

GREAT DESIGNS IN **STEEL**

MULTIDISCIPLINARY SPOTWELD OPTIMIZATION USING OPTIM WELDS

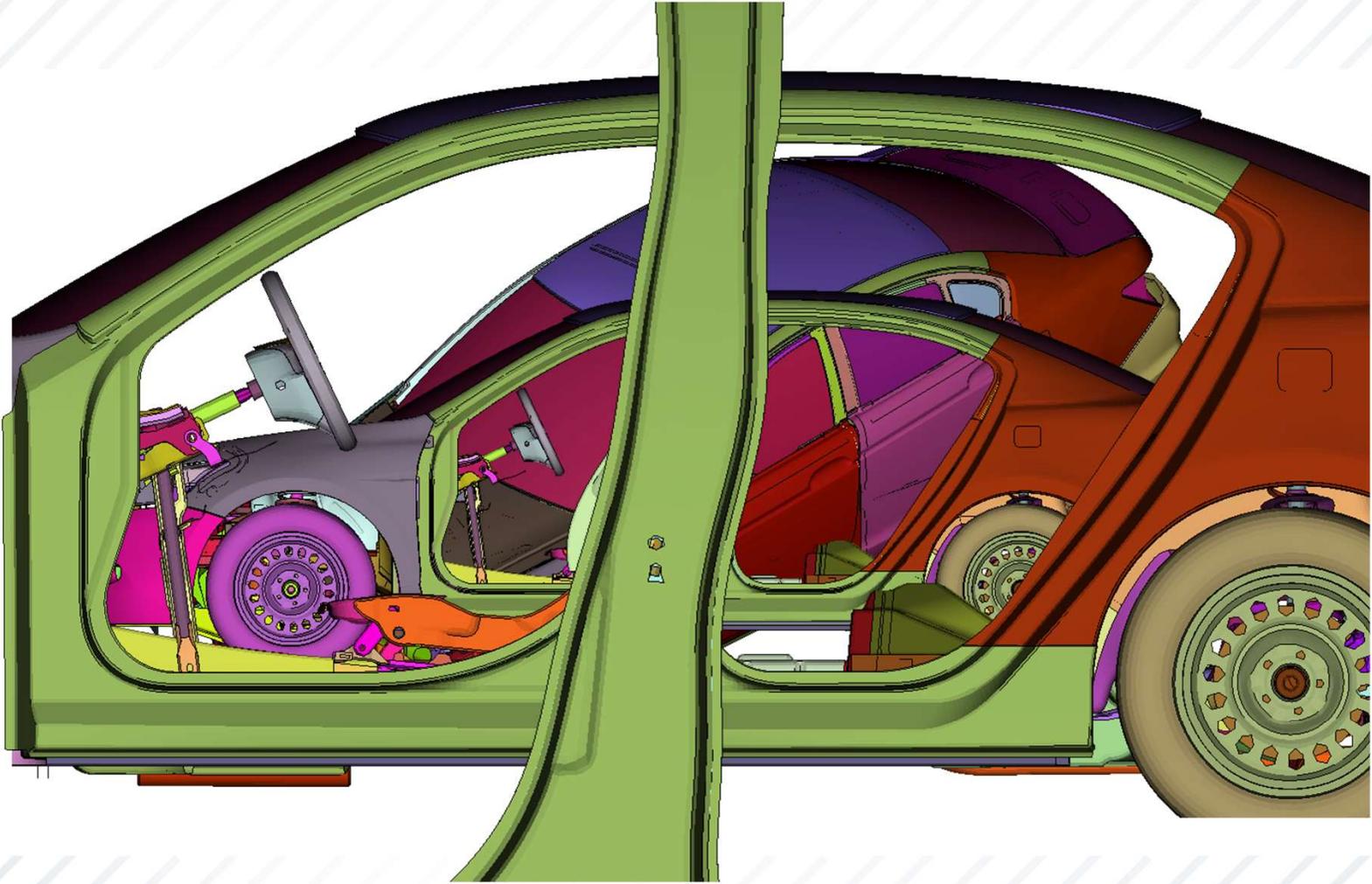
Ravi Nimbalkar
BETA CAE Systems USA

OVERVIEW

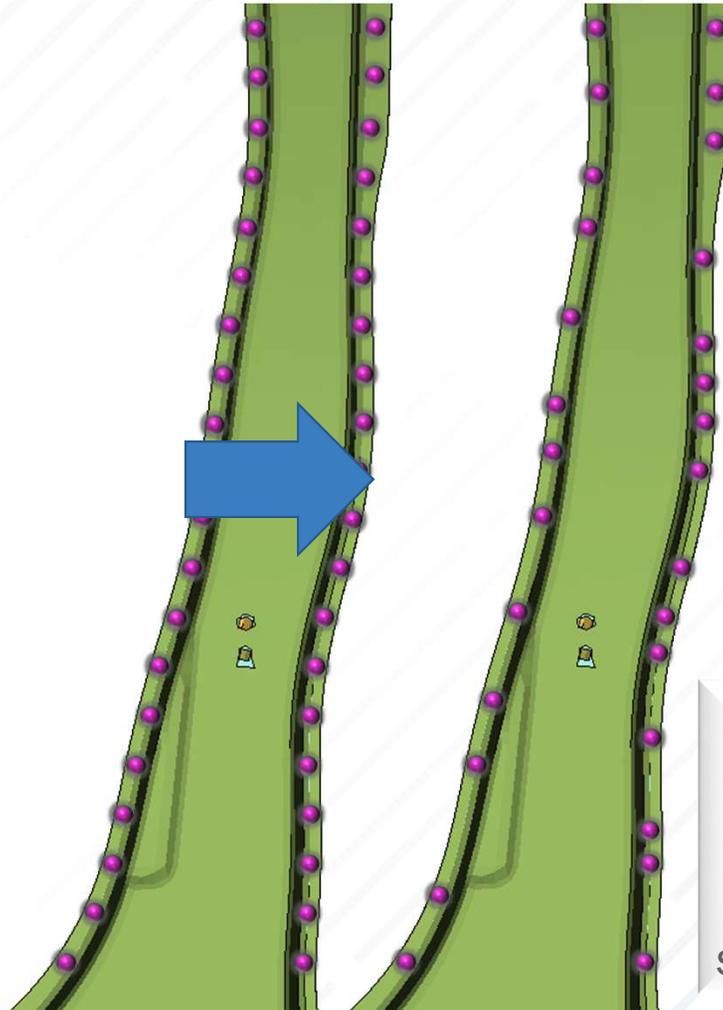
- Current weld optimization approach
- New weld optimization process - Concept
- Case Study: MDO based weld optimization
- Current project with Ford MDO team
- Summary and future work

CURRENT WELD OPTIMIZATION APPROACH

- Current weld optimization process
 - Limited capabilities
 - Computationally expensive
 - Time-consuming
 - Inefficient
- This leads to...
 - Increased cost
 - Manufacturing delays
- We set out to test a process that is...
 - User friendly
 - Robust
 - Time saving
 - Less computationally expensive
 - Multidisciplinary
- Which leads to...
 - Reduced manufacturing cost
 - Increased production speed

