International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 9 Issue 2, Mar-Apr 2025 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Comparative Analysis of Precast RCC I Beam Girder and Cast in Situ T-Beam Bridges under Continuous Span by Midas Civil (2022)

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ABSTRACT

Precast Girders Commonly Used in Bridge like ROB, RUB, Flyovers, Expressways etc. to achieve fast construction, with minimum disturbance of exist traffic and better design methodology. The present study is concerned with analyze the precast I Girder or T beam type super structures generally adopted in most of the national high ways in the country. A typical precast I- beam girder generally comprises the longitudinal reinforced concrete girder with a cast in situ continuous deck slab & cross girders or diaphragms to provide lateral rigidity to the bridge. This paper describes the comparative analysis with IRC loading of cast in situ T beam and precast concrete I- girder with cast in situ deck slab super structure. In this study is also aims at understanding the effects of to apply moving load and vehicle load test to study the maximum deflections occur in bridge. The selected Geometry model is done by using Midas civil (2022) software. Therefore, Analyses the model over Loading Combination to Study the Behavior over the Bending moment at Support, mid spans, Shear forces at Support and deflection Causes due to Applied IRC Loading and Their Combination. Results extracted from the Midas Software further enhanced with multiplication factor incl. Congestion factor and impact factor on live loads. In this Present Study/ analysis precast concrete I-girder with cast in situ deck slab give the 12-15% lesser moment and 16-20% lesser Shear Force at continuous support in comparison to the cast in situ T- beam super structure.

KEYWORDS: *Girder Analysis, Midas Civil (2022), IRC 6:2016 (Section II), Precast I-Girder, Cast In-Situ T-Beam, Max Moments, Shear Force and Deflection*

How to cite this paper: Juhi Sharma | Dr. P. K Singhai "Comparative Analysis of Precast RCC I Beam Girder and Cast in Situ T-Beam Bridges under Continuous Span by Midas Civil (2022)" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-9 | Issue-2, April 2025, pp.753-764, URL: www.ijtsrd.com/papers/ijtsrd78490.pdf

IJTSRD78490

INTRODUCTION

This template, modified in MS Word 2007 and saved as a In general, girder bridges are made up of many parallel longitudinal girders that are joined by a deck slab and, if necessary, by cross beams or diaphragms. It is difficult to predict how a bridge will react to live loads. The process of calculating each girder's carrying proportion for the live load, such as the weight of trucks or cars, is known as live-load distribution. The distribution is required because live load application has unanticipated eccentricities and not all bridge lanes are always fully laden. The maximum truck (or lane of traffic) moment on a single girder is used to estimate the design live-load moment induced by a truck (or lane of traffic). The maximum single girder moment is then multiplied by a factor, commonly referred to as the live-load distribution factor (LLDF), to get the design moments for each girder. Economy and safety should be the two main considerations while developing a construction. Overestimating the load will make the structure unprofitable; while underestimating it will threaten the structure's safety. Therefore, it is important to be very precise when calculating the load and its combination. The precast girder bridge's overall loads are computed, along with the bending moments, shear forces, and axial forces that any load combination will have on the structure.

OBJECTIVE

To analyze/ Investigate the three span Continuous Super structure using precast I Beam Girder with cast in situ deck slab & cast in situ T Beam Super Structure and find various parameter such as Max. bending moment at Continuous Support, Max. Shear Force at support, using Basic ULS Combination on FEM based software.

METHODOLOGY

In general Structures are analysed in Software for finding more frequent results for multiple iterations, Therefore, A three Span Continuous Super Structure is analysed in Midas civil Software Which is FEM Based and Having good UI.

A General Outline of the method is used as below.

Selected a Real geometry of almost Straight 3 Span Continuous Super Structure and Done the Analytical modelling on Midas Civil, followed through the assignments of defined x-sections, properties, Loads and their Combinations, Diaphragm, Support Conditions at base. And Lastly Analysed the structure on Selected Modes and Load Combinations.

PRESENT WORK DESCRIPTION/ PROBLEM STATEMENT

Taking a Three Span Continuous Super Structure, modelled and analysed in Midas Civil 2022. Analysis Done on both cases either precast girder super structure and cast in situ T Beam Super Structure. So, in this study, comparison of parameters Like max. bending moment, maximum shear force is done on the both of the structural System.

