STRUCTURAL HEALTH MONIROING OF VISAKHAPATNAM PORT TRUST BRIDGE

OVERVIEW

DGC Engineering Pvt.Ltd. was awarded the contract for Structural Health Monitoring of Visakhapatnam port trust bridge by IIT Hyderabad.

This Flyover in located in Vishakhapatnam connects the port area and Airport to Vishakhapatnam city and NH-5. The length of this flyover is approximately 1.2 km. This flyover bridge is constructed on pile foundation, having Reinforced concrete piers. There was little deterioration observed in structural members and bearings. All spans are deviated longitudinally from their original positions and different gaps were found between them.

Fig 1:- Visakhapatnam port trust Bridge .

STRUCTURAL HEALTH MONITORING OF BRIDGE.

The Bridge was monitored to find out its Deflection, Natural Frequency, Crack Width, and Braking Load Test and to find out Measurement of movement along with inclination of girders of 5 spans of Vishakhapatnam port Trust Bridge.

Static load testing and Dynamic load testing were performed to know the behaviour of girders in flexure under live loads. Six loaded trucks of 22 tonnes each were used to perform the load test. Axle load distribution and load configuration of loaded test trucks were used for static loading. They were placed behind each other in three lanes at the centre of the deck for each span.

SOLUTION WITH APPROPRIATE SENSORS

- **Deflection Measurement**: -The mid Span Deflections were taken by installing the LVDT's at the mid of Girders. Draw wire type arrangement were used to connect the displacement sensors to the soffit of the girder.

Fig 2: - Linear Potentiometer to find deflection.

- **Natural Frequency measurement: -** Natural frequencies of the RCC girders and deck were measured by installing accelerometer on the deck. All the 5 spans were tested for their Natural Frequency in Dynamic Motion .

Fig 3 :- Accelerometer placed under the Girder

Fig 3:- Accelerometer

- **Crack Width measurement: -** In this test, the increase in width the existing cracks were measured. An omega type displacement transducer (crack width sensor) was mounted across the crack. It is a strain gauge-based transducers which can measure minute displacements.

Fig 4 :- Omega Sensor and Vernier Calliper to measure crack width.

- **Measurement of Girder Inclination: -** A digital magnetic inclinometer with an accuracy of 0.05 degrees was used to study the inclination of girders before and after the Static Load Test. Inclinometer were mounted on a metal surface which was bonded to the girder with a proper adhesive and sealing compound.

Fig 5: Digital Tiltmeter

- **Braking Load Test:**

During inspection it was found that all girders are displaced longitudinally from their original position creating gaps in expansion joints. Some gaps are so huge that it can be easily noticed from top as the gaps are opened up with filler material.

Fig 6: Placing of Linear Potentiometer

Observations: -

1) It was found by visual inspection that the condition of expansion joints is not good. There huge gaps between expansion joints and the joints have got opened despite the filler material.
2) This has initiated the hammering action of vehicles which are further worsening the condition of joints. The impact of vehicles while passing the gap can easily is felt at bridge site. These gaps are created due to random longitudinal movements of girders.
3) The maximum longitudinal and transverse displacement measured is 0.58 mm and 0.44 mm respectively. This indicates that due to longitudinal braking forces of test vehicles, the girders got displaced slightly even after removal of loads.
4) The maximum deflection of 6 mm has been recorded at mid-span of the girder at the centre of span 69-70 where Linear Potentiometers were placed
5) The natural frequencies of the girders are in the range of 4.411 Hz to 4.612 Hz. There is very minor variation in natural frequencies which indicate that the flexural stiffness of girders is almost similar.
6) The maximum inclination has been recorded as 0.6 degrees for girder G4 of span 70-71.
7) These opening are of considerable magnitude and are in the range of 0.6 mm to 0.9 mm. This indicates that these are active structural cracks and required to be repaired on priority.
8) Expansion joints got damaged and improper which need to be repaired as and where required.

Fig 7 :- Trucks placed for Load testing

CONCLUSION

Tests were successfully performed under the supervision of NHAI, IIT Hyderabad and the supporting team of VJTI under guidance of Prof.Abhay Bambole.
The whole Load testing was completed in 3 days along with installation of sensors and Static as well as Dynamic loading.

The required data was acquired and forwarded to the client for further course of action.