

Steel Processing Properties and their Effect on Impact Deformation of Lightweight Structures

Srdan Simunovic
Oak Ridge National Laboratory

July 11, 2000
Southfield, MI

www-cms.ornl.gov

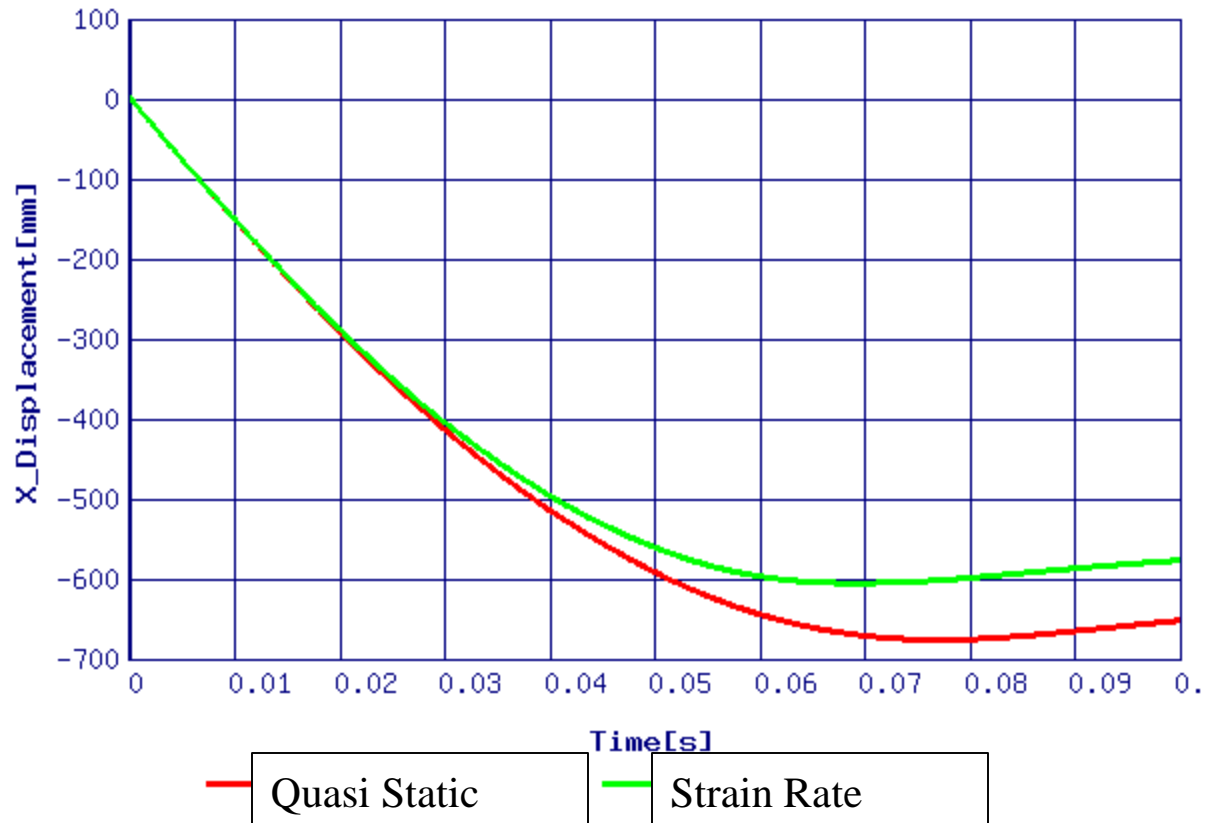
Activities Since Last Quarterly Report

- Material Forming Simulations for ULSAB Front Crash Parts
 - Replaced thickness increases in formed part with original value
 - Results are practically the same as for the previous version
 - Performed literature survey
- Data Analysis
 - Added displacements at control points to the Graph Server
 - Analyzed results
- IBEC Papers
 - First draft on Crash Compatibility is available, end date 7/21/00
 - First draft on Forming and Strain Rate Sensitivity
 - first draft 7/17/00, end date 7/21/00

New Developments

- Modeling of material strain rate sensitivity and forming influences vehicle displacements to quantitatively appreciable levels
- The effect can be seen at different characteristic nodal locations
- Displacement information has been combined with cross section data to quantify crush effectiveness and stability in vehicle crush members

