Experimental Investigation on Artificially made Continuous Beam Under Cyclic Loading

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Abstract: A continuous span is a bridge segment with structural members that cross over one or more substructure units without a break. The structural members may have to be spliced to obtain the necessary length; however, they are still considered one-piece members. The advantages of continuous girders that are statically indeterminate structure have been established but the experimental behavior of artificially made continuous beam is not found .Hence this experimental investigation is taken off to access the behavior of continuous beam with artificially made continuity on the load carrying capacity, the cumulative ductility factor values, the cumulative energy absorption values, Stiffness and deflection of Made Continuous Beam under cyclic loading are found out and compared with the conventional one.

Keywords – artificially made RC continuous bridge, cumulative ductility factor values, cyclic loading.

1.INTRODUCTION

Reinforced concrete continuous bridges are generally adopted for longer multiple spans. The bridge deck comprises either the solid slab, Tee beam and slab or box girders continuous over several spans. Continuous solid slab bridges are economical for shorter spans while Tee beam and slab continuous bridges are economical in the span range of 10 to 35 meters. Continuous bridges are adopted as units of three, four or five spans. The three span continuous bridges is the most common type-generally used for highway bridges. The bending moments and shear forces at various sections of a continuous girder bridge can be evaluated by using influence lines. Continuous girders are of variable cross-section so that the moment of inertia of the girder section is proportional to the bending moments developed at the section.

2.EXPERIMENTAL INVESTIGATION

2.1 CEMENT

Cement is the most important constituent of concrete, in that it forms the binding medium for the discrete ingredients made out of naturally occurring raw materials and sometimes blended with industrial wastes. Cement comes in various types and chemical compositions 53 grade Portland Pozzolana Cement conforming to IS 1489-1976 is used for the study.

2.2 FINE AGGREGATE

The material smaller 4.75mm size us called fine aggregate. Natural sands are generally used as fine aggregate. It may be obtained from pits, rivers, lake, but it should free from clay and silt. Sea shore sand may contain chloride, which may cause efflorescence and may cause corrosion of reinforcements. Angular grained sand produces, good and strong concrete because it has good interlocking property, while round grained particle of sand do not afford interlocking. River sand was used in preparing the concrete as it was locally available in sand quarry.

The specific gravity and water absorption were found to be 2.7 and 1,0% respectively, with sieve analysis data and fineness modulus value of sand confirms to grading zone II.

Table 2.1 Test on Fine aggregate

Properties	Value
Fineness modulus	2.52
Bulk density	1670 kg/m3
Water absorption	1.05%

2.3 COARSE AGGREGATE

The material retained on 4.75mm sieve is termed as coarse aggregate. Crushed stone and natural gravel are the common materials used as coarse aggregate for concrete. Coarse aggregate are obtained by crushing various types of granites, schist and gneiss, crystalline and lime stone and good quality sand stones. Concrete made with sand stone aggregate give trouble due to cracking because of high degree of shrinkage.

For coarse aggregate crushed 20mm, normal size grade aggregate was used. The specific gravity and water absorption were found to be 2.7 and 0.5% respectively.

Table 2.2 Test on Coarse aggregate

Properties	Value
Fineness modulus	6.25
Bulk density	1650 kg/m^3
Water absorption	1.15%

2.4 DIMENSIONS AND REINFORCEMENT:

CB	Continuous beam	80 x 120 x 3000	2 No's of 8mm dia in top & bottom	6mm dia @ 150mm c/c
MCB-C1, MCB-GF	Made continuous beam	80 x 120 x 1600	2 No's of 8mm dia in top & bottom	6mm dia @ 150mm c/c

2.5 LOADING AND LOAD DEFLECTION BEHAVIOR

- The beam specimen was placed on the loading frame and tested under two-point loading condition.
- The forward cyclic load was applied by using screw jack and to record the load precisely, proving ring was used.The beam was gradually loaded by increasing the load level in each cycle such as 1.5, 3, 4.5, 6, 7.5 KN etc. up to the maximum load of that cycle. At the end of each cycle the load was gradually released and deflections during unloading were noted.
- The beam was loaded up to failure and the values of load at first crack and ultimate failure stage and crack pattern were noted. The cracks were marked by different colours to show clearly the failure patterns of beam.
- As the load was increased in each cycle, the observed deflection was greater than in earlier cycle. The history of load sequence followed for the test is presented in fig 2.1

