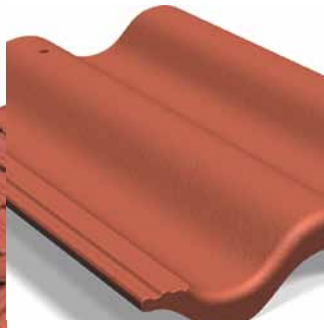
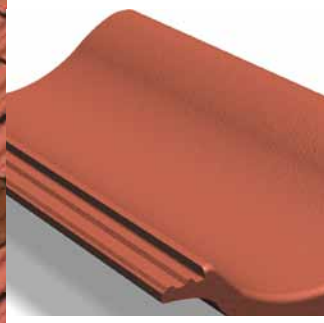
BENDERS ROOF

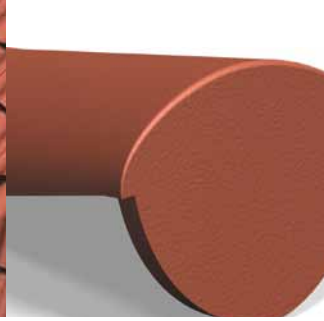
TILE INSTALLATION

1- AND 2-BARRELLED CONCRETE TILE,

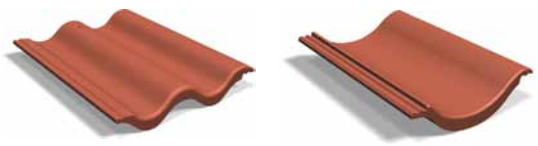
ACCORDING TO SWEDISH REGULATION







For roofers or for you who install the roof yourself