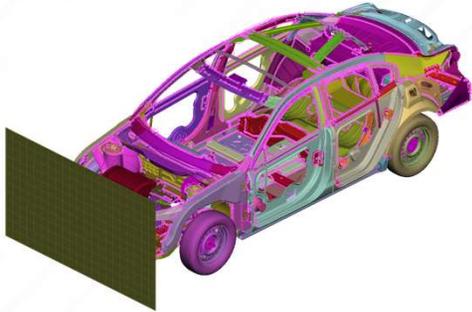


Uniform weld
distribution
High number of
welds



Non-uniform weld
distribution
Overall reduction in
welds
Similar performance

MULTIDISCIPLINARY OPTIMIZATION CASE STUDY

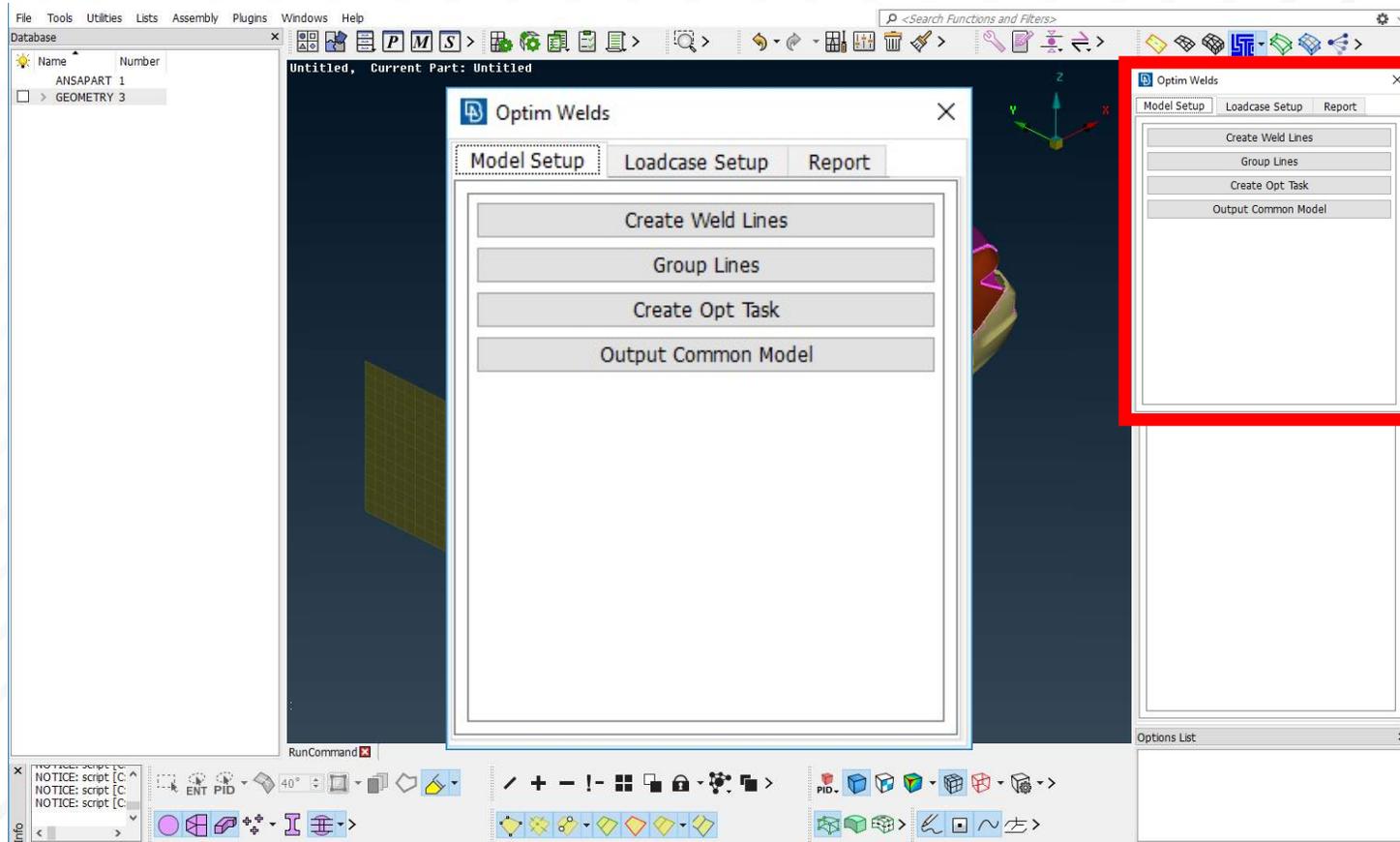


Baseline Design		
Number of Welds	Front Intrusion (mm)	Side Intrusion (mm)
7094	64.7	195.7

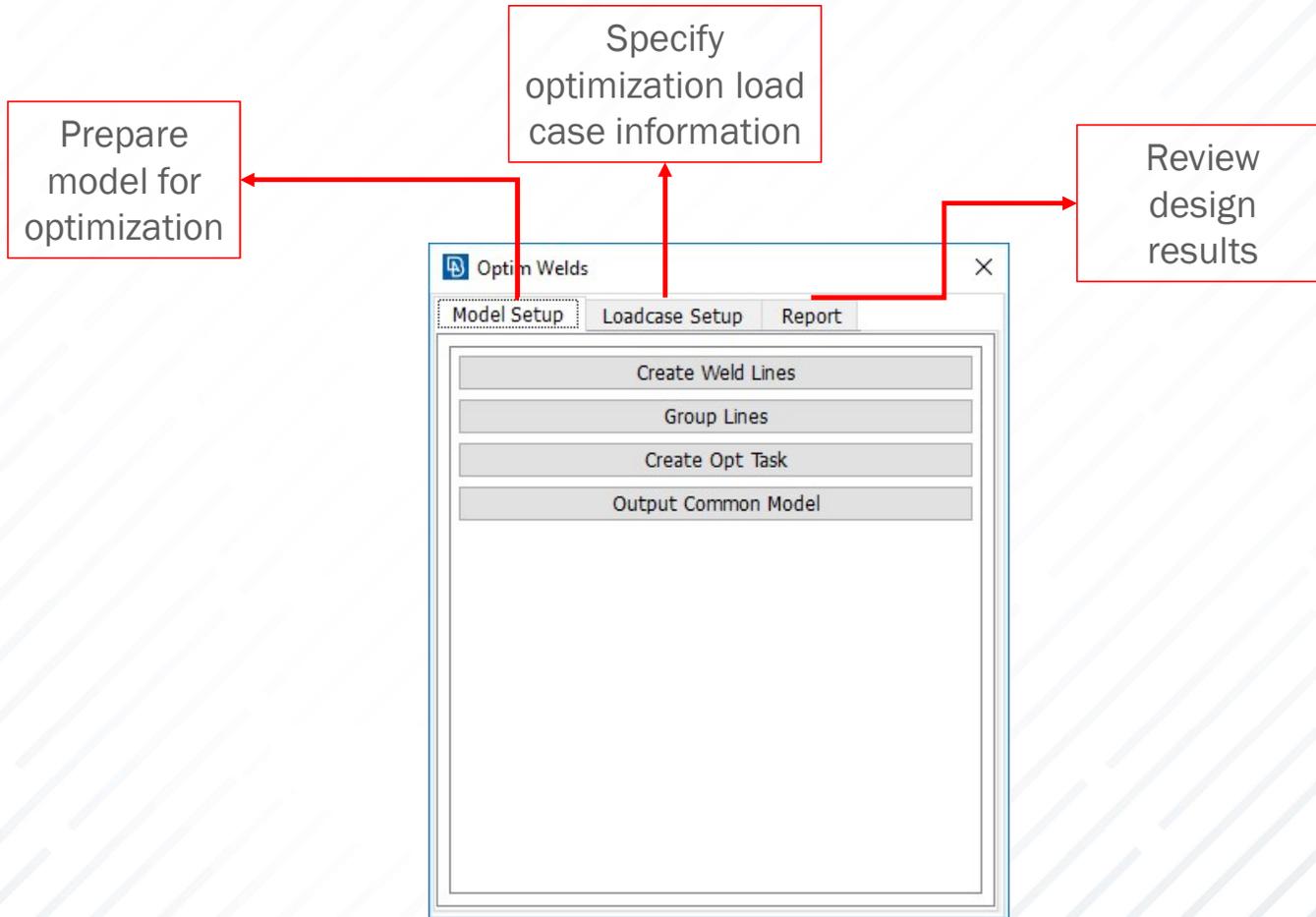


- Open source model simplified for faster simulation.
- Front and side impact cases tested in parallel.
- Spot weld points were converted into lines and parameterized.
- **Objective:** Reduce total number of welds in model.

