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Collision Model Test Matrix #2

Objective: Assess the sensitivity of damage penetration to striking ship speed and local strike location (ie. different locations relative to webs). Consider only right angle collision with zero speed for struck ship so that *DAMAGE* results may be included. Compare results from all models.

Struck Ship: 150k dwt DH Tanker, $V_A = 0$ knt, $T = 16.8$ m, $\Delta = 178867$ MT, baseline design.

Striking Ship: 150k dwt Bulk Carrier; $V_B = 3, 4, 5, 6, 7$ knt; $T=15.96$ m, $\Delta = 174,850$ MT.

Scenario: collision angle = 90 deg, strike location = center of COT 4P ($x_c=3.5$ m Fms, at web), $x_c= 4.325$ m, $x_c=5.15$ m, $x_c=2.675$ m, $x_c=1.85$ m.

Plots: Penetration vs. V_B at each location (6); Penetration vs. location at each V_B - (6) + (5) - 11 plots each model

Models: - *SIMCOL V 2.1*; *DAMAGE*; Technical University of Denmark (DTU) / Lutzen; ALPS/SCOL / Paik

Observations: (submit via email to brown@aoe.vt.edu)

- ALPS/SCOL predicts much higher penetration than SIMCOL2.1, DAMAGE and DTU that have reasonable agreement. Agreement is best at high energy end. SIMCOL is less symmetrical.
- Low energy ($V_b=3,4$ knt): All models have slight local minima on the web.
- High energy ($V_b=6,7$ knt): SIMCOL2.1, DAMAGE and DTU have excellent agreement with SIMCOL2.1 showing a substantial minima on the web. ALPS/SCOL has a maxima on the web.
- SIMCOL2.1 results not always symmetrical around web.

Discussion: (submit via email to brown@aoe.vt.edu)

