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

Quarterly Report 10/19/1999

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Activities Since Last Quarterly Report

- Prepared WWW interface for SOW modification
  - AISI members can log into Web page to comment and review the project's SOW
- Strain Rate Sensitivity Study of ULSAB
  - Analyzed Auto/Steel Partnership project data and reports on strain rate sensitivity
  - Prepared data for constitutive material models for crash simulations
  - Performed ULSAB crash simulations using strain rate data
  - Developed WWW report for the study

SOW Modification Web page

1. Go to: http://www-explorer.ornl.gov
2. Click on 'Collaboration'
3. On 'Collaboration' page, scroll down to 'Ongoing Initiatives'
4. Click on 'Steel Processing Properties and Their Effect on Impact Deformation of Lightweight Structures'
5. When prompted, provide (case sensitive):
   user: aisi
   password: Steel1
6. Add/Review comments, print commented document, etc.

Strain Rate Sensitivity Study of ULSAB

Strain Rate Sensitivity Study - Overview

- Objective
  - Perform preliminary study of strain rate effects in ULSAB
- Approach
  - Combine ULSAB computational models and Auto/Steel Partnership data on steel strain rate sensitivity
- Expected Benefits
  - Develop data for FEM computational modeling of steel impact problems
  - Determine feasibility of strain rate dependent constitutive models for ULSAB computational models

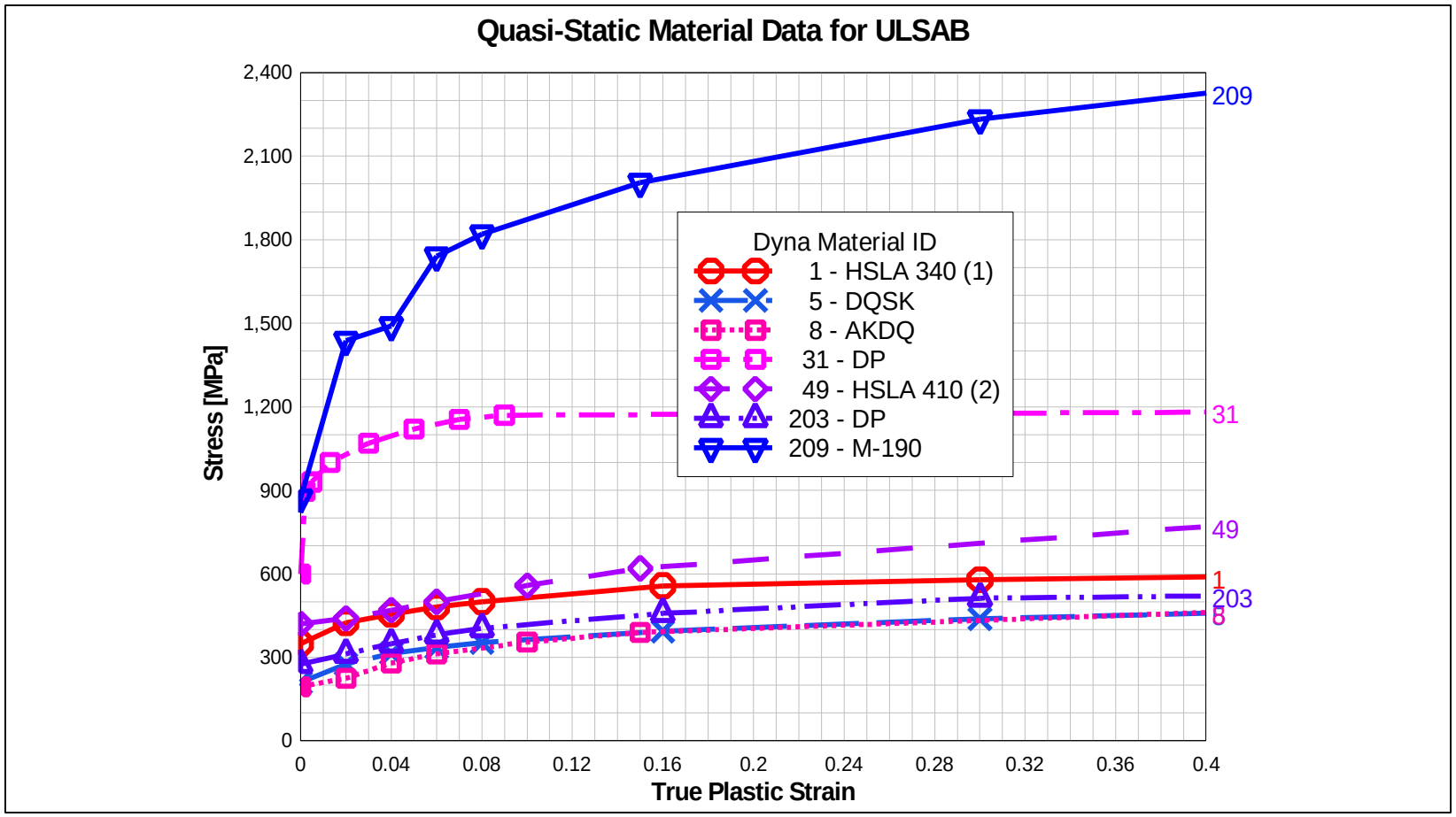
A/SP Materials

- Phase 1
  - DQSK
  - HSLA 340
  - IF
  - M-190
- Phase 2
  - AKDQ
  - HSLA 410
  - DP

ULSAB Materials

ULSAB Material ID	Yield Stress [MPa]
1	350
5	210
8	140 (195)
31	600
49	420
203	276
209	872

A/SP - ULSAB Materials Correlation



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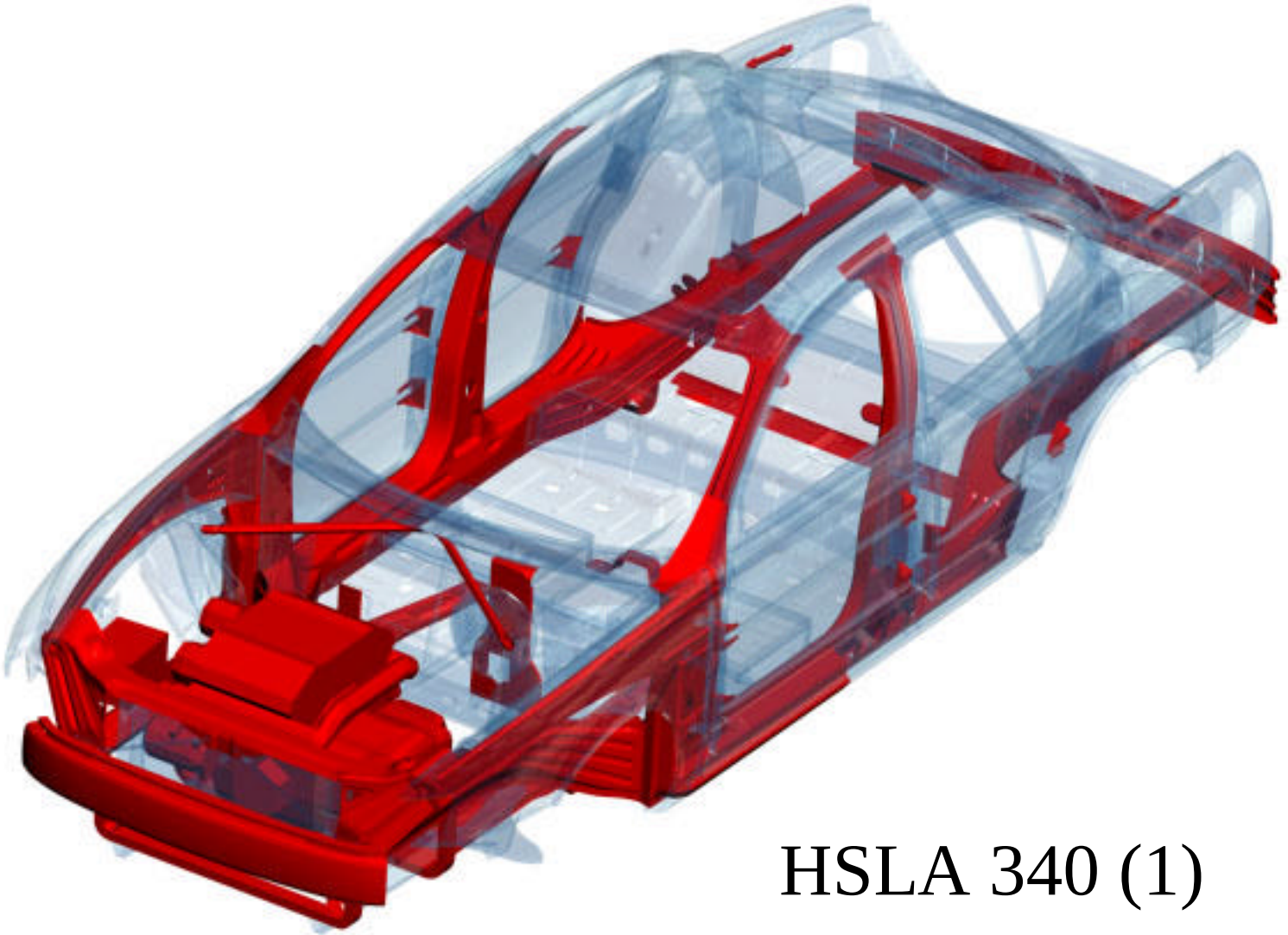

HSLA 340 (1)

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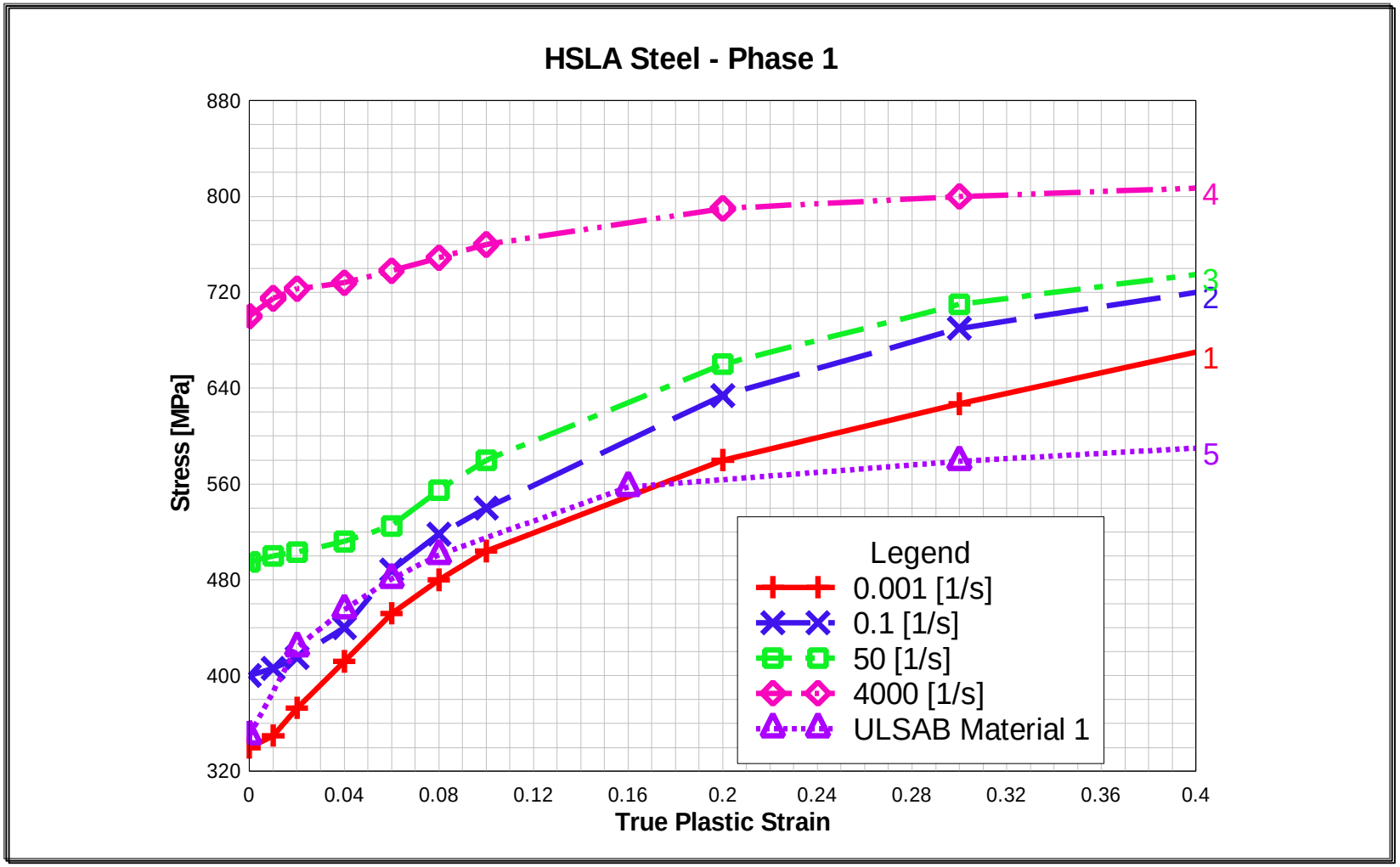

