**BACKGROUND**
- The ballistic penetration resistance behavior of a material is difficult to determine experimentally.
- Quasi-static punch shear testing (QS-PST; Gama and Gillespie, 2008) provides a means of determining a material’s ballistic behavior from its quasi-static behavior.
- Penetration mechanics is a complex problem involving many variables, including:
  - Projectile and target material properties
  - Target dimensions and boundary conditions
  - Projectile dimensions, geometry, mass, and impact velocity
- Dimensional analysis permits grouping of these variables to reduce the complexity of the problem.

**RESEARCH OBJECTIVES**
- Develop a dimensionless model for application of the QS-PST method to different target dimensions and projectile dimensions and geometries.
- Verify this model with analytical, numerical, and experimental tools.

**QS-PST TEST FIXTURE**
- Fixture allows variation of many experimental parameters, including:
  - Support span
  - Specimen thickness
  - Punch diameter
  - Punch geometry
  - Penetration depth

**DIMENSIONAL EFFECTS**
- 0.50" Punch
- 0.30" Punch
- Partial penetration of 22L S-2 glass/SC15 epoxy panels with span-to-punch ratio = 2.0 at similar loading points.
- Penetration mechanisms are a function of the punch-to-thickness ratio.
- Stiffer panels accumulate more damage from shear than bending.

**LS-DYNA RESULTS**
- Effect of projectile diameter on ballistic penetration curve (cylindrical projectile).
- Larger projectile-to-thickness ratio has greater penetrating ability.

**PROJECTILE GEOMETRIES**
- Change in penetrator-target contact area with penetration depth due to projectile geometry effects the shape of the load-displacement curve.

**GEOMETRIC EFFECTS**
- Change in penetrator-target contact area with penetration depth due to projectile geometry effects the shape of the load-displacement curve.

**DIMENSIONLESS NUMBERS**
- Useful dimensionless relationships:
  - **Nose geometry function, N** – represents slenderness of projectile.
  - **Response number, Rn** – relates severity of impact with dimensions and material properties of the target.

\[
N = \frac{M}{\rho d^2} \frac{1}{B N_1} \quad R_n = \frac{\rho c}{\sigma_s} \left( \frac{D_p}{H_c} \right)^2
\]

**ACKNOWLEDGEMENTS**
- This work is supported by the Army Research Office and the Army Research Laboratory under Cooperative Agreement Number W911NF-07-1-0294.

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