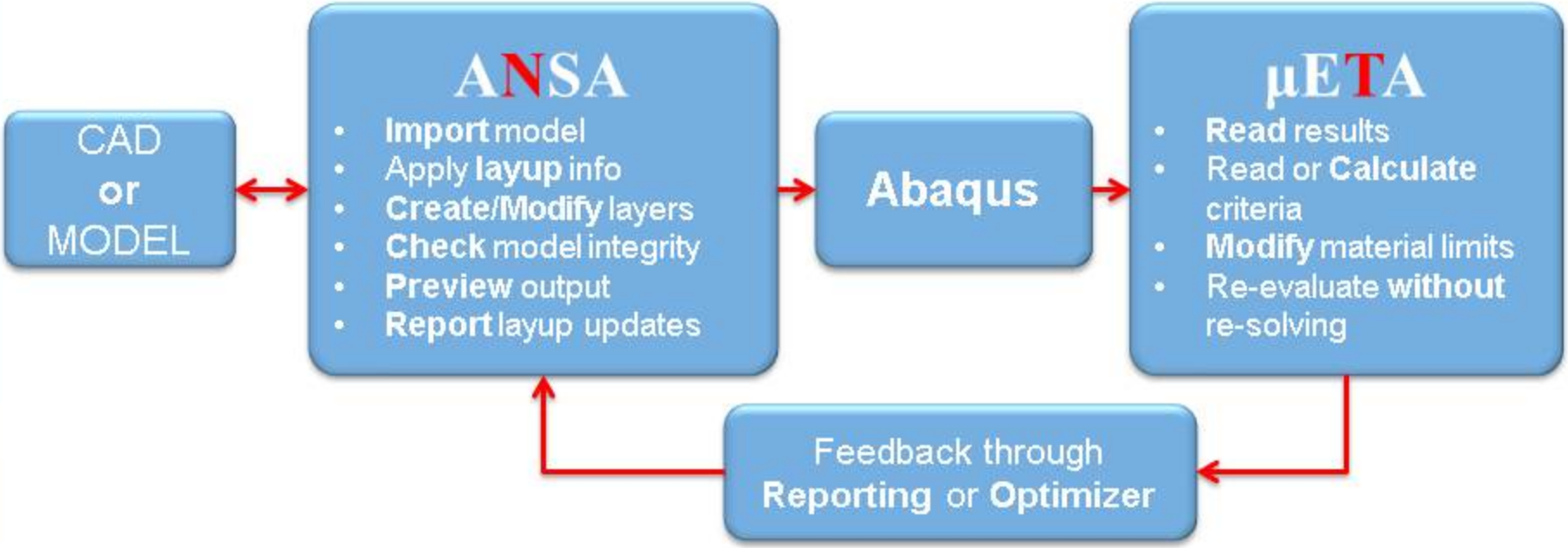
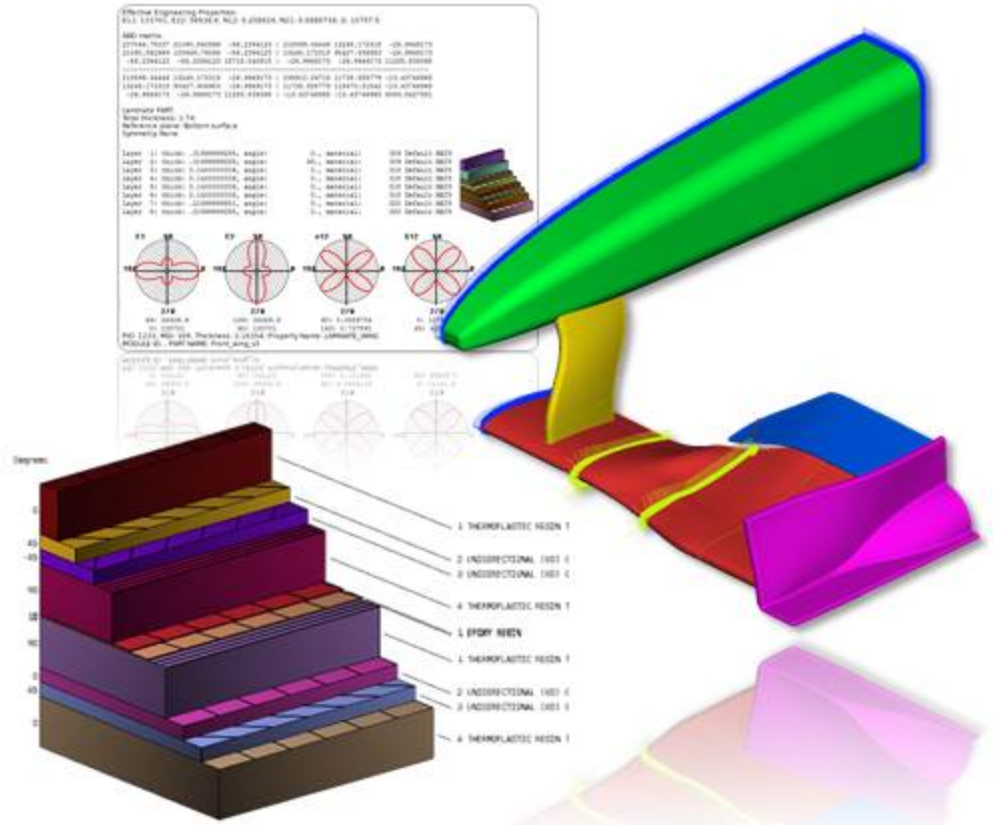
ANSA
μETA

BETA CAE Systems S.A.

Laminated Composites Modeling & Analysis

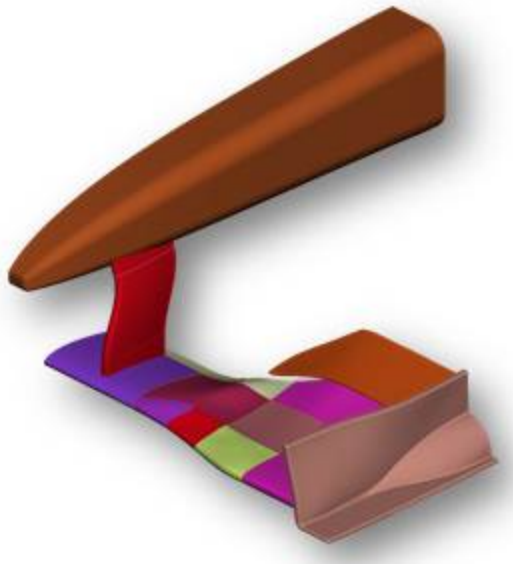
Complete CAE tools that simplify overall process

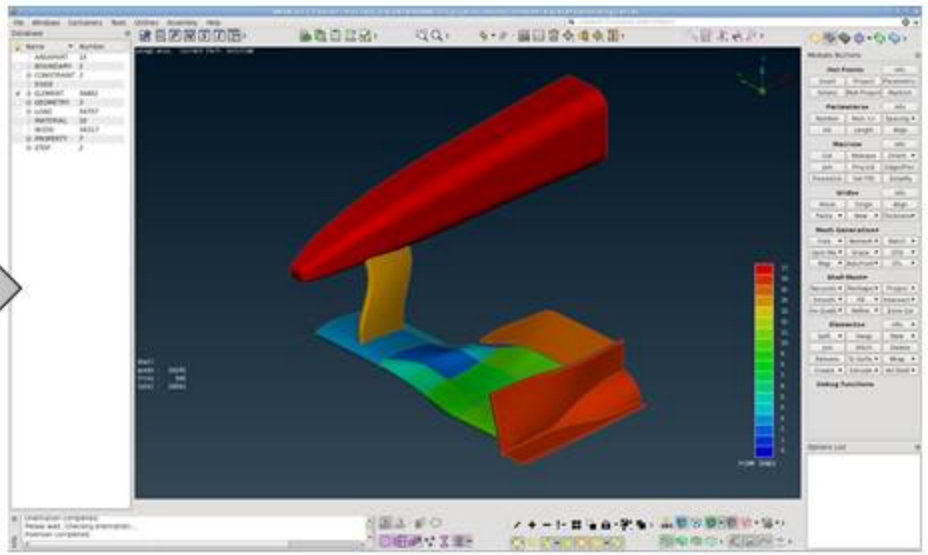




ANSA

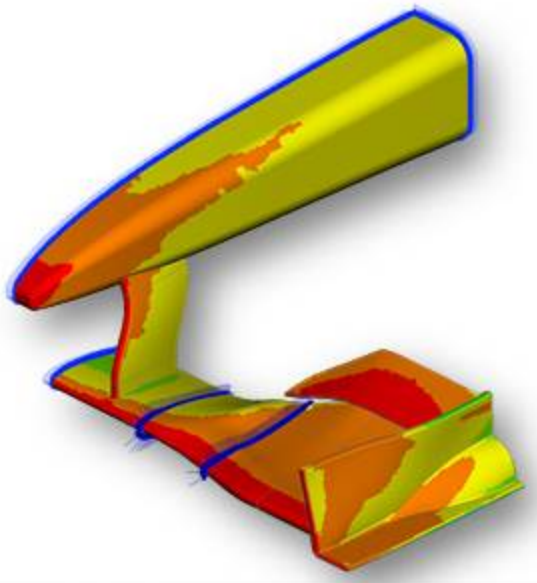
Mapping of laminate information



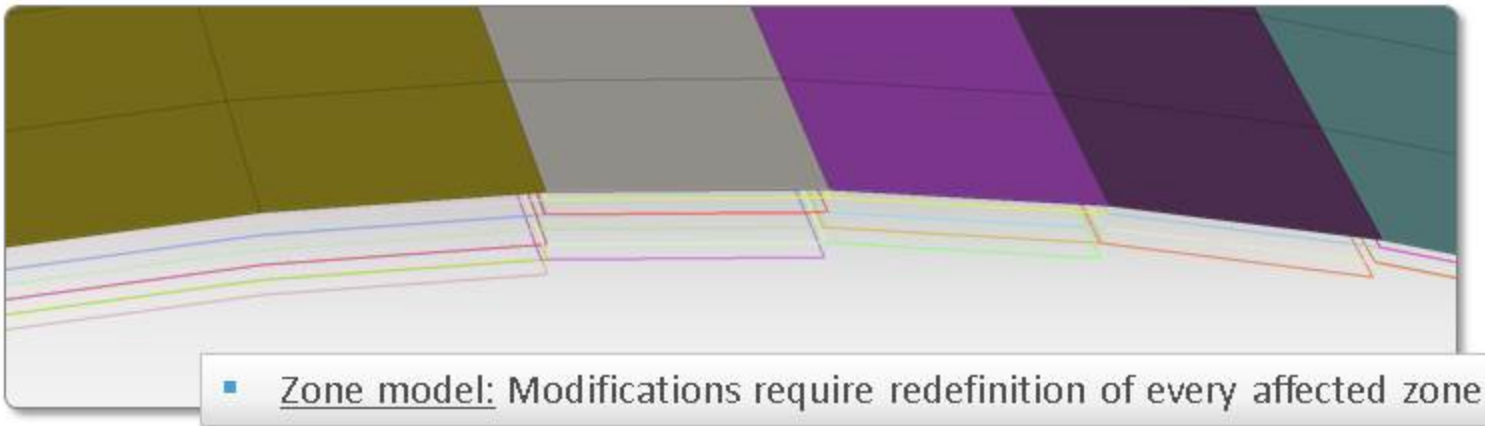


- Import of Simulayt (*.Layup) files in ANSA.
- Process composites data via Results Mapper tool.
- Preview of Position, Thickness & Orientation
- Automatic creation of the LAMINATE Property

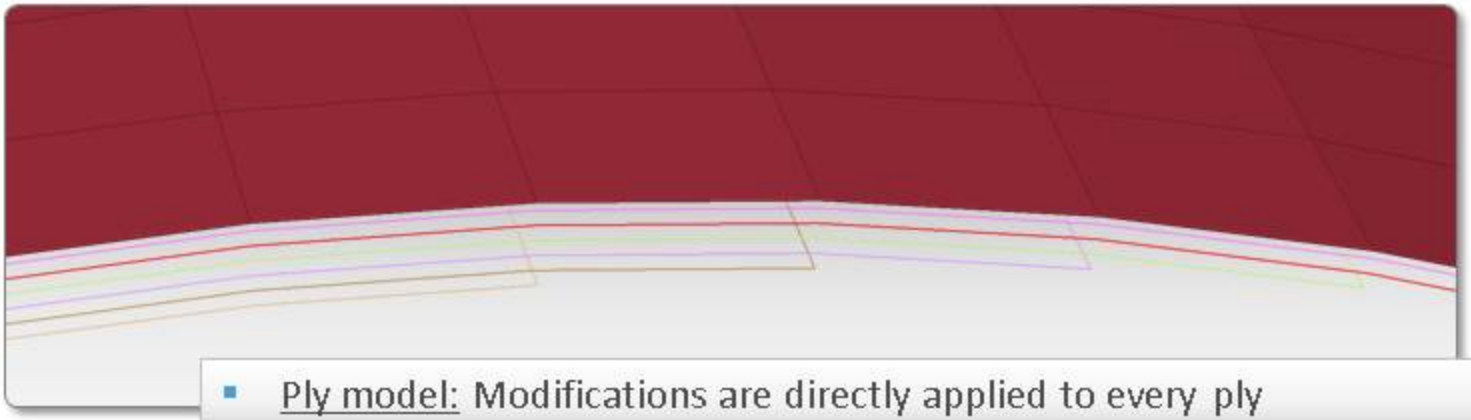
The Results mapper can also be used to apply pressures from a CFD analysis



