

Multi-Shape Modeling of Line Welds in Crash Models using ANSA

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Acknowledgments & Team

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- Motivation and History
- CAE Approach and Implementation
- Pre-processing
 - CAD XML Heritage
 - Templates
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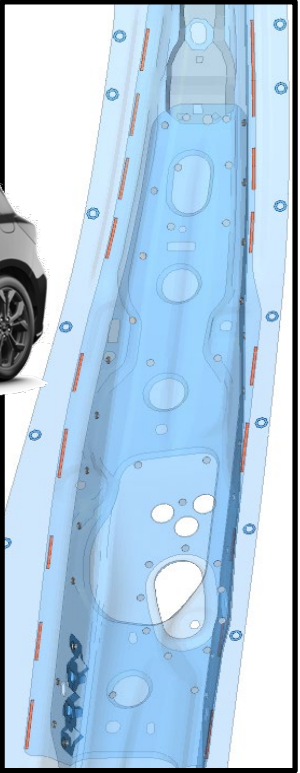
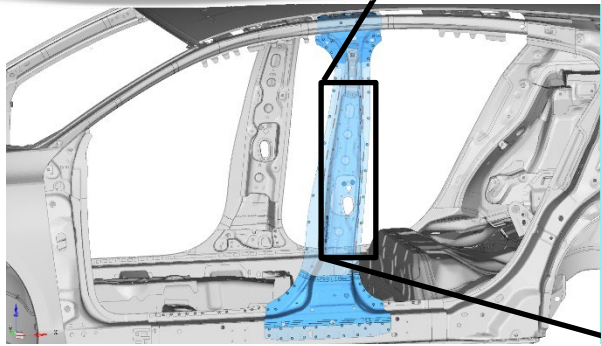
Motivation

- Examples

Explorer: gas metal arc welds



Focus: laser beam welds

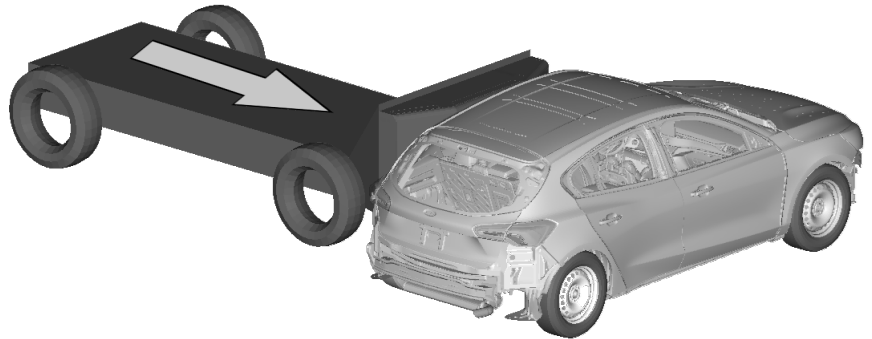


Line welds are well known and several applications are in production!

