MANUFACTURER

ASSOGRIGLIATI

ITALIAN ASSOCIATION OF ELECTRO-WELDED
AND PRESSED STEEL GRATING AND FENCING MANUFACTURERS

QUALITY AND SAFETY

Member

ANIMA®

THE FEDERATION OF THE ITALIAN ASSOCIATIONS
OF MECHANICAL AND ENGINEERING INDUSTRIES

CONFINDUSTRIA

GUIDE TO THE USE OF GRATINGS

GRATINGS, STEPS, FORKLIFT TRUCKS, CROSSBAR BEAMS.

The load tests for the capacity tables were performed at the Politecnico di Milano

POLITECNICO
DI MILANO

What is Assogrigliati

In 1998, several grating manufacturers decided to establish a national Association of Italian manufacturers of electro-welded and/or pressed gratings in steel and aluminium alloys. The Association is called “ASSOGRIGLIATI” and operates within ANIMA (Federation of National Associations of Mechanical and Engineering Industries).

Assogrigliati brings together qualified and prestigious manufacturers of electro-welded and/or pressed gratings, a sector that employs about 400 workers and has developed an output of 125 million Euro.
In order to obtain a reference standard, in 1999 the associates drew up the “technical specifications” and delivered to UNI (Ente di Normazione Italiano // National Italian Agency for Standardisation) to promote Work Group n. 5 “electro-welded and/or pressed grating panels” of sub-commission 1 “External/internal partitions, windows, doors and stairs” that worked on the development of the standards UNI 11002-1-2-3 published in August 2002 and subsequently reviewed in 2009.

With the disclosure of this publication, Assogrigliati intends to provide the industry with the most suitable instrument for choosing, producing and installing grating panels in compliance with the standards in force and with adequate respect for safety standards and product quality.
Technical evaluations of the data contained in this Guide have been elaborated by Assogrigliati on the basis of the tests performed at the Politecnico di Milano.

Note: The information given has been drafted and checked with the greatest attention. However Assogrigliati assumes no responsibility for eventual errors, omissions or inaccuracies due to technical and graphic needs. Assogrigliati reminds everyone that the present guide does not replace the mentioned standards and that the client is required to consult them.

Updated list of members – June 2015

C.M.D. S.R.L.
Via E. Novati 6/8 - 20832 Desio (MB)
Tel. +39 0362308939 - Fax +39 0362308930 | info@cmdgrigliati.it - www.cmdgrigliati.it

---

CONTE S.R.L.
Via Privata delle Industrie 4 - 20834 Nova Milanese (MI)
Tel. +39 0362450810 - Fax +39 0362450778 | conte@conte-af.it - www.conte-af.it

---

I.M.I. INDUSTRIA METALLURGICA IRPINA S.R.L.
Via Nazionale 142 - 83013 Mercogliano (AV)
Tel. +39 082773558 - Fax +39 082773478 | imi@industrieabate.com - www.imigrigliati.com

---

ITALIANA KELLER GRIGLIATI SCRL
S.S. Flaminia Km 89 - 05035 Narni (TR)
Tel. +39 0744760711 - Fax +39 0744715696 | mail@kellerit.com - www.kellerit.com

---

MEC MASTER GRIGLIATI S.N.C.
Via Degli Artigiani 6 - 31035 Crocetta Montello (TV)
Tel. +39 0423639111 - Fax +39 042383359 | grigliati@mecmaster.com - www.mecmastergrigliati.com

---

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OFFICINE FABRIS S.R.L.
Via Industria 20 - Località Arzerini - 30010 Camponogara (VE)
Tel. +39 041410797 - Fax +39 0414196190 | info@officinefabris.it - www.officinefabris.it

OMAF S.R.L.
Via Luigi Cazzola 22 - 36015 Schio (VI)
Tel. +39 0445575664 - Fax +39 0445575815 | info@omaf.it - www.omaf.it

SCARICA ALFREDO S.P.A.
Via Nazionale Ovest 56 - 43044 Collecchio (PR)
Tel. +39 0521802641 - Fax +39 0521802009 | info@grigliatiscarica.it - www.grigliatiscarica.it

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Chapter 1 – UNI Standard regarding electro-welded and/or pressed gratings

1.0 STANDARD UNI 11002 ON ELECTRO-WELDED AND/OR PRESSED GRATINGS

The standard UNI 11002 "Electro-welded and/or pressed grating panels and steps, promoted by Assogrigliati and published in August 2002 and subsequent reviews, has the purpose of establishing definitions, materials, tolerances, load classes, and tests as well as samples and acceptance criteria for these products.

1.1 STANDARD NUMBER: UNI 11002.1:2009

- **Title**: Electro-welded and/or pressed grating panels and steps – Part 1: Terminology, tolerances, requirements and testing methods for panels for applications in walkways and driveways.
- **Summary**: The standard regards the electro-welded and/or pressed grating panels for walkways and driveways. The purpose of the standard is to establish definitions, materials, tolerances, capacity classes and tests for electro-welded and/or pressed grating panels. The standard applies to electro-welded and/or pressed grating panels consisting of bars.

Standard Index:

1. application purpose and scope
2. regulatory references
3. terms and definitions
4. materials
5. tolerances
6. capacity classes - loads - load concentration on grating areas (an excerpt of which is reported in the table)
7. capacity tests on panels
8. test results

Class	Use	Dynamic load on load concentration on grating area (daN)	Load concentration on grating area (mm x mm)
1	Dense crowd	600	1000x1000
2	Automobiles	1000	200x200
3	Light weight lorries	3000	400x200
4	Lorries and articulated trucks	9000	600x250

Note: capacity class 4) includes W.F. vehicles
The table in the appendix of the hereby guide specifies he ground mass of the vehicles and the dynamic load with the relative load concentration on grating area.

Chapter 1 – UNI Standard regarding electro-welded and/or pressed gratings

To determine the dynamic load working on the load concentration on grating area of the various types of vehicles the following procedure was used: this load includes the weight of the grating itself and the dimensional tolerances of the load bearing bars (§5.3 of the UNI Standard)

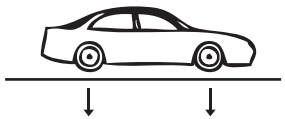
- **Class 1 (dense crowd)** reference M.D. 14.01.2008
- **Class 2 (automobiles)** reference M.D. 14.01.2008
- **Class 3 (lightweight lorries)** total ground mass up to 6000 kg.
- **Class 4 (lorries/ articulated trucks)** reference Highway Code

Compact crowd (class 1)

The dynamic load of 6 kN / m2 complies with M.D. 14.01.2008 section 3.1.4, Table 3.1.II, Category E

Automobiles (class 2)

The dynamic load of 10 kN on the 200 x 200 mm load concentration on grating area complies with the M.D. 14.01.2008, section 3.1.4, Table 3.1.II, Category F



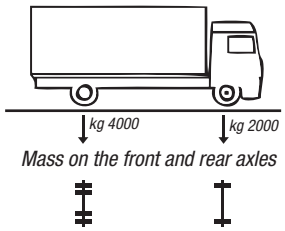
Lightweight lorries, Key (class 3)

Dynamic load on load concentration on grating area 400 x 200 mm

Front axle 2000 kg: 2 x 1.5 = 1500 kg ~ 1500 daN

Rear axle 4000 kg: 2 x 1.5 = 3000 kg ~ 3000 daN 1 kg = ~ 1 daN *Note: 1 kg ≙ 1 daN*

It was considered the ground mass of the front and rear axles of the vehicles in circulation multiplied by an average coefficient K equal to 1.5 (stop or acceleration effect) in accordance with the usual technical specifications.



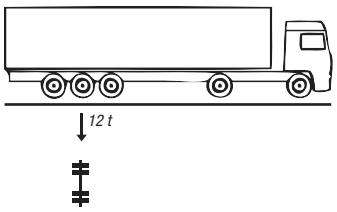
Mass on the front and rear axles

Lorries (class 4) and articulated trucks

The Highway Code, Article 63, Item 5, specifies that, regardless the type of vehicle, the mass weight on the most heavily loaded axle shall not exceed 12 tonnes. Therefore:

Dynamic load on load concentration on grating area 600 x 250 (mm) 12000 km: 2 x 1.5 = 9000 kg ~ 9000 daN *Note: 1 kg ≙ 1 daN*

It was considered the ground mass of the front and rear axles of the vehicles in circulation multiplied by an average coefficient K equal to 1.5 (stop or acceleration effect) in accordance with the usual technical specifications.



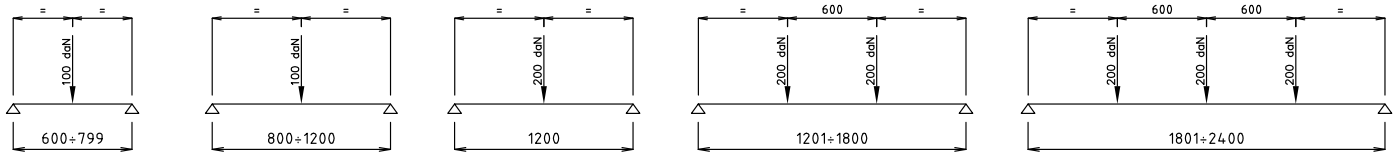
Chapter 1 – UNI Standard regarding electro-welded and/or pressed grating panels and steps

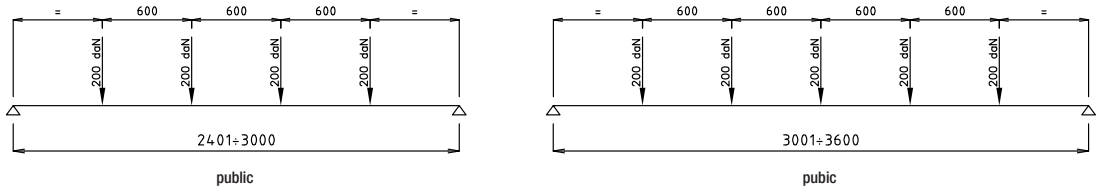
1.2 STANDARD NUMBER: UNI 11002-2:2009

- **Title**: Electro-welded and/or pressed grating steps – Part 2: Terminology, tolerances, requirements and testing methods for steps
- **Summary**: The standard deals with electro-welded and/or pressed grating steps. The purpose of the standard is to establish definitions, materials, tolerances, capacity classes and tests for electro-welded and/or pressed grating steps. The standard applies to electro-welded and/or pressed grating panels consisting of bars.

Standard Index:

1. application purpose and scope
2. normative references
3. terms and definitions
4. materials
5. tolerances
6. loads and load concentration on grating areas
7. capacity test on steps
8. test results





1.2.2.

It specifies that when gratings for stairs and landings are chosen, a preliminary analysis must be conducted to determinate the type of anchorage to the support structure.
In compliance with the UNI standards 10803, 10804, and 10812 currently in force for steps in prefabricated stairways, the intended use of the step is clarified. The legislation in force divides stairways into two groups: public use and private use.

Private use is subdivided according to the following criteria:

- principal private use, with the function of providing the main link between usable and completely inhabitable spaces.
- secondary private use, with the function of providing a secondary link between uninhabitable spaces or a second link.

Chapter 1 – UNI Standard regarding electro-welded and/or pressed grating panels and steps

1.3 STANDARD NUMBER: UNI 11002-3:2002

- **Title**: Electro-welded and/or pressed grating panels and steps – Part 2: Terminology, tolerances, requirements and testing methods for steps.
- **Summary**: The standard deals with electro-welded and/or pressed grating panels and steps. The purpose of the standard is to establish definitions, samples and criteria for accepting electro-welded and/or pressed grating panels and/or steps whenever they are subjected to a hot-dip galvanising treatment. The standard applies to electro-welded and/or pressed grating panels and steps consisting of bars.

Standard Index:

1. purpose and scope of the application
2. normative references
3. terms and definitions
4. samples
5. lot acceptance criteria

1.3.3.

Regarding the properties of the zinc coating, section 5.2 of Standard UNI 11002-3 constitutes a necessary clarification for the correct application of the standard UNI EN ISO 1461 (Hot-dip galvanised coatings on finished ferrous products and steel articles) in the specific case of grating panels and steps. It should be noted that on sample pieces two or three sections have been identified (according to the length of the article) and the bars on which to perform the measurements of the zinc coating thickness (§5.2.2 – fig. 1).
Several other elements have also been identified, such as: the measurement area, the reference area, local thickness and average thickness of the coating (§5.2.3 – fig. 2)
The §5.2.3 of standard UNI 11002-3, developed in collaboration with the Technical Committee of the Associazione Italiana Zincatore (Italian Association of Galvanisers) specifies the visual aspect of the zinc covering and the respective tolerances to the presence of zinc lumps and accumulations on panels and steps.

Chapter 2 – Glossary

In order to carry out a correct sizing of the grating panels and to avoid possible misunderstandings, below are some of the terms usually used in the client-supplier relationship.

Standard UNI 11002-1 defines:

- **ELECTRO-WELDED AND/OR PRESSED GRATING** A "network structure consisting of load bearing bars perpendicularly connected to crossbars (see figure 1A and 2A. 1B and 2B of the present section). The connection of points between the two types of bars are called 'knots'".

- **ELECTRO-WELDED GRATING** "The load bearing bars are joined to the crossbars through the combined action of electro-welding – without using additional material – and pressure, concentrated on all the knots. This procedure determines the penetration of the crossbars into the load bearing bars".

- **PRESSED GRATING** "The load bearing bars are joined to the crossbars by means of the pressure exerted on the crossbars to wedge them into the preformed slots on the load bearing bars. In some case the crossbars also have pre-formed slots".

- **Load bearing barS** (h x s) Elements arranged parallel to each other, able to bear the load acting on the grating. They are defined by the height (h) and the thickness of the bar (s). (see figures 1A and 1B of the present section).

- **CROSSBARS** Elements arranged transversally to the load bearing bars. They have the function of connecting and maintaining a constant distance between the load bearing bars and to trasversally divide the load (see figure 1A and 1B of the present section).

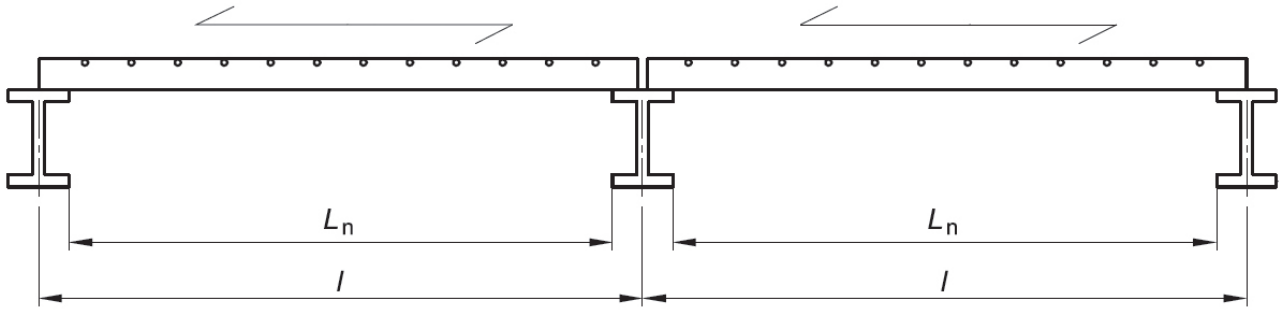
- **Load bearing bar DISTANCE** (A) Distance between the centre lines of two consecutive load bearing bars (see figures 1A and 1B of the present section)

- **CROSSBAR DISTANCE** (B) Distance between the centre lines of two consecutive crossbars (see figures 1A and 1B of the present section)

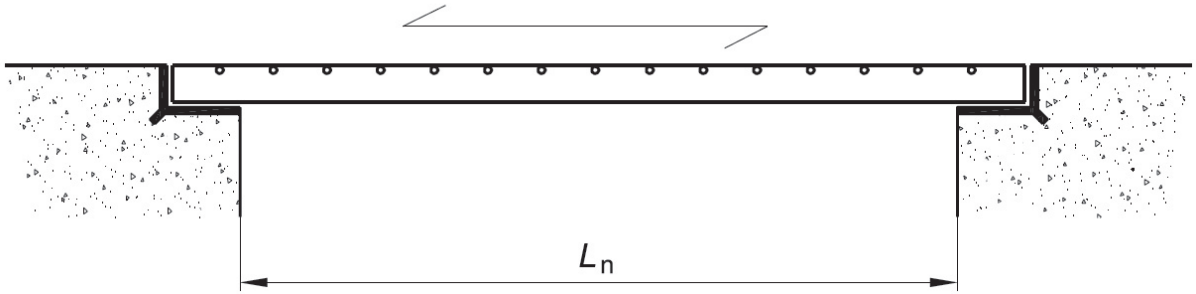
- **MESH** It indicates (A x B). (see figures 1A and 1B of the present section). The distance between parallel bars (A) is always indicated first. Example: distance between bars (A) = 25 mm distance (B) = 76 mm mesh = 25 x 76 mm

- **PANEL LENGTH** (X) Maximum size measured in the direction of the load bearing bars. (see figures 2A and 2B of the present section)
- **PANEL WIDTH** (Y) Maximum size measured in the direction of the crossbars. (see figures 2A and 2B of the present section).
- **PANEL SIZE** Indicated by (X x Y). (see figures 2A and 2B of the present section). The length (X) is always indicated first.
- **LOAD CONCENTRATION ON GRATING AREA** Surface of the grating directly interested by the load. Defined by the dimensions (u x v). (see drawings section 4.6)
- **LOAD EVENLY DISTRIBUTED** Load distributed uniformly over the whole surface of the panel.
- **LOAD CONCENTRATED ON THE LOAD CONCENTRATION ON GRATING AREA** Load exerted directly on the load concentration on grating area.
- **SAG** (f) Vertical offset with respect to the horizontal plane of a point on the panel due to the acting load. Maximum sag: 1/200 of Ln; Maximum sag: 5 mm) For further information refer to the standard UNI 11002-1.

PANELS ON CONSECUTIVE SUPPORTS



PANELS ON A FRAME



Also defined

- **CENTRE-TO-CENTRE DISTANCE BETWEEN SUPPORTS** (Ln) Measurement of the centre-to-centre distance between two adjacent support structures, measured in the direction of the load bearing bars.
- **SERRATED GRATING** The serrated grating is a grating obtained by using as components load bearing bars and/or crossbars in laminate or sheared material which are provided on the surface with suitably shaped teeth that work as slip resistance.

Gratings for civilian use

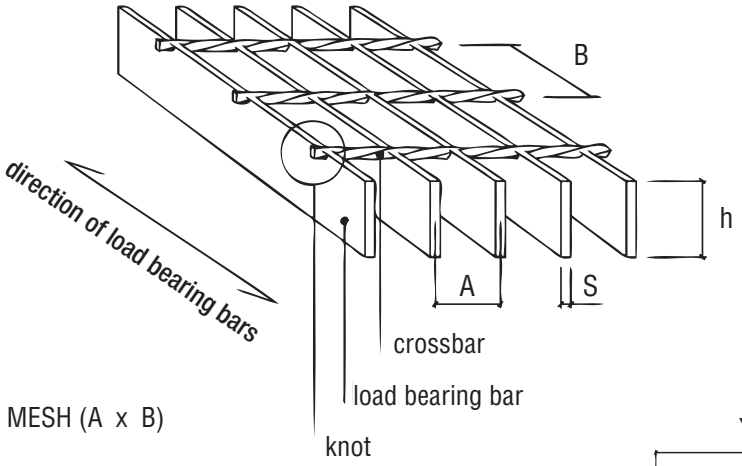
- **HEEL-PROOF GRATING** "There are no reference standards, even though if it is usually define a grating as "heel-proof" when it has either the load bearing bars or the crossbars with a centre distance equal to or less than 15 mm".
- **"ANTI-SPHERE" OR "ANTI-MARBLE" GRATING** Gratings inserted into a flooring made of mesh which cannot be crossed by a sphere measuring 2 mm in diameter. (see MD 14/6/89 n. 236 article 8.2.2)

Gratings for industrial use

- **GRATINGS FOR WORK PLATFORMS AND TRANSIT CORRIDORS** Gratings that satisfy the requirements described in standard UNI EN 14122-2.
- **OFFSHORE GRATINGS** Gratings with serrated load bearing bars, obtained by alternating flat and round, which cannot be crossed by a sphere measuring 15mm in diameter.

