(MANUSCRIPT)

VSM - Information

SEMI – FINISHED PRODUCTS OF HOT ROLLED STEEL

especially thin plates (3.0 mm ≤ t ≤ 8.0 mm) and small profiles (60 mm ≤ b ≤ 180 mm)

CONTENT:

1 ALLOWED DEVIATIONS OF DIMENSION AND FORM (TOLERANCES) OF SMALL PROFILES

Higher standards of allowed deviations of dimension and form – additionally to existing valid standards – can be agreed for the delivery of small profiles, namely

a) for flat steel additionally to DIN 1017 (= “basic” resp. “class 2”) and

b) for universal flats additionally to DIN 59200 (= “basic” resp. “class 2”)

in each case the higher standard “special” resp. “class 1” (see ***Annexes 1.1 and 1.2***) as well as

c) for bulb flats additionally to DIN 10067 (= “basic” resp. “class 3”)

the higher standards either „standard“ resp. „class 2“ or „special“ resp. „class 1“ (see ***Annex 1.3***).

2 METHOD OF INSPECTION

2.1 Principles

The inspection of compliance of allowed deviations of dimension and form has to be accomplished as a matter of principle only by a **check of dimension**, using solid measure tools representing the dimension.

Depending on the individual task of inspection, namely check of compliance of allowed

- deviations of dimension,
- deviations of form of cross section and
- deviations from plane surface / straight line,

usage of different solid measure tools is recommended (see also ***Annex 2.1***):

a) Gauges, predominately
   - Cross section shape gauge (L1),
   - Radius gauge (L2),
   - Distance gauge (L3) and
   - Angle gauge (L4)

   as well as

b) Measuring tools, predominately
   - Sliding calliper (M1),
   - Measuring tape (M2),
   - Goniometer (M3) and
   - Measuring stick (M4), possibly combined with additional measuring tools.

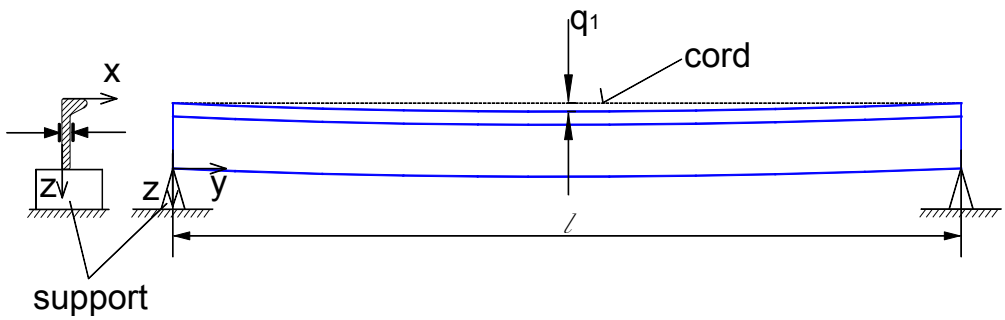
2.2 Small profiles

Solid measure tools listed in ***Annex 1.1 to 1.3*** have to be used for inspection of allowed deviations of dimension and form.

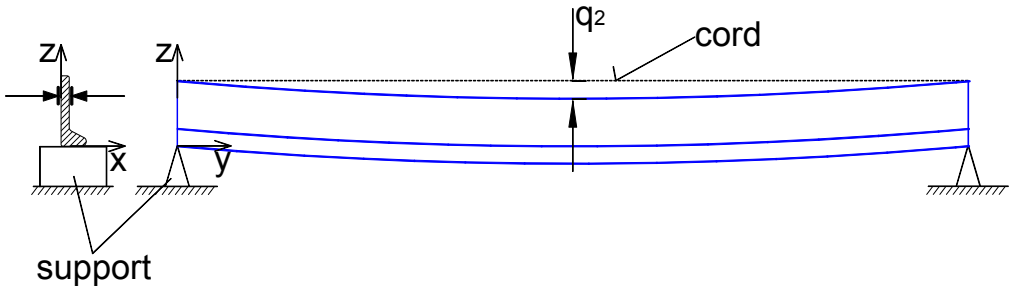
To inspect the bending q in the plane of the web (deviation of form 3.1 („sabre shape“) the following methods of inspection have to be applied:

Method A (so-called „Gravity method“)

The profile has to be free supported on two end points, being perpendicular upright, possibly to be supported sideways (bulb flats can have the bulb on either side, i.e. up or down). After that a cord has to be stretched across the concave long side of the profile. The bending q_1 (y) has then to be measured with the measuring stick (M4), preferably at half length, but also at other significant points over the profile length.