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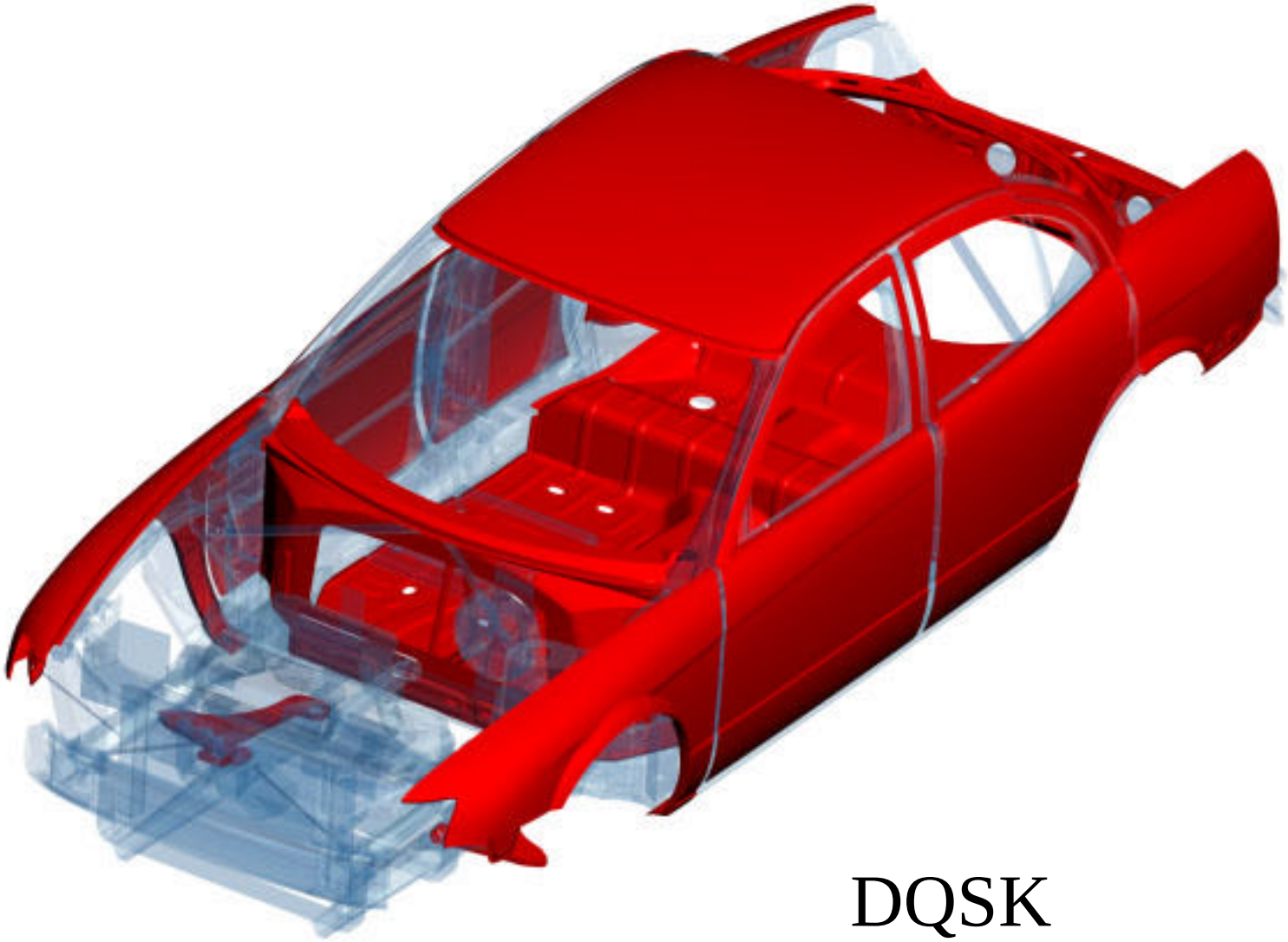

DQSK

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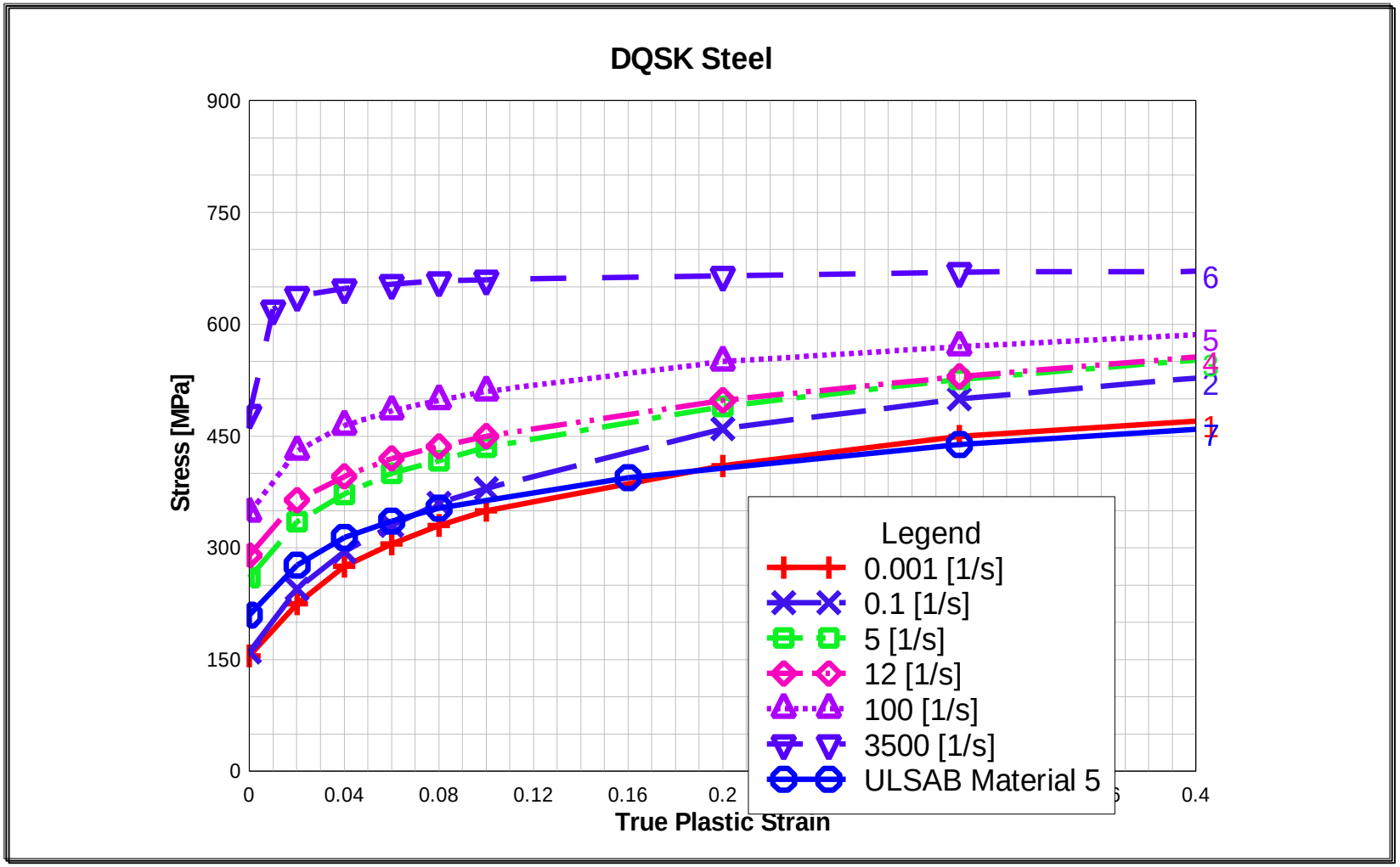