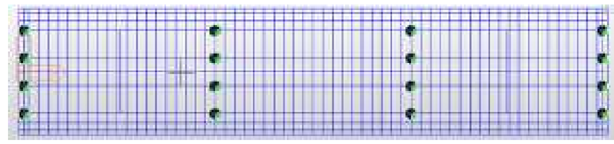

Fig. 1 Plan of Three Span Continuous Super Structure

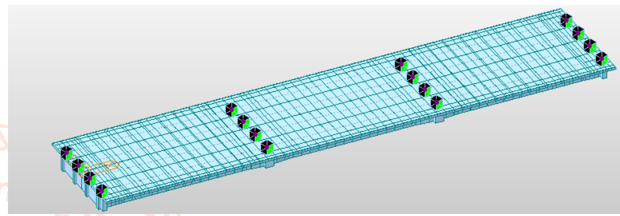

Fig. 2 3D view of Three Span Continuous Super Structure

TABLE I. SPECIFICATION OF THE MODEL

Specification	Model Case	
	Precast girder with cast in situ slab Super Structure	Cast in Situ T Beams Super Structure
Model	3span Continuous Super Structure	3span Continuous Super Structure
Total length of Span	60000mm (20000+20000+20000) mm	60000mm (20000+20000+20000) mm
Effective length of Span	19500+20000+19500mm	19500+20000+19500mm
Overall Width of Carriageway	12900mm	12900mm
Clear Carriageway	10500mm	10500mm
Crash Barrier	500 mm both Side	500mm both side
Safety Kerb	750 mm both Side	750 mm both side
C/C Spacing of Girder	2800 mm	2800 mm
Thickness of Slab	225 mm	225 mm
Overall depth of Super Structure	1800 mm	1800 mm
Width of intermediate diaphragms	300 mm	300 mm
Width of End/ Continuous diaphragms	500 mm,1000 mm	500mm,1000 mm

TABLE II. SUPER STRUCTURE MATERIAL PROPERTIES

Specification	Model Case	
	Precast girder with cast in situ slab Super Structure	Cast in Situ T Beams Super Structure
Grade of Concrete	M35	M35
Unit Weight of RCC	2500 kg/m 3	2500 kg/m 3

TABLE III. SECTIONAL PROPERTIES OF PRECAST GIRDER

Properties	Sectional Details	
	Mid- Section	End Section
Top Width	2800mm	2800mm
Flange thickness	225mm	225mm
Flange depth in straight	100mm	100mm
Flange depth in slope	50mm	33mm
Depth of Girder	1575mm	1575mm
Bottom width of girder	500mm	500mm
Flange depth in straight (B)	250mm	250mm
Flange depth in slope	100mm	0 mm
No. of Girder	4	4
Flange thickness	225mm	225mm

TABLE IV. SECTIONAL PROPERTIES OF CAST IN SITU SUPER STRUCTURE

Properties	Sectional Details	
	Mid-Section	End Section
Top Width	2800mm	2800mm
Flange thickness	225mm	225mm
Hunch depth	150mm	133.33mm
Hunch width	450mm	400mm
Width of Ribs	300mm	400mm
No. of Ribs	4	4
Top Width	2800mm	2800mm
Flange thickness	225mm	225mm
Hunch depth	150mm	133.33mm
Hunch width	450mm	400mm

MIDAS MODELLING

1. Defination- This step includes defining material specifications and sectional properties of Girder and Slab as per the geometry of the structure which was previously described.
2. Geometry modelling- Modelling of Super structure as per Midas
3. Load calculation & assignment
4. Analysis
5. Result data

Precast Girder Properties. (mid-section)