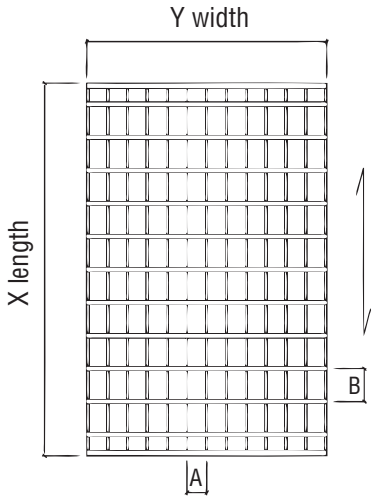
ELECTRO-WELDING GRATING

FIGURE 1A



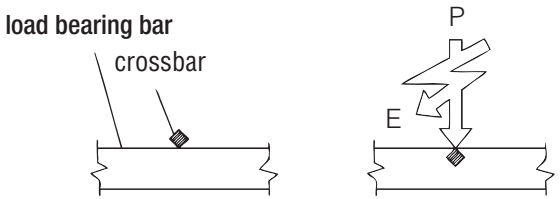
MESH (A x B)

FIGURE 2A



Panel dimensions (X x Y)

"KNOT" DIAGRAM



On "every knot" (the connection point between the load bearing bars and the crossbars) an electrode comes down to apply pressure (P) simultaneously. The next passage of electricity (E) develops heat, causing a localised fusion of the components in contact. The combined action of pressure-electro-welding without adding any material produces the penetration of the crossbar into the load bearing bar.

PRESSED GRATING (GP)

FIGURE 1B

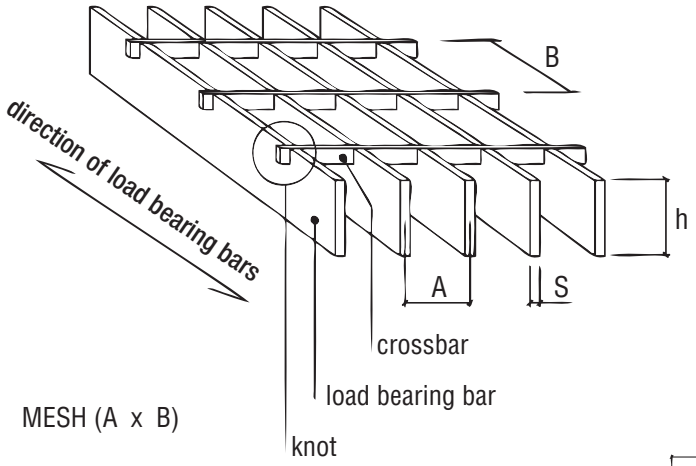
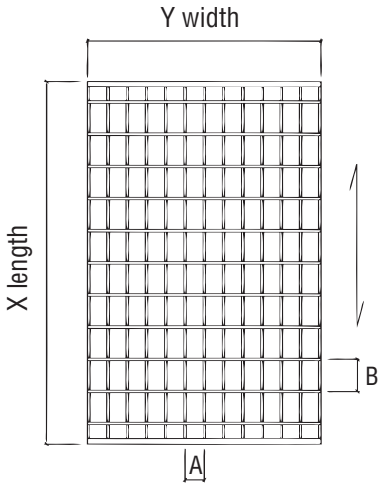
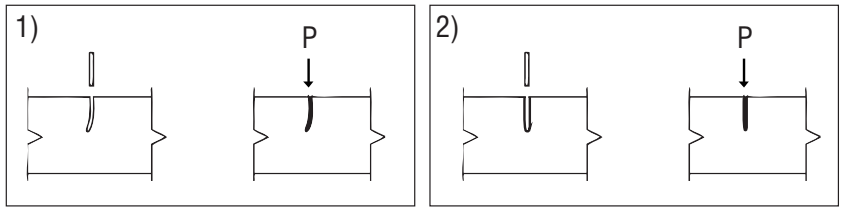


FIGURE 2B



Panel dimensions (X x Y)

"KNOT" DIAGRAM EXAMPLES



The "knot" is the support bond of each joint between the support elements and the connecting elements. This is achieved by fitting the crossbars into the slots predisposed on the load bearing bars by applying high pressure (P).

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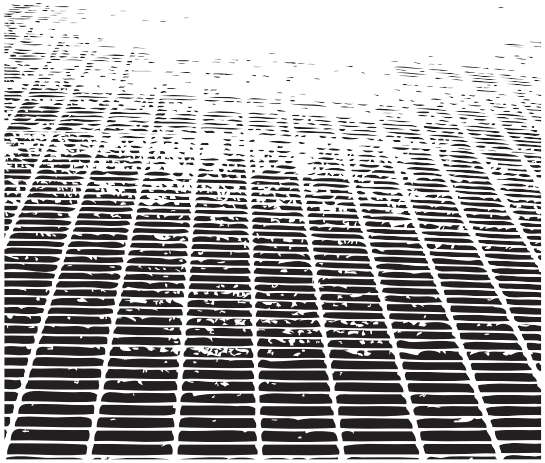
GRATINGS



Chapter 3 – Technical selection criteria for grating panels

3.1 USE OF CAPACITY TABLES

The basic elements for the technical choice of gratings are:

- il tipo di sovraccarico che grava sul pannello. Il Committente deve sempre precisare la Classe di portata

  that is:
  pedestrian load (distributed) Class 1
  road vehicle load (concentrated on the load concentration on grating area) Classes 2-3-4.

- the centre-to-centre distance between two consecutive supports.

To optimize the choice of the grating, it is also important to take into consideration ulterior factors such as: the distance between the load bearing bars and the distance between the crossbars (the mesh), the height and the thickness of the load bearing bar, and the possible use of “section breaker beams”.

3.2 COLLABORATION BARS METHOD

The electro-welded and/or pressed grating is a reticulated structure formed of bars connected together orthogonally crossbars. The latter has a dual function:

1. to determine the constancy of the distance between the load bearing bars to give linearity to the panel.
2. to distribute the load acting on a surface larger than the load concentration on grating area, to improve the capacity conditions of the panel.

Based on laboratory tests conducted at the Politecnico di Milano, Assogrigliati has elaborated the following table:

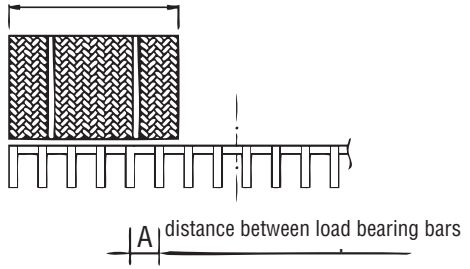
COLLABORATION BARS TABLE
for loads concentrated on grating areas

ELECTRO-WELDED GRATING		PRESSED GRATING	
MESH (mm)	n' = number of bars in collaboration	MESH (mm)	n' = number of bars in collaboration
11x76	2,7	11x66	2,7
15x76	2,5	15x66	2,5
17x76	2,4	22x66	2,3
22x76	2,3	25x66	2,1
25x76	2,1	30x66	1,9
30x100	1,9	33x66	1,7
34x76	1,7	44x44	1,5
44x44	1,5	66x33	1,3
		88x33	0
		99x33	0

Note: the numbers of cooperation bars shown in the two tables are valid for the load concentration on grating areas of the various capacity classes. For load concentration on grating areas that are different due to special concentrated loads, the Client must contact the Technical Office of the Supplier Company. In particular the n' value of the collaboration bars are only valid when:

- *for the electro-welded grating, all the panel knots have a complete penetration into the load bearing bars using the procedures described on page 13 of the present Guide*
- *for pressed grating, the complete wedging for all the knots of the crossbars and load bearing bars is done by applying high pressure, as indicated on page 14 of the present Guide.*

Load concentration on grating area = V



1° plate always on the border of the Load concentration on grating area
n = bar below load concentration on grating area = v/A (consider the whole +1)
n' = collaboration bars (noted in the table)
N = number of load bearing bars = n + n' = v/A (whole) + 1 + n'

Example:
centre distance between bars A = 30 mm
load concentration on grating area v = 200 mm
NUMBER OF Load bearing barS = 200/30 + 1 + 1.9 = 8.9

The tables have been calculated according to Ministerial Decree of 14 January 2008

The testing is performed:

1.) according to the criteria of the latest limits state, elasticity method (E) with the following coefficients:

- Multiplying coefficient of the load $\gamma_{Qi} = 1,5$

M.D. 14 January 2008, 2.6.1, table 2.6.1

Safety coefficient for the resistance of the sections for the classes 1-2-3-4 $\gamma_{M0} = 1,05$
M.D, 14 January 2008, 4.2.4.1.1, table 4.2.V

- Material S235JR
- Sigma enervation (σ_{sn})= 23,5 daN/mm^2
- Sigma comparison (σ_{sn} / γ_{M0})= 22,38 daN/mm^2

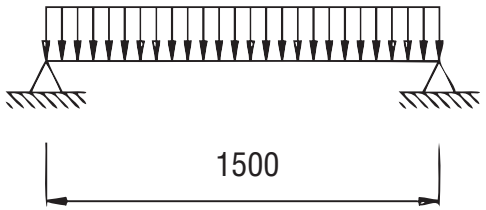
2.) calculating the sag caused by the net real load of the multiplying coefficient of the load γ_{Qi}

- $f \leq \frac{1}{200}$ Ln
- $f \leq$ 5 mm

3.3.1 CALCULATION EXAMPLE FOR EVENLY DISTRIBUTED LOAD

DATI:

Evenly distributed dynamic load (class 1)	$Q = 600$ daN/m^2
Centre-to-centre distance between supports	L_n =1500 mm
Electro-welded grating	30x3 - 15x76
Pressed grating	30x3 - 15x66
Resistance modulus	$W = 450$ mm^3
Inertia moment	$J = 6750$ mm^4
Elasticity modulus	$E = 21000$ daN/mm^2
Material S235JR Sigma enervation	$\sigma_{sn} = 23{,}5$ daN/mm^2



centre-to-centre distance

CALCOLI:

Amplified load

$$Q_1 = Q \cdot \gamma_{Qi} = 600 \cdot 1{,}5 = 900 \text{ daN/m}^2$$

Number of load bearing bars in 1 metre width

$$N = \frac{1000}{15} = 66{,}67$$

Load on a load bearing bar per Sigma calculation

$$q_1 = \frac{Q_1 \cdot L_n \cdot 1}{N} = \frac{900 \cdot 1{,}5 \cdot 1}{66{,}67} = 20{,}24 \text{ daN}$$

Bending moment

$$M = \frac{q_1 \cdot L_n}{8} = \frac{20{,}24 \cdot 1500}{8} = 3795 \text{ daN} \cdot \text{mm}$$

Sigma comparison

$$\sigma_c = \frac{\sigma_{sn}}{\gamma_{M0}} = \frac{23{,}5}{1{,}05} = 22{,}38 \text{ daN/mm}^2$$

Unitary bending stress

$$\sigma = \frac{M}{W} = \frac{3795}{450} = 8{,}4 \text{ daN/mm}^2 < \sigma_c = 22{,}38 \text{daN/mm}^2$$ *verified*

Load on a load bearing bar for sag calculation

$$q = \frac{Q \cdot L_n \cdot 1}{N} = \frac{600 \cdot 1{,}5 \cdot 1}{66{,}67} = 13{,}49 \text{ daN}$$

Elastic sag

$$f = \frac{5 \cdot q \cdot L_n^3}{384 \cdot E \cdot J} = \frac{5 \cdot 13{,}49 \cdot 1500^3}{384 \cdot 21000 \cdot 6750} = 4{,}18 \text{ mm} < 5 \text{ mm}$$ *verified*

Sag/ centre-to-centre distance Ratio

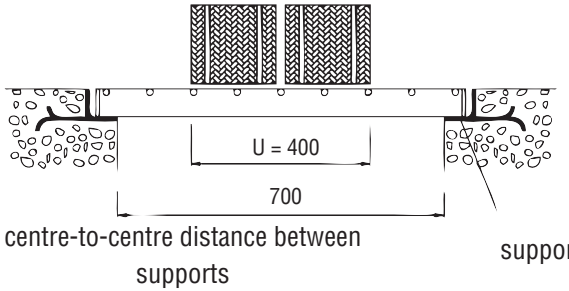
$$\frac{f}{L_n} = \frac{4{,}18}{1500} = \frac{1}{359} < \frac{1}{200}$$ *verified*

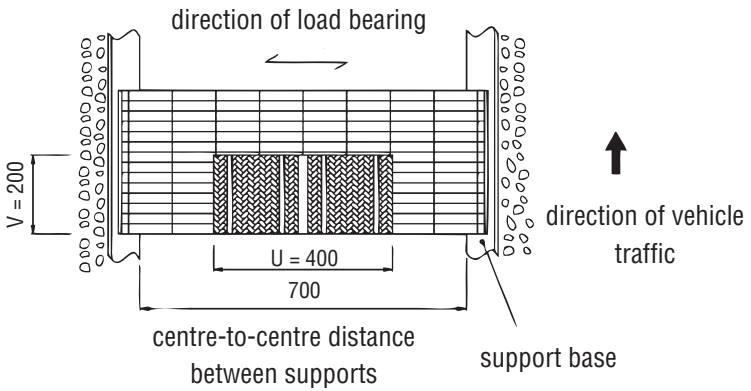
3.3.2 CALCULATION EXAMPLE FOR LOAD ON LOAD CONCENTRATION ON GRATING AREA (LOAD CONCENTRATION ON GRATING AREA SMALLER THAN CENTRE-TO-CENTRE DISTANCE)

DATA:

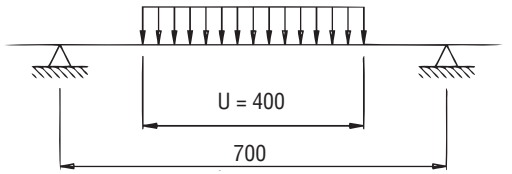
Dynamic load on load concentration on grating area (class 3)	Q = 3000 daN
Centre-to-centre distance between supports	L_n =700 mm
Load concentration on grating area	v x u = 200x400 mm
Electro-welded grating	60x4 - 25x76
Pressed grating	60x4 - 25x66
Resistance modulus	W = 2400 mm^3
Inertia moment	J = 72000 mm^4
Elasticity modulus	E = 21000 daN/mm^2
Collaborative bars (see § 3.2)	n' = 2,1
Material S235JR Sigma enervation	σ'_{sn} = 23,5 daN/mm^2

Note: for capacity classes with a rectangular load concentration on grating area, the capacity verification should be done in the two way direction of the vehicle movement (parallel and perpendicular to the load bearing bars direction).





Calculation scheme



CALCULATIONS:

Amplified load $Q_1 = Q \cdot \gamma_{Qi} = 3000 \cdot 1,5 = 4500$ daN

Number of load bearing bars under load concentration on grating area $n = \frac{200}{25} + 1 = 9$ (intero + 1)

Total number of load bearing bars $N = n + n' = 9 + 2,1 = 11,1$

Load on a load bearing bar per Sigma calculation $q_1 = \frac{Q_1}{N} = \frac{4500}{11,1} = 405,4$ daN

Bending moment $M = \frac{q_1}{8} \cdot (2 \cdot L_n - u) = \frac{405,4}{8} \cdot (2 \cdot 700 - 400) = 50675$ daN · mm

Sigma comparison $\sigma_c = \frac{\sigma_{sn}}{\gamma_{M0}} = \frac{23,5}{1,05} = 22,38$ daN/mm²

Unitary bending stress $\sigma = \frac{M}{W} = \frac{50675}{2400} = 21,11$ daN mm² $< \sigma_c = 22,38$ daN/mm² *verified*

Load on a load bearing bar for sag calculation $q = \frac{Q}{N} = \frac{3000}{11,1} = 270,27$ daN

Elastic sag $f = \frac{q}{384 \cdot E \cdot J} \cdot (8 \cdot L_n^3 - 4 \cdot u^2 \cdot L_n + u^3) = \frac{270,27}{384 \cdot 21000 \cdot 72000} (8 \cdot 700^3 - 4 \cdot 400^2 \cdot 700 + 400^3) = 1,09$mm < 5 mm *verified*

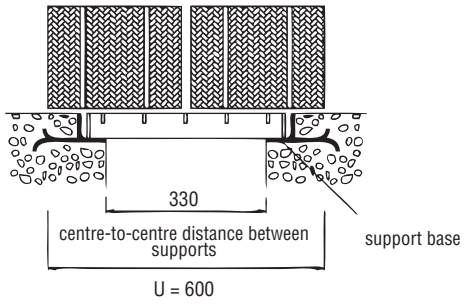
Sag/ centre-to-centre distance Ratio $\frac{f}{L_n} = \frac{1,09}{700} = \frac{1}{642} < \frac{1}{200}$ *verified*

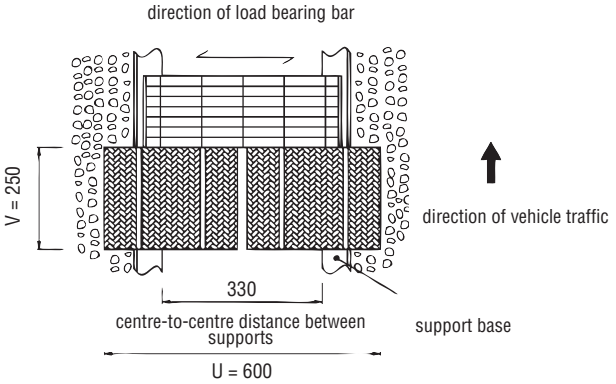
3.3.3 CALCULATION EXAMPLE FOR LOAD ON LOAD CONCENTRATION ON GRATING AREA (LOAD CONCENTRATION ON GRATING AREA LARGER THAN THE CENTRE-TO-CENTRE DISTANCE)

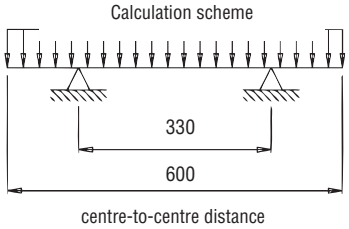
DATA:

Dynamic load on load concentration on grating area (class 4)	Q = 9000 daN
Centre-to-centre distance between supports	L_n =330 mm
Load concentration on grating area	v x u = 250x600 mm
Electro-welded grating	40x4 - 25x76
Pressed grating	40x4 - 25x66
Resistance modulus	W = 1067 mm^3
Inertia moment	J = 21333 mm^4
Elasticity modulus	E = 21000 daN/mm^2
Collaborative bars (vedere § 3.2)	n' = 2,1
Material S235JR Sigma enervation	σ'_{sn} = 23,5 daN/mm^2

Note: for capacity classes with a rectangular load concentration on grating area, the capacity verification should be done in the two way direction of the vehicle movement (parallel and perpendicular to the load bearing bars direction).