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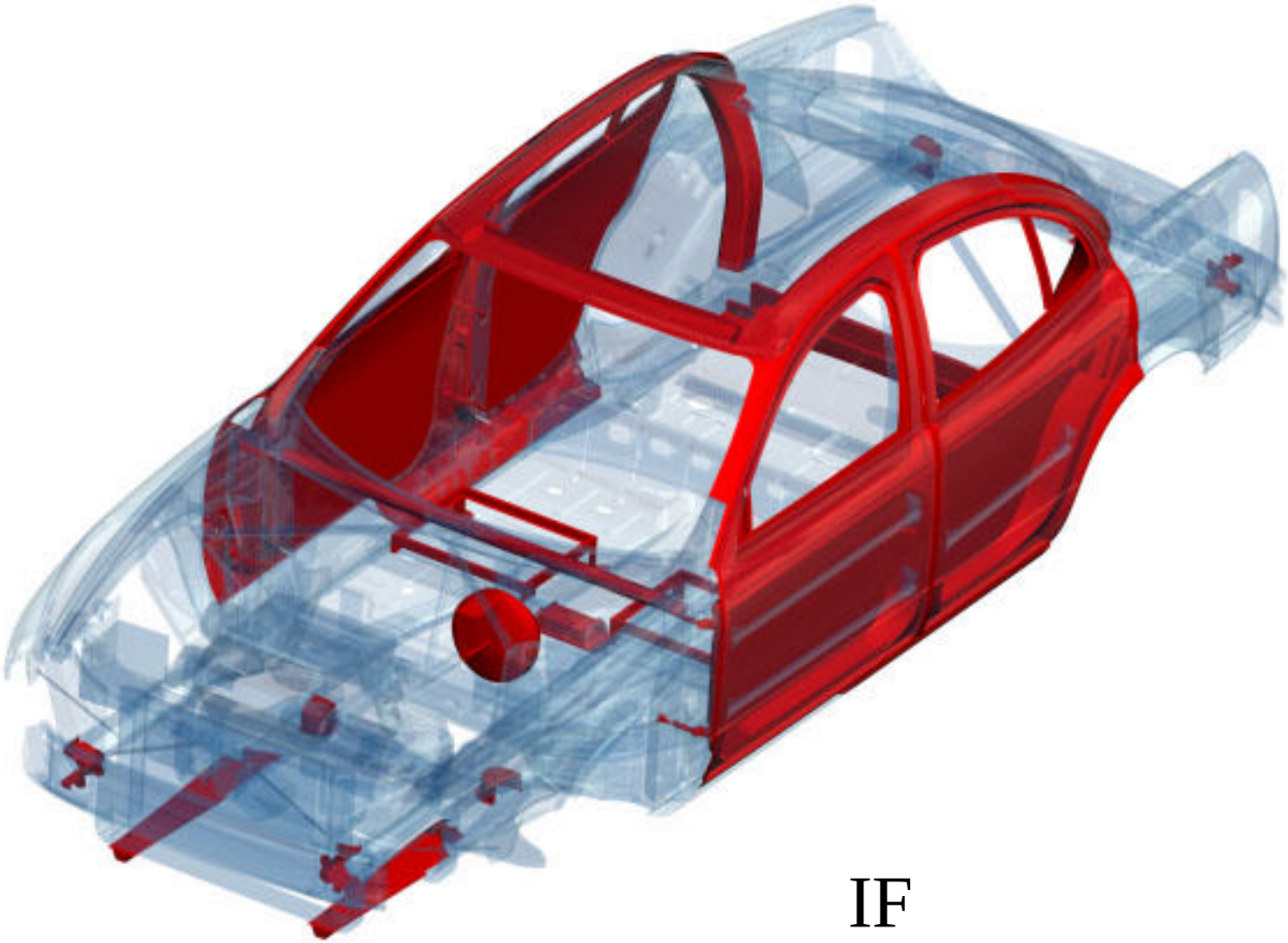

IF

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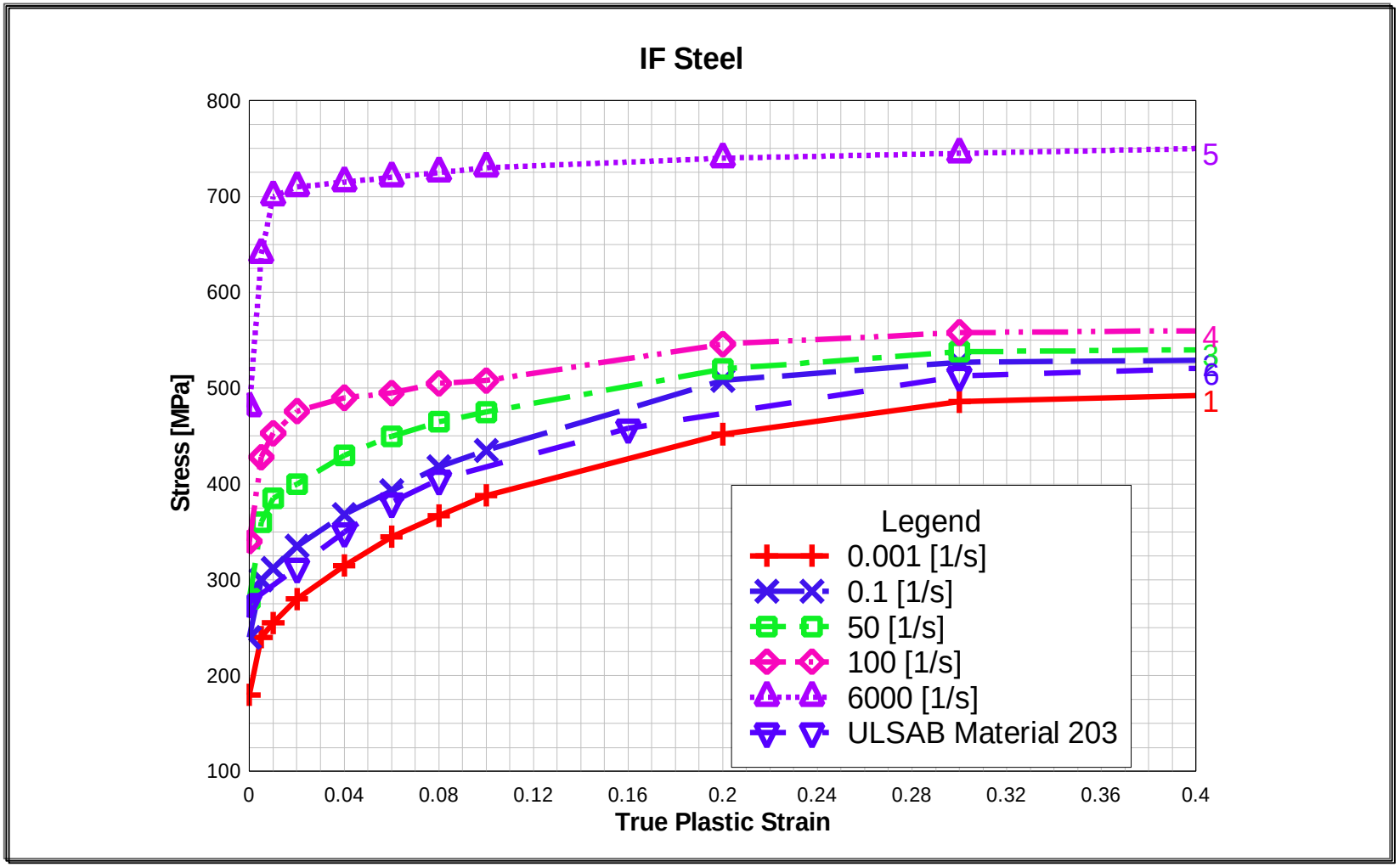

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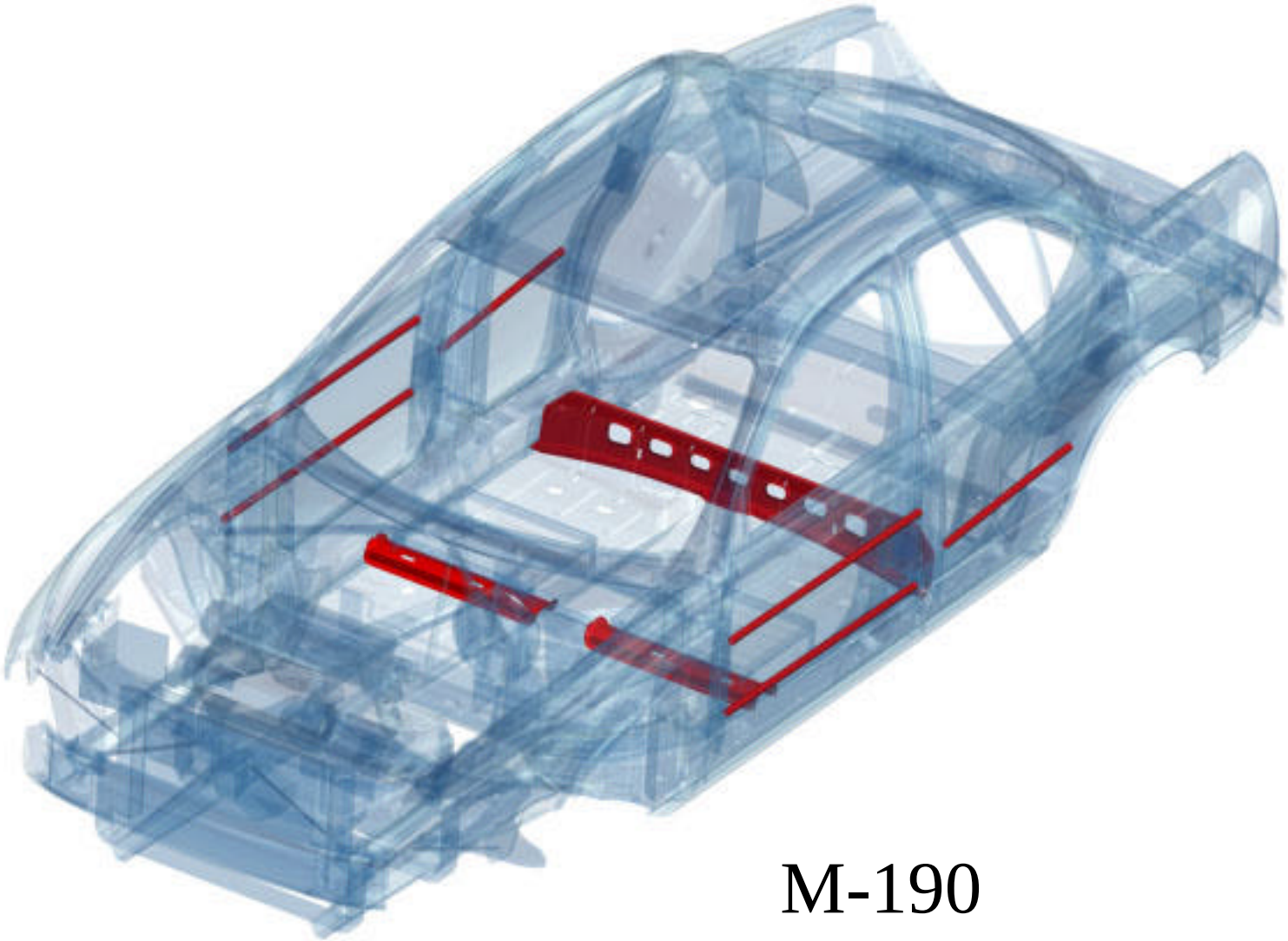