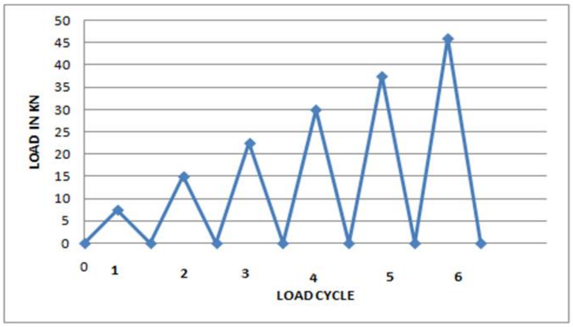

Fig 2.1 LOAD SEQUENCE DIAGRAM OF CB BEAM,MCB C1,MCB GF

3.RESULTS AND DISCUSSIONS

3.1 TEST RESULTS OF MCB-C1 BEAM

Yield deflection Δy=1.34 mm

Table 3.1TEST RESULTS OF MCB – C1 BEAM

Cycle No	Max Load kN	Central Deflection in mm	Ductility factor	Cumulative Ductility Factor	Energy Absorption Capacity kN-mm	Cumulative Energy Absorption Capacity kN-mm	Stiffness kN/mm
1	7.5	0.32	0.24	0.24	0.6	0.6	26.25
2	15	0.96	0.72	0.96	3	3.6	24
3	22.5	1.46	1.09	2.05	4.8	8.4	21.4
4	30	2.34	1.75	3.8	34.2	42.6	18.75
5	37.5	3.82	2.64	6.44	39	81.6	15
6	46	7.16	5. 4	11.84	102	183.6	13.5

3.2 TEST RESULTS OF CONTINUOUS BEAM

Yield deflection Δy=1.38 mm

Table 3.2 TEST RESULTS OF CB BEAM

Cycle No	Max Load kN	Central Deflection in mm	Ductility factor	Cumulative Ductility Factor	Energy Absorption Capacity kN-mm	Cumulative Energy Absorption Capacity kN-mm	Stiffness kN/mm
1	7.5	0.29	0.21	0.21	0.75	0.75	25
2	15	0.63	0.46	0.67	1.95	2.7	24
3	22.5	1.2	0.87	1.54	6.6	9.3	20
4	30	1.95	1.41	2.95	10.2	19.5	18
5	37.5	2.92	2.11	5.06	21.9	41.4	17.14
6	46	3.96	2.87	7.93	21	62.4	15

3.3 TEST RESULTS OF MCB-GF BEAM

Yield deflection Δy=1.32 mm

Table 3.3 TEST RESULTS OF MCB-GF BEAM

Cycle No	Max load	Central Deflection in mm	Ductility factor	Cumulative Ductility factor	Energy Absorption Capacity kN-mm	Cumulative Energy Absorption Capacity kN-mm	Stiffness kN/mm
1	7.5	0.34	0.26	0.26	1.35	1.35	26.25
2	15	0.87	0.66	0.66	2.85	4.2	22.5
3	22.5	1.63	1.24	2.16	7.65	11.85	20
4	30	2.52	1.91	4.07	12.6	24.45	17.5
5	37.5	3.4	2.56	6.63	45.3	69.75	15
6	46	6.336	4. 8	11.43	96.6	166.35	13.33