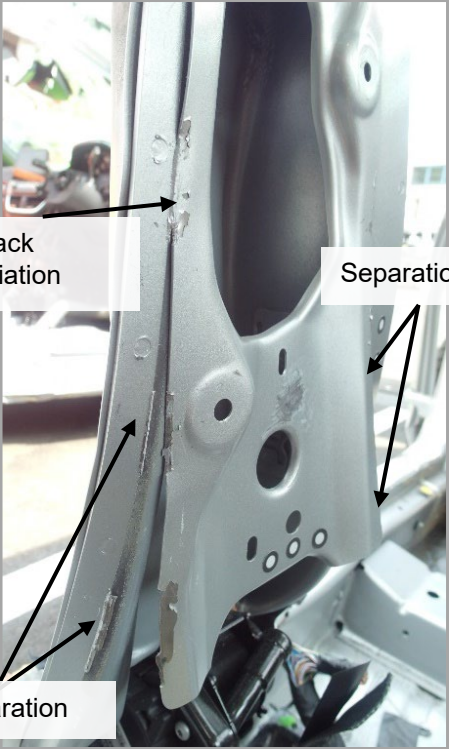
History

- Prototype example

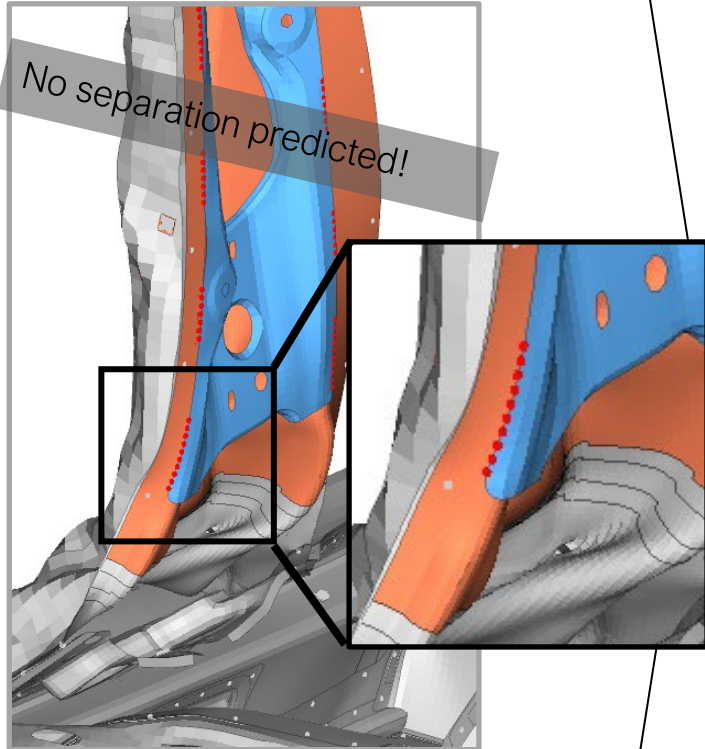
Test Setup



Test results



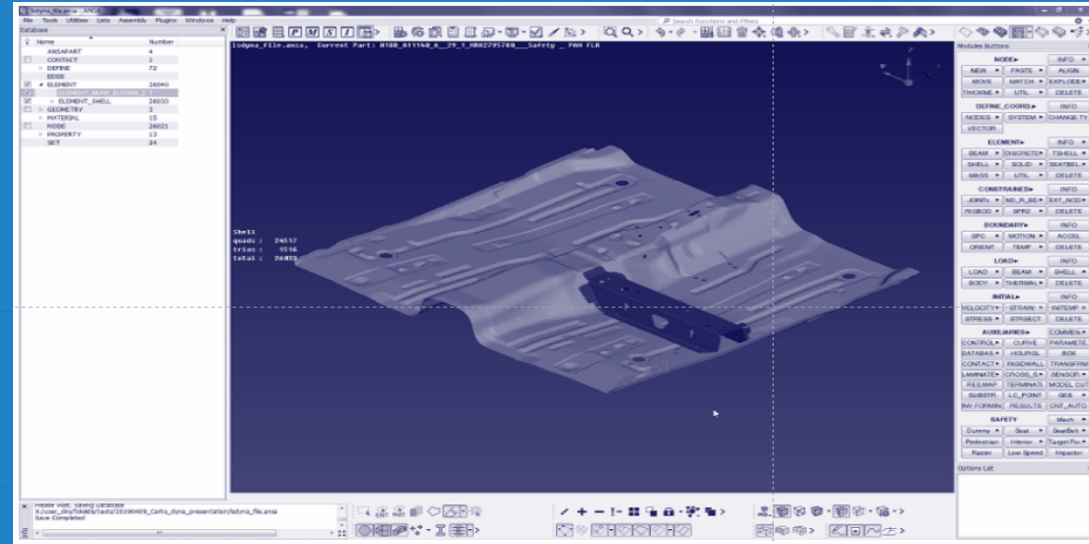
Heritage approach



Virtual Design and digital sign-off require highly predictive approaches

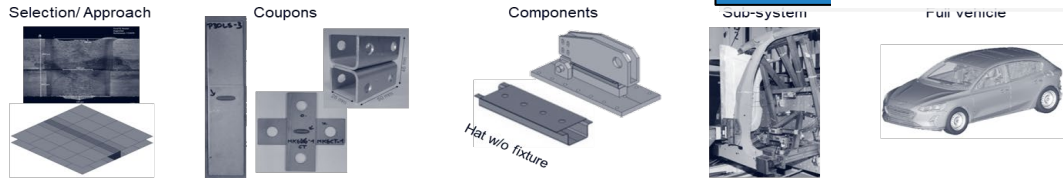
CAE Approach and Implementation

Implementation at Ford Product Development



Development of a highly predictive CAE approach

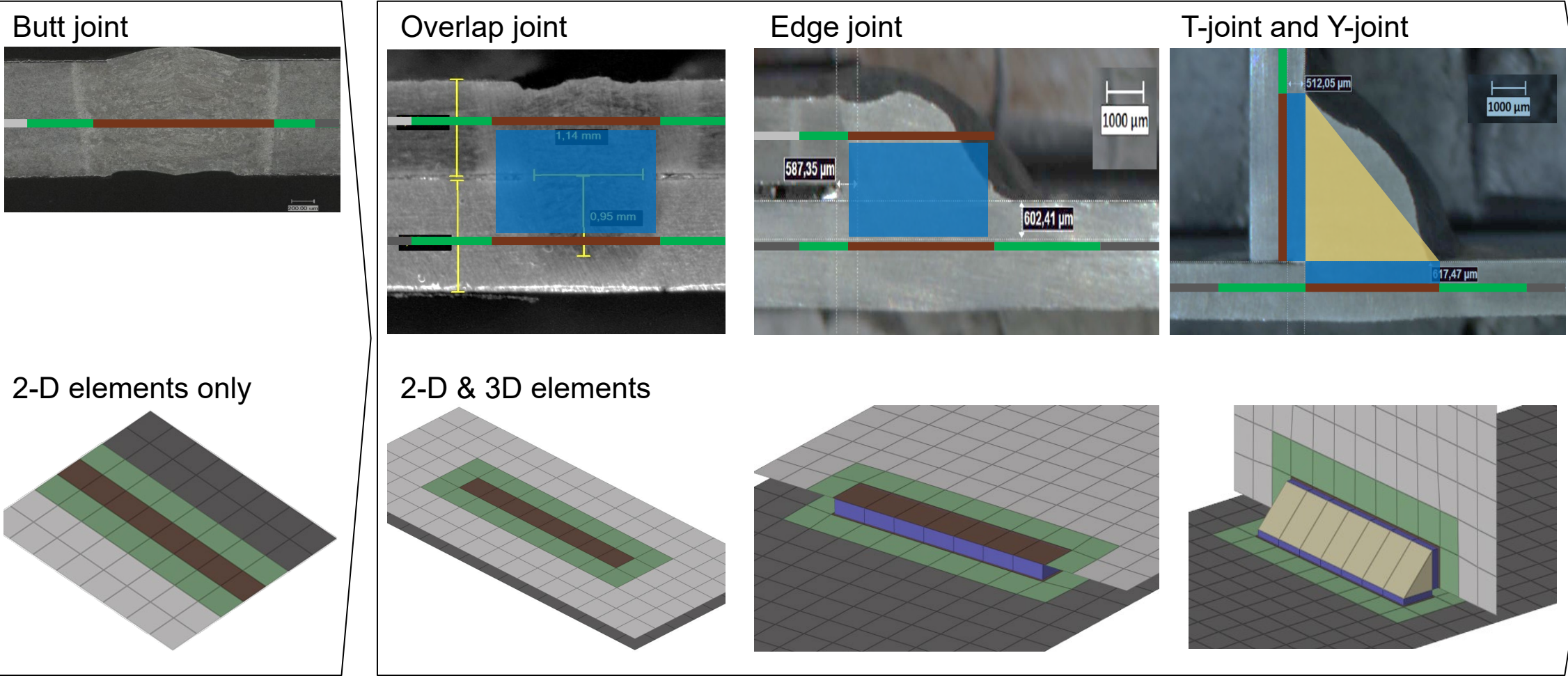
Load case comp



Consideration of user-friendly and effective implementation for model build

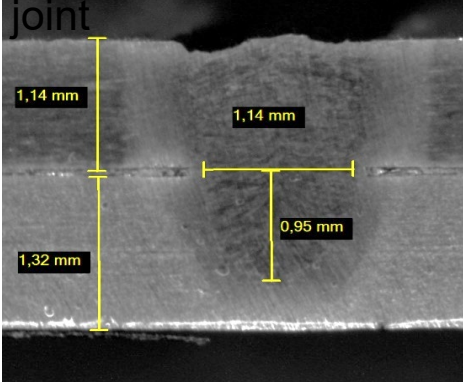



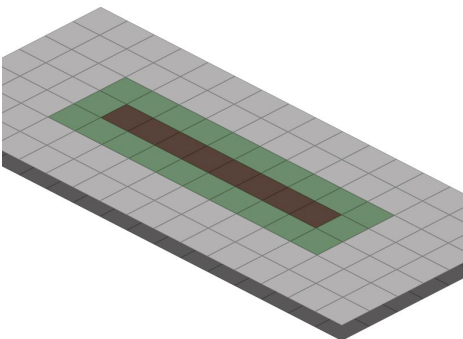
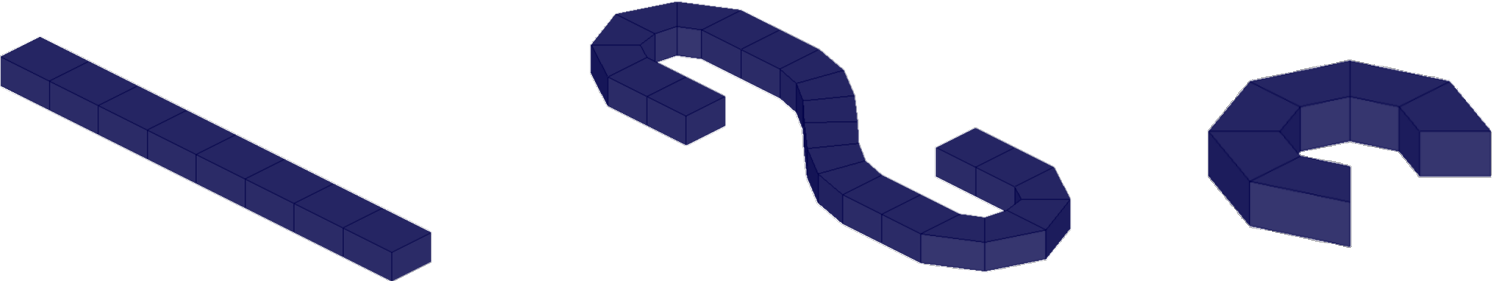
From Physical Line Weld to CAE Approach

- Physical x-sections and CAE line welds



Overlap Connection and CAE Shape

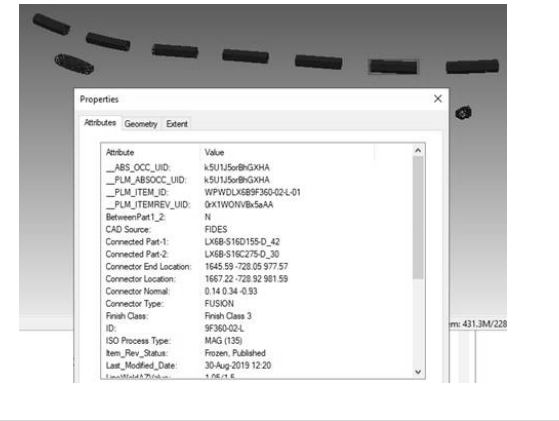
- Different overlap joint geometry and corresponding FE realization of weld line

<p>Overlap joint</p> 	<p>Stitch</p> 	<p>S-shape</p> 	<p>Circle</p> 
<p>2-D & 3D elements</p> 	<p>Geometry design 3D weld line elements</p> 		

CAD to Automated FE Relization

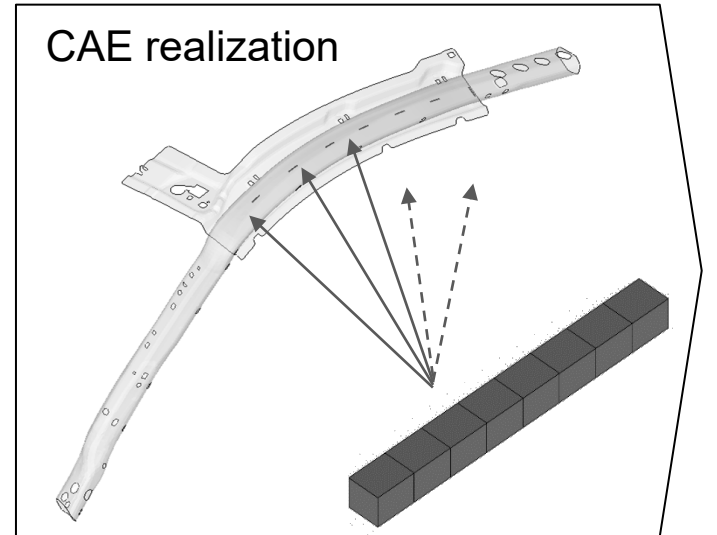
- Implementation of meshing automation into commercial software tools available at Ford

