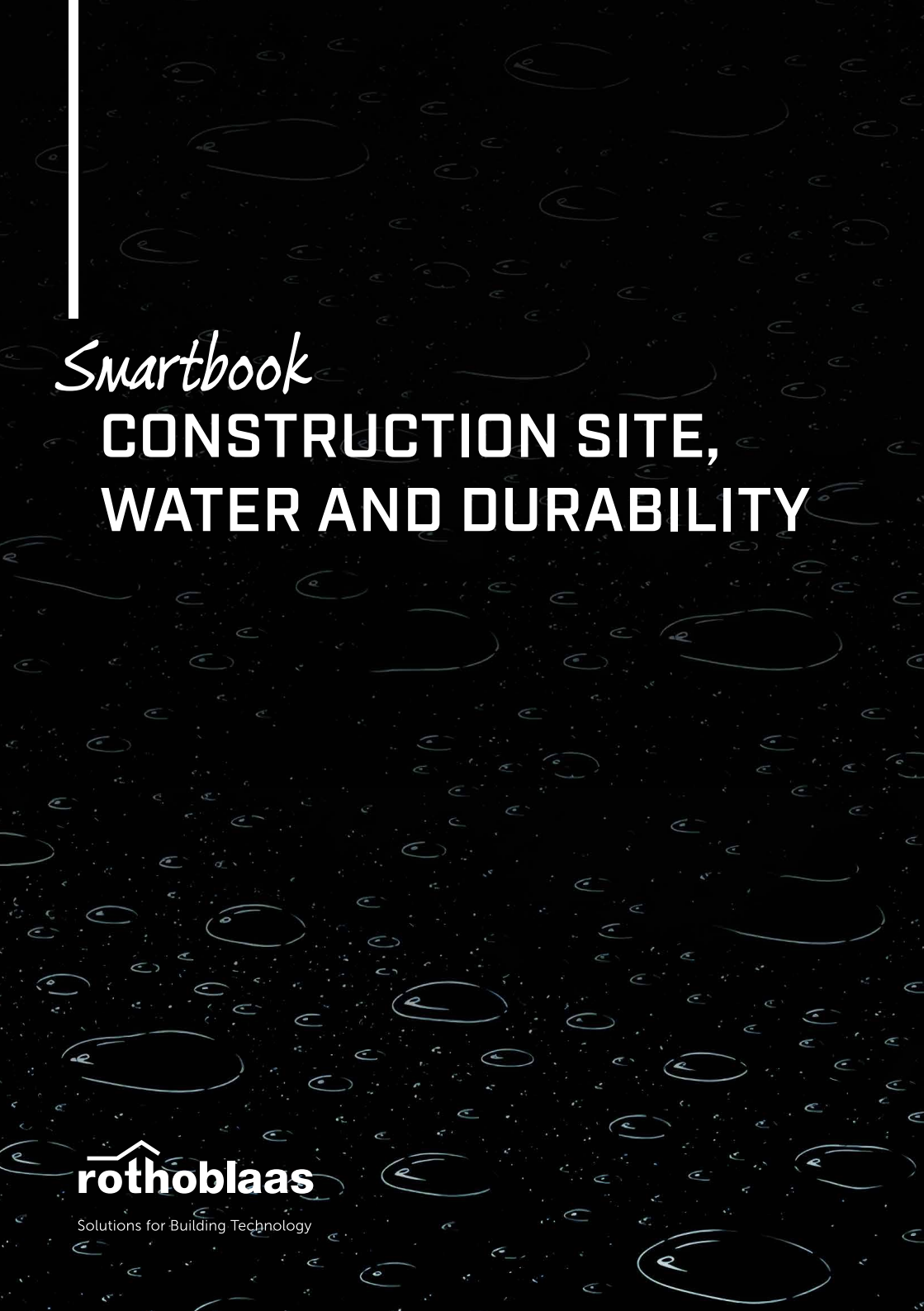




Smartbook

CONSTRUCTION SITE, WATER AND DURABILITY

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DESIGN GUIDELINES

from page **5**

Careful design ensures definition of the structural system, construction details and fastening systems, taking the construction stage into account, too. Every decision made at this stage reduces critical variables on site. It is not sufficient to design only the structure and certain construction details: execution and temporary protection measures must also be planned. Long-term performance and durability depend on these choices.

CONNECTIONS

from page **17**

Connections are among the most sensitive points of the structure. Moisture, standing water, corrosion, incorrect construction details and errors in the installation of fastenings can compromise durability and safety. For this reason, it is essential to identify critical connections, properly design the joint, and ensure the correct installation and inspection of fastening systems.

MEMBRANES AND TAPES

from page **71**

Proper design of protection systems and airtight, watertight and vapour-control layers requires a preliminary assessment of the construction element and exposure conditions. The choice of solutions is never arbitrary and directly affects performance, flow control and the durability of the building envelope.

CONSTRUCTION DETAILS

from page **129**

Key construction details – such as base connections, doors and windows, water drainage, ventilation and service penetrations – require careful design. Every discontinuity is a potential weak point. The overall performance of the system depends on the quality of workmanship.

CONSTRUCTION PROJECT EXECUTION PLANS

from page **173**

The transport, storage, assembly and moisture management stages are defined through construction project execution and control plans that address common critical issues: safety, performance, durability and overall build quality. The moisture management plan does not overlap with the others, but instead runs through them, influencing timing, detailing and control procedures at every stage of operation.

DESIGN GUIDELINES



DESIGN GUIDELINES

Careful design ensures definition of the structural system, construction details and fastening systems, taking the construction stage into account, too. Every decision made at this stage reduces critical variables on site. It is not sufficient to design only the structure and certain construction details: execution and temporary protection measures must also be planned. Long-term performance and durability depend on these choices.

BUILDING DESIGN

from page **6**

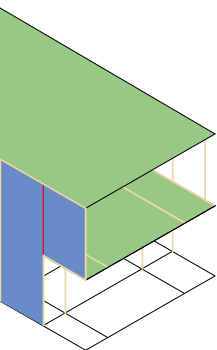
DESIGN FOR THE CONSTRUCTION STAGE

from page **10**

CONSTRUCTION PROJECT EXECUTION AND SITE SUPERVISION

from page **13**

BUILDING DESIGN



1 IDENTIFY THE STRUCTURAL SYSTEM AND THE OVERALL LOAD PATH

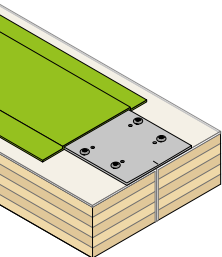


Structural system with redundancies and alternative load paths: a local failure does not lead to global collapse. Supports and connections are designed to redistribute loads.



Structural system with isostatic behaviour or with few alternative load paths: connections assume a particularly important role in the overall structural behaviour. In these cases, greater attention is required in the design of details, moisture management and the selection of fastenings.

See further details on page 186



2 DESIGN THE CONNECTION DETAIL TO MANAGE WATER AND MOISTURE

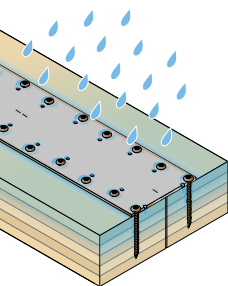


Joint designed to limit water ingress and standing water: continuous protection and sealing of weak points, water drainage, and the possibility of ventilation and drying.



Joint with partial or absent water management: discontinuous protection, possible water ingress and localised standing water, including geometries that encourage water pooling, lack of drainage and difficult drying conditions.

See further details on page 42



3 SELECT FASTENINGS SUITABLE FOR IN-SERVICE AND ON-SITE CORROSIVITY CONDITIONS



For critical connections and/or humid environments: stainless steel or carbon steel with advanced coating systems (e.g. EVO). Clear specifications in the technical documentation and verified compatibility between timber, fastenings and paired metals to prevent galvanic corrosion.



Use of standard electro-galvanised coatings in non-dry conditions or in polluted or coastal environments: corrosion resistance may be insufficient. Unclear technical specifications and possible galvanic coupling.

See further details on page 18

DESIGN A SUITABLE BASE CONNECTION



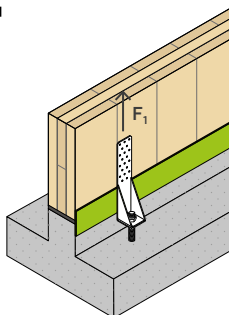
Detail designed with the wall raised above ground level, continuous waterproofing, correct sealing, adequate slopes, effective drainage and absence of thermal bridges. Connections protected from water at the base, compliance with edge distances, construction of regular kerbs, and correct arrangement of fastenings.



Wall below ground level, or otherwise exposed to persistent moisture; missing or incorrectly installed waterproofing; presence of thermal bridges; ineffective slopes and drainage resulting in standing water. Base connections exposed to prolonged wetting, holes or plates that retain water, contact with damp concrete, galvanic coupling and failure to comply with minimum edge distances.

See further details on page 130

4



SELECT THE CORRECT MEMBRANE FOR VAPOUR CONTROL



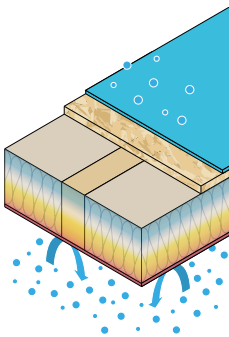
Membrane with an S_d value defined in accordance with the design and climatic conditions. S_d value verified through calculation to ensure hygrothermal balance and proper vapour management. Climatic conditions characterised by dry cycles help reduce the risk of condensation.



Membrane with an unsuitable or unverified S_d value. Unplanned, untaped or incorrectly executed details reduce the functionality of the assembly and increase the risk of water ingress and condensation. Extreme climatic conditions, critical positioning of membranes within the build-up and tropical climates introduce further uncertainties in predictions.

See further details on page 94

5



ENSURE THE AIRTIGHTNESS OF THE BUILDING ENVELOPE

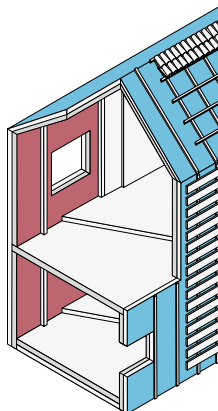


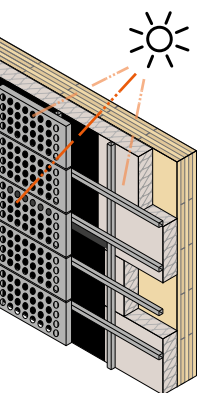
System designed and installed to ensure the continuity of the air barrier throughout the entire assembly. Properly sealed joints, carefully executed interfaces between elements and absence of discontinuities.



Unsealed joints, discontinuities at interfaces and untreated penetrations compromise the continuity of the air barrier and increase the risk of water ingress, interstitial condensation and loss of energy efficiency.

6





7 DEFINE THE FINISHING LAYER OF THE BUILDING ENVELOPE

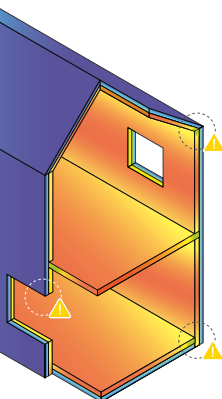


Certified and tested membranes resistant to weathering ensure protection and durability. Controlled and limited exposure of the membrane reduces stress on tapes and improves system stability.



Products not certified for the intended use, or of poor quality, deteriorate rapidly and provide limited protection. Prolonged exposure and the risk of repeated weather events accelerate membrane degradation and increase stress on the tapes.

See further details on page 106



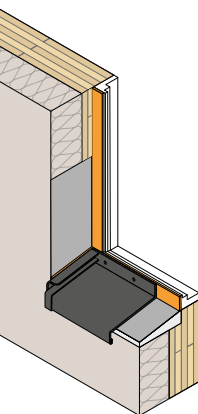
8 AVOID THERMAL BRIDGES



Details designed to ensure thermal continuity through continuous insulation and effective sealing, limiting heat loss and condensation.



The presence of unassessed or poorly designed thermal bridges, interruptions in the insulation layer, and the introduction of elements that reduce the temperature within the assembly encourage condensation, with a consequent risk of material degradation.



9 DESIGN THE WINDOW-TO-STRUCTURE JUNCTION



Detail designed according to the three-level protection principle. Continuity of watertightness, airtightness, and thermal and acoustic insulation ensures system performance. Provision of drainage and correct slopes enables effective water management and prevents moisture build-up. Window sills and shading systems already integrated into the detail during the design phase, ensuring continuity of the functional layers.



Window-to-structure junction lacking a clear three-level protection strategy. Discontinuities in seals and interfaces compromise airtightness and watertightness. Absence of drainage and adequate slopes results in standing water and moisture build-up. Window sills and shading systems not integrated into the detail create weak points.

See further details on page 140

PROVIDE INTEGRATED DESIGN



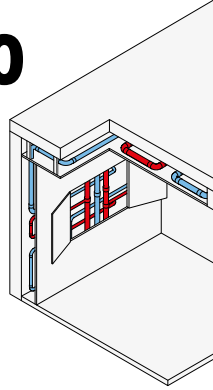
Plumbing and electrical systems designed and integrated within the assembly, with defined routes separated from structural elements. Service penetrations correctly sealed to ensure continuity of the air and water barrier.



Services installed without prior design planning, with improvised penetrations interrupting the continuity of the air and water barriers. Unsealed openings and incompatible materials encourage water ingress and premature deterioration.

See further details on page 166

10



DESIGN RAINWATER DRAINAGE



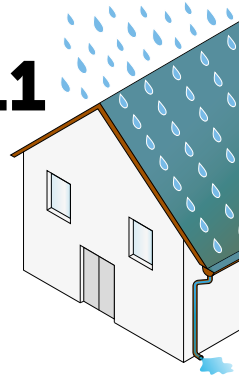
Drainage system designed to ensure rapid water run-off, with correct slopes and outlets sized in accordance with regulations. Provide overflow channels and avoid recessed gutters. Ensure proper maintenance throughout the entire life cycle of the building.



Absence of adequate slopes or under-sized outlets causes standing water and pooling. Failure to design critical details such as downpipes and integrated gutters reduces system functionality.

See further details on page 156

11



PROVIDE VENTILATED ASSEMBLIES



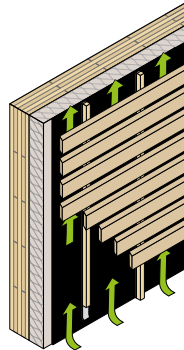
Effective ventilation of the layers promotes drying and reduces the risk of condensation.



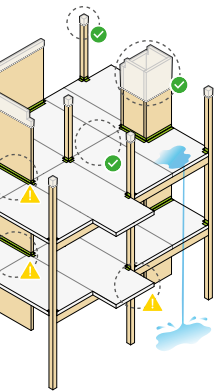
Lack of ventilation, or insufficient ventilation, causes moisture build-up and accelerated material deterioration.

See further details on page 150

12



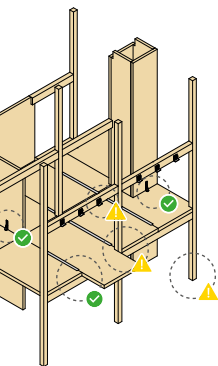
DESIGN FOR THE CONSTRUCTION STAGE



1 ASSESS THE TYPE OF CONSTRUCTION ELEMENT AND WEAK POINTS

	
Assess the risk according to the geometry and inclination of the elements, and provide solutions for water deflection, runoff, drainage and drying, ensuring that the timber remains dry or can dry rapidly. Plan site activities taking into account weather conditions and the duration of exposure to water.	Ignore exposure to weathering and water retention on elements. Horizontal surfaces, enclosed environments, complex junctions, recesses and routing for beams, as well as wall bases and end-grain sections, encourage standing water, slow down drying and increase the risk of premature deterioration of the timber.

See further details on page 72



2 IDENTIFY CRITICAL CONNECTIONS

	
Protect connections with thick steel plates, avoiding direct contact with water and preventing prolonged water pooling. Apply upper and lower protection measures and carefully implement the details along the building perimeter. Opt for inclined or vertical configurations and adopt drained, inspectable solutions separated from timber elements.	Construct connections with thick steel plates that are unprotected and poorly drained, particularly around the perimeter of the building. Provide membrane upstands without drainage paths, which encourage standing water. Design balconies, projections and curtain wall fastenings with exposed, large connections that are not adequately protected from water.

See further details on page 34

ASSESS CONSTRUCTION LOADS ON THE CONNECTION



The connection is not be loaded before all its fastenings have been installed. Fastenings correctly installed and tightened. No storage or assembly loads applied to the screws; the area remains protected or the building is enclosed.

Where loads are expected (storage, transport, movement of personnel on site), finish installing the connection before applying the loads.



Loading the connection on site without proper verification: even if the loads are lower than the design loads, they may be repeated or of a different nature (propping, temporary supports, storage loads). If construction-stage loads have not been assessed, or are equal to or greater than the design stresses, the risk of local overload on the screws increases. Partially installed connections.

See further details on page 186

IDENTIFY THE WEATHER WINDOW AND THE CORROSIVITY OF THE ENVIRONMENT DURING CONSTRUCTION



Low probability of rain, or covered construction site, with limited and controlled exposure. Drying planned through ventilation/battening and continuous moisture control, including before closing the details. Environment located away from the sea or protected; in corrosive or humid environments, suitable protections and fastenings/coatings are already specified. No galvanic coupling on site, or adequately managed where present.



Frequent rainfall or unmanaged weather windows: repeated wetting, difficult drying and possible standing water. Corrosive environment without adequate protective measures. Prolonged exposure of timber to highly corrosive conditions. Galvanic coupling present and not mitigated.

See further details on page 18

SELECT SITE PROTECTION MEASURES



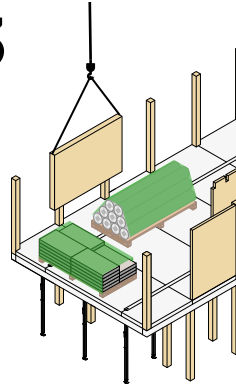
Complete protection of construction elements with correctly installed waterproof membranes. Sealing of joints and areas at risk of water ingress. Possible use of treated timber to increase the level of protection. Areas with moderate rainfall and stable thermal cycles reduce risk.



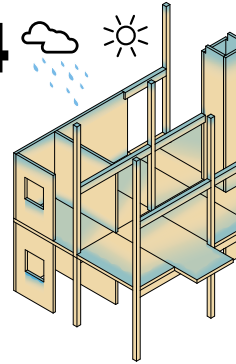
Lack of protection systems, or the use of incorrectly installed membranes, encourages water ingress and standing water. Details that do not protect timber elements or allow them to dry, together with timber having high initial moisture content, increase the risk. Persistent rainfall, snow, frequent freeze-thaw cycles and day-to-night temperature fluctuations that promote dew formation increase the risk and provide limited drying potential.

See further details on page 82

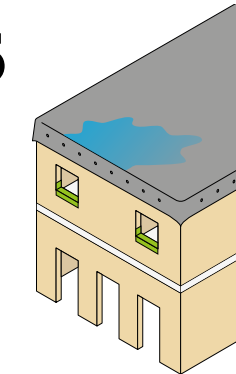
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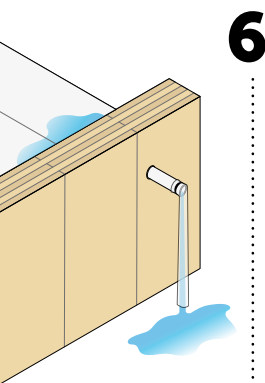


4



5





6 DESIGN TEMPORARY WATER DRAINAGE SYSTEMS



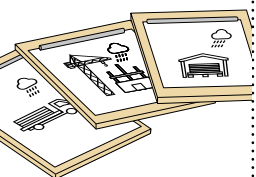
Provide temporary deflection and drainage systems, and design adequately sealed joints and connections to prevent water ingress and standing water, promoting drying of the assemblies.



Incorrect water management, standing water in undrained areas, unsealed joints and inadequate slopes encourage water pooling and increase the risk of water ingress.

See further details under "ASSESSMENT OF THE STRUCTURAL ELEMENT AND CRITICAL AREAS" on page 72

See further details under "RAINWATER DRAINAGE AND DEFLECTION" on page 156



7 DEVELOP CONSTRUCTION PROJECT EXECUTION PLANS FOR MATERIAL HANDLING ON SITE

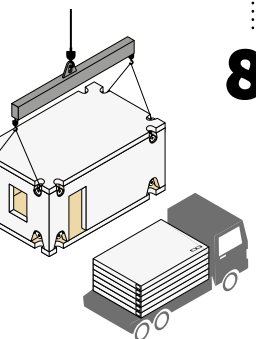


Defined and coordinated construction project execution plans for transport and lifting, storage, assembly, moisture management and safety. Roles, inspections, operational sequences, temporary protection measures, moisture monitoring and verification criteria are defined in accordance with scheduling requirements, construction details and site exposure conditions.



Construction project execution plans absent, incomplete or uncoordinated, including safety-related aspects. Moisture management, temporary protection measures, inspections, installation sequences, corrective actions and acceptance limits are not clearly defined. Long and complex construction sites significantly increase risk.

See further details on page 175



8 MANAGE PRE-INSTALLATION AND PREFABRICATION



Installation of the protection system off site under controlled temperatures, with correct overlaps and in a clean environment. This ensures adhesion of the sealing elements and the effectiveness of the system. Gypsum and moisture-sensitive materials used for fire protection or finishing must be installed after the roof covering is completed in order to reduce risk.



On-site installation under variable climatic conditions (cold, humidity, risk of rain) and unresolved details reduce the effectiveness of the protection system. Prefabrication of moisture-sensitive materials increases the need for protection. Contact with damp materials, or with materials having different hygrothermal behaviour, encourages rising damp.

CONSTRUCTION PROJECT EXECUTION AND SITE SUPERVISION

SELECT EXPERIENCED INSTALLERS



Installers with specific experience in the assembly of timber structures and knowledge of construction project execution plans. Experience in applying installation procedures, temporary protection measures, inspections and moisture management throughout the various operational stages.



Installers without specific experience or lacking knowledge of the construction project execution plans. Errors in handling, installation or temporary protection measures may increase the risk of wetting, damage to construction details, corrosion or damage to fastenings, and loss of performance during construction.

1



CARRY OUT CONSTRUCTION PROJECT EXECUTION PLANS FOR MATERIAL HANDLING ON SITE

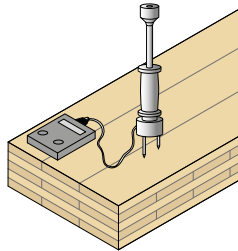


Construction project execution plans correctly carried out by experienced installers: handling, storage, installation, temporary protection measures and moisture management performed in accordance with the specified procedures. Connections and airtightness/water-tightness details correctly executed, with inspections carried out throughout the various operational stages.



Construction project execution plans not applied, or applied without proper control: errors in handling, storage, installation sequence or assembly may compromise temporary stability, quality of workmanship and the correct execution of connections and construction details.

2



See further details on page 175

CORRECTLY APPLY PROTECTION SOLUTIONS ON SITE

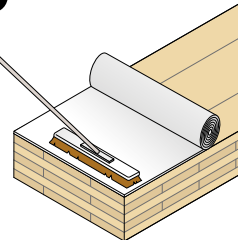


Protection solutions correctly applied and consistent with the weather window, construction period and level of exposure. Temporary protection measures, drainage systems, seals and coverings maintained in effective condition throughout the different operational stages, with prompt inspections and interventions in the event of rain or damage.



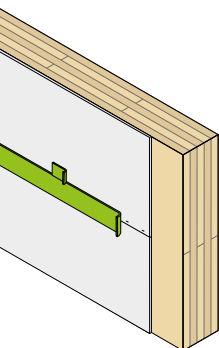
Protection solutions absent, incomplete or not maintained during construction. Failure to manage the weather window, discontinuous or damaged protection measures, and unmanaged standing water or water ingress increase the risk of prolonged wetting, material deterioration and corrosion of connections.

3



See further details on page 118

4 CHECK THE QUALITY OF THE INSTALLATION OF TAPES, MEMBRANES AND FOAMS



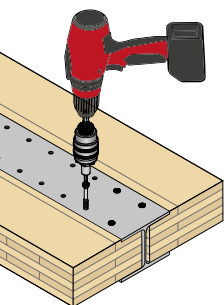
Membrane installed with the correct tension, overlaps suitable for the requirements of the detail, and continuous sealing (every penetration taped, every corner properly sealed). Adhesive product selected according to function, substrate type and application temperature. Tapes applied using a roller on dry, clean and compact surfaces. Use of primer where the substrate is porous, rough or difficult. Polyurethane foam suitable for its intended function.



Membrane too tight or too loose, causing water pooling and increased vulnerability to wind. Adhesive product incompatible with the substrate, temperature or service conditions. Tape applied without pressure, or onto wet, dusty or unsuitable-temperature surfaces. Failure to manage discontinuities created during installation. Foam unsuitable for the intended function.

See further details on page 118

5 CORRECTLY INSTALL FASTENING SYSTEMS



Fastenings installed in accordance with instructions and design specifications: correct insertion angle, suitable screw-drivers/drills, pre-drilling or pilot holes where required, installation torque control, and installation sequence consistent with ensuring uniform stress distribution within the connections.



Incorrect installation of fasteners: screws deviating from the intended installation angle, overtorque, use of impact drivers, absence of pre-drilling where required, or incorrect installation sequences may introduce overloads, damage coatings and reduce connection performance.

See further details on page 46

MONITOR, INSPECT AND MANAGE THE CONSTRUCTION SITE



Construction site monitored through planned inspections and checks on moisture, temporary protection measures, drainage and correct fastening installation. Any water ingress or anomalies are identified and promptly managed before compromising connections and materials.



Insufficient monitoring or ineffective inspections: water ingress, damage to protection systems, standing water, incorrectly installed fasteners or premature failures, if not identified, encourage degradation and progressive deterioration of the connections.

See further details under "INSTALLATION AND INSPECTION OF FASTENING SYSTEMS" on page 46

See further details under "CONSTRUCTION PROJECT EXECUTION PLANS" on page 174

TEST BUILDING SERVICES BEFORE CLOSING OR ENCASING CONNECTIONS



Building services tested before connections are closed, with no leaks or water ingress, or with the possibility of intervention and repair without significant damage to construction elements or connections.



Connections encased or closed without prior testing of building services: any leaks or water ingress may remain undetected, causing persistent moisture and premature deterioration.

MANAGE SERVICE PENETRATIONS AND INTEGRATIONS



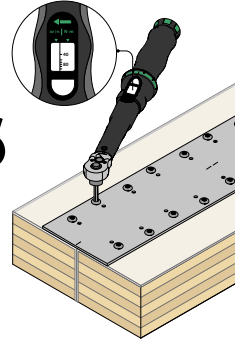
Services penetrations and integrations introduced during the construction stage are properly managed, ensuring continuity of the layers, airtightness, watertightness and performance consistent with the design.



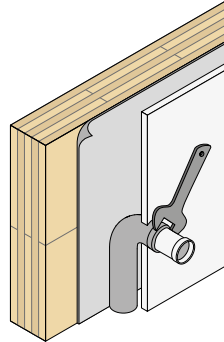
Penetrations and integrations carried out without proper detailing compromise the continuity of the layers, creating entry points for water and air and encouraging deterioration.

See further details on page 168

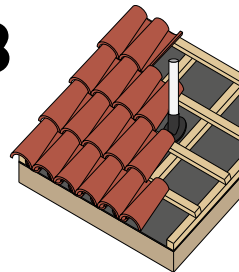
6



7



8



CONNECTIONS



CONNECTIONS

Connections are among the most sensitive points of the structure. Moisture, standing water, corrosion, incorrect construction details and errors in the installation of fastenings can compromise durability and safety. For this reason, it is essential to identify critical connections, properly design the joint, and ensure the correct installation and inspection of fastening systems.

CORROSIVITY CONDITIONS ON SITE

from page **18**

CRITICAL CONNECTIONS: IDENTIFICATION AND VERIFICATION

from page **34**

CONNECTION DETAILS FOR MANAGING WATER AND MOISTURE

from page **42**

INSTALLATION AND INSPECTION OF FASTENING SYSTEMS

from page **46**

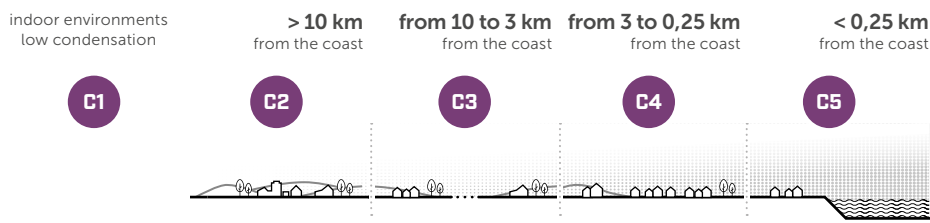
CORROSIVITY CONDITIONS ON SITE

Addressing environmental corrosivity is essential in preserving the performance of metal elements for the entire service life of the building. For this reason, corrosivity must be assessed on two different scales, or “magnifying lenses”, differing both in terms of time horizon and the conditions considered: **design corrosivity** and **construction-stage corrosivity**.

DESIGN CORROSIVITY CONDITIONS

Starting from the **project geolocation**:

- the **atmospheric corrosion class** is determined by superimposing the project location onto the corrosivity zoning map of the area in which the building will be constructed. The zoning may vary according to the type of metal used (bright zinc-plated carbon steel, see page 20, or stainless steel, see page 21);
- subsequently, according to the exposure of the connection (and therefore the moisture conditions to which the timber will be exposed) and the wood species used, the **wood corrosion class** is determined;
- finally, for **timber-to-metal** connections, **material compatibility** is verified in order to prevent or limit **galvanic coupling**.



Atmospheric corrosivity categories according to Fpr EN 1995-1:2025, based on ISO 9223.

SERVICE CLASS	SC1	SC2	SC3	SC3	SC4	WET ^(*)
TIMBER MOISTURE CONTENT	 ≤ 10%	10% <  ≤ 16%	16% <  ≤ 20%	16% <  ≤ 20%	 > 20%	
TIMBER pH AND TREATMENT	any	any	pH > 4 and without treatments	pH ≤ 4 or treated timbers	any	
WOOD CORROSIVITY CLASS	T1	T2	T3	T4	T5	

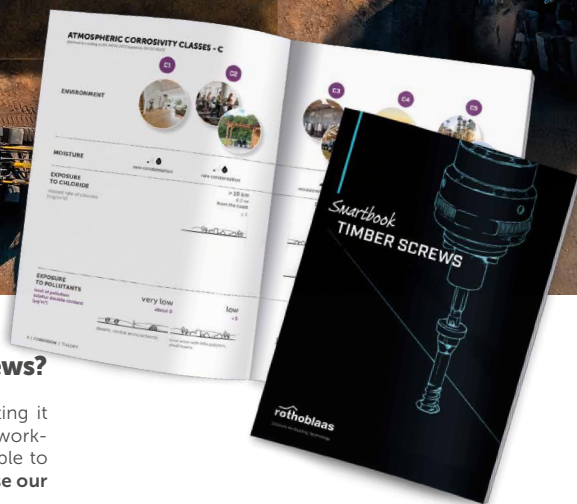
Wood corrosivity categories according to Fpr EN 1995-1:2025.
(*) The WET moisture condition is defined in the NDS (USA) and CSA O86 (Canada) standards as a timber moisture content greater than 19%.

For connections in conventional buildings, **it is the design corrosivity that determines the material** to be used. However, **corrosivity during construction** may temporarily be more severe and should therefore be assessed to determine whether additional protection is required, particularly in the case of long construction periods or demanding environmental conditions.



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ZONING EXAMPLE

Metallic components made of carbon steel with a zinc-based coating, exposed to the atmosphere.

city: Barcelona (Spain)

reference standard:

Fpr EN 1995-1:2025, based on ISO 9223

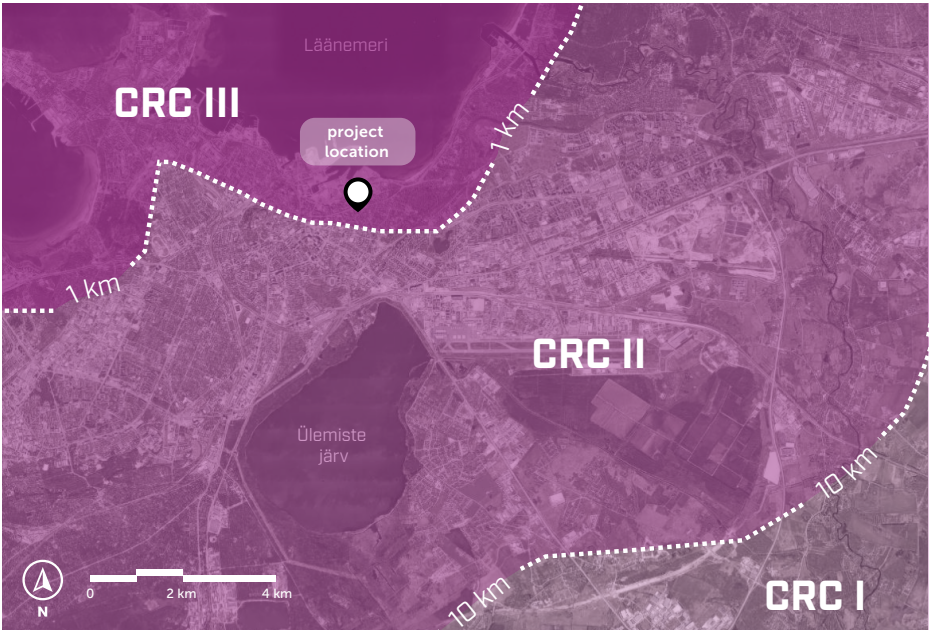


Atmospheric corrosion classes [C _E]	Recommended minimum zinc base coating [C _R]	ROTHOBLAAS RECOMMENDS	
C2	10 µm	Zn ELECTRO PLATED	ELECTROLYTIC GALVANIZING Coating consisting of a 5 to 12 µm layer of electrolytic galvanizing with Cr passivation; standard for most connectors.
C3	55 µm	ORGANIC COATING	ORGANIC ANTI-CORROSION COATING Coloured organic-based coating that provides excellent resistance to atmospheric and wood corrosive agents in outdoor applications.
 C4	110 µm	C4 EVO COATING	C4 EVO ANTI-CORROSION COATING Inorganic-based multilayer coating with an external functional layer of about 15-20 µm in an epoxy matrix with aluminium flakes. Suitability for atmospheric corrosivity class C4 proven by RISE.
C5	n.a.	C5 EVO COATING	C5 EVO ANTI-CORROSION COATING Multi-layer coating capable of withstanding outdoor environments classified C5 according to ISO 9223. Salt spray test (SST) exceeding 3.000 h, carried out on screws previously driven into and removed from Douglas fir.

ZONING EXAMPLE

Metallic components made of stainless steel, exposed to the atmosphere.

city: Tallinn (Estonia) reference standard: EN 1993-1-4:2024, Annex A



Minimum Corrosion Resistance Class [CRC]	Recommended minimum stainless steel grade	ROTHOBLAAS RECOMMENDS	
I	AISI 410	410 AISI	AISI410 STAINLESS STEEL Martensitic stainless steel. Characterised by high mechanical properties. Suitable for outdoor applications (SC3). Of the available stainless steel types, this is the one offering the highest mechanical performance.
II	1.4301 A2 AISI 304/305	A2 AISI 304 A2 AISI 305	A2 AISI304 STAINLESS STEEL Austenitic stainless steel. It is the most common of the austenitic steels. It offers an excellent level of protection against generalised corrosion. A2 AISI305 STAINLESS STEEL Austenitic stainless steel similar to A2 AISI304. This alloy contains slightly more carbon than 304, making it more workable in production.
III	1.4401 A4 AISI 316	A4 AISI 316	A4 AISI316 STAINLESS STEEL Austenitic stainless steel. The presence of molybdenum provides high resistance to generalised and crevice corrosion.
IV	1.4439	-	-

CORROSION DURING THE CONSTRUCTION PERIOD

The longer a construction site remains open and exposed to the weather, the more likely the metals used in connections are to experience environmental conditions more aggressive than those anticipated at the design stage.

Fasteners are normally designed for defined service conditions (for example, **service class 1 or 2**, or **dry conditions**). During construction, however, connections and structural elements may be directly exposed to rain, high humidity and repeated wetting and drying cycles.

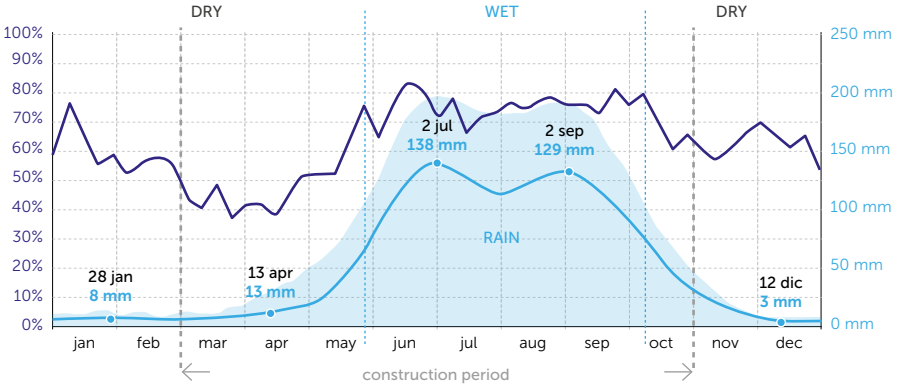
For this reason, corrosivity during construction may be temporarily **higher than that assumed in the design**.

WEATHER WINDOW AND ESTIMATED CONSTRUCTION PERIOD

In simplified terms, there are two main factors:

- **the duration of the construction site**, indicating how long the elements are exposed to environmental conditions;
- **the weather window**, indicating the level of moisture and wetting to which the elements may be exposed.

The weather window is determined by overlapping the planned construction period with the climatic data for the relevant period (rainfall, humidity and probability of weather events). This makes it possible to identify the most favourable periods for carrying out moisture-sensitive operations and to assess the actual corrosion conditions.



Weather conditions in Mexico City during 2025. Meteoblue Weather Archive, 2026.

For the assessment of **wood corrosivity**, the main parameters to be considered are:

- **rainfall (mm)**: indicates the quantity of water potentially present on surfaces and the risk of standing water;
- **number of rainy days**: indicates the frequency of wetting cycles and the possibility for elements to dry between rainfall events;
- **relative humidity**: provides an indication of the tendency of timber to maintain a high moisture content for prolonged periods and therefore to fall within a specific wood corrosivity category.

In particular, the weather window indicates the level of moisture to which timber and connections may be exposed during construction. This affects both **atmospheric corrosivity**, which is generally better known and already considered in material selection, and, above all, **wood corrosivity**, namely the moisture conditions in the material that may accelerate the corrosion of fasteners embedded within.

SELECTION OF PROTECTIVE MEASURES ON SITE

The **severity resulting from the combination of the weather window and construction period** may influence the choice of protective measures (see the chapter "SITE PROTECTION: SYSTEM SELECTION" on page 82).



In practice, for **small and medium-sized sites** with **favourable weather windows**, **localised measures** are often sufficient.



Temporary surface coverings are becoming increasingly widespread because they provide protection while allowing greater flexibility during construction activities, whereas **side coverings** are particularly useful where rain is driven by wind.



Full site enclosure (tenting) represents the ideal scenario, but it is often costly and not always feasible due to space constraints or the size of the structure.



LOCALISED MEASURES

- tape the joints
- rout recesses for connections to promote drainage
- cover the tops of wall panels to promote water run-off



SURFACE MEASURES

- apply temporary top or side coverings (in the case of wind-driven rain)
- apply membranes to entire panels



TOTAL MEASURES

- fully enclose the construction site (tenting)

\$

low
cost



high
risk

\$\$

medium
cost



medium
risk

\$\$\$

high
cost



low
risk



RISK

COST \$

construction period and weather window severity

The objective is not to prescribe a single solution, but to **assess the risk** and select protective measures consistent with the construction period, weather conditions and exposure of the elements. In many cases, the assessment process leads to different combinations of protective measures, which may vary throughout the construction period.

The selection of protective measures according to the severity of the weather window is not related solely to corrosivity, but also to the potential impact of timber swelling, which in some cases can generate significant unforeseen loads.

CORROSION ON SITE: TYPICAL SCENARIO

Rothoblaas conducted a testing campaign to study the progression of **fastener corrosion** by varying:

- exposure conditions (moisture),
- wood species,
- fastener materials and coatings.

The samples were installed in timber and left under the specified exposure conditions for **12 months**. For each configuration, **12 samples** were prepared. One sample was removed at the end of each month, allowing the progression of the phenomenon to be assessed on a monthly basis.



White corrosion affects the **zinc-plated** layer. It indicates that the coating is reacting with the environment and performing its **sacrificial protection** function for the steel. Although visually evident, it does not result in a significant loss of performance over the design life of the building.



Red corrosion, on the other hand, consists of the corrosion products of **carbon steel**. It indicates that, in that area, the zinc layer has been completely consumed and the steel is exposed. This phenomenon significantly affects the durability of the connection.



Fasteners showing red corrosion during construction must be removed and replaced.



Corrosion assessment was carried out using the first visible signs of corrosion (red or white), detectable with the naked eye, as the evaluation criterion. It is important to note that the times observed for the onset of corrosion phenomena depend on the climatic conditions during testing, particularly rainfall and the environmental corrosion class (C2 in this specific case). The values reported should therefore be considered indicative and applicable only to this specific test scenario.



TYPICAL SCENARIO

exposure conditions:

SC3

unprotected exposure

type of wood:

T3

fir

**white corrosion**

presence of whitish deposits, indicating the reaction of the coating with the environment and its sacrificial protection function for the steel.

**red corrosion**

presence of reddish deposits, indicating that the zinc layer in that area has been completely consumed and the steel is exposed

month	1	2	3	4	5	6	7	8	9	10	11	12
Zn ELECTRO PLATED	-	-										
C4 EVO COATING	-	-	-	-	-	-	-	-	-	-	-	-

1 month

**Zn**
ELECTRO
PLATED**C4**
EVO
COATING

3 months

**Zn**
ELECTRO
PLATED**C4**
EVO
COATING

11 months

**Zn**
ELECTRO
PLATED**C4**
EVO
COATING

Tests carried out on **electro-galvanised carbon steel** fasteners embedded in spruce timber showed:

- no signs of **white corrosion** for approximately **2 months**;
- no **red corrosion** for approximately **10 months**.

Fasteners with the **EVO** coating, on the other hand, demonstrated significantly greater durability, thereby providing an important additional safety margin on site.

It is normal for a coating such as **electro-galvanising**, designed for service classes 1 and 2, to show signs of corrosion when fully exposed to weathering, because environmental conditions during construction may be more aggressive than those anticipated in service.

These results highlight the importance of:

- protecting the construction site or connections where weather forecasts indicate prolonged exposure to the elements;
- selecting higher-performance materials or coatings when the construction period may exceed the expected durability of the coating.

CORROSION ON SITE: HIGH-AGGRESSIVENESS SCENARIOS

In this series of tests, various **coatings on carbon steel and stainless steel** were analysed in combination with less common, yet still relevant, wood species.

These included **acidic timber**, such as **oak**, which represents a particularly aggressive case and therefore serves as a useful reference for other acidic wood species.

Thermally-modified timber and **acetylated timber** were also tested.

As in the previous tests, the samples were exposed for **12 months**, with one screw removed each month to assess the progression of corrosion over time.

ACID TIMBER

exposure conditions:

SC3

unprotected exposure

type of wood:

T4

oak



white corrosion

presence of whitish deposits, indicating the reaction of the coating with the environment and its sacrificial protection function for the steel.



red corrosion

presence of reddish deposits, indicating that the zinc layer in that area has been completely consumed and the steel is exposed

month	1	2	3	4	5	6	7	8	9	10	11	12
Zn ELECTRO PLATED	-											
HOT DIP	-											
C4 EVO COATING	-	-										
410 AISI	-	-	-	-	-	-	-	-	-	-	-	-

The results show that, under fully exposed design conditions (SC3 / Wet), coatings on carbon steel are generally unsuitable, whereas **AISI 410 stainless steel showed no visible signs of corrosion** throughout the entire test period.

During construction, the progressive development of corrosion can be observed across the various coatings tested. The **EVO coating** proved to be a suitable solution for medium-length construction projects, offering **superior performance compared with hot-dip galvanising**.

For further information on coating types, please refer to the **TIMBER SCREWS SMARTBOOK**.

1 month

Zn
ELECTRO
PLATEDHOT
DIP

3 months

Zn
ELECTRO
PLATEDHOT
DIP

11 months

Zn
ELECTRO
PLATEDHOT
DIP

1 month

C4
EVO
COATING410
AISI

3 months

C4
EVO
COATING410
AISI

11 months

C4
EVO
COATING410
AISI

HEAT-TREATED WOOD

exposure conditions:

SC3

unprotected exposure (screws partially embedded in timber)

type of wood:

T4

thermally-modified tulipwood



white corrosion

presence of whitish deposits, indicating the reaction of the coating with the environment and its sacrificial protection function for the steel.



red corrosion

presence of reddish deposits, indicating that the zinc layer in that area has been completely consumed and the steel is exposed

month	1	2	3	4	5	6	7	8	9	10	11	12
Zn ELECTRO PLATED	-											
C4 EVO COATING	-	-	-	-	-	-	-	-	-	-	-	-
ORGANIC COATING	-	-	-	-	-	-	-	-	-	-	-	-
410 AISI	-	-	-	-	-	-	-	-	-	-	-	-

1 month

Zn
ELECTRO
PLATED**C4**
EVO
COATING

3 months

Zn
ELECTRO
PLATED**C4**
EVO
COATING

11 months

Zn
ELECTRO
PLATED**C4**
EVO
COATING

1 month

**ORGANIC
COATING****410**
AISI

3 months

**ORGANIC
COATING****410**
AISI

11 months

**ORGANIC
COATING****410**
AISI

Thermally-modified timber exhibits higher corrosivity than untreated timber.

In the case of **electro-galvanised** fasteners, red corrosion appeared as early as the **third month**.

By contrast, **EVO C4, organic coating and AISI 410** showed no signs of corrosion throughout the **12-month test period**.

ACETYLATED WOOD

**white corrosion**

presence of whitish deposits, indicating the reaction of the coating with the environment and its sacrificial protection function for the steel.

**red corrosion**

presence of reddish deposits, indicating that the zinc layer in that area has been completely consumed and the steel is exposed

exposure conditions:

SC3

unprotected exposure

type of wood:

T4

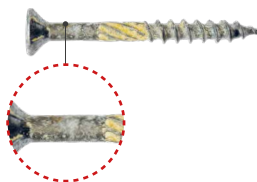
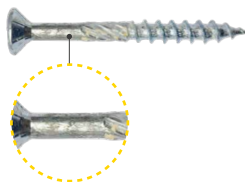
acetylated timber (Accoya)

month	1	2	3	4	5	6	7	8	9	10	11	12
Zn ELECTRO PLATED												

1 month

3 months

11 months



exposure conditions:

SC3

protected exposure

type of wood:

T4

acetylated timber (Accoya)

month	1	2	3	4	5	6	7	8	9	10	11	12
Zn ELECTRO PLATED	-											

1 month

3 months

11 months



Acetylated timber is classified in corrosivity class **T4** and, under service conditions, **requires the use of stainless steel**.

The test was useful in highlighting the difference between:

- fully exposed conditions (**SC3**)
- protected conditions (**SC3 non-exposed**), introduced in the new Eurocode 5

The difference is significant: under fully exposed conditions, red corrosion appears as early as the third month, whereas under protected conditions it may not occur for up to 12 months.

CORROSION ON SITE: GALVANIC COUPLING

Galvanic coupling occurs when dissimilar metals are brought **into contact in the presence of moisture**. Under these conditions, the potential difference generates a galvanic current that can cause localised corrosion. In indoor (dry) environments, this phenomenon is rarely critical, whereas on construction sites and under weather exposure it can become a significant factor affecting the durability of the structure.

To measure and quantify this effect, Rothblaas carried out a testing campaign in collaboration with the University of Trento, using a potentiostat in ZRA (Zero Resistance Ammeter) mode in accordance with ASTM G71.

The tests covered various combinations of screws, washers, post bases and LOCK connectors, coupled with different materials and coatings.

GALVANIC COUPLING TEST

galvanic current vs potential difference for macroscopic galvanic couples.

MATERIALS TESTED

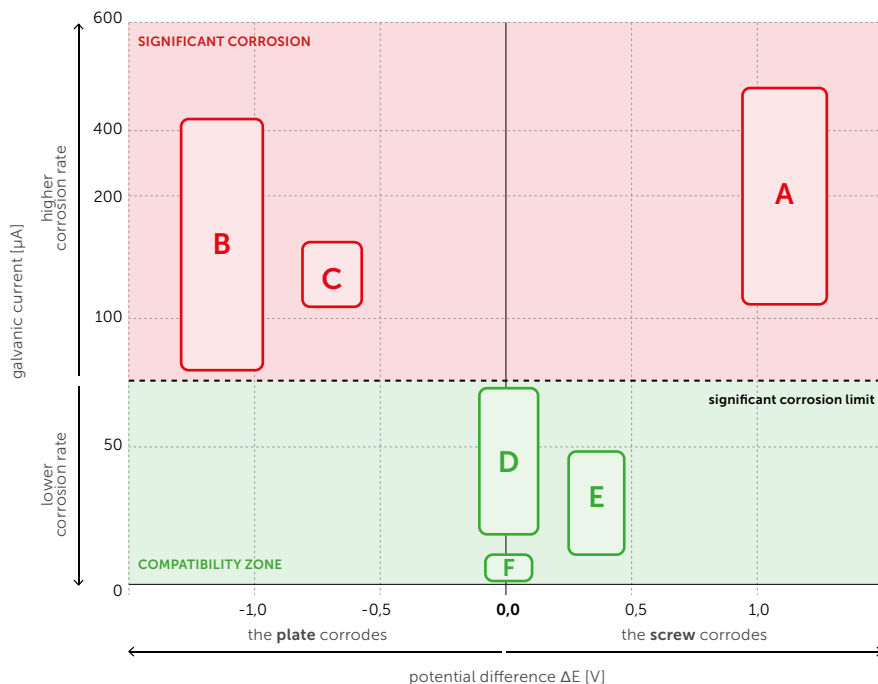
		electro-galvanised coating with chromium passivation Fe/Zn
coated carbon steel		hot dip galvanising
		EVO C4 coating
		DAC COAT organic coating
aluminium		EN AW-6082 aluminium alloy
		EN AW-6005A aluminium alloy
		EN AW-6005A aluminium alloy + EVO coating
stainless steel		martensitic stainless steel AISI 410
		austenitic stainless steel A2 / AISI 304
		austenitic stainless steel A4 / AISI 316
		HCR A8 / AL-6XN super-austenitic stainless steel

In the graph:

- the **horizontal axis** represents the potential difference between the two metals and indicates both how electrochemically different they are and which of the two tends to corrode;
- the **vertical axis** represents the intensity of the galvanic current. Higher values correspond to greater corrosion. Each coloured rectangle represents the set of results obtained for a specific material pairing. The greater its development along the vertical axis, the greater the dimensional effect observed during testing, determined by testing the same materials using components of different sizes, ranging from washers approximately 30 mm in diameter to post bases with an area of approximately 200 cm².