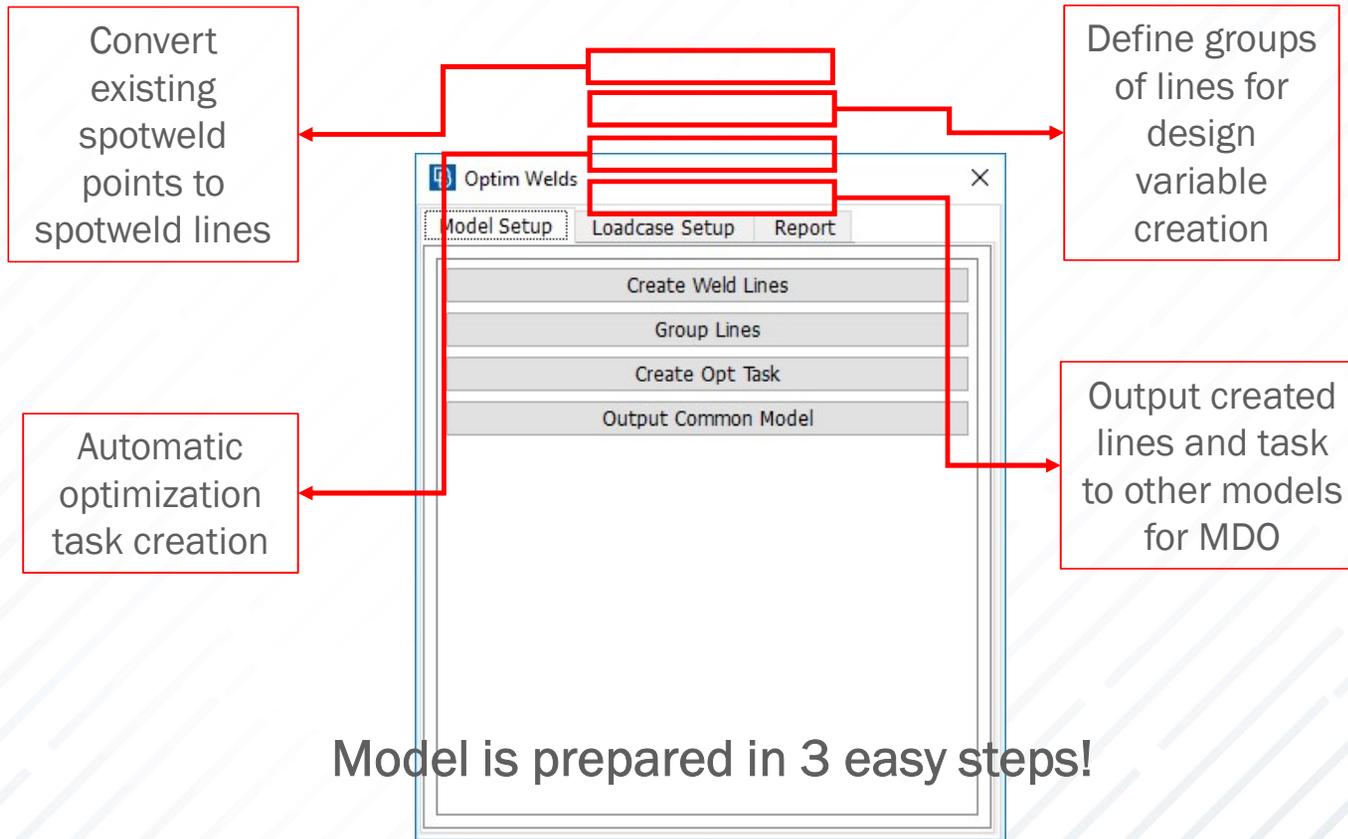
OPTIM WELDS GUI – A PLUGIN IN ANSA



OPTIM WELDS GUI

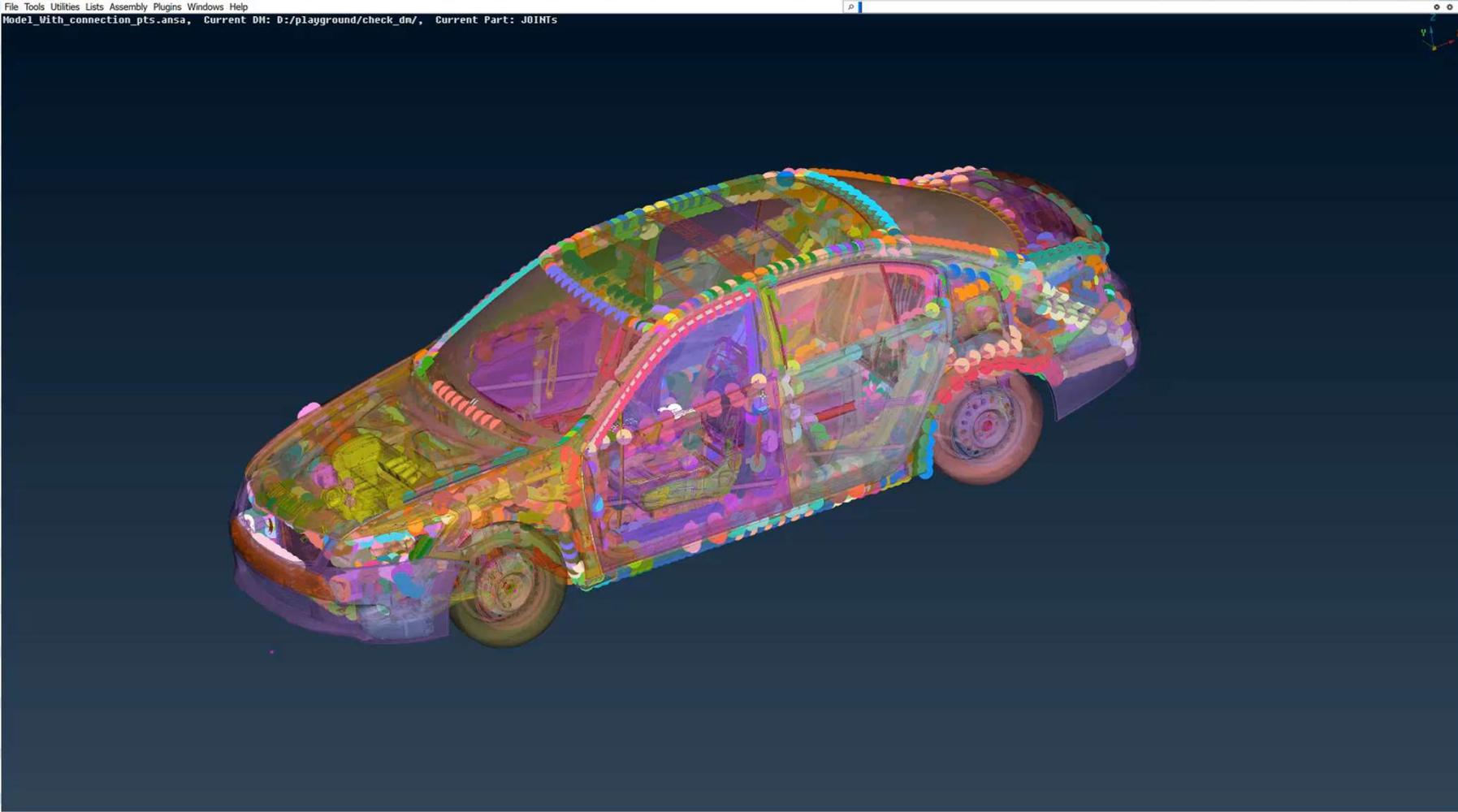


MODEL SETUP

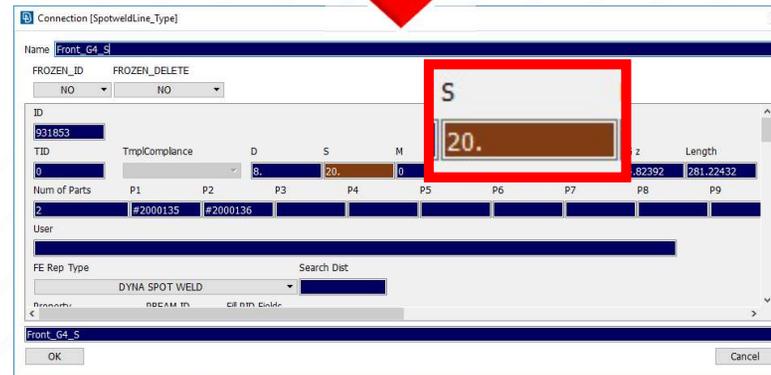
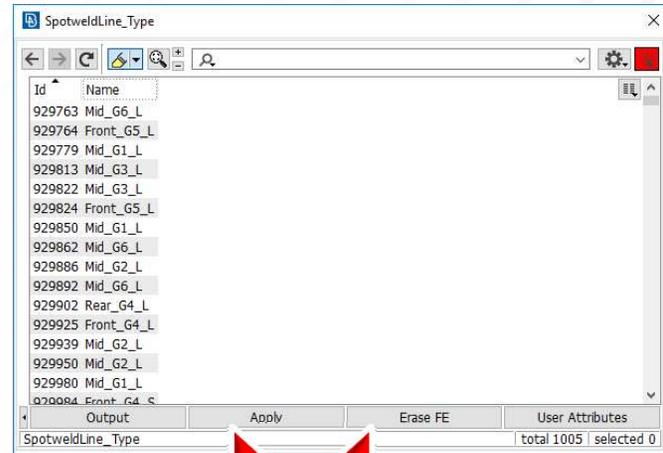
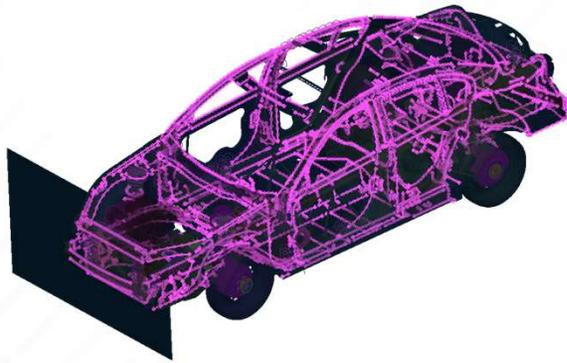


