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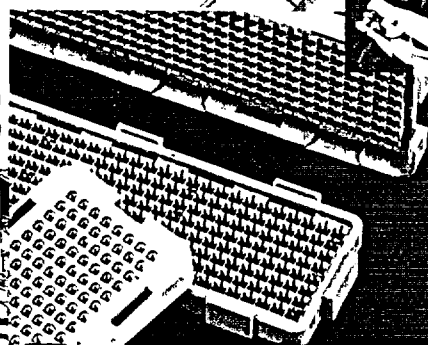
OFFICE OF THE SECRETARY
RULEMAKINGS AND
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Advanced Contact and Bolt Pretension

Training Manual

for Release 5.6

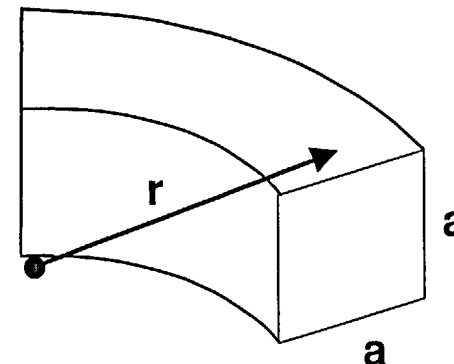
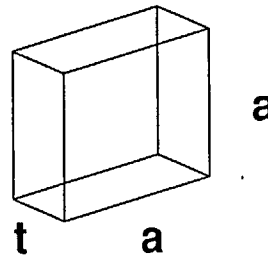
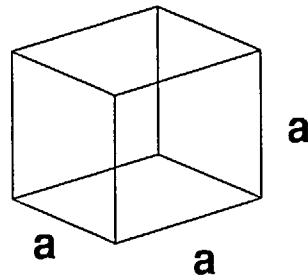
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- For bulky solids, the *Hertz contact stiffness* often provides an appropriate basis for the penalty stiffness. This stiffness can be estimated from the element size and Young's modulus.
- For a uniformly-shaped 3D element, the Hertz stiffness would be approximately $k_{\text{Hertz}} \cong a \times E$, where a is the characteristic element size, and E is the Young's modulus.



- For 2D elements with thickness (t), Hertz stiffness would be approximately $k_{\text{Hertz}} \cong t \times E$.
 - For 2D axisymmetric elements, the “thickness” is 1 radian $\times r$, giving a Hertz stiffness of approximately $k_{\text{Hertz}} \cong r \times E$.

- As a practical matter, a good first trial value for bulky contact stiffness would be $k_{\text{contact}} = f_{\text{bulk}} \times k_{\text{Hertz}}$, where f_{bulk} is a factor usually between 0.1 and 10 for bulky solids.

- Because the starting estimated value of f_{bulk} ranges over at least two orders of magnitude, and because k_{contact} will be adjusted by trial-and-error anyway, it is usually not justifiable to worry about the element's size when estimating the penalty stiffness.

- *For bulky solids*, simply estimate the penalty stiffness by

$$k = f_{\text{bulk}} \times E$$

- where the factor f_{bulk} is usually between 0.1 and 10, and a good starting value for f_{bulk} is often $f_{\text{bulk}} = 1.0$.
- This estimate assumes an approximate “unit” element size; for very large or very small elements, you might need to adjust the starting value of f_{bulk} accordingly.

Advanced Contact & Penetration 3.3

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