CAD information



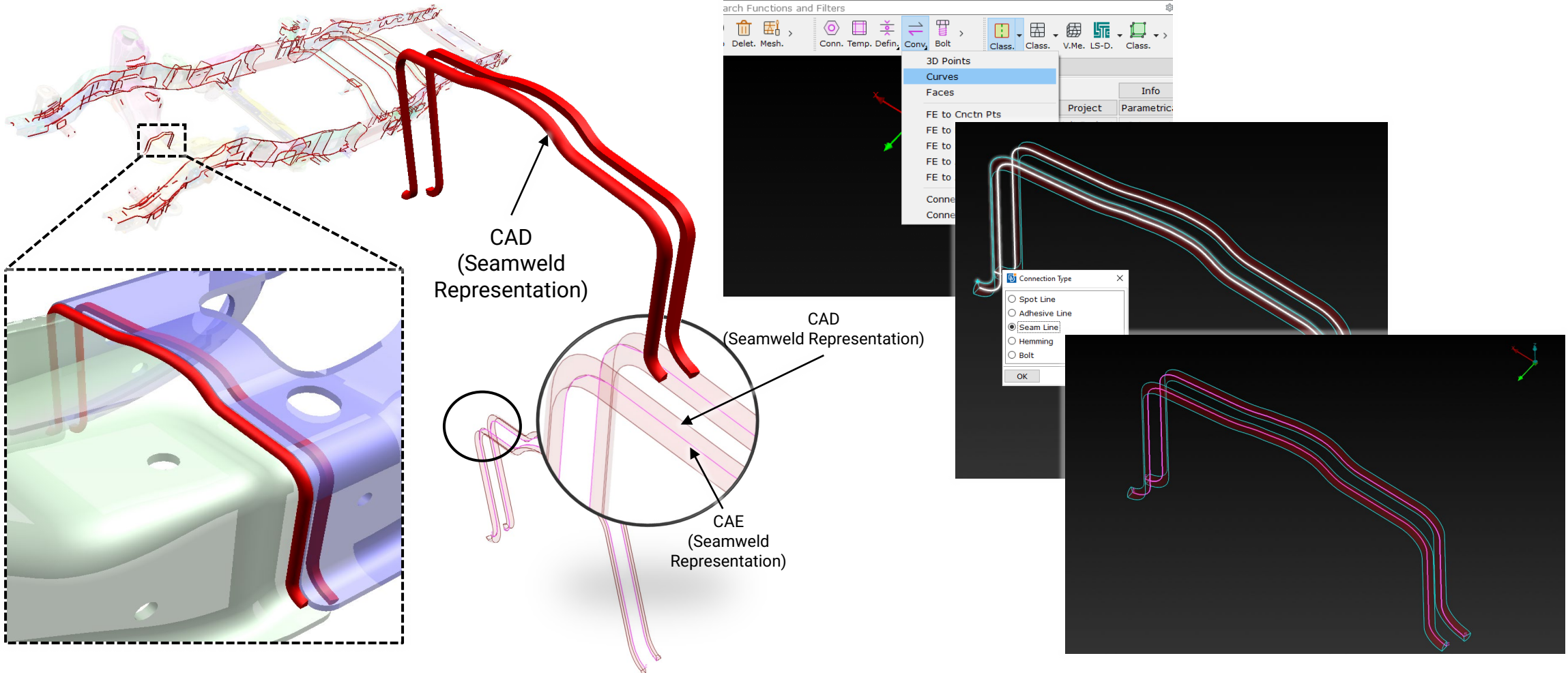
Cooperation → BETA CAE Systems and Ford

CAE realization



Pre – Processing of seamlines in ANSA

From CAD Data to ANSA Seamlines



CAD (Seamweld Representation)

CAD (Seamweld Representation)

CAE (Seamweld Representation)

arch Functions and Filters

3D Points

Curves

Faces

FE to Cnctn Pts

FE to

FE to

FE to

FE to

Conne

Conne

Connection Type

Spot Line

Adhesive Line

Seam Line

Hemming

Bolt

OK

CAD data can be easily translated to CAE seamline connections

From XML File to ANSA Seamlines

```

<connection_list>
<connection_id>
<id> 100024 </id>
<type>seamweld</type>
<loc_list>
<loc> 1078.63545 -31.541872999999995 596.04401 </loc>
<loc> 1079.1559500000003 -61.535523999999995 596.04401 </loc>
</loc_list>
</connection_id>
</connection_list>

```

Connection [SeamLine_Type]

Name: EDGE_JOINT_GMAW

Main Misc

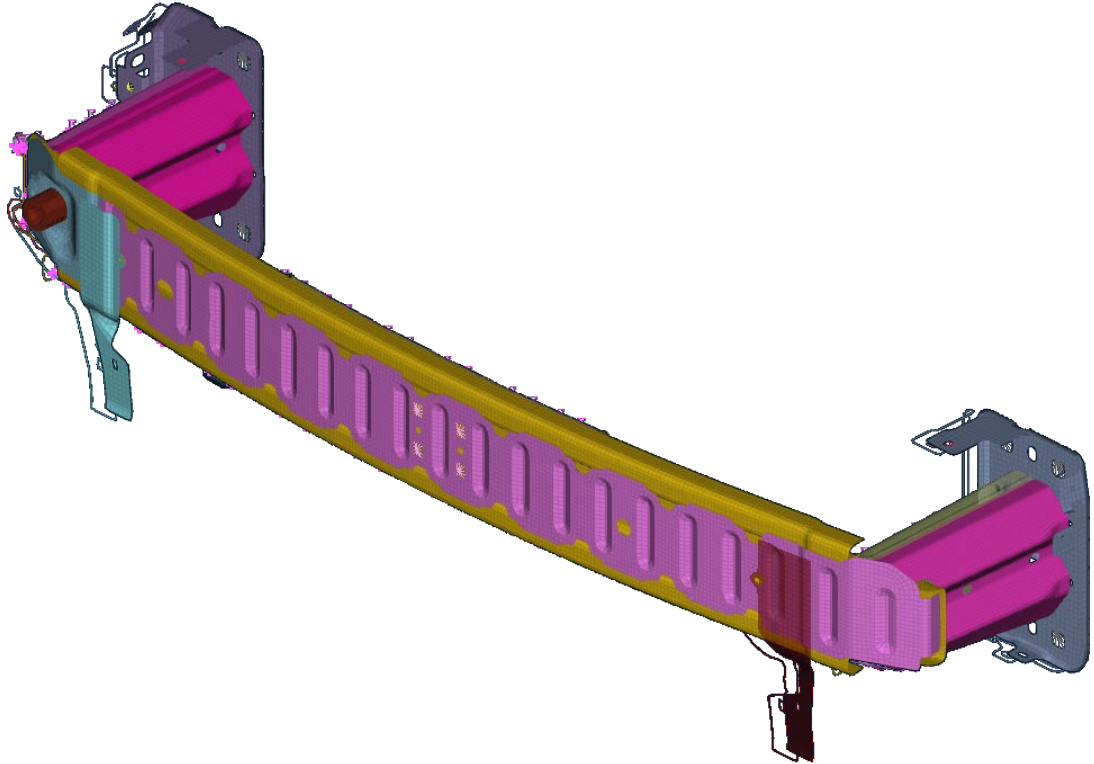
ID								
100027								
TID	TmplCompliance	W	M1	M2	COG x	COG y	COG z	Length
0		3.74978144	0	0	1088.57817	232.411082	596.04401	29.9980964

Num of Parts	P1	P2	P3	Status	Error Class
2	#421004	#421006			No FE Rep.

User

FE Rep Type: <none>

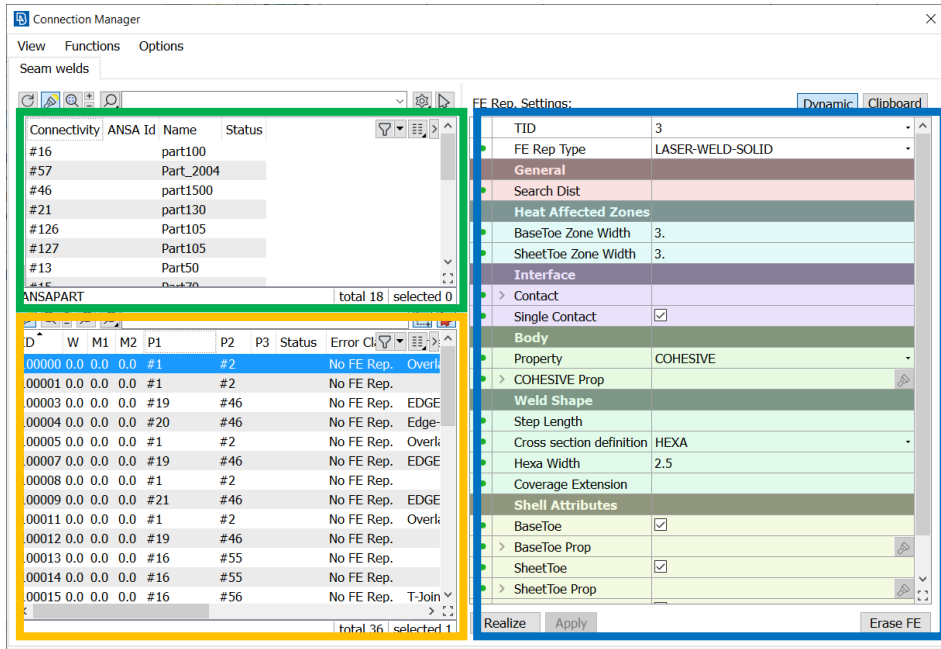
OK Cancel



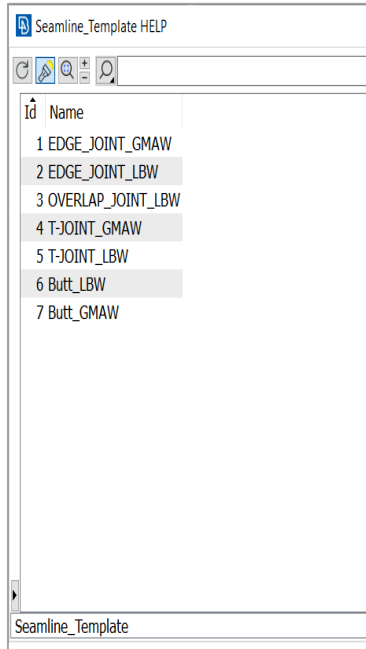
XML file can be read and seamline connections can be created holding all the appropriate info

