EUROPEAN ASSESSMENT DOCUMENT

EAD 090101-00-0404

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CRUCIFORM GLAZING SUPPORT TO BE USED IN CURTAIN WALLS

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

The cruciform glazing supports and T cleats are used in combination with mullion-transom-connections in curtain walls. The load on the façade, caused by dead weight, wind pressure and wind suction, is transferred by the cruciform glazing supports and T cleats into the loadbearing structure.

Depending on the combination of T-cleats and cruciform glazing supports at different filling depths or glass thicknesses, max. loads will be determined in order to ensure the usability of the cruciform glazing supports and T cleats in the overall system. The cruciform/corner glass support is attached to the mullion and the transom.

See Annex A for drawings of the cruciform glazing supports and T cleats.

The product is not covered by a harmonized European standard.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product, as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document, shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The cruciform glazing supports and T cleats are used as part of curtain wall system, which is CE marked in accordance with EN 13830.

This EAD covers parts of curtain walling ranging from a vertical position to ±15° from the vertical.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the glazing support for the intended use of 25 years. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1 The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the assumed working life.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of the cruciform glazing support to be used in curtain walls are established in relation to the essential characteristics.

Table 1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics.

No.	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description)
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic Works Requirement 4: Safety in use			
2	Resistance of the mechanical supports to wind load	2.2.2	Level
3	Resistance of the mechanical supports to dead load	2.2.3	Level
4	Resistance to combined loads	2.2.4	Level

2.2 Methods and criteria for assessing and classification of the performance of the product in relation to essential characteristics of the product

Assessment of products' characteristics, notably, material properties, geometry and dimensions, shall be done in accordance with available specifications.

2.2.1 Reaction to fire

The cruciform glazing supports and T cleats shall be tested using the procedures test method(s) referred to in EN 13501-1 and relevant for the corresponding reaction to fire class, as described in EN 13830. The product shall be classified according to Commission Delegated Regulation (EU) No 2016/364.

The cruciform glazing supports and T cleats are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the EC Decision 96/603/EC (as amended) without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision

The class is stated in the ETA

2.2.2 Resistance to wind load

The resistance to horizontal wind load of cruciform glazing supports and T cleats is tested according to the principles in EN 16758 section 5.3.4 considering the section 5.2 (figure 1) for definition of the test specimen taking into account that the cruciform/corner glass support is attached to both the mullion and the transom, since this aspect is not covered by EN 16758. See annex B for additional test specifications. The resistance to horizontal load for pressure and suction ($F_{h,des,+}$ and $F_{h,des,-}$) is stated in the ETA.

2.2.3 Resistance to dead load

The resistance to vertical dead loads of cruciform glazing supports and T cleats is tested according to the principles in EN 16758 section 5.3.3 considering the section 5.2 (figure 1) for definition of the test specimen taking into account that the cruciform/corner glass support is attached to both the mullion and the transom, since this aspect is not covered by EN 16758. See annex B for additional test specifications. The resistance under dead load is given for different deflections preventing a contact between glass support and infill panel.

The resistance to dead load $F_{v,des}$ for the different directions is stated in the ETA.

2.2.4 Resistance to combined loads

The resistance of the cruciform glass supports and T-cleats under combined loading (wind and dead load) is determined according to section 6.2 method B of EN 16758.

The resistance for horizontal loads (wind) are combined with different load percentages of vertical load. The load percentages are given in the section 6.2 method B of EN 16758.

The wind load is combined with 0% and 100% of dead load. The load levels are given in EN 16758.

The resistance to wind load under combined loading in the direction of dead load is stated in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is Decision 1996/580/EC as amended by Decision 2001/596/EC.

The applicable AVCP system is **3** for any use except for uses subject to regulations on reaction to fire.

For uses subject to regulations on reaction to fire the applicable AVCP systems regarding reaction to fire are **1** or **3** depending on the conditions defined in the said Decision.

3.2 Tasks of the manufacturer

The corner stones of the actions to be undertaken by the manufacturer of glazing support in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; corner stones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method *(refer to 2.2 or 3.4)*	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC)					
1	Reaction to fire of components	2.2.1	2.2.1	one	Once every two years
2	Instructions on e.g.: - type and quality of all materials and components incorporated in the kit - overall dimensions of prefabricated elements - tolerances of geometry - surface treatments when relevant - markings for correct position and installation in the works - packaging and transport protection	According to control plan	According to control plan	According to control plan	According to control plan

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance of the cruciform glazing support to be used in curtain walls are laid down in Table 3.

The intervention of the notified body under AVCP system 1 is only necessary for reaction to fire for products for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material).

In this case the cornerstones of the tasks to be undertaken by the notified body under AVCP system 1 are laid down in Table 3.

Table 3: Tasks for the notified body;

