Tom Cat Designs LLC Protective Hull Modeling & Simulation Results For Iteration 1

Sebastian Karwaczynski

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TOM CAT DESIGNS LLC PROTECTIVE HULL MODELING AND SIMULATION RESULTS FOR ITERATION 1

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Approved for public release; distribution unlimited

NA

Same as Report (SAR)
• Fit and Function Analysis
• Mobility Analysis
• Blast Analysis
• Design Suggestions
• Conclusion
Fit and Function Analysis 9°

9 Deg Underbody Kit
- During installation/removal of the underbody kit, the attachment locations are potentially difficult to reach.
- All 8 bolts are blind operation.
BELLY PLATE ASS’Y
BELLY PLATE IS BOLTED TO VEHICLE FRAME
Fit and Function Analysis 22°
Fit and Finish Analysis

- During installation/removal of the underbody kit, the attachment locations are potentially difficult to reach.
- All 8 installation bolts are blind operation.
# Mobility Analysis

<table>
<thead>
<tr>
<th>Maneuver</th>
<th>Requirement</th>
<th>Baseline w/V-hull</th>
<th>Baseline w/OGPK &amp; V-hull</th>
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<tr>
<td>AVTP</td>
<td>43 MPH</td>
<td>44</td>
<td>42</td>
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<td>SS</td>
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<tr>
<td>RMS 1.00</td>
<td>30 MPH</td>
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<td>RMS 1.50</td>
<td>20 MPH</td>
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<tr>
<td>RMS 2.00</td>
<td>15 MPH</td>
<td>10</td>
<td>10</td>
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<td>RMS 2.50</td>
<td>13 MPH</td>
<td>5</td>
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<tr>
<td>HR4</td>
<td>50 MPH</td>
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<td>HR6</td>
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<td>HR8</td>
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<tr>
<td>HR10</td>
<td>5 MPH</td>
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**CLEARANCE - HULL TO GROUND (IN)**

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<th>18 IN</th>
<th>Front</th>
<th>Middle</th>
<th>Rear</th>
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<th>Middle</th>
<th>Rear</th>
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</table>

*Unclassified.*
• With the V-hull configuration, **performance improved** for Double Lane Change Maneuver (AVTP), Side Slope, Ride Quality, and Shock Quality due to lower CG height and increased weight. However, for course roughness’s greater than 2.0” RMS and bump heights greater than 8” HR (Half Round) ground/hull **interference occurred**.

• With the V-hull configuration, **performance was reduced** for the Vertical Step due to ground/hull interference—greatest in the rear section (reduced from 18” to 8”).

• **Biggest risk is reduction in mobility over obstacles for the V-hull configuration**
• The following slides illustrate blast simulations for both the 9° and 22° V-Hull Designs
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.00012492
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.00019998
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.00027486
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.00034992
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.00044982
9° Simulation
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.0005994
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.00074988
9° Simulation

LS-DYNA keyword deck by LS-PrePost
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9° Simulation

LS-DYNA keyword deck by LS-PrePost
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9° Simulation

LS-DYNA keyword deck by LS-PrePost
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9° Simulation

LS-DYNA keyword deck by LS-PrePost
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9° Simulation

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9° Simulation

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9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.015
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.0225
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.03
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.0375
9° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.045
9° Simulation

LS-DYNA keyword deck by LS-PrePost

Time = 0.06
22° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0
22° Simulation
22° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.00027486
22° Simulation
22° Simulation

LS-DYNA keyword deck by LS-PrePost
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22° Simulation
22° Simulation
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22° Simulation

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22° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.03
22° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.0375
22° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.045
22° Simulation

LS-DYNA keyword deck by LS-PrePost
Time = 0.06

Unclassified.
• Performance of the 9° and 22° V-Hulls Produced:
  – High accelerative loads
  – Unfavorable displacement
Design Suggestions

Connect assembly at each corner

Gussets

Front
Design Suggestions

Extend Length and Connect Assembly To Side Sills

Increase overall Thickness to 2”
Connect front and rear of assembly to body and frame.

Gussets on the inner and outer if possible.

Provision for driveline / tunnel.

Front Plate Connector, Replicate Rear Plate Connector and Gussets.

Rear Plate Connector.
Conclusion

- The system in its current configuration provides assembly issues due to the accessibility of the mounting holes
- Underbody produces an unfavorable drop in mobility
- Deformation to the underbody is not favorable and does not provide adequate protection from an underbody blast perspective
- To produce favorable results for Fit and Finish, Mobility and Blast it is strongly recommended that a complete redesign by the Contractor be considered
- The current design is not feasible for Fit and Finish, Mobility or Blast