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# Analysis of Two Way Slabs by FINITE ELEMENT METHOD using MATLAB

Mr. Kallakury .Srinivas
Department of Civil Engineering
V R Siddhartha Engineering College
Vijayawada, India

Sri V.Ramesh
Associate Professor
Department of Civil Engineering
V R Siddhartha Engineering College
Vijayawada, India
snsdnsn

**Abstract - The Slabs can be two way or oneway based on Long span to short span ratio. From the years the slabs are being analyzed based on (I)RankineGrashoff Theory and IS 456 procedure for slabs simply supported on four sides with corners not held down (II) PigeaudMethod,IS 456 and Marcus Method for Slabs with edges fixed or continuous and carrying uniformly distributed load.**

**In the present study of slabs, it is aimed at study of two way slabs with different edge conditions using plate bending models using Finite Element Analysis assuming plates to be isotropic and for linear analysis. The results are compared with Timoshenko Tables based on exact analysis for uniformly distributed loads.Later , the concept is extended and for study on slabs subjected to concentrated loads or patch loads at two different locations i.e. one concentric patch load and patch load eccentric to both the axes , as in the case of bridges and these results are compared with Pigeaud analysis.**

**The thin plates are analyzed based on Kirchhoff's theory using 4noded rectangular elements with 3dof. The moderately thick plates are studied as per Mindlin – Reissner Theory using 4 Noded Elements for all-round simply supported and all-round clamped plates and 8Noded Elements for all round clamped plates with 3dof at each node. These results are obtained for thickness span ratio of 0.05. The Poisson'sratio of 0.2 has been used in analysis. The software used for the analysis is MATLAB.**

The Results are tabulated and the following conclusions are derived from the thesis.

When subjected to udl with all-round clamped plates a 8N isoparametric element with 4*4 subdivision have exhibited the following results for span ratios varying from 1.00 to 2.00

i) Positive Moments at centrei.e. Mx is varying from 15.05 to 17.34%, My is varying from 15.96% to 24.58% from exact analysis

ii) Negative Moments at edges i.e. Mx is varying from 5.00% to 7.6%, My is varying from 7.6% to 24.04% from exact analysis.

The same properties in case of 4N elements using Mindlin theory with 8*8 subdivisions are like this

i) Positive Moments at centrei.e. Mx is varying from 0.00% to 2.7%, My is varying from 0% to 3.35% from exact analysis

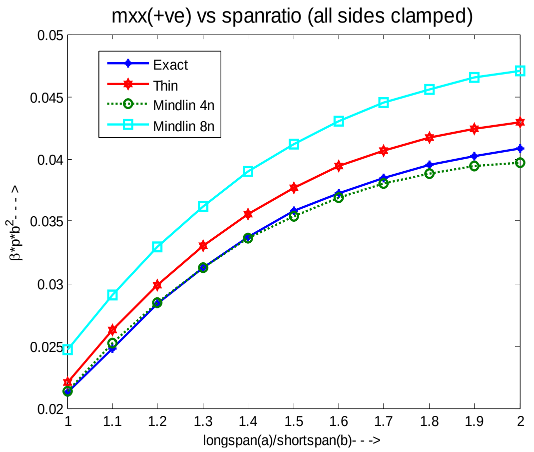
ii)Negative Moments at edges i.e. Mx is varying from 33.53% to 40.16%,My is varying from 40.16% to 59.72% from exact analysis It can be readily understood that negative moments i.e. at edges are not converging in the case of 4N elements but Positive moments are converging towards exact analysis. But it is contrary in the case of 8N Elements where in negative moments are converging but positive moments are away from 25%.