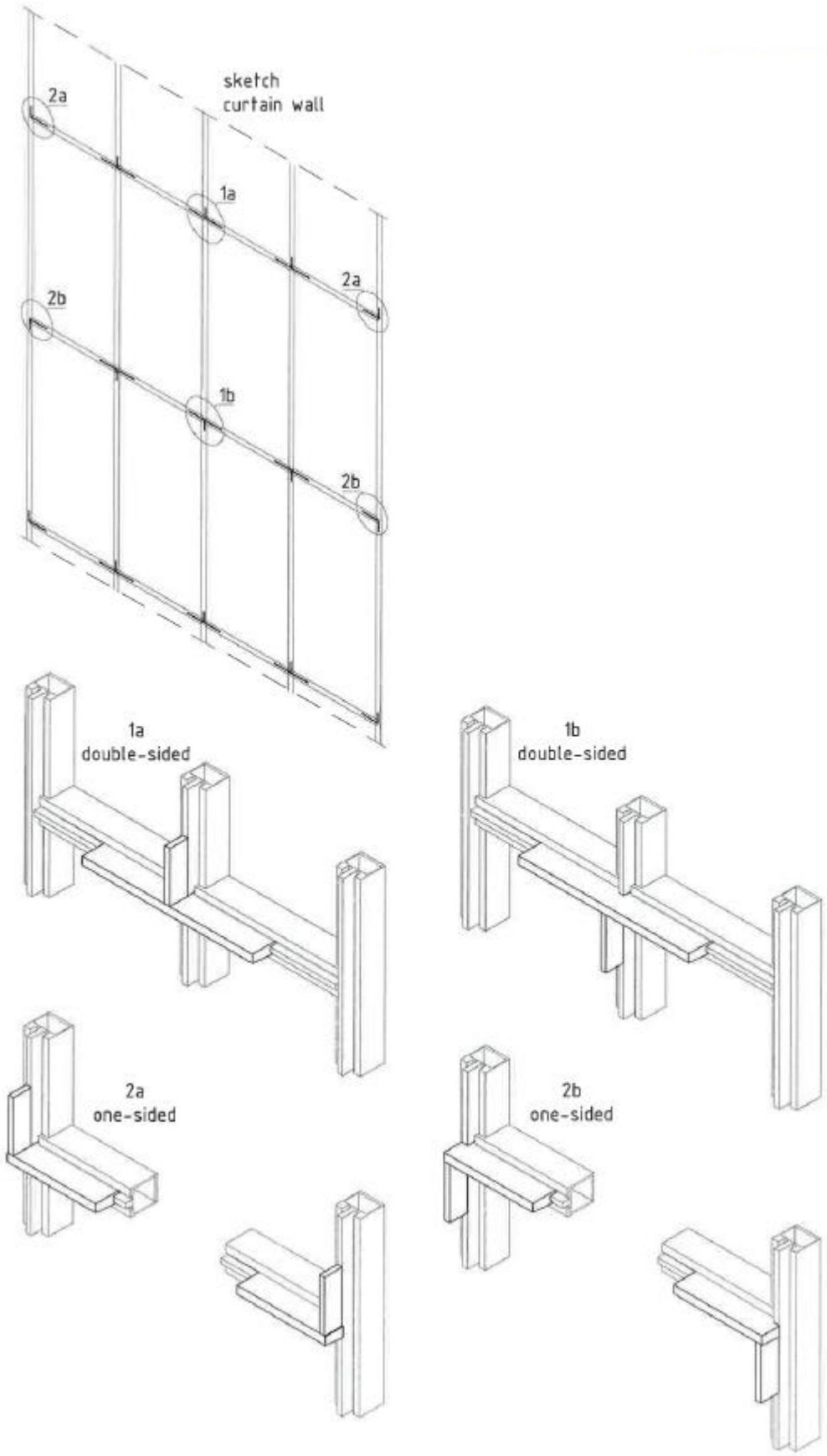
Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control				
Initial inspection of the manufacturing plant and of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardants.	According to control plan	According to control plan	According to control plan	According to control plan
Continuous surveillance, assessment and evaluation of factory production control				
Continuous surveillance, assessment and evaluation of the factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardants.	According to control plan	According to control plan	According to control plan	According to control plan

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EN13830	Curtain walling – Product standard
EN13501-1	Fire classification of construction products and building elements - Part 1: Classification using test data from fire reaction to fire tests
EN 16758 December 2016	Curtain walling - Determination of the strength of sheared connections - Test method and requirements

ANNEX A ILLUSTRATIONS OF THE CONSTRUCTION PRODUCT



ANNEX B TEST SPECIFICATIONS

General

According to EN 16758 the following points are to be respected during the experimental procedure of the component tests:

- The component tests are carried out at room temperature
- The component tests are carried out as pure loading tests without insertion of glass panels
- The load is increased with a test speed of 5mm/min

The test sample shall represent the original construction. Each component is tested on a minimum of 5 samples.
Following load direction should be tested:

1. Dead load (vertical load)
2. Wind load (wind suction and pressure, horizontal loads)
3. Interaction of dead load and wind load

B.1 Dead load

B.1.1 Specimen

In addition to the prescriptions of EN 16758 section 5.3.3 the test specimen tested with a load eccentricity (figure 9). To can handle different glass thickness, the choice of specimen for the cruciform glass supports shall respect the following criteria. The linear load is applied to the glass supports with a minimum and maximum load eccentricity.

The cruciform glass support concerned by this document consist of a vertical and a horizontal part, which are connected to each other and fixed to the transom and the mullion. The different glass supports for different glass thicknesses shall be taken into account in the tests by defining governing load eccentricities.

The eccentricity shall be determined as follows:

$$e=d+\frac{t}{2}$$

d = thickness of the joint

t/2= center of the glass/glazing block

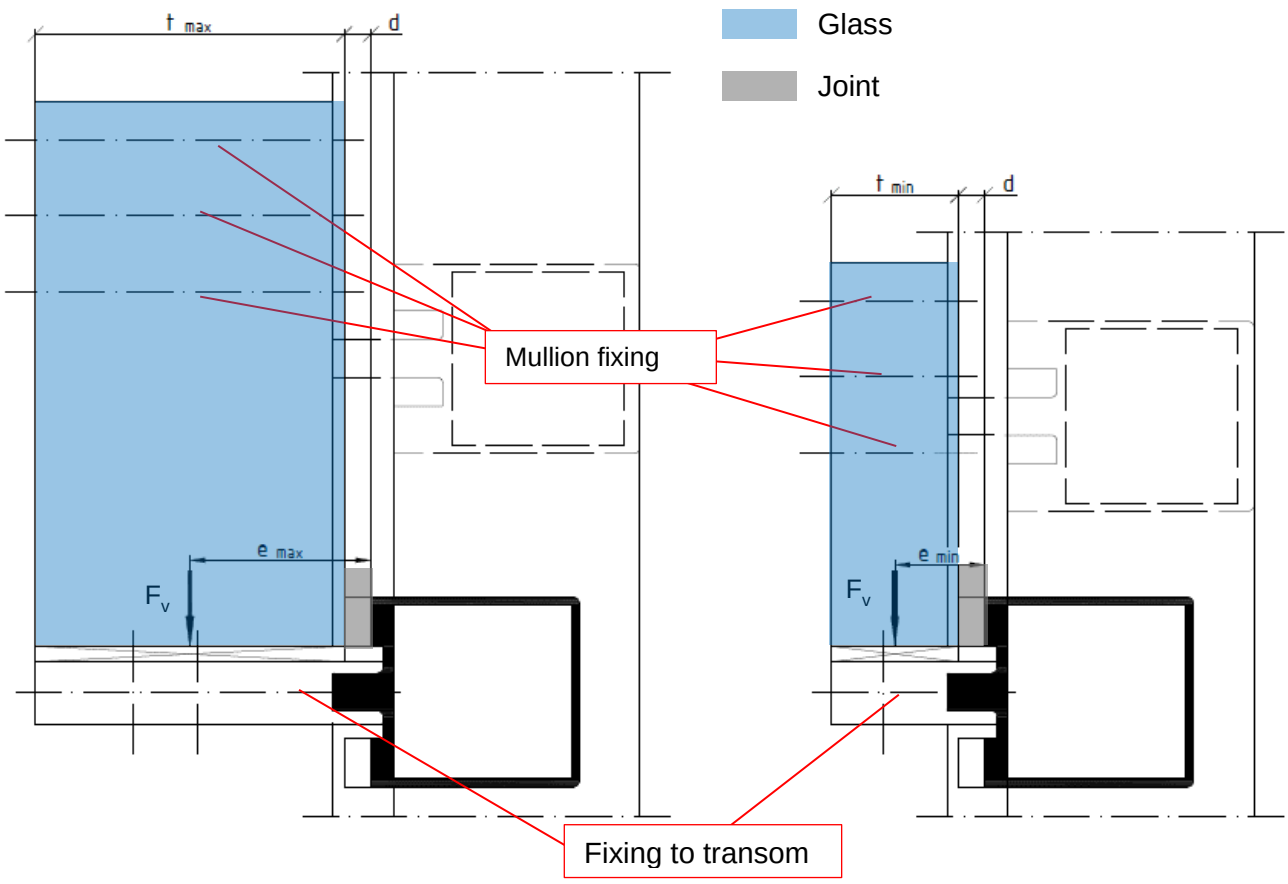


Figure B.1 Eccentricities for minimum and maximum glass thickness (cruciform glazing support)

B.1.2 Deflection measurement

The design load for the serviceability limit state shall be determined for a defined maximum deflection of the horizontal part of the cruciform glass carrier. It is evaluated with the mean value under a defined deflection limit for each component. The deflection limit shall prevent contact between adjacent components of the kit and is to be defined in the ETA.

Transducers for the measurement of the deflection shall be positioned at the point of maximum expected deformation. It shall take into account the deflection of the transom, the rotation of the transom and the deflection of the horizontal part of the glass support.

In order to evaluate the maximum deflection of the cruciform glass support the transducers are to be placed according to figure B.2.

If the point of maximum deflection cannot be determined with certainty (e.g. due to experience with the system), the deflection behavior shall be determined by adequate pre-testing.