ANSA Seamline Templates

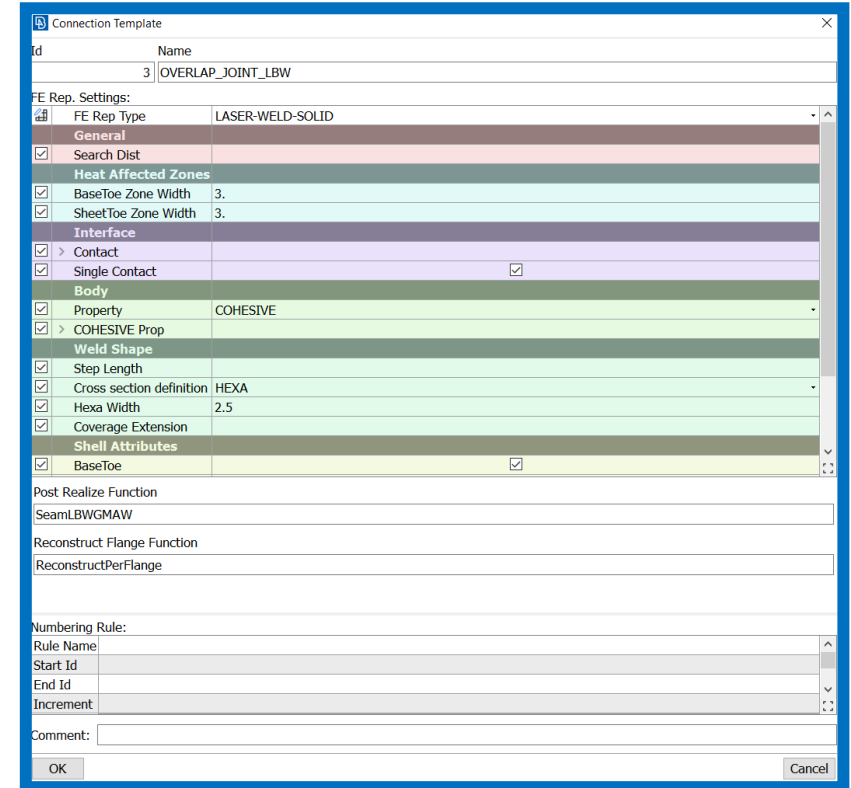
Connection Manager



Templates list

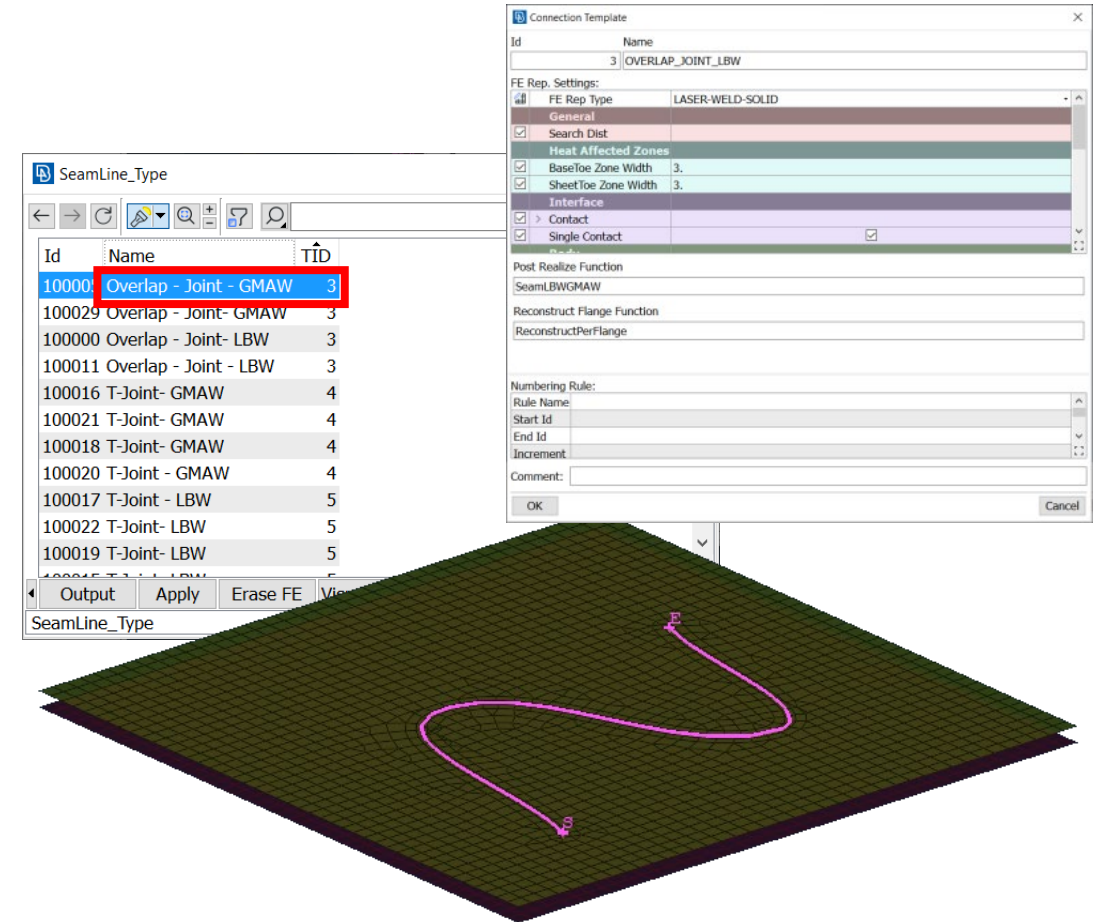
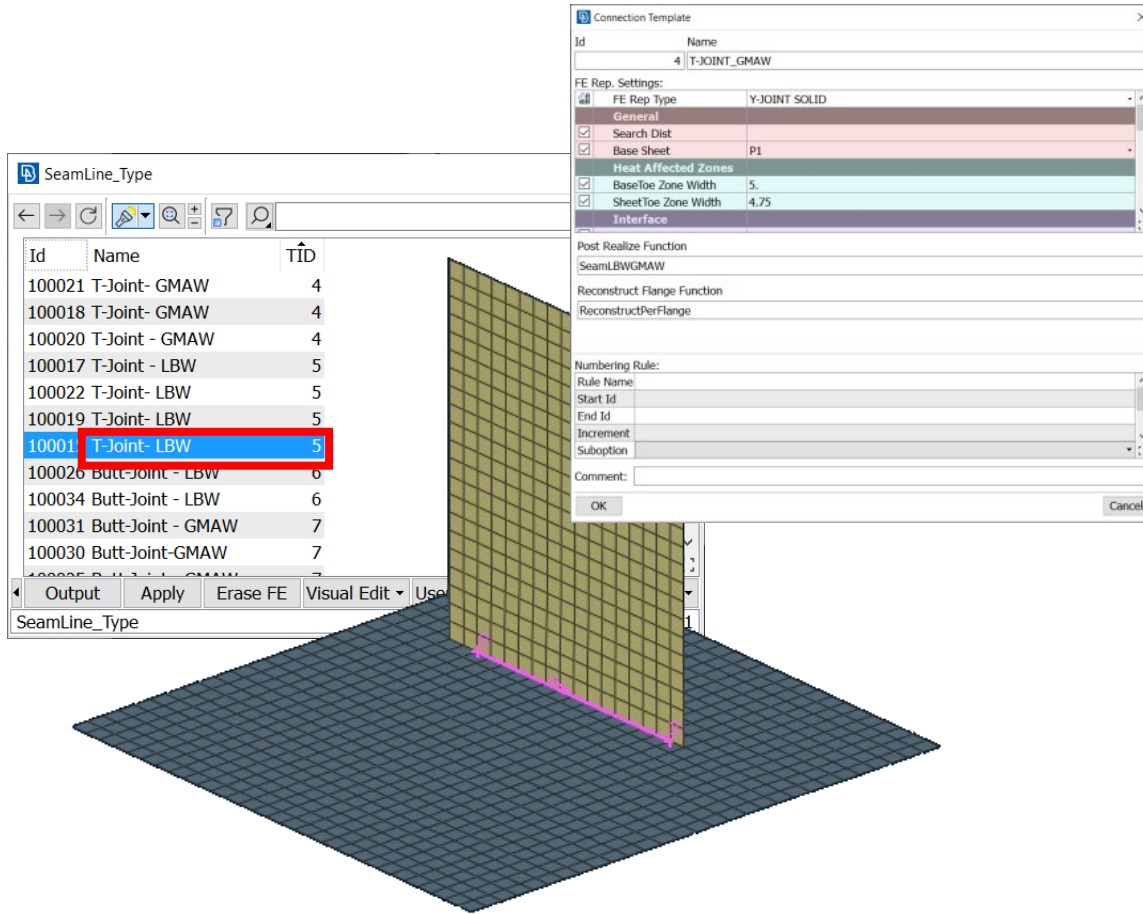


