

## Design of Pressure Vessels Nozzles: Assessment of Pressure Area Method with Limit Analysis

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### Abstract

Nozzles in pressure vessels are designed by area replacement methods or pressure area method. Area replacement method is used in many design codes including ASME section III and in section VIII division II, editions before 2007. Area replacement is used in many European design codes. In 2007 edition of ASME section VIII division III area replacement rules are replaced by Pressure Area Method. However area replacement procedure given ASME section VIII division II, differs from procedure given in European code. Maximum allowable pressure in European design codes is obtained by limiting general primary membrane stress intensity at the nozzle junction, while maximum allowable pressure in ASME section VIII division II is obtained by limiting local primary stress intensity. Limit on General primary stress intensity is necessary to ensure safety against rupture/bursting failure mode while limit on local primary stress intensity ensures that local deformation will be small.

Objective of this work is to compare the pressure area methods given in ASME section VIII division II and European code. Safety margin available in both procedures is evaluated. In this work local primary stress intensity is evaluated by linear elastic analysis using finite element method and general primary stress intensity is obtained by Limit load analysis using finite element method. Different cases of nozzles are considered in the study. In this work equivalence between area replacement and pressure area method is also shown. Additionally general primary stress intensity is evaluated using elastic compensation method and results obtained are compared with limit load method.