Nodal Displacements in Vehicle Center

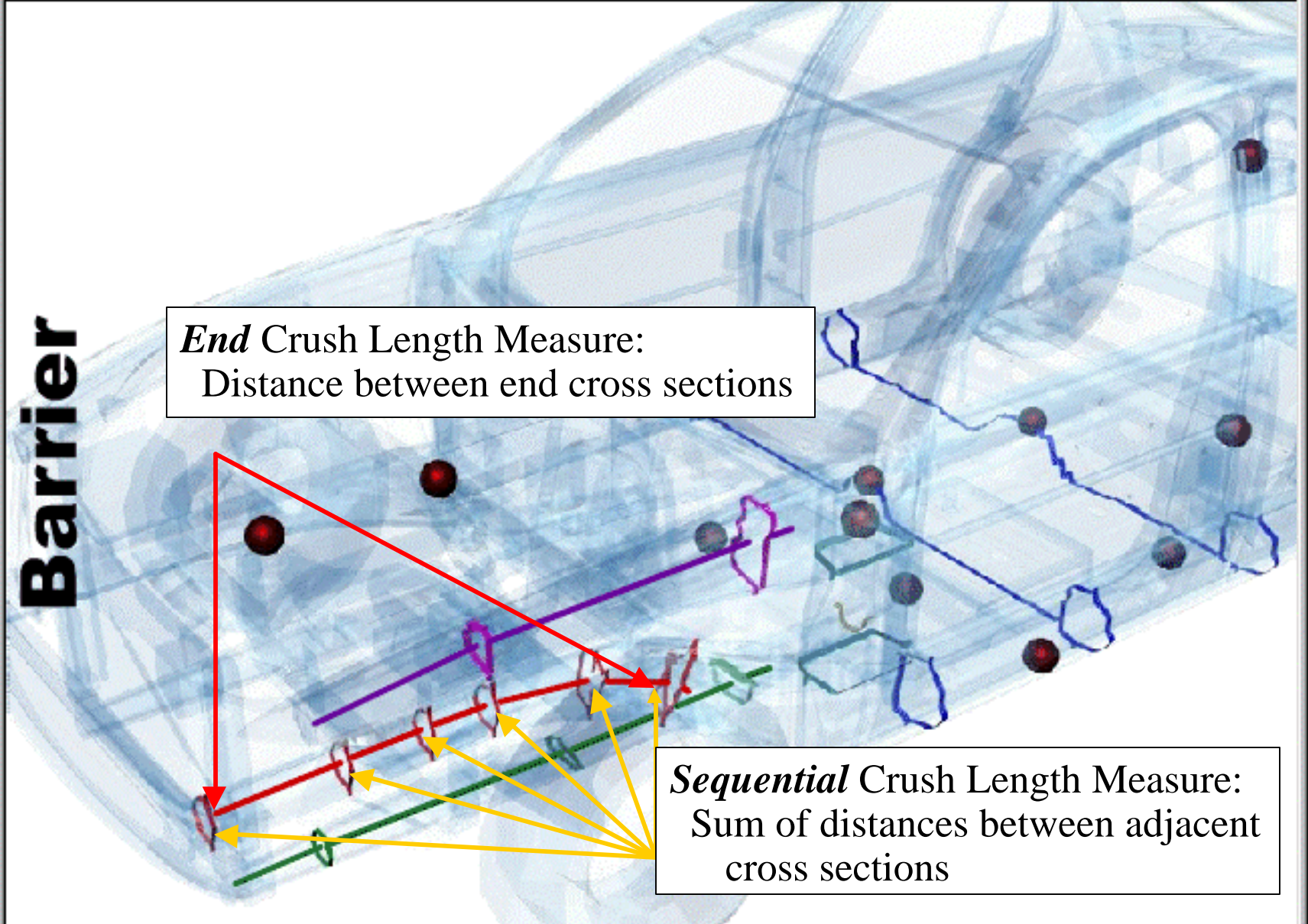


Strain rate sensitivity reduces overall displacement and time to zero velocity

