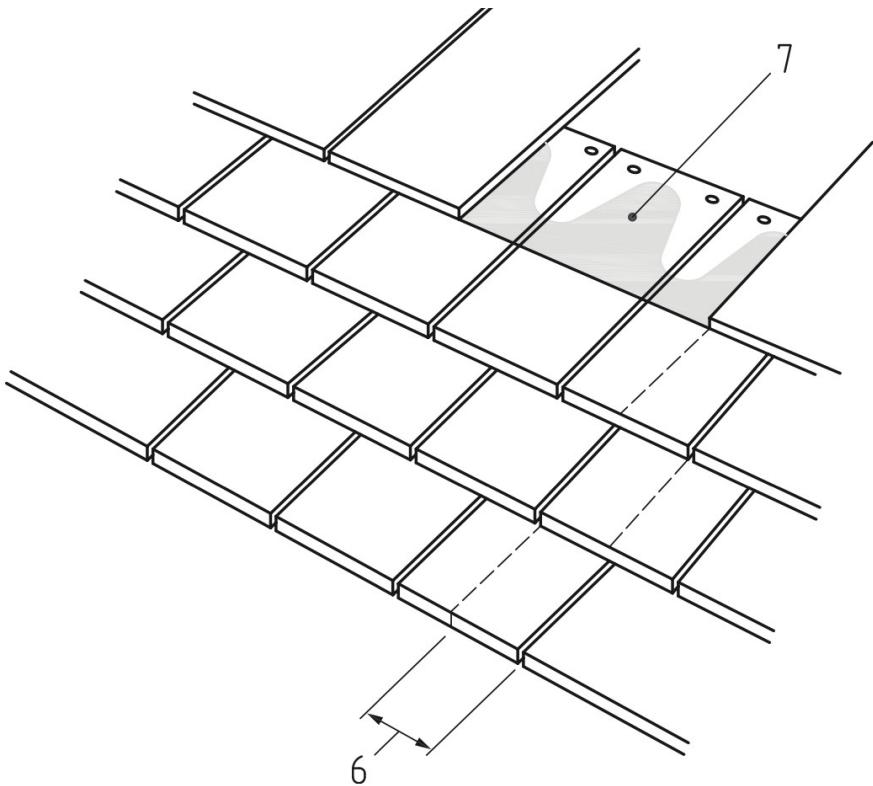


Key

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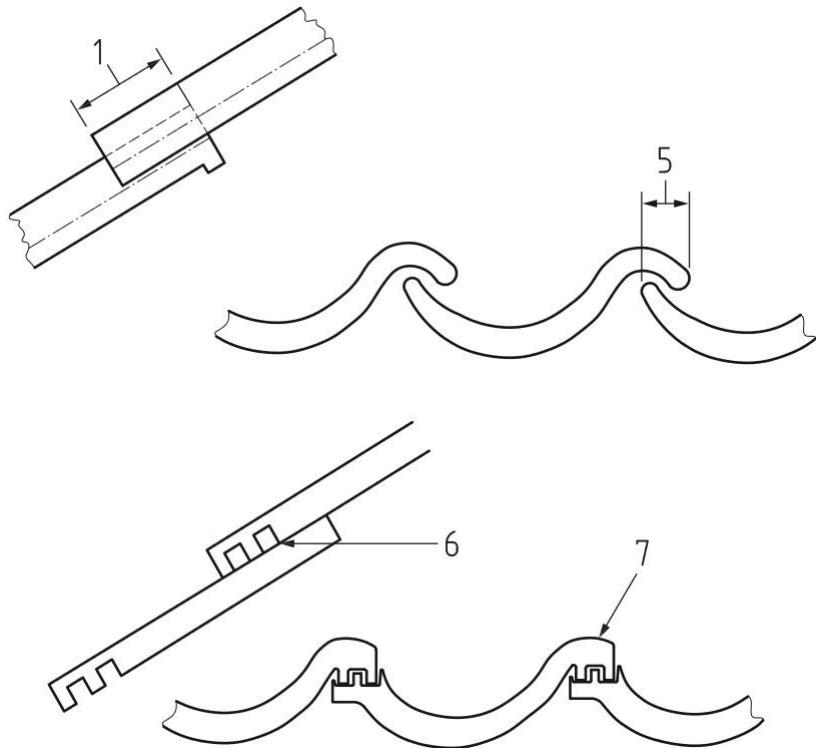
Side laps



6 Side-lap

7 Area of spread of water

(BS 5534:2014+A2:2018)



5 Overlapping side-lap

6 Anti-capillary bars

7 Side interlock



TRADITIONAL SLATES SIZE IN INCHES - LENGTH x WIDTH

EMPERESS	26 x 16	VISCOUNTESS	18 x 9
PRINCESS	24 x 14	WIDE LADY	16 x 10
DUCHESS	24 x 12	BROAD LADY	16 x 9
SMALL DUCHESS	22 x 12	LADY	16 x 8
MARCHIONESS	22 x 11	WIDE HEADER	14 x 12
BROAD COUNTESS	20 x 12	HEADER	14 x 10
COUNTESS	20 x 10	SMALL LADY	14 x 8
SMALL COUNTESS	18 x 10	NARROW LADY	14 x 7



Detailing and supplementary guidance from manufacturers.





Profile sheets

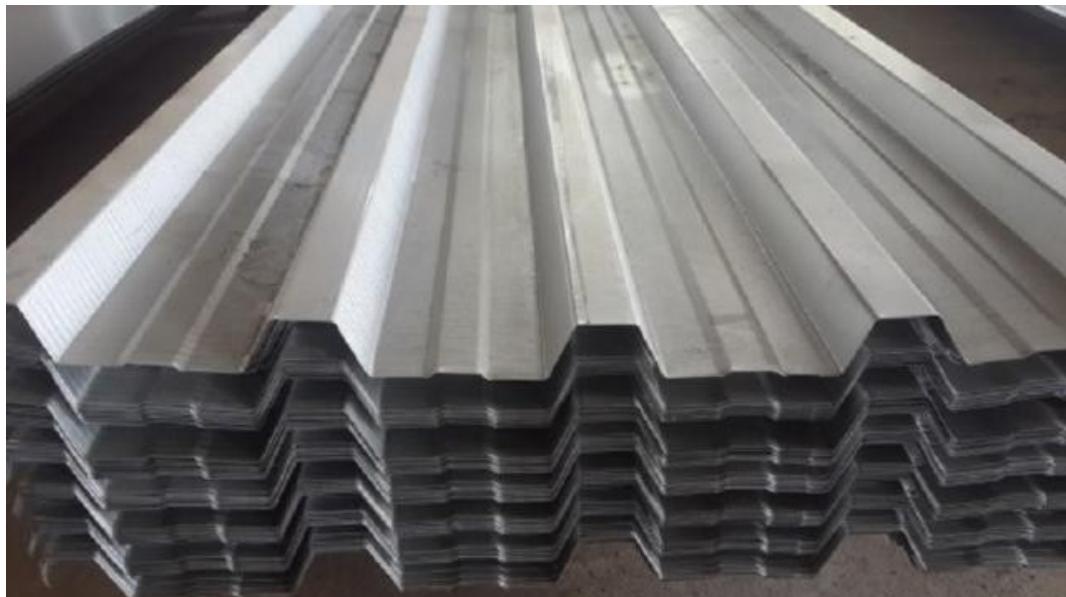
Corrugated steel (iron)





