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Analysis of plates on elastic foundations using 8-node serendipity elements

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SUMMARY

Plates on elastic foundations have been the subject of interest for a long time and, with the appearance of finite elements quadratic isoparametric elements have become one of the key performers in the analysis. There are reported difficulties in the analysis of plates on elastic foundations when using standard 8-node serendipity elements in those cases where soil subgrade modulus and plate stiffness are of about the same order. It has been observed that elements that perform very well in concrete plate analyses exhibit erroneous patterns when used in conjunction with the Winkler soil model. In the case of 8-node serendipity element problems can be attributed to spurious modes that usually do not appear in engineering practice. Contrary to the common opinion that it can be attributed only to the element spurious modes, this paper shows that soil treatment needs also some changes.

There were many attempts to improve the behaviour of the isoparametric elements, but quadratic elements are most economically modified using the assumed shear strain method. In this paper we adopt a version of the assumed shear strain method to obtain a well behaving 8-node plate element. Numerical examples have confirmed that a well performing element is not sufficient to obtain stable plate behaviour in all possible cases. Instead, the so-called consistent loading approach is required in the determination of soil spring stiffness in order to obtain correct results. The developed procedure can be offered as a substitute for a two parameter soil model.

Several element formulations and soil treatment with and without consistent approaches are compared using a set of numerical examples.