BRITISH STANDARD

BS EN
12444:2001

Industrial, commercial and garage doors and gates — Resistance to wind load —Testing and calculation

The European Standard EN 12444:2000 has the status of a British Standard

ICS 91.060.50

National foreword

This British Standard is the official English language version of EN 12444:2000.

The UK participation in its preparation was entrusted by Technical Committee B/538, Doors, windows, shutters, hardware and curtain walling, to Subcommittee B/538/5, Industrial, commercial and garage doors and gates, 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.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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Compliance with a British Standard does not of itself confer immunity from legal obligations.

Further information

Users of this standard are informed that the UK submitted a vote of disapproval on the final voting stage of the draft EN for the following reasons:

1) The Standard does not indicate how to relate the results of testing to the wind load classifications given in EN 12424.

2) EN 12424 identifies wind load classes under which no permanent deformation of the door or its components that could influence the function and safety performance of the door is permitted. Beyond that point, the door is required to stay in place, even permanently distorted, under an additional 25% wind load above the classification load. EN 12444 does not indicate how to verify conformity to this requirement.

3) EN 12444 does not indicate how to apply the safety factors given in EN 12604 to cover the transfer of test results or calculated results (which have different factors) into classifications.

4) The wording of 9.2.2 is not clear and attempts are being made to have the clause rewritten as follows:

"When the product is exposed to wind pressures up to a required classification level, the seals between moving parts, such as those located on the perimeters of door panels, may be breached. Where this occurs, seals shall not be physically damaged to prevent compliance with achieved classifications for other characteristics such as air permeability, water penetration or thermal resistance."

5) The issues outlined in 1, 2 and 3 are being considered in the course of the preparation of the product standard, EN 13241 to which reference should be made.

6) The UK mirror committee (B/538/5) is continuing to apply for amendments to EN 12444 to deal with all the issues outlined.

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 March 2001

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 15 and a back cover.

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

Amendments issued since publication

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12444

November 2000

ICS 91.060.50

English version

Industrial, commercial and garage doors and gates — Resistance to wind load — Testing and calculation

Portes équipants les locaux industriels, commerciaux et de garage — Résistance à la charge de vent — Essais et calculs

Tore — Widerstand gegen Windlast — Prüfung und Berechnung

This European Standard was approved by CEN on 27 October 2000.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 12444:2000 E

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 33, Doors, windows, shutters, building hardware and curtain walling, the Secretariat of which is held by AFNOR.

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 May 2001, and conflicting national standards shall be withdrawn at the latest by May 2001.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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 performance standards identified within the product standard prEN 13421:1999.

This European Standard as well as relevant national regulations and standards will enable the actual exposure levels to be determined for the individual locations of the products.

Annexes A and B are informative.

Introduction

The objective of strength tests and calculations according to this standard is to assess that the strength of the door assembly is sufficient to fulfil the essential requirements in the directives, to ensure that the products remain safe independent of their conditions. Tests and/or calculations may be performed by the manufacturer and/or approved laboratory.

1 Scope

1.1 General

This European Standard specifies the test method and/or calculation of resistance to wind load for doors in a closed position.

The doors are intended for installation in areas in the reach of people, for which the main intended uses are giving safe access for goods, vehicles and persons in industrial, commercial or residential premises.

The doors may be manually or power operated.

This document applies to all doors provided in accordance with prEN 13241:1998.

1.2 Exclusions

This document does not apply to:

- lock gates and dock gates;
- doors on lifts;
- doors on vehicles;
- armoured doors;
- doors mainly for the retention of animals;
- theatre textile curtains;
- horizontally moving doors less than 2,5 m wide and 6,25 m^2 area, designed principally for pedestrian use;
- revolving doors of any size;
- doors outside the reach of people (such as crane gantry fences);
- railway barriers;
- barriers used solely for vehicles.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 12424:2000	*Industrial, commercial and garage doors and gates — Resistance to wind load — Classification*
EN 12433-1	*Industrial, commercial and garage doors and gates — Terminology — Part 1: Types of doors*
EN 12433-2	*Industrial, commercial and garage doors and gates — Terminology — Part 2: Parts of doors*
EN 12604	*Industrial, commercial and garage doors and gates — Mechanical aspects — Requirements*
prEN 13241:1998	*Industrial, commercial and garage doors and gates — Product standard*
EN ISO 7345	*Thermal insulation — Physical quantities and definitions (ISO 7345:1987)*

3 Terms and definitions

For the purpose of this standard the terms and definitions in EN 12433-1 and EN 12433-2 as well as EN ISO 7345 shall apply.

