Lasitude and Retrofitting to Bridge

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Abstract--- *Bending moments shear forces, stresses, displacements are important failure modes under traffic loading. However, bridges have so many accredit that it is difficult to analyze their lassitude damages. Numerical simulation is a feasible method of studying such fatigue, displacement, stresses, damages this paper develops bridge stability and safe by using retrofitting technique during heavy traffic and aged bridge. With the purpose to provide a retrofit method with good workability for reinforced concrete (RC) highway bridge columns under severe construction work conditions, a retrofit method with combination of carbon fiber reinforced polymer (CFRP) sheet and steel jacketing has been proposed in this research project. This paper provide an introduction of the proposed retrofit method companying with descriptions on the CFRP-steel bonded connection and RC bridge column provide great stiffness.*

Keywords--- *Displacement, Fatigue Failure, Stresses, Finite Element, Retrofitting.*

I. INTRODUCTION

THIS bridge structure is a built to span physical obstacles without closing the way underneathsuch as a body of water ,valley or road, for the purpose of providing passage over the obstacle. There are many different designs that each serve a particular purpose and apply to different situations. Designs of bridges vary depending on the function of the bridge, the nature of the terrain where the bridge is constructed and anchored, the material used to make it, and the funds available to build it. History of bridges started in ancient times, and ever since then architect and engineers improved them to the point they are today-mighty structures that span mountains, lakes and oceans.

Structural togetherness and failure is an aspect of engineering which deals with the ability of a structure to support a designed load (weight, force, etc...) without breaking, tearing apart, or collapsing, and includes the study of breakage that has previously occurred in order to prevent failures in future designs.

Structural togethernessis the term used for the performance characteristic applied to a component, a single structure, or a structure consisting of different components. Structural integrity is the ability of an item to hold together under a load, including its own weight, resisting breakage or bending. It assures that the construction will perform its designed function, during reasonable use, for as long as the designed life of the structure. Items are constructed with structural integrity to ensure that catastrophic failure does not occur, which can result in injuries, severe damage, death, and/or monetary losses.

Structural failure refers to the loss of structural togetherness, which is the loss of the load-carrying capacity of a component or member within a structure, or of the structure itself. Structural failure is initiated when the material is stressed beyond its strength limit, thus causing fracture or excessive deformations. In a well-designed system, a localized failure should not cause immediate or even progressive collapse of the entire structure. Ultimate failure strength is one of the limit states that must be accounted for in structural engineering and structural design.

Bending moments, shear forces, displacements, stresses is an important failure mode for steel structures. In fact, 80–90% of failures in steel structures are related to fatigue and stresses and displacements. Nowadays, more and more large steel bridges are being constructed worldwide, and some are expected to be vulnerable to laitude-related problems. It is important to study lasitude damage in these bridges. Lasitude analysis for an existing bridge is predominantly based on stress analysis, to get the distribution of stress in structures. Heavy traffic running on this bridge, bridge may significantly change local dynamic behavior and affect the fatigue life of the bridge. Many experimental techniques that have been shown to be successful for structural identification of short- and medium-span bridges cannot simply be scaled-up to long-span bridge. All of these factors make it very difficult to study lassitude damage in long-span bridges with experimental measurement. Correspondingly, numerical simulation is a feasible method to study such lasitude damage. In this bridge Firstly I used up to 50 years corresponding population loads. After I used heavy loads to same bridge and considered further 50 years corresponding population loads and that bridges gave lot fatigues, stresses, displacements and its more than previous 50 years. So observed these laitudeness and used retrofitting techniques to columns and becomes got sufficient results for this bridge.

A. *Five Big Reasons Contributing to Bridge Fail*

- Natural calamities.
- Construction failures
- Defective design
- Poor maintenance
- Low grade materials

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B. *Objectives of the Project*

In this paper the bridge is analyzed by using STAAD-Pro software.The bridge is analyzed for present and future traffic loading. Comparing these traffic loads retrofitting techniques are adopted.

II. METHODOLOGY

1st case: In this case up to 50years of traffic load due to population and corresponding results are arrived. STAAD.Pro software is used for the analysis.