Templates example



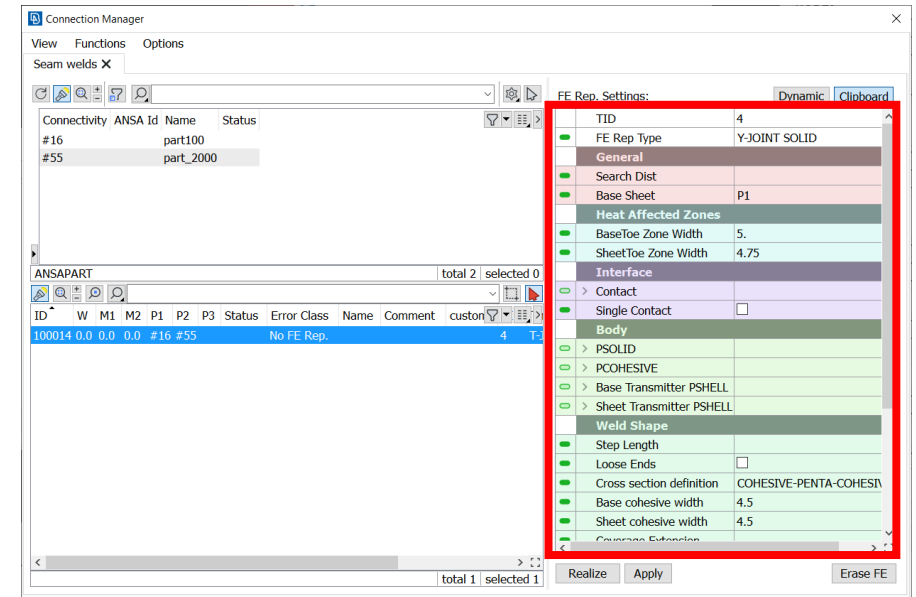
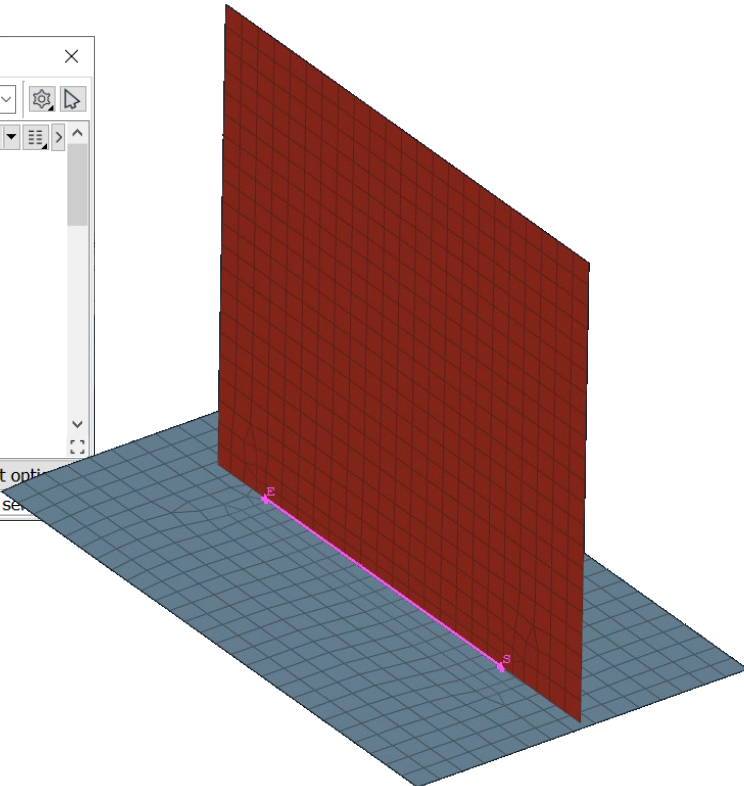
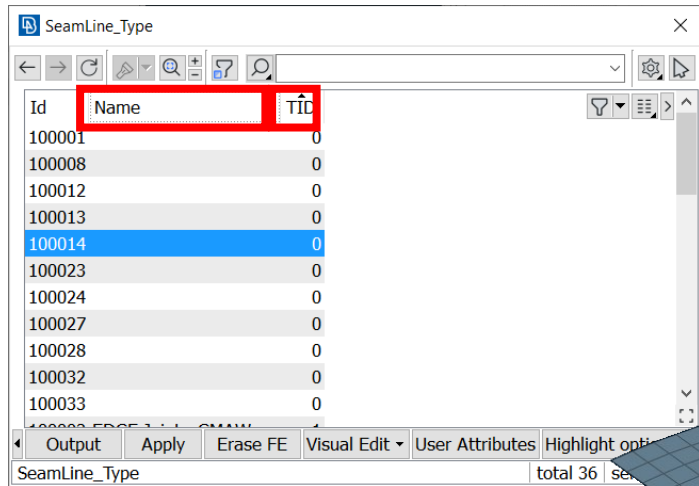
FE-Representation settings can be assigned to a template for each seamline type

Automated Templates Assignment



Templates are automatically assigned according to the connection name

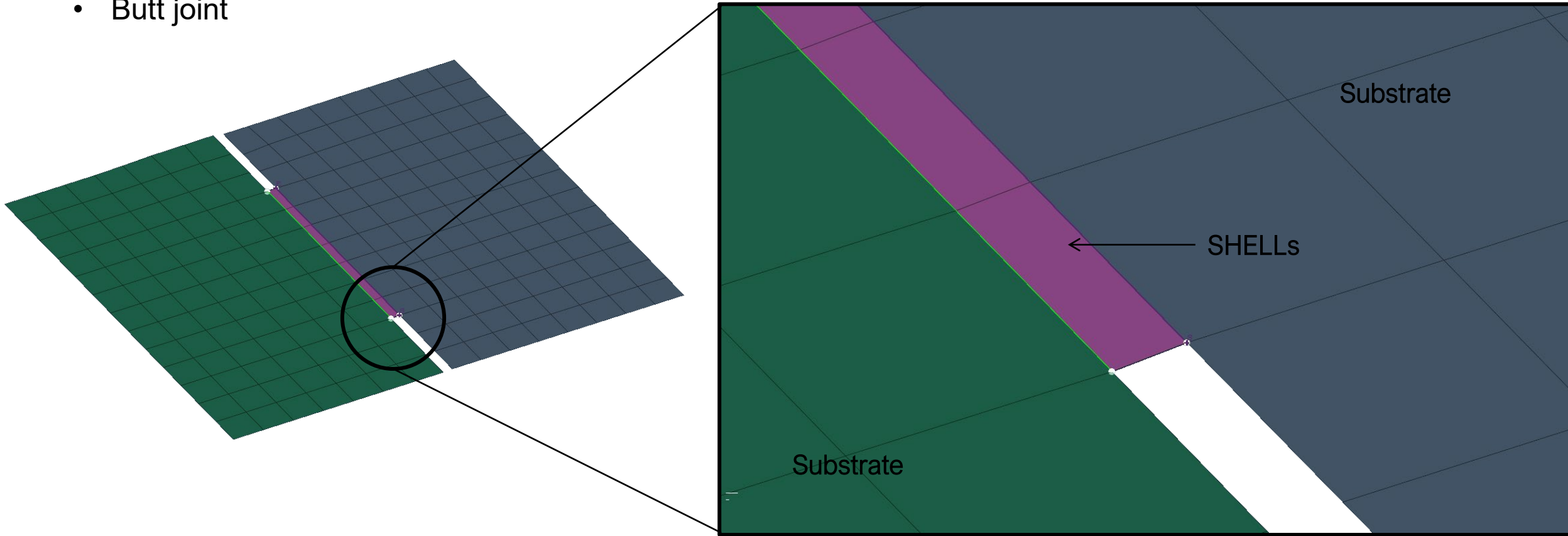
Manual Template Selection



A template can be assigned to a connection at any time during the assembly process

FE-Representations for Seamlines

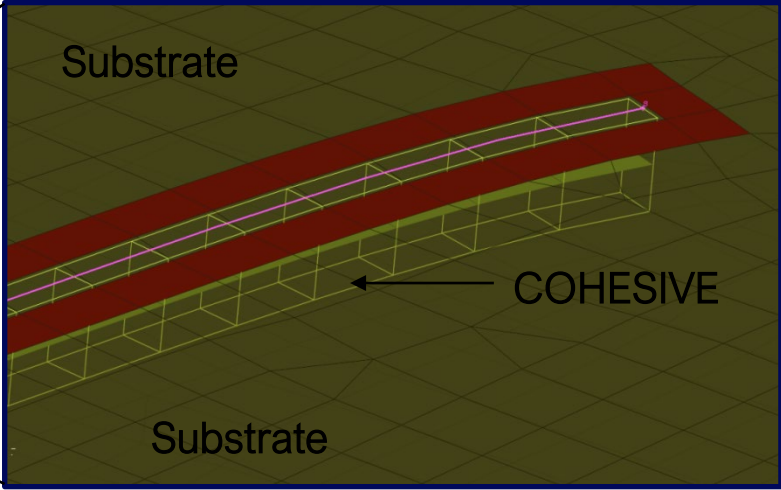
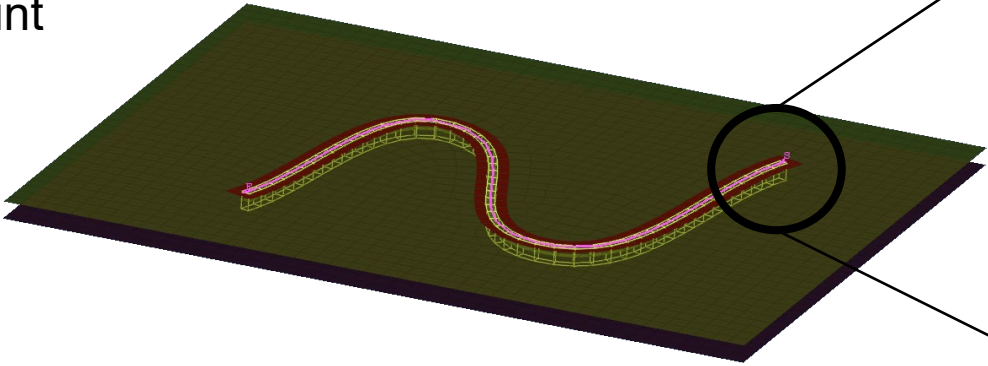
- Butt joint