Ply Vs Zone model



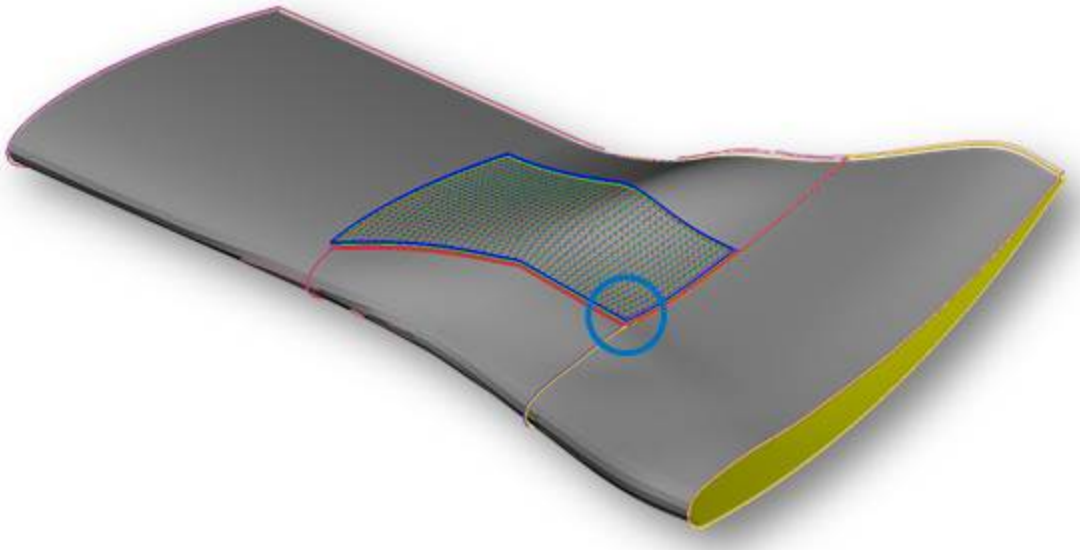
- Zone model: Modifications require redefinition of every affected zone

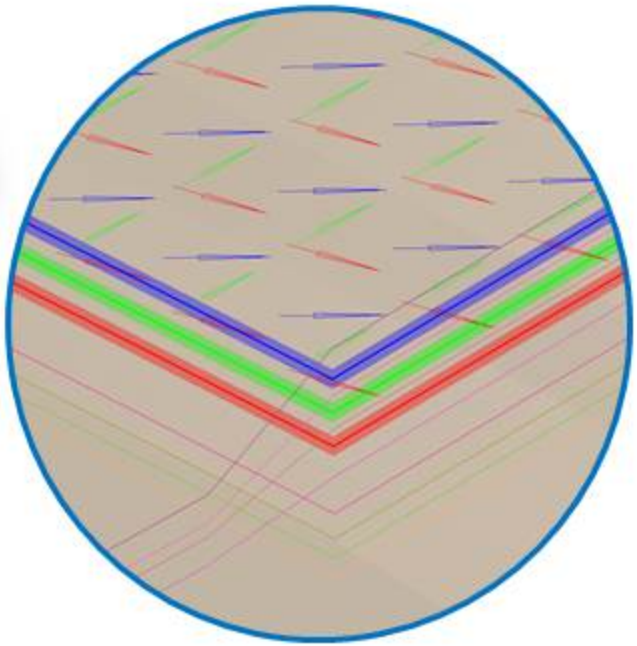


- Ply model: Modifications are directly applied to every ply

- ANSA LAMINATE property enables Ply-based modeling
  - More natural, since it follows the manufacturing process (Drop-offs)
  - Simple to add, remove and modify plies without redefining zones and zone properties

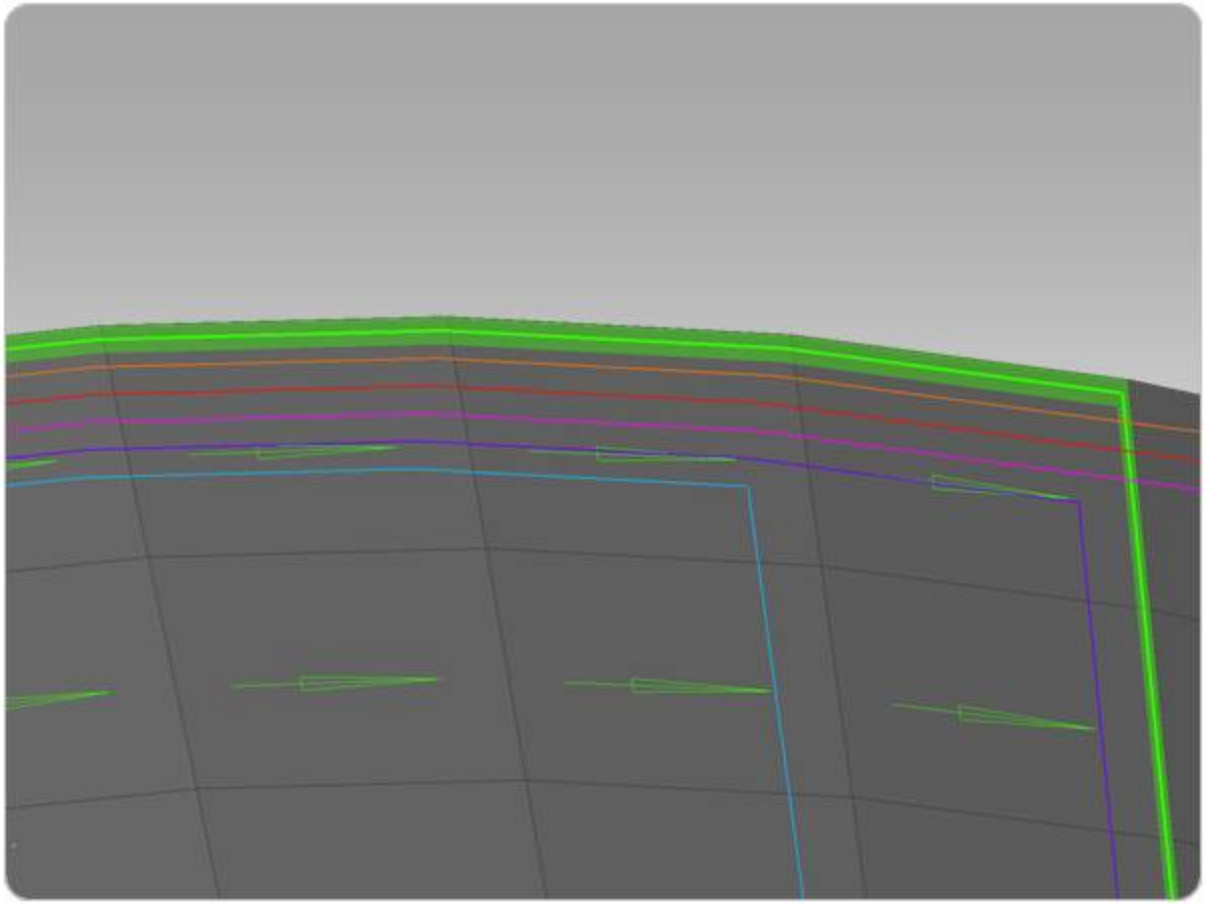
Laminate tool





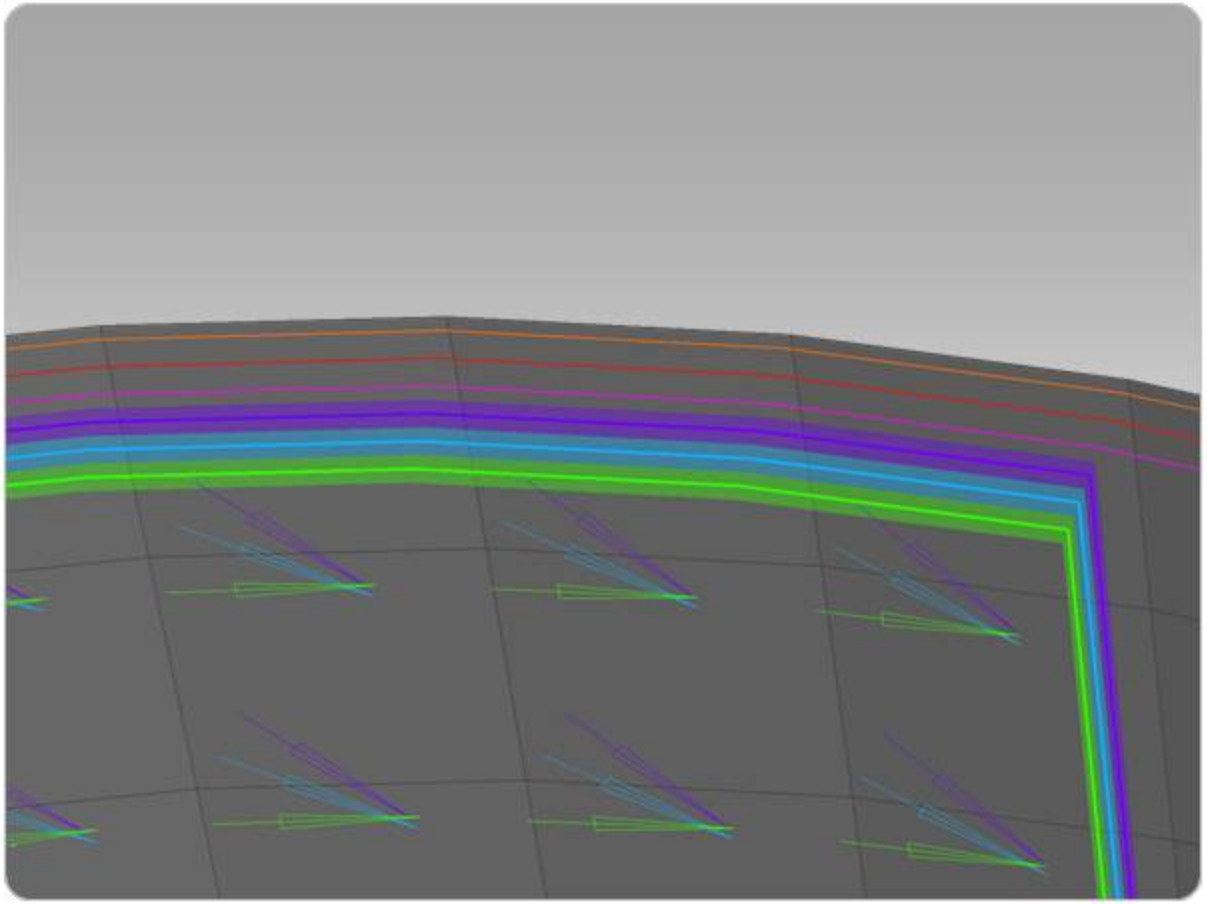
- Laminate tool
  - Inspect Composites and Laminates
  - Control Layers

Modifications per Layer



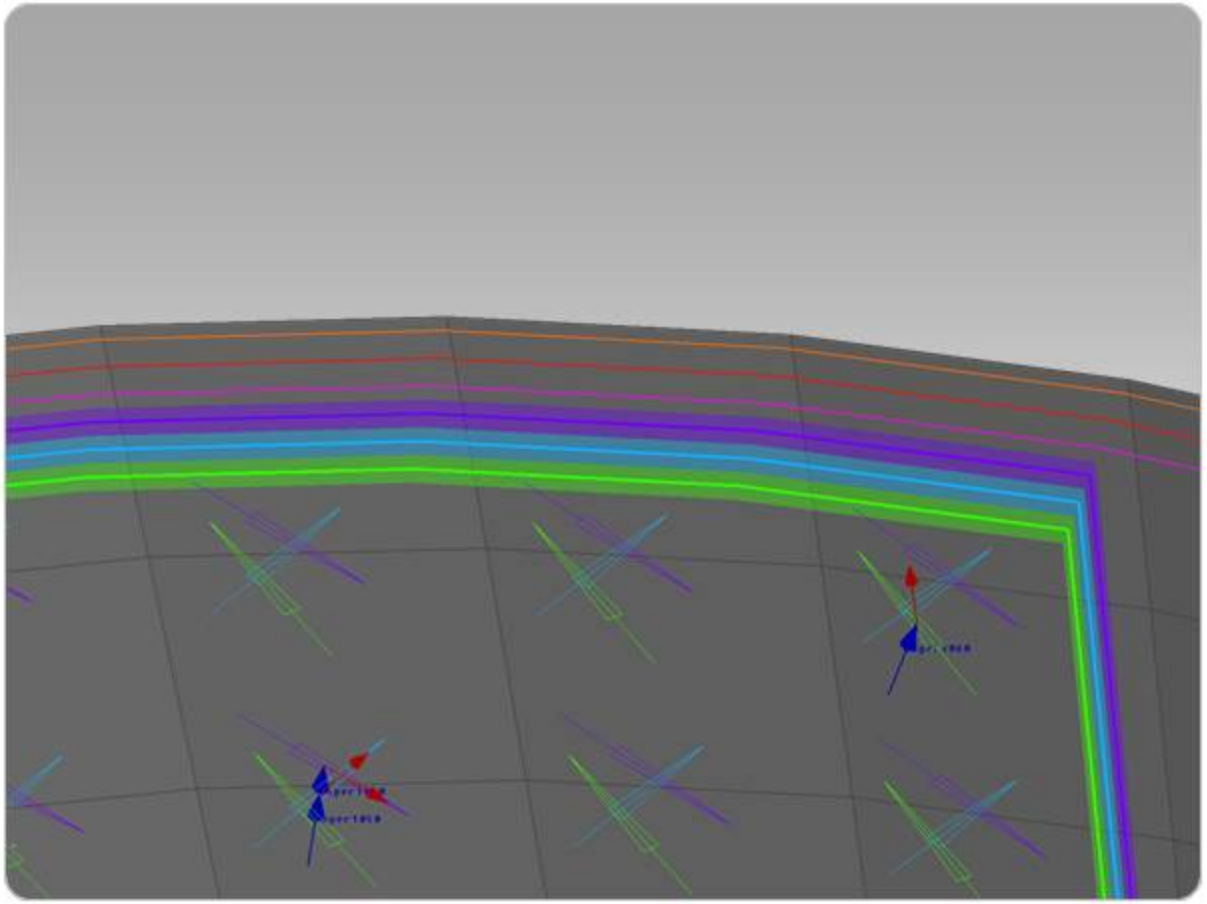
- Change stacking order
- Assign elements per layer

