Hygrothermal performance of building components and building elements — Determination of the resistance of external wall systems to driving rain under pulsating air pressure

The European Standard EN 12865:2001 has the status of a British Standard

ICS 91.120.30

National foreword

This British Standard is the official English language version of EN 12865:2001.

The UK participation in its preparation was entrusted by Technical Committee B/540, Energy performance of materials, components and buildings, to Subcommittee B/540/1, European Standards for thermal insulation, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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This British Standard, having been prepared under the direction of the Sector Committee for Building and Civil Engineering, was published under the authority of the Standards Committee and comes into effect on 15 May 2001

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 11 and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 36062 8

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12865

March 2001

ICS 91.120.30

English version

Hygrothermal performance of building components and building elements - Determination of the resistance of external wall systems to driving rain under pulsating air pressure

Performance hygrothermique des composants et parois de bâtiments - Détermination de la résistance à la pluie battante des systèmes de murs extérieurs sous pression d'air pulsatoire

Wärme- und feuchteschutztechnisches Verhaltens von Bauteilen - Bestimmung des Widerstandes des Außenwandsystems gegen Schlagregen bei pulsierendem Luftdruck

This European Standard was approved by CEN on 29 December 2000.

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Ref. No. EN 12865:2001 E

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 89 "Thermal performance of buildings and building components", the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2001, and conflicting national standards shall be withdrawn at the latest by September 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This standard is one of a series of standards which specify test methods for the thermal and moisture related properties of buildings, building components, building products and building materials.

Annex A is informative.

Introduction

Driving rain is often the cause of building damage due to the penetration of wind driven rain into or through external wall elements. The amount of driving rain impinging on a local part of an external wall surface depends on the rainfall and wind speed occurring simultaneously, the exposure of the building and the architectural / structural details of the surface. National standards define areas with different classes of driving rain severity which may be used to determine the protection needed against driving rain.

Protection can be achieved by measures such as:

a) architectural / structural design to reduce the amount of driving rain (e.g. roof overhangs);
b) ventilated or unventilated air space behind cladding (any water penetrating the cladding flows down on the internal face of the cladding and is drained out at specified openings; an air flow in a ventilated air space due to stack effects accelerates the drying);
c) rendering on external wall surfaces with appropriate properties to absorb or repel the water during driving rain and allow drying during the following drying period;
d) proper detailing to prevent water ingress around openings;
e) providing a defined water tightness of the wall element including existing joints so as to limit water penetration to an acceptable level.

This standard specifies a test method to determine the resistance of wall elements to driving rain, thus mainly covering measure e).

The specified test conditions, with pulsating air pressure difference, simulate in a simplified way the dynamic nature of rain and wind pressure against a wall.

Test methods for the determination of the resistance to driving rain under static air pressure may lead to different results.

This standard is intended to be used by product specifications, except where specific products have properties which make application of this standard difficult.

1 Scope

This standard specifies a general method for assessing the driving rain resistance of wall systems by determining the water tightness of wall systems or part of wall systems under pulsating air pressure.

2 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

2.1
driving rain resistance
ability of the test specimen to resist water penetration under the conditions of the test

2.2
water penetration
water continuously or repeatedly reaching the inside surface of the test specimen or parts of the specimen not designed to be wetted or where the water is not drained out

2.3
pulsating air pressure difference
air pressure difference across the specimen alternating periodically between zero and a specified higher level

2.4
limit of water tightness
maximum pulsating air pressure difference, in Pa, for which water penetration does not occur during the test

2.5
water absorption
mass of absorbed water per area, in kg/m^2

3 Principle

A test specimen is fitted into the driving rain test apparatus, the external surface of the test specimen is sprayed continuously with water at a specified rate while the pulsating air pressure difference is increased in specified steps. The time of water penetration, if any, the maximum air pressure difference applied and the location of any penetrations are noted.