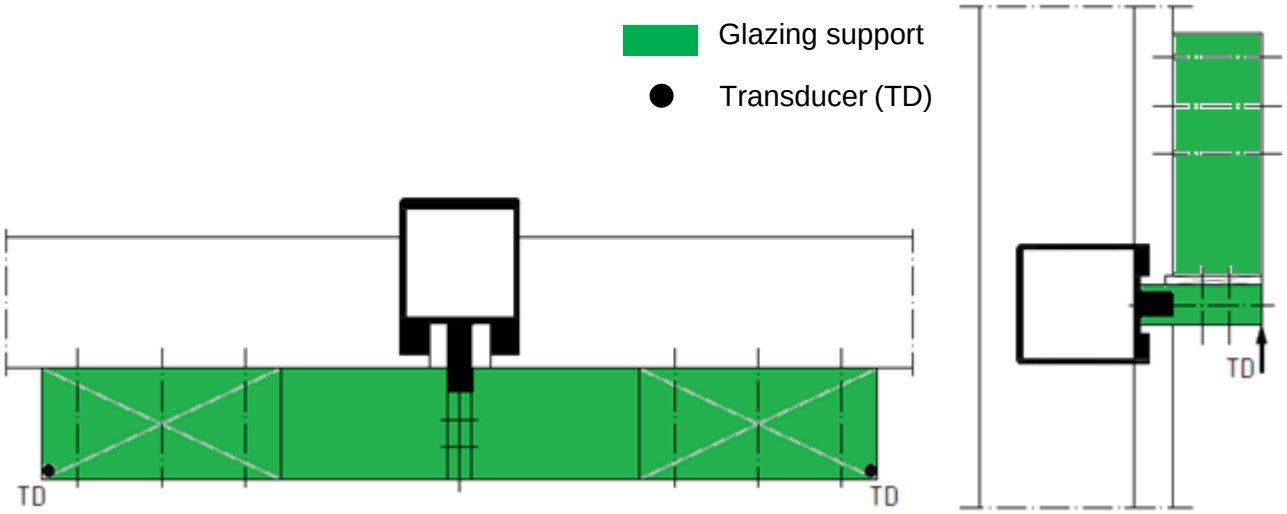


Figure B.2 Position of the transducers

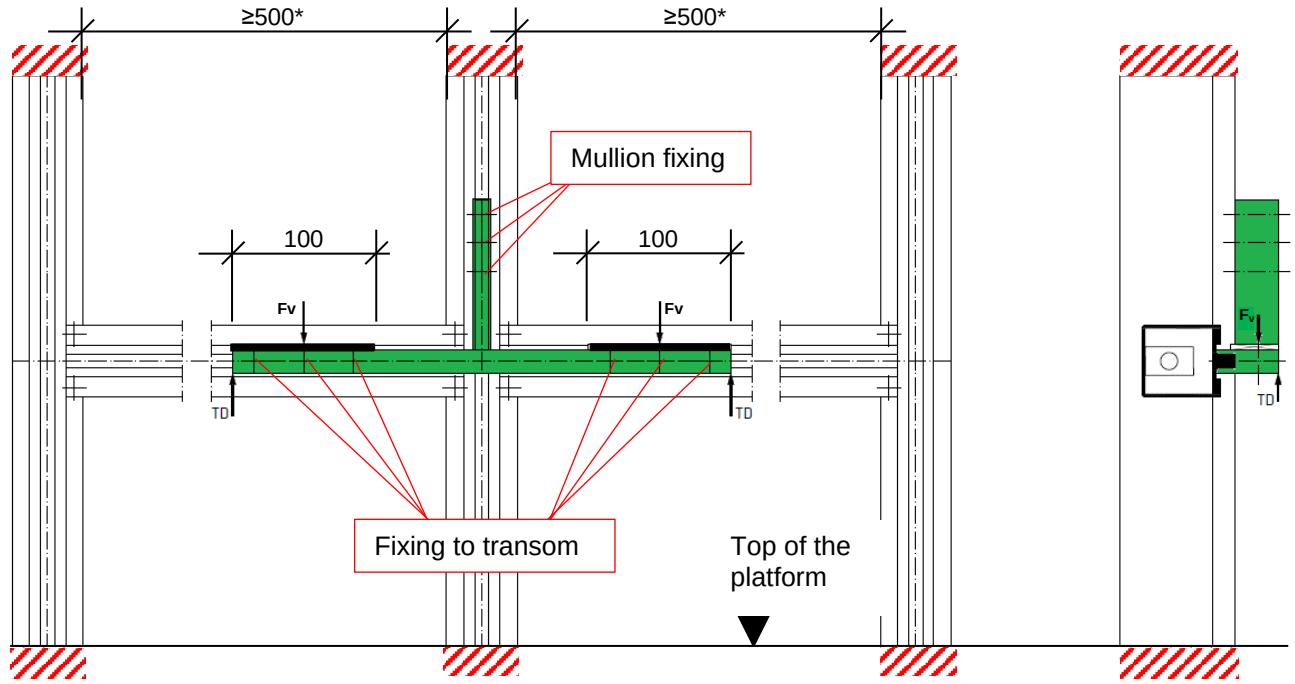
B.1.3 Cruciform glazing support (double-sided)

Double-sided cruciform glass supports are tested on double H specimen according to figure 3. The tested specimen displays the original construction and respect all system influences. The fixing of the specimen to the test platform shall not prevent any deformation or rotation of the specimen.

The dead load is applied as a linear load on the horizontal part of the glass support, taking into account the different load eccentricities described in B.1.1. The length of the linear load is selected according to the length of the glass block (normally 100mm). The load is applied to the test specimen at the position of the glass block. Figure B.3 shows an exemplary presentation of the point of application of the dead load. The linear load represents the dead load of the infill element and is applied over the width of the original glass block. The distance to the mullion shall be chosen in accordance with the manufacturers requirements for installation of the setting blocks.

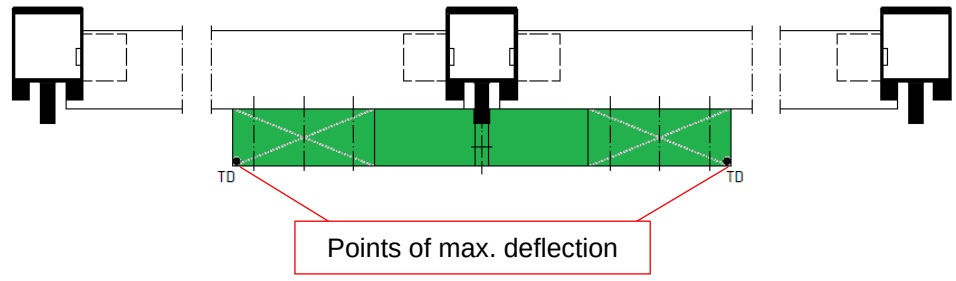
The transducers shown in figure B.3 are located at the point of maximum deflection for the given system as described in B.1.2.

Front view test set-up:



*dimensions according to the H test samples in EN 16758

Top view test set-up:



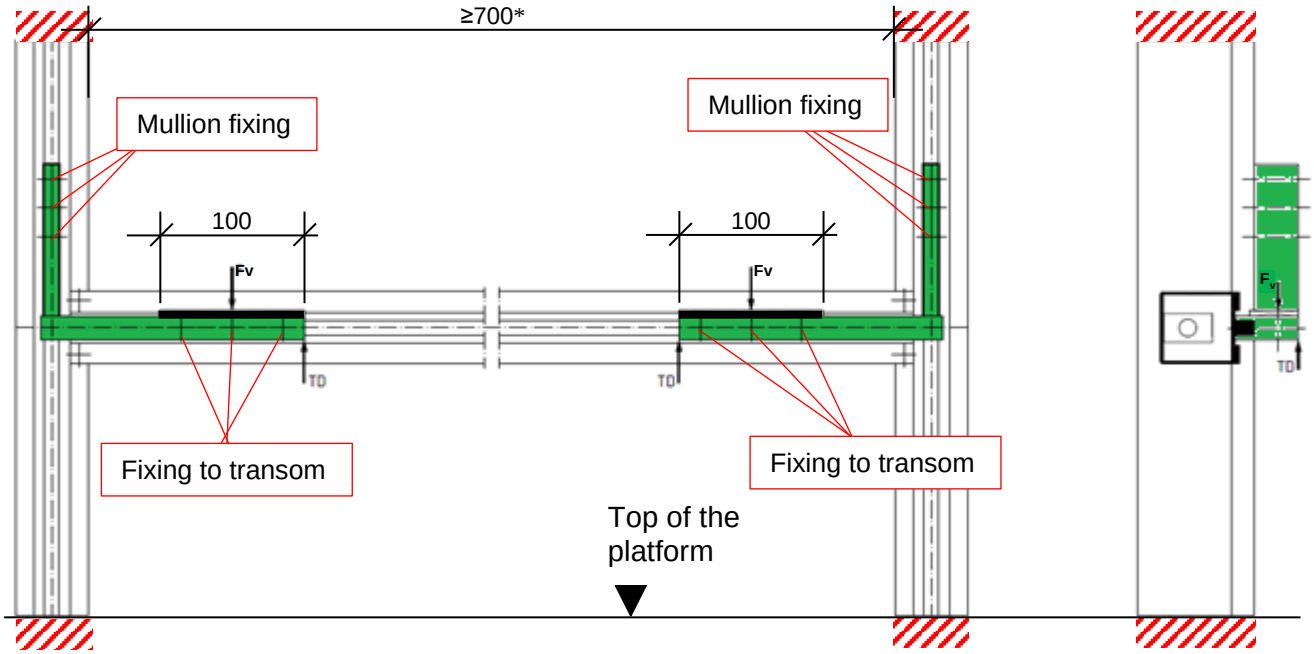
Glazing support Mounting Transducer (TD)

Figure B.3 Exemplary presentation of test setup and position of the load (cruciform glazing support, double-sided)

B.1.4 Cruciform glazing support (one-sided)

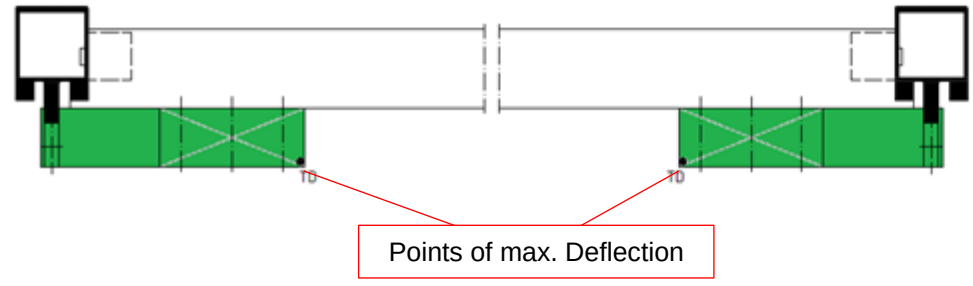
The one-sided cruciform glass supports are tested on H specimen according to the exemplary presentation shown in figure B.4. The test set-up corresponds to the one for double sided glass supports. The transducers shown in figure B.4 are located at the point of maximum deflection for the given system as described in B.1.2.

Front view test set-up:



*dimensions according to the H test samples in EN 16758

Top view test set-up:



Glazing support Mounting Transducer (TD)

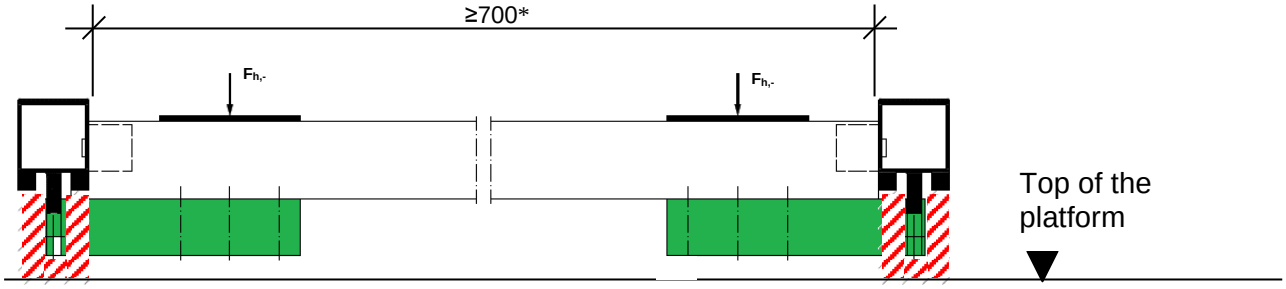
Figure B.4 Exemplary presentation of test setup and position of the load (cruciform glazing support, one-sided)

B.2 Wind load

In order to determine the resistance against wind load, the cruciform glazing supports are tested under horizontal loads. The tests are realized on the same H specimen which are defined in figure B.4 and according to figure 4 in the section 5.2 of EN 16758. The dimensions are to be selected as in figure B.4. The specimen is fixed on the top of the test platform. The specimen shall represent the original construction. Special attention has to be drawn on the combination of T-connector and cruciform glass support.

Figure B.5 and figure B.6 show the test setups for wind suction figure B.5) and wind pressure (figure B.6). To handle the load introduction easier the glass support is oriented downwards. In the exemplary presentation in figure B.5 the load which is introduce to the test specimen should simulate the horizontal load in the direction of wind. The load shall be applied over the width of the transom. The fixing of the specimen to the test platform shall not prevent any deformations or rotation of the specimen.

