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Stress Linearisation for Practising Engineers

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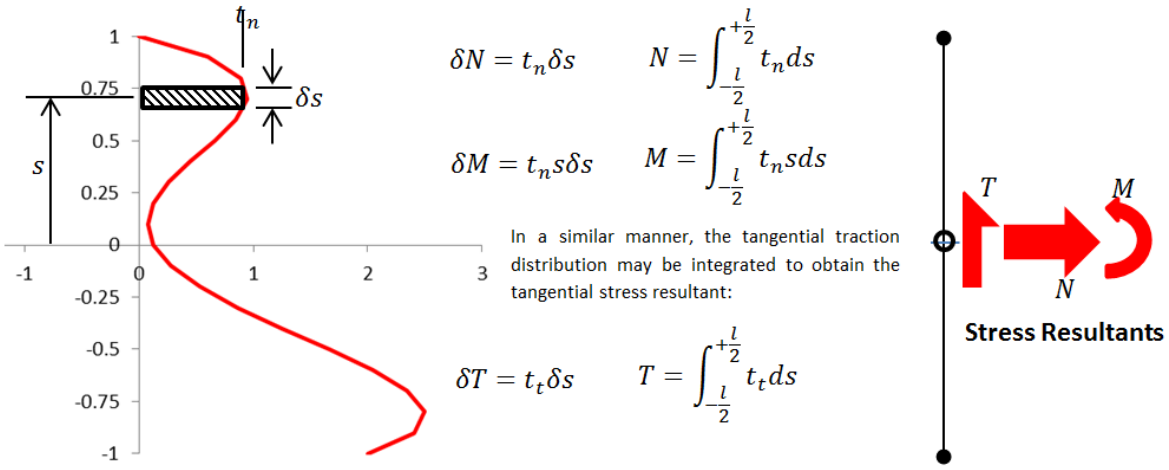
This post provides an overview of the complete article, which may be freely obtained from:

http://www.ramsay-maunder.co.uk/stress-linearisation-article--contact/

Background of Stress Linearisation

The process of stress linearisation was originally developed to assist practising engineers working in the design and analysis of pressure retaining equipment (pressure vessels, pipes, pumps, etc.) and, using general finite element models, to predict the stresses in these structures. In a mechanics of materials approach, structural forms such as pressure vessels are considered as shells and the codified assessment procedures, such as ASME, require the stresses to be cast in the form of stress resultants found in a shell member, i.e., membrane, bending shear resultants etc. When a pressure vessel, or similar, is analysed using continuum finite elements, then these stress resultants are not part of the standard output. These stress resultants may, however, be recovered by operating on the finite element stress field by the process of stress linearisation. The stress resultants may then further be operated on to obtain stress measures suitable for comparison with allowable limits prescribed in the codes of practice.



Conclusions

If the author was asked whether a practising engineer should use stress linearisation to determine stress resultants from a CFE model then he would have to advise against it. Far better to make use of nodal forces which are guaranteed (all else being equal) to be in equilibrium with the applied loads. It is noted, though, that if the aim of stress linearisation is to classify the stresses according to, for example, the ASME pressure vessel codes, then the use of nodal forces, whilst giving the stress resultants, will not provide the self-balancing traction distribution. In such cases, one might recommend that the stress resultants obtained by stress linearisation are verified through those calculated from nodal forces.