4 Principle of test

The principle of test is to apply a pressure differential across the test specimen, to determine failure.

Full size specimen shall be tested. If it is impossible or uneconomical to achieve full-scale testing, parts of door assemblies (elements E) shall be tested for calculating a result for a full door calculation.

Whether testing full door assemblies or elements of doors, the maximum height/width dimension which is critical to the wind load resistance (e.g. width for vertically operating doors) shall be tested for each design criterion.

In order to provide information for the extrapolation of results for smaller sizes, at least one additional test shall be completed on an alternative dimension for each design criterion.

5 Apparatus

A surround for the test specimen or elements shall be prepared; it shall be able to withstand the pressures applied during the test without deflecting to an extent likely to impair jointing or to impose bending stresses that might affect the performances of test specimen.

6 Preparation of test specimen or elements (E)

6.1 The test specimen or elements shall be installed in the test position as advised by the manufacturer, taking into account the frame tracks and any wind resisting devices.

6.2 The test specimen or elements shall consist of parts that in detail conform to the production level of quality. Whenever possible the test specimen should be newly made. Doors and parts in stock are to be regarded as newly made if they fully comply with the specification of the running production.

7 Test procedure

7.1 Testing of complete doors

7.1.1 Loads applied to the sample should be in accordance with annex B to give the classification as noted in Table 1 from EN 12424:2000.

7.1.2 An evenly distributed load or pressure may be applied to the surface. This can be achieved in various ways, for example, but not restricted to:

a) air-pressurized chamber, in which case steps shall be taken to eliminate all air leakage on the product and its attachment to the supporting construction;
b) bags filled with sand or water distributed over the surface of the test sample, see annex B;
c) air-pressurized bags applied across the whole surface between a fixed rigid surface, for example the floor and the surface of the test sample.

7.2 Testing of individual or collective elements

7.2.1 Uniformly distributed loads shall be applied in the same manner as described in 7.1.2 in gradual steps and the effect upon deflection of the product, permanent distortion, engagement within the door frame and ultimate failure shall be recorded after removing the loading when considered necessary (see annex A). The original sub-assembly mass and self-deflection shall be taken into account.

NOTE: For elements which contain only completely homogenous material a central point loading may be used as an alternative to uniformly distributed loading.

7.2.2 To calculate the resistance for the whole door assembly, according to the example in annex A the strength of components may be individually tested for failure by applying a load in the same direction as will result from an applied wind load.

NOTE: The whole door may contain elements incorporating features such as windows or pass doors.

7.2.3 To ensure that production methods and material consistency will not adversely affect the results, the test result shall contain a safety factor according to EN 12604.

8 Calculation

8.1 Calculations shall be done in accordance with normal engineering practice. Calculations can be performed by using parameters which have been determined by preliminary tests on defined elements, such as finite-element methods.

Annex A describes such a simplified method.

8.1.1 Calculations shall be carried out to verify that the largest size of product to be manufactured is capable of withstanding the highest load (differential pressure) within the classification group according to EN 12424:2000 that the product is to perform.

8.1.2 It is not a requirement of this standard that every assembly that is produced shall have a set of calculations produced to suit. It is expected that factory control procedures and design control procedures will ensure consistent product quality and performance.

8.2 The structural opening size and area shall be used to determine the load to be applied.

8.3 When strength calculations are carried out on fixings and/or location features between a door and frame, the number of such features on a door assembly shall share the load, with an included safety factor in accordance with EN 12604.

9 Failure criteria

9.1 Full-scale tests, calculations, indicative testing shall all show that materials are not subjected to such loads that would cause the product to collapse.

9.1.1 Breakage of any component shall not occur.

9.1.2 Permanent deformation of components which will influence the functional and safety performance of the door shall not occur.

9.2 Deflections of materials shall be limited such that:

9.2.1 Failure and collapse through disengagement is prevented, i.e. the door from its tracks or frame.

9.2.2 The functional performance of the door is not permanently affected, i.e. seals are not broken where thermal resistance or water resistance or acoustic properties are affected in a negative way.

