ISSN 2229-5518

Analysis of Rcc and Psc Bridge Deck Slab for Various Spans

Thanushree H, Siddesha H, Dattatreya J K, Dr.S.V.Dinesh

Abstract -The effect of various span on single-span reinforced concrete bridges and PSC bridges are analysed using the finite-element method and the results are presented in this paper. Investigations are carried out on RC slab bridge decks and PSC bridge decks to study the influence of aspect ratio, span and type of load. The finite-element analysis results for bridges are compared to the reference analytical solution for dead load, IRC Class AA loading. Also comparative analysis of response of RCC and PSC slab bridge decks with that of equivalent of FEM analysis of bridge deck is made. Number of bridge models is analysed and the variation of critical structural response parameters such as longitudinal bending moment, longitudinal stresses and support reaction with analytical solution is studied. The benefit of prestressing is reflected more significantly increase in longitudinal bending moment and longitudinal stresses.

Index Terms, Bridge: Concrete slabs; Dead load; Finite element method; Live load: span length; IRC Class AA loading.

———————————— ◆ ————————————

1 INTRODUCTION

A bridge is an arrangement made to cross an obstacle in the form of a low ground or a stream or a river without closing the way beneath Reinforced concrete decks supported by longitudinal girders, with main reinforcement placed perpendicular to traffic, Ever since the development of prestressed concrete by Freyssinet in the early 1930s, the material has found extensive application in the construction of long-span bridges, gradually replacing steel which needs costly maintenance due to the inherent disadvantage of corrosion under aggressive environment conditions. As in case of bridge design, span length and live load are always important factor. Modern reinforced concrete emerged as the building material of choice towards the end of the nineteenth century, and prestressed concrete followed in the late 1920s as a special variation of structural concrete.

Sadaqat Ullah Khan et al. (2014) have studied the analysis of a prestressed highway bridge and its strengthening. Using software "SAP 2000" for the actual or modified vehicular loading present over the bridge. And compared with Rcc Bridge and proved that Psc Bridge exerts more strength than Rcc Bridge. Francis T.K.

2 PARAMETRIC STUDY

A simply supported, single span, two lanes RCC and PSC slab bridge deck is considered. The span is varied from 10m, 20m and 30m and depth of the slab 450mm for all spans. The bridge deck is analysed for Dead load as well as one class of live load i.e. IRC ClassAA tracked loading and also for combination (LL+DL) Of loads. Comparison of critical structural response parameter of above cases is presented in the following for RCC and PSC slabs

Table 2.1: Geometric parameters of slab bridge decks

No	Span (m)	Width (m)	Aspect ratio (span/width)
1	10	7.5	1.33
2	20	7.5	2.66
3	30	7.5	4

.

3. LOAD ON BRIDGE DECK MODELS

The vehicular live load consist of a set wheel loads and are treated as concentrated loads acting at centres of contact areas, one class of load i.e. IRC Class AA is considered for analysis. The peak values of critical structural response parameter such as longitudinal bending moment and longitudinal stresses are analysed. Different positions of loading systems are considered from table 2 of IRC 6:2010.

4. FINITE ELEMENT MODELING

The analysis is carried out using finite element method. The concrete slabs are modelled using shell elements. Simple support condition is provided.

ELASTIC MODULUS	25000 Mpa
POISSON'S RATIO	0.2
DENSITY OF CONCRETE	25kN/m2

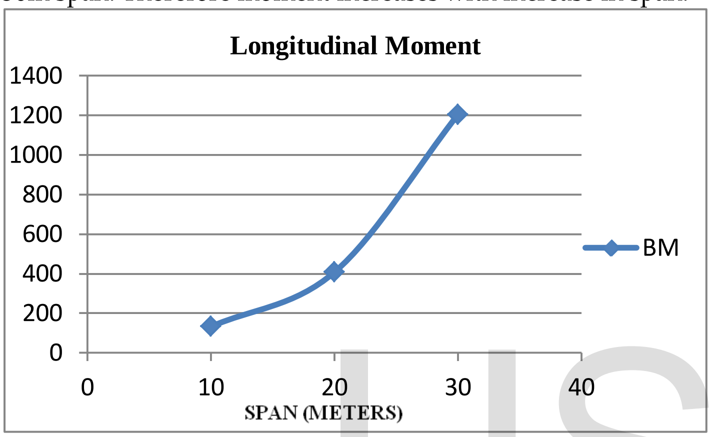
5. RESULTS AND DISCUSSION

The FEA results are obtained and presented in terms of critical structural response parameter such a longitudinal bending moment and longitudinal stresses in the bridge deck models due to the applied wheel load. The variations of the critical structural response parameter due to changes in span are presented in the following.