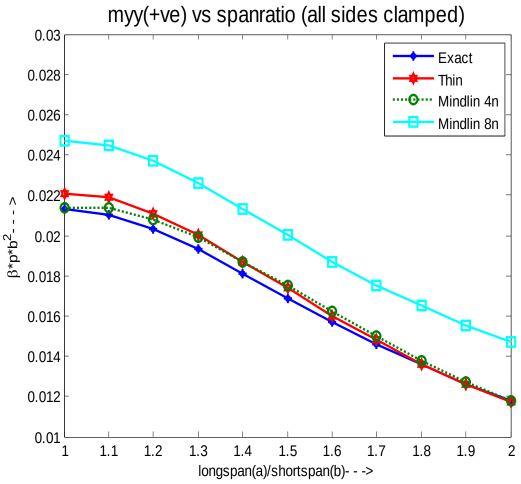
When thin plate theory has been used for the above case, the findings are like this

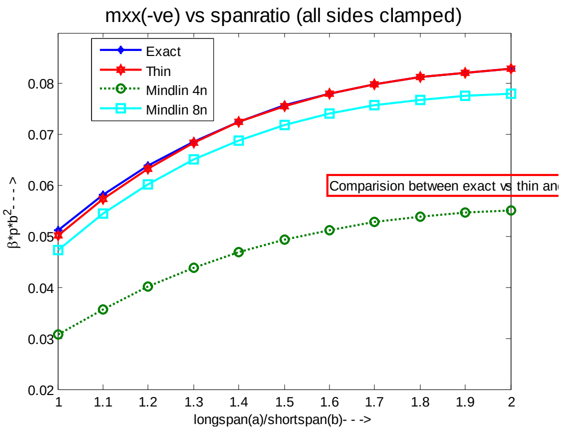
i) Positive Moments at centrei.e. Mx is varying from 0.0% to 6.05%, My is varying from 0.00% to 4.29% from exact analysis

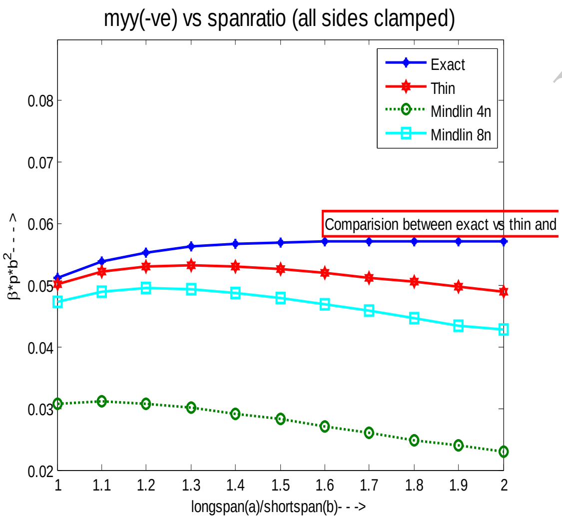
ii) Negative Moments at edges i.e. Mx is varying from 0.00% to 2.14%, My is varying from 2.14% to 14.36% from exact analysis.

It is observed that the behaviour of positive moments in case of 4Noded Mindlin Plates is consistent than that of thin plate theory. The My Negative is decreasing regularly from span ratios of 1.3 in case of 4N and thin, and from 1.4 in case of 8N elements. But in exact analysis it is increasing up to 1.6 and from then onwards it is constant.





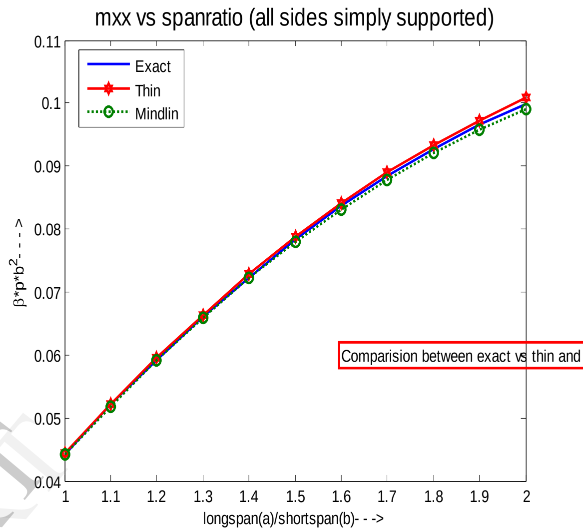

When Subjected to udl with all-round simply supported condition, a 4Noded Mindlin isoparametric element with 8*8 subdivision have exhibited the following results for span ratios varying from 1.00 to 2.00