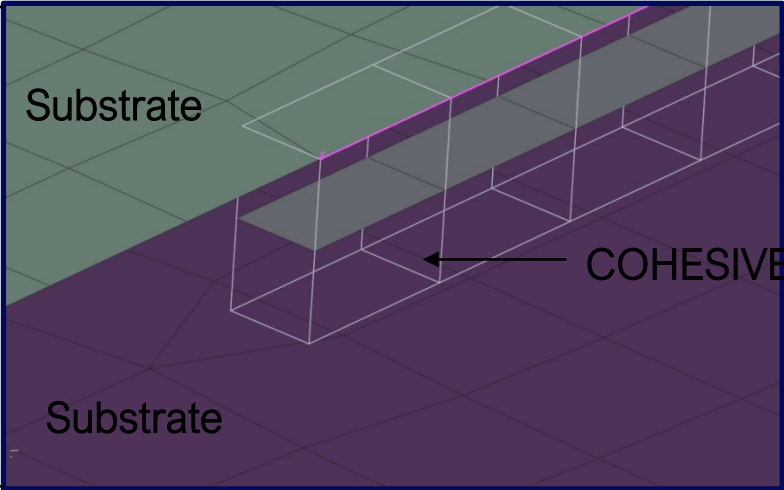
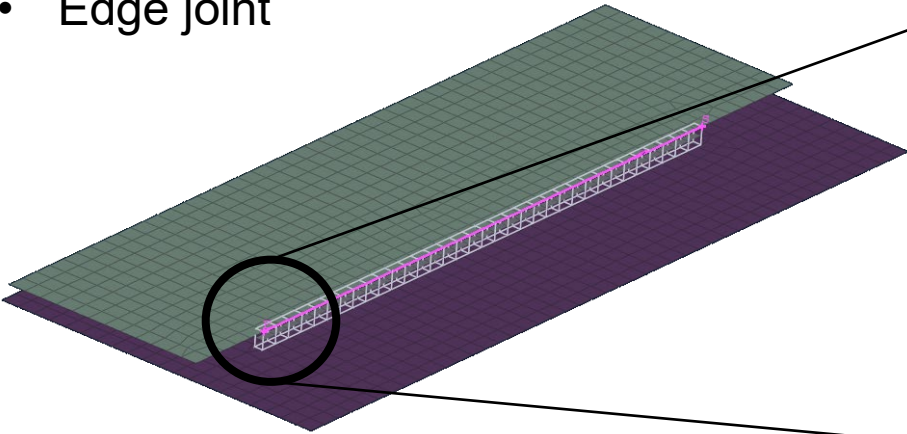
Butt Joint: SHELLS with node to node correspondence

FE-Representations for Seamlines

- Overlap joint



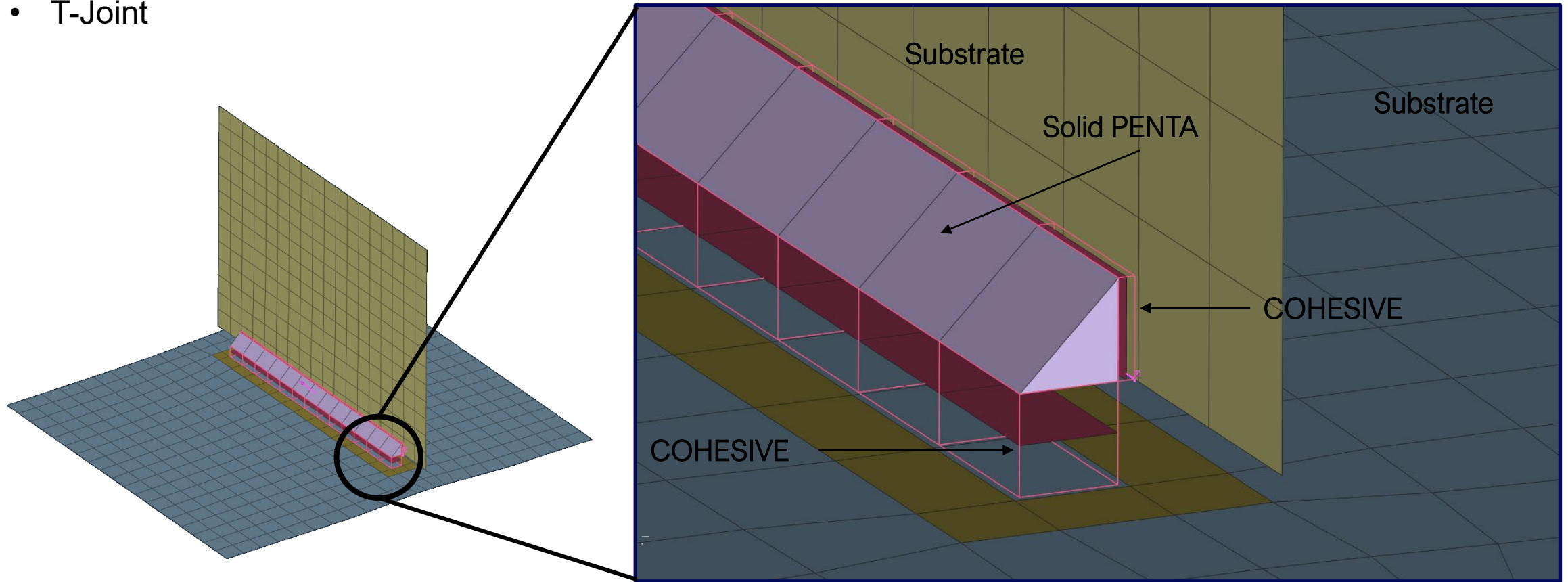
- Edge joint



OVERLAP and EDGE Joints: COHESIVE with TIED contact on the flanges

FE-Representations for Seamlines

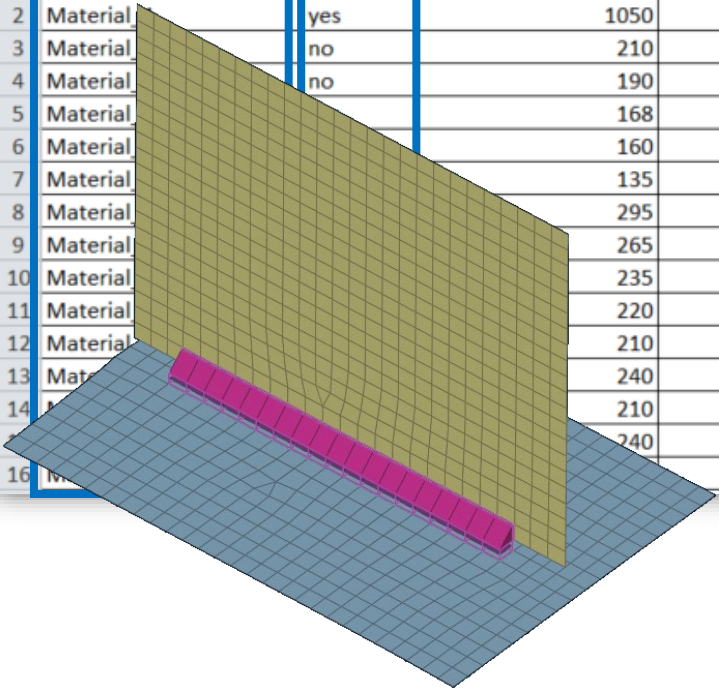
- T-Joint



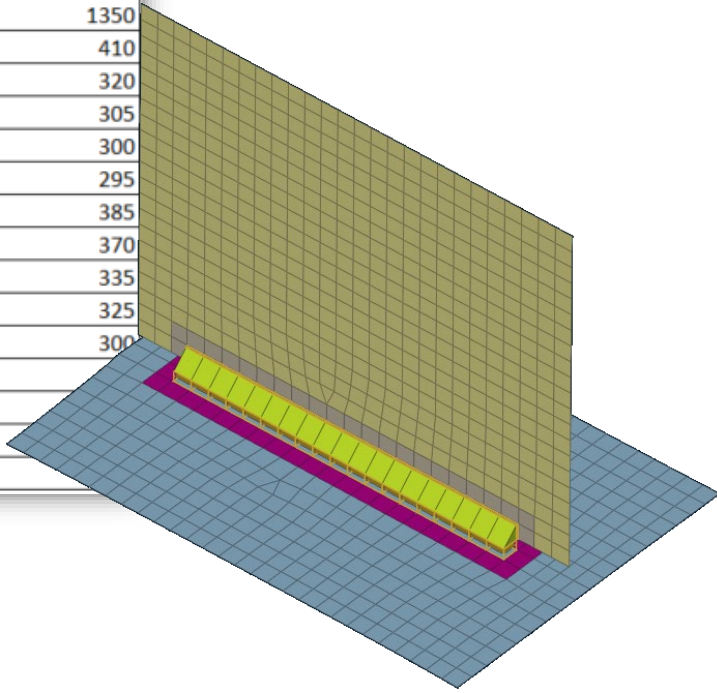
T-Joint : COHESIVE-PENTA-COHESIVE with TIED contact on the flanges

