Title: Assessment of adhesive system for bonding façade panels

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Attachment:	Instruction for Use TWEHA Bonding Systems
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Resume

From Client, the assignment was received to carry out an assignment investigation regarding adhesion of TWEHA StoneMate on

Coverlam 5.6 mm

On behalf of several projects.

The study was carried out according to the assessment model, as shown below.

A test close to reality so you can make a claim about behaviour.

Panels have been bonded onto ventilated façade constructions for four decades. Materials used for the panels include fiber cement-bonded plates, hpl, glass, plastics, aluminum, ceramics, and natural stone.

The lifetime of a product depends on the inherent durability and normal maintenance.
The latter depends on many factors, such as design, location of use (exposure), installation, use and maintenance, which are beyond the control of the producer.

A clear distinction must therefore be made between the assumed economic reasonable lifespan for a product (also called "design life"), which underlies the assessment of sustainability in technical specifications and the actual life span (also called: "working life ") of an applied product.

Table 2.1 of the EN 1990: 2002 Eurocodes sets the requirement that for a product the life span during which the performance of a product will be maintained at a level that allows well-designed and executed works, in case of replacement of construction and/or components, the 'design life category: 2' and 'working life category: normal', a reference period of 25 years applies.

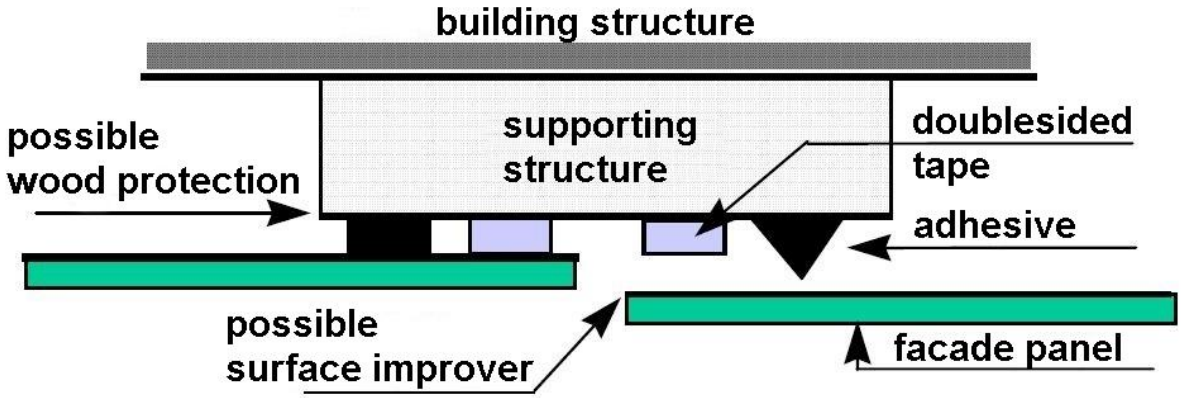
This also applies to wall cladding because it is also considered as a repairable element that can be replaced with light effort.

To achieve a high-quality and durable adhesive connection, quality must be achieved by implementing suitable methods and measures. The purpose of the tests described here is to establish a quality level that, from the point of view of economic and safety consequences, will assign the moment of failure of the adhesive connection within acceptable limits.

Common

The bonded joint differs from a mechanical connection because the strength only takes place during the curing-, production- or application process and therefore the strength must always be tested (!) and qualified beforehand.

The construction of a bonded façade panel construction is as follows:



Surface Tension

The surface tension of a substrate is of great importance for the adhesion of our bonding systems.

Surface tension arises because the molecules on the surface of the substrate strongly attract. Because the molecules attract one another a tension of the surface occurs. This can be seen as a tension between the molecules. The molecules continue to attract each other and will remain close together as long as possible. Because of this they do not give passage, because then they must be separated. This physical activity at the surface substrate makes the adhesive flows out well, and then can adhere well to the surface. This is called 'wetting'.

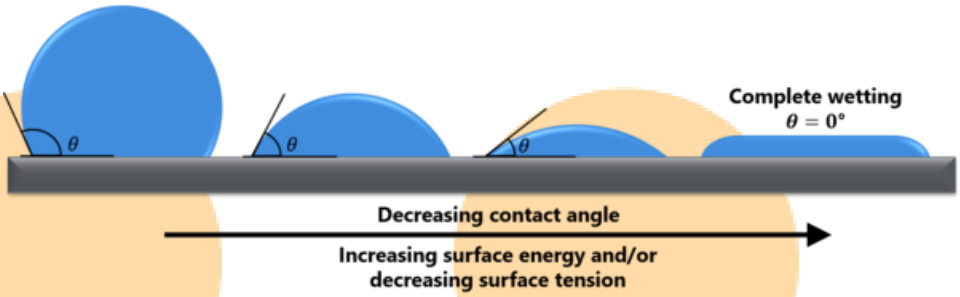
It can be illustrated well with a drop of water. When a drop is placed down on very clean glass, it spreads completely. This is because of the high surface tension of glass. By contrast, the same drop deposited on a sheet of plastic, with a very low surface tension, the drop remains stuck in its place.

By nature, some materials and with manufacturing of some facade panels sometimes processing aids (mold release agents) are used e.g. to allow the panel to come out of the mold easily. In the event a protection foil is applied on the facade panels, the surface is pre-treated to lower the surface tension and thereby facilitating the detachment of the foil. Please take notice of the fact that these substances reduce the chemical activity at the surface and must be removed from the surface before bonding to.

Good wetting is achieved when the surface tension of the adhesive is lower than the surface tension of the surfaces to be bonded. The TWEHA adhesives, based on Silane modified polymers, are polar

and therefore have a relatively high surface energy. Therefore, achieve these adhesives an optimal adhesion to polar substrates (e.g., glass or metal) with a relatively high surface energy.

Critical is bonding on materials with a low surface tension (a-polar substrates) such as most polymers (plastics) which are characterized with low to very low surface tensions. It explains why it is so difficult to achieve good adhesion to low surface tension materials such as polyethylene, polypropylene, silicones, and polytetrafluoroethylene (Teflon™).



The surface tension of the substrate is, moreover, easy to indicate by placing (demineralized) water, in the form of a drop on the surface. If the drop of water remains lying than the surface tension of the substrate is low (eg Teflon). If the waterdrop flows out (angle O < 90°) the surface tension of the substrate is high(er). TWEHA tested and approved materials on this issue also. Unless otherwise indicated, bonding without addition or modification with TWEHA's bonding products is allowed.

