CABIN

