EAN '97

35th International Conference on
Experimental Stress Analysis
June 4 - 6, 1997, Olomouc, Czech Republic

METHODS OF JUDGEMENT OF POSSIBILITY CRANE AND THE CRANE RAIL ONE-TIME OVERLOADING

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The author have elaborated a realisation of a converter ladle displacement by one crane with lifting capacity of 250t. The mass of the converter ladle was up to 300 t. Principal assumptions for using one crane is experimentally checked condition of the cranes steel construction for single overloading, check computation of the cranes steel construction, hoist and mechanisms for single overload of the main lift with weight of 300t -experimentally checked condition of the crane rails steel construction for single overloading and check computation of the crane rail for single overloading.

The author have elaborated a realisation of a new converter ladle displacement from the pre-assembly place to the place of insertion. The along distance of transport was 34 m. The pre-assembly and the insertion were realised at a converter hall provided with two heavy casting gantry cranes with bearing capacity of main lift 250 t ,and span 21 m. The mass of the converter ladle was up to 300 t, that is about 20% more than the allowable bearing capacity of one crane. The user considered the transport of converter ladle with two coupled cranes but this is exacting from both, technical and economical point of view. That is why the authors decided to realise this transport by one lifting capacity of 250 t.

Principal assumptions for using one crane:

- good technical condition of both, the crane and the crane rail,
- experimentally checked condition of the cranes steel construction for single overloading,
- check computation of the cranes steel construction, hoist and mechanisms for single overload of the main lift with weight of 300t -experimentally checked condition of the crane rails steel construction for single overloading,
- check computation of the crane rail for single overloading.

The scheme of converter ladle transport is in fig.1.

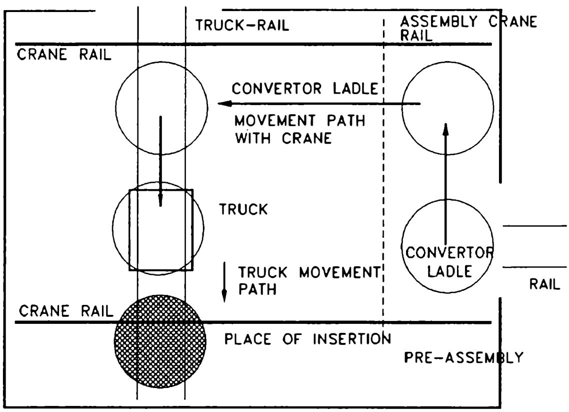

Fig.1

Experimentally checked condition of the cra ne steel construction and rail construction, judgement of the cumulation of fatigue damage

The experimental checking of the crane and crane rails construction was realised by strain gauge measurement. The placement of sensors on the principal beams and the crane beams 250t+ 63/12,5t-21m is in fig.2. The placement of sensors on the crane rail is shown in fig.3.

The measurement of tension increase was realised in real work conditions and expressed as time function at different load. The heaviest load was 245t. The maximum tension increases at 300t were found out by linear interpolation. This load equals to the converter ladle. In fig.4. is the simulated tension time response in spot 2 on the crane girder (see fig.2.) for bearing capacity 300t with the measured 245t weight. In fig.5. is the simulated tension response in spot 1 (see fig.3) on the crane rail for weight 300t with the measured 245t weight.

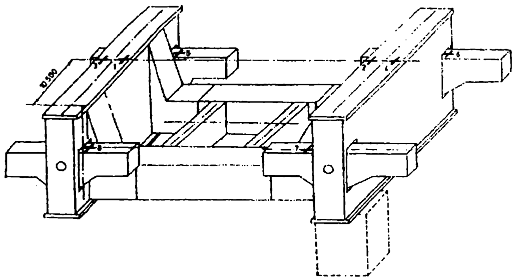

Fig.2.

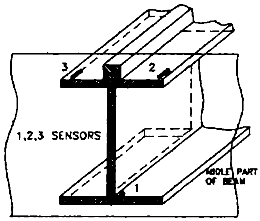

Fig.3.

There are in tab.1 the result tension found out at critical spots of steel construction crane rail.

Tab.1

Crane 250t-21m			Crane rail		
measured and simulated tension increase [MPa]	tension from own gravity [MPa]	result tension [MPa]	measured and simulated tension increase [MPa]	tension from own gravity [MPa]	result tension [MPa]
72 see Fig.4	42	114	105 see Fig.5	6	111

Introduced values of measured and computed tensions are lower than computed by standard procedure. From the measured time response on the crane and crane rail with regard to their working time and using the hypothesis of cumulation of fatigue damage according to P-M, H and C-D follows, that exhausting of fatigue life has not occurred.