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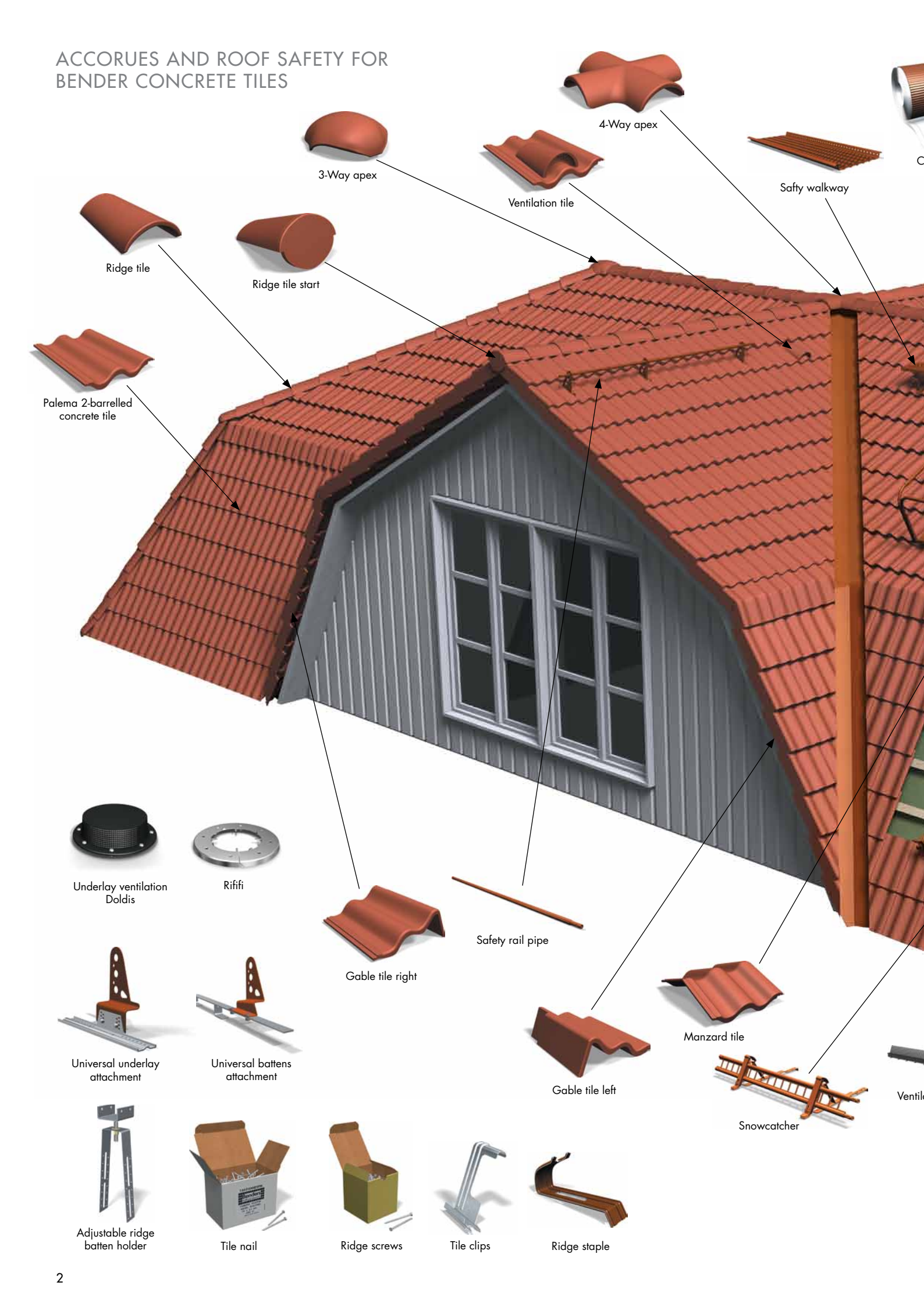
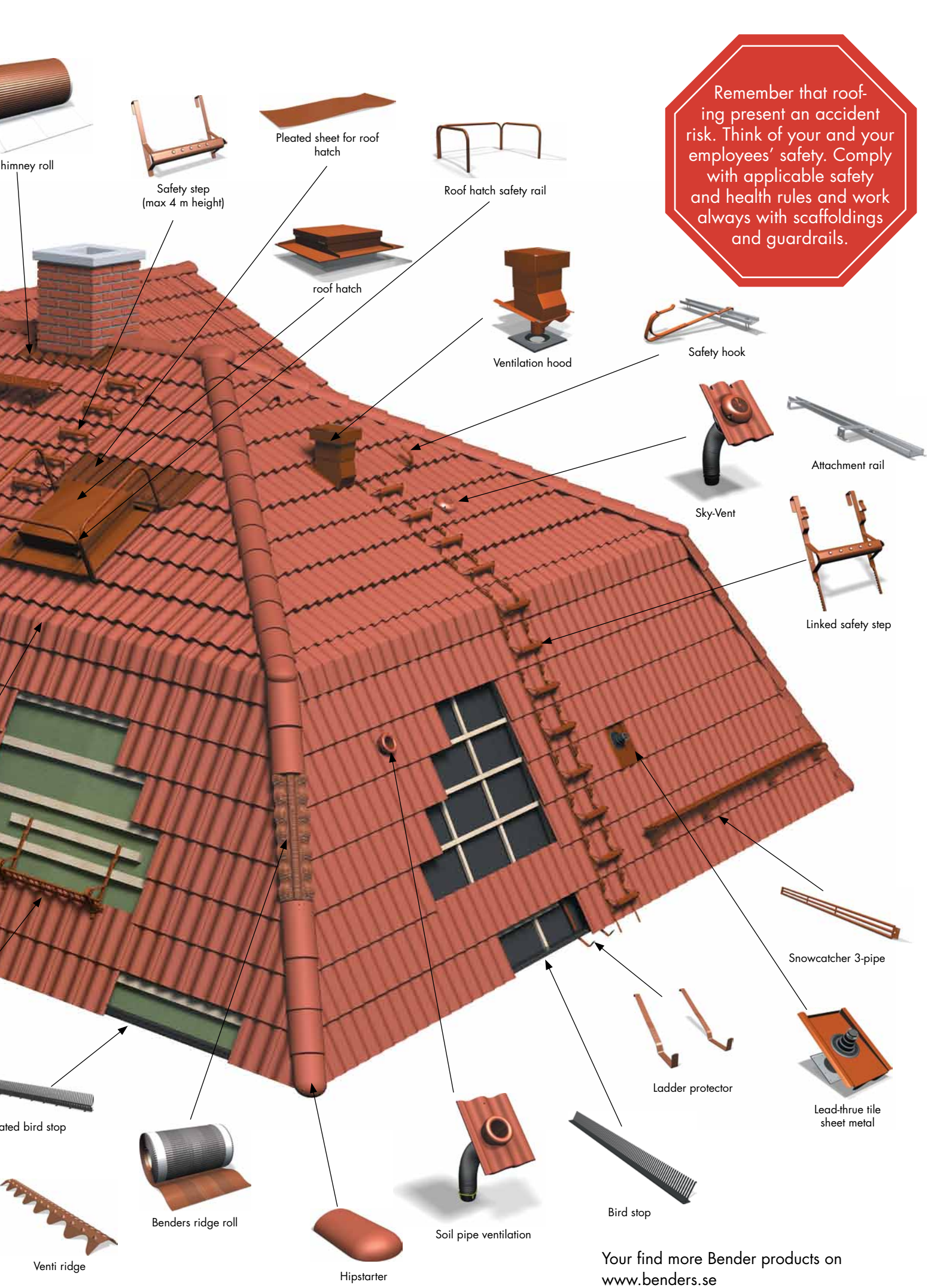
ACCORUES AND ROOF SAFETY FOR BENDER CONCRETE TILES





Remember that roofing present an accident risk. Think of your and your employees' safety. Comply with applicable safety and health rules and work always with scaffoldings and guardrails.