Profile sheets

Box section - plain & Insulated





Profile sheets

Plastic, steel or composite replicating tiles or slates





Solar roofing tiles





Any questions?



Exercise

Design the following elements of a pitched roof:

- Structure frame (5m span)
- Eave
- Valley
- Encounter with a chimney
- How do you insulate the roof?

ROOF CONSTRUCTION

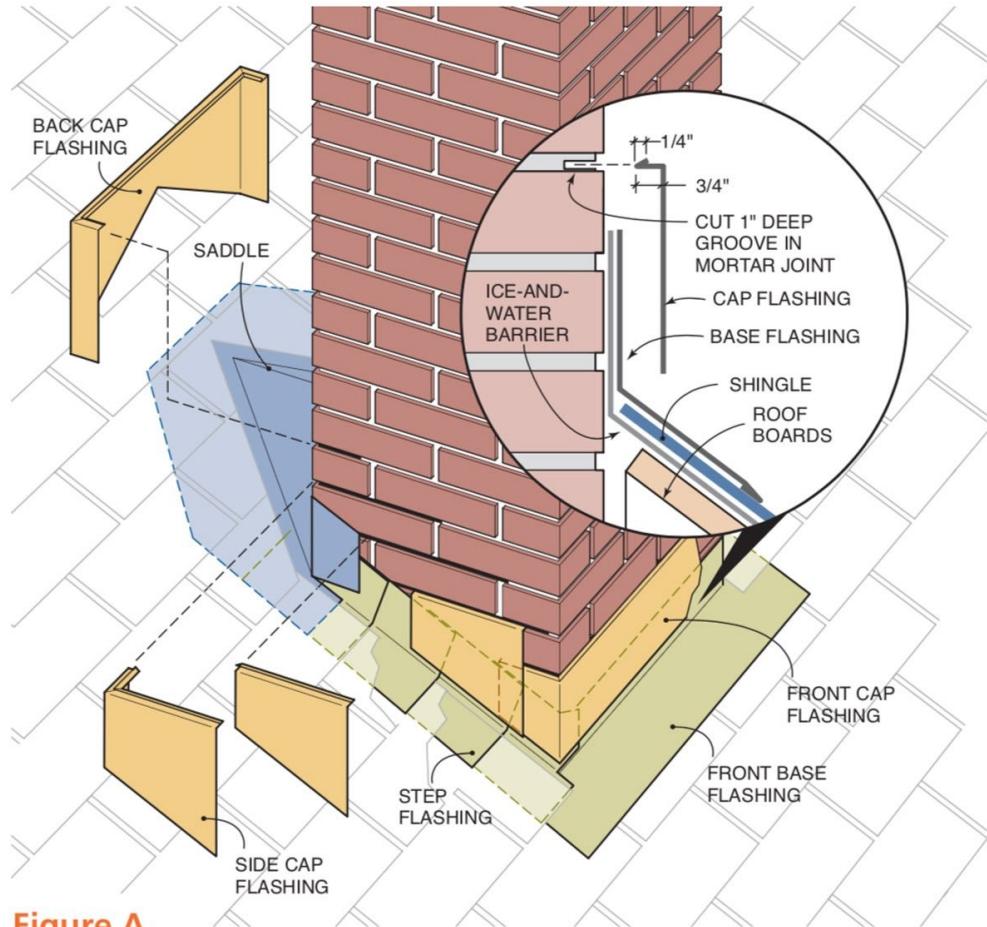
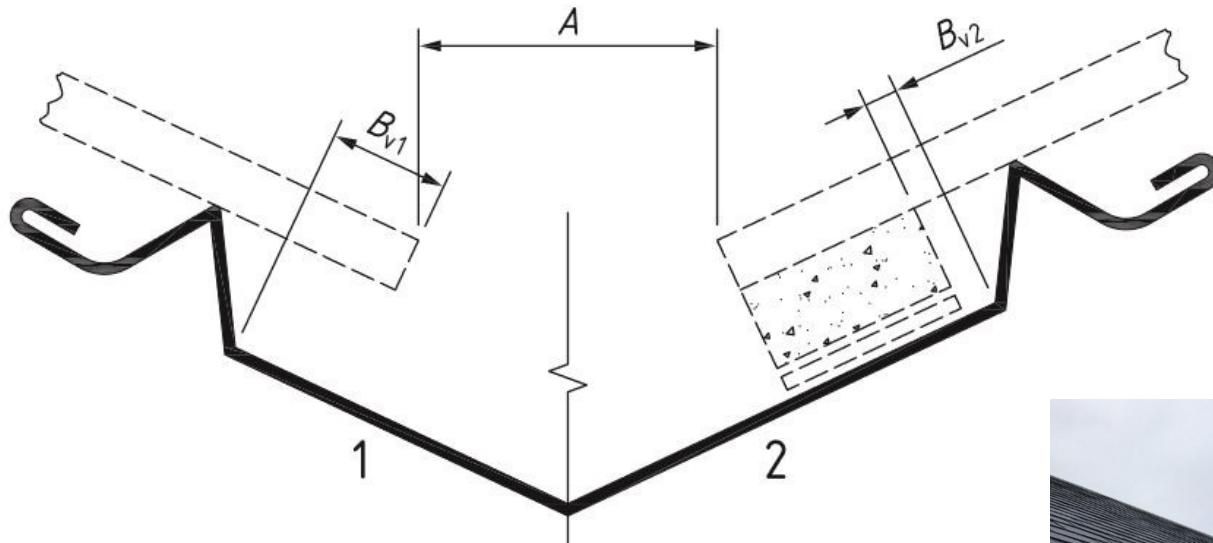