HAZ Assignment

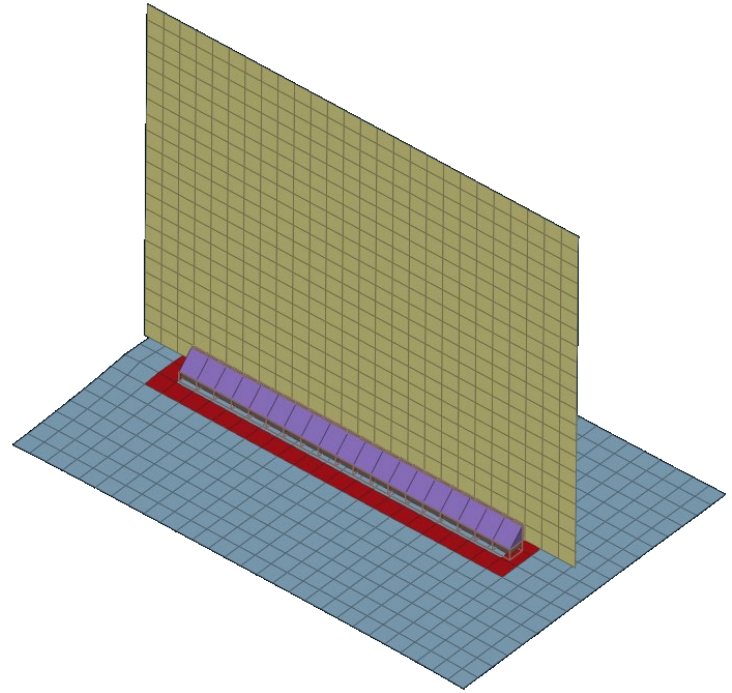
	A	C	D	E
1	#Current	with HAZ	Parameter_1 [N/mm2]	Parameter_2 [N/mm2]
2	Material	yes	1050	1350
3	Material	no	210	410
4	Material	no	190	320
5	Material		168	305
6	Material		160	300
7	Material		135	295
8	Material		295	385
9	Material		265	370
10	Material		235	335
11	Material		220	325
12	Material		210	300
13	Mat		240	
14	M		210	
16	M		240	



No HAZ



HAZ in both flanges



Hybrid

HAZ assignment is individual and based on a material list and automatically created

Connection Creation: Video

ANSYS v22.1.1 (D:/DATA/Conferences_Presentations/202203_EU_BETA_Conference/Model_To_Beta_no_connections.ans)

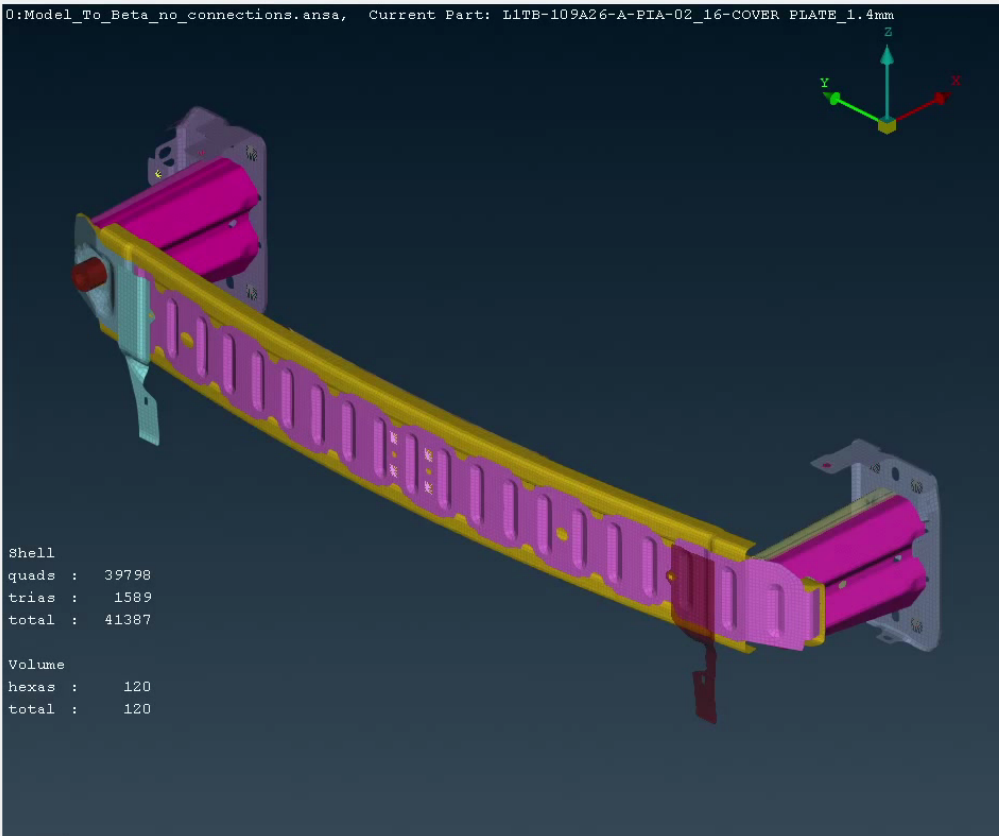
File Tools Utilities Lists Assembly Analysis Tools Plugins Windows Help

Search Functions and Filters

Database

Name	Number	Visible
ANSAPART	30	
<input checked="" type="checkbox"/> > CONSTRAINED	8	8
<input type="checkbox"/> CONTACT	2	0
<input type="checkbox"/> > DATABASE	2	0
> DEFINE	1	
EDGE		
<input checked="" type="checkbox"/> > ELEMENT	41637	41637
<input type="checkbox"/> FE PERIMETER	1021	0
<input type="checkbox"/> > GEOMETRY	3	0
HOURLGLASS	2	
LOCK_VIEW	6	
> MATERIAL	10	
<input type="checkbox"/> NODE	42613	
> PROPERTY	23	
> SECTIONS	27	
SET	13	
SOLIDFACET		

0:Model_To_Beta_no_connections.ans, Current Part: L1TB-109A26-A-PIA-02_16-COVER PLATE 1.4mm



```

Shell
quads : 39798
trias : 1589
total : 41387

Volume
hexas : 120
total : 120
    
```