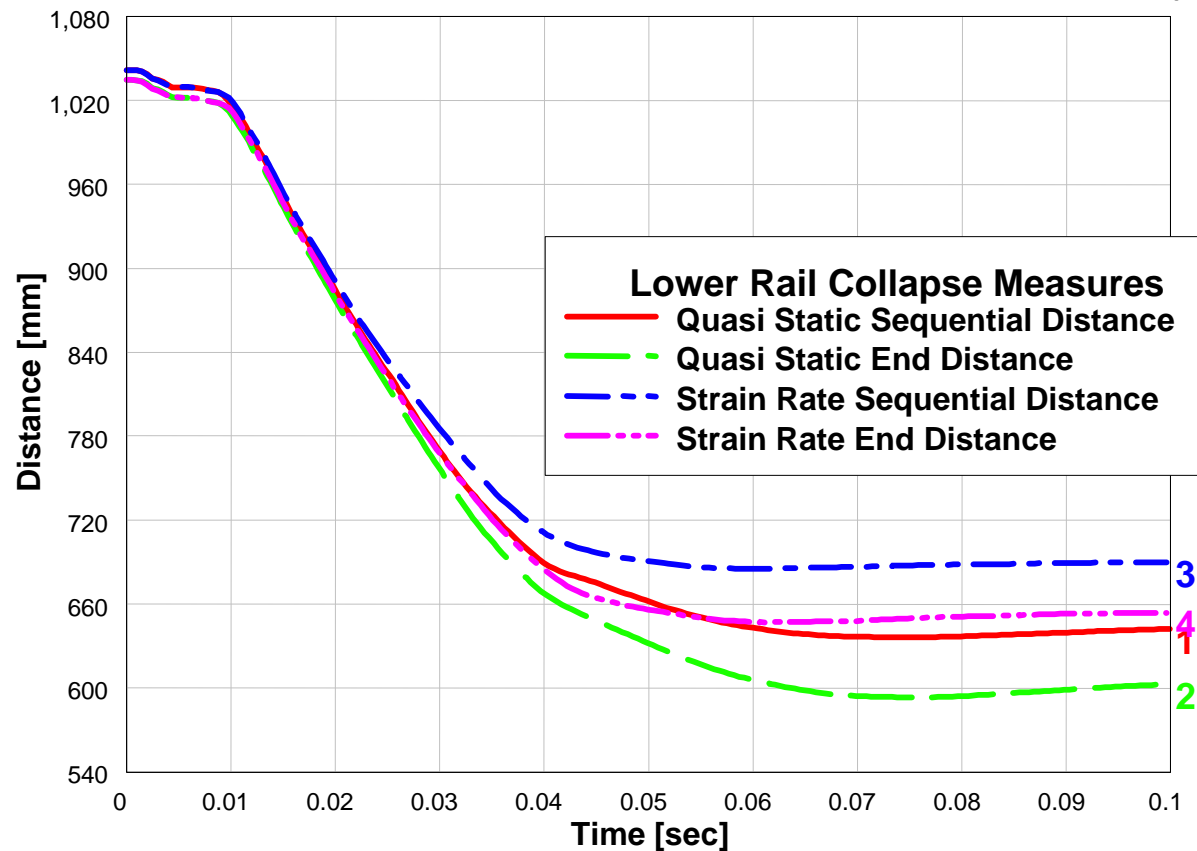
Barrier

End Crush Length Measure:
Distance between end cross sections

Sequential Crush Length Measure:
Sum of distances between adjacent
cross sections