Due to the fact that each reading $q_1 (y^*)$ includes a (elastic) self-loaded deflection, the profile has to be turned 180° and the measurements have to be repeated at the same point(s) (→ reading(s) $q_2 (y^*)$), in order to eliminate the (elastic) self-loaded deflection:



The measured figure of the permanent (plastic) bending at the point y_i, namely $q_{pl} (y_i)$, results to

$q_1 (y_i) = q_{pl} (y_i) + q_{self\text{-}load} (y_i) \quad \Rightarrow \quad q_{pl} (y_i) = q_1 (y_i) - q_{self\text{-}load} (y_i)$

$q_2 (y_i) = q_{pl} (y_i) - q_{self\text{-}load} (y_i) \quad \Rightarrow \quad q_{pl} (y_i) = q_2 (y_i) + q_{self\text{-}load} (y_i)$

$q_{pl} (y_i) = (q_1 (y_i) + q_2 (y_i) / 2$ [mm].

The received measured figure $q_{pl} (y_i = l/2)$ represents the „sabre shapeness“ of the profile and it must not exceed the allowed bending in the web plane (tolerance).

This method can only be applied depending on profile's width up to certain maximum length due to the limited stiffness of small profiles:

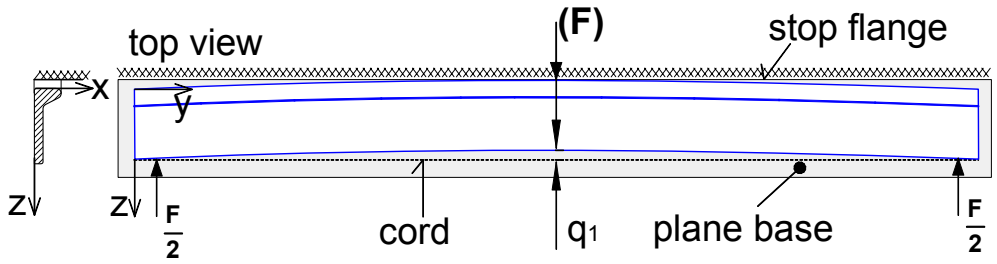
Profile dimensions	bulb flat	flat steel/universal flat
40 x (6 to 20)		l ≤ 7.000 mm
50 x (6 to 10)		l ≤ 8.000 mm
60 x (6 to 15)		l ≤ 8.000 mm
70 x (8 to 20)		l ≤ 9.000 mm
80 x (6 to 15)	l ≤ 10.000 mm	l ≤ 10.000 mm
100 x (6 to 20)	l ≤ 12.000 mm	l ≤ 11.000 mm
120 x (8 to 20)	l ≤ 13.000 mm	l ≤ 12.000 mm
150 x (10 to 20)		l ≤ 14.000 mm
160 x (7 to 11)	l ≤ 15.000 mm	l ≤ 14.000 mm
180 x (7 to 11)	l ≤ 16.000 mm	l ≤ 14.000 mm

For profiles of greater length (and / or smaller profile width b) only Method B is applicable (so-called „Touch method“).

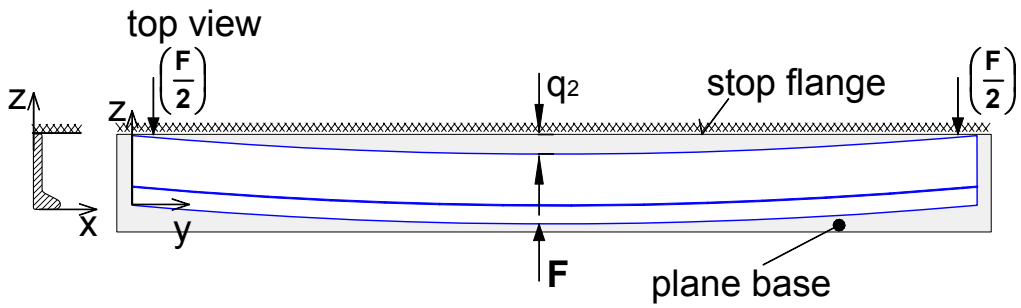
Method B (so-called „Touch method“)

The profile has to be laid down on a plane base, as far as possible over the entire length of the profile, and has then to be pushed against a stop flange

a) in case of a convex shape of the profile related to the stop flange with a (“elastic”) force ½*F on each end.



b) in case of a concave shape of the profile related to the stop flange with a (“elastic”) force F at the middle of the profile length.



