



Dynamics Modeling of the Vertical Impulse Measurement Fixture [VIMF]

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VIMF Project

- **Goal:**
 - Measure the vertical displacement of a rigid body subjected to loads from buried mine detonation.
 - Allows engineers and scientists to characterize the impulse generated by a buried land mine on rigid bodies
 - With that, engineers can design better armored vehicles
- **Creation:**
 - Construction started FY '98 and completed FY '03



- **Concerns:**
 - Damage to test facility
 - Accuracy

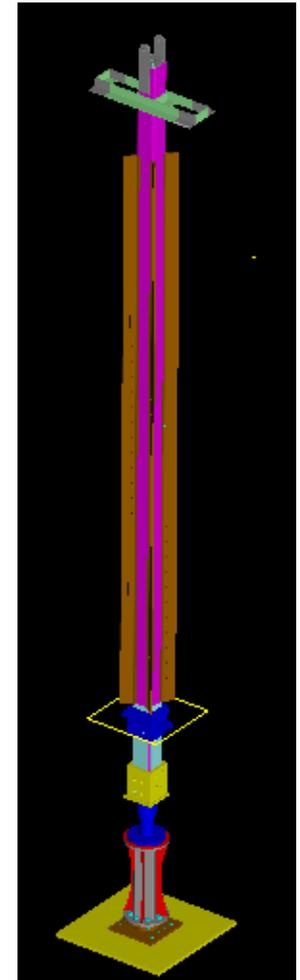
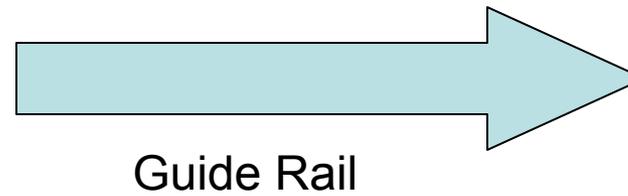
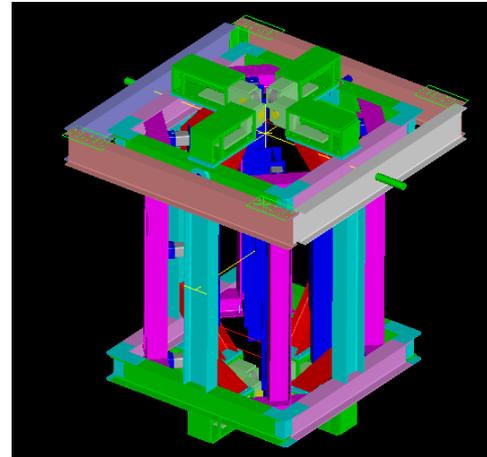
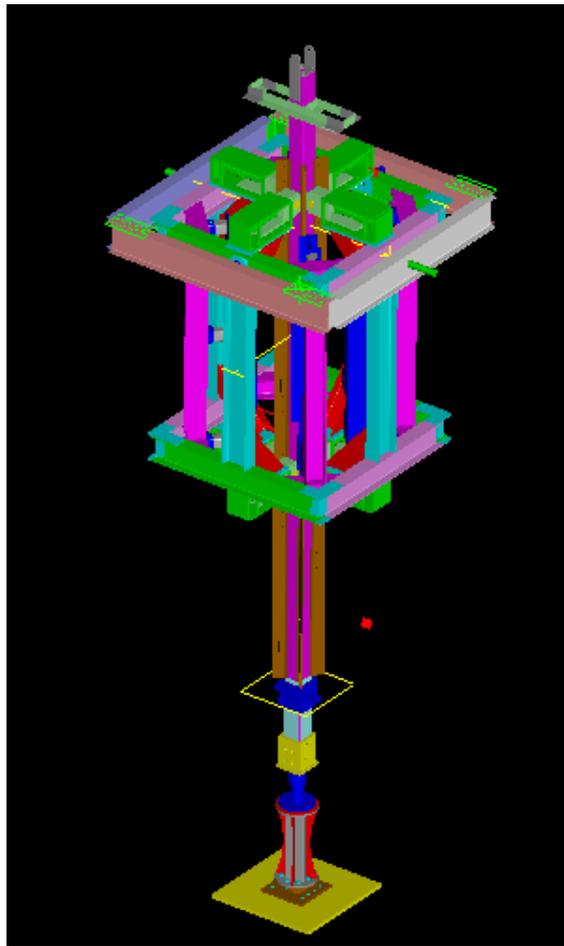


Why Simulate?

