

# Some considerations on the implementation of FE models imposing strong forms of equilibrium

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## ABSTRACT

In this communication we discuss the practical aspects of implementing finite element models that impose a strong form of equilibrium. The solutions provided by these models, when combined with the more classical compatible approaches, lead to the determination of bounds of the error of these approximations, following concepts that were introduced almost one century ago[1]. The authors have worked on this topic for more than twenty-five years, leading to the recent publication of a book on the topic [2].

We will revisit the implementation of equilibrium finite elements, showing that the difficulties usually envisaged when considering the application of such models are not as complex as it is considered by those that are not aware of the details involved, and that simple and effective recovery techniques lead to efficient estimates of the solution errors.

We address in particular the derivation and computational implementation of self equilibrated approximation functions, the enforcement of interelement equilibrium and the stability issues that may be potentially associated with these models.

Computer codes using these formulations, which are being completed for future distribution as open source, will be previewed.

## REFERENCES

- [1] E.A.W. Maunder “Trefftz in translation”, *Computer Assisted Mechanics and Engineering Sciences*, **10**(4), 545–564 (2003). (Translated from E. Trefftz 1926 “Ein gegenstück zum ritzschen verfahren”, *Proceedings of the 2<sup>nd</sup> International Congress of Applied Mechanics*, 131-137 (1926).)
- [2] J.P. Moitinho de Almeida and E.A.W. Maunder, *Equilibrium Finite Element Formulations*, John Wiley & Sons, (2017).