Figure A

Chimney flashing details



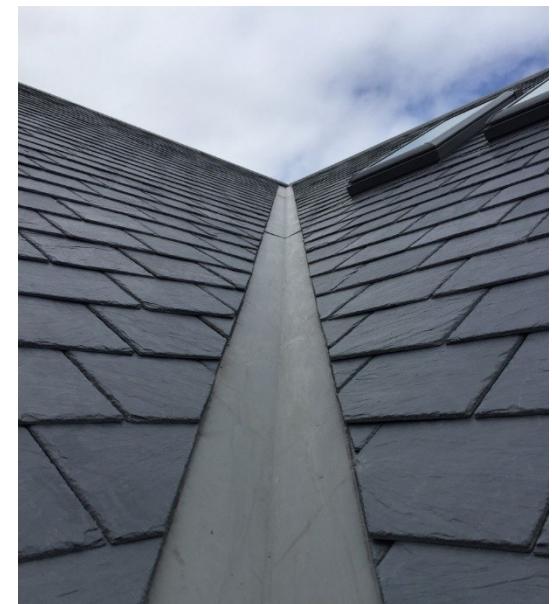


Key

A Valley gutter width

B_{v1} Tile/slate overhang to the tilting fillet to be not less than 50 mm

B_{v2} Clear channel between bedding and tilting fillet to be not less than 25 mm





Minimum gutter valley width (BS 5534:2014+A2:2018)

Roof pitch	Valley gutter width (A) ^{A)}					
	Design rainfall rate 225 mm/h		Design rainfall rate 150 mm/h		Design rainfall rate 75 mm/h	
	$X_d \leq 25$ m ² on plan ^{B)}	$X_d > 25$ m ² , ≤ 100 m ² on plan ^{C)}	$X_d \leq 25$ m ² on plan ^{B)}	$X_d > 25$ m ² , ≤ 100 m ² on plan ^{C)}	$X_d \leq 25$ m ² on plan ^{B)}	$X_d > 25$ m ² , ≤ 100 m ² on plan ^{C)}
degrees (°)	mm	mm	mm	mm	mm	mm
12.5 to 17	150	250	125	200	125	150
17.5 to 22	125	200	125	150	100	125
22.5 to 29	100	150	100	125	100	100
30 to 34	100	125	100	100	100	100
≥35	100	100	100	100	100	100

NOTE See also NFRC Technical Bulletin 28 [12].

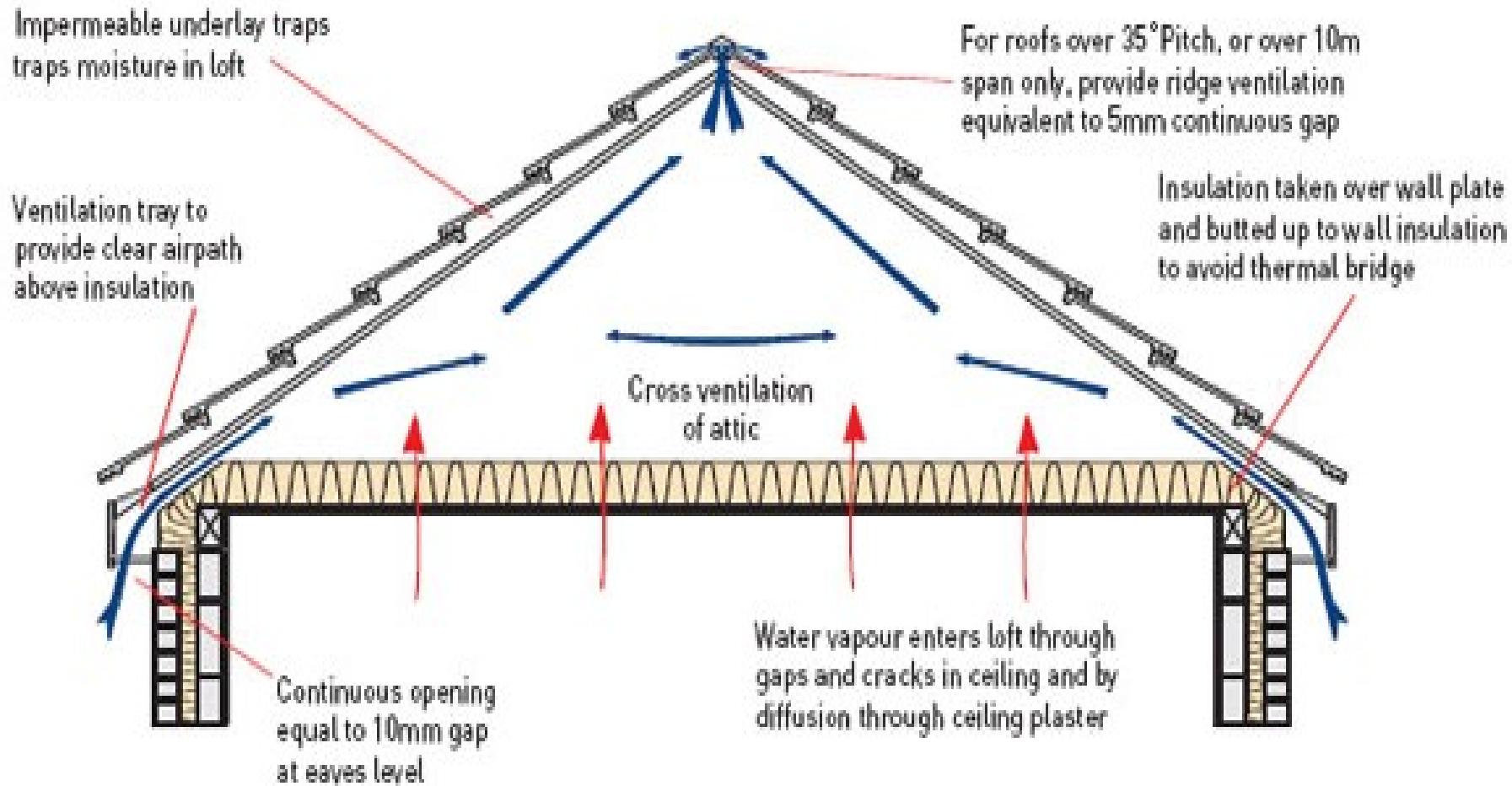
^{A)} Dimension A (see [Figure 7](#)) is measured as a horizontal distance between the tiles or slates in metres.

