

Examination of the stability of steel strip coils having a horizontal centre line, taking into account the storeroom floors which are common today

A study carried out by the Fachvereinigung Kaltwalzwerke e.V. and the chair for structural steel engineering of the RWTH Aachen.

It was the objective of the study "Examination of the stability of steel strip coils having a horizontal centre line, taking into account the storeroom floors which are common today" to determine the relationship of the width to the outer diameter of steel strip coil in such a way that the stability of these coils, depending on the storeroom floor, is ensured.

The former conditions which had been laid down by the Bundesanstalt für Arbeitsschutz [1], provided that steel strip coils having a horizontal centre line shall be considered stable if, firstly, the outer diameter of the steel strip coil is smaller than 4 times the steel strip coil width and, secondly, a tilting force of 0,5 kN being applied on the outer edge of the steel strip coil will not cause the coil to topple.

However, the resulting admissible dimensioning range was determined taking into account old storeroom floors and not taking into account dynamic impact forces.

However, this study took into account the mostly existing modern, very stable and, above all, almost level storeroom floors, dynamic impact forces and the new standard generation (Eurocode).

In order to evaluate the essential influence parameters which are necessary for the determination of admissible steel strip coil dimensions, the Fachvereinigung Kaltwalzwerke e.V. and the chair for structural steel engineering of the RWTH Aachen co-operated in developing a catalogue of questions which was distributed to the members of the Fachvereinigung Kaltwalzwerke. A total of 18 members replied to the catalogue of questions which asked e.g. for the form of the stored steel strip coil, the soil bearing capacity and the evenness of the floor surface.

As to the form of the stored steel strip coils, the following 3 deformed systems showed apart from the non-deformed system; the concerned enterprises used these systems to determine the respective dimensions.

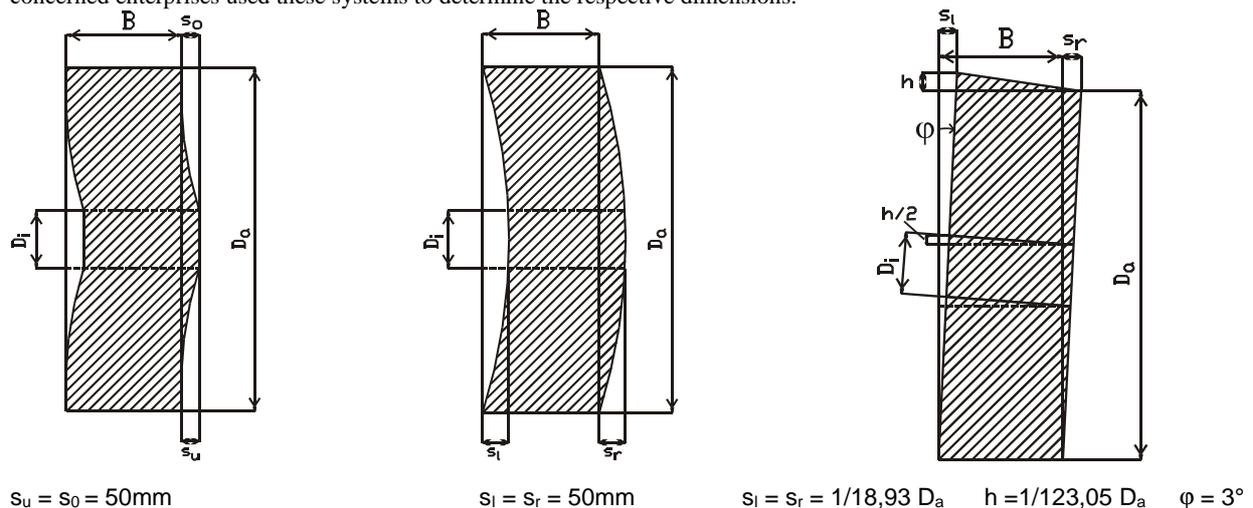


Fig. 1: Relevant deformed steel strip coil types with indication of the maximum admissible deformations

A surveyor measured a measuring square of 2 x 2 m² of the different floors in 3 enterprises; the existing slopes were determined by carrying out a graduated regression analysis. This surveying covered a total of 73 % of the floors mentioned in the catalogue of questions, the percentage of which is shown in the following illustration.

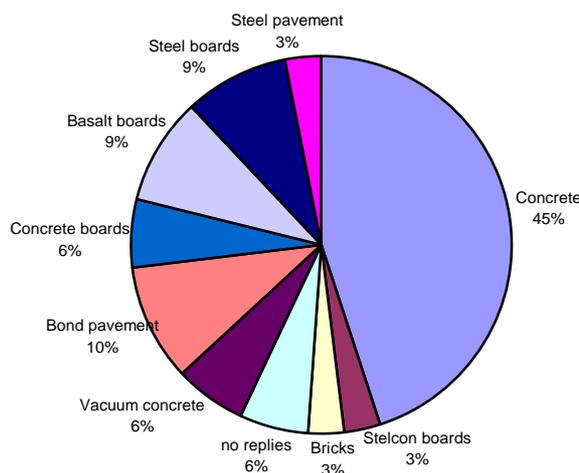


Fig. 2: Percentage of the mentioned surface types

These surveyings and evaluations revealed that the slope does not exceed 2 ° (incl. surface slope for fluid drainage). However, it is necessary to remedy smaller damages/defective parts immediately.

