COMPARISON OF DOUBLE WARREN AND K-TYPE STEEL TRUSS BRIDGE FOR WEIGHT SUBJECTED TO DOUBLE TRACK RAILWAY LOADING

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***Abstract*— Steel truss bridges are widely adopted for railways in India for long span bridges (span > 30m). The most significant advantage of using trusses for bridges is that it allows us to span a considerable distance without creating a massive weight penalty for the structure. This design makes it possible to install a bridge in places where the volume of the structure impacts the surrounding environment.**

In this paper comparison of Double warren truss is done with K-type truss considering weight of the truss. Span of the truss is 121.320m c/c and of depth 17m which is caring double track 25T railway loading.

***Keywords*— Truss, Double warren, K-type, etc.**

I. Introduction

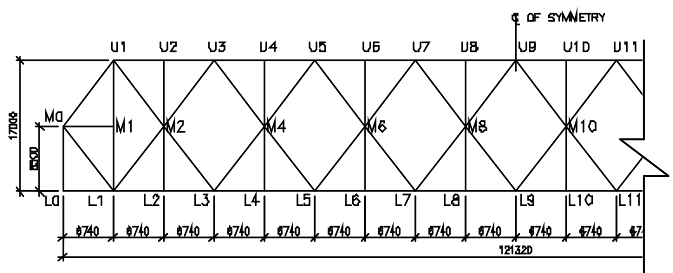
The load bearing capacity of the trusses is very huge as compare to same span bridge of girder type. By spreading load from floor arrangement to the truss nodes and then to whole truss, it manages by compression and tension. This triangular arrangement insures nearly proportionate amount of force carried by each member. The building of a large truss bridge can be a very economical option, when compared to other bridge designs. Truss bridges withstands extreme conditions where other bridges such as beam and arch bridges may not be a reliable option. They are able to span great lengths, and often used in precarious locations such as deep valleys between mountain regions. You will see in India almost every large spans and spans in mountain regions are truss only.

In this paper configuration optimization is proposed. Double warren truss is compared with K-type truss. since the trusses are checked for two track railway loading, for design Railway codes issued by RDSO followed. Each and every clause for design is followed from railway codes. Truss of 17m depth double warren configuration is approved by Railway authority and it is followed for construction.

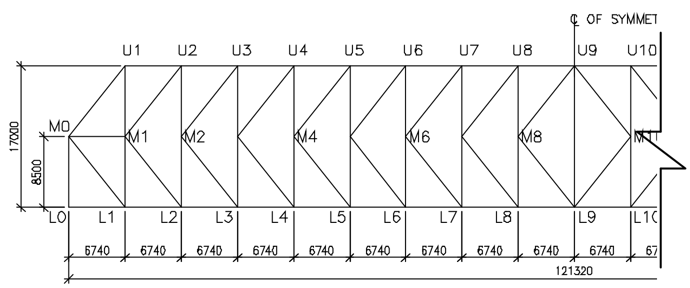
Following are existing double warren truss.

Sr. No.	Railway Bridge Name	Span (m)
1.	Rajendra Setu, Mokama, Bihar	122.95
2.	Srikrishna Setu Munger Ganga Bridge, Bihar	125.00
3.	Digha–Sonpur rail–road bridge, Patna	123.00
4.	Nabadwip railway Bridge, Nadia, West Bengal	105.00

As from this table it is clear that double warren truss type is followed for spans greater than 100m. The present study will clear that why double warren truss is followed in most of the cases and whether K- type truss will be economical over double warren truss.



Double warren truss



K-type truss

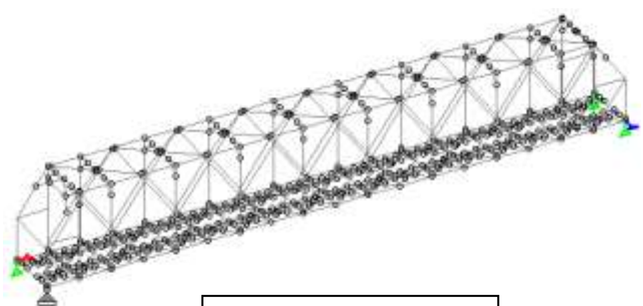
Method of Erection:

Since the bridge is across river Ganga and of 1.8km long. It is very important to construct the truss with that ease and economic. Hence method of erection plays an important role in this project. Cantilever construction method is adopted.