Massive Layer Modification



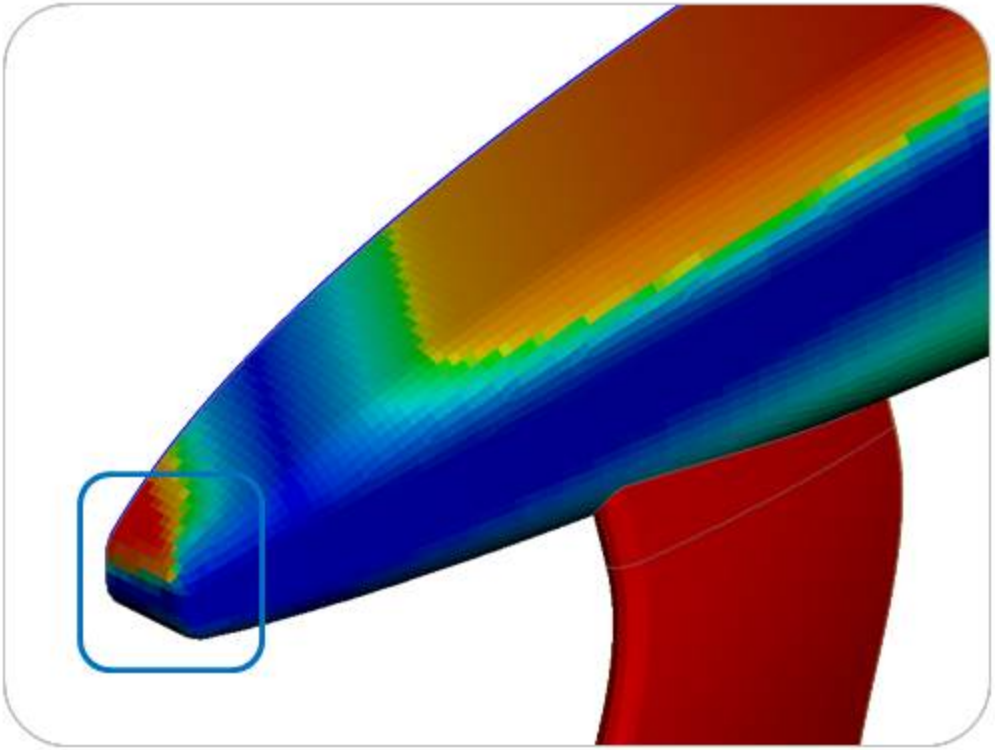
- Modify / Redefine layers massively (Modify Contents)

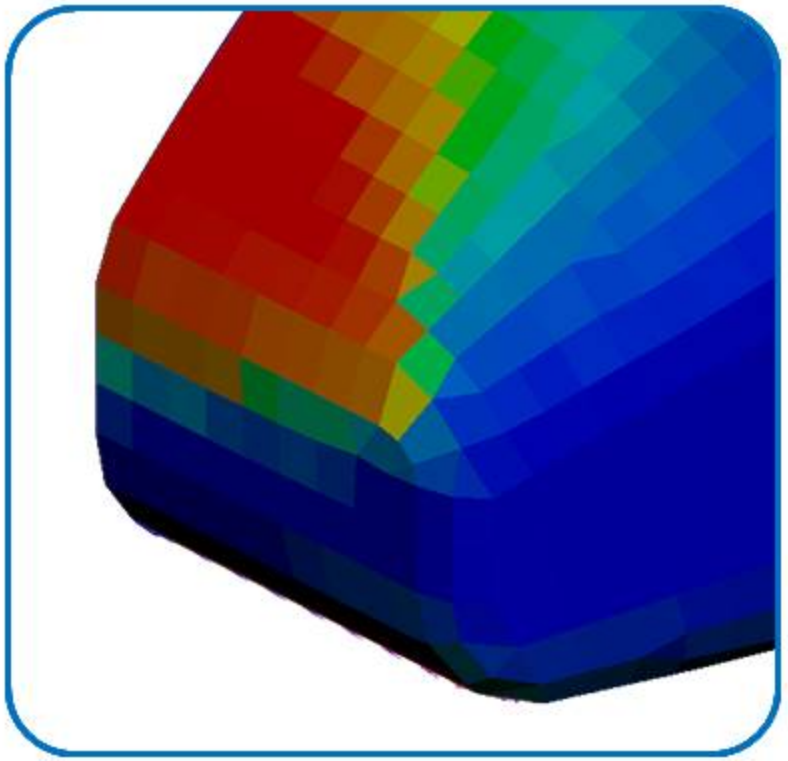
Rosettes import and modification



- Rosettes can be imported from a CAD file
- Create / Modify / Redefine rosettes

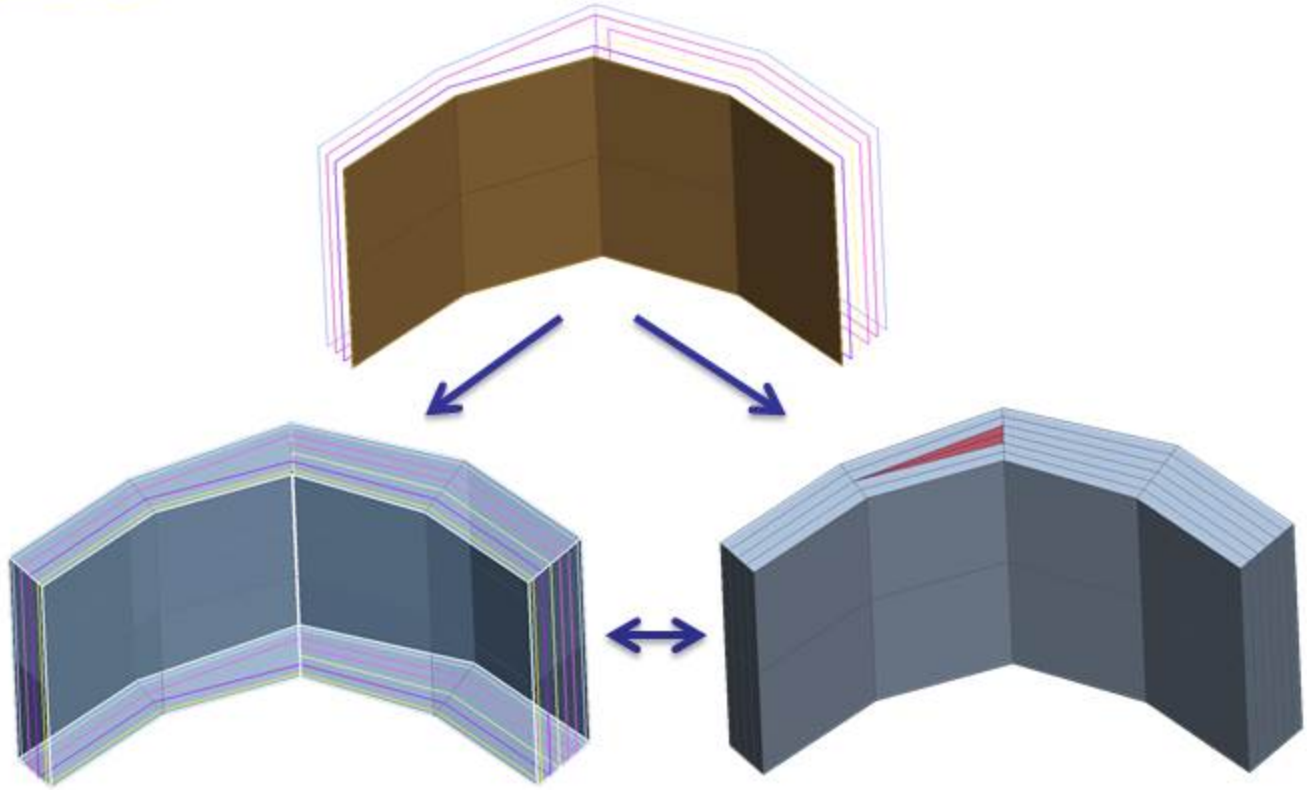
Laminate tool: Draping





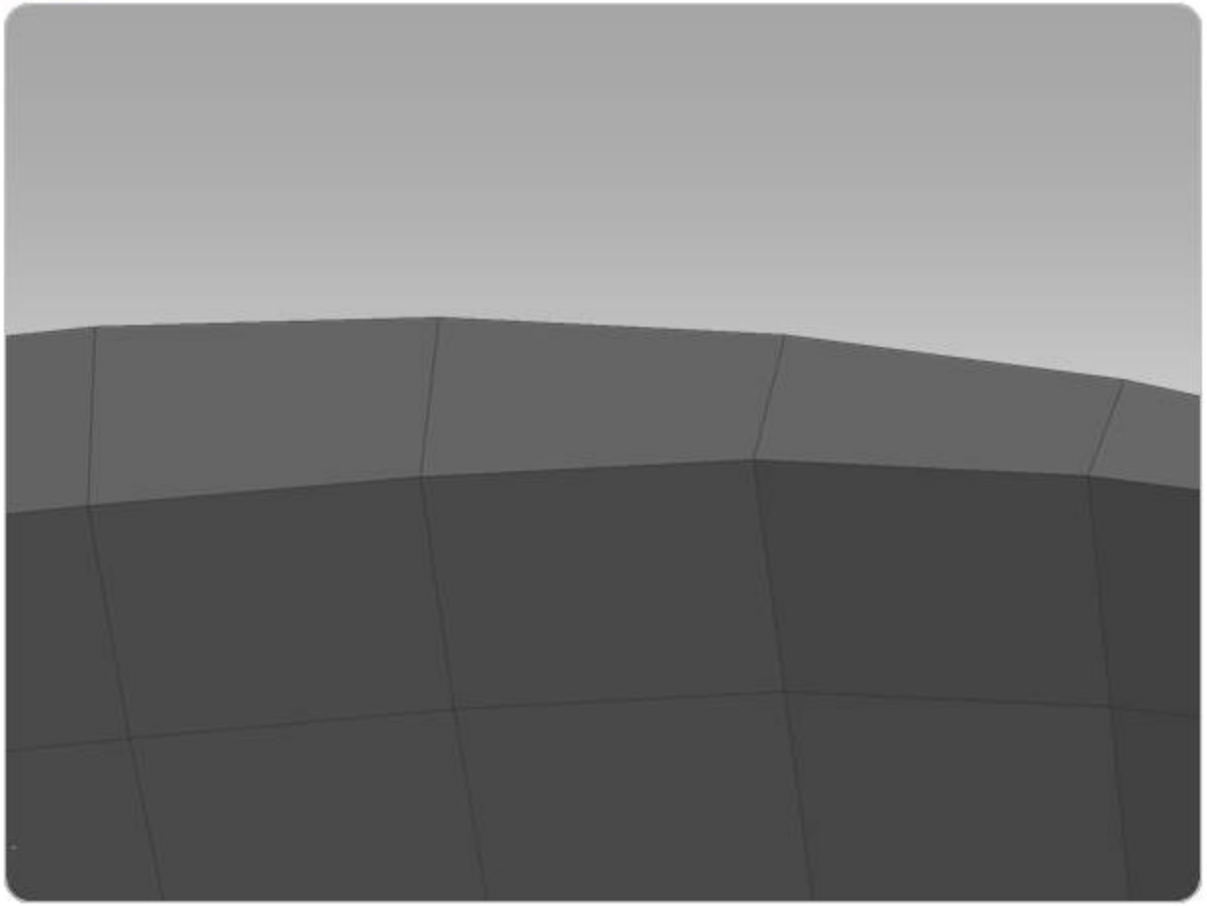
- Integrated **Draping** algorithm
- Based on **Rosettes** with start and stack directions
- Calculate **orientation** of warp and weft and **thickening** of woven fabrics

