

## Comparative Study on Super Structure of Box Girder Bridge and Cable Stayed Bridge with Extra Dosed Bridge

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**Abstract :** Bridges Have Been One Of The Most Important Source Of Transportation. Therefore, It Becomes Compulsory For Designers And Those Related To This Field To Take Special Concern In Regards To Designing And Maintenance Of Such Heavy Structures. This Review Is Mainly Focused On Extra Dosed Bridge; As It Is A New Type Of Bridge Engineering Design Concepts. In This Paper Parametric Study Of Superstructure Extradosed Bridge, Cable Stayed Bridge And Box Girder Bridge Presented. In This Paper Parametric Study Done For Clear Bridge Span Of 50m To 300 M. From This Study It Was Found That The Girder Bridge Is Preferable For The Span Up To 50m, While Extradosed Bridge Is Preferable For The Span Of 50m To 300m.

**Keywords**—Box Girder Bridge, Cable Stayed Bridge, Extra Dosed Bridge, Parametric Study, Transportation

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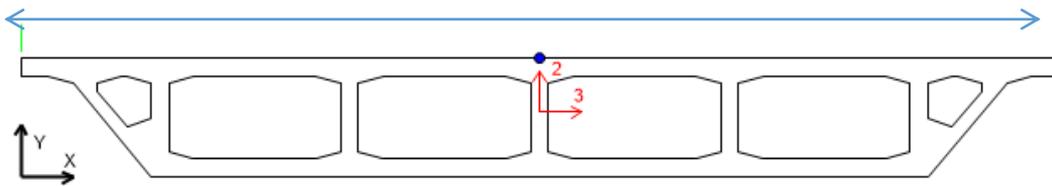
### I. INTRODUCTION

Bridge Engineering Has Become One Of The Most Important Needs For Today Therefore Getting It Updated With Technological Trends Is Of Utmost Importance In Order To Provide With Proper Sustenance Against Future Threats. For Bringing The Term Technology Into Picture It Has Become Very Important To Use Newer Tools Which Have More Organized Computing Functionalities As In To Get Accurate Results When Comes To Heavy Load Transfer And Building A Safe Design. In India Mostly Used Bridges Are Girder Bridge And Cable-Stayed Bridges Although Adding To The Advancements They Have Started Adopting New Bridge Type I.E. Extradosed Bridge For Construction. There Are Only Four Extra Dosed Bridge In India. Such A Bridge Is Extradosed Bridge; There Is 4 Extradosed Bridge In India Located At Kolkata, Delhi, Mumbai And Bharuch. Now A Days Extradosed Bridge Is Preferred For Medium Span. This Type Of Bridge Is Low In Cost, Fast In Construction And Preferable Nearby Airport Because Of Its Low Pylon Height. To Findout Optimum Effective Span It Is Necessary To Do Comparative Study Between Presently Used Bridge I.E. Girder Bridge And Cable Stayed Bridge.

### II. DATA

To Do Parametric Study On Superstructure Of Extradosed Bridge, Cable Stayed Bridge And Box Girder Bridge We Have To Fix Common Parameters Of These Bridges. Fixed Parameter Of Bridge And Data Taken For Analysis Are As Following:

- Deck Type In These Three Bridge: Box Girder
- Width Of Bridge: 20m [4 Lane]
- Tendon Profile : Parabolic
- Time Variables: Creep And Shrinkage Included.
- Temperature : Variation Between : 5°-45° C
- Quake Zone : Zone-V [IS 1893:2002]
- Wind Load : As Per IS 875 : 1987
- Vehicle Loading : IRC AA-Wheeled Loading [As Per IRC]
- Staged In Analysis Done In Cable Stayed Bridge And In Extradosed Bridge
- Bridge Impact Factor : 1 [As Per IRC]
- Concrete : M60
- Steel : Fe500
- Cable : 1.5 N/Mm<sup>2</sup>



### III. ANALYSIS

Analysis Is Done In Computer Aided Software As Per Indian Standards. After Analysing These Three Bridges For Span Of 50m, 100m, 150m, 200m, 250m And 300m. Forces Are Compared And Estimation Is Done From Bridge's Geometry And Member Forces. Parametric Study Of Bridge Forces And Moments Is As Follows:

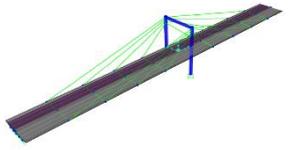
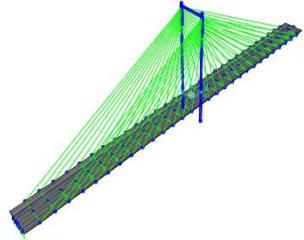
**Table No 1: 50 M Clear Span**

	Figure	Avg. Cable Axial Force (Kn)	Pylon Axial Force (Kn)	Pylon Moment (Kn.M)	Tendon Cross Section (M <sub>2</sub> )	Deck Axial (Kn)	Deck Moment (M Kn.M)
Box Girder Bridge		0	0	0	9.67E+02	628.45	8.07E+01
Extradosed Bridge		2670.94	2741.64	2978.96	8.47E+02	4113.24	1.93E+01
Cable Stayed Bridge		2964.74	4551.12	2412.95	9.45 E+02	1937.74	1.13E+01