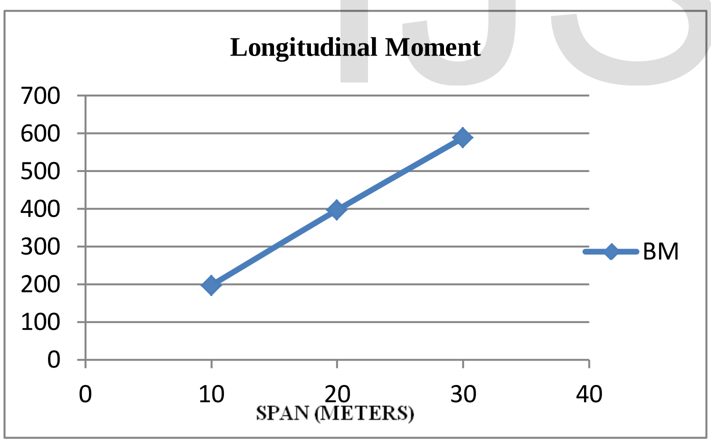
5.1. RCC Deck

5.1.1 Longitudinal Bending Moment (kNm)

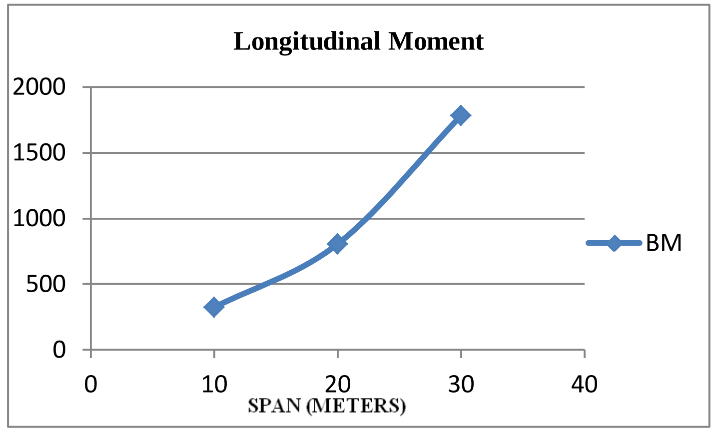
It is observed that the maximum dead load longitudinal bending moment and wheel load longitudinal bending moment for 30m span. Therefore moment increases with increase in span.