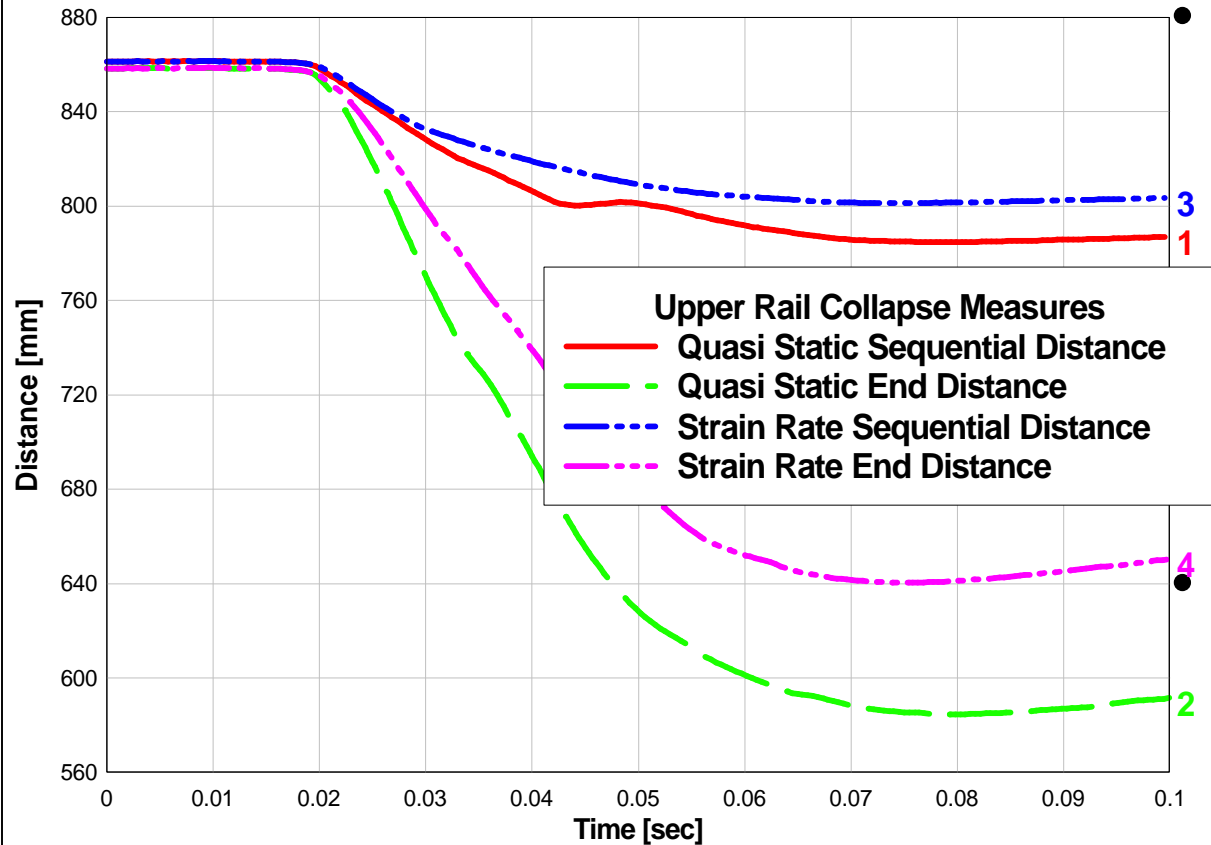
Lower Rail Crush Measures



- The difference should be negligible for effective compact collapse

Differences in lower rail with modeling approaches are in 10-20% range

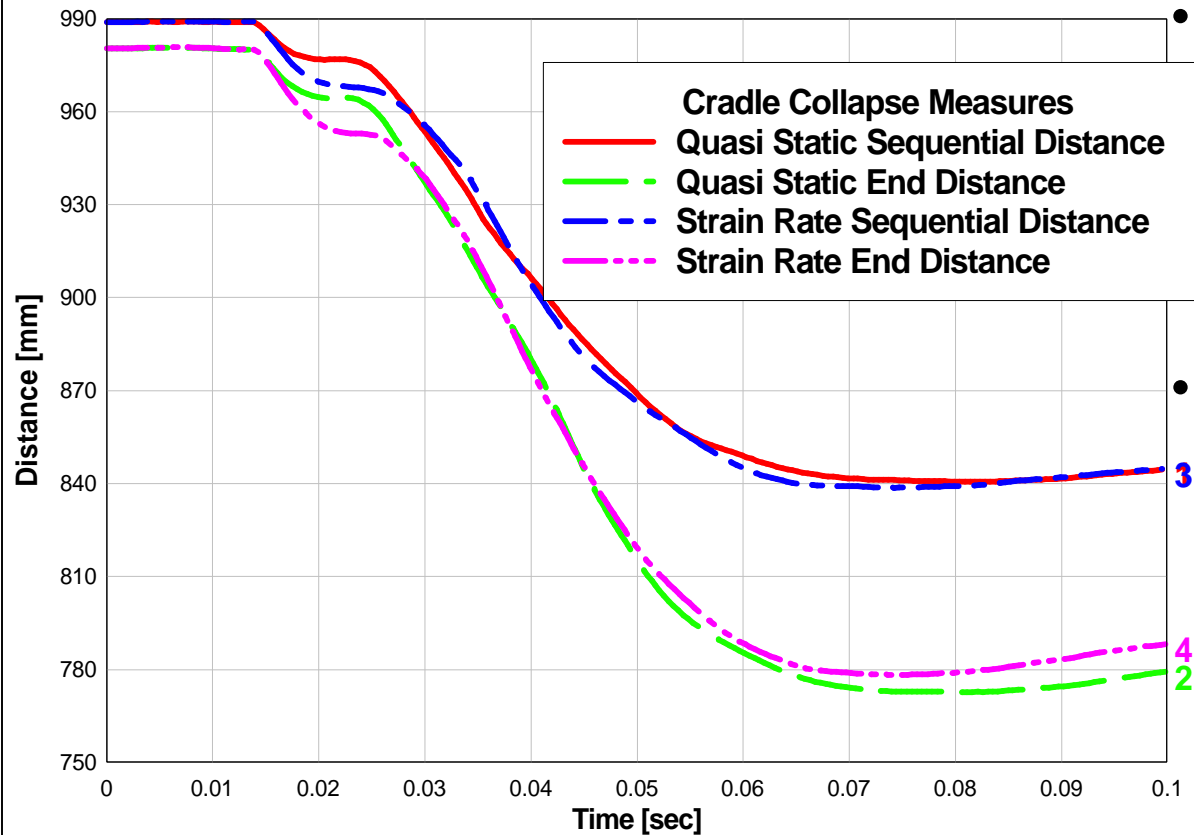
Upper Rail Crush Measures



• Difference between crush measures indicates non-compact collapse