10 Test report

In case of a test, the report shall contain as a minimum the following information:

a) date;

b) reference to this standard;

c) name of the approved laboratory if applicable;

d) all necessary references to identify the specimen;

e) all relevant details concerning the dimensions of the specimen, its materials, design, construction and manufacture and its finished surface and fittings and also its method of delivery;

f) drawings of details of the specimen shall be of a suitable scale;

g) drawing and description of the test equipment;

h) test method;

i) test procedures, including storage and conditioning prior to test and mounting the specimen ready for test;

j) test climates used;

k) test results recording loads, deflection, permanent deformation, damages;

l) summary with observations;

m) determine the classification according to EN 12424:2000;

n) signature of the responsible person.

Annex A (informative)

Example for calculation and test of door leaves.

A.1 Preamble

As most industrial and commercial doors are required to be supplied in a variation of sizes, some of which preclude the products from full size testing, the following simplified method of elemental testing followed by calculation presents a suitable alternative route to classification.

Most types of door leaves can be sub-divided into single (or plural) elements; for instance, individual sections of sectional overhead or folding doors, or groups of laths in rolling shutter doors as indicated in Figure A.1. The elements (E) for rolling shutter doors may incorporate benefits to be derived from guide/track interlocks, top sections which include support shafts/rollers and bottom sections with bottom rails.

In cases where the various elements E are not of the same homogeneous content, then each variation of the element such as E_b (bottom section), E_w (window section), E_t (top section) and E_l (intermediate section) shall be evaluated separately.

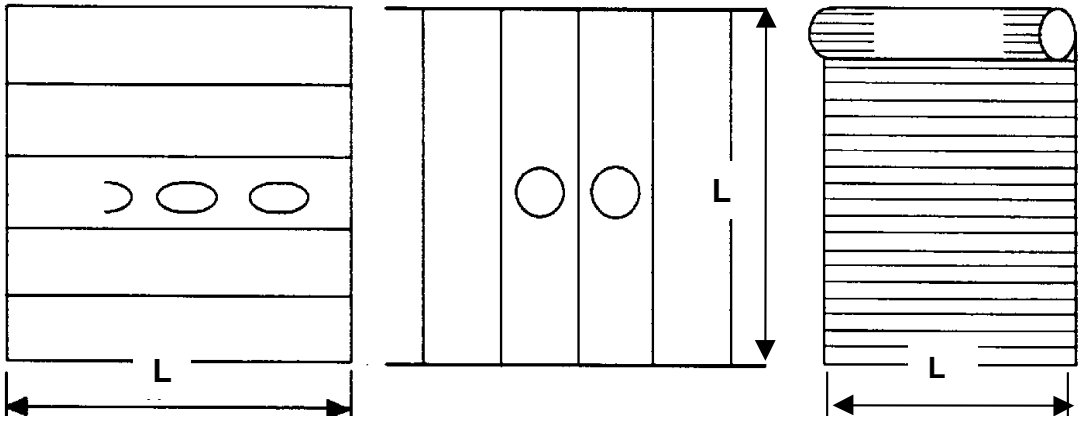


Figure A.1 — Examples of elements of door leaves

A.2 Hypothesis

The failure of elements depends greatly on the benefit or lack of benefit from the end restraints used in real installations. These two completely different options permit two forms of simplified evaluation.

A.2.1 Without significant end restraint assistance

Where the mode of failure is largely independent of any derived benefit from end restraints, each element can be tested by either central point loading or uniformly distributed loading of the element supported on knife edge supports as detailed in A.3.1.1.

A.2.2 With significant end restraint assistance

Where the mode of failure is directly influenced by the incorporation of wind end-locking situations in the end restraints, then the simplified method described in A.2.1 above is not acceptable and the test and calculation technique in A.3.2.1 shall be followed.

A.3 Elemental test and calculation

The determination of the differential pressure (differential wind load pressure) for a complete door leaf may be evaluated from a summation of each of the different elements which make up the door leaf.

The calculation of elemental load pressure shall be based on the results of weight testing of the element. The various formulae in the following clauses are based on the following characters:

A	the area of the leaf element	(m^2)
E	single element or series of laths	
F	single point load	(N)
L	width for vertically moving doors and height for horizontally moving doors	(m)
M	the bending moment	(Nm)
Mm	maximum bending moment	(Nm)
P	load pressure	(N/m^2)
Q	uniformly distributed load	(N)
Q_O	mass of the sample	(N)
S	safety factor according to EN 12604	

A.3.1 Testing/calculation for elements without end restraint

Where the elements E do not gain any significant restraint from end mountings, they may be tested as simply supported on knife edge supports.