MODEL SETUP

GDIS



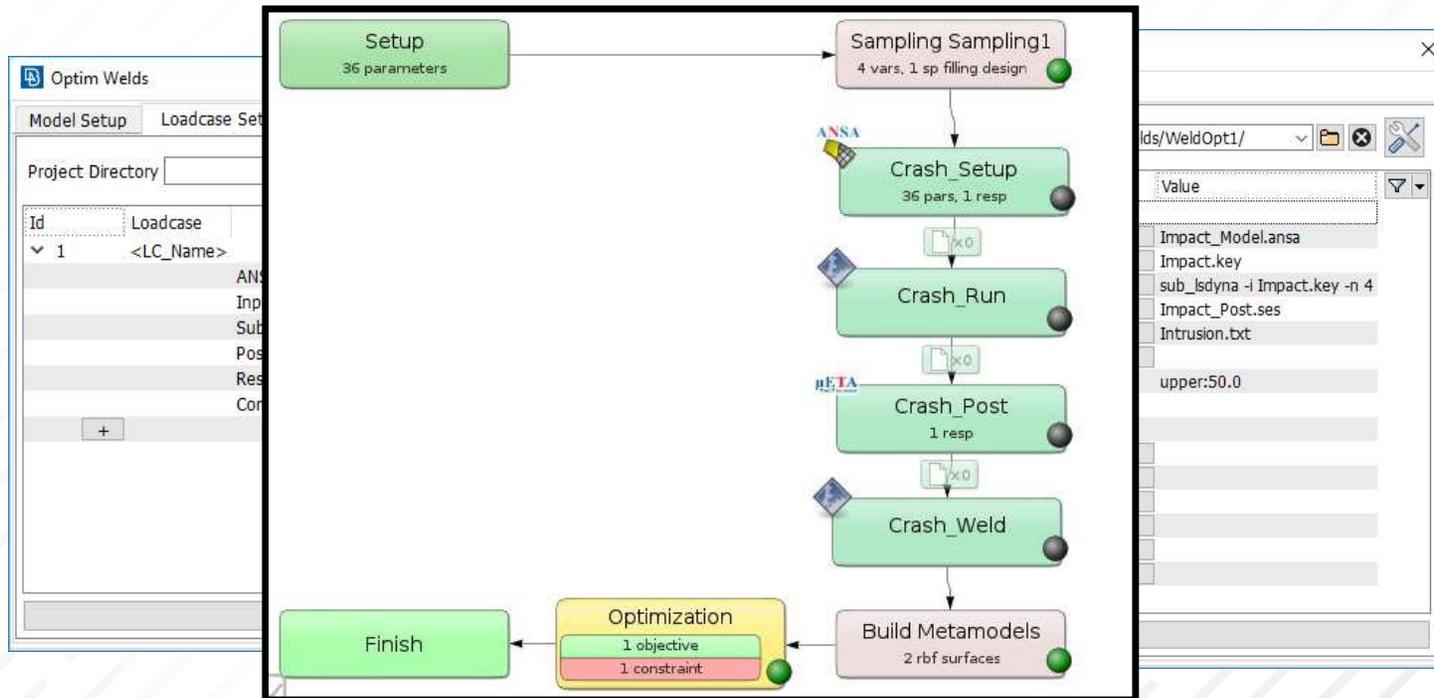
SPOT WELD LINE GROUPING



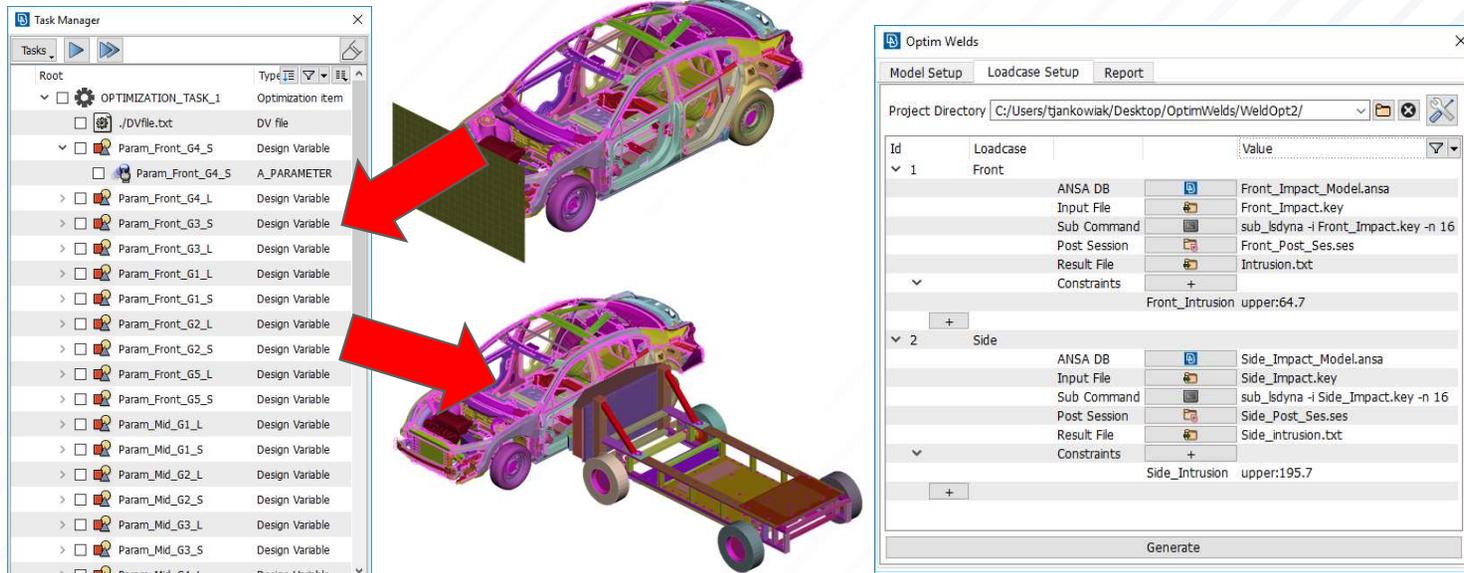
- Lines divided into 16 groups according to location.
- These groups are divided according to length of line.
- A total of 32 groups and design variables were used.

LOADCASE SETUP

- Specify loadcase files and parameters.