- A computer model of the VIMF will allow simulations to test the test facility under specific loads
- The simulation can predict the movement of the fixture and estimate stresses the fixture experiences
- Theoretical results from the simulation can help indicate the possibility of a problem with a test.



Main Assemblies

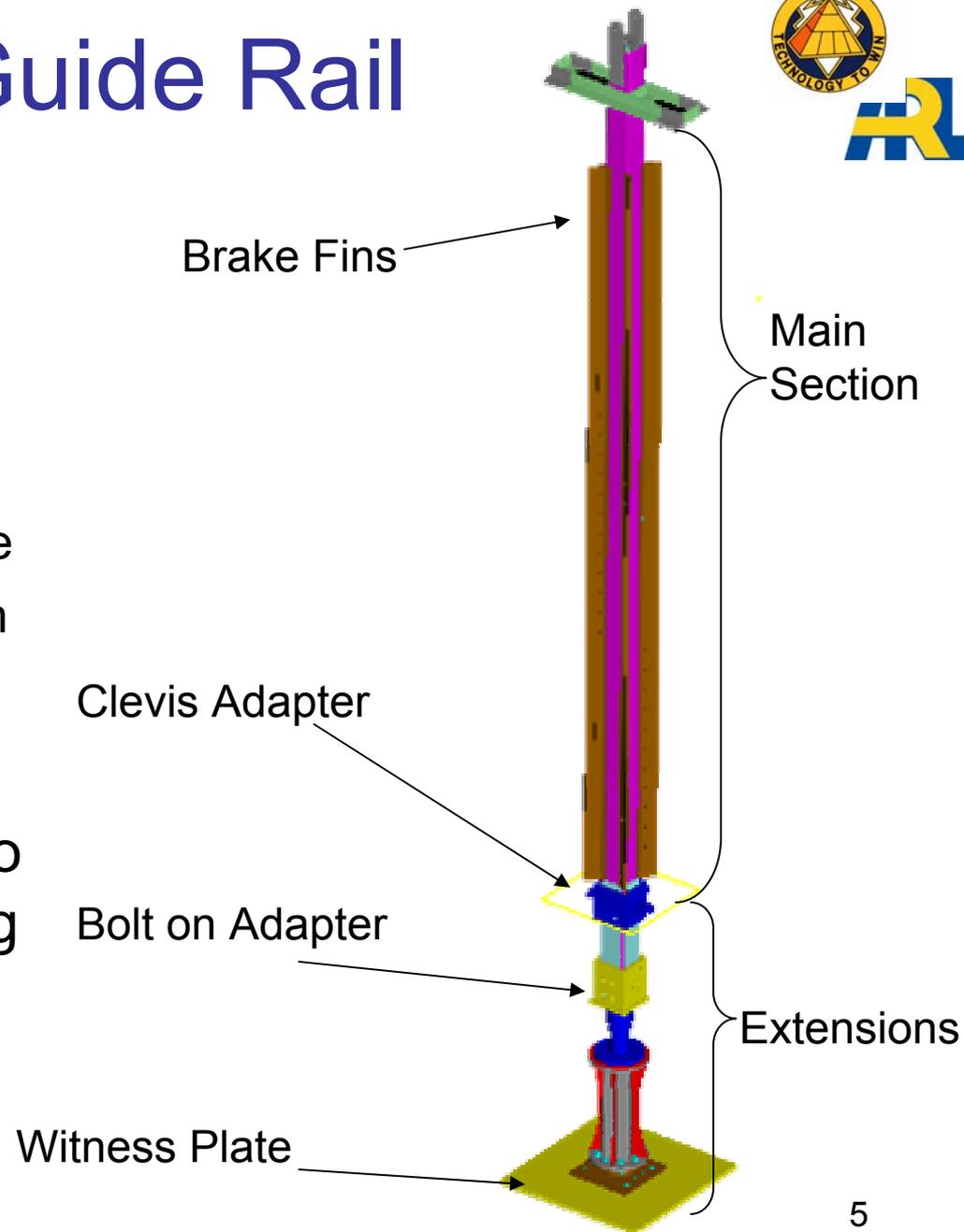