Your find more Bender products on www.benders.se

Benders Palema two-barrelled concrete roof tiles are easy to install. Choose a sunny day and a helpful neighbour and your new roof will be installed within a day. The tools required are a hammer, a saw and a folding rule.
If your roof has angles and valleys you will sometimes have to cut the tiles to make them fit properly. Simply use a circular saw with a diamond blade to easily cut through the solid concrete tiles.

IS BENDERS PALEMA YOUR CHOICE?

The angle of the roof can sometimes determine what type of roofing material you should go with. Benders roof tiles can be installed on surfaces with a pitch down to 14°.
Follow these steps to calculate the roof pitch in degrees: Measure out a 100 cm horizontal distance of the house's gable. Then measure the orthogonal distance in centimeters from leg end points up to the ceiling, see Figure 1. Subtract the smaller number (B) from the larger number (A), e.g. 157-112 = 45 cm, which gives you how much the roof rises per meter, See Table 1 in order to obtain the degree: 45 cm = 24° roof pitch.

PREPARATIONS

We presume that some preparatory work has been made before following steps in this installation manual are initiated:

- Before installing new roof tiles on an older house, you should thoroughly and carefully inspect the roof – both internally and outwardly – to make sure there is no leakage, moisture or mold. Take an extra look on the ridge area and ventilation entries. The deck/ underlay and battens should be in good condition.
- A newly constructed house should have a finished and approved underlay.
- Any plates, metal sheets or chimney crickets should be installed.
- Paperboard quality should be at least YAP 2200. If the roof pitch is below 22° the paperboard must be seam glued.
- An anti-ponding board should not be used on roof pitches below 22°.

START WITH THE COUNTER BATTENS

The counter battens are placed vertically from the eave to the ridge; the recommended dimensions are 25 x 38 mm (+/-2mm), with a minimum of 25 x 25 mm (+/-2 mm). Attach one counter batten on every rafter;

Figure 1. Subtract measured number (B) from measured number (A) to get the roof pitch, See table 1.

Table 1. Roof pitch

Heaving in cm	Roof pitch (°)	Heaving in cm	Roof pitch (°)
25	14	75	37
30	17	78	38
36	20	84	40
40	22	90	42
45	24	100	45
49	26	104	46
53	28	111	48
58	30	119	50
62	32	133	53
67	34	143	55
73	36	173	60

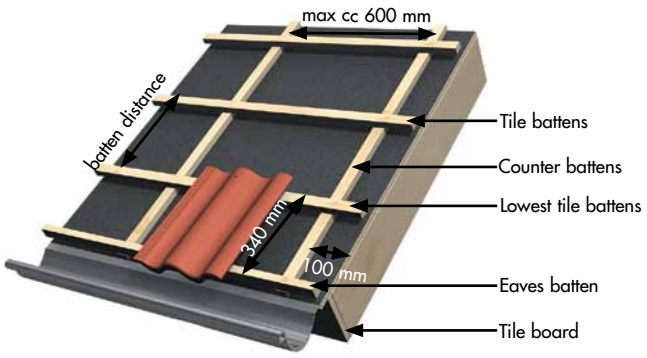


Figure 2. The batten distance is measured from top edge to top edge. Note that the distance from the eaves batten edge to the eaves battens top edge should not exceed 340 mm. Also note that the eaves batten should be 20 mm wider than the rest of the tile battens, as the lower tiles do not rest on other tiles (does not apply on ventilating birdstops).

Figure 3. The distance between the ridge batten and the upper tile batten should be around 30 mm. Make sure that the ridge tiles covers the nail holes on the upper tiles.

Table 2. Höjd nockbräda i mm (räknat från undertakets spets)

Roof pitch(°)	Ridge tile		Bevelled ridge	
	2-barrell	1-barrell	2-barrell	1-barrell
14	125	125	145	150
18	110	120	140	145
22	105	115	130	135
27	100	110	125	130
35	85	105	95	110
45	80	100	75	95

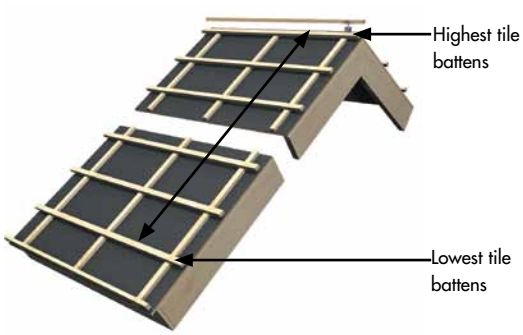


Figure 4. Use the distance between the upper and lower battens to calculate the correct batten distances.

