Maintenance of steel structures: discussion

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Maintenance of steel structures

Discussion

Unterhalt von Stahlbauten

Diskussion

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Discussão

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Discussion

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Mr. BERRIDGE remarked that he could not agree with the author's contention that loose rivets could be tightened by welding round the heads. The number of tests, four, was inadequate to form the basis for so far-reaching a claim contrary to the principles of both riveting and welding. The heat from the welding was bound to lengthen the shank of a rivet and so reduce the friction between the faying surfaces of the parts joined. The clamping effect of the rivet caused by contraction of the shank on cooling immediately after driving was of primary importance in the transfer of shear across a joint; and, if there was a loss of this clamping effect as would be indicated by looseness, no amount of welding round the head was ever likely to restore the high degree of friction required to keep the parts from slipping under the application of a shearing force.

Mr. BERRIDGE showed slides (not reproduced) indicating how by simple modifications the maintenance of the girderwork of steam locomotive turntables built some 50 to 60 years ago for a railway in India had been greatly simplified and the future life of the steelwork extended. The rails had been lifted on steel packings; the solid plate deck between the girders had been replaced with an open grill; the outside deck plating had been kept clear of the girder flanges, and the edge angles which used to contain water on the plating had been inverted. These modifica-

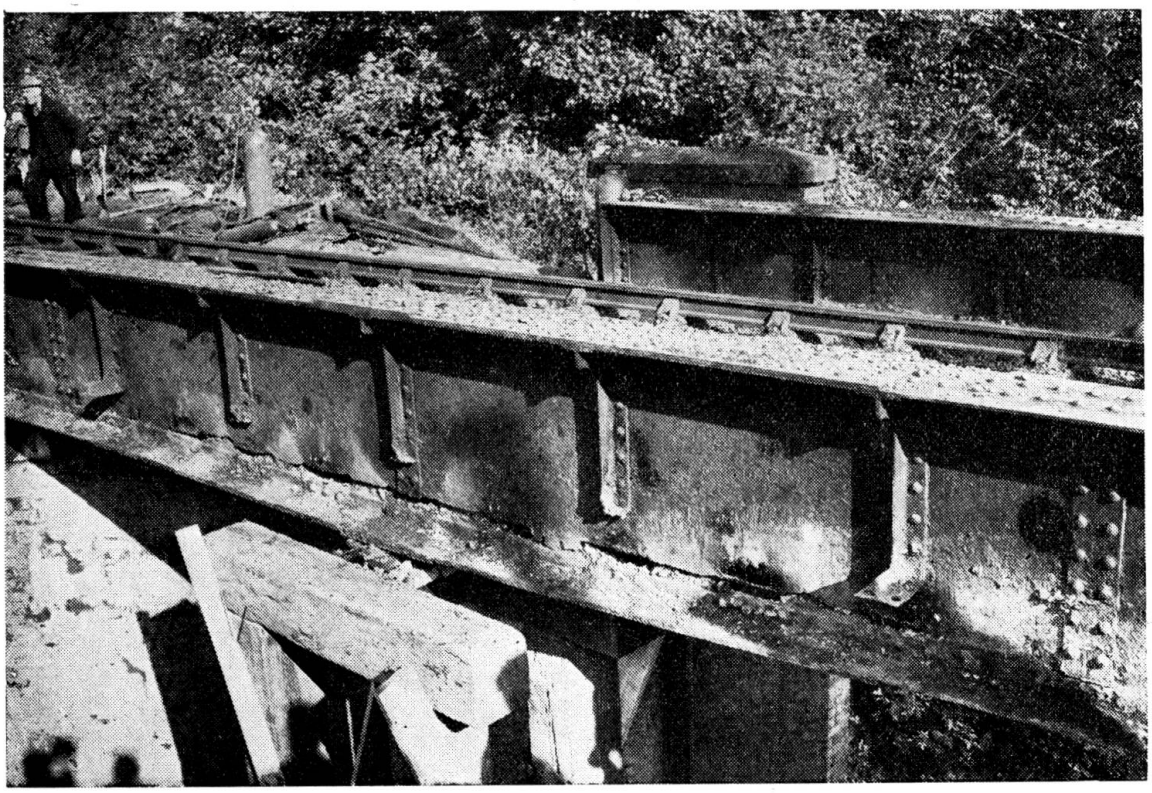


FIG. 1. The failure of a plate girder caused by corrosion fatigue of the mild steel web which had been obscured by concrete haunching. The decking on the nearside of the girder had been removed before this photograph was taken

