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WITH SPIDER8 ON RAILS

Abstract:
The carrying of heavy trains on large inclines can produce the breaking of the draw hook. The railway freight operator, want to carry long trains because of the economic reasons. This paper will present the steps of tests performing in purpose to measure the tensile forces from the locomotive draw hook equipped with strain gages. The purpose of the tests was increasing the tonnage of the trains on the inclines (the tonnage of the trains on the inclines is restricted by railway regulations).

Keywords:
Hottinger, Spider8, Catman, strain gauges

INTRODUCTION

Circulation on Romanian Railways is done under regulations in purpose to ensure optimal conditions of safety for passenger and freight trains.
From the point of view of passenger options there are alternatives at trains (cars, buses etc.), but regarding the freight transport there are some products which it will be always carry by the trains (cereals, oil, coal etc.).
If the freight trains run on plate ground, there aren't any problems if there is even one electrical locomotive of 5100 kW power. But, if the train run on inclines (which in Romania can have the value of 25‰) then a second locomotive it is necessary depending of the total length of train or his weight.
Romanian railways freight operators from Romania have electrical locomotives on four or six axles. If they use more than one locomotive at one train on the inclines the solve the problem of additional needed power, but another question appears: will the locomotive hook break it?
In purpose to measure the forces which appear in the drawing hook, one of the methods which can be used is applying strain gauges on the hook and measuring of the strains during the train's circulation.

MEASUREMENT POINTS, DEVICES AND TESTS

The measurements were performed with Hottinger Spider8 device connected to a laptop. The acquisition software used was Catman 4.5 also from Hottinger.

For simple loads (tensile/compression for example) it is necessary to glue strain gauges like those presented in figure 1.a.

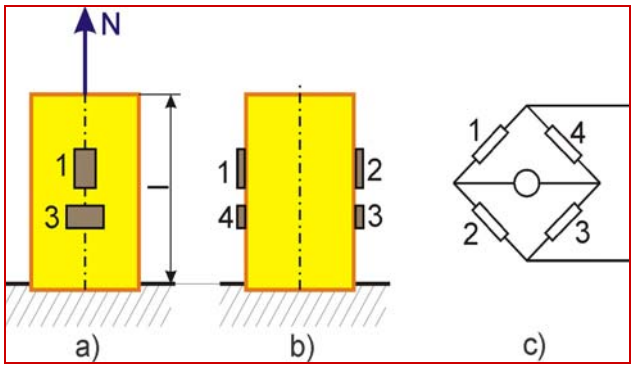

Figure 1 Tensile/compression loads transducer

Because any transducer is sensitive to different types of loads in the same time, the strain gauge glued on it, measure a strain witch represents the algebraic sum of the strains for each load type. The separation for each load type can be done if are glued more strain gauges.
In the tensile load, principal strain 1 is parallel with the longitudinal axe of the elastic element and principal strain 2 is perpendicular on principal strain 1.
The coupling hook it is an assembly of many articulated components. The thread axe where the strain gages were glued is load only with tensile forces.
A full Wheatstone bridge was used for measuring the tensile forces from the drawing hook of the locomotive (figure 1.b and figure 1.c.). The strain gauges were connected to Hottinger Spider8 measuring device.
In fig. 2 is shown the drawing hook of the locomotive which has strain gauges glued on it.
The drawing hook was mounted the second locomotive and the first wagon of the train.
The measuring of tensile forces was performed in two variants of locomotive coupling:

(EA+EC and EC+EC),

where EA is electrical locomotive with six axles, 5100 kW power and EC is electrical locomotive with four axles, 3400 kW power.

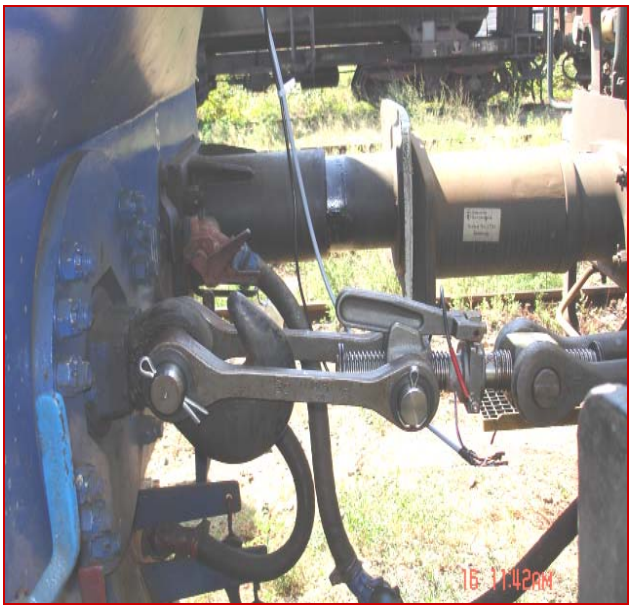

Figure 2 Drawing hook with strain gauges

The tests was done between railway stations Drobeta Turnu Severin – Şimian – Balota – Prunişor (Balota is the highest point of an incline with the maximum value of 29‰).
The performed tests were:

- *Between railway stations Şimian and Balota the locomotives were coupled EA+EC, the train weight was 1218t;*
- *Between railway stations Drobeta Turnu Severin and Balota the locomotives were coupled EC+EC, the train weight was 1218t;*

Between railway stations Prunişor and Balota the locomotives were coupled EA+EC, the train weight was 2960t.