a) Dead Load



b) Live Load

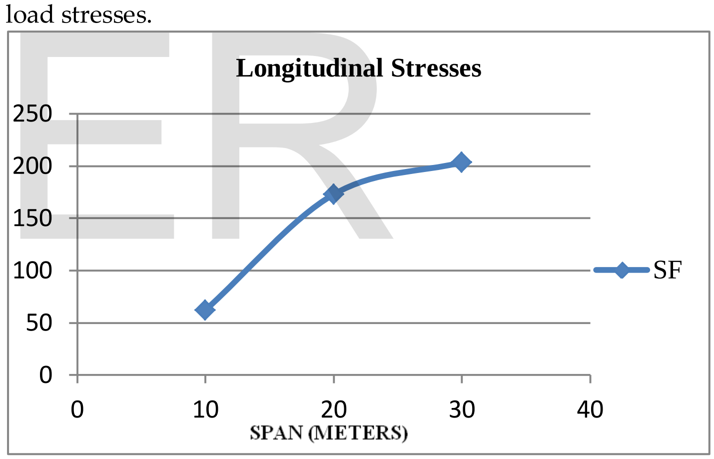


c) (LL+DL) Load

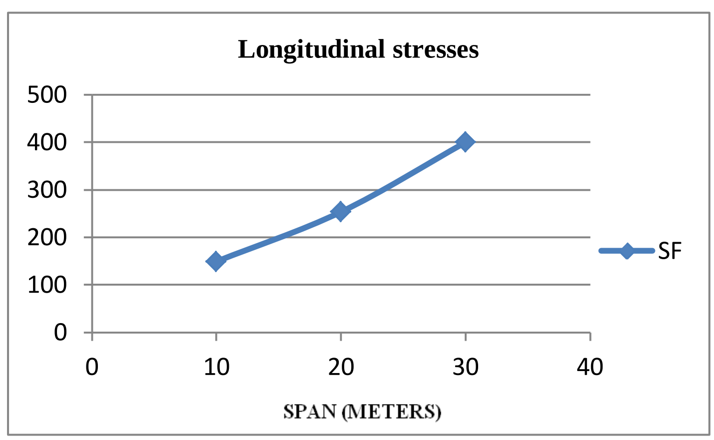
Fig 1: Variation of Longitudinal Moment Due To Dead Load and Live Load and the Combination of (LL+DL) on Deck Slab.

5.1.2 Longitudinal Stresses (kNm)

The trend in longitudinal stresses is similar to combination of loads in longitudinal moment. It is observed that as span increases the dead load stresses varies linearly compared to live load stresses.

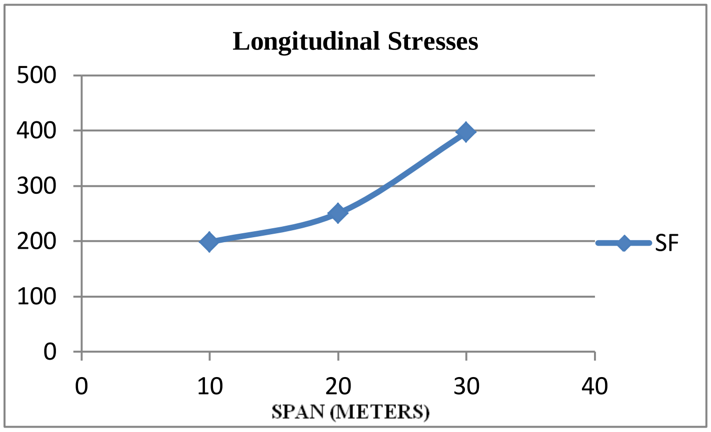


a) Dead Load



b) Live Load

ISSN 2229-5518



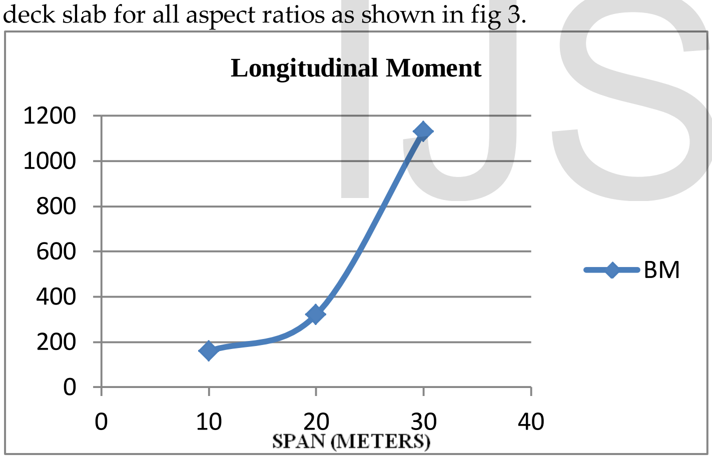
c) (LL+DL) Load

Fig2: Variation of Longitudinal Stresses Due To Dead Load and Live Load and the Combination (LL+DL) on Deck Slab.