Front view test set-up:



*dimensions according to the H test samples in EN 16758

Top view test set-up:

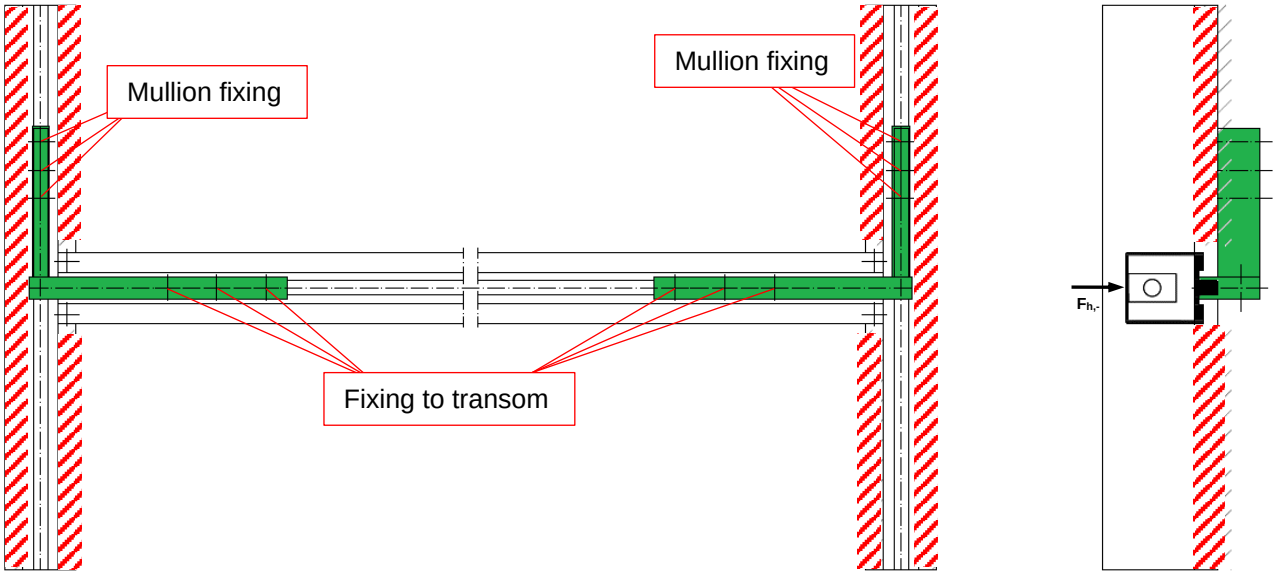
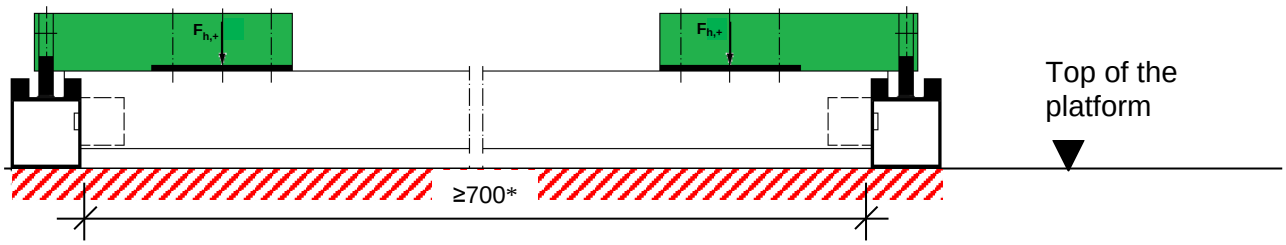


Figure B.5 Test setup and position of the load (wind suction)

Front view test set-up:



Top view test set-up:

*dimensions according to the H test samples in EN 16758

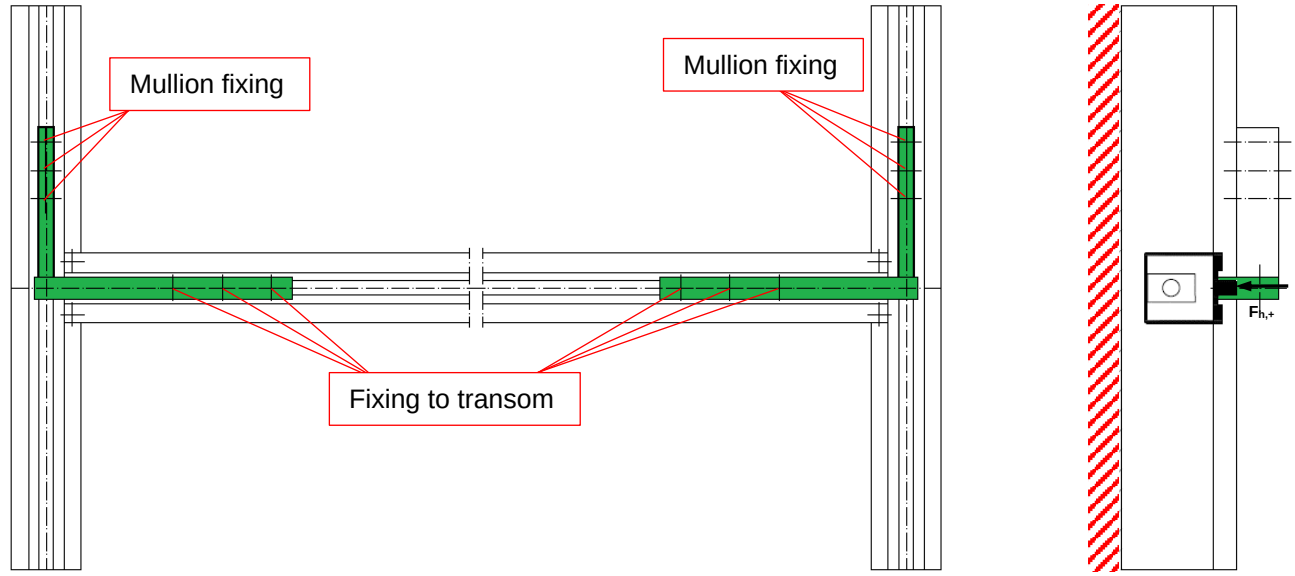


Figure B.6 Test setup and position of the load (wind pressure)

B.3 Combined loads, dead load – wind load

In order to determine the resistance of the cruciform glass support under combined loads for wind and dead load, the double-sided support is fixed to a double H test sample as shown in figure B.7. The sample is mounted on the test platform. The load is applied by a U-shaped steel-construction which permits to apply two different loads in different load directions.