Solid Laminates



- **Volumize** Composite shell elements
- **Single** element modeling (modify layer stackup)
- **Per-ply** element modeling (fill ply drop-offs)
- **Bidirectional** single to per-ply conversion

Solid Laminates



- Volumize Composite shell elements
- Single element modeling (modify layer stackup)
- Per-ply element modeling (fill ply drop-offs)
- Bidirectional single to per-ply conversion

Laminate tool: Report

Material Table

ID	Name	Area	Weight
1	UNIDIRECTIONAL (UD) GRAPHITE/EPOXY	671416	0.000130842
3	EPOXY RESIN	270287	3.11533e-06
4	THERMOPLASTIC RESIN T300 FABRIC	671416	0.000364786

Layers

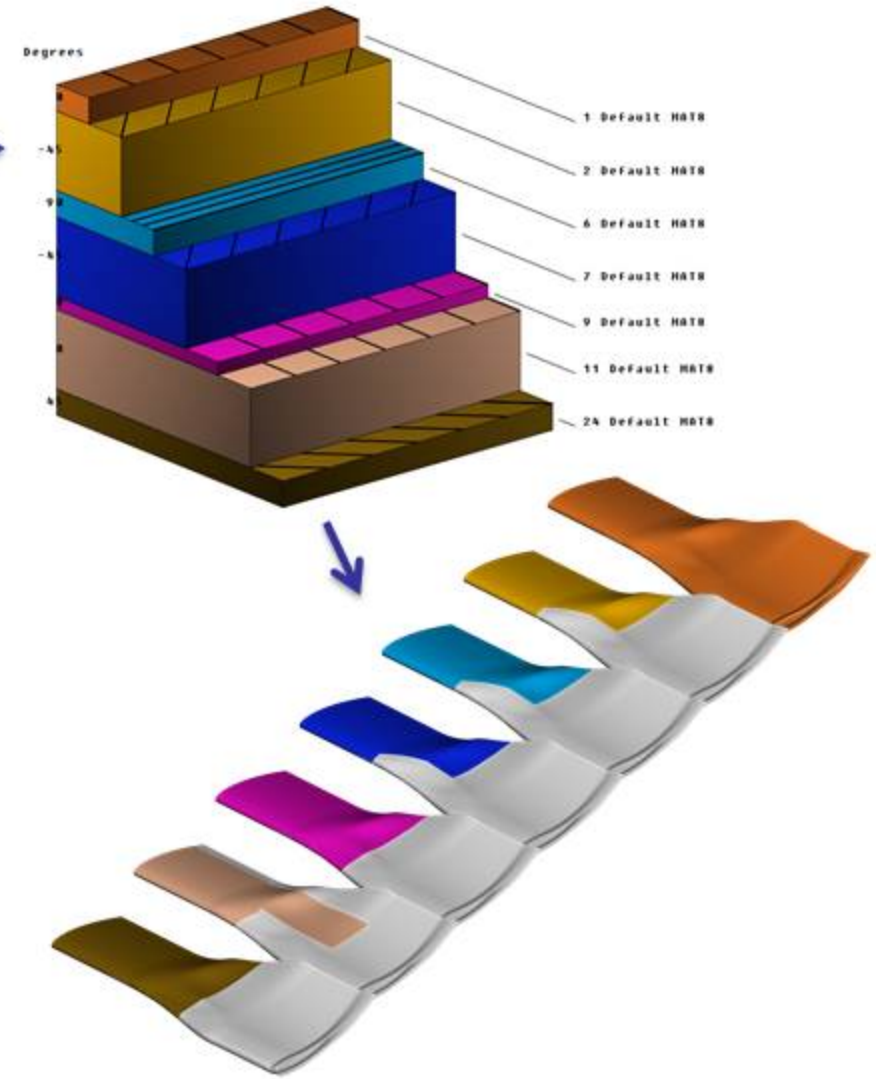
Layer	Ply Name	MID	Thickness (average)	Weight	Area (initial)	Angle	PCOMP1	PCOMP2	PCOMP3	PCOMP4	View
Stacking							s1 pc1 prpng	s1 pc2 prpng	s1 pc3 prpng	s1 pc4 prpng	
View							s1 pc1.png	s1 pc2.png	s1 pc3.png	s1 pc4.png	s1 pc0.png
Sequence 1	s1										s1 s1 0.png
1	_stackup	4	0.35	7.33152e-05	135143	0	x	x	x	x	s1 s1 0.png
2	_woven1.p1	1	0.131194	2.60057e-05	135143	45	x	x	x	x	s1 s1 0.png
3	_woven2.p1	1	0.131194	2.60057e-05	135143	-45	x	x	x	x	s1 s1 0.png
4	_stackup	4	0.35	7.33152e-05	135143	90	x	x	x	x	s1 s1 90.png
Sequence 2	s2										s1 s2 0.png
1	_stackup	3	0.01	1.56766e-06	135143	10	x	x	x	x	s1 s2 0.png
Sequence 3	s3										s1 s3 0.png
1	_stackup	4	0.35	2.79673e-05	51552.6	0	x	x	o	o	s1 s3 0.png
2	_woven1.p2	1	0.101268	8.87504e-06	51552.6	45	x	x	o	o	s1 s3 0.png
3	_woven2.p2	1	0.101268	8.87504e-06	51552.6	-45	x	x	o	o	s1 s3 0.png
4	_stackup	4	0.35	2.79673e-05	51552.6	90	x	x	o	o	s1 s3 90.png
Sequence 4	s4										s1 s4 0.png
1	_stackup	4	0.35	7.79508e-06	14368.8	90	x	o	x	o	s1 s4 0.png
2	_woven1.p4	1	0.103181	2.5204e-06	14368.8	0	x	o	x	o	s1 s4 0.png
3	_woven2.p4	1	0.103181	2.5204e-06	14368.8	45	x	o	x	o	s1 s4 0.png
4	_stackup	4	0.35	7.79508e-06	14368.8	0	x	o	x	o	s1 s4 90.png
Sequence 5	s5										s1 s5 0.png
1	_stackup	3	0.01	1.56766e-06	135143	10	x	x	x	x	s1 s5 0.png
Sequence 6	s6										s1 s6 0.png
1	_stackup	4	0.35	7.33152e-05	135143	90	x	x	x	x	s1 s6 0.png
2	_woven1.p3	1	0.121962	2.80201e-05	135143	0	x	x	x	x	s1 s6 0.png
3	_woven2.p3	1	0.121962	2.80201e-05	135143	45	x	x	x	x	s1 s6 0.png
4	_stackup	4	0.35	7.33152e-05	135143	0	x	x	x	x	s1 s6 90.png
Thickness							3.62	2.72	2.72	1.82	
Plies							18	14	14	10	
Weight							7.82641e-05	0.000168887	4.46318e-06	0.000147147	

ABD Matrices (in a random position in the Zone)

PCOMP1

Effective Engineering Properties: E11: 10520.2, E22: 12217.8, N12: 0.494838, N21: 0.54402, G: 4067.95

230455.542699854905	64494.7605592981586	359321.31475426869	398354.484035825	91628.7611339112	-63625.1988012355
64494.7605592981586	255631.755370043037	27043.4110492013613	91628.7611339112	431370.90618690989	44440.557313472
359321.31475426869	27043.4110492013613	59037.3449784432	-63625.1988012355	44440.557313472	82633.1492428
398354.484035825	91628.7611339112	-63625.1988012355	629176.2262823546	206977.37681163137	162153.0022752
91628.7611339112	431370.90618690989	44440.557313472	206977.37681163137	1001731.9823980078	125480.6865037
-63625.1988012355	44440.557313472	82633.1492428	162153.0022752	125480.6865037	165769.7586581



- Thickness, Area & Weight
- ABD matrices
- Stacking order overview
- Snapshot per layer

Information on the Element

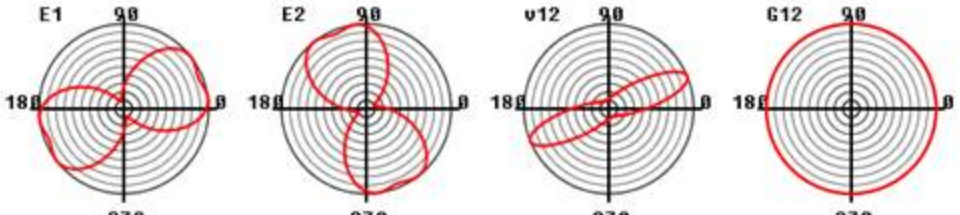
Effective Engineering Properties:
E11: 46445.2, E22: 12521.8, N12: 0.701893, N21: 0.189234, G: 11932.1

ABD matrix:

38776.730273	7337.8615417	7080.5869321	-1879.940274	598.3540796	640.7930971
7337.8615417	10454.382544	7080.5869321	598.3540796	683.2321146	640.7930971
7080.5869321	7080.5869321	8638.8474333	640.7930971	640.7930971	598.3540796
-1879.940274	598.3540796	640.7930971	1693.8191735	320.52755569	309.28945842
598.3540796	683.2321146	640.7930971	320.52755569	456.66133983	309.28945842
640.7930971	640.7930971	598.3540796	309.28945842	309.28945842	377.35635049

Laminate PART.
Total thickness: 0.724
Reference plane: Middle surface
Symmetry: None

Layer 1: thick: .18099999428,	angle:	0., material:	4 KEVLAR
Layer 2: thick: .18099999428,	angle:	45., material:	4 KEVLAR
Layer 3: thick: .18099999428,	angle:	0., material:	4 KEVLAR
Layer 4: thick: .18099999428,	angle:	45., material:	4 KEVLAR



E1	E2	ν12	G12
112: 4676.08	23: 4676.08	293: 0.164381	70: 11932.1
7: 47726.1	97: 47726.1	22: 1.59808	60: 11932.1

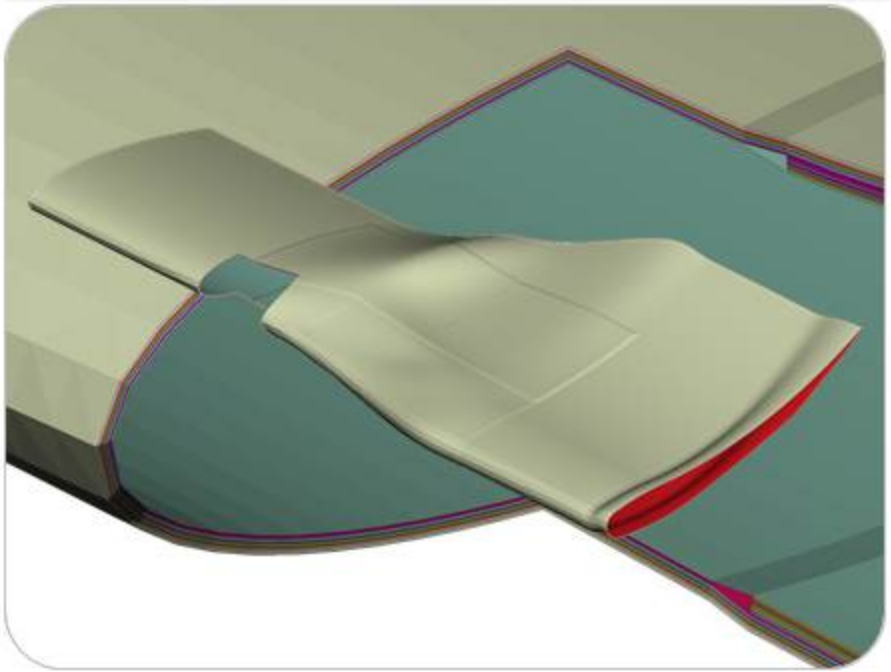
PID: 2, MID: 4, Thickness: 0.724, Property Name: wing_01
MODULE ID: , PART NAME: WING