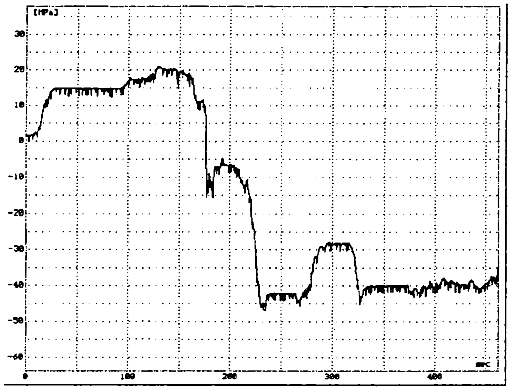

Fig.4

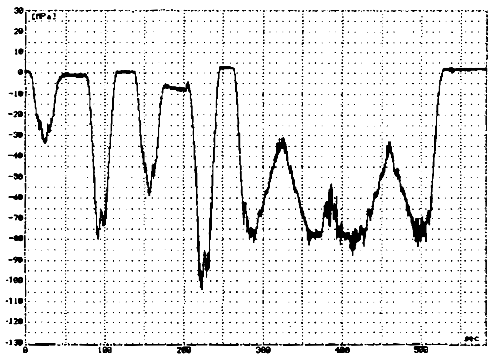

Fig.5

Static check computation of crane mechanisms, crabs, steel construction and crane rail for bearing capacity of 300t.

The static and power check computation of crane mechanisms considered a detailed re-counting of the main lift, recounting of the hoist drive of the main lift and recounting of the crane drive. A recounting of the crossrail, rope, rollers, winches, shafts, bearings, gears, break and electric motors was realised. It was proved by calculations that they are satisfactory for lift of 300t if the elements of the 250t-21m crane are unbroken. This condition is illustrated on installed and calculated powers according to tab. 2.

Tab.2.

Installed power on the 250t crane			Calculated powers for crane 300t		
lift [kW]	crab [kW]	crane rail [kW]	lift [kW]	crab [kW]	crane rail [kW]
160	2x14	2x77	155,5	2x8,2	2x27

At the control of hoist frame with weight of 300t at the most stressed cross section the tension achieves 114 MPa. At the strength control of own mass load ,constant weight, weight of 300t and inertia effects the calculated maximum tension was 131 MPa. The experimentally stated maximum tension was 114 MPa (tab.1). From this point of view it is necessary to adapt main crane girders for the transport of the converter ladle.

The strength and stability calculating control of the crane rail confirmed the fact, that the crane rail is satisfactory at manipulating with 300t weight. The crane rail section ,where the ladle will be lifted ,is not satisfactory from the stability point of view and it is necessary to adapt it with other reinforcement (see fig.3.)

Adaptation of main crane girders and crane rail

The insufficient flange of main crane girders (fig.6.) for manipulation with 300t weight needs their adaptation according to fig.7. Welding of the profiles L80x 80x 6 secures a safe manipulation with the 300t weight. This fact was checked by calculation.

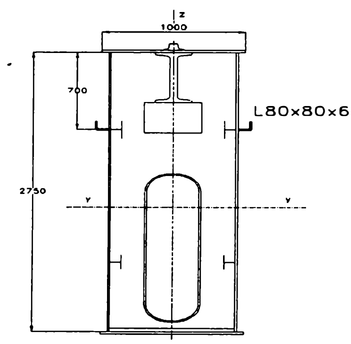

Fig.6.

Analogously was adopted the end of the crane rail according to fig.7. This recurred safety against swell of thin walls at lifting of 300t weight. This proposal was checked by calculation as well.

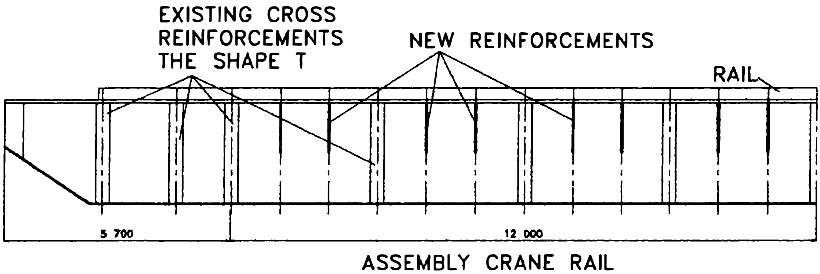

Fig.7.

Conclusion

The extensive experimental analysis, extensive calculating functions and adaptation proposals according to fig.6 and fig.7. secure a safe converter ladle transport of 300t of weight from the place of its pre-assembly to the place of insertion (see fig.1.) provided with one gantry crane of bearing capacity of 250t.

This solution was confirmed by Technical Inspection of SR and was first-time in history of Slovakia ,but also in former Czechoslovakia.

Literature

[1.] Bigoš,P. a kol.; Posúdenie a pretypovanie nosnosti žeriavovej dráhy rady C a D nalievacich žeriavov, vo väzbe na jednorázové zvýšenie nosnosti nalievacieho žeriava 250t č.2 na 295t pre akciu 9050 „Výmena KK5 na OC2“. Cassovia technopolis, Košice, jún 1995, 80 pages.

[2.] Bigoš,P. a kol.; Posúdenie a pretypovanie nalievacieho žeriava na OC2 pre jednorázové preťaženie na 295t pre akciu 9050 „Výmena KK5 na OC2“. Cassovia technopolis, Košice, jún 1995, 160 pages.

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