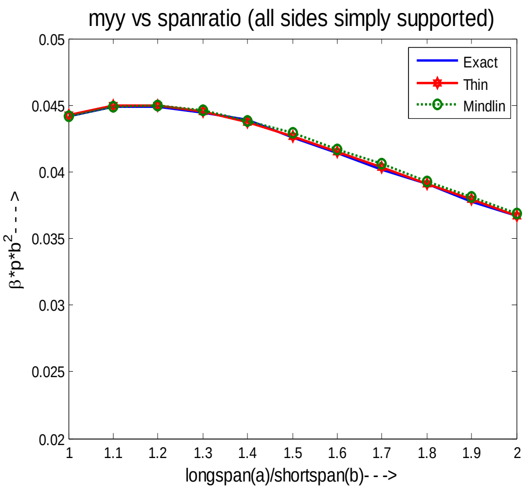
i) Positive Moments at centrei.e. Mx is varying from 0.0 to 0.94%, My is varying from 0.00% to 0.99% from exact analysis

When CPTwith 8*8 subdivisions is used for the above case, the findings are like this

i) Positive Moments at centrei.e. Mx is varying from 0.23% to 0.89%, My is varying from 0.00% to 0.42% from exact analysis

It is observed that the behaviour of the elements is roughly similar. Both the thin Plates and Mindlin Plates are behaving roughly in the same way. Thus, it can be stated that positive moments are alike in the above two cases even the plates to be analysed fall within thin plate classification.



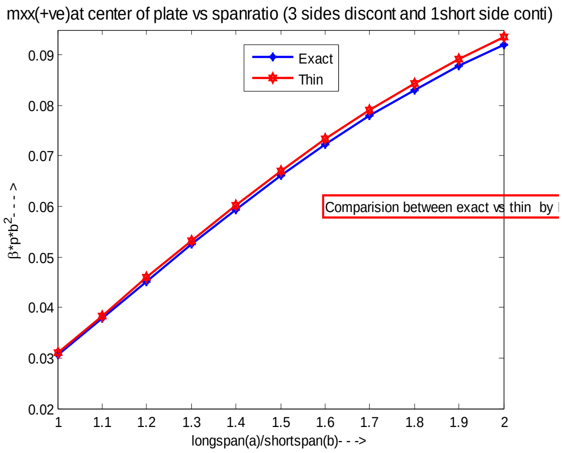



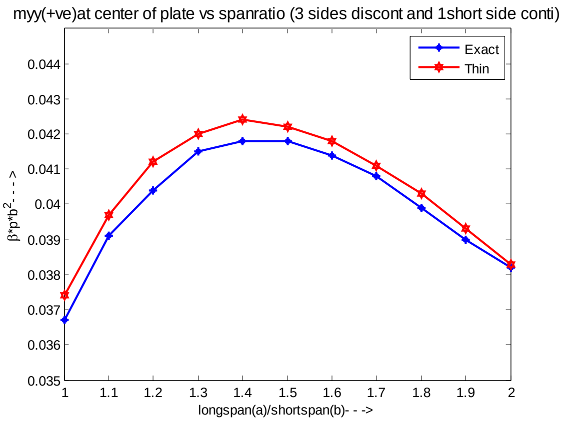

For all other cases, only 8*8 subdivision Kirchhoff elements are considered and the observations are like this.

