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Mine Blast Analysis Tool for Rigid Body Response

A Quick, Reliable Predictive Methodology to Estimate Relative Acceleration Environments Experienced by Crewmembers in Specific Vehicle-Mine Scenarios

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Background

- Improvised mine threats in theater (10X)
- Survivability testing consumes resources.
- A predictive tool can reduce testing needed.
- Desired: A tool to assess relative severity of potential test scenarios.

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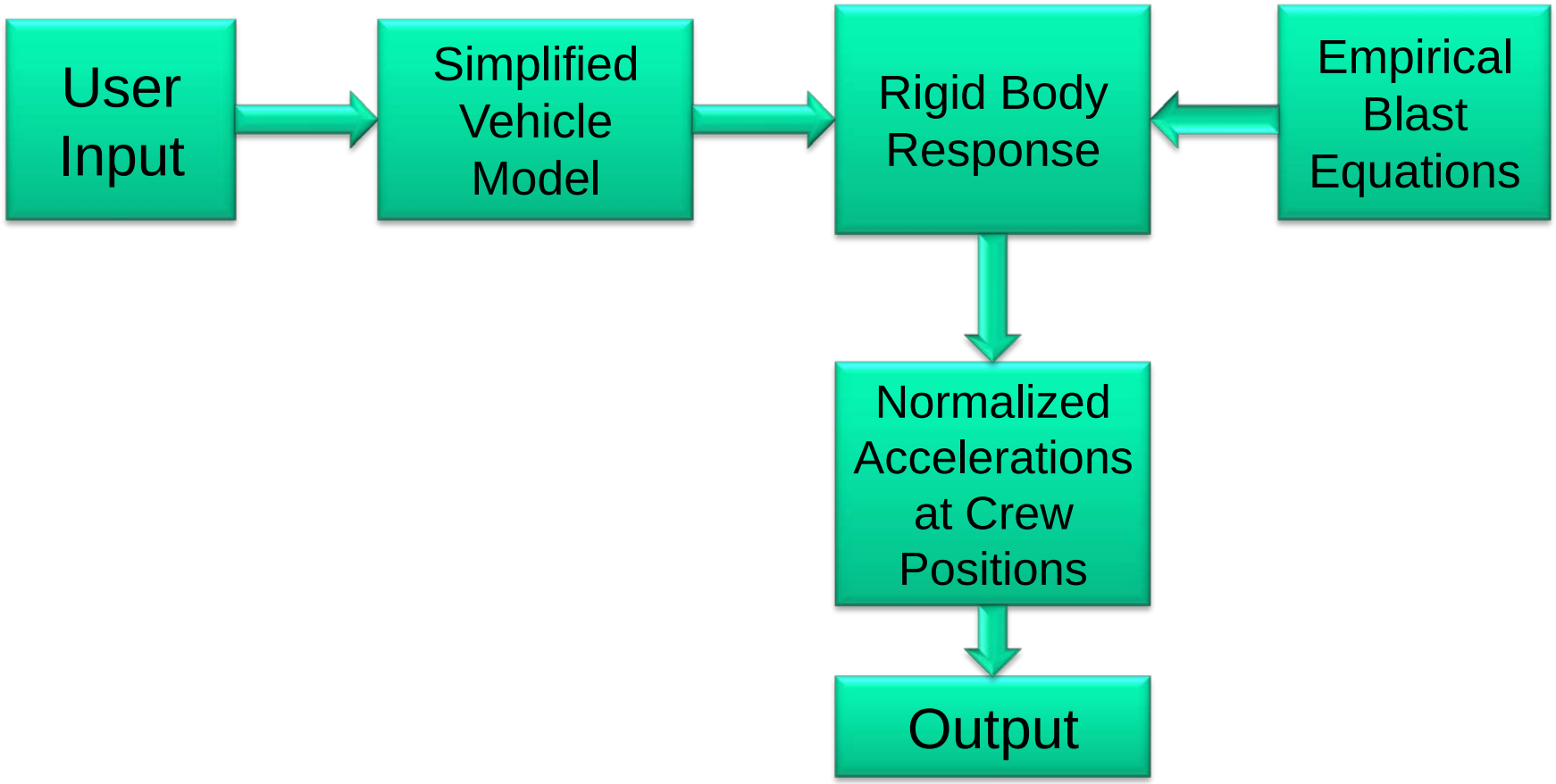
MBAT Methodology



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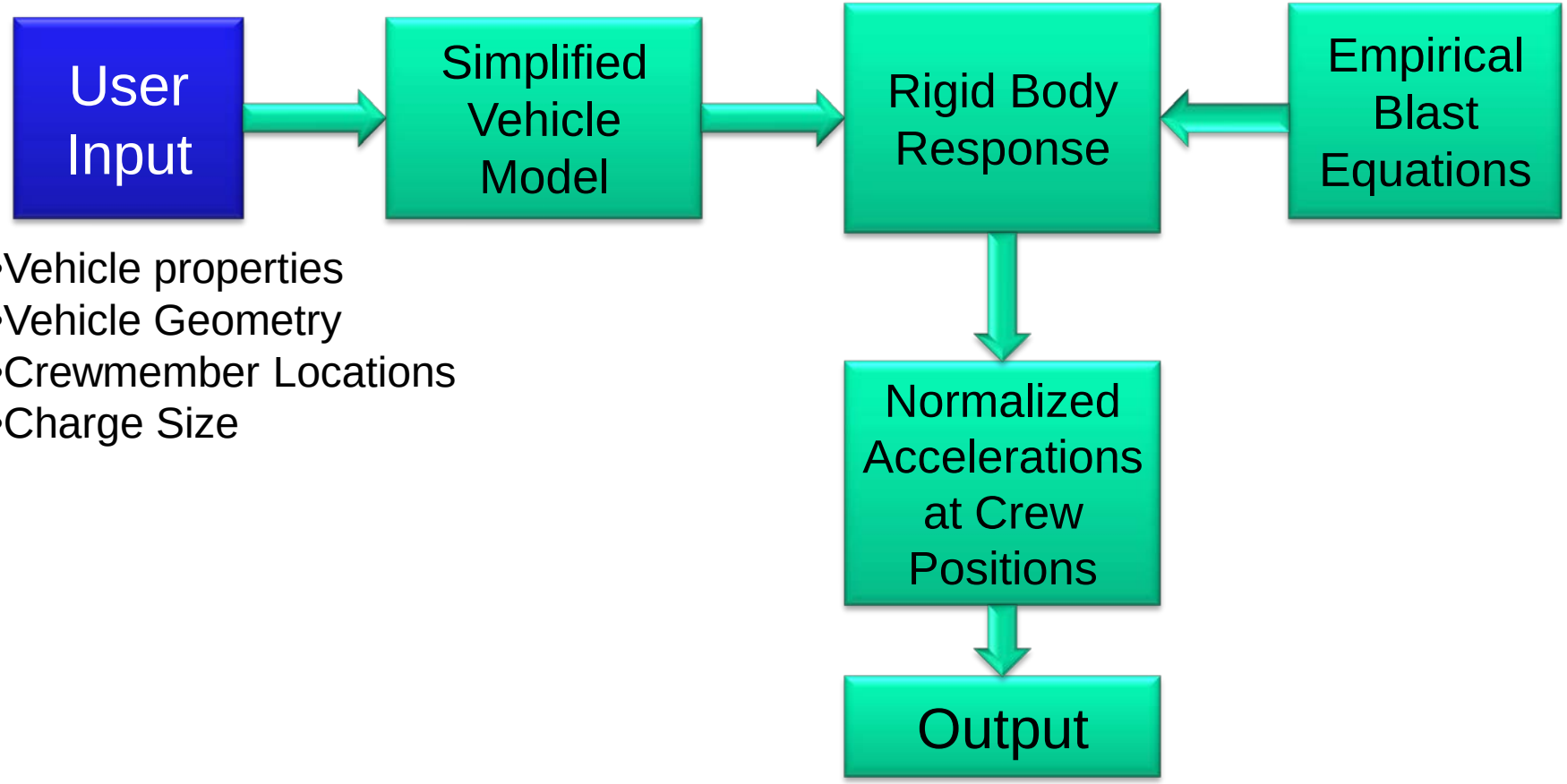
MBAT Methodology