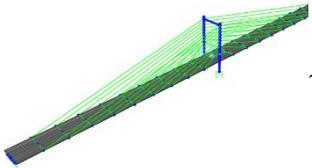
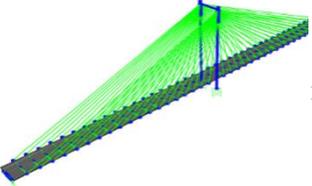
**Table No 2: 100 M Clear Span**

	Figure	Avg. Cable Axial Force (Kn)	Pylon Axial Force (Kn)	Pylon Moment (Kn.M)	Tendon Cross Section (M <sup>2</sup> )	Deck Axial (Kn)	Deck Moment (M Kn.M)
Extradosed Bridge		5890.79	5694.14	5140.87	1.32E+02	9071.81	0.14
Cable Stayed Bridge		8600.55	10534.15	3907.06	2.75E+02	5621.27	0.12

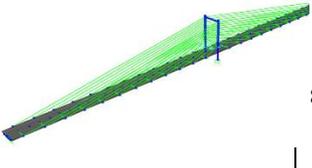
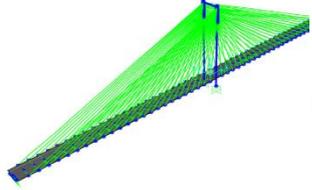
**Table No 3: 150 M Clear Span**

	Figure	Avg. Cable Axial Force (Kn)	Pylon Axial Force (Kn)	Pylon Moment (Kn.M)	Tendon Cross Section (M <sup>2</sup> )	Deck Axial (Kn)	Deck Moment (M Kn.M)
Extradosed Bridge		6487.56	6578.41	6985.24	4.51 E+02	9990.84	0.30
Cable Stayed Bridge		9471.83	12959.46	5029.37	6.67E+03	6190.74	0.24

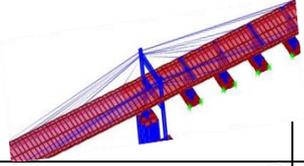
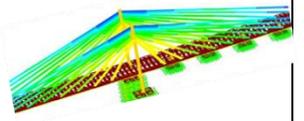
**Table No 4: 200 M Clear Span**

	Figure	Avg. Cable Axial Force (Kn)	Pylon Axial Force (Kn)	Pylon Moment (Kn.M)	Tendon Cross Section (M <sup>2</sup> )	Deck Axial (Kn)	Deck Moment (M Kn.M)
Extradosed Bridge		7847.56	7945.54	7823.24	0.10	12085.24	0.07
Cable Stayed Bridge		12163.71	17003.45	5319.80	0.1749	7950.14	0.05

**Table No 5: 250 M Clear Span**

	Figure	Avg. Cable Axial Force (Kn)	Pylon Axial Force (Kn)	Pylon Moment (Kn.M)	Tendon Cross Section (M <sup>2</sup> )	Deck Axial (Kn)	Deck Moment (M Kn.M)
Extradosed Bridge		8690.78	8655.41	8746.68	0.17	13383.80	0.071
Cable Stayed Bridge		16251.75	19388.11	5422.94	0.27	10622.06	0.046

**Table No 6: 300 M Clear Span**

		Avg. Cable Axial Force (Kn)	Pylon Axial Force (Kn)	Pylon Moment (Kn.M)	Tendon Cross Section (M <sup>2</sup> )	Deck Axial (Kn)	Deck Moment (M Kn.M)
Extradosed Bridge		9733.66	10273.97	10224.86	0.21	16563.49	0.075
Cable Stayed Bridge		15573.85	21575.33	8864.91	0.33	340928.6	0.083

#### IV. CONCLUSION

For 4-Lane Bridge Is Analysed For Box Girder Bridge, Cable Stayed Bridge And Extra Dosed Bridge; It Is Compared For Different Spans I.E. 50m, 100m, 150m, 200m, 250m And 300m. To Know Which Bridge Is More Economic For Each Span. Parametric Study Can Be Done From Five Main Parameters; Cable Axial Force, Pylon Axial Force, Pylon Moment, Deck Axial Force And Deck Moment.

a) Deck Axial Force - Comparison:

- For **50m** Clear Span Bridge: Box Girder Bridge Has Axial Force Of **6.28E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **2.08E+02%** And Extra Dosed Bridge Has **5.54E+02%** Higher Axial Force In Deck.
- For **100m** Clear Span Bridge: Box Girder Bridge Has Axial Force Of **1.31E+03 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **3.29E+02%** And Extra Dosed Bridge Has **5.93E+02%** Higher Axial Force In Deck.
- For **150m** Clear Span Bridge: Box Girder Bridge Has Axial Force Of **1.38E+03 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **3.48E+02%** And Extra Dosed Bridge Has **6.23E+02%**
- For **200m** Clear Span Bridge: Box Girder Bridge Has Axial Force Of **1.65E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **3.81E+02%** And Extra Dosed Bridge Has **6.31E+02%** Higher Axial Force In Deck.
- For **250m** Clear Span Bridge: Box Girder Bridge Has Axial Force Of **1.82E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **4.84E+02%** And Extradosed Bridge Has **6E+02%** Higher Axial Force In Deck.
- For **300m** Clear Span Bridge: Extradosed Bridge Has **1.66E+04 Kn**. Comparison Intermis Of %-Percentage; Cable Stayed Bridge Has **19.58%** Higher Axial Force In Deck.