M-190

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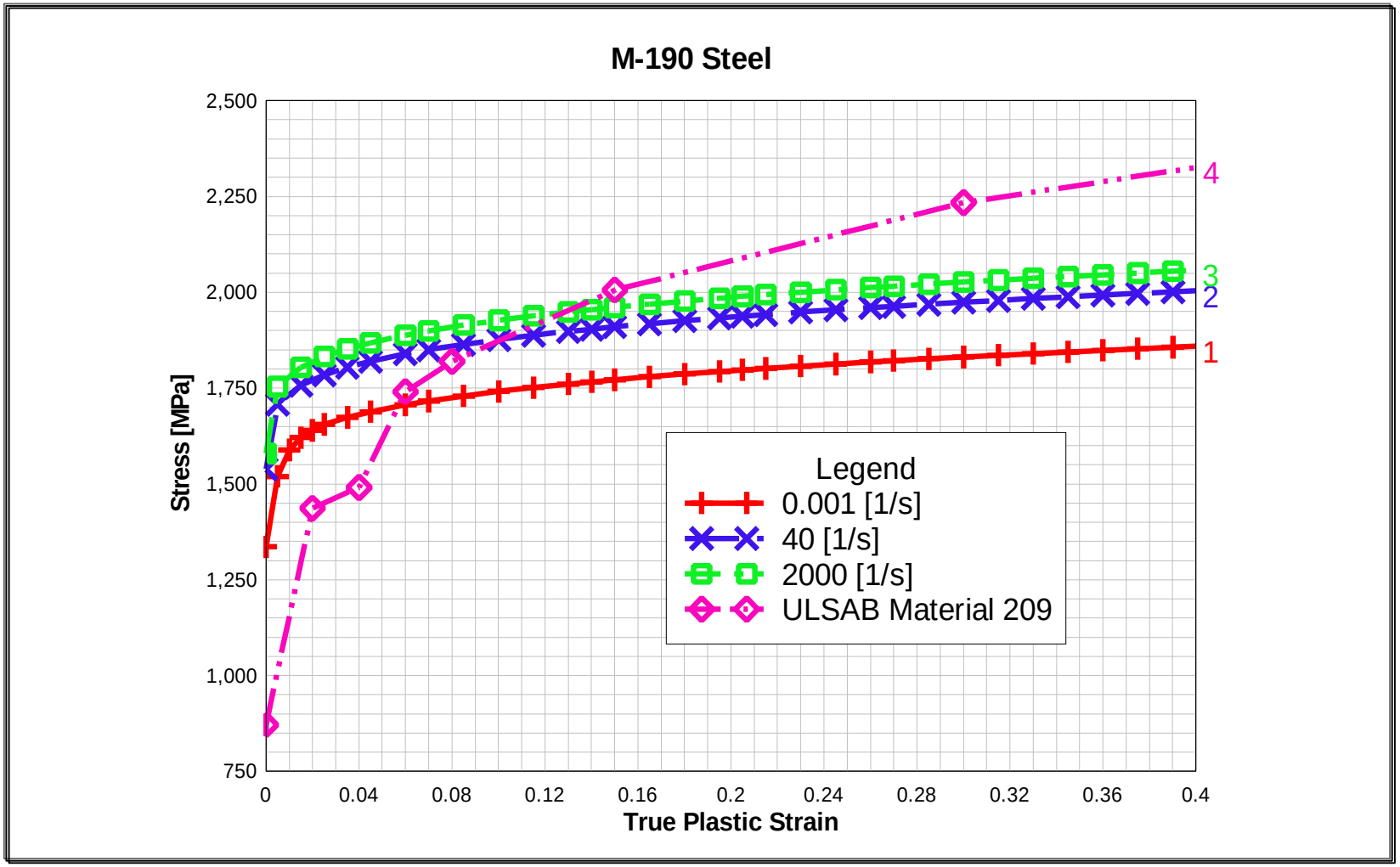

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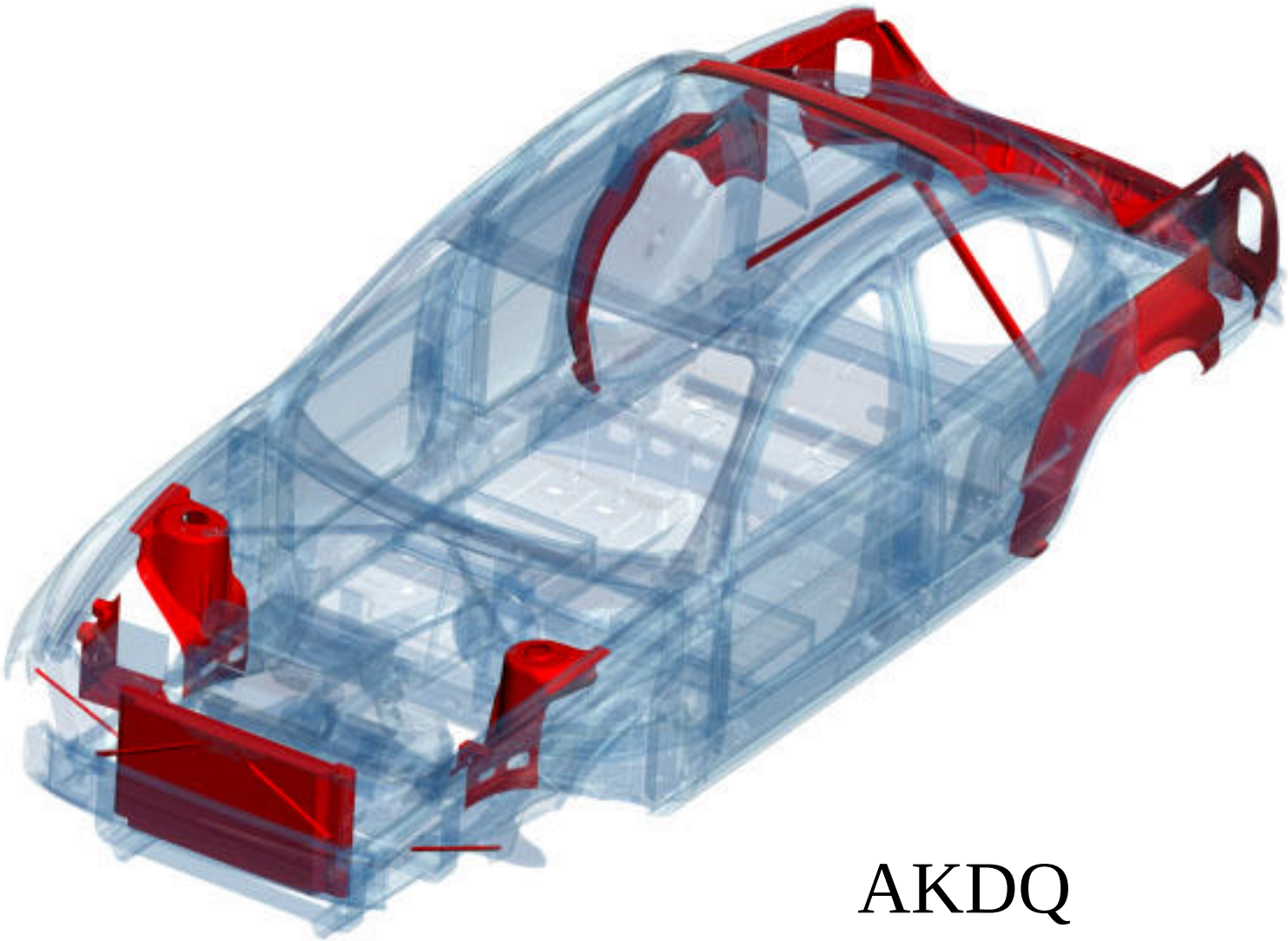

AKDQ

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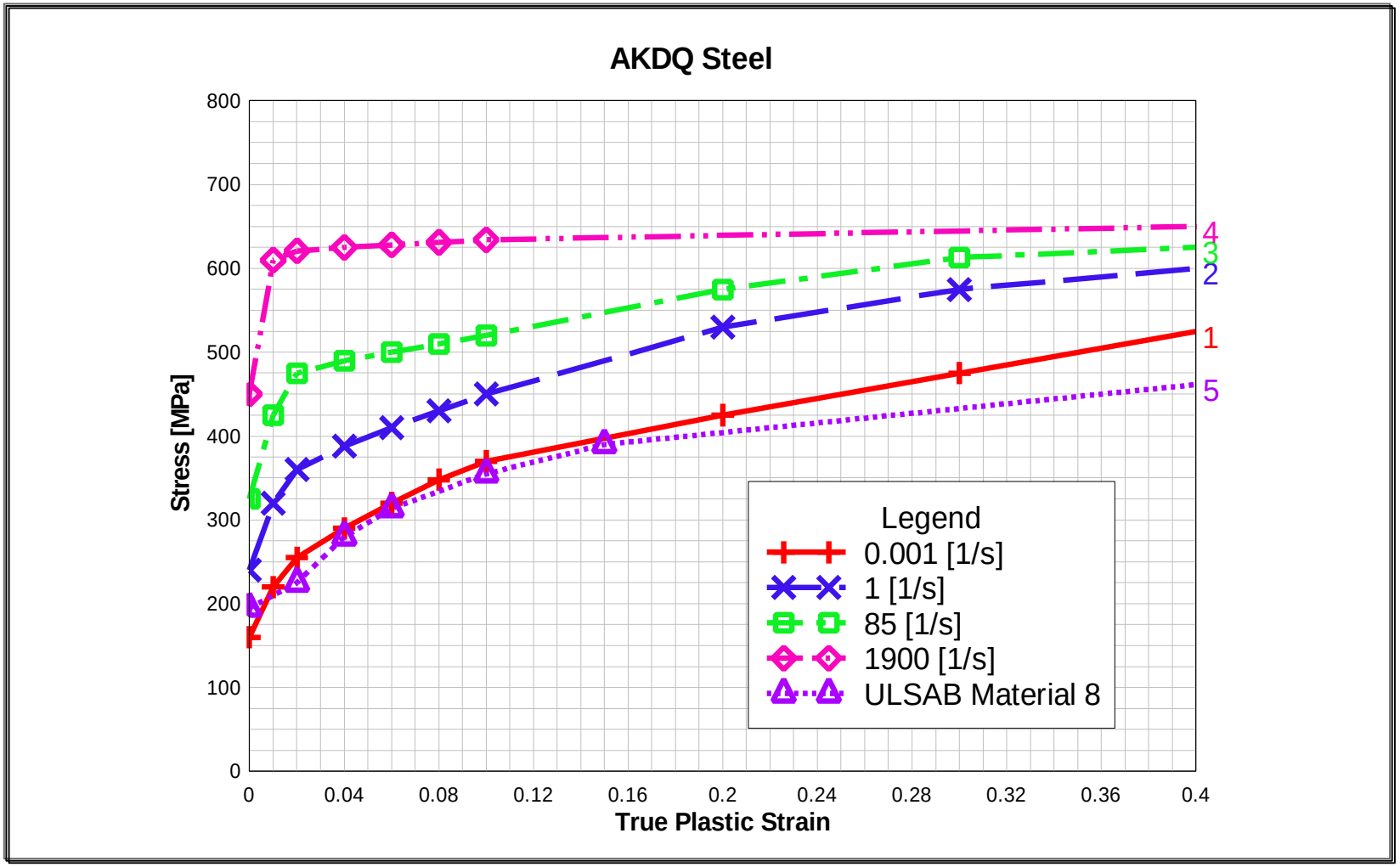
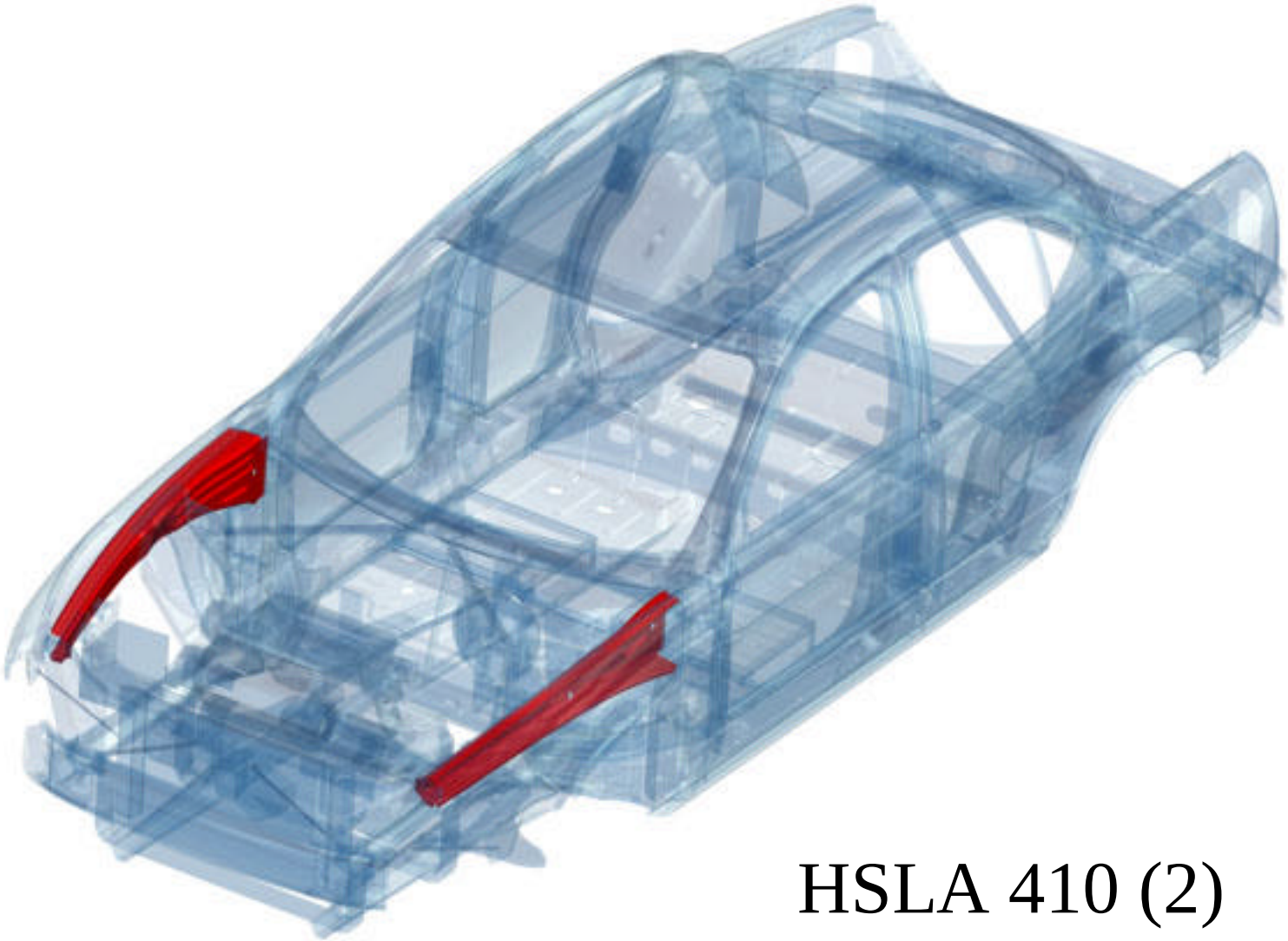