The Guide Rail



- 40 feet of 12x12 in Square Tube
 - Supported internally by a 10" Ø Double Strong Pipe
 - Filled with Syntactic Foam
- Extended 7 feet with an assortment of tubing
- Witness plate attached to bottom to receive loading from mine blast





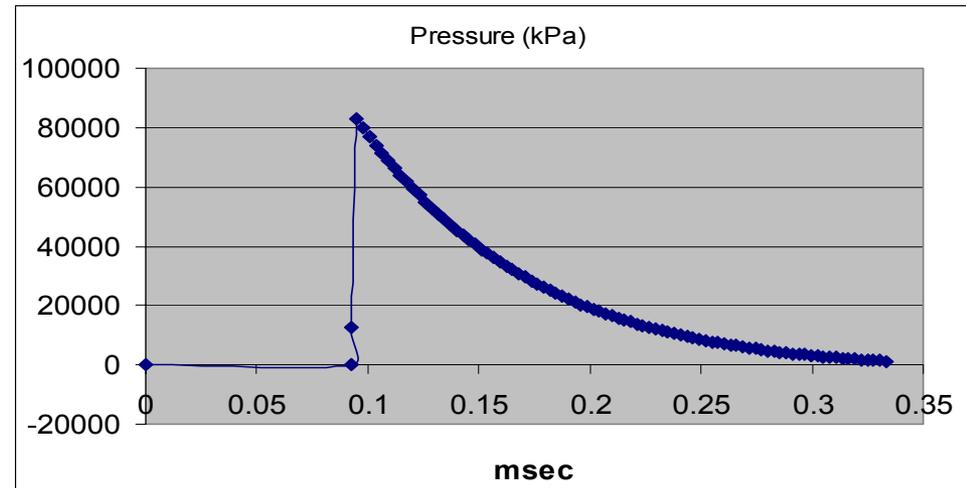
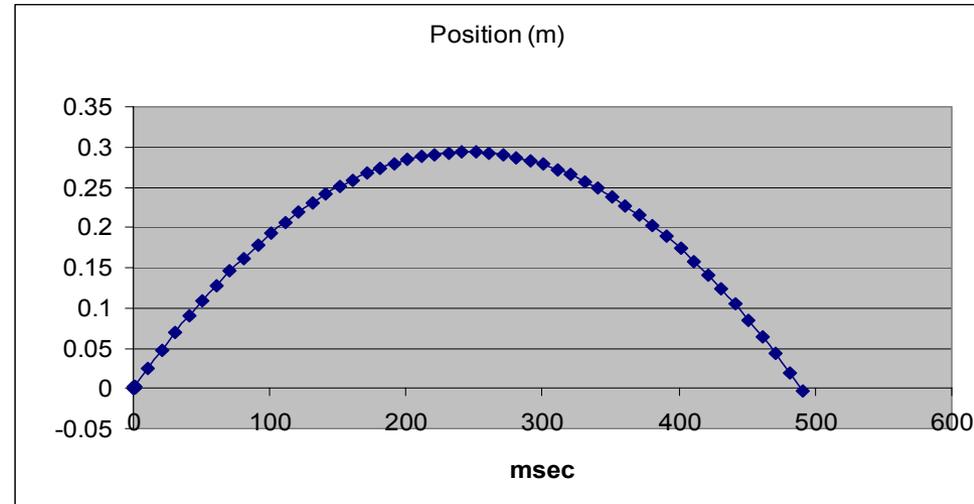
Guide Rail Weight Calculations