CALCULATIONS:

Dynamic load on effective load concentration on grating area $Q_1 = \frac{Q \cdot L_n}{u} = \frac{9000 \cdot 330}{600} = 4950$ daN

Amplified dynamic load on effective load concentration on grating area $Q_2 = \frac{Q \cdot L_n}{u} \cdot \gamma_{Qi} = \frac{9000 \cdot 330}{600} \cdot 1{,}5 = 7425$ daN

Number of load bearing bars under load concentration on grating area $n = \frac{250}{25} + 1 = 11$ (whole + 1)

Total number of load bearing bars $N = n + n' = 11 + 2{,}1 = 13{,}1$

Load on a load bearing bar per Sigma calculation $q_2 = \frac{Q_2}{N} = \frac{7425}{13{,}1} = 566{,}7$ daN

Bending moment $M = \frac{q_2 \cdot L_n}{8} = \frac{566{,}7 \cdot 330}{8} = 23376$ daN · mm

Sigma comparison $\sigma_c = \frac{\sigma_{sn}}{\gamma_{M0}} = \frac{23{,}5}{1{,}05} = 22{,}38$ daN/mm²

Unitary bending stress $\sigma = \frac{M}{W} = \frac{23376}{1067} = 21{,}9$ daN/mm² $< \sigma_c = 22{,}38$ daN/mm² *verified*

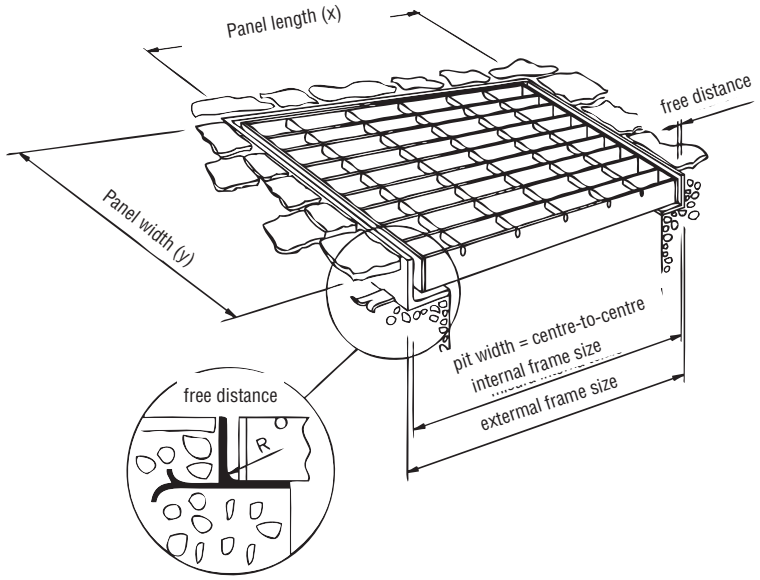
Load on a load bearing bar for sag calculation $q_1 = \frac{Q_1}{N} = \frac{4950}{13{,}1} = 377{,}8$ daN

Elastic sag $f = \frac{5 \cdot q_1 \cdot L_n^{\,3}}{384 \cdot E \cdot J} = \frac{5 \cdot 377{,}8 \cdot 330^3}{384 \cdot 21000 \cdot 21333} = 0{,}39$ mm < 5mm *verified*

Sag/ centre-to-centre distance ratio $\frac{f}{L_n} = \frac{0{,}39}{330} = \frac{1}{846} < \frac{1}{200}$ *verified*

4.1 MEASURING A PIT

The measures needed to determine the size the covering panel for a pit are specified in the figures.



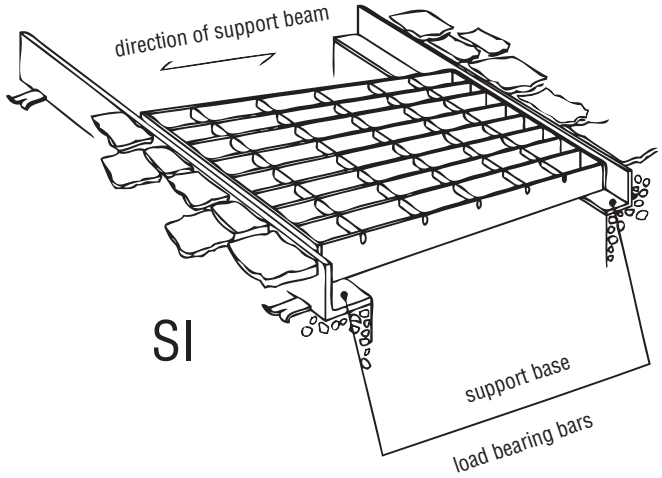
The free distance or free space is determined by the radius of curvature “R” of the support structure that can be found in the manuals. The grating panel base of the load bearing bars on the frame should not be less than 2/3 of the height of the load bearing bars and therefore larger than 20 mm. The area covering is done by using a series of panels in standard company widths plus an eventual panel for completion.

Note: The indicative design is valid for both electro-welded and pressed gratings.

4.2 INSTALLATION OF PANELS

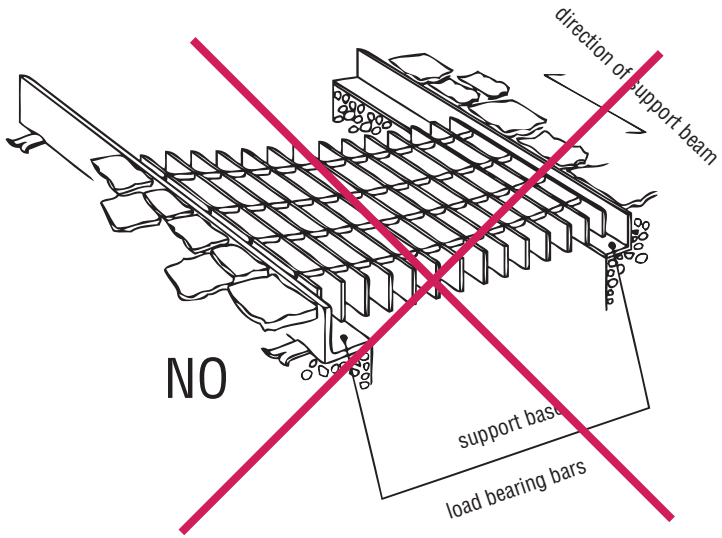
4.2.1 CORRECT INSTALLATION

All load bearing bars are laid at both ends. The connecting bars are facing upwards, that is, turned towards the surface in contact with the vehicles and/or pedestrians.
Special attention is required for squared panels.



4.2.2 INCORRECT INSTALLATION

The ends of the load bearing bars are not positioned on the support structure, and therefore proper support is missing.



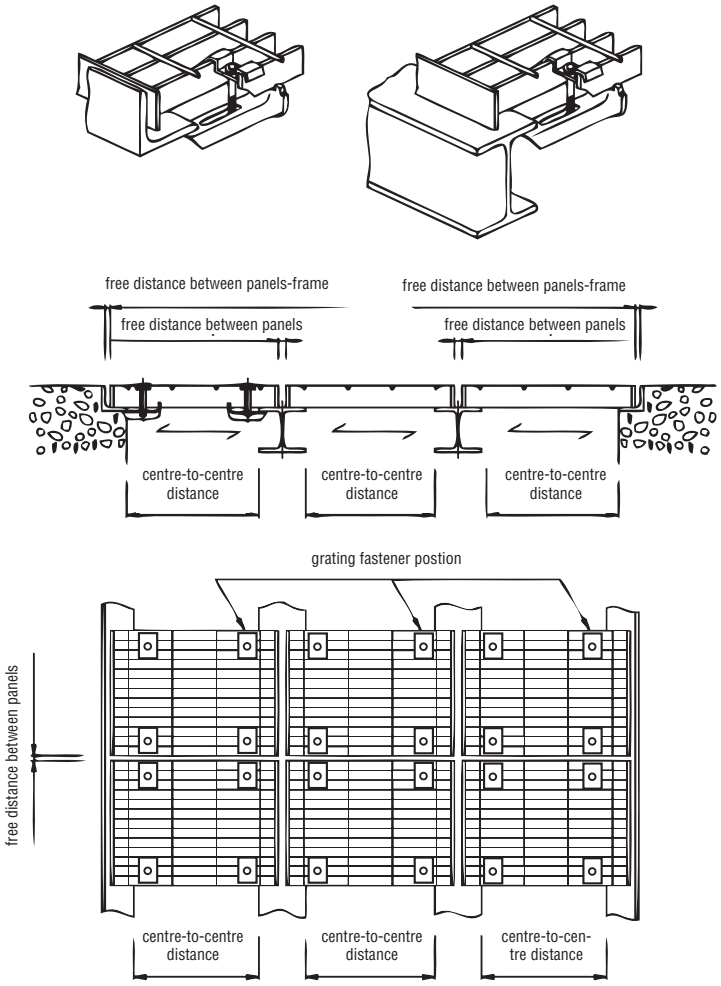
Note: The drawings are indicative and are valid for both electro-welded and pressed grating panels.

4.3 GRATING FASTENERS (FIXING HOOKS)

In the standard UNI 11002-1 – section 3.14 – the appropriately shaped elements to use for technical reasons and/or safety reasons to anchorage the grating panels to support structure and/or fix them to each other are mentioned.

Whenever the intended use of the grating fasteners is particularly difficult (example: shopping centres, public roads, etc. …) it is necessary to provide suitable devices to prevent unscrewing (example: self-locking nuts, anchorage with perforated plate screws between the support plates, welding between panel and support, etc. …) and to increase the check-ups frequency of the grating fasteners state.

To fasten the panels to the support structure, it is recommended to use at least four grating fasteners.



4.4 GRATING FOR FLOORING

STANDARD

4.4.1 The use of grating for flooring panels, in specific applications, must comply with the requirements of M.D. n. 236 of 14.06.1989 "Technical regulations necessary to guarantee accessibility, adaptability, and visibility of private buildings and subsidised and assisted housing, in order to overcome or remove architectural barriers".

In particular the indications given in section 8.2.2 of M.D. 236 of 14/689 should be followed:
[…] The gratings inserted into the flooring must be elaborated with a mesh that cannot traversed by a 2 cm diameter sphere: the gratings with parallel elements must be in any case placed orthogonally in the traffic direction.

4.4.2 The capacity class 1 of the standard UNI 11002-1 does not refer to any other applications of local concentrated loads (cabinet stoppers, shelves, etc.) for which it is necessary to provide a specific manual verification.

4.5 EMPTY/FULL RATIO FOR GRATING PANELS

The opening of natural ventilation for garages, in accordance with section 3.9.1 of M.D. 01.02.1986 (Fire Safety standard) must have a surface of not less than 1/25 of the floor area in the compartment. Therefore, when using grating panels for covering aeration zones, it is necessary to keep in mind the “empty / full ratio” of the various types of gratings for these items, as shown in the following tables:

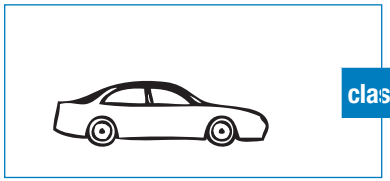
ELECTRO-WELDED GRATING											
Load bearing bar thickness	Crossbar thickness	MESH (mm)									
		11x76	15x76	17x76	22x38	22x76	25x24	25x76	30x50	30x100	34x38	34x76
2	4	0,78	0,82	0,84	0,81	0,86	0,77	0,87	0,86	0,90	0,84	0,89
3	4,5	0,68	0,75	0,77	0,76	0,81	0,72	0,83	0,82	0,86	0,80	0,86
4	5	0,59	0,69	0,71	0,71	0,76	0,67	0,78	0,78	0,82	0,77	0,82
5	5	0,51	0,62	0,66	0,67	0,72	0,63	0,75	0,75	0,79	0,74	0,80

PRESSED GRATINGS											
Load bearing bar thickness	Crossbar thickness	MESH (mm)									
		11x66	15x66	22x22	22x66	25x66	33x33	33x66	44x44	66x11	66x33
2	2	0,79	0,84	0,83	0,88	0,89	0,88	0,91	0,91	0,79	0,91
3	2	0,71	0,78	0,79	0,84	0,85	0,85	0,88	0,89	0,78	0,90
4	3	0,61	0,70	0,71	0,78	0,80	0,80	0,84	0,85	0,68	0,85
5	3	0,52	0,64	0,67	0,74	0,76	0,77	0,81	0,83	0,67	0,84

4.6 CAPACITY CLASSES (LOADS AND LOAD CONCENTRATION ON GRATING AREAS)

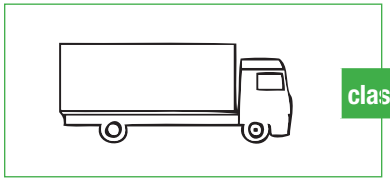
class 1

dense crowd
(pedestrian capacity)
dynamic load 600 daN/m2



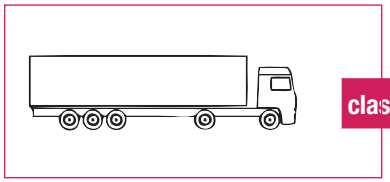
class 2

limited transit to automobiles
total ground mass (static)
dynamic load up to 3000 kg 1000 daN on load concentration on grating areas 200X200 mm



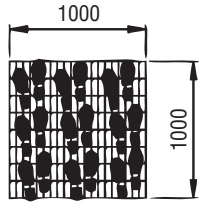
class 3

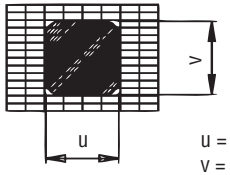
limited transit to lightweight lorries
total ground mass (static)
dynamic load up to 6000 kg 3000 daN on load concentration on grating areas 400X200 mm

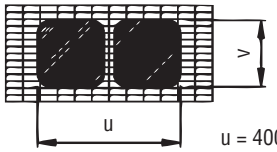


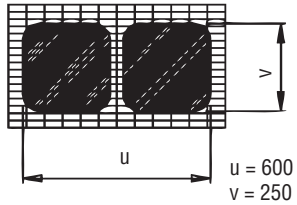
class 4

transit of lorries and articulated trucks
total ground mass (static)
dynamic load up to 45000 kg 9000 daN on load concentration on grating areas 600X250 mm









Note:
For capacity classes with rectangular load concentration on grating areas the verification of the capacity must be made in both directions of vehicle traffic (parallel and perpendicular to the load bearing bars).
The capacity classes and the load concentration on grating areas indicated in the prospectus refer to vehicles with pneumatic tyres. This does not refer to construction or earthmoving vehicles.

GRATING CAPACITY TABLE

Class 1 – Dense crowd (pedestrian capacity) – according to UNI 11002-1

- M.D. 14 January 2008 – 3.1.4 – table 3-1-II – Category E
- Dynamic load 600 daN/m2
- Steel material S235JR – Sigma enervation = 23.5 daN/mm2 – Sigma comparison = 22.38 daN/mm2
- Maximum sag 5 mm
- Maximum sag 1/200 di Ln

Table part 1

Load bearing bar section	Centre distance between load bearing bars (mm)																			
	11		15		17		22		25		30		33		34		44		66	
	Ln = maximum centre-to-centre distance between supports (mm) - f = elastic deflection (sag) (mm)																			
	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*
20 x 2	**1129**	5,00	**1045**	5,00	**1013**	5,00	**933**	4,65	**894**	4,46	**842**	4,21	**815**	4,06	**807**	4,02	**741**	3,70	**633**	2,96
25 x 2	**1335**	5,00	**1235**	5,00	**1197**	5,00	**1123**	5,00	**1087**	5,00	**1039**	5,00	**1014**	5,00	**1007**	5,00	**926**	4,62	**792**	3,71
30 x 2	**1531**	5,00	**1417**	5,00	**1373**	5,00	**1287**	5,00	**1247**	5,00	**1191**	5,00	**1163**	5,00	**1154**	5,00	**1082**	5,00	**950**	4,44
35 x 2	**1718**	5,00	**1590**	5,00	**1541**	5,00	**1445**	5,00	**1400**	5,00	**1337**	5,00	**1306**	5,00	**1296**	5,00	**1215**	5,00	**1098**	5,00
40 x 2	**1900**	5,00	**1758**	5,00	**1704**	5,00	**1597**	5,00	**1547**	5,00	**1478**	5,00	**1443**	5,00	**1432**	5,00	**1343**	5,00	**1214**	5,00
45 x 2	**2075**	5,00	**1920**	5,00	**1861**	5,00	**1745**	5,00	**1690**	5,00	**1615**	5,00	**1577**	5,00	**1565**	5,00	**1467**	5,00	**1326**	5,00
50 x 2	**2246**	5,00	**2078**	5,00	**2014**	5,00	**1888**	5,00	**1829**	5,00	**1747**	5,00	**1706**	5,00	**1694**	5,00	**1588**	5,00	**1435**	5,00
25 x 3	**1478**	5,00	**1367**	5,00	**1325**	5,00	**1242**	5,00	**1203**	5,00	**1150**	5,00	**1123**	5,00	**1114**	5,00	**1045**	5,00	**926**	4,62
30 x 3	**1694**	5,00	**1568**	5,00	**1519**	5,00	**1425**	5,00	**1380**	5,00	**1318**	5,00	**1287**	5,00	**1278**	5,00	**1198**	5,00	**1082**	5,00
35 x 3	**1902**	5,00	**1760**	5,00	**1706**	5,00	**1599**	5,00	**1549**	5,00	**1480**	5,00	**1445**	5,00	**1434**	5,00	**1345**	5,00	**1215**	5,00
40 x 3	**2102**	5,00	**1945**	5,00	**1885**	5,00	**1768**	5,00	**1712**	5,00	**1636**	5,00	**1597**	5,00	**1585**	5,00	**1486**	5,00	**1343**	5,00
45 x 3	**2296**	5,00	**2125**	5,00	**2060**	5,00	**1931**	5,00	**1870**	5,00	**1787**	5,00	**1745**	5,00	**1732**	5,00	**1624**	5,00	**1467**	5,00
50 x 3	**2485**	5,00	**2300**	5,00	**2229**	5,00	**2090**	5,00	**2024**	5,00	**1934**	5,00	**1888**	5,00	**1874**	5,00	**1757**	5,00	**1588**	5,00
60 x 3	**2850**	5,00	**2637**	5,00	**2556**	5,00	**2396**	5,00	**2321**	5,00	**2217**	5,00	**2165**	5,00	**2149**	5,00	**2015**	5,00	**1821**	5,00
70 x 3	**3199**	5,00	**2960**	5,00	**2869**	5,00	**2690**	5,00	**2605**	4,99	**2489**	5,00	**2430**	5,00	**2412**	5,00	**2262**	5,00	**2044**	5,00
80 x 3	**3536**	5,00	**3272**	5,00	**3171**	5,00	**2973**	5,00	**2880**	5,00	**2751**	5,00	**2687**	5,00	**2667**	5,00	**2500**	5,00	**2259**	5,00

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer. The capacity table has been developed applying a single load concentration on grating area on the centre line of the panel.

