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

Cable Behavior in Cable Stayed Bridge due to Sudden Ground Motion

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Abstract – *Cable Stayed Bridge are advanced structures used in modern life to facilitate the connection between one point to another. This kind of structure is purely based on the transfer of load from deck to cable then cable to tower forwarded to ground afterwards. In which cable plays an important role in load transfer mechanism, which should be analyzed for all kind of severe weather conditions. For this purpose, the behavior of cable is checked under IRC Class A loading with impact of sudden ground motion at rock bed due to plate tectonics.*

Key Words: **Cable Stayed Bridge, IRC class a loading, Impact load**

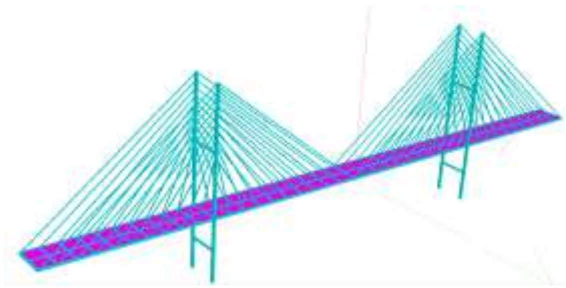
1. INTRODUCTION

As we all know that in recent time, the foot over suspension Cable Bridge in Florida, United States is collapsed due to severe wind pressure leads to cable failure. This failure leads to tolls 6 dead and 9 injuries. For this reason, cable is getting checked for harsh weather condition and different critical condition. To analyse this, my concern is subjected to load impact due to sudden ground motion in different weak rock bed support condition. This impact intensity is considered by taking load peaks from live examples and analysed on staad pro with IRC guidelines.

1.1 Details of Bridge parameter for Design

Bridge Span : 200m
Tower height: 60m
Cable diameter: 300mm
Width of deck: 10m
Thickness of deck: 300mm
Steel Grade : HYSD Fe 415
Live Load: IRC Class A Loading
No of lanes: 2

1.2 Section Details:



1.3 Bridge Load Case Assigned:

1.Dead load
2.IRC Class A Loading N37 Disp X +ve
3.IRC Class A Loading N56 Disp Y +ve
4.IRC Class A Loading N1 React^n Fy +ve
5.IRC Class A Loading N34 React^n Fy +ve
6.IRC Class A Loading N66 React^n Fy +ve
7.IRC Class A Loading N99 React^n Fy +ve

1.4 Load under observation:

- Dead load
- IRC Class A Loading (IRC 6 2014)
- Impact Load

1.5 Impact observation details:

The example under consideration is for same bridge with different values of impact load to check the stress variation in cable.

Case 1: Bridge under normal conditions with fixed support
Case 2: Bridge under impact load of 500 KN in traffic direction and 400 KN from bottom (assumed intensity of load) with pinned support Fx = 0
Case 3: Bridge under impact load of 500 KN in traffic direction and 400 KN from bottom (assumed intensity of load) with pinned support Fz = 0
The above case leads to observe the variation in cable with increasing intensity of load at support.

2. Results summary:

As per IRC, MORTH and Indian standard, the stress of cable is analysed on Staad Pro and results are mentioned below: -

Table 1: Cable stresses at member no 51 in Staad at one end

	Cable stresses in N/mm^2		
Loadings	Without impact load	With impact load but Support release Fx	With impact load but Support release Fz
Dead load	-8.805	-8.805	-8.805
IRC Class A Loading N37 Disp X +ve	-8.666	-19597.814	-8.664
IRC Class A	-11.294	-11.307	-11.293

Loading N56 Disp Y +ve			
IRC Class A Loading N1 Reactⁿ Fy +ve	-11.176	-685.219	-11.175
IRC Class A Loading N34 Reactⁿ Fy +ve	-8.667	-3335.927	-8.665
IRC Class A Loading N66 Reactⁿ Fy +ve	-10.992	-2148.883	-10.92
IRC Class A Loading N99 Reactⁿ Fy +ve	-8.668	-8963.27	-8.686

Fig 1: Cable stress diagram without impact in Load case 2 in assigned member 51

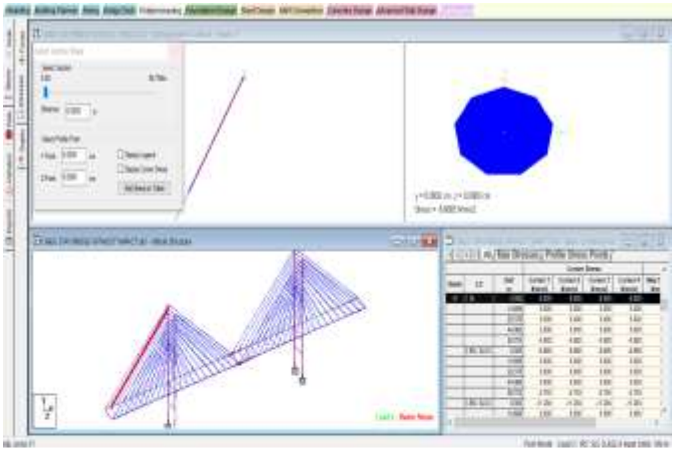


Fig 2: Cable stress diagram with impact and Fx = 0 in Load case 2 in assigned member 51