- LS-Opt workflow is automatically generated.



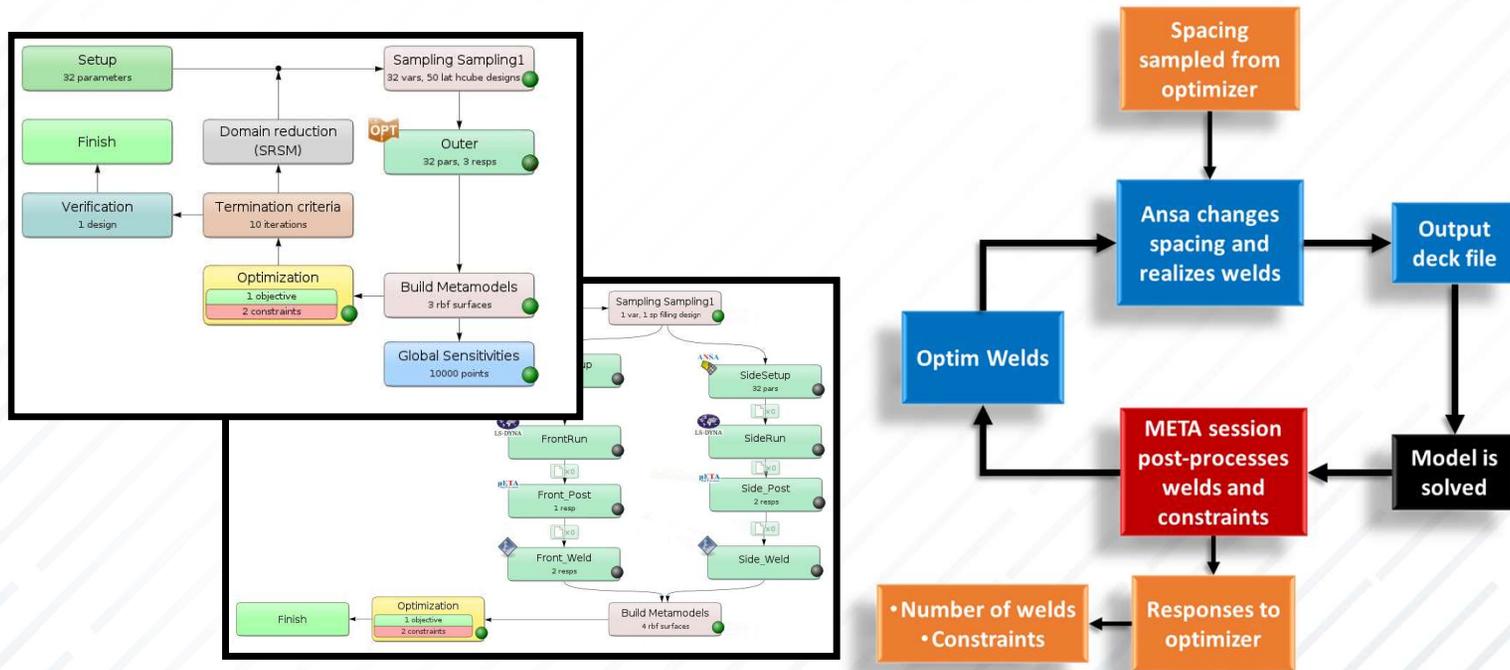
OPTIM WELDS LOADCASES



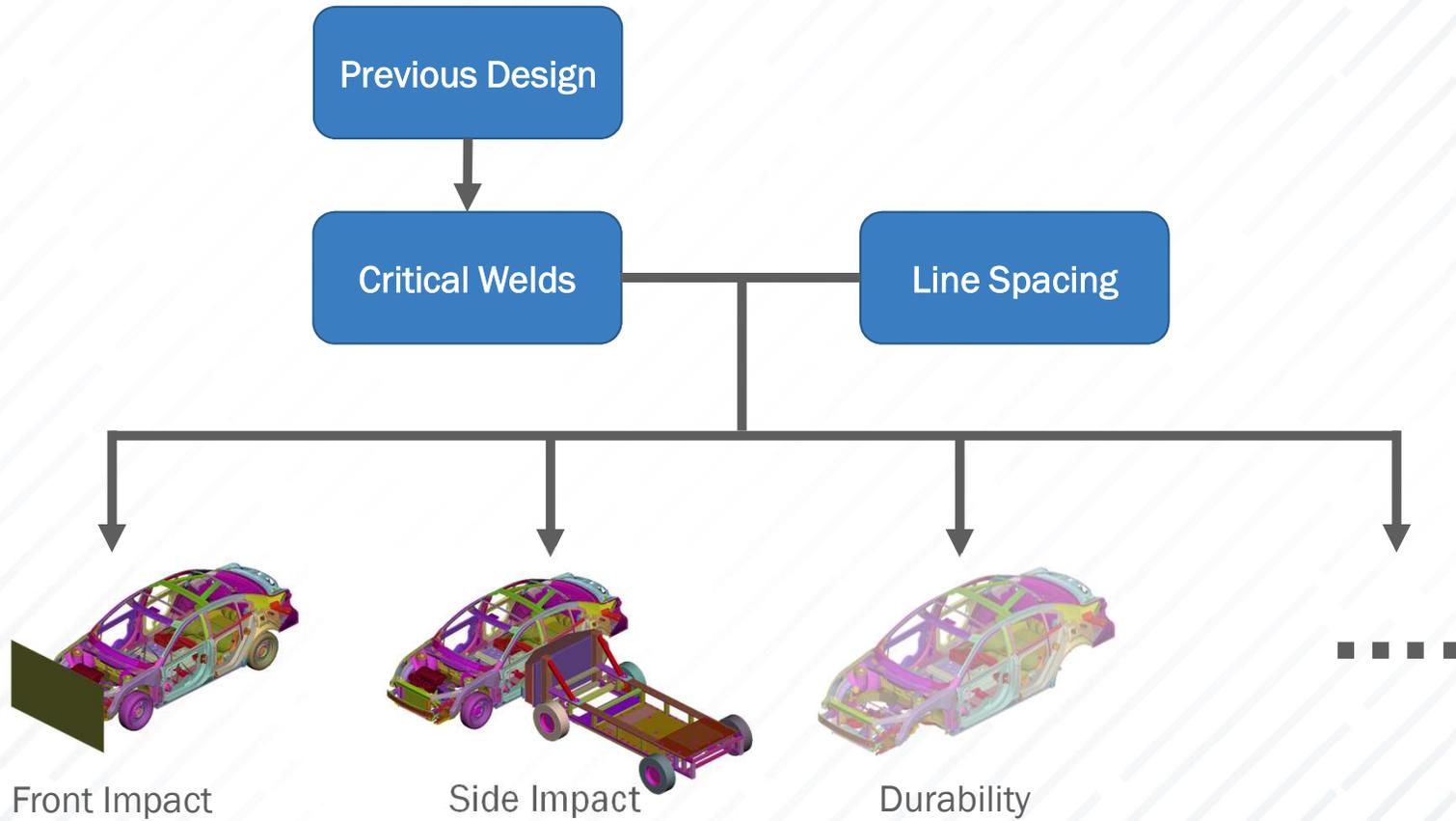
- Optimization task with parameterized lines is created.
- Weld lines along with the optimization task are transferred to any additional loadcases.
- Loadcases are then defined inside Optim Welds.