4 Apparatus

The driving rain test apparatus shall include:

a) chamber with an adjustable opening to which the test specimen is fitted;

b) means of providing a controlled differential air pressure across the test specimen with a control uncertainty of ± 5 %;

NOTE 1 The control should be able to keep the pulsating pressure difference within the above mentioned accuracy even when the air permeability varies during the test due to the water film on the surface and the water absorbed by the test specimen.

c) device able to apply rapid controlled changes of the differential air pressure operating between defined limits (see clause 6.2 and Figure 1 for the sequence of a typical pressure pulse);

d) spraying system applying a continuous film of water all over the surface of the test specimen;

The applied amount of water consists of two parts:
- run-off water, 1,2 l/(m·min), evenly distributed at the top of the test specimen;
- driving rain, 1,5 l/(m^2 ·min), evenly distributed over the external surface of the test specimen.

NOTE 2 A spraying device, usually calibrated in litres per minute, which complies with this requirement is shown in annex A.

The distribution of driving rain can be controlled using driving rain gauges mounted on a panel. The height and width of the gauges shall not exceed 200 mm. The deviation from nominal values shall not exceed 0,3 l/(m·min) for run off water and 0,5 l/(m^2·min) for driving rain.

e) devices to measure the amount of supplied water to an accuracy of ± 10 %;

f) means of measuring the differential air pressure between the two faces of the test specimen to an accuracy of ± 5 %;

g) a supply of water which is clean enough to ensure that all nozzles spray correctly;

NOTE 3 It may be necessary to use demineralized or deionised water to prevent clogging of nozzles.

h) scale or any weighing device able to determine the mass of the test specimen to an accuracy of at least ± 0,1 %.

5 Test specimens

5.1 Dimensions of the test specimen

The dimensions of the test specimen shall be as specified by the relevant product specification. In the absence of such a specification, the dimensions of the test specimens shall be as large as necessary to be representative of the intended use, but not less than:

width 1200 mm
height 2400 mm

The joints of modules in the test specimen shall be representative, e.g. the same length per square metre as in reality.

5.2 Number of test specimens

The number of test specimens shall be as required by the relevant product specification or, in its absence, as agreed between the parties.

NOTE Normally one test specimen is sufficient.

5.3 Preparation of the test specimen

The test specimen shall be representative of the intended use and constructed according to the client's specification. The test specimen may be built in a frame, which does not absorb water, to facilitate transport and fitting to the opening of the driving rain test apparatus. The joint between test specimen and frame shall be sealed, but in a way not preventing the free drainage of water.

If a frame is used, it shall be sufficient to withstand the pressures applied during the test without deflecting to an extent to influence the test results. The frame shall be prepared and installed so that any water penetration shall be readily detectable.

The test specimen shall be fixed plumb, level, square and without visible twists or bends induced by the fixing.

5.4 Conditioning of the test specimen

Conditioning, including drying, curing etc. of the specimen shall be according to the relevant product specification or, in its absence, as agreed between the parties.

6 Procedure

6.1 Test conditions

The test shall be carried out at a temperature of (23 ± 5) °C.

6.2 Test procedure

Fit the test specimen to the opening of the apparatus. Spray water on the specimen at the specified rate and, after an initial period with no pressure difference, apply the pulsating air pressure difference steps and the time intervals according to Table 1. Each pressure pulse consists of four stages: a rising pressure stage of (3 ± 1) s, a maximum pressure stage of (5 ± 1) s, a falling pressure stage of (2 ±1) s and a zero pressure stage of (5 ± 1) s. The total duration of a pulse shall be (15 ± 2) s. The test procedure is shown also graphically in Figure 1. Two test procedures are defined, procedure A for qualitative short time testing and procedure B for quantitative testing where water absorbed by the test specimen or penetrating the test specimen during the test has to be determined.