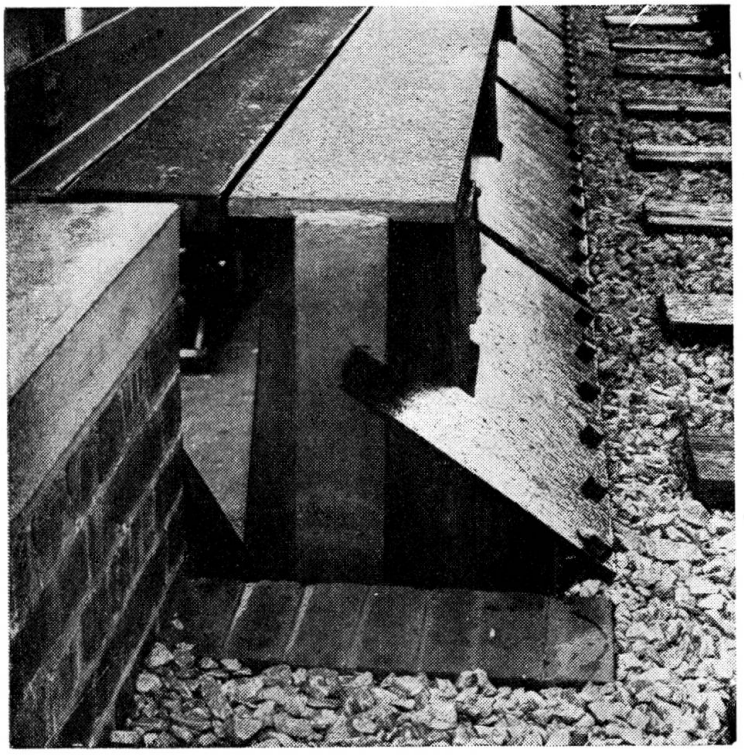
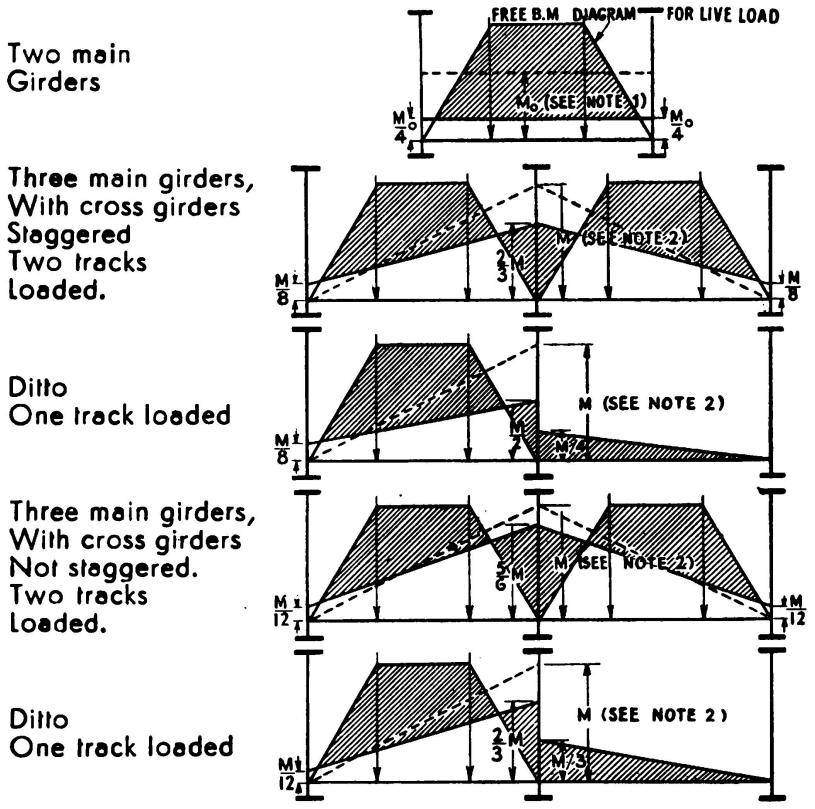


FIG. 2. The end of a welded plate girder showing how, by the removal of the bolted weather plates, full access is given to the joints between the deck units and the main girders

tions had made all parts fully accessible for painting and had, by allowing free circulation of air between the girders, removed a condition which had previously been very favourable to the propagation of rust.

Turning to the importance of accessibility for the proper maintenance of railway girder bridges, Mr BERRIDGE showed a picture (Fig. 1) of a centre girder of a double track half-through type plate girder span which through corrosion fatigue had developed a crack in the web plate



NOTES:—1. For bridges with two main girders, and when gross girder is symmetrically loaded, M_o = average height of free B. M. diagram.

2. For bridges with three main girders, M = end moment for full fixity at centre girder. (When loading is symmetrically placed on either o both cross girders, M = 1.5 times the average heigh of the free B. M. diagram).