Theoretical Surface Failure of a Bonded Connection

The durability of SMP adhesives (Silyl Modified Polymers, also known as MS Polymer Adhesive (Modified Silane Polymer) is good, because they are only sensitive to high concentrations of solvents, which in practice will be used little on facade panels.

The cohesive properties of the used adhesive products from TWEHA are known. This is a constant value. Because this material property is not substrate dependent, the characteristic strength can be determined based on the manufacturer's specifications.

The adhesive properties, on the other hand, are variable under the influence of the respective substrate and environmental conditions. It is therefore important to determine whether long-term adhesion is at all possible to a substrate.

A bonded failure mechanism is how an adhesive bond can break. In the rare cases that an adhesive connection still detaches over the years, it is caused by poorly execution. In those cases, it is not the adhesive product itself that is responsible but caused by poor implementation (f.e. insufficient (pre-) treatment of the substrate), incorrect detailing or use of another, often unreliable, adhesive system.

The failure mechanism of an adhesive connection will have to be approached as follows: an optimum adhesive connection fails with a cohesive fracture. This is a breakage in the adhesive material.

A bonded connection consists of a maximum of 9 components, namely:

- the part to be bonded (the façade panel)
- the interface between adhesive or surface improver (1) and the part to be bonded (façade panel)
- in case of densification of porous surface: a surface improver (1)
- interface between adhesive and surface improver (1)
- the adhesive
- interface between adhesive and a wood preservative (2)
- in case of application of a wooden framework: a wood preservative (2)
- the interface between substrate and adhesive or a wood preservative (2)
- the substrate (framework / facade / supporting structure

Newly made adhesive bonding of two materials depends on the strength of the aforementioned nine factors (links).

To achieve a good quality adhesive connection, quality control must be achieved by implementing appropriate methods and measures. The aim is to achieve a quality that only varies within acceptable limits, depending on the economic and safety consequences in case of failure of the connection.

And the failure mechanism can be analysed as follows:

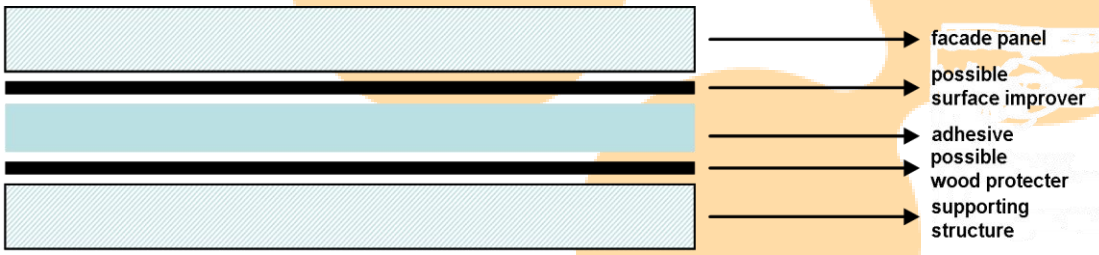


Figure 1. Schematic overview of bonded façade system.

An optimal bonded connection fails (collapses) with a cohesive fracture. This is a break in the adhesive material.
However, a bonded connection can collapse in several ways. For each of these failure forms it is indicated how the strength should be tested (see also the diagram of figure 1.)

The bonded joint can be represented as a chain, the weakest link of which determines the strength. There are nine failure links to distinguish, namely:

- cohesion strength of the façade panel itself.
- adhesion strength between the dried surface improver and surface façade panel.
- cohesive strength of the dried surface improver itself.

- adhesion strength between the cured adhesive layer and the dried surface conditioner.
- cohesive strength of the cured adhesive layer itself.
- adhesion strength between the cured adhesive layer and the dried wood preservative.
- cohesive strength of the dried wood preservative.
- adhesion strength between the dried wood preservative and the support structure.
- cohesion strength of the supporting structure itself.

In the case of a further assessment of the quality of an adhesive joint, the quality of these nine links must be known.
The system can fail on or in each of these components as well as on the boundary layers (where the components contact each other). This does not have to be limited in or to one of these components, but this can also be divided over the different components. In the case of failure at the interfaces, is called 'adhesive failure'. In the case of failure in the adhesive, the primer or the substrates is called a 'cohesive failure'.

It is also possible that the substrate or the part to be bonded fails. After failing it is very important to find out what the cause of the failure was and where it occurred. In this approach, pre-treatments of the substrate or part to be bonded (for example with primers) are considered.
In the specific case of façade panels, the supporting structure is a substrate and the façade panel the part to be bonded. In principle, many combinations are possible between the materials in this system. To introduce some systematics here, we now have an overview of the possible causes of failure in each of the components.

Possible causes in the event of a failure of adhesive connection

- the supporting structure

Thanks to a good adhesion between the facade panel and adhesive, the supporting structure can fail, so that a piece of its material (f.e. wood) can be found on the failed system. Another possibility is that one of the components from the adhesive affects the supporting structure.

- the interface between supporting structure, wood preservative or the adhesive

The adhesive or wood preservative has not properly adhered to the (pre-treated) surface of the supporting structure or has been released over time. This should result in a "clean" surface after failure, showing only a small part of the adhesive or, for example, wood preservative.

- the surface improver and / or wood preservative

A cohesive break in the surface improver or wood preservative is very clearly visible because it adheres both to the substrate (the façade or supporting construction) and the adhesive.

- The adhesive

The adhesive itself is torn, cohesive failure. This can be related to creep or, for example, embrittlement due to chemical attack. This is very clearly visible because it adhered to the substrate (the façade panel or supporting structure) on both sides.

- The interface between adhesive and surface improver and/or wood preservative

The adhesive or surface improver has not properly adhered to the (pre-treated) surface of the façade panel or has been released over time. This should result in a "clean" surface after failure, showing only a small part of the adhesive or, for example, wood preservative.

- The interface between adhesive or surface improver and the façade panel

The panel has been released due to a poor adhesion between adhesive or surface improver on the façade panel. This is due to poor adhesion of the adhesive or surface improver on the façade panel, which can be caused by insufficient pre-treatment. It is also possible that an adhesive has been used that affects the façade panel.

- The façade panel

Finally, the material of the façade panel itself can also fail, leaving a piece of façade panel behind on the façade with the adhesive. This could happen, for example, because a bonded glass plate breaks.