- Vehicle properties
- Vehicle Geometry
- Crewmember Locations
- Charge Size

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User Input

- Vehicle Mass
- Center of Gravity Coordinates
- Moments of Inertia (about each axis)
- Crewmember locations
- Vehicle Geometry
- Charge Size

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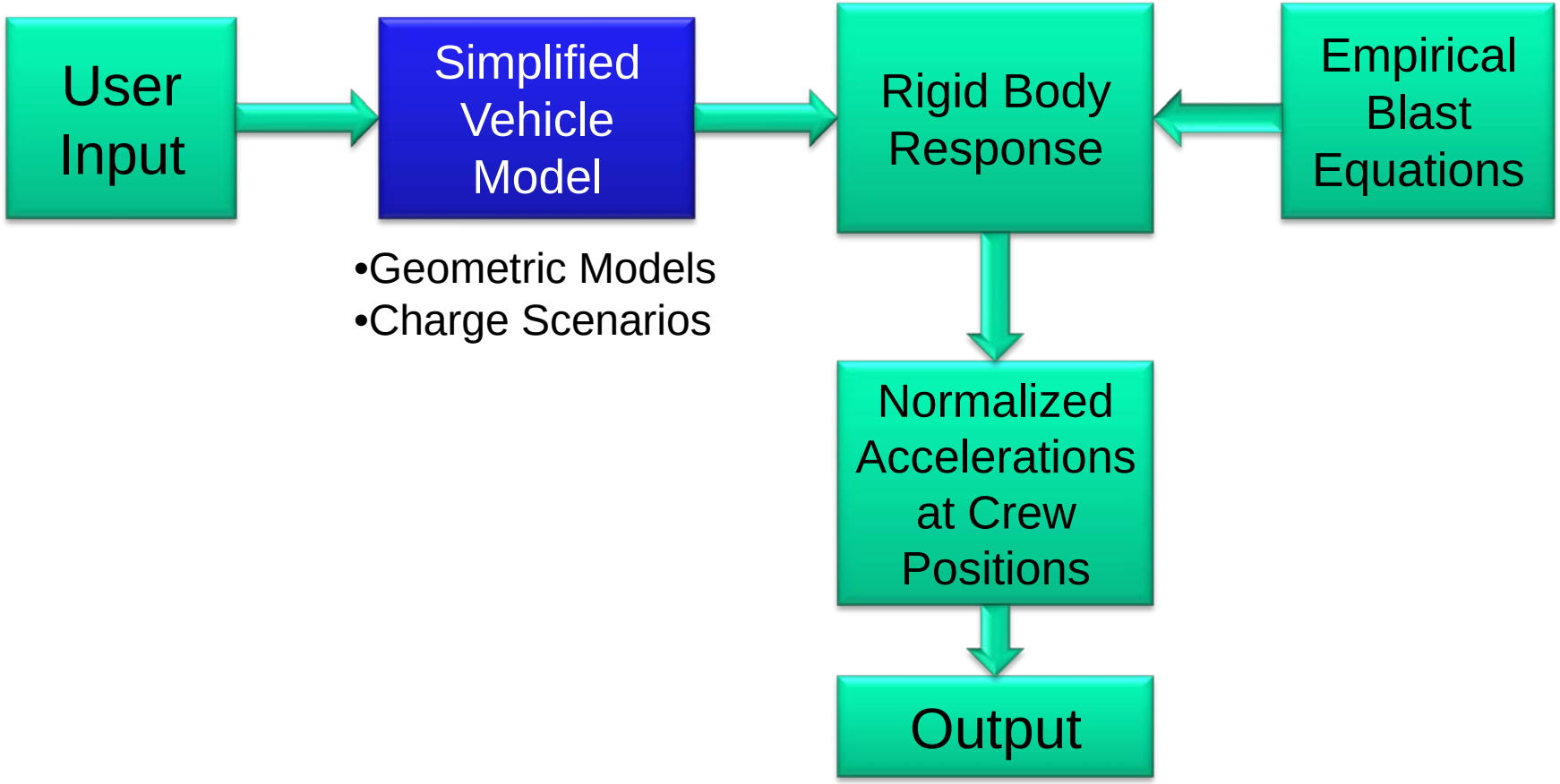
MBAT Methodology