Where the elements are completely homogenous, a central point loading F, as shown in Figure A.2, may be used.

Where the element is not completely homogenous, a uniformly distributed load, as indicated in Figure A.3, shall be used.

The objective is to evaluate the maximum bending moment Mm demonstrated in Figures A.4 and A.5.

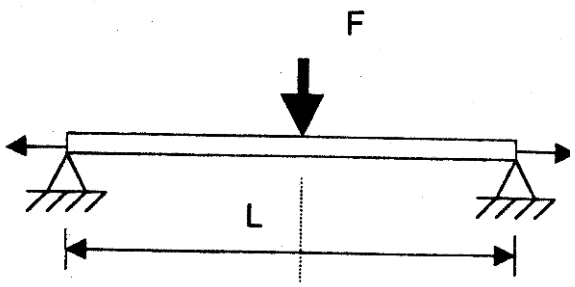


Figure A.2 —
One central single point load

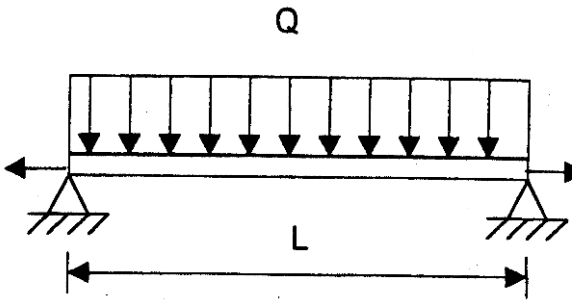


Figure A.3 —
Uniformly distributed load

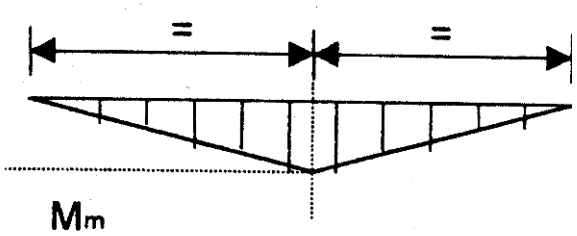


Figure A.4 —
Bending moment diagram
for a homogenous specimen

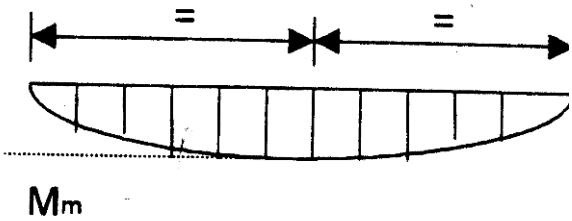


Figure A.5 —
Bending moment diagram
for non-homogenous specimen

A.3.1.1 Test procedure

The test may be done by the following steps:

a) Weigh the element to be tested (Q_o).
b) Position the element onto the end supports as Figures A.2 and A.3.
c) Measure the initial deflection due to the panel's own weight (d_o).
d) Add suitable loadings (F) in gradual increases.
e) After each additional loading remove the total load and measure the resulting residual distortion (d_r).
f) Remove the total loading at each stage and obtain the resultant residual distortion (d_r) by subtraction of d_o from d_l and record this, together with a comment on whether such a distortion would be detrimental to subsequent safe functional operation of a complete door leaf.
g) Continue with additional loadings until failure is identified, at which point Mm can be evaluated according to A 3.1.2.

A.3.1.2 Calculations for elements

For the calculation procedure consider the following points:

a) For simply supported point loaded elements, the maximum bending moment according to Figure A.4 is:

- for vertically or horizontally moving door leaf:

$$Mm = 1/8\ Q_o \times L + 1/4\ F_{max} \times L$$

b) For simply supported uniformly distributed loaded elements, the maximum bending moment according to Figure A.5 is:

- for vertically or horizontally moving door leaf:

$$Mm = 1/8\ (Q_o + Q_{max}) \times L$$

c) In order to allow the results of the test to be used for different lengths (i.e. widths for vertically operating doors, heights for horizontally operating doors), then a reference maximum moment Mm shall be calculated as the average from the results of three tests for the same homogeneous construction in three different lengths.

d) From the evaluation of Mm as above, Q for each element can be evaluated at any length on the basis of:

$$Q = \frac{Mm \times 8}{L}$$

A.3.1.3 Calculation for full door

The evaluation of Q shall be made for each element in a door construction using the approach above.