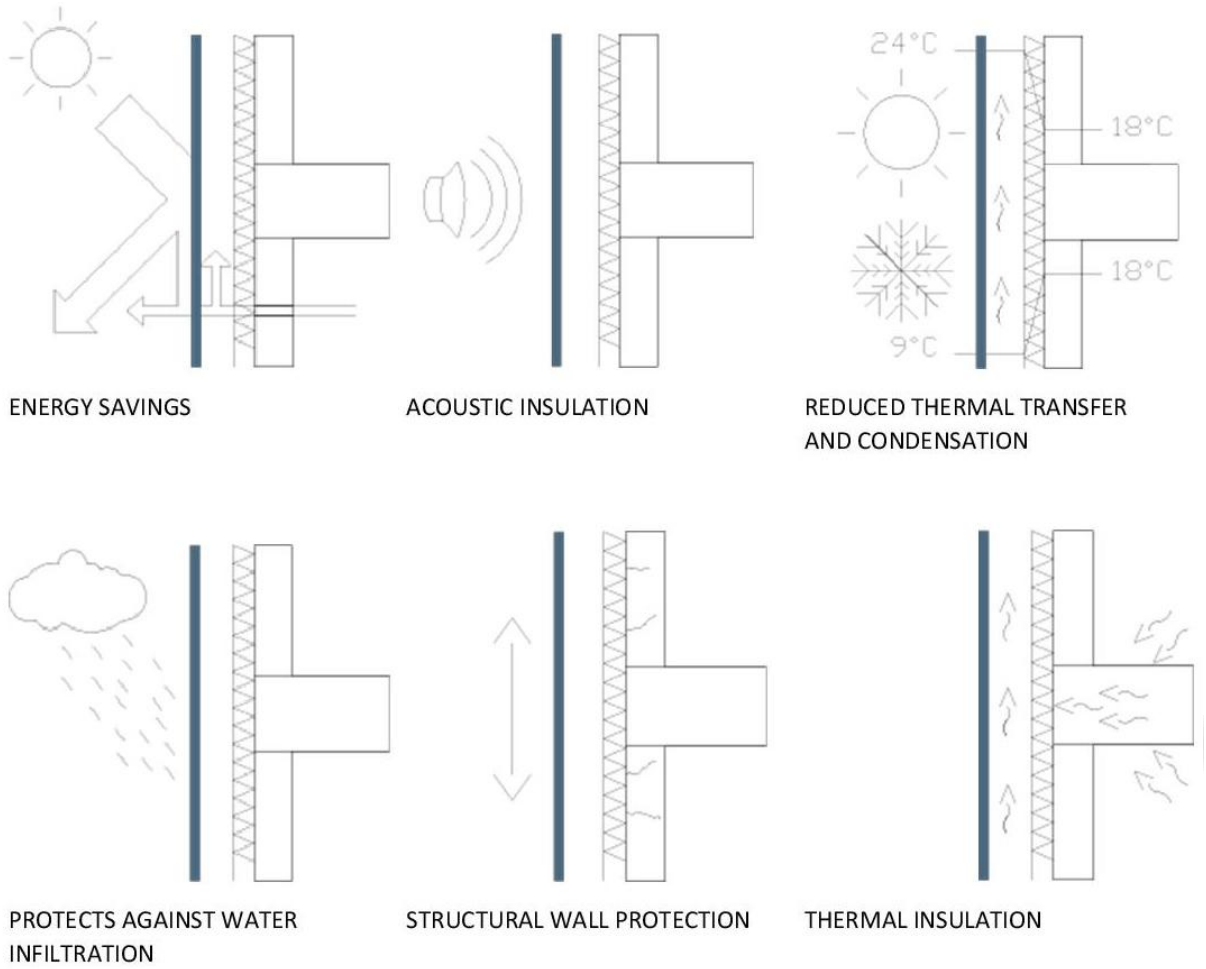
Experiences

In the four decades that bonded façade cladding are used, relatively few cases of damage are known. Experience figures and research teaches us, if there is a failure of the adhesive connection, causes can generally be subdivided as follows:

1. In 45% of cases, the failure is due to:
   - o incorrect structural design and / or implementation of the connections. The durability of a connection is largely determined by the way in which it is established. In most cases, façade panel bonding systems come with a processing instruction with instructions for pre-treating the façade, applying products and the conditions under which bonding can take place. These instructions are often very detailed, and the environmental factors must fall within a bandwidth (for example the air humidity or the wood moisture content of the framework).
   - o corrosion of embedded metals.
   - o failing construction to accommodate tolerances, displacements and / or differences by thermal expansion.
2. In 40% of the cases, a strength reduction of the subsurface or support structure because of exposure to the "outside world" was found.
3. In 15% of cases, because of leakage towards the inside of the cladding construction, in combination with the absence of a drainage and / or drainage system for penetrated water.

In accordance with available experience from practice, the risk of damage due to mechanical aging (creep and dynamic loading) of the adhesive system is low. On the one hand, this is the result of a relatively low static load on the adhesive system, since much more bonding material is often used than theoretically is required to absorb stresses due to the weight of the façade panel and the occurring wind load. On the other hand, the applied adhesive systems are hardly sensitive to a dynamic load caused by, for example, the wind.

Classification ventilated cladding



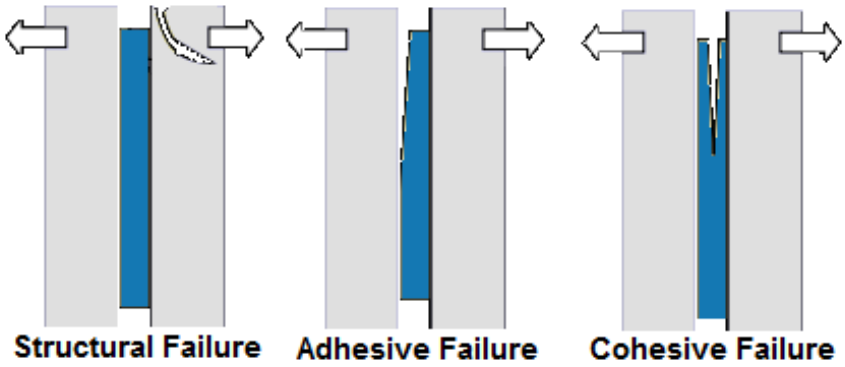
This façade covering is designed as a ventilated façade system. The outer covering is applied to a supporting structure behind which an air cavity or gap of> 20 mm. All this in accordance with the processing guidelines.