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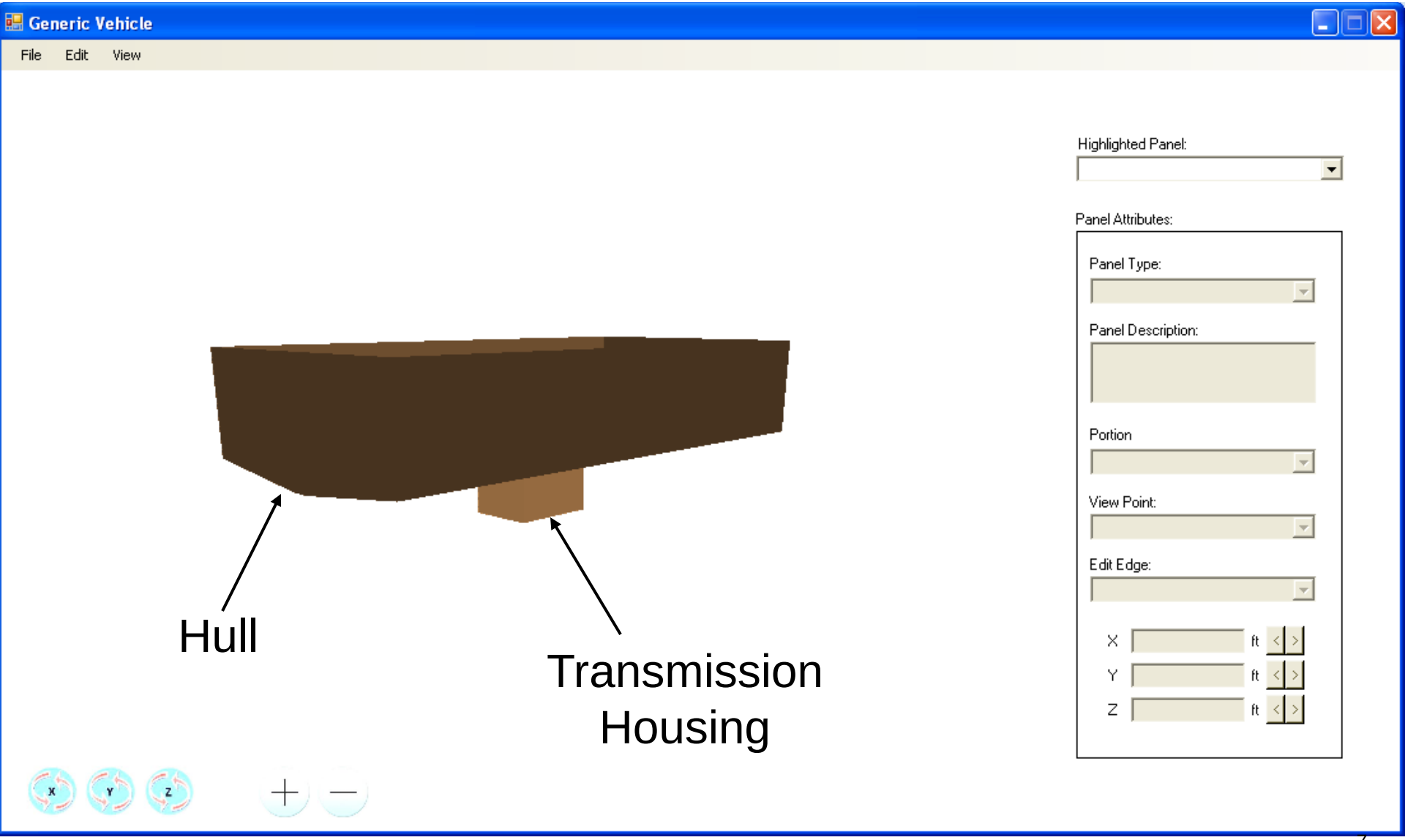
Simplified Vehicle Model