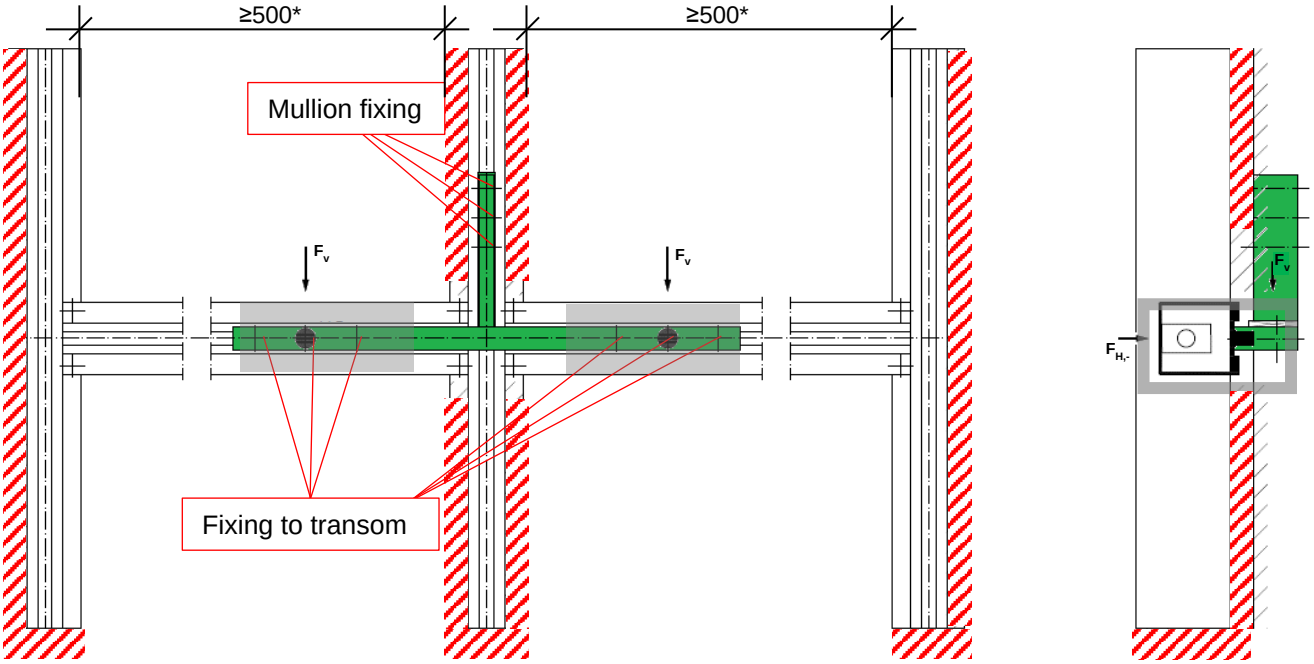
The maximum resistance under dead load has to be determined according to section B.1. The maximum load capacity (5% fractile with 75% confidence level) is evaluated according to Annex D of EN 1990. To handle the introduction of two loads easier the test glass supports oriented downwards (see in the following figure B7 and B8). This dead load is applied in the horizontal direction by one test cylinder and held constant during the tests.

The second test cylinder applies vertical loads on the glass support and transom in direction of the wind load.

As a result of the test, the load resistance in ultimate limit state in direction of wind under simultaneously applied maximum dead load is determined. The test does not take into account the deflection of the glass support, the transom or the rotation of the transom. The serviceability limit state has to be tested in each case according to section B.1.

In accordance to EN 16758 section 6.2 the tests under combined loads can be determined for different values of dead load (0%, 20%, 40%, 60%, 80% or 100%). The minimum test procedure shall cover 0% and 100% dead load.

Front view test set-up:



Top view test set-up:

*dimensions taking into account to the H test samples in EN 16758

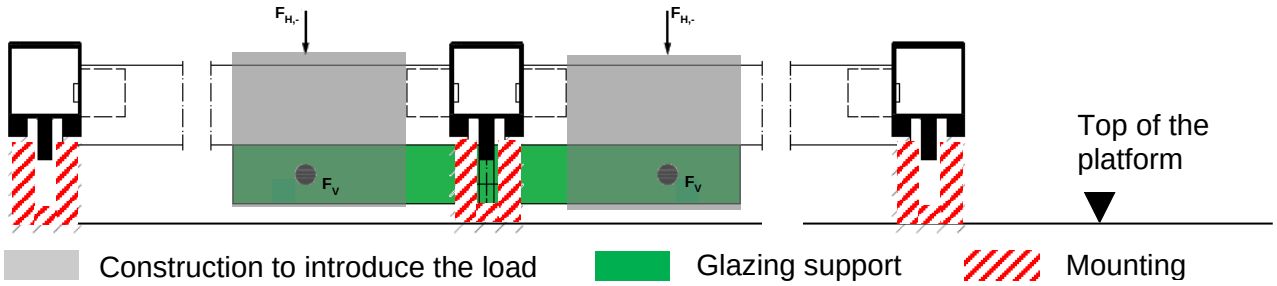
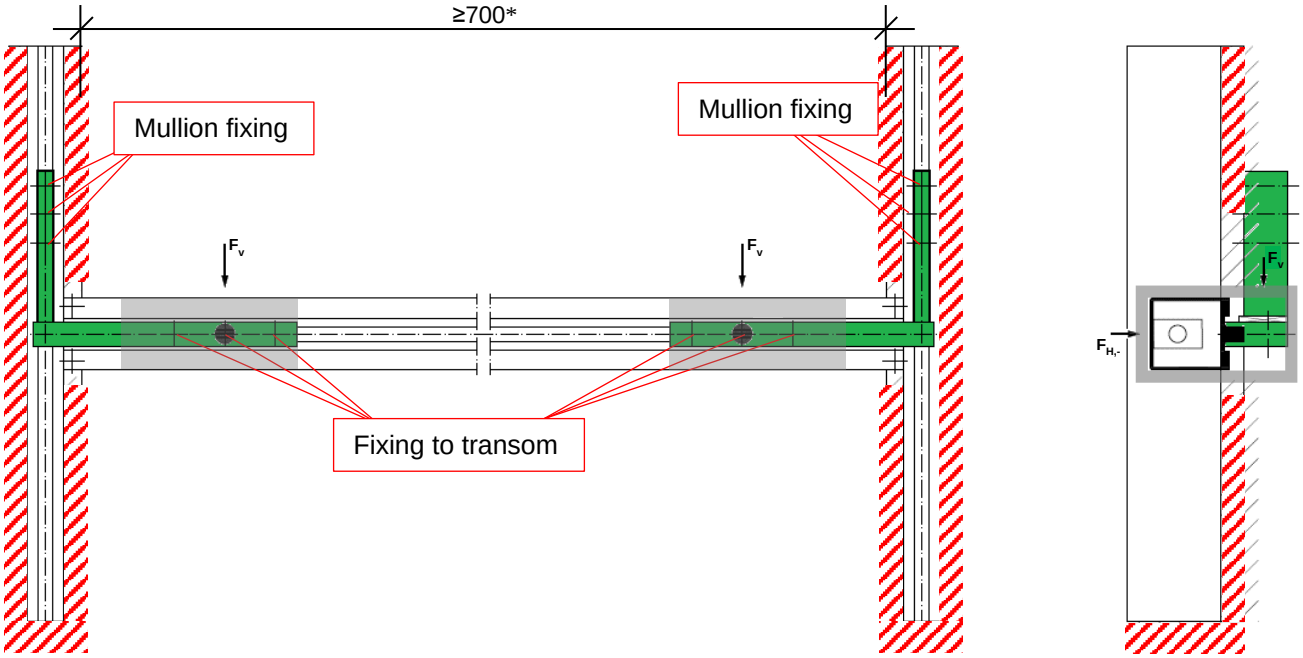


Figure B.7 Test setup and applied load direction (cruciform glazing support, double-sided combined load)

The one-sided cruciform glass supports are tested on H specimen according to figure B.8. The test set-up corresponds to the one for double sided glass supports.

Top view test set-up:



Front view test set-up:

*dimensions taking into account to the H test samples in EN 16758

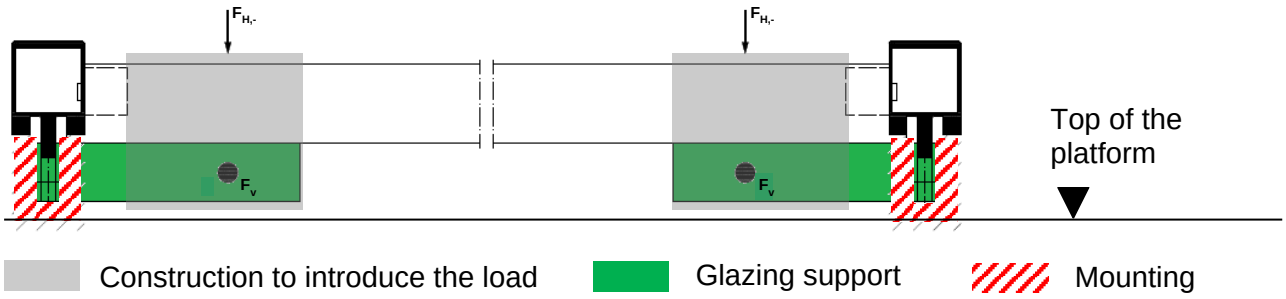


Figure B.8 Test setup and applied load directions (cruciform glazing support, one-sided combined loads)

B.4 Statistical Evaluation

The statistical evaluation of the results is realized according to EN 1990 Annex D. The maximum characteristic load capacity of the components is calculated under the assumption of a Gaussian distribution.

There is a difference between the determination of the load bearing capacity for ultimate limit state and the determination of the service load under a defined deformation (serviceability limit state).

In case of a criterion of load capacity the evaluation of the load capacity (ultimate limit state) is realized on basis of the 5% fractile with a confidence level of 75% for the given characteristic value.

In case of a verification of serviceability (e.g. limitation of deformation as a result of tightness or appearance of the structure) the evaluation can be based on the mean value of the rest results.

$$F_c=F_m-k_n \cdot s$$

Where:

F_C = the characteristic breaking load giving 75% confidence that 95% of the test results will be higher than this value

F_m = the mean value load

k_n = the variable as a function of the number of test specimen for 5% with a 75% confidence level when the population standard deviation is unknown (see table B.1)

s = the standard deviation

Table B.1 The variable k_n as a function of the number of test specimen (see EN 1990 Eurocode, Table D1, V_x unknown)

No. of test specimen	**3**	**4**	**5**	**6**	**8**	**10**	**20**	**30**	**∞**
Variable k_n	3,37	2,63	2,33	2,18	2,00	1,92	1,76	1,73	1,64