• Sections at front, middle and end of rail were used

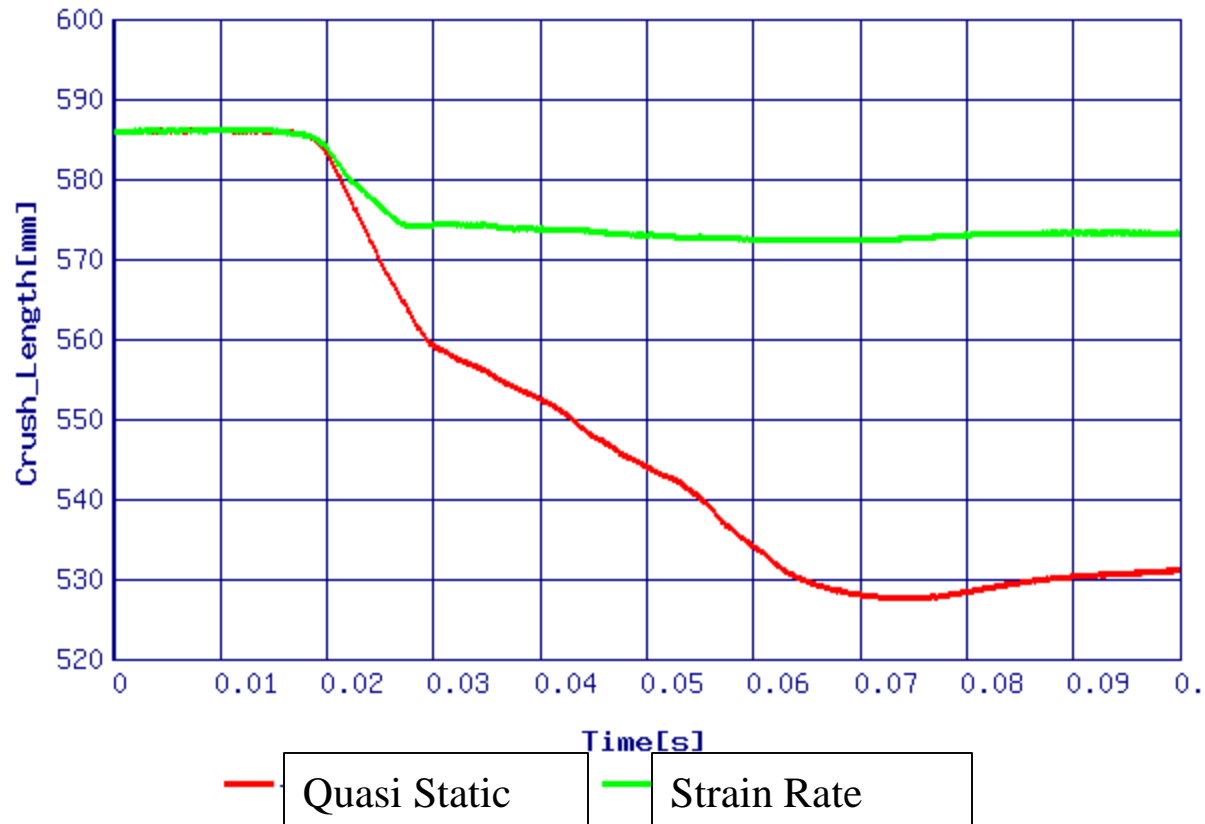
Cradle Crush Measures



- Small difference between crush measures indicates compact collapse

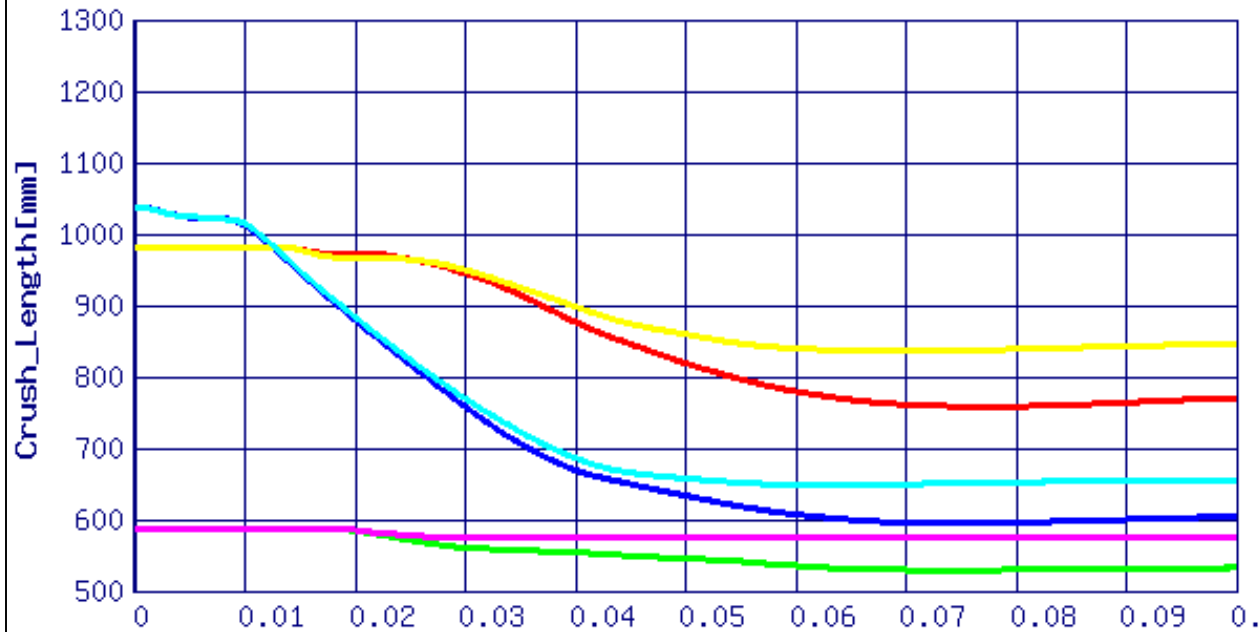
- However, front end of cradle collapses in compact mode, but plastic hinge at the end of the rail fails the component in bending mode

Upper Rail Strain Rate Sensitivity

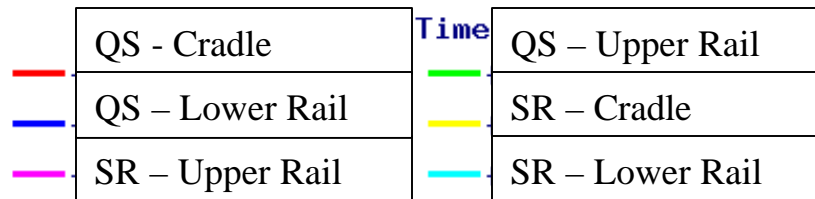


- Deformation of upper rail is less stable than for lower rail
- Modeling approaches result in considerable difference
- Sections at middle and end of rail were used for plotting