For further information, the complete test report is available at www.rothblaas.com





COUPLINGS

- (A)** Zn / EVO screw + stainless steel plate
→ the **screw** corrodes
 $\Delta E \approx +0,9 \text{ V} \cdot 129\text{--}513 \text{ µA}$
- (B)** stainless steel screw + Zn / EVO /HDG / Dac-coat plate
→ the **plate** corrodes
 $\Delta E \approx 0,4\text{--}0,9 \text{ V} \cdot 61\text{--}447 \text{ µA}$
- (C)** stainless steel screw + Al plate (LOCK)
→ the aluminium corrodes
 $\Delta E \approx -0,6 \text{ V} \cdot 110\text{--}122 \text{ µA}$

- (D)** Zn / EVO screw + HDG plate
→ compatibility close to limit
 $\Delta E \approx -0,03 \text{ V} \cdot 10\text{--}60 \text{ µA}$
- (E)** Zn / EVO screw + Al plate
→ negligible corrosion on Zn
 $\Delta E \approx -0,3 \text{ V} \cdot 10\text{--}50 \text{ µA}$
- other pairings of similar materials**
- (F)** EVO-Zn, INOX-INOX, EVO/Zn-Dac-coat
 $\Delta E \approx 0 \text{ V} \cdot I < 50 \text{ µA}$

Rectangle height: cathode size variability (washer $\varnothing \sim 30 \text{ mm}$ → plate $\sim 200 \text{ cm}^2$).

Method: Potentiostatic ZRA — ASTM G71

KEY FINDINGS

Galvanic current measurements (ZRA) show:

- ⚠ a **significant potential difference** between **zinc-based coatings** (electro-galvanising, EVO) and **stainless steels**;
- a significant potential difference also between **uncoated aluminium** (LOCK) and **stainless steels** (AISI 410).

Conversely, the measurements indicate:

- ✅ an **almost negligible potential difference** between **different zinc-based coatings** (for example EVO vs electro-galvanising);
- an almost negligible potential difference between **different stainless steels** (for example AISI 410 and AISI 316);
- in pairings between **zinc-based coatings** (electro-galvanising or EVO) and **aluminium**, or between electro-galvanising and hot-dip galvanising, the corrosion phenomena observed are not such as to compromise the coupling, which can generally be considered acceptable.

PRACTICAL COMPATIBILITY TABLE

LEGEND

- possible coupling
- coupling with limited corrosion
- coupling not possible
The anodic element (zinc) undergoes significant corrosion.

		washer/plate							
		Zn ELECTRO PLATED	C4 EVO COATING	HOT DIP	DAC COAT	alu	alu EVO	A2 AISI 304	A4 AISI 316
screw	Zn ELECTRO PLATED	possible coupling	possible coupling	possible coupling	possible coupling	possible coupling	possible coupling	coupling not possible	coupling not possible
	C4 EVO COATING	possible coupling	possible coupling	possible coupling	possible coupling	possible coupling	possible coupling	coupling not possible	coupling not possible
	410 AISI	coupling not possible	coupling not possible	coupling not possible	coupling with limited corrosion	coupling with limited corrosion (*)	coupling with limited corrosion (*)	possible coupling	possible coupling
	A2 AISI 304 A4 AISI 316	coupling not possible	coupling not possible	coupling not possible	coupling with limited corrosion	coupling with limited corrosion (*)	coupling with limited corrosion (*)	possible coupling	possible coupling

NOTE: The indications provided in the table are valid provided that the exposure conditions specified for each material/coating are respected. For further information, see the TIMBER SCREWS SMARTBOOK.

(*) see the section below entitled "TIMBER AND GALVANIC COUPLING".

TIMBER AND GALVANIC COUPLING

Where connections are located outdoors but installed within protected and sealed joints, **preventing the ingress of free water** or exposure to weathering agents, the surrounding timber may also provide a protective effect against galvanic corrosion. Under these conditions, it is sufficient for the paired materials to be compatible with both the corrosivity of the timber and that of the exposure environment.

In such situations, the use of pairings that are normally discouraged (e.g. aluminium with stainless steel) may be considered following a technical assessment supported by Rothoblaas.

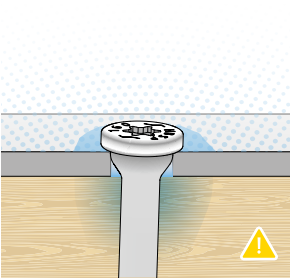


CORROSION ON SITE: HYDROGEN EMBRITTLEMENT

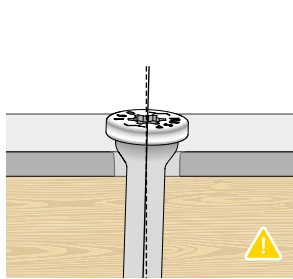
Under certain conditions, corrosion may be associated with a more complex phenomenon known as hydrogen embrittlement, which can lead to the initiation and propagation of microcracks in the steel, ultimately resulting in brittle failure of the fastener under load.



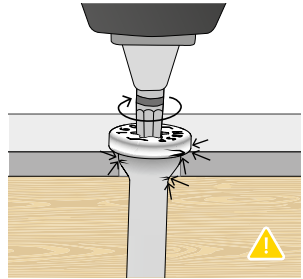
For the phenomenon to occur, several conditions generally need to be **simultaneously** satisfied:



Presence of moisture, which activates the corrosive environment within the timber and may promote galvanic coupling between dissimilar materials.



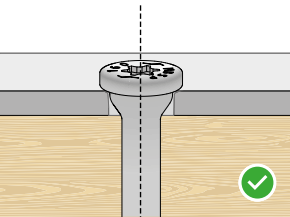
Damage to, or discontinuities in, the coating that may occur during installation.



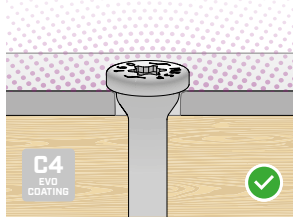
Stresses within the fastener, resulting from applied loads or, more commonly, from suboptimal installation conditions.



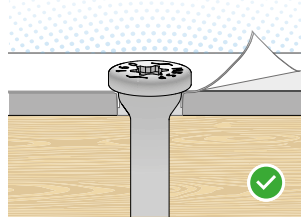
Prevention of this phenomenon requires a **combination of several protective measures**. The most important include:



Correct installation, reducing the risk of coating damage and the introduction of undesirable stresses into the fastener.



Selection of **materials or coatings appropriate to the corrosion** expected under both service and construction conditions.

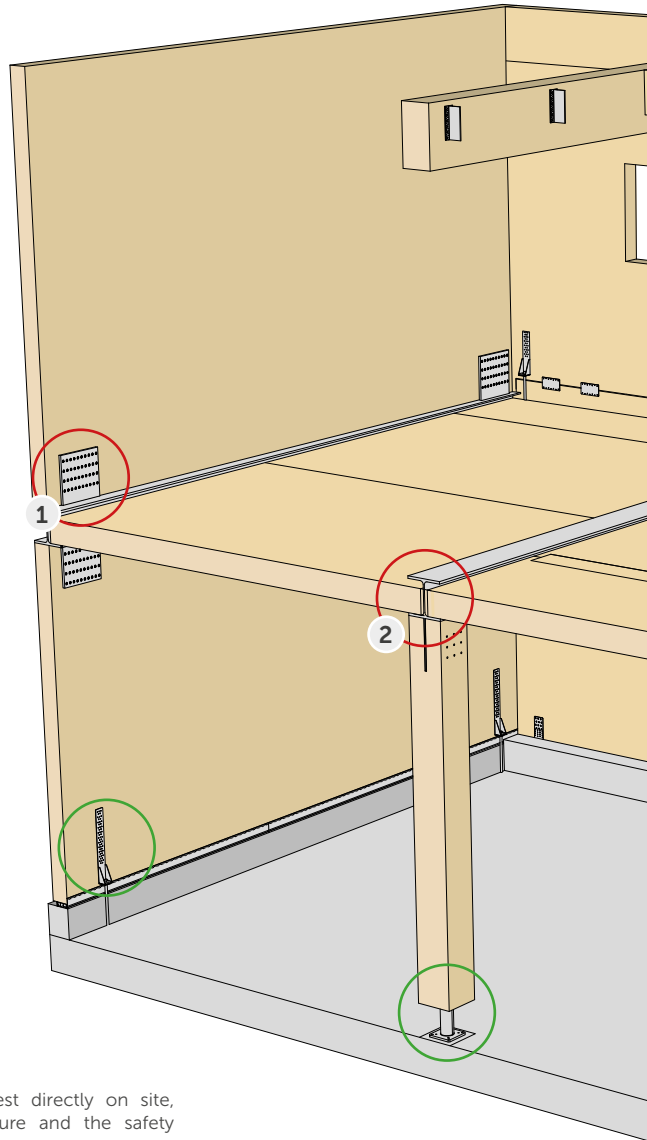


Protection from moisture through proper site management and temporary protection of connections from water ingress.

For further information on premature failure and the role of hydrogen embrittlement in timber fasteners, please refer to the White Paper "Premature Failure in Timber Screws: Insights into Hydrogen Embrittlement and Stress-Driven Risk".



CRITICAL CONNECTIONS: IDENTIFICATION AND ASSESSMENT

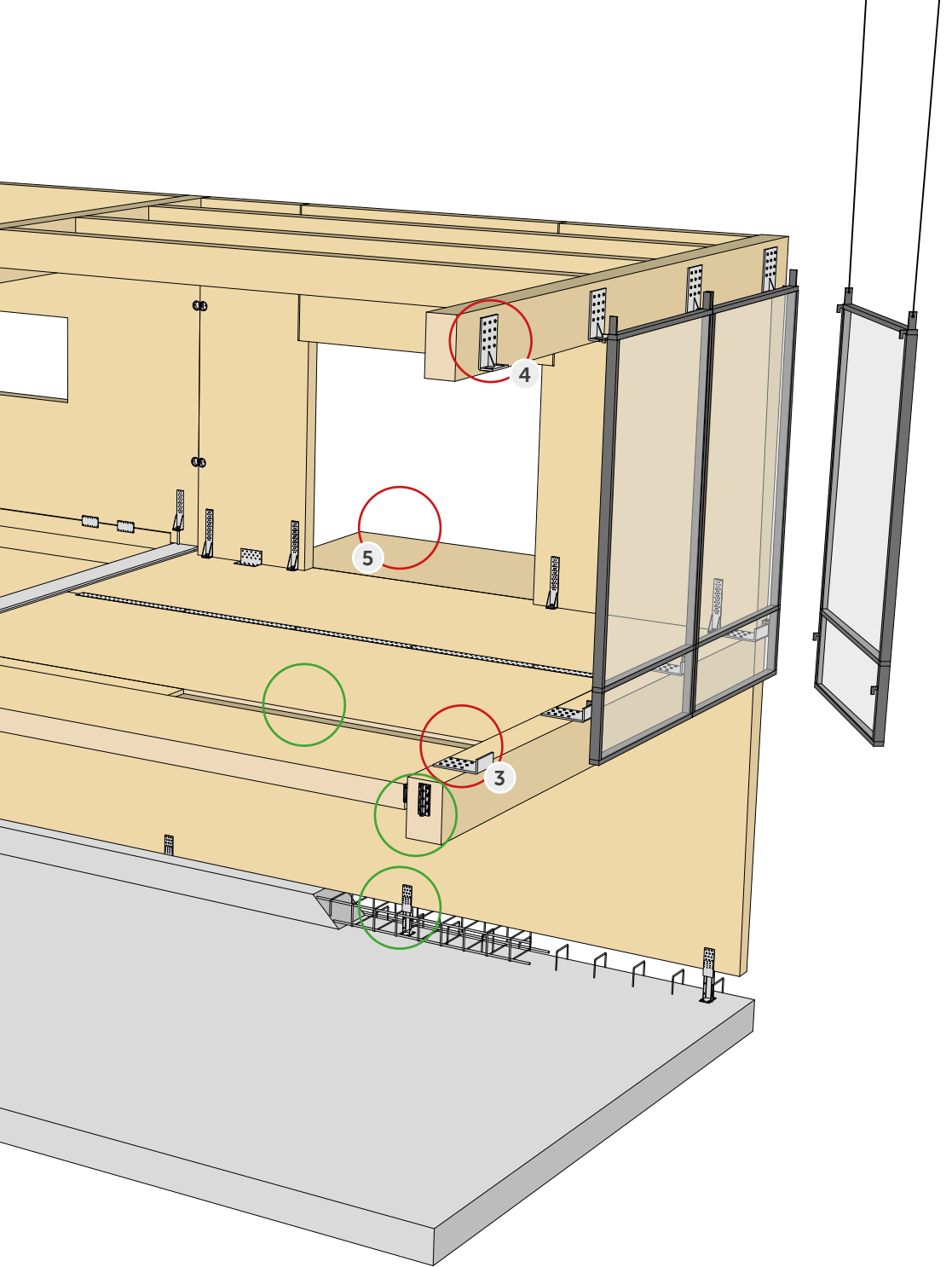


○ RISK ON SITE

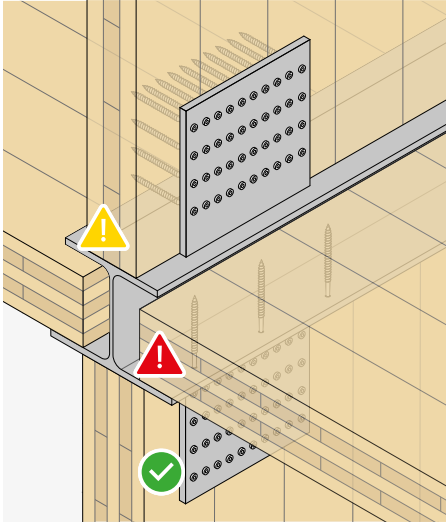
Potential risks whose effects may manifest directly on site, compromising the stability of the structure and the safety of those working within it.

○ LONG-TERM DESIGN RISK

Potential risks resulting from inadequate design, discussed in detail throughout the various chapters of this Smartbook. If not properly managed or mitigated, these issues may affect the long-term durability of the structure.



1. TIMBER-TO-STEEL CONNECTIONS IN AREAS PRONE TO STANDING WATER



LOW RISK

Connection with a thick steel plate, potentially sensitive to screw installation errors. However, this condition is characterised by a low risk of exposure to weathering and the absence of standing water.



MEDIUM RISK

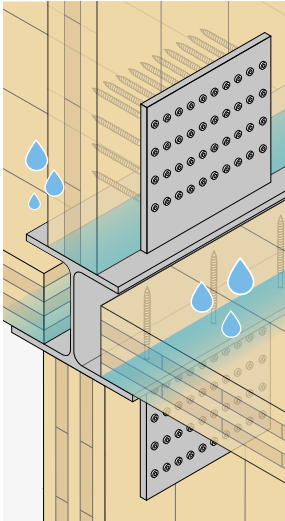
Connection with a steel plate potentially exposed to water on site. The vertical configuration promotes drainage but does not eliminate the possibility of standing water at the wall-to-beam interface.



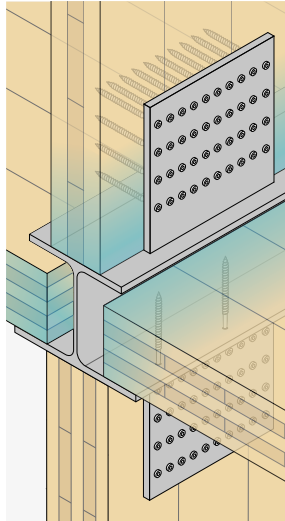
HIGH RISK

Connection with a thick steel plate in an area subject to standing water and pooling.

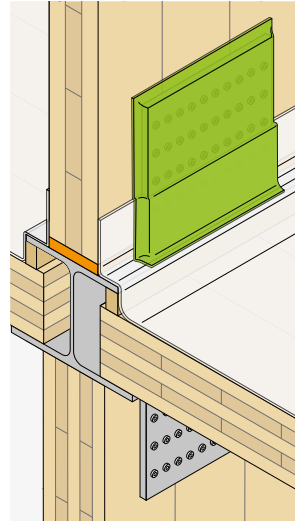
RISK OF WATER INGRESS ON SITE



During construction, rainfall may cause water ingress at the exposed tops of CLT panels.

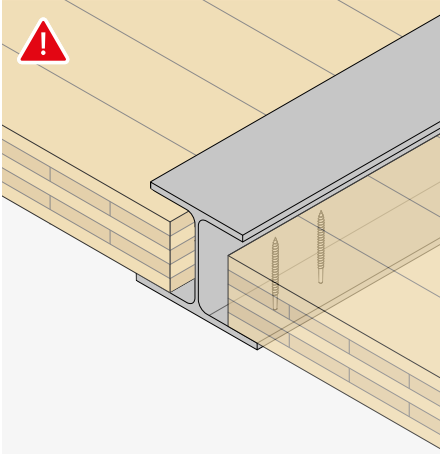


Where water accumulates, the timber rapidly absorbs moisture, resulting in timber swelling and corrosion of metal components.

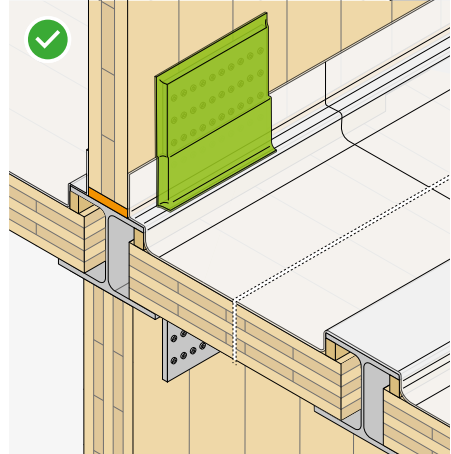


The use of acoustic isolation mats beneath the wall separates the timber from the water and prevents excessive moisture absorption. Extend the protection 300 mm above floor level and cover the metal components and joints.

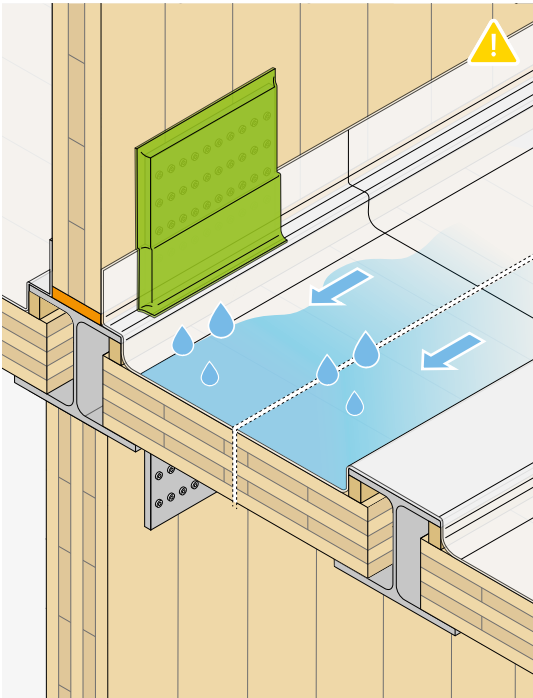
2. STANDING WATER AND POOLING ON SITE



High-risk connection: thick steel plate in an area subject to standing water and pooling.

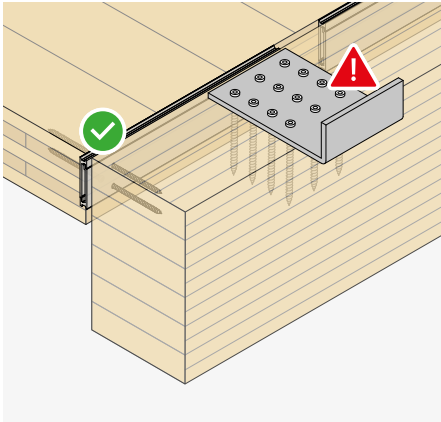


Temporary site protection sealing the most sensitive areas.



During construction, temporary protective membranes are often subjected to significant stresses, such as panels being dragged or accidental trampling of nails or screws. Although membranes are designed to withstand site operating conditions, they may nevertheless become damaged over time. Once the floor surface has been waterproofed, provision should be made for water drainage, preferably directing water outside and away from the timber structures.

3. TIMBER-TO-STEEL CONNECTIONS AT THE BUILDING PERIMETER



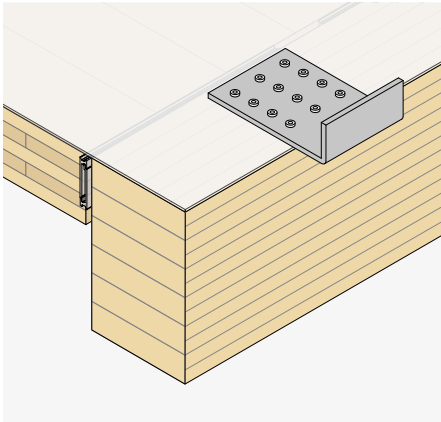
LOW RISK

If the connection is localised, water can drain away quickly. If the connection is continuous, as in the case of **LOCK FLOOR**, drainage points must be provided by separating the profiles.

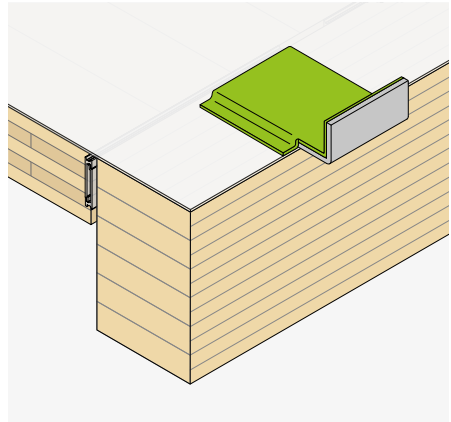


HIGH RISK

Connection with a thick steel plate located in an area prone to standing water and pooling. Façade plates, positioned along the building perimeter, are among the elements most exposed to water during construction.



Install a membrane between the plate and the timber. Rothoblaas recommends **DEFENCE ADHESIVE**.



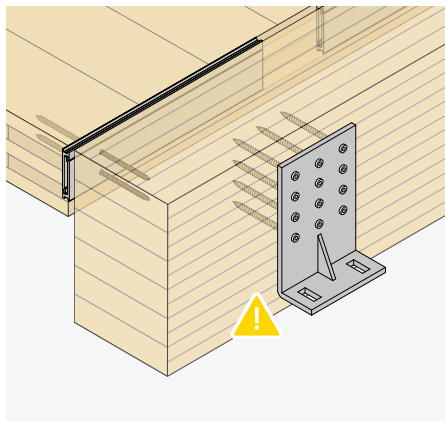
Cover the plate with a waterproof element. The connection is located on the building perimeter and requires careful protection.



Ventilation cavities can create a chimney effect and, in the event of a fire, accelerate the spread of flames. For this reason, the use of products with a fire reaction class higher than the standard is recommended, particularly products classified as B-s1, d0 (EN 13501) or higher.

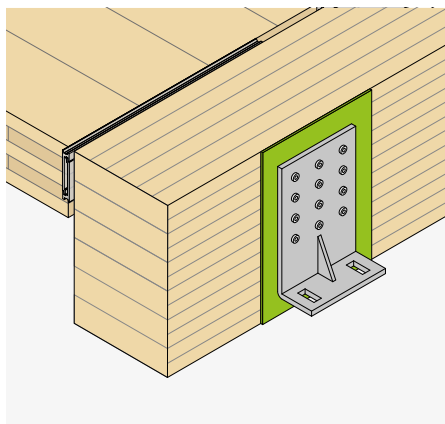
See further details under "ASSESSMENT OF THE STRUCTURAL ELEMENT AND CRITICAL AREAS" on page 72

4. TIMBER-TO-STEEL CONNECTIONS AT THE BUILDING PERIMETER

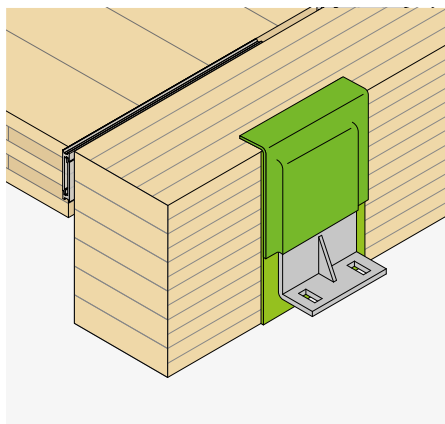


MEDIUM RISK

A vertical localised connection is less susceptible to standing water, allowing water to drain quickly and the timber to dry. However, the thick steel plate remains an area more exposed to water and requires appropriate protective measures.



Install a membrane between the plate and the timber.



Seal the upper joint with tape to prevent water ingress.

ROTHOBLAAS RECOMMENDS

DEFENCE ADHESIVE
SELF-ADHESIVE
PROTECTIVE MEMBRANE
FOR BUILDING ELEMENTS



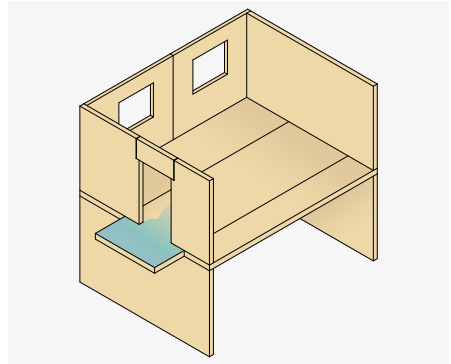
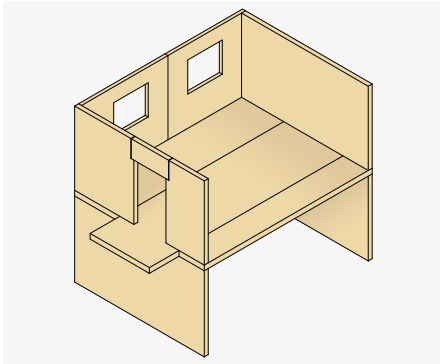
INVISI BAND

TRANSPARENT SINGLE-SIDED
ADHESIVE TAPE WITHOUT LINER,
RESISTANT TO UV
AND HIGH TEMPERATURES

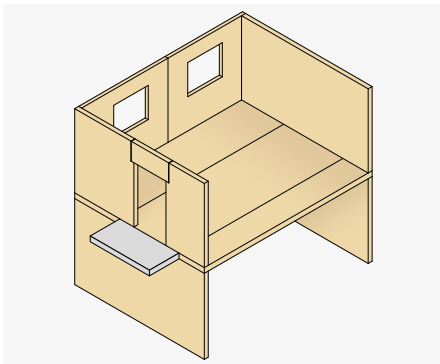


5. RISKS ASSOCIATED WITH BALCONIES IN TIMBER STRUCTURES

The balcony junction is a critical detail that must ensure both **stability** and **durability** over time.



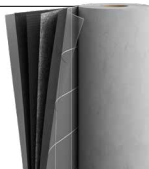
When the CLT panel is continuous with the balcony, no structural connections are present at floor level. This configuration reduces the risks associated with complex connection details but increases vulnerability to water ingress. In the event of ingress, water can spread from the exterior to the interior of the building, facilitated by the structural continuity between the two areas. Any deterioration or decay may therefore compromise not only the balcony but also the internal floor structure. For this reason, the timber element must be designed and built with a level of waterproofing equivalent to that required for flat roofs and terraces.



Where the balcony is not continuous with the CLT floor structure, careful consideration must be given to the material and construction solution adopted for the cantilevered balcony. Integrating the projecting balcony by means of a joint or connection requires the use of metal structural elements, often characterised by their high thickness. These elements constitute potentially weak points: located on the external perimeter of the building, they are exposed to water. Specific protection and treatment measures must be provided to ensure the durability of the system.

ROTHOBLAAS RECOMMENDS

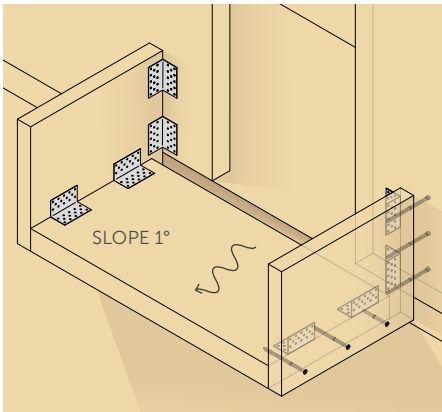
BYTUM BASE 2500
SELF-ADHESIVE
BITUMINOUS MEMBRANE



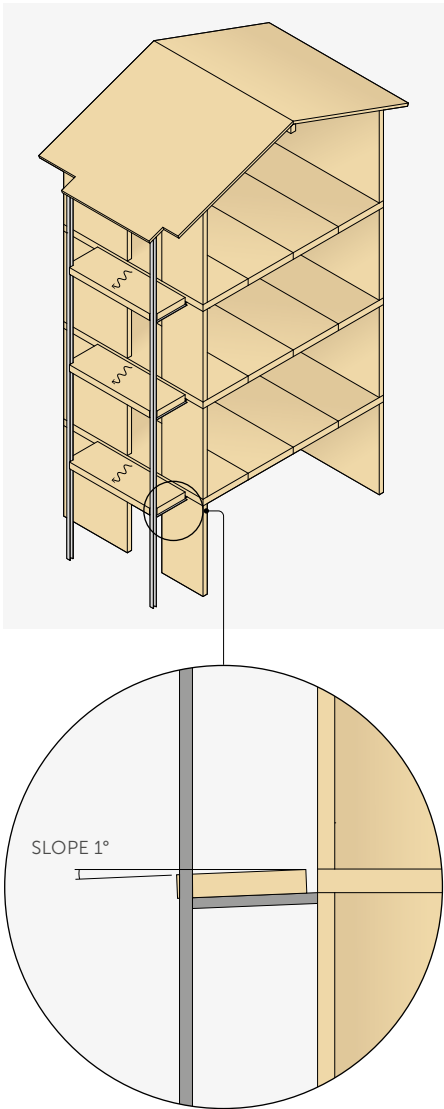
See further details under "RAINWATER DRAINAGE
AND DEFLECTION" on page 156

Exposure of timber to moisture significantly reduces its long-term durability. For external elements such as balconies, it is advisable to adopt construction systems and connections that allow easy dismantling in the event of water ingress. It is recommended to use replaceable external structures that can be removed without intervening on the building's primary structure. One example is external landings supported by independent columns, allowing the balcony to be removed without affecting the internal floor structure or other structural elements.

Various solutions are available for fastening easily demountable external structures. Among these, side railings can be used as structural elements, acting as cantilever beams fixed to the façade by means of certified angle brackets capable of resisting shear and tensile forces. This represents an alternative, yet compliant and certified use of our **ANGLE BRACKETS** or **HOLD DOWN** systems, enabling the construction of efficient, reversible structures that meet durability and maintainability requirements.



Example: **TITAN S** angle bracket with high tensile strength. The combination of a thin plate and a large-diameter screw reduces the forces generated by timber swelling. Easily demountable solution.



The separation between the balcony structure and the building structure allows a layer of thermal insulation to be installed, reducing thermal bridging. This separation also improves durability: in the event of water ingress, water cannot reach the internal structure, limiting damage to load-bearing elements.

CONNECTION DETAILS FOR MANAGING WATER AND MOISTURE

The durability principles discussed in the chapter “BASE CONNECTIONS: JUNCTION DESIGN” (p. 130) also apply to connection details. Risk management is based on four key aspects:

- surface protection of the elements
- protection and sealing of the joint
- proper management of water drainage (avoiding standing water)
- adequate ventilation

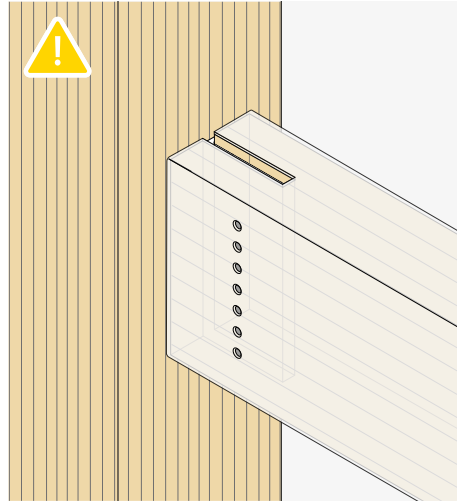
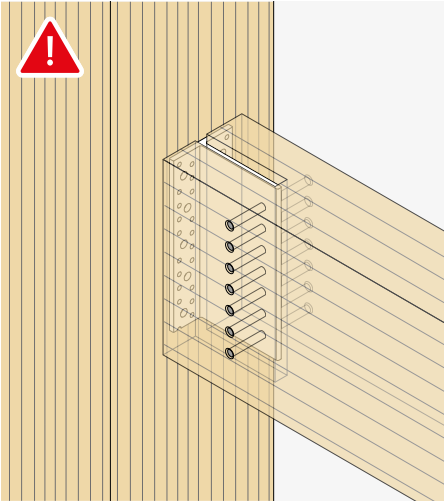
RISK ASSESSMENT			
	LEVEL OF PROTECTION	EFFECT	
 very low risk	complete protection, with all holes and joints sealed and drainage provided at weak points	elements fully protected against water ingress and standing water	
 low risk	elements protected over most of their surface, with drainage provided at weak points	elements protected only near weak points, with a limited risk of water ingress	
 medium risk	partial protection of timber elements, with exposed connectors and no drainage management at weak points	elements partially protected, with possible water ingress	
 high risk	no protection	unprotected elements	

The level of risk also depends on factors such as the construction period, geographical location, proximity to aggressive environments, and the moisture content of timber elements, particularly where seasoning processes are involved. The acceptability of the risk is the responsibility of the designer.

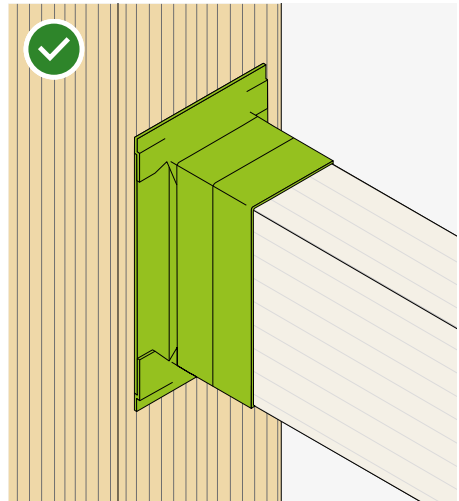
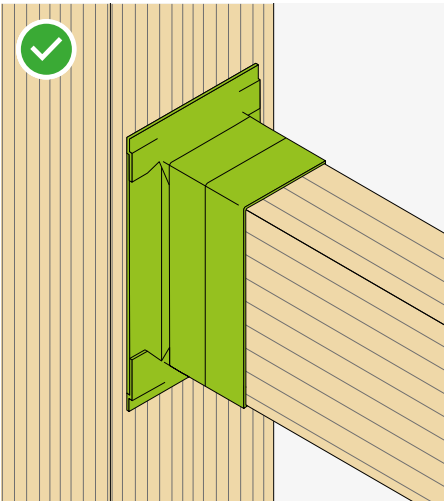
See further details under “CORROSIVITY CONDITIONS ON SITE” on page 18

INTERNAL KNIFE-PLATE JOINT

Although the routed profile promotes water drainage and the head protection limits moisture uptake at the most critical location, the connection remains partially exposed, creating a risk of corrosion of the metal components. It is common practice to protect the timber beam with a membrane; however, following assembly of the beam and connection, openings will remain in the membrane: on the top of the beam and where the dowels are installed.

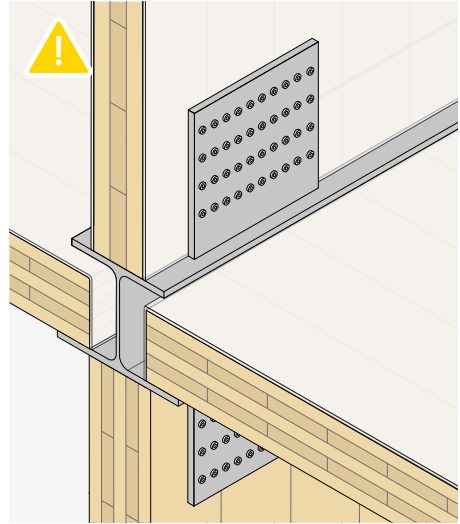
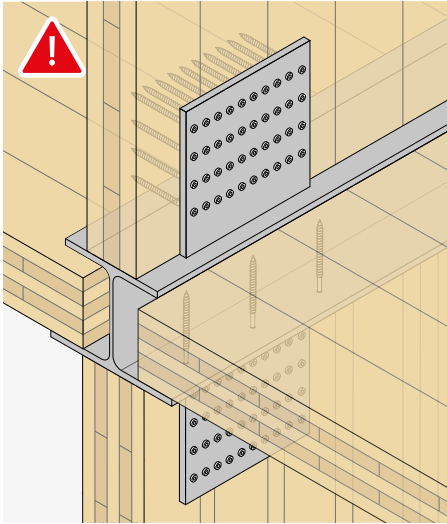


Full sealing, applying tape to the area adjacent to the routing, prevents moisture absorption by the timber, improving the durability of the connection. In addition, applying a protective membrane to the beam limits water absorption during the transport and storage of timber structural elements.

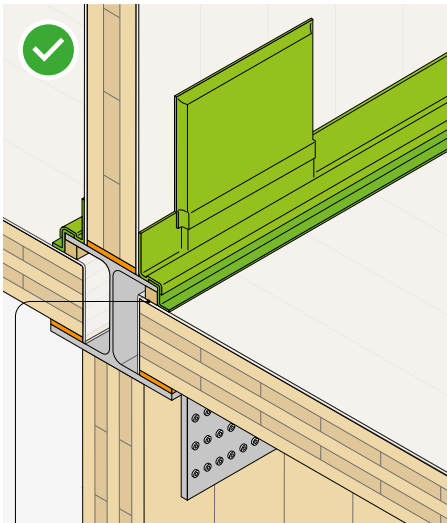


IPE BEAM-CLT ELEMENT CONNECTION

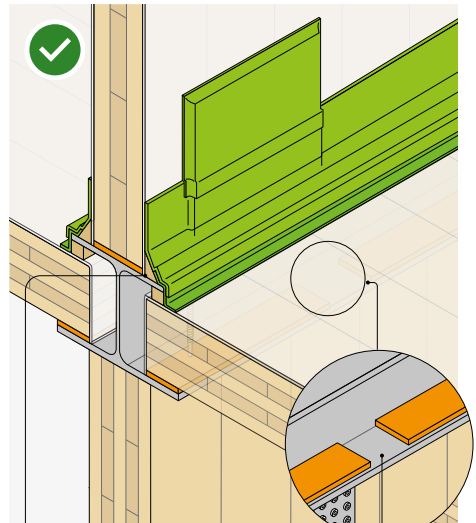
The use of tapes and/or membranes significantly reduces water absorption. Joints should provide adequate overlap, avoiding localised stresses on the membrane.



It is important to facilitate water drainage from weak points to prevent standing water in the event of localised water ingress. For example, slopes and packing may be introduced to create drainage paths, which also function as ventilation zones for drying.



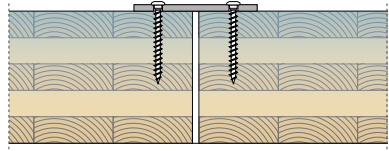
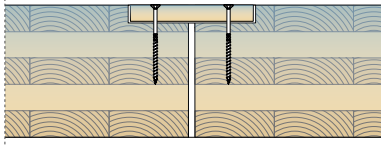
anti-tear wedge



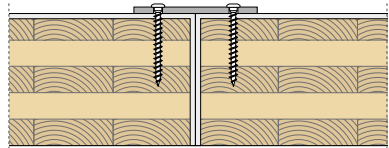
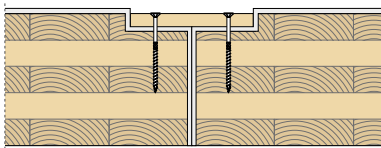
timber or insulating wedge

drainage and ventilation

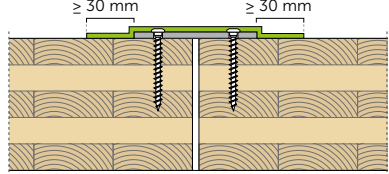
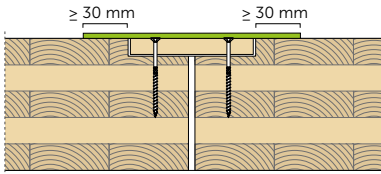
LINEAR JOINTS



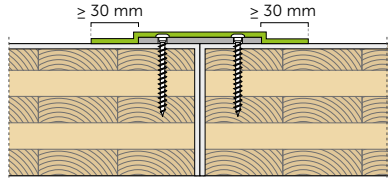
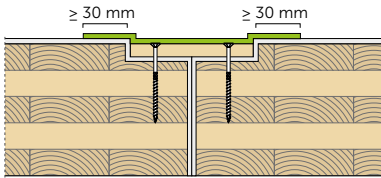
Standing water must be avoided, particularly in geometries that promote water pooling. Exposure of the connection causes corrosion of the metal connectors and swelling of the timber, reducing the durability of the joint.



The use of membranes alone **limits water ingress** through capillary absorption, reduces the risk of localised swelling and improves the durability of timber elements. However, the possibility of standing water remains, as does the risk of localised membrane punctures that may compromise its effectiveness.



The use of membranes and/or tapes to seal joints significantly reduces **water ingress into the gaps** between connected panels. However, issues remain relating to the exposure, even if partial, of the elements and the risk of localised puncturing of the membranes. Local protection of the connection area limits the risk of corrosion and the effects of localised swelling, but does not eliminate timber durability issues or the effects of non-uniform swelling on a larger scale.



Membranes and tapes, applied to timber elements and connections, provide a high level of protection for the joint. Protection must be continuous and properly integrated at connection points, with particular attention to standing water and localised puncturing caused by connectors.

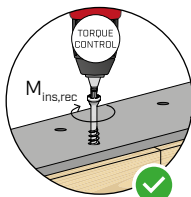
INSTALLATION AND INSPECTION OF FASTENING SYSTEMS

CORRECT INSTALLATION TORQUE

During installation, the torque setting must be sufficient to overcome the resistance to insertion and allow the screw to penetrate the timber.

Installation should be stopped as soon as the head comes into contact with the metal element or is fully embedded in the timber.

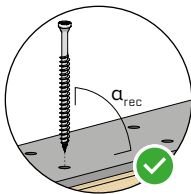
Further tightening does not improve the safety of the connection. Instead, it increases the risk of damage or failure.



CORRECT INSERTION ANGLE

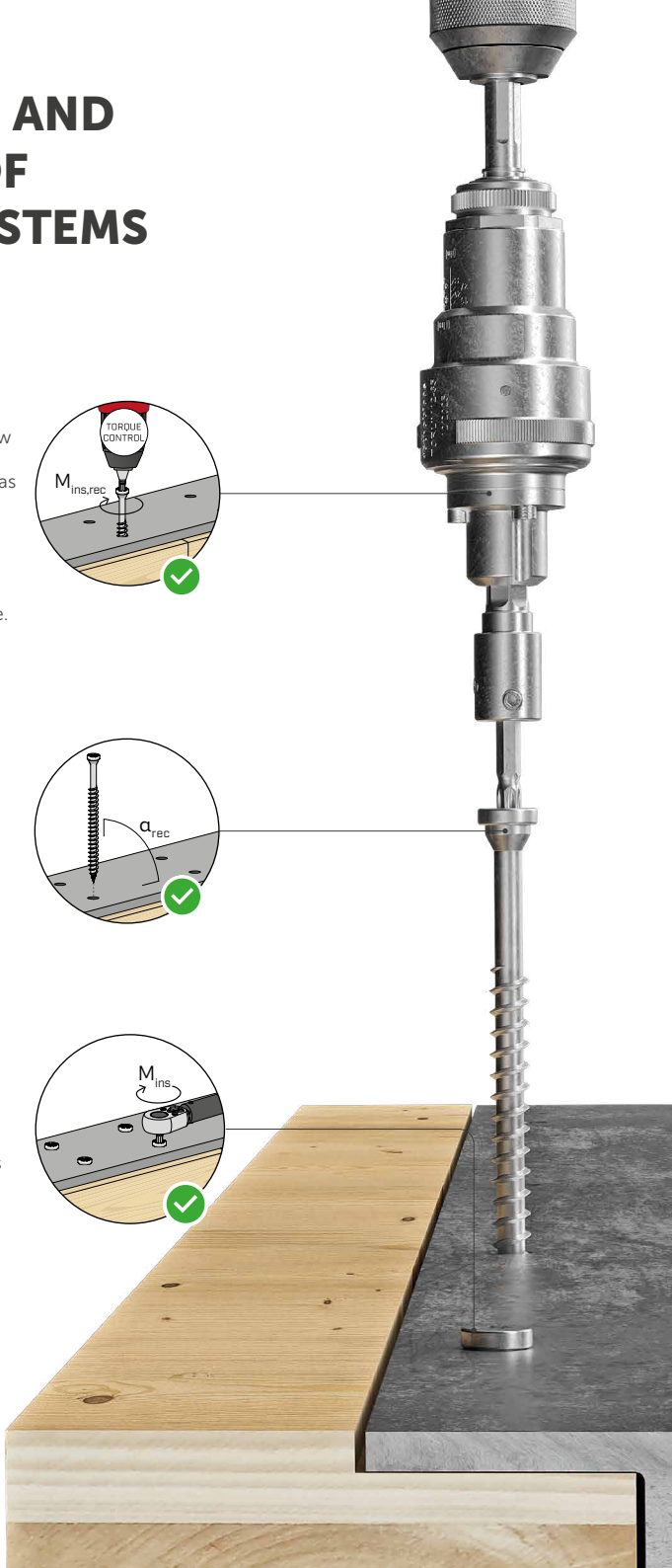
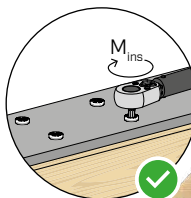
The connector performs correctly only if the specified installation angle is respected.

This check is particularly important in connections involving metal plates.



UNIFORM STRESS DISTRIBUTION

To prevent certain screws from being subjected to higher loads than others and to ensure the proper "group effect" assumed by calculation models, screws must be tightened with torque values that are as uniform as possible and following an appropriate installation sequence.



TIGHTENING

RECOMMENDED INSERTION MOMENT

The torque required to install a screw depends on the type and dimensions of the connector, as well as the characteristics of the substrate.

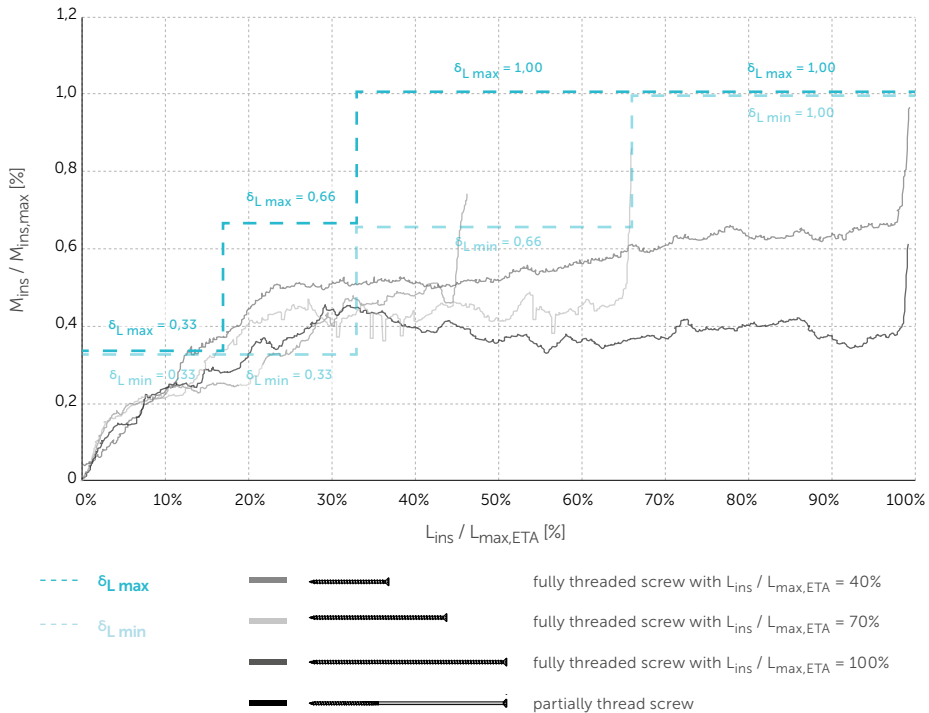
To ensure correct installation, the applied torque must be suited to the actual application conditions and controlled using appropriate equipment.

Even under identical installation conditions, the torque required for insertion may vary.

For this reason, reference should be made to an installation torque range within which effective screw installation is ensured without compromising the performance of the connection.

The **recommended insertion torque** shall be determined according to the actual insertion length (L_{ins}).

Insertion torque trends for different screws and insertion lengths:



$L_{ins} / L_{max,ETA}$	< 17%	17% - 33%	33% - 66%	> 66%
$\delta_{L \min}$	0,33	0,33	0,66	1,00
$\delta_{L \max}$	0,33	0,66	1,00	1,00

This distinction is particularly important for fully threaded screws; for partially threaded screws, $\delta_L = 1.00$ is always assumed.

RECOMMENDED INSTALLATION TORQUE ($M_{ins, rec}$)

As a manufacturer of high-performance fasteners, Rothoblaas specifies, for each screw type, diameter and insertion length, a **recommended installation torque** range ($M_{ins, rec, min}$ and $M_{ins, rec, max}$).

It is recommended that screw insertion be stopped as soon as the head comes into contact with the metal plate in steel-to-timber connections, or when the upper surface of the head is flush with the surface of the timber element (unless specific geometric requirements apply, such as recessing the head into the timber).

CARBON STEEL SCREWS (electro-galvanised and EVO-coated)

	d	L	$M_{ins, rec, min}$	$M_{ins, rec, max}$	d	L	$M_{ins, rec, min}$	$M_{ins, rec, max}$
	[mm]	[mm]	[Nm]	[Nm]	[in]	[in]	[ft-lbs]	[ft-lbs]
HBS PLATE	8	≤ 100	8	12	0.32	≤ 4"	5	8
		> 100	10	20		> 4"	7	14
	10	≤ 120	10	20	0.40	≤ 4 3/4"	7	14
		> 120	15	30		> 4 3/4"	11	22
	12	≤ 140	20	30	0.48	≤ 5 1/2"	14	22
		> 140	25	40		> 5 1/2"	18	29
VGS PLATE	11	≤ 160	12	25	0.44	≤ 6 1/4"	8	18
		> 160	20	30		> 6 1/4"	14	22
LBS HARDWOOD (*)	5	≤ 120	3	5	0.20	≤ 4 3/4"	2	3
	7	≤ 100	4	10	0.28	≤ 4"	2	7
		> 100	8	12		> 4"	5	8
VGS VGZ	7	< 160	4	10	0.28	< 6 1/4"	2	7
		160 - 280	8	12		6 1/4" - 11"	5	8
		> 280	12	12		> 11"	8	8
	9	< 200	7	13	0.36	< 8"	5	9
		200 - 360	10	20		8" - 14 1/4"	7	14
		> 360	20	20		> 14 1/4"	14	14
	11	≤ 350	13	26	0.44	≤ 13 3/4"	9	19
		350 - 600	26	40		13 3/4" - 23 5/8"	19	29
		> 600	40	40		> 23 5/8"	29	29
	13	< 250	15	25	0.52	< 10"	11	18
		250 - 500	20	35		10" - 19 3/4"	14	25
		500 - 1000	30	50		19 3/4" - 39 3/8"	22	36
		> 1000	50	50		> 39 3/8"	36	36
VGZ HARDWOOD (*)	6	≤ 220	4	8	0.24	≤ 8 5/8"	2	5
		> 220	8	12		> 8 5/8"	5	8
	8	≤ 280	7	13	0.32	≤ 11"	5	9
		> 280	10	20		> 11"	7	14
LBS	5	≤ 70	3	3	0.20	≤ 2 3/4"	2	2
	7	≤ 100	10	10	0.28	≤ 4"	7	7
HBS TBS HBSP	5	≤ 120	3	3	0.20	≤ 4 3/4"	2	2
	6	≤ 400	6	6	0.24	≤ 15 3/4"	4	4
	8	≤ 600	14	14	0.32	≤ 23 5/8"	10	10
	10	≤ 600	20	20	0.40	≤ 23 5/8"	14	14
	12	≤ 1000	26	26	0.48	≤ 39 3/8"	19	19
HBS HARDWOOD (*)	6	≤ 160	12	12	0.24	≤ 6 1/4"	8	8
	8	≤ 480	25	25	0.32	≤ 19"	18	18

STAINLESS STEEL SCREWS

	d	L	M _{ins,rec,min}	M _{ins,rec,max}	d	L	M _{ins,rec,min}	M _{ins,rec,max}
	[mm]	[mm]	[Nm]	[Nm]	[in]	[in]	[ft-lbs]	[ft-lbs]
HBS PLATE A4	8	≤ 100	5	10	0.32	≤ 4"	3	7
		> 100	8	15		> 4"	5	11
	10	≤ 120	7	13	0.40	≤ 4 3/4"	5	9
		> 120	10	20		> 4 3/4"	7	14
	12	≤ 140	12	27	0.48	≤ 5 1/2"	8	19
		> 140	20	34		> 5 1/2"	14	25
VGS A4	9	≤ 240	6	15	0.36	≤ 9 1/2"	4	11
		> 240	12	18		> 9 1/2"	8	13
	11	< 250	10	20	0.44	< 10"	7	14
		250 - 400	18	29		10" - 19 3/4"	13	21
SCI A2	5	≤ 100	3	3	0.20	≤ 4"	2	2
	6	≤ 160	5	5	0.24	≤ 6 1/4"	3	3
	8	≤ 320	11	11	0.32	≤ 12 5/8"	8	8

The tabulated values apply to the insertion of screws in spruce timber (maximum density 490 kg/m³ / SG < 0.47) without pre-drilling. They are derived from experimental testing based on ETA-11/0030 and in compliance with the torsional resistance of the connector.