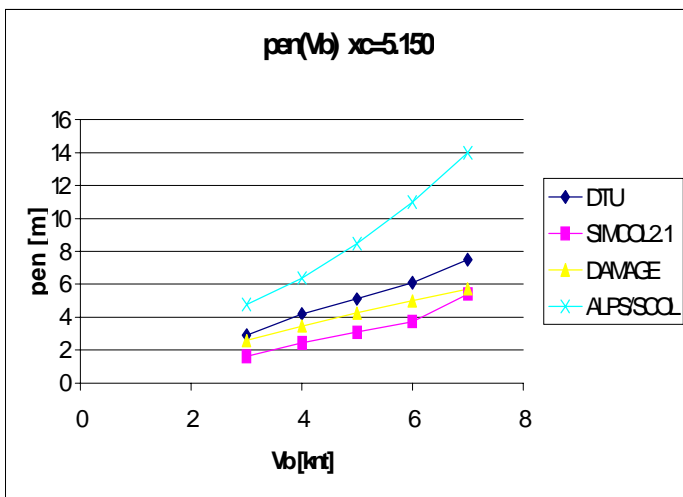
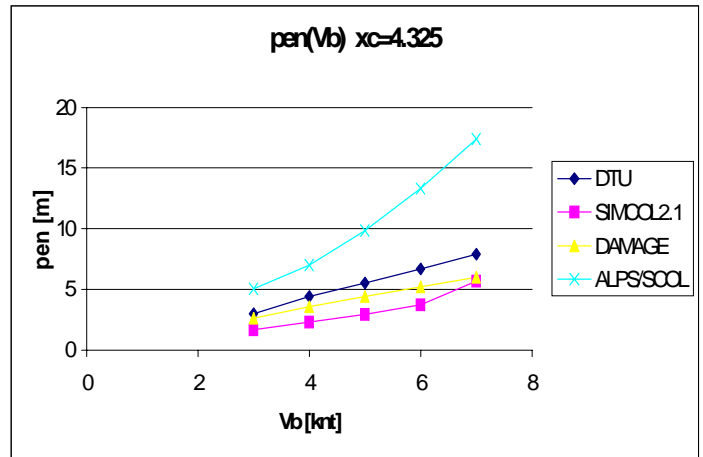
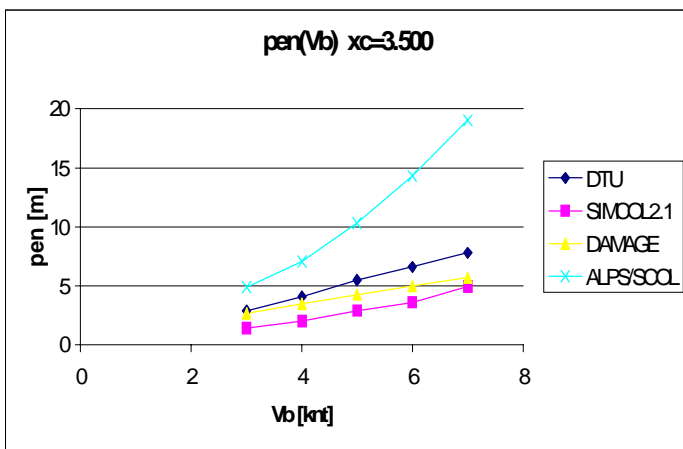
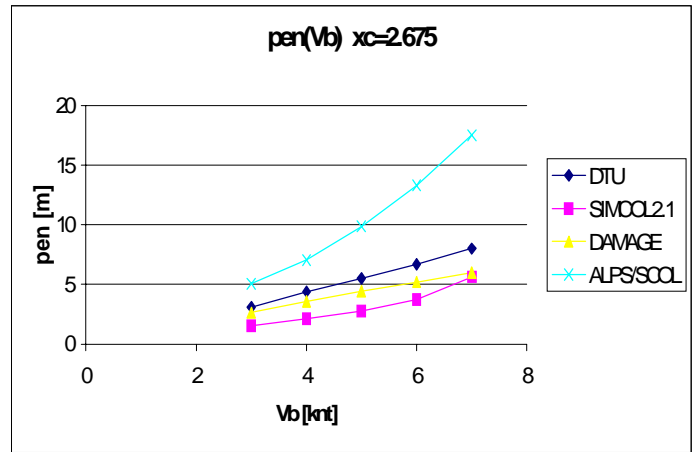
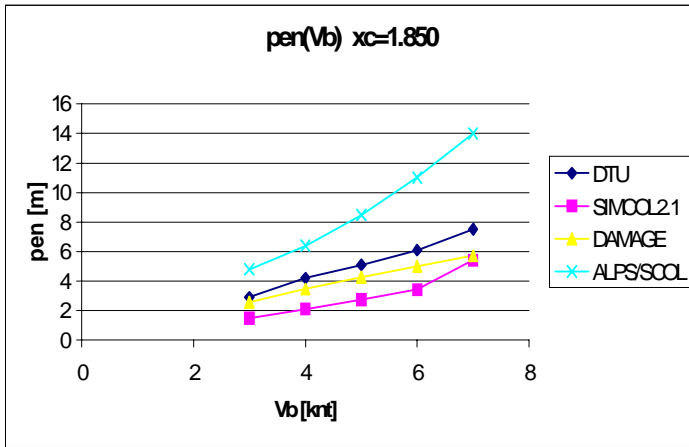
- Fair agreement between SIMCOL2.1, DAMAGE and DTU. DAMAGE and SIMCOL both use similar intersection element, tearing and crushing models. SIMCOL2.1 uses completely different models. Right angle midship strike emebane phenomena discussed in Matrix 1 likely causing SIMCOL2.1 to predict less penetration in all Matrix 2 cases (1-1.5m less)
- ALPS/SCOL results are not understood, particularly maxima on the web. Any thoughts?