LS-DYNA

NODE INFO

NEW PASTE ALIGN

MOVE MATCH EXPLODE

THICKNE UTIL DELETE

DEFINE_COORD INFO

NODES SYSTEM CHANGE TY

VECTOR

ELEMENT INFO

BEAM DISCRET TSHELL

SHELL SOLID SEATBEL

MASS UTIL DELETE

BEARING

CONSTRAINED INFO

JOINTs ND_R_BD EXT_NOD

RIGBOD SPR2 DELETE

IN_SOLID TIED_NO

BOUNDARY INFO

SPC MOTION ACCEL

ORIENT SPC_SYM AMBIENT_E

TEMP DELETE

LOAD INFO

LOAD BEAM SHELL

BODY THERMAL DELETE

INITIAL INFO

VELOCITY STRAIN INITEMP

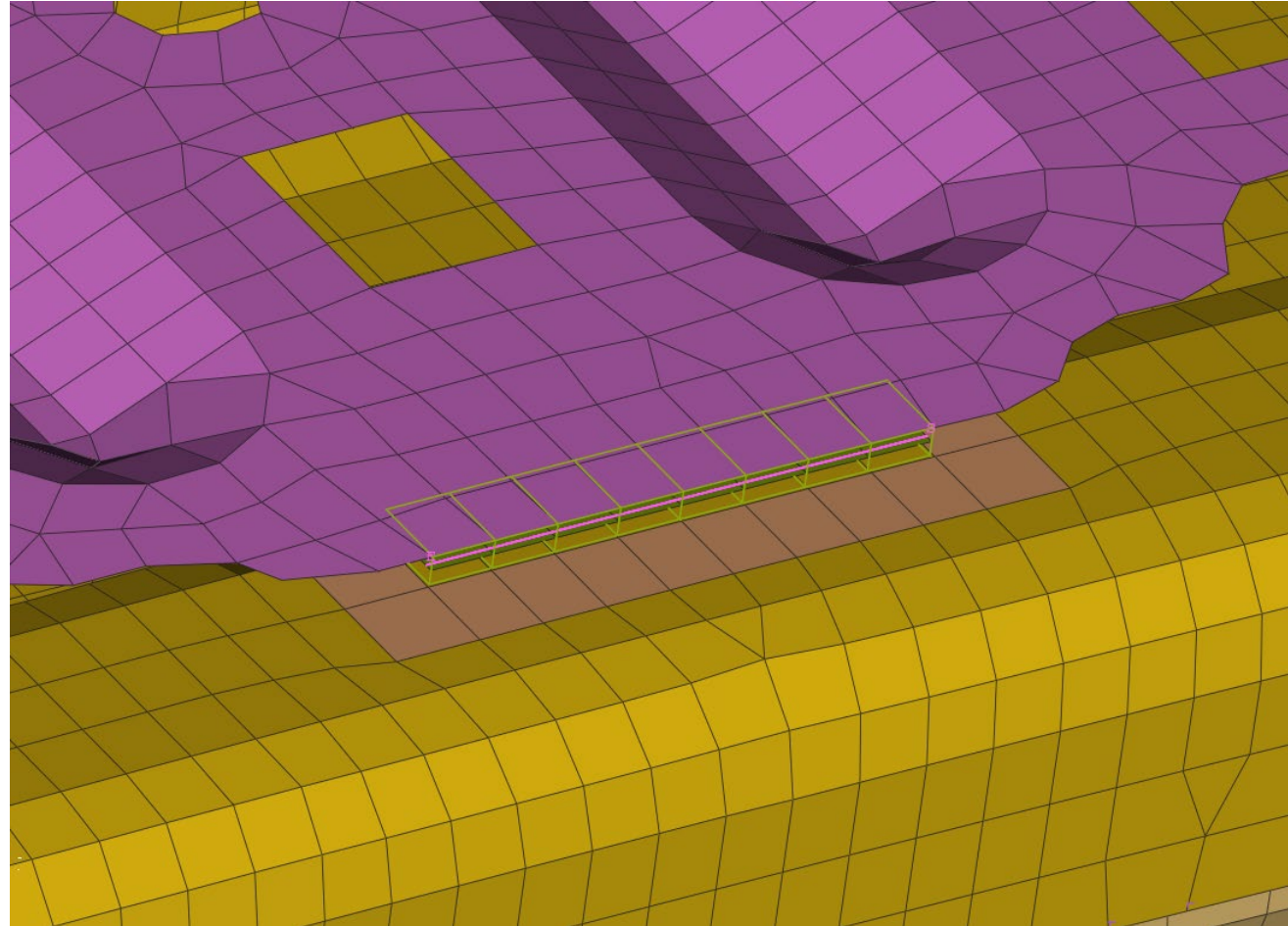
STRESS STRSECT DELETE

AUXILIARIE

DATABAS CURVE CNT_ADD

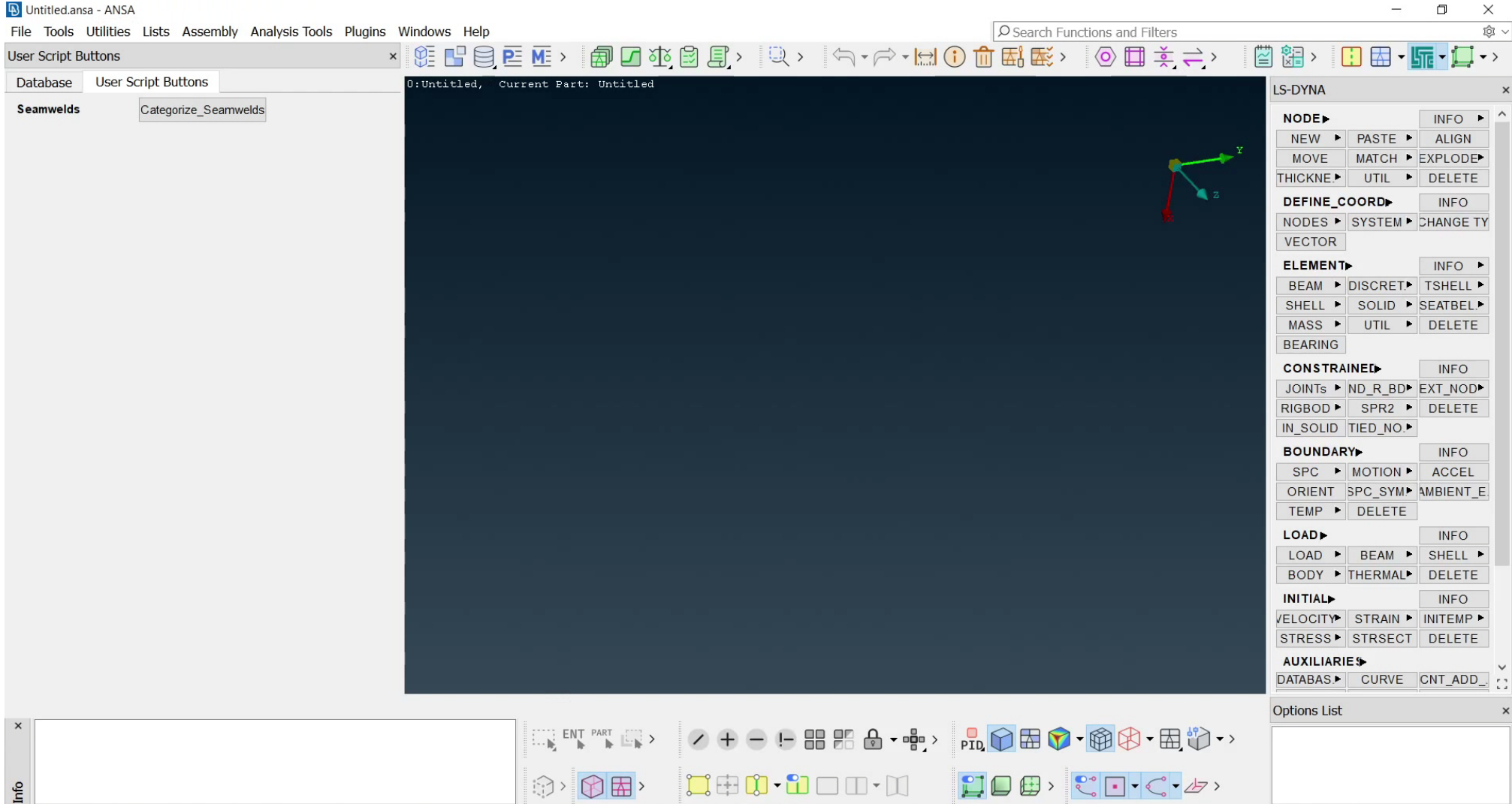
Options List

Heritage Model Treatment



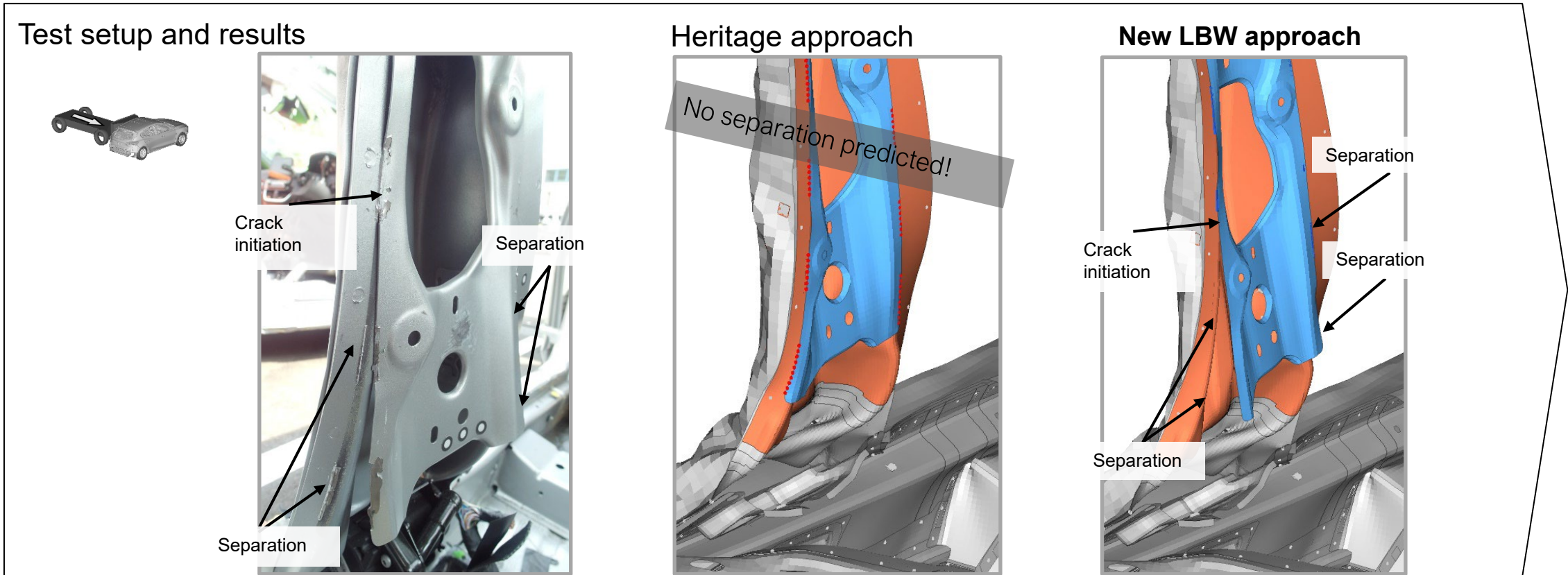
Transform a line connected model to a solid connected one

Heritage Model Treatment: Video



Application Example of New Approach

- Comparison of deformation between prototype test and CAE



→ New predictive LBW approach automated for PD

Conclusion and Outlook

Implementation of a new mesh dependent and independent line weld modeling approach enabled by:

- **Automated assembly process** for seamlines including HAZ creation based on ANSA templates
- **Treatment of unconnected and heritage line connected models** with the new approach
- **User-friendly interactive and scripted “on the fly” line weld processing** covered

THANK YOU!