- ELEMENTS > INFO
- Effective Engineering Properties, ABD Matrix, Polar plots

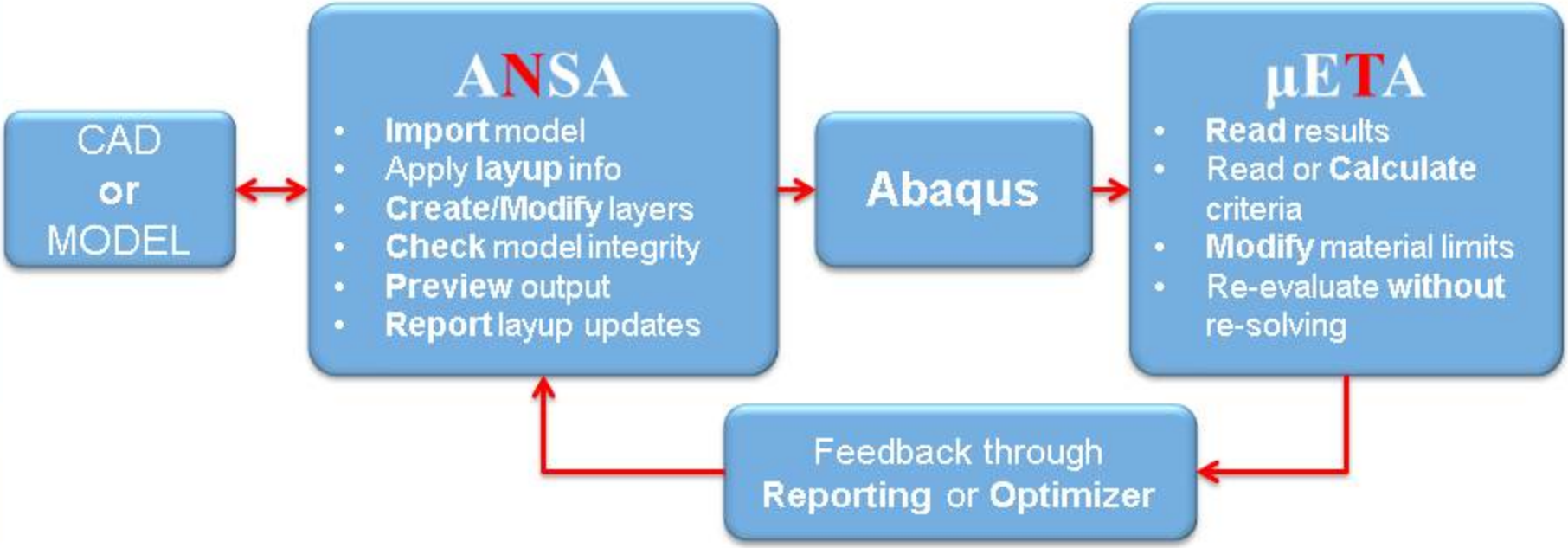
Feedback to CAD

3D Curves

STL files



- Automatic creation of **3D curves** per ply
- **Output** of 3D curves in neutral CAD files (e.g. *.vda, *.step, *.iges)
- Export of **STL files** (per layer)
- **Communicate** changes to layer boundaries and stacking order back **to CAD**



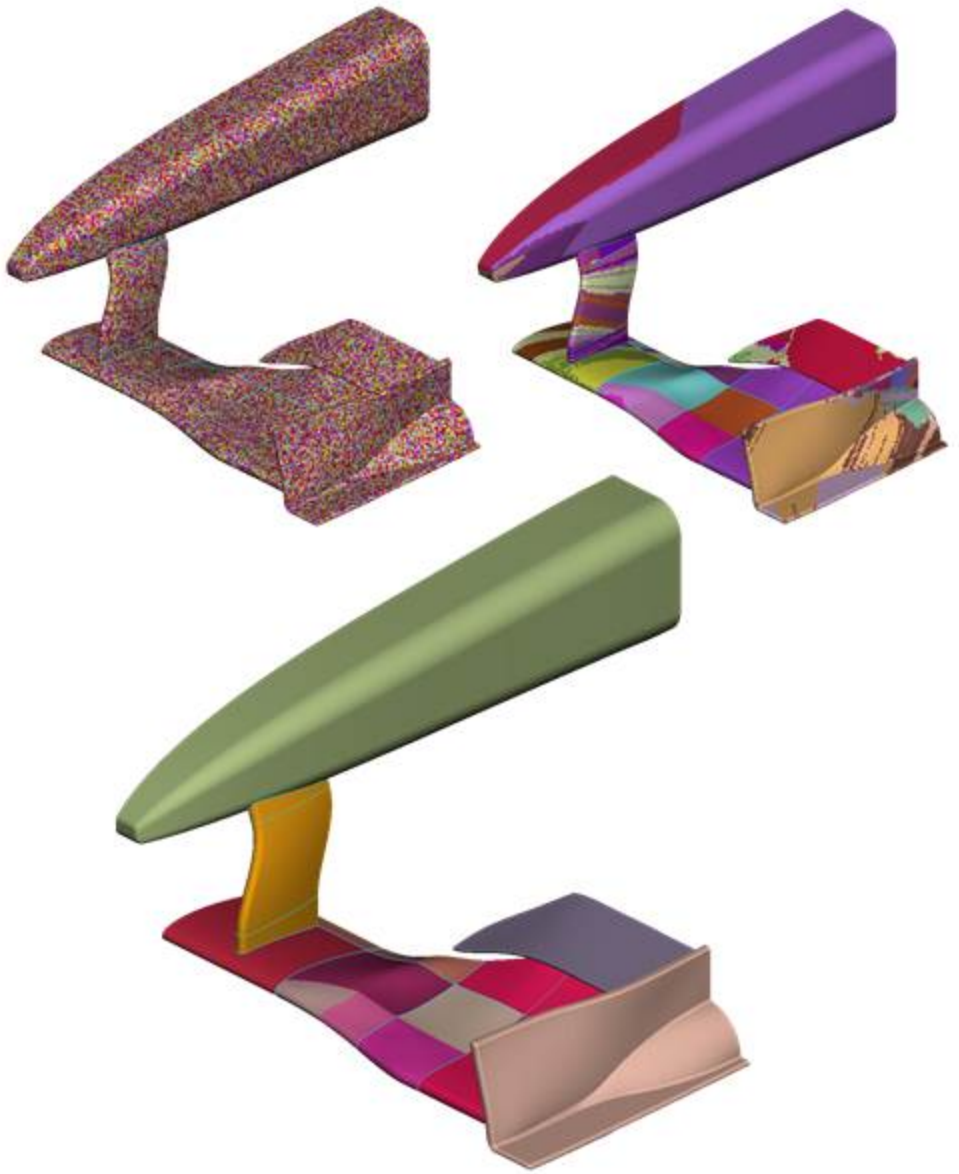
Solver Output

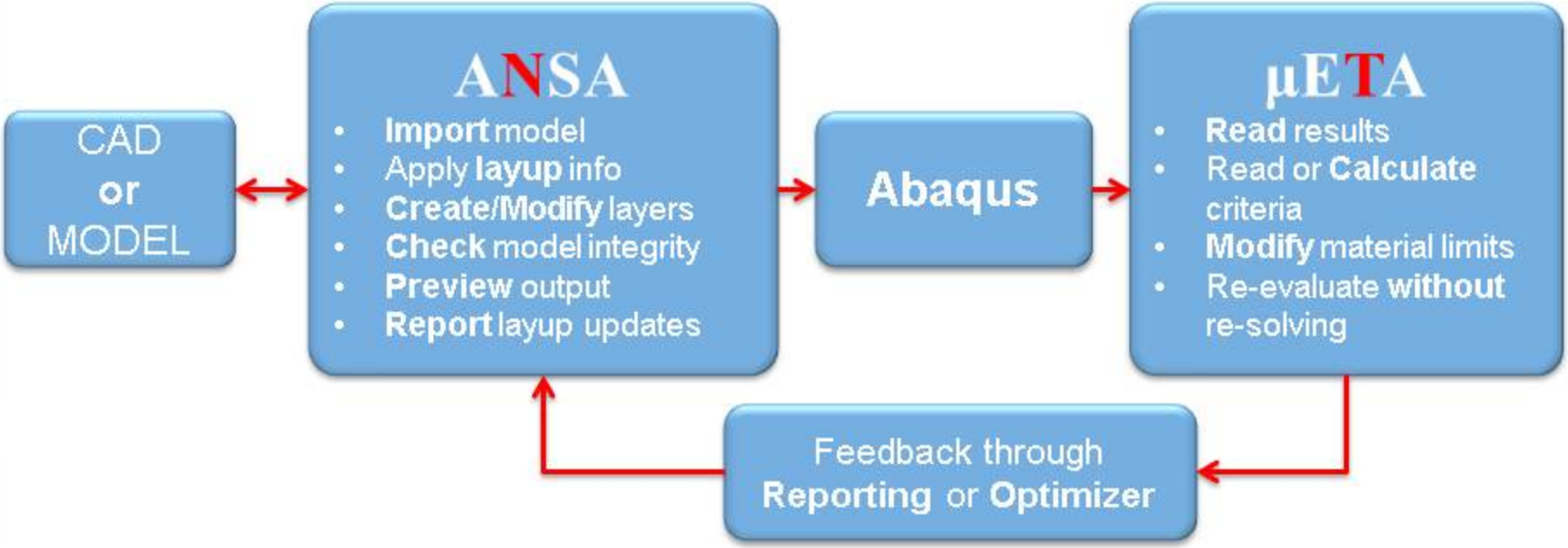
Output Keywords

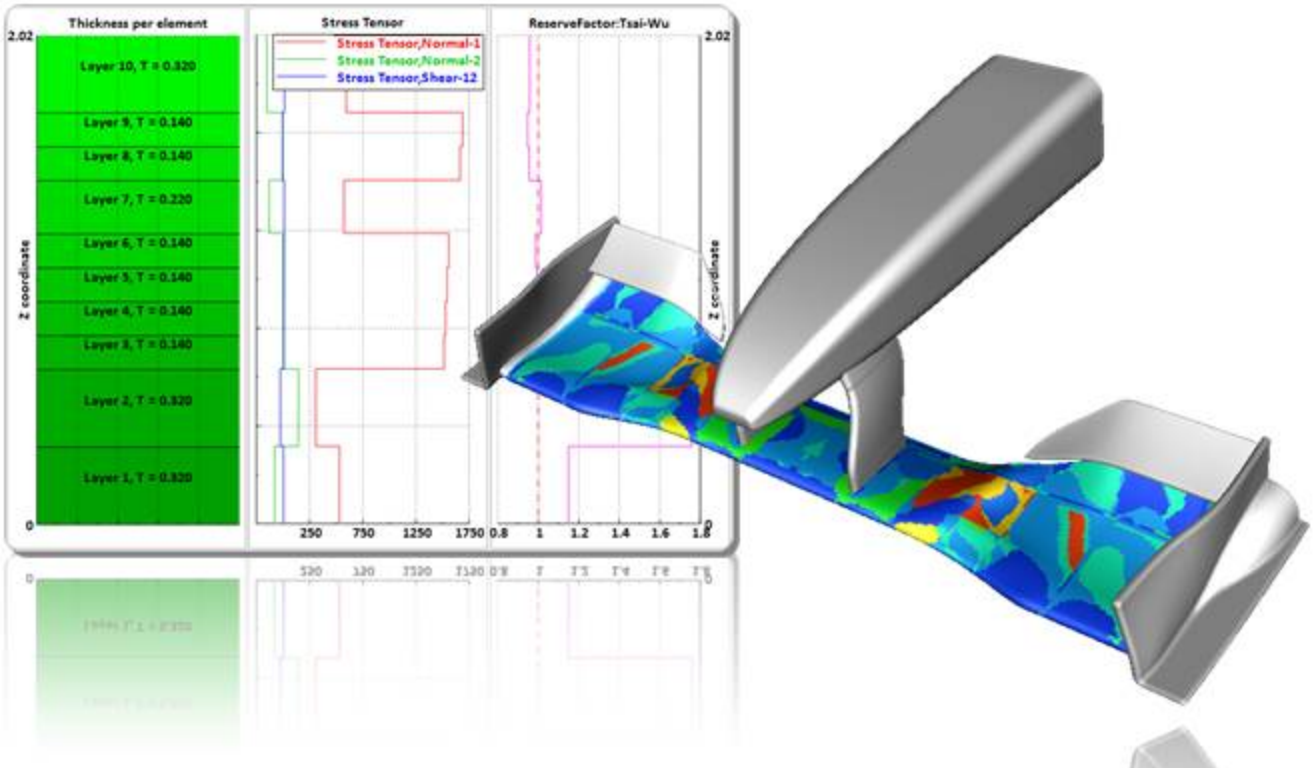
ANSA laminate property will be converted to composite keywords on-the-fly during output.

- Solver cards are created automatically for:
  - Abaqus: *DISTRIBUTION TABLE
  - ANSYS: SECBLOCK
  - LS-DYNA: *PART_COMPOSITE, *ELEMENT_SHELL_COMPOSITE
  - Nastran: PCOMP, PCOMPG
  - PAM-CRASH: PLY
  - PERMAS: $PLY

Metadata as ANSA Comments preserve the laminate property for reuse in ANSA and μETA.







