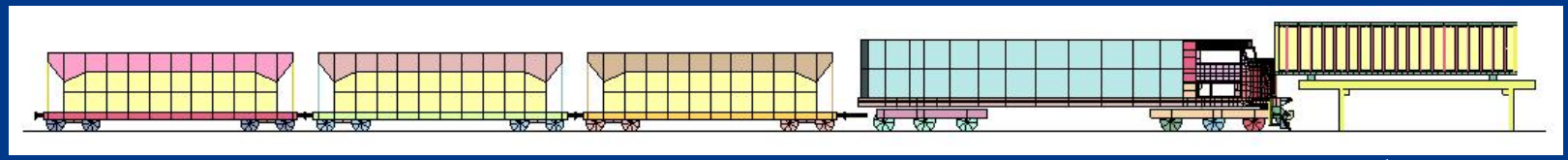
Locomotive Collision Test #9

Freight Locomotive With a Strengthened Windshield Frame Impacting a High/Offset Intermodal Container

Test #9: Set-Up



3 loaded Hopper cars

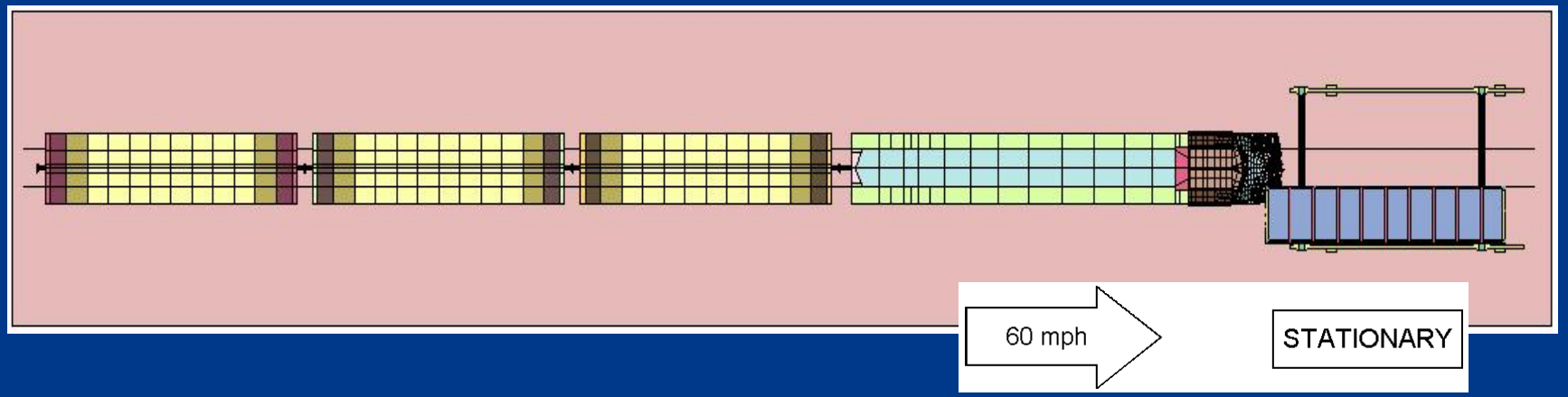
Test Locomotive (SD-45, front end converted to SD-70)