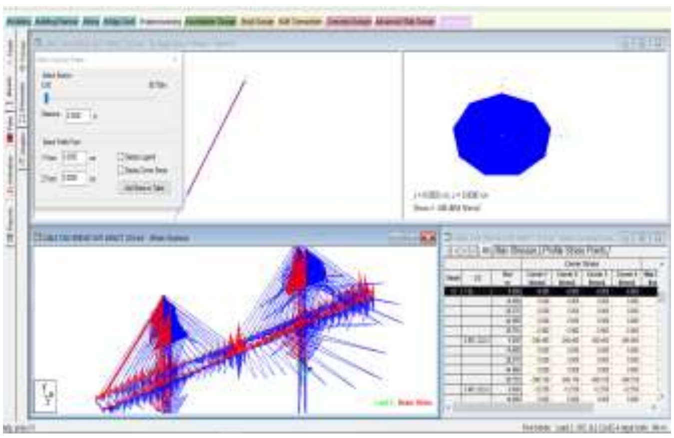


Fig 3: Cable stress diagram with impact and Fx = 0 in Load case 2 in assigned member 51

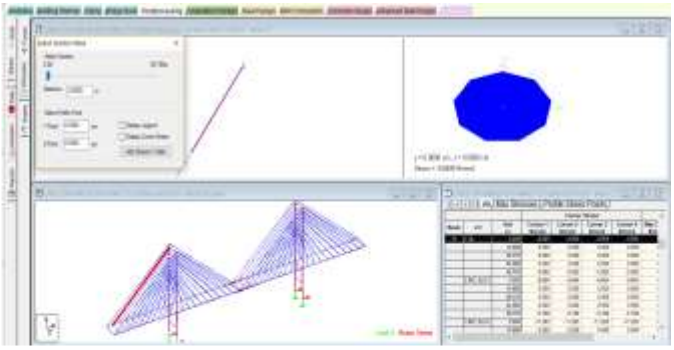


Fig 4: Moment diagram without impact in Load case 2 in assigned member 51

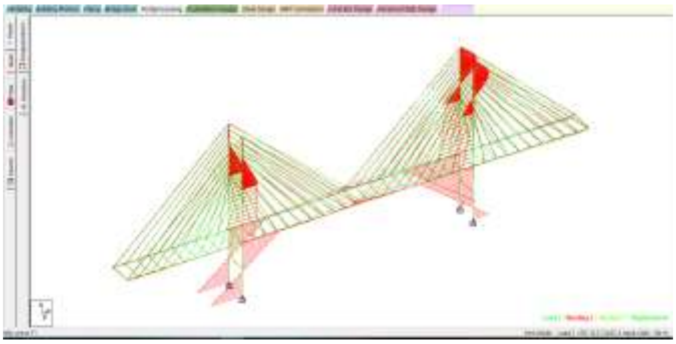


Fig 5: Moment diagram with impact and Fx = 0 in Load case 2 in assigned member 51

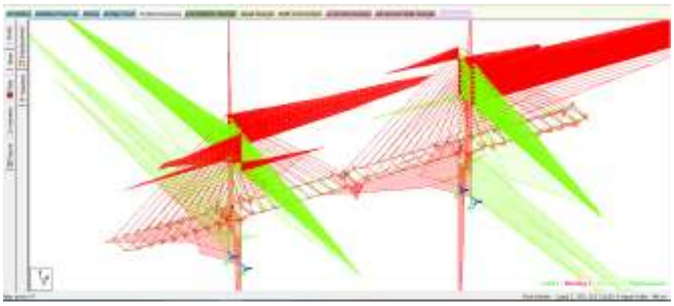
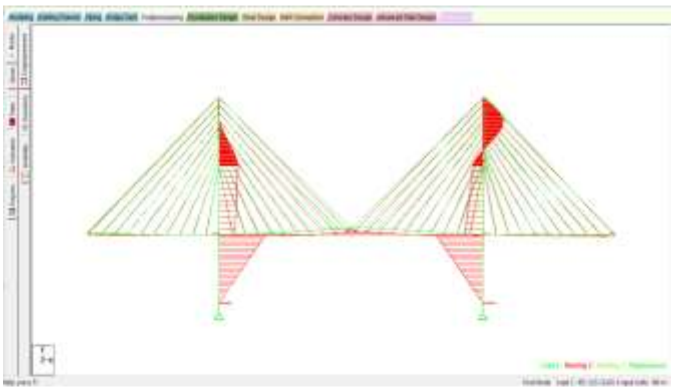


Fig 6: Moment diagram with impact and Fz = 0 in Load case 2 in assigned member 51



3. CONCLUSIONS:

1. As per Table 1, the change in stress of cable is varying with the support case in Fx = 0 creating instability in bridge in huge amount in tower , cable, and at mid of deck of the bridge while nominal in case of without impact and impact with Fz = 0.
2. As per Fig 3, 4 & 5, the moment on Bridge is clearly representing the behavior of bridge under different support condition. This indicated the moment resistance of the section is good in normal condition as shown but gets fluctuated at base of tower and at junction of cable.
3. There is some increase in stress over the previous article impact value in case of Fx = 0 as published before for 800 KN and 650 KN from bottom direction for Load case 2 in the analysis of the bridge.

ACKNOWLEDGEMENT

I would like to thank Director sir for their precious guidance and support.

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