3.4 COMPARSION OF CB and MCB -C1

3.4.1 LOAD DEFLECTION BEHAVIOUR

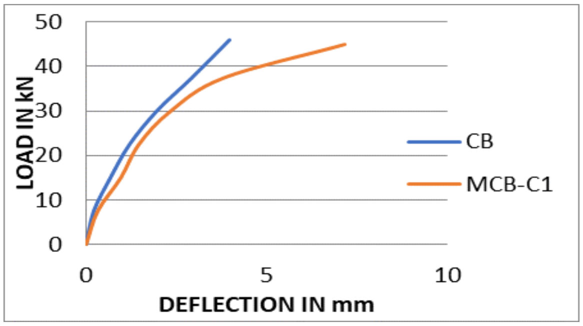

FIG 3.4.1COMPARISON OF LOAD DEFLECTION BEHAVIOUR

3.4.2 CUMULATIVE DUCTILITY CHARACTERSTICS

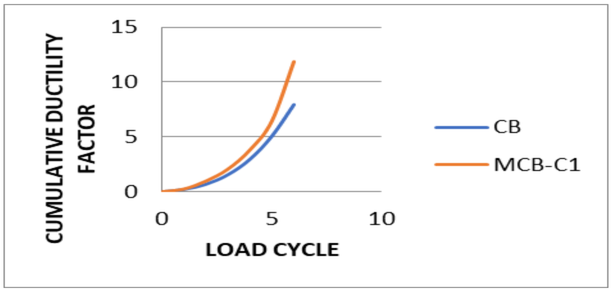

FIG 3.4.2VARIATION OF CUMULATIVE DUCTILITY FACTOR

3.4.3 ENERGY ABSORPTION CAPACITY CHARACTERISTICS

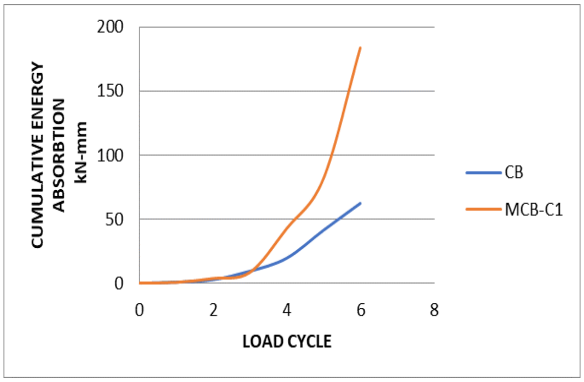

FIG 3.4.3 VARIATION OF CUMULATIVE ENERGY ABSORPTION CAPACITY WITH LOAD CYCLE

3.4.4 STIFFNESS CHARACTERISTICS

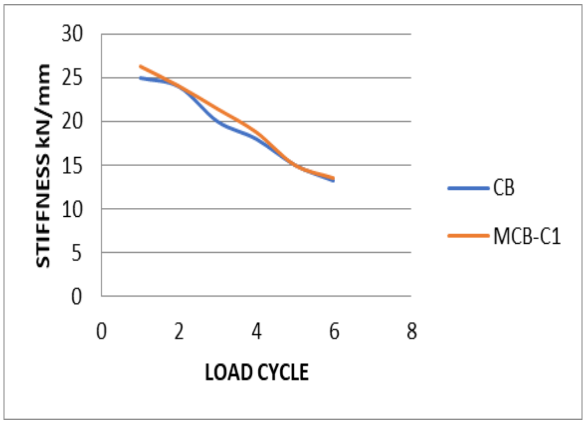

FIG 3.4.4.COMPARISON OF STIFFNESS WITH LOAD CYCLES

3.5 COMPARSION OF MCB -C1 and MCB -GF

3.5.1 LOAD DEFLECTION BEHAVIOR

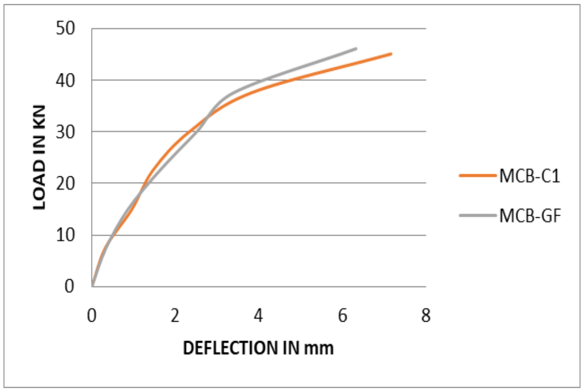

FIG 3.5.1COMPARISON OF LOAD DEFLECTION BEHAVIOUR

3.5.2 CUMULATIVE DUCTILITY CHARACTERISTICS

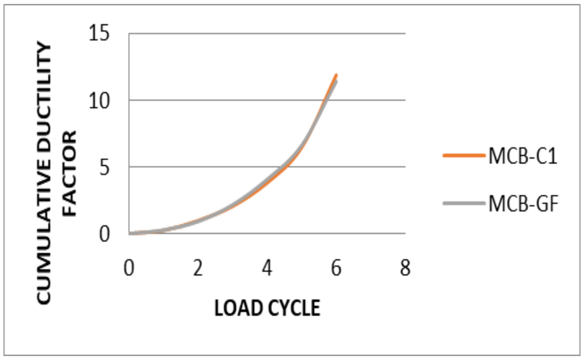

FIG 3.5.2 VARIATION OF CUMULATIVE DUCTILITY FACTOR

3.5.3 CUMULATIVE ENERGY ABSORPTION CAPACITY CHARACTERISTICS

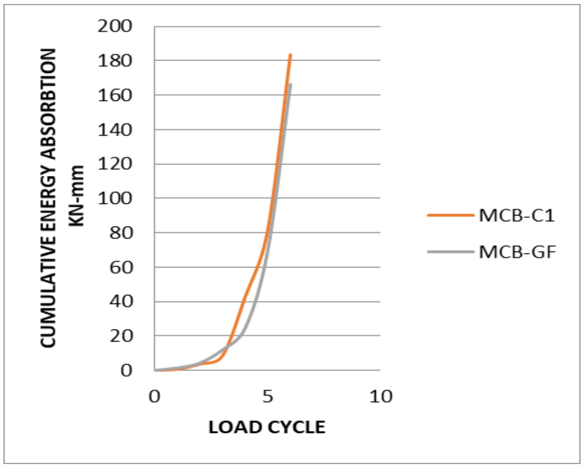

FIG 3.5.3VARIATION OF CUMULATIVE ENERGY ABSORPTION CAPACITY WITH LOAD CYCLE