Table 1 - Test procedures

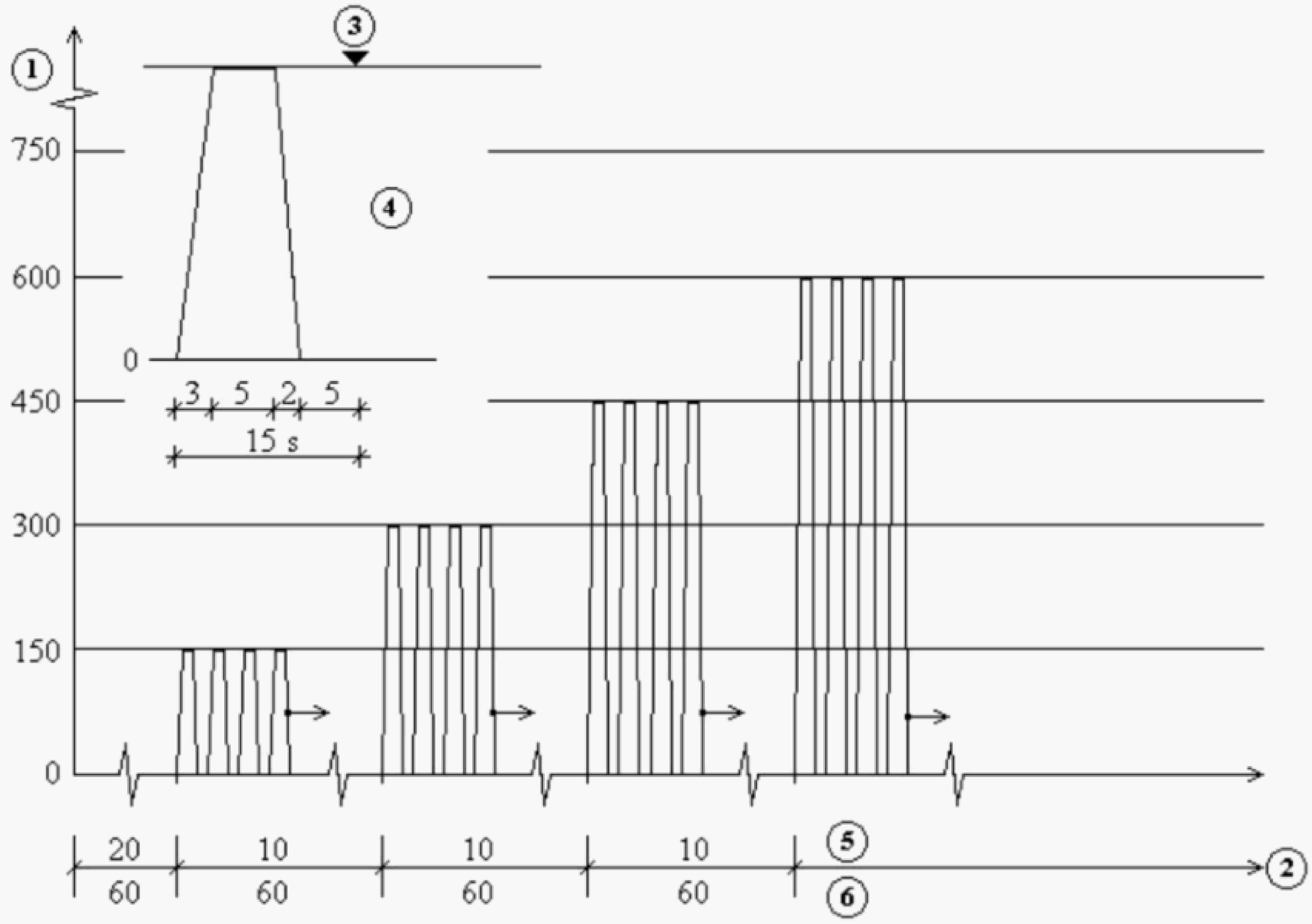
	Procedure A		Procedure B	
Pressure difference Pa	**Time interval** min	**Total time at end of steps** min	**Time interval** min	**Total time at end of steps** min
0	20	20	60	60
0 to 150	10	30	60	120
0 to 300	10	40	60	180
0 to 450	10	50	60	240
0 to 600	10	60	60	300
600 + i · 150 i= 1,2,3,…n	10	60 + i · 10	60	300 + i · 60

Record the temperature of the spraying water before and after the test, the air temperature and the relative humidity of the laboratory during the test.