AKDQ Steel
Stress [MPa]
True Plastic Strain
0
100
200
300
400
500
600
700
800
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0.32
0.36
0.4
Legend
0.001 [1/s]
1 [1/s]
85 [1/s]
1900 [1/s]
ULSAB Material 8
1
2
3
4
5



HSLA 410 (2)

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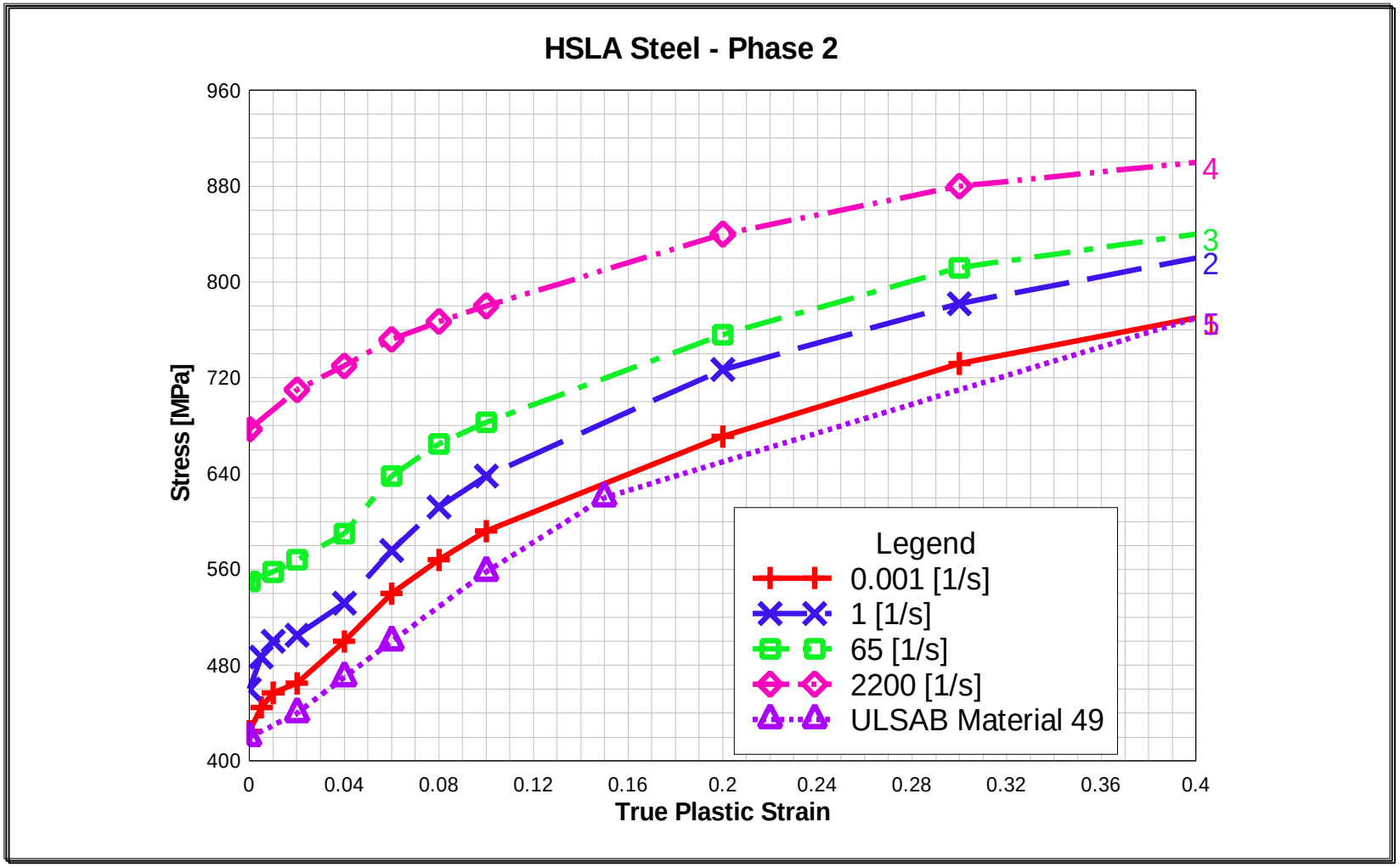

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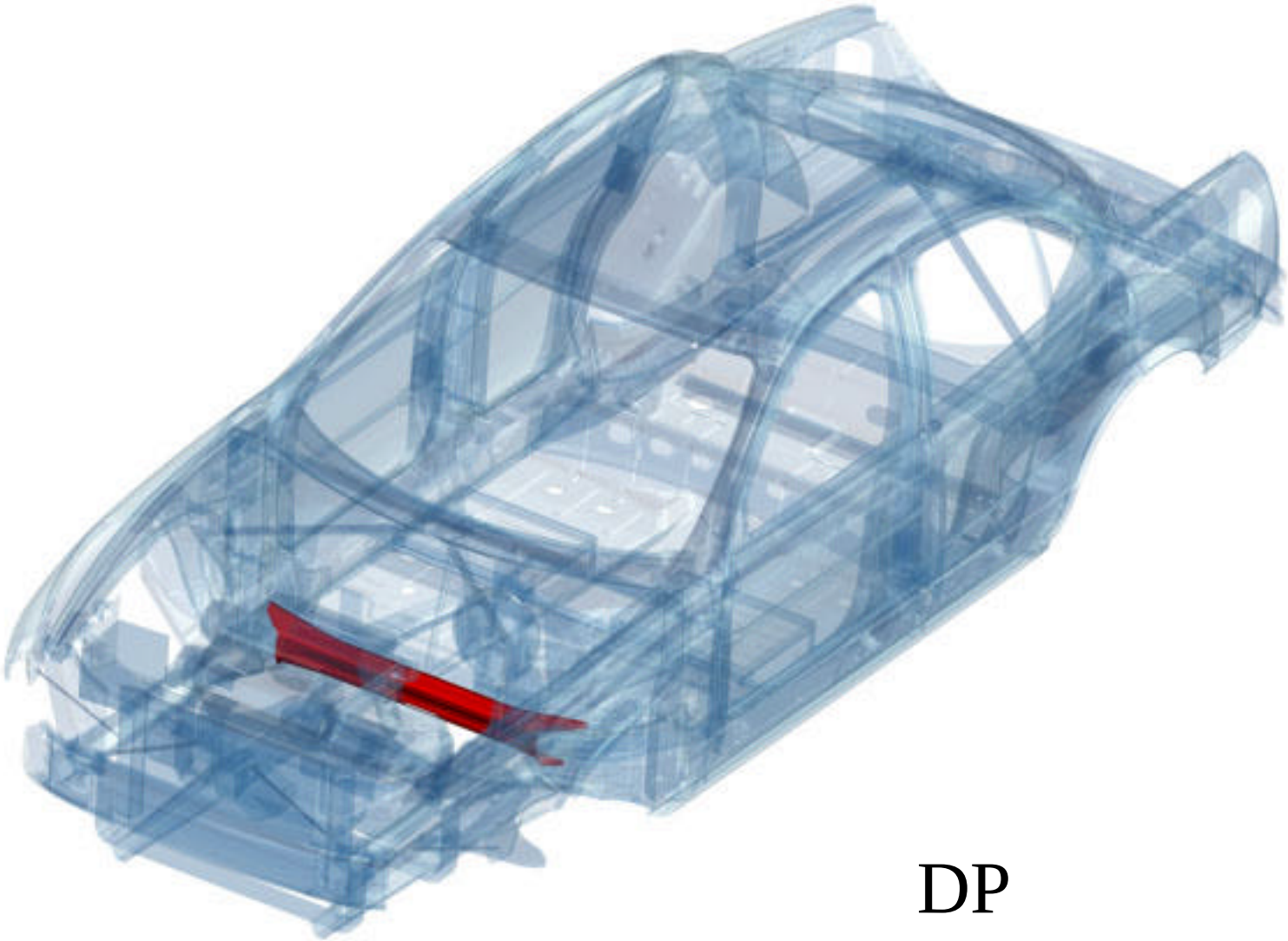
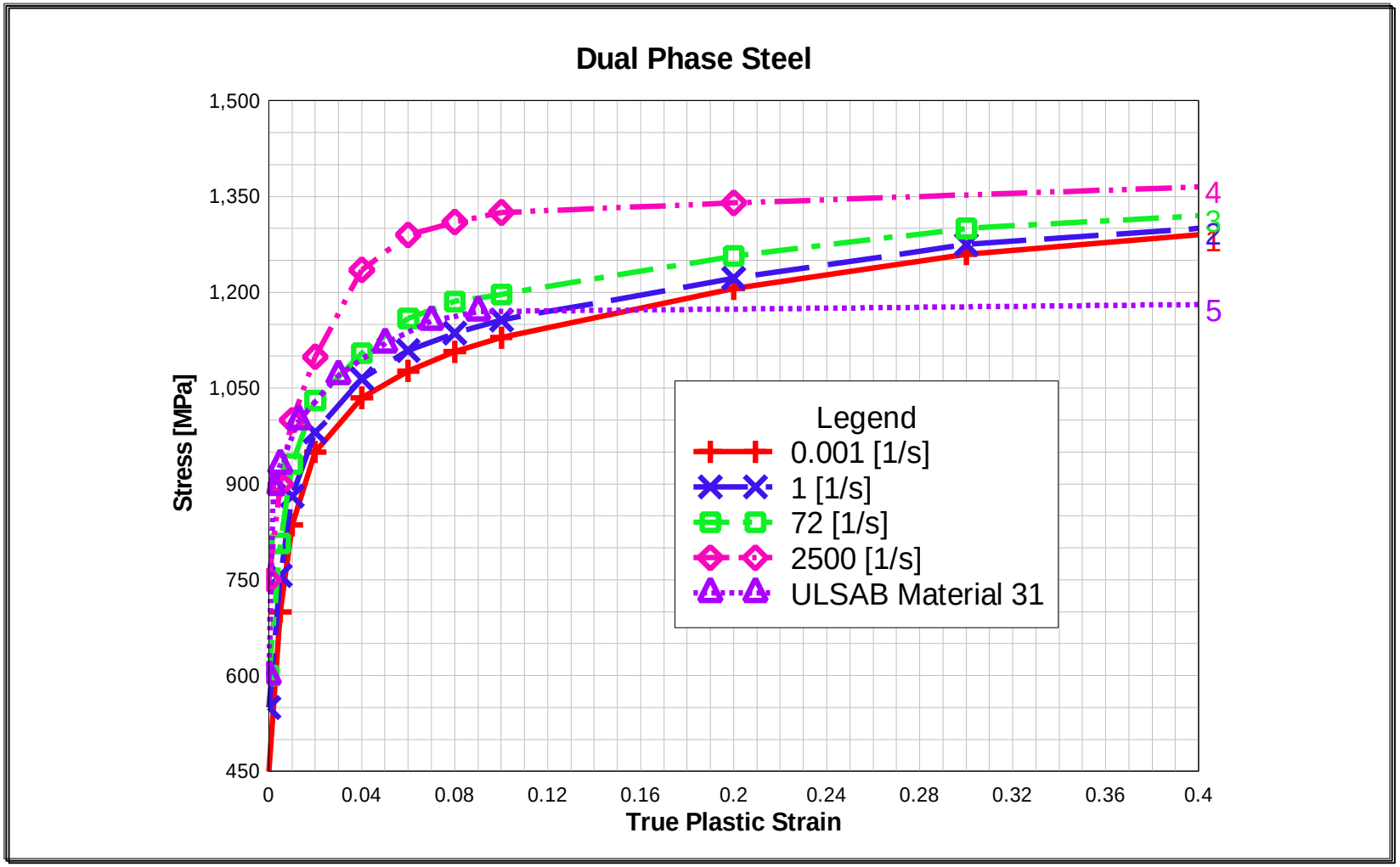