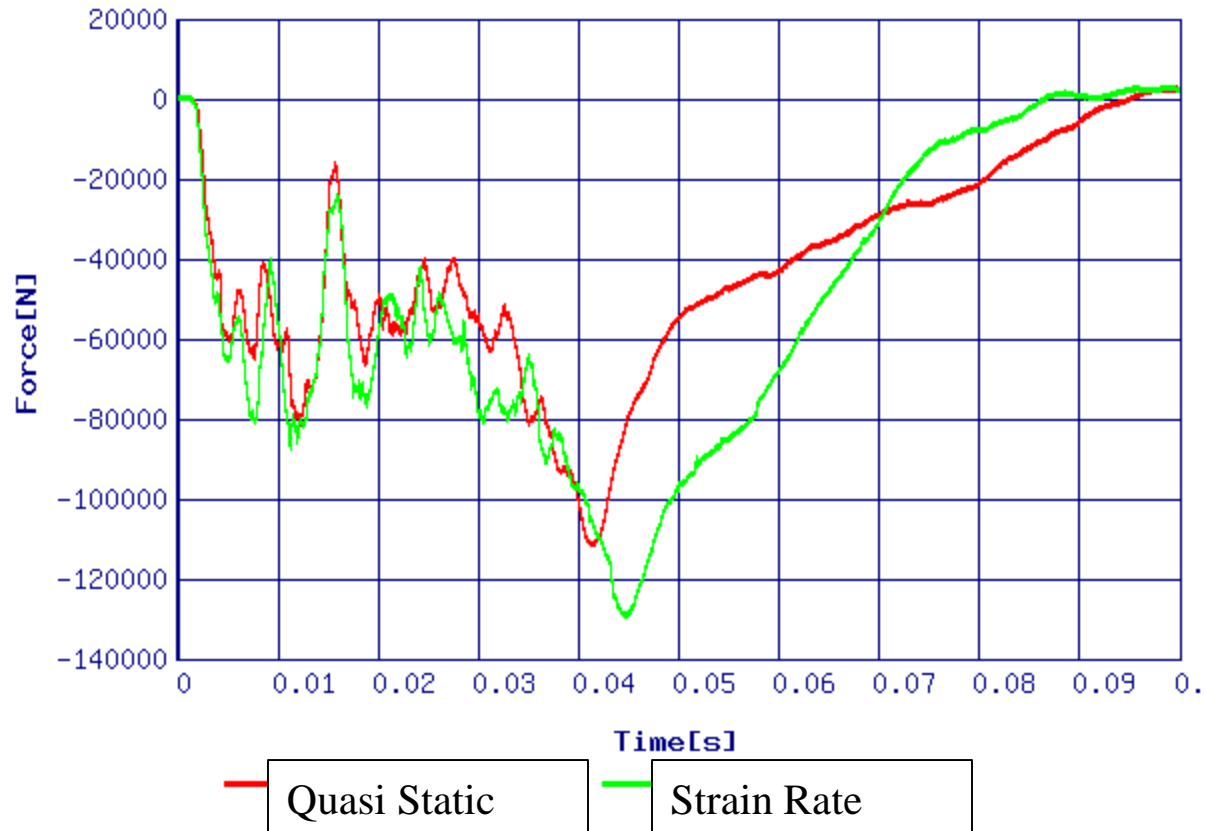
Overall Response



- QS- Quasi Static
- SR- Strain Rate
- All SR crush lengths are lower and consistent with results in literature

