International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 07 | July 2019 www.irjet.net p-ISSN: 2395-0072

Train Impact Analysis on Prestressed Concrete Girder

Dr. J.N. Vyas [1], Tarun Pal[2]

[1]Director, Mahakal Institute of Technology and Management Ujjain
[2]Student, Dept. of Civil Engineering, Mahakal Institute of Technology and Management Ujjain

---

Abstract – *Railway is best and economical medium of transportation which requires heavy rails, ballast and sleeper. On past studies the transfer of train load from rails to sleeper then sleeper to ballast forwarded to embankment. Generally we cannot change very much of rails, sleeper, embankment or bridge deck but we can minimize the use of ballast. Environmental impact on earth can be reduced by preserving the rocks which minimize the disturbance in ecosystem. This phenomenon is maximum at bridge location with respect to earthen embankment. For this purpose, observing the impact of train passing through bridge on prestressed concrete girder as per Indian Railway guidelines and to determine the ballast usage characteristics to minimize the cost of bridge and solution to minimize the structural weight.*

Key Words: **Prestressed Concrete Girder, Indian Railway Bridge Rules, IRS Concrete Bridge Code**

1. INTRODUCTION

From the start of the 20th century, Indian railway has adopted the Broad Gauge(1.676 m) in its default procedure which have general guideline to maintain ballast thickness of minimum 400mm on any embankment as per clause 2.2.2 of Indian railway bridge rules, to negotiate with the thickness of ballast and the criteria to design the prestressed concrete girder, we have considered three different span bridges (11.4m,15.4m,17.9m) and checking the variation of stress on the girder as per Indian railway guidelines with 300mm thickness of ballast for first trail.

1.1 Details of Bridge parameter for Design

Bridge Span 1 : 11.4m

Bridge Span 2 : 15.2m

Bridge Span 3 : 17.9m

Concrete Grade : M50

Steel Grade : HYSD Fe 415

Width of deck : 11.8 m

Ballast Thickness : 300mm

Live Load : Heavy Mineral Loading

1.2 Impact under Observation:

The impact of train is transferred to the deck, at this location there are various factors which makes observation complicated like local stresses, mode shapes of element, resonance condition and etc. To simplify the stress check it should checked at girder top and bottom. The girder shape used as per RDSO Drawing is divided into six segments and analysed. The girder is analysed in staad pro to calculate only maximum and minimum force estimation, design calculation is done manually as per Indian railway guidelines.

1.3 Section Details:

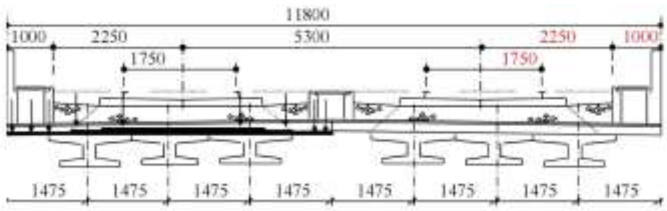

Fig 1: Assembly drawing under consideration

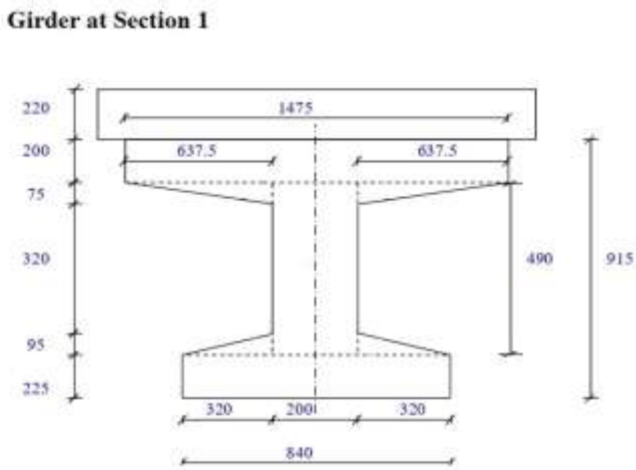

Fig 2: Girder at section 1

1.4 Bridge loadings used under analysis:

- Wt of railing
- Wt of duct wall
- Wt of footpath grating
- Wt of cables/pipelines
- Wt of ballast
- Wt of sleeper
- Wt of wearing course
- Wt of deck slab
- Live load EUDL
- Derailment Load
- Longitudinal forces & tractive force

1.5 Abbreviation used:

M1DL = Moment due to self weight of girder
M2DL = Moment due to diap. & deck slab
M2'DL = Moment due to retainers
M3DL = Moment due to remaining SIDL
MFPLL = Moment due to Footpath live load
MLL = Moment due to live load