The plane base must be in such a way that the profile can relax almost “frictionless” after (“elastic”) pushing (for example by a ball bearing bed or by a sledge).
The bending has to be measured after relaxation of the profile by a measuring stick (M4) either

a) $q_1 (y_i)$ against a cord, which is stretched across the concave long side of the profile or

b) $q_2 (y_i)$ against the straight stop flange.

Each measured figure $q_1 (y_i = l/2)$ or $q_2 (y_i = l/2)$ represents the „sabre shapeness“ of the profile, which must not exceed the maximal allowed bending in the web plane (tolerance).

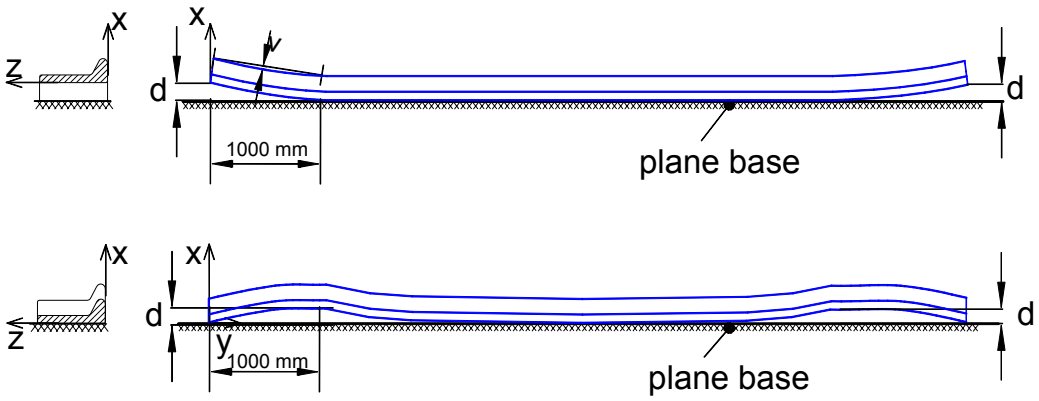
The inspection of the bending p perpendicular to the web plane (deviation of form 3.4 / “Deviation aloft”) the following method has to be applied:

Method C (so-called „Caliber method“)

The profile has to be laid down flat (bulb flats on its back) on a plane base. Due to limited stiffness of small profile transversal to the web plane, it will fit to the plane base almost over its entire length. If there are local permanent bending („Deviation aloft“) at the ends (→ bending up d perpendicular to the web plane) and / or between the ends (→ longitudinal waves v perpendicular to the web plane), then they have to be measured by

a) a caliber (length usually 1.000 mm) and a measuring stick or

b) a (small plates) distance gauge (L3) with 0,5 mm graduation:



Each measured figure represents a measurement for the „deviation aloft“ of the profile, which must not exceed the maximal allowed bending perpendicular to the web plane (tolerance).

3 HANDLING

3.1 Thin plates

a) Storage

Principle: *Storage of thin plates must not cause any bending.*

- The storage of thin plates has to be flat and horizontal, either on a plane and generally stiff base or on a plane grid.

- Neither pads nor distance holders made of timber or other materials are allowed, in order to avoid bending of the thin plates.

- Thin plates with smaller dimensions have preferably to be stored on top of those with bigger dimensions, in order to avoid overhanging.

b) Lifting / Handling tools

Principle: *Tools to lift or handle thin plates must be appropriate, i.e. avoiding bending as far as possible.*

- Lifting of thin single plates with clamps or similar is not allowed, due to concentrated loads at thin plates resp. plate edges.
(*Exception: Lifting / handling of packages of thin plates, e.g. discharge from vessel to shore, with clamps is acceptable as long as the thin plates of one single package have the same width.)*

- Single thin plates have only to be lifted / handled with hoisting devices clamping on traverses, which almost apply loads plane-like to the thin plates (“multi point hanging”).