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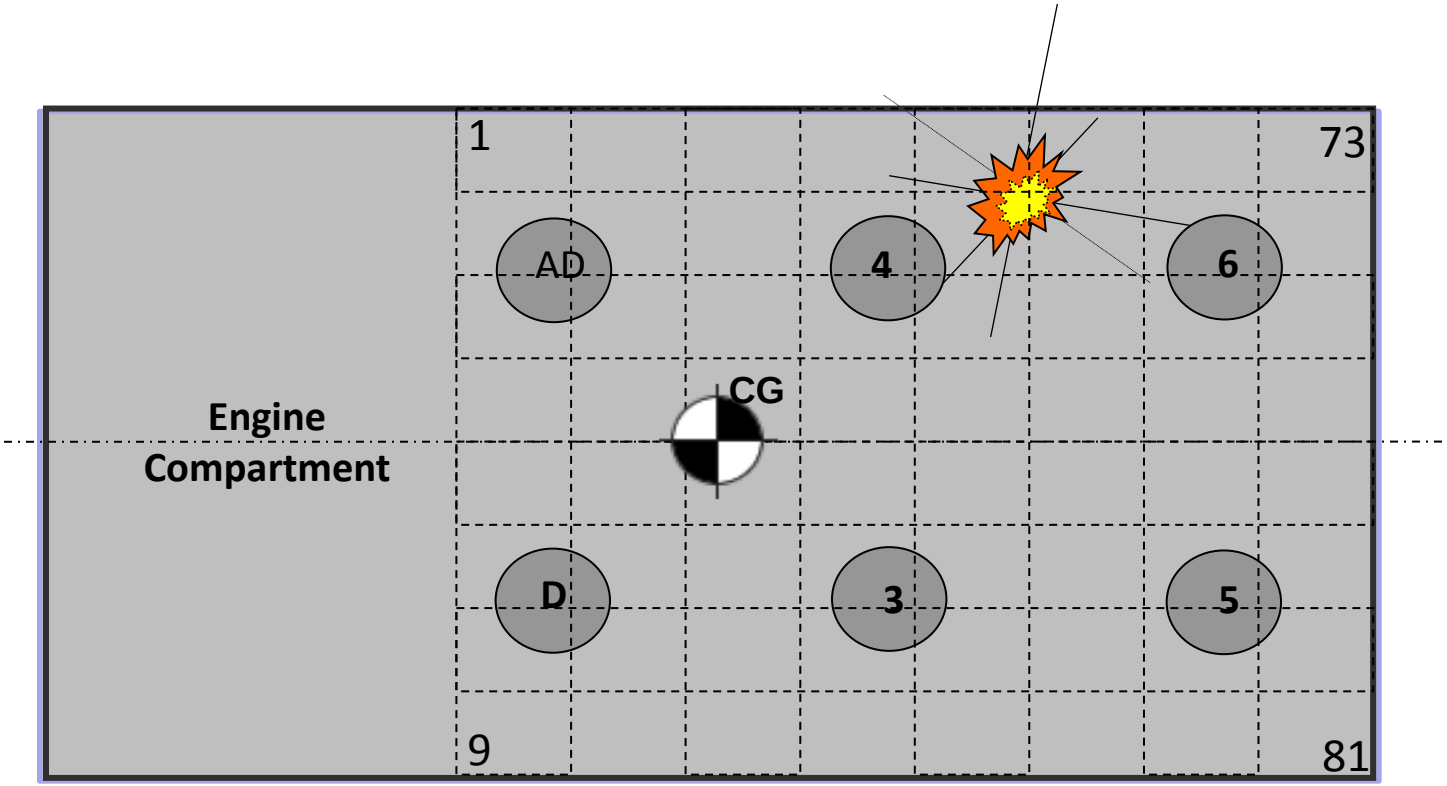
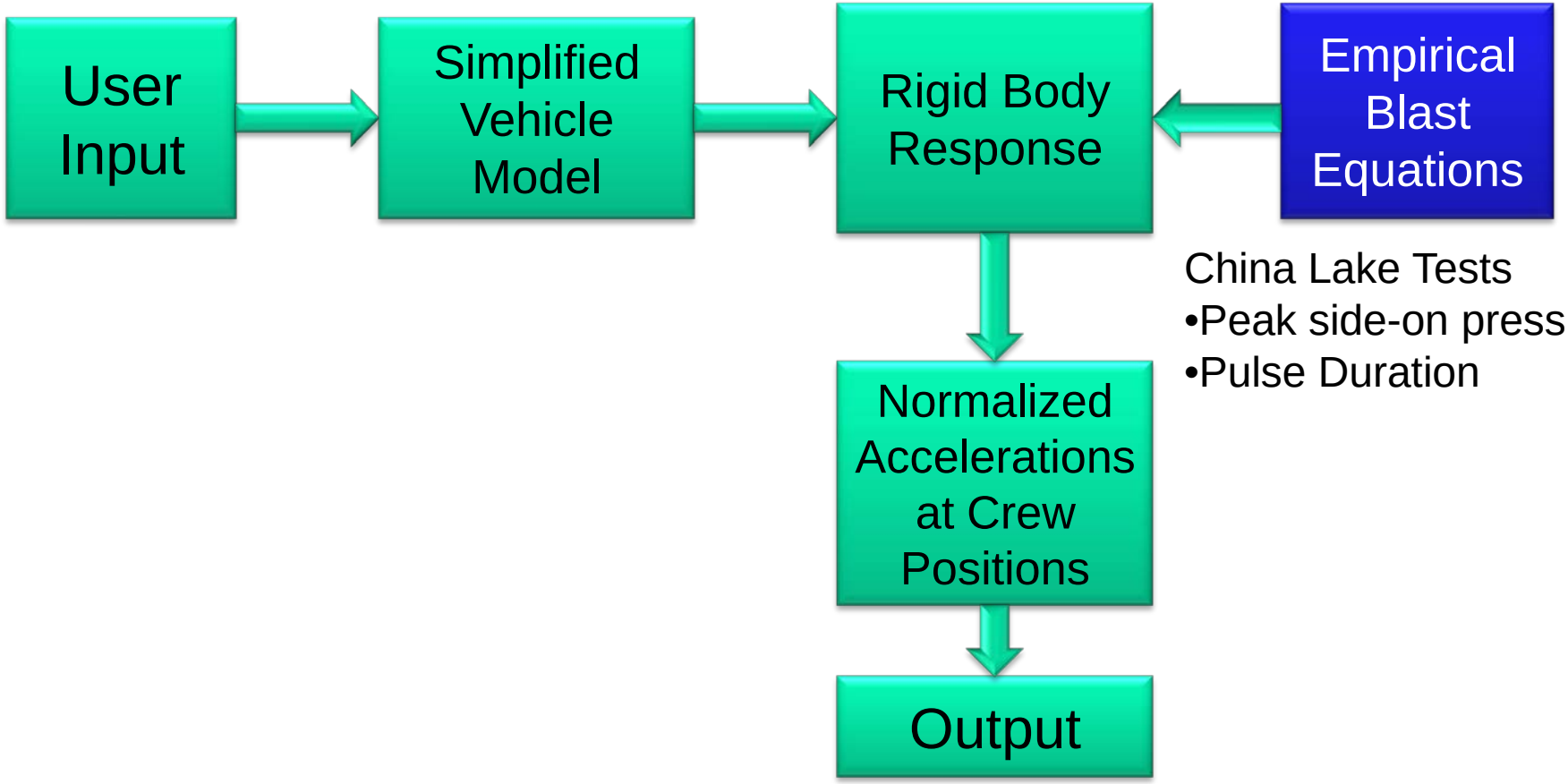
Charge Scenarios



MBAT Methodology



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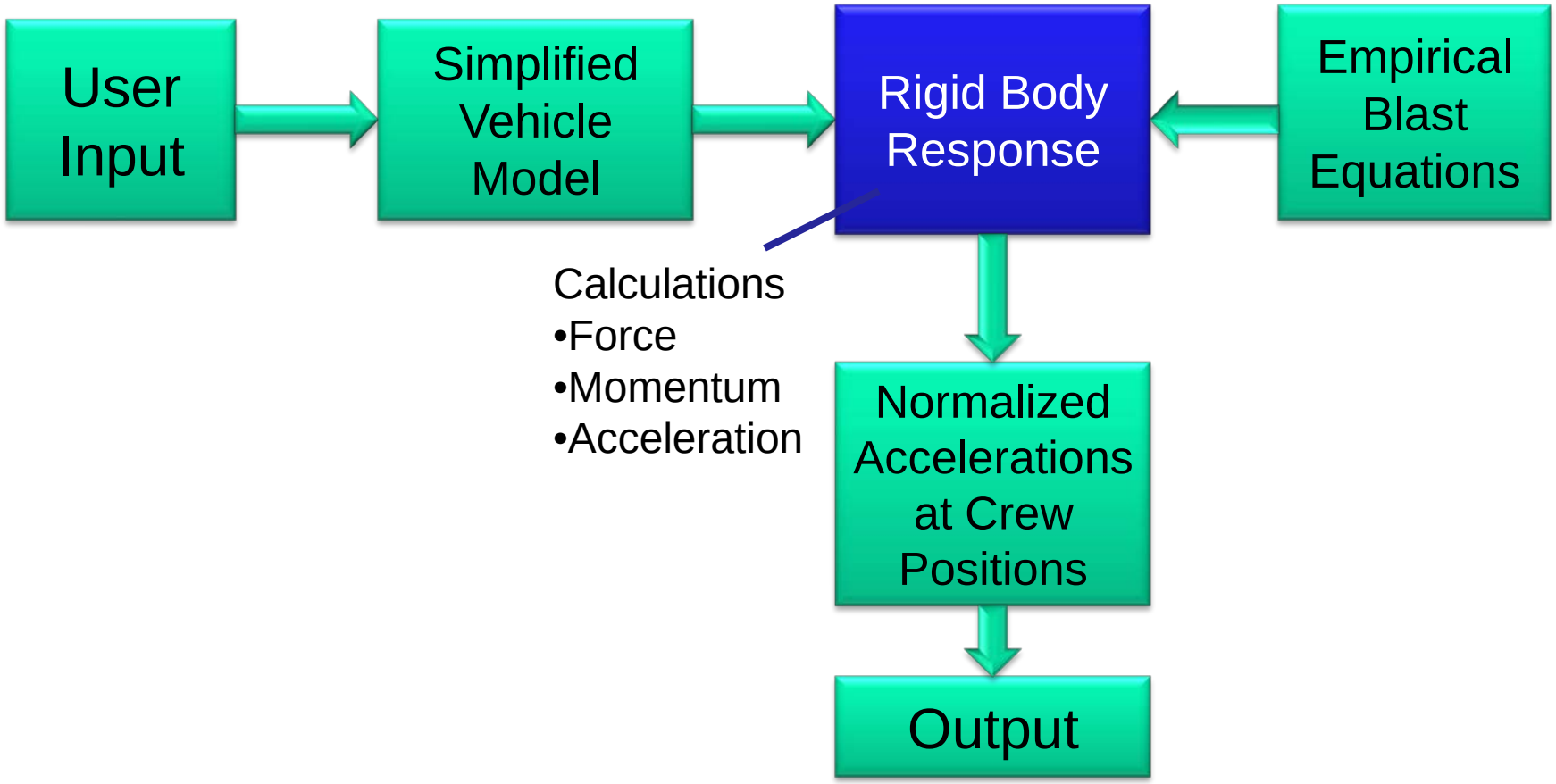
MBAT Methodology