Some specific characteristics for this type of cladding are:

- Optimization of thermal insulation values. As a result, the inner wall is less subject to large temperature changes because, among other things, the sunlight is reflected in the summer. At the same time, the ventilated air cavity avoids the occurrence of condensation.
- The air cavity behind the façade panel is ventilated through ventilation openings on the bottom and top, which allows the moisture to evaporate naturally.
  If the façade system is not ventilated, moisture cannot evaporate, which leads to mold and rot and ultimately an unhealthy building envelope.

• This ventilation opening itself must be at least 10 mm at the top and bottom. If ventilation profiles are used, the perforation holes must together be at least equal to 100 cm2 per meter running.

1. Bonding characteristics



1.1. Type of failure: Cohesive

In case of a cohesive failure in the adhesive, there will still be an adhesive layer on the surface at both material sides. In that case there is an excessive tensile or shear stress, in which the breaking stress in the adhesive joint has proved to be the critical factor.

Because this material property does not depend on the features of the substrate, the characteristic strength can be determined based on the manufacturer's declaration which is determined according EN 54505.

The calculation rule of the model must be such that the result corresponds to a probability of inferential statistic is < 5%, so that the required reliability is achieved (the minimum strength is determined from tests and then reduced by a material factor).

1.2. Type of failure: Adhesive

In the case of an adhesive break, the adhesion of the adhesive to the substrate will prove to be the limiting factor and thus the weakest link in the connection.
The bond breaks are because the physicochemical connections are not created between the adhesive and the substrate.

Even for the failure of the adhesive joint at the interface between the adhesive and the substrate, hardly any theoretical models are available. As long as there is no good model for adhesive collapse, the design philosophy is used, the starting point is that this collapsed shape may never occur.

Determination that an adhesive break does not occur can only be done with the help of tests. For this reason, the characteristic strength must be determined for each substrate based on a test series.

2. Assignment

From Client, the assignment was received to carry out an assessment investigation.

2.1. In General

To determine whether strength and structure takes place and remains present on an adhesive, with the requirement that after testing no adhesive fracture (adhesion <95%) may occur, tests are performed on suitable substrates on which is determined the adhesive strength is stronger than the adhesion properties of the adhesive itself.

The variety of cladding materials used in ventilated façade constructions is diverse. In addition to the specific strength properties of the adhesive, the strength of the adhesive bond plays a decisive role in the functional properties of these façade constructions since damage is most likely to occur because of an adhesive fracture.

The measurement of the specific adhesion strength on the substrate is thus critical for the design and application of structures with two or more materials.

Current practice for determining the strength of bonded substrates can be classified as tensile strength test of a composition of materials only.
The tensile strength test is based on a commonly used method whereby a tensile stress is applied perpendicularly to the adhesive surface. After curing or completing courses in different circumstances, test pieces are tested in a universal draw / press bench with a deformation rate of 5 mm / min. to rupture.

Besides pure tensile strength of the adhesive concerned a general adhesion strength criterion is preferred to characterize the strength property of the adhesion more realistically and adequately.

In succession/addition to the outdated and/or expired guidelines BRL 4Dekton-7 and BUtgb TWEHA developed this ageing procedure by making a distinction between:

A. the strength properties of the adhesive bond only, to be determined/controlled once a year (or when changes in formulation occurs), following EN 53504.

B. the adhesion strength of the adhesive bond on a specific substrate, to be determined when information about the influence of the specific substrate on adhesion strength, in relation to obtain a calculation value in the structural calculations, is required.

C. the interface adhesion strength on each specific substrate, to be determined on behalf of each type of substrate, and then valid for a period of 36 months (or when changes in material composition of the substrate occurs). Tests where assessment of no detachment is required.

2.2 Scope

This procedure, according - Chapter 2-, describes laboratory ageing conditions under which adhesive connections of cladding material may be exposed to various environmental influences — climatic or chemical — for the purpose of assessing the effects of such influences on certain properties.
The ageing conditions are applicable to bonded assemblies and may be used to constitute a set of tests for the evaluation of an adhesive.

2.3. Cycle

In this type of ageing, according - Chapter 4-, the specimen is exposed for several successive periods, under single-variable and/or multi-variable conditions, on a cyclic basis. In some cases, transfers from one chamber to another are necessary; unless otherwise specified, such transfers shall be carried out in less than 3 min.
Curing, immersion in water, exposure to cold, exposure to dry heat (thermal shock) and humidity through cataplasma test.

2.3. Properties TWEHA Adhesives

In January of this year TWEHA StoneMate was evaluated. Annual Comparison values are:

TWEHA
StoneMate

TECHNICAL SPECIFICATONS					
properties	measure unit	test method	samples tested	nominal range	typical value
Shore-A hardness	Shore-A	DIN 53505 - ISO 868 - ASTM D2240	3	55±2	56
Modulus Elongation at 100%	MPa	DIN 53504 - ISO 37 - ASTM D 412	3	1,75	1,74
Elongation at Break	%	DIN 53504 - ISO 37 - ASTM D 412	3	325	321
Tensile Strength	MPa	DIN 53504 - ISO 37 - ASTM D 412	3	>2.8	2,84
Tooling Time	Minutes		3	13	17
Curing Rate after 24 hrs.	mm/24hrs		3	3-4	3-4

LABORATORY AGEING TESTS TWEHA ADHESIVES REFERRING TO ISO 9142:2003.

This describes laboratory ageing conditions under which adhesive joints may be exposed to various environmental climatic influences for the purpose of assessing the effects of such influences on certain properties to establish the behavior of an adhesive over a period under service.

For properties that can be measured, the results obtained are expressed as a relative variation with respect to the initial value.
The nature of the effects observed shall be noted if other than failure of cohesion of the adhesion joint will be established, e.g. rupture between the substrate and adhesive, failure of adhesion of the adhesive joint due to partial or total corrosion of the substrate beneath the adhesive, etc.

