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Damage of Bridge Lifting Cranes and Crane Metal Structures

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Abstract: This study summarizes the results of surveys for crane metal structures and bridge crane metal structures with the load capacity from 5+5 tons up to 500/100/20 tons with various operating modes operating at oxygen-converter plants. Based on our own research and on the analysis of the works by other researchers in this field, the researcher of the study established the statistics of the damage of bridge cranes in oxygen-converter plants, depending on their carrying capacity. Characteristic defects and damages are revealed. All the variety of defects and damages is classified into the following main groups: critical, significant and minor. The figures of typical defects and damages are presented.

Key words: Instrumental survey, bridge crane, crane metal structures, defects and damages, significant, presented

INTRODUCTION

The existing defects and damages have great influence on the actual work of both bridge cranes and crane metal structures as well as load-bearing frames of industrial buildings of oxygen-converter plants in general. During many years of operation bridge cranes and crane metal structures, operated at oxygen-converter plants, receive various defects and damages. Over the years of operation, taking into account the possible unsteadiness of loading, bridge cranes and crane metal structures accumulate various defects and damages, consisting of initial defects that occurred during manufacture and installation and operational defects, arising during the operation period.

Timely detection, classification and elimination of detected defects in the early stages of the operation of the industrial building frames significantly reduces the likelihood of failures of critical elements and units as well as prolongs the period of their safe operation. Increase of operational reliability of bridge cranes and crane metal structures is achieved due to early detection and elimination of critical and significant defects and damages.

MATERIALS AND METHODS

During the period from 2009-2016, the researcher of this study carried out the studies of metal structure damageability concerning various bridge cranes and crane structures operated at oxygen-converter plants with the load capacity from Q = 5+5 tons up to Q = 500/100/20 tons. A set of methods was used in the research including field studies with statistical processing of the obtained data and computer modeling. Theoretical and empirical scientific research methods such as analysis and synthesis, observation (direct and indirect), measurement, and mental modeling were also used.

The methods of visual and instrumental survey for the metal structures of various bridge cranes and crane structures, operated at oxygen-converter plants, were used in the work.

Based on the own research and analysis of the research by other researchers, Nischeta (2015) in this area, the researcher of the study established the damage statistics of bridge cranes in oxygen-converter shops depending on their carrying capacity. All the variety of defects and damages occurring are classified into the following main groups: critical, significant and minor.

Critical defects represent the greatest danger for bridge cranes and crane metal structures, since, similar defects make their operation impossible or unacceptable. Significant defects are less dangerous, however, they significantly affect the service life and premature wear of the main parts of bridge cranes and crane metal structures. Minor defects do not practically affect the service life and premature wear of the main parts of bridge cranes and crane metal structures.

The value of the results of the above study is to increase the operational reliability of bridge cranes and crane metal structures by their testing for the presence of the said critical and significant defects and damages.

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RESULTS AND DISCUSSION

In accordance with the guidelines (Nischeta, 2015) the detection of faults and damages was performed on the trolleys of bridge cranes, main beams, in the nodes of element connection as well as in the points of corner box and balancer attachment. The performance of deadlock stops was evaluated, the wear of the crane rails was evaluated, the absence of cracks in all elements was checked. Besides, the state of the crane structures was studied thoroughly: the presence of initial and operational defects and Crane-Sub-Truss (CST) damage at the spans over 24 m, the operation modes of 7-8 K and the load capacity of 500 tons, crane girders, brake structures and junction points.

The studies carried out on bridge cranes of various carrying capacity established the regularities of horizontal load increase on crane girders, dead ends and columns caused by skewed wheels and crane bridges due to accumulated damage (Nischeta, 1983, 2014).

Among the examined ones the bridge cranes of oxygen-converter plants up to 50 tons make 28.6%, from 50-150 tons -39.6%, over 150 tons -31.8% (Permyakov, 2013).

The result of more than 600 detected defects and damages analysis is their classification into the following main groups.

Critical-the damages of load-bearing structures of emergency nature: cracks in the places of corner box fixation to the end beams or the balancers of bridge cranes, the cracks in the nodes of the main and end beams connection, the displacement of CST support parts relative to the axes of columns, the displacement of CST post edges, the displacement of crane rail edges, the cracks in the welded joints of crane rails. The examples of these damages are shown in Fig. 1-5.

Significant defects and damages to structures and equipment installed on overhead cranes which make a significant impact on safe operation: the damage of the cab fixing elements, the wear of the winch drums and side elements on the crane trucks by cable casings, the destruction of rail fastenings installed on the main beams of the bridge cranes, the loosening bolt tension fixing corner bushings, the absence or the damage of elastic stops, the deformation of the stiffeners, the damage or lack of supporting racks for jacks, the destruction of paintwork, the corrosion of metal. The most typical damages are shown in Fig. 6-8.

Minor defects and damages to structures and equipment that do not have a significant effect on safe operation: the absence or the deformation of railing elements on trolleys, end beams and the service areas of bridge cranes, the destruction of staircase and transitional site fastenings, the absence of welded seams on steel flooring fixture, the slots of maintenance area steel

Fig. 1: The cracks in the welds of the end beam of a bridge crane with the load-carrying capacity of Q = 16+16 t

Fig. 2: Cracks in the joint node of the main and end beams of the bridge crane with the load capacity of Q = 50/10 tons

Fig. 3: The shift of CST support relative to the axis of the column

Fig. 4: The shift of CST pillar edges

Fig. 5: Poor performance of the weld in the joint fastening of crane rails. The displacement of the rail edges by 10 mm

Fig. 6: The gap between the stops, the ends of the stops are not planed

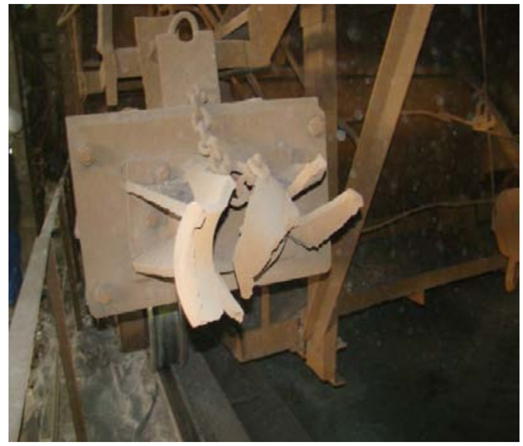

Fig. 7: Bridge crane stop destruction

Fig. 8: The destruction of the paintwork and the surface corrosion of CST internal surface

Fig. 9: The absence of the guard rail middle element

flooring, the absence of covers, caps and hatches. The most characteristic damages are shown on Fig. 9-12. The feasibility and reliability of scientific provisions and conclusions are confirmed by the use of certified software products, sufficient volume of conducted studies,

Fig. 10: The absence of a weld seam between the plates of the brake flooring

Fig. 11: Non-standard holes in the transverse stiffeners

Fig. 12: Non-standard holes in the brake deck to pass engineering communications

application of the proven and recognized methods of data collection and statistical processing (Narkevich and Nischeta, 2012; Narkevich, 2012)

CONCLUSION

In order to ensure safe and accident-free operation ofoverhead cranes and crane metal structures operated at oxygen-converter plants, it is recommended to conduct surveys in timely manner, according to which the design organizations issue the decisions on specified comments (approvals, decisions to strengthen structures and components, etc.) elimination.

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