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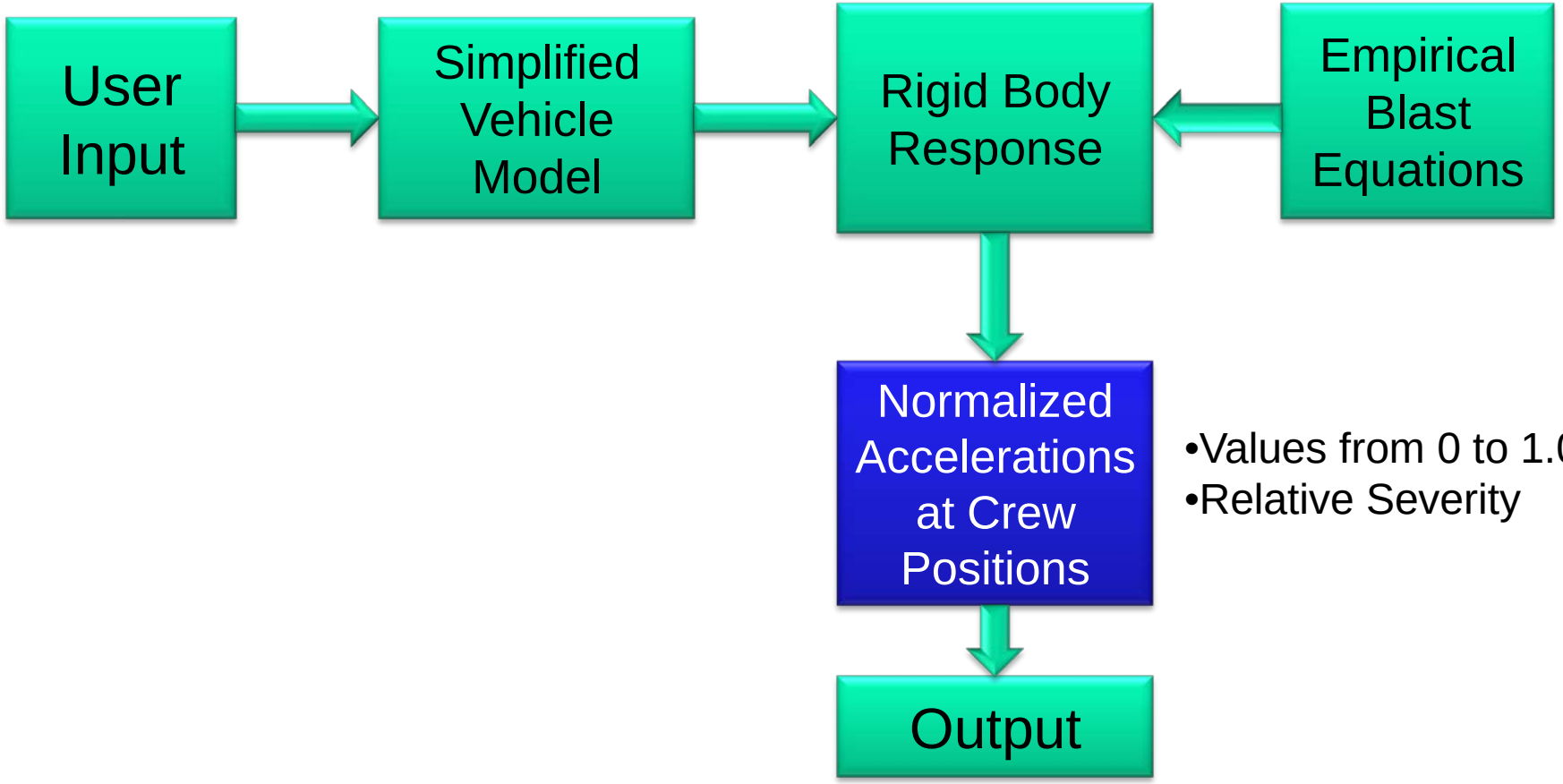
MBAT Methodology