Observe the surface of the test specimen and note the time, the maximum air pressure difference when water penetration occurs and the location of the penetration areas.

Stop the test when water penetration occurs. Note the limit of water tightness in Pascals.

If required the water absorbed by the test specimen during the test shall be determined by weighing the test specimen before and after the exposure to driving rain. The mass of the test specimen after the test shall be determined after the test specimen has "drained" for a period of (10 ± 2) min at normal laboratory conditions.



Key

1 Air pressure, in Pa
2 Time, in minutes
3 Maximum
4 Typical pulse
5 Procedure A
6 Procedure B

Figure 1 - Schematic test procedure

7 Expression of results

The test result is the limit of water tightness expressed in Pascals. If more than one test has been made, the result is the lowest limit of water tightness. It shall be expressed as x_A or x_B where x is the air pressure difference in Pascals (e.g. 300_A).

NOTE If required, the water absorption can be calculated using equation (1).

$$w_A = (m_1 - m_0) / A \qquad (1)$$

where

- w_A is the mass of absorbed water per area, in kg/m²;
- m_0 is the initial mass of the test specimen, in kilograms, including the frame if used;
- m_1 is the mass of the test specimen after the test, in kilograms, including the frame if used;
- A is the area of the test specimen, in square metres.

8 Accuracy

The error of the pulsating pressure difference is expected to be less than ± 8 %.

> NOTE This is based on the assumption that the errors given in clause 4 b) (5 %) and clause 4 f) (± 5 %) are non-correlated errors. The square root of the sum of the squares of these errors is less than 8 %.

The influence of the errors in the applied amount of water and water distribution given in clause 4 d) is not known.

According to clause 6 this method gives the limit of water tightness in steps of 150 Pa. Although the influence of all errors given in clause 4 is not known, the overall error in limit of water tightness is expected to be less than one step.

9 Test report

The test report shall contain the following:

a) reference to this standard;