Part	Sub Parts	Geometry	Dimensions Verified	Material	Volume in ³	Density lb / in ³	Weight (lb)
Main Tube		12x12x1/2	from steel manual	Square Pipe	10672.1	0.284	3026
10" Tube		10"x .75"	"		7657.1	0.284	2171
Inner Tubing			"		636.6	0.284	181
4ft Guiderail Extension					3156.8	0.284	895
Stub Collar			On Site		1944.0	0.284	551
Bolt On Adapters					6168.0	0.284	1749
Hoist Clevis	2x plates	40 mm THK		RHA	635.1	0.284	180
Cam Plates	4x plates	1/2 in		Mild steel	1063.6	0.284	302
Guide Rail Caps	2x plates	1 in		Mild Steel	236.1	0.284	67
Syntactic Foam					45194.9	0.025	1151
Guide Rail Stop		L 6x6x3/4	On Site		1591.5	0.284	451
Break Fins			On Site		13020.8	0.284	3692
Witness Plate			On Site		14623.5	0.284	4147
Washer					382.0	0.284	108
Accepted Value:	18600				Total Weight (lb) :		18671
Error	71.5						
% Error	0.38%						



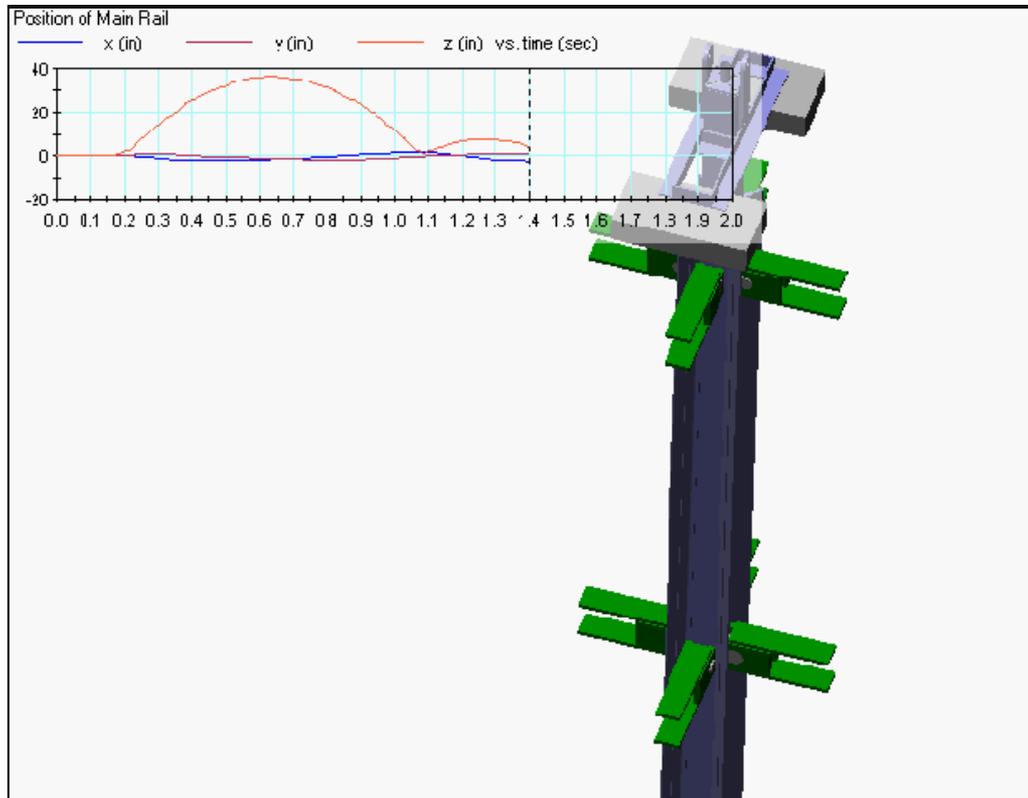
Flight Calculations

- Vertical flight based on pressure time history from Conwep
- Computer model produced similar results