Example: Vertically moving sectional overhead door

The typical door arrangement is shown in Figure A.6 where the elements are identified as follows:

E_t = top section;
E_i = intermediate section;
E_w = window section;
E_b = bottom section.

In this example, the total loading is given by:

$$Q = (Q_b + 2Q_i + Q_t + Q_w)$$

Instead of a window section, other sections such as those incorporating a pass door may be allowed (see Figure A.7). In such a case, E_b shall be one element covering all the sections which are affected by the introduction of the pass door. The calculation procedure shall then be similar to the above.

From the total differential, maximum pressure containable by the total door, independent of any end restraint, can be evaluated as:

$$P = \frac{Q}{A \times S}$$

The calculation for horizontally moving sectional doors (see Figure A.8) may be performed in a similar way.

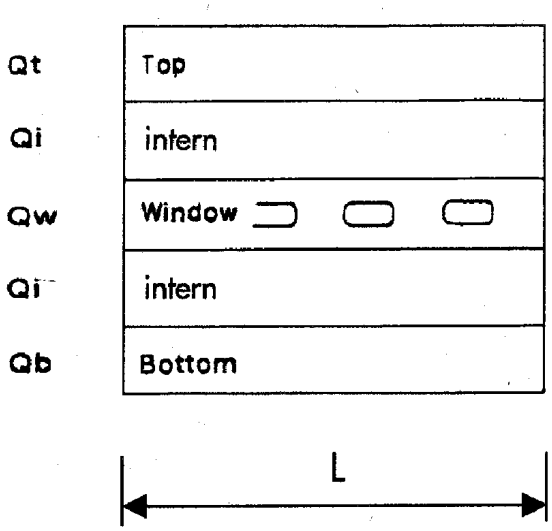


Figure A.6 — Vertically moving sectional door

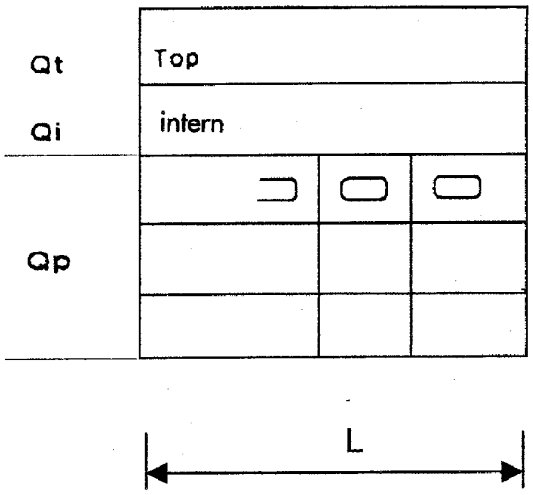


Figure A.7 — Vertically moving door with pass door included

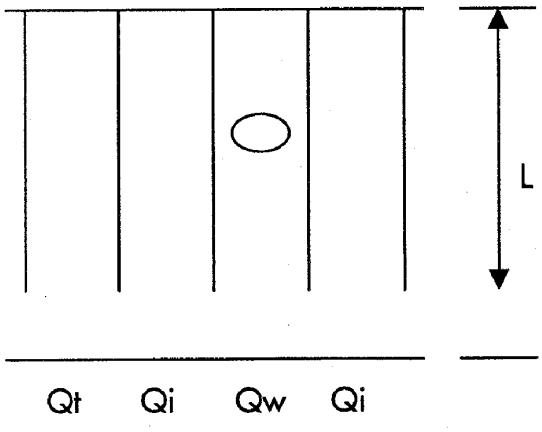


Figure A.8 — Horizontally moving door

A.3.2 Testing/calculation for elements with end restraint

Where the elements E do gain significant restraint from their end mounting components, the above simplified test and calculation technique is not applicable.

In these cases, such as rolling shutter doors with end locks/guide restraint, it is necessary to complete the testing of each element of the total leaf construction at the maximum length (width for vertically moving doors and height for horizontally moving doors) for which the particular size/shape/thickness of each homogeneous element is to be used.

In order to provide information for the extrapolation of results to smaller lengths than the maximum, at least one additional test shall be completed on an alternative length for each design guide.

For all products with end restraint, the following simplified method of testing of elements to evaluate door performance may be used. In all such cases, the test loading shall be uniformly distributed.