Table 3.	**2-barrelled**		**1-barrelled**	
Roof pitch (°)	**Batten** distance (mm) 2-bar	**Numbers of tiles** (m^2) 2-bar	**Batten** distance (mm) 2-bar	**Numbers of tiles** (m^2) 1-bar
22 –	375	8,9	375	10,7
	370	9,0	370	10,8
	365	9,2	365	11,0
	360	9,3	360	11,1
	355	9,4	355	11,3
	350	9,6	350	11,5
	345	9,7	345	11,6
18 – 21	340	9,8	340	11,8
	335	10,0	335	12,0
	330	10,1	330	12,2
	325	10,3	325	12,3
14 – 17	320	10,4	320	12,4
	310	10,8	310	12,8

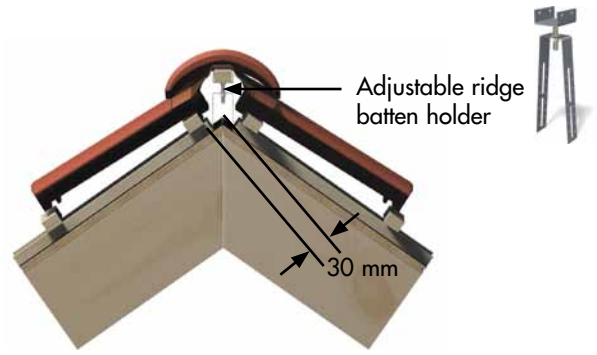


Figure 5. The counter battens are omitted entirely when use of roof board.

thereafter add another between them. Recommended maximum distance between counter battens is 600 mm cc (center to center), See Figure 2. Only nail the ends of each counter batten at start. Nail the rest as you attach the horizontal battens, See Figure 2. The counter batten closest to the gable should be nailed about 100 mm from the edge, See Figure 2**.**

CONTINUE WITH THE TILE BATTENS

The tile battens should be placed horizontally over the counter battens. The minimum distance for Benders roof tiles is 310 mm, and maximum is 375 mm. If the roof has a pitch lower then 22° you will be required to use a shorter distance between battens. In those cases we recommend 310 – 340 mm, See Table 3. A shorter distance between tile battens is also recommended in areas with tough weather conditions - this applies to both our one-barrelled and two-barrelled roof tiles. The dimensions of each batten should be 25 x 38 mm (+/-2). If use of 'Simple underlay', see 'Simple underlay', the batten dimension should be 45 x 70 mm (+/-2 mm) if the rafters are 1200 c/c.

EAVES BATTEN

Step one is to attach the eaves batten to the eave, See Figure 2. The eaves batten should be 20 mm higher then the rest of the horizontal battens in order to keep the pitch at the lowest row of tiles at the same degree as the rest of the roof.

Then apply a tile at the eave to try out where the next horizontal batten should be placed. This is a way to secure the ultimate water coverage and flow away of water to the gutter. If you do not have a tile at your disposal, a distance of 340 mm from the bottom of the eaves batten to the bottom of the tile batten is recommended, See Figure 2. This is a great and universal way of measuring that works on every roof. Measure and attach the eaves batten.

TOP TILE BATTEN

Continue at the top of the roof by attaching the top tile batten 30 mm from the ridge, See Figure 4 and 5. Use a tile to make sure that the tiles lugs fit between the top tile batten and the ridge batten. Use of Benders adjustable ridge batten racket eliminates the risk of the lugs not fitting properly between the battens, See Figure 5. Apply a ridge tile in order to make sure that the ridge tile covers the nail holes on the top row tiles on each side of the roof. If the underlay is constructed before the tiles are delivered, only nail the top tile batten definitely. This leaves you the opportunity to make adjustments, if necessary, as you install the tiles.

BATTEN DISTANCE

As the eaves batten and ridge batten are in place, the next step is to measure the distance between the battens from top edge to top edge, See Figure 4. Divide the measured distance with the maximum batten distance for the given pitch in order to receive the amount of tile rows. Example: The distance between eaves batten and ridge batten = 4700 mm with a roof pitch of 18°. At a pitch of 18° the batten distance is maximized at 340 mm, See table 3. 4700 / 340 = 13,8 which gives you 14 rows while rounding up = 4700 / 14 = 335 mm in batten distance. Then place and attach the counter and tile battens.

RIDGE TRY-OUT

A universal and good way to get the preferred height of the ridge batten – which should be about 34 mm wide – is to simply apply a couple of tiles on each side of the ridge and then add a ridge tile, See Table 2 and Figure 3. Ultimately, the ridge should rest on both the ridge and the tiles. The ridge tile should not rest solely on the ridge batten. Do not nail any tiles just yet. Remove the tiles after this try-out. If you are in a lack of tiles, Use Table 2. This procedure helps you avoid having to make adjustments to the ridge batten (e.g. planing) after the roof has been installed.