Simulations

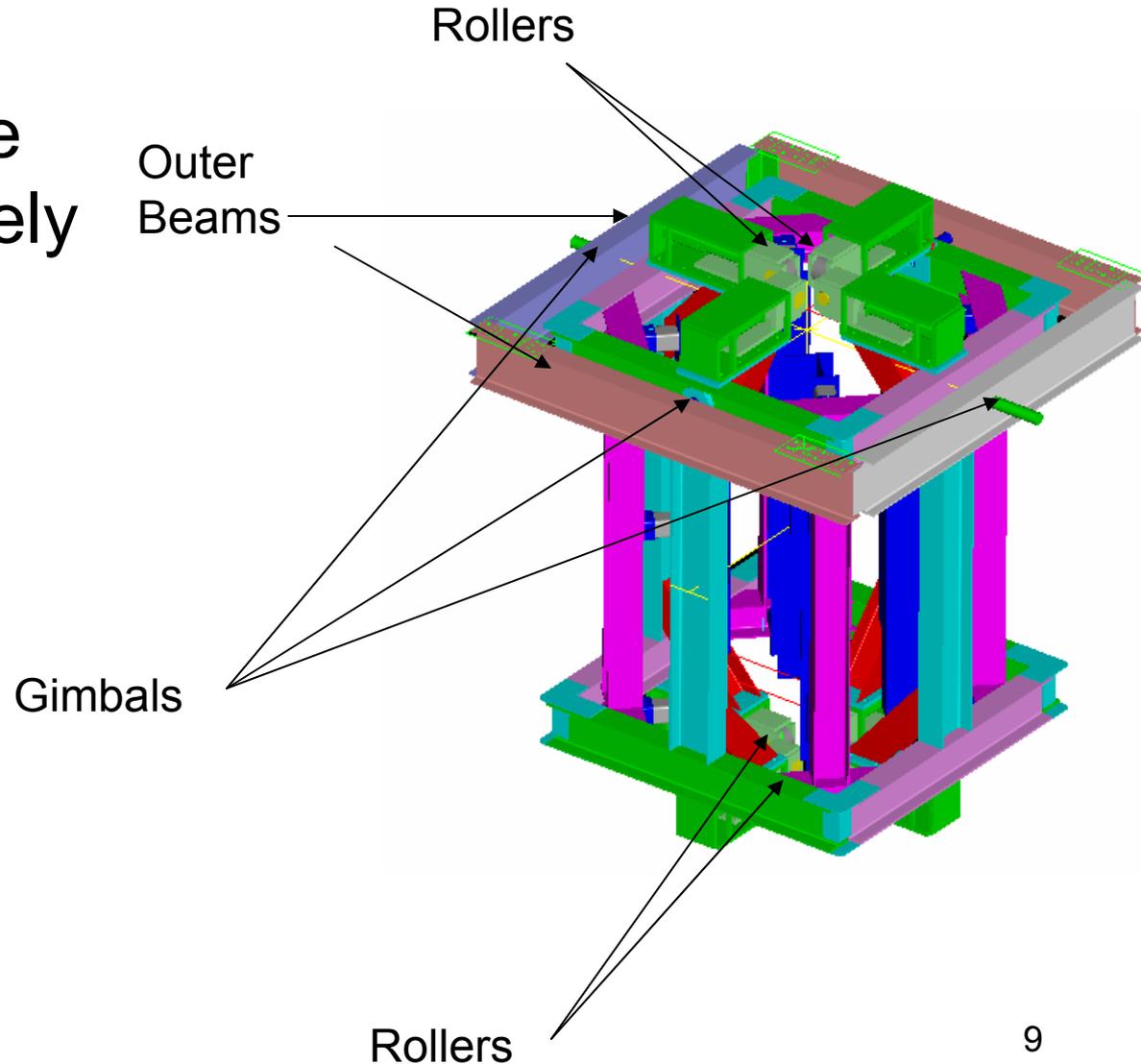


- CAD models of the Guide Rail were imported into Visual Nastran 4D for simulations
- First simulations only accounted for vertical motion.
- Spring mounts were added to limit horizontal movement and rotation



Guidance Housing

- Allows the Guide Rail to move freely up and down
- Constrains the Guide Rail's rotation about gimbals