μETA

Supported decks and criteria

Supported decks

- Abaqus
- ANSYS
- LS-DYNA
- Nastran
- OptiStruct
- PERMAS

Supported results

- Failure Index, Reserve Factor, Effort for the following criteria:
  - Max Stress / Strain
  - Hill
  - Hoffman
  - Tsai-Wu
  - Azzi-Tsai-Hill
  - Interlaminate
  - PuckFF, PuckX, Puck Y
  - HSBIFF
  - Hashin Fiber/Matrix failure
  - Puck Matrix cracking
- VDI 2014 Part III

Dedicated toolbar for composites

CompositePost toolbar

- Reading model geometry & results:
  - Read model geometry
  - Choose failure criterion / VDI 2014 Part III method
  - Inspect model
  - Setup materials (define material limits)
  - Calculate results
- Post-Processing:
  - Find and isolate critical elements
  - Examine neighboring elements
  - Plot results through thickness
  - Re-evaluate criteria by modifying material limits

Inspect: Visualize material / fiber orientation

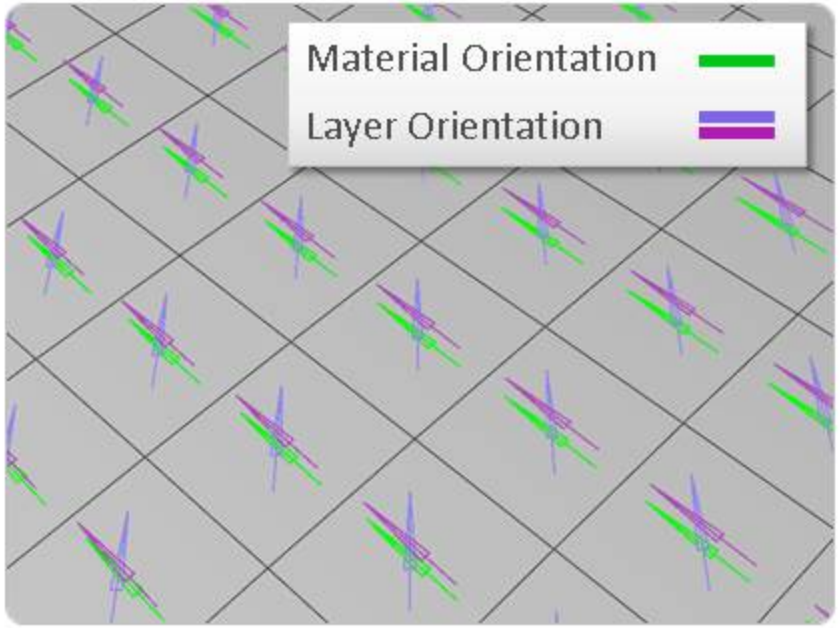
Laminate Tool

Parts

Pid	Type	Name	Number of Layers
45	PComp	LAMINATE_WING	5
46	PComp	LAMINATE_WING	8
47	PComp	LAMINATE_WING	12
48	PComp	LAMINATE_WING	19
49	PComp	LAMINATE_WING	12
50	PComp	LAMINATE_WING	14
51	PComp	LAMINATE_WING	8

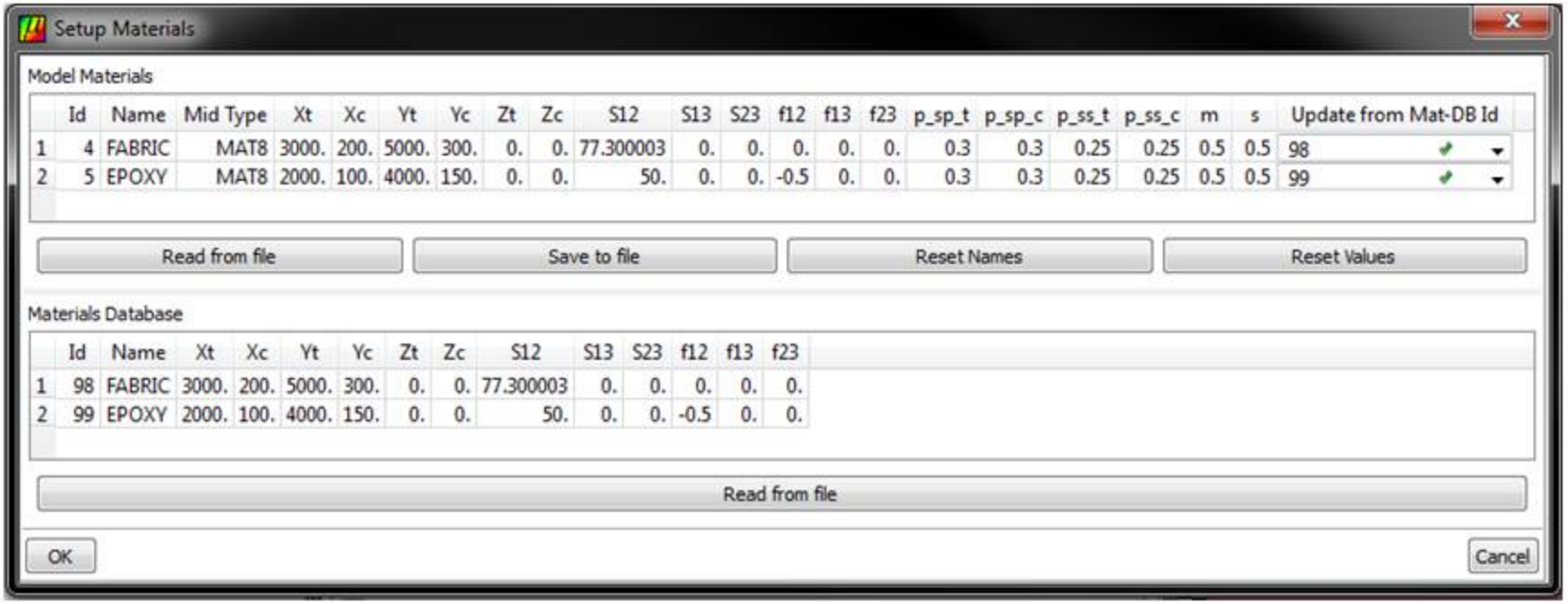
Layers

Layer Id	Color	GPLYID	Mid	Thickness	Theta	Name
1		1	309	0.3200	0.000	Global_Layer_0
2		2	309	0.3200	45.000	Global_Layer_45
3		3	318	0.1400	45.000	OBD_Patch_45
4		4	318	0.1400	0.000	OBD_Patch_45
5		5	318	0.1400	45.000	OBD_Patch_45
6		6	318	0.1400	45.000	OBD_Patch_45
7		7	320	0.2200	0.000	IBD_Cloth_Patch



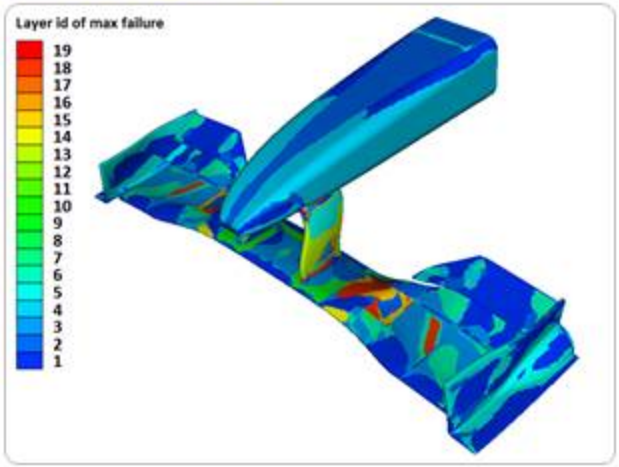
- Laminate Tool
- Communication of ply definitions from ANSA via comments.

Setup Material limits

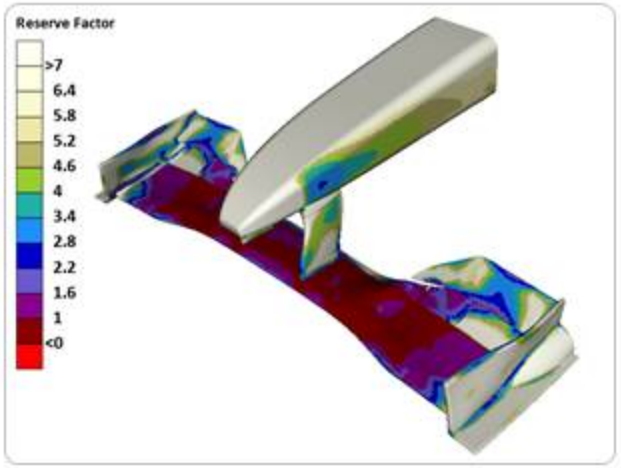


- Read and update **Material Database** from *.csv file
- **Modify limits** of used materials
- **Re-evaluate** failure criteria

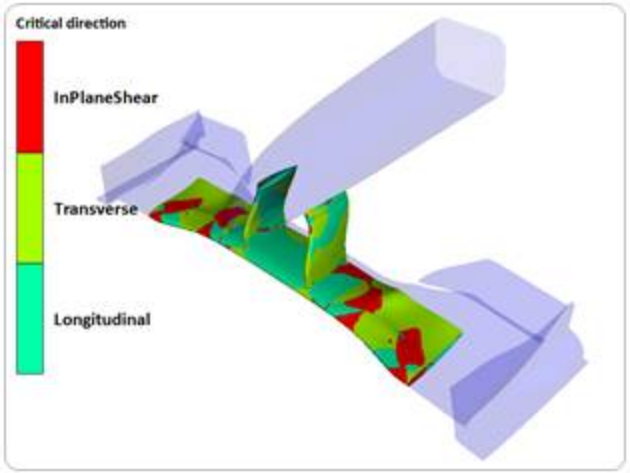
Calculated results



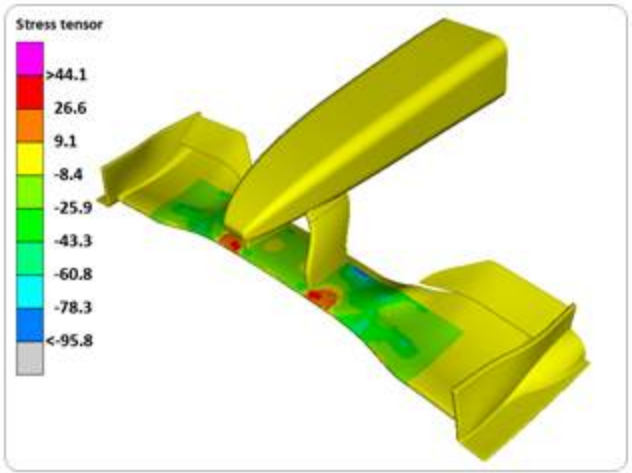
Layer id of max failure, All Layers



ReserveFactor:Tsai-Wu,MinofAllLayers

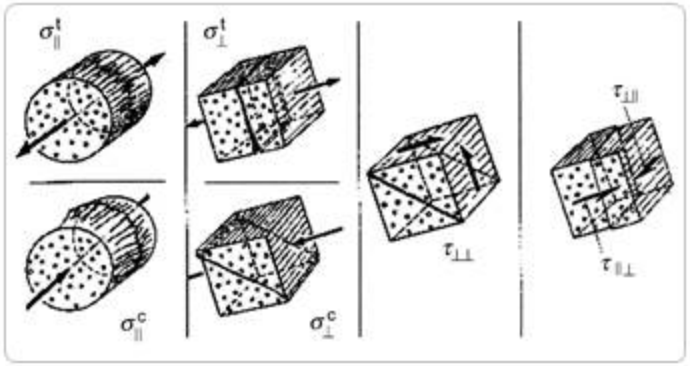


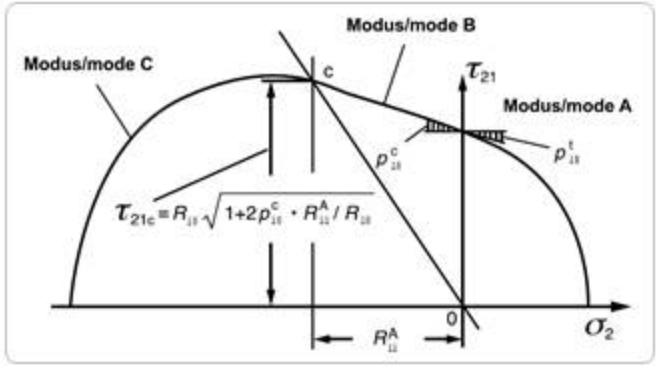
Critical direction, FailureIndex:MaxStress,Layer:10

