ANALELE UNIVERSITĂȚII
"EFTIMIE MURGU" REȘIȚA
ANUL XV, NR. 1, 2008, ISSN 1453 - 7397

Tiberiu Ştefan Mănescu, Gilbert Rainer Gilich, Nicuşor Laurenţiu Zaharia

A Small Angle Bracket with Big Importance at Railway Vehicles

The paper presents the importance of the angle brackets and will compare two constructive manners for the ending of the chassis for freight wagons at railway vehicles.

Keywords: *angle brackets, railway, vehicles, stress*

1. Introduction

The strength structure of railway vehicles are manufactured from steel bars and plates joint by welding. The vehicle body is self-supporting and it had a chassis, lateral walls, frontal walls and roof. Except the chassis all other components of vehicle body can be eliminates in purpose to obtain different types of wagons:

- Flat wagons – those type of wagons have only the chassis;
- Uncovered wagons – the body of the vehicle is made from chassis, lateral and frontal walls;
- Covered wagons – the body of the vehicle is made from chassis, lateral and frontal walls and roof.

Indifferently the type of wagon, the chassis is the most important part of the vehicle body, because the higher stress is in him. Generally speaking the chassis is build from longitudinal elements (longitudinal beams), transverse beam (perpendicularly on longitudinal beams) and diagonal beams.

2. The necessity of Angle Brackets

The welding of the angle brackets on strength structure at railway vehicles it is knotty problem because:

- Depending on size of the vehicle body, the total weight of all angle bracket can be around 1 ton, which is a big value for freight wagon because by increasing the weight oh vehicle body, it decreased the maximum payload (which is limited from maximum the axle load);

The lack angle brackets can increase the stress at elements joints area.

The angle brackets are made in many shapes and dimensions but basically they look like in figure 1. At railway vehicles the angle brackets are triangular steel plates (Figure 1).

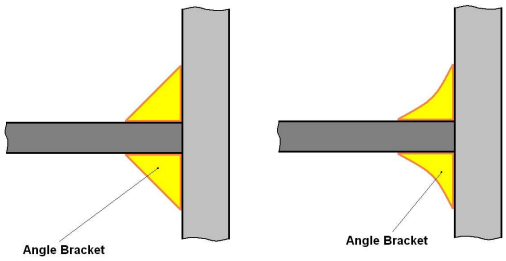

Figure 1. Types of angle brackets

The dimension of angle brackets is established from calculus or testing (if after the test the dimensions of the angle bracket are not large enough it can be replaced with another angle bracket with proper dimensions).

The consequence of using angle brackets can be shown with experimental stress analysis with strain gages. In figure 2 is shown the applying point for strain gages (SG) in two designs: with and without angle brackets.

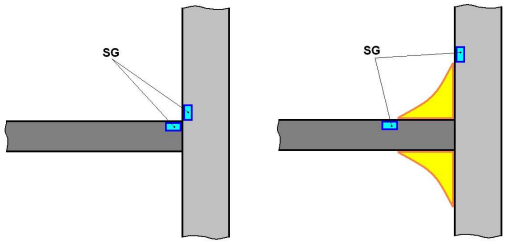

Figure 2. Strain gages glued on strength structure (of the railway vehicle)

In first design – without angle brackets the measured strains with SG are larger than the second design (where a angle bracket is welded).

3. Results

Performing tests on many types of wagons had revealed some times overstressing if the vehicle body was build without angle brackets. Most of the times, repairing of design errors was to reinforcing the area with overstressing with angle brackets. After the angle brackets were welded the measured strain was smaller than before. According to ERRI B12/RP17, permissible stress for steel when the test is made with vertical load are larger when the angle bracket is welded on the

vehicle body (C class σ_a=133N/mm^2) comparing with the vehicle body without angle bracket (D class, σ_a=110N/mm^2). According to the same document (ERRI B12/RP17) permissible stress for steel when the test is made with horizontal load is σ_a=355N/mm^2 (S355 steel) for an area without welding and σ_a=317N/mm^2 for an area with welding.