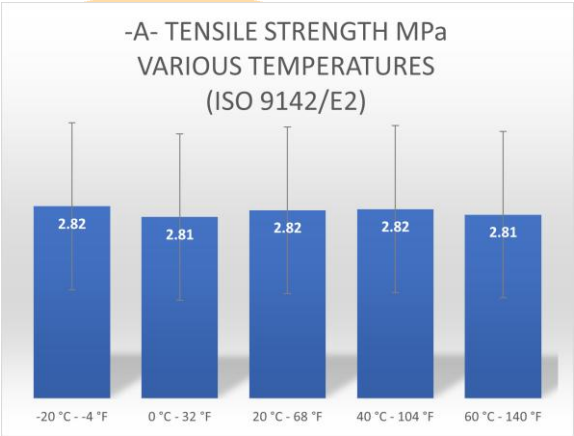
-A- TENSILE STRENGTH MPa - VARIOUS TEMPERATURES
The specimen is exposed to dry heat in the dry heat chamber for 24 h, the temperature exposure being selected from the lists of preferred values -20°C, 0°C, 20°C, 40°C and 60°C (-4°F, 32°F, 68°F, 104°F and 140°F) before measurement of the tensile strength immediately.

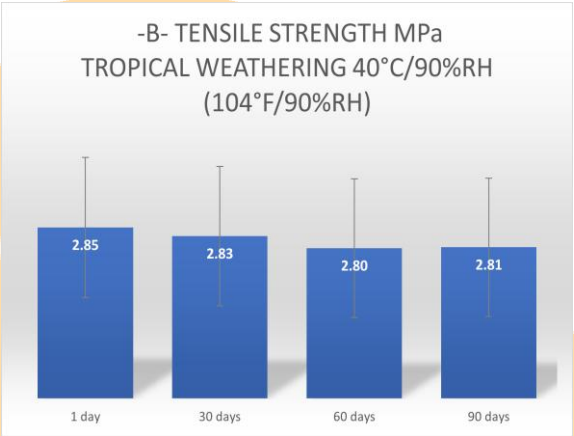
-B- TENSILE STRENGTH MPa - TROPICAL WEATHERING 40°C/90%RH (104°F/90%RH
The specimen is during 1, 30, 60 and 90 days exposed in a heat chamber with a the temperature exposure 40°C (104°F) and a relative humidity of 90 % followed by conditioning the specimens at 23°C (74°F) and (50 ± 5) % R.H. for 24 h before measurement of the tensile strength.

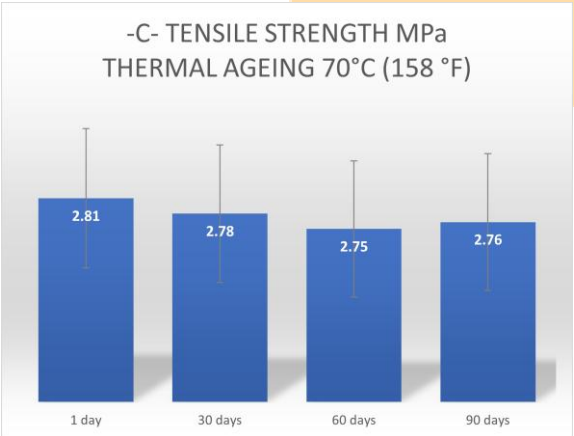
-C- TENSILE STRENGTH MPa - THERMAL AGEING 70°C (158°F)
The specimen is during 1, 30, 60 and 90 days exposed in a dry heat in the dry heat chamber with the temperature exposure 70°C (158°F) before measurement of the tensile strength immediately.

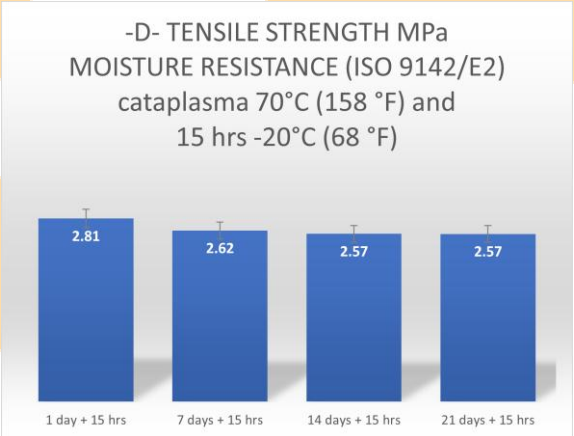
-D- TENSILE STRENGTH MPa - MOISTURE RESISTANCE (ISO 9142/E2)
cataplasma 70°C (158°F) and 15 hrs -20°C (-4°F)

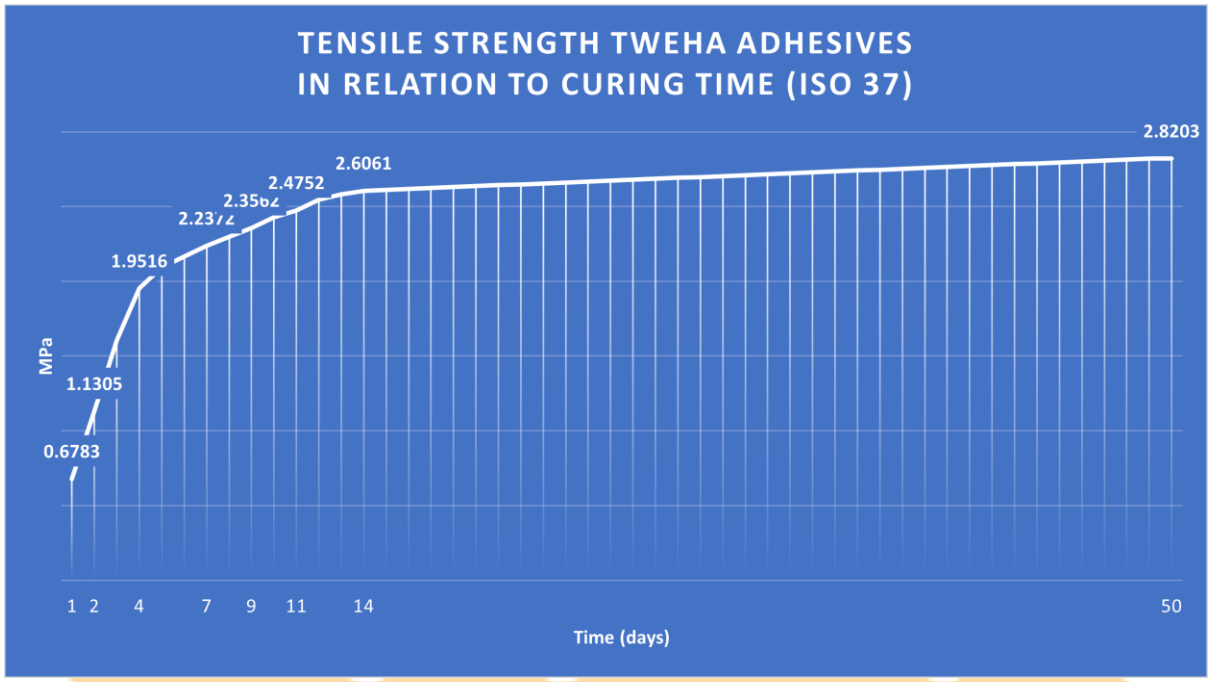
Produce the damp-surface contact conditions by wrapping the test specimens in cotton wool and placing them in one of the weldable bags. Saturate the cotton wool with de-ionized water and seal the bag by welding (For exposure periods of longer than 14 days, open the bag and re-saturate the cotton wool every 14 days and reseal).
Expose the bag with specimen, for an exposure period of 1, 7, 14 and 21 days to dry heat in a heat chamber with temperature of 70°C 158°F). Then remove the bag from the chamber and allow it to thaw out followed by conditioning the specimen at -20°C (68°F) for 15 hrs.
Then remove the contents from the bag, discard the cotton wool and condition the specimens at 23 °C (74°F) and (50 ± 5) % R.H. for 24 h before measurement of the tensile strength.