(*) For installation in hardwood, the tabulated values may be increased by 25%.

To avoid overtorque, the minimum installation torque (M_{ins,rec,min}) must be applied. If the screw cannot be inserted, the torque may be increased up to the maximum recommended torque value (M_{ins,rec,max}).

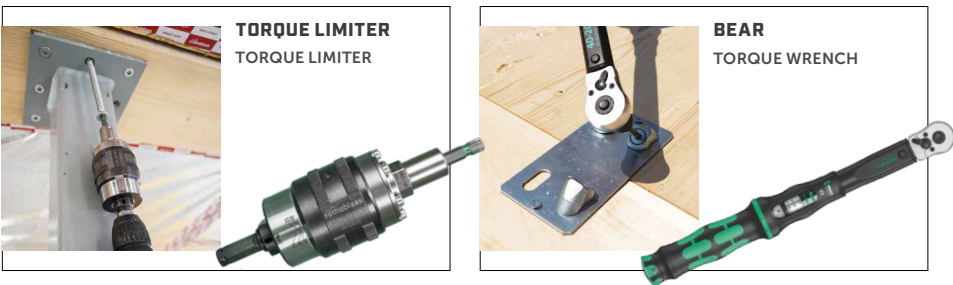


When installing through a metal plate, the use of a TORQUE LIMITER is recommended; in this configuration, M_{ins,rec,max} may be set.

TIGHTENING CONTROL

Control of the installation torque must be ensured through the use of suitable tools capable of monitoring and limiting the torque applied during installation.

ROTHOBLAAS RECOMMENDS

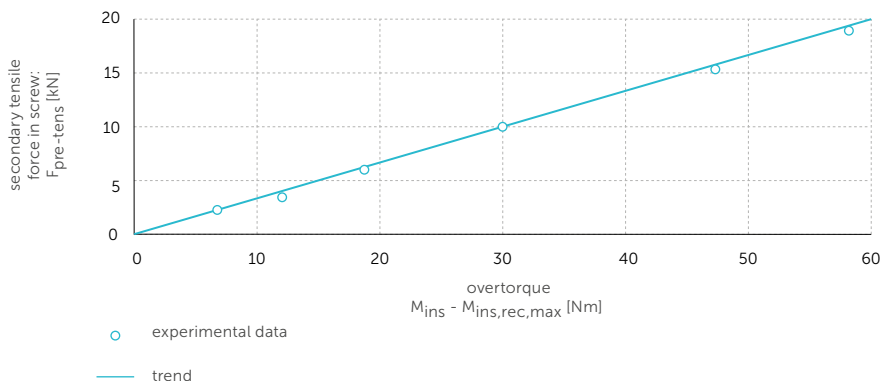


OVERTORQUE: EFFECTS ON THE CONNECTOR

To penetrate the timber, a screw must be installed with sufficient insertion torque to overcome the material's resistance to screw insertion.

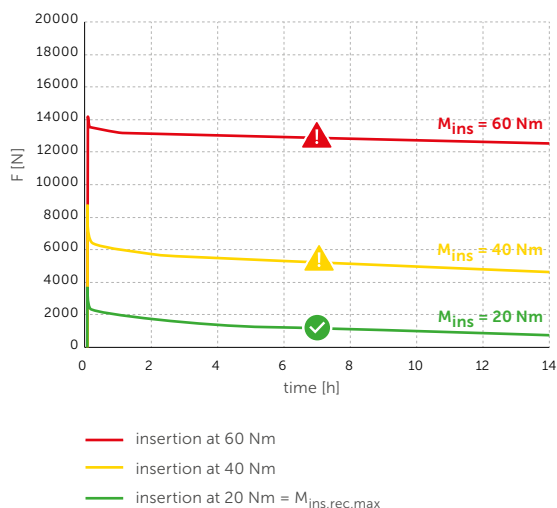
When the screw head comes into contact with the **plate**, the plate acts as a restraint, preventing further penetration of the screw into the timber. If tightening torque continues to be applied, a **secondary tensile load** is generated in the screw: the screw tends to advance, but its movement is restrained by the metal element. The tensile load induced in the screw is directly proportional to the **overtorque** applied.

Secondary tensile force as a function of the overtorque



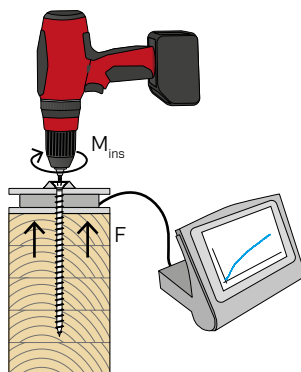
To analyse and quantify the risk associated with this phenomenon, Rothoblaas conducted dedicated experimental tests using load cells and driving screws through thick steel plates, progressively increasing the installation torque to generate overtorque.

Effects of overtorque



screw:

➡ VGS Ø9 x 200 mm



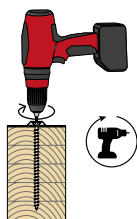
A. Notari (2026) - Designing the Durability of Timber Joints: Hygroscopic Effects and Site Application

OVERTORQUE: EFFECTS ON THE TIMBER

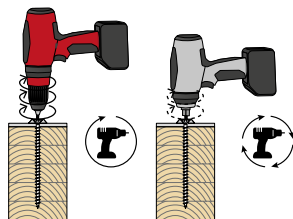
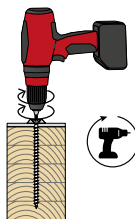
If excessive installation torque is applied during installation ($M_{ins} > M_{ins,rec}$), an over-tightening condition occurs. Once the screw head comes into contact with the plate, further penetration into the timber is prevented. Excessive tightening can cause thread stripping, resulting in damage to the timber grain and a reduction in pull-out strength.

In the case of **correct installation** without *overtorque* (OT), the phenomenon is generally limited, particularly when **thin plates** are used, as they are less stiff, more deformable and offer less resistance to screw advancement. In the presence of OT and **thick plates**, once the screw head comes into contact with the plate, the thread encounters greater resistance to advancement and tends to **damage the surrounding timber grain**, increasing thread stripping. The most critical condition occurs when **impact drivers** are used without torque control, as this further amplifies damage to the timber.

thin plate



thick plate



OVER-TORQUING OT



100%
pull-out strength



75% (-25%)
pull-out strength



25% (-75%)
pull-out strength

For short screws, experimental testing (Alma Mater Studiorum – University of Bologna, Research Centre for Building and Construction) shows that tightening beyond the recommended value significantly reduces pull-out strength: the screw strips the timber, degrading the performance of the anchor system.

SOURCE: Bellini, A.; Morganti, A.; Conquista, F.; Savoia, M.; Pozza, L. (2025). Reuse of HBS PLATE screws on RAPTOR lifting hook: Definition of representative damage mechanism of screw during use and experimental characterization of RAPTOR lifting hook fastened with damaged screws. Alma Mater Studiorum – Università di Bologna, CIRI Edilizia e Costruzioni.

INSTALLATION INSPECTION

Tightening is inspected using the reverse procedure, employing a torque wrench to measure the **loosening torque** of a screw installed through a metal plate; this value is correlated with the degree of tightening applied during installation.

During inspection, it must be verified that the ratio between the loosening torque ($M_{\text{loos, insp}}$) and the recommended tightening torque falls within the limits specified in the table below.

$$M_{\text{loos, insp}} / M_{\text{ins, rec, max}}$$

$$< 0,35$$



low
risk

correct
tightening torque

$$M_{\text{loos, insp}} / M_{\text{ins, rec, max}}$$

$$0,35 < x < 0,45$$



medium
risk

limit
tightening torque

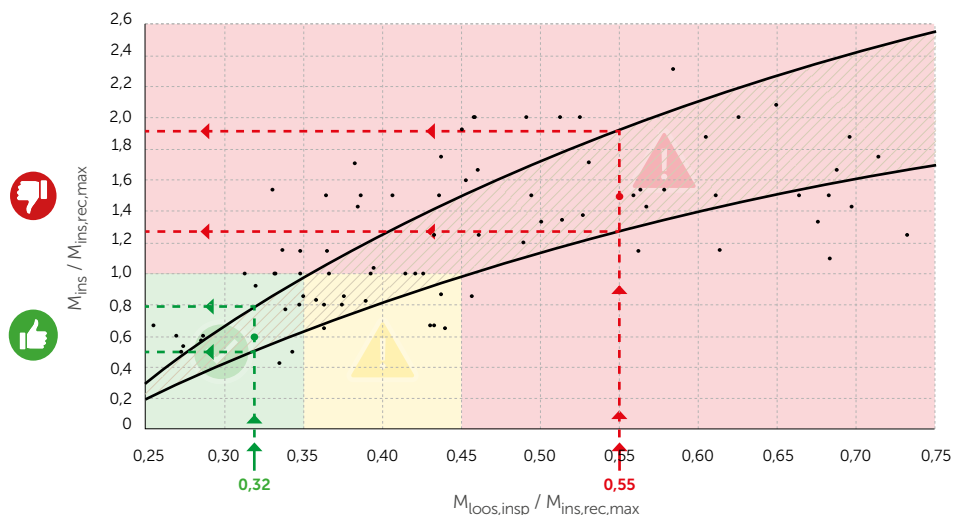
$$M_{\text{loos, insp}} / M_{\text{ins, rec, max}}$$

$$> 0,45$$



high
risk

excessive
tightening torque (OT)



The graph shows the installation examples presented on the following page.

The graph derived from the test results provides a qualitative assessment of the applied torque based on the loosening torque.

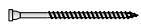
The curves represent the minimum and maximum torque values applied during installation.



EXAMPLE

how to carry out a correct installation and check by inspection

screw:



HSPL Ø10 x 180 mm

support:



spruce glulam (without pre-drilling)

INSTALLATION

- 1 Determine the recommended installation torque from the table according to the screw type, diameter and insertion length;

$$M_{ins,rec,min} = 15 \text{ Nm}$$
$$M_{ins,rec,max} = 30 \text{ Nm}$$

	d	L	$M_{ins,rec,min}$	$M_{ins,rec,max}$	d	L	$M_{ins,rec,min}$	$M_{ins,rec,max}$
	[mm]	[mm]	[Nm]	[Nm]	[in]	[in]	[ft-lbs]	[ft-lbs]
HBS PLATE	8	≤ 100	8	12	0.32	≤ 4"	5	8
		> 100	10	20		> 4"	7	14
	10	≤ 120	10	20	0.40	≤ 4 3/4"	7	14
		> 120	15	30		> 4 3/4"	11	22

- 2 Insert the connector with the torque control set to $M_{ins,rec,min}$.

$$M_{ins} = M_{ins,rec,min} = 15 \text{ Nm}$$

- 3 If the screw cannot be inserted, the tightening torque may be increased up to $M_{ins,rec,max}$.

$$M_{ins} = M_{ins,rec,max} = 30 \text{ Nm}$$

- 4 Ensure that the recommended installation torque is not exceeded during insertion.



installation torque:

$$M_{ins} = 20 \text{ Nm}$$



installation torque:

$$M_{ins} = 40 \text{ Nm}$$

INSPECTION

- 1 Record the loosening torque

$$M_{loos,insp}$$

- 2 Compare it with the maximum recommended installation torque

$$M_{loos,insp} / M_{ins,rec,min}$$

loosening torque:

$$M_{loos,insp} = 9,5 \text{ Nm}$$

CONTROL PARAMETER

$$M_{loos,insp} / M_{ins,rec,max} = 9,5 \text{ Nm} / 30 \text{ Nm} =$$

0,32  low risk

It is assumed that the installation torque applied is between 0.55 and 0.75 times the maximum recommended torque.



correct installation

loosening torque:

$$M_{loos,insp} = 16,5 \text{ Nm}$$

CONTROL PARAMETER

$$M_{loos,insp} / M_{ins,rec,max} = 16,5 \text{ Nm} / 30 \text{ Nm} =$$

0,55  high risk

It is assumed that the installation torque applied is between 1.45 and 1.90 times the maximum recommended torque.



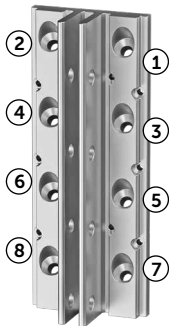
over-torquing (OT)

UNIFORM STRESS DISTRIBUTION

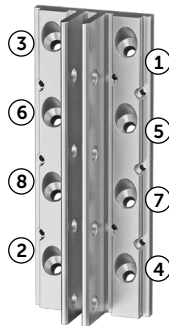
A consistent installation sequence must be defined to ensure correct and uniform load distribution among all connectors.

For axially loaded screws, the use of positioning screws is always recommended in order to prevent sudden or unintended displacement of the elements being connected, particularly where metal plates are involved.

As a general rule, asymmetric or random installation sequences should be avoided. Instead, screws should be installed following an orderly sequence, for example progressing from one side of the joint to the other or adopting a cross-pattern arrangement, both for positioning screws and structural screws. This approach enables a more uniform distribution of stresses and a more balanced overall structural response of the connection.



ALUMEGA JVG
tightening option 1



ALUMEGA JVG
tightening option 2



The full assembly instructions are available
at www.rothoblaas.com





How to correctly install a screw

The full installation instructions for timber screws are available at rothoblaas.com.



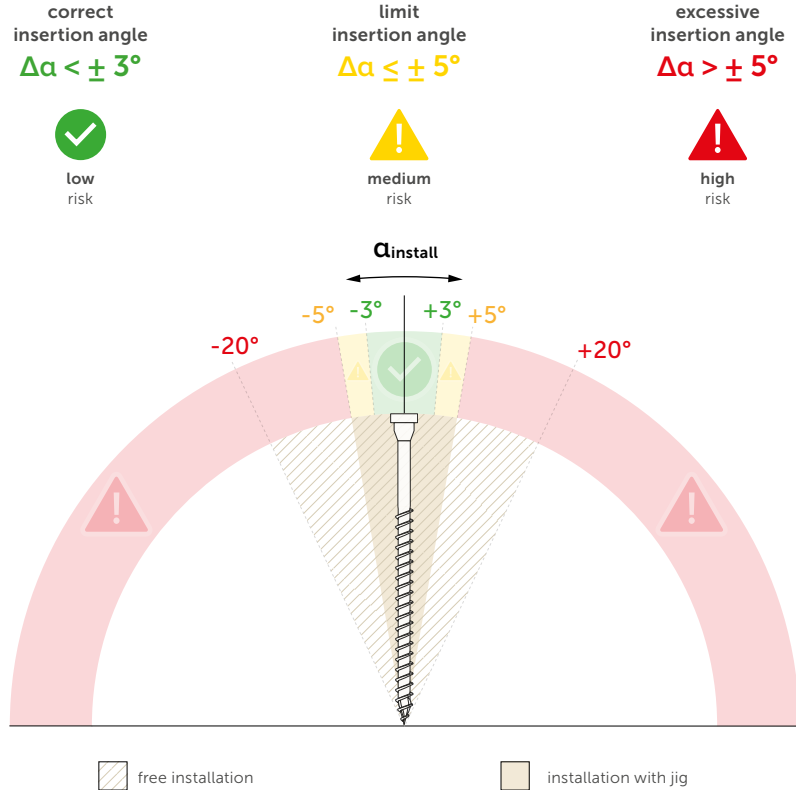
rothoblaas.com

rothoblaas

Solutions for Building Technology

INSERTION ANGLE

According to *Eurocode 5 – Part 3 Execution: Fpr EN 1995:2025-3*, during installation, a maximum **deviation ($\Delta\alpha$) of 5°** is permitted between the actual installation angle (α_{install}) and the design angle (α_{rec}), with no variation in the strength or stiffness of the connection:



Depending on the installation method, deviations from the recommended angle may be greater or smaller.

$$\Delta\alpha = \alpha_{\text{install}} - \alpha_{\text{rec}}$$



SENSITIVITY TO DEVIATION WITH RESPECT TO THE SCREW HEAD GEOMETRY

Depending on the installation method and the material in contact with the screw head, deviation from the recommended insertion angle may be more or less critical.

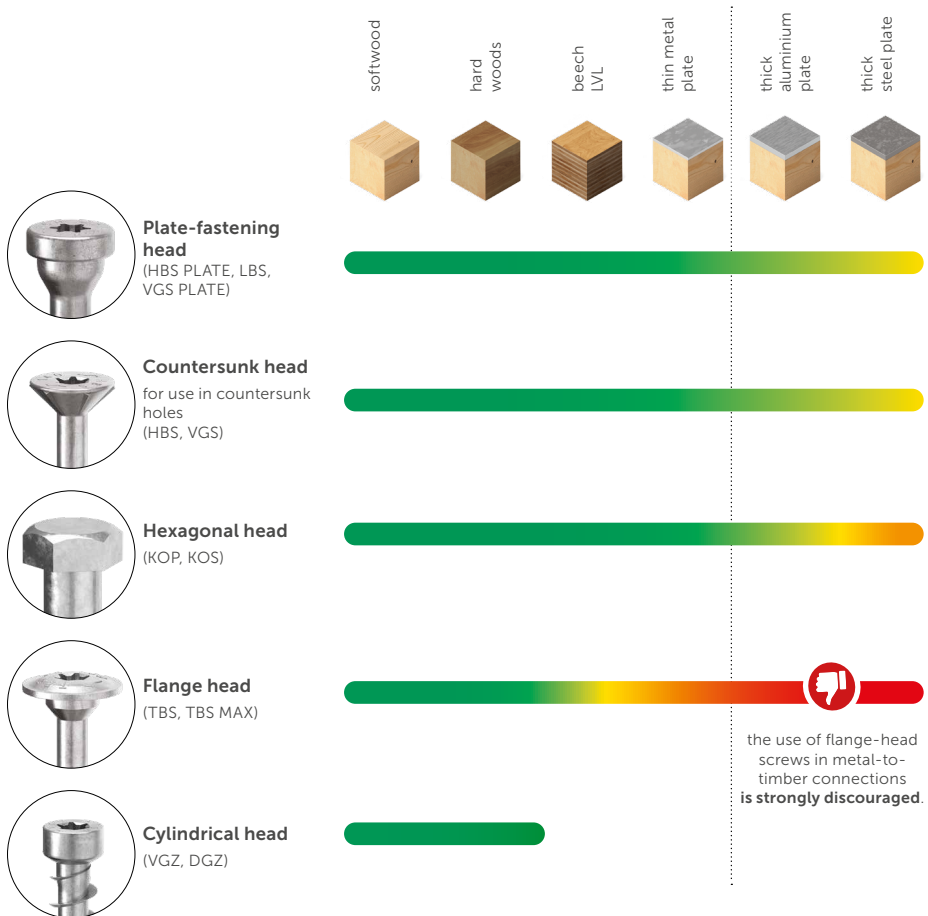
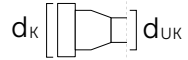
The deviation is more marked when the screw head bears against a stiff, low-deformability material, such as a metal plate. Under these conditions, any angular misalignment cannot be absorbed by **deformation of the supporting material** and results in non-uniform distribution of contact stresses. By contrast, when the screw head bears against timber, the greater deformability of the material allows partial adaptation of the bearing area, reducing the adverse effects of minor misalignments.

SENSITIVITY AS A FUNCTION OF THE DEFORMABILITY OF THE MATERIAL IN CONTACT WITH THE HEAD

Head geometry ratio

The sensitivity of the screw head to secondary bending moments caused by angular deviation depends on the ratio between the head diameter (d_K) and the under-head diameter (d_{UK}).

$$d_K / d_{UK}$$



INSTALLATION WITH JIGS

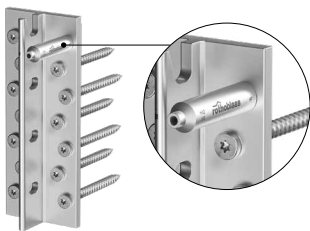
STARTER HOLE: PRE-DRILLING AND PILOT HOLE

Pre-drilling allows the screw to be inserted with less effort and minimises damage to the timber, whereas pilot or guide holes are used primarily to ensure correct screw alignment.

INSTALLATION AT 90°

90° cylindrical holes

correct guidance of the screw tip and correct insertion direction

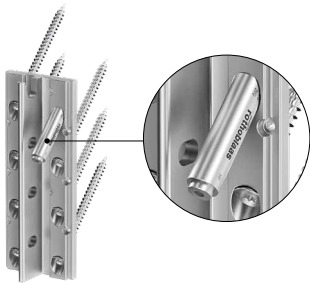


E.g. ALUMEGA, perforated IPE profiles

INSTALLATION AT 45°

45° pre-shaped holes

pre-drilled or pilot hole with correct inclination and diameter



E.g. ALUMEGA

JIG VGS



JIGVGS9	JIGVGSH9
d _v = 5 mm	d _v = 6 mm
HBS PLATE Ø8	HBS PLATE Ø10

JIG VGS



JIGVGS9	JIGVGSH9
d _v = 5 mm	d _v = 6 mm
VGS Ø9	VGSH Ø9



INSTALLATION AT 45°

VGU (pre-positioned)

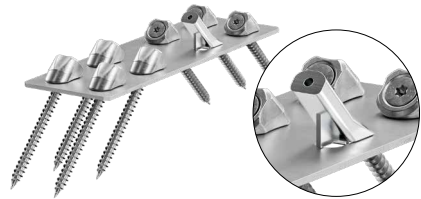
pre-drilled or pilot hole with correct inclination and diameter



E.g. SPIDER (with welded VGU)

VGU (plates with slotted holes)

pre-drilled or pilot hole with correct inclination and diameter



E.g. VGU PLATE T

JIG VGU



JIGVGU945

JIGVGU1145

JIGVGU1345

$d_v = 5 \text{ mm}$

$d_v = 6 \text{ mm}$

$d_v = 8 \text{ mm}$

VGS Ø9

VGS Ø11

VGS Ø13

JIG VGU TOTAL



JIGVGU945T

JIGVGU1145T

JIGVGU1345T

$d_v = 5 \text{ mm}$

$d_v = 6 \text{ mm}$

$d_v = 8 \text{ mm}$

VGS Ø9

VGS Ø11

VGS Ø13



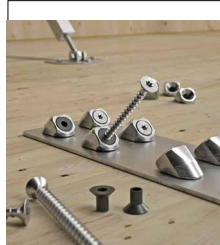
USE OF SACRIFICIAL JIGS

ENSURING THE INSTALLATION ANGLE

ROTHOBLAAS RECOMMENDS



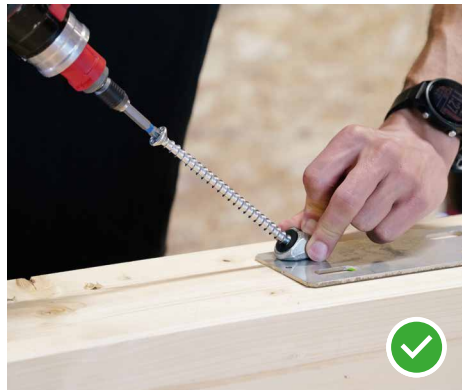
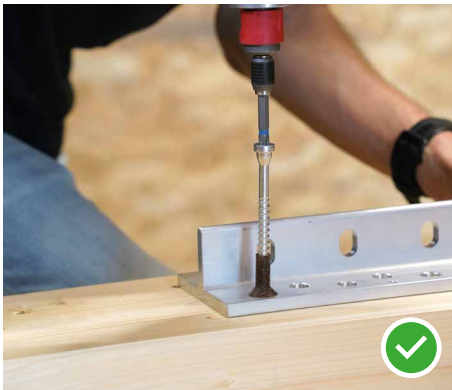
FIT JIG HP
SACRIFICIAL JIG FOR HBS
PLATE SCREWS



FIT JIG VG
SACRIFICIAL JIG FOR
VGS SCREWS

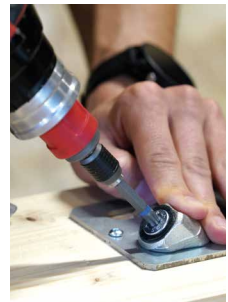


FIT JIG HP and **FIT JIG VG** sacrificial jigs represent a significant advancement in screw application. They enable precise insertion angles even **without the aid of a pilot hole** in standard applications. They do not replace the full pre-drilling required to ensure correct installation when using long screws, where exceptionally high accuracy is required, or when working with high-density timber elements.



SIGNIFICANT REDUCTION IN INSTALLATION STRESS

More than just alignment. Manufactured from a deformable polymer material, it acts as a **dampener**, **absorbing up to 30%** of the peak insertion moment generated by head-to-metal contact, thereby reducing damage, overtorque, overloads and stress concentrations. In addition, by preventing direct contact between the screw and the washer, **it acts as an insulating element against galvanic corrosion**.



INSTALLATION OF HBS PLATE SCREWS AT 90°



Insert the jig onto the screw until the tip protrudes.



Position the screw with the jig in the hole.



Continue driving the screw until it comes into contact with the plate.



If necessary, remove any remaining jig material around the screw and dispose of it.

INSTALLATION OF VGS SCREWS AT 45° WITH VGU



Insert the jig into the screw installation hole.



Insert the screw into the jig until the tip protrudes.



Continue driving the screw until it is flush with the outer surface of the **FIT JIG**.



INCORRECT INSERTION DIRECTION: SCREW FAILURE

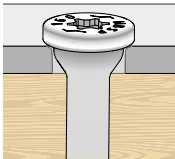
Any screw may fail during installation if it is driven at an angle that generates a secondary bending moment. This induces a combined shear and tensile stress in the head region, which may exceed the screw's strength even in the absence of moisture or corrosive phenomena.

The image opposite illustrates the effect of installing HBSP screws through a thin steel plate into softwood at varying insertion angles (45°, 50° and 60°), combined with overtorque (OT). The correct reference angle is 90°.

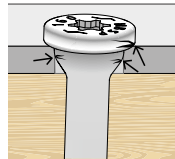


Image source: Denz, C., *Bestimmung möglicher Einflüsse auf die Tragfähigkeit von Stahlblech-Holz-Verbindungen mit Vollgewindeschrauben durch unsachgemäße Montage*, Bachelor's thesis, KIT, 2023.

INCORRECT INSERTION DIRECTION: INDUCED ADDITIONAL STRESSES



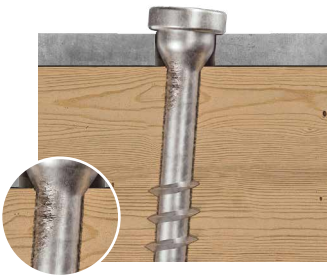
Uniform, well-distributed contact surface.



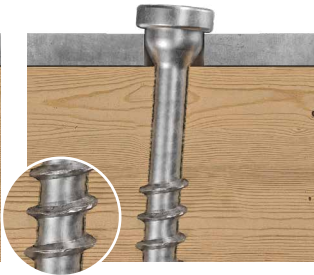
Localised (as opposed to distributed) contact points, concentrated at the edges. Possible secondary bending moments.

INCORRECT INSERTION DIRECTION: DAMAGE

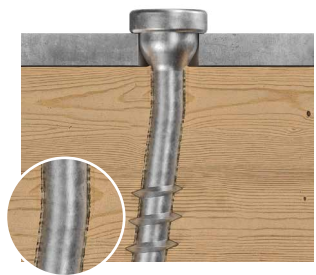
In addition to immediate failure during installation, an incorrect insertion angle may lead to further issues.



Damage to the coating: reduced corrosion resistance and an increased risk of HI-SCC/EHE.



Damage to, or wear of the thread: reduced pull-out strength.



Plastic bending deformation: reduced tensile and bending resistance of the screw. Formation of microcracks.

See further details under "CORROSIVITY CONDITIONS ON SITE" on page 18

INSPECTION: INSERTION ANGLE

It is recommended that a minimum representative number of screws be **partially unscrewed** for each connection type and that the insertion angle be measured using a **protractor**.

It is important to check that the extracted screw shows no obvious signs of plastic deformation associated with over-tightened installation.

correct
insertion angle

$$\Delta\alpha < \pm 3^\circ$$



low
risk

limit
insertion angle

$$\Delta\alpha \leq \pm 5^\circ$$



medium
risk

excessive
insertion angle

$$\Delta\alpha > \pm 5^\circ$$



high
risk



$$\begin{aligned}\alpha_{\text{rec}} &= 45^\circ \\ \alpha_{\text{insp}} &= 45,95^\circ \\ \Delta\alpha &= 0,95^\circ\end{aligned}$$



$$\begin{aligned}\alpha_{\text{rec}} &= 90^\circ \\ \alpha_{\text{insp}} &= 79,45^\circ \\ \Delta\alpha &= 10,55^\circ\end{aligned}$$

$$\Delta\alpha = \alpha_{\text{insp}} - \alpha_{\text{rec}}$$



INSTALLATION WITH OVERTORQUE

Compliance with the specified installation torque is essential for reliable verification of the insertion angle during inspection and to ensure the fastener has been safely installed.

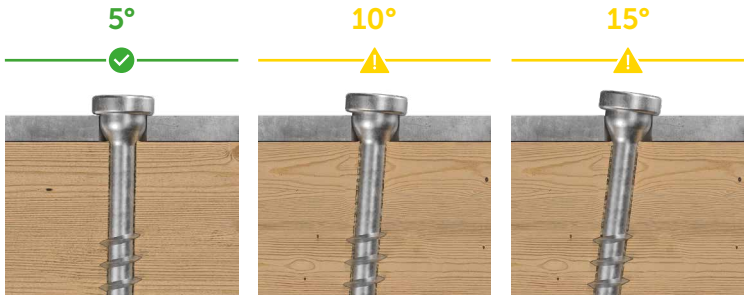
In the event of overtorque (OT), once the head bears against the surface, the screw tends to conform to the geometry of the hole, inducing bending and deformation along the shank and making angular installation errors far less evident during inspection.

The test campaign carried out in collaboration with KIT (*Karlsruhe Institute of Technology*) demonstrated that tightening has a significant influence on the ability to detect an incorrect insertion angle during installation.

INSTALLATION AT 90°

IF TORQUE CONTROL **HAS BEEN USED**:
THE DEVIATION REMAINS VISIBLE AND IS NOT CORRECTED DURING TIGHTENING.

Plate-fastening
head
HBS PLATE



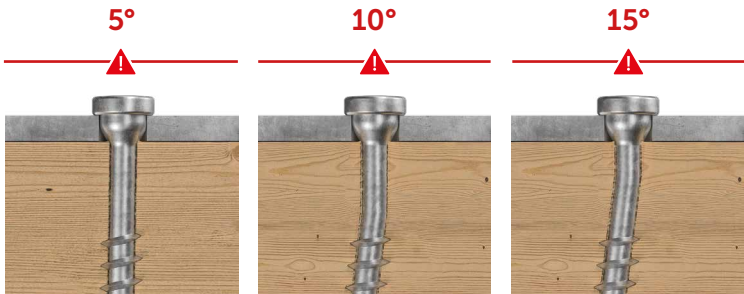
Compliant installation: the head angle and position are correct and stable.

The deviation from the recommended angle remains visible and is not corrected during tightening.

Non-compliant installation: the excessive angle is easily identified during inspection.

IF TORQUE CONTROL **HAS NOT BEEN USED**:
OVER-TIGHTENING MAY CONCEAL DEVIATIONS FROM THE RECOMMENDED INSERTION ANGLE

Plate-fastening
head
HBS PLATE

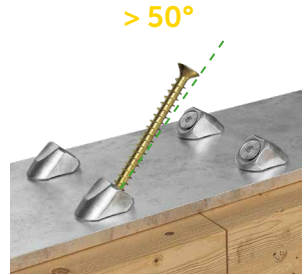
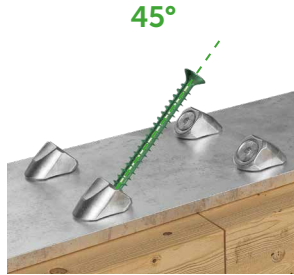
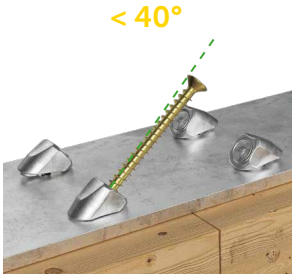


Even with the correct angle, the absence of torque control may cause deformation of the connector.

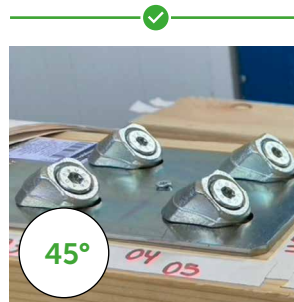
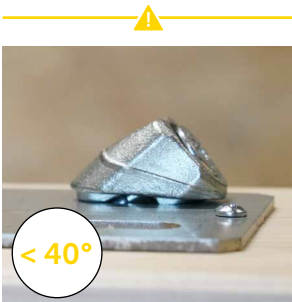
Over-tightening can mask deviations from the recommended installation angle.

Non-compliant installation: over-tightening may compensate for an incorrect inclination, inducing local deformations and stress concentrations.

INSTALLATION AT 45°



IF TORQUE CONTROL **HAS BEEN USED**:
THE DEVIATION REMAINS VISIBLE AND IS NOT CORRECTED DURING TIGHTENING.



Visible incorrect installation angle: possible lifting of the washer or screw head not fully in contact with the surface.

Compliant installation: the head angle and position are correct and stable.

Screw head not fully in contact with the surface (on the lower side).

IF TORQUE CONTROL **HAS NOT BEEN USED**:
OVER-TIGHTENING MAY CONCEAL DEVIATIONS FROM THE RECOMMENDED INSERTION ANGLE



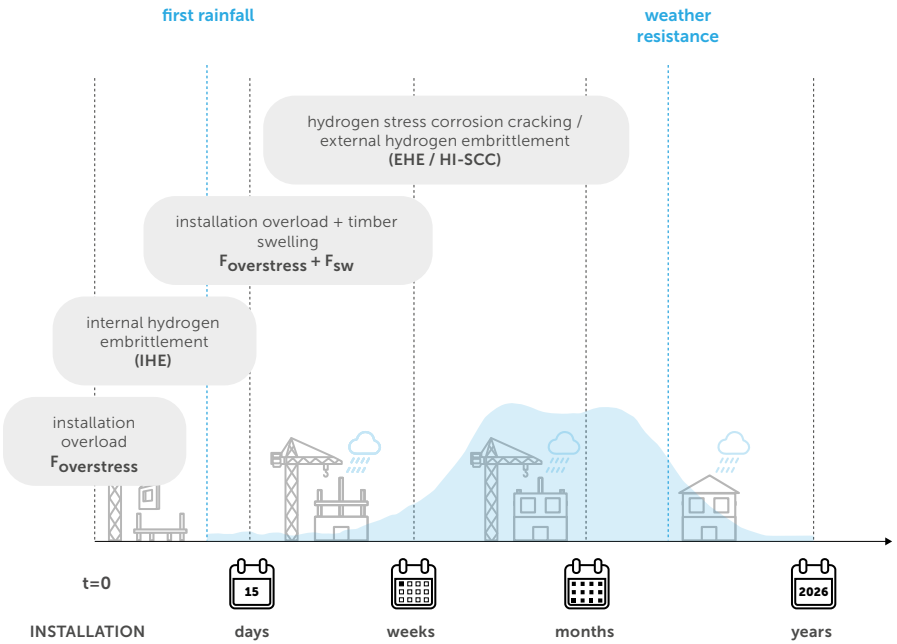
Some lifting of the washer may be visible, but the actual angle cannot be clearly determined.

Even with the correct angle, the absence of torque control may induce local deformations and stress concentrations.

The actual angle cannot be determined visually: over-tightening may conceal an incorrect inclination.

INSPECTION: BROKEN SCREWS

As discussed in the previous sections, a number of factors may lead to premature failure of fasteners. The graph provides an indicative representation of the time period in which the most common types of failure occur, from installation (time $t = 0$) until the completion of construction, when the connection is no longer exposed to weather conditions.



On site, examination of failed samples, the fracture surface and marks on the fastener can provide **initial indications of the cause of failure**. However, failures should always be assessed with the support of specialists. In most cases, laboratory analysis is required to reliably identify the actual failure mechanism. The main **signs to be identified on site** for the correct analysis and interpretation of the phenomenon are listed below.

SIGNS OF TIMBER MOISTURE

These indicate the extent of exposure to rainfall and are associated with shank corrosion and possible overloads caused by timber swelling.



SIGNS OF CORROSION

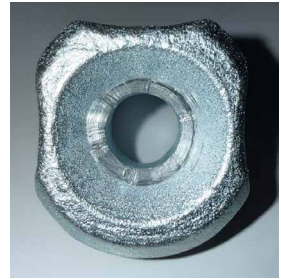
Corrosion (white or red) on the surface of the shank may indicate excessive exposure to an aggressive environment.

Corrosion on the fracture surface can develop within a few hours and is therefore not necessarily indicative of the cause of failure.



SIGNS OF WEAR OR DAMAGE

Marks on the screw coating or on the supporting material may indicate deviations from the recommended insertion angle or installation overloads.



FRACTURE SURFACE MORPHOLOGY

May provide useful indications regarding the failure mechanism.

In general:

- circular patterns indicate **torsional overload**;
- linear patterns and elongated lips indicate **tensile overload**;
- patterns that are both circular and elongated indicate the combined presence of **torsional overload** and **tensile overload**;
- failure of the screw head may be associated with an incorrect **insertion angle**;
- predominantly flat surfaces, possibly showing signs of corrosion, may indicate **brittle failure**, including hydrogen-embrittlement-related failure in the presence of overloads.



INSPECTION FAILED: REMEDIAL ACTIONS

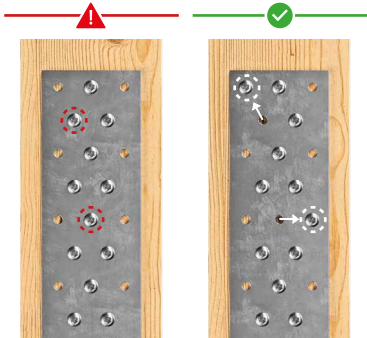
There is no single solution that is suitable for all cases. Where broken screws, torsional overload, damage to the internal thread in the timber, or red rust corrosion are present, the repair strategy must be assessed on a case-by-case basis.

In more complex cases, support from the Rothoblaas technical consultancy service is recommended. Several possible strategies are outlined below:

MODIFICATION OF THE NAILING LAYOUT

If the connector includes unused holes, the non-compliant screw can be removed and replaced with a new screw of the same size in one of the adjacent unused holes.

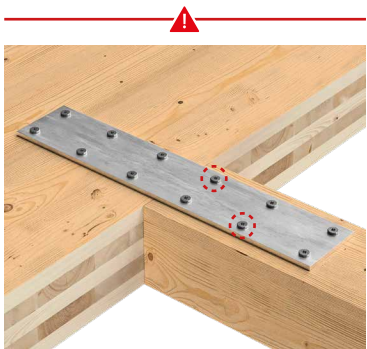
This is a typical case for plates with partial fastening patterns (perforated steel straps, angle brackets, etc.).



The same principle can also be applied to non-standard plates. In these cases, there are generally no unused or available holes; modifying the fastening pattern is therefore not always possible and it is often necessary to drill a new hole in the plate.

In these situations, the new holes should be positioned in a staggered arrangement relative to the existing fasteners, **while always respecting the minimum spacing requirements.**

It is good practice to fill unused holes with epoxy resin to restore the damaged timber grain.



ROTHOBLAAS RECOMMENDS



REPLACING A NON-COMPLIANT SCREW WITH A LARGER-DIAMETER SCREW

Where the fastener cannot be relocated to an alternative hole, replacement with a larger-diameter fastener may be considered, subject to enlargement of the hole in the plate.

As a general rule, reinserting a screw of the same type, diameter and length is not considered reliable. The decision whether to replace only the damaged fastener or to adopt a more extensive remedial solution should be carefully assessed.

REPLACEMENT WITH LARGER SCREWS:

nominal diameter of screw to be replaced $\leq$ pilot-hole diameter for new screw

screw to be replaced
LBS Ø7

$d_1 = 7,0 \text{ mm}$

$\leq$

new screw
VGS Ø13

$d_v = 8,0 \text{ mm}$



REPLACEMENT WITH LARGER BOLTS OR THREADED RODS:

nominal diameter of screw to be replaced $\leq$ nominal diameter of new bolt/threaded rod

screw to be replaced
HBS PLATE Ø8

$d_1 = 8,0 \text{ mm}$

$\leq$

new bolt
KOS M10

$d = 10,0 \text{ mm}$



WARNING! In all cases, the new solution must be verified by the designer with regard to load-bearing capacity, stiffness, ductility, geometry, corrosion resistance, minimum spacing requirements, etc.

MEMBRANES AND TAPES



MEMBRANES AND TAPES

Proper design of protection systems and airtight, watertight and vapour-control layers requires a preliminary assessment of the construction element and exposure conditions. The choice of solutions is never arbitrary and directly affects performance, flow control and the durability of the building envelope.



ASSESSMENT OF THE STRUCTURAL ELEMENT AND CRITICAL AREAS

from page **72**



SITE PROTECTION: SYSTEM SELECTION

from page **82**



VAPOUR CONTROL MEMBRANES

from page **94**



WINDTIGHT MEMBRANES

from page **106**



INSTALLATION OF TAPES, MEMBRANES AND FOAMS

from page **118**

ASSESSMENT OF THE STRUCTURAL ELEMENT AND CRITICAL AREAS



This chapter presents the analysis of a typical construction site, with the aim of identifying the areas most exposed to risk and defining appropriate mitigation measures.

The content revisits and summarises the topics covered in other chapters, highlighting the need to adapt solutions to the specific context. Not all areas of a construction site present the same level of risk: some require greater attention and more targeted measures.

In particular, this chapter refers to and expands upon the following topics:

- Critical connections: identification and inspection (page 34)
- Selection of site protection systems (page 82)
- Selection of the correct membrane (page 94)
- Correct installation of tapes, membranes and foams (page 118)
- Rainwater drainage and deflection (page 156)

The images use a colour-coding system to facilitate the understanding and interpretation of the proposed solutions:

- **Green:** generic tapes to be applied on site;
- **White:** temporary site protection membranes, including the complete system (membrane, tapes and overlaps);
- **Grey:** membranes specified by the designer for moisture control, airtightness and windtightness, which also provide temporary protection.

The base connection of the structural elements is not shown in the diagrams.

For further details, see the chapter "BASE CONNECTIONS: JUNCTION DESIGN" on page 130.

RISK ASSESSMENT



low
risk



medium
risk



high
risk



very high
risk



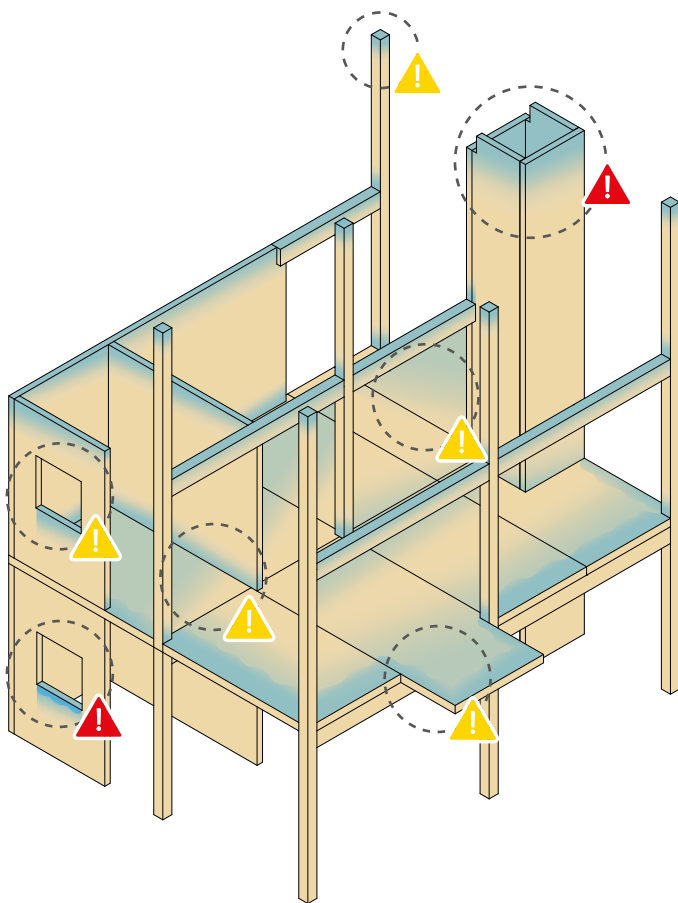
SITE ANALYSIS AND MANAGEMENT OF HIGH-RISK AREAS

ASSEMBLY OF THE FIRST STOREY OF THE STRUCTURE

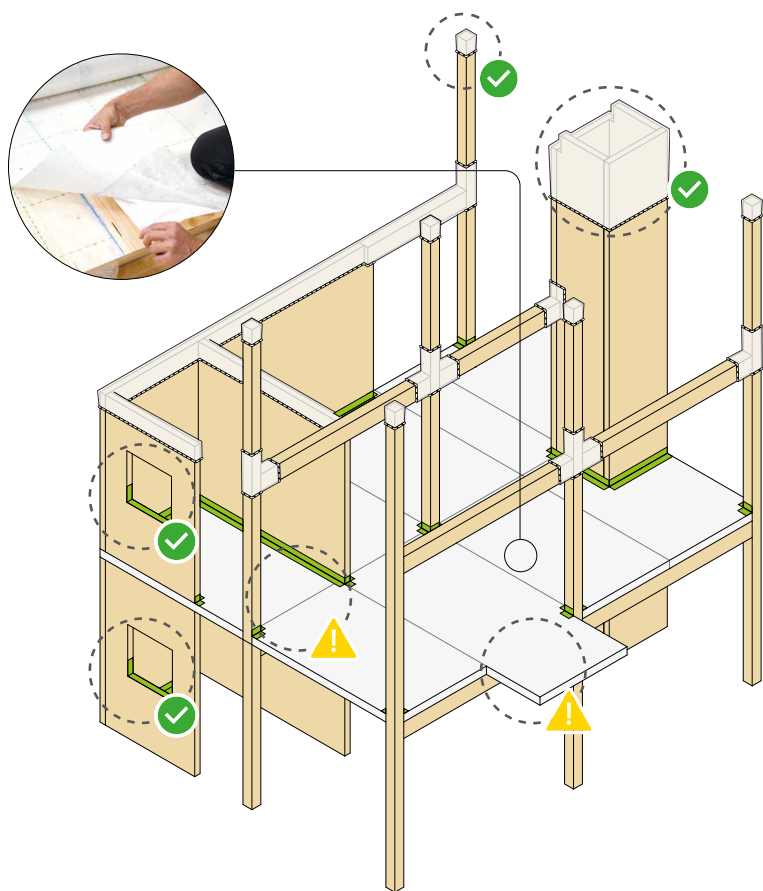
The entire timber surface is exposed to water. In the event of rain, the elements will start to become wet. During the initial stage, the most sensitive areas are surfaces with exposed timber grain, such as:

- column tops
- window openings
- exposed ends of CLT walls.

Where present, the lift shaft tends to accumulate water internally in an area with limited ventilation and slow drying.



If the CLT panels arrive on site already waterproofed, they are protected from water ingress. However, temporary site protection systems alone are not sufficient to eliminate all risks. It remains essential to dry the structure after rainfall and to provide suitable drainage paths for water run-off.



See further details under "SITE PROTECTION: SYSTEM SELECTION" on page 82

ROTHOBLAAS RECOMMENDS

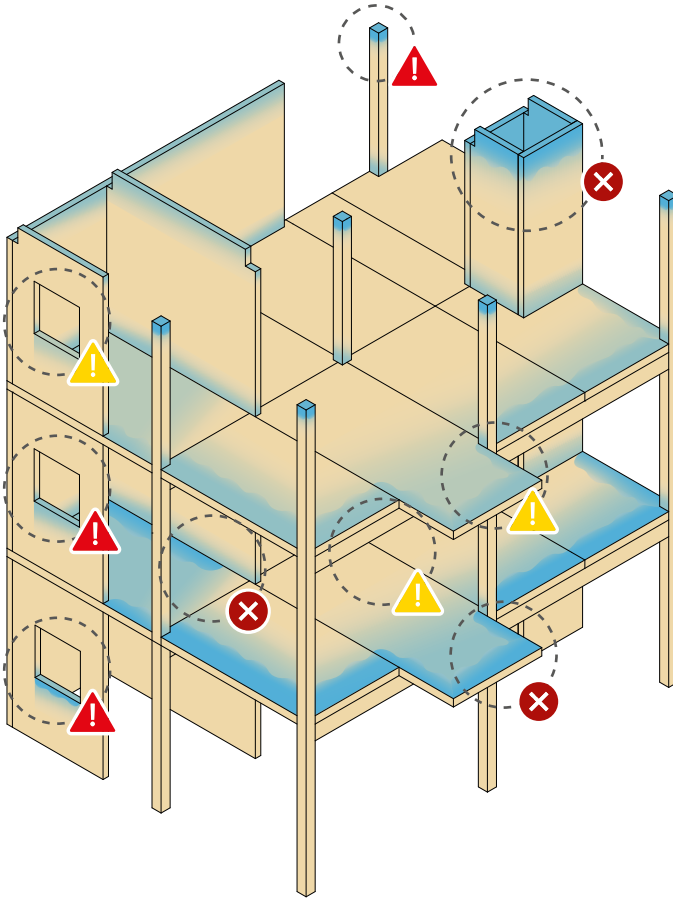
**DEFENCE ADHESIVE
REMOVABLE**
REMOVABLE SELF-ADHESIVE
PROTECTIVE MEMBRANE





ASSEMBLY OF THE SECOND STOREY OF THE STRUCTURE

The upper storeys cover and protect the lower levels. The perimeter areas and the joints between panels remain exposed. The lift shaft acts as a sump: the collected water is unable to dry because the area remains permanently shaded and poorly ventilated. Column tops are particularly exposed to water, and enclosed spaces dry with difficulty.