Hence while designing the truss for railway loading truss is also checked for cantilever construction method with crane on top chord to feed the material. Sections are strengthened to satisfy the design in construction. In this erection method, initially trestle supported span will be used as anchor span, by using link members to anchor span node to node erection will be completed by cantilever method.

Methodology:

1. Analysis will be done on STAAD-pro by modeling 3-D truss.
2. 3-D truss is not released for any moments because of the connection detailing. But top and bottom bracing system are leased for moments and assumed to carry only axial forces.
3. Loading is applied on truss as per RDSO bridge rules.
4. Force and moment resultants are extracted from STAAD-pro and put in excel design files.
5. Design excel files are as per code RDSO steel bridge code.
6. Then design section is updated and new section is put into STAAD model and again analysis run is taken.
7. This process is done 2 to 3 times till we get final section.
8. Using final sections truss weight is calculated.



Double warren truss 3D model

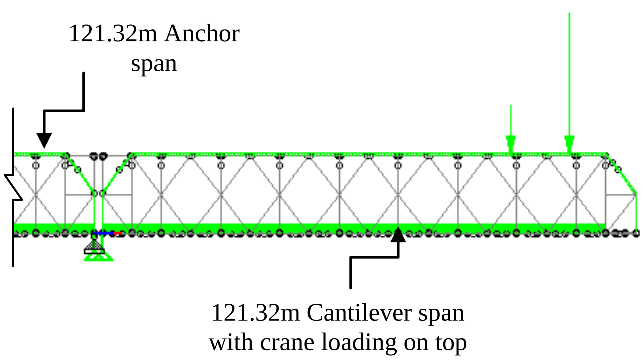
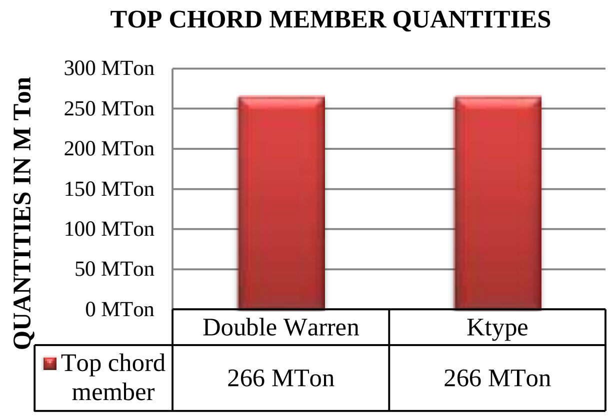


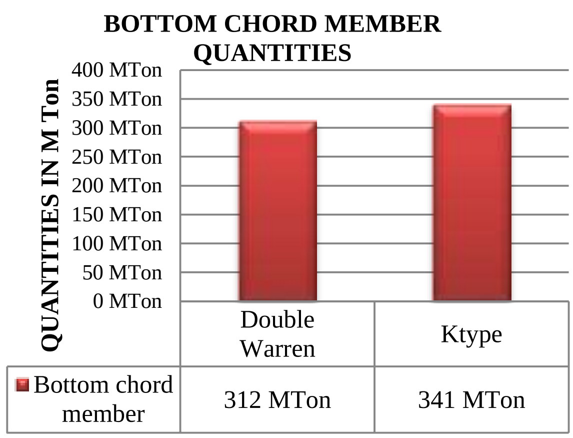
Table 1 Common Geometry & Design Input

Span (m)	121.32m
Truss Height (m)	17 m
No. of Bays (nos.)	18
Bay length	6.740m
Truss Spacing (m)	11.1 m
Basic Wind Speed	47 m/sec (PATNA)
Life of structure	100 years
Allowable Deflection	span/600
Seismic zone	IV
Gauge	Broad gauge
Loading Standards	25T-2008
No. of tracks	2
Design codes	RDSO railway codes