GRATING CAPACITY TABLE

Class 1 – Dense crowd (pedestrian capacity) – according to UNI 11002-1

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)																			
	11		15		17		22		25		30		33		34		44		66	
	Ln = maximum centre-to-centre distance between supports (mm) - f = elastic deflection (sag) (mm)																			
	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*
90 x 3	**3862**	5,00	**3574**	5,00	**3464**	5,00	**3248**	5,00	**3146**	5,00	**3005**	5,00	**2935**	5,00	**2913**	5,00	**2731**	5,00	**2468**	5,00
100 x 3	**4180**	5,00	**3868**	5,00	**3749**	5,00	**3515**	5,00	**3404**	5,00	**3253**	5,00	**3176**	5,00	**3152**	4,99	**2956**	5,00	**2671**	5,00
30 x 4	**1821**	5,00	**1685**	5,00	**1633**	5,00	**1531**	5,00	**1483**	5,00	**1417**	5,00	**1383**	5,00	**1373**	5,00	**1287**	5,00	**1163**	5,00
40 x 4	**2259**	5,00	**2090**	5,00	**2026**	5,00	**1900**	5,00	**1840**	5,00	**1758**	5,00	**1716**	5,00	**1704**	5,00	**1597**	5,00	**1443**	5,00
45 x 4	**2468**	5,00	**2284**	5,00	**2213**	5,00	**2075**	5,00	**2010**	5,00	**1920**	5,00	**1875**	5,00	**1861**	5,00	**1745**	5,00	**1577**	5,00
50 x 4	**2671**	5,00	**2471**	4,99	**2395**	5,00	**2246**	5,00	**2175**	5,00	**2078**	5,00	**2029**	5,00	**2014**	5,00	**1888**	5,00	**1706**	5,00
60 x 4	**3062**	5,00	**2834**	5,00	**2746**	5,00	**2575**	5,00	**2494**	5,00	**2383**	5,00	**2327**	5,00	**2309**	5,00	**2165**	5,00	**1956**	5,00
70 x 4	**3437**	5,00	**3181**	5,00	**3083**	5,00	**2890**	5,00	**2800**	5,00	**2675**	5,00	**2612**	5,00	**2592**	5,00	**2430**	5,00	**2196**	5,00
80 x 4	**3800**	5,00	**3516**	5,00	**3408**	5,00	**3195**	5,00	**3094**	5,00	**2957**	5,00	**2887**	5,00	**2865**	5,00	**2687**	5,00	**2428**	5,00
90 x 4	**4151**	5,00	**3841**	5,00	**3722**	5,00	**3490**	5,00	**3380**	5,00	**3230**	5,00	**3154**	5,00	**3130**	5,00	**2935**	5,00	**2652**	5,00
100 x 4	**4492**	5,00	**4157**	5,00	**4029**	5,00	**3777**	5,00	**3658**	5,00	**3495**	5,00	**3413**	5,00	**3388**	5,00	**3176**	5,00	**2870**	5,00
110 x 4	**4825**	5,00	**4465**	5,00	**4327**	5,00	**4057**	5,00	**3929**	5,00	**3754**	5,00	**3666**	5,00	**3639**	5,00	**3411**	5,00	**3083**	5,00
120 x 4	**5150**	5,00	**4766**	5,00	**4619**	5,00	**4331**	5,00	**4194**	5,00	**4007**	5,00	**3913**	5,00	**3884**	5,00	**3642**	5,00	**3290**	5,00
40 x 5	**2389**	5,00	**2210**	5,00	**2142**	5,00	**2009**	5,00	**1945**	5,00	**1859**	5,00	**1815**	5,00	**1801**	5,00	**1689**	5,00	**1526**	5,00
50 x 5	**2824**	5,00	**2613**	5,00	**2533**	5,00	**2375**	5,00	**2300**	5,00	**2197**	5,00	**2146**	5,00	**2130**	5,00	**1997**	5,00	**1804**	5,00
60 x 5	**3238**	5,00	**2996**	5,00	**2904**	5,00	**2723**	5,00	**2637**	5,00	**2519**	5,00	**2460**	5,00	**2442**	5,00	**2289**	5,00	**2069**	5,00
70 x 5	**3635**	5,00	**3363**	5,00	**3260**	5,00	**3056**	5,00	**2960**	5,00	**2828**	5,00	**2762**	5,00	**2741**	5,00	**2570**	5,00	**2322**	5,00
80 x 5	**4018**	5,00	**3718**	5,00	**3603**	5,00	**3378**	5,00	**3272**	5,00	**3126**	5,00	**3053**	5,00	**3030**	5,00	**2841**	5,00	**2567**	5,00
90 x 5	**4389**	5,00	**4061**	5,00	**3936**	5,00	**3690**	5,00	**3574**	5,00	**3415**	5,00	**3335**	5,00	**3310**	5,00	**3103**	5,00	**2804**	5,00
100 x 5	**4750**	5,00	**4395**	5,00	**4260**	5,00	**3994**	5,00	**3868**	5,00	**3696**	5,00	**3609**	5,00	**3582**	5,00	**3358**	5,00	**3035**	5,00
110 x 5	**5102**	5,00	**4721**	5,00	**4575**	5,00	**4290**	5,00	**4155**	5,00	**3970**	5,00	**3876**	5,00	**3847**	5,00	**3607**	5,00	**3259**	5,00
120 x 5	**5446**	5,00	**5039**	5,00	**4884**	5,00	**4579**	5,00	**4435**	5,00	**4237**	5,00	**4138**	5,00	**4107**	5,00	**3850**	5,00	**3479**	5,00

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer. The capacity table has been developed applying a single load concentration on grating area on the centre line of the panel.

GRATING CAPACITY TABLE

Class 2 – Automobiles – according to UNI 11002-1

- M.D. 14 January 2008 – 3.1.4 – table 3-1-II – Category F
- Dynamic load 1000 daN/m2 on an load concentration on grating area 200 x 200 mm total ground mass up to 3000 kg
- Steel material S235JR – Sigma enervation = 23.5 daN/mm2 – Sigma comparison = 22.38 daN/mm2
- Maximum sag 5 mm
- Maximum sag 1/200 di Ln

Load bearing bar section	Centre distance between load bearing bars (mm)																			
	11		15		17		22		25		30		33		34		44		66	
	Ln = maximum centre-to-centre distance between supports (mm) - f = elastic deflection (sag) (mm)																			
	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*
20 x 2	**272**	0,54	**231**	0,39	**214**	0,34	**197**	0,28	**187**	0,26	**168**	0,21	**166**	0,20	**156**	0,18	**143**	0,15	**129**	0,12
25 x 2	**369**	0,77	**305**	0,54	**279**	0,45	**252**	0,37	**238**	0,33	**210**	0,26	**208**	0,26	**195**	0,22	**179**	0,19	**162**	0,15
30 x 2	**488**	1,09	**395**	0,73	**357**	0,60	**320**	0,49	**298**	0,43	**259**	0,33	**255**	0,32	**237**	0,27	**216**	0,23	**194**	0,18
35 x 2	**628**	1,51	**502**	0,99	**450**	0,80	**399**	0,64	**370**	0,55	**316**	0,41	**312**	0,40	**287**	0,34	**258**	0,28	**229**	0,22
40 x 2	**790**	2,05	**625**	1,31	**558**	1,06	**491**	0,83	**453**	0,71	**383**	0,52	**376**	0,50	**345**	0,42	**306**	0,34	**268**	0,26
45 x 2	**974**	2,73	**764**	1,71	**680**	1,37	**595**	1,06	**547**	0,90	**458**	0,65	**450**	0,62	**410**	0,52	**361**	0,41	**313**	0,31
50 x 2	**1179**	3,55	**920**	2,20	**816**	1,75	**711**	1,34	**652**	1,14	**542**	0,80	**532**	0,77	**482**	0,64	**423**	0,50	**363**	0,37
25 x 3	**504**	1,39	**407**	0,93	**368**	0,77	**329**	0,62	**307**	0,54	**265**	0,41	**262**	0,40	**243**	0,35	**221**	0,29	**198**	0,23
30 x 3	**682**	2,06	**543**	1,34	**486**	1,08	**430**	0,86	**398**	0,74	**339**	0,55	**333**	0,53	**306**	0,45	**274**	0,36	**242**	0,29
35 x 3	**893**	2,97	**703**	1,88	**626**	1,50	**549**	1,17	**505**	1,00	**425**	0,72	**418**	0,70	**381**	0,59	**337**	0,46	**293**	0,35
40 x 3	**1136**	4,13	**887**	2,56	**787**	2,04	**687**	1,57	**629**	1,33	**524**	0,94	**515**	0,91	**467**	0,75	**410**	0,59	**353**	0,44
45 x 3	**1360**	5,00	**1097**	3,43	**970**	2,70	**843**	2,06	**770**	1,73	**637**	1,21	**625**	1,16	**565**	0,96	**492**	0,74	**420**	0,55
50 x 3	**1510**	5,00	**1330**	4,48	**1174**	3,52	**1017**	2,66	**928**	2,24	**763**	1,53	**749**	1,48	**674**	1,21	**584**	0,92	**495**	0,67
60 x 3	**1811**	5,00	**1653**	5,00	**1580**	5,00	**1421**	4,24	**1292**	3,53	**1056**	2,39	**1034**	2,29	**927**	1,86	**798**	1,39	**669**	0,99
70 x 3	**2111**	5,00	**1928**	5,00	**1842**	5,00	**1748**	5,00	**1690**	5,00	**1401**	3,54	**1372**	3,40	**1225**	2,73	**1050**	2,02	**874**	1,42
80 x 3	**2412**	5,00	**2202**	5,00	**2105**	5,00	**1997**	5,00	**1930**	5,00	**1794**	5,00	**1761**	4,83	**1570**	3,86	**1341**	2,84	**1112**	1,98

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer. The capacity table has been developed applying a single load concentration on grating area on the centre line of the panel.

GRATING CAPACITY TABLE

Class 2 – Automobiles – according to UNI 11002-1

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)																			
	11		15		17		22		25		30		33		34		44		66	
	Ln = maximum centre-to-centre distance between supports (mm) - f = elastic deflection (sag) (mm)																			
	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*
90 x 3	**2713**	5,00	**2477**	5,00	**2367**	5,00	**2246**	5,00	**2171**	5,00	**2017**	5,00	**2002**	5,00	**1922**	5,00	**1671**	3,88	**1381**	2,68
100 x 3	**3014**	5,00	**2752**	5,00	**2630**	5,00	**2495**	5,00	**2412**	5,00	**2241**	5,00	**2224**	5,00	**2135**	5,00	**2018**	5,00	**1681**	3,53
30 x 4	**877**	3,34	**690**	2,11	**615**	1,69	**540**	1,32	**497**	1,13	**418**	0,81	**411**	0,79	**375**	0,66	**332**	0,52	**289**	0,40
40 x 4	**1331**	5,00	**1150**	4,22	**1016**	3,32	**883**	2,54	**806**	2,13	**666**	1,48	**653**	1,42	**590**	1,18	**513**	0,90	**437**	0,66
45 x 4	**1496**	5,00	**1366**	5,00	**1260**	4,48	**1091**	3,39	**994**	2,83	**817**	1,94	**800**	1,87	**720**	1,53	**623**	1,16	**527**	0,84
50 x 4	**1661**	5,00	**1517**	5,00	**1450**	5,00	**1323**	4,43	**1204**	3,69	**985**	2,51	**965**	2,41	**865**	1,95	**746**	1,47	**627**	1,06
60 x 4	**1992**	5,00	**1819**	5,00	**1739**	5,00	**1650**	5,00	**1595**	5,00	**1374**	3,97	**1346**	3,82	**1202**	3,07	**1031**	2,28	**859**	1,61
70 x 4	**2323**	5,00	**2121**	5,00	**2027**	5,00	**1924**	5,00	**1859**	5,00	**1728**	5,00	**1715**	5,00	**1601**	4,59	**1367**	3,37	**1133**	2,35
80 x 4	**2655**	5,00	**2423**	5,00	**2316**	5,00	**2198**	5,00	**2124**	5,00	**1974**	5,00	**1959**	5,00	**1881**	5,00	**1755**	4,80	**1449**	3,31
90 x 4	**2986**	5,00	**2726**	5,00	**2605**	5,00	**2472**	5,00	**2389**	5,00	**2220**	5,00	**2203**	5,00	**2115**	5,00	**1999**	5,00	**1808**	4,53
100 x 4	**3317**	5,00	**3028**	5,00	**2894**	5,00	**2746**	5,00	**2654**	5,00	**2466**	5,00	**2447**	5,00	**2350**	5,00	**2221**	5,00	**2075**	5,00
110 x 4	**3649**	5,00	**3331**	5,00	**3183**	5,00	**3020**	5,00	**2919**	5,00	**2712**	5,00	**2691**	5,00	**2584**	5,00	**2443**	5,00	**2282**	5,00
120 x 4	**3980**	5,00	**3633**	5,00	**3472**	5,00	**3294**	5,00	**3184**	5,00	**2958**	5,00	**2936**	5,00	**2819**	5,00	**2664**	5,00	**2489**	5,00
40 x 5	**1433**	5,00	**1308**	5,00	**1245**	4,92	**1078**	3,73	**983**	3,12	**808**	2,14	**792**	2,06	**712**	1,68	**617**	1,28	**521**	0,93
50 x 5	**1789**	5,00	**1634**	5,00	**1561**	5,00	**1482**	5,00	**1432**	5,00	**1206**	3,70	**1181**	3,56	**1057**	2,87	**908**	2,14	**758**	1,51
60 x 5	**2146**	5,00	**1959**	5,00	**1872**	5,00	**1777**	5,00	**1717**	5,00	**1596**	5,00	**1584**	5,00	**1478**	4,58	**1263**	3,38	**1048**	2,35
70 x 5	**2502**	5,00	**2284**	5,00	**2183**	5,00	**2072**	5,00	**2002**	5,00	**1861**	5,00	**1847**	5,00	**1773**	5,00	**1676**	5,00	**1391**	3,49
80 x 5	**2859**	5,00	**2610**	5,00	**2495**	5,00	**2367**	5,00	**2288**	5,00	**2126**	5,00	**2110**	5,00	**2026**	5,00	**1915**	5,00	**1787**	4,98
90 x 5	**3216**	5,00	**2936**	5,00	**2806**	5,00	**2662**	5,00	**2573**	5,00	**2391**	5,00	**2373**	5,00	**2278**	5,00	**2153**	5,00	**2012**	5,00
100 x 5	**3573**	5,00	**3262**	5,00	**3117**	5,00	**2958**	5,00	**2858**	5,00	**2656**	5,00	**2636**	5,00	**2531**	5,00	**2392**	5,00	**2235**	5,00
110 x 5	**3930**	5,00	**3587**	5,00	**3428**	5,00	**3253**	5,00	**3144**	5,00	**2921**	5,00	**2899**	5,00	**2783**	5,00	**2631**	5,00	**2458**	5,00
120 x 5	**4287**	5,00	**3913**	5,00	**3740**	5,00	**3549**	5,00	**3429**	5,00	**3186**	5,00	**3162**	5,00	**3036**	5,00	**2870**	5,00	**2681**	5,00

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer. The capacity table has been developed applying a single load concentration on grating area on the centre line of the panel.

GRATING CAPACITY TABLE

Class 3 – Lightweight lorries – according to UNI 11002-1

- Dynamic load 3000 daN/m2 on an load concentration on grating area 400 x 200 mm total ground mass up to 6000 kg
- Steel material S235JR – Sigma enervation = 23.5 daN/mm2 – Sigma comparison = 22.38 daN/mm2
- Maximum sag 5 mm
- Maximum sag 1/200 di Ln

Tabella parte 1

Load bearing bar section	Centre distance between load bearing bars (mm)																			
	11		15		17		22		25		30		33		34		44		66	
	Ln = maximum centre-to-centre distance between supports (mm) - f = elastic deflection (sag) (mm)																			
	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*
20 x 2	**205**	0,31	**176**	0,23	**167**	0,21	**150**	0,17	**142**	0,15	**129**	0,12	**124**	0,11	**120**	0,11	**110**	0,09	**93**	0,06
25 x 2	**264**	0,41	**222**	0,29	**209**	0,26	**187**	0,21	**177**	0,18	**162**	0,15	**156**	0,14	**150**	0,13	**138**	0,11	**117**	0,08
30 x 2	**321**	0,51	**276**	0,37	**257**	0,32	**227**	0,25	**213**	0,22	**194**	0,18	**187**	0,17	**180**	0,16	**165**	0,13	**140**	0,10
35 x 2	**375**	0,59	**327**	0,45	**305**	0,39	**273**	0,31	**255**	0,27	**229**	0,22	**219**	0,20	**211**	0,19	**193**	0,16	**164**	0,11
40 x 2	**430**	0,68	**374**	0,52	**349**	0,45	**323**	0,39	**302**	0,33	**268**	0,26	**255**	0,24	**245**	0,22	**222**	0,18	**187**	0,13
45 x 2	**491**	0,79	**421**	0,58	**393**	0,51	**363**	0,43	**345**	0,39	**309**	0,31	**297**	0,28	**283**	0,26	**254**	0,21	**211**	0,15
50 x 2	**559**	0,91	**473**	0,66	**438**	0,57	**403**	0,48	**383**	0,43	**343**	0,35	**339**	0,34	**319**	0,30	**290**	0,24	**237**	0,16
25 x 3	**328**	0,63	**283**	0,47	**264**	0,41	**232**	0,32	**218**	0,28	**198**	0,23	**191**	0,22	**184**	0,20	**169**	0,17	**143**	0,12
30 x 3	**394**	0,77	**343**	0,58	**321**	0,51	**290**	0,41	**270**	0,35	**242**	0,29	**231**	0,26	**222**	0,24	**202**	0,20	**172**	0,15
35 x 3	**464**	0,91	**401**	0,68	**374**	0,59	**346**	0,51	**328**	0,45	**293**	0,35	**279**	0,32	**266**	0,29	**240**	0,24	**201**	0,17
40 x 3	**545**	1,08	**462**	0,79	**429**	0,68	**395**	0,58	**375**	0,52	**336**	0,42	**332**	0,41	**313**	0,36	**283**	0,29	**232**	0,20
45 x 3	**637**	1,30	**532**	0,92	**490**	0,78	**447**	0,65	**423**	0,59	**378**	0,47	**374**	0,46	**352**	0,41	**323**	0,34	**267**	0,23
50 x 3	**739**	1,55	**610**	1,07	**558**	0,91	**505**	0,75	**476**	0,67	**421**	0,52	**416**	0,51	**391**	0,45	**359**	0,38	**306**	0,27
60 x 3	**977**	2,19	**790**	1,46	**715**	1,21	**640**	0,98	**597**	0,86	**518**	0,65	**511**	0,64	**475**	0,55	**432**	0,46	**389**	0,37
70 x 3	**1257**	3,03	**1004**	1,98	**901**	1,61	**799**	1,28	**741**	1,11	**633**	0,82	**624**	0,80	**575**	0,69	**516**	0,56	**458**	0,44
80 x 3	**1581**	4,11	**1250**	2,62	**1116**	2,11	**983**	1,66	**906**	1,42	**766**	1,04	**753**	1,00	**690**	0,85	**613**	0,68	**537**	0,53

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer. The capacity table has been developed applying a single load concentration on grating area on the centre line of the panel.