For the impact load test, also the impact of a moving worker ($m = 85 \text{ kg}$ [2] and $v = 6 \text{ km/h}$) was taken into account in addition to the previously defined static tilting force of 0,5 kN. In accordance with the new standard generation (Eurocode), a partial safety factor of 1,5 was applied to these effects. Due to their favourable effect, the resistance side is multiplied by a partial safety factor of 1,0.

When determining the balance of the static or dynamic effect and the mass impedance by taking into account the lever arms, the maximum admissible deformations of the steel strip coils, the lifting of the steel strip coils from zero level and the surface slope, the following dimensioning diagram results (inner diameter = 500 mm; $\varrho_{\text{steel}} = 78,5 \text{ kN/m}^3$).

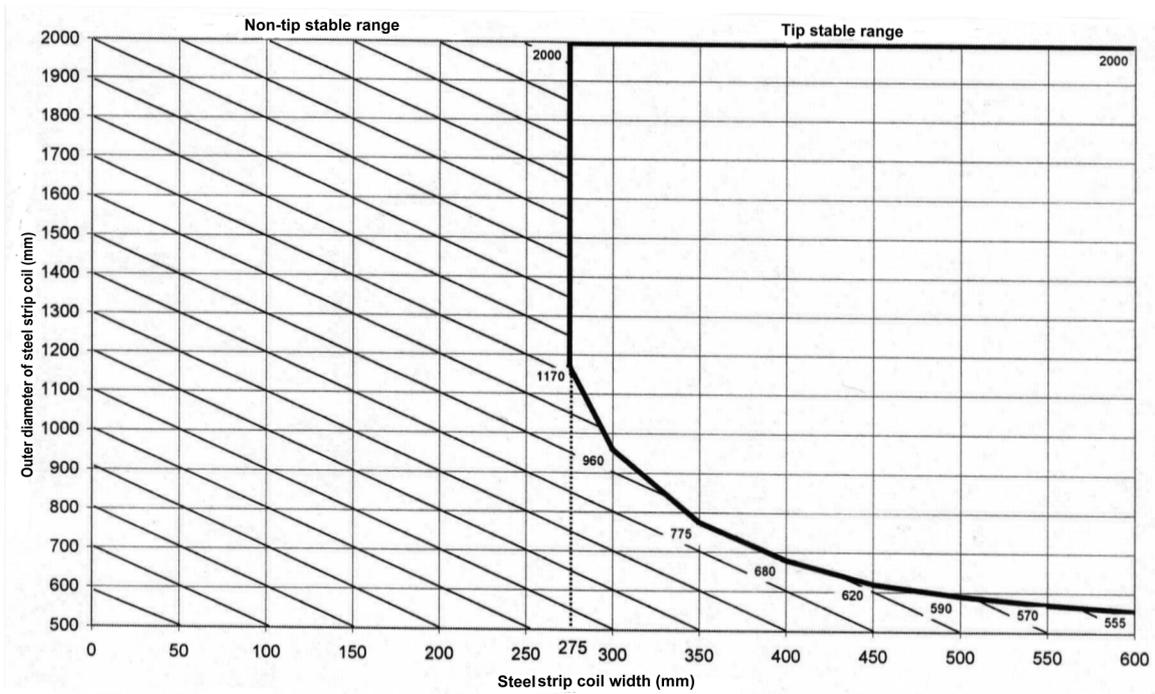


Figure 3: Demarcation of the tip stable range for steel strip coils ($D_i = 500 \text{ mm}$)

The examinations carried out in this study show that it is only partially possible to reach the goal to extend the dimensioning range laid down by the Bundesanstalt für Arbeitsschutz.

From the dimensioning proposal shown in figure 3, the range results in which a single steel strip coil having a horizontal centre line is to be considered stable. In order to be able to apply this dimensioning proposal, the following conditions apply:

- The individual enterprises ensure the soil bearing capacity.
- The steel strip coil deformations are smaller than the maximum admissible deformations listed in fig. 1.
- The surface slope (incl. the surface slope for fluid drainage) is less than 2 °. Smaller damages/defective parts are to be remedied immediately.
- Storage rooms are located in areas lying in earthquake zone 0 [3] and are fully enclosed.

This dimensioning proposal does not cover dynamic impact forces due to crane or forklift truck operation.

Where these conditions are not fulfilled, the steel strip coils shall be stored in a stable way in cradles or similar.

As a matter of principle, steel strip coils having a width of $< 275 \text{ mm}$ shall be stored in a stable way in cradles or similar, or they shall be tied together until a stable storing acc. to figure 3 is possible.

Due to the new dimensioning proposal, it becomes possible to make optimum use of the space available for the storing of steel strip coils having a horizontal centre line whilst preserving the necessary and prescribed occupational safety at the workplace.

- [1] Storing of coils and steel strip coils
Bundesanstalt für Arbeitsschutz, H.-H. Kamps, Dortmund 1985
- [2] Statistisches Bundesamt Deutschland
Mikrozensus-Ergebnisse, April 2002
- [3] Draft DIN 4149: Buildings in German earthquake zones, September 2003