^{B)} See [6.13.2b\)](#).

^{C)} See [6.13.2c\)](#).

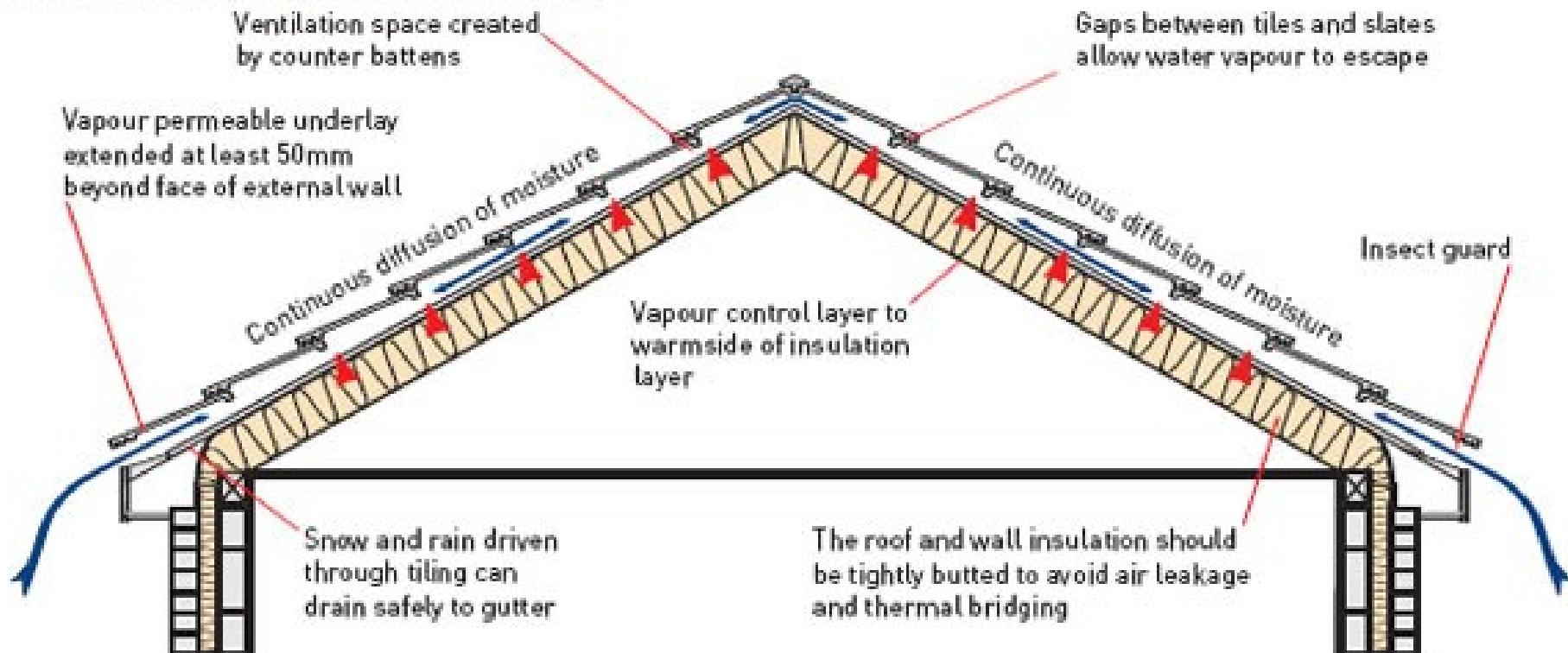


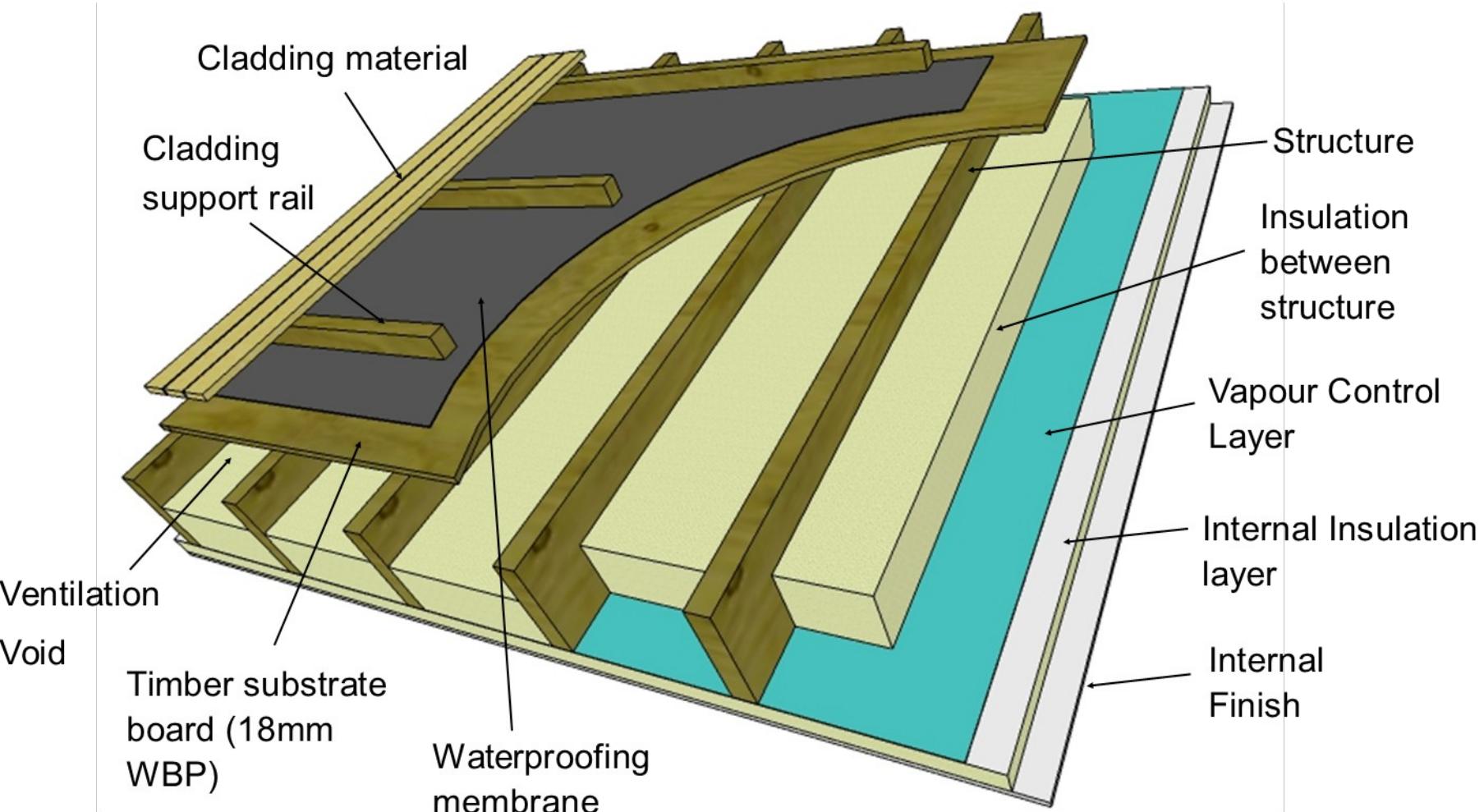
Cold Roof detail (ventilated)