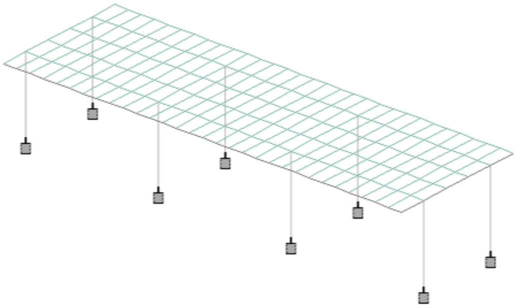


Figure 1: Bridge Model

Table1: Bridge details

Data	
Length of the bridge	30m
Width of the bridge	5m
Effective span	10.3m
Width of the support	0.3m
Number of lanes	02
Slab thickness	0.2m

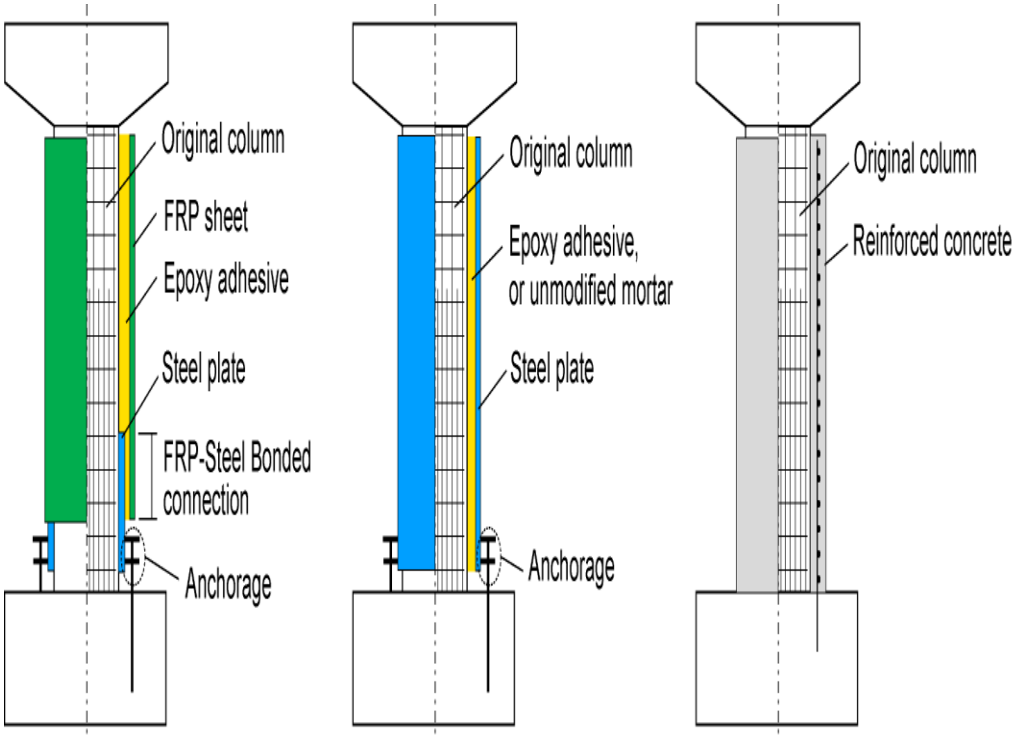
2nd case: In this case future load for 50years is applied for heavy traffic due to population. Due to heavy movements bridge receives heavy load. Either bridge may carry this heavy load or there is large displacements and stresses, moments along node and beams, this beams is middle of supports. This is caused because of tiredness of bridge. From this point of view this bridge can resist these loads up to some years but it may fail to resist heavy traffic. Because of this purpose retrofitting to same bridge got good results to resist heavy loads. Further tables show case1, case 2 and retrofitting values.

3rd case: In this case also future load for 50years is applied for heavy traffic due to population. But in this case retrofitting technique is used .hence slab is not retrofitted, only columns are retrofitted so got feasible results compare to 2nd case it is sufficient to resist heavy loads.

A. *Retrofitting*

Attributing to the merits of high strength, light-weight and outstanding workability,fiber reinforced polymer (FRP) sheet has been widely used in repairing orstrengtheningreinforced concrete (RC) members in the recent decades. As for seismic retrofit of RC highway bridge columns in Japan, FRP sheet is usually used to retrofit columns with premature termination of longitudinal reinforcements without enough development length at the midheight. CFRP sheet was jacketed around the termination sections of the longitudinal reinforcements in the longitudinal direction and circumferential direction to reinforce flexural and shear strength. In some other cases, FRP sheet is also used to reinforce ductility of the columns by jacketing around the plastic hinge in the circumferential direction.