Use Benders adjustable ridge batten holder in order to ensure that the ridge is always straight and at a desired height. When use of our adjustable ridge batten holder the dimensions of the ridge batten should be 45x45.

SIMPLE UNDERLAY

Roof board is a simpler alternative to paperboard and T & G. The tile battens are installed continuously with the roofing felt; this makes is possible to use the tile battens as foothold during installation. The simpler underlays can be constructed in various different ways. Roof boards or insulation sheets can be installed with a slight sag between the rafters and the tile battens should be attached directly to the rafters. When stretching the insulation sheets over the rafters, the counter battens (25x38mm) should be nailed to the rafter and be placed between the sheets and the tile battens. Carefully follow the manufacturer's instructions! At a rafter distance of 800-1200 mm the tile battens should be planed and have a dimension of 45x70 mm (+/- 2mm). The counter battens should range over at least 3 rafters. Use the same batten distances as recommended for paperboard and T & G.

Larger ceiling ducts should be prepared with lintels. Preferably use prefabricated ducts with impermeability to water and moist. Use Benders custom solutions for ducts used for soil and kitchen ventilation. To ensure

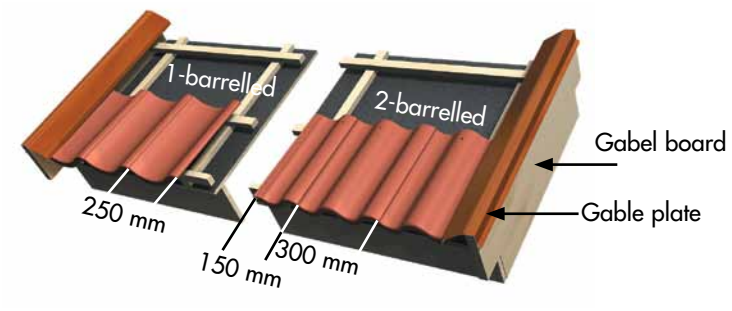


Figure 6. Calculate the roofs width in tiles. Note that the last tile, closest to the gable, should have a width of 300 mm.

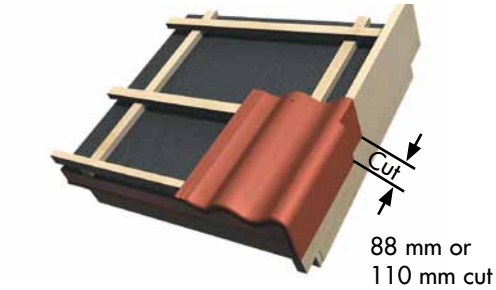


Figure 7. Benders gable tiles insulates extremely well. It also protects and prolongs the life span of the wooden gable board.

Figure 8. The clip is installed in a way that locks both tiles to the batten.

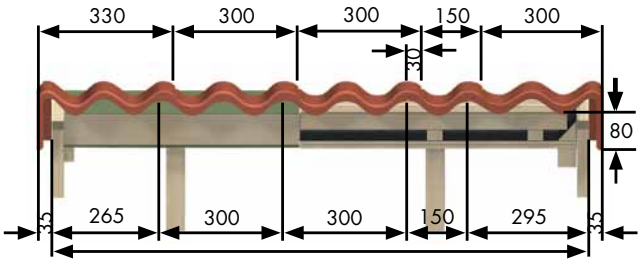


Figure 9. Calculate the gables. Get the exact measurement on our homepage, www.benders.se.

Figure 10. Construct from right to left and start by installing the entire lower row (=row closest to the eaves). Start from the right hand side and apply two to three tiles in a row all the way up to the ridge. Make sure that the rows are straight.

Figure 11. Nail all the highlighted tiles.

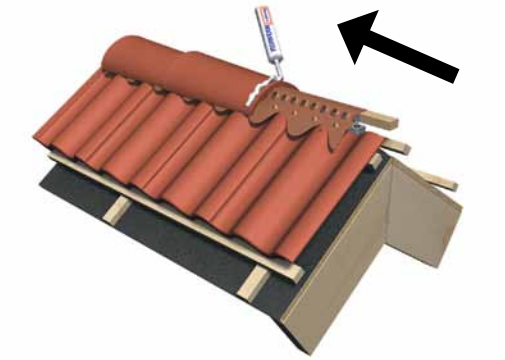


Figure 12. Insulation of a paperboard underlay with closed ridge. Benders Ventiridge is applied and attached in order to protect the ridge from precipitation. It also ventilates, this prevents the roof from rotting.