OPTIMIZATION WORKFLOW

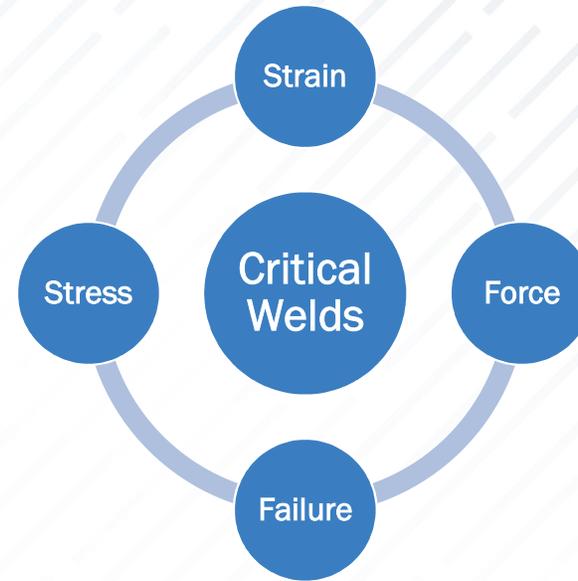
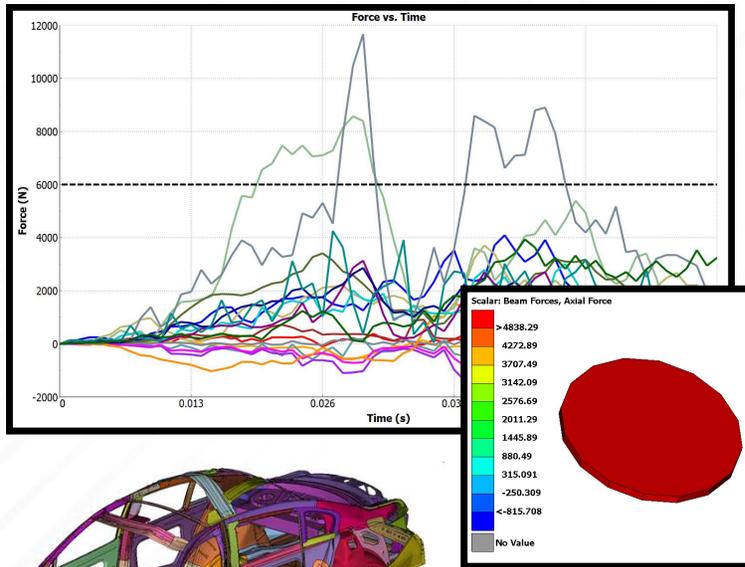
- Optimization process is driven by LS-Opt.
- LS-Opt workflow is automatically generated and executed.
- The optimizer drives the spacing for defined weld groups.