However, it is not an effective method to reinforce the flexural strength of the column base by jacketing FRP sheet in the longitudinal direction. Generally, high elongation is required locally in both of the longitudinal and circumferential directions at the base. Enhancement of ductility capacity of the base can not be obtained because elongation of the FRP sheet is rather lower before breaking. From the point of view, a method with using combination of CFRP sheet and steel jacketing has been proposed. It should be noted for the retrofit method that bonding behavior between CFRP sheet and steel plate is a key issue, because the longitudinal force induced from the additional anchor bolts must be transmitted to CFRP sheet and thus the steel plate should be bonded with CFRP sheet in the inelastic response of the column.



a) Combination (b) Steel Jacketing (c) RC Jacketing and Steel Jacketingof CFRP

Figure 2: Schematics of Seismic Retrofit Methods for RC Bridge Columns

Data

Length of bridge = 30m

Width of the supports= 0.5m

Width of the bridge = 5m

Effective span = 10.5m

After retrofitting width of support and effective span are increased.

III. RESULTS AND DISCUSSION

Table 2: Node Displacements

Nodes	*1st case displacement(mm)*	*2nd case displacement(mm)*	*Retrofitting displacement(mm)*
4th	1.77	5.105	1.9
5th	1.857	4.9	1.7
12th	1.596	3.9	2.39
13th	1.551	3.91	2.39
20th	0.019	0.083	0.074
21st	0.022	0.078	0.080
28th	0.005	0.042	0.053
29th	0.017	0.270	0.032
57th	15.517	23.434	15.575
61st	7.555	40.05	29.025
111th	3.415	6.99	3.017
115th	2.070	9.012	4.088
165th	0.711	1.722	0.419
169th	0.611	1.921	0486

Table 3: Beam Displacements

Beams	*1st case displacement (mm)*	*2nd case displacement (mm)*	*Retrofitting displacement (mm)*
4th	0.325	0.895	0.550
7th	0.252	0.627	0.460
30th	0.006	0.021	0.018
43rd	0.001	0.002	0.003
92nd	0.195	0.315	0.243
99th	0.098	0.563	0.473
196th	0.028	0.071	0.028
203rd	0.022	0.075	0.035
300th	0.006	0.015	0.003
307th	0.005	0.016	0.004

Table 4: Bending Moments

Beams	*1st case(kNm)*	*2nd case (kNm)*	*Retrofitting (kNm)*
4th	14.060	35.400	22.700
17th	14.425	18.657	13.526
30th	0.209	0.650	0.535
43rd	0.064	0.142	0.183
92nd	25.953	41.117	32.000
99th	13.168	70.980	59.715
196th	3.860	9.264	4.326
203rd	3.293	10.334	5.018
300th	0.800	2.071	0.532
307th	0.742	2.270	0.590

Table 5: Shear Forces

Beams	*1st case (kN)*	*2nd case (kN)*	*Retrofitting (kN)*
4th	4.524	9.51	6.53
17th	0.150	0.362	0.029
30th	0.025	0.041	0.009
43rd	0.041	0.083	0.075
92nd	6.110	8.442	6.96
99th	3.334	9.930	8.43
196th	1.134	3.642	2.001
203rd	1.332	3.163	1.880
300th	0.221	0.605	0.267
307th	0.221	0.607	0.531

Table 6: Tensile Stresses

beam	1st case (N/mm^2)	2nd case (N/mm^2)	Retrofitting (N/mm^2)
4	3.129	7.863	5.04
17	1.679	4.139	3.009
30	0.048	0.147	0.125
43	0.017	0.039	0.05
92	5.739	9.099	7.033
99	2.914	15.7	13.129
196	0.853	2.1	0.965
203	0.732	2.286	1.109
300	0.173	0.453	0.113
307	0.163	0.474	0.119