Hoisting devices shall be lifting magnets (usually round magnets, but also square magnets) as well as vacuum devices (circle vacuum suction cups).

- Lifting / handling of thin plates shall be done by hoisting devices clamping on traverses with at least one single hoisting device for each 6 m².

c) Transport

<u>Principle:</u> *Transporting of single thin plates shall be done without any bending.*

- The requests of point 3.1.a) and 3.1.b) have to be complied with.

- Transport of thin plates has to be carried out using carriages, which are open or can be opened top, in order to charge or discharge with hoisting devices on traverses.

- If there are no hoisting devices on traverses available at the delivery (charge of carriage) or at the reception (discharge of carriage), then transport pallets have to be used, which must only be charged or discharged at sites with hoisting devices on traverses available.

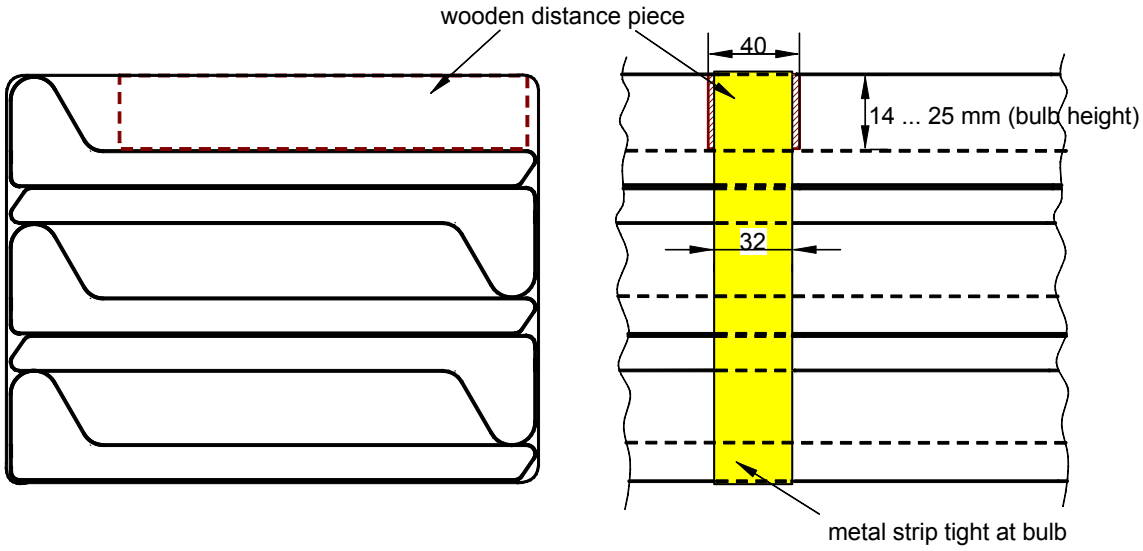
3.2 Small profiles

a) Storage

Principle: *Storage of small profiles must not cause any bending.*

- Small profiles have to be stored as bundles horizontally (usually up to 3 t each), whereby bundles consist of profiles with equal dimensions.
  In case of bulb flats the bundles consist – depending on dimensions – maximal of 10 profiles (HP 180 x 11, 15 m length) up to 40 profiles (HP 60 x 4 / 80 x 5, 10 m length).

- The bundles have to be packed tight, in order to increase their stiffness. Flat steel and universal flats have to be piled up, also bulb flats, latter namely either all profiles in a staggered stack (normal) or in exact one by one bulb to bulb stack (special). Each stack has generally to be clamped by metal strip (width at least 32 mm).



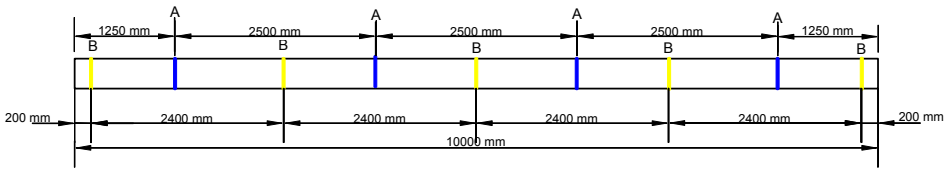
Bulb to bulb stack (special)

- Clamping of piled up profiles by metal strip has to be carried out as sketched below, i.e.
  * 10 m length on at least 5 positions,
  * 12 m length on at least 6 positions and
  * 15 m length on at least 7 positions.