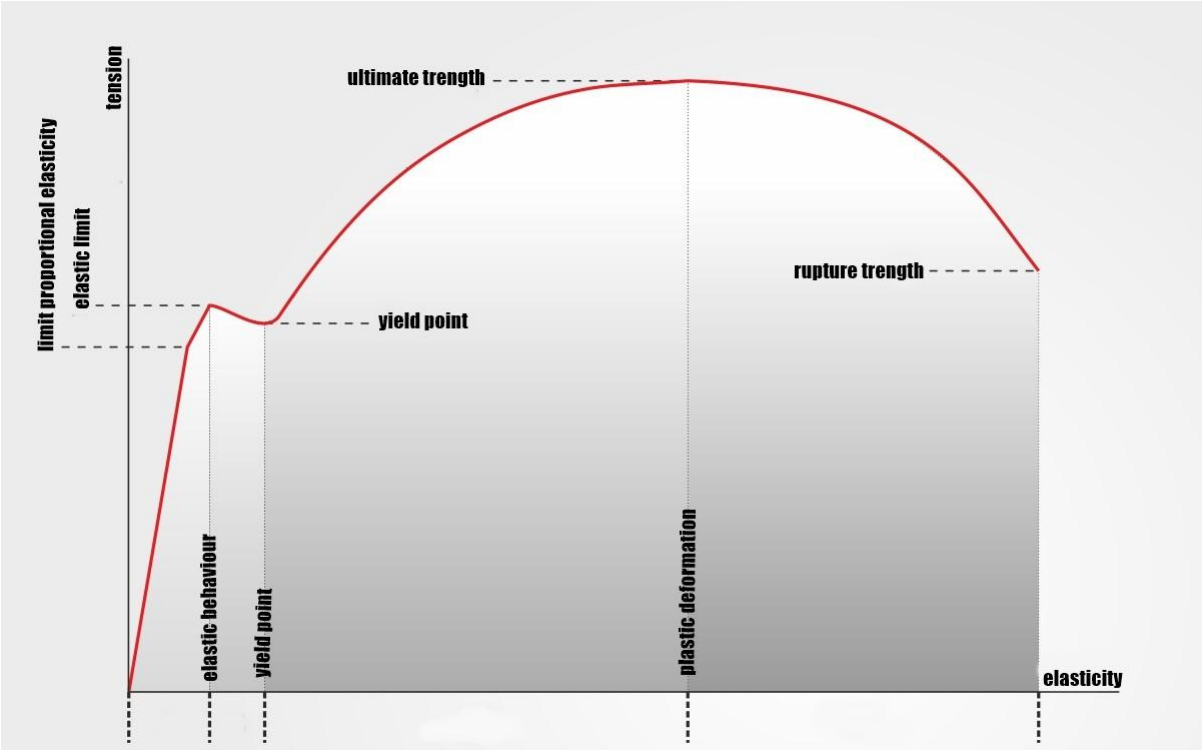


3. Cohesive Characteristics

The cohesive properties of the adhesive bond are known. This is a constant value. Because this material property does not depend on the substrate, the characteristic strength can be determined based on the manufacturer's declaration.

3.1. PART I: Strength properties of the adhesive

Determination of tensile strength at break, tensile stress at yield, elongation at break and stress values in a tensile test according EN 53504.


tension
ultimate trength
limit proportional elasticity
elastic limit
rupture trength
yield point
elastic behaviour
yield point
plastic deformation
elasticity

4. Adhesive Characteristics

The adhesive properties are variable under the influence of the respective substrate. It is therefore important to determine whether any long-term adhesion is possible on a substrate at all. To determine the adhesive properties, which substrate is dependent, on each substrate, after a progressive environmental test, a so-called Quick-Knife-test or Peel-Adhesion-Test the adhesion must be executed.

4.1. PART II: Adhesion Strength on Substrates

The influence of the properties of the different substrates concerned, have their effect on the application. In TWEHA's laboratory procedure for ageing conditions for bonded cladding the baseline is, in addition to the specific strength properties of the adhesive only, the assessment of the extent of adhesion on the substrate since damage is most likely to occur because of an adhesive fracture.

Current practice for determining the adhesion strength of bonded substrates can be classified as tensile strength test of a composition of materials only.
This tensile strength test is based on a commonly used method whereby a tensile stress is applied perpendicularly to the adhesive surface.
After curing or completing courses in different circumstances, test pieces are tested in a universal draw / press bench with a deformation rate of 5 mm / min. for tensile.