Table 7: Compressive Stresses

beam	*1st case (N/mm^2)*	*2nd case (N/mm^2)*	*Retrofitting (N/mm^2)*
4	3.142	7.902	5.115
17	1.687	4.158	3.063
30	0.047	0.145	0.122
43	0.013	0.028	0.04
92	5.798	9.2	7.194
99	2.941	15.9	13.425
196	0.863	2.1	0.962
203	0.733	2.31	1.123
300	0.183	0.47	0.125
307	0.168	0.498	0.143

A. Comparision of Results Between Displacements, Stresses, Bending Moments, Shear Forces

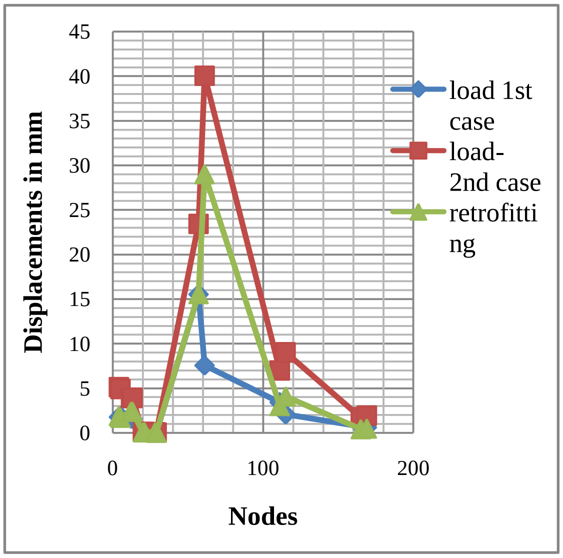


Figure 3: Node Displacements in Between Supports

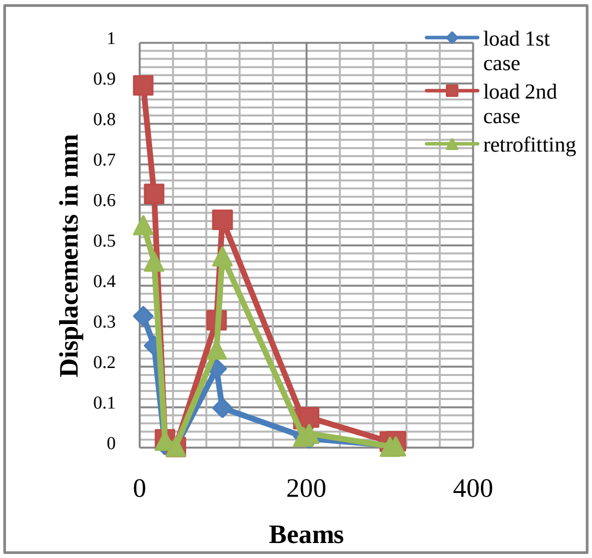


Figure 4: Beam Displacements in between Supports

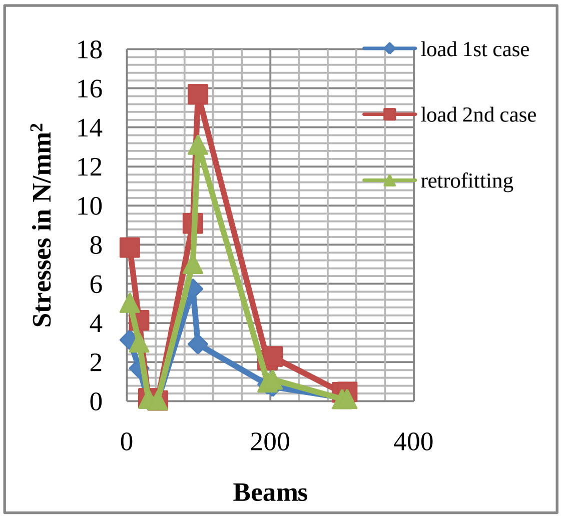


Figure 5: Tensile Stresses

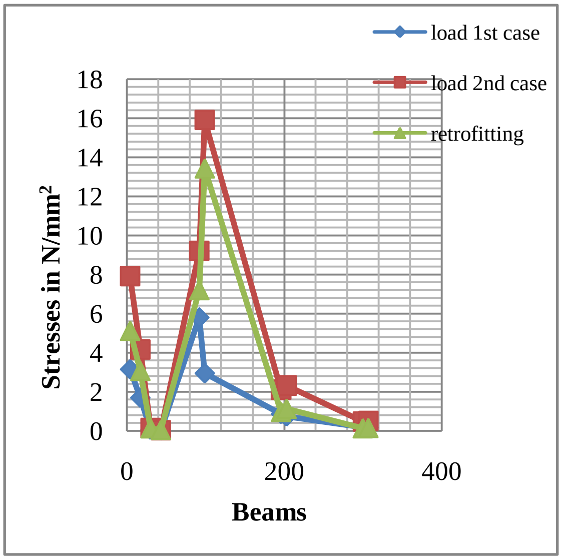


Figure 6: Compressive Stresses

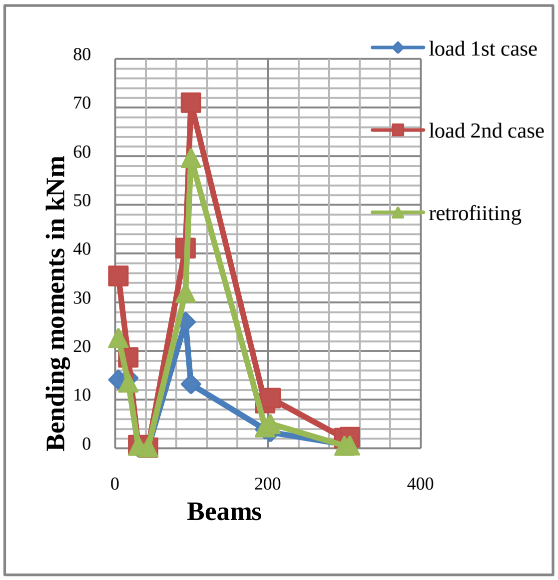


Figure 7: Bending Moments

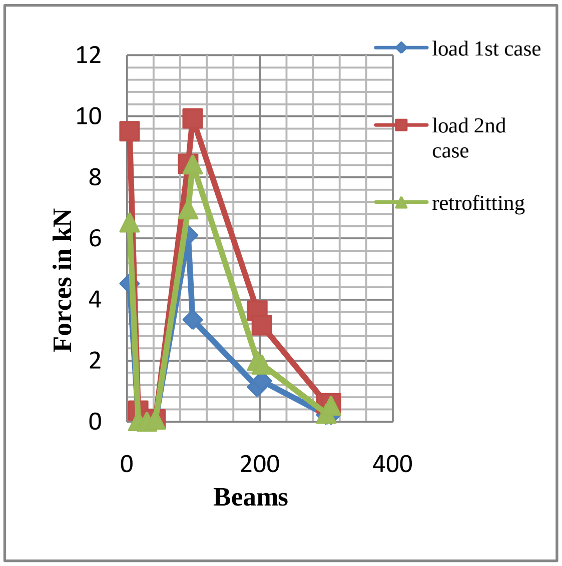


Figure 8: Shear Force

B. Overall Comparision

Maximum Stresses

	1^{st} case	2^{nd} case	Retrofitting
Compressive stresses (N/mm^2)	20.26	34.024	14.464
Tensile stresses (N/mm^2)	17.942	31.748	13.577

Maximum Displacements

	1^{st} case	2^{nd} case	Retrofitting
Displacements (mm)	1.777	2.833	0.750

Over All Reactions

	1^{st} case	2^{nd} case	Retrofitting
Moments (kNm)	1359.1	3191.99	3191.9
Forces(KN)	282	699.9	699.9

After retrofitting bridge is capable of carrying heavy traffic load.

IV. CONCLUSION

A large FE model of a bridge was thrive in this paper. In order to be suitable for lasitude stress analysis, the developed FE model express the spatial presentation of the original structure. Consider all above results we can easily use retrofitting technique without disturbing the traffic and also can also save bridges about many years. During the remove of the bridge responses under heavy traffic loadings. The computed stress spectra in the bridge could be used for subsequent lasitude damage analyses. These results show that the proposed FE model in this paper is efficient for lassitude analysi Retrofit method with using a combination of CFRP sheet jacketing and steel jacketing was proposed in this research project with the purpose to provide a retrofit method for RC bridge columns under severe construction work conditions.

V. SCOPE FOR FUTURE WORK

This work can be extended by using deflection to determine the failure. Other methods of retrofittings are concrete jacketing, composite material jacketscan be implemented.

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