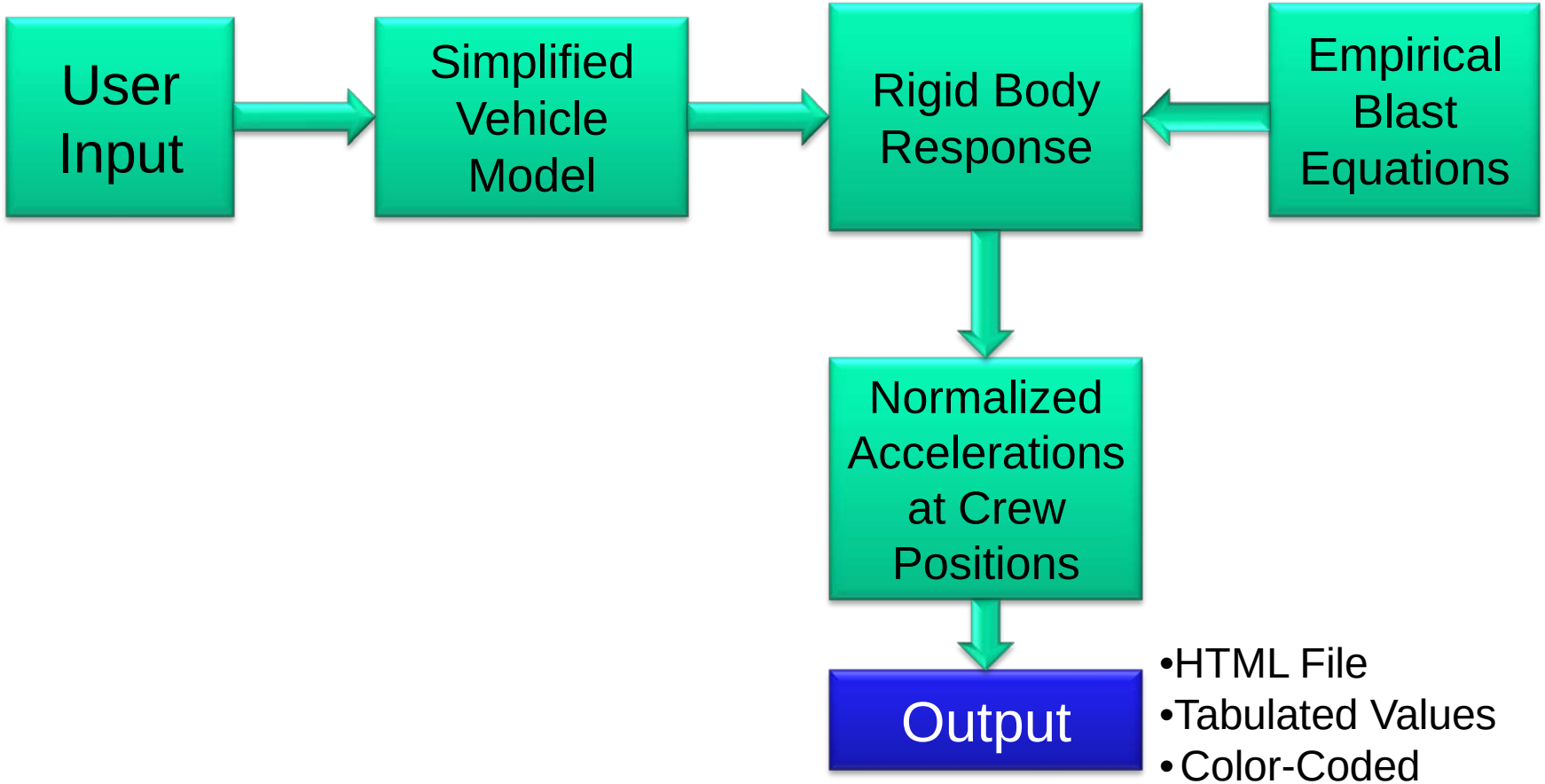
- Values from 0 to 1.0
- Relative Severity

Normalized Vertical Accelerations

$$A_{Norm,N} = \frac{A_{Z,N}}{A_{Z,max}}$$

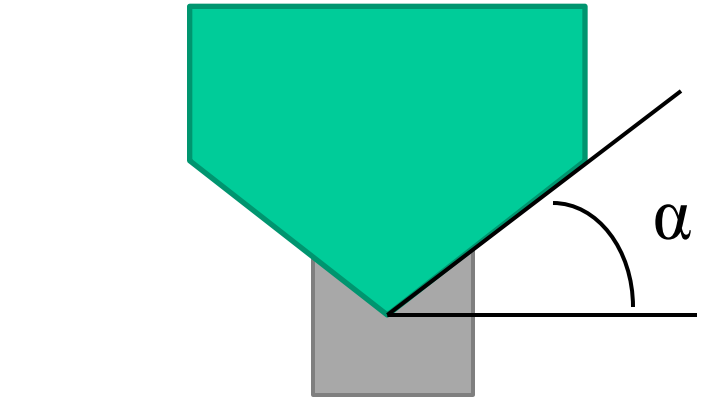
- $A_{Norm,N}$ = Normalized vertical acceleration at a given crew position
- $A_{Z,N}$ = calculated acceleration in g's at the crew position
- $A_{Z,Max}$ = maximum vertical acceleration experienced at any charge or crewmember location

Methodology



Factors Investigated/Capabilities

- Vehicle Geometry
  - Ground Clearance
  - Hull Vee Angle
  - Salients
- Charge Size
- Charge Location



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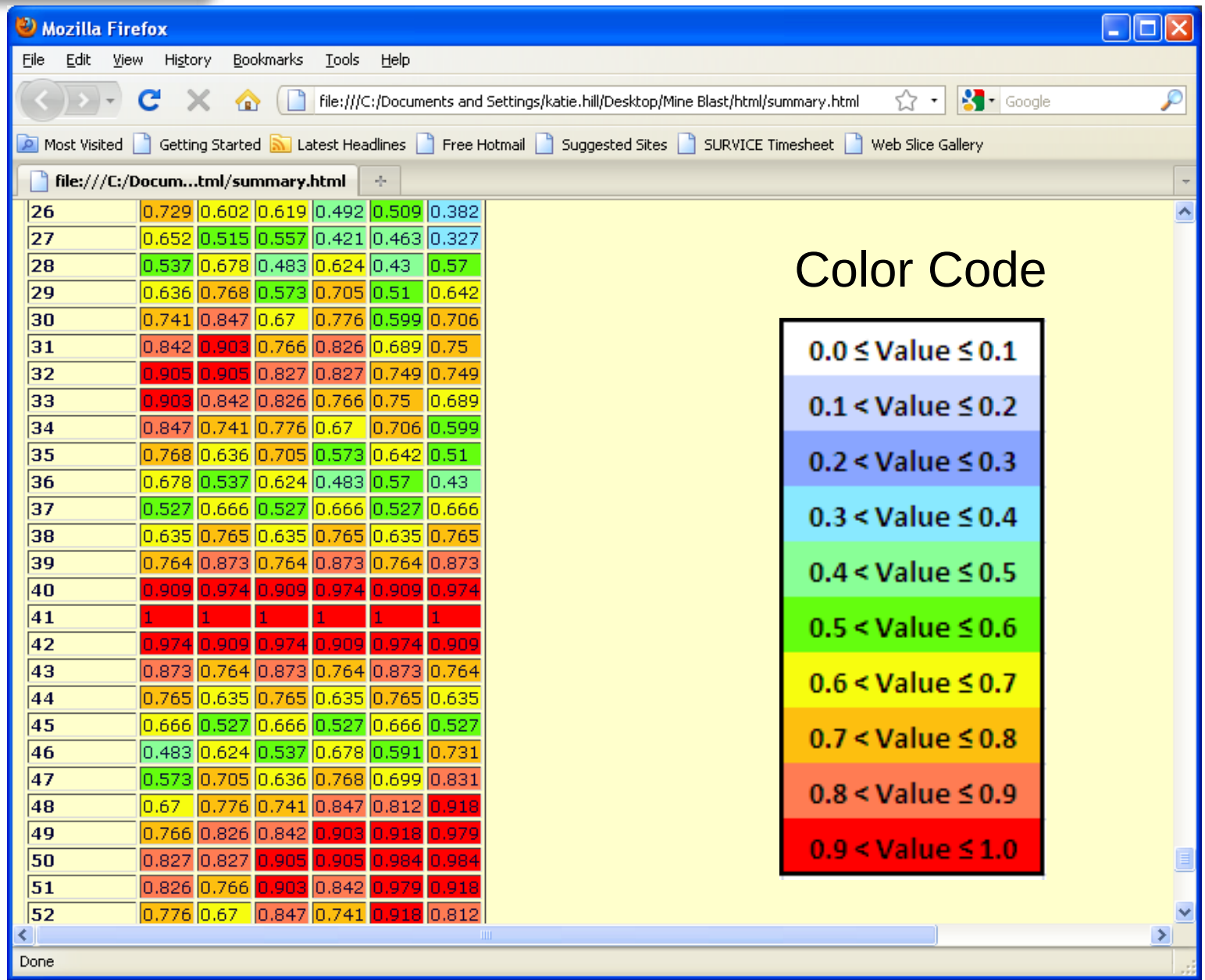
Output