GRATING CAPACITY TABLE

Class 3 – Lightweight lorries – according to UNI 11002-1

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)																			
	11		15		17		22		25		30		33		34		44		66	
	Ln = maximum centre-to-centre distance between supports (mm) - f = elastic deflection (sag) (mm)																			
	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*
90 x 3	**1893**	5,00	**1529**	3,42	**1360**	2,74	**1191**	2,13	**1094**	1,81	**917**	1,29	**900**	1,25	**820**	1,05	**723**	0,82	**627**	0,63
100 x 3	**2100**	5,00	**1841**	4,40	**1632**	3,49	**1423**	2,69	**1304**	2,27	**1085**	1,60	**1065**	1,55	**965**	1,28	**846**	1,00	**727**	0,75
30 x 4	**459**	1,04	**396**	0,77	**370**	0,67	**342**	0,57	**325**	0,52	**289**	0,40	**275**	0,37	**263**	0,34	**237**	0,28	**199**	0,20
40 x 4	**660**	1,56	**550**	1,10	**505**	0,93	**461**	0,78	**435**	0,70	**388**	0,56	**384**	0,54	**361**	0,48	**332**	0,41	**276**	0,28
45 x 4	**782**	1,91	**643**	1,32	**586**	1,10	**530**	0,91	**498**	0,81	**439**	0,63	**433**	0,61	**406**	0,54	**373**	0,46	**322**	0,33
50 x 4	**919**	2,34	**747**	1,58	**677**	1,31	**607**	1,06	**568**	0,94	**495**	0,72	**488**	0,70	**455**	0,61	**415**	0,51	**374**	0,39
60 x 4	**1236**	3,42	**987**	2,23	**887**	1,82	**787**	1,45	**729**	1,26	**624**	0,93	**615**	0,91	**567**	0,78	**510**	0,63	**453**	0,50
70 x 4	**1610**	4,86	**1272**	3,10	**1135**	2,49	**999**	1,96	**921**	1,68	**778**	1,22	**765**	1,18	**700**	1,00	**622**	0,80	**544**	0,62
80 x 4	**1852**	5,00	**1600**	4,20	**1422**	3,35	**1244**	2,60	**1142**	2,21	**955**	1,57	**938**	1,52	**853**	1,27	**751**	1,00	**649**	0,75
90 x 4	**2081**	5,00	**1901**	5,00	**1746**	4,42	**1521**	3,39	**1392**	2,86	**1156**	2,01	**1134**	1,94	**1027**	1,60	**898**	1,24	**769**	0,93
100 x 4	**2310**	5,00	**2110**	5,00	**2017**	5,00	**1831**	4,36	**1672**	3,66	**1380**	2,53	**1353**	2,44	**1221**	2,01	**1062**	1,54	**902**	1,13
110 x 4	**2539**	5,00	**2319**	5,00	**2217**	5,00	**2105**	5,00	**1981**	4,61	**1628**	3,16	**1596**	3,04	**1435**	2,48	**1243**	1,89	**1050**	1,37
120 x 4	**2768**	5,00	**2528**	5,00	**2417**	5,00	**2294**	5,00	**2217**	5,00	**1899**	3,89	**1861**	3,74	**1670**	3,04	**1441**	2,29	**1212**	1,65
40 x 5	**775**	2,12	**637**	1,46	**581**	1,22	**526**	1,01	**494**	0,90	**436**	0,70	**430**	0,68	**404**	0,60	**371**	0,51	**320**	0,37
50 x 5	**1099**	3,28	**883**	2,17	**796**	1,78	**709**	1,43	**660**	1,25	**568**	0,94	**560**	0,91	**519**	0,79	**469**	0,65	**419**	0,52
60 x 5	**1495**	4,92	**1184**	3,15	**1059**	2,55	**934**	2,01	**862**	1,73	**731**	1,26	**719**	1,22	**659**	1,04	**587**	0,83	**516**	0,65
70 x 5	**1748**	5,00	**1540**	4,46	**1369**	3,56	**1199**	2,77	**1101**	2,35	**922**	1,68	**906**	1,63	**825**	1,36	**728**	1,08	**630**	0,82
80 x 5	**1994**	5,00	**1822**	5,00	**1727**	4,86	**1505**	3,74	**1377**	3,15	**1144**	2,22	**1123**	2,14	**1016**	1,77	**889**	1,37	**762**	1,03
90 x 5	**2240**	5,00	**2046**	5,00	**1957**	5,00	**1851**	4,94	**1690**	4,15	**1395**	2,87	**1368**	2,77	**1233**	2,27	**1072**	1,74	**911**	1,28
100 x 5	**2486**	5,00	**2271**	5,00	**2171**	5,00	**2061**	5,00	**1993**	5,00	**1675**	3,67	**1642**	3,53	**1476**	2,88	**1277**	2,18	**1078**	1,58
110 x 5	**2733**	5,00	**2496**	5,00	**2386**	5,00	**2265**	5,00	**2190**	5,00	**1985**	4,63	**1945**	4,45	**1744**	3,61	**1503**	2,71	**1263**	1,95
120 x 5	**2980**	5,00	**2722**	5,00	**2602**	5,00	**2469**	5,00	**2387**	5,00	**2219**	5,00	**2203**	5,00	**2038**	4,46	**1751**	3,33	**1465**	2,37

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer. The capacity table has been developed applying a single load concentration on grating area on the centre line of the panel.

GRATING CAPACITY TABLE

Class 4 – Lorries and articulated trucks – according to UNI 11002-1

- Highway Code – Article 62. Mass limit - Section 5. For every type of vehicle, the heavier mass on the most loaded axle shall not exceed 12 t
- Dynamic load 9000 daN/m2 on an load concentration on grating area 600 x 250 mm total ground mass up to 45000 kg
- Steel material S235JR – Sigma enervation = 23.5 daN/mm2 – Sigma comparison = 22.38 daN/mm2
- Maximum sag 5 mm
- Maximum sag 1/200 di Ln

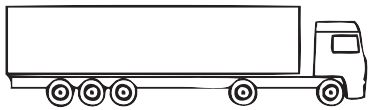


Tabella parte 1

Load bearing bar section	Centre distance between load bearing bars (mm)																			
	11		15		17		22		25		30		33		34		44		66	
	Ln = maximum centre-to-centre distance between supports (mm) - f = elastic deflection (sag) (mm)																			
	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*
20 x 2	**159**	0,19	**138**	0,14	**130**	0,12	**115**	0,10	**109**	0,09	**100**	0,07	**95**	0,07	**93**	0,06	**82**	0,05	**70**	0,04
25 x 2	**199**	0,23	**173**	0,18	**162**	0,15	**144**	0,12	**136**	0,11	**125**	0,09	**119**	0,08	**116**	0,08	**103**	0,06	**88**	0,05
30 x 2	**239**	0,28	**208**	0,21	**195**	0,19	**173**	0,15	**164**	0,13	**150**	0,11	**143**	0,10	**139**	0,09	**124**	0,08	**106**	0,06
35 x 2	**281**	0,33	**242**	0,25	**228**	0,22	**202**	0,17	**191**	0,15	**176**	0,13	**167**	0,12	**163**	0,11	**144**	0,09	**123**	0,06
40 x 2	**329**	0,40	**278**	0,28	**260**	0,25	**231**	0,20	**218**	0,17	**201**	0,15	**191**	0,13	**186**	0,13	**165**	0,10	**141**	0,07
45 x 2	**371**	0,45	**319**	0,33	**296**	0,29	**260**	0,22	**246**	0,20	**226**	0,17	**215**	0,15	**209**	0,14	**186**	0,11	**159**	0,08
50 x 2	**412**	0,50	**359**	0,38	**337**	0,33	**292**	0,25	**274**	0,22	**251**	0,19	**239**	0,17	**233**	0,16	**206**	0,12	**176**	0,09
25 x 3	**244**	0,35	**212**	0,27	**199**	0,23	**177**	0,19	**167**	0,16	**154**	0,14	**146**	0,13	**142**	0,12	**126**	0,09	**108**	0,07
30 x 3	**297**	0,43	**254**	0,32	**239**	0,28	**212**	0,22	**201**	0,20	**184**	0,17	**175**	0,15	**171**	0,14	**152**	0,11	**129**	0,08
35 x 3	**353**	0,52	**301**	0,38	**280**	0,33	**248**	0,26	**234**	0,23	**215**	0,19	**205**	0,18	**200**	0,17	**177**	0,13	**151**	0,10
40 x 3	**404**	0,60	**352**	0,46	**328**	0,39	**285**	0,30	**268**	0,26	**246**	0,22	**234**	0,20	**228**	0,19	**202**	0,15	**173**	0,11
45 x 3	**455**	0,68	**396**	0,51	**374**	0,46	**328**	0,35	**306**	0,30	**278**	0,25	**263**	0,23	**257**	0,22	**228**	0,17	**194**	0,12
50 x 3	**505**	0,75	**440**	0,57	**416**	0,51	**376**	0,41	**349**	0,35	**314**	0,29	**296**	0,26	**288**	0,24	**253**	0,19	**216**	0,14
60 x 3	**606**	0,90	**528**	0,69	**499**	0,61	**452**	0,50	**433**	0,46	**395**	0,38	**372**	0,33	**360**	0,31	**310**	0,24	**259**	0,16
70 x 3	**717**	1,08	**616**	0,80	**582**	0,72	**528**	0,59	**505**	0,54	**460**	0,45	**434**	0,40	**434**	0,40	**376**	0,29	**308**	0,20
80 x 3	**845**	1,30	**713**	0,93	**669**	0,83	**603**	0,67	**577**	0,61	**526**	0,51	**496**	0,45	**496**	0,45	**437**	0,35	**364**	0,24

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer. The capacity table has been developed applying a single load concentration on grating area on the centre line of the panel.

GRATING CAPACITY TABLE

Class 4 – Lorries and articulated trucks – according to UNI 11002-1

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)																			
	11		15		17		22		25		30		33		34		44		66	
	Ln = maximum centre-to-centre distance between supports (mm) - f = elastic deflection (sag) (mm)																			
	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*	Ln	*f*
90 x 3	**990**	1,56	**823**	1,10	**767**	0,96	**684**	0,77	**651**	0,69	**592**	0,58	**559**	0,51	**559**	0,51	**491**	0,40	**413**	0,28
100 x 3	**1152**	1,87	**946**	1,29	**876**	1,11	**774**	0,88	**734**	0,79	**661**	0,64	**621**	0,57	**621**	0,57	**546**	0,44	**459**	0,31
30 x 4	**350**	0,60	**298**	0,44	**277**	0,38	**245**	0,29	**232**	0,27	**213**	0,22	**202**	0,20	**197**	0,19	**175**	0,15	**149**	0,11
40 x 4	**467**	0,81	**406**	0,61	**384**	0,54	**339**	0,42	**316**	0,36	**286**	0,30	**271**	0,27	**264**	0,26	**234**	0,20	**199**	0,15
45 x 4	**525**	0,91	**457**	0,68	**432**	0,61	**391**	0,50	**367**	0,43	**330**	0,35	**310**	0,31	**301**	0,30	**263**	0,23	**224**	0,16
50 x 4	**583**	1,00	**508**	0,76	**480**	0,68	**435**	0,56	**416**	0,51	**378**	0,41	**353**	0,36	**342**	0,34	**296**	0,26	**249**	0,18
60 x 4	**709**	1,23	**610**	0,92	**576**	0,82	**522**	0,67	**500**	0,62	**456**	0,51	**430**	0,46	**430**	0,46	**371**	0,33	**304**	0,23
70 x 4	**856**	1,52	**722**	1,09	**676**	0,96	**609**	0,78	**583**	0,72	**532**	0,60	**502**	0,53	**502**	0,53	**441**	0,41	**369**	0,28
80 x 4	**1027**	1,88	**851**	1,31	**792**	1,15	**704**	0,91	**670**	0,83	**608**	0,68	**573**	0,61	**573**	0,61	**504**	0,47	**424**	0,33
90 x 4	**1220**	2,32	**998**	1,59	**923**	1,37	**812**	1,07	**769**	0,96	**690**	0,78	**647**	0,69	**647**	0,69	**567**	0,53	**477**	0,37
100 x 4	**1436**	2,85	**1162**	1,90	**1069**	1,63	**932**	1,25	**879**	1,12	**781**	0,89	**728**	0,78	**728**	0,78	**631**	0,59	**530**	0,42
110 x 4	**1674**	3,46	**1343**	2,28	**1230**	1,93	**1064**	1,46	**1000**	1,30	**883**	1,03	**818**	0,89	**818**	0,89	**701**	0,66	**583**	0,46
120 x 4	**1936**	4,18	**1541**	2,71	**1407**	2,28	**1210**	1,71	**1133**	1,51	**993**	1,18	**917**	1,01	**917**	1,01	**777**	0,74	**637**	0,50
40 x 5	**522**	1,01	**454**	0,76	**429**	0,68	**389**	0,56	**364**	0,48	**327**	0,39	**308**	0,35	**299**	0,33	**262**	0,25	**223**	0,18
50 x 5	**655**	1,27	**568**	0,95	**537**	0,85	**486**	0,70	**466**	0,64	**425**	0,53	**401**	0,48	**397**	0,45	**339**	0,34	**281**	0,23
60 x 5	**811**	1,60	**687**	1,16	**646**	1,03	**584**	0,84	**559**	0,77	**510**	0,64	**481**	0,57	**481**	0,57	**423**	0,44	**349**	0,29
70 x 5	**995**	2,02	**828**	1,43	**771**	1,24	**687**	0,99	**654**	0,90	**595**	0,75	**561**	0,66	**561**	0,66	**493**	0,51	**414**	0,36
80 x 5	**1208**	2,56	**989**	1,75	**915**	1,51	**805**	1,18	**763**	1,07	**685**	0,86	**643**	0,76	**643**	0,76	**564**	0,59	**474**	0,42
90 x 5	**1450**	3,22	**1172**	2,15	**1078**	1,83	**940**	1,42	**886**	1,26	**787**	1,01	**734**	0,88	**734**	0,88	**635**	0,66	**533**	0,47
100 x 5	**1720**	4,01	**1377**	2,63	**1261**	2,22	**1090**	1,69	**1023**	1,49	**902**	1,18	**836**	1,02	**836**	1,02	**714**	0,75	**592**	0,52
110 x 5	**2018**	4,94	**1603**	3,18	**1463**	2,68	**1256**	2,01	**1175**	1,77	**1028**	1,37	**948**	1,18	**948**	1,18	**801**	0,85	**654**	0,57
120 x 5	**2205**	5,00	**1851**	3,84	**1684**	3,21	**1437**	2,37	**1342**	2,08	**1167**	1,60	**1071**	1,36	**1071**	1,36	**896**	0,97	**721**	0,64

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer. The capacity table has been developed applying a single load concentration on grating area on the centre line of the panel.

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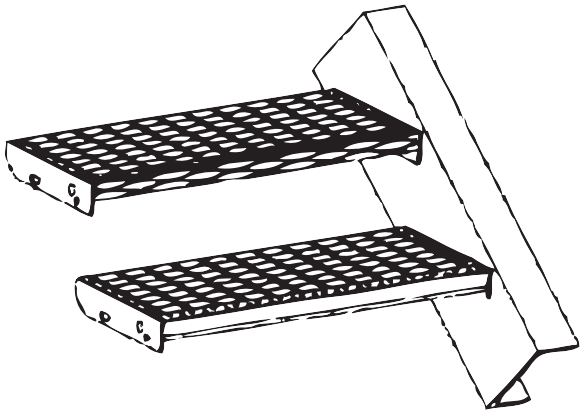
STEPS



Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

5.1 LOADS ACTING ON STEPS

The UNI 11002-2 § 6.1 figure 5 specifies the dynamic loads on stairway steps for public and private use, from the weight of the grating to the dimensional tolerances of the load bearing bars. This considers their circular load concentration on a 120 mm diameter on the grating area and a position flush with the front edge of the step at 600 mm modular distance.
To calculate the capacity refer to the load patterns indicated in section §1.2 of the present manual.

5.2 COLLABORATION BARS

Based on laboratory tests conducted at the Politecnico di Milano, Assogrigliati has drafted the following table that shows the number of collaboration bars (n') per step:

ELECTRO-WELDED GRATING		PRESSED GRATING	
MESH (MM)	n'= number of collaboration bars	MESH (MM)	n'= number of collaboration bars
11x76	1,7	11x66	1,7
15x76	1,6	15x66	1,6
17x76	1,5	22x66	1,4
22x76	1,4	25x66	1,2
25x76	1,2	30x66	1,1
30x100	1,1	33x66	1,0
34x76	1,0	44x44	0,9
44x76	0,9	66x33	0,7
		88x33	0,0

Note: the numbers of collaboration bars n' shown in the table are valid for a load concentration on grating circular area with a diameter of 120 mm. For other load concentration on grating areas due to special loads, the customer must first contact the Supplier's Technical Office. The number of load bearing bars N taken into consideration to determine the size is: n (bars below the load concentration on grating area) = (load concentration on grating area – nose): Distance (considering the entire+1), n'(collaboration bars) = see table, N = n + n'

Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

5.3 BOLTED STEP CONSTRAINTS

The constraint of the steps bolted to the sides cannot be considered a simple support nor an interlocking assembly. On the base of the results of the tests carried out at the laboratories of the Politecnico di Milano, the coefficient reductions for the elastic sag K1 and the bending moment K2 were calculated with respect to a calculation made by considering the steps tied to a simple support.

STEP	WIDTH 1200 (mm)		WIDTH 1800 (mm)	
Type of grating	Electro-welded gratings	Pressed gratings	Electro-welded gratings	Pressed gratings
Coefficient K_1 sag reduction	0,62	0,75	0,79	0,70
Coefficient K_1 bending moment	0,73	0,82	0,82	0,74

Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

5.4 DIMENSION AND LOAD CHARACTERISTICS OF THE STEPS

BASE ELEMENTS FOR CALCULATION					
Dimensions	Use	Type of load	Load concentration on grating area	Constraint coefficients	
Width mm		(daN)		Sag K_1	Bending moment K_2
600-799	Secondary Private	100	Pointy	0,75	0,82
800-1200	Main Private	100	Pointy	0,75	0,82
=1200	Public	200	Pointy	0,75	0,82
1201-1800	Public	200+200	Pointy	0,79	0,82
1801-2400	Public	200+200+200	Pointy	1	1
2401 - 3000	Public	200+200+200+200	Pointy	1	1

The capacity table has been calculated taking into account:

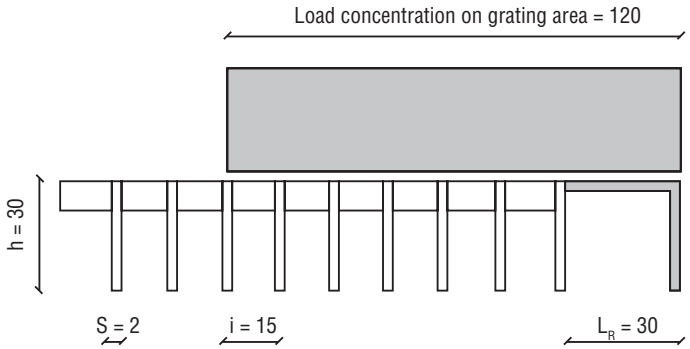
- Loads determinated by UNI 11002-2 standard.
- Number of collaboration bars as shown in the table on page 40 (§5.2) of the “Guide to the Use of Gratings”.
- Nose in “L” profile in height equal to the grating support plate height, in thickness equal to the grating support plate thickness, and with a wing profile of 30 mm wide.
- The constraint coefficients K_1 and K_2 used are those imposed for the most extreme calculation conditions.
- Elastic sag $\leq$ 5 mm; $\leq$ 1/200 of the centre-to-centre distance.
- Unitary enervation solicitation 23.5 daN / mm2
- Steel material S235JR UNI EN 10025.

Note: If for company requirements it is necessary to use a nose different than those considered in the table, a verifying calculation making reference to the procedures indicated on page 43 of the “Guide to the Use of Gratings” must we done.

Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

5.5 CALCULATION EXAMPLE FOR STEPS OF 1200 MM

5.5.1 STEP INERTIA CALCULATION ELECTRO-WELDED GRATINGS 30X2 – 15X76 / PRESSED GRATINGS 30X2 – 15X66



DATA:

Plate centre distance	i = 15 mm
Plate height	h = 30 mm
Plate thickness, nose thickness	s = 2 mm
Circular load concentration on grating area	d = 120 mm
Nose width	L_R = 30 mm
Plates under load concentration on grating area	n = 7,0
Collaboration plates	n' = 1,6 (see table § 5.2)
Nose vertical plate	1,0
Total plates	N = 9,6

Vertical bars area $A_1 = N \cdot s \cdot h = 9{,}6 \cdot 2 \cdot 30 = 576 \text{ mm}^2$

Horizontal nose area $A_2 = s \cdot (L_R - s) = 2 \cdot (30 - 2) = 56 \text{ mm}^2$

Inertia moment of vertical bars $J_1 = \frac{N \cdot s \cdot h^3}{12} = \frac{9{,}6 \cdot 2 \cdot 30^3}{12} = 43200 \text{ mm}^4$

Inertia moment of horizontal nose $J_2 = \frac{(L_R - s) \cdot s^3}{12} = \frac{(30 - 2) \cdot 2^3}{12} = 18{,}7 \text{ mm}^4$

Barycenter position $Y_G = \frac{A_1 \cdot \frac{h}{2} + A_2 \cdot \frac{s}{2}}{A_1 + A_2} = \frac{576 \cdot \frac{30}{2} + 56 \cdot \frac{2}{2}}{576 + 56} = 13{,}76 \text{ mm}$

Inertia moment $J_G = J_1 + A_1 \cdot (\frac{h}{2} - Y_G)^2 + J_2 + A_2 \cdot (Y_G - \frac{s}{2})^2 =$

$= 43200 + 576 \cdot (\frac{30}{2} - 13{,}76)^2 + 18{,}7 + 56 \cdot (13{,}76 - \frac{2}{2})^2 = 53222 \text{ mm}^4$

Elasticity modulus $W_G = \frac{J_G}{h - Y_G} = \frac{53222}{30 - 13{,}76} = 3277 \text{ mm}^3$

Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

5.5.2 CALCULATION EXAMPLE FOR STEPS OF 1200 MM

DATA:

Electro-welded grating	30x2 - 15x76
Pressed grating	30x2 - 15x66
Nose	L 30x30x2 mm
Load	P= 200 daN
Circular load concentration on grating area	d = 120 mm
Step length	L = 1200 mm
Collaboration bars	n' = 1,6 (vedi tabella § 5.2)
Step resistance modulus	W= 3277 mm^3
Step Inertia moment	J = 53.222 mm^4
Elasticity modulus (steel S235JR)	E = 21.000 daN/mm^2
Coefficient of sag reduction	K_1 = 0,75 (see table § 5.4)
Coefficient of moment reduction	K_2 = 0,82 (see table § 5.4)
Material S235JR	σ'_{sn} = 23,5 daN/mm^2

Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

CALCULATION EXAMPLE FOR STEPS OF 1200 MM

CALCULATIONS:

Bending moment

$$M = K_2 \cdot \frac{P \cdot \gamma_{qi} \cdot L}{4} = 0{,}82 \cdot \frac{200 \cdot 1{,}5 \cdot 1200}{4} = 73.800 \text{ daN} \cdot \text{mm}$$

Sigma comparison

$$\sigma_c = \frac{\sigma_{sn}}{\gamma_{M0}} = \frac{23{,}5}{1{,}05} = 22{,}38 \text{ daN/mm}^2$$

Uniform bending stress

$$\sigma = \frac{M}{W} = \frac{73.800}{3277} = 22{,}52 \text{ daN/mm}^2 < \sigma_c = 22{,}38 \text{ daN/mm}^2 \quad \sigma \approx \sigma_c$$

verified

Elastic sag

$$f = K_1 \cdot \frac{P \cdot L^3}{48 \cdot E \cdot J} = 0{,}75 \cdot \frac{200 \cdot 1200^3}{48 \cdot 21.000 \cdot 53.222} = 4{,}8 \text{ mm} < 5\text{mm}$$

verified

Sag/centre-to-centre distance ratio

$$\frac{f}{L_n} = \frac{4{,}8}{1200} = \frac{1}{250} < \frac{1}{200}$$

verified

Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

5.6 CALCULATION EXAMPLE FOR STEPS OF 1800 MM

5.6.1 STEP INERITA CALCULATION ELECTRO-WELDED GRATINGS/PRESSED GRATINGS 50X3 – 15/76

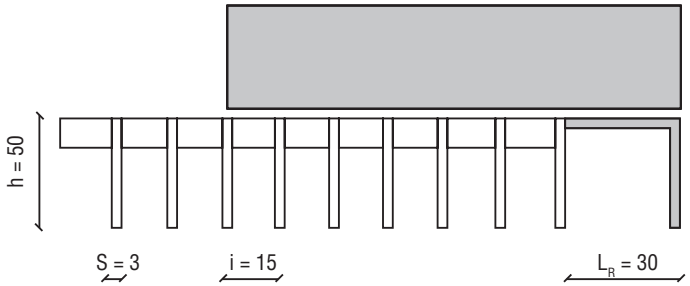


Plate centre distance	i = 15 mm
Plate height	h = 50 mm
Plate thickness, nose thickness	s = 3 mm
Circular load concentration on grating area	d = 120 mm
Nose width	L_R = 30 mm
Plates under load concentration on grating area	h = 7,0
Collaboration plates	n^1= 1,6 (see table § 5.2)
Nose vertical plate	1,0
Total plates	N = 9,6

Vertical bars area $A_1 = N \cdot s \cdot h = 9,6 \cdot 3 \cdot 50 = 1440\ mm^2$

Horizontal nose area $A_2 = S \cdot (L_R - s) = 3 \cdot (30-3) = 81\ mm^2$

Inertia movement of vertical bars $J_1 = \frac{N \cdot s \cdot h^3}{12} = \frac{9,6 \cdot 3 \cdot 50^3}{12} = 300000\ mm^4$

Inertia movement of horizontal nose $J_2 = \frac{(L_R-s) \cdot s^3}{12} = \frac{(30-3) \cdot 3^3}{12} = 60,8\ mm^4$

Barycenter position $Y_G = \frac{A_1 \cdot \frac{h}{2} + A_2 \cdot \frac{s}{2}}{A_1 + A_2} = \frac{1440 \cdot \frac{50}{2} + 81 \frac{3}{2}}{1440 + 81} = 23,75\ mm$

Inertia moment $J_G = J_1 + A_1 (\frac{h}{2} - Y_G)^2 + J_2 + A_2 (Y_G - \frac{s}{2})^2 = 300000 + 1440 (\frac{50}{2} - 23,75)^2 + 60,8 + 81 (23,75 - \frac{3}{2})^2 = 342411\ mm^4$

Resistance modulus $W_G = \frac{J_G}{h-Y_G} = \frac{342411}{50-23,75} = 13043\ mm^3$

Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

5.6.2 CALCULATION EXAMPLE FOR STEPS OF 1800 MM

DATA:

Electro-welded grating	50x3 - 15x76
Pressed grating	50x3 - 15x66
Nose	L 30x50x3
Load	$P_1 = P_2 = 200$ daN
Circular load concentration on grating area	d =120 mm
Step length	L = 1800 mm
Collaboration bars	n' = 1,6 (vedi tabella § 5.2)
Step resistance modulus	W= 13.043 mm^3
Step inertia moment	J = 342.411 mm^4
Elasticity modulus (steel S235JR)	E = 21.000 daN/mm^2
Coefficient of sag reduction	K_1 = 0,79 (see table § 5.4)
Coefficient of moment reduction	K_2 = 0,82 (see table § 5.4)
Material S235JR	$\sigma'_{sn} = 23,5$ daN/mm^2

Chapter 5 – Criteria for determining the size of grating steps for public and private use stairways (steel S235JR UNI EN 10025)

CALCULATIONS:

Bending moment

$$M = K_2 \cdot (R_A \cdot 900 - P_1 \cdot 300) \cdot \gamma_{Qi} = 0{,}82\ (200 \cdot 900 - 200 \cdot 300) \cdot 1{,}5 = 147.600\ \text{daN} \cdot \text{mm}$$

Sigma comparison

$$\sigma_c = \frac{\sigma_{sn}}{\gamma_{M0}} = \frac{23{,}5}{1{,}05} = 22{,}38\ \text{daN/mm}^2$$

Uniform bending stress

$$\sigma = \frac{M}{W} = \frac{147600}{13043} = 11{,}31\ \text{daN/mm}^2 < \sigma_c = 22{,}38\ \text{daN/mm}^2$$ *verified*

Elastic sag

$$f = 2 \cdot K_1 \cdot \frac{P L^3 C}{6 E J L}\left(1 - \frac{C^2}{L^2} - \frac{X^2}{L^2}\right)\frac{X}{L} =$$

$$= 2 \cdot 0{,}79\ \frac{200 \cdot 1800^3 \cdot 600}{6 \cdot 21000 \cdot 342411 \cdot 1800}\left(1 - \frac{600^2}{1800^2} - \frac{900^2}{1800^2}\right)\frac{900}{1800} = 4{,}5\ \text{mm} < 5\ \text{mm}$$ *verified*

Sag/centre-to-centre distance ratio

$$\frac{f}{L_n} = \frac{4{,}8}{1800} = \frac{1}{375} < \frac{1}{200}$$ *verified*

Step capacity table

- Material steel S235JR – Sigma enervation = 23.5 daN/mm2 – Sigma comparison = 22.38 daN/mm2
- Maximum sag 5 mm
- Maximum sag 1/200 of Ln

Colori:

- green = secondary private use 100 daN on circular load concentration on grating area Ø 120 mm
- red = main private use 100 daN on circular load concentration on grating area Ø 120 mm
- black = public use 200 daN on circular load concentration on grating area Ø 120 mm

Table part 1

		Centre distance between load bearing bars (mm)									
		11	15	17	22	25	30	33	34	44	66
		Ln = maximum centre-to-centre distance between supports (mm)									
		Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
Load bearing bar section	20 x 2	1097	1040	984	872	748	737	622	622	611	481
	25 x 2	1200	1200	1200	1200	1145	1129	951	951	935	735
	30 x 2	1200	1200	1200	1200	1200	1200	1200	1200	1200	1038
	35 x 2	1290	1233	1200	1200	1200	1200	1200	1200	1200	1200
	40 x 2	1436	1368	1330	1289	1239	1235	1200	1200	1200	1200
	45 x 2	1583	1506	1462	1414	1357	1352	1294	1294	1288	1200
	50 x 2	1733	1645	1595	1541	1476	1471	1405	1405	1398	1279
	25 x 3	1200	1200	1200	1200	1200	1200	1200	1200	1200	1073
	30 x 3	1272	1216	1200	1200	1200	1200	1200	1200	1200	1200
	35 x 3	1439	1371	1333	1291	1242	1238	1200	1200	1200	1200
	40 x 3	1609	1530	1484	1436	1378	1373	1313	1313	1308	1233
	45 x 3	1780	1690	1638	1582	1515	1510	1441	1441	1435	1349
	50 x 3	1800	1800	1793	1730	1655	1648	1571	1571	1563	1466
	60 x 3	2013	1919	1865	1807	1800	1800	1800	1800	1800	1702

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Step capacity table

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)									
	11	15	17	22	25	30	33	34	44	66
	Ln = maximum centre-to-centre distance between supports (mm)									
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
70 x 3	2281	2168	2103	2033	1950	1942	1857	1857	1849	1800
80 x 3	2486	2400	2346	2264	2166	2157	2057	2057	2047	1921
90 x 3	2724	2593	2518	2438	2385	2375	2260	2260	2249	2103
100 x 3	2966	2818	2733	2641	2532	2522	2410	2410	2400	2288
30 x 4	1370	1307	1271	1232	1200	1200	1200	1200	1200	1200
40 x 4	1746	1658	1607	1552	1487	1482	1415	1415	1408	1324
45 x 4	1800	1800	1778	1715	1641	1634	1558	1558	1550	1454
50 x 4	1882	1800	1800	1800	1796	1788	1702	1702	1693	1584
60 x 4	2175	2069	2009	1944	1866	1859	1800	1800	1800	1800
70 x 4	2417	2347	2275	2196	2103	2095	1999	1999	1990	1869
80 x 4	2678	2551	2478	2400	2344	2334	2222	2222	2211	2070
90 x 4	2944	2798	2714	2624	2516	2506	2400	2400	2400	2273
100 x 4	3153	3006	2954	2851	2729	2718	2592	2592	2580	2422
110 x 4	3396	3231	3137	3035	2945	2932	2791	2791	2778	2600
120 x 4	3600	3460	3355	3242	3107	3096	2993	2993	2978	2780
40 x 5	1800	1765	1710	1650	1579	1573	1500	1500	1492	1400
50 x 5	1993	1900	1847	1800	1800	1800	1800	1800	1800	1683
60 x 5	2312	2197	2131	2059	1974	1967	1880	1880	1871	1800
70 x 5	2557	2439	2400	2334	2232	2223	2119	2119	2108	1976
80 x 5	2842	2703	2623	2538	2435	2426	2361	2361	2350	2195
90 x 5	3080	2972	2880	2782	2664	2653	2532	2532	2520	2400
100 x 5	3340	3180	3088	3000	2896	2884	2746	2746	2733	2560
110 x 5	3600	3426	3323	3211	3079	3067	2963	2963	2948	2754
120 x 5	3600	3600	3560	3437	3290	3277	3125	3125	3111	2951

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

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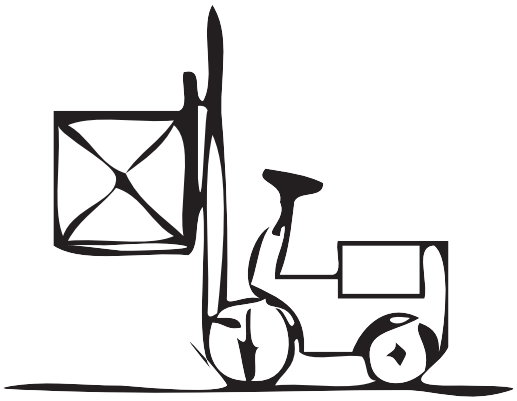
FORKLIFT TRUCKS



Chapter 6 – Forklift trucks

6.1 FORKLIFT TRUCKS CAPACITY CLASSES
EXCERPT FROM STANDARD UNI EN 1991-1-1 AUGUST 2004

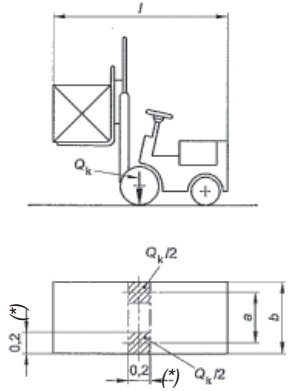
6.3.2.3 Actions induced by forklift trucks
(1) The forklift trucks must be classified in 6 classes from F1 to F6 according to their empty Weight, size and carried loads. (see table 6.5)

table 6.5 Size of forklift trucks according to FL classes

Forklift truck class	empty weight [kN]	carried load [kN]	axle width a [m]	total width o[m]	total length f[m]
FL 1	21	10	0,85	1,00	2,60
FL 2	31	15	0,95	1,10	3,00
FL 3	44	25	1,00	1,20	3,30
FL 4	60	40	1,20	1,40	4,00
FL 5	90	60	1,50	1,90	4,60
FL 6	110	80	1,80	2,30	5,10

(2) The vertical static axial load Qx of a forklift truck depends on the class from FL1 to FL 6 and must be obtained from table 6.6.

Figure 6.1 Forklift trucks dimensions



(7) The horizontal loads caused by the acceleration or deceleration of the forklift trucks, can be considerer equal to 30% of the vertical axial loads Qx.
Note: the dynamic coefficients must not be applied

Table 6.6 Forklift trucks axial load

Forklift trucks class	Load per axle Qx [kN]	Dynamic load on rigid wheel load concentration on grating area [kN]	Load concentration on grating area mm
FL 1	26	26	130x130
FL 2	40	40	175x150
FL 3	63	63	200x200
FL 4	90	90	300x200
FL 5	140	140	375x200
FL 6	170	170	450x200

(3) The vertical static axial load Qx must be increased by the dynamic coefficient φ through the expression (6.3).

Where:
Q_{kdyn} is the dynamic characteristic value of the action;
φ is the dynamic amplification coefficient;
Q_x is the static characteristic value of the action.

(4) The dynamic coefficient φ for the forklift truck considers the inertial effect caused by the acceleration and deceleration of the carried load and must equal to:
φ = 1.40 for forklift trucks on tyres,
φ = 2.00 for forklift trucks on rigid wheels.

(5) For forklift trucks that have an empty weight of more than 110 kN, the loads must be defined through a more accurate analysis.

(6) The vertical axial load Q_x or Q_{xdym} of a forklift truck must be arranged according to the indications in figure 6.1.

(*) see proxy UNI from 21/10/2008

Proxy UNI from 21/10/2008

"It is considered that the requirements of Eurocode 1 (UNI EN 1991-1-1) regarding the forklift trucks load concentration on grating areas are not applicable to grating panels, because the distribution of the vertical loads is different between a homogeneous surface (for example concrete flooring) and an uneven surface (such as grating panels), composed of a variable number of load bearing bars that depend on the dimensions of the load concentration on grating area".

Chapter 6 – Forklift trucks

The capacity tables have been calculated taking into account:
Loads considered in table §6.1 of this guide with load concentration on grating area as UNI proxy.