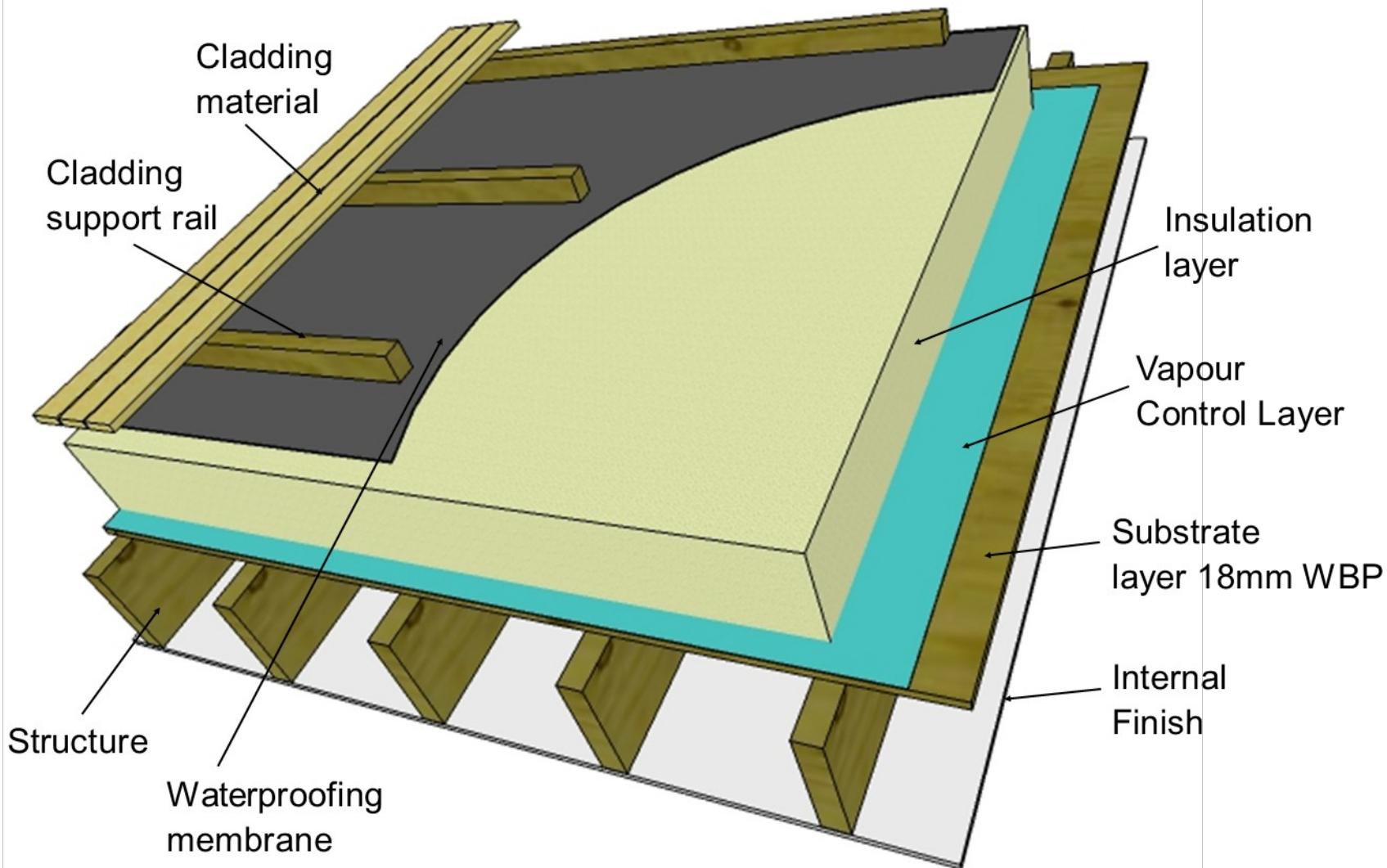


Warm Roof detail (with permable membrane)