DP



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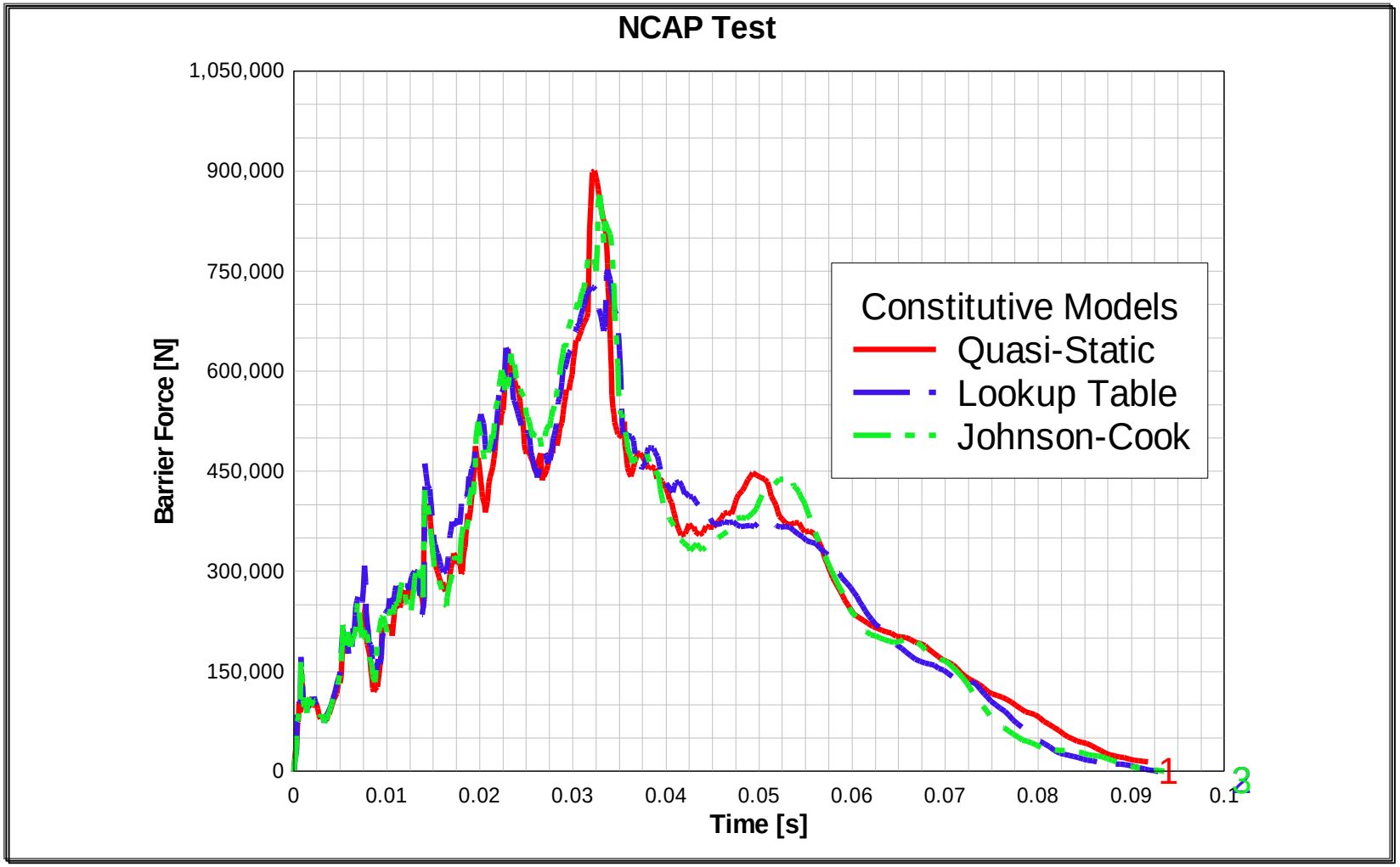

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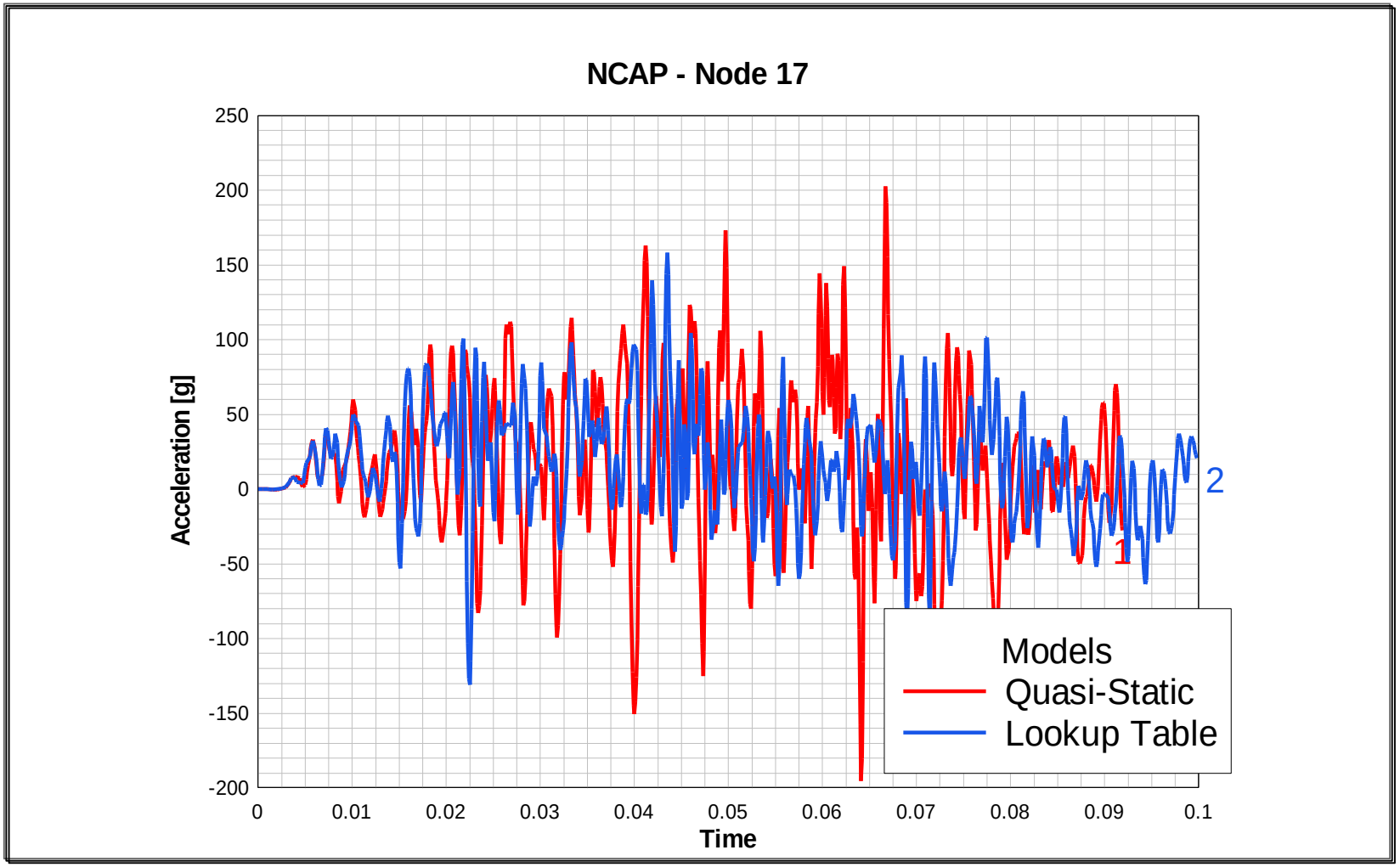