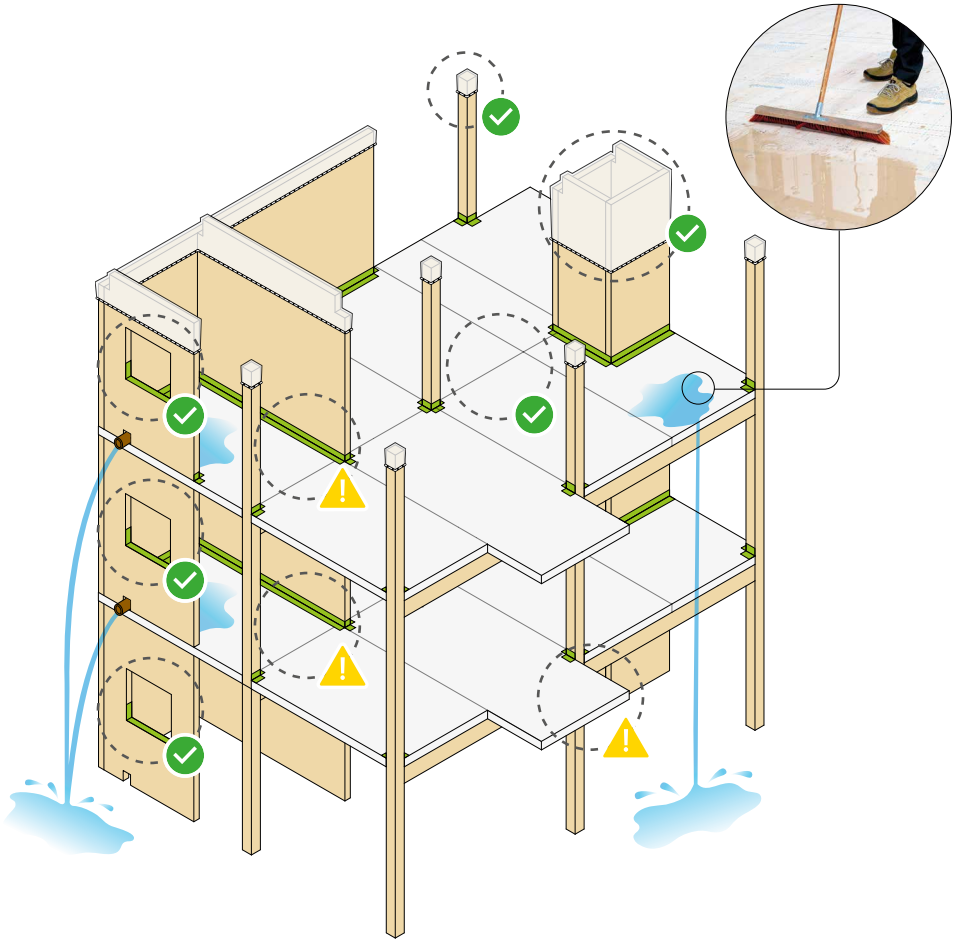
ROTHOBLAAS RECOMMENDS

DEFENCE ADHESIVE

SELF-ADHESIVE PROTECTIVE
MEMBRANE FOR BUILDING
ELEMENTS



The structure remains protected even when water is present; nevertheless, any build-up must be removed.



ROTHOBLAAS RECOMMENDS

CAP TOP
TARPAULIN FOR ROOFS

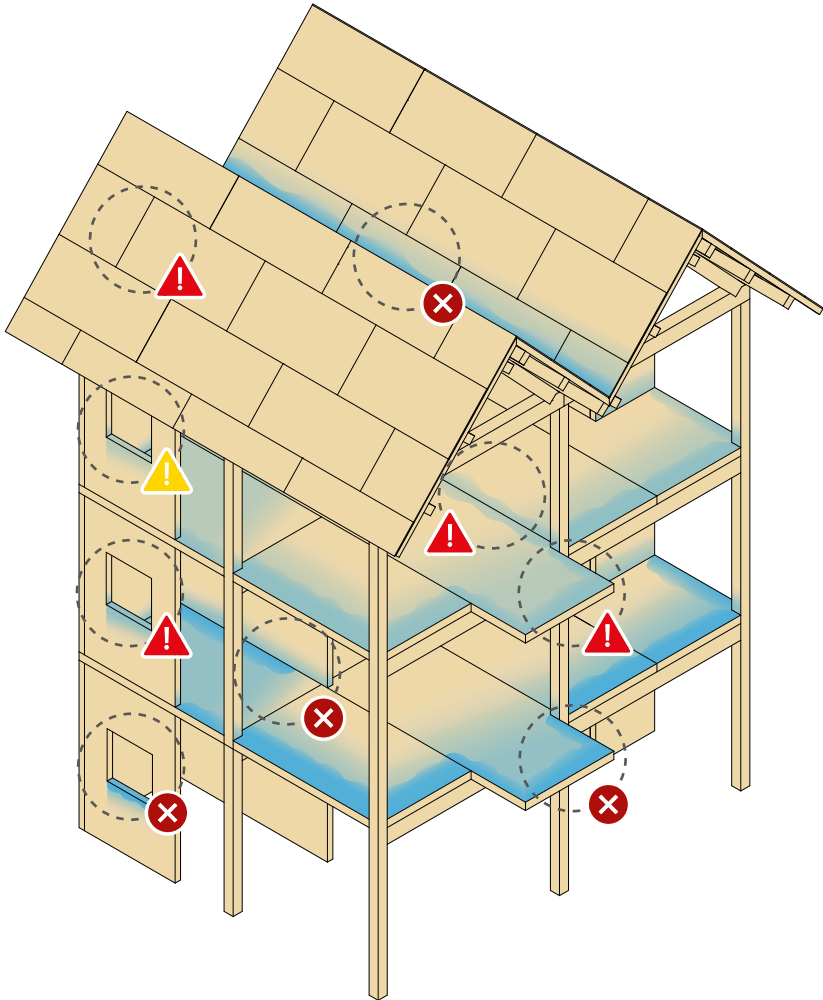


ASSEMBLY OF A PITCHED ROOF

Once installed, the roof protects the storeys below from weather exposure. However, the perimeter zones of the building remain exposed and represent areas of increased risk.

WATER BEHAVIOUR ON PITCHED ROOFS

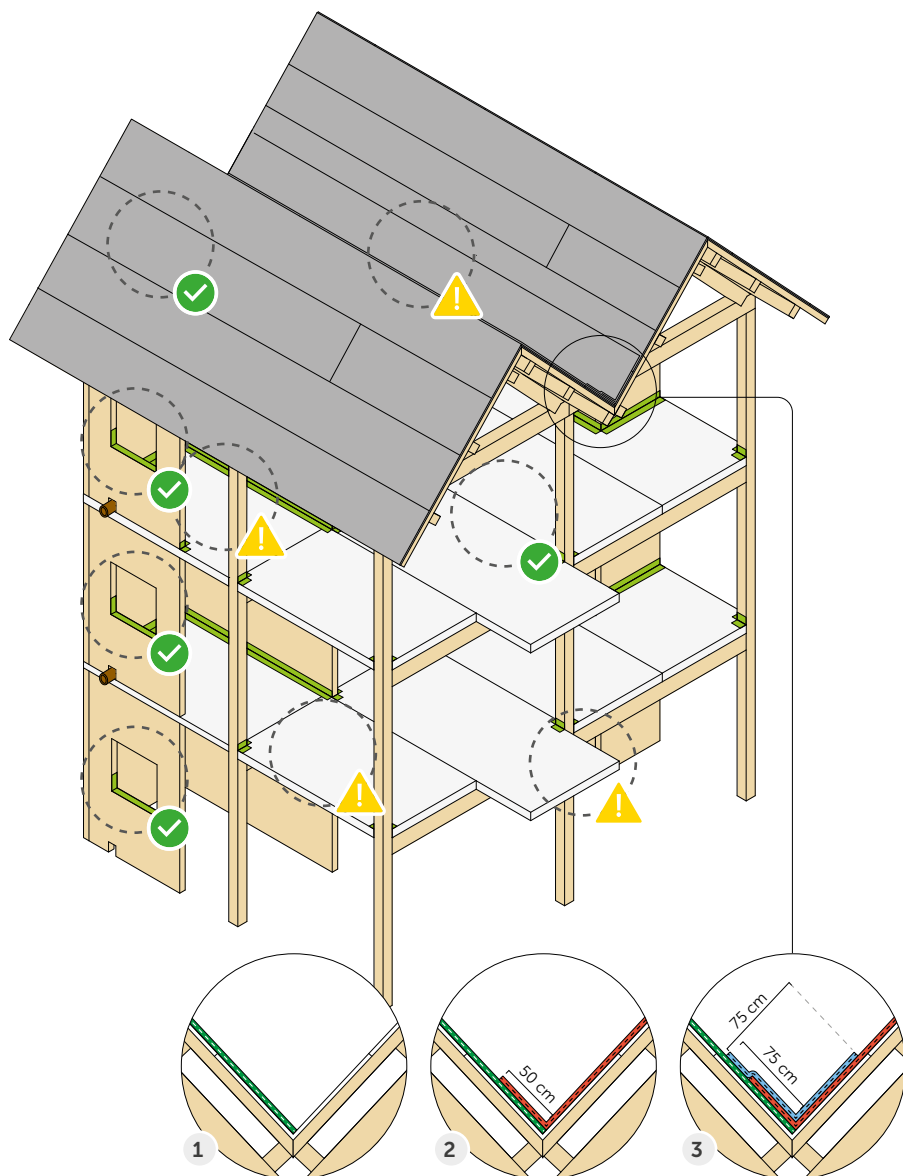
On pitched roofs, rainwater naturally drains away without creating standing water, a condition that is generally favourable for the durability of the roofing system. Particular attention should nevertheless be paid to eaves gutters, where water may accumulate and increase the risk of water ingress.



EAVES GUTTERS: CRITICAL ISSUES AND REQUIREMENTS

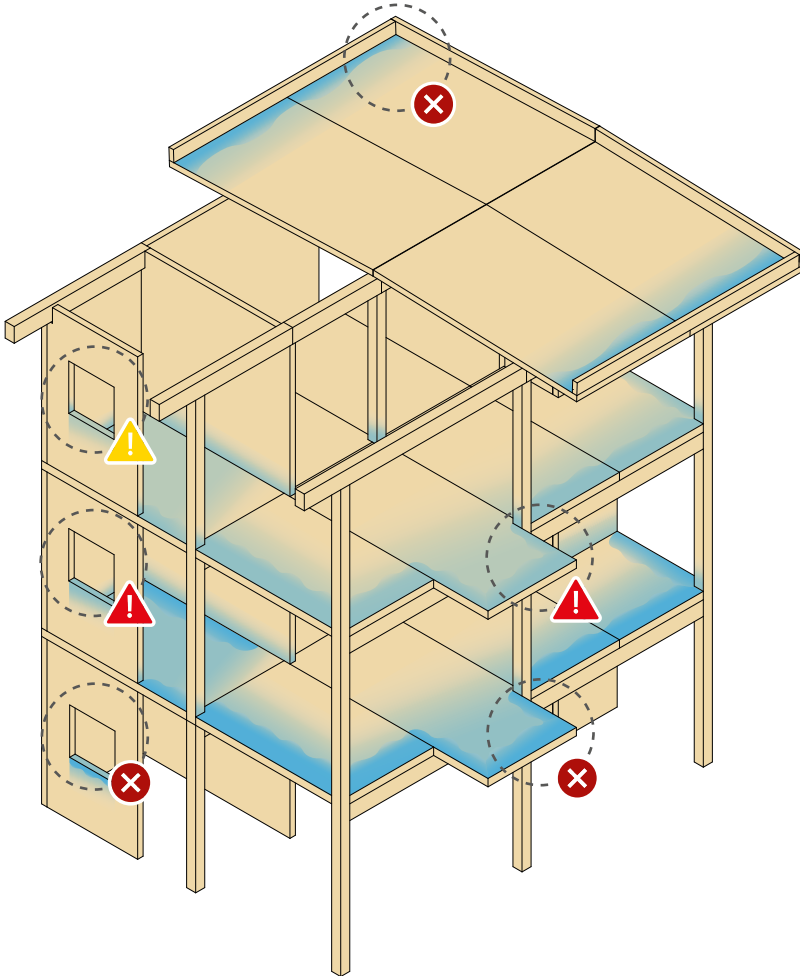
Eaves gutters are critical areas during the construction stage. They are frequently used as access routes and for the temporary storage of roofing materials, making them subject to greater mechanical stress and reduced drying capacity.

Eaves gutters must therefore be adequately protected with multiple protective layers to increase the mechanical strength of the system and prevent damage to waterproofing membranes.



ASSEMBLY OF A FLAT ROOF

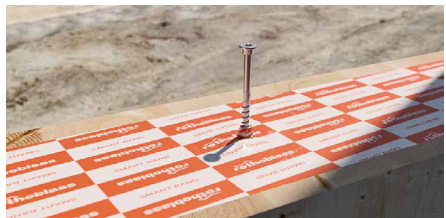
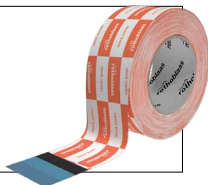
For flat roofs, local falls should be incorporated into the load-bearing structure to facilitate drainage and reduce the risk of standing water during construction. Providing structural falls reduces the risk of water pooling, but this measure alone is not sufficient.



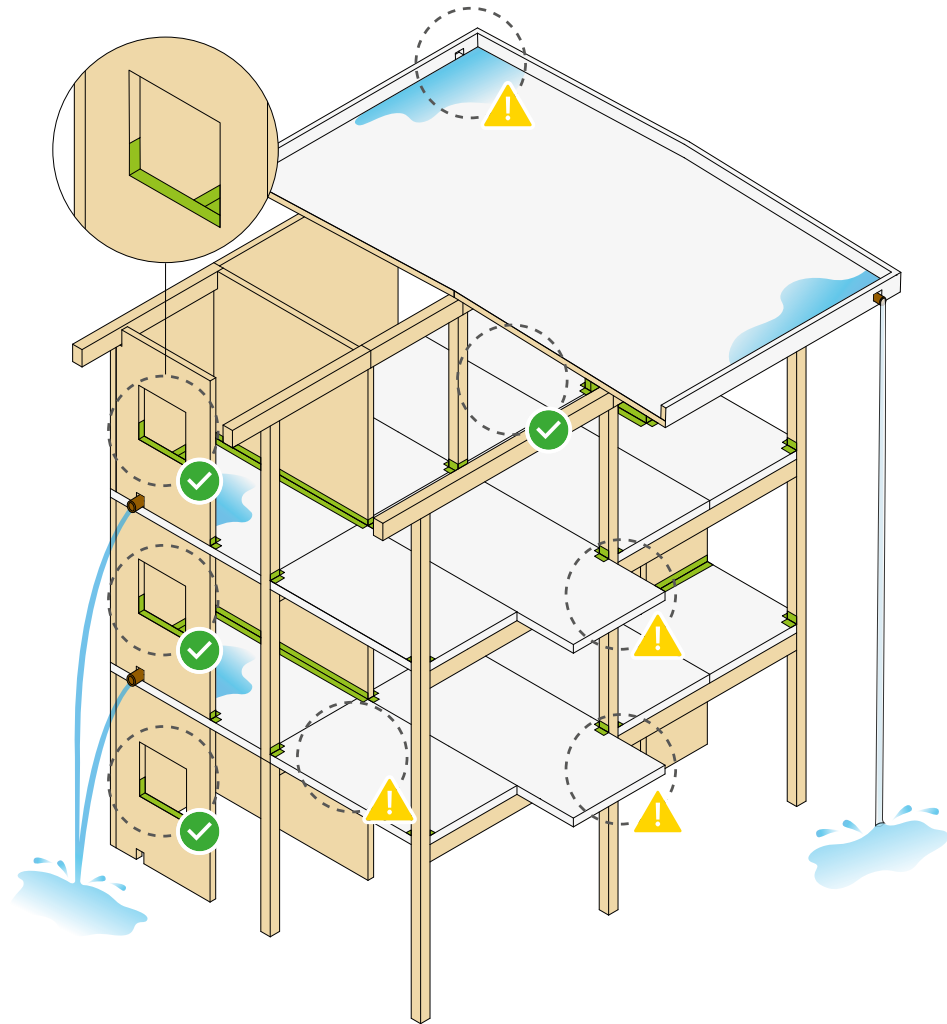
ROTHOBLAAS RECOMMENDS

SMART BAND

UNIVERSAL SINGLE-SIDED
TAPE WITH SEPARABLE LINER



Rapid waterproofing of the structure is essential, either through the application of temporary protection during panel production or through the prompt installation of vapour control membranes on site. Appropriate solutions for the drainage of rainwater must also be provided at structural level.

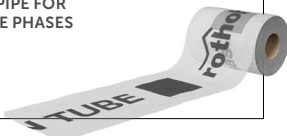


See further details under "RAINWATER DRAINAGE AND DEFLECTION" on page 156

ROTHOBLAAS RECOMMENDS

RAIN TUBE

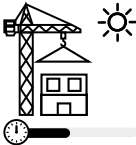
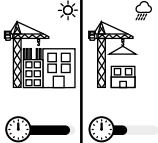
TEMPORARY DOWNPIPE FOR CONSTRUCTION SITE PHASES



SITE PROTECTION: SYSTEM SELECTION

The selected level of site protection depends on exposure to weather conditions and the acceptable level of risk.

RISK MATRIX				
				
very low risk	low risk	medium risk	high risk	risk to be avoided

SITE PROTECTION			
			
	LOCAL	SURFACE	TOTAL
 short-term exposure and a low-rainfall climate			
 long-term exposure or a very rainy and/or humid climate			
 long-term exposure and a very rainy and/or humid climate			



A thorough risk assessment makes it possible to choose the most suitable solution, identifying the right balance between project execution costs and the required level of protection.

LOCAL



PROTECTION OF END-GRAIN SECTIONS AND SENSITIVE ELEMENTS

The timber is exposed to weather conditions and only the parts most susceptible to capillary uptake are protected. In the event of rain, remove water from timber elements to prevent standing water on surfaces and panel end-grain sections.

SURFACE



PROTECTION OF TIMBER ELEMENTS WITH TEMPORARY TARPULINS OR ADHESIVE MEMBRANES

The timber is protected, but the membrane remains exposed to weather conditions. In the event of heavy rain, installation errors or standing water, the timber may absorb moisture. It is therefore necessary to remove water from timber elements to prevent standing water on surfaces and panel end-grain sections.

TOTAL



PROTECTION USING A TEMPORARY STRUCTURE

The construction site is protected from weather conditions throughout all stages of assembly. Even in the event of heavy rainfall and/or extended construction periods, the timber structure remains protected from direct contact with water.

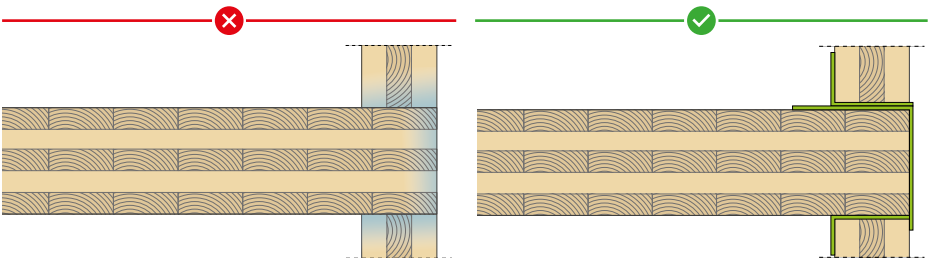
LOCAL PROTECTION

PROTECTION OF END-GRAIN SECTIONS AND SENSITIVE ELEMENTS

The timber is exposed to weather conditions and only the parts most susceptible to capillary uptake are protected.

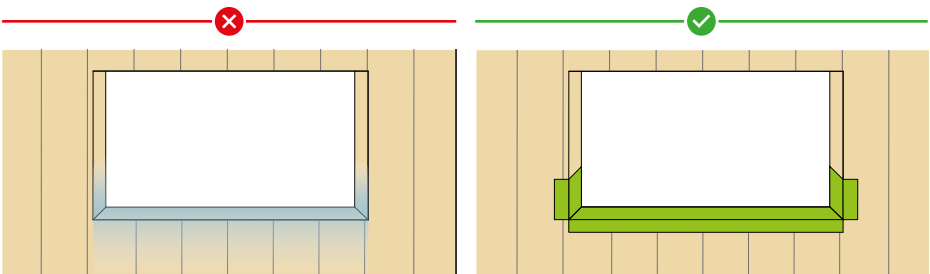
AREAS SENSITIVE TO CAPILLARY UPTAKE: end-grain sections

End-grain sections absorb more water due to capillary uptake and are therefore particularly vulnerable.



DOOR AND WINDOW OPENINGS

Door and window openings increase the risk of water absorption and may promote localised standing water, making these areas particularly critical.



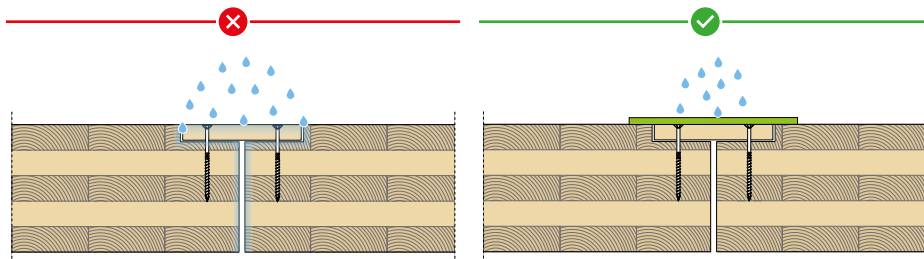
MATERIALS WITH HIGHER WATER ABSORPTION: OSB

Some materials, such as OSB, absorb more water than solid timber and, when exposed to moisture, may swell and experience reduced mechanical performance.



AREAS SUBJECT TO STANDING WATER AND WITH LIMITED DRYING POTENTIAL: SMALL GAPS

Small gaps and notches can create areas where water accumulates and is difficult to dry.



ROTHOBLAAS RECOMMENDS

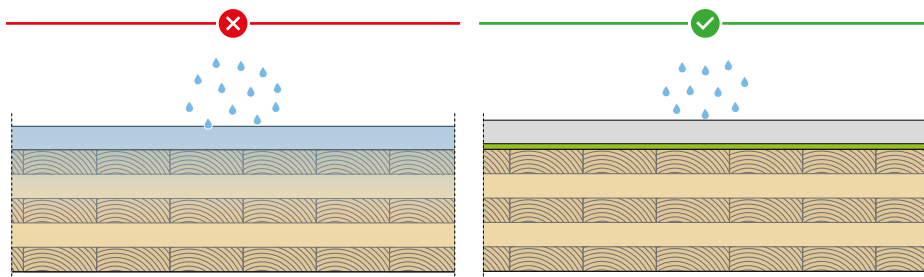
TITAN PLATE T PLATES FOR TIMBER

- ▶ Reduction in complex processing and easier installation
- ▶ Reduced risk of standing water at joints
- ▶ Creation of diaphragm-action floors and restoration of continuity between adjacent panels
- ▶ Design and application versatility thanks to the possibility of using LBA nails or LBS screws with diameters of 5 or 7 mm, with full or partial fastening patterns



TIMBER IN CONTACT WITH MOIST MATERIALS OR MOISTURE-SENSITIVE COVERINGS: screeds or prefabricated plasterboard panels exposed to weather conditions

Moisture-sensitive coverings may absorb water and transfer it to adjacent timber, which tends to become wet and remain damp for extended periods due to limited ventilation and the difficulty of drying the outer layers.



DID YOU KNOW THAT...

DEFENCE and **INVISI BAND** products are semi-transparent, allowing any on-site water ingress or problems to be immediately identified. **DEFENCE ADHESIVE REMOVABLE** can also be used for temporary applications on non-visible elements: the ideal solution where adhesives need to be applied or where subsequent construction phases require direct fastening to the timber.

PROTECTION WITH ADHESIVE MEMBRANES

The choice of adhesive membrane varies according to external conditions and the moisture content of the timber. To determine the most suitable solution, three types of membrane were tested on timber in three different service classes, identifying the best combination for each site scenario.

TIMBER CONDITIONING

SC1

service class 1:
dry timber
(moisture content 10-12%)

SC2

service class 2:
moist timber
(moisture content 16-20%)

SC3

service class 3:
wet timber
(moisture content > 20%)

The timber samples were conditioned to three different initial moisture contents and subsequently covered with the various adhesive membranes.

SCENARIO 1:
membrane applied off site

SCENARIO 2:
membrane applied on site
under dry conditions

SCENARIO 3:
membrane applied on site
under wet conditions

timber exposure conditions:		SC1	timber exposure conditions:		SC2	timber exposure conditions:		SC3
initial timber moisture:		10%	initial timber moisture:		16%	initial timber moisture:		23%
products	BARRIER ALU NET ADHESIVE 300		products	BARRIER ALU NET ADHESIVE 300		products	BARRIER ALU NET ADHESIVE 300	
	DEFENCE ADHESIVE			DEFENCE ADHESIVE			DEFENCE ADHESIVE	
	DEFENCE ADHESIVE TRASPIR EVO			DEFENCE ADHESIVE TRASPIR EVO			DEFENCE ADHESIVE TRASPIR EVO	
	timber without membrane			timber without membrane			timber without membrane	

SIMULATION OF THE CONSTRUCTION STAGE

All samples were then placed in a climate chamber to reproduce two different environmental conditions and assess their behaviour over time.

UNFAVOURABLE SITE CONDITIONS
(humid environment)

exposure conditions:



temperature 20°C

relative air humidity 75% UR

duration 17 days

FAVOURABLE SITE CONDITIONS
(drying possible)

exposure conditions:

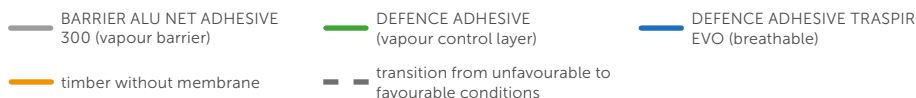


temperature 20°C

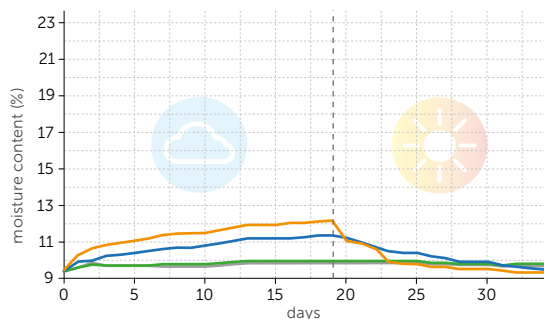
relative air humidity 50% UR

duration 17 days

KEY FINDINGS

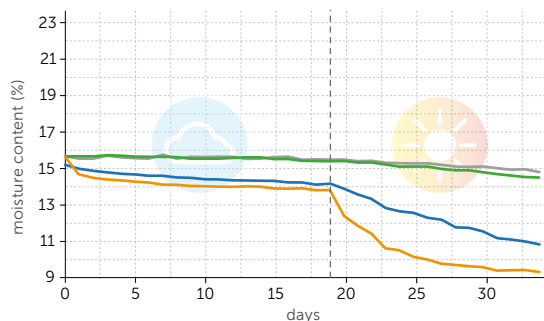


SCENARIO 1: membrane applied off site



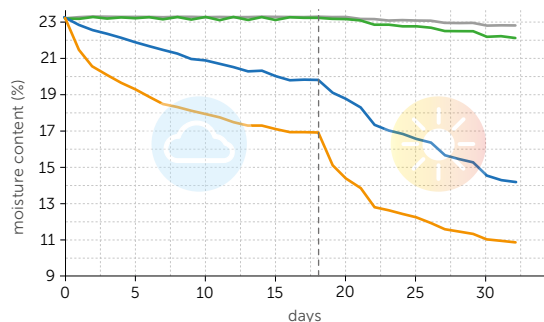
When the membrane is applied off site, with the timber moisture content controlled and no damage anticipated during construction, Rothoblaas recommends the use of **DEFENCE ADHESIVE**, which ensures effective protection and keeps the panel dry.

SCENARIO 2: membrane applied on site under dry conditions



For on-site applications on dry panels, or in the event of minor accidental damage, Rothoblaas recommends **DEFENCE ADHESIVE TRASPIR EVO**, which protects the timber while allowing residual vapour diffusion, promoting proper drying of the material.

SCENARIO 3: membrane applied on site under wet conditions



If the panels are wet, they should be left to dry for a period before applying the membrane. **DEFENCE ADHESIVE TRASPIR EVO** protects the timber from subsequent weather exposure while facilitating the dissipation of residual moisture.

Note: The moisture content of the timber was always determined on a mass basis and verified using a moisture meter.

CONCLUSIONS: MEMBRANE SELECTION MATRIX

very low
risklow
riskmedium
riskhigh
riskrisk
to be avoided**service class 1:**
dry timber
(moisture content
10-12%)**service class 2:**
moist timber
(moisture content
16-20%)**service class 3:**
wet timber
(moisture content
> 20%)

		SITE CONDITIONS			
		hot climate with low rainfall	cold and humid climate with low rainfall	humid climate with moderate rainfall	very humid climate with high rainfall
SCENARIO	membrane applied off site SC1	BARRIER ALU NET ADHESIVE 300 DEFENCE ADHESIVE DEFENCE ADHESIVE TRASPIR EVO	BARRIER ALU NET ADHESIVE 300 DEFENCE ADHESIVE DEFENCE ADHESIVE TRASPIR EVO	DEFENCE ADHESIVE TRASPIR EVO DEFENCE ADHESIVE BARRIER ALU NET ADHESIVE 300	BARRIER ALU NET ADHESIVE 300
	membrane applied on site under dry conditions SC2	DEFENCE ADHESIVE DEFENCE ADHESIVE TRASPIR EVO	DEFENCE ADHESIVE TRASPIR EVO DEFENCE ADHESIVE	DEFENCE ADHESIVE TRASPIR EVO DEFENCE ADHESIVE	-
	membrane applied on site under wet conditions SC3	DEFENCE ADHESIVE TRASPIR EVO	DEFENCE ADHESIVE TRASPIR EVO	-	-

CLIMATE CHAMBER TESTING



Timber conditioning



Simulation of the construction stage

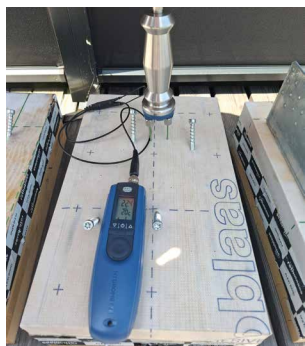
MEMBRANE DAMAGED DURING CONSTRUCTION

During construction, protective membranes may be accidentally damaged due to material handling, site traffic, or the installation of fastening elements.

TEST CONDITIONS

A preliminary test was conducted to assess the effects of different types of damage.

CASE 1



Damage caused by the insertion of 4 inclined screws.

CASE 2



Damage caused by the installation of a plate fastened with screws.

CASE 3



Damage resulting from surface abrasion, foot traffic and minor accidental tears.

SIMULATION OF THE CONSTRUCTION STAGE

The specimens were exposed to weather conditions for approximately 35 days under alpine spring climate conditions (April–June). During this period, they were subjected to day-night cycles with significant temperature fluctuations, rainfall and subsequent drying periods.



35 days



Note: The moisture content of the timber was always determined on a mass basis and verified using a moisture meter.

IMPLICATIONS ACCORDING TO THE TYPE OF DAMAGE

The preliminary test shows that **DEFENCE ADHESIVE TRASPIR EVO**, thanks to its breathability, promotes more effective timber drying and limits moisture-related damage.

The different types of damage give rise to specific issues:

- **CASE 1:** a condition particularly susceptible to water ingress; consequently, additional tests were carried out to investigate waterproofing performance;
- **CASE 2:** increased risk associated with potential timber swelling;
- **CASE 3:** highly variable behaviour that is difficult to reproduce; for water ingress, refer to CASE 1.

MEMBRANE DAMAGE IN THE PRESENCE OF SCREWS

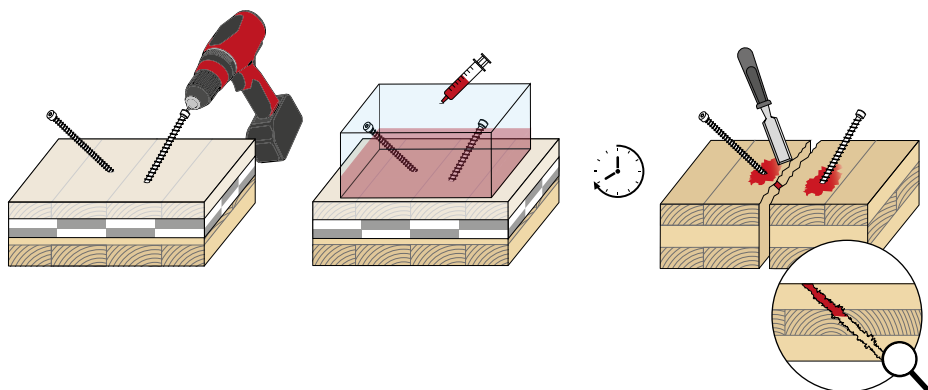
To evaluate membrane performance under these conditions, tests were carried out with screws inserted to simulate potential water ingress beneath the protective layer.

TEST CONDITIONS

initial timber moisture content	10%
screw insertion method	WITHOUT PRE-DRILLED HOLE WITH PRE-DRILLED HOLE

SIMULATION OF THE CONSTRUCTION STAGE

The test procedure involves inserting 45° inclined screws, creating a larger-diameter hole and lifting the underlying timber grain, thereby creating a potential path for water ingress. Coloured water is then applied to simulate prolonged exposure to rain during construction. After one week, the remaining water is removed and the level of water ingress and drying time of the timber element are assessed.

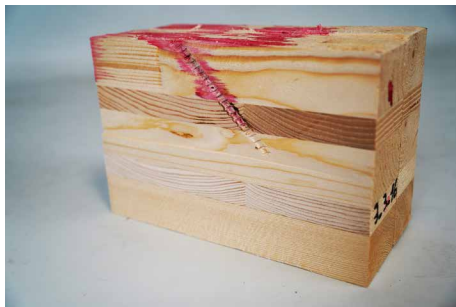


Note: The timber moisture content was measured at various locations using a moisture meter.

KEY FINDINGS

Mapping of water ingress beneath the membrane.

WITHOUT PRE-DRILLED HOLE



Wood fibres break more easily, creating an irregular hole that is more susceptible to deformation.

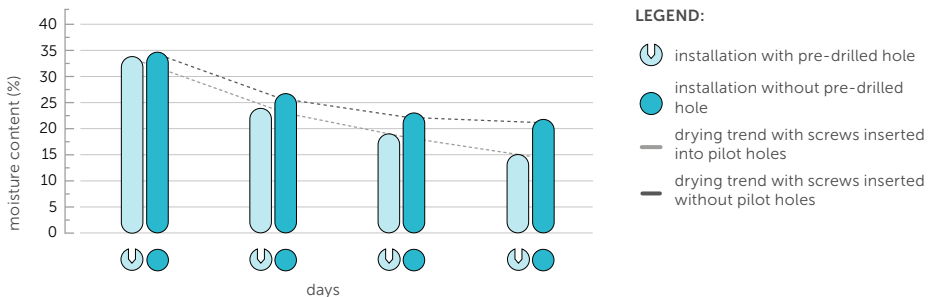
WITH PRE-DRILLED HOLE



Controlled screw insertion reduces local stress and limits grain damage.

CONCLUSIONS

Assessment of the drying behaviour of the timber specimen after removal of surface water.



The presence of a pilot hole limits water ingress beneath the membrane and allows faster drying.

The test also shows that, in the event of accidental damage, prolonged exposure to standing water may result in timber moisture content exceeding 30%.

PROTECTION WITH TARPAULINS

For small to medium-sized construction sites, or for parts of larger structures, temporary covering tarpaulins can be used to provide temporary protection during construction.



Fast installation

Quick to install, even for short-term use (e.g. overnight), providing immediate protection against unexpected rainfall.



Weather protection

The tarpaulin must be properly secured to ensure stability, even in adverse weather conditions.



Fastening eyelets

Possibility to properly secure the tarpaulin to the roof structure.



Tarpaulin selection

The choice of tarpaulin depends on the intended period of use, the area to be covered, the level of risk, the expected severity of adverse weather conditions and the available budget.



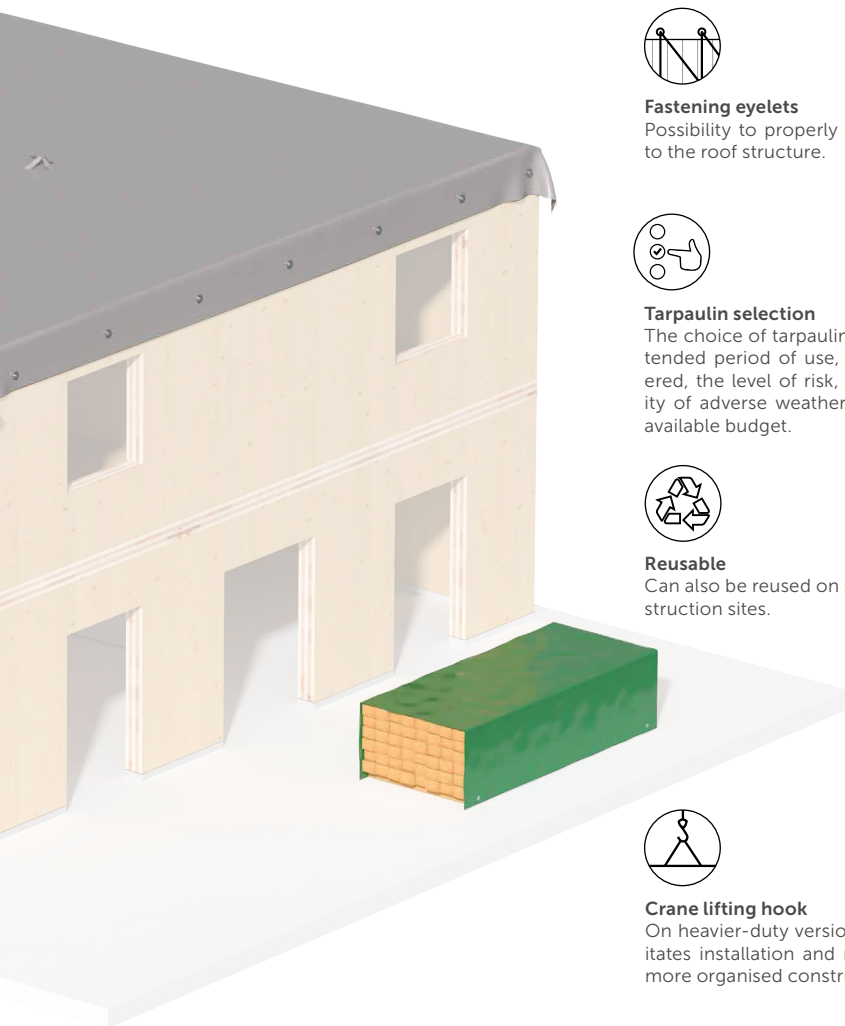
Reusable

Can also be reused on subsequent construction sites.



Crane lifting hook

On heavier-duty versions, the hook facilitates installation and removal on larger, more organised construction sites.



CAP TOP TARPAULIN FOR ROOFS



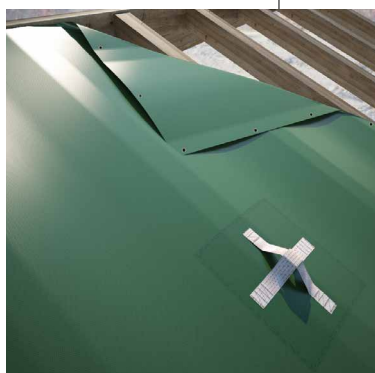
- ▶ Each size is equipped with a reinforced lifting hook for easier installation.
- ▶ Thanks to the metal fastening eyelets every metre, it is possible to fix the tarpaulin to the roof.
- ▶ The large mass per unit area and the type of material guarantee better mechanical resistance and durability over time.
- ▶ When fixing the tarpaulin to the roof it is important that all eyelets are always anchored so that the wind load is spread over as many eyelets as possible.



CAP PLUS TARPAULIN FOR ROOFS



- ▶ **CAP PLUS** tarpaulin for construction sites protects roofs and work areas from the weather.
- ▶ With a mass per unit of 300 g/m², it has good mechanical strength characteristics both to traction and tearing.
- ▶ It is available in various sizes.



CAP ECO TARPAULIN FOR ROOFS



- ▶ **CAP ECO** is the tarpaulin for roofs for construction sites with a mass per unit of 210 g/m².
- ▶ Available in two sizes, it is particularly **resistant to UV rays** thanks to the black inner support. It is easily and quickly fixed to the roof by means of the metal eyelets arranged every metre.
- ▶ **CAP ECO**, the simple and effective solution to cover the building site protecting it from the weather.



VAPOUR CONTROL MEMBRANES

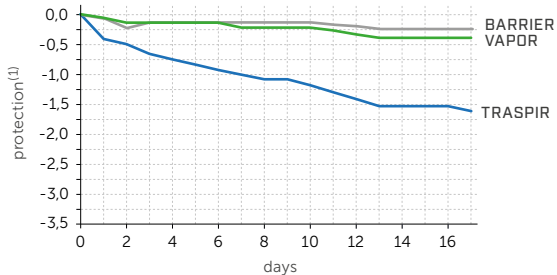
The building envelope is subject to continuous flows of heat, vapour, air and wind which, if not properly controlled, compromise the performance of building components. The properties of membranes are defined by the CE marking standards: EN 13984 for vapour control membranes, EN 13859-1 for underlays for discontinuous roof coverings, and EN 13859-2 for wall underlays. The classification of membranes according to their Sd values is not uniform, as it depends on individual national regulations.

PROPERTIES

Membranes can be divided into three main categories according to their hygrothermal behaviour.

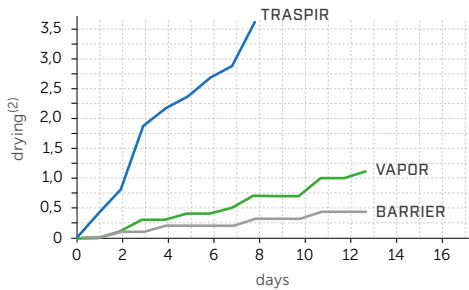
PROTECTION

Behaviour of a dry material exposed to a humid environment



DRYING

Behaviour of a moist material in a dry environment



The graphs are based on the results of the test campaign described on page 86.

(1) Reduction in protection due to moisture absorbed by the CLT panel.

(2) Drying capacity of the CLT panel with membrane applied.



watertightness



vapour
transmission

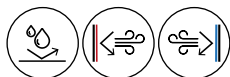
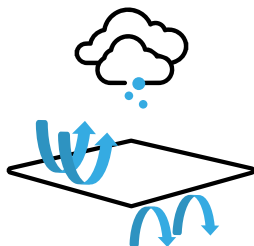


windtightness



airtightness

BARRIER



prevents water transmission



prevents vapour transmission



prevents drying

VAPOR



prevents water transmission

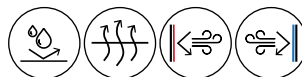


limits vapour transmission



limits drying

TRASPIR



prevents water transmission



allows vapour transmission



allows drying



BARRIER membranes provide a high level of resistance to vapour transmission, but they do not allow materials to dry after exposure to rain during construction or following installation errors.

RISK OF CONDENSATION

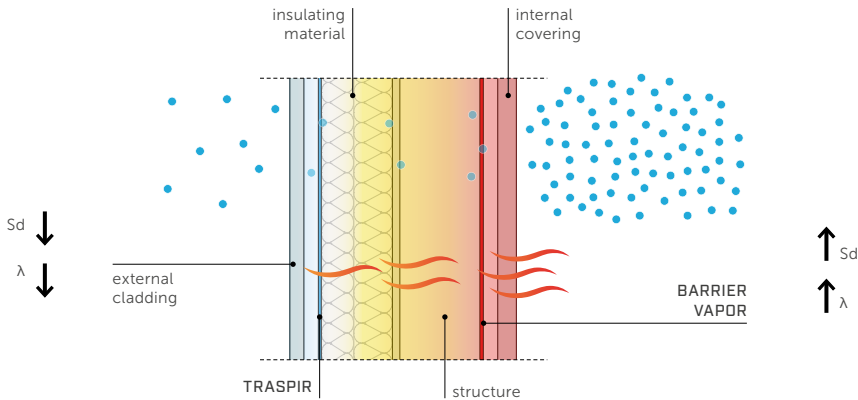
To reduce the risk of condensation, vapour control membranes should be installed on the warm side of the building element, limiting moisture migration through the building element. On the cold side, insulation layers and breathable materials should be positioned to maintain the build-up at a higher temperature and promote the dissipation of residual vapour.

LEGEND:

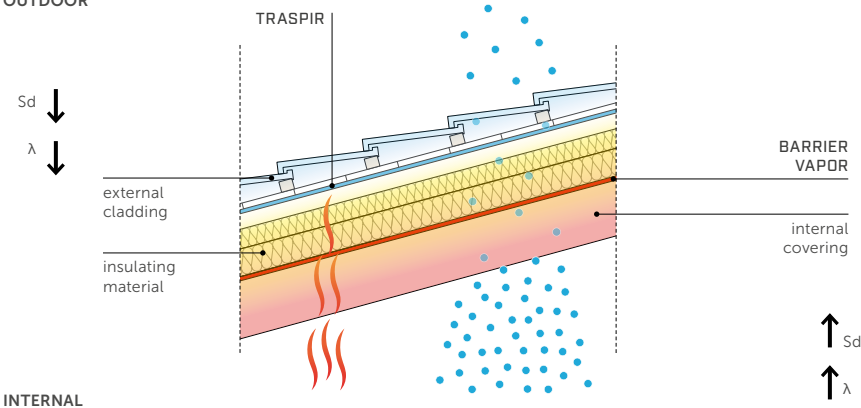


COLD SIDE

WARM SIDE

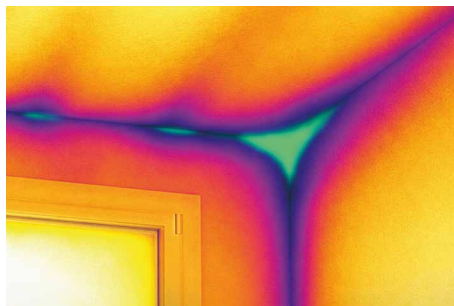


OUTDOOR



COLD SPOTS

Thermal bridges are geometric or material discontinuities within the building envelope that alter the temperature distribution within building components. When the surface temperature falls below the dew-point temperature, the risk of surface condensation and mould growth increases; if this occurs within the build-up, interstitial condensation can occur, causing damage to the materials.



HIGH MOISTURE LEVELS

When moisture levels within materials or indoor environments are very high, the risk of mould and component degradation increases significantly. The main causes include the absence of membranes that limit moisture accumulation within the build-up, ground-bearing floors or basements that transfer moisture to upper storeys, rising damp, water ingress, leaks from building services, and insufficient ventilation.



temperature	°C 25° C	°C 14° C ↓	°C 25° C	°C 25° C
absolute humidity	11,5 g/m ³	11,5 g/m ³	11,5 g/m ³	23 g/m ³ ↑
relative humidity	50%	100% ↑	50%	100% ↑



Absolute humidity depends solely on the quantity of water vapour present in the air, whereas relative humidity depends on both the amount of water vapour and the air temperature. As temperature rises, the air can hold more water vapour and the relative humidity decreases.

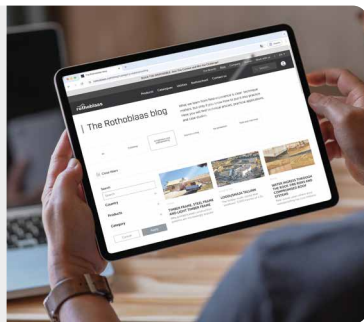
From theory to installation

On the Rothblaas BLOG you'll find technical articles on waterproofing to guide you in your on-site choices.

Here you will find technical articles, practical applications, and case studies



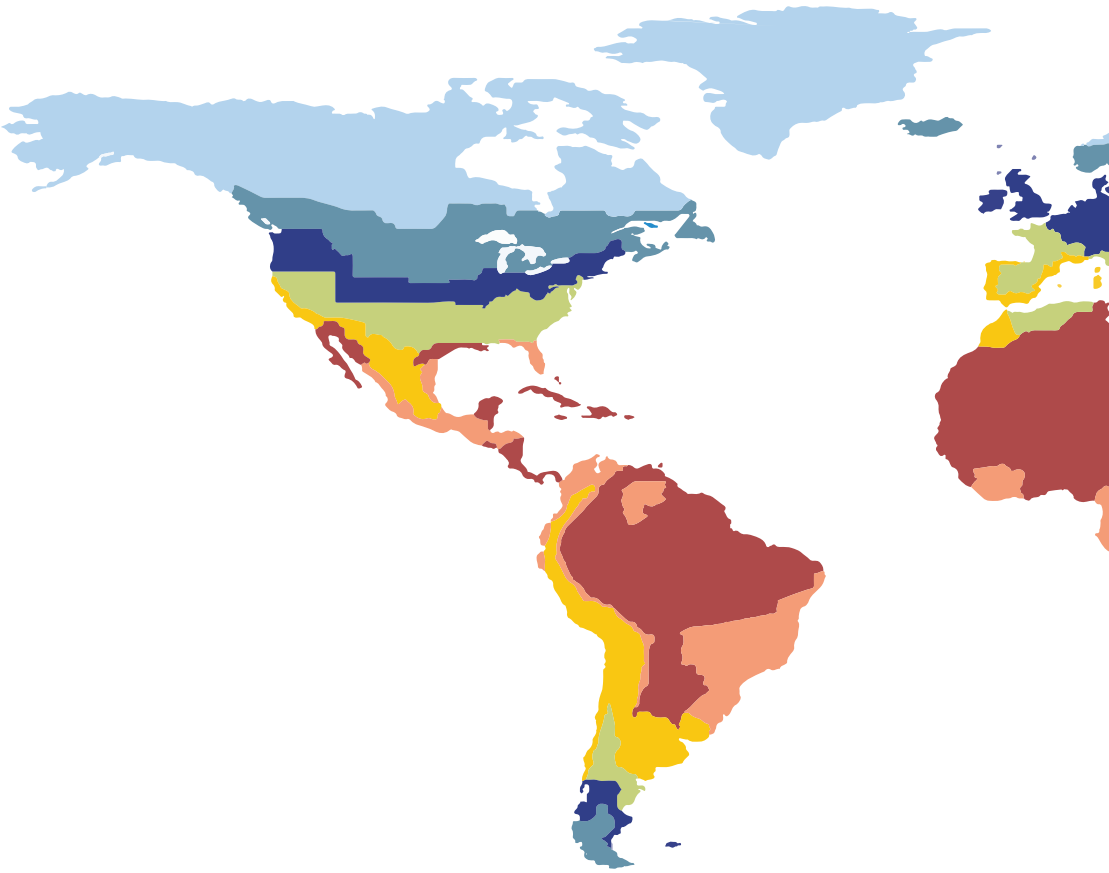
rothblaas.com



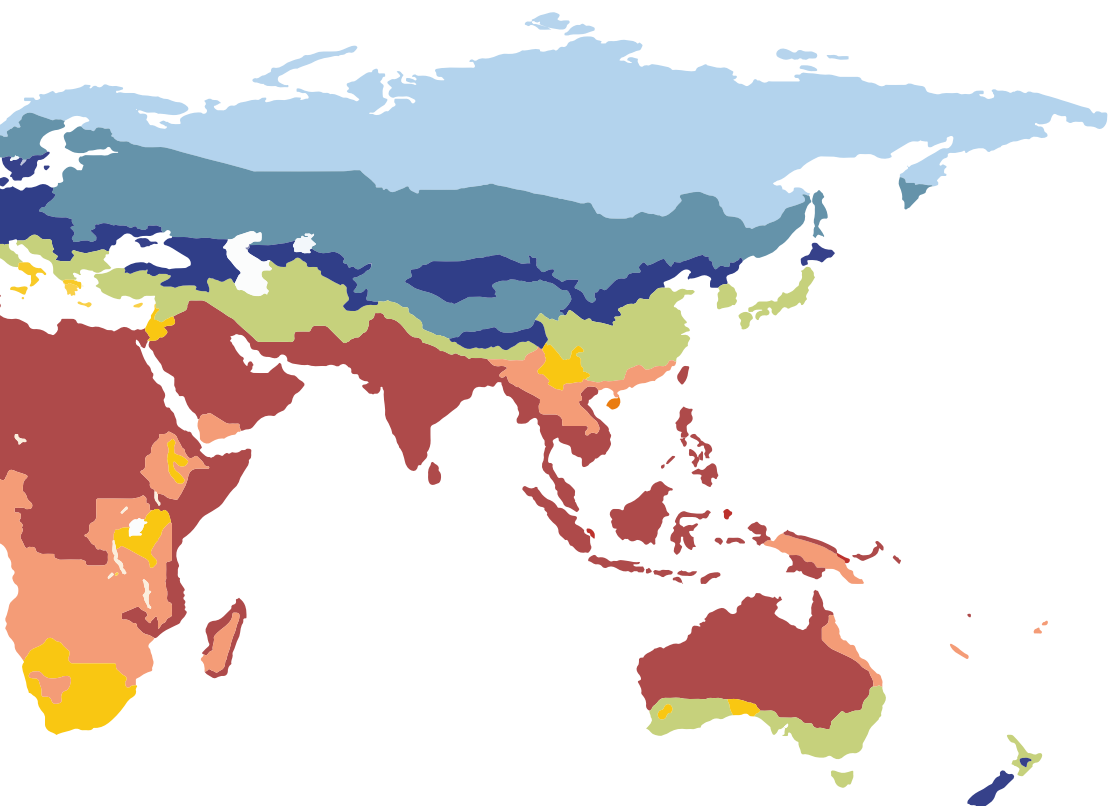
MEMBRANE SELECTION ACCORDING TO CLIMATE ZONE

The most suitable solution depends on several factors: climatic conditions, the construction system used and the intended application.