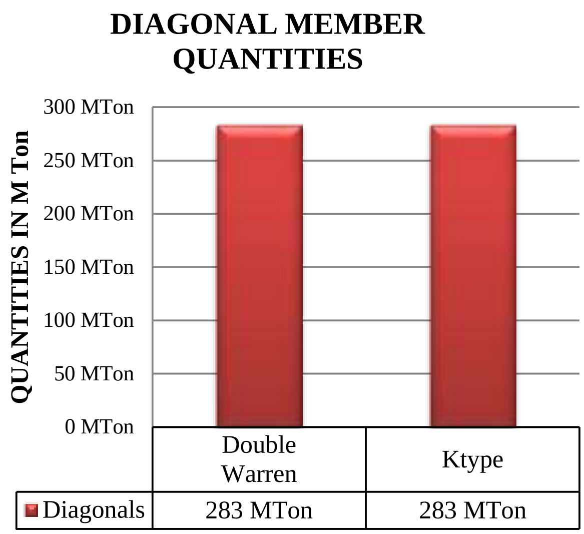
Result Interpretation:

Both Double warren and K-type truss is analyzed and designed as per RDSO steel bridge code. Considering weight of different components following results can be interpreted.

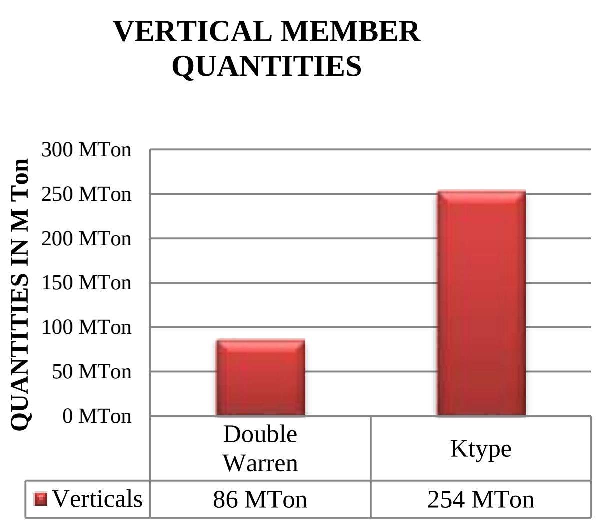




As the depth of superstructure is 17m for both double warren & K-type truss. Axial force in top and bottom chord remained unaltered. hence the quantities of top & bottom chord are almost same. Because of the force distribution due to different diagonals arrangement bottom chord weight is slightly more in K-type truss.

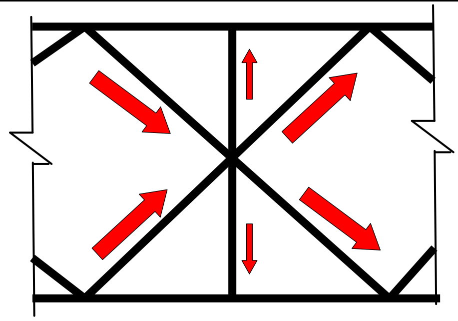


As the number of diagonal members and their lengths are same in both trusses, diagonal member weight remains unchanged.



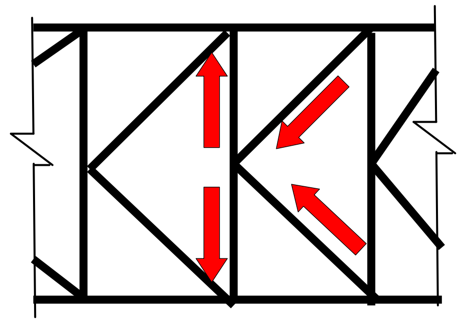
Vertical members show very high difference in the weight. This is because diagonal member arrangement at the centre of vertical member.

DOUBLE WARREN

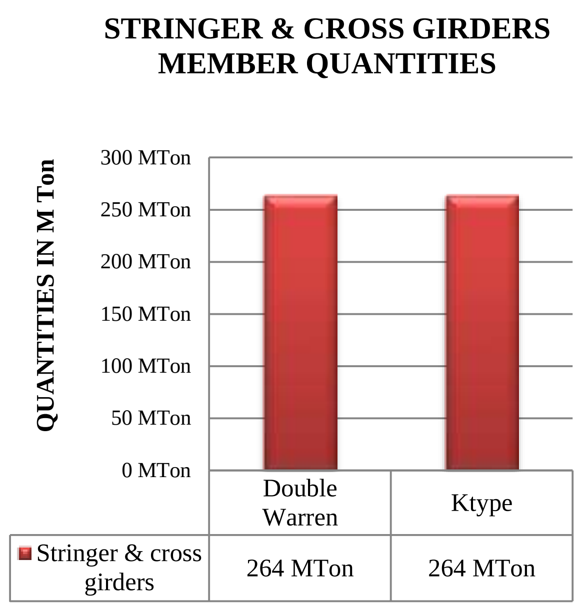


Due to this arrangement forces coming from diagonals are travelled in the line of opposite diagonal. Hence force distributed in vertical member is very less.