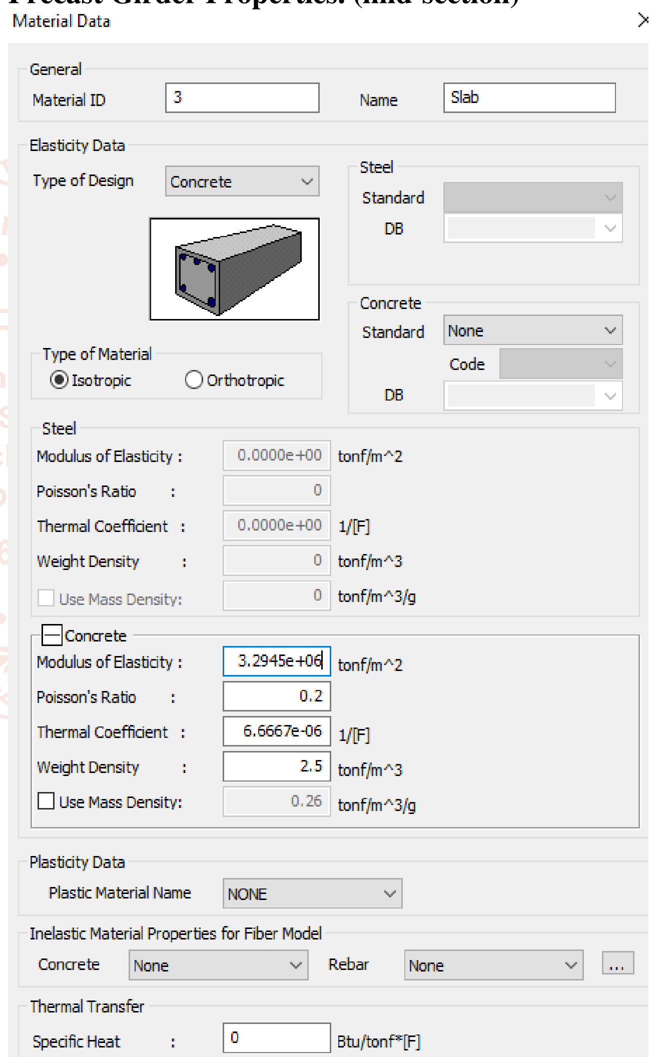

Fig. 3 Material Data in MIDAS Interface

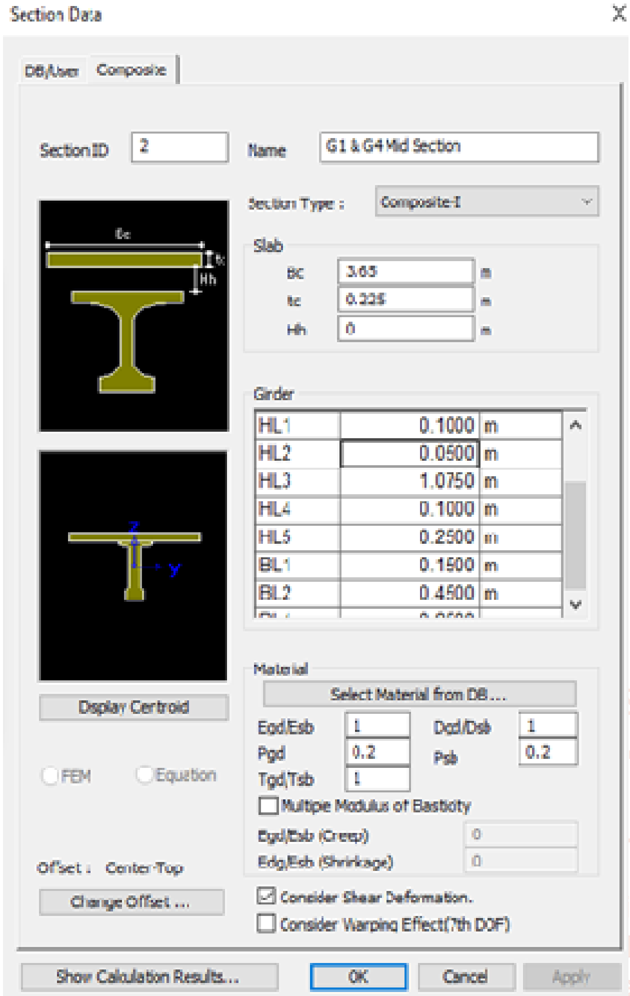

Fig. 4 Sectional Data for Beam Girder in MIDAS Interface

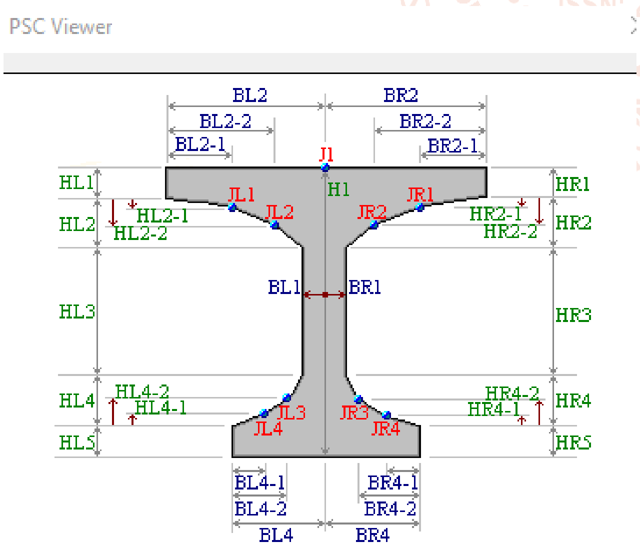

Fig. 5 Typical PSC Beam Girder Section Nomenclature in MIDAS Interface

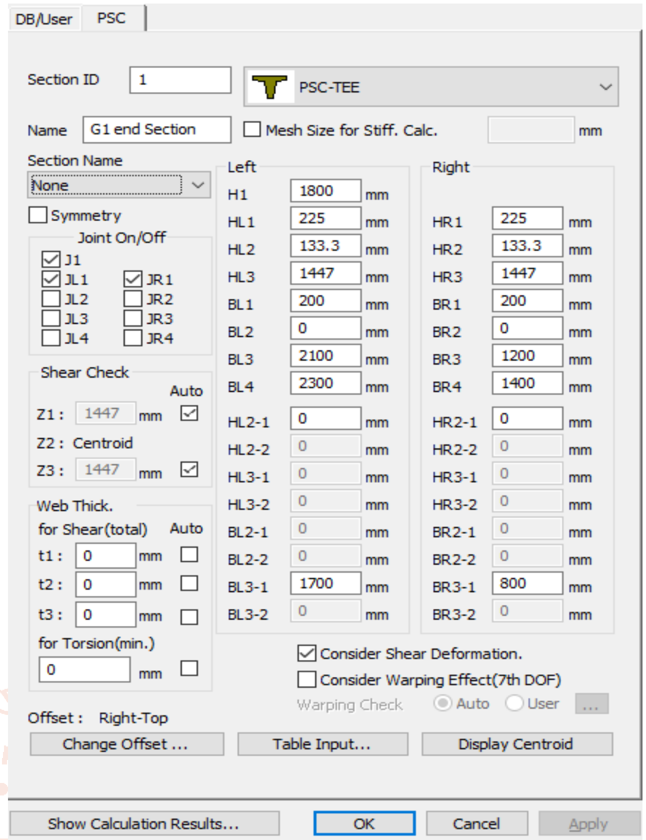

Fig. 6 PSC Beam Tee Girder Sectional data in MIDAS Interface

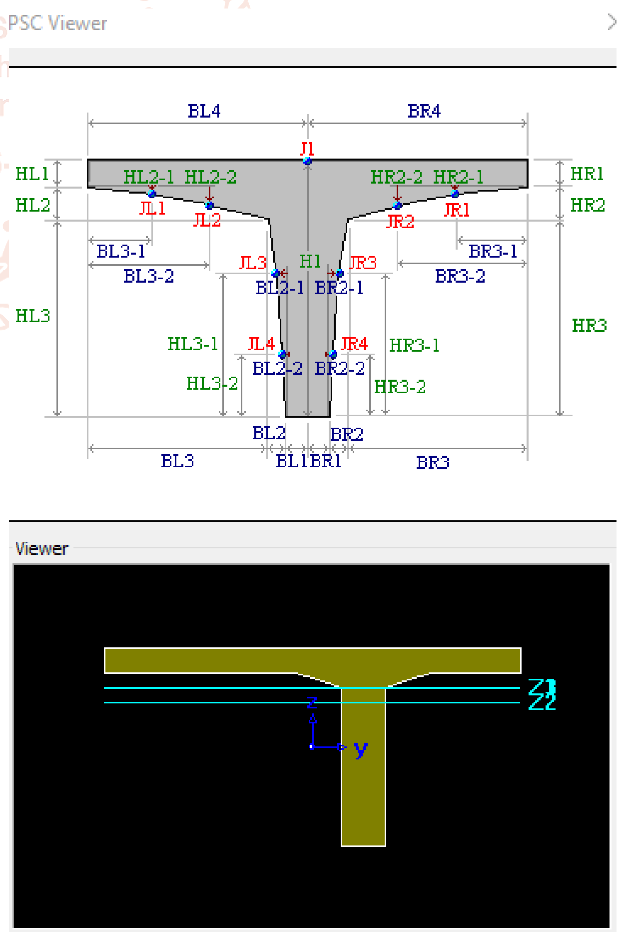

Fig. 7 Typical PSC Tee Beam Girder Section Nomenclature in MIDAS Interface

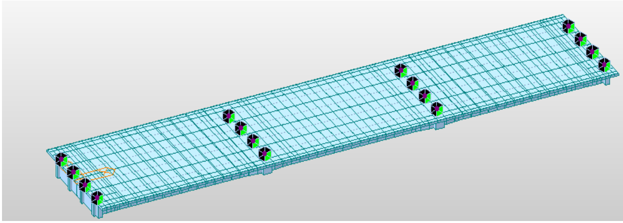

Fig. 8 Three Span Continuous Support condition shown in MIDAS Interface

Load Calculations

1. Dead load

On floor slabs:

Self-weight => Self weight of the Super Structure is Calculate in Midas civil model Properties

Wearing Coat Load – Thickness of Wearing Coat – 65mm

Density of Wearing Coat – 25kN/m^3

Load - 0.065x25= 1.62500 KN/m^2 Applying as a Floor load.

Crash Barrier – 9.81 KN at 1000mm interval Appling as a Nodal load.