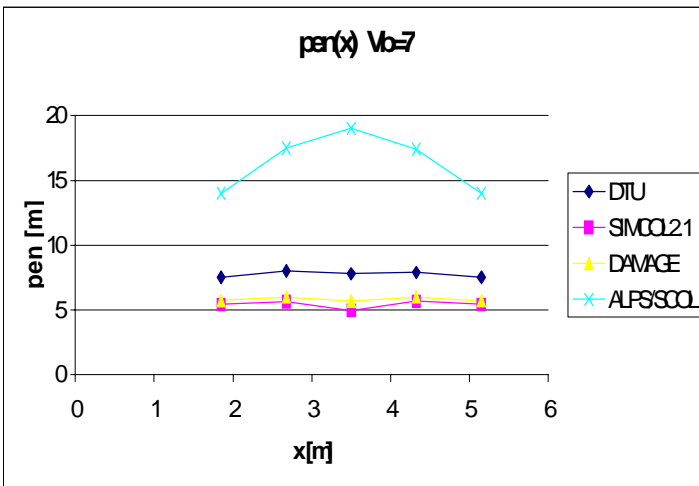
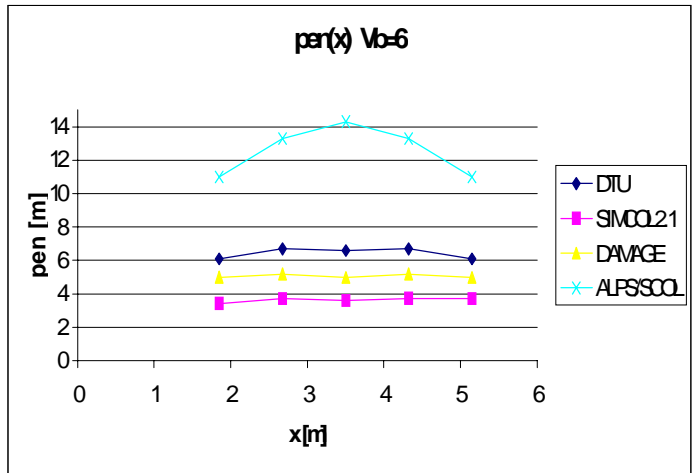
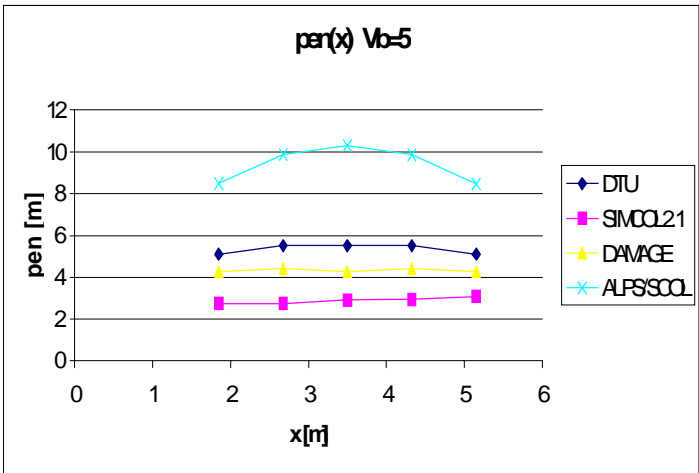
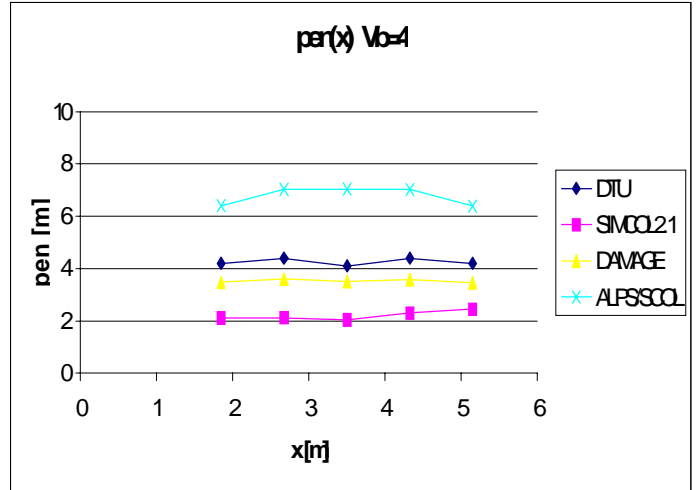
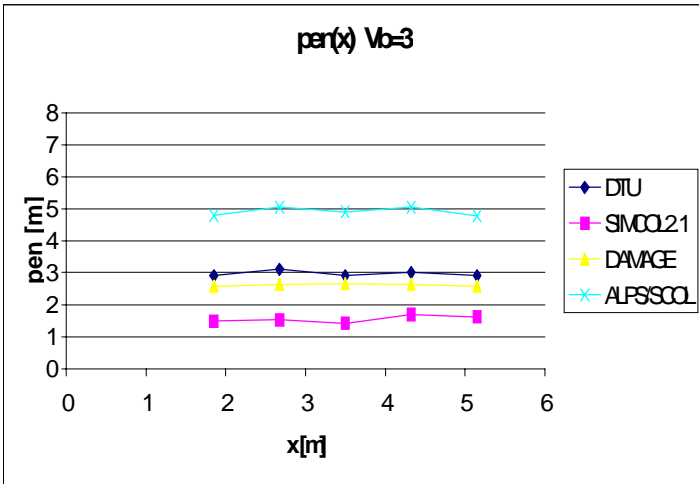
- SIMCOL2.1 lack of symmetry due to interaction with external dynamics and membrane model penetration sensitivity to small angular changes.

Conclusions: (submit via email to brown@aoe.vt.edu)

- SIMCOL2.1 results for right angle midship strike again lower. Other trends good. As discussed in Matrix 1, may want to disable this non-conservative mechanism.
- Validation is required to evaluate the significant difference between SIMCOL2.1, DAMAGE and DTU models vs. ALPS/SCOL. Should compare absorbed energy and make sure same definition for penetration is being used.

Results:





Longitudinal extent of damage (SIMCOL 2.1):

