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No.CBS/DOW

Dated: 24-04-2015

ThePrincipal Chief Engineers,
The CAO/Construction,
OfAll ZonalRailways

M. Sridhar Rao

Sub: Guidelines on Residual Camber in Open Web Girders

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Presently there are no limits prescribed for camber loss in Open Web Girders. This has led to confusions and disputes in various Open web girder fabrication and erection works. There is also a misunderstanding on the types of Camber given in the RDSO drawings.

Standard Open Web Girders from RDSO are all designed as Pre-Stressed and Pre-Cambered girders. The Gusset Plates are fabricated to Nominal shape of girders and the Pre-Cambering of girder results in reverse secondary stresses which reduces to zero under full load condition because the girder is designed to be horizontal under full load condition. However, the girders are designed without taking any advantage of this pre-stressing. The permissible stresses in the steel bridge code already includes allowance for the secondary stress and in case secondary stresses are separately computed, the permissible stresses are supposed to be increased accordingly.Therefore, secondary stresses in the girder due to lower camber values alone is not a dangerous condition.

Under good quality control, the actually measured camber value are within +5% and -5% of the designed camber as given the Camber sheet of RDSO drawings. The Camber values as given in the Camber Sheet of RDSO drawings of different spans, are designed **Overall** Camber Values which include camber loss due to Self-Weight of Girder Frames + Self weight of Track component + Live Load + Impact load. This camber value is used only while the Girder is placed on Jacks and assembled. Measurement of Girder Camber after Girder Erection, Launching and track linking shall be Residual Camber as given in RDSO Drawing numbers CBS-0026/0027/0029R/0013/0040/0028**minus**deflections due to Self-weight of Track Components (approx. 4 to 5% of Overall Camber).

Guideline for Acceptance of Measured Camber Values:-

1. All the Girder members and its joints are fabricated with certain tolerances as given in the Steel Bridge and Fabrication codes. Due to these allowable tolerances, we can accept some camber loss as camber loss due to fabrication tolerances. Hence, up to 10% of **Designed Residual Camber** (Camber after Release of Jacks) may be allowed as loss under fabrication tolerances. For example for 61.0m girder for MBG Loading (Drg. no BA-11321), Camber on Jack is 81 mm and Residual Camber (Camber after release of Jacks) is 62 mm (Drawing number CBS-0013) then a camber loss of 10% of 62 mm i.e. 6.2 mm may be allowed as loss under fabrication tolerances. After Bridge Commissioning, the Self Weight of Track i.e. Sleepers and Rails will cause additional dead weight deflections of 4 mm. The Camber measurement on Site after erection and track fitting with 10% Camber loss would be, 62 mm – 6.2 mm – 4 mm = 51.8 say 52 mm under Dead weights only. Therefore, 52 mm measured camber, under no traffic condition shall be treated as within the fabrication tolerances even though the designed Overall Camber value for this Girder is 81 mm.
2. For Camber loss beyond 10% and up to 25% of the designed Residual Camber, the girders shall be carefully inspected for any distress (without opening any joints) and full speed shall be allowed if nothing unusual is detected.
3. Camber loss beyond 25% and up to 50% of the Designed Residual Camber is quite abnormal and will be treated as Poor Workmanship in fabrication and error in erection sequence and procedures. This may be a result of localized stress concentration and overstressing of some members due to irregular and unplanned deformations. To ascertain whether the camber loss is due to local stress failure, 10% of the rivets in last four joints of the Girder (L_0, L_1, U_1, U_2 + other ends equivalent four joints) may be opened and inspected for rivet hole elongations beyond permissible values as given in the fabrication codes. The Girder may be thoroughly inspected for any signs of overstress. If there are no signs of stress concentration / elongation of rivet holes in Gusset/ Members, then full speed of traffic may be passed. In case of any joint overstressing or hole elongation is noted, the girder should be monitored through instrumentation and be kept under observation for at least 3 months under caution and speed increased progressively.

The above guidelines do not allow the executing agencies any relaxation in quality control in the fabrication and erection work. The Fabrication tolerances as given in Fabrication codes shall be strictly followed.

24/4/15

(A.K Dadarya)
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