OPTIM WELDS FOR MDO



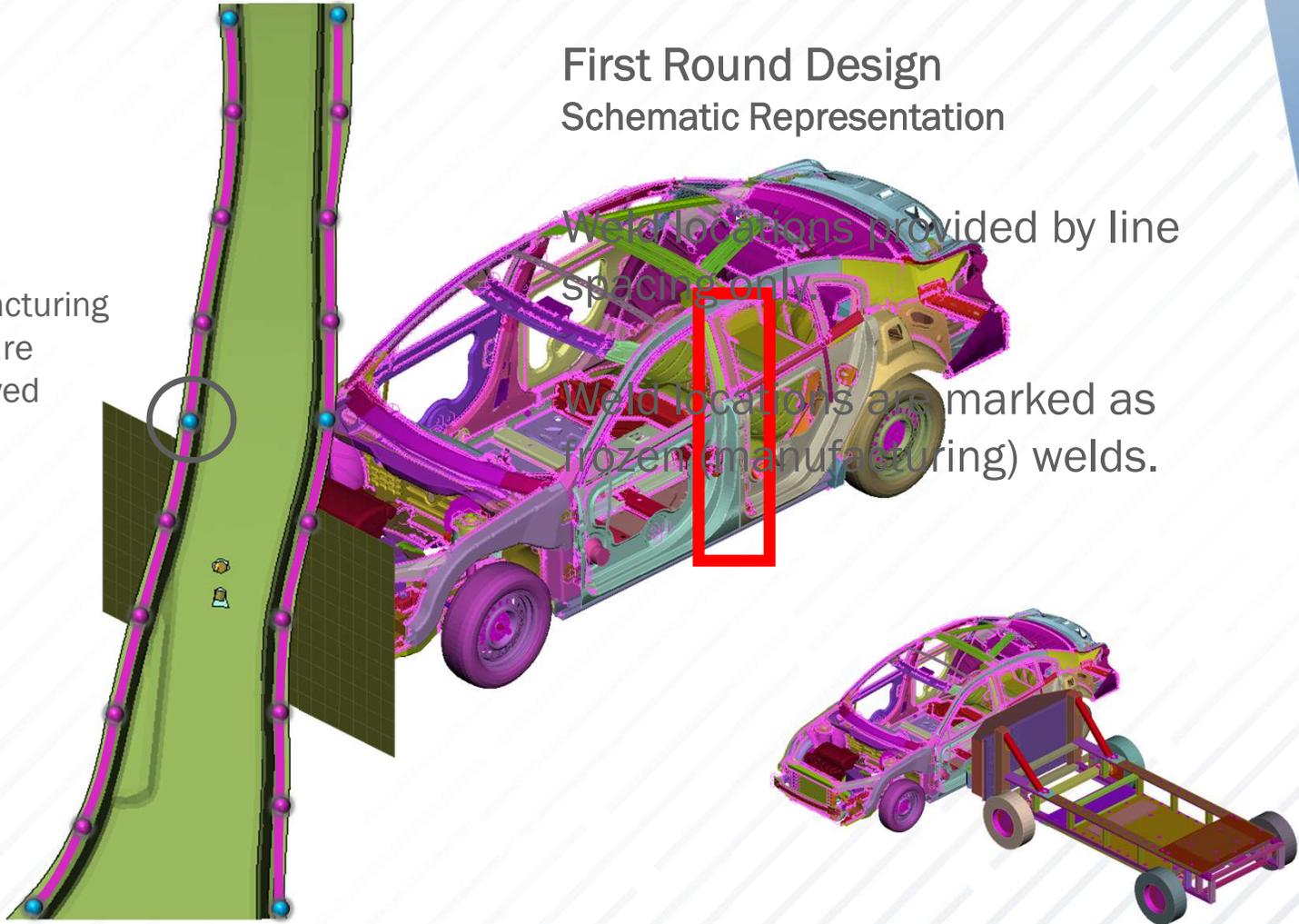
CRITICAL WELDS



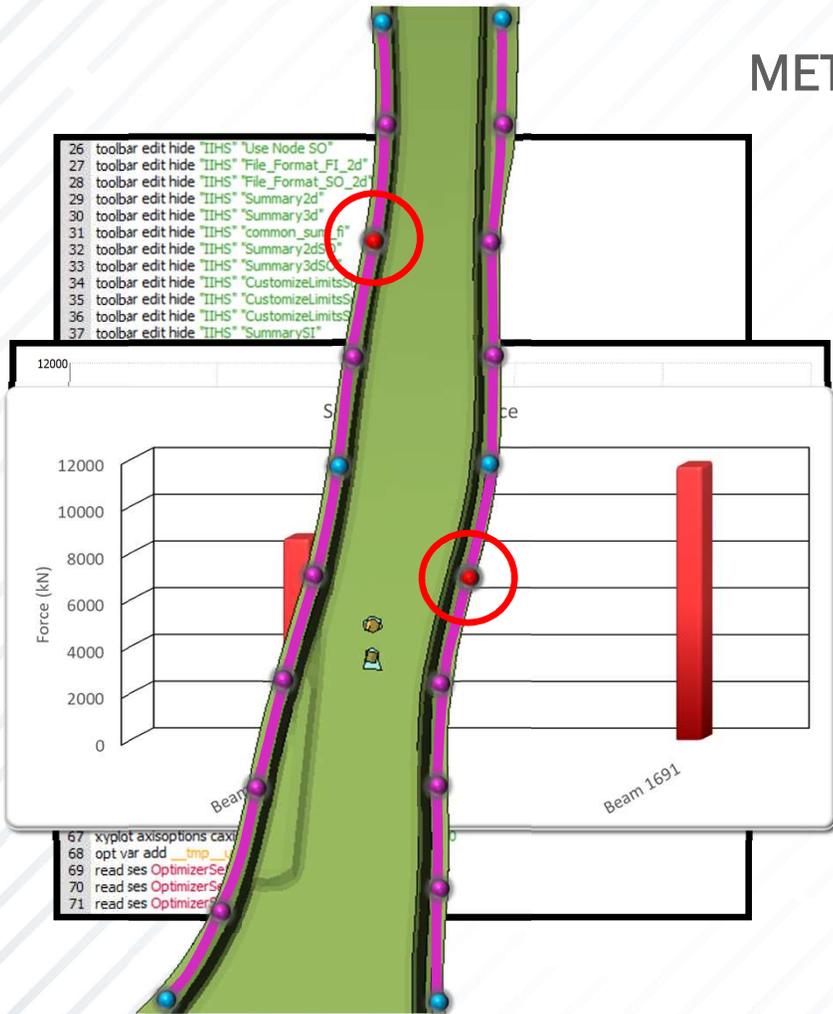
- Welds are post-processed through a META session.
- A weld that passes a user-defined threshold is considered critical.
- These welds are carried over to the next design.
- Connectivity is preserved.

First Round Design Schematic Representation

Manufacturing
welds are
preserved



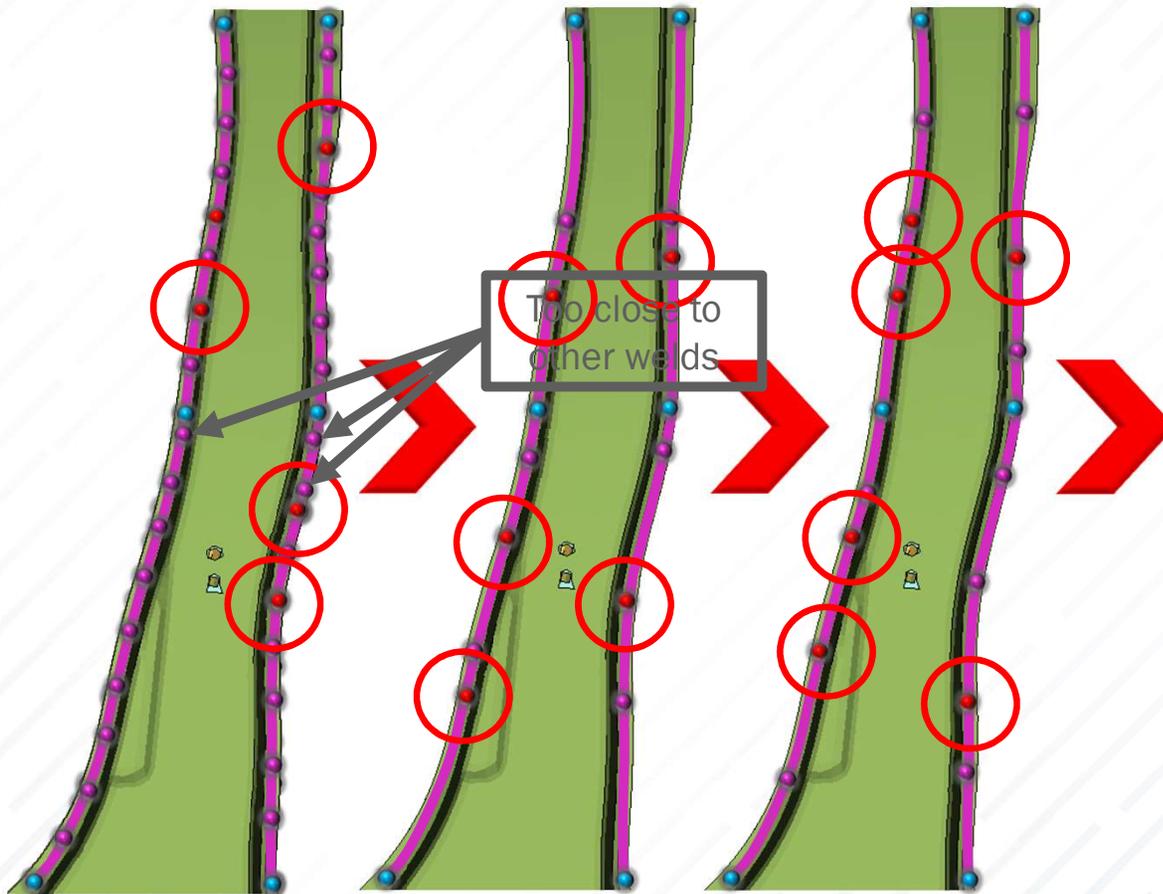
META Post-Processing



Beam force plot is 6000 N for the whole length of the beam. The force plot is plotted.