3.5.4 STIFFNESS CHARACTERISTICS

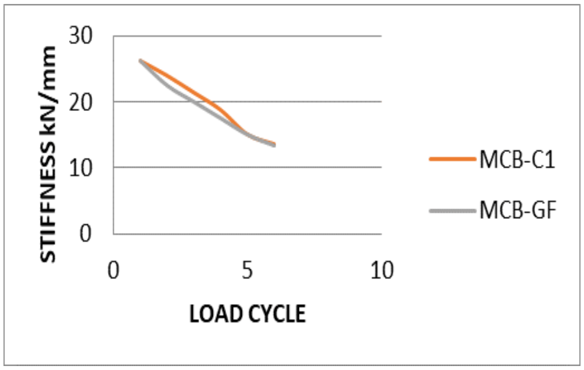

FIG 3.5.4 COMPARISON STIFFNESS WITH LOAD CYCLES

4. CONCLUSION

4.1 RESEARCH FINDINGS BASED ON CONTINUOUS BEAM AND MADE CONTINUOUS BEAM-CONVENTIONAL BEAM

1. The load carrying capacity of Made Continuous Beam -Conventional is nearly equal to continuous beam.
2. The cumulative ductility factor values for Made Continuous Beam -Conventional is about 1.49 times that of continuous beam.
3. It is observed that the cumulative energy absorption values of Made Continuous Beam -Conventional beam is about 2.94 times that of continuous beam.

4.2 RESEARCH FINDINGS BASED ON MCB-CI AND MCB-GF BEAM

1. The load carrying capacity of MCB-C1 and MCB-GF is more or less same.
2. The load –deflection behaviour is similar for both the beams
3. The cumulative ductility factor values for MCB-C1 and MCB-GF has marginal variation in-between.
4. The cumulative energy absorption values of MCB-C1 and MCB-GF beam has moderate variation only.

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