Safety Kerb load - thickness of Safety Kerby – 300mm

Load - 0.3 x25- 7.5Kn/m^2 Applied as a floor Load

Safety Kerb live load-For effective spans of over 7.5 m but not exceeding 30 m, the intensity of load shall be determined according to the equation.

$$P = P^1 - \left(\frac{40L - 300}{9}\right)$$

= (400-((40x19.5-300)/9))
= 3.4667 KN/m^2

2. Live load Arrangement According to Carriageway.as per IRC -6 2016
   Case -1 70R+Ax1 Lane
   Case -2 Class Ax3 Lane

Live load Eccentricity According to Carriageway.

Case -1 70R+Ax1 Lane

70R Eccentricity – 12.9/2-(0.45+0.75+1.2+0.43+1.93/2)
= 2.655m

Ax1 For70R Eccentricity-

12.9/2-(0.45+0.75+.25+1.8/2) =-3.155m

For Ax3 Loading

Ax1 Eccentricity –
12.9/2-(0.45+0.75+0.15+0.25+1.8/2) =3.95m

Ax2 Eccentricity-
12.9/2-(0.45+0.75+0.15+0.25+1.8+0.25+1.2+0.25+1.8/2)
= 0.45m

Ax3 Eccentricity

=12.9/2(0.45+0.75+0.15+0.25+1.8+0.25+1.2+0.25+1.8+0.25+1.2+0.25+1.8/2)= - 3.05m

Arrangements of Loading

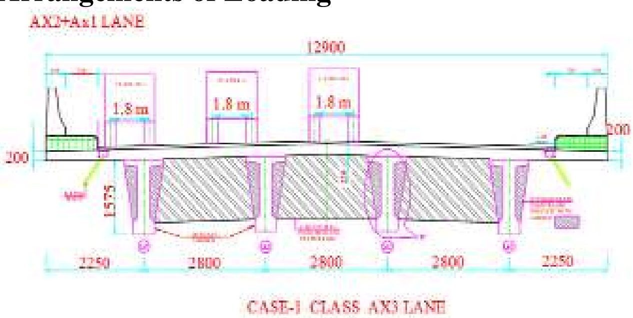

Fig. 9 Class AX3 Lane Loading arrangements as Per IRC

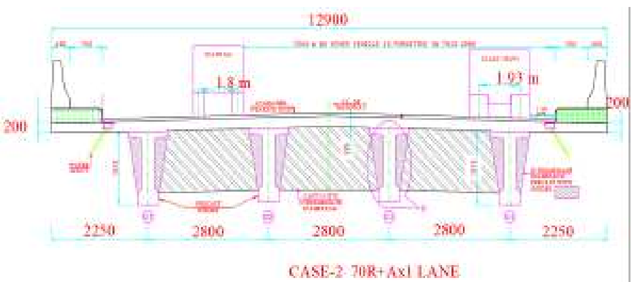

Fig. 9 Class 70R+Axl Lane Loading arrangements as Per IRC

Factors used in Calculation of Live loads -

Impact Factor – Provision for impact or dynamic action shall be made by an increment of the live load by an impact allowance expressed as a fraction or a percentage of the applied live load.

The impact factor shall be determined from the following equations which are applicable for spans between 3 m and 45 m.

Impact Factor for reinforced Concrete Bridges - 4.5/(6+L).

Impact Factor for Steel Bridges- 9/(13.5+L).

Factors used in Calculation of Live loads

Congestion Factor –For bridges, flyovers/grade separator's close to areas such as ports, heavy industries and mines and any other areas where frequent congestion of heavy vehicles may occur, additional check for congestion of vehicular live load on the carriageway shall be considered. In the absence of any stipulated value, the congestion factor, as mentioned in Table 3shall be considered. This factor shall be used as a multiplying factor on the global effect of vehicular live load only. Under this condition, horizontal force due to braking/acceleration, centrifugal action and temperature

Load combination

Load combination that is to be used for Ultimate Limit state Design (ULS) of reinforced concrete structure are listed below.

1.35DL+1.75WC +1.5LL+1.0sinking of Support

TABLE V. CONGESTION FACTORS AS PER IRC

SL No.	Congestion Factors	
	Span Range	Congestion Factors
1.	Above 10 m and up to 30m	1.15
2	30 m to 40m	1.15to 1.3
3	40 m to 50 m	1.3 to 1.45
4	50 to 60 m	1.45 to 1.6
5	60 to 70 m	1.6 to 1.7
6	Beyound70 m	1.7
7	30 m to 40m	1.15to 1.3

ANALYSIS RESULTS FROM MIDAS

Based on result obtained by Midas the results are tabulated as below

Results Bending Moments at Mid Span

Case I- Bending Moment Due Dead load at mid Span of the Girder.