To support the design stage, a dedicated tool is available on the Rothoblaas website, enabling users to identify the most suitable build-up for a specific project in just a few steps.



ARCTIC CLIMATE	TEMPERATE WARM CLIMATE	HOT CLIMATE
COLD CLIMATE	WARM CLIMATE	
TEMPERATE COOL CLIMATE	HOT CLIMATE	



The right membrane for your project

Choose the ideal membrane according
to the climate zone and construction system.

Find our tips at:



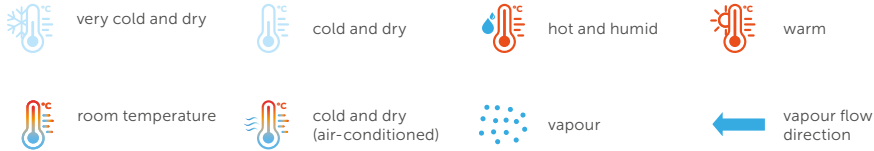
rothoblaas.com



CLIMATIC CONDITIONS

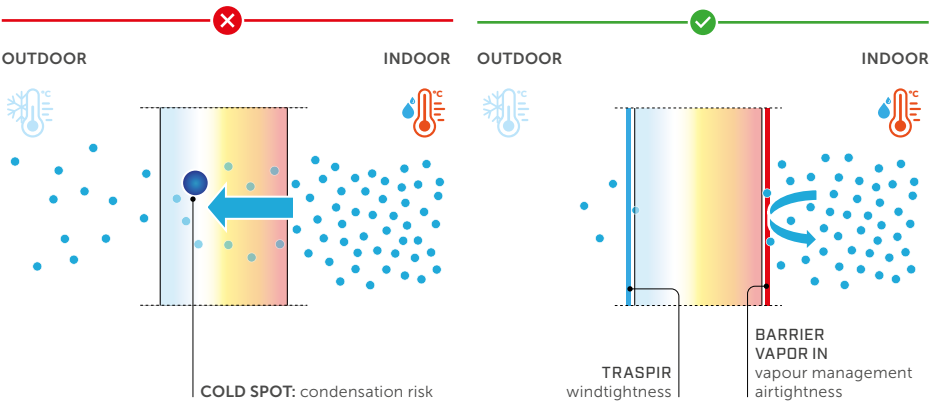
The typical behaviour of building elements varies according to the climatic context. The information provided is intended as general guidance only: the final selection of materials and arrangement must always be verified through project-specific hygrothermal simulations.

LEGEND:



COLD CLIMATES

High risk of interstitial condensation in winter.



A significant difference in temperature and humidity between the interior and exterior drives vapour migration through the building element towards colder areas, where it may reach the dew-point and condense.

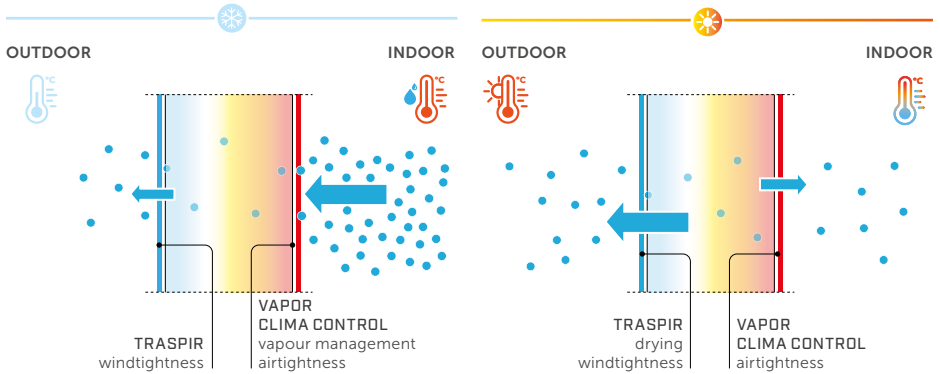
Vapour barriers and vapour control layers on the warm side limit vapour flow, while the breathable membrane on the external side allows residual vapour to escape without condensing within the build-up.



In particularly cold and humid climates near coastlines or watercourses, it may be beneficial to provide a vapour control layer on the external side as well.

TEMPERATE CLIMATES

Vapour migrates in winter, with drying potential in summer.

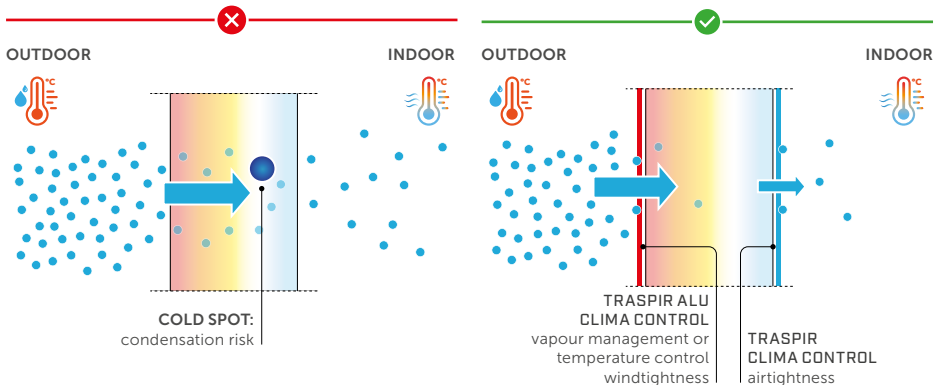


A smaller temperature difference between the interior and exterior reduces vapour flow through the building element. To prevent condensation, a vapour control layer or a variable-permeability membrane is generally sufficient.

Any moisture accumulated within the build-up may dry out during the summer season, because of warmer and drier conditions that promote vapour migration.

HOT / TROPICAL CLIMATES

Risk of interstitial condensation in summer.



Vapour flow occurs from the warm, humid exterior towards the cool, air-conditioned interior.

CLIMA CONTROL adapts to the hygrothermal conditions within the materials, providing protection while promoting drying. **TRASPIR ALU** reflects the heat, reducing the surface temperature of materials.

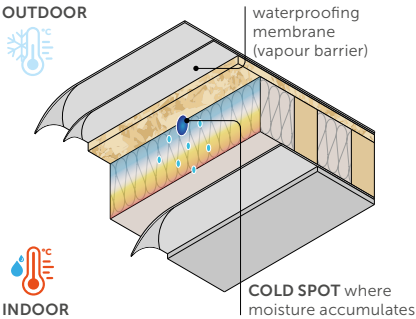


The reliability of these recommendations depends on the level of air conditioning and the temperature difference between the interior and exterior environments. Pronounced day-night temperature fluctuations introduce additional variations in vapour transport mechanisms, increasing uncertainty regarding the hygrothermal behaviour of the build-up.

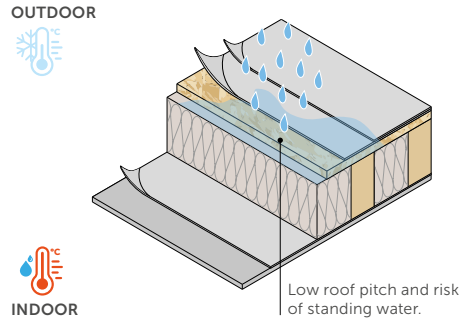
FLAT ROOF



CONDENSATION RISK



WATER INGRESS RISK



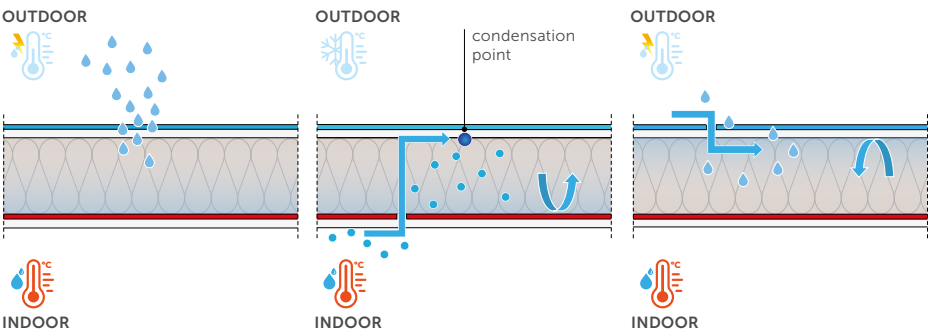
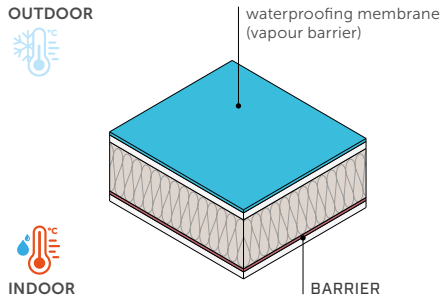
BARRIER

CLOSED SYSTEM:

high protection, no drying potential.

BARRIER on the internal side: prevents vapour transmission and avoids the formation of condensate. This case can be simulated under steady-state conditions (Glaser method) to assess condensation phenomena under average, constant climatic conditions.

Note: all membrane penetrations caused by fasteners must be sealed with tapes and nail-sealing products to ensure continuity of the layer and maintain the integrity of the vapour barrier.



Rainwater during construction remains trapped.

Installation defects in the vapour barrier may cause localised condensation problems.

Water ingress is not visible, it can trap moisture.



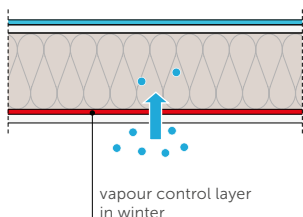
CLIMA CONTROL

SMART SYSTEM: medium protection, medium drying potential.

CLIMA CONTROL: limits vapour transmission during winter and promotes drying during summer.

This case must be simulated under dynamic conditions, because it considers actual variations in temperature and humidity over time and provides a more accurate assessment, including drying processes.

OUTDOOR

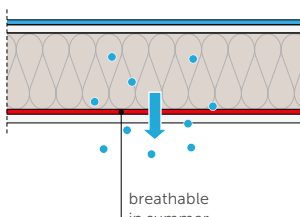


INDOOR



vapour control layer
in winter

OUTDOOR



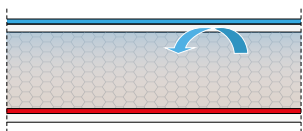
INDOOR



breathable
in summer



OUTDOOR

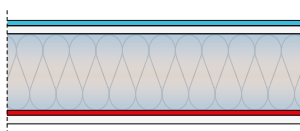


INDOOR



Non-breathable insulation materials do not allow drying.

OUTDOOR



INDOOR



Limited sunlight exposure during summer inhibits drying processes.

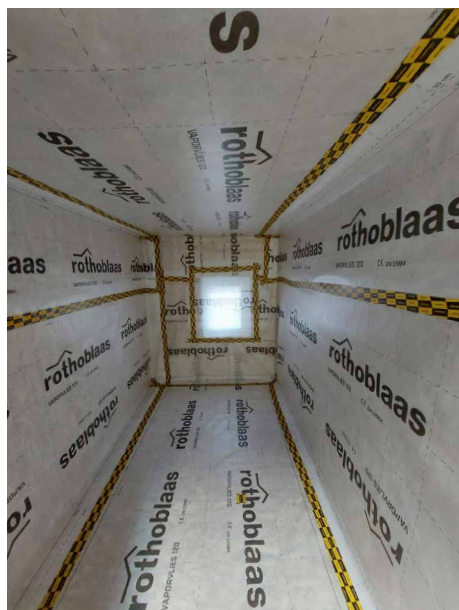
See further details under "RAINWATER DRAINAGE AND DEFLECTION" on page 156



DID YOU KNOW THAT...

For flat timber roofs, it is preferable to provide an exposed load-bearing structure with continuous boarding, as this limits the accumulation of moisture within the structure and provides favourable conditions for inspecting and drying of timber elements, avoiding closed, non-inspectable assemblies.

For further information on CLIMA CONTROL testing, refer to the catalogue "TAPES, MEMBRANES, SEALANTS AND FIRE PROTECTION", available at www.roteblaas.com.



Membrane correctly installed with adequate overlaps and properly taped joints, ensuring layer continuity and airtightness.



A Blower-Door test carried out at an intermediate stage, are installed before building services and finishes, to verify the continuity of the airtight layer.



Self-adhesive barrier applied under suitable weather conditions, with continuous installation and correctly executed overlaps.



Vapour barrier installed without taped joints, potentially reducing airtightness and vapour-control performance.



Vapour barrier damaged at multiple points by building services and untaped fasteners, without restoring layer continuity.



Vapour barrier extensively damaged and repaired only locally, with discontinuous remedial work reducing the effectiveness of the layer.

For further details, refer to "RECOMMENDATIONS FOR INSTALLATION: INTERNAL MEMBRANES".

Available in the Catalogues section
at www.rothoblaas.com.



WINDTIGHT MEMBRANES

1 CHOOSE HIGH-QUALITY (MONOLITHIC) MEMBRANES



Certified and tested membranes designed to withstand weather exposure provide protection and durability. The use of monolithic membranes and higher grammage membranes increases durability and abrasion resistance, reducing the risk of damage.



Low-cost or non-certified products deteriorate rapidly and do not provide adequate protection.

2 PLAN THE CONSTRUCTION STAGE TO LIMIT WEATHER EXPOSURE



Limit exposure to prevent premature membrane degradation and reduce stress on taped joints. Reduce the risks associated with severe weather events and carry out installation in dry conditions, avoiding strong winds and rain to prevent moisture from becoming trapped within the build-up.



Prolonged exposure accelerates membrane degradation, increases stress on taped joints and heightens the risks associated with repeated weather events. Strong winds, cloudbursts, thunderstorms and exceptional weather events during construction increase the risk of damage and water ingress.

3 ENSURE MEMBRANE CONTINUITY



Layer continuity is ensured through overlaps appropriate to the roof pitch, correctly executed taping, and sealing of all penetrations in the membrane, including those created by fasteners.



Unsealed and untaped overlaps compromise continuity, airtightness and watertightness, promoting water ingress and premature deterioration.

4 DESIGN VENTILATED SYSTEMS AND PREVENT OVERHEATING



An effective ventilation system promotes heat dissipation and rapid drying of the build-up.



Insufficient or absent ventilation causes overheating, accelerates degradation and reduces drying capacity.

5 CHOOSE COMPATIBLE SUBSTRATES



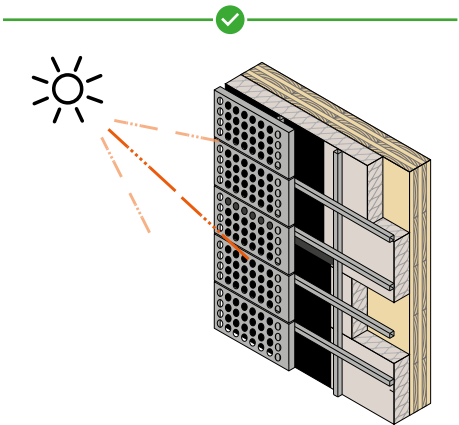
Use a stable, compliant substrate (such as panels, even surfaces, membranes), free from chemicals, oils, grease and solvents.



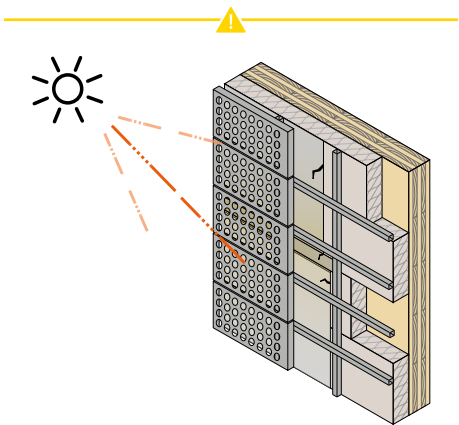
An uneven or incompatible substrate can cause wrinkling, stress concentrations and loss of performance. The presence of chemicals, oils, grease and solvents may compromise the functional film.

VENTILATED FAÇADE

OPEN-JOINTED FAÇADES: PROTECT AGAINST UV RAYS

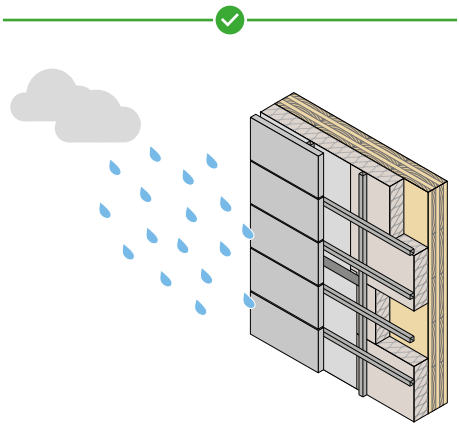


A membrane certified for UV exposure remains stable over time.

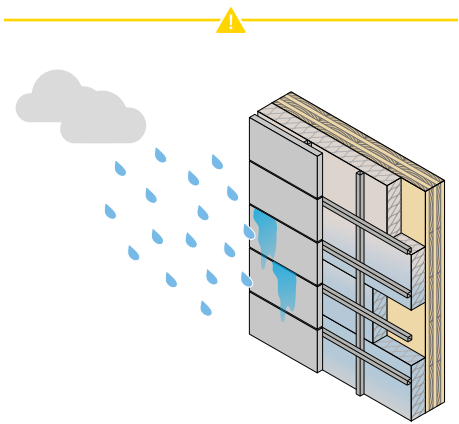


A membrane that is not UV-resistant will deteriorate prematurely and lose performance.

CLOSED-JOINTED FAÇADES: PROTECT THE INSULATION LAYER



A breathable membrane ensures protection and durability of the entire assembly, even in the event of accidental damage or minor water ingress.

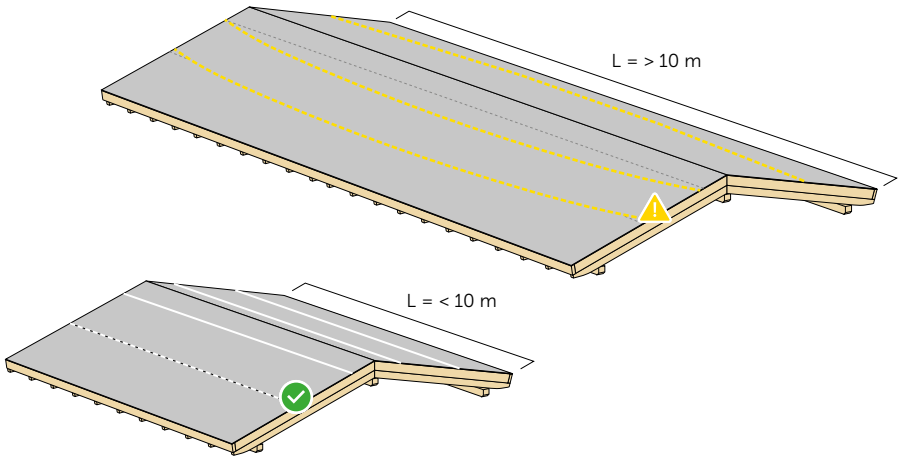


Without a membrane, the façade is exposed to water ingress and deterioration of the insulation layer's performance.

See further details under "INSTALLATION OF TAPES, MEMBRANES AND FOAMS" on page 118

DISCONTINUOUS ROOFING

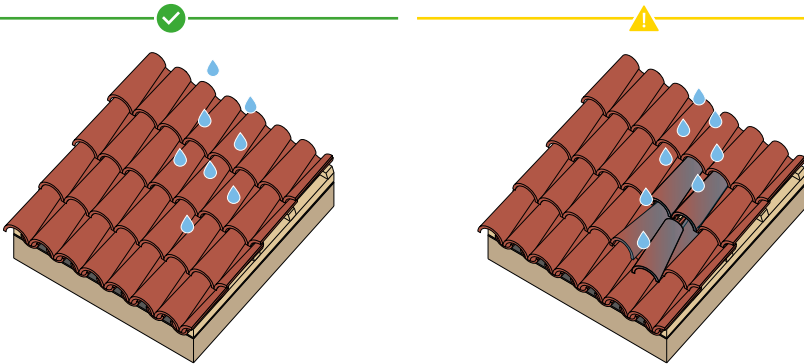
ASSESS THE ROOF SLOPE LENGTH



Roof slopes of limited length ($< 10 \text{ m}$) facilitate installation and reduce stresses on the system.

Long roof slopes ($> 10 \text{ m}$) increase the risk of membrane sagging and slippage and require reinforced fasteners and particular attention to taped joints.

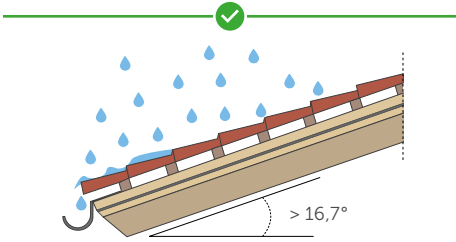
ASSESS THE FINAL WATERPROOF LAYER



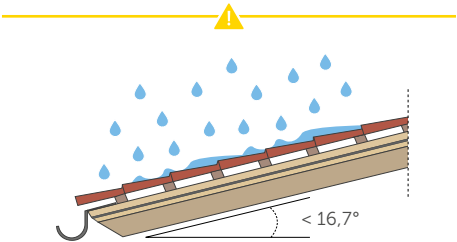
A new roof covering compliant with specifications (e.g. tiles or metal) provides optimum protection.

Refurbished roof coverings, or coverings with non-watertight elements (e.g. shingles), roof pitches below the certified minimum increase the risk of water ingress.

CONSIDER THE ROOF PITCH

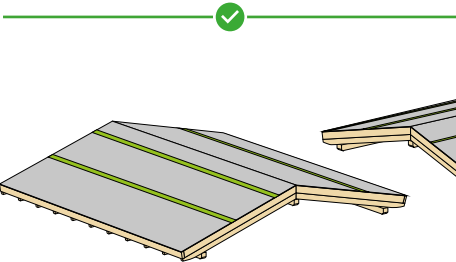


A pitch roof $>30\%$ ($\approx 16,7^\circ$) promotes rapid water run-off. For lower pitches, membranes with a higher mass per unit area and increased overlap widths are required.

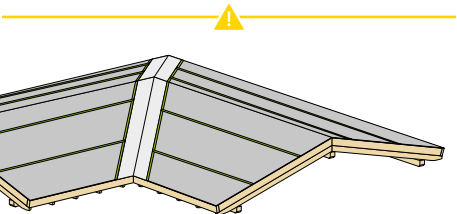


A pitch roof $<30\%$ slows water run-off and increases the risk of water ingress. Steep pitches combined with poor membrane mechanical performance increase the risk of tearing.

ASSESS ROOF COMPLEXITY

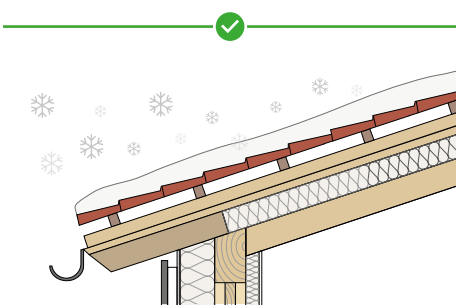


Simple, linear roof geometries facilitate installation and reduce the risk of errors. Complex geometries (e.g. eaves gutters, corners and junctions) require carefully designed details to minimise risk.



Poorly designed complex geometries (e.g. eaves gutters, corners and junctions) increase the risk of standing water and installation defects.

AVOID SNOW BUILD-UP



Snow build-up can be reduced through adequate roof pitch and efficient drainage, preventing build-up and promoting water run-off.

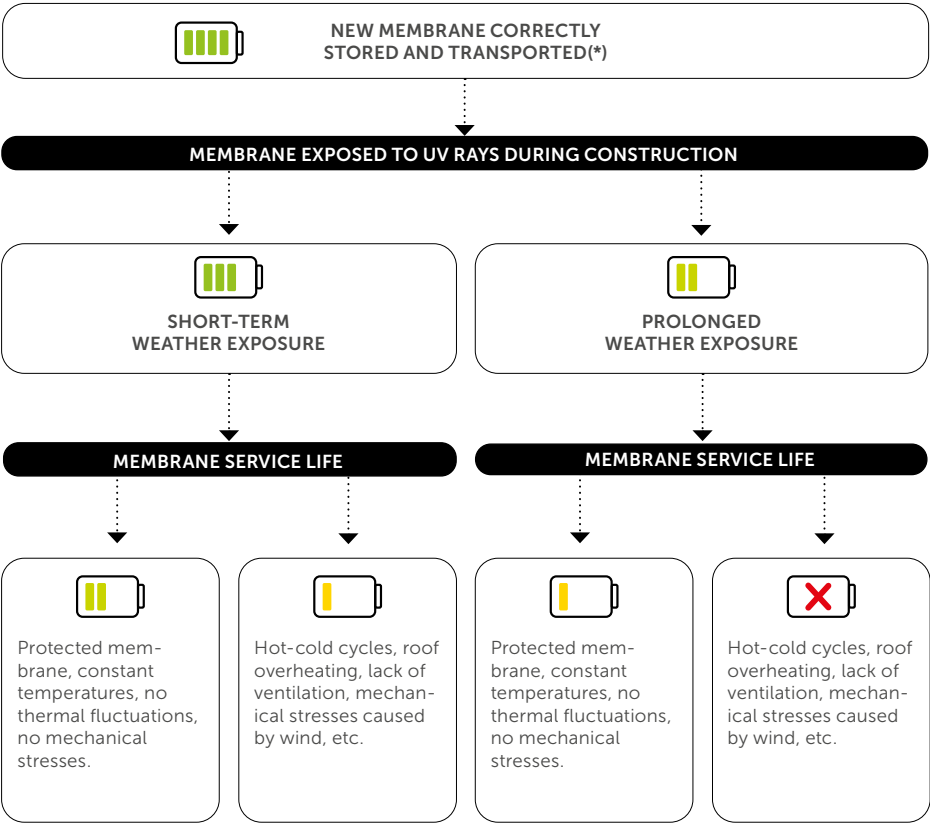


Snow build-up on the roof increases retained moisture and slows water run-off. The risk of water ingress increases particularly where roof the pitch is low, details are complex, ventilation is inadequate, or membranes have not been correctly installed.

LIMIT WEATHER EXPOSURE AND USE MONOLITHIC MEMBRANES

PRESERVE THE MEMBRANE

During construction, membranes are exposed to numerous stresses that can compromise their function. Proper on-site management enables the membrane to maintain its performance over time and the durability of the building system.



 (*) High temperatures, outdoor storage, significant temperature fluctuations and prolonged storage periods may compromise membrane performance.

MEMBRANE DURABILITY

Membranes are plastic materials composed of polymers, molecular chains that determine their strength and flexibility.

To ensure long-term membrane durability, it is essential to limit degradation mechanisms caused by exposure to:



chemical substances



mechanical stress



UV radiation



temperature



CHEMICAL SUBSTANCES

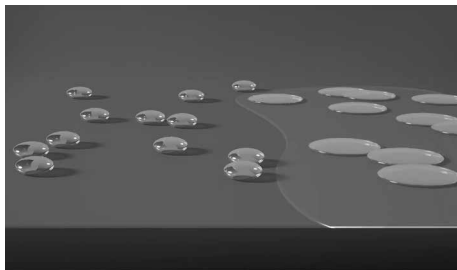
Many products commonly found on construction sites can release surfactants that reduce the surface tension of liquids and may compromise the watertightness of membranes.



MICROPOROUS



MONOLITHIC

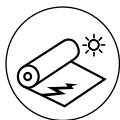


Substances containing surfactants reduce the surface tension of liquids allowing them to penetrate materials more easily, compromising the watertightness of microporous films.

SURFACTANTS

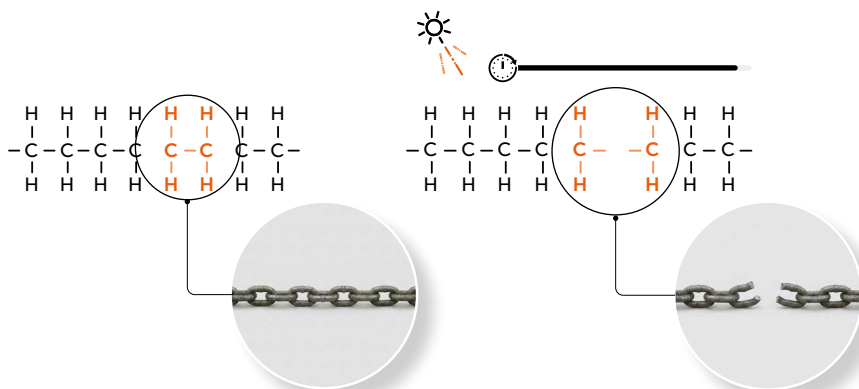
- detergents and degreasers
- lubricants and tool maintenance products
- concrete admixtures
- solvents and thinners
- paints and primers

Monolithic membranes have a continuous functional film: their vapour permeability is linked to a chemical process rather than a porous structure. Consequently, the presence of surfactants does not compromise their watertightness.



UV + MECHANICAL STRESS

Polymers are sensitive to UV radiation, which can progressively degrade their molecular structure. Exposure to ultraviolet radiation alters the chemical bonds within polymer chains, causing a loss of mechanical strength, increased stiffness, brittleness and colour changes. To ensure durability, high-performance polymers with improved UV resistance (acrylate and monolithic materials) are used and stabilised with additives that disperse solar radiation.



MEMBRANES

MICROPOROUS

MONOLITHIC



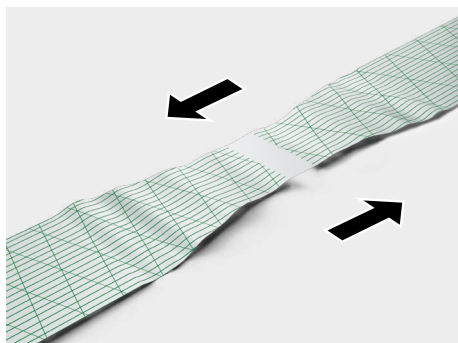
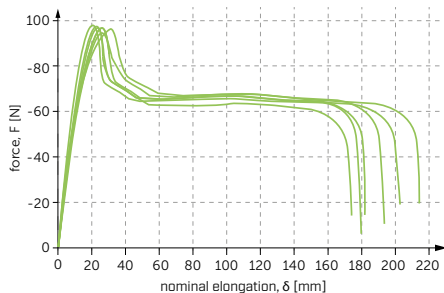
Microporous membranes, like traditional rigid plastic clothes pegs, perform well initially but tend to become brittle, develop microcracks and fail when exposed to sunlight for prolonged periods, as their structure is more sensitive to UV rays.

Monolithic membranes, comparable to softer, more flexible clothes pegs, retain their flexibility over time and offer better resistance to solar exposure. The polymers used in monolithic membranes provide superior UV resistance, are not subjected to mechanical stress during the manufacturing process, and retain their elasticity and watertightness even after prolonged exposure.

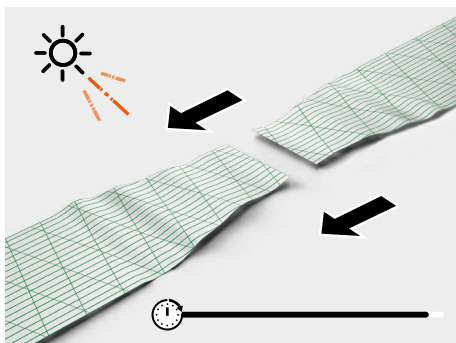
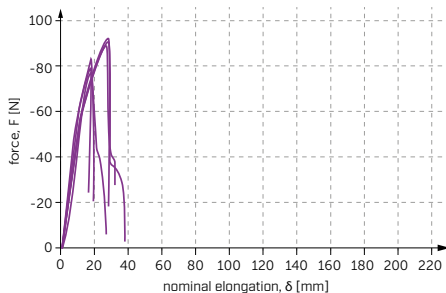
TAPES

Following UV ageing, tapes reinforced with a mesh scrim retain maximum strength that remains almost unchanged compared with unexposed material. The main difference is deformation behaviour: the carrier loses elasticity and the maximum elongation is significantly reduced. The tape fails when it reaches peak load due to rupture of the reinforcing scrim and loss of carrier deformability.

TAPE NOT EXPOSED TO UV RAYS



TAPE EXPOSED TO UV RAYS



Building envelope

Airtightness, wind resistance and fire protection for façades, doors and windows.

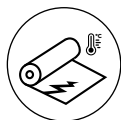
A well-designed envelope reduces energy consumption, improves comfort and increases the durability of materials.

Reduce risks and improve construction quality



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HIGH TEMPERATURES + MECHANICAL STRESS

Polymers are sensitive to high temperatures because increased molecular chain mobility reduces their stability and mechanical strength. Heat can promote deformation and degradation, resulting in loss of functionality.



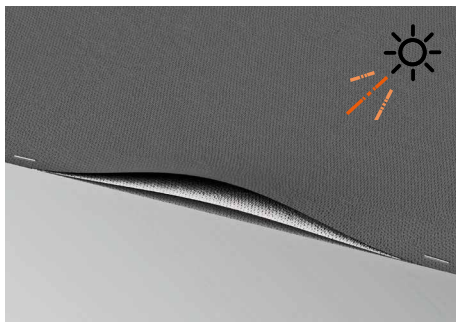
MICROPOROUS



During the production of microporous films, the material is stretched, orienting the polymer chains and inducing residual stresses, which increase membrane stiffness. When the membrane is exposed to high temperatures, these stresses may relax and the polymer tends to partially recover its original configuration. The greater thermal sensitivity of microporous membranes compared with monolithic membranes therefore makes them less stable over time.



MONOLITHIC



No mechanical or thermal stresses are applied during the production process of monolithic membranes. In addition, the polymers used in our monolithic films have higher glass transition temperatures, making them more resistant to thermal stress.



DID YOU KNOW THAT...

During the production of microporous membranes, stretching of the polymers aligns the molecular chains and makes the material stiffer. When heated, the chains tend to return to their original configuration, causing the material to shrink. In microporous membranes, this movement is restrained by the fasteners, generating stresses that can lead to film rupture.



For further information on this topic, refer to the WCTE paper available at www.rothoblaas.com.

SELECTION BASED ON PERFORMANCE

Depending on climatic conditions and the characteristics of the building, certain national standards provide guidance on membrane selection based on type, mechanical performance and grammage. The following practical recommendations have been developed on the basis of the main national guidelines to assist in selecting the most suitable membrane for a project.

In adverse site conditions requiring a high level of weather protection, **TRASPIR WELD EVO 360** enables the creation of a continuous welded layer with exceptional watertightness.

The selection of membranes according to roof pitch is governed by various national standards. These recommendations have been developed to simplify membrane selection and application.

Roof pitches > 80% (38.6°)



Roof pitches < 30% (16,7°)



Tensile strength MD > 300 N/50 mm



Mass per unit area $\geq 200 \text{ g/m}^2$



Nail tear resistance > 225 N

For façades, the main selection criteria are not mechanical performance but UV stability and fire performance, to limit flame spread.

For further information on TRASPIR WELD EVO 360 testing, refer to the catalogue "TAPES, MEMBRANES, SEALANTS AND FIRE PROTECTION", available at www.rothoblaas.com.



Rothoblaas membranes Ce-marked that are in accordance with EN 13984 and EN 13859 are waterproofing, airtight and windtight elements capable of draining rainwater in the event of accidental damage to, or displacement of the upper waterproof layer. This is a safety function intended to limit damage and does not replace the final waterproof covering (tiles, metal roofing elements, sheets), which alone is responsible for the watertightness of the roof. For this reason, there is no specific minimum pitch requirement for membranes: the applicable pitch is that required by the selected roofing system.



Adhesive membrane taped at weak points.



Membrane correctly taped around door and window openings.



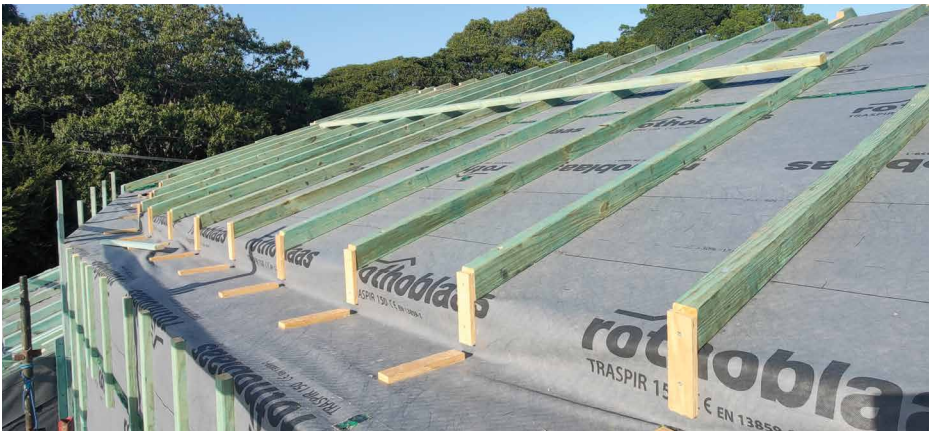
Membrane correctly installed from the bottom up, with layer continuity ensured by tapes and nail sealing.



Membrane not taped with no nail sealing provided.



Aligned vertical joints create a preferential path for water ingress.
Failure to tape ends and fastener penetrations.



No nail sealing, particularly in low-pitch areas.

INSTALLATION OF TAPES, MEMBRANES AND FOAMS

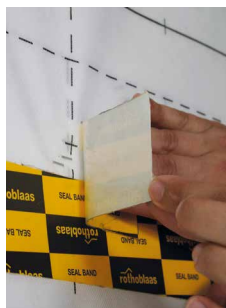
Correct installation of membranes and tapes, which provide airtightness, windtightness and vapour control, is essential to the long-term performance of both the build-up and the building itself.

ASSEMBLY TENSION AND OVERLAPS



Provide overlaps of adequate width according to the type detail:

- 10 cm - walls, steeply pitched roofs
- 20 cm - exposed joints, wall-to-floor junctions, low-pitch roofs.



Ensure continuity of the seal: a single unsealed penetration can compromise the performance of the entire membrane. Pay attention to work carried out after the membrane has been installed (e.g. building services), which may create discontinuities in the sealing layer.



For base connections, tapes with a pre-cut or easily divisible release liner facilitate installation.



Adhesive membranes: apply pressure using a roller or broom to achieve proper adhesion to the surface.

Download "Recommendations for installation: INTERNAL MEMBRANES" for full details.
Available at www.rothoblaas.com



Excessive tension: risk of tearing at fastening points due to thermal expansion and contraction. Potential issues may also arise with the adhesion of sealing tapes.



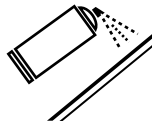
Insufficient tension: formation of depressions that allow water ponding, excessive stress on tapes and nail seals, and increased vulnerability to wind.

PROTECT THE MEMBRANE DURING AND AFTER INSTALLATION

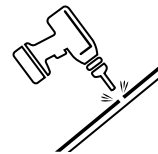
Main risks to the membrane between installation and completion of the building assembly:



aggressive chemicals
e.g. engine oil



solvent-based products
e.g. markers
or spray products



mechanical damage
e.g. punctures
or high-temperature chips

Guidelines for application: a technical reference

Scan the QR code
to download

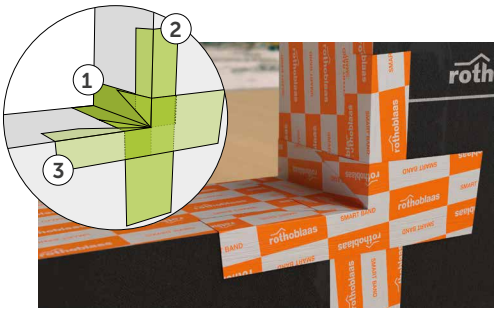


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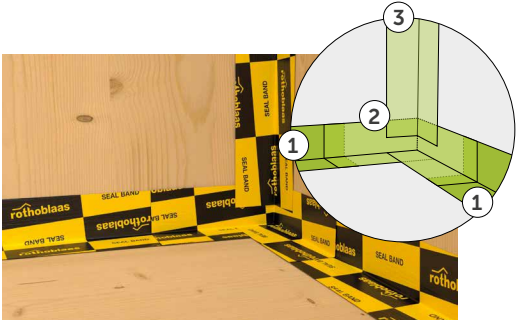


CRITICAL INSTALLATION POINTS

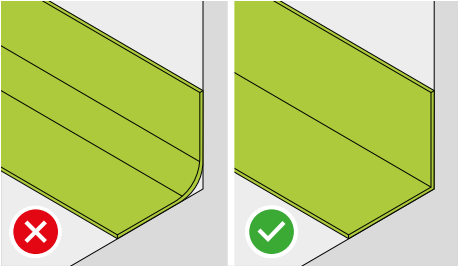
Certain junctions are subject to greater mechanical stresses and a higher risk of water exposure. Pay particular attention during installation.



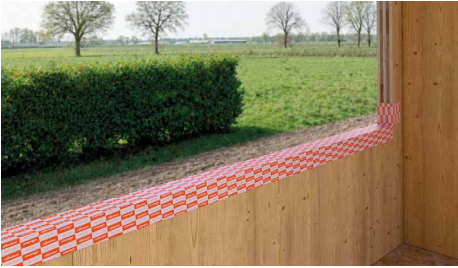
Use redundant systems. An elastic, deformable tape facilitates the sealing of weak points.



Use foldable tapes for corner details.



Pay attention to corners: a tape that does not conform properly to the corner is more susceptible to damage.



Use a single tape of adequate width rather than multiple narrow tapes placed side by side. Tape joints represent potential weak points.



Protect end-grain sections and door and window openings with suitable products (e.g. FLASHING TAPE).

ROTHOBLAAS RECOMMENDS

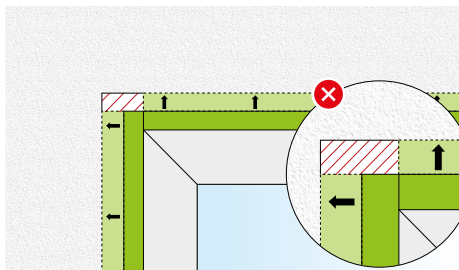
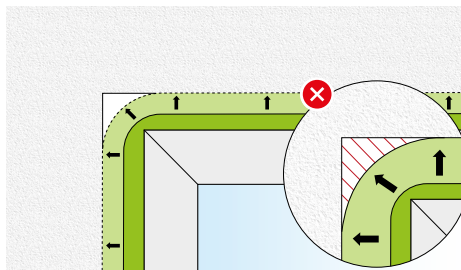
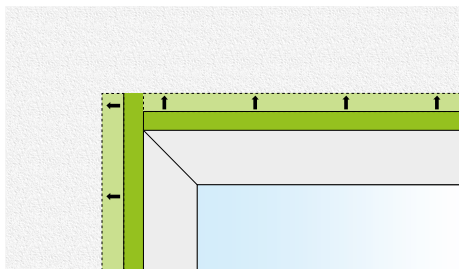
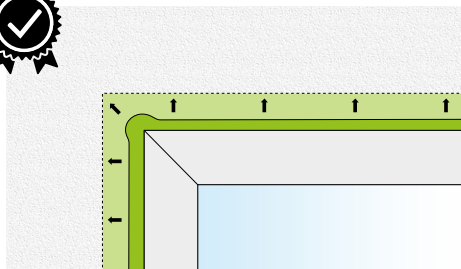
SMART BAND

UNIVERSAL SINGLE-SIDED TAPE WITH SEPARABLE LINER

A tape for sealing external doors and windows, compliant with the requirements for external applications. Also suitable in the presence of standing water, heavy rain and penetrations.

EXPANDING TAPES

Verify that the tape is capable of expanding and properly filling corner details.

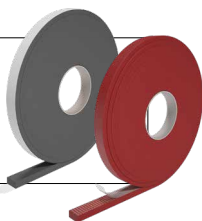


Join the beginning and end of the tape using a 45° cut to allow proper expansion and an optimal seal.



ROTHOBLAAS RECOMMENDS

EXPAND BAND
SELF-EXPANDING
SEALING TAPE



WINDOW BAND
SELF-EXPANDING
SEALING TAPE
FOR WINDOWS
AND DOORS



ADHESIVE PRODUCT SELECTION

The choice of adhesive product depends on its function, the substrate, the application and service temperatures, and the level of exposure to weathering and UV radiation.
The selected product must be applied correctly.

PSA — PRESSURE SENSITIVE ADHESIVE

To perform properly, adhesive products must be applied using pressure with a roller or spatula.

The diagram illustrates the correct application of Pressure Sensitive Adhesive (PSA). On the left, a roller is shown applying adhesive to a substrate, resulting in a smooth, uniform layer. This is marked with a red 'X' above it. On the right, a roller is shown applying adhesive to a substrate, resulting in a smooth, uniform layer. This is marked with a green checkmark above it. Labels indicate the 'adhesive' and 'carrier' layers. A circular inset image shows a hand using a roller to apply adhesive to a surface.

TYPES OF ADHESIVE

Adhesives can be divided into different families, each characterised by specific properties and areas of application. The selection depends on the intended function, substrate, application and service temperatures, and exposure to weather conditions.

	ACRYLIC	BUTYL	BITUMINOUS
initial tack	★★★★★	★★★★★	★★★★★
maximum adhesion	★★★★★	★★★★★	★★★★★
water resistance	✗	✓	✓
low temperature performance	✓	⚠	⚠
substrate compatibility	★★★★★ ⁽¹⁾	★★★★★ ⁽¹⁾	★★★★★ ⁽¹⁾

Performance varies according to the specific adhesive compound formula.
⁽¹⁾ See the complete compatibility table in the catalogue "TAPES, MEMBRANES, SEALANTS AND FIRE PROTECTION".

PRIMER: WHEN AND HOW TO USE IT

A Primer evens out the substrate and improves adhesion, particularly on porous, rough or difficult-to-clean surfaces.

ADHESIVE TYPE

- **Acrylic primers**
Compatible with acrylic, polyurethane, MS polymer and butyl adhesives.
- **Bituminous primers**
For bituminous systems and butyl tapes or sealants.

BASE TYPE

- **Solvent-based**
Fast-drying with good wetting properties, even on relatively smooth surfaces.
- **Water-based**
Slower-drying, suitable for porous substrates and indoor environments.

Note: apply the adhesive as soon as the primer has dried: the effectiveness of the treatment decreases over time.

ROTHOBLAAS RECOMMENDS

PRIMER

UNIVERSAL PRIMER FOR ACRYLIC ADHESIVE TAPES

- Compensates for surface irregularities and improves the adhesion of all tapes and adhesives.



PRIMER SPRAY

UNIVERSAL SPRAY PRIMER FOR ACRYLIC ADHESIVE TAPES

- Even the roughest and most fibrous surfaces before the application of tapes or sealants.



BYTUM PRIMER

UNIVERSAL PRIMER FOR MEMBRANES AND BITUMINOUS TAPES

- Water-based
- Forms a durable bonding layer



BYTUM SPRAY

BITUMINOUS MEMBRANE SEALANT SPRAY

- Can also be used as a primer
- Adheres to a wide range of material and shapes, including roofs, gutters, terraces, skylights and PVC or metal drainage pipes.

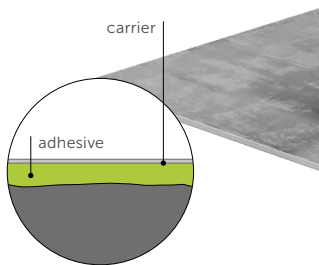


For further information, see the dedicated section in the catalogue "TAPES, MEMBRANES, SEALANTS AND FIRE PROTECTION" available at www.rothoblaas.com

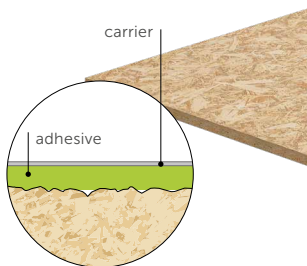
SURFACE CONDITIONS

COMPACT SURFACE

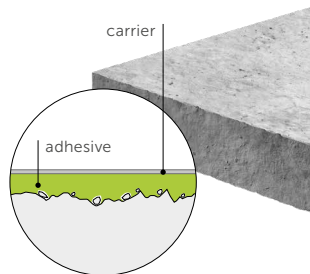
The tape must be in contact with the substrate across the entire adhesive surface. Friable, dusty or uneven surfaces drastically reduce the actual contact area.



**very compact
very smooth**



**fairly compacted
irregular**



**poorly compacted
irregular**

When surfaces are poorly bonded or contaminated with residues such as sawdust, dust or oils, the adhesive tends to stick to the surface particles rather than to the stable substrate underneath.



SUBSTRATE MOISTURE



Water film: the tape floats on the water layer without adhering to the surface.



Water or trapped moisture: evaporation causes the tape or adhesive membrane to lift. Even breathable products may initially be affected by this phenomenon.



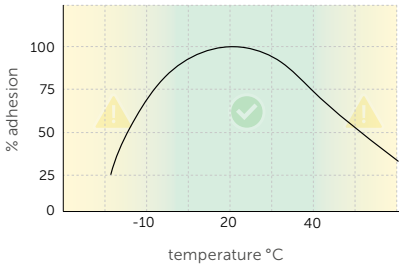
Prolonged exposure to high humidity: possible rehydration of water-based adhesives and loss of adhesion.



In windy conditions, the acrylic adhesive dries more quickly before bonding and can stress the tape before adhesion is achieved. Work in windy conditions, in short sections and press immediately.

TEMPERATURE

ON-SITE APPLICATION



Before application, check that the air and substrate temperatures fall within the ranges indicated by the manufacturer.



Excessively high temperatures: the tape softens, shrinks and may form ripples, detaching from the substrate and exposing the adhesive.



Excessively low temperatures: tape and adhesive become rigid, with limited adhesion and reduced ability to accommodate substrate movement. There is a high risk of detachment.

STORAGE

Particular attention must also be paid to climatic conditions during storage, and specific precautions must be taken:



Maintain
at the specified
temperature



Protect
from sunlight



Protect from
high humidity



Store in the original
packaging until use

Note: limiting the storage period reduces the risk of deterioration and preserves the product's effectiveness during use.