To emphasis the importance of the angle brackets, we will compare two constructive manners for the ending of the chassis for freight wagons:

- Classic manner (figure 3). The legend for figure 3 is: 1 – buffer beam, 2 – central longitudinal beam, 3 – diagonal beam, 4 – pivot bearing beam; 5 – longitudinal beam;

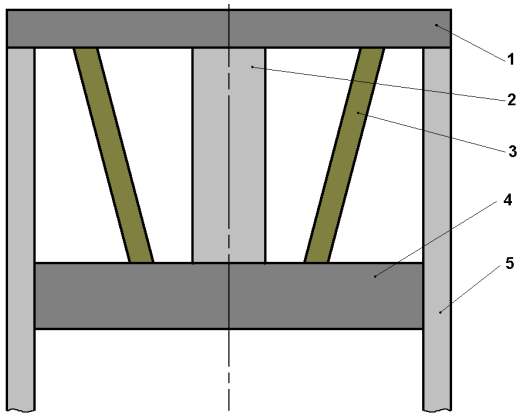

Figure 3. Classic design for ending of freight wagon chassis

- New design (Figure 4). The legend for figure 4 is: 1 – buffer beam, 2 – central longitudinal beam, 3 – angle brackets, 4 – pivot bearing beam; 5 – longitudinal beam.

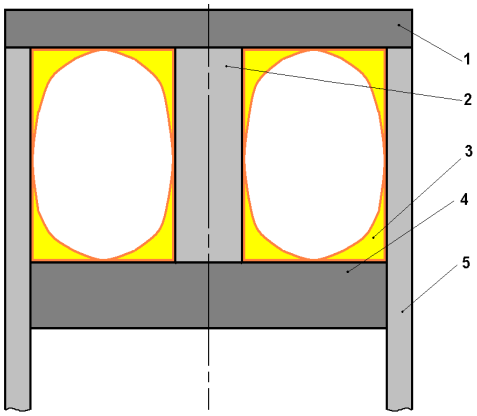

Figure 4. New design for ending of freight wagon chassis

In figure 3, the diagonal beam taking over some of the forces from the buffers.

In figure 4, the diagonal beam was replaced with large elliptical angle brackets.

4. Conclusions

Diagonal beams are large metal pieces with huge importance in taking over the forces applied on buffers; we can tell that diagonal beam is some of the most elements/components of the vehicle body. However in case of a great idea and very good calculus the diagonal beams – those important components of vehicle body was replaced with simple steel pieces – the angle brackets presented in figure 4. More, the angle brackets can be used as reinforcing elements in weakened area. But, any designer must remember that the owner of the wagon want to carry a large amount of freight with a lighter vehicle, so the decreasing of the dead weight it is very good; the decreasing of the dead weight can be made with strength structure optimization in Finite Element Analysis and testing of the prototype to validate the design.

References

[1] Avril J., *Encyclopedie Vishay d'Analyse des Contraintes*, Vishay-Micromesures France.

[2] Burada C., Buga M., Crăsneanu A. *Elemente şi structuri portante ale vehiculelor de cale ferată,* Editura Tehnică 1980.

[3] ***** *ERRI B12/RP17, Wagons, Programme des essais à châssis et suprastructure en acier (apte à recevoir l'attelage automatique de choc et traction) et à leur bogies à châssis en acier*. Utrecht 1997.

[4] Mănescu T.Ş., Olaru S., Copaci I., Creangă F. *Tensometria electrică în cercetarea experimentală*, Editura Mirton, 2006.

Addresses:

- Prof. Dr. Eng. Tiberiu Ştefan Mănescu, "Eftimie Murgu" University of Reşiţa, Piaţa Traian Vuia, nr. 1-4, 320085, Reşiţa, t.manescu@uem.ro
- Prof. Dr. Eng. Gilbert Rainer Gilich, "Eftimie Murgu" University of Reşiţa, Piaţa Traian Vuia, nr. 1-4, 320085, Reşiţa, prorector_invatamant@uem.ro
- Eng. Nicuşor Laurenţiu Zaharia, Autoritatea Feroviară Română – AFER, Calea Griviţei, nr. 393, 010719, Bucureşti, laurentiu@afer.ro