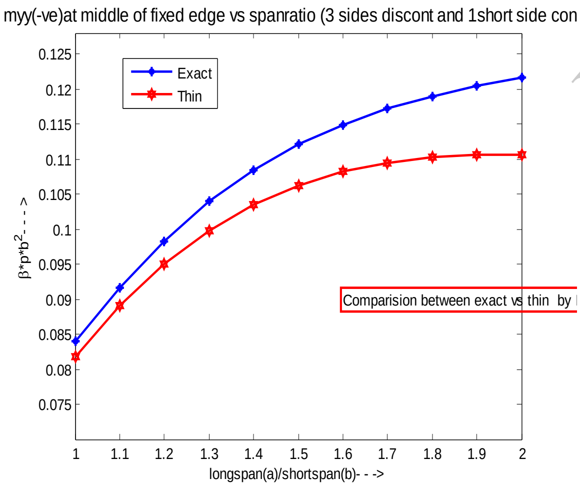
In the case of 3 sides discontinuous and one short side continuous, the observations are like this.

i) Positive Moments at centre i.e. Mx is varying from 1.3% to 1.52%,My is varying from 0.26% to 1.98% from exact analysis

ii) My at middle of fixed edge is ranging from 2.6% to 9.05%



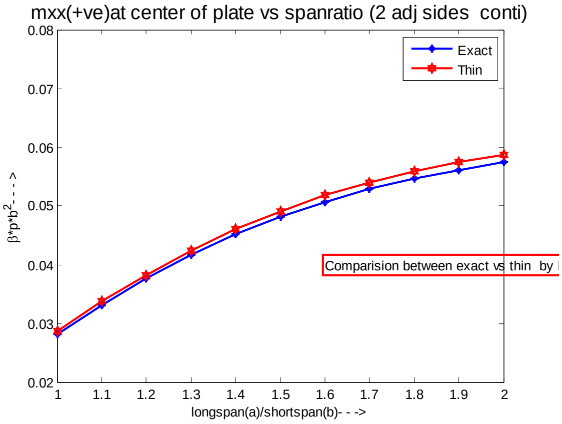



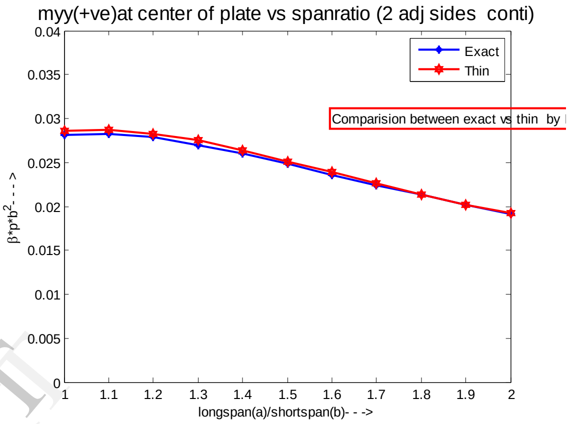

In the case of 2 adjacent sides continuous, the observations are like this.

i) Positive Moments at centre of plate i.e. Mx is varying from 1.6% to 2.32%,My is varying from 0% to 1.85 % from exact analysis

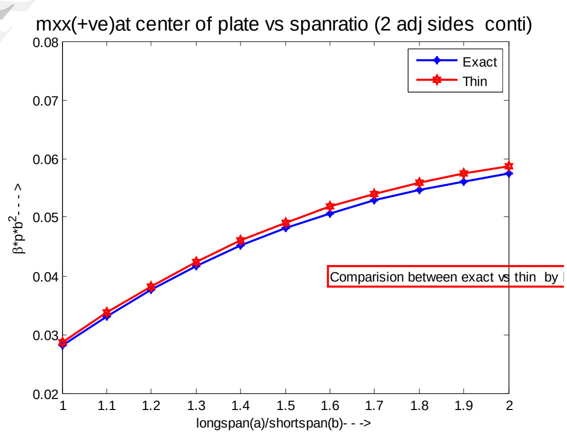
ii) Negative Moments at middle of fixed edges i.e. Mx is varying from 0.26% to 1.77%, and My is varying from 1.77% to 7.88%