Prolonged exposure to high temperatures presents a greater risk than exposure to low temperatures.

POLYURETHANE FOAMS

Polyurethane foam is a chemical sealant used for waterproofing, insulating and sealing. It is used in door and window installation to fill gaps and cavities, or to bond different elements, preventing water ingress and air leakage.

HIGH EXPANSION



High volumetric expansion (up to 3 times the applied volume). Ideal for filling large and irregular cavities.

Typical uses:

- wide gaps and air voids
- filling service cavities

ROTHOBLAAS RECOMMENDS

SMART FOAM
GENERAL PURPOSE
FOAM SEALANT



LOW EXPANSION



Controlled and reduced expansion. Suitable where mechanical stress on materials must be minimised.

Typical uses:

- door and window installation (window-to-frame joint)
- narrow gaps and service penetrations
- areas where excessive expansion could cause deformation
- improved thermal insulation and acoustic

ROTHOBLAAS RECOMMENDS

FIRE FOAM
HIGHLY FIRE-RESISTANT
SEALING
POLYURETHANE FOAM



HERMETIC FOAM
SOUNDPROOFING
SEALING
POLYURETHANE FOAM

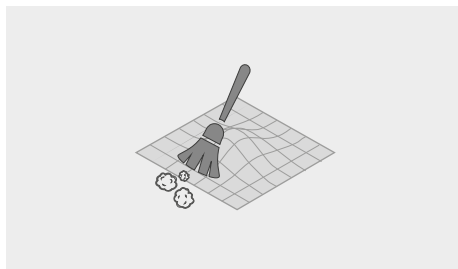


ADHESIVES

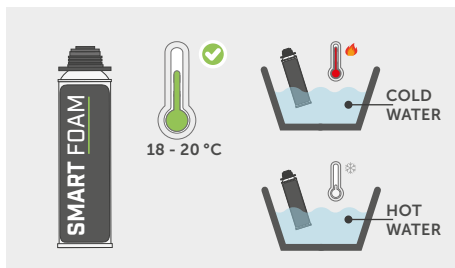
Adhesive foams are specifically formulated for bonding. They have very low expansion and are formulated to ensure high adhesion and long-term stability. They are not suitable where effective sealing is required, as they fill voids. By contrast, sealing foams, even low-expansion ones, are designed to expand and adapt to cavities and do not provide adequate performance bonding.

TIPS FOR CORRECT APPLICATION

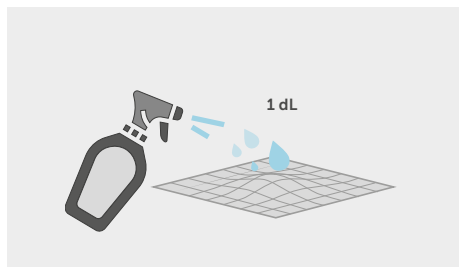
BEFORE APPLICATION



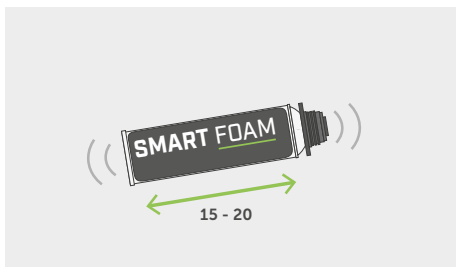
Clean the surface



Bring the canister temperature to the ideal application range



Moisten the surface

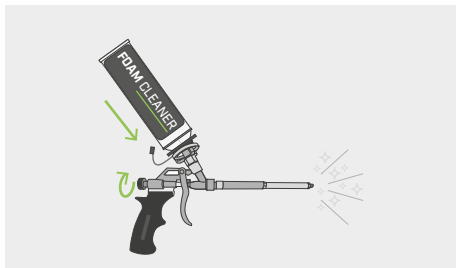


Shake at least 15 to 20 times before use



Do not fill the entire cavity: the foam expands up to 3 times the applied volume. Fill approximately two-thirds of the cavity.

AFTER APPLICATION



Clean both the inside and outside of the gun to prevent blockages and allow the gun to be reused.

For further information, see the dedicated section in the catalogue "TAPES, MEMBRANES, SEALANTS AND FIRE PROTECTION" available at www.rothoblaas.com

CONSTRUCTION DETAILS

CONSTRUCTION DETAILS

Key construction details – such as base connections, doors and windows, water drainage, ventilation and service penetrations – require careful design. Every discontinuity is a potential weak point. The overall performance of the system depends on the quality of workmanship.

BASE CONNECTIONS: JUNCTION DESIGN

from page **130**

WINDOW-TO-STRUCTURE JUNCTION

from page **140**

VENTILATION IN ROOFS AND FAÇADES

from page **150**

RAINWATER DRAINAGE AND DEFLECTION

from page **156**

INTEGRATED DESIGN

from page **166**

SERVICE PENETRATIONS AND FASTENING OF FAÇADE ELEMENTS

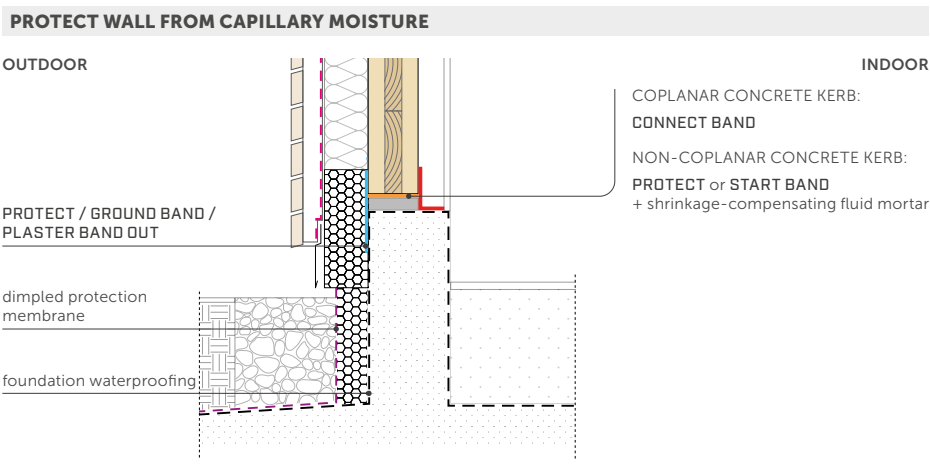
from page **168**



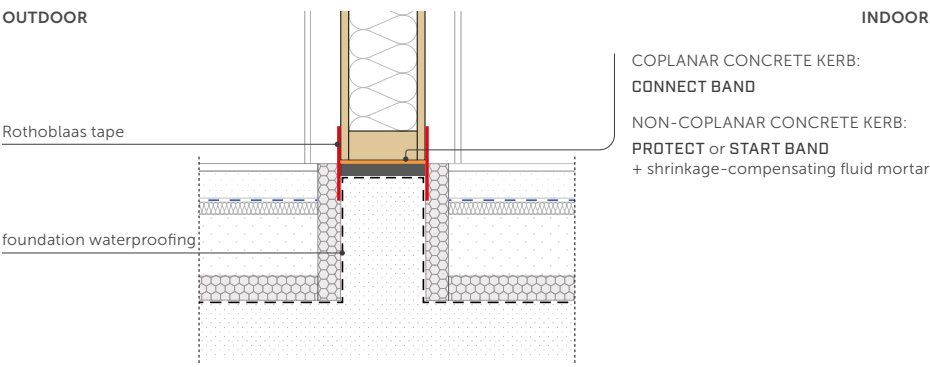
The construction details shown in this chapter highlight the main issues and set out possible solutions. The guidance provided is not exhaustive and does not replace project-specific design. Each solution must be checked against the applicable national regulations, the construction system adopted, and the specific climatic and design conditions of the project.

BASE CONNECTIONS: JUNCTION DESIGN

The base detail requires precision that both the design and working stages. The detail may vary depending on the architectural requirements, but the objective is always the same: to isolate the timber structure from ground moisture.



Install a **waterproof barrier between the timber and the concrete**, preferably applied on the concrete base so that it does not compromise the breathability of the wall base. For slabs in contact with the ground, continuous waterproofing is required.

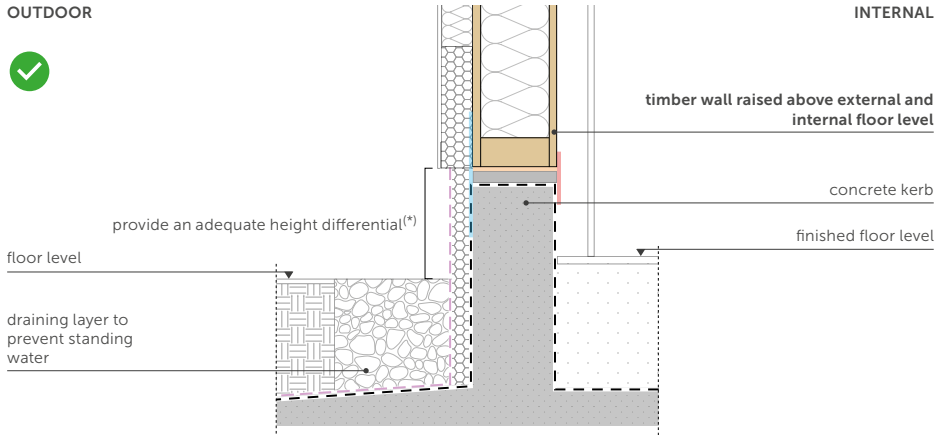


Not only perimeter walls, but **also internal walls** must be separated from the concrete using a waterproof barrier and raised sufficiently in order to prevent rising damp.

AVOID DIRECT CONTACT WITH THE GROUND

OUTDOOR

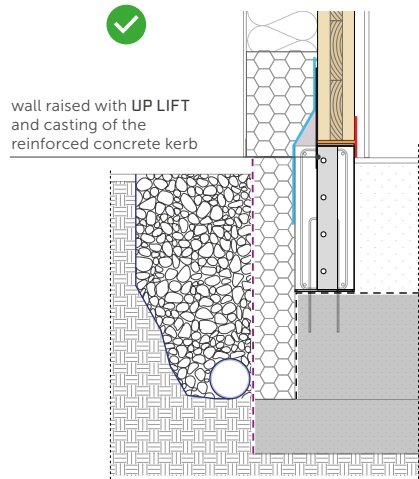
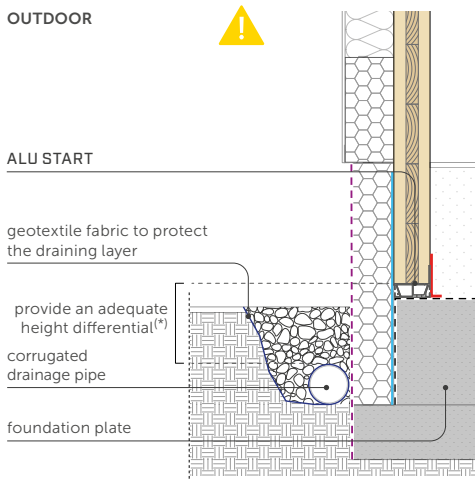
INTERNAL



The **concrete kerb** raises the support level of the timber structure above the finished external and internal floor levels, reducing the risk of standing water and moisture. This keeps the timber clear of the ground and limits possible damage caused by leaks from services or accidental wetting of indoor spaces. To ensure correct installation of the timber structure, the kerb must be constructed with a coplanar surface.

(*) The level difference must be sized according to the project context and local regulations.

OUTDOOR



In the absence of a concrete kerb, the detail requires careful design because the placing the wall below finished internal floor level increases the risk of accidental wetting. The junction must ensure sufficient **distance from the drainage plane**, permeable external paving and appropriate waterproofing in order to keep water away from the base of the timber wall. For critical situations, planned periodic inspection for seals, waterproofing and services are recommended.

AVOID INTERSTITIAL CONDENSATION

OUTDOOR

INTERNAL

external wall insulation

PROTECT or GROUND BAND for waterproofing + windtightness

external floor level

Rothblaas tape for airtightness

finished floor level

continuous insulation below the timber wall

service penetration that does not come into contact with the timber wall and does not interrupt the insulation and waterproofing of the concrete kerb

In addition to waterproofing, ensure **airtightness** using self-adhesive products and reduce thermal bridges by ensuring **the insulation continues** over the outside face of the foundation to prevent the formation of cold spots.

OUTDOOR

external wall insulation

PROTECT or GROUND BAND for waterproofing + windtightness

shaped insulation to turn up the waterproofing and prevent standing water

INTERNAL

COPLANAR CONCRETE KERB:
CONNECT BAND

NON-COPLANAR CONCRETE KERB:
PROTECT or START BAND
+ shrinkage-compensating fluid mortar

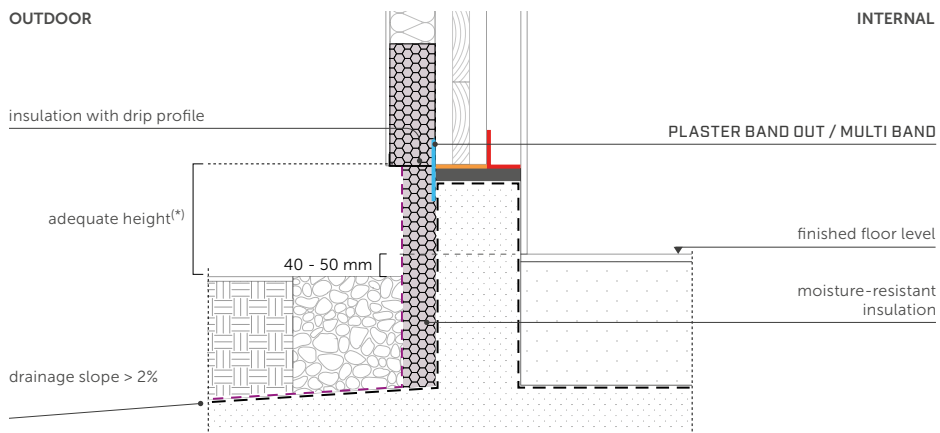


If angle brackets or other fastening elements puncture the vapour control membrane, continuity of the airtight layer and vapour control layer must be restored.

PROTECT AGAINST RAIN SPLASHBACK AND FACILITATE DRAINAGE

OUTDOOR

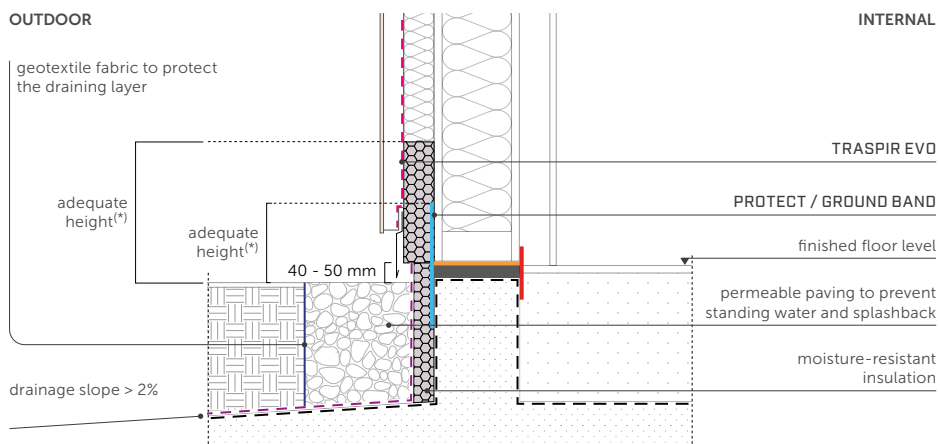
INTERNAL



Protect the wall with a butyl- or bitumen-based waterproofing layer; where the timber wall sits sufficiently above finished external ground level, an adhesive tape is sufficient, preferably breathable and suitable for plastering over. It is advisable to install a perimeter drainage strip to prevent standing water and splashback, ensure an internal/external level difference of 4–5 cm, and install paving with a minimum slope of 2%, with a greater fall at door thresholds.

OUTDOOR

INTERNAL



(*) Dimensions must be determined according to the project context and local regulations.

ROTHOBLAAS RECOMMENDS

PROTECT

SELF-ADHESIVE
BUTYL BAND,
CAN BE PLASTERED



START BAND

WATERPROOF PROFILE
WITH HIGH MECHANICAL
RESISTANCE



PLASTER BAND OUT

SPECIAL HIGH-ADHESION
TAPE, CAN BE PLASTERED



CHOOSE THE CORRECT FASTENING SYSTEM

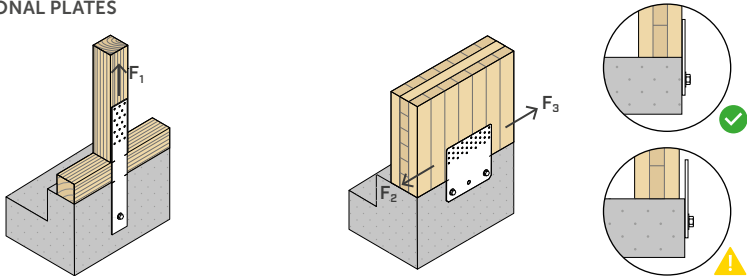
To install the construction detail correctly, it is essential to consider the choice of fastening system from the outset, depending on the presence of the concrete kerb, wall alignment, and compliance with the required edge distances for timber and concrete.

THREE-DIMENSIONAL ANGLE BRACKETS



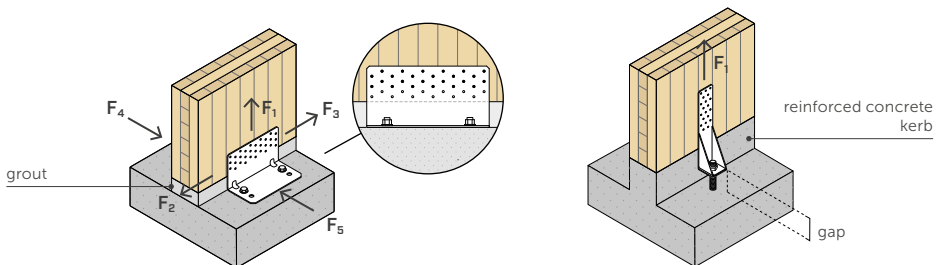
Timber walls are generally fixed to a foundation using hold-downs, such as **WHT** or **WKR**, at the wall ends to resist tensile forces. Shear angle brackets such as **TITAN** or **NINO** are positioned at regular intervals and, as they are certified for loads in all directions, can replace hold-downs.

TWO-DIMENSIONAL PLATES



Alternatively, use two-dimensional plates such as **WHT PLATE C** for tension or **TITAN PLATE C** for shear. In this case, particular care is needed when casting the concrete, which must be correctly aligned with the timber wall.

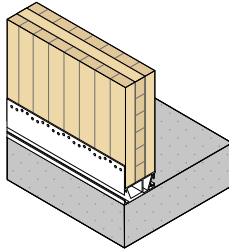
LEVEL TOLERANCE MANAGEMENT



Place grout between the wall and the concrete to level the base. ETA-certified partial fastening layouts allow the nails or screws to be positioned higher in order to accommodate the mortar layer. **WHT** and **WKR** can be installed with a clearance gap to facilitate the installation of raised walls.

INTEGRATED SYSTEMS FOR BASE CONNECTIONS

NON-RAISED BUILDING

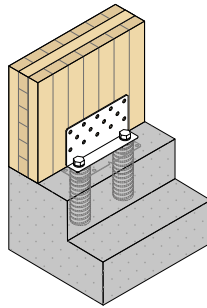


ALU START

In the absence of a reinforced concrete kerb, Rothoblaas recommends using **ALU START**. The aluminium profiles allow accurate horizontal and vertical positioning before the installation of the timber walls. The aluminium also acts as a barrier against rising damp from the foundation.

RAISED BUILDING

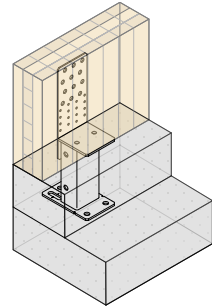
THE KERB IS CAST BEFORE WALL INSTALLATION



TITAN DIVE

Where a reinforced concrete kerb is present, Rothoblaas recommends **TITAN DIVE**. Corrugated pipes pre-installed in the kerb allow the installation of angle brackets and timber walls with generous horizontal and vertical tolerances. All base fastenings are made without the need for drilling anchors on site.

THE KERB IS CAST AFTER WALL INSTALLATION



UP LIFT

Where a reinforced concrete kerb is present, Rothoblaas recommends **UP LIFT**. The steel supports carry the weight of the building during installation, while the reinforced concrete kerb is cast afterwards, adapting to the position of the walls and giving the installer maximum flexibility during installation. In this case too, no on-site drilling is required for anchor installation.

A bond beyond the limit

It is through our metal connectors that we make our way into building sites of traditional and hybrid, prefabricated and demountable timber constructions.

The **PLATES AND CONNECTORS FOR TIMBER, CONCRETE AND STEEL** catalogue is now more up-to-date than ever. Products for every load range, complete design tables, precise solutions for different construction systems.

Download the catalogue and start designing with us

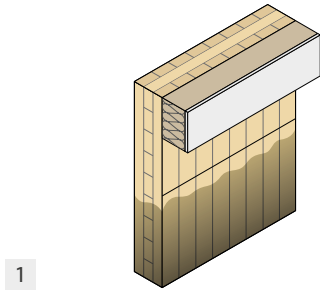


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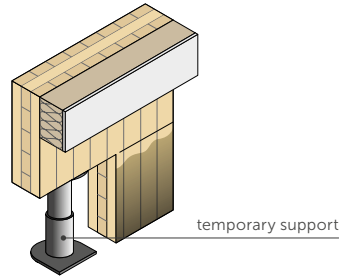
STRUCTURAL RESTORATION

Where walls have been damaged by water ingress or moisture, **UP LIFT** can also be used to used when replacing the damaged lower section with a concrete kerb detail.



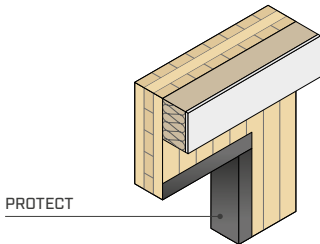
1

Remove the external wall finishes to expose the damaged area and define the cutting line.



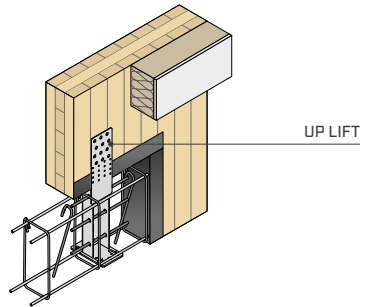
2

Carry out the work in sections. Cut the wall while temporarily supporting it with props to ensure the stability of the structure.



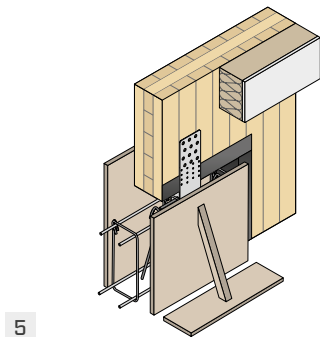
3

Apply **PROTECT** to waterproof the timber wall and prevent rising damp.



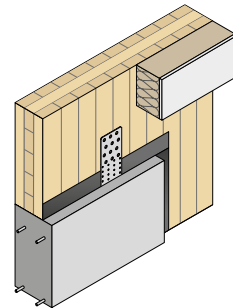
4

Position **UP LIFT** and level out any level irregularities using **SHIM**. Install the kerb reinforcement and insert starter bars between the kerb and the existing foundation.



5

Build the formwork for the kerb and cast the kerb using fluid shrinkage-compensated concrete.



6

Once the work is complete, the wall is supported by the new reinforced concrete kerb and is secured to the base using the **UP LIFT** supports. The external finishes can then be reinstated.



Greater acoustic comfort in your timber home.

XYLOFON is the very high-performance resilient profile that ensures acoustic comfort in timber structures and houses. Made of a polyurethane compound, it is available in 6 versions, according to the load it must support. Tested and certified for use as a decoupling and mechanical interruption layer between structural elements, it reduces the transmission of airborne and structural noise (up to more than 15 dB). **Rely on the best performing acoustic profile on the market.**



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the technical features of XYLOFON



rothoblaas.com

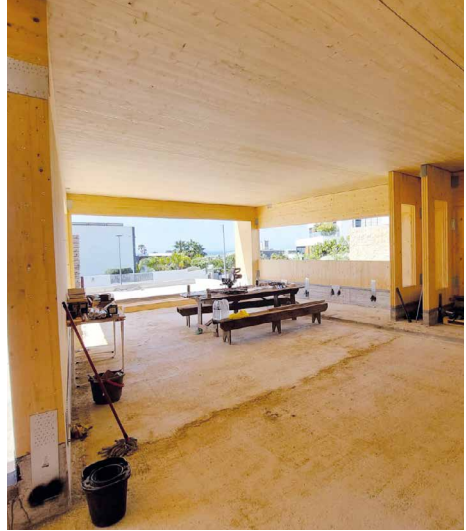


rothoblaas

Solutions for Building Technology



Timber structure raised by means of a kerb. Waterproofing applied to the concrete base, with the wall aligned flush with the internal face with the internal face.

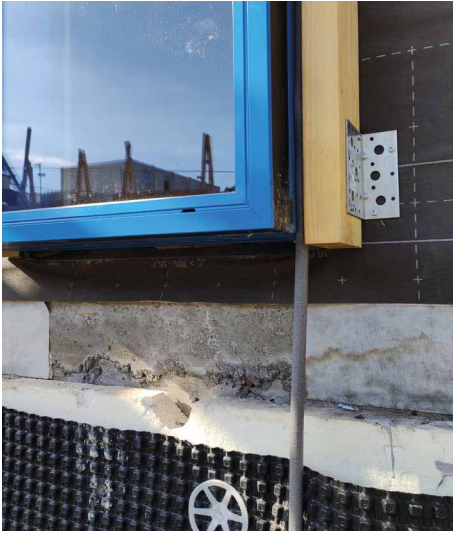


Perimeter and internal timber walls raised on a concrete kerb, with the concrete kerb shaped at door openings.



Timber wall raised on a kerb, with moisture-resistant insulation used at the base of the wall.

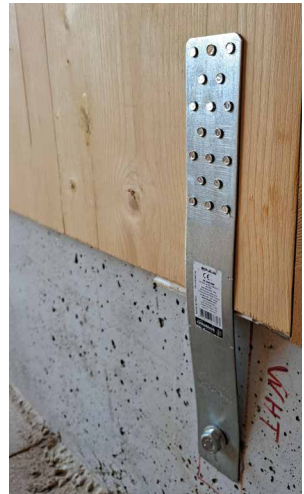




Butyl product protecting the wall applied discontinuously, and dimpled membrane penetrated by the anchor.



Timber wall below the external finished level, no insulation below the timber wall (thermal bridge risk) and inadequate waterproofing system.



Fastening plates incorrectly installed: failure to comply with edge distances or the presence of an uneven kerb, preventing correct insertion of screws and anchors and which may deform the connector plate.

WINDOW-TO-STRUCTURE JUNCTION

DESIGN THE WINDOW JUNCTION

The window-to-wall junction is one of the most sensitive points in the building envelope. This is where atmospheric, hygrothermal and mechanical stresses are concentrated: water and air can enter, and heat can escape. To ensure consistent performance and durability of the window, the detail must work as a single, continuous system, capable of draining water, sealing joints and maintaining insulation continuity.

LEVELS OF PROTECTION



OUTDOOR

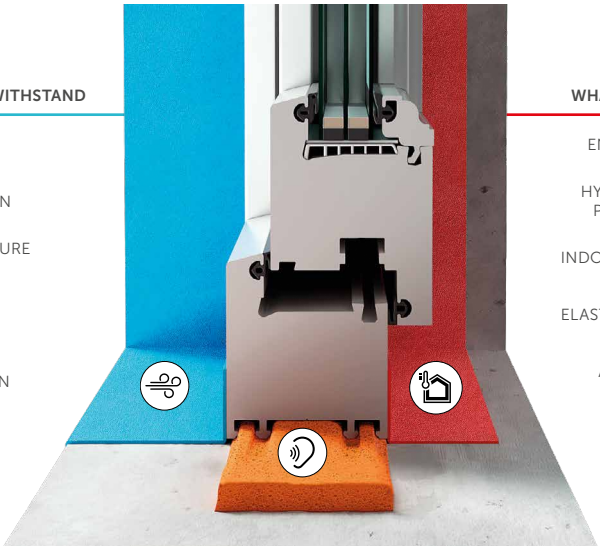
WHAT IT MUST WITHSTAND

- UV RAYS
- HEAVY RAIN
- TEMPERATURE CHANGES
- WIND
- NOISE POLLUTION
- FIRE

INTERNAL

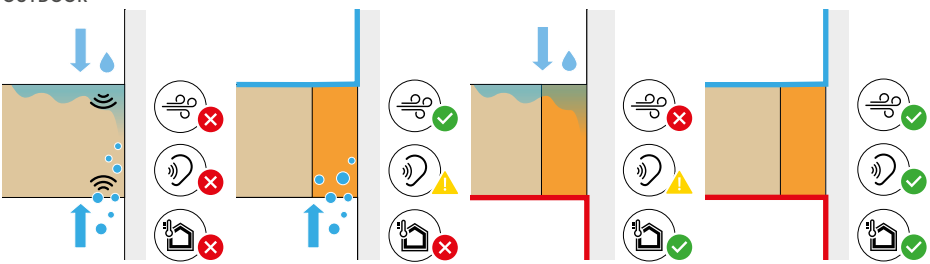
WHAT IT MUST GUARANTEE

- ENERGY SAVING
- HYGROTHERMAL PERFORMANCE
- INDOOR COMFORT
- ELASTIC RESPONSE
- AIRTIGHTNESS



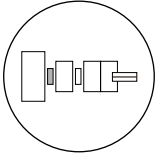
The details show how correct design of the three protection levels prevents water ingress and standing water.

OUTDOOR



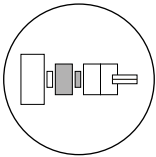
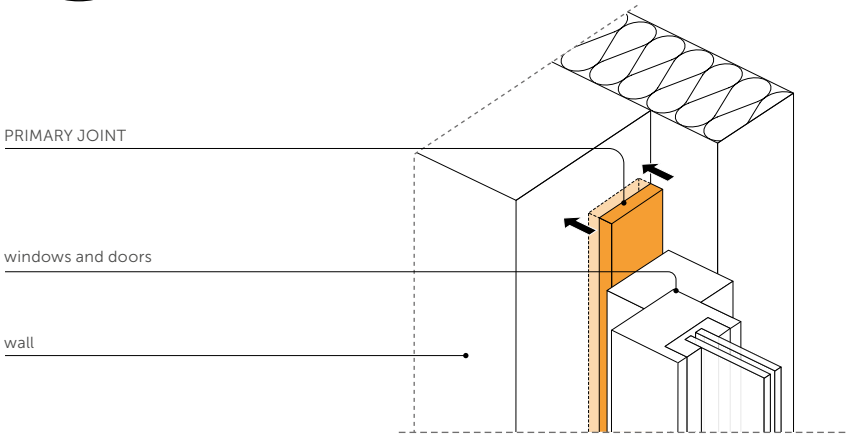
INTERNAL

DETAILS TO CONSIDER WHEN DESIGNING WINDOW INSTALLATIONS



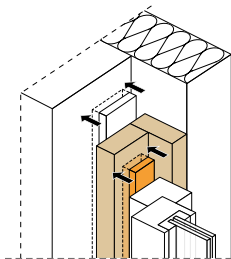
PRIMARY JOINT

Connects the opening to the subframe or, where there is no subframe, to the fixed window frame. Transfers loads and provides continuous support: this is the element and ensures the stability of the entire window system.



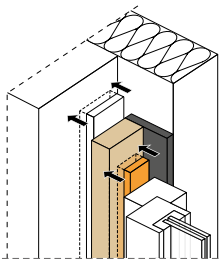
SECONDARY JOINT AND SUBFRAME

The subframe ensures correct alignment and flatness of the window, compliance with dimensional tolerances, and makes future replacement easier. The secondary joint connects the subframe and the window.



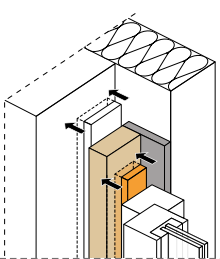
TIMBER-TO-TIMBER

Ensures consistency with the insulation build-up and reduces the risk of thermal bridges.



TIMBER-TO-PVC

It provides good performance thanks to the low thermal conductivity of PVC and helps maintain insulation continuity.



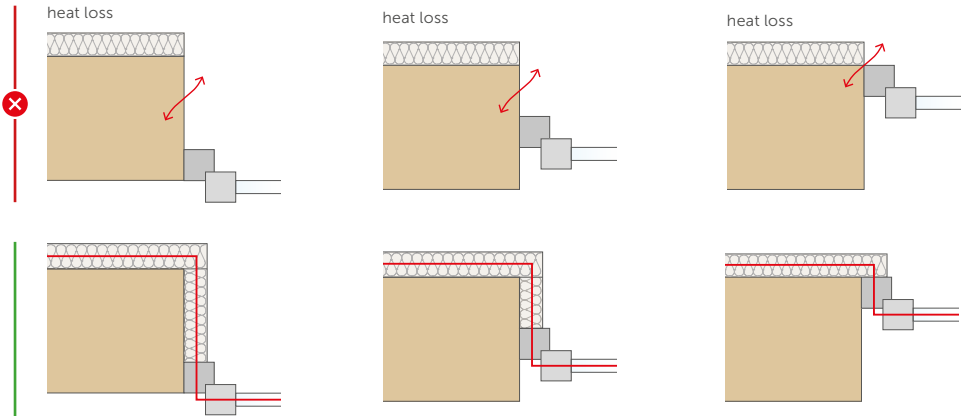
TIMBER-TO-METAL

Because of its high conductivity, metal creates linear thermal bridges and is not suitable where high thermal insulation performance is required.



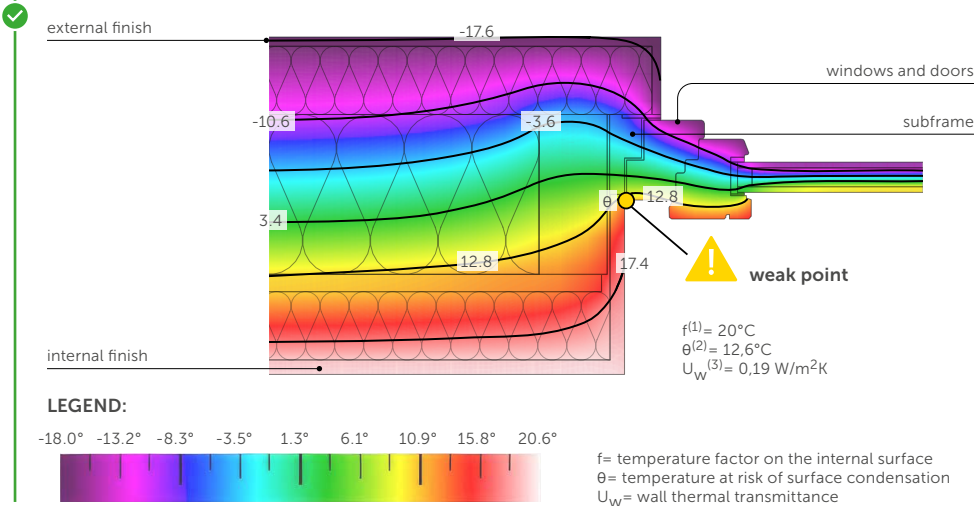
DESIGN CORRECTLY TO AVOID THERMAL BRIDGES

Thermal bridges in the window-junction design are caused by discontinuous connections between the window, structure and insulation. Correct window design ensures continuity of the building envelope, reduces heat loss, prevents condensation and helps ensure high performance of the entire window system.



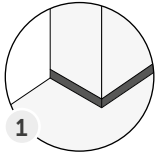
SIMULATIONS UNDER EXTREME CONDITIONS USING A CERTIFIED CALCULATION METHOD

In the window-to-wall junction, the most weak point from a thermal perspective are concentrated at the joint, with an internal temperature of +20 °C and an external temperature of -18 °C. Maintaining a window-edge internal surface temperature at the window edge of ≥ 12.6 °C, where mechanical ventilation with heat recovery (MVHR) is provided, prevents condensation and mould and maintain suitable hygrothermal conditions in the construction detail. Since the surface temperatures are close to the limit value (≈ 12.8 °C), the design of the junction becomes critical and must ensure continuity of the functional layers, including tapes and thin layers, to reduce the risk of thermal bridges.

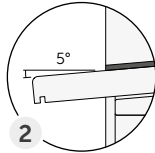


DETAIL THE WINDOW SILL CORRECTLY

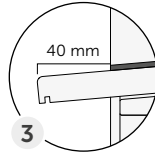
The sill is the most exposed element of the lower window junction: here, any discontinuity can lead to water ingress, deterioration of the reveal, air leakage or a thermal bridge. For this reason, the detail must ensure continuity between the window and the façade, prevent standing water, and provide uninterrupted sealing and insulation.



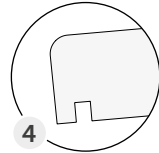
MF1 expanding tape



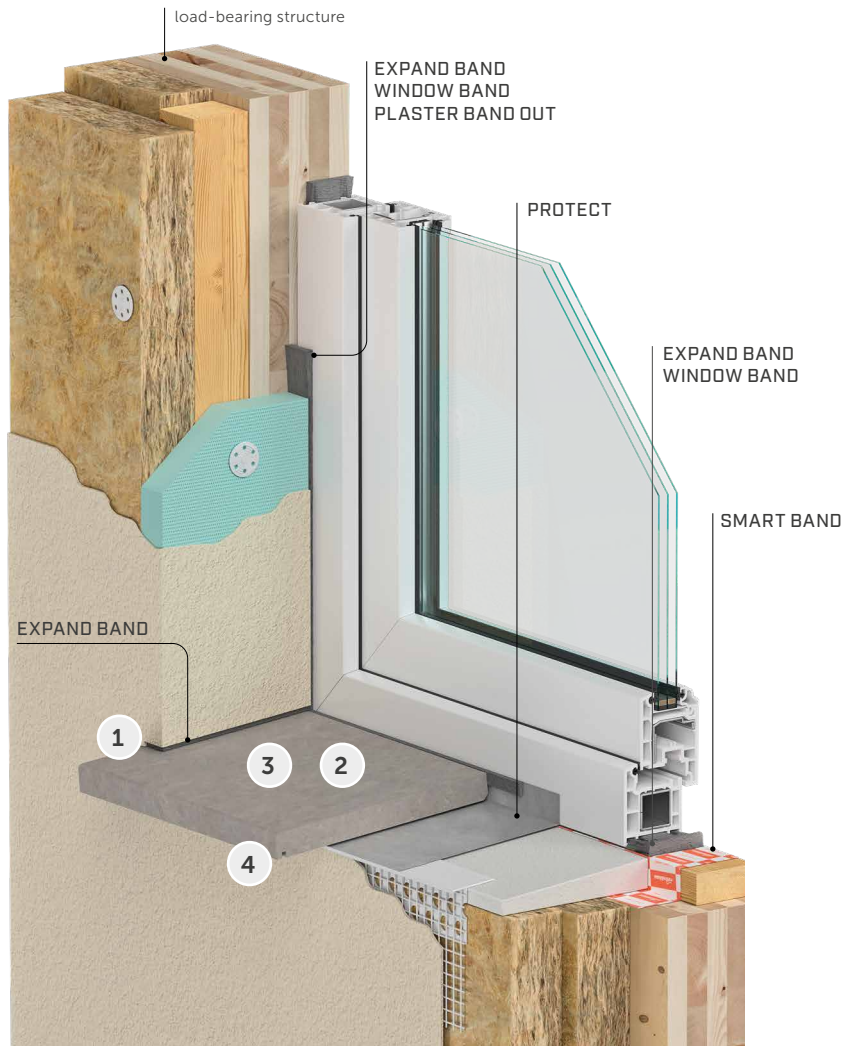
minimum slope of 5°
towards the outside



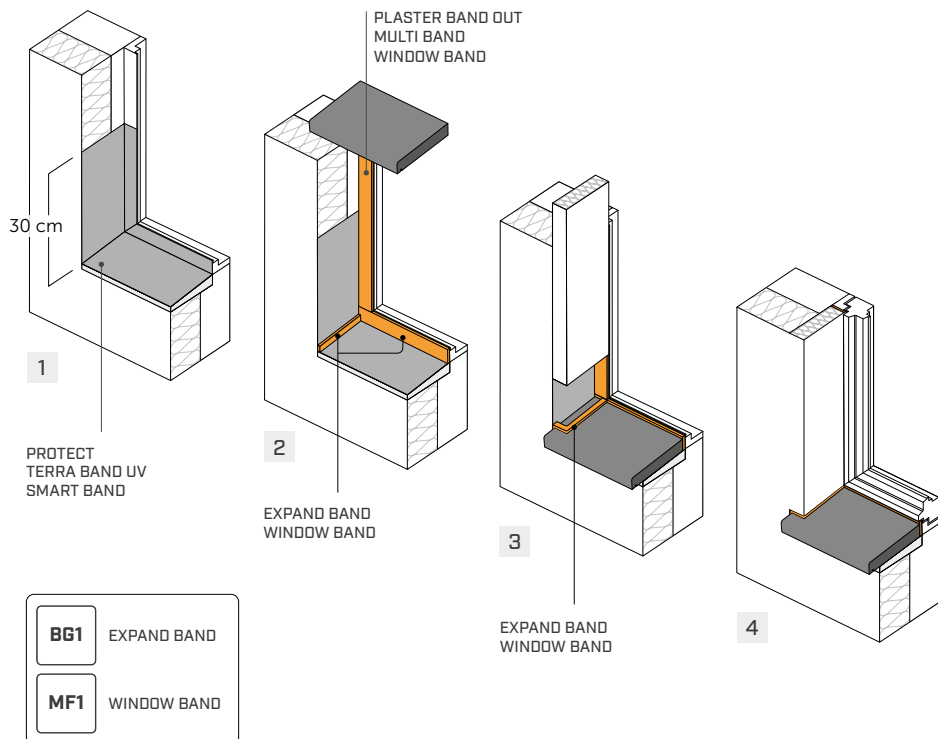
projection ≥ 40 mm
beyond façade face



sill with
drip groove



STONE SILL



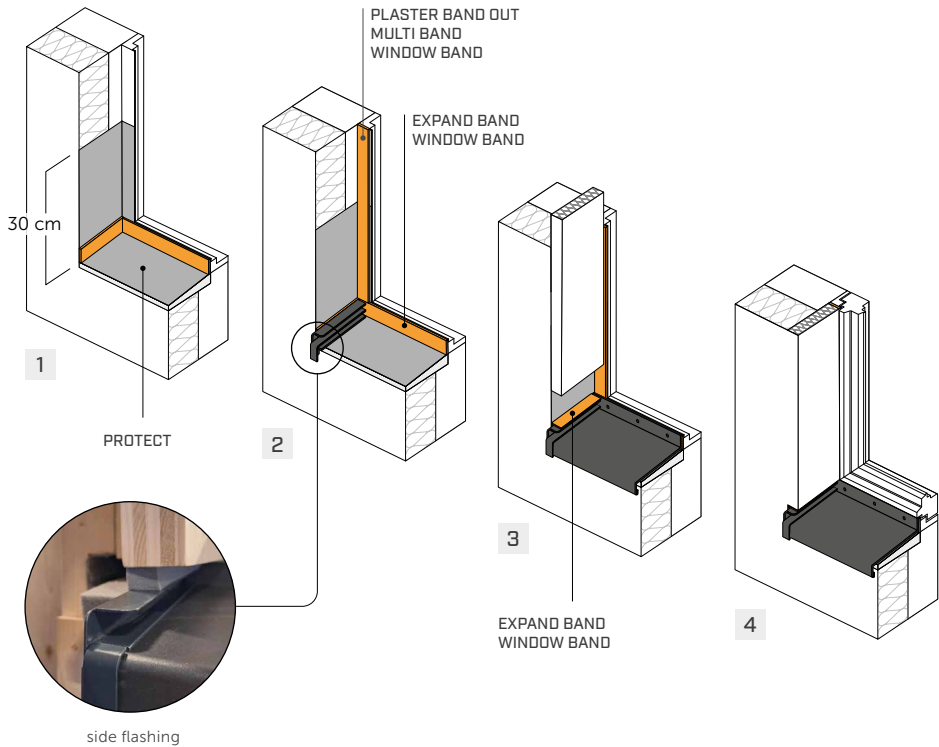
Incorrect sill detailing. Using multiple patches instead of a single continuous tape creates discontinuities and weak points.



Incorrect taping of the sub-sill and the corners of the window opening.

For further details, see "INSTALLATION OF TAPES, MEMBRANES AND FOAMS" on page 118

SHEET METAL SILL



Incorrect welding of the sheet metal can create a path for water ingress if the sub-sill is not properly waterproofed, resulting in water ingress and long-term damage.



Correct sealing on the internal side: tape applied at the window-to-sill joint to ensure airtightness.

DESIGN THE SHUTTER BOX

The shutter box, another weak point in the window junction, must be designed as an integral part of the window-façade system. Continuity between the guide rail, reveal and integrated unit is essential for the correct integration of the three functional layers and for reducing water ingress and thermal bridging. Proper connection to the façade materials and provision allowing for effective drainage near the guide rails ensure long-term performance and the full performance of the building envelope.

LEGEND:

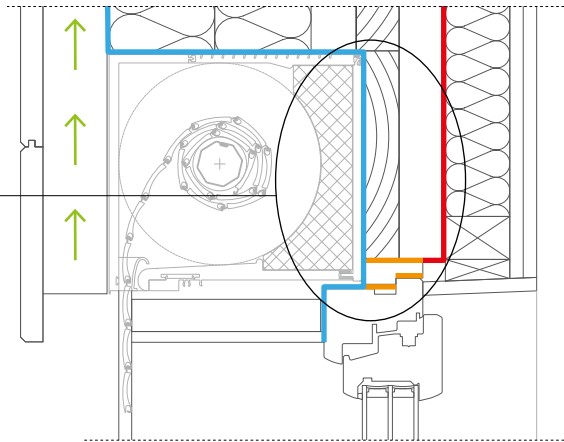
— windtight layer — airtight layer — WINDOW BAND EXPAND BAND — NAIL BAND GEMINI → ventilation

BUILDING ENVELOPE MANAGEMENT



WEAK POINT

Structural obstruction and thermal bridge risk

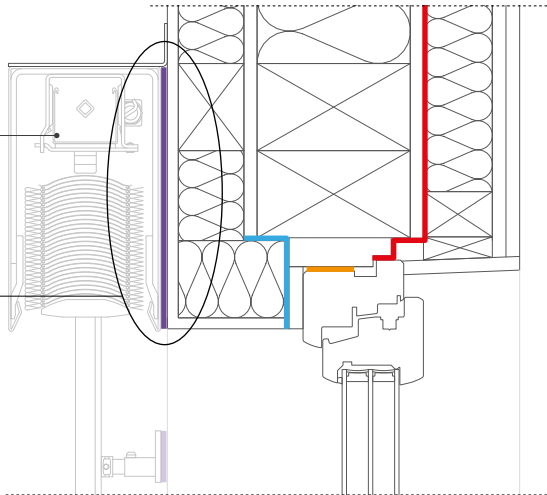


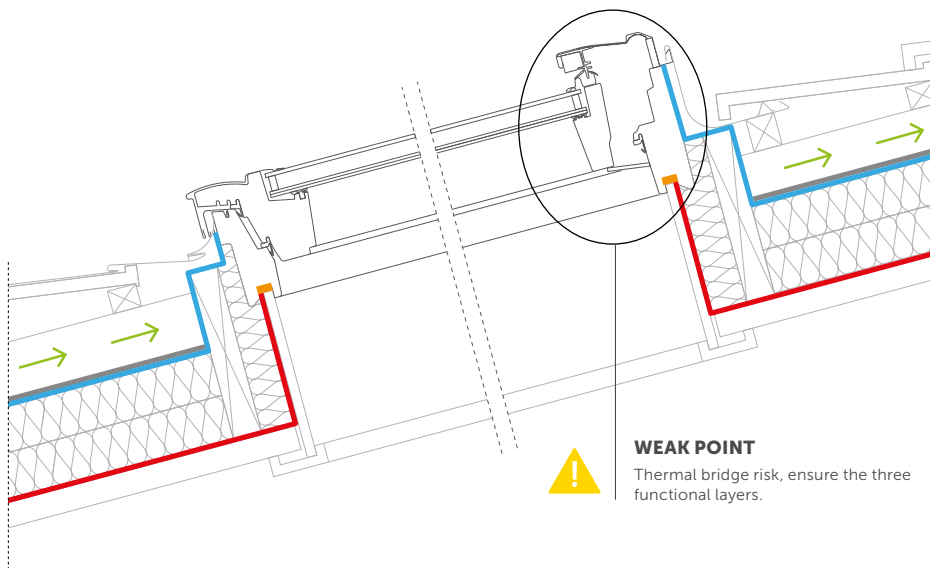
shading system



WEAK POINT

Risk of water ingress and discontinuity in the building envelope





Roof window installed at a later stage: the membrane is cut to create the opening, resulting in an interrupted layer not connected to the window. This installation method fails to ensure membrane continuity or correct sealing of the junction.



Correct use of expanding tape to seal around the window perimeter: the material is installed continuously along the reveal, adapting to irregularities in the substrate and providing effective sealing against air and water.

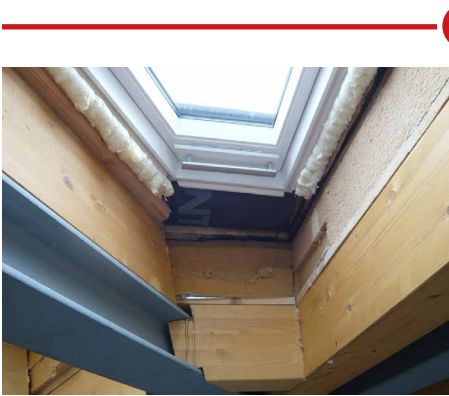
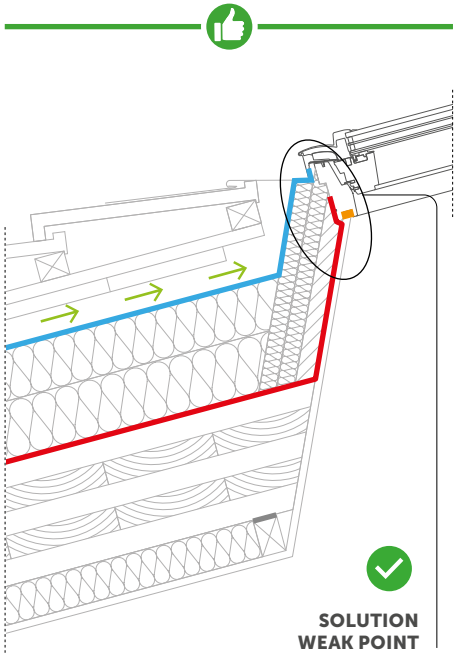
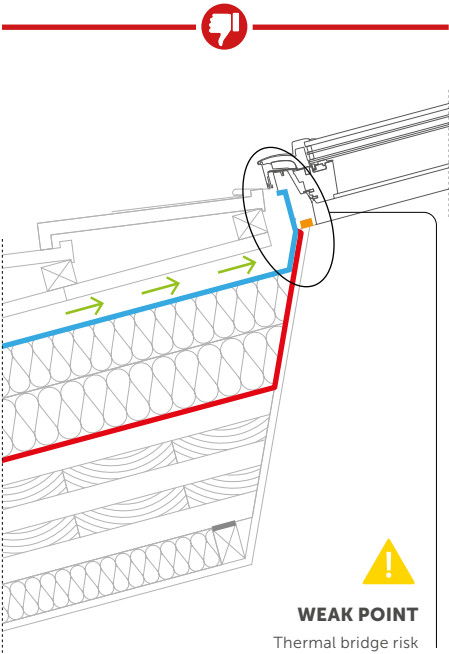


ROOF SKYLIGHT SEALING - MEMBRANE & TAPES

Scan the QR code and watch the video.
SUBSCRIBE to our **YOUTUBE** channel and keep up to date on Rothoblaas products and news.