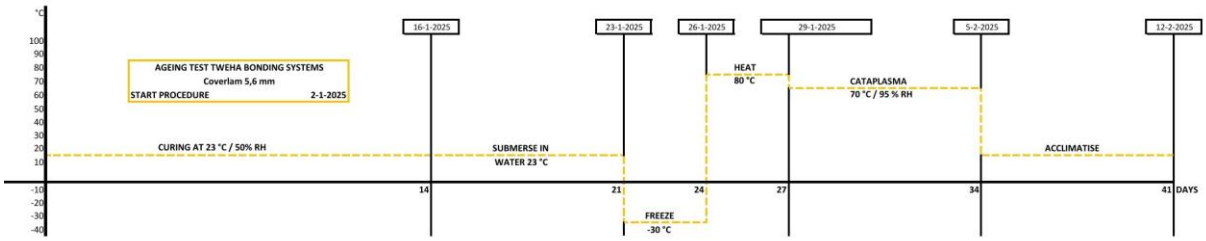
4.2. PART III: Adhesion Influences on Substrates

The circumstances that we face in practice, as well as the influence of the properties of the different substrates concerned, have their effect on the application. In TWEHA's laboratory procedure, in addition to the specific strength properties of the adhesive only, we investigate the influences by temperature and moisture on adhesion on the substrate since damage is most likely to occur because of an adhesive fracture.
To determine whether any adhesion takes place and remains present on a substrate, procedure 4.2.1. is performed.

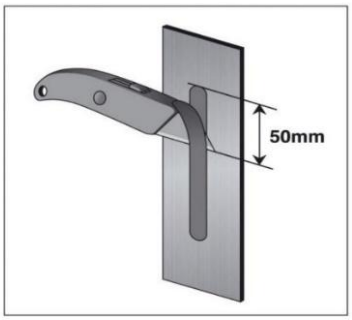
On each substrate, the test must be commenced within 2 days after receipt, whereby test pieces provided with an adhesive bead is checked by means of a so-called peel test on a suitable substrate, with the requirement that after *testing* no adhesive failure may occur.

The adhesive properties are variable under the influence of the respective substrate. It is therefore important to determine whether any long-term adhesion is possible on a substrate at all.

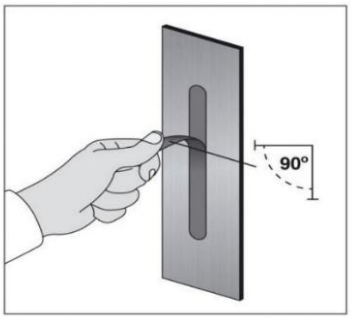
To determine the adhesive properties, which substrate is dependent, on each substrate, after a progressive environmental test, a so-called Quick-Knife-test or Peel-Adhesion-Test the adhesion must be executed.



A. Test adhesion immediately after conditioned hardened adhesive 20° C / 65% RH
B. Test adhesion immediately after a water load of 7 days 20° C
C. Adhesion test immediately after for three days in ambient - 30 ° C
D. Test adhesion immediately after three days in ambient + 80 ° C
E. Test adhesion immediately after cataplasm testing for seven days



1. Make a vertical cut approx. 5 cm (two inches) long in the length of the glue bead only.



2. Grasp the cut loose piece of glue bead firmly between the fingers and pull down at a 90° angle or more, and try to pull the glue bead off.

* 1 = After each test, the adhesive bead is tested for adhesion by manually pulling it out at an acute angle from the substrate (if necessary, first cut a small piece with a sharp knife).

After having followed the test procedure with a duration of 41 days in different circumstances, the requirement that no adhesive breakage (adhesion <95%) may occur is applicable.

Because an adhesive break is not allowed and will not occur because of this test, the cohesive strength of the adhesive bond that is used by the manufacturer can then be used as a calculation value in the structural calculations.

4.2.1 Test Procedure Adhesion in/after Harsh Conditions

We are familiar with the cohesive properties of the adhesive connection. However, it is important to determine whether long-term adhesion is possible to a substrate at all.

To determine the adhesive properties, variable under the influence of the respective substrate, the adhesion must be checked on each substrate, after a progressive environmental test, by means of a so-called quick knife test or peel test.

Method A. This test means that after 14 days of curing at 23°C (73°F) / 50% RH, the test pieces/adhesive beads is loaded by pulling it off manually at an acute angle from the substrate (if necessary, first cut a small piece with a sharp knife.

Method B. After approval of the above procedure, submerge the test pieces for 7 days under water (at room temperature). Let it dry at 23°C (73°F) / 50% RH for 2 hours and then test the test pieces/adhesive bead in the same way as described in 4.2.1.A. on adhesion.

Method C. After approval for the aforementioned tests, a third follows, whereby the wet test pieces are subsequently exposed to -30°C (22°F) for 3 days. Let it thaw at 23°C (73°F) / 50% RH for 2 hours and then test the test pieces/adhesive beads in the same way as described in 4.2.1.A. on adhesion.

Method D. After approval for the aforementioned tests, a fourth is followed, the test pieces left over subsequently being exposed to 80°C (176°F) for 3 days. Let it cool at 23°C (73°F) / 50% RH and then test the test pieces/adhesive beads after 2 hours in the same way as described in 4.2.1.A. on adhesion.

Method E. After satisfying the aforementioned four tests, a fifth, so-called cataplasm test, followed by exposing the test pieces/adhesive beads to 70°C (158°F) / 100% RH for another 7 days. The test piece is wrapped in wet cotton wool, wrapped in aluminum foil and then placed in a closed plastic bag for 7 days in an oven. Allow the test piece to dry after these 7 days at 23°C (73°F) / 50% RH and then test the test pieces/adhesive beads in the same way as described in 4.2.1.A. on adhesion.

Where the requirement applies that after the entire test procedure of 41 days in all circumstances no adhesive break (adhesion <95%) may occur. The cohesive strength of the adhesive connection can then be used as the material value. Because an adhesive break is not permitted and will not occur according to the results of this test procedure.

5. Conduct of the Study

The study was carried out according to the assessment model, as stipulated.

5.1 PART II: Tensile Test

For this type of tests TWEHA uses an aluminum pull module (on behalf of the tensile tester) bonded on a sample of the material concerned.

Besides pure strength properties of the adhesive concerned a general adhesion strength criterion is preferred to characterize the strength property of the bonded structures more realistically and adequately with two or more materials adhesion.

Advised is to test on 10 pieces/samples to obtain a realistic average.

Method F. This test means that after the harsh conditions as mentioned in 4.2.1, the 10 test pieces are tested in a universal draw / press bench with a deformation rate of 5 mm / min. for tensile test.

5.2 PART III: Peel-Adhesion Test

To determine the suitability of the adhesive system, one or more test pieces (in accordance with the sketch below) are assembled and subjected to the various sub-studies.