ROOF CONSTRUCTION



ROOF CONSTRUCTION



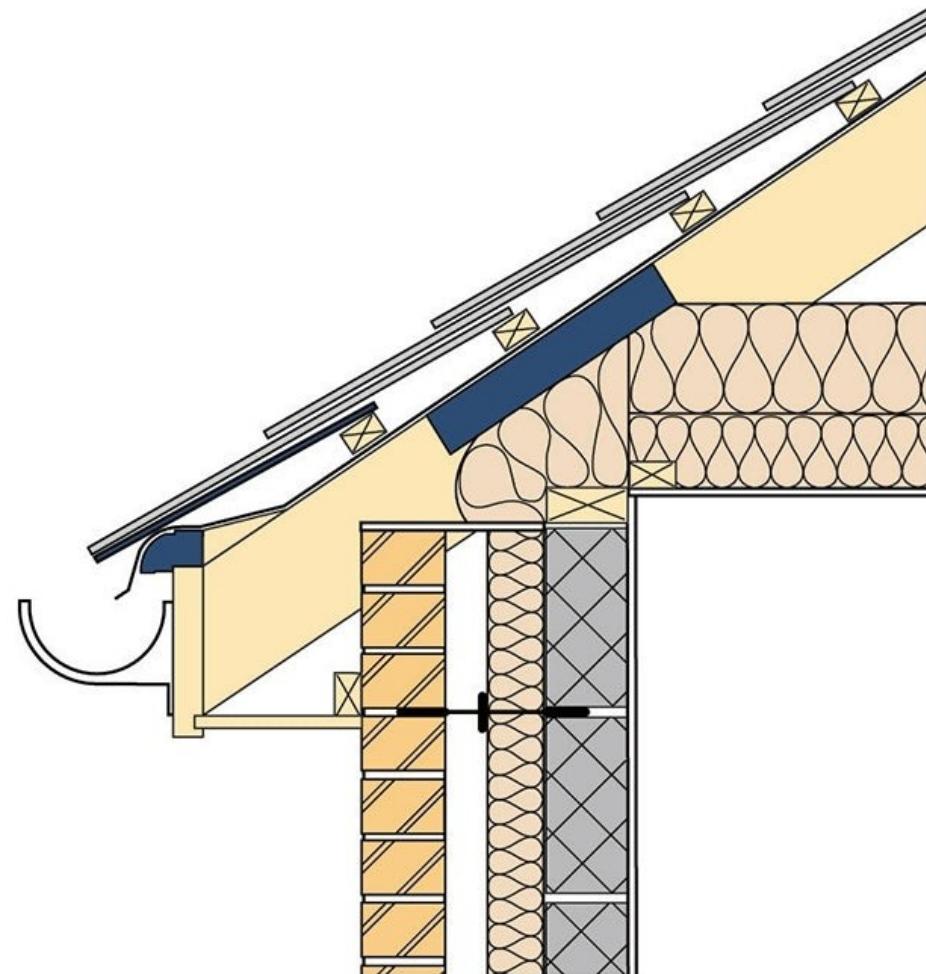
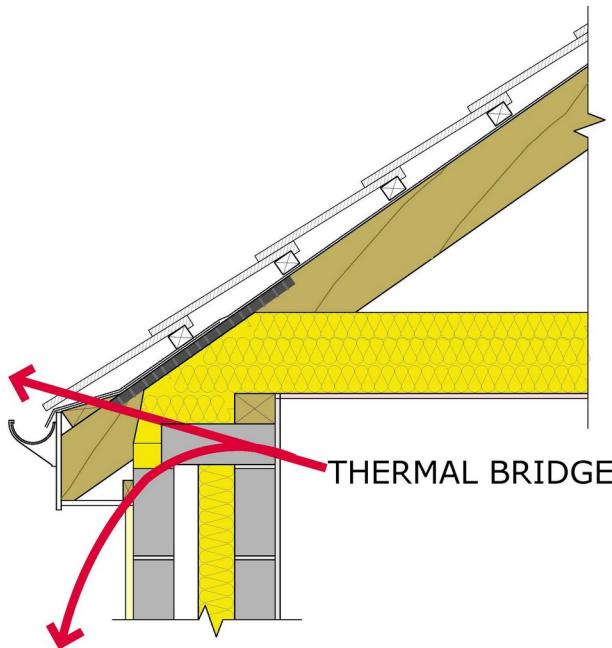
ROOF CONSTRUCTION



ROOF CONSTRUCTION



ROOF CONSTRUCTION





Any questions?



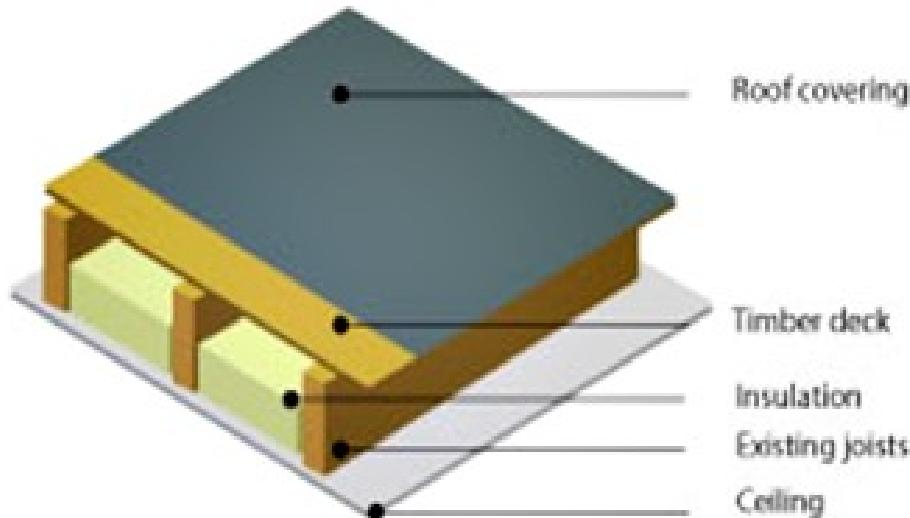
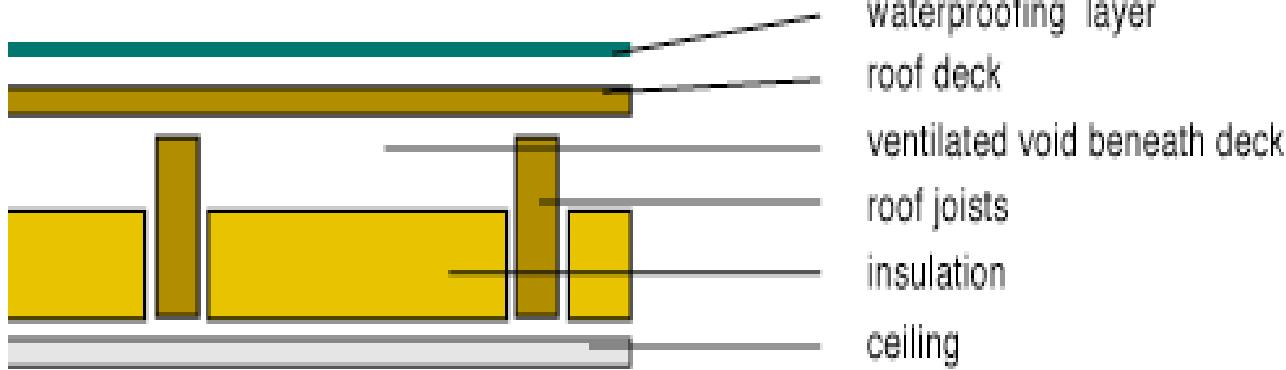
FLAT ROOFS