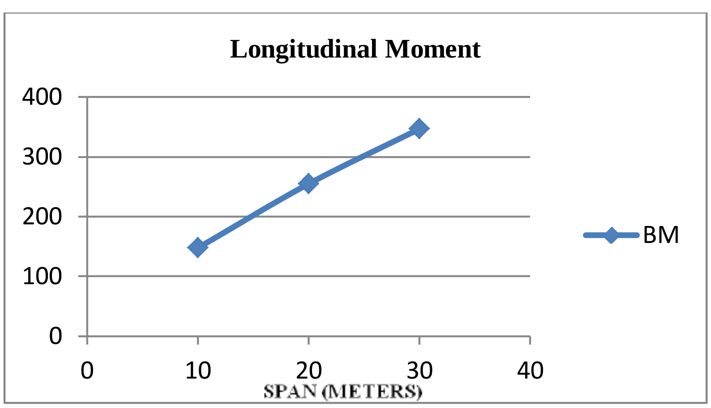
5.2 PSC Deck

5.2.1 Longitudinal Bending Moment

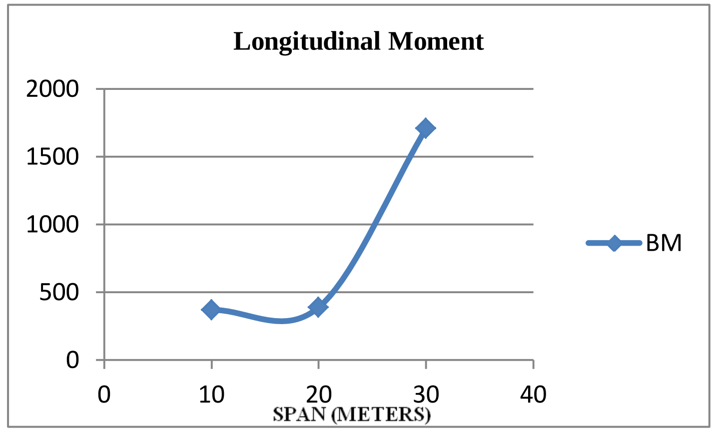
It is observed that the maximum dead load longitudinal bending moment and wheel load longitudinal bending moment for 30m span deck slab compared to that of 10m and 20m span deck slab for all aspect ratios as shown in fig 3.



a) Dead Load



b) Live Load

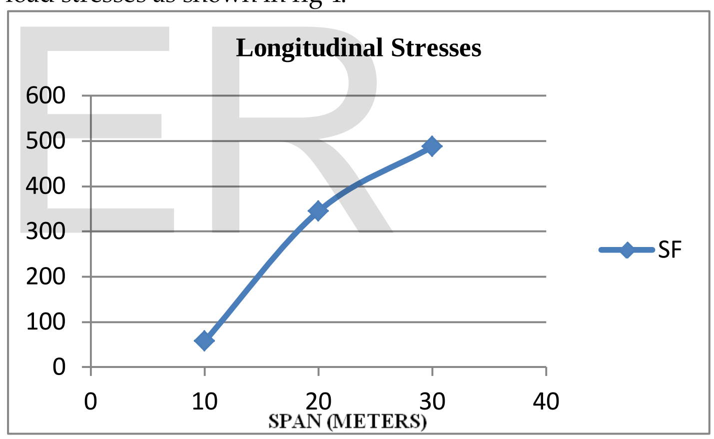


c) (LL+DL) Load

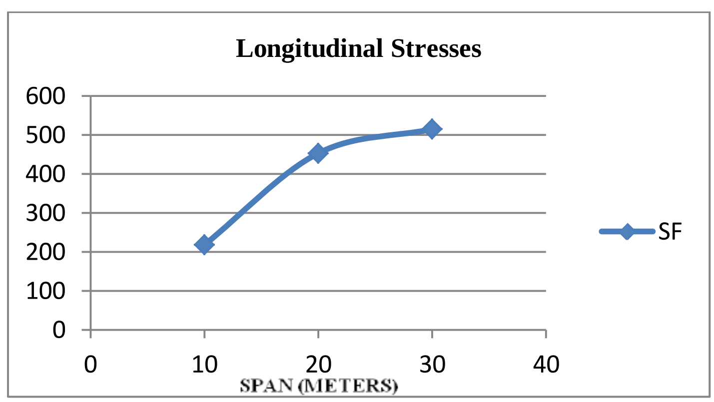
Fig3: Variation of Longitudinal Moment Due To Dead Load and Live Load and the Combination (LL+DL) on Psc Deck Slab.