FIG. 3. Diagram indicating the end fixing moments on cross girders in half-through type spans

at a point just above the bottom flange angles. The crack had extended over a length of 19 feet in a 30-foot span. The primary cause had been the masking of the girder by concrete haunching placed against the web with the object of reducing maintenance work. Damp had got down between the concrete and the steel web plate with the result that corrosion had set in where it was wholly obscured from view. The decking was of transverse steel troughing resting on the bottom flanges of the girders

and the web stiffeners stopped on the top of the troughing so that there was in fact no connection between these stiffeners and the bottom flange of the girder. Alternations of loading by the passage of trains, first on one track, and then on the other, had led to high concentrations of stress on the web plate at a point immediately above the flange where moisture was trapped behind the concrete. To guard against such a failure it was imperative that the all-important connections between decking and main girders should be wholly accessible for inspection and painting; no concrete should be placed against steelwork unless it was absolutely certain that no moisture could get down between the concrete and the steel. Showing a slide (Fig. 2) he indicated how bolted joints between deck units and the main girders of a bridge carrying a ballasted sleeper track could be made fully accessible for maintenance. On the subject of the connections between cross girders, deck units, etc. and main girders in half-through type spans, Mr BERRIDGE showed a diagram (Fig. 3) indicating the bending moments caused by the end fixity of the deck members. In the past so many bridges had been built on the assumption that cross girders were simple beams unrestrained at the ends. Such an assumption was quite wrong when, as generally happened, some degree of fixity became inevitable in designing the connection between a cross girder and the side of a plate girder. In the joint just visible below the weather plates (Fig. 2) the moment stresses due to end fixity were taken by high strength bolts connecting the deck units to the sloping flanges of web stiffeners on the main girders.

SUMMARY

The author said that loose rivets could not be tightened by welding round the heads. Such process was contrary to good practice.

Stressing the importance of accessibility, the author instanced (Fig. 1) a double track half-through type plate girder bridge where concrete haunching against the web of the middle girder had prevented the detection of a serious corrosion fatigue fracture of the web plate.

Improvements in the connections of deck units to main girders were shown (Fig. 2); attention was focused on the importance of designing such joints to carry the stresses induced by the end fixing moments inevitable wherever there is end restraint (Fig. 3).

ZUSAMMENFASSUNG

Der Verfasser ist der Auffassung, dass lose Nieten nicht durch Anschweissen der Nietköpfe befestigt werden könnten. Dieses Vorgehen widerspricht einer guten Praxis.

Als Beispiel für die Bedeutung guter Zugänglichkeit führt der Verfasser einen Vollwandträger für eine zweigleisige Brücke mit einer in Trägermitte liegenden Geleisewanne in Beton an. Der an den Steg des mittleren Trägers anstossende Beton hatte die Entdeckung eines ernsthaften Ermüdungsbruches infolge Korrosion verhindert (Fig. 1).

Es wurden Verbesserungen gezeigt bei den Verbindungen zwischen Deckenplatten und Hauptträgern (Fig. 2) ; besondere Aufmerksamkeit wurde der Bedeutung des Entwurfes von Verbindungen geschenkt, die die Beanspruchungen durch Endeinspannungsmomente, die unvermeidlich auftreten, wo immer das Endauflager an der freien Beweglichkeit gehindert ist, aufzunehmen haben (Fig. 3).

RESUMO

O autor indica que os rebites frouxos não se podem voltar a apertar soldando as cabeças, indo este processo contra boa técnica.

Insistindo na importância da acessibilidade, o autor cita o exemplo (Fig. 1) de uma ponte de via dupla com vigas semi-contínuas de alma cheia, em que a acumulação de betão contra a alma da viga central impediu a verificação de uma fractura importante da alma devida à corrosão.

O autor mostra como se pode melhorar a ligação do tabuleiro às vigas principais (Fig. 2) e chama a atenção para a necessidade de projectar estas ligações de modo a que possam suportar as tensões produzidas pelos momentos devidos à imobilização das extremidades, inevitáveis quando existe uma limitação do movimento das mesmas.

RÉSUMÉ

L'auteur indique que les rivets desserrés ne peuvent être réparés par la soudure des têtes, ce procédé étant contraire à la bonne pratique.

En insistant sur l'importance de l'accessibilité, l'auteur cite l'exemple (Fig. 1) d'un pont à double voie, à poutres semi-continues à âme pleine, dans lequel l'accumulation de béton contre l'âme de la poutre médiane a empêché de constater l'existence d'une fracture importante de l'âme due la corrosion.

L'auteur montre comment il est possible d'améliorer la liaison du tablier aux poutres-maîtresses (Fig. 2) ; il fait remarquer qu'il est necessaire de calculer ces liaisons de manière à ce qu'elles puissent supporter les contraintes produites par les moments dûs à l'immobilité des extrémités, inévitables chaque fois qu'il existe une limitation du mouvement de ces extrémités.

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