Guidance Housing Weight Calculations

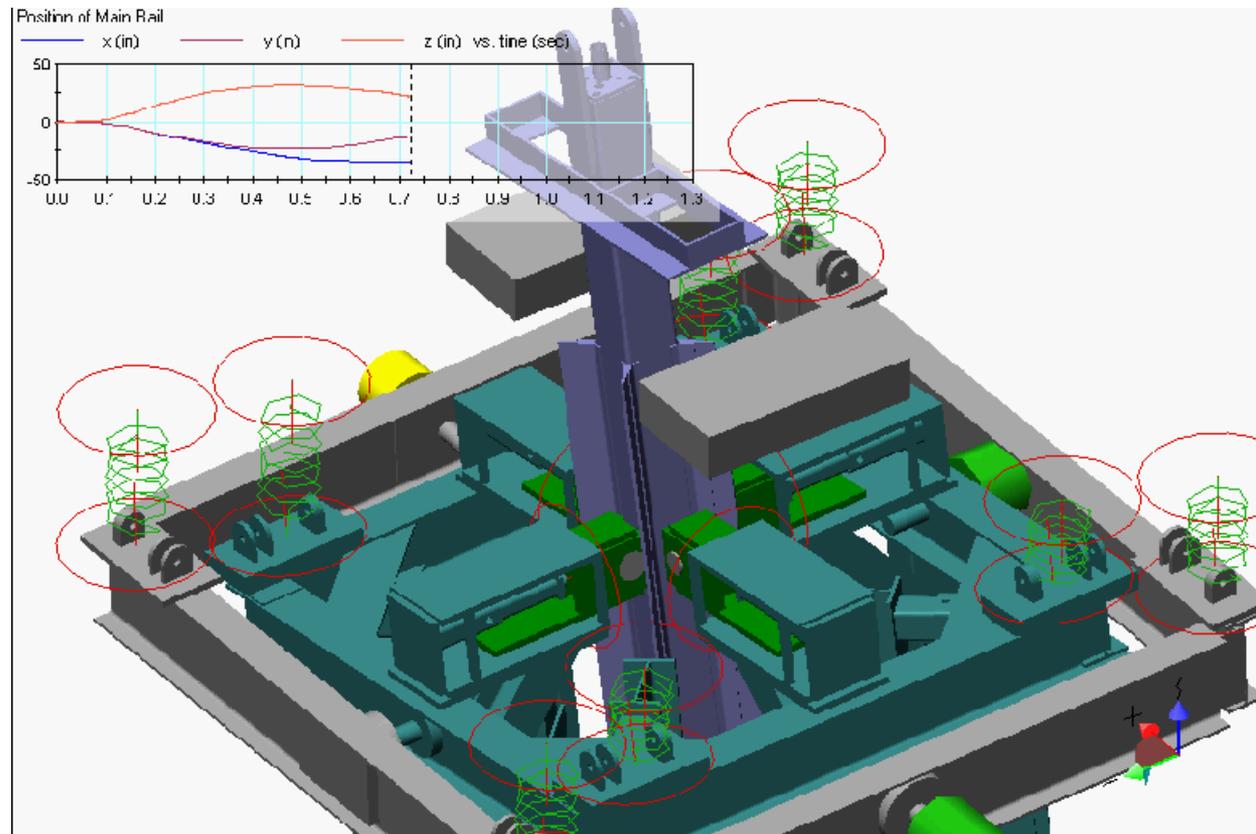
Part	Geometry	Dimensions Verified	Volume (in ³)	Density (lb / in ³)	Weight (lb)
Vertical Beams	W16x89 x 132"	On Site	13949.5	0.284	3956
Brake mount Beams - added	W12x72 x 136.5	On Site	11603.3	0.284	3290
Top Box Beams			18362.6	0.284	5207
Brake Mount Assemblies			25735.6	0.284	7298
Bottom Box Beams			17578.5	0.284	4985
Roller Mounts			16747.7	0.284	4749
Roller Assemblies			43365.7	0.284	12297
			Total Weight (lb) :		41781



Simulations with the Guidance Housing



- Guide rail moves as constrained by the Guidance Housing
- Realistic movement
- Off center loads can now be tested.





Any Questions?