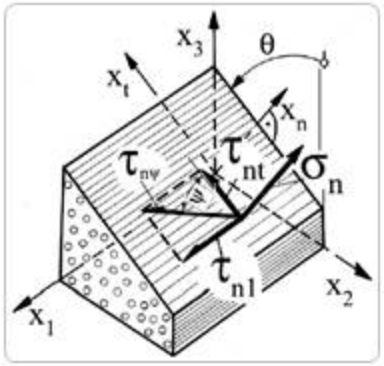


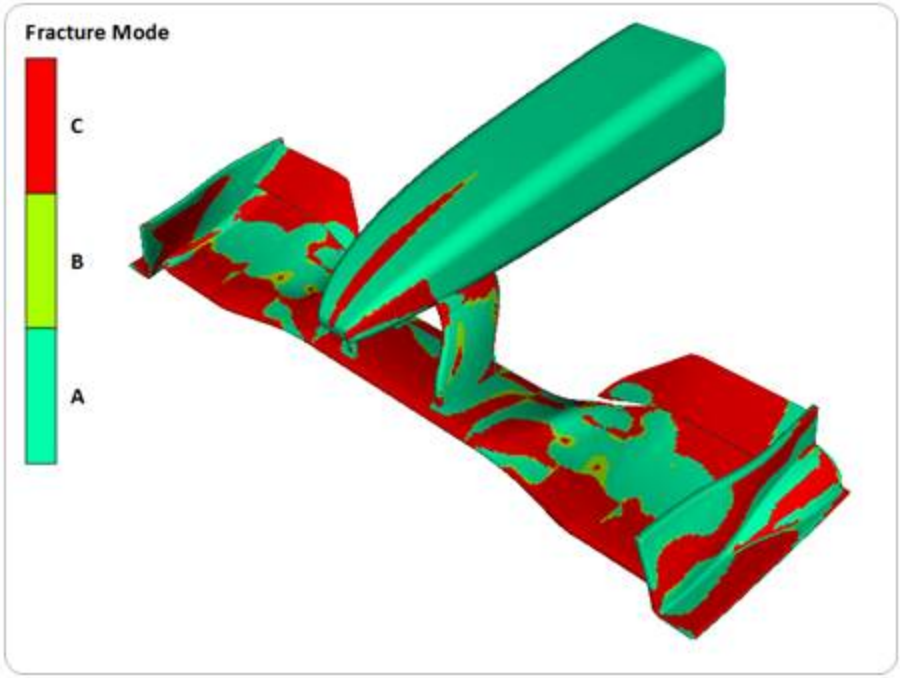
Stress Tensor,Shear-12,Layer:10

Calculated results: VDI 2014 Part III

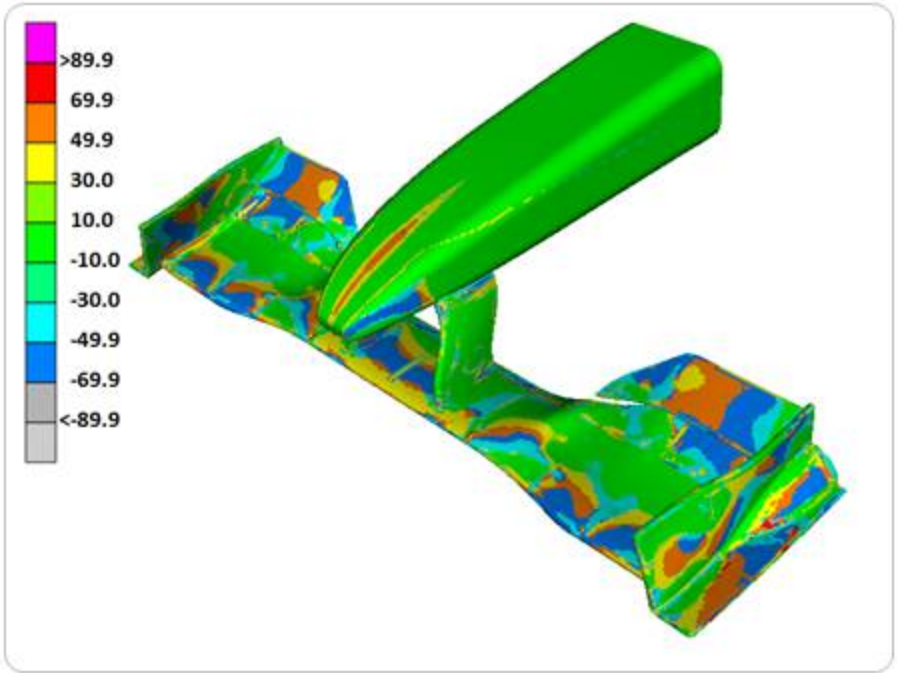






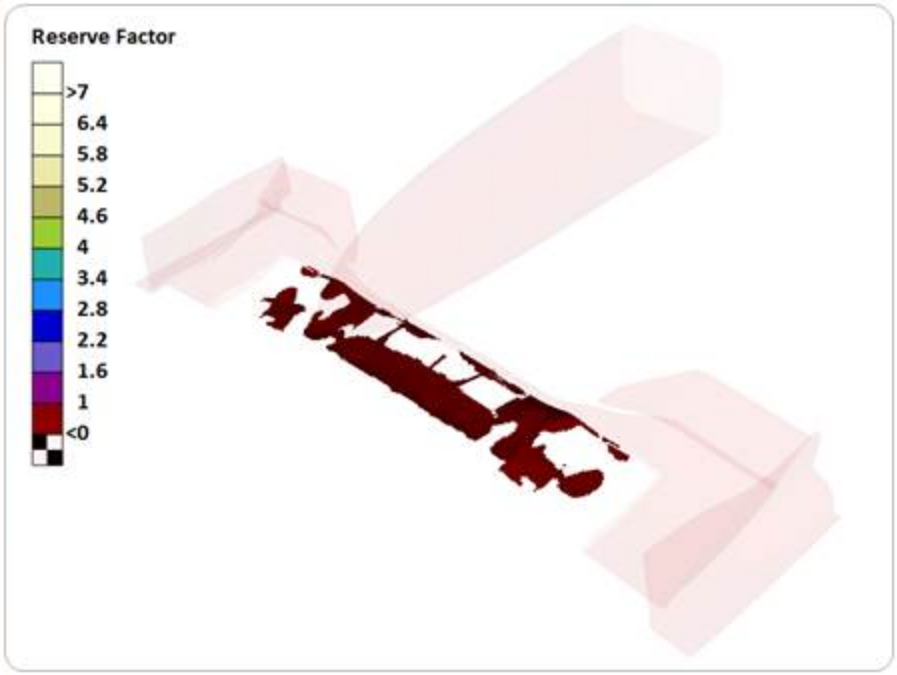


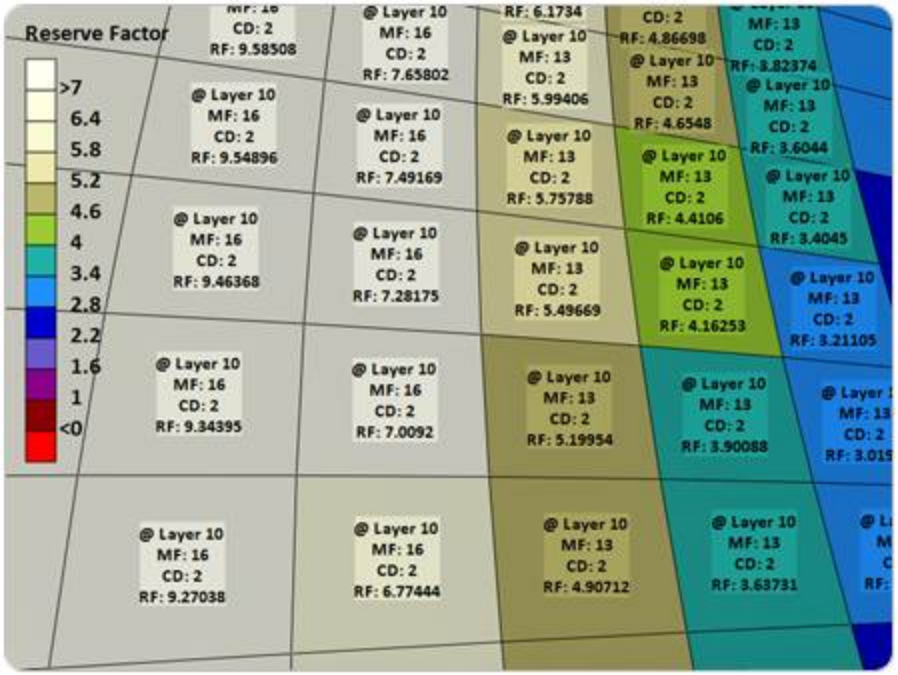
Fracture Mode,Layer:10



Fracture Angle,Layer:10

Post-Processing: Isolate and Anotate critical areas

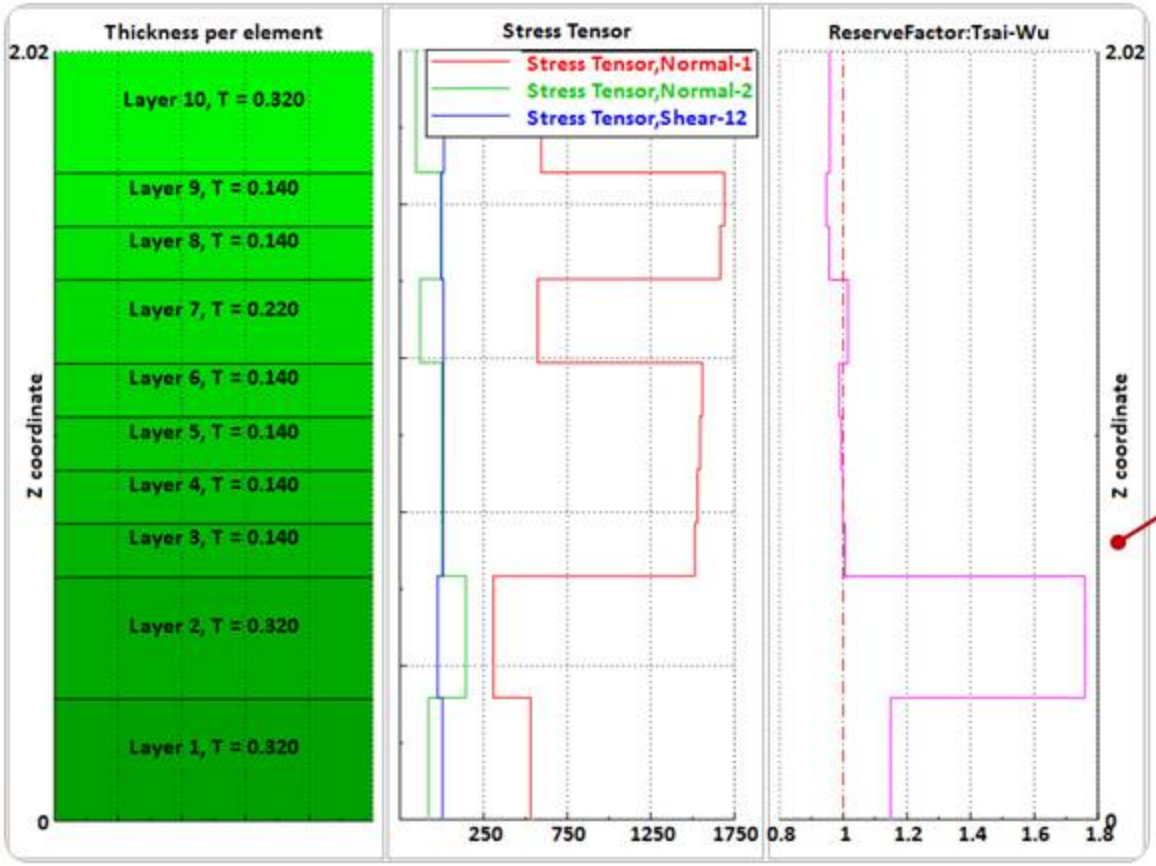


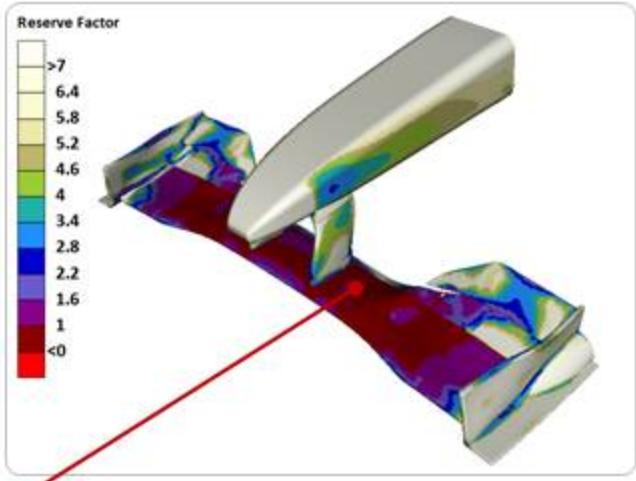


Isolate Failed Elements

Inspect critical areas by visualizing **multiple results** using annotations

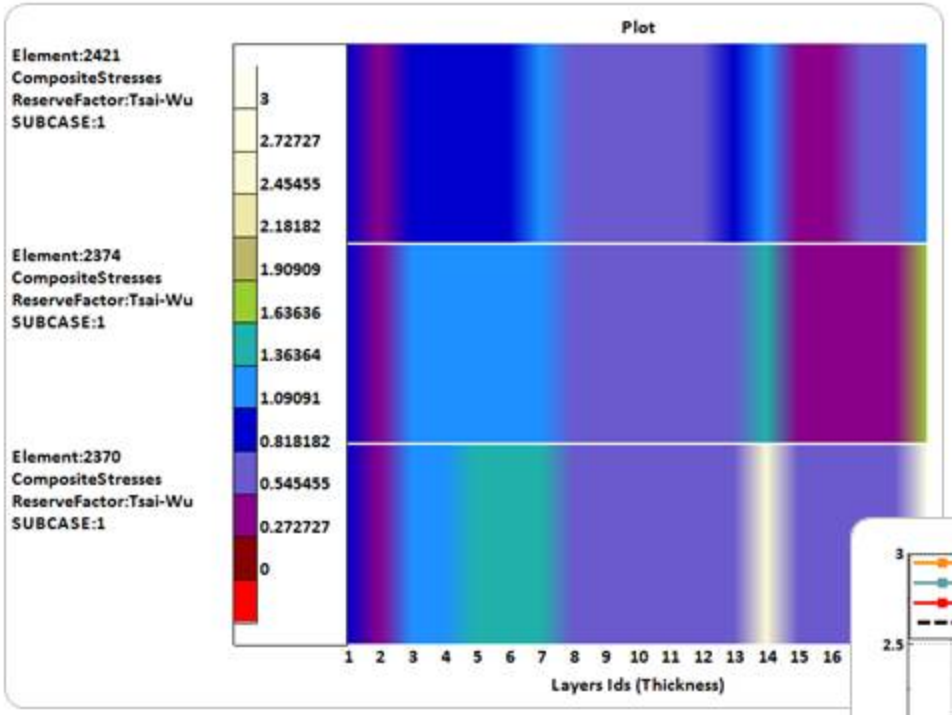
Post-Processing: 2d Plots

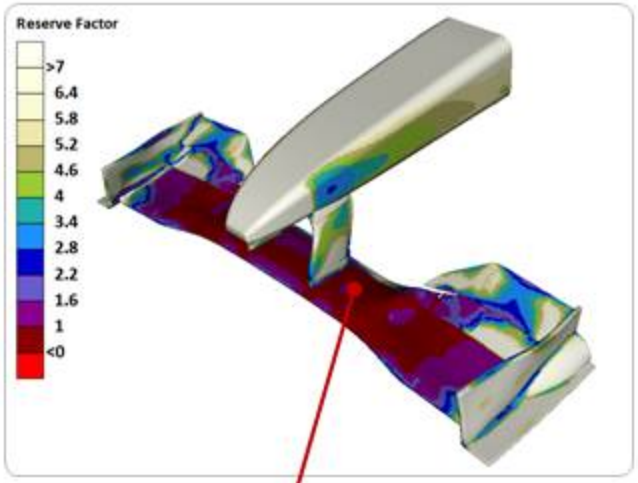


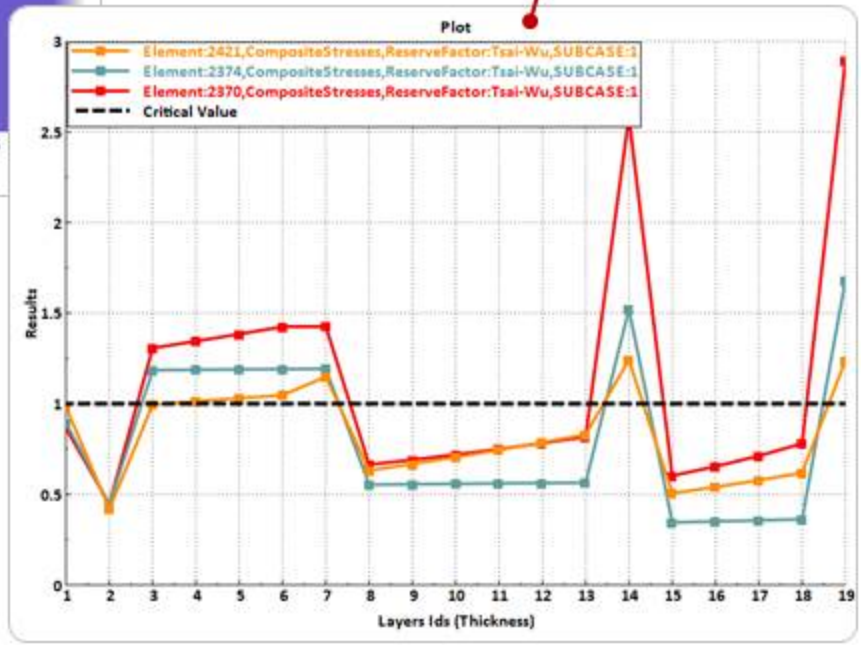


Plot **layer information** and **multiple results** through thickness

Post-Processing: 2d Plots

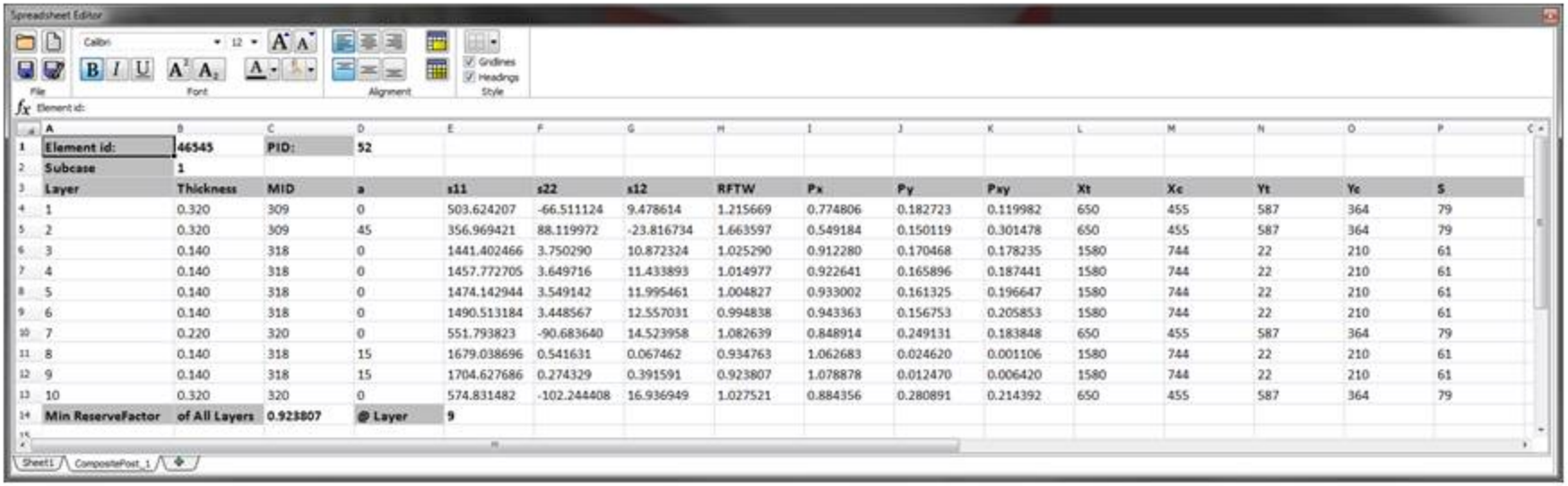






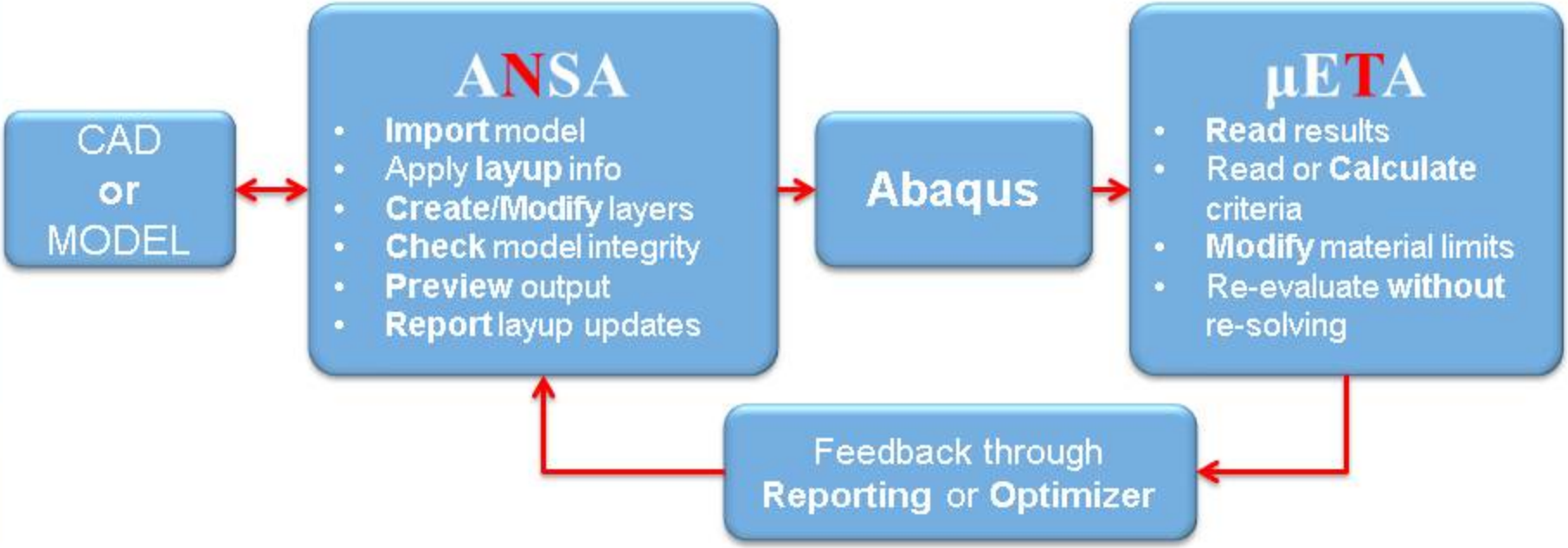
Plot results versus **layers ids** for **multiple elements**

Post-Processing: Detailed results reporting for specific elements

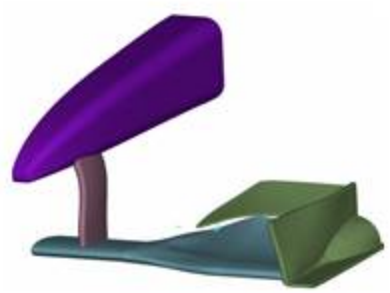


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Element id:**	**46545**	**PID:**	**52**												
2	**Subcase**	**1**														
3	**Layer**	**Thickness**	**MID**	**a**	**s11**	**s22**	**s12**	**RFTW**	**Px**	**Py**	**Pxy**	**Xt**	**Xc**	**Yt**	**Yc**	**S**
4	1	0.320	309	0	503.624207	-66.511124	9.478614	1.215669	0.774806	0.182723	0.119982	650	455	587	364	79
5	2	0.320	309	45	356.969421	88.119972	-23.816734	1.663597	0.549184	0.150119	0.301478	650	455	587	364	79