The test pieces are provided with one or more adhesive beads each.

The test pieces are composed according to the Instructions for Use of the bonding method to be tested.
The adhesive bead is partially cut loose, after which, in accordance with the sketch below, after the test environment described, adhesion is tested using a so-called Peel-Adhesion Test.

6. Materials used

The following materials have been tested:

- TWEHA StoneMate
- TWEHA Cleaner+
- TWEHA PreFix X-tra
- Coverlam 5.6 mm

7. Equipment used

1. Precision measuring magnifier Mitutoyo
2. Caliper Mitutoyo
3. Accelerated weathering chamber SHR
4. Wind– en water tightness cabinet SHR.
5. Hartech Testometric tension- en pressure bench M350-10kN CX
6. LabExchange Atlas Xenotest Alpha LM
7. LabExchange Freezer Kirsch Froster MED 70
8. Waterbath GFL
9. UV box
10. Heraeus Tamson oven

8. Time frame research

Research was conducted from January 2, 2025, to February 12, 2025

9. Results

PART II: Results tensile tests on Coverlam 5.6 mm

Subject:	TWEHA in-house testing structural bonding tensile strength
Job no.	100
Client	Client
Type of panel	Coverlam 5.6 mm
Type of adhesive	TWEHA StoneMate
Date bonding samples	January 2, 2025
Carried out by	MA
Date testing samples	February 12, 2025
Carried out by	ML

Results:

nr.:	glue area mm²	peak force [N]	tensile strength N/mm²	adhesive crack cohesief %	crack in substrate %	crack on substrate adhesief %	crack on module adhesief %	remarks
1	1963,5	2981	1,518	100				without TWEHA PreFix X-tra
2	1963,5	3401	1,732		100			without TWEHA PreFix X-tra
3	1963,5	3359	1,711		100			without TWEHA PreFix X-tra
4	1963,5	3207	1,633		100			without TWEHA PreFix X-tra
5	1963,5	3098	1,578	100				without TWEHA PreFix X-tra
6	1963,5	3167	1,613		100			without TWEHA PreFix X-tra
7	1963,5	3083	1,570		100			without TWEHA PreFix X-tra
8	1963,5	3261	1,661		100			without TWEHA PreFix X-tra
9	1963,5	3133	1,596		100			without TWEHA PreFix X-tra
10	1963,5	3082	1,570	100				without TWEHA PreFix X-tra

Expected lowest value after statistical analyse: 1.48 MPa

Results:

nr.:	glue area mm²	peak force [N]	tensile strength N/mm²	adhesive crack cohesief %	crack in substrate %	crack on substrate adhesief %	crack on module adhesief %	remarks
1	1963,5	3037	1,547	100				with TWEHA PreFix X-tra
2	1963,5	3359	1,711		100			with TWEHA PreFix X-tra
3	1963,5	3369	1,716		100			with TWEHA PreFix X-tra
4	1963,5	3298	1,680		100			with TWEHA PreFix X-tra
5	1963,5	3319	1,690		100			with TWEHA PreFix X-tra
6	1963,5	3327	1,694		100			with TWEHA PreFix X-tra
7	1963,5	3296	1,679		100			with TWEHA PreFix X-tra
8	1963,5	3274	1,667		100			with TWEHA PreFix X-tra
9	1963,5	3189	1,624		100			with TWEHA PreFix X-tra
10	1963,5	3156	1,607		100			with TWEHA PreFix X-tra

Expected lowest value after statistical analyse: 1.55 MPa

PART III: Results peel adhesion tests on Coverlam 5.6 mm

	Substrate	Treatment	Result				
			A	B	C	D	E
01	Grespania Coverlam 5.6 mm	without special treatment	1	1	1	1	1
02	Grespania Coverlam 5.6 mm	without special treatment	1	1	1	1	1
03	Grespania Coverlam 5.6 mm	without special treatment	1	1	1	1	1
04	Grespania Coverlam 5.6 mm	without special treatment	1	1	1	1	1
05	Grespania Coverlam 5.6 mm	without special treatment	1	1	1	1	1
06	Grespania Coverlam 5.6 mm	with TWEHA PreFix X-tra	1	1	1	1	1
07	Grespania Coverlam 5.6 mm	with TWEHA PreFix X-tra	1	1	1	1	1
09	Grespania Coverlam 5.6 mm	with TWEHA PreFix X-tra	1	1	1	1	1
09	Grespania Coverlam 5.6 mm	with TWEHA PreFix X-tra	1	1	1	1	1
10	Grespania Coverlam 5.6 mm	with TWEHA PreFix X-tra	1	1	1	1	1

Result	Description result	Qualification
1	adhesion OK	< 95% adhesive failure
2	adhesion OK	95% < x > 75% adhesive failure
3	adhesion **not** OK	75% < x > 25% adhesive failure
4	adhesion **not** OK	> 25% adhesive failure
5	adhesion **not** OK	full adhesive failure
P	adhesion **not** OK	Primer failure (n.a.)

Method	**Testing Conditions**
A	14 days curing at 23°C / 50% RH (73°F / 50% RH)
	+
B	7 days immersion in demineralized water at 23°C (73°F) drying for 2 hours at 23°C (73°F)
	+
C	3 days of storage at -30°C (22°F) drying for 2 hours at 23°C (73°F)
	+
D	3 days of storage at 80°C (176°F) drying for 2 hours at 23°C (73°F)
	+
E	7 days cataplasma at 70°C / 95% RH (158°F / 50% RH) drying for 2 hours at 23°C (73°F)

10. Conclusion

Based on the research carried out, it can be concluded that on the material Coverlam 5.6 mm a sufficiently durable adhesive connection with TWEHA StoneMate can be realized.

It should be noted that the adhesion to the substrate is more than sufficient but the result in the measurement was negatively affected by the complete collapse of the substrate, due to the tensile force occurring.

Follow the procedure of application with TWEHA Cleaner, TWEHA Tape and TWEHA StoneMate as shown in our Instructions for Use. The use of TWEHA PreFix X-tra is not necessary.

According to our tensile tests the measure giving value of the tensile strength of the adhesive on the tested samples varies from 1.57 to 1.73 MPa. Expected lowest value after statistical analyse: 1.48 MPa**.**
We recommend using the value 1 MPa in the static assessments.

TWEHA BV

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