Characteristics

- Having a pitch below 10°
- Continuous covering
- Asphalt, fibre glass = 1:80 12mm/m
- Built up 3-layer felt, ruberoid felt = 1:60 17mm/m
- Minimum falls – if more than one fall (creating a valley) then the fall should be doubled



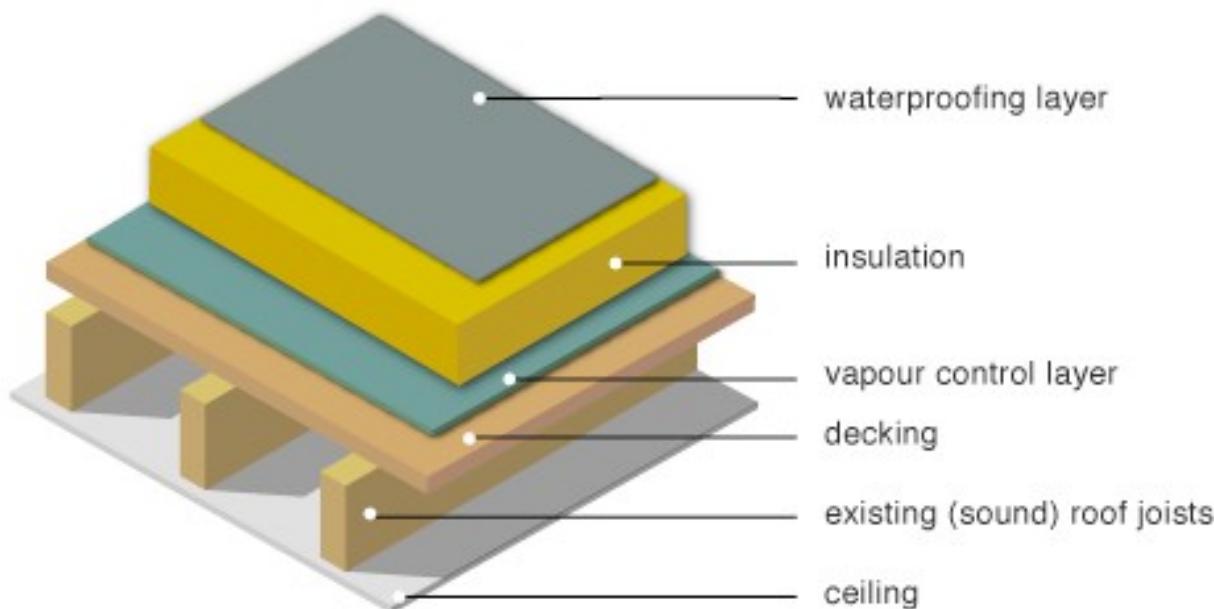
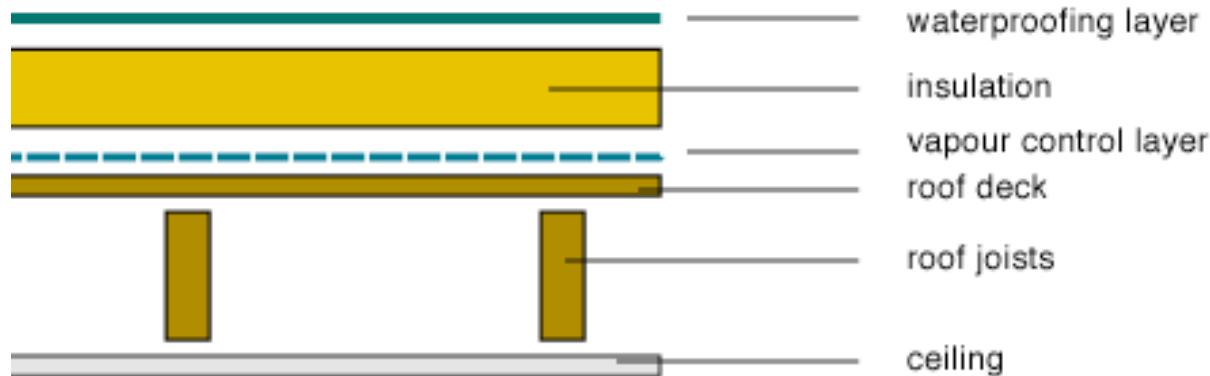
Cold Deck roof



Structural elements are not protected
Ventilation is required above the insulation
Not recommended today
Banned in Scotland