Supported offset Container

Collision Speed - 60 mph

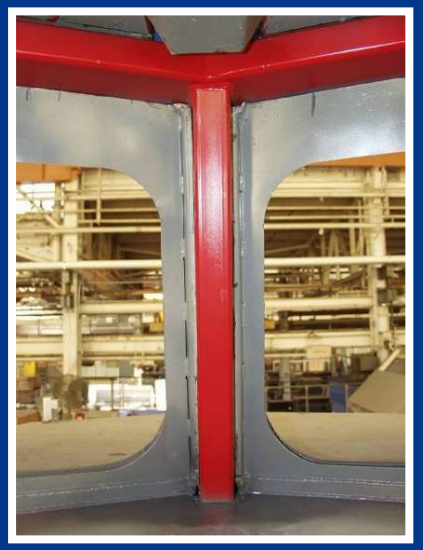
Bullet Consist

Target Container

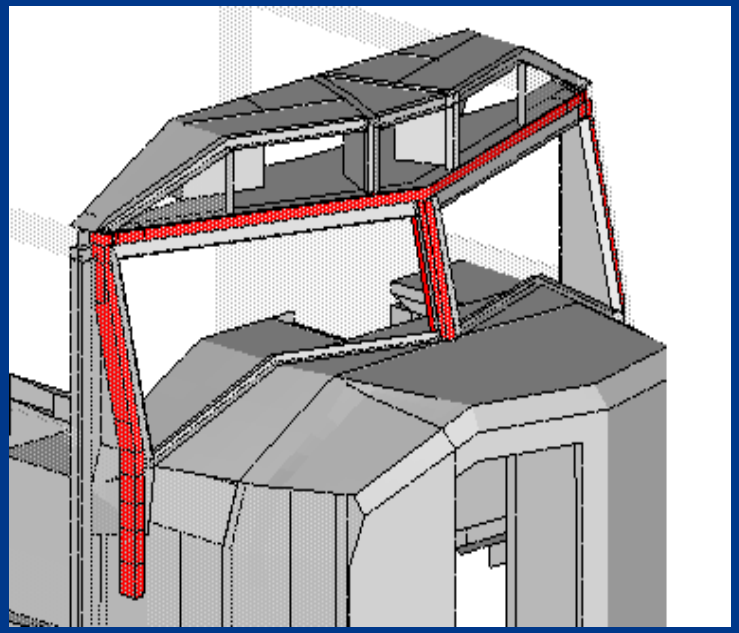


Test # 9: Cab Strengthening - Basic Approach

- Intended to demonstrate potential strengthening approach for the exposed upper cab and windshield area
- Surround upper windshield, connect to primary cab structure, and fit into cab wall and windshield post spaces
  - Windshield center and corner posts
  - Strong connections at base of posts and tube junctions to existing primary cab structure
- Principal objectives:
  - Preserve the original windshield and windshield post layout
  - Retain all outer skin, windshield frame, roof and side window structure
  - No significant intrusion on in-cab visibility or space
  - Moderate cost, both for new construction and retrofit
  - Only minor modifications required to accommodate added structure
  - Generous tolerances to accommodate normal cab fabrication variations
- Potential retrofit application

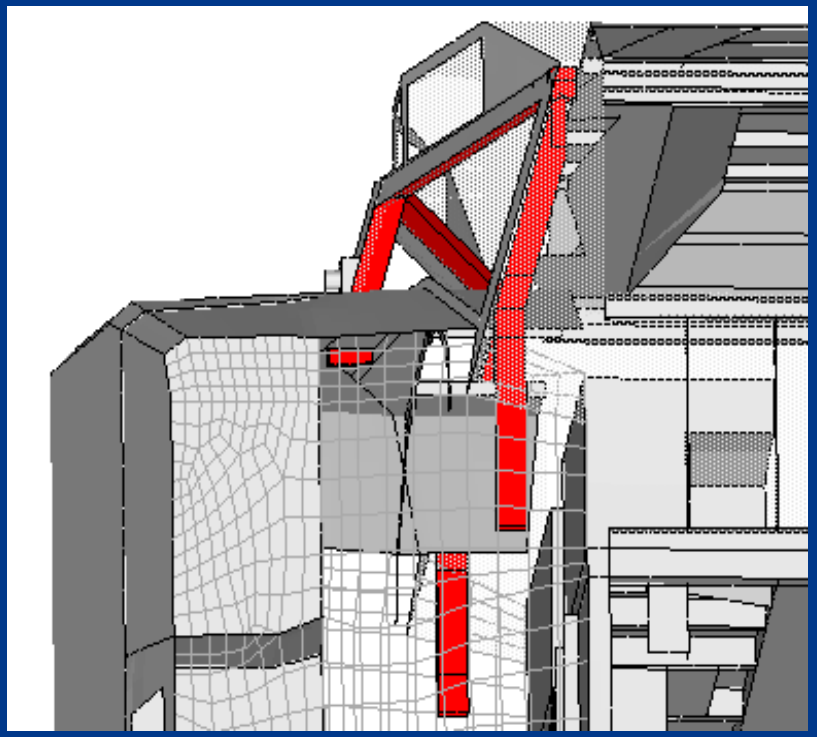


Test #9: CAD Layout of Cab Strengthening



Welded structural tube frame fitted into windshield posts and top

Utilize aft support strength of existing members atop and in front of side window



Test #9: Pre-Test Photos

Strengthened Cab

Test #9: Post Test Photos

- Corner post and windshield frame remained intact
- Minor hood corner damage from initial container contact

- Minor damage to cabin roof or side but w/minimal interior volume reduction

Comparison of Strengthened vs. Original Cab

Test #9 – Strengthened Cab

- No significant roof or corner post failure; primarily outer roof skin and side wall deformations
- Inner added structure preserved cab volume (no intrusion)
- Corner post-windshield-roof connections intact

Test #6 – Unstrengthened Cab

- Collapse and tear of roof and corner post in impact zone
- Substantial cab volume reduction
- Container corner intrusion to crew compartment
- Inward side wall intrusion

Test #9: Outcome

- Cab modifications improve crew compartment structural integrity
- Strengthened Cab design showed:
  - No significant roof or corner post failure; primarily outer roof skin and side wall deformations
  - Inner added structure preserved cab volume (no intrusion)
  - Corner post-windshield-roof connections intact