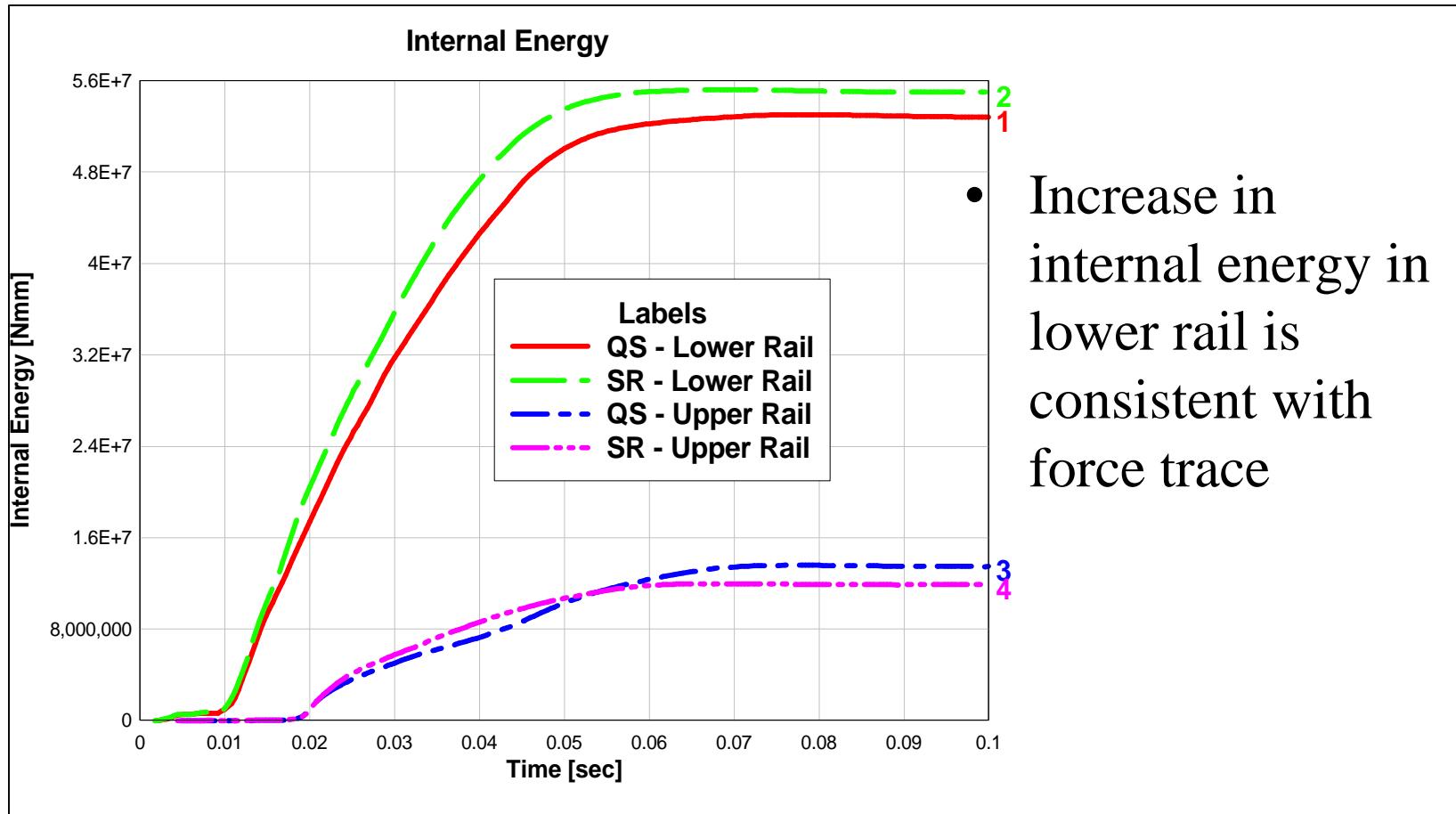


Forces in Lower Rail

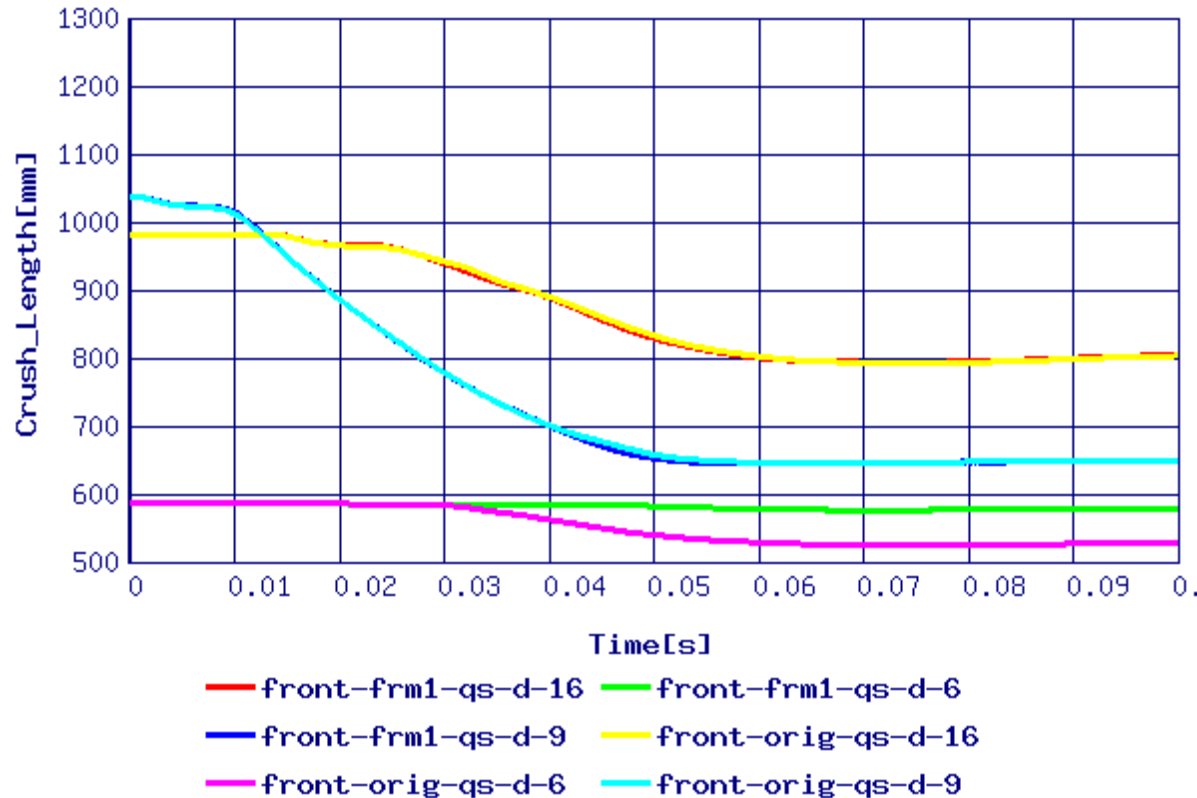


Lower rail picks more force for longer time with strain rate sensitive model

Internal Energy in Rails



Effect of Forming on Crush Length



Upper rail is the only one influenced

Such behavior may again indicate design sensitivity

Next Tasks

- Review crash compatibility results
- Complete IBEC papers