RESULTS

The maximum values of measured tensile forces are presented in table 1.

Table 1. The maximum values of measured tensile forces

Between	Force [kN]
Şimian – Balota	470,2
Dr. Tr. Severin – Balota	384,8
Prunişor – Balota	457,6

The graphic representation of the tensile forces it is shown in fig. 3÷5.

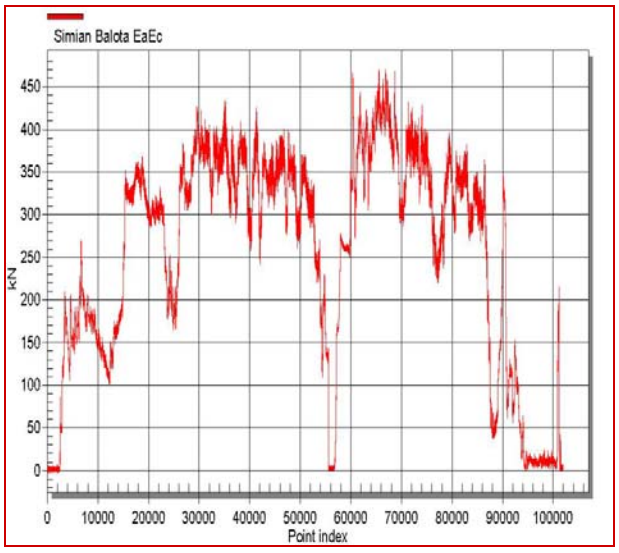

Figure 3 Locomotive coupled EA+EC

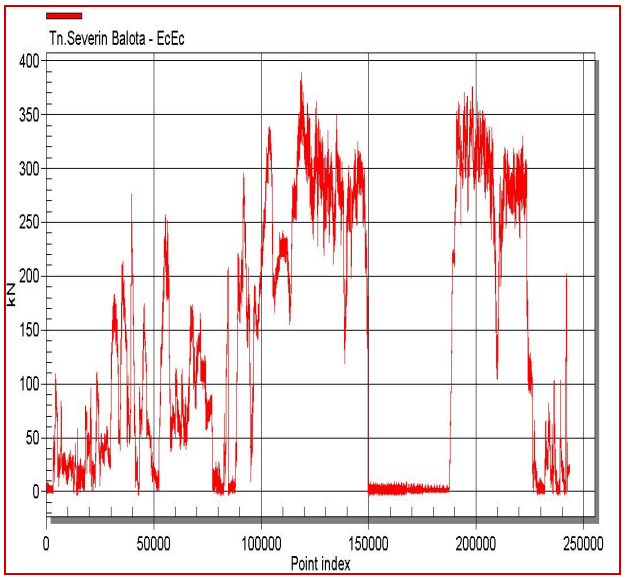

Figure 4 Locomotive coupled EC+EC

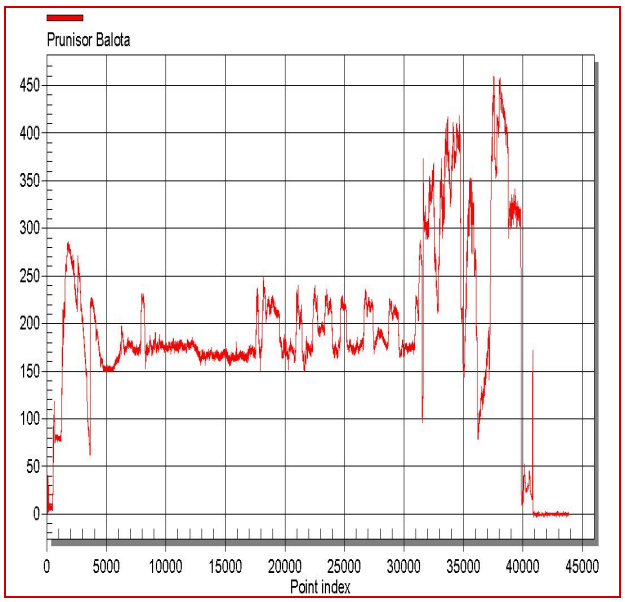

Figure 5 Locomotive coupled EA+EC

CONCLUSION

The results obtained after the finishing the tests can be used to adjust the weight of the train by increasing the weight of those but only if the technical condition of the locomotives is optimal especially from the point of view of weight balance on axle and good maintenance of the sanders.
In all cases which was study during those tests it was prove that when two locomotives are used is better that first to be an EC type locomotive

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