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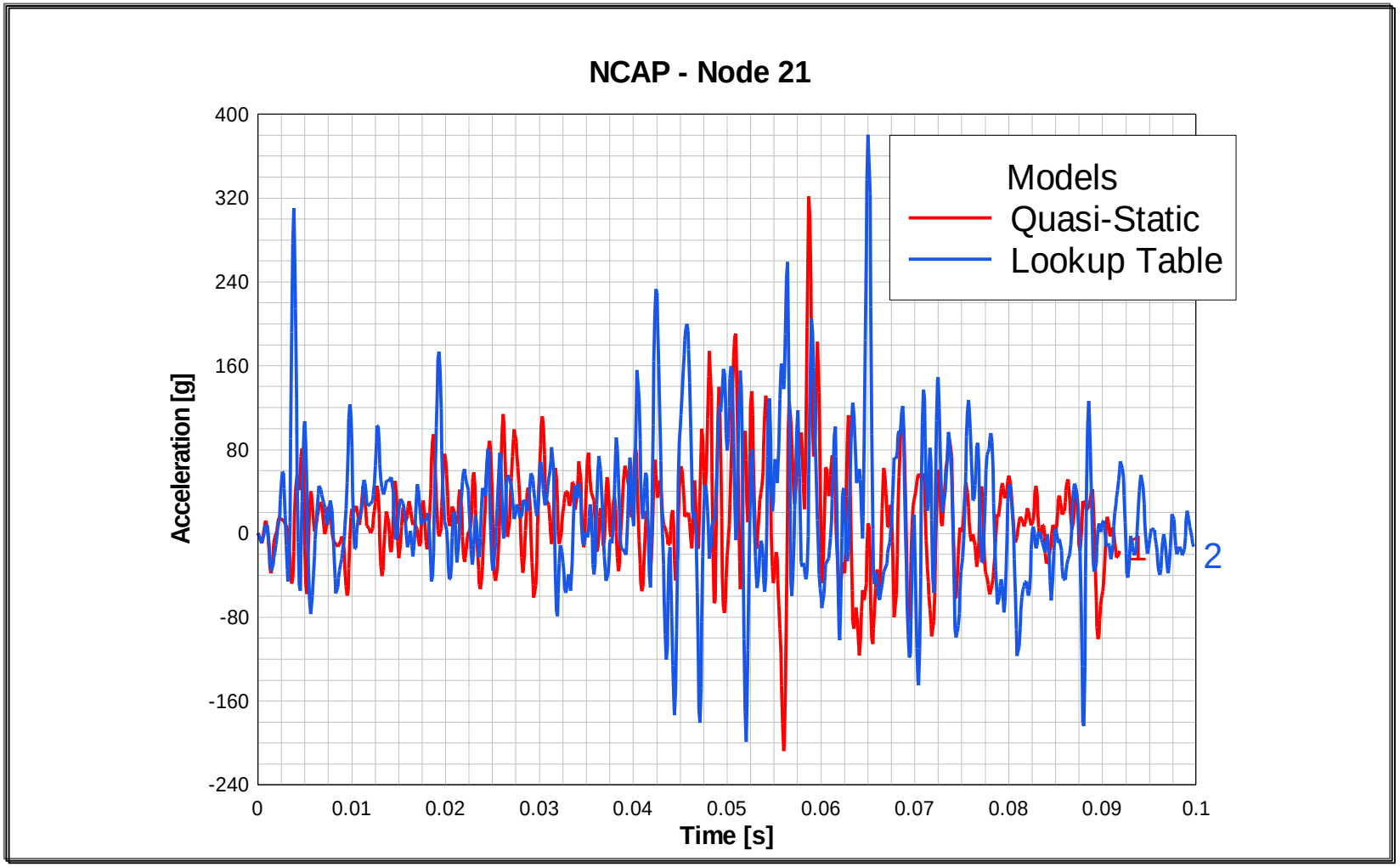

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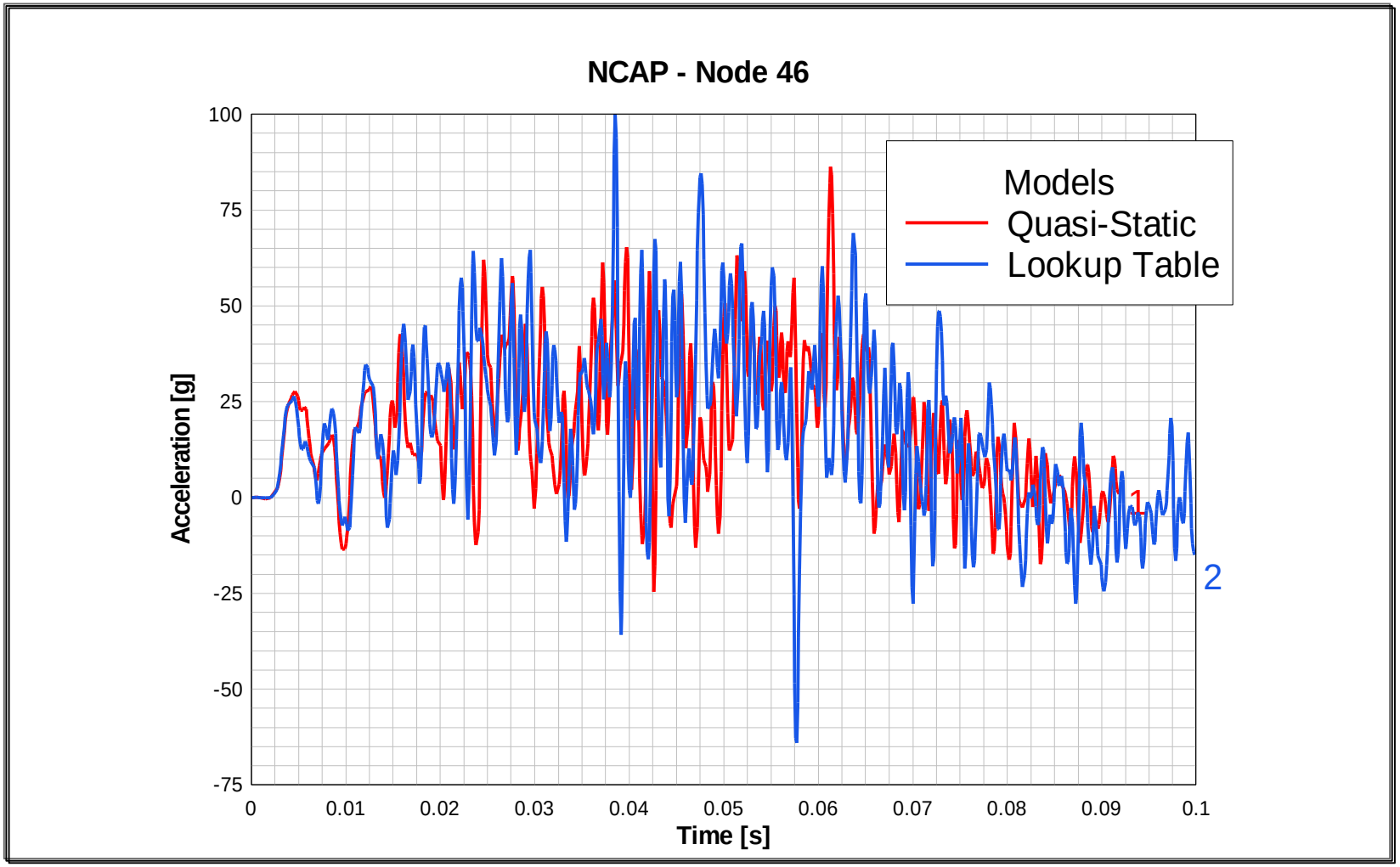

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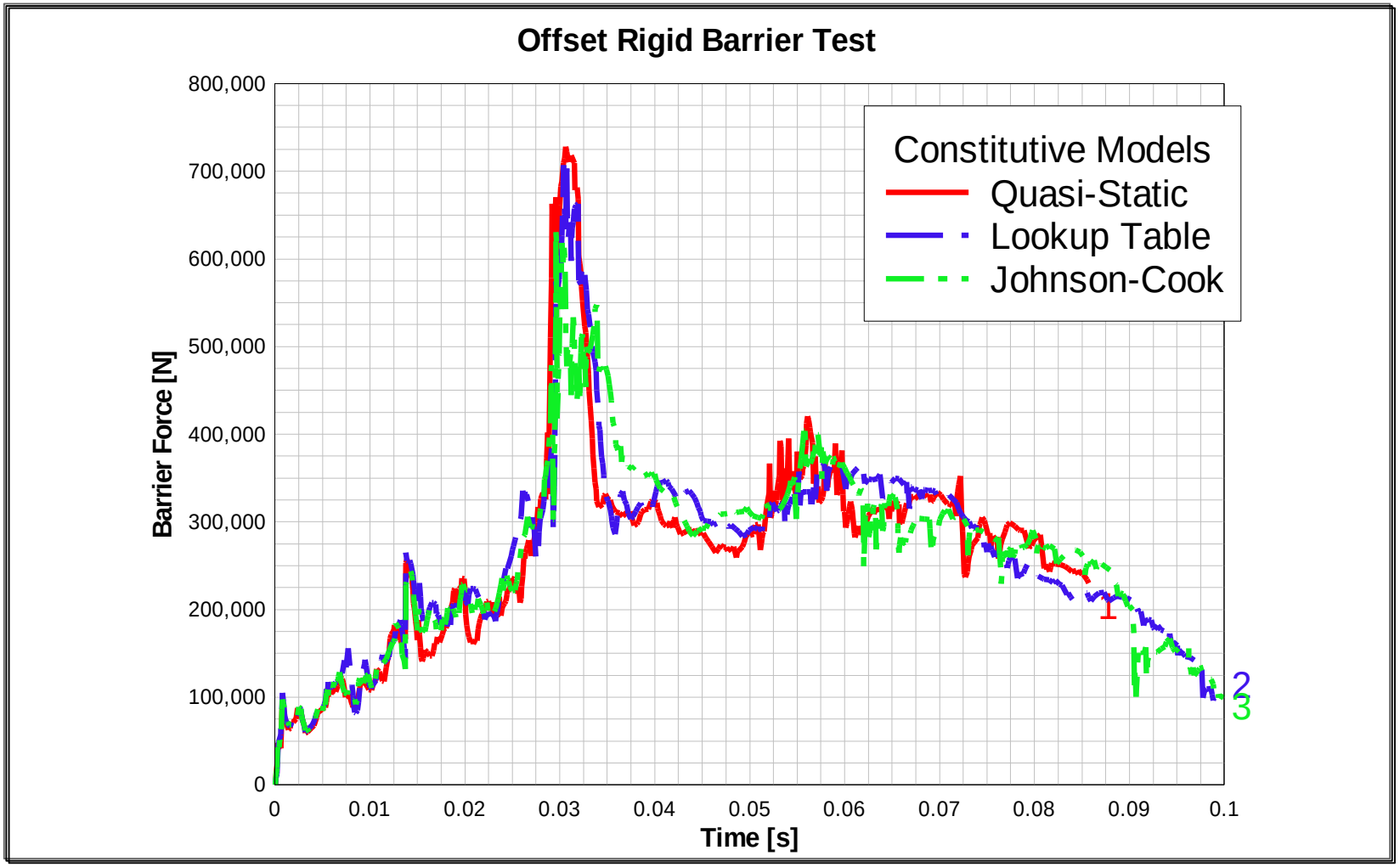

