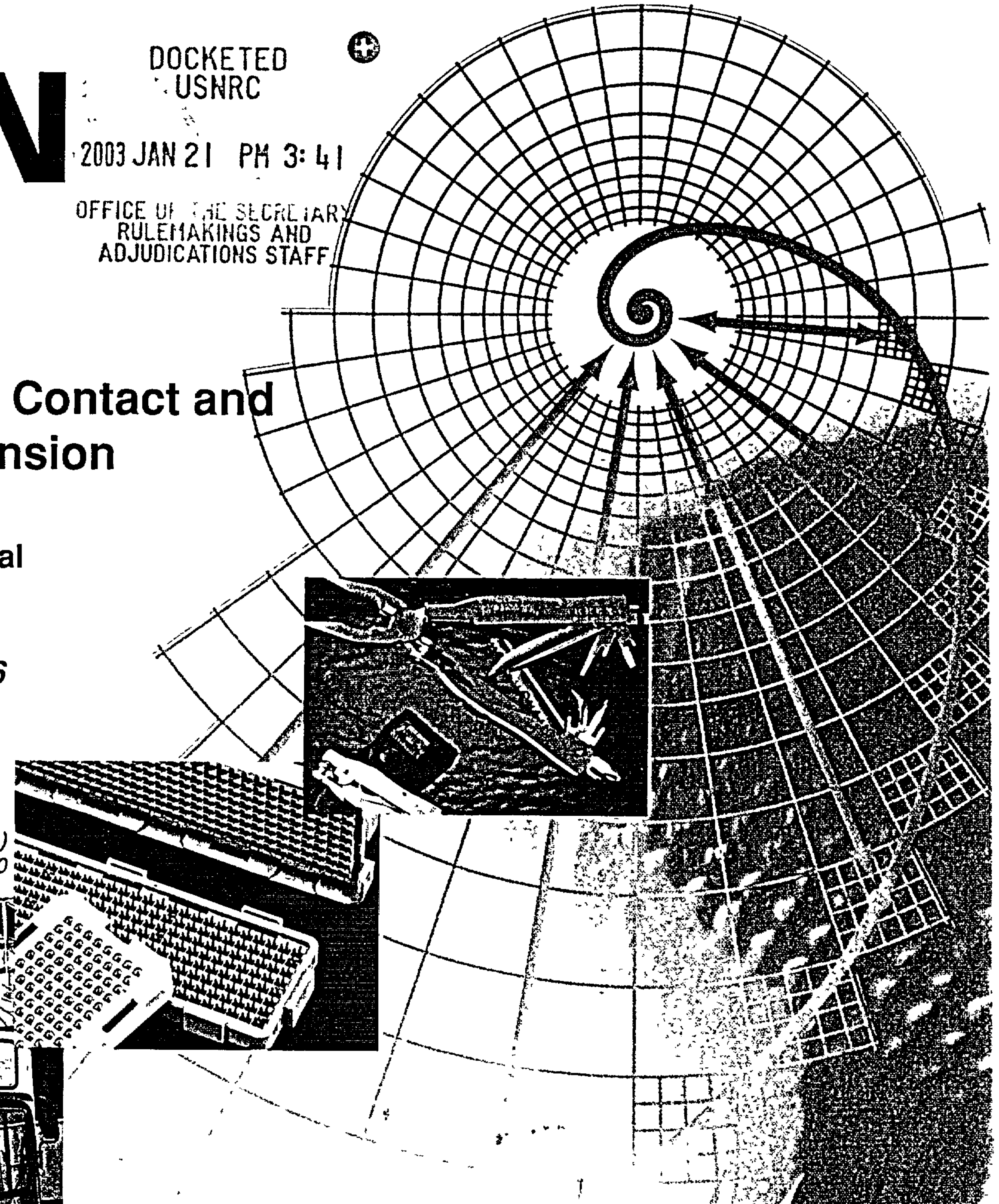

Advanced Contact and Bolt Pretension

Training Manual

for Release 5.6

001361 (Volume 1)
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ANSYS, Inc.
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Company

quality
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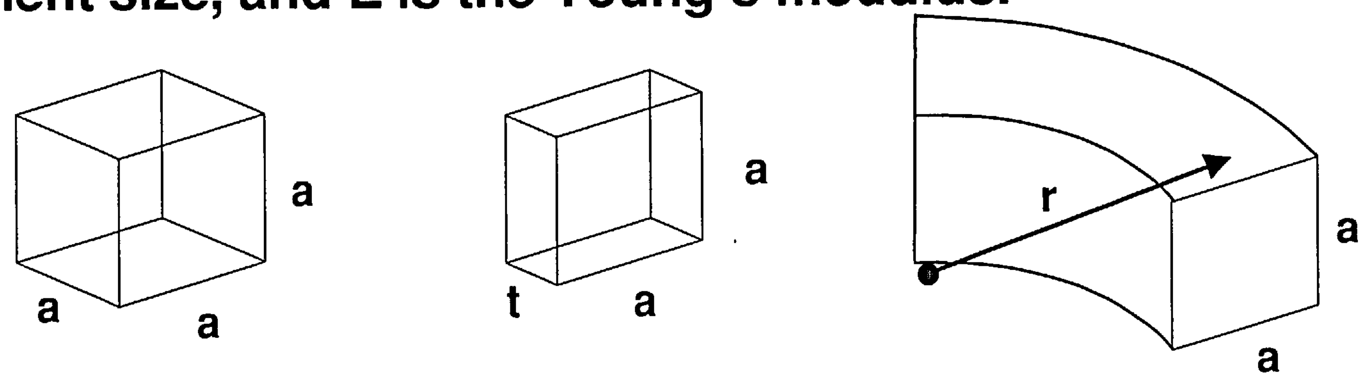
... Determining a value

- 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 $k_{Hertz} \cong a \times E$, 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 $k_{Hertz} \cong t \times E$.
  - For 2D axisymmetric elements, the "thickness" is 1 radian x r, giving a Hertz stiffness of approximately $k_{Hertz} \cong r \times E$.

... Determining a value

- As a practical matter, a good first trial value for bulky contact stiffness would be $k_{contact} = f_{bulk} \times k_{Hertz}$, 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

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

  - where the factor f_{bulk} is usually between 0.1 and 10, and a good starting value for f_{bulk} is often $f_{bulk} = 1.0$.
  - 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.

NUCLEAR REGULATORY COMMISSION

Docket No. ______________ Official Exh. No. 221

In the matter of ______________

Staff ______________ IDENTIFIED X

Applicant X ______________ RECEIVED ______________

Intervenor ______________ REJECTED ______________

Other ______________ WITHDRAWN ______________

DATE 6-3-02 Witness ______________

Clerk ______________