Pay particular attention to the reveal: insulation and membranes, tapes and other thin functional layers must continue up to the top of the opening, minimising thermal bridging as much as possible.



Vapour barrier cut and left unconnected to the window. Unsealed voids between the frame and timber structure, with potential critical issues.



Window side detail: discontinuous insulation and irregular structural connections between timber, insulation and substrate, with a risk of air and water ingress and reduced thermal performance.

FOR WINDOW SOUNDPROOFING, ALSO CONSIDER JOINT PERFORMANCE



WINDOW BAND

SELF-EXPANDING SEALING TAPE FOR WINDOWS AND DOORS

Soundproofing of the gap:
10 mm $R_{s,w(ift)}$ (C;Ctr) = 59 (-2;-3) dB



DID YOU KNOW THAT...

Do all expanding tapes offer the same performance?

				intended use under the standard	resistance to heavy rain	permanent exposure
BG1			-	external-windtightness	≥ 600 Pa	yes
BG2			-	external-windtightness	≥ 300 Pa	no
BGR	-		-	internal-airtightness	-	no
MF1				multifunction-3 levels	≥ 600 Pa	yes
MF2				multifunction-3 levels	≥ 300 Pa	no



HERMETIC FOAM

SOUNDPROOFING SEALING
POLYURETHANE FOAM

Soundproofing of the gap:
10 mm $R_{s,w(ift)}$ (C;Ctr) = 63 (-1;-5) dB
20 mm $R_{s,w(ift)}$ (C;Ctr) = 62 (-1;-5) dB



MBS | MBZ

SELF-TAPPING SCREW
FOR MASONRY

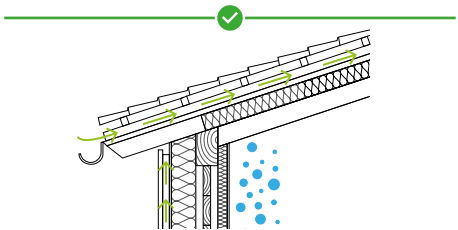
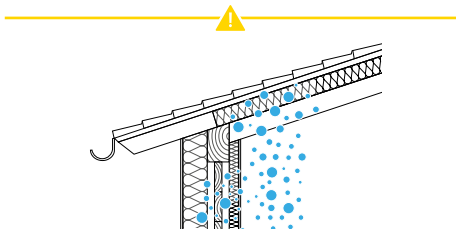
Tested by ift Rosenheim in accordance with MO-02/1 for pull-out, compression, pure shear and eccentric shear on calcareous substrates such as concrete and masonry. They ensure safe and durable fastenings in the primary joint, even under high-stress conditions.



VENTILATION IN ROOFS AND FAÇADES

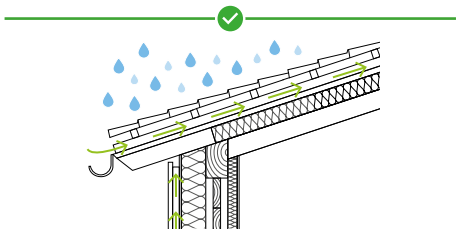
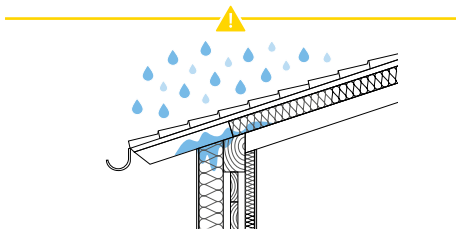
Upon completion of construction, buildings often contain high levels of moisture and possible standing water due to construction processes that introduce moisture into some layers and materials. Therefore, the building must be designed to promote the dissipation and drying of the hygrothermal load. Ventilation plays a key role in expelling moisture over time, including in the event of leaks or standing water caused by other events during the building's service life.

PROVIDE ADEQUATE VENTILATION



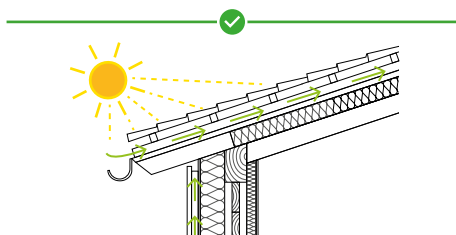
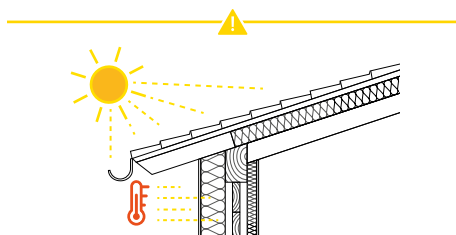
MOISTURE MANAGEMENT

Good ventilation helps moisture dry out within the building envelope within the building envelope, helping prevent interstitial condensation in the insulation and structure. It also helps dry out water ingress and vapour passing through the layers, reducing the risk of mould and decay.



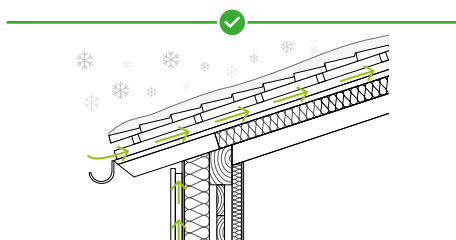
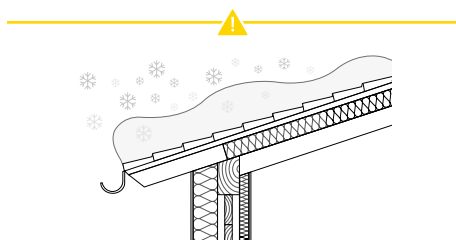
ADDITIONAL PROTECTION

The ventilation layer provides additional protection in the event of accidental water ingress. It creates a second drainage level and prevents standing water. The possibility of drying reduces biological degradation and maintenance requirements, increasing the durability of the structure and materials.



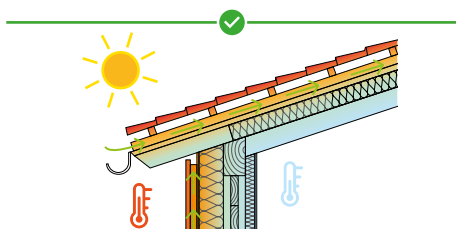
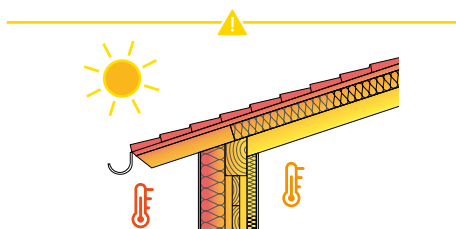
MATERIAL DURABILITY

Ventilation helps dissipate the heat that builds up beneath sun-exposed layers to solar radiation and lowers the operating temperatures of insulation, membranes, tapes and building materials in general, limiting ageing caused by thermal stress.



IN WINTER

Ventilation allows any snow accumulated on the roof to melt evenly.



IN SUMMER

Ventilation helps dissipate the heat that builds up beneath the outer layer, improving indoor comfort. The airflow reduces the heat accumulated by the cladding and allows the insulation layer to work under smaller temperature differences, reducing cooling demand.

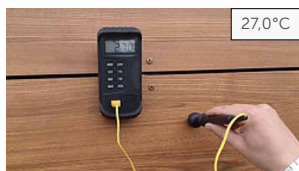
ON SITE MEASUREMENTS



External air temperature



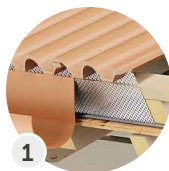
Internal wall temperature



HPL panel temperature

ROOF AND FAÇADE VENTILATION DETAIL





1

VENTILATION OPENINGS

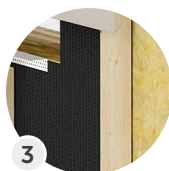
Ventilation openings must be unobstructed and protected (insect mesh, grilles). For maintenance, provide access to inspect and clean of the air inlets. This ensures continuous ventilation without the need for active components or parts prone to deterioration.



2

CONTINUOUS AIRFLOW PATH

Avoid obstructions at window sills, chimneys, windows, doors, roof windows and corners. Where necessary, interrupt the battens or create openings so that air can pass through. Use vertical battens on façades wherever possible.



3

AIRTIGHT LAYER

The airtight layer (membranes, plaster, panels or taping) must be sealed and intact to ensure windtightness and watertightness, and to promote drainage without creating pockets or areas of standing water.



4

VENTILATION CAVITY

Design the thickness of the ventilation cavity carefully, particularly in façades and flat roofs. In general, the cavity is usually a few centimetres deep, depending on the pitch and length of the roof slope or façade.

Pitched roofs: 4–6 cm (more for long roof slopes)

Ventilated façades: 2–5 cm (always check any applicable regulations or specific project requirements, including hygrothermal performance)



5

COMPATIBILITY AND THERMAL RESISTANCE

Check the compatibility of materials and their resistance to heat and UV rays, especially where the cladding is not perfectly sealed and has small gaps or discontinuities. Choosing the right products is essential to protect the insulation layer and structure.

ROTHOBLAAS RECOMMENDS

AIRTIGHTNESS AND WATERPROOFING



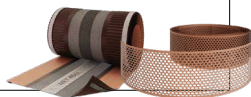
PASSIVE FIRE PROTECTION



SEALANTS, FOAMS AND LIQUID MEMBRANES



ROOF AND VENTILATION ELEMENTS



For further information, see the catalogue TAPES, MEMBRANES, SEALANTS AND FIRE PROTECTION.



Obstruction of the ventilation cavity by foam, tape or unprotected insulation.



Discontinuous air inlets, with insufficient or interrupted inlet and outlet openings, for example at doors and windows, corners and chimneys.



Details that do not drain retain water, such as window sills and horizontal joints.



Clean and unobstructed ventilation cavity to promote airflow.



Continuous ventilation openings, free from debris or residue.



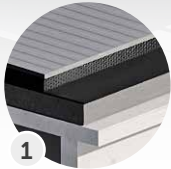
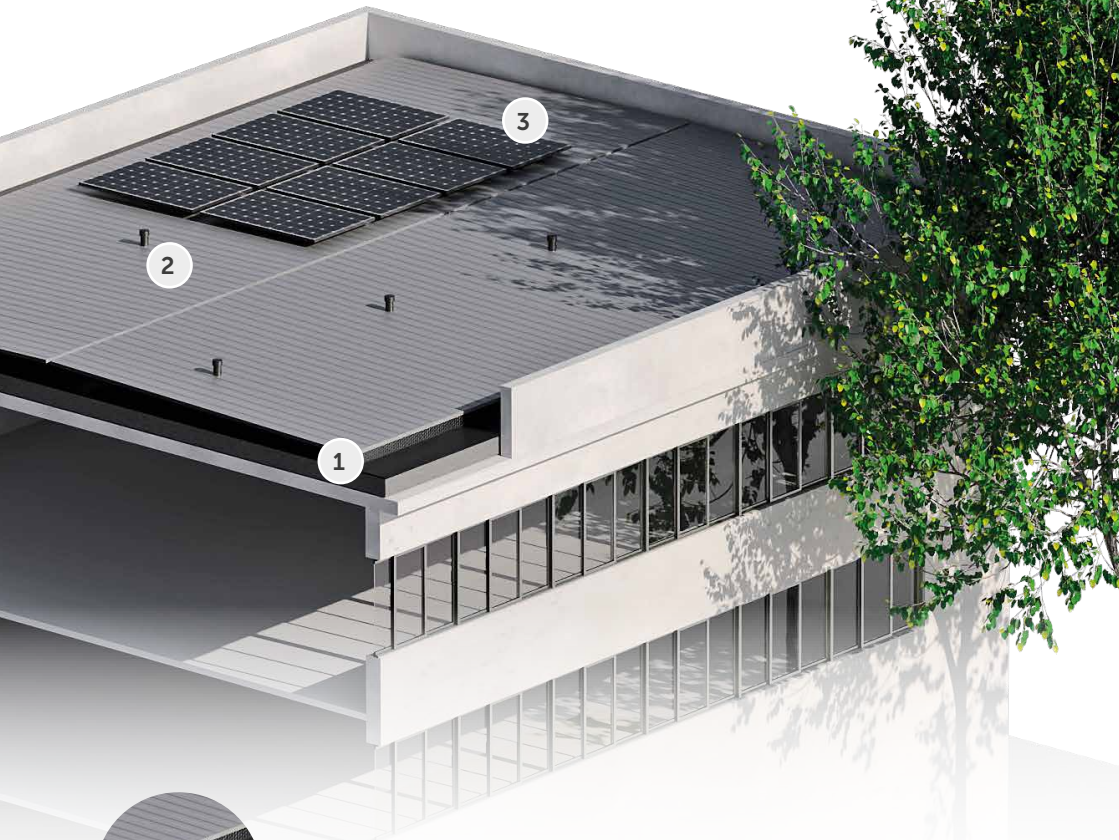
Drainage system at facade breaks/discontinuities.



Ventilation cavities can create a chimney effect and, in the event of a fire, accelerate the spread of flames. For this reason, the use of products with a fire reaction class higher than the standard is recommended, particularly products classified as B-s1, d0 (EN 13501) or higher.



Ventilation cavities without proper design or correct installation can be harmful, creating trapping warm air and increasing the risk of condensation prone to condensation.



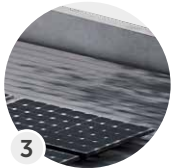
AIR INLETS

Air inlets should preferably face the prevailing wind and arranged with a slight difference in height between the inlet and outlet openings.



VENTILATION AND WATERPROOFING

Use dedicated accessories for the ventilation of flat roofs and terraces that ensure both ventilation and watertightness.



SOLAR RADIATION

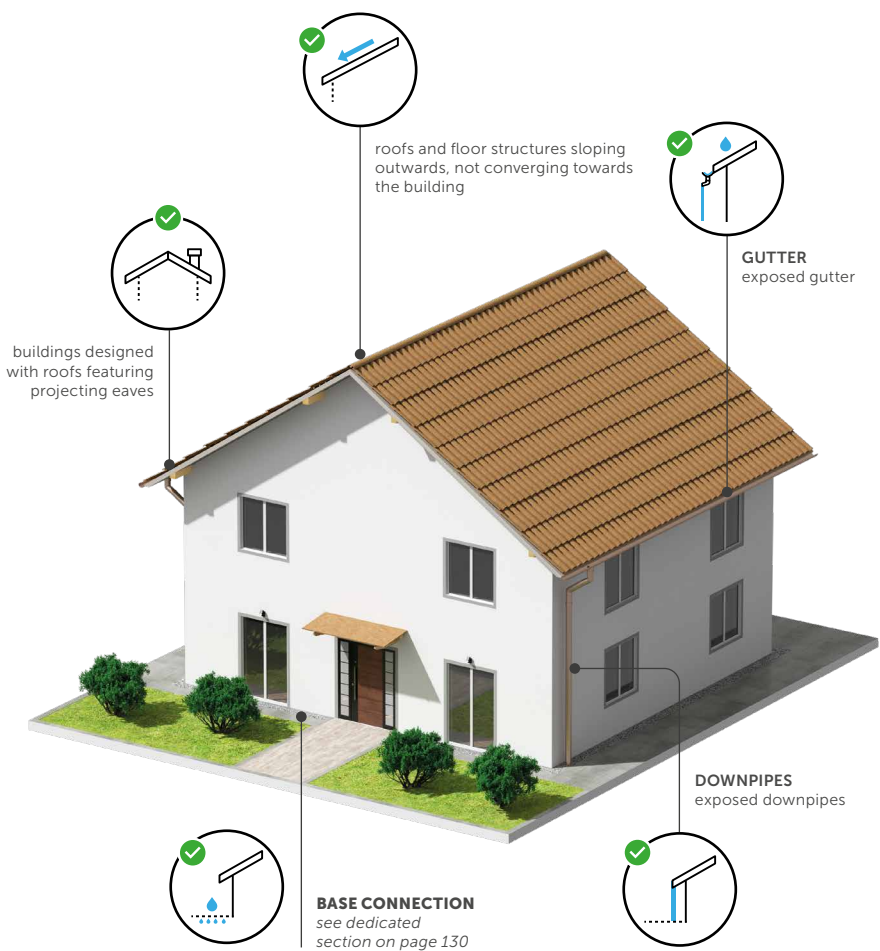
Different levels of solar exposure across different areas of the roof (e.g. existing buildings, trees, photovoltaic or solar roofs) promotes ventilation, as it creates air at different temperatures within the ventilated cavity, triggering convective airflow.

RAINWATER DRAINAGE AND DEFLECTION

STANDARD BUILDINGS

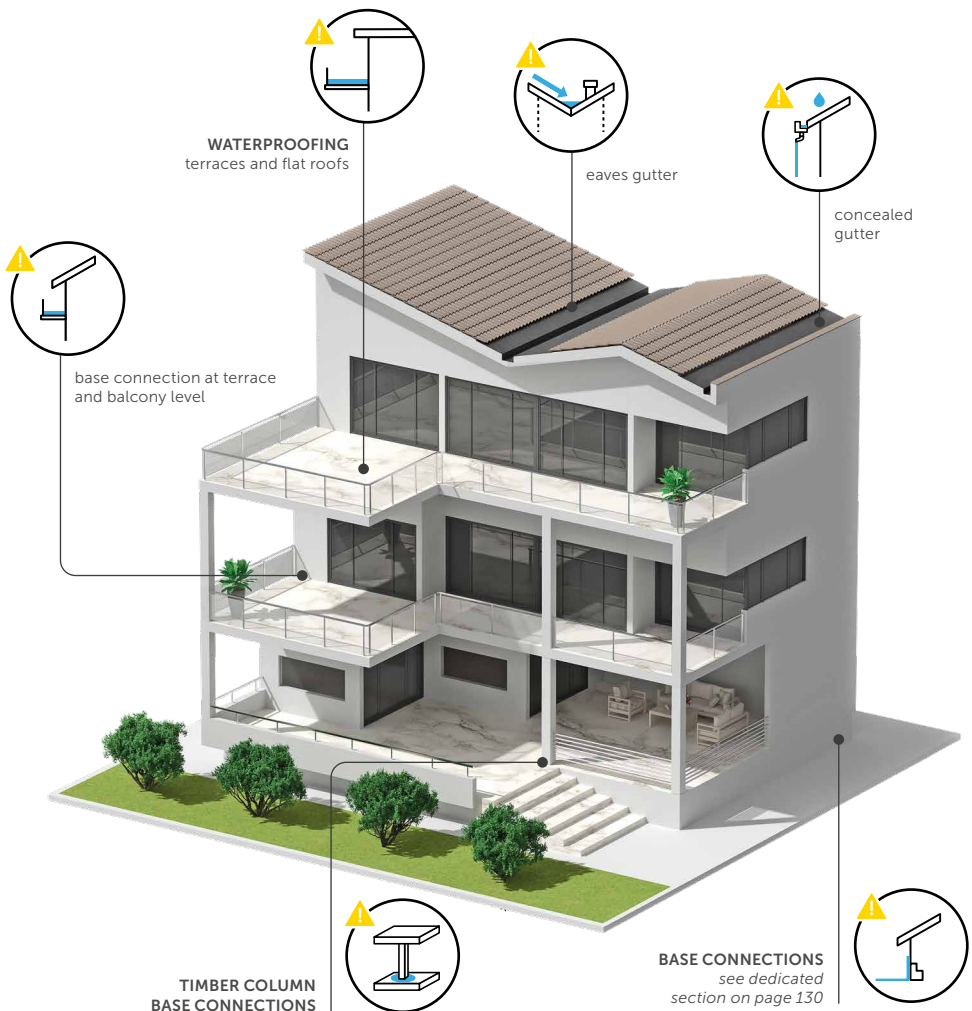
When designing timber buildings, the designer must ensure correct water drainage along the full height of the building, considering the route from the highest point down to the base connection. No areas or details should allow water to stand.

For proper rainwater drainage, buildings should be designed with projecting eaves and projecting elements, with floors and roof surfaces falling outwards. Avoid layouts that direct water back towards the building.



COMPLEX BUILDINGS

The use of concealed downpipes and gutters is not recommended, as they make maintenance and cleaning difficult. Buildings with flat roofs, converging roof slopes and exposed timber elements require specific detailing, covered in the dedicated sections.



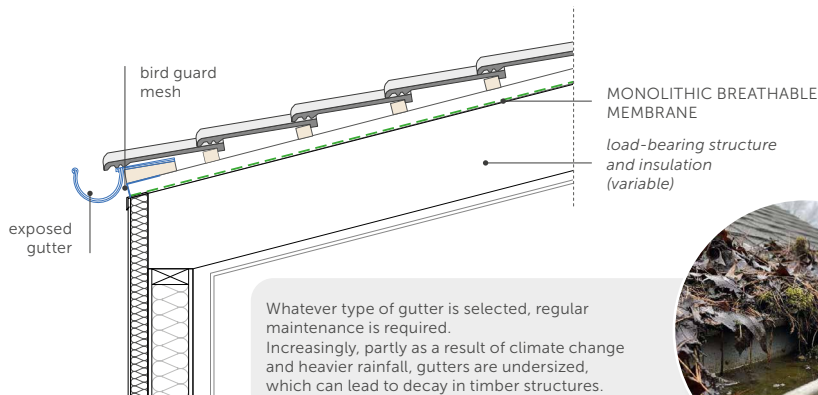


GUTTER

The use of eaves without an overhang with concealed gutters and downpipes is not recommended. Concealed rainwater drainage systems increases the risk of decay, especially where maintenance is poor or there are design or installation errors. The concealed-gutter detail can also be adapted for gutters between adjacent buildings by mirroring the arrangement

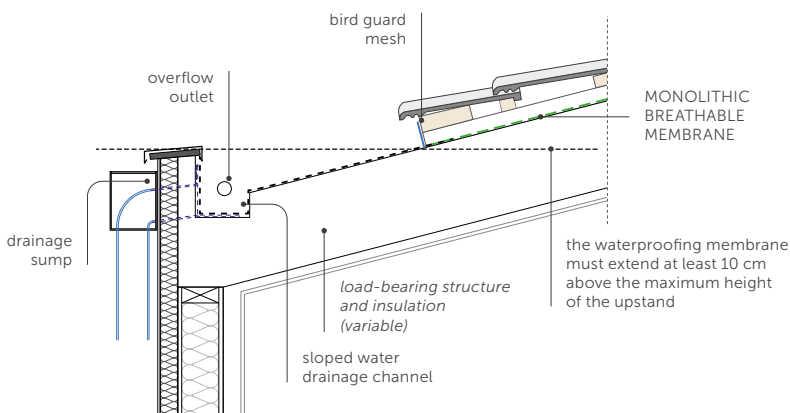
EXPOSED GUTTER

Install the sheet-metal gutter so that it remains exposed, to facilitate maintenance easier and the blockages easy to identify.



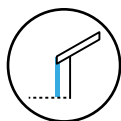
CONCEALED GUTTER

The construction of a concealed gutter requires specific design to ensure effective rainwater drainage and provides suitable technical solutions to prevent possible blockages.



Note: Do not create the outlet connection in the sump using a simple folded sheet-metal piece sealed with silicone. Use purpose-made components, such as L-shaped performed outlets, made from the same material as the waterproofing membrane and complete with overflow.

Note: Where there is a risk of snow accumulation, provide heating cables.



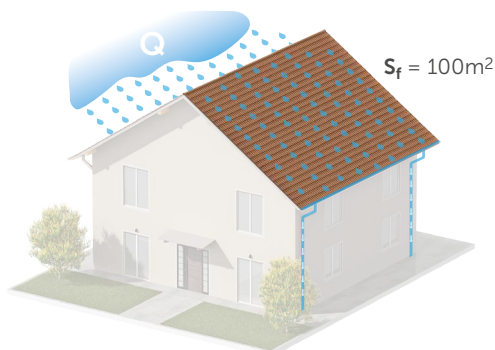
DOWNPIPES

The number and location of downpipes must be defined at the design stage, before work begins on site.

UNI 12056-3 may be used to size and position downpipes. The standard applies to both pitched roofs and flat roofs and terraces.

The standard does not prescribe a fixed number of downpipes, but requires calculation of:

- drainage area S_f
- design rainfall intensity
- run-off coefficient
- flow rate to be drained Q
- minimum diameter based on water velocity
- pressure loss verification



As a general guide, one Ø10 downpipe is considered for every 70–100 m² of roof area, and 1 downpipe every 15–25 m of gutter.

For pitched roofs, the gutter is normally installed with a slope of 0.2–0.3%, whereas for flat roofs and terraces the rainwater drainage system must be designed specifically for the project.

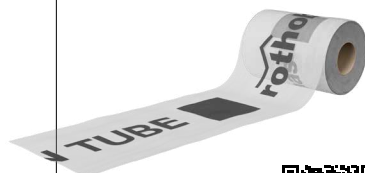


Increasingly, partly as a result of climate change and heavier rainfall, gutters are undersized, which can lead to decay in timber structures.

ROTHOBLAAS RECOMMENDS

RAIN TUBE TEMPORARY DOWNPIPE FOR CONSTRUCTION PHASES

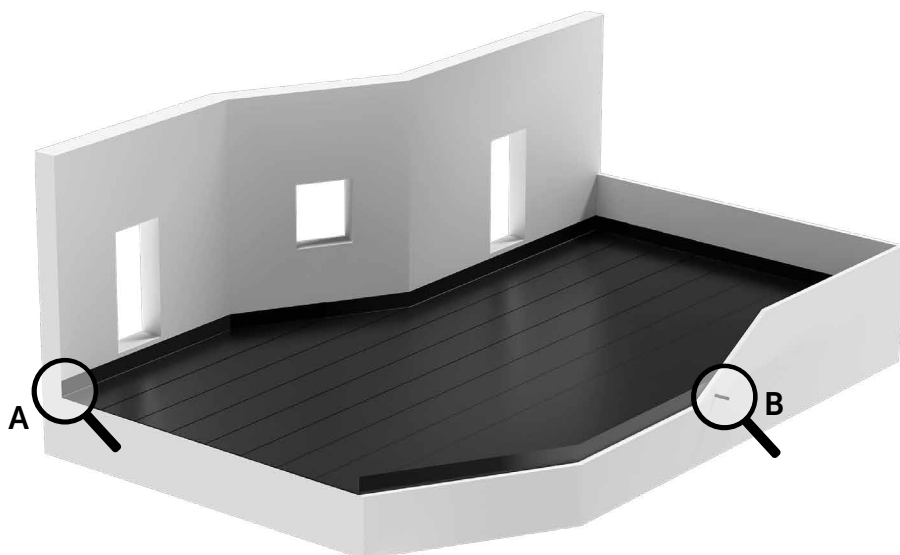
- ▶ It protects building façades during construction or renovation work
- ▶ Versatile, easy-to-use solution
- ▶ Can be used until the permanent downpipes are installed



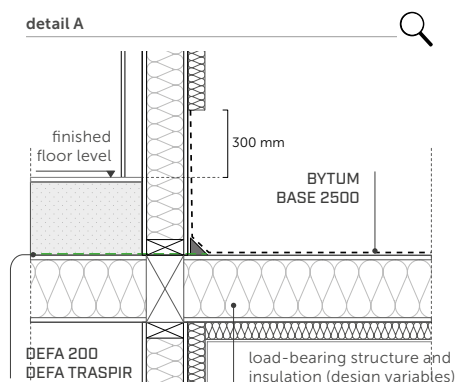


TEMPORARY ON-SITE WATERPROOFING FOR FLAT ROOFS AND TERRACES

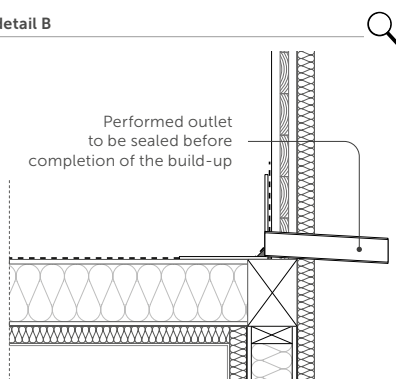
Temporary waterproofing ensures temporary protection of the roof layers during installation of the roof build-up. The system must ensure watertightness, compatibility with subsequent layers and resistance to site conditions until the final waterproofing layer is installed.



detail A

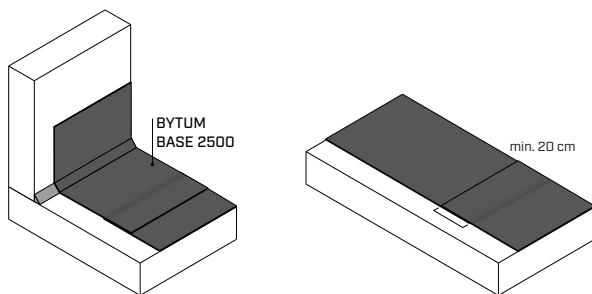


detail B



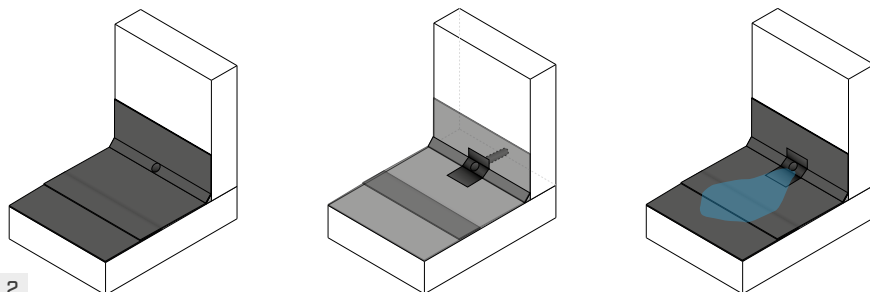
The illustrated example intentionally represents the most critical case, so as to be effective even in less demanding situations. For flat timber roofs, it is preferable to use a load-bearing structure with exposed joists and decking, designed with a minimum slope of 2% for all functional layers, as indicated by certain standards (e.g. ÖNORM B 3691), in order to reduce the risk of standing water and water ingress even if the roof covering is incorrectly installed. Under these conditions, BARRIER ALU NET ADHESIVE 300 can be used both as temporary protection and as a vapour barrier.

Particular attention must be paid to CLT railings, which are particularly sensitive to standing water, and for which waterproofing and drainage details must be carefully designed. The integration of monitoring systems, such as moisture sensors, is also recommended to detect water ingress promptly and prevent structural damage.



1

Install a temporary bituminous membrane (BYTUM BASE 2500 or GROUND BAND), laid parallel to the side of the building and turned up the wall for at least 30 cm above the finished external floor level. At right-angled corners, always provide an XPS or timber fillet.



2

To allow water to drain during temporary waterproofing, provide L-shaped performed drainage outlets made from the same material as the temporary membrane.



Temporary on-site waterproofing installed correctly.

ROTHOBLAAS RECOMMENDS

GROUND BAND

SELF-ADHESIVE BITUMINOUS
MEMBRANE



BYTUM BASE 2500

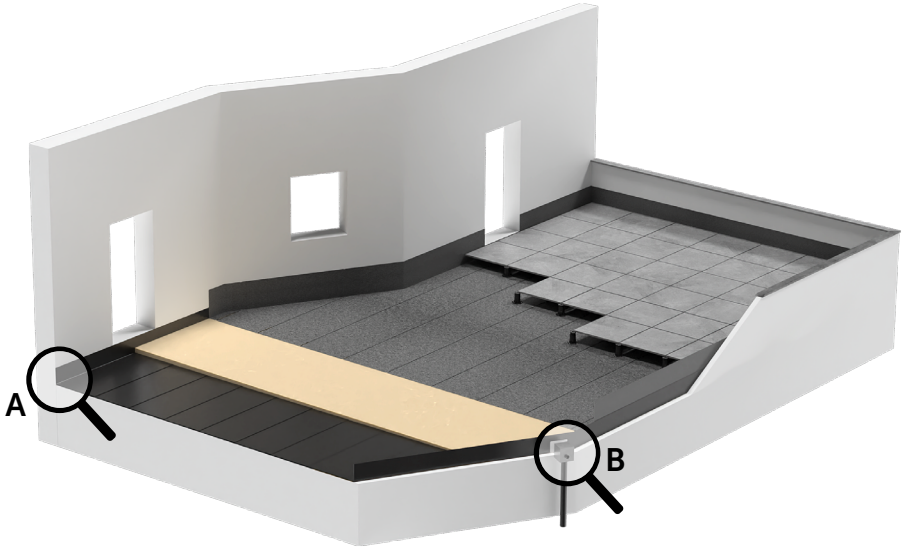
SELF-ADHESIVE BITUMINOUS
MEMBRANE



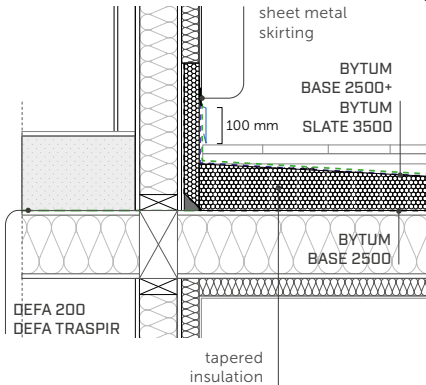


FINAL WATERPROOFING FOR FLAT ROOFS AND TERRACES

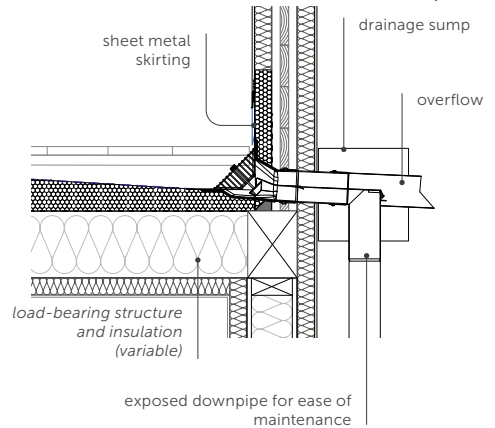
Final waterproofing ensures the long-term watertightness of the roof. The system must guarantee continuity, mechanical strength and durability, protecting the underlying layers and ensuring effective rainwater drainage in accordance with the project specifications.



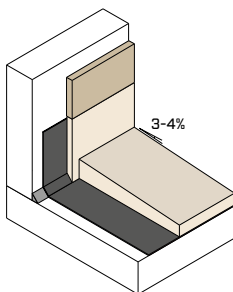
detail A



detail B

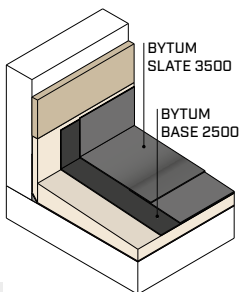


The design of rainwater drainage for flat roofs and terraces follows the same methodology. The roof area must be calculated and identify suitable points for the installation of downpipes, collection sumps and overflows, ensuring proper rainwater drainage in accordance with the project specifications.



1

Where necessary, provide an insulation build-up above the temporary membrane using pre-shaped insulation with a 3–4% slope.



2

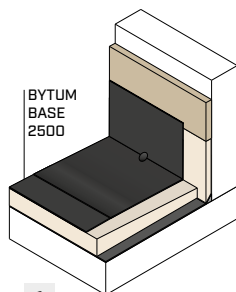
Complete the waterproofing with a bituminous membrane (BYTUM BASE 2500 + BYTUM SLATE 3500) or an EPDM or PVC membrane.

ROTHOBLAAS RECOMMENDS

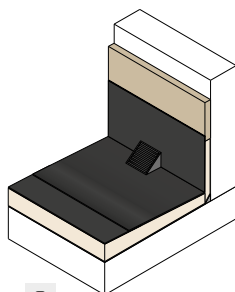
BYTUM SLATE 3500
SELF-ADHESIVE
SLATED BITUMINOUS
MEMBRANE



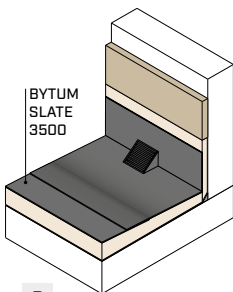
BYTUM BASE 2500
SELF-ADHESIVE
BITUMINOUS
MEMBRANE



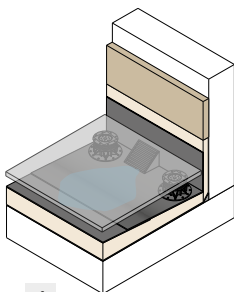
1



2



3

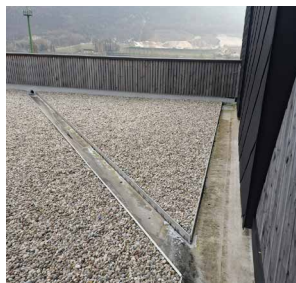


4

Complete the drainage outlets with L-shaped performed outlets, made from the same material as the membrane and fitted with an overflow.

Note: Do not create the outlet connection in the sump using a simple folded sheet-metal piece sealed with silicone. Use purpose-made components, such as L-shaped performed outlets, made from the same material as the waterproofing membrane and fitted with an overflow.

Note: BYTUM BASE 2500 + BYTUM SLATE 3500 is a suitable solution for terraces and non-accessible roofs, or roofs with raised flooring.

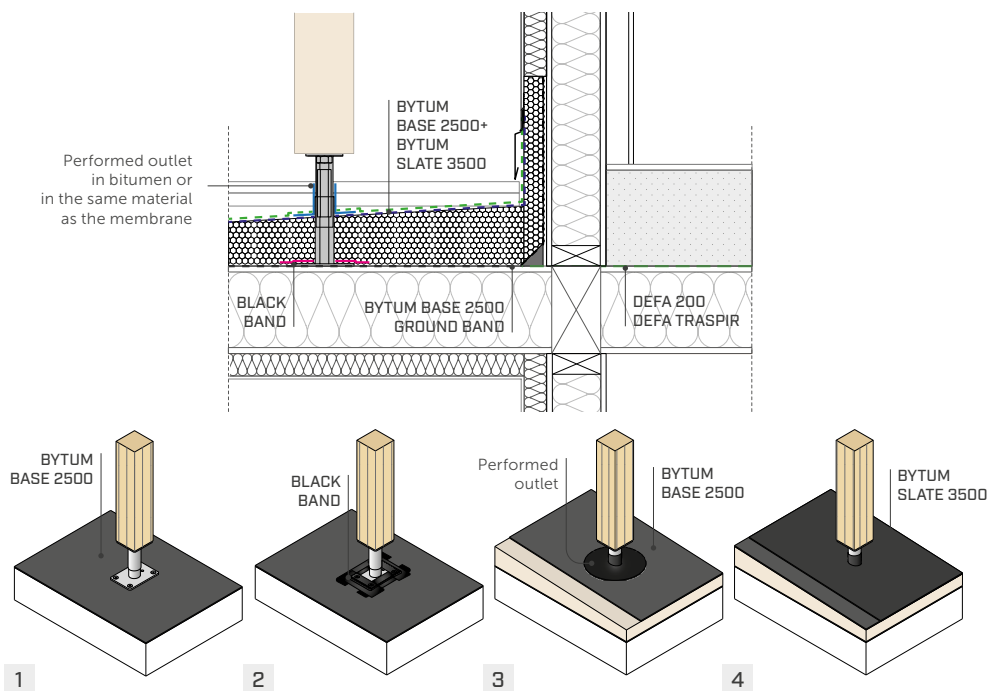


Keep drainage channels free of gravel to allow unobstructed rainwater run-off.



COLUMN BASE CONNECTION

Timber elements such as columns, whether in contact at ground level or on terraces, must always be raised at least 10 cm above the finished external floor level.



Where fastenings pass through the waterproofing membrane, use preformed outlets in the same material as the membrane to reinstate the waterproofing layer.



The use of silicone instead of preformed outlets is not recommended.



Firestop penetrations in timber structures

The most suitable passive fire protection for service penetrations depends on the installation context.



Download the full brochure



rothoblaas.com



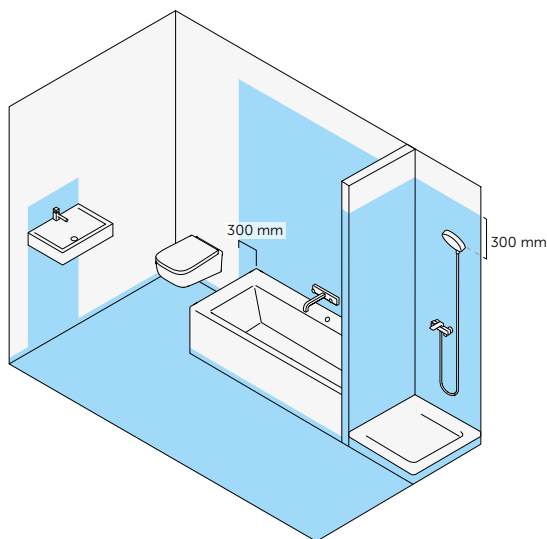
rothoblaas

Solutions for Building Technology

INTEGRATED DESIGN

Moisture management directly affects the durability and performance of timber structures. An integrated approach makes it possible to protect the structure and ensure long-term durability and performance.

PROTECTION OF TIMBER STRUCTURES



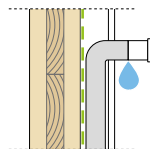
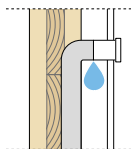
LEGEND:

 critical areas

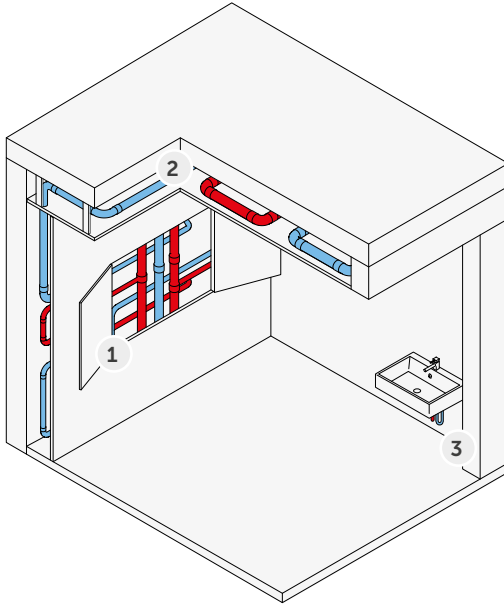
- Pay particular attention to areas most exposed to moisture, such as bathrooms, kitchens, laundries and rooms served by water systems.
- Identification of critical areas and use of waterproof membranes. Complete systems or liquid sheaths may be used in combination with cement-based glues and plastic adhesives.
- Provide a concealed primary waterproofing layer between the edge of the sanitary fitting and the wall finish (elastic two-component cementitious membrane), and a visible secondary waterproofing layer using suitable sealants (water-repellent grout or silicone) around sanitary fittings and sinks.
- Use suitable cladding: avoid standard plasterboard and opt for fibre cement or other materials resistant to moisture and condensation.

For further design guidance, refer to DIN 18534.

As a general rule, continuous waterproofing should be applied to the entire wall behind ceramic tile finishes. Avoid configurations where a bathtub is used as a shower and solutions with flush shower trays.



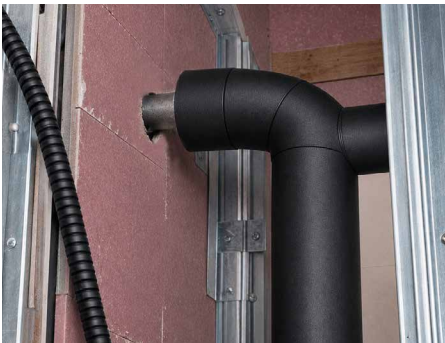
Water systems must be installed in a service wall, avoiding runs within the timber load-bearing structure. If the available space is insufficient, the service wall must be increased in depth, without cutting grooves into the timber, and provision must be made for temporary end caps to extend beyond the tiled finish layer. These are temporary components, subject to movement and not suitable for ensuring watertightness.



- 1 Grouped services within ducts and/or accessible service routes to facilitate maintenance of the entire building services system and inspection of pipes and air ducts.
- 2 Install within service walls or suspended ceilings, avoiding runs within the timber load-bearing structure.
- 3 Carry out regular maintenance of drain traps to prevent the progressive build-up of residue (grease, soap, hair, etc.), which reduce the effective pipe section, compromise drainage capacity and increase the risk of standing water and backflow, with negative effects on system durability and on the frequency of emergency interventions.

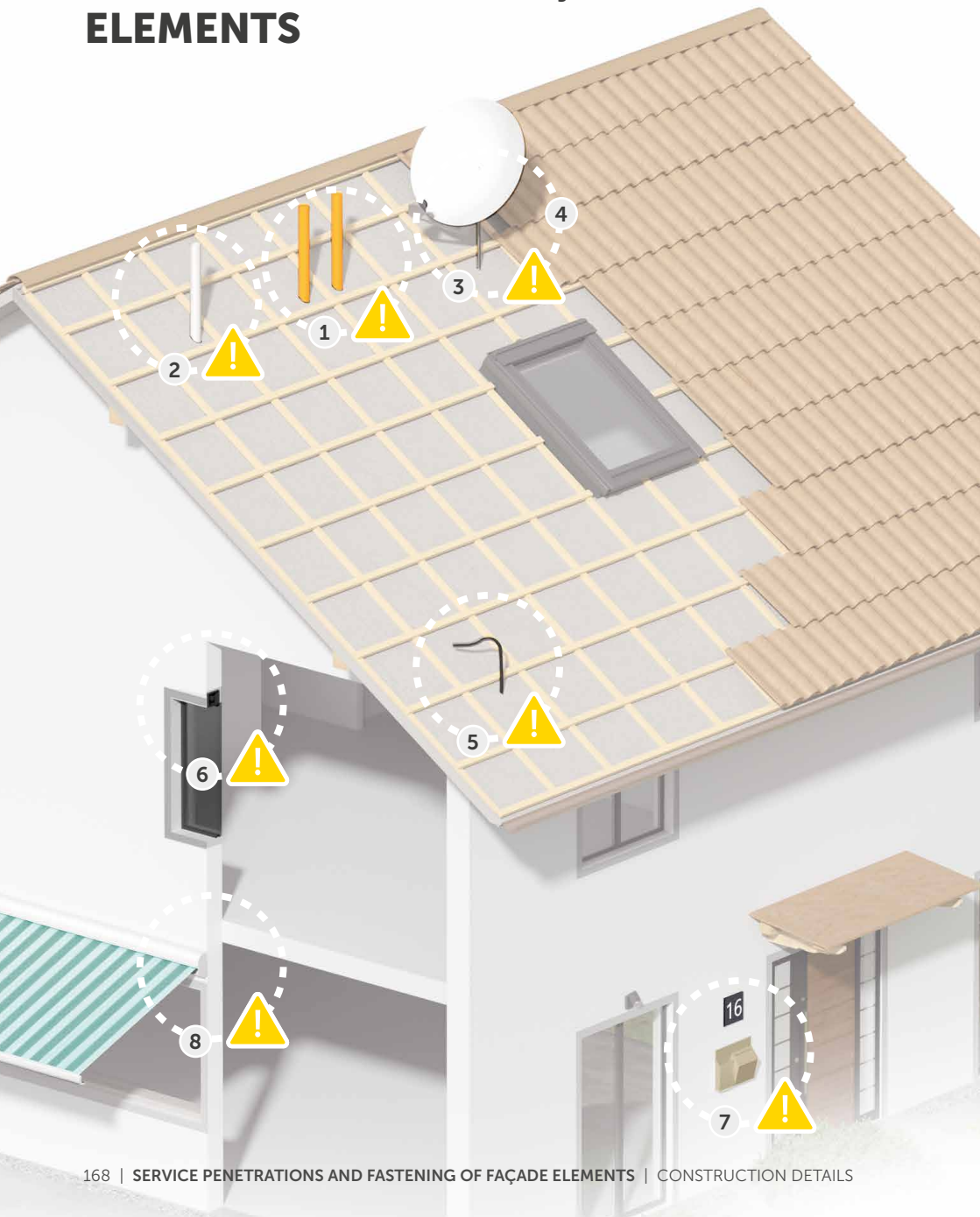


It is recommended to use components from the same building services system to ensure compatibility and correct functioning.



To avoid the risk of condensation, cold water pipes must be properly insulated along their entire route, ensuring continuity of insulation. During construction, their integrity must be preserved, avoiding damage that could compromise performance.

SERVICE PENETRATIONS AND FASTENING OF FAÇADE ELEMENTS



When the windtight and airtight envelope is interrupted by service penetrations in the roof or façade, the sealing must be reinstated using specific products.

The same methods apply to both airtightness and wind tightness.

1

sealing of bathroom vent pipes

MANICA FLEX + FLEXI BAND, MANICA PLASTER, WELDING PIPE

2

sealing of extractor hood vent pipe

MANICA FLEX + FLEXI BAND, MANICA PLASTER, WELDING PIPE

3

sealing of antenna pipe on the membrane

MANICA PLASTER, FLEXI BAND, MANICA FLEX + FLEXI BAND, MANICA, WELDING PIPE

4

sealing of antenna pipe on the roof covering

MANICA POST, MANICA LEAD

5

sealing of photovoltaic panel pipes:

MANICA PLASTER, MANICA FLEX + FLEXI BAND

6

sealing of power supply penetrations for electric mechanical shutters on the internal airtight side:

MANICA PLASTER, MANICA FLEX + FLEXI BAND, TUBE STOPPER, BLACK BAND

FASTENING LIGHTWEIGHT FAÇADE ELEMENTS

7

At the design stage, incorporate high-density non-structural insulating elements into the external insulation system to prevent deformation under load. Use gaskets to ensure correct sealing of the opening.

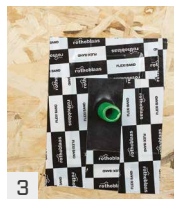
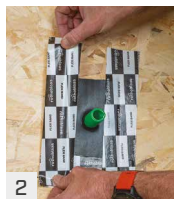
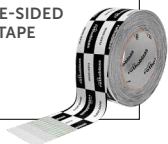
FASTENING HEAVY AND STRUCTURAL FAÇADE ELEMENTS

8

Install high-density structural insulation inserts within the external wall insulation layer. For the fixing of external components to the insulation system, use connectors fitted with sealing gaskets to ensure proper sealing of the penetration point.

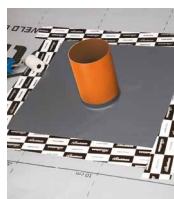
FLEXI BAND

UNIVERSAL SINGLE-SIDED
HIGH-ADHESION TAPE



MANICA FLEX

SEALING SLEEVE
FOR CONDUIT
AND CABLE PASSAGE



Chemical sealing.

Hot-air sealing.

Tape sealing.

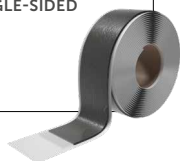
MANICA PLASTER

ADHESIVE SEALING
SLEEVE THAT CAN BE
PLASTERED



BLACK BAND

UNIVERSAL SINGLE-SIDED
BUTYL TAPE



Chemical sealing.

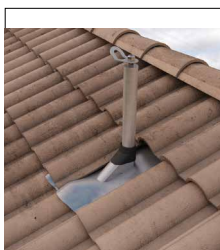
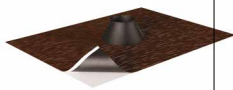
Hot-air sealing.