Figure 13. Benders ridge roll is easy to install. Attach the ridge roll to the ridge batten – by nailing or stapling. Remove the protective tape on the bottom of the roll and press to form the roll after the tiles.

good airflow and ventilation in the addict area use Benders aerator Doldis together with under fitting Rififi. Also, use Benders ridge roll to protect the roof from deteriorating forces of excess heat and moisture build-up.

CALCULATE THE AMOUNT OF TILES

Calculating the amount of tiles you will need to your roof is a easy and simple process. The number of tile battens, excluding the eaves batten, is the number of tiles you will need vertically. The amount of tiles horizontally is the total width of the roof divided by the width of the tile. 2-barrelled tiles are 300 mm wide, and 1-barrelled are 250 mm. Keep in mind that you also can use half tiles with a width of 150 mm to avoid having to cut tiles (only applies to 2-barrelled roof tiles) See Figure 6. Usage of gable flashing gives you the possibility to make small adjustment to the tiles placement horizontally. To correctly install the gable flashing, the flashings upper edge should be 75 mm above the tile battens top edge when installing 2-barrelled tiles. 100 mm with 1-barrelled. **If you, on the other hand, use gable tiles the width must be measured more precisely and have a batten distance of at least 335 mm, with a side lap of 88 mm. Request a separate table for exact measurement on gable tiles.**
Note: If nothing else is specified when ordering, the delivered gable tiles will have a side lap of 88 mm. 110 mm side lap is also available for batten distances down to 315 mm, See Figure 7.

TILE INSTALLAION

Always begin the tile installation in the lower right corner. Construct from right to left and start by installing the entire lower row (=row closest to the eaves). In some cases you will find it necessary to insert a half tile when installing 2-barrelled tiles.
Then construct upwards, See Figure 10. Start from the right-hand side and apply two to three tiles in a row all the way up to the ridge. Use a straightedge to get straight vertical rows. Continue until the whole roof is covered**.**

MIX FROM DIFFERENT PALLETS

When use of Benders Natural tiles without top coating, such as Antik or Flash, it is recommended that you mix tiles from different pallets in order to get the greatest results.

WHICH TILES TO NAIL

All of the brightly highlighted tiles, See Figure 11, should be nailed to the tile battens. Nail the two outer rows around the entire roof and the two rows placed

next to the larger ducts, chimney, skylights etc. Use Benders stainless steal nails, screws or clips. In areas with risk of extreme weather conditions, we recommend using clips (storm clips) in order to keep the 2-barrelled tiles in place, See Figure 8. Benders 1-berrelled tiles can only be attached with clips.
If the roof has a pitch over 45° and is located in an area with risk of strong winds, you will have to nail the tiles with a shorter frequency (every five tile). Nail every tile if the roof pitch exceeds 55°.

EFFECTIVE RIDGE INSULATION

It is very important that the underlay meets all requirement for ventilation. The ridge area is particularly vulnerable. It should be both insulated and ventilated. To ensure this, use Benders ridge seal. Also use Benders Ventiridge and Benders Ridgeroll. Ventiridge can only be installed on horizontal ridges and is only compatible with 2-barrelled roof tiles. Benders RidgeRoll can be used on hipped ridges and vertical ridges. Both systems are easy to install – just nail them to the ridge batten, See Figure 12 and 13.

ADD THE RIDGE TO CROWN IT ALL

The ridges should be attached with stainless steal nails or screws. We recommend you to use screws, as they are easier to work with.
If you have a hipped roof you should have a hipstarter at the eaves and a Y-apex at the point where the three ridges meet.
Place the ridges towards the most common wind direction in order to get the wind to move smoothly across the ridges. Apply a layer of Benders ridge seal, See Figure 12. Perform this along the entire ridge.
You can adjust the overlap slightly on every ridge to avoid having to cut the last ridge. In areas with risk of extreme weather conditions or if the roof is hipped, we recommend using ridge clips.

BIRDSTOP AT THE EAVES

Install Benders Birdstop at the eaves to ensure maximum protection. Birds nests under the tiles can in some cases cause rot to the underlay, See the illustrations at page 2-3.

PREFABRICATED SOLUTIONS FOR DUCTS AND PENETRATIONS

Benders offers a wide range of customized and prefabricated products for ducts and penetrations. Use Benders soil pipe ventilation, ventilation hoods and penetration solutions for good insulation and easy installation, See the illustrations at page 2-3.

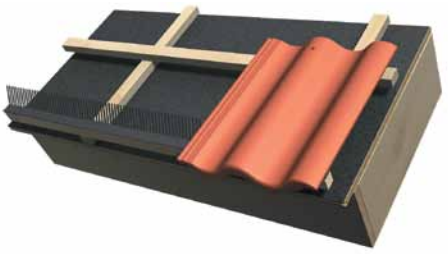


Figure 14. The birdstop is attached to the eaves. This prevents birds from nesting under the tiles. There are different kinds of birdstop – ventililating and non-ventilating.