The calculations were carried out considering the least favourable direction.
Number of collaboration bars as in table – section 3.1 of the present guide.
Elastic sag ≤ 5 mm; $\leq \frac{1}{200}$ of the centre-to-centre distance

Unitary stress enervation 23,5 daN/mm^2

Material steel S235JR

Chapter 6 – Forklift trucks

Class FL1 Forklift trucks

- Load per axle *Qk* 2600 daN
- Dynamic load 2600 daN on rigid wheel load concentration on grating area (130x130)
- Material steel S235JR – Sigma Enervation = 23,5 daN/mm² - Sigma comparison = 22,38 daN/mm²
- Maximum sag 5 mm
- Maximum sag 1/200 of Ln

Table part 1

		Centre distance between load bearing bars (mm)								
		11	15	17	22	25	30	33	34	44
		Ln = maximum centre-to-centre distance between supports (mm)								
		Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
Load bearing bar section	20 x 2	108	95	90	81	80	74	67	67	59
	25 x 2	135	119	113	101	100	92	84	84	74
	30 x 2	166	144	136	121	120	111	101	101	89
	35 x 2	202	172	162	142	140	129	117	117	104
	40 x 2	244	205	192	166	164	149	134	134	119
	45 x 2	292	243	226	193	190	171	153	153	134
	50 x 2	346	284	263	223	219	196	174	174	151
	25 x 3	170	147	139	124	122	113	103	103	91
	30 x 3	216	183	172	150	148	136	123	123	109
	35 x 3	271	226	211	181	178	162	145	145	128
	40 x 3	334	276	255	217	213	191	169	169	147
	45 x 3	406	332	306	257	253	225	197	197	169
	50 x 3	486	394	363	303	297	262	228	228	194
	60 x 3	672	540	494	407	399	350	300	300	250
	70 x 3	891	711	649	531	520	453	385	385	318
	80 x 3	1144	909	828	674	659	571	483	483	395

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
90 x 3	1431	1134	1031	836	818	706	594	594	483
100 x 3	1752	1384	1258	1017	994	856	719	719	581
30 x 4	267	223	208	179	176	160	143	143	126
40 x 4	424	346	319	268	263	233	204	204	175
45 x 4	520	421	387	322	316	278	241	241	204
50 x 4	627	504	462	382	374	328	283	283	237
60 x 4	874	698	637	522	511	445	379	379	312
70 x 4	1167	927	844	687	672	582	492	492	402
80 x 4	1504	1191	1083	877	858	740	623	623	505
90 x 4	1887	1490	1354	1093	1069	920	771	771	622
100 x 4	2119	1824	1656	1335	1304	1120	937	937	753
110 x 4	2330	2147	1990	1601	1564	1342	1120	1120	898
120 x 4	2542	2342	2265	1894	1849	1585	1321	1321	1056
40 x 5	514	416	383	319	312	276	239	239	202
50 x 5	767	614	562	461	452	394	337	337	280
60 x 5	1077	856	781	636	622	540	457	457	374
70 x 5	1442	1142	1039	842	824	711	599	599	486
80 x 5	1826	1472	1338	1081	1056	909	762	762	615
90 x 5	2054	1846	1676	1351	1320	1134	948	948	762
100 x 5	2282	2103	2034	1652	1614	1384	1155	1155	925
110 x 5	2510	2313	2237	1986	1939	1662	1384	1384	1106
120 x 5	2738	2523	2440	2263	2245	1965	1635	1635	1304

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Chapter 6 – Forklift trucks

Class FL2 Forklift trucks

- Load per axle *Qk* 4000 daN
- Dynamic load 4000 daN on rigid wheel load concentration on grating area (175x150)
- Material steel S235JR – Sigma Enervation = 23,5 daN/mm^2 - Sigma comparison = 22,38 daN/mm^2
- Maximum sag 5 mm
- Maximum sag 1/200 of Ln

Table part 1

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
20 x 2	105	93	89	78	77	68	67	67	57
25 x 2	132	116	111	98	97	85	84	84	71
30 x 2	158	139	133	117	116	102	101	101	85
35 x 2	188	163	155	137	135	120	118	118	100
40 x 2	220	190	178	156	155	137	135	135	114
45 x 2	255	221	202	178	176	154	152	152	128
50 x 2	295	255	229	203	200	173	170	170	143
25 x 3	162	142	136	120	118	105	103	103	87
30 x 3	199	172	163	144	142	126	124	124	105
35 x 3	240	207	191	169	167	147	145	145	122
40 x 3	286	248	223	197	195	169	166	166	140
45 x 3	339	291	259	227	224	194	188	188	158
50 x 3	398	339	300	260	257	222	212	212	177
60 x 3	536	450	393	337	331	287	267	267	222
70 x 3	697	580	504	427	420	363	332	332	276
80 x 3	884	732	631	531	521	452	407	407	337

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
90 x 3	1096	903	776	649	637	552	492	492	407
100 x 3	1333	1094	937	781	766	664	587	587	485
30 x 4	237	204	189	167	165	145	143	143	121
40 x 4	353	302	268	235	232	200	194	194	162
45 x 4	423	359	317	274	270	234	222	222	185
50 x 4	502	423	370	318	313	271	254	254	211
60 x 4	685	570	495	420	413	357	327	327	271
70 x 4	901	745	643	540	531	460	414	414	343
80 x 4	1150	946	813	679	666	577	514	514	425
90 x 4	1433	1175	1006	836	820	711	627	627	518
100 x 4	1748	1430	1221	1012	992	860	753	753	622
110 x 4	2097	1712	1459	1206	1182	1025	893	893	736
120 x 4	2299	2021	1720	1419	1390	1206	1047	1047	862
40 x 5	419	356	314	272	268	232	220	220	184
50 x 5	606	507	441	376	370	320	295	295	245
60 x 5	835	691	597	503	494	428	387	387	321
70 x 5	1104	909	782	654	641	556	495	495	410
80 x 5	1416	1161	994	827	811	703	620	620	512
90 x 5	1769	1447	1235	1024	1003	870	762	762	628
100 x 5	2064	1766	1504	1243	1218	1057	920	920	758
110 x 5	2270	2115	1802	1486	1456	1263	1095	1095	902
120 x 5	2476	2307	2128	1752	1716	1489	1287	1287	1059

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Chapter 6 – Forklift trucks

Class FL3 Forklift trucks

- Load per axle *Qk* 6300 daN
- Dynamic load 6300 daN on rigid wheel load concentration on grating area (200x200)
- Material steel S235JR – Sigma Enervation = 23,5 daN/mm^2 - Sigma comparison = 22,38 daN/mm^2
- Maximum sag 5 mm
- Maximum sag 1/200 of Ln

Table part 1

		Centre distance between load bearing bars (mm)								
		11	15	17	22	25	30	33	34	44
		Ln = maximum centre-to-centre distance between supports (mm)								
		Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
Load bearing bar section	20 x 2	104	91	85	78	74	67	66	62	57
	25 x 2	130	114	106	98	93	83	82	77	71
	30 x 2	157	136	127	118	112	100	99	93	85
	35 x 2	183	159	149	137	131	117	116	109	100
	40 x 2	209	182	170	157	149	134	132	124	114
	45 x 2	238	205	191	177	168	150	149	140	128
	50 x 2	271	230	213	197	187	167	165	155	143
	25 x 3	160	139	130	120	114	102	101	95	87
	30 x 3	192	167	156	144	137	123	121	114	105
	35 x 3	225	195	182	168	160	143	142	133	122
	40 x 3	264	225	209	193	183	164	162	152	140
	45 x 3	308	258	238	217	206	184	182	171	157
	50 x 3	356	295	270	245	231	205	203	190	175
	60 x 3	470	381	345	309	289	251	248	231	210
	70 x 3	603	482	434	385	357	306	301	278	250
	80 x 3	757	600	536	472	436	369	363	333	297

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
90 x 3	932	733	652	571	525	441	433	395	349
100 x 3	1127	881	782	682	625	521	512	464	407
30 x 4	223	193	180	167	158	142	140	132	121
40 x 4	319	266	245	224	212	189	187	176	162
45 x 4	377	311	284	257	241	213	211	198	182
50 x 4	442	360	327	294	275	240	237	221	202
60 x 4	593	475	427	379	352	302	297	275	247
70 x 4	771	610	545	480	443	375	369	338	301
80 x 4	977	766	682	597	548	459	451	411	362
90 x 4	1210	944	836	729	667	555	545	493	432
100 x 4	1470	1142	1009	876	801	662	649	586	510
110 x 4	1758	1360	1200	1039	948	780	764	688	596
120 x 4	2073	1600	1409	1218	1109	909	891	800	691
40 x 5	374	308	281	255	240	212	209	197	181
50 x 5	528	425	384	342	319	275	271	251	228
60 x 5	716	568	509	449	415	352	347	318	284
70 x 5	939	738	657	575	529	444	436	397	351
80 x 5	1196	933	827	721	660	549	539	489	428
90 x 5	1487	1155	1020	886	809	669	656	592	515
100 x 5	1813	1402	1236	1071	976	802	786	707	613
110 x 5	2130	1676	1475	1274	1160	950	931	835	720
120 x 5	2323	1975	1737	1498	1361	1111	1089	975	838

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Chapter 6 – Forklift trucks

Class FL4 Forklift trucks

- Load per axle *Qk* 9000 daN
- Dynamic load 9000 daN on rigid wheel load concentration on grating area (300x200)
- Material steel S235JR – Sigma Enervation = 23,5 daN/mm² - Sigma comparison = 22,38 daN/mm²
- Maximum sag 5 mm
- Maximum sag 1/200 of Ln

Table part 1

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
20 x 2	104	91	84	75	73	67	64	61	54
25 x 2	130	113	106	94	91	84	80	76	68
30 x 2	156	136	127	113	109	101	96	92	82
35 x 2	182	159	148	132	127	118	112	107	95
40 x 2	208	182	169	151	146	135	128	123	109
45 x 2	237	205	191	170	164	151	144	138	123
50 x 2	268	229	212	189	182	168	160	153	137
25 x 3	159	139	130	116	111	103	98	94	83
30 x 3	191	167	156	139	134	124	118	113	100
35 x 3	224	195	182	162	156	144	137	131	117
40 x 3	262	224	208	185	179	165	157	150	134
45 x 3	295	257	236	209	201	186	177	169	151
50 x 3	329	286	267	235	225	206	196	188	167
60 x 3	409	346	321	294	280	252	239	227	201
70 x 3	502	418	383	349	330	294	290	273	238
80 x 3	610	500	455	411	385	338	334	313	280

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
90 x 3	732	593	536	480	448	389	383	356	324
100 x 3	869	697	627	557	518	445	438	405	365
30 x 4	222	193	180	161	155	143	136	130	116
40 x 4	303	264	244	215	206	191	181	173	155
45 x 4	344	297	278	245	235	215	204	195	174
50 x 4	389	332	309	280	266	242	229	218	193
60 x 4	495	412	379	345	326	291	286	270	235
70 x 4	620	507	461	416	390	342	338	316	284
80 x 4	763	616	557	498	464	401	396	367	333
90 x 4	927	740	665	590	547	468	461	425	382
100 x 4	1109	879	786	693	640	543	534	490	437
110 x 4	1310	1032	920	807	743	626	615	561	497
120 x 4	1531	1200	1066	933	856	716	703	640	563
40 x 5	341	295	276	244	233	214	203	194	173
50 x 5	449	377	348	319	303	271	261	247	217
60 x 5	581	478	436	394	370	327	323	303	269
70 x 5	737	596	539	483	450	390	385	358	326
80 x 5	917	733	659	585	542	464	457	422	379
90 x 5	1121	888	794	700	646	548	539	494	440
100 x 5	1349	1061	945	829	763	641	630	575	509
110 x 5	1601	1253	1112	972	892	745	731	664	584
120 x 5	1876	1463	1295	1128	1033	858	842	762	667

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Chapter 6 – Forklift trucks

Class FL5 Forklift trucks

- Load per axle *Qk* 14000 daN
- Dynamic load 14000 daN on rigid wheel load concentration on grating area (375x200)
- Material steel S235JR - Sigma Enervation = 23,5 daN/mm² - Sigma comparison = 22,38 daN/mm²
- Maximum sag 5 mm
- Maximum sag 1/200 of Ln

Table part 1

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
20 x 2	92	80	75	67	64	58	55	55	48
25 x 2	115	100	94	84	80	72	69	69	61
30 x 2	138	120	113	101	96	87	83	83	73
35 x 2	162	140	132	118	112	101	97	97	85
40 x 2	185	160	151	135	128	116	111	111	97
45 x 2	208	181	170	152	144	130	125	125	109
50 x 2	233	201	189	169	160	145	139	139	122
25 x 3	141	123	116	104	98	89	85	85	74
30 x 3	170	147	139	124	117	106	102	102	89
35 x 3	198	172	162	145	137	124	119	119	104
40 x 3	228	197	186	166	157	142	136	136	119
45 x 3	262	223	209	187	176	160	153	153	134
50 x 3	294	251	235	208	196	178	170	170	149
60 x 3	353	308	287	255	238	214	205	205	179
70 x 3	414	359	335	310	289	255	243	243	209
80 x 3	483	412	383	354	336	301	286	280	243

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Table part 2

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
90 x 3	562	472	436	399	379	339	335	315	281
100 x 3	650	539	494	449	424	377	372	350	322
30 x 4	196	170	161	144	136	123	118	118	103
40 x 4	271	229	215	192	181	164	157	157	138
45 x 4	306	264	246	216	204	185	177	177	155
50 x 4	340	296	277	244	228	205	197	197	172
60 x 4	409	355	332	307	285	252	240	240	207
70 x 4	489	417	388	358	340	304	290	283	246
80 x 4	582	487	449	411	389	348	344	324	290
90 x 4	687	567	518	470	443	392	387	364	334
100 x 4	804	656	596	537	502	440	434	406	372
110 x 4	933	754	682	610	569	493	486	452	411
120 x 4	1075	862	776	690	641	551	543	502	453
40 x 5	304	261	244	215	202	184	176	176	154
50 x 5	380	331	309	280	260	232	221	221	193
60 x 5	465	398	371	343	326	290	275	271	234
70 x 5	565	474	438	401	380	340	337	317	282
80 x 5	680	562	514	467	439	389	385	362	332
90 x 5	811	662	601	541	506	443	437	409	374
100 x 5	958	773	699	624	581	503	496	461	418
110 x 5	1120	896	806	716	664	570	561	518	466
120 x 5	1297	1031	924	816	755	642	632	581	520

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Chapter 6 – Forklift trucks

Class FL6 Forklift trucks

- Load per axle *Qk* 17000 daN
- Dynamic load 17000 daN on rigid wheel load concentration on grating area (450x200)
- Material steel S235JR - Sigma Enervation = 23,5 daN/mm² - Sigma comparison = 22,38 daN/mm²
- Maximum sag 5 mm
- Maximum sag 1/200 of Ln

Table part 1

Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum free space between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
20 x 2	90	79	74	66	62	57	54	54	48
25 x 2	113	98	92	82	78	72	67	67	60
30 x 2	135	118	111	99	94	86	81	81	72
35 x 2	158	138	129	115	109	101	94	94	84
40 x 2	180	158	148	132	125	115	108	108	96
45 x 2	203	178	166	148	141	130	121	121	108
50 x 2	227	197	185	165	157	144	135	135	120
25 x 3	138	121	113	101	96	88	83	83	74
30 x 3	166	145	136	121	115	106	99	99	88
35 x 3	193	169	159	141	134	124	116	116	103
40 x 3	222	193	181	161	153	141	132	132	118
45 x 3	255	219	204	182	173	159	149	149	133
50 x 3	291	247	229	202	192	177	166	166	148
60 x 3	351	306	285	247	233	213	199	199	177
70 x 3	409	357	333	300	281	253	235	235	207
80 x 3	468	408	381	352	335	299	276	276	240

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Table part 2

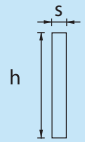
Load bearing bar section	Centre distance between load bearing bars (mm)								
	11	15	17	22	25	30	33	34	44
	Ln = maximum centre-to-centre distance between supports (mm)								
	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln	Ln
90 x 3	533	459	429	396	376	337	323	313	277
100 x 3	605	514	477	440	418	374	370	348	319
30 x 4	191	168	157	140	133	122	115	115	102
40 x 4	263	225	210	186	177	163	153	153	136
45 x 4	304	258	239	210	200	184	172	172	153
50 x 4	338	294	272	236	223	204	191	191	171
60 x 4	405	353	330	296	277	250	232	232	205
70 x 4	473	412	385	356	338	303	280	280	243
80 x 4	550	472	440	407	386	346	335	322	287
90 x 4	636	537	497	458	435	389	385	362	333
100 x 4	732	611	562	512	484	432	428	402	370
110 x 4	839	692	632	573	539	477	471	443	407
120 x 4	956	781	710	639	599	524	518	484	444
40 x 5	302	256	237	209	198	183	171	171	152
50 x 5	377	329	307	270	254	230	214	214	191
60 x 5	453	395	369	341	322	288	265	265	231
70 x 5	536	461	431	398	378	338	325	315	279
80 x 5	631	533	494	455	432	387	382	360	330
90 x 5	739	616	566	516	488	435	430	405	372
100 x 5	859	707	646	584	549	485	479	450	413
110 x 5	993	809	734	660	617	540	532	497	455
120 x 5	1139	920	831	743	692	599	591	549	498

For availability of load bearing bar and the centre distance between load bearing bars, contact the manufacturer.

Chapter 7 – Dimensional tolerances of the load bearing bars and crossbars

7.1 ELECTRO-WELDED GRATING

Section 5.3, table 1 of the standard UNI 11002-1:2009 specifies that in respect to the nominal dimensions, height differences must not exceed the tolerances given in the table below.

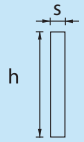
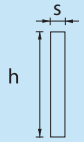
TOLERANCES OF THE LOAD BEARING BARS AND CROSSBARS (MM)		
Load bearing bars	Nominal dimensions	Tolerances
	$20 \leq h \leq 120$	+1,1 -1,1
	$2 \leq s \leq 5$	+0,25 -0,25
Crossbars	**Nominal dimensions**	**Tolerances**
Round	$4 \leq d_t \leq 5$	+0,25 -0,25
Twisted square bar	$4 \leq l_t \leq 5$	+0,25 -0,25

Within the limits considered in the hereby tolerances, the performance of the grating will not experience any variation regarding the capacity tables shown in the present Guide.

Chapter 7 – Dimensional tolerances of the load bearing bars and crossbars

7.2 PRESSED GRATING

Section 5.3, table 2 of the standard UNI 11002-1:2009 specifies that in respect to the nominal dimensions, height differences must not exceed the tolerances given in the table below.

TOLERANCES OF THE LOAD BEARING BARS AND CROSSBARS (MM)		
Load bearing bars	Nominal dimensions	Tolerances
	20 ≤ h ≤ 120	+1,1 -1,1
	2 ≤ s ≤ 5	+0,25 -0,25
Crossbars	Nominal dimensions	Tolerances
	8 ≤ h ≤ 120	+0,1 -1,1
	2 ≤ s ≤ 5	+0,15 -0,20

Within the limits considered in the hereby tolerances, the performance of the grating will not experience any variation regarding the capacity tables shown in the present Guide.

Chapter 8 – Electro-welded and pressed gratings weight tables

ELECTRO-WELDED GRATING

Table of theoretical weights (kg/m2) bordered and galvanised material

The shown weights must be intended as the material and manufacturing net tolerances considering a 1000x1000 panel.