6	3	0.140	318	0	1441.402466	3.750290	10.872324	1.025290	0.912280	0.170468	0.178235	1580	744	22	210	61
7	4	0.140	318	0	1457.772705	3.649716	11.433893	1.014977	0.922641	0.165896	0.187441	1580	744	22	210	61
8	5	0.140	318	0	1474.142944	3.549142	11.995461	1.004827	0.933002	0.161325	0.196647	1580	744	22	210	61
9	6	0.140	318	0	1490.513184	3.448567	12.557031	0.994838	0.943363	0.156753	0.205853	1580	744	22	210	61
10	7	0.220	320	0	551.793823	-90.683640	14.523958	1.082639	0.848914	0.249131	0.183848	650	455	587	364	79
11	8	0.140	318	15	1679.038696	0.541631	0.067462	0.934763	1.062683	0.024620	0.001106	1580	744	22	210	61
12	9	0.140	318	15	1704.627686	0.274329	0.391591	0.923807	1.078878	0.012470	0.006420	1580	744	22	210	61
13	10	0.320	320	0	574.831482	-102.244408	16.936949	1.027521	0.884356	0.280891	0.214392	650	455	587	364	79
14	**Min ReserveFactor**	**of All Layers**	**0.923807**	**@ Layer**	**9**											

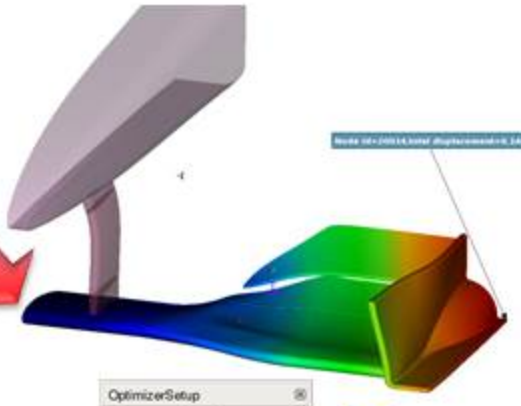
Detailed results output in **Excel** format



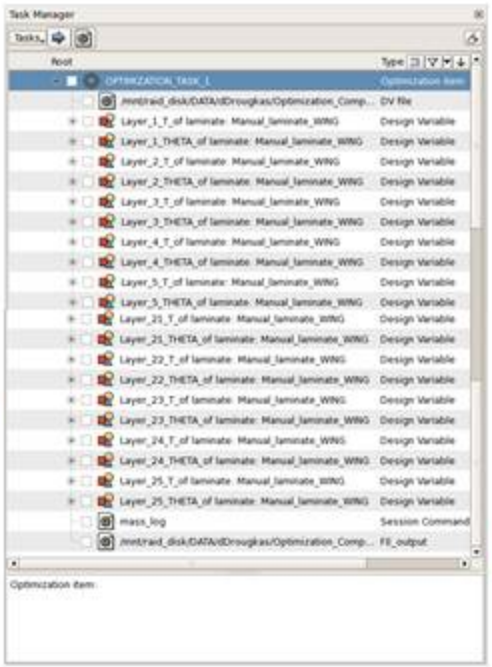
ANSA, µETA Isight Optimization



Abaqus



ANSA Optimization Task



Isight

µETA Optimizer Setup

Conclusions

- **Complete CAE tool** that simplifies overall process
- **Direct communication** of CAD data and faster model updates
- Unified handling of **shell and solid** laminate models
- Results evaluation by **calculating criteria** (e.g. VDI 2014 Part III)
- Re-evaluation by altering material limits **without re-solving**
- Ability to couple the process with **optimizers** (e.g. iSight)

Contact details

Thank you

Stay connected

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