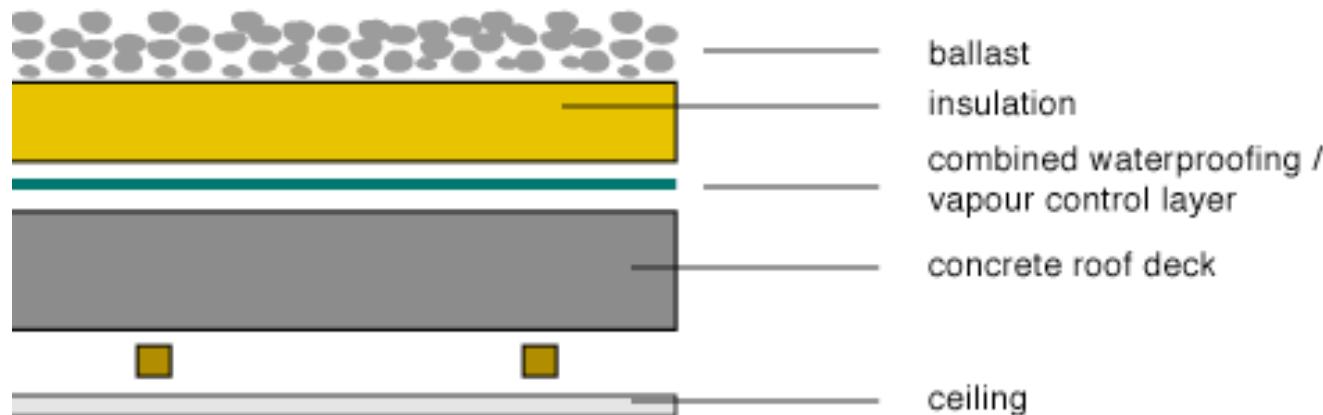
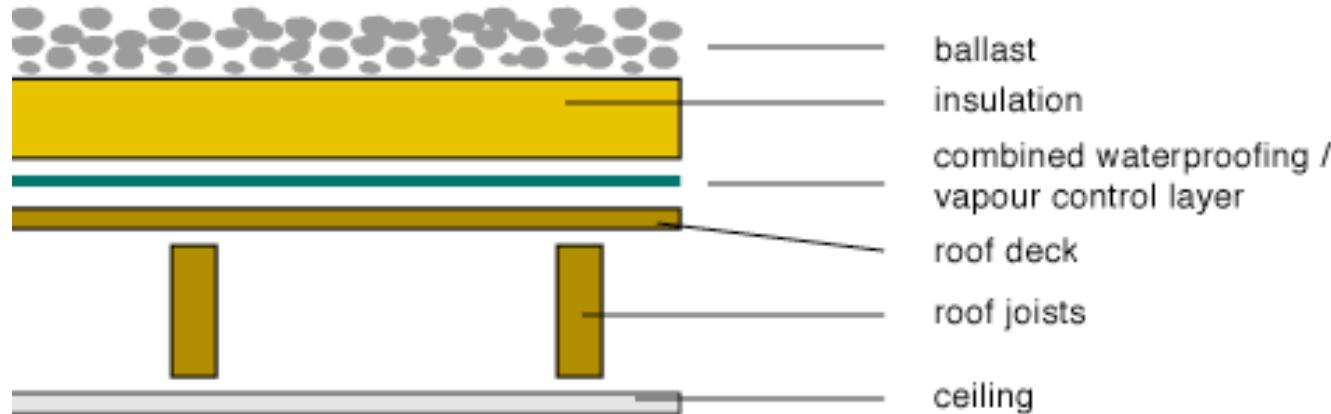


Warm Deck roof





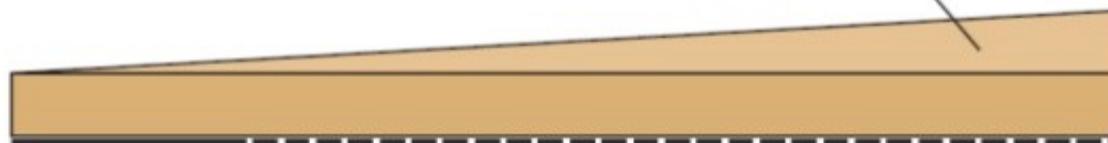
Inverted (upside down) roof



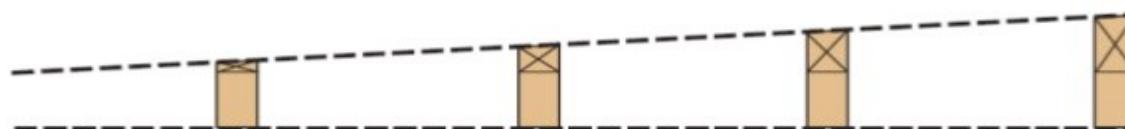


Creating the slope on a timber flat roof

Tapered furring pieces



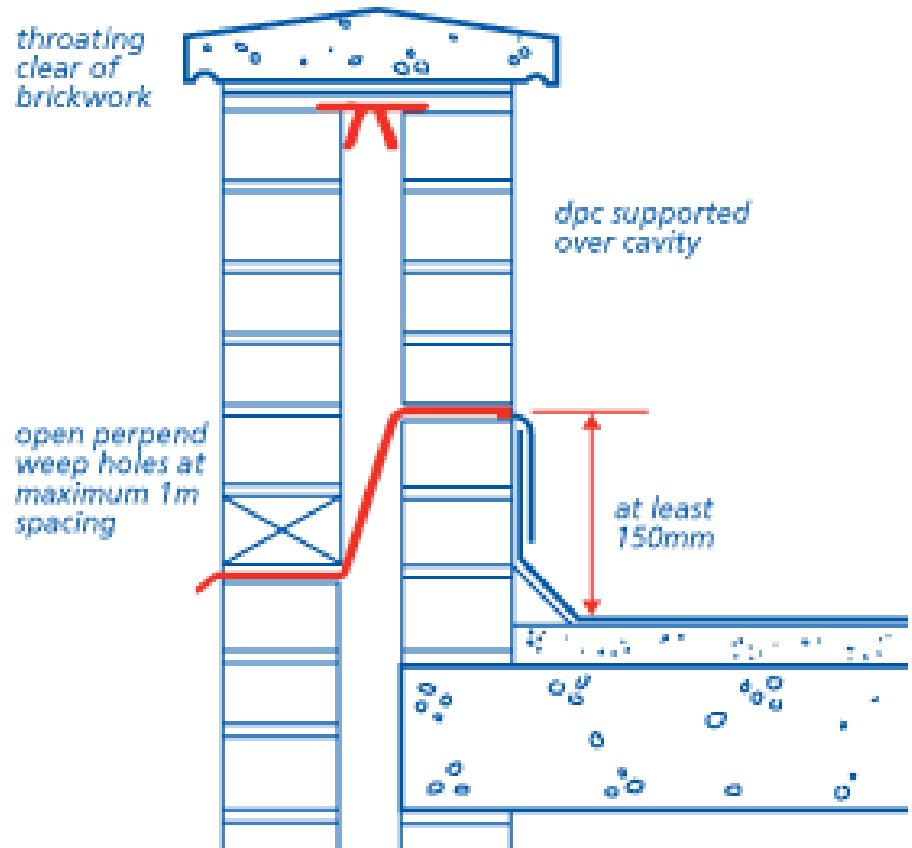
Parallel furring pieces







- **Abutment details:**
- Twice weathered Concrete Coping
- DPC below coping
- Cavity tray
- Weep holes @ 1m c-c
- 50mm angle fillet
- Code 3 lead flashing built into mortar joint
- Lead upstand flashing
- 3-layer felt dressed up masonry
- Screed to concrete roof @ 1:60 minimum fall





Building Regulations Approved Document H

- Water should drain to one or two edges
- There must be a slope of 1:80
- Waterproofing should extend up the adjacent walls at least 150mm from the roof surface
- Cold roofs must have ventilation
- Warm roofs must have a vapour control layer bonded to the deck
- Roofs must be wind resistant and strong enough to walk on



Any questions?