26	0.729	0.602	0.619	0.492	0.509	0.382
27	0.652	0.515	0.557	0.421	0.463	0.327
28	0.537	0.678	0.483	0.624	0.43	0.57
29	0.636	0.768	0.573	0.705	0.51	0.642
30	0.741	0.847	0.67	0.776	0.599	0.706
31	0.842	0.903	0.766	0.826	0.689	0.75
32	0.905	0.905	0.827	0.827	0.749	0.749
33	0.903	0.842	0.826	0.766	0.75	0.689
34	0.847	0.741	0.776	0.67	0.706	0.599
35	0.768	0.636	0.705	0.573	0.642	0.51
36	0.678	0.537	0.624	0.483	0.57	0.43
37	0.527	0.666	0.527	0.666	0.527	0.666
38	0.635	0.765	0.635	0.765	0.635	0.765
39	0.764	0.873	0.764	0.873	0.764	0.873
40	0.909	0.974	0.909	0.974	0.909	0.974
41	1	1	1	1	1	1
42	0.974	0.909	0.974	0.909	0.974	0.909
43	0.873	0.764	0.873	0.764	0.873	0.764
44	0.765	0.635	0.765	0.635	0.765	0.635
45	0.666	0.527	0.666	0.527	0.666	0.527
46	0.483	0.624	0.537	0.678	0.591	0.731
47	0.573	0.705	0.636	0.768	0.699	0.831
48	0.67	0.776	0.741	0.847	0.812	0.918
49	0.766	0.826	0.842	0.903	0.918	0.979
50	0.827	0.827	0.905	0.905	0.984	0.984
51	0.826	0.766	0.903	0.842	0.979	0.918
52	0.776	0.67	0.847	0.741	0.918	0.812

Color Code

0.0 ≤ Value ≤ 0.1
0.1 < Value ≤ 0.2
0.2 < Value ≤ 0.3
0.3 < Value ≤ 0.4
0.4 < Value ≤ 0.5
0.5 < Value ≤ 0.6
0.6 < Value ≤ 0.7
0.7 < Value ≤ 0.8
0.8 < Value ≤ 0.9
0.9 < Value ≤ 1.0

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Capabilities: Charge Location

Mozilla Firefox

File Edit View History Bookmarks Tools Help

file:///C:/Documents and Settings/katie.hill/

Most Visited Getting Started Latest Headlines Free Hotmail Sugge

file:///C:/Docum...tml/summary.html

26	0.729	0.602	0.619	0.492	0.509	0.382
27	0.652	0.515	0.557	0.421	0.463	0.327
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30	0.741	0.847	0.67	0.776	0.599	0.706
31	0.842	0.903	0.766	0.826	0.689	0.75
32	0.905	0.905	0.827	0.827	0.749	0.749
33	0.903	0.842	0.826	0.766	0.75	0.689
34	0.847	0.741	0.776	0.67	0.706	0.599
35	0.768	0.636	0.705	0.573	0.642	0.51
36	0.678	0.537	0.624	0.483	0.57	0.43
37	0.527	0.666	0.527	0.666	0.527	0.666
38	0.635	0.765	0.635	0.765	0.635	0.765
39	0.764	0.873	0.764	0.873	0.764	0.873
40	0.909	0.974	0.909	0.974	0.909	0.974
41	1	1	1	1	1	1
42	0.974	0.909	0.974	0.909	0.974	0.909
43	0.873	0.764	0.873	0.764	0.873	0.764
44	0.765	0.635	0.765	0.635	0.765	0.635
45	0.666	0.527	0.666	0.527	0.666	0.527
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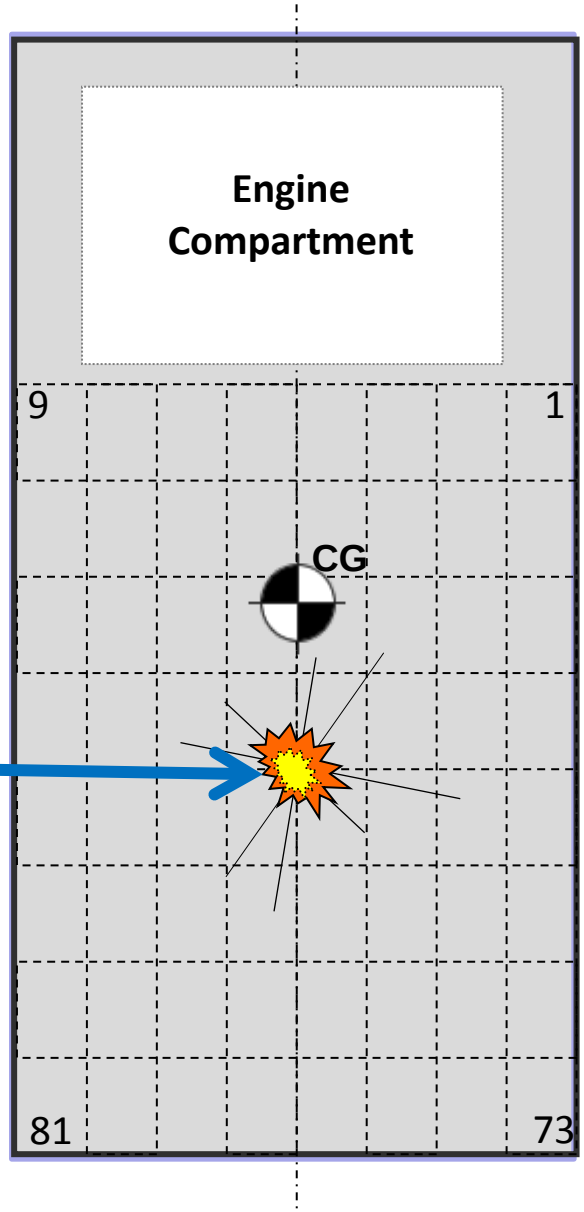
51	0.826	0.766	0.903	0.842	0.979	0.918
52	0.776	0.67	0.847	0.741	0.918	0.812