The objective in these cases is to evaluate Q_E for each element of the door leaf construction.

A.3.2.1 Test procedure

a) Weigh the element to be tested.

b) Mount the element into normal restraints which are firmly supported using a normal fixing centre on a rigid test frame similar to that in Figure A.9.

c) Measure the deflection due to the element's own weight (d_o).

d) Add suitable uniformly distributed loadings in gradual increases.

e) After each additional loading, remove the total load and measure the resultant deflection (d_r).

f) Remove the total loading at each stage and measure the resultant distortion (d_r) by subtracting d_o from d_l and record this, together with a comment on whether the distortion would be detrimental to subsequent safe functional operation of a complete door leaf.

g) Continue with additional loadings until failure is identified, at which point Q_{max} for the element can be recorded.

A.3.2.2 Calculation for the full door

Once the evaluation of Q_{max} has been achieved for each element of door leaf construction at the intended maximum length, the differential pressure can be evaluated.

The typical door arrangement is shown in Figure A.10 where the elements are identified as follows:

E_t = top section;
E_b = bottom section;
E_i = intermediate section.

In this example, the total loading is given by:

$$Q = (Q_t + Q_b + 2Q_i)$$

From this, the maximum differential pressure applicable to the maximum length of product (width for vertically moving, height for horizontally moving) can be evaluated as follows:

$$P = \frac{Q}{A \times S}$$

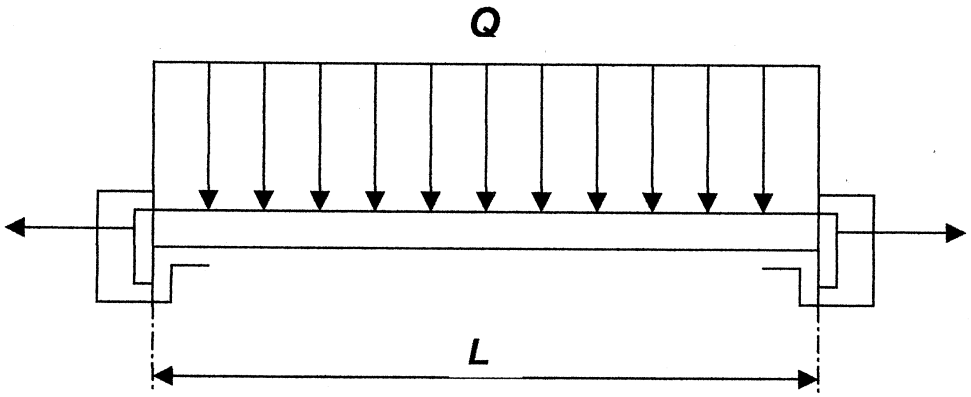


Figure A.9 — Uniformly distributed load Element with end restraint

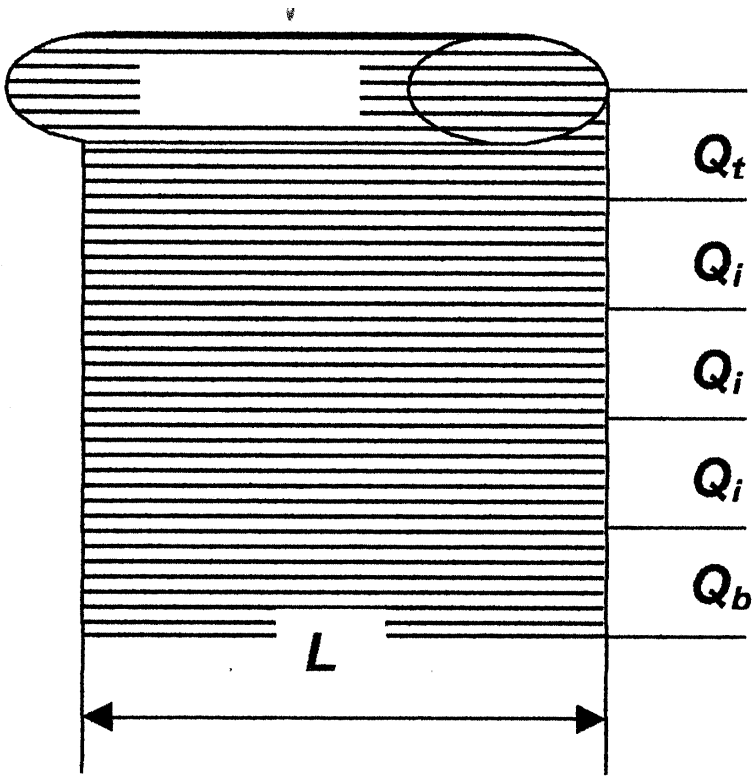
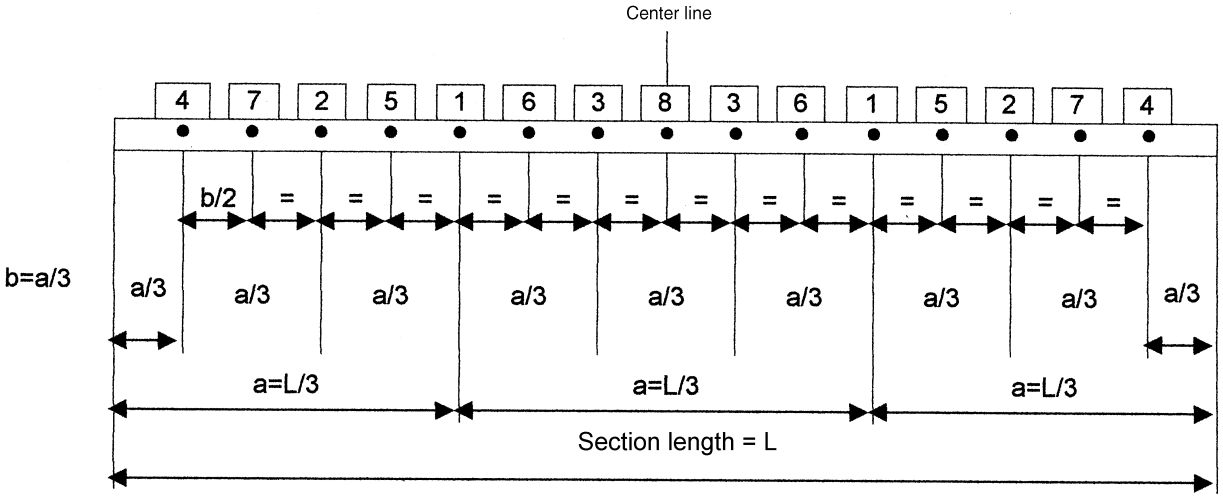


Figure A.10 — Vertically moving rolling shutter door

Annex B (informative)

Differential pressure — Test loading of door leaves



NOTE: If necessary, put another weight above the first one to continue, and from stages 1 to 8.

Table B.1 — Load application

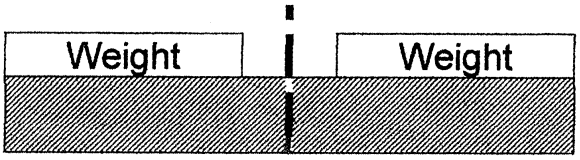


Figure B.1 — Load distribution, in pairs for a section

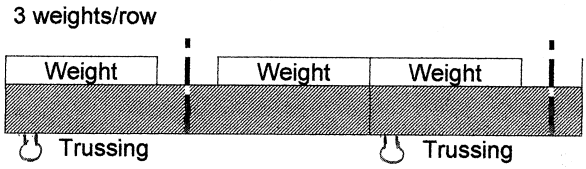


Figure B.2 — Load distribution, in pairs for two adjacent sections

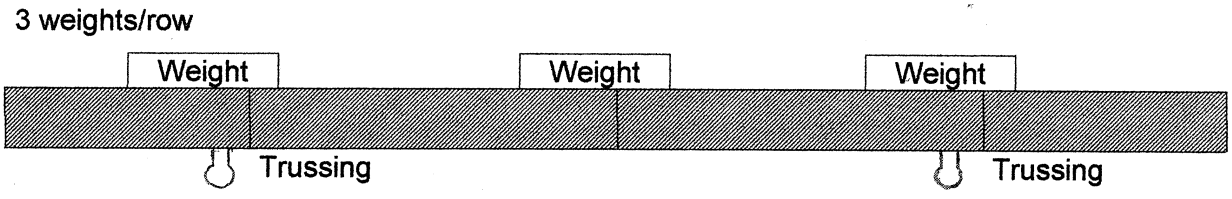


Figure B.3 — Load distribution for three adjacent sections

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