Factored Design Load (1.35DL)

TABLE VI. CASE I- A. BENDING MOMENT DUE DEAD LOAD AT MID SPAN OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Self wt. (KN-m)	Self wt. (KN-m)
1	1838.48	2121.3
2	1328.15	1795.92
3	1328.15	1795.92
4	1838.48	2121.3

Case II- Bending Moment Due Wearing Coat at mid Span of the Girder.

Factored Design Load - 1.75 (WC)

TABLE VII. CASE II- B. BENDING MOMENT DUE WEARING COAT AT MID SPAN OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	WC (KN-m)	WC (KN-m)
1	219.18	216.84
2	219.18	211.95
3	219.18	211.84
4	219.18	216.95

Case III- Bending Moment Due live load at mid Span of the Girder.

Factored Design Load - 1.5(70R+Ax1)

TABLE VIII. CASE III- BENDING MOMENT DUE LIVE LOAD AT MID SPAN OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	70R+Ax1(KN-m)	70R+Ax1(KN-m)
1	2387.826	2527.227
2	2137.3605	2055.90
3	2137.3605	2055.90
4	2387.826	2527.227

Case IV- Bending Moment Due Live load at mid Span of the Girder.

Factored Design Load - 1.5(Ax2+Ax1)

TABLE IX CASE IV- BENDING MOMENT DUE LIVE LOAD AT MID SPAN OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Ax2+Ax1(KN-m)	Ax2+Ax1(KN-m)
1	1871.2755	1839.483
2	1656.4095	1623.024
3	1656.4095	1623.024
4	1871.2755	1839.483

Case V- Bending Moment Due Safety Kerb live at mid Span of the Girder.

TABLE X. CASE V- BENDING MOMENT DUE SAFETY KERB LIVE AT MID SPAN OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Safety k. live (KN-m)	Safety k. live (KN-m)
1	88.73	75.45
2	24.22	45.14
3	24.22	45.14
4	88.73	75.45

Case VI- Bending Moment Due Sinking of Support at mid Span of the Girder

TABLE XI. CASE VI- BENDING MOMENT DUE SINKING OF SUPPORT AT MID SPAN OF THE GIRDER

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Sinking of Support (KN-m)	Sinking of Support (KN-m)
1	511.32	486.4
2	471.29	449.36
3	471.29	449.36
4	511.32	486.4

Results for Bending Moments at Continuous Support

Case I- A. Bending Moment Due Dead load at Continuous Support Girder.

Factored Design Load - 1.35(DL+CB +SK)

TABLE XII. CASE I- BENDING MOMENT DUE DEAD LOAD AT CONTINUOUS SUPPORT GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Self wt. (KN-m)	Self wt. (KN-m)
1	2743.12	1834.55
2	1820.3	1017.5
3	1820.3	1017.5
4	2743.12	1834.55

Case II- Bending Moment Due Wearing Coat at Continuous Support of the Girder.

Factored Design Load - 1.75(WC)

TABLE XIII. CASE II- BENDING MOMENT DUE WEARING COAT AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	WC (KN-m)	WC (KN-m)
1	281.41	289.58
2	232.8	300.96
3	232.8	300.96
4	281.41	289.58

Case III- Bending Moment Due live load at Continuous Support of the Girder.

Factored Design Load - 1.5(70R+Ax1)

TABLE XIV. CASE III- BENDING MOMENT DUE LIVE LOAD AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	70R+Ax1(KN-m)	70R+Ax1(KN-m)
1	1985.3	1817.3
2	1554.09	1552.29
3	1554.09	1552.29
4	1985.30	1817.3

Case IV- Bending Moment Due Live load at Continuous Support of the Girder.

Factored Design Load - 1.5(Ax2+Ax1)

TABLE XV. CASE IV- BENDING MOMENT DUE LIVE LOAD AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Ax2+Ax1(KN-m)	Ax2+Ax1(KN-m)
1	1645.09	1429.46
2	1370.25	1288.39
3	1370.25	1288.3900
4	1645.09	1429.46

Case V- Bending Moment Due Safety Kerb live at mid Span of the Girder.

Factored Design Load - 1.5(SF)

TABLE XVI. CASE V- BENDING MOMENT DUE SAFETY KERB LIVE AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Safety k. live (KN-m)	Safety k. live (KN-m)
1	145.59	128.16
2	11.83	25.67
3	11.83	25.67
4	145.59	128.16

Case VI- Bending Moment Due Sinking of Support at Continuous Support of the Girder.

Factored Design Load -1.0(Sinking of Support)

TABLE XVII.CASE V- BENDING MOMENT DUE SINKING OF SUPPORT AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Sinking of Support (KN-m)	Sinking of Support (KN-m)
1	1018.81	1147.41
2	947.11	1132.19
3	947.11	1132.19
4	1018.81	1147.41

Results for Shear Forces at Continuous Support

Case I- Shear Force Due Dead load at Continuous Girder.