2. Stress Results of Prestressed Concrete Girder calculated using Staad Pro & MS excel at section 1

As per chapter 11, **IRS Concrete Bridge Code: -**

Table 1, For Span 11.4 m

Loading	Stress at Girder Top (t/m^2)	Stress at Girder Bottom (t/m^2)
Stage 1 + M1DL	69.57	486.80
Stage 1 losses	83.11	424.01
M2DL	258.61	239.23
M2'DL	266.20	215.71
Stage 2 prestress	415.64	1338.31
Stage 2 losses	409.93	1112.79
M3DL	467.57	934.23
MFPLL + MLL	663.80	326.28

Table 2, For Span 15.40m

Loading	Stress at Girder Top (t/m^2)	Stress at Girder Bottom (t/m^2)
Stage 1 + M1DL	91.84	1045.35
Stage 1 losses	123.97	896.40
M2DL	366.76	640.77
M2'DL	374.33	617.31
Stage 2 prestress	537.41	1879.83
Stage 2 losses	543.10	1542.71
M3DL	655.64	1193.99
MFPLL + MLL	974.47	206.02

Table 3, For Span 17.9 m

Loading	Stress at Girder Top (t/m^2)	Stress at Girder Bottom (t/m^2)
Stage 1 + M1DL	127.19	314.94
Stage 1 losses	138.75	264.29
M2DL	257.47	141.45
M2'DL	260.54	133.95
Stage 2 prestress	375.98	1130.87
Stage 2 losses	374.77	932.20
M3DL	462.31	718.09
MFPLL + MLL	671.19	207.29

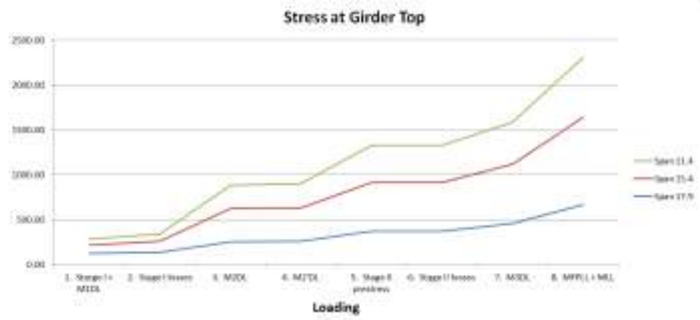

Chart 1: Stress at Girder Top comparison between span

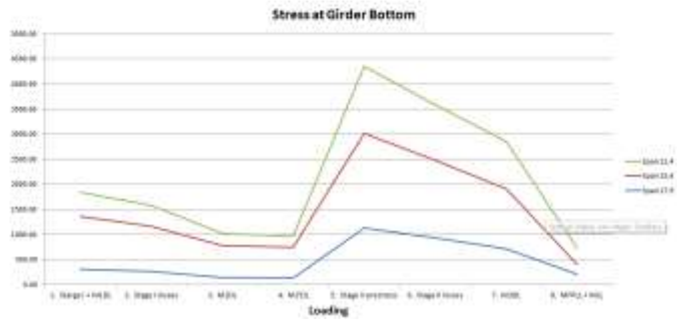

Chart 2: Stress at Girder Bottom comparison between span

3. CONCLUSIONS

1. As per Chart 1 & 2, the stress intensity of live load and footpath load is increasing in same manner at top, decreasing towards the bottom in traditional manner.
2. The stress intensity of prestressing force is increased at bottom to compensate the tensile stresses.
3. The changes in girder top stress are in linear variation and maintaining the variation in similar manner indicating the St. venant's principle for local stress due to uniformly distributed load.
4. The changes in girder bottom stress are similar for span 15.4m & 17.9m but low stress for span 11.4m indicating increase in impact of tensile at bottom.
5. By comparing both 300mm and 400mm ballast stresses at the section 1 of the prestress concrete girder, there is minute difference between the stresses. 300mm thickness ballast is recommended.

ACKNOWLEDGEMENT

I would like to thank director sir for their precious guidance and support.
I would like to thank to P.K. Sharma (AXEN/Con/SASR) and Rajesh Kumar (SSE/CON/CWA). I also appreciate Ajay Kumar (XEN Design Bilaspur), S.E.C. Railway for providing data and kind support.

REFERENCES

[1] Thakkar Kaushal Rajesh Kumar, "Response of steel railway bridges on 25T route due to train load", Department of earthquake engineering, IIT Roorkee, June 2011

[2] N. Krishna Raju, Prestressed Concrete Book, Tata McGraw Hill, 2018

[3] IRS Concrete Bridge Code, 1997

[4] Indian Railway Bridge Rules

[5] IS 456 2000, B.I.S.

[6] Concrete Technology, Indian railway Institute of civil engineering pune, March 2007

[7] Indian Railway Permanent way manual, Indian railway Institute of civil engineering pune, second edition,2004

[8] Tarun pal, "Train impact analysis on prestressed concrete girder", www.irjet.net , volume 6, issue 7, paper id – FTP670510, July 2019