5.2.2 Longitudinal Stresses

The trend in longitudinal stresses is similar to combination of loads in longitudinal moment. It is observed that as span increases the dead load stresses varies linearly compared to live load stresses as shown in fig 4.



a) Dead Load



b) Live Load

ISSN 2229-5518

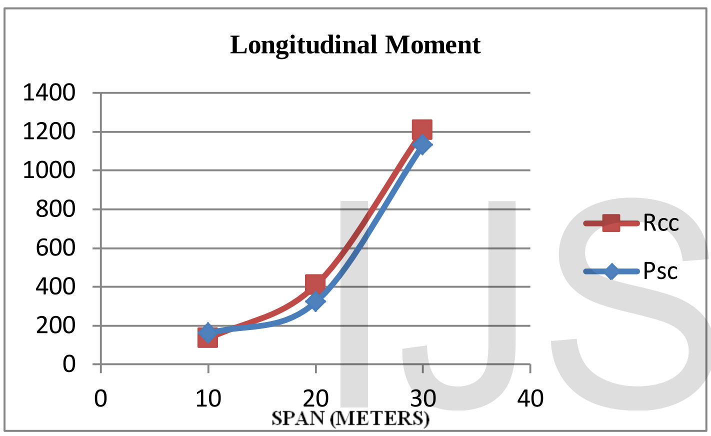
SPAN (METERS)

c) (LL+DL) Load

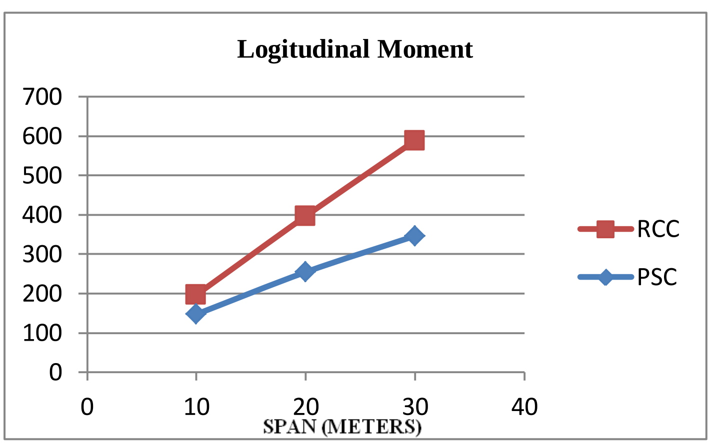
Fig4: Variation of Longitudinal Stresses Due To Dead Load and Live Load and the Combination (LL+DL) on Deck Slab.

5.3 COMPARISON OF RCC AND PSC SLAB

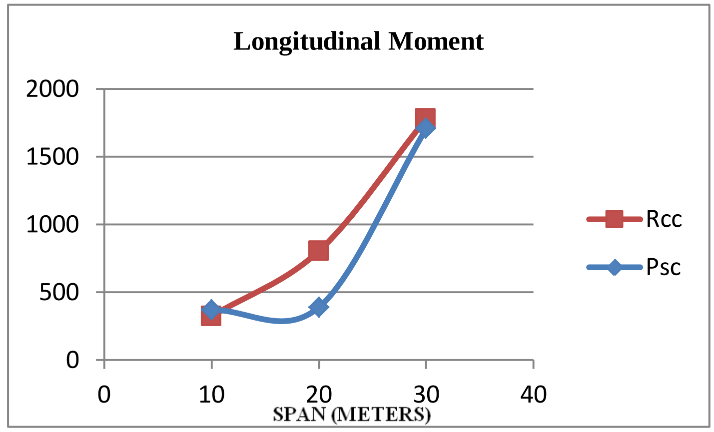
It is observed that the maximum dead load and wheel load moments for deck slabs reduces for PSC deck compared with that of RCC deck this is because by Prestressing the slab the deck becomes stiff and thus the moments are reduced as shown in fig5. But Stresses for RCC deck decreases compared with that of PSC deck.