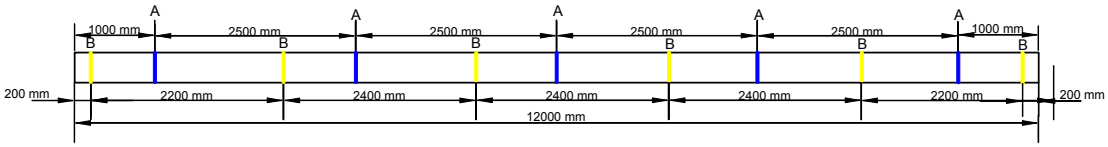
  The distance between bundling positions (metal strips) must not exceed 2.40 m.

  At each metal strip a wooden pad has to be used. Professional metal strip clamps have to be used for clamping.

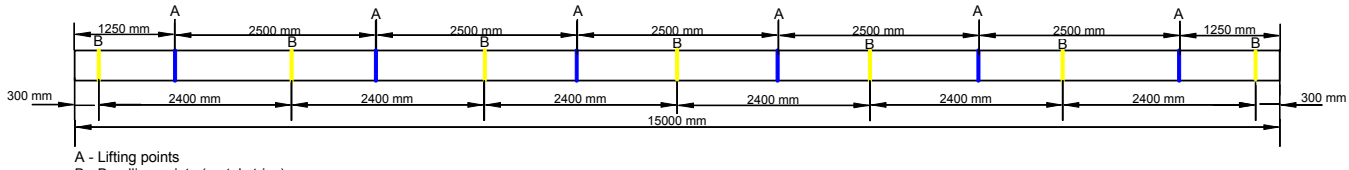
10 m - Bundle of profiles (5 points of bundling and 4 points for lifting)



12 m - Bundle of profiles (6 points of bundling and 5 points for lifting)



15 m - Bundle of profiles (7 points of bundling and 6 points for lifting)



A - Lifting points
B - Bundling points (metal strips)

Bundling of profiles

- In case of special request, the manufacturer has to attach in the middle between each two metal strips an additional belt, which serves to attach ropes / chains or facilitates handling, in order to avoid later need for entwining of ropes / chains.

- After taking single profiles out of bundles, both the extracted profiles and the remainder bundle have to be clamped as outlined above, unless the profiles lay in special profile pallets.

b) Lifting / Handling tools

Principle: *Lifting / handling tools for small bars must avoid any bending.*

- Lifting / handling is generally not allowed for
  * bundles with small profiles, even not for single profiles, by fork lifts or
  * single profiles by crane without use of a traverse.

- As lifting / handling tools can explicitly be used
  * for bundles of small profiles only traverses with ropes / chains,
  * for small single profiles only traverses with hoisting devices (square / box magnets),

  in order to ensure equally distributed loads into the bundles of small profiles resp. into small single profiles (“multi point hanging”).

- The lifting points (ropes / chains or hoisting devices) on a traverse, which serves to lift / handle bundles of small profiles or small single profiles, must be equally distributed over the length, whereby the lifting points should be at the middle between each of two metal strips (see sketch Bundling of profiles), i.e.
  * bundle of 10 m length lifting points at least at 4 positions,
  * bundle of 12 m length lifting points at least at 5 positions and
  * bundle of 15 m length lifting points at least at 6 positions.

  The distance between lifting points must not exceed 2.5 m.
  The use of metal strips, which keep the bundle tight together, as lifting points to clamp / handle is prohibited.

c) Transport

<u>Principle:</u> *Transporting small profiles any bending has to be avoided.*

- The requests of points 3.2.a) and 3.2.b) have to be complied with.

- Transport of small profiles has to be carried out using carriages (trucks / railway cars / ships), which are open or can be opened top, in order to charge or discharge with the use of
  * bundle of small profiles only with traverses with ropes / chains and
  * small single profiles only with traverses with hoisting devices (square / box magnets).

- If there are no traverses with ropes / chains (for bundles of small profiles) resp. with hoisting devices (for small single profiles) available at the delivery (charge of carriage) or at the reception (discharge of carriage), then transport pallets have to be used, which must only be charged or discharged at sites with traverses available.