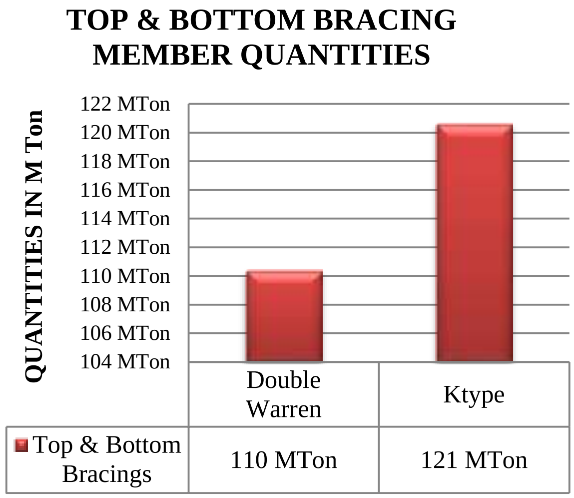
K-TYPE



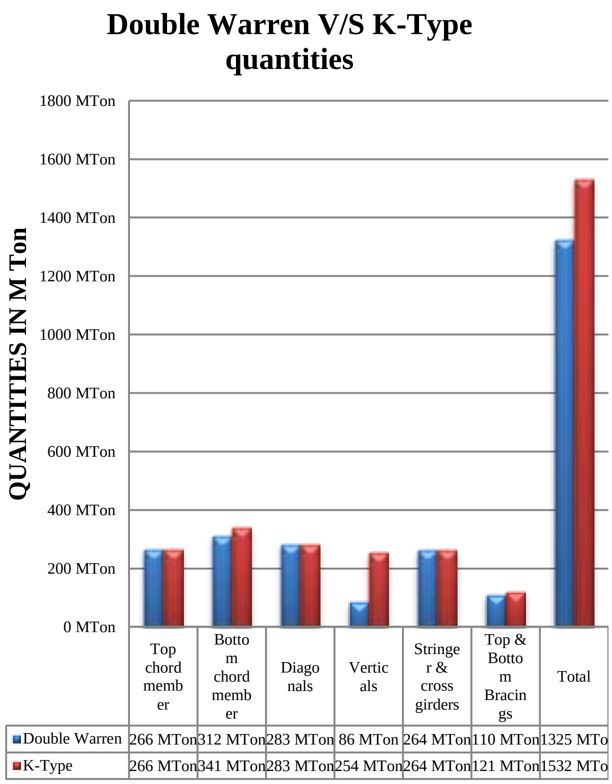
On the other hand, there is no diagonal at the opposite end. Hence force coming from diagonal is distributed in vertical only. Also, verticals are provided at each node, hence number of verticals increased.



As the panel length are same in both trusses, stringer span is same (i.e., 6.740m). Also, transverse spacing of two trusses are same hence cross girder span is same (i.e., 11.1m). hence weight of stringer & cross girder remains same.



Due to vertical at each node sway girder is provided at each vertical location in top bracing. hence quantity for top bracing increased.



Conclusion:

By comparing each truss designs, we have got the differences in truss weights. With above graph it is clear that total weight of double warren truss is 1325 MT v/s K-type truss is 1532 MT. Hence adopting double warren truss configuration for our bridge is more economical.

Hence, it is more economical to adopt double warren configuration for railway bridges over 100m span. Also, it gives economic design satisfying the member section for erection method (i.e., cantilever construction method).

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f) Optimization and rationalization of truss design (Upendra Pathak, Dr. Vivek Garg)

g) IRS Bridge Rules-2014 (By RDSO)

h) IRS Steel Bridge Code-2017 (By RDSO)

i) Permanent Way Manual

j) Schedule of Dimension (SOD):

k) IS 2062:2011 (Hot rolled medium and high tensile structural steel — specification):

l) IRS welded bridge code of practice for metal arc welding in structural steel bridges carrying rail, rail-cum-road or pedestrian traffic.

m) RDSO guidelines on seismic design of railway bridges.