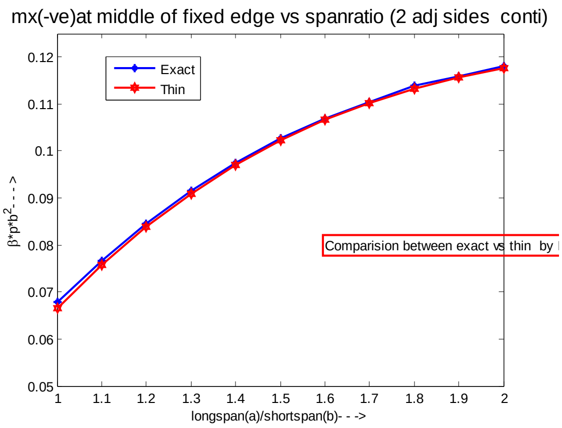
iii)Mmax at x=0.4a and y=0.4b from discontinuous edges, it is varying from 0.66 to 3.02%.

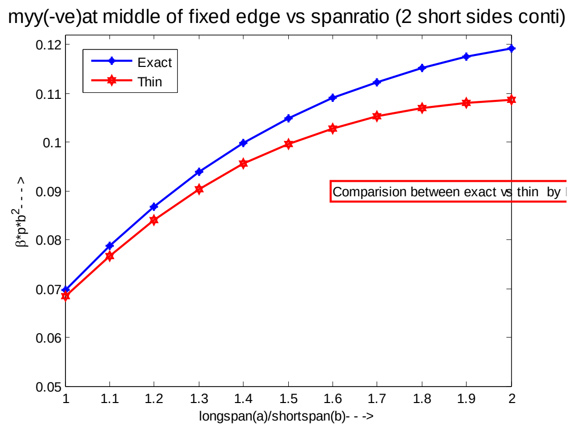


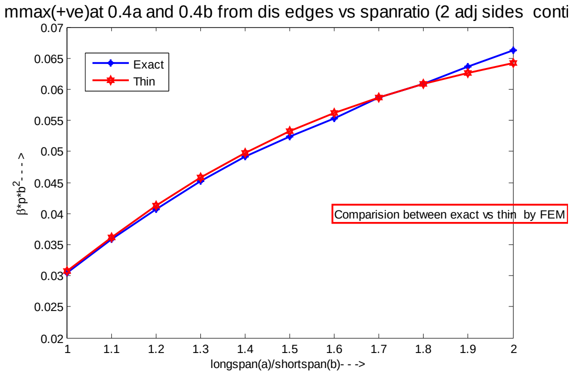





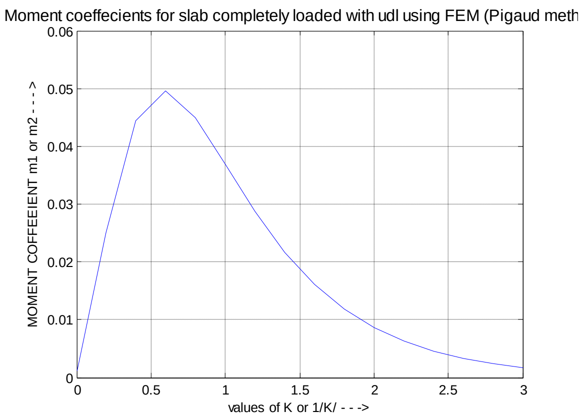






Likewise, the Stress resultants at all important locations are studied for different edge conditions for span ratios from 1.0 to 2.0. It has been observed that the Positive Moments about both the spans and Negative Moments about short span are within a range of 3% from exact analysis. But Negative Moments about long span are oscillating up to 10%.

Pigeaud curve for all sides simply supported condition is also prepared for the span ratios from 0.0 to 3.0 and it is observed that the error is about 3.0% compared to Pigeaud curve.




From the above observations, it can be concluded that FEM results are in line with exact analysis with any type of loading and boundary conditions. But judicious use of Modelling and software are essential.

I conclude by paying my tributes to Clough and Zienckewicz for this wonderful concept. Can we call them "Finiteers".

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