Factored Design Load - 1.35(DL+CB +SK)

TABLE XVIII. CASE I- A. SHEAR FORCE DUE DEAD LOAD AT CONTINUOUS GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Self wt. (KN)	Self wt. (KN)
1	760.86	467.22
2	525.37	246.22
3	525.37	246.22
4	760.86	467.22

Case II- Shear Force Due Wearing Coat at Continuous Support of the Girder.

Factored Design Load - 1.75(WC)

TABLE XIX. CASE II- SHEAR FORCE DUE WEARING COAT AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	WC (KN)	WC (KN)
1	77.48	66.7
2	87.04	77.03
3	87.04	77.03
4	77.48	66.7

Case III- A. Shear Force Due live load at Continuous Support of the Girder.

Factored Design Load - 1.5(70R+Ax1)

TABLE XX. CASE III- A. SHEAR FORCE DUE LIVE LOAD AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	70R+Ax1 (KN)	70R+Ax1(KN)
1	708.264	721.9665
2	755.298	732.78
3	755.298	732.78
4	708.264	721.9665

Case IV- Shear Force Due Live load at Continuous Support of the Girder.

Factored Design Load - 1.5(Ax2+Ax1)

TABLE XXI. CASE IV- SHEAR FORCE DUE LIVE LOAD AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Ax2+Ax1 (KN)	Ax2+Ax1(KN)
1	534.22	526.777
2	527.121	531.279
3	527.121	531.279
4	534.22	526.777

Case V- Shear force Due Safety Kerb live at mid Span of the Girder.

Factored Design Load - 1.5(SF)

TABLE XII. CASE V- SHEAR FORCE DUE SAFETY KERB LIVE AT MID SPAN OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Safety k. live (KN)	Safety k. live (KN)
1	35.27	37.66
2	3.45	6.34
3	3.45	6.34
4	35.27	37.66

Case VI- Shear Force Due Sinking of Support at Continuous Support of the Girder.

Factored Design Load - 1.0(Sinking of Support

TABLE XII. CASE VI- SHEAR FORCE DUE SINKING OF SUPPORT AT CONTINUOUS SUPPORT OF THE GIRDER.

S. NO.	Cast in situ T beam Super	Precast Girder with Cast in situ Deck.
	Si0nking of Support (KN)	Sinking of support (KN)
1	101.22	121.42
2	93.84	114.93
3	93.84	114.93
4	101.22	121.42

SUMMARY OF ANALYSIS RESULTS

Summary of all design moments and shear forces extracted from MIDAS analysis are tabulated as below.

TABLE XIII. TOTAL DESIGN MOMENTS AT MID -SPAN OF OUTER GIRDER

SL Nos.	Parameters	Total Design Moments at Mid -Span of Outer Girder		
		Cast in situ case (Kn-M)	Precast Girder (Kn-M)	Difference (%)
1	Self-weight of Super Structure	1838.48	2121.33	15%
2	Wearing Coat	219.18	216.84	-1%
3	Live load Case -1 70R+ AX1	2387.826	2527.227	6%
4	Case -2 Ax2+Ax1	1871.2755	1839.483	-2%
5	Safety kerb Live load	88.73	78.45	-12%
6	Shrinking of Support	511.32	486.4	-5%
	Total Design Moment	**5045.536**	**5430.247**	**8%**

TABLE XIV. TOTAL DESIGN MOMENTS AT MID -SPAN OF INNER GIRDER

SL Nos.	Parameters	Total Design Moments at Mid -Span of Inner Girder		
		Cast in situ case (Kn-M)	Precast Girder (Kn-M)	Difference (%)
1	Self-weight of Super Structure	1328.1	1795.92	35%
2	Wearing Coat	219.18	211.950	-3%
3	Live load Case -1 70R+ AX1	2137.3	2055.5	-4%
4	Case -2 Ax2+Ax1	1656.4	1623.0	-2%
5	Safety kerb Live load	24.22	45.14	86%
6	Shrinking of Support	471.29	449.36	-5%
	Total Design Moment	**4180.19**	**4558.2**	**9%**

TABLE XV. TOTAL DESIGN MOMENTS AT CONTINUOUS SUPPORT OF OUTER GIRDER

SL Nos.	Parameters	Total Design Moments at Continuous Support of Outer Girder		
		Cast in situ case (Kn-M)	Precast Girder (Kn-M)	Difference (%)
1	Self-weight of Super Structure	2743.12	1834.55	-33%
2	Wearing Coat	281.41	*289.58*	3%
3	Live load Case -1 70R+ AX1	1985.81	1817.30	-8%
4	Case -2 Ax2+Ax1	1645.10	1429.46	-13%
5	Safety kerb Live load	145.19	128.1	-12%
6	Shrinking of Support	1018.0	1147.41	13%
	Total Design Moment	**6173.7**	**5217.07**	**15%**