(see section 7.1 and 7.2 of the present Guide)

WEIGHTS OF ELECTRO-WELDED GRATINGS IN BORDERED, GALVANISED MATERIAL

Load bearing bar section

h x s	15x76 Round	17x76 Round	22x38 Round	22x76 Round	25x25 Round	25x76 Round	30x50 Twisted square bar	30x100 Twisted square bar	34x38 Twisted square bar	34x76 Twisted square bar
20 x 2	24,4	21,8	18,8	17,5	31,3	15,8	14,7	13,4	14,1	12,5
25 x 2	30,1	26,9	22,9	21,5	36,6	19,4	17,7	16,5	16,8	15,2
30 x 2	35,9	31,9	26,9	25,5	47,0	23,1	20,8	19,5	19,5	17,9
40 x 2	47,4	42,1	34,9	33,6	57,4	30,3	26,8	25,6	24,9	23,3
45 x 2	53,1	47,2	38,9	37,6	67,8	33,9	29,9	28,6	27,7	26,0
50 x 2	58,8	52,3	42,9	41,6	78,2	37,5	32,9	31,6	30,4	28,7
25 x 3	43,6	38,8	32,6	30,9	88,6	27,8	25,1	23,5	23,6	21,5
30 x 3	52,0	46,1	38,4	36,7	41,2	33,0	29,4	27,8	27,5	25,4
40 x 3	68,7	60,9	50,0	48,3	48,1	43,4	38,1	36,5	35,2	33,1
50 x 3	85,4	75,7	61,6	59,9	61,9	53,9	46,8	45,3	43,0	40,9
60 x 3	102,1	90,4	73,2	71,5	75,8	64,3	55,6	54,0	50,7	48,6
70 x 3	118,8	105,2	84,9	83,2	89,6	74,7	64,3	62,7	58,4	56,4
80 x 3	135,5	120,0	96,5	94,8	103,4	85,1	73,0	71,4	66,2	64,1

h x s	15x76 Round	17x76 Round	22x38 Round	22x76 Round	25x25 Round	25x76 Round	30x50 Twisted square bar	30x100 Twisted square bar	34x38 Twisted square bar	34x76 Twisted square bar
25 x 4	57,8	51,4	43,0	40,9	117,3	36,8	33,0	31,0	31,0	28,4
30 x 4	68,9	61,2	50,7	48,6	49,5	43,8	38,8	36,8	36,1	33,5
40 x 4	91,1	80,8	66,1	64,0	58,1	57,6	50,4	48,4	46,4	43,8
50 x 4	113,3	100,4	81,6	79,5	75,3	71,4	61,9	60,0	56,7	54,1
60 x 4	135,5	120,0	97,0	94,9	92,4	85,2	73,5	71,6	67,0	64,4
70 x 4	157,7	139,6	112,4	110,3	109,5	99,1	85,1	83,1	77,3	74,7
80 x 4	179,8	159,2	127,9	125,8	126,7	112,9	96,7	94,7	87,6	85,0
25 x 5	71,2	63,2	52,3	50,2	143,8	45,2	40,0	38,0	37,2	34,6
30 x 5	85,0	75,4	61,9	59,7	15,8	53,7	47,2	45,2	43,5	41,0
40 x 5	112,5	99,7	81,0	78,9	19,4	70,9	61,5	59,6	56,3	53,7
50 x 5	140,0	124,0	100,1	98,0	23,1	88,0	75,9	73,9	69,1	66,5
60 x 5	167,5	148,3	119,3	117,2	30,3	105,2	90,2	88,3	81,8	79,3
70 x 5	195,0	172,6	138,4	136,3	33,9	122,3	104,6	102,6	94,6	92,0
80 x 5	222,5	196,9	157,5	155,4	37,5	139,5	118,9	117,0	107,3	104,8

Note 1: The border consists of a plate of the same type as the supporting one and of a hot-dip galvanising treatment according to standard UNI EN ISO 1461:2009
Note 2: The crossbars can be different from those indicated in the table depending on the manufacturer standards

Chapter 8 – Electro-welded and pressed gratings weight tables

ELECTRO-WELDED GRATINGS: BORDERED ROUGH MATERIAL WEIGHTS

Load bearing bar section

h x s	15x76 Round	17x76 Round	22x38 Round	22x76 Round	25x25 Round	25x76 Round	30x50 Twisted square bar	30x100 Twisted square bar	34x38 Twisted square bar	34x76 Twisted square bar
20 x 2	23,1	20,6	17,9	16,6	30,2	15,0	14,1	12,8	13,6	11,9
25 x 2	28,6	25,5	21,7	20,4	35,2	18,5	17,0	15,7	16,1	14,5
30 x 2	34,1	30,3	25,5	24,2	45,3	21,9	19,8	18,6	18,7	17,1
40 x 2	45,0	40,0	33,2	31,9	55,3	28,8	25,6	24,4	23,9	22,2
45 x 2	50,5	44,8	37,0	35,7	65,4	32,2	28,5	27,3	26,5	24,8
50 x 2	55,9	49,7	40,8	39,5	75,5	35,6	31,4	30,1	29,0	27,4
25 x 3	42,0	37,3	31,3	29,7	85,5	26,8	24,3	22,7	22,9	20,8
30 x 3	50,1	44,5	37,0	35,3	39,7	31,8	28,5	26,9	26,6	24,5
40 x 3	66,2	58,8	48,2	46,6	46,4	41,9	36,9	35,3	34,1	32,0
50 x 3	82,4	73,0	59,4	57,8	59,8	52,0	45,3	43,7	41,6	39,5
60 x 3	98,6	87,3	70,7	69,1	73,2	62,0	53,8	52,2	49,1	47,0
70 x 3	114,7	101,6	81,9	80,3	86,6	72,1	62,2	60,6	56,6	54,5
80 x 3	130,9	115,9	93,2	91,5	100,0	82,2	70,6	69,0	64,1	62,0

h x s	15x76 Round	17x76 Round	22x38 Round	22x76 Round	25x25 Round	25x76 Round	30x50 Twisted square bar	30x100 Twisted square bar	34x38 Twisted square bar	34x76 Twisted square bar
25 x 4	55,7	49,5	41,4	39,4	113,4	35,5	32,0	30,0	30,0	27,5
30 x 4	66,5	59,0	48,9	46,9	48,0	42,2	37,6	35,6	35,0	32,5
40 x 4	88,0	78,0	63,8	61,8	56,3	55,6	48,8	46,8	45,0	42,4
50 x 4	109,5	97,0	78,8	76,8	73,0	69,0	60,0	58,1	55,0	52,4
60 x 4	131,0	116,0	93,7	91,7	89,7	82,4	71,2	69,3	64,9	62,4
70 x 4	152,5	135,0	108,7	106,7	106,5	95,8	82,5	80,5	74,9	72,4
80 x 4	174,0	154,0	123,7	121,7	123,2	109,2	93,7	91,7	84,9	82,3
25 x 5	69,1	61,3	50,7	48,7	139,9	43,8	38,9	37,0	36,2	33,7
30 x 5	82,5	73,1	60,0	58,0	15,0	52,2	45,9	44,0	42,4	39,9
40 x 5	109,3	96,8	78,6	76,6	18,5	68,9	59,9	57,9	54,9	52,3
50 x 5	136,1	120,6	97,3	95,3	21,9	85,6	73,9	71,9	67,3	64,8
60 x 5	162,9	144,3	116,0	114,0	28,8	102,3	87,9	85,9	79,8	77,2
70 x 5	189,7	168,0	134,6	132,6	32,2	119,0	101,9	99,9	92,2	89,6
80 x 5	216,6	191,7	153,3	151,3	35,6	135,7	115,9	113,9	104,6	102,1

CROSSBAR DIMENSIONS (MM)

THICKNESS	ROUND DIAMETER	TWISTED SQUARE BAR SIDE
2	4	4
3	4,5	4,5
4	5	5
5	5	5

Note 1: The border consists of a plate of the same type as the supporting one and of a hot-dip galvanising treatment according to standard UNI EN ISO 1461:2009
Note 2: The crossbars can be different from those indicated in the table depending on the manufacturer standards

PRESSED GRATING

Table of theoretical weights (kg/m2) bordered and galvanised material

The shown weights must be intended as the material and manufacturing net tolerances considering a 1000x1000 panel.

(see section 7.1 and 7.2 of the present Guide)

Load bearing bar section

ELECTRO-WELDED GRATINGS: BORDERED GALVANISED MATERIAL WEIGHTS

h x s	Crossbar	11x66	15x66	17x66	22x22	22x66	25x66	33x33	33x66	44x11	66x11	66x22	66x33
20 x 2	------	34,1	26,2	23,6	24,3	19,3	17,6	16,8	14,3	24,5	21,9	14,4	11,9
25 x 2		42,0	32,1	28,8	28,5	23,5	21,4	19,8	17,3	26,9	23,6	16,1	13,6
30 x 2		49,9	38,0	34,1	32,6	27,6	25,2	22,7	20,2	29,3	25,3	17,8	15,3
35 x 2		57,7	43,9	39,3	36,8	31,8	28,9	25,7	23,2	31,7	27,0	19,5	17,1
40 x 2		65,6	49,8	44,5	41,0	36,0	32,7	28,6	26,1	34,0	28,8	21,3	18,8
45 x 2	10 x 2	73,5	55,7	49,8	45,2	40,2	36,5	31,6	29,1	36,4	30,5	23,0	20,5
50 x 2		81,3	61,6	55,0	49,4	44,4	40,2	34,5	32,0	38,8	32,2	24,7	22,2
25 x 3		59,6	45,0	40,2	37,3	32,3	29,2	25,7	23,2	31,4	26,6	19,1	16,6
30 x 3		71,0	53,5	47,7	43,2	38,2	34,6	29,8	27,3	34,7	28,9	21,4	18,9
35 x 3		82,4	62,0	55,2	49,1	44,1	39,9	33,9	31,4	38,0	31,2	23,7	21,2
40 x 3		93,8	70,5	62,7	55,1	50,1	45,2	38,0	35,5	41,2	33,5	26,0	23,5
45 x 3		105,1	78,9	70,2	61,0	56,0	50,6	42,1	39,6	44,5	35,8	28,3	25,8
50 x 3	------	116,5	87,4	77,7	66,9	61,9	55,9	46,3	43,8	47,8	38,1	30,6	28,1
60 x 3		139,8	104,9	93,2	80,3	74,3	67,0	55,5	52,5	57,3	45,6	36,7	33,7
70 x 3	12 x 2	162,5	121,8	108,2	92,2	86,2	77,7	63,7	60,7	63,8	50,2	41,3	38,3
80 x 3		185,3	138,7	123,2	104,0	98,0	88,3	72,0	69,0	70,4	54,8	45,9	42,9
90 x 3		208,0	155,7	138,3	115,9	109,9	99,0	80,2	77,2	76,9	59,5	50,5	47,5
100 x 3	------	230,8	172,6	153,3	127,8	121,8	109,7	88,4	85,4	83,4	64,1	55,1	52,1

h x s	Crossbar	11x66	15x66	17x66	22x22	22x66	25x66	33x33	33x66	44x11	66x11	66x22	66x33
30 x 4	------	96,6	73,4	65,6	64,2	53,0	48,2	44,1	38,5	59,6	51,8	35,1	29,6
40 x 4		126,8	95,9	85,6	79,9	68,8	62,4	55,0	49,5	68,3	58,0	41,3	35,7
50 x 4		157,1	118,4	105,5	95,7	84,6	76,5	66,0	60,4	77,0	64,1	47,4	41,8
60 x 4		187,3	140,9	125,4	111,5	100,3	90,7	76,9	71,3	85,7	70,2	53,5	47,9
70 x 4		217,5	163,4	145,4	127,2	116,1	104,8	87,8	82,3	94,3	76,3	59,6	54,0
80 x 4	15 x 3	247,7	185,9	165,3	143,0	131,8	119,0	98,8	93,2	103,0	82,4	65,7	60,1
90 x 4		277,9	208,4	185,3	158,7	147,6	133,1	109,7	104,1	111,7	88,5	71,8	66,3
100 x 4		308,2	230,9	205,2	174,5	163,4	147,3	120,7	115,1	120,4	94,7	78,0	72,4
110 x 4		338,4	253,4	225,1	190,3	179,1	161,4	131,6	126,0	129,1	100,8	84,1	78,5
120 x 4	------	368,6	276,0	245,1	206,0	194,9	175,6	142,5	137,0	137,8	106,9	90,2	84,6
40 x 5		157,7	119,3	106,5	100,5	85,8	77,8	69,1	61,8	87,3	74,5	52,5	45,1
50 x 5		195,2	147,2	131,3	120,0	105,3	95,3	82,7	75,3	98,1	82,1	60,1	52,7
60 x 5		232,7	175,2	156,0	139,5	124,8	112,9	96,3	88,9	108,9	89,7	67,7	60,3
70 x 5		270,1	203,1	180,7	159,1	144,4	130,4	109,8	102,5	119,7	97,3	75,3	67,9
80 x 5	15 x 4	307,6	231,0	205,4	178,6	163,9	148,0	123,4	116,0	130,4	104,9	82,8	75,5
90 x 5		345,1	258,9	230,2	198,2	183,5	165,5	136,9	129,6	141,2	112,5	90,4	83,1
100 x 5		382,5	286,8	254,9	217,7	203,0	183,1	150,5	143,2	152,0	120,1	98,0	90,7
110 x 5		420,0	314,7	279,6	237,2	222,5	200,6	164,1	156,7	162,8	127,7	105,6	98,3
120 x 5	------	457,5	342,6	304,3	256,8	242,1	218,2	177,6	170,3	173,5	135,2	113,2	105,8

Note 1: The border consists of a plate of the same type as the supporting one and of a hot-dip galvanising treatment according to standard UNI EN ISO 1461:2009
Note 2: The crossbars can be different from those indicated in the table depending on the manufacturer standards

Chapter 8 – Electro-welded and pressed gratings weight tables

ELECTRO-WELDED GRATINGS: BORDERED ROUGH MATERIAL WEIGHTS

h x s	Crossbar	11x66	15x66	17x66	22x22	22x66	25x66	33x33	33x66	44x11	66x11	66x22	66x33
20 x 2	------	32,3	24,8	22,3	23,0	18,3	16,7	16,0	13,6	23,2	20,7	13,6	11,3
25 x 2		39,8	30,5	27,3	27,0	22,3	20,3	18,8	16,4	25,5	22,3	15,3	12,9
30 x 2		47,3	36,1	32,3	31,0	26,2	23,9	21,6	19,2	27,7	24,0	16,9	14,6
35 x 2		54,8	41,7	37,3	34,9	30,2	27,5	24,4	22,0	30,0	25,6	18,6	16,2
40 x 2		62,3	47,3	42,3	38,9	34,2	31,1	27,2	24,8	32,3	27,3	20,2	17,8
45 x 2	10 x 2	69,8	52,9	47,3	42,9	38,2	34,7	30,0	27,7	34,5	28,9	21,8	19,5
50 x 2		77,3	58,6	52,3	46,9	42,2	38,3	32,8	30,5	36,8	30,5	23,5	21,1
25 x 3		57,4	43,3	38,7	35,8	31,0	28,1	24,6	22,3	29,9	25,3	18,2	15,8
30 x 3		68,4	51,5	45,9	41,5	36,8	33,3	28,6	26,2	33,1	27,5	20,4	18,1
35 x 3		79,4	59,7	53,2	47,2	42,5	38,4	32,6	30,2	36,3	29,7	22,7	20,3
40 x 3		90,4	67,9	60,4	53,0	48,3	43,6	36,6	34,2	39,4	31,9	24,9	22,5
45 x 3		101,4	76,1	67,7	58,7	54,0	48,7	40,6	38,2	42,6	34,2	27,1	24,7
50 x 3	------	112,4	84,3	75,0	64,4	59,7	53,9	44,5	42,2	45,8	36,4	29,3	27,0
60 x 3		134,9	101,2	89,9	77,3	71,7	64,7	53,4	50,6	54,9	43,7	35,2	32,4
70 x 3	12 x 2	156,9	117,6	104,5	88,8	83,2	75,0	61,4	58,6	61,2	48,1	39,7	36,8
80 x 3		178,9	134,0	119,0	100,3	94,6	85,3	69,4	66,5	67,6	52,6	44,1	41,3
90 x 3		200,9	150,4	133,5	111,8	106,1	95,6	77,3	74,5	73,9	57,0	48,6	45,7
100 x 3	------	222,9	166,7	148,0	123,2	117,6	105,9	85,3	82,5	80,02	61,5	53,0	50,2

h x s	Crossbar	11x66	15x66	17x66	22x22	22x66	25x66	33x33	33x66	44x11	66x11	66x22	66x33
30 x 4	------	93,2	70,7	63,3	61,7	51,1	46,4	42,4	37,1	57,1	49,6	33,7	28,4
40 x 4		122,5	92,6	82,6	77,0	66,4	60,2	53,0	47,7	65,5	55,5	39,6	34,3
50 x 4		151,7	114,4	101,9	92,3	81,7	73,9	63,6	58,3	73,9	61,4	45,5	40,2
60 x 4		181,0	136,2	121,2	107,5	96,9	87,6	74,2	68,9	82,3	67,4	51,5	46,2
70 x 4		210,3	158,0	140,6	122,8	112,2	101,3	84,8	79,5	90,7	73,3	57,4	52,1
80 x 4	15 x 3	239,6	179,8	159,9	138,1	127,5	115,0	95,4	90,1	99,2	79,2	63,3	58,0
90 x 4		268,9	201,6	179,2	153,4	142,8	128,7	106,0	100,7	107,6	85,1	69,3	64,0
100 x 4		298,2	223,4	198,5	168,6	158,0	142,5	116,6	111,3	116,0	91,1	75,2	69,9
110 x 4	------	327,5	245,3	217,8	183,9	173,3	156,2	127,2	121,9	124,4	97,0	81,1	75,8
120 x 4		356,8	267,1	237,2	199,2	188,6	169,9	137,8	132,5	132,8	102,9	87,0	81,7
40 x 5		153,2	115,9	103,5	97,4	83,3	75,5	67,0	60,0	84,4	72,0	50,8	43,7
50 x 5		189,8	143,1	127,6	116,5	102,3	92,6	80,3	73,2	94,9	79,4	58,2	51,1
60 x 5		226,3	170,4	151,7	135,5	121,4	109,7	93,5	86,4	105,4	86,8	65,6	58,5
70 x 5		262,9	197,6	175,8	154,6	140,5	126,9	106,7	99,7	115,9	94,2	73,0	65,9
80 x 5	15 x 4	299,4	224,8	199,9	173,6	159,5	144,0	119,9	112,9	126,4	101,6	80,4	73,3
90 x 5		335,9	252,0	224,0	192,7	178,6	161,1	133,2	126,1	137,0	109,0	87,8	80,7
100 x 5		372,5	279,2	248,1	211,8	197,6	178,2	146,4	139,3	147,5	116,4	95,2	88,1
110 x 5		409,0	306,4	272,2	230,8	216,7	195,3	159,6	152,6	158,0	123,8	102,6	95,5
120 x 5	------	445,6	333,7	296,4	249,9	235,7	212,4	172,9	165,8	168,5	131,2	110,0	102,9

Note 1: The border consists of a plate of the same type as the supporting one and of a hot-dip galvanising treatment according to standard UNI EN ISO 1461:2009
Note 2: The crossbars can be different from those indicated in the table depending on the manufacturer standards

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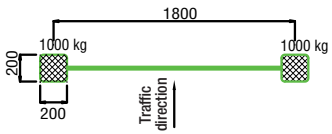
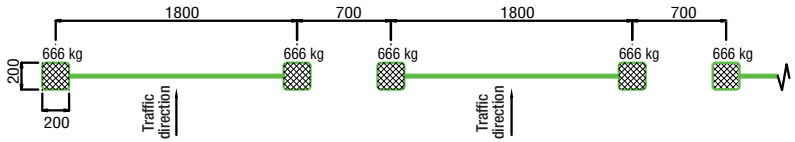
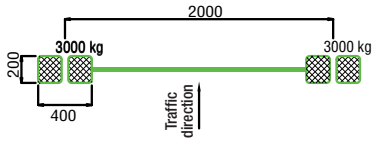
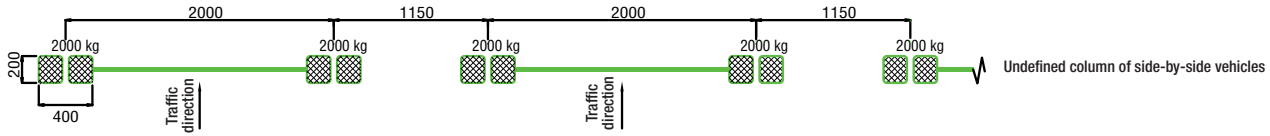
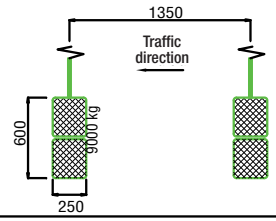
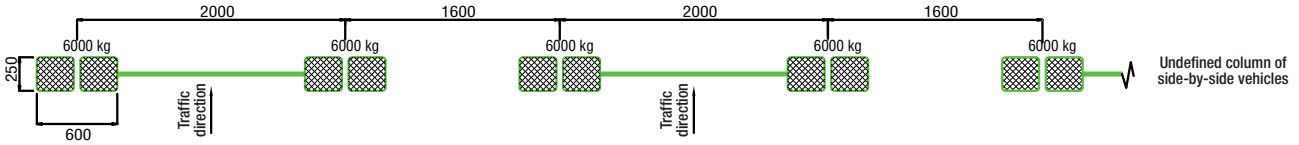
SECTION BREAKER BEAMS

LOAD DIAGRAMS FOR SECTION BREAKER BEAMS CALCULATION

Hereunder is the diagram that can be used for sizing the section breaker beams.
Eventual particular cases must be specified by the client
For each class, calculate the beam in the least favourable situation with:

- A single axle of the vehicle with dynamic load
- More axles of the vehicles with static load in relation of the length of the beam

	DYNAMIC	STATIC
Class 2		
Class 3		
Class 4		

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Associazione Assogrigliati c/o Federazione ANIMA
via A. Scarsellini 13 - 20161 Milano IT
ph. +39 0245418.576 - fax +39 0245418.545
assogrigliati@anima.it - www.assogrigliati.it

The load tests for the capacity tables were performed at the Politecnico di Milano

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