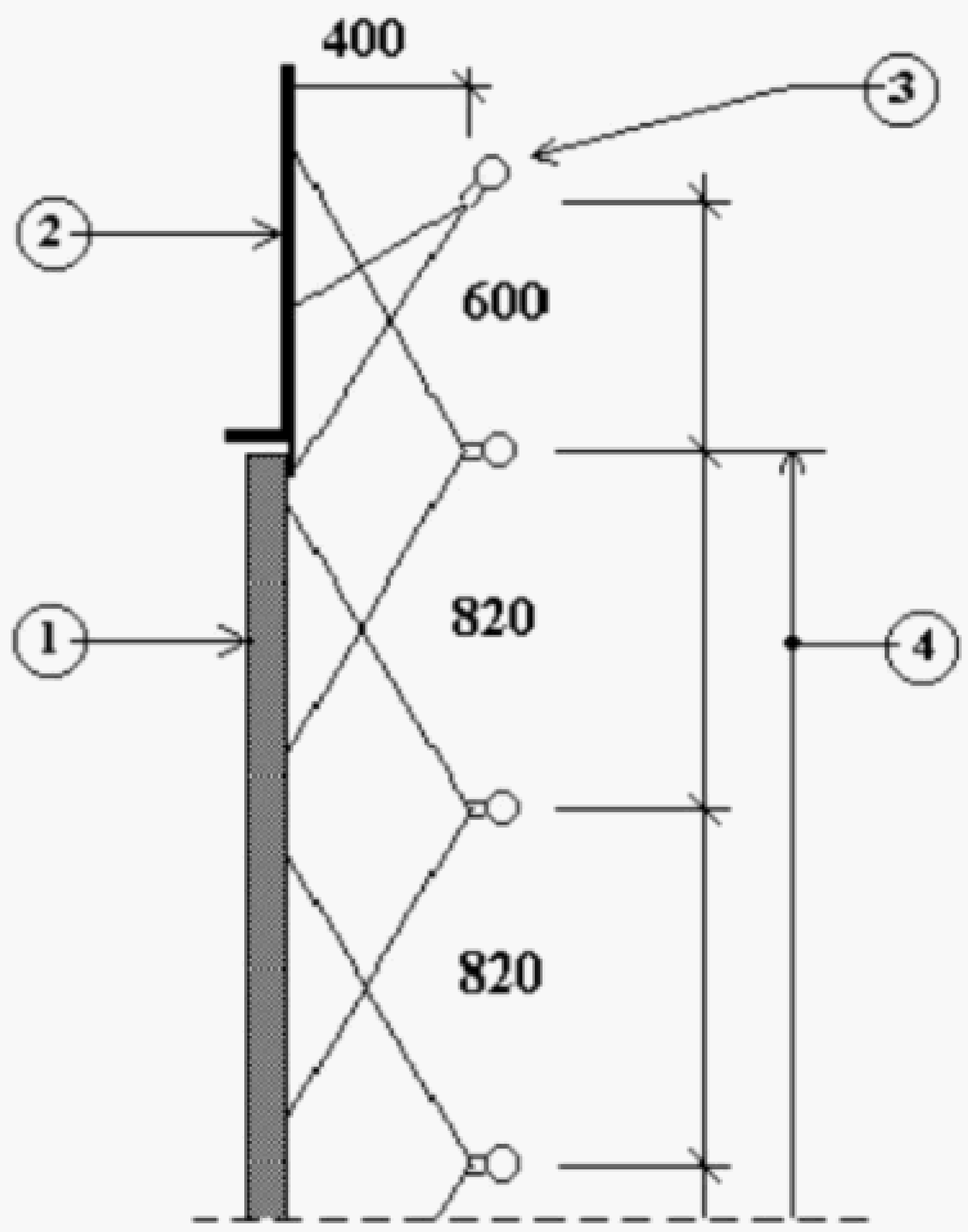
b) product identification:
- construction details of the test specimen; - relevant properties of the materials used;
- details of the frame if used and the sealing;
- dimensions of the test specimen and details of mounting in the apparatus;
- other information as appropriate;

c) test procedure:
- sampling;
- conditioning;
- information about the apparatus and the water spraying device used;
- test condition (air temperature, relative humidity, water temperature at the beginning and the end of the test);
- procedure used (A or B);
- any deviations from clauses 5 and 6;
- date of testing;
- general information relating to the test;
- the name of the test institution;
- the identity of the technician;

d) results:
- limit of water tightness, in Pa;
- a view of the internal surface of the test specimen showing the water penetration area and the time it occurred for each test specimen;
- if required the value of the absorbed water, in kilograms per square metre, rounded to the nearest 0,1 kg/m^2.

Annex A (informative)
Example of water spraying system

Dimensions in millimetres



Key
1 Specimen
2 Apparatus or surrounding frame
3 One row of wide angle flat spray nozzles, spaced horizontally at equal distances to give 0,5 l/(m·min) extra run-off water
4 Grid of full circular cone nozzles, spray angle 120°, spaced horizontally and vertically at equal distances of 820 mm to give 1,5 l/(m²·min) driving rain

Figure A.1 - Example of a water spraying system

Alternative arrangements from that shown in Figure A.1 may be used. It should however provide an approximately continuous film of water over the test specimen surface.

For the grid shown in Figure A.1 the flow of water required for each nozzle is 1 l/min. To achieve an acceptable distribution the nozzles should have a spray angle of 120° and a distance of 0,4 m from the surface of the test specimen.

The driving rain nozzles in Figure A.1 give an amount of run-off water at the top of the specimen of approximately 0,7 l/(m.min). To achieve a total amount of run off water of 1,2 l/(m.min) there is an extra row of wide angle flat spray nozzles at the top giving 0,5 l/(m.min). If the nozzles are spaced horizontally at same distance as the driving rain nozzles, the water required for each nozzle is 0,4 l/min.

To maintain acceptable water distribution it might be necessary to clean the spraying nozzles before each test.

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