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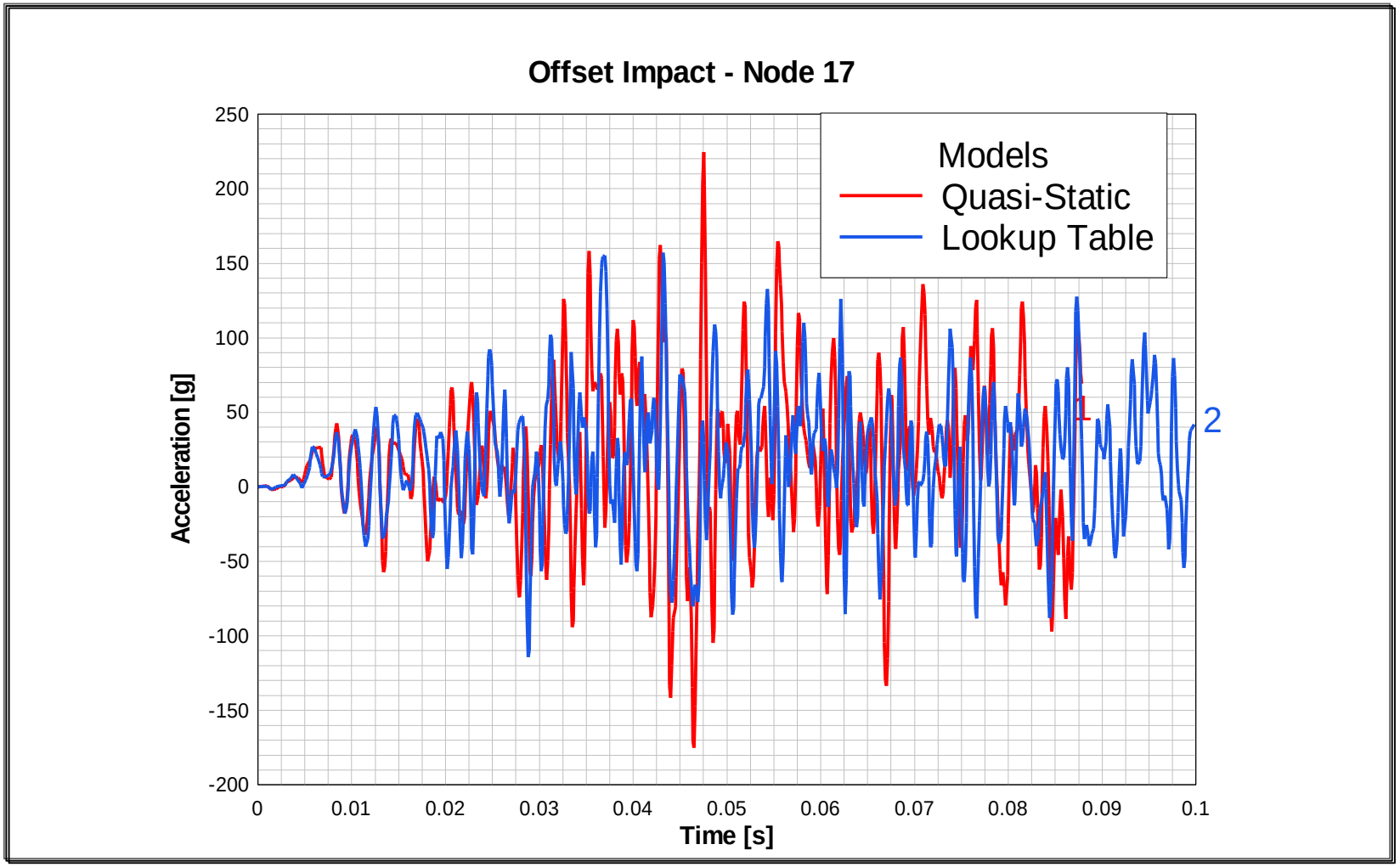

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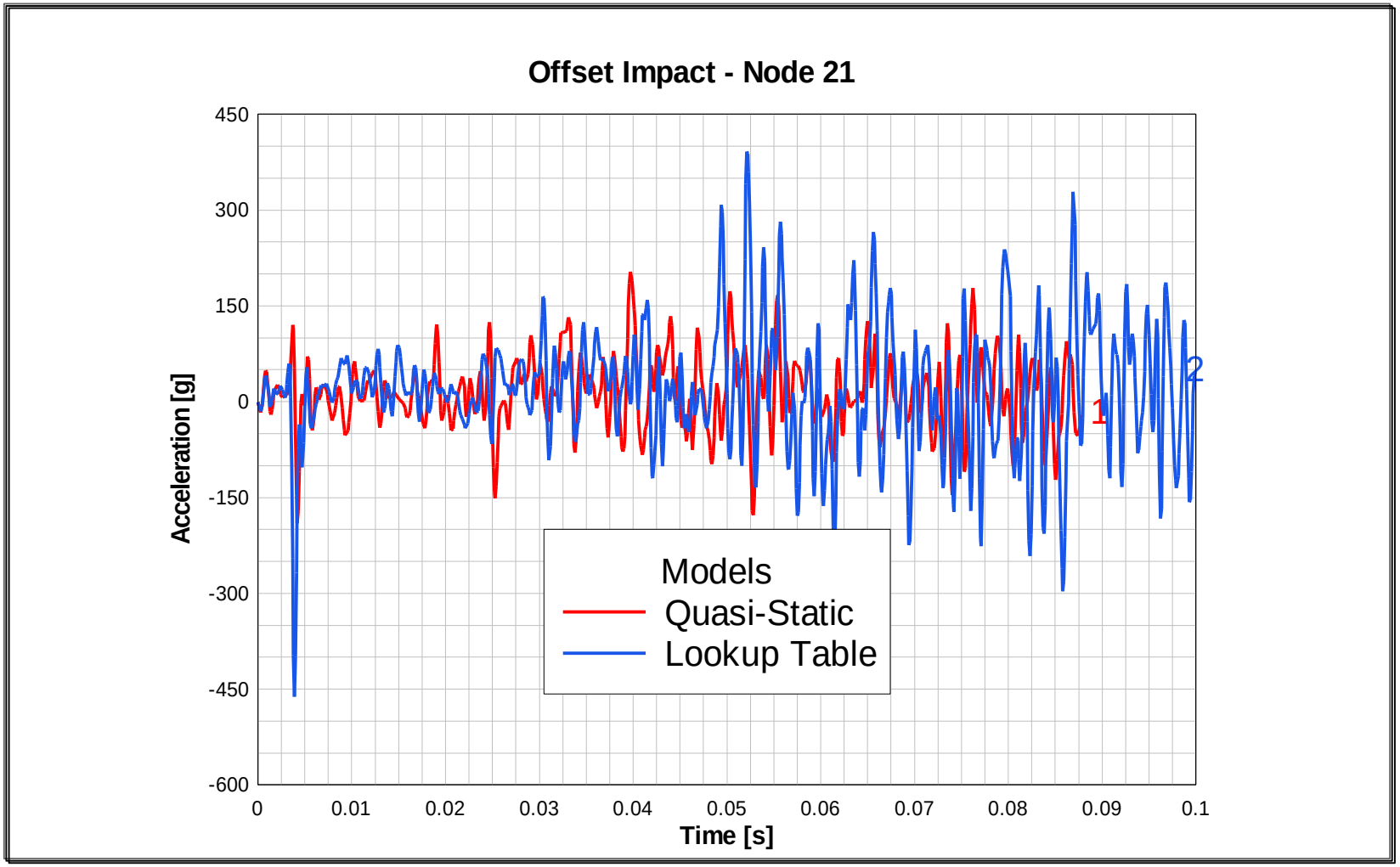

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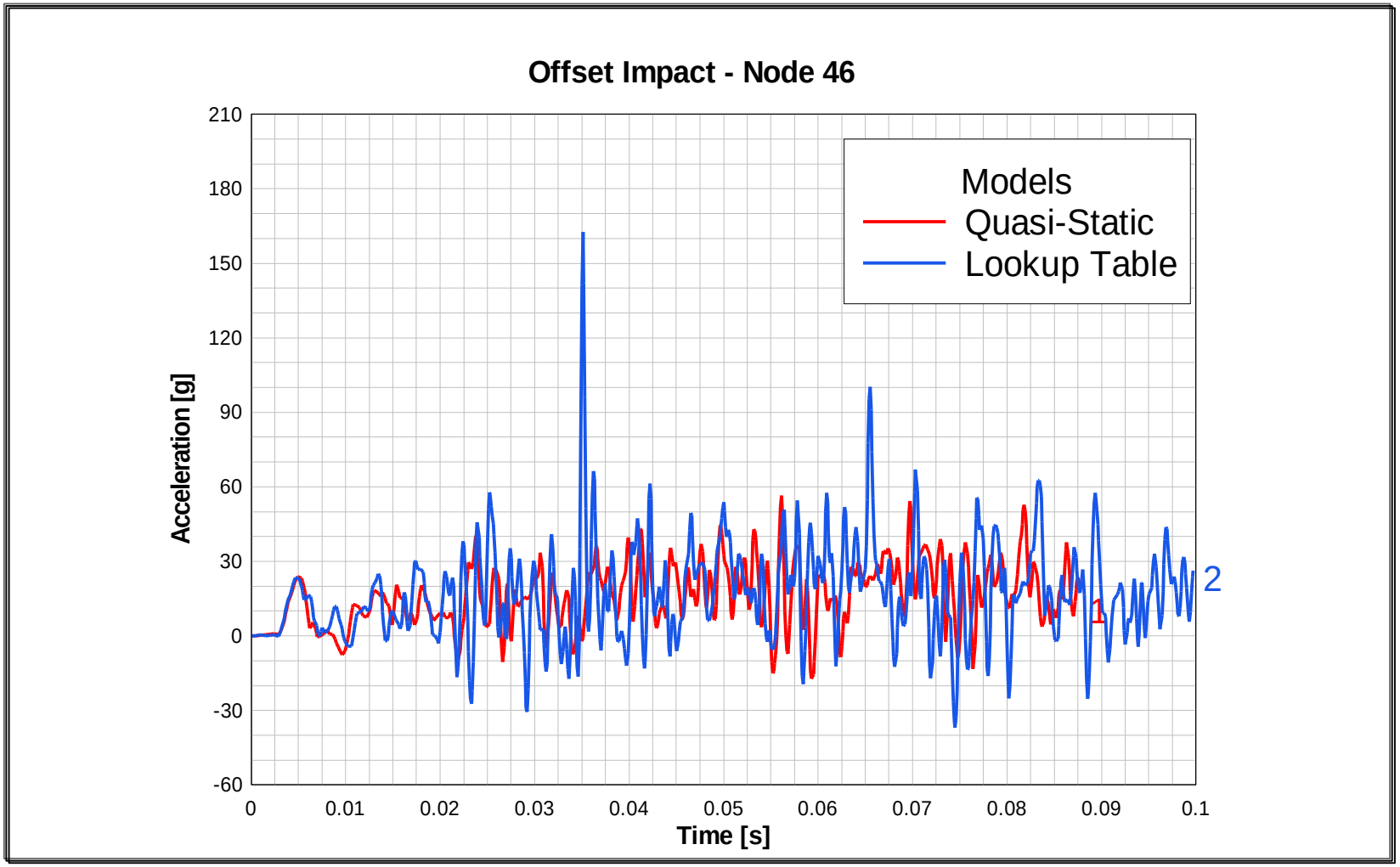

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Conclusions

- All results not in yet
- Initial simulations indicate modest influence of strain rate effects on ULSAB model
  - main load path is HSLA 340 material with relatively low strain rate sensitivity
  - **modeling can make a big role!**
  - new research project has been initiated with A/SP on modeling impact collapse of steel structures
- Final results available by 11/8/1999 on project Web page

Next Steps

- Define modifications to SOW
  - Further pursue strain rate analysis?
  - Develop forming and processing data?
- Determine activities for the next quarter