Done



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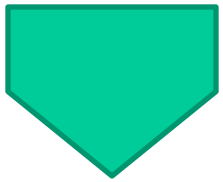
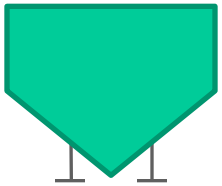
Capabilities: Salients

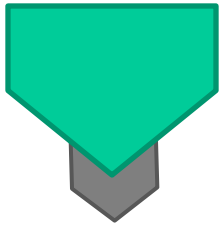
Smooth Hull



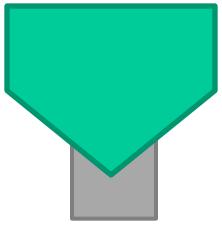
Frame Rails

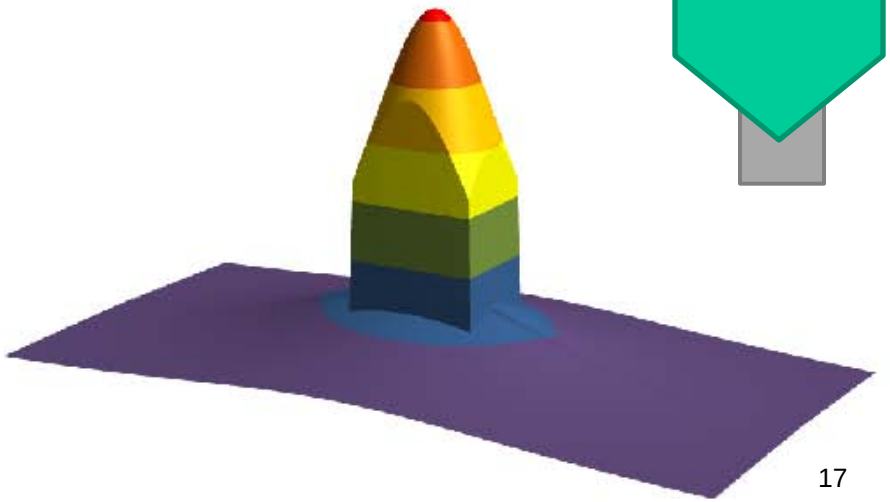


Vee-Bottomed Transmission Housing



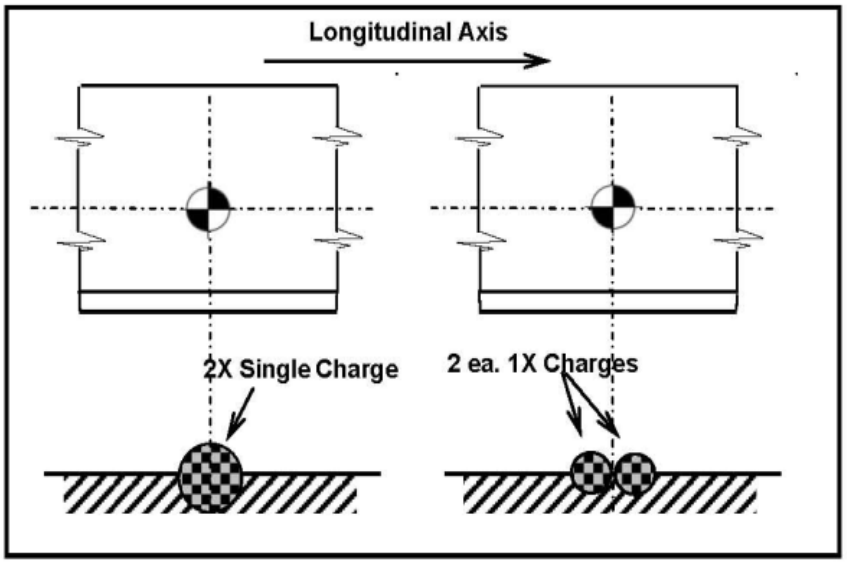
Flat-Bottomed Transmission Housing

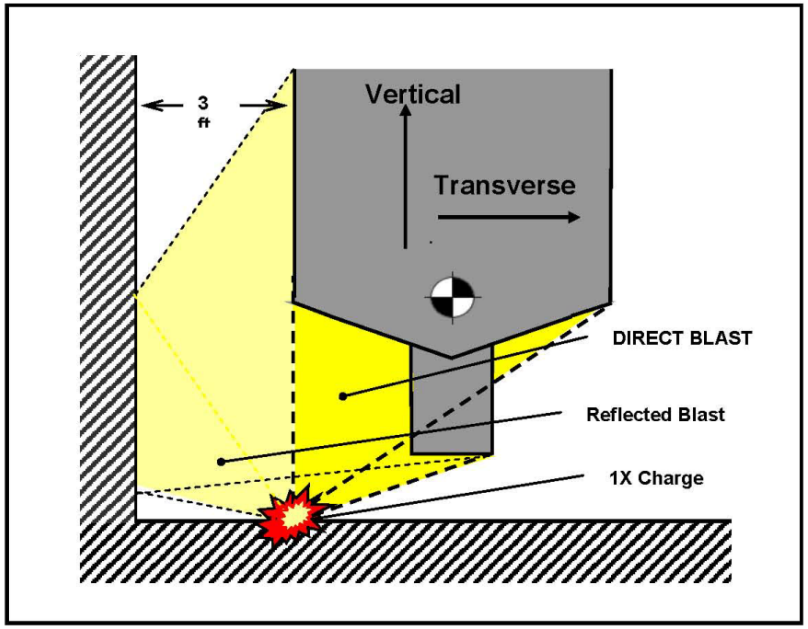




Future Capabilities

- Multiple charges
- Overturning of the vehicle
- Adjacent walls
- Dynamic Response





Questions?