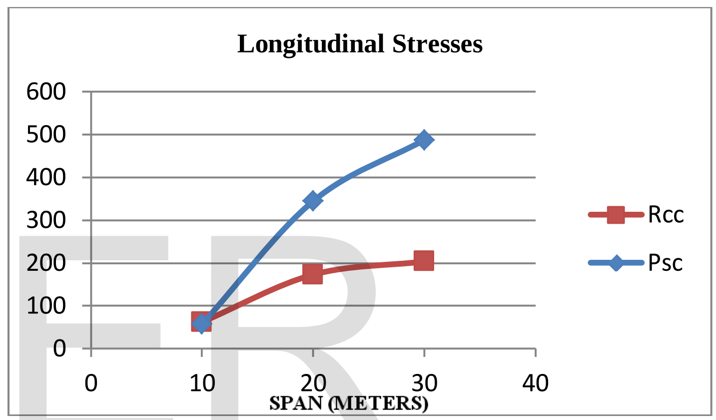
a) Dead Load



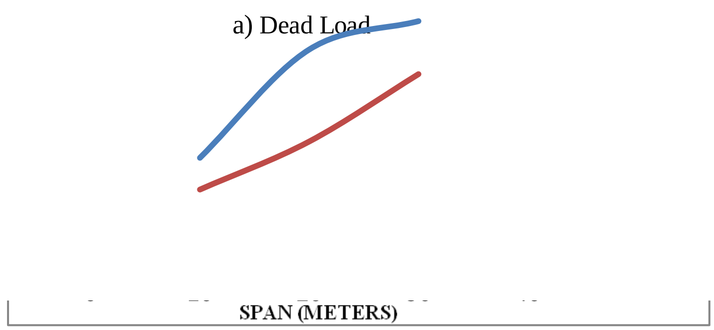
b) Live Load



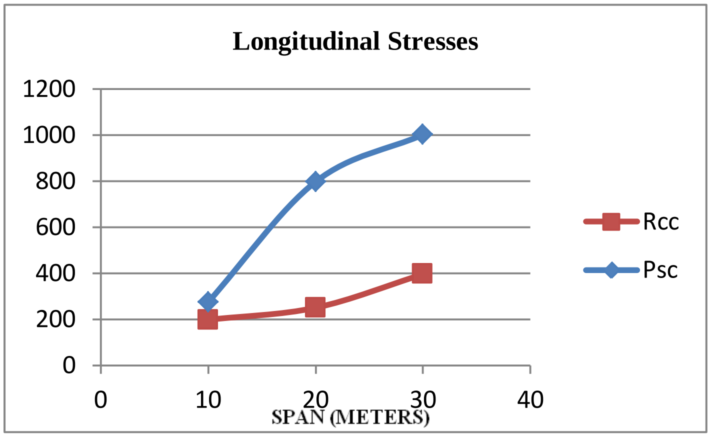
c) (LL+DL) Load



a) Dead Load



b)Live Load



c) (LL+DL) Load

Fig 5: Comparison of RCC and PSC Deck Slab for Live Load, Dead Load and (LL+DL) Condition.

CONCLUSIONS

1. The maximum longitudinal bending moment shows pattern of linear variation with increase in span and maximum bending moment occurs for RCC bridge deck slabs as compared to PSC bridge deck slab. Maximum wheel load longitudinal bending moment decreases around 2% to 3% for PSC deck.
2. The maximum longitudinal bending moment shows pattern of increment with increase in span and maximum increment due to dead load is found to be 5 % for RCC Bridge compared to PSC Bridge for all aspect ratio.
3. It is observed that the dead load and wheel load longitudinal stresses for RCC deck slab increases with the increase in span for all aspect ratios.
4. It is observed that the maximum moments for dead load, wheel load and combination of loads for deck slabs reduces for PSC deck compared with that of RCC deck this is because by Prestressing the slab the deck becomes stiff and thus the moments are reduced. But stresses for RCC deck decreases compared with that of PSC deck.

• *Thanushree H pursuing masters degree program in structural engineering, Siddaganga Institute of Technology Tumkur, Karnataka, India*

Siddesha H ,Associate Proffessor Siddaganga Institute Of Technolo gy,Tumkur,Karnataka,India.

References

[1] Francis T. K. AU and Cliff C. Y. LEUNG, Full-Range Analysis of Multi-Span Prestressed Concrete Segmental Bridges, *Journal of Bridge Engineering*, Vol. 12, No. 2, March 1, 2007.

[2] AASHTO LRFD (2006), “Standard Specification for highway Bridges”, 16th ed., American Association of state highway and transportation officials, Washington, D.C.

[3 Wolde-Tinsea, A. M. and Klinger, J. E. (1987). Integral abutment bridge design and construction, Final Report, FHWA/MD-87/04, Maryland DOT, Baltimore, MD, 71 p.]

. Standard Codes

1. IRC 6:2000 “Standard Specifications and Code of Practice for Road Bridges, Section-II Loads and Stresses”, Indian Road Congress, New Delhi.
2. IRC 21:2000 “Standard Specifications and Code of Practice for Road Bridges, Section-III Cement Concrete (Plain and Reinforced)”, Indian Road Congress, New Delhi.