**WELDING PIPE
SLEEVE**





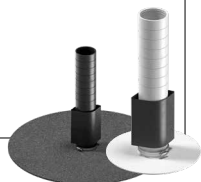
MANICA POST
ADHESIVE SEALING
SLEEVE FOR OUTDOORS



MANICA LEAD
LEAD PROFILE
WITH EPDM SLEEVE



MANICA
SEALING SLEEVE
WITH SHRINK TUBING
AND CLAMP



TUBE STOPPER
CABLE SEALING PLUGS



rothschoo

Thanks to partnerships with universities, research centres and specialised companies worldwide, Rothoblaas courses bring speakers with practical experience and proven expertise in technical consultancy into the classroom. The training combines theoretical knowledge with practical application and is aimed at engineers, architects, carpenters, safety specialists and other professionals in the construction sector.

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We bring training directly to local areas, with hands-on sessions for industry professionals.

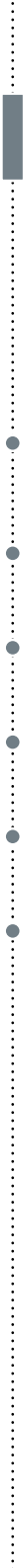
Find the course that suits you!



[rothoblaas.com](https://www.rothoblaas.com)



CONSTRUCTION PROJECT EXECUTION PLANS



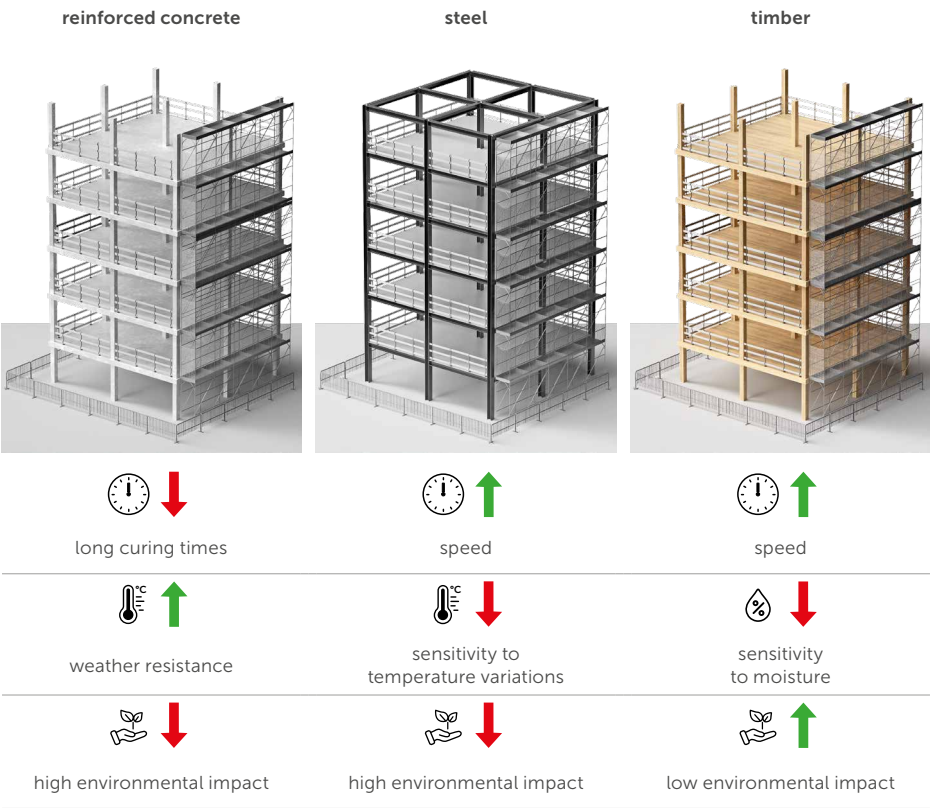
CONSTRUCTION PROJECT EXECUTION PLANS

The transport, storage, assembly and moisture management stages are defined through construction project execution and control plans that address common critical issues: safety, performance, durability and overall build quality. The moisture management plan does not overlap with the others, but instead runs through them, influencing timing, detailing and control procedures at every stage of operation.

●	CONSTRUCTION PROJECT EXECUTION PLANS	from page 175
●	MOISTURE MANAGEMENT PLAN	from page 176
●	TRANSPORT AND LIFTING PLAN	from page 180
●	STORAGE PLAN	from page 184
●	ASSEMBLY PLAN	from page 186
●	SAFETY PLAN	from page 192

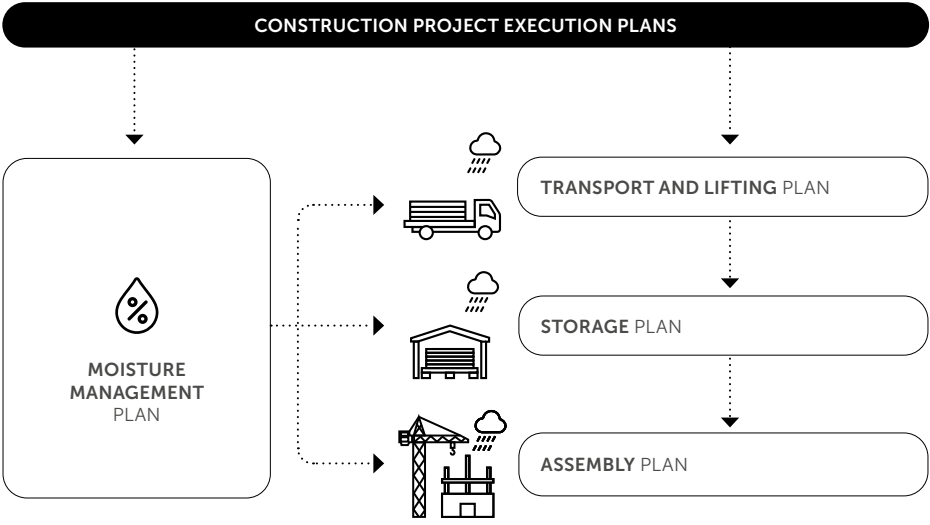
ON-SITE MATERIAL MANAGEMENT PLANS

Logistics management on timber construction sites plays a decisive role, as it **speeds up project execution**. Through sequenced deliveries, reduced storage and limited intermediate handling, idle time on-site and exposure and exposure to external agents are reduced.

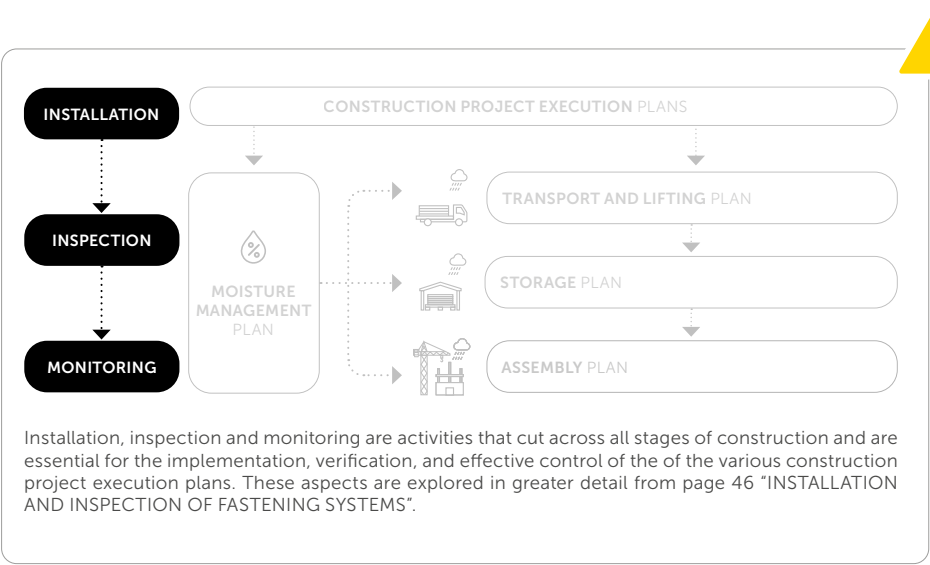


The primary regional-scale reference having an explicit regulatory role in these aspects is now **Eurocode 5 Part 3** (Fpr EN 1995-3:2025), which links design and project execution through the construction specification. The document transfers the requirements defined at the design stage to the contractor and provides guidance for supervision and inspection, introducing minimum requirements for fabrication, assembly and installation, including moisture control during project execution, protection details, execution quality and geometric deviations. This regulatory framework highlights the decisive role of the project execution stage in ensuring the safety, durability and final quality of the works.

CONSTRUCTION PROJECT EXECUTION PLANS



Transport, storage, assembly and moisture management are temporary conditions that affect the safety, performance, durability, cost and quality of the building. Water is a cross-cutting factor, which is why moisture management is integrated into all the other plans.

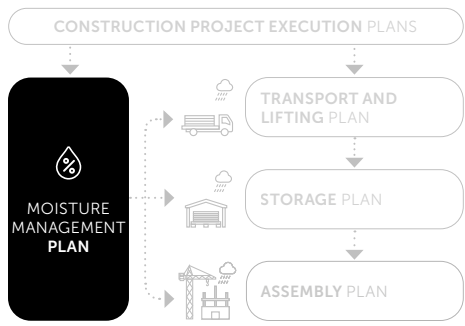


Installation, inspection and monitoring are activities that cut across all stages of construction and are essential for the implementation, verification, and effective control of the of the various construction project execution plans. These aspects are explored in greater detail from page 46 "INSTALLATION AND INSPECTION OF FASTENING SYSTEMS".

MOISTURE MANAGEMENT PLAN

The moisture management plan is intended to **prevent damage to the structure caused by moisture variations** during manufacturing, transport, storage, assembly and in-situ drying.

It is not a standalone plan, but a cross-cutting one, as it influences the timing, details and checks relating to transport, storage and assembly.



The plan must define:

- the **moisture content limit**, or the acceptable range, at the various stages
- the conditions required to limit swelling, shrinkage, excessive deformation or **deterioration of the timber and connections**
- the measures to limit moisture absorption not compatible with the service conditions
- the **methods for checking, monitoring and managing** deviations from the established limits.



REFERENCE MOISTURE CONTENT VALUES BY ELEMENT TYPE



BY TIMBER TYPE

types	upon delivery to site	in service SC1	in service SC2
solid softwood	< 20%	8 - 13%	8 - 13%
glulam	about 12% ± 3%	6 - 10%	9 - 13%
LVL	about 10% ± 2%	6 - 10%	10 - 16%
CLT	about 12% ± 2 - 3%	6 - 12%	9 - 15%

GENERAL VALUES FOR EACH STAGE

condition	reference value
sawn timber	may exceed 100%
timber dried for engineered timber products	12% ± 3%
acceptable for enclosure / roofing	<15%
balanced moisture content in service	6 - 8%
risk of fungal growth	26 - 60%

SOURCE: adapted from the 2025 International Mass Timber Report

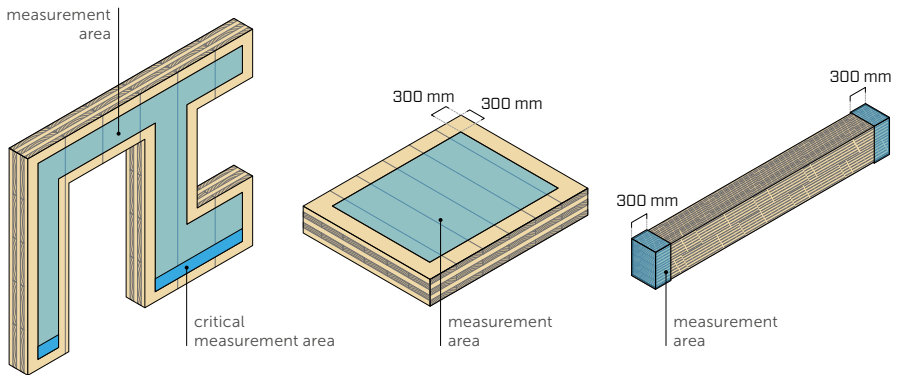
TEMPORARY SUPPORT STRUCTURES

The **plan also establishes who measures, where measurements are taken, how measurements are taken and how the results are recorded**. Inspections must be carried out at representative points and in the areas at greatest risk, avoiding measurements taken on free water or standing surface water, as these would alter the result.

The plan must also establish **which data are to be recorded** at each inspection; at a minimum, the following shall be included:

- weather conditions
- the condition of the storage area
- the effectiveness of temporary protection
- the presence of standing water
- any corrective actions taken

For each structural element, the measurement points and reading methods must be defined.

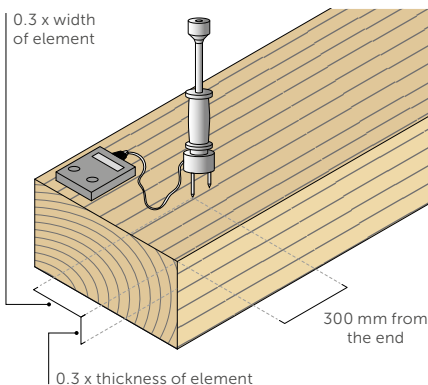


Example of measurement area for CLT wall panels.

Example of measurement area for CLT floor panels.

Example of measurement area for beams and columns.

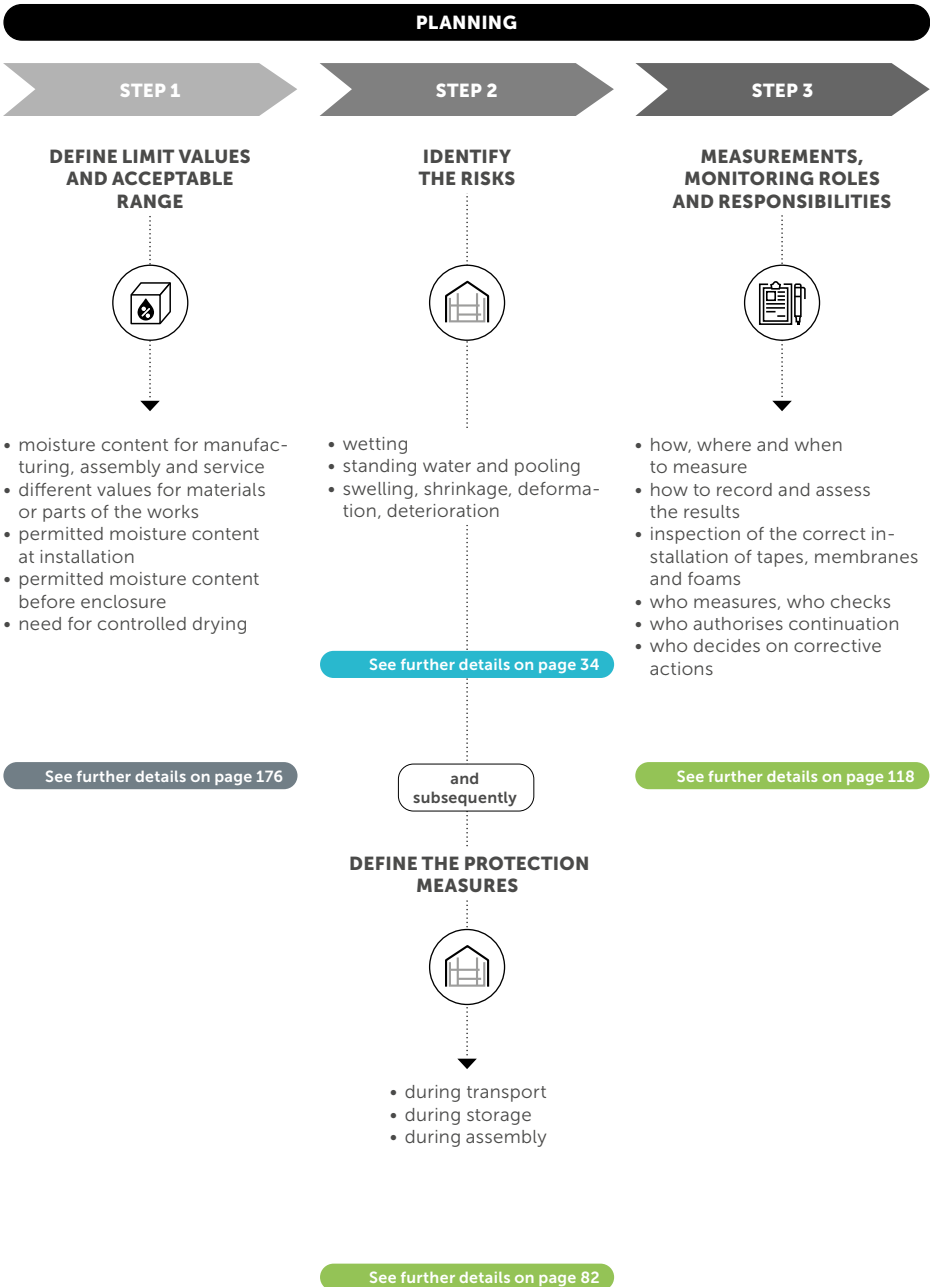
MEASURE THE TIMBER MOISTURE CONTENT



When measuring timber moisture content, if electrical moisture meters are used, it is recommended to use **EN 13183-2:2022** as the reference standard. The method and frequency must be defined and scheduled at the most significant stages of the construction process:

- at delivery
- during storage
- during assembly
- and upon enclosure of the works.

SOURCE: The Swedish Forest Industries Federation, 2026.



MARGIN

STEP 4

MEASURE THE AMBIENT CONDITIONS



- when to record temperature and relative humidity
- how to correlate these measurements with moisture content values
- when to integrate site data with local weather data

See further details on page 18

STEP 5

DEFINE THE CORRECTIVE ACTIONS



- suspension of works
- restoration of protection measures
- water drainage and removal
- controlled drying
- review of the sequence or enclosure

See further details on page 156

STEP 6

CHECK BEFORE ENCLOSURE



- moisture content
- absence of free water
- effectiveness of protection measures and drainage
- compliance with the plan limits

See further details on page 176

define for the project
and for critical elements

PLAN OUTPUT



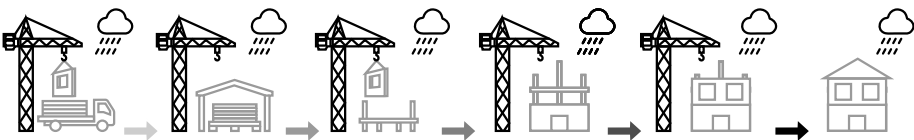
- | | |
|--|--|
| ☐ Moisture limit values and acceptable ranges | ☐ Methods, timing and responsibility for measurements |
| ☐ Risk of wetting and standing water | ☐ Corrective actions in the event of deviations |
| ☐ Protection measures planned for each step | ☐ Pre-enclosure checks |

TRANSPORT AND LIFTING PLAN

The transport plan is the first point of control during project execution. It concerns not only delivery to site, but also the preservation of the integrity and performance of the elements.

At this stage, it is important to distinguish between two related aspects: **lifting**, concerning attachment, handling and positioning, and **transport**, concerning restraint, protection and delivery up to the point of installation.

LIFTING



For structural elements, lifting requires a specific **assessment of temporary loads and the lifting system**. An element correctly designed for its final configuration may be damaged if lifted at inappropriate points, using devices that are not compatible with the geometry of the element, or using procedures that do not comply that do not comply with the operating instructions. In the worst-case scenario, such an error may result in damage to the element and site accidents related to loss of stability or detachment of the load.

See further details on page 182.

TRANSPORT

Transport concerns the restraint and protection of the element on the vehicle until delivery. Avoid displacement, damage to edges, **damage to membranes** and already-applied details, **corrosion of pre-installed fastenings** and, more generally, conditions that may compromise the quality of the element before installation.



land transport (short and medium haul)



Use of straps to secure the panels to the vehicle during transport.

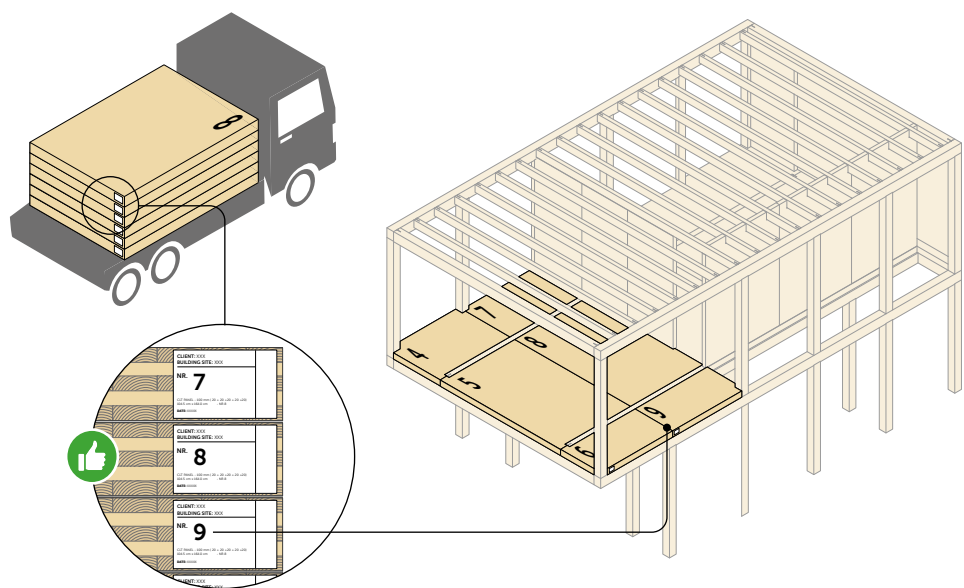


land or sea transport (long haul)



Additional protection of the panels in the case of long journeys or possible exposure to corrosive agents.

The transport plan must ensure two outcomes: the preservation of the functional and aesthetic requirements of the materials during transfer, and the coordination of delivery with assembly, so as to **minimise on-site storage**. Where possible, the most effective solution is just-in-time delivery, with immediate installation or installation shortly after unloading.

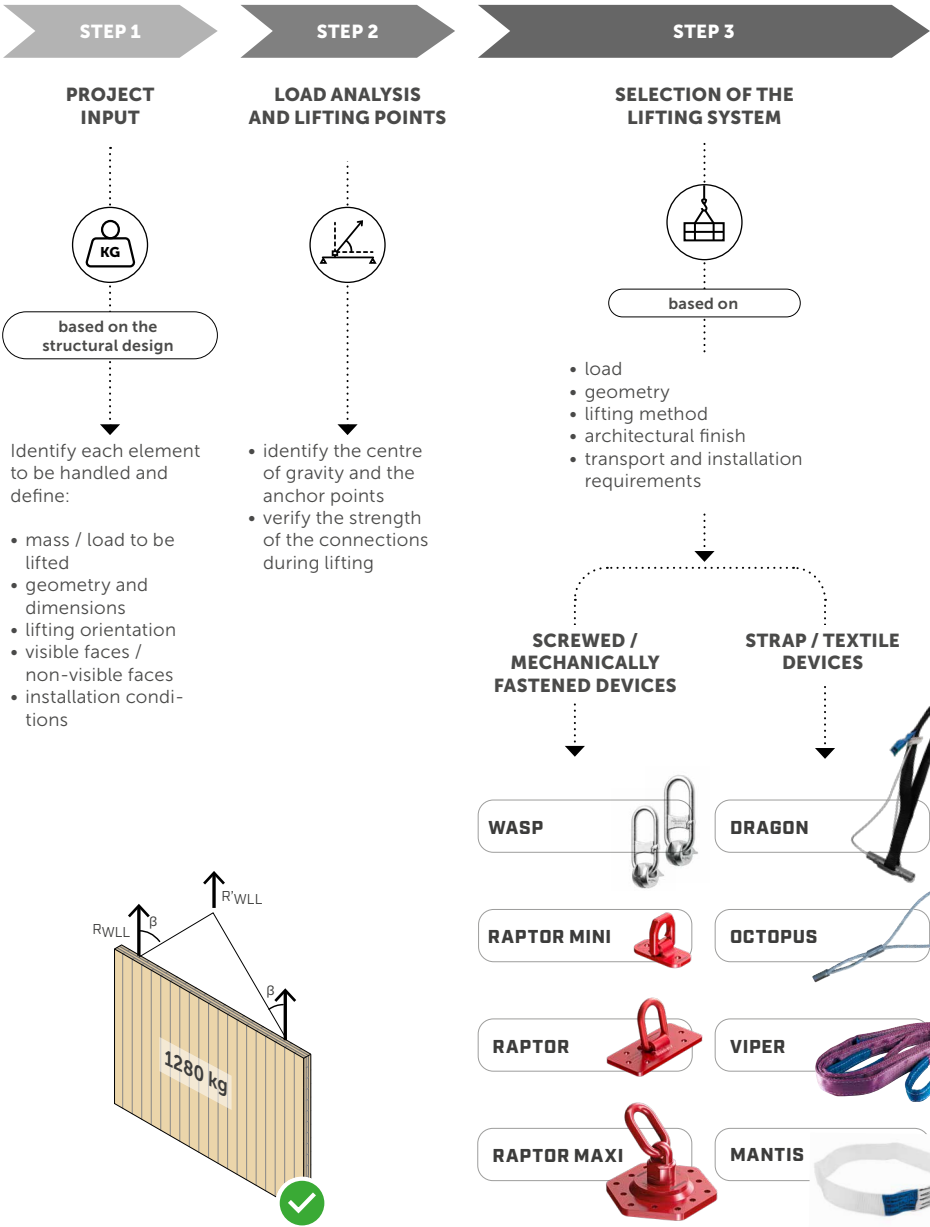


Arrangement of panels during transport to facilitate their lifting and assembly. The panels must be numbered according to the **installation sequence** and positioned during loading so as to allow unloading and installation in the planned order.

ROTHOBLAAS RECOMMENDS



LIFTING PLAN WORKFLOW



For further information, see the catalogue
"TOOLS FOR TIMBER CONSTRUCTION"

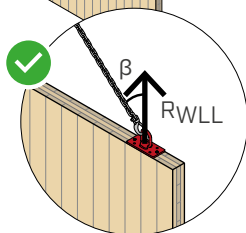
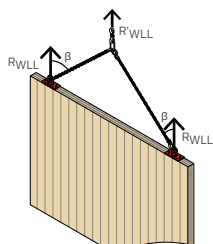
STEP 4

SIZING OF THE LIFTING DEVICE



in accordance with the applicable standards

- verify the load capacity of each lifting device, taking into account the type and number of fastenings and the lifting angle.
- verify the need for **spreader beams** to ensure load balance



STEP 5

INSTRUCTIONS FOR USE

before use

INSTALLATION OF THE SYSTEM ACCORDING TO THE MANUALS

- correct positioning of the device
- correct installation of the fastenings
- required tightening torque
- minimum distance from the edge

after use

DISPOSAL DIRECTIONS



REUSE INSTRUCTIONS



- **DEVICE:**
refer to the manual
- **FASTENING:**
possible only when used with **VGS PLATE**

VGS PLATE REUSE GUIDELINES



The reuse guidelines are available at www.rothoblaas.com



LIFTING PLAN OUTPUT

final check

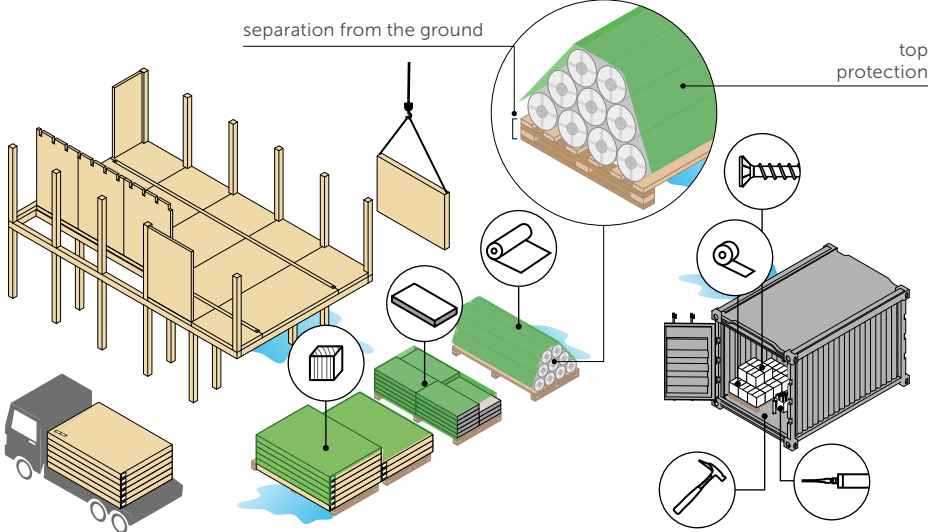


- ☐ Code / element identification
- ☐ Weight
- ☐ Lifting points
- ☐ Selected device
- ☐ Category: screwed / mechanical or textile / strap
- ☐ Category: single-use / multiple-use
- ☐ Verify requirements
- ☐ Reference manual
- ☐ Architectural notes
- ☐ Lifting and installation sequence

STORAGE PLAN

The plan is activated **when there is a time interval between delivery and installation**. Each material has specific requirements, but, in general, proper storage is based on **two principles or forms of protection**:

- **from below:** separation from the ground
- **from above:** top protection



TIMBER AND TIMBER-BASED STRUCTURAL MATERIALS

Store according to the **assembly sequence**, without obstructing unloading, handling and installation.



INSULATION

Avoid **compression caused by stacking**, especially for soft insulation materials.



MEMBRANES

Store on pallets, avoiding contact with the ground, UV exposure and high temperatures, with particular attention to adhesive and bituminous membranes.



METALWARE AND FASTENINGS

Store protected from salts and **corrosive agents**, particularly in environments exposed to marine aerosol.



TAPES

Store in the original packaging in a dry, covered location, with particular attention to butyl tapes. Protect from UV exposure.



ADHESIVES, RESINS, SEALANTS

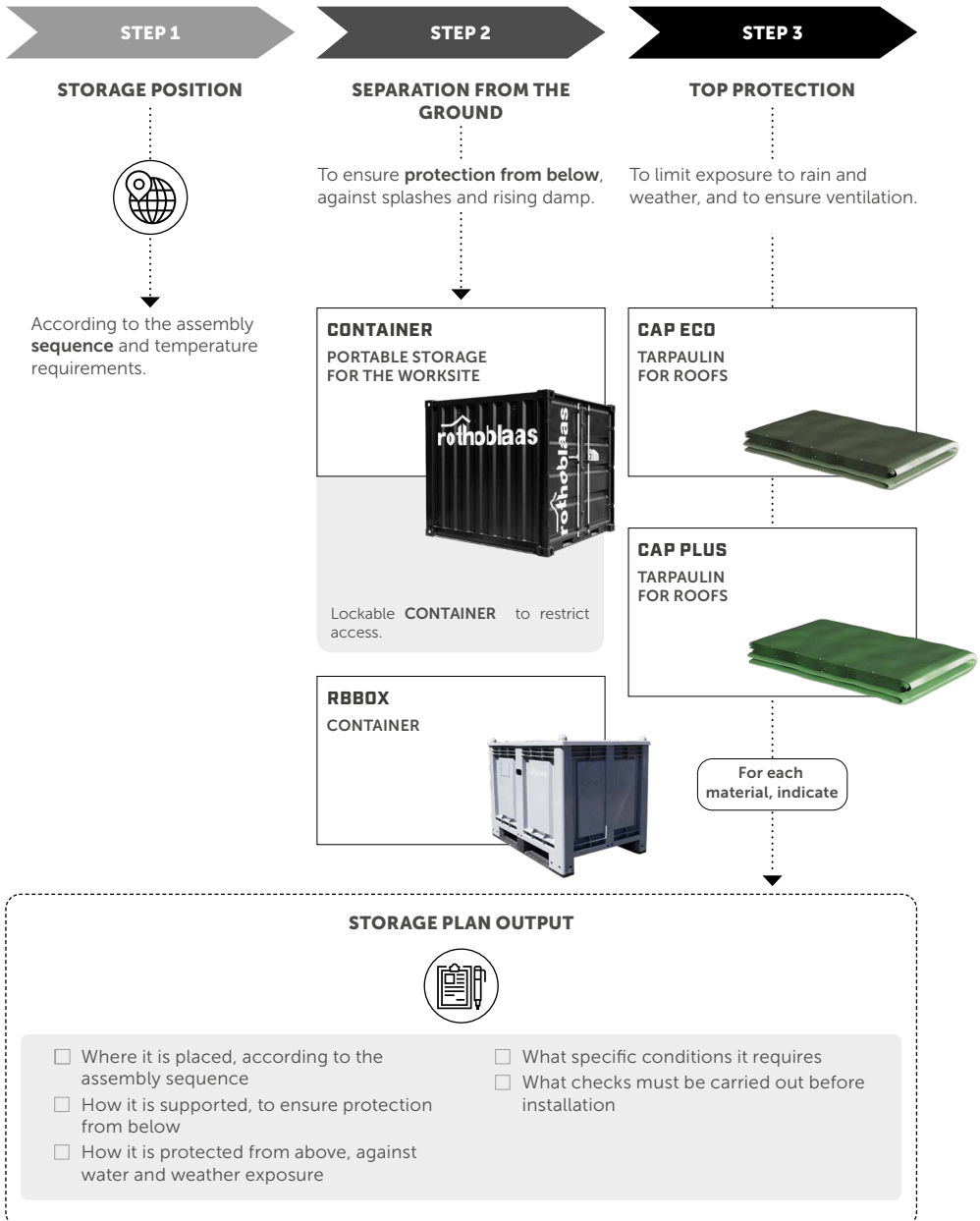
Store in a dry, covered location, maintaining the temperature specified in the technical data sheet.



For each product, always refer to the **technical data sheet** and, where available, the **instruction manual**, to ensure correct storage, durability and performance. For further details, also consult the catalogues. Use a lockable container to protect tools and machinery from weather and theft.

STORAGE PLAN WORKFLOW

For each material, the storage plan must define:

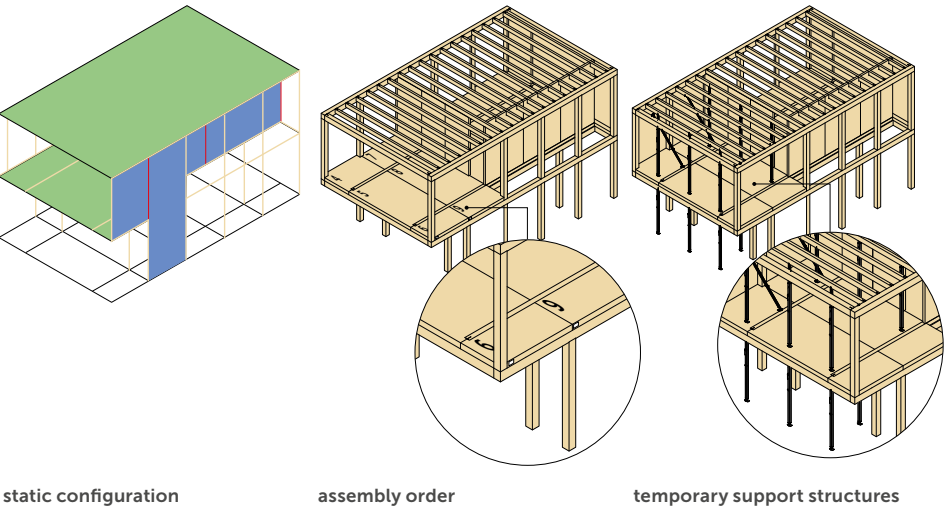


ASSEMBLY PLAN

The assembly plan governs the transition from a sequence of individual elements to a load-bearing system that is not yet complete. **It is not enough for the finished building to be correct; each intermediate stage must also be kept under control**, not only for the durability of the finished building, but also for site safety.

ASSEMBLY SEQUENCE

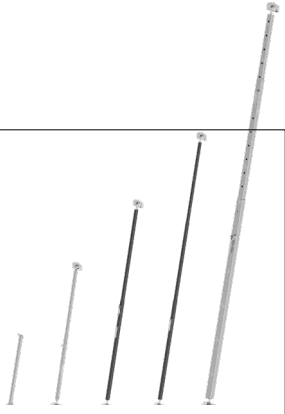
The assembly sequence must be consistent with the structural design, which governs the entire project execution process; **the assembly methods must be compatible with its underlying assumptions**. At this stage, **load paths are checked** and temporary configurations, provisional loads and intermediate installation steps are verified, avoiding risks to both the structure and the safety of workers on site.



ROTHOBLAAS RECOMMENDS



GIRAFFE
ASSEMBLY
SUPPORT



TEMPORARY SUPPORT STRUCTURES

Props, bracing, temporary supports and retaining devices, including fall-arrest systems and collective protection measures, are not merely site accessories, but necessary conditions for assembly. They must be consistent with the structural design, verified for the actual conditions of use, and made up of certified systems. Without adequate temporary supports and collective protection measures, the minimum conditions for safe assembly do not exist.

CHECKING TEMPORARY SUPPORTS ON SITE

1 2 3 4 5

Checking the support using **GIRAFFE CALCULATOR**.

Positioning of the head plate on the upper third (as **BRACING**) or on the bottom of the panel (as a **PROP**).

Checking the correct angle and fastening of the base plate.

Adjustment and levelling using the handle.

After fastening the wall, disassemble the **GIRAFFE** supports and prepare them for reuse.



GIRAFFE as a PROP.



GIRAFFE as BRACING.

Use the GIRAFFE CALCULATOR to verify the assembly support.

Find the course that suits you!



rothoblaas.com



PARTIAL FASTENINGS AND INSTALLATION

Partial fastenings may be necessary during the initial installation stages, but must never be considered sufficient to transfer loads for which they were not designed. A temporary connection with only a few fastenings may serve to keep the element in position, but not to withstand load conditions that require completion of the structural detail. Therefore, it is essential to verify that at every stage of assembly, **no element relies on an insufficient number of fastenings** or on temporary configurations incompatible with the loads.

LEGEND



very low risk



risk to be avoided



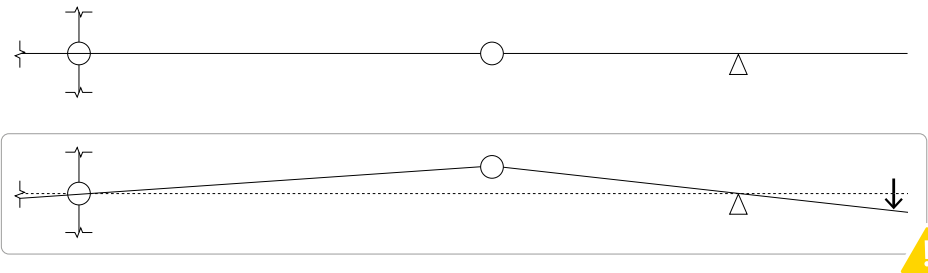
Connections compatible with temporary partial fastening during assembly.



Connections not compatible with temporary partial fastening: all fastenings must be installed before loads are applied in order to guarantee structural safety.

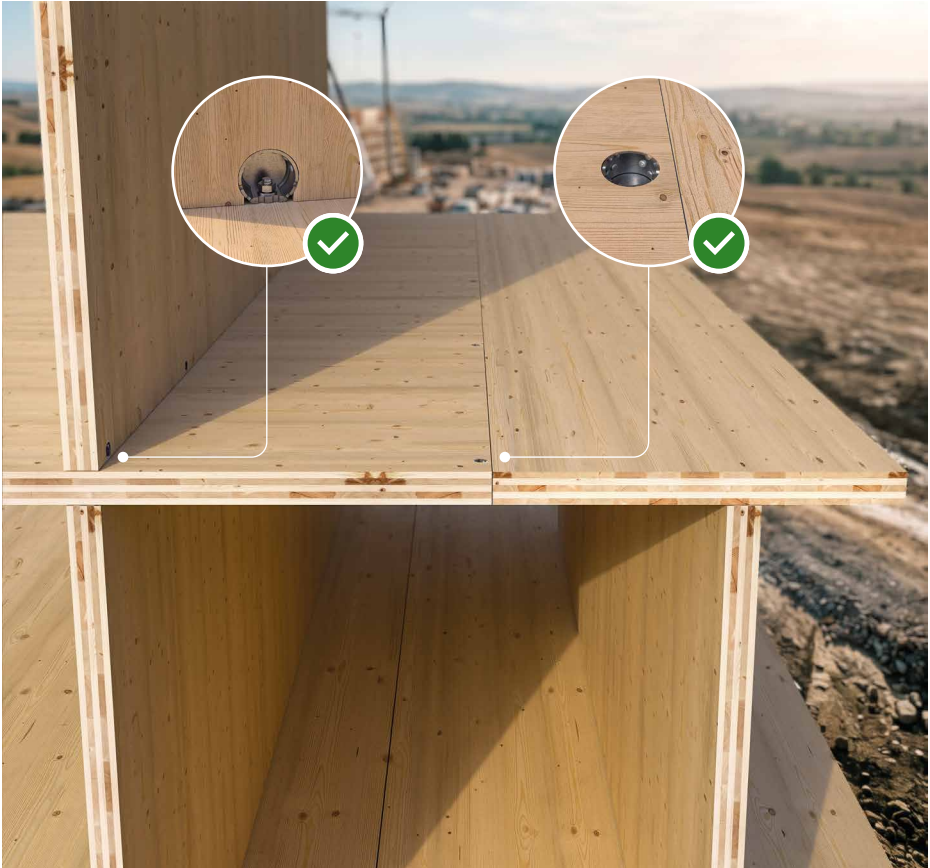


Structural behaviour of the connections





Reduce the need for temporary fastenings and the associated risks by using innovative RING and RADIAL connectors, pre-assembled or installed directly on site.



ROTHOBLAAS RECOMMENDS

RING

REMOVABLE CONNECTOR
FOR STRUCTURAL PANELS



RADIAL

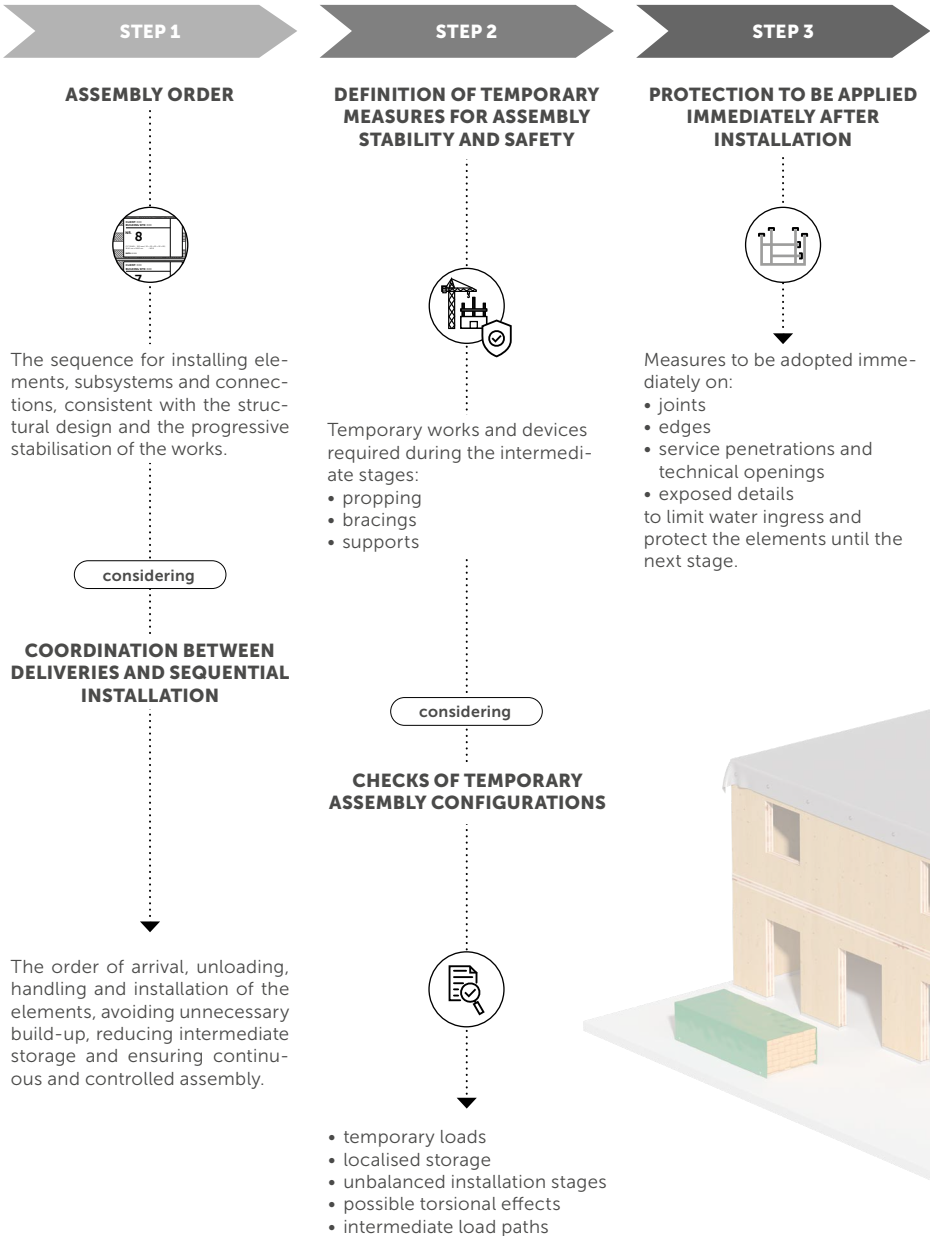
CONNECTORS
FOR TIMBER BEAMS
AND PANELS



LBS HARDWOOD EVO

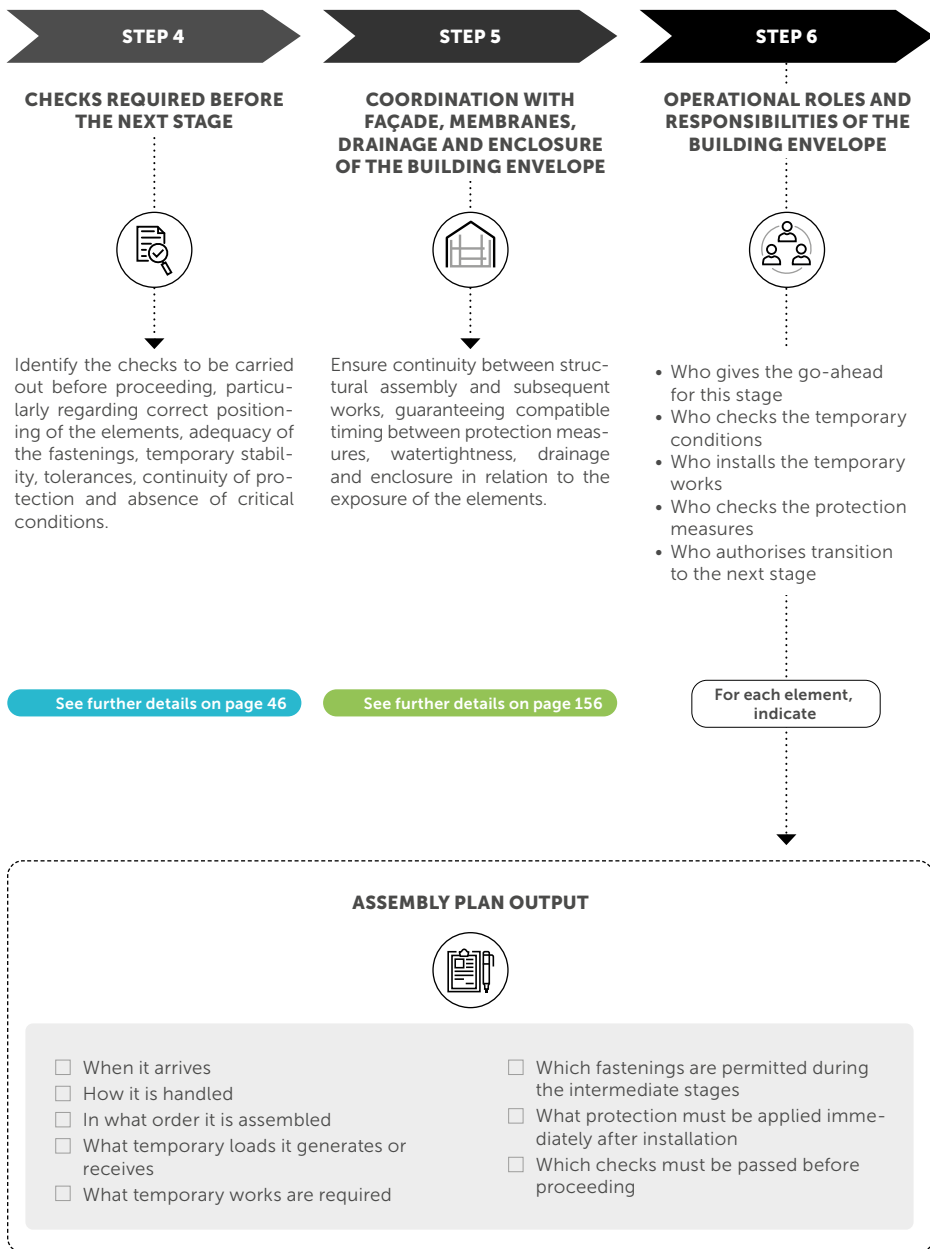
ROUND HEAD SCREW
FOR PLATES ON
HARDWOODS





See further details on page 46

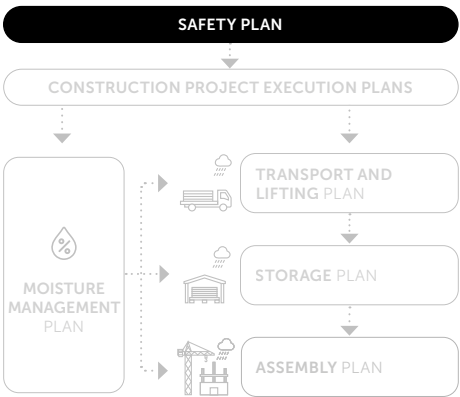
See further details on page 82



SAFETY PLAN

The Safety Plan is the cross-cutting document governing the other construction project execution plans for all aspects related to prevention and protection on site. It defines, for each operational stage, the measures necessary to ensure that works, assembly sequences, handling operations and temporary works are carried out under safe conditions. Applicable national regulations must be complied with.

The site must be equipped with the necessary **collective protection measures**. Each operator must be protected with **personal protective equipment (PPE)** appropriate to the activity being carried out. The safety manager must supervise the correct application of the planned measures and their consistency with the various stages of operation.



PERSONAL PROTECTIVE EQUIPMENT

HELMET

HERO
HELMET FOR WORK AT HEIGHT, ON CONSTRUCTION SITES OR IN INDUSTRIAL AREAS



SLING

SPARTA
COMPLETE PROFESSIONAL HARNESS FOR FALL PROTECTION SYSTEMS, POSITIONING, ROPE ACCESS WORK



GLOVES

GLOVE MID
RECYCLED NYLON&SPANDEX/ NITRILE FOAM GLOVES



HIGH-VISIBILITY VESTS

VEST
HIGH-VISIBILITY GARMENT

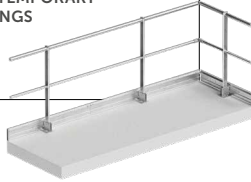




RAILINGS

BORDER

ALUMINIUM PERMANENT
AND TEMPORARY
RAILINGS



EDGE TEMP 1

TEMPORARY RAILING
ROOF SIDE



TEMPORARY
LIFELINES

HOLD SYSTEM

TEMPORARY HORIZONTAL
ANCHORING DEVICE



TEMPORARY

TEMPORARY
LIFELINE



SINGLE
ANCHOR
SYSTEMS

WING

ANCHOR POINT
FOR ROPE
ACCESS WORK



KITE

ANCHOR POINT



Use **TOOLGRAB** to prevent tools from falling from height on site.



FALL
PROTECTION
NETS

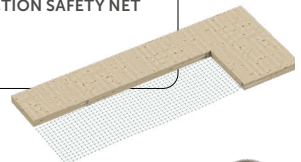
OVERNET

PERMANENT FALL
PROTECTION SYSTEM
FOR INDUSTRIAL ROOFING



HORIZONTAL NET

HORIZONTAL
POLYPROPYLENE FALL
PROTECTION SAFETY NET



Use the **carabiner** for fastening fall protection nets.



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This *Smartbook*
is neither a guide
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It is a **practical tool** for identifying risks before they escalate into damage. It starts with the critical points where water can affect site operations: lack of coordination between construction stages, areas left exposed for longer than expected, and details that work on paper but perform differently on site.

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It is a tool for use on site.

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