B) Deck Moment - Comparison:

- For **50m** Clear Span Bridge: Box Girder Bridge Has Moment **4.71E-02 M Kn.M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-76%** And Extradosed Bridge Has **-86%** Less Moment In Deck.
- For **100m** Clear Span Bridge: Box Girder Bridge Has Moment **8.48E-02 M Kn.M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-79%** And Extradosed Bridge Has **-81%** Less Moment In Deck.
- For **150m** Clear Span Bridge: Box Girder Bridge Has Moment **1.531E-01 M Kn.M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-80%** And Extradosed Bridge Has **-84%** Less Moment In Deck.
- For **200m** Clear Span Bridge: Box Girder Bridge Has Moment **2.97E-01 M Kn.M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-74%** And Extradosed Bridge Has **-88%** Less Moment In Deck.
- For **250m** Clear Span Bridge: Box Girder Bridge Has Moment **3.12E-01 M Kn.M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-77%** And Extradosed Bridge Has **-85%** Less Moment In Deck.
- For **300m** Clear Span Bridge. Extradosed Bridge Has **0.075 M Kn.M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **11%** Higher Moment In Deck.

C) Pylon Axial Force - Comparison:

1. For **50m** Clear Span Bridge: Extradosed Bridge Has Axial Force In Pylon Is **27.40E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **66%** Higher Axial Force In Pylon.
2. For **100m** Clear Span Bridge: Extradosed Bridge Has Axial Force In Pylon Is **56.94E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **85%** Higher Axial Force In Pylon.
3. For **150m** Clear Span Bridge: Extradosed Bridge Has Axial Force In Pylon Is **65.78E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **97%** Higher Axial Force In Pylon.
4. For **200m** Clear Span Bridge: Extradosed Bridge Has Axial Force In Pylon Is **79.45E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **11.4E+01%** Higher Axial Force In Pylon.
5. For **250m** Clear Span Bridge: Extradosed Bridge Has Axial Force In Pylon Is **86.55E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **12.4E+01%** Higher Axial Force In Pylon.
6. For **300m** Clear Span Bridge: Extradosed Bridge Has Axial Force In Pylon Is **102.74E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **52%** Higher Axial Force In Pylon

D) Pylon Moment - Comparison:

1. For **50m** Clear Span Bridge: Extradosed Bridge Has Moment In Pylon Is **29.78E+02 Kn·M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-19%** Less Moment In Pylon.
2. For **100m** Clear Span Bridge: Extradosed Bridge Has Moment In Pylon Is **51.40E+02 Kn·M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-24%** Less Moment In Pylon.
3. For **150m** Clear Span Bridge: Extradosed Bridge Has Moment In Pylon Is **69.85E+02 Kn·M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-28%** Less Moment In Pylon.
4. For **200m** Clear Span Bridge: Extradosed Bridge Has Moment In Pylon Is **78.23E+02 Kn·M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-32%** Less Moment In Pylon.
5. For **250m** Clear Span Bridge: Extradosed Bridge Has Moment In Pylon Is **87.46E+02 Kn·M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-38%** Less Moment In Pylon.
6. For **300m** Clear Span Bridge: Extradosed Bridge Has Moment In Pylon Is **102.24E+02 Kn·M**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **-13%** Less Moment In Pylon.

D) Cable Axial Force - Comparison:

1. For **50m** Clear Span Bridge: Extradosed Bridge Has Tensile Force In Cable Is **26.70E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **37%** Higher Tensile Force In Cable.
2. For **100m** Clear Span Bridge: Extradosed Bridge Has Tensile Force In Cable Is **58.90E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **46%** Higher Tensile Force In Cable.
3. For **150m** Clear Span Bridge: Extradosed Bridge Has Tensile Force In Cable Is **64.87E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **51%** Higher Tensile Force In Cable.
4. For **200m** Clear Span Bridge: Extradosed Bridge Has Tensile Force In Cable Is **78.47E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **55%** Higher Tensile Force In Cable.
5. For **250m** Clear Span Bridge: Extradosed Bridge Has Tensile Force In Cable Is **86.90E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **87%** Higher Tensile Force In Cable.
6. For **300m** Clear Span Bridge: Extradosed Bridge Has Tensile Force In Cable Is **97.33E+02 Kn**. Comparison In Terms Of %-Percentage; Cable Stayed Bridge Has **37%** Higher Tensile Force In Cable

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