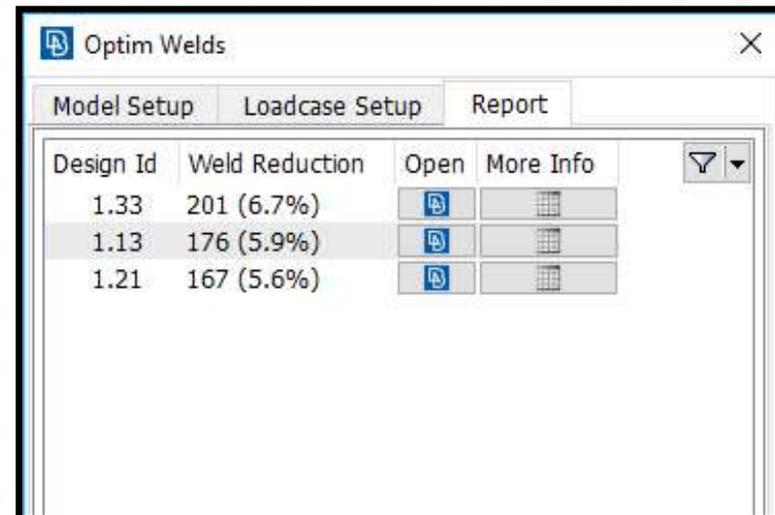
The plot is a very good one for the chimney. It will be significant at the section for the six tubes.

OPTIMIZATION PROGRESSION



REPORT WINDOW

- Best designs are dynamically reported in the GUI.
- Design ID and reduction of welds is displayed.
- Models can be imported for inspection.
- Detailed design info concerning responses can be found under More Info.



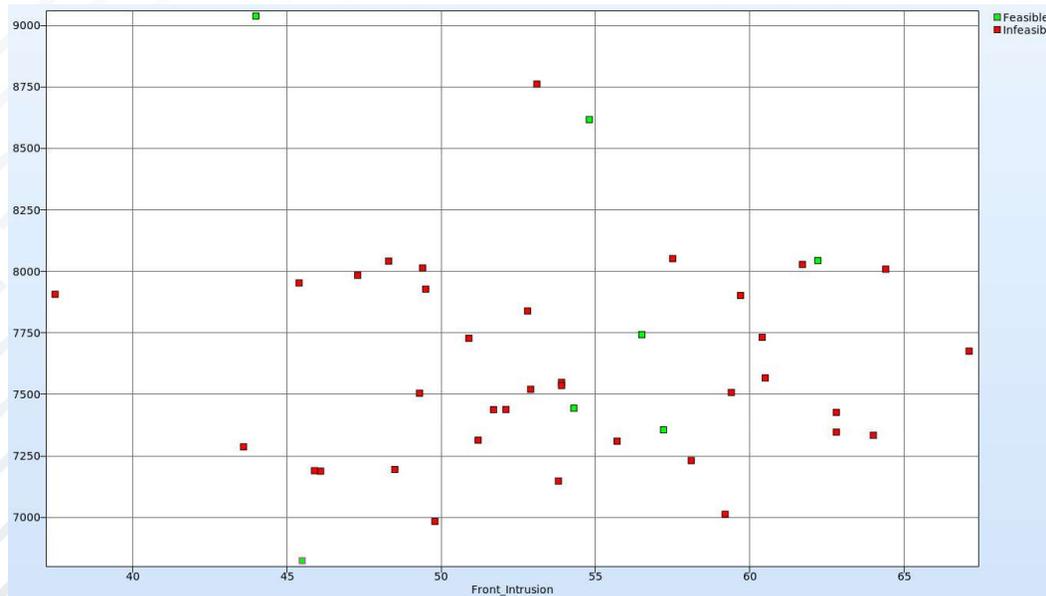
The screenshot shows a software window titled 'Optim Welds' with three tabs: 'Model Setup', 'Loadcase Setup', and 'Report'. The 'Report' tab is active, displaying a table with the following data:

Design Id	Weld Reduction	Open	More Info
1.33	201 (6.7%)		
1.13	176 (5.9%)		
1.21	167 (5.6%)		

OPTIMUM DESIGN

- Optimum design reduced total number of welds in the model by 3.8%

	Number of Welds	Front Intrusion (mm)	Side Intrusion (mm)
Baseline	7094	64.7	195.7
Optimized	6824	60.5	185.3

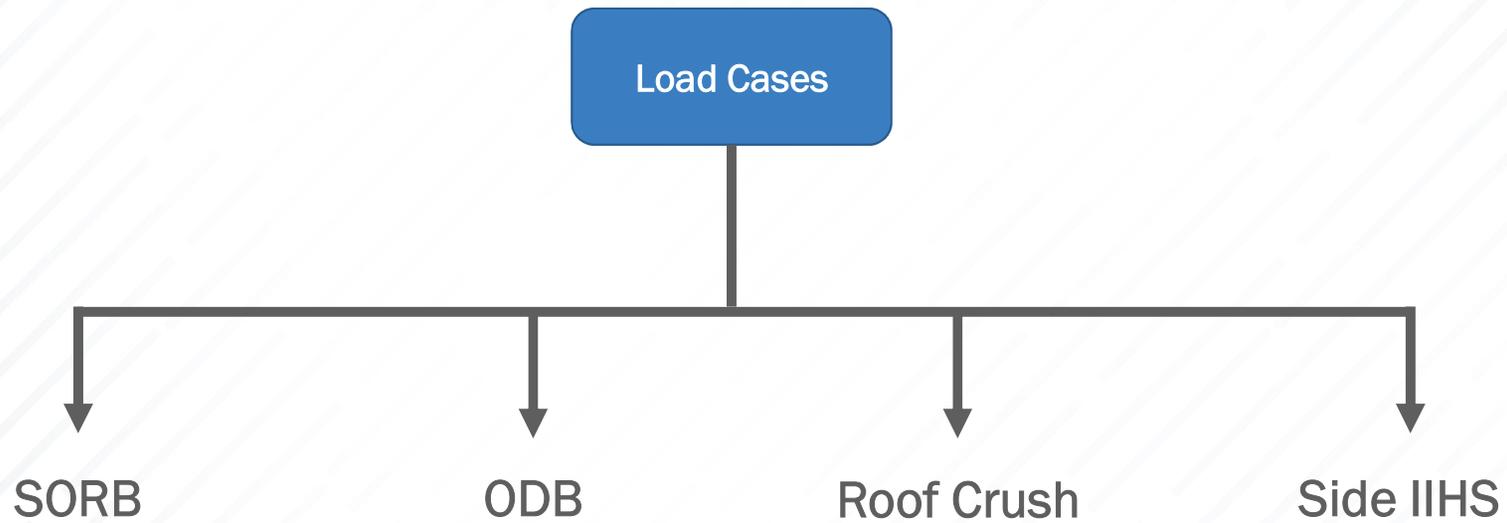


Design Id	Weld Reduction	Open	More Info
2.27	270 (3.8%)		
1.24	143 (2.0%)		
1.40	91 (1.3%)		

CONTINUATION OF WORK

CURRENT PROJECT WITH FORD MDO TEAM

CURRENT PROJECT WITH FORD MDO TEAM



CONCLUSIONS

- Optim Welds process is able to reduce overall number of welds in a vehicle or assembly
- Extremely flexible and allows users to optimize with multi-discipline models
- Fewer number of runs compared to traditional spotweld line optimization
 - Important welds are targeted and non-critical welds are free to be deleted
- Non-uniform distribution of welds means more efficient weld placement
- Reducing the number of welds leads to:
 - Faster production
 - Cost savings: 270 welds removed, Assuming 5000 cars/week

\$/Weld	\$/Car	\$/Week	\$/Year
0.05	13.5	67,500	3,510,000

THANK YOU

Q & A

Ravi Nimbalkar
BETA CAE Systems USA, Inc.
ravi@ansa-usa.com

GREAT DESIGNS IN STEEL

Presentations will be available for download on SMDI's website on Wednesday, May 22