TABLE XV. TOTAL DESIGN MOMENTS AT CONTINUOUS SUPPORT OF INNER GIRDER

SL Nos.	Parameters	Total Design Moments at Mid -Span of Outer Girder		
		Cast in situ case (Kn-M)	Precast Girder (Kn-M)	Difference (%)
1	Self-weight of Super Structure	1820.3	1017.5	-44%
2	Wearing Coat	232.85	300.96	-29%
3	Live load Case -1 70R AX1	1554.09	1552.30	0%
4	Case -2 Ax2+Ax1	1370.25	1288.40	-6%
5	Safety kerb Live load	11.83	25.48	115%
6	Shrinking of Support	947.11	1132.1	20%
	Total Design Moment	**4566.1**	**4028.4**	**-12%**

TABLE XVI. TOTAL SHEAR AT CONTINUOUS SUPPORT OF OUTER GIRDER

SL Nos.	Parameters	Total Shear Force at Cont. Support of Outer Girder		
		Cast in situ case (Kn)	Precast Girder (Kn)	Difference (%)
1	Self-weight of Super Structure	706.86	467.22	-39%
2	Wearing Coat	87.04	77.03	-12%
3	Live load Case -1 70R+ AX1	708.19	721.9665	2%
4	Case -2 Ax2+Ax1	534.222	526.77	-1%
5	Safety kerb Live load	35.27	37	5%
6	Shrinking of Support	101.22	121.42	20%
	Total Shear Force	**1692.654**	**1424.6365**	**-16%**

TABLE XVII. TOTAL SHEAR AT CONTINUOUS SUPPORT OF INNER GIRDER

SL Nos.	Parameters	Total Shear Force at Cont. Support of Inner Girder		
		Cast in situ case (Kn)	Precast Girder (Kn)	Difference (%)
1	Self-weight of Super Structure	525.37	246.22	-53%
2	Wearing Coat	87.04	77.03	-12%
3	Live load Case -1 70R+ AX1	755.298	732.78	-3%
4	Case -2 Ax2+Ax1	527.121	531.27	1%
5	Safety kerb Live load	3.45	6.34	84%
6	Shrinking of Support	93.84	114.93	22%
	Total Shear Force	**1464.998**	**1177.3**	**20%**

CONCLUSION / SUMMARY AND FINDINGS

1. Conclusion on Total Design Bending Moments at Mid Span & Total Shear Force at Continuous Support.

1. Total Design Bending Moment at Mid Span, Inner girder has subjected to 9% higher Design Bending Moment in case of precast girder if compared to Cast in situ Girder.
2. Total Design Bending Moment at mid Span, Outer girder has subjected to 8% higher Design Bending Moment in case of precast girder if compared to Cast in situ Girder.
3. Total Design Bending Moment at Support, Outer girder has subjected to 15% Lower Design Bending Moment in case of precast girder if compared to Cast in situ Girder.
4. Total Design Shear Force at Support, Inner girder has subjected to 20% Lower Design Shear Force in case of precast girder if compared to Cast in situ Girder.
5. Total Design Shear Force at Support, Outer girder has subjected to 16% Lower Design Shear Force in case of precast girder if compared to Cast in situ Girder.

2. Conclusion on Bending Moments at mid Span due to Self-weight

1. The Bending Moment at mid Span, due to Self-weight of Super Structure in the case of precast Girder Taken, as Extracted from the analysis done in Midas Civil is 15.38 percent greater Value in compare to cast in situ structure.
2. Found 49.09 percent lesser Value of Bending Moment at the continuous support, due to Self-weight of Super Structure in the case of precast Girder Taken, as Extracted from the analysis done in Midas Civil.
3. Found 1 percent lesser Value of Bending Moment at the mid span, due to wearing coat of in the case of precast Girder Taken, as Extracted from the analysis done in Midas Civil.
4. Found 6 percent greater Value of Bending Moment at the continuous support, due to wearing coat of in the case of precast Girder Taken, as Extracted from the analysis done in Midas Civil.

3. Conclusion on Shear Force at Continuous Support

1. Found 62 percent greater Value of Shear Force at Continuous Support, due to Self-weight of Super Structure in the case of cast in situ case Taken, as Extracted from the analysis done in Midas Civil.
2. Found 14 percent lesser Value of Shear Force at the continuous support, due to Wearing Coat of Super Structure in the case of precast Girder Taken, as Extracted from the analysis done in Midas Civil.
3. Found 3 percent lesser Value of Shear Force at the continuous support, due to Live load of in the case of precast Girder Taken, as Extracted from the analysis done in Midas Civil.

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