Figure 15. By valleys, use half tiles to prevent the usage of too small pieces of tiles that can be difficult to attach and nail (only apply to 2-barrelled tiles). The half tile is highlighted in the figure. Mark the tiles on the roof – cut them on the ground – rinse the tiles with water directly after cutting!

Figure 16. In order to prevent damages to the valleys caused by sliding snow, install snow hooks. Snow hooks are very easy to install. Use about 3-4 per m².

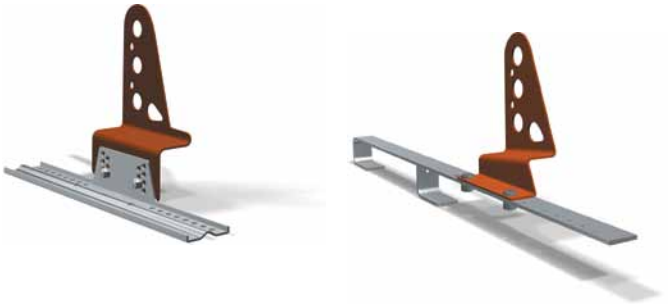


Figure 17. Use underlay attachments and battens attachments when installing safety systems.

Figure 18. Snow catcher 3-pipe.

Figure 19. Snow catcher 3-pipe installed on roof.

WHEN CUTTING TILES

At ducts and penetrations, or if the roof is hipped or has plenty of angels, you will sometime have to cut tiles. Use half tiles to prevent the usage of too small pieces of tiles that can be difficult to attach and nail, See Figure 15.

Place the tiles and mark where to cut. Use a straigh-tedge to make it easier. Then remove the tiles, bring them down from the roof and cut them on the ground. Use a circular saw with a diamond blade. **Always take proper safety precautions; use safety goggles and mask.**

Be sure to rinse the tiles with water directly after cutting in order to prevent concrete dust from sticking to the tile surface. Apply Benders Benderit paint to cut surfaces for better looks.

ROOF SAFETY

Safety equipment such as ridge railings, walkways, snow catchers or railings to sunroofs are installed by attaching them either to the tile battens or directly to the underlay. To get a clean and good fit between the equipment and tiles we recommend you to grind out parts of the tiles side lap.

Some safety solutions, e.g. safety steps, require you to grind off the lower lugs on the tiles. This prevents the tile from lifting.

RESPONSIBILITIES

The construction developer makes sure that building regulations are followed. The contractor or other employers involved in the roof installation are responsible of ensuring that health and safety laws are complied. This includes regulations concerning fall hazards. It is the property owner's responsibility to ensure that the necessary roof protection is in place and in good condition, and that there is no risk of falling snow or ice.

SNOW CATCHER 3-PIPE

Use of snow catchers will prevent larger masses of snow from falling down the roof and risk injuring people or damaging objects in the buildings vicinity. Install snow catchers along the entire eaves. If not, the attachments may not endure the pressure from the snow.

If you have any questions or thoughts concerning installation, consult your building materials supplier or us, Benders.

SNOW GUARDS

Above entrances without roof protection and public spaces (e.g. sidewalks, schools) the use of snow guards or snow catchers are permitted by law, See BBR 2008. This also apply on roofs with a pitch of 18° and a façade height of 3 meters and all roofs with a façade height over 8 meters.

Snow catchers are to be attached to the underlay or the tile battens – depending on underlay type.

The distance between attachments depends on roof pitch and which snow zone the roof is in. The table below shows maximum permitted roof distance if maximum distance between attachments, 1200 mm, is used. For shorter distances between attachments see table at www.perwikstrand.se.

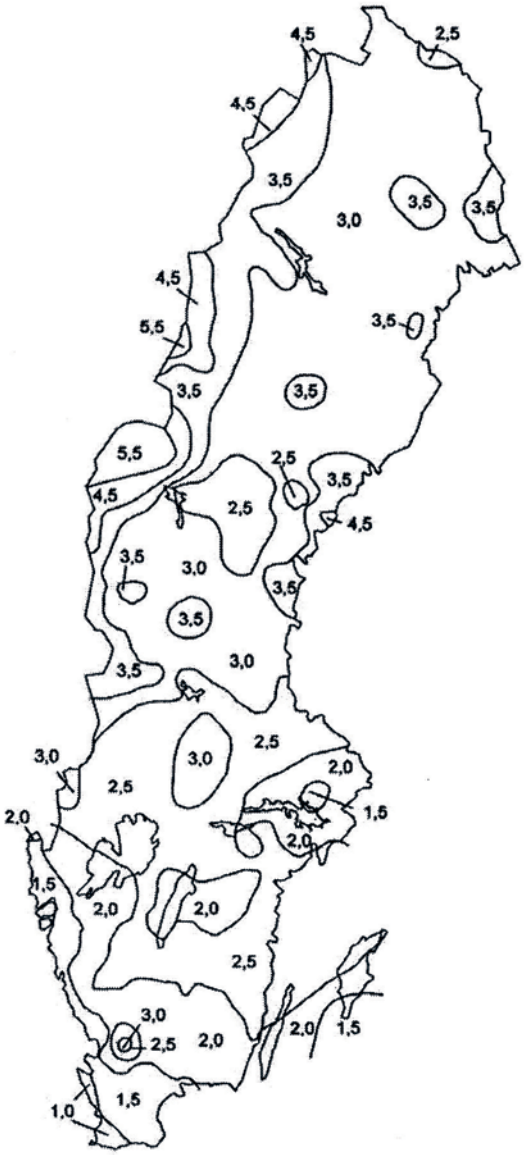
According to "Swedish Board of Housing, Building and Planning" the usage of snow guards should be in correlation to which snow zone the property is located. Naturally, areas with heavy precipitation require greater use of snow guards.

1 meter of newly fallen snow equals about 100 kg/m2 or 1,0 kN/m2 in load.

Note that this weight increases as the snow compresses. If the underlay is not insulated properly, heat leakage from the property can create ice that can result in heavy pressure on areas such as the valleys.

In order to prevent damage to the valleys caused by sliding snow, install snow hooks. The hooks keep snow in place, allowing the snow to melt gradually, and keeping it from sliding down with heavy force.

Snow guards along the eaves also functions as an extra roof safety.



DISTANCE TABLE FOR SNOW CATCHERS SS 831 385 (M)

	Snow zones according to the contruction regulations of Swedish Board of Housing, Building and Planning									
Roof pitch	**1**	**1,5**	**2**	**2,5**	**3**	**3,5**	**4**	**4,5**	**5**	**5,5**
6	60,0	40,0	30,0	24,0	20,0	17,0	15,0	13,0	12,0	11,0
10	37,0	24,0	18,0	15,0	12,0	10,0	9,1	8,1	7,3	6,6
14	27,0	18,0	13,0	11,0	8,9	7,6	6,7	5,9	5,3	4,8
18	21,0	14,0	11,0	8,5	7,1	6,1	5,3	4,7	4,3	3,9
23	17,0	12,0	8,7	7,0	5,8	5,0	4,3	3,9	3,5	3,2
27	15,0	10,0	7,7	6,2	5,2	4,4	3,9	3,4	3,1	2,8
33	15,0	10,0	7,6	6,1	5,1	4,3	3,8	3,4	3,0	2,8
38	18,0	12,0	8,8	7,0	5,9	5,0	4,4	3,9	3,5	3,2
42	21,0	14,0	10,0	8,4	7,0	6,0	5,2	4,7	4,2	3,8
45	25,0	17,0	13,0	10,0	8,3	7,1	6,3	5,6	5,0	4,5
50	38,0	25,0	19,0	15,0	13,0	11,0	10,0	5,8	7,6	6,9
55	80,0	53,0	40,0	32,0	27,0	23,0	20,0	18,0	16,0	15,0

REGULATIONS, BBR 2008

In July 2009, BBR 2008 took over as the main controlling regulation. Below is a brief overview of the most common examples for roof pitches up to 14°. These regulations apply to both new constructions and renovation work.

For full and complete regulations and for further information, see www.taksakerhet.se. See www.benders.se for further information on each product.

WHEN ACCESSING ROOF

- **Ladder protector.**
  Facade heights up to 4 meters.
- **Wall mounted latter with safety cage**
  Facade heights between 4 and 8 meters.
- **Sunroof entrance 600 x 900 with guardrails.**
  Facade height above 8 meters.

PROTECTIVE

- **Ridge rail along the entire ridge distance**
  Facade heights above 4 meters.
- **Walkway along the entire ridge distance**
  Facade heights above 8 meters, replaces ridges rails.
- **Snow guards**
  Above entrances without roof protection and public spaces (e.g. sidewalks, schools) the use of snow guards or snow catchers are permitted. This also applies to roof pitches over 18° with facades heights over 3 meters and all roofs with a facade height over 8 meters.
- **Safety railing at the roofs eave**
  Facade height above 8 meter and a roof pitch of 18°.

MOVEMENT ON THE ROOF AREA

- **Safety steps and safety hooks**
  Facade height up to 4 meters and a maximum roof pitch of 45°. Installed vertically from eaves to ridge
- **Linked safety steps**
  Facade height above 4 meters or a roof pitch between 45-65°. The linked safety steps should be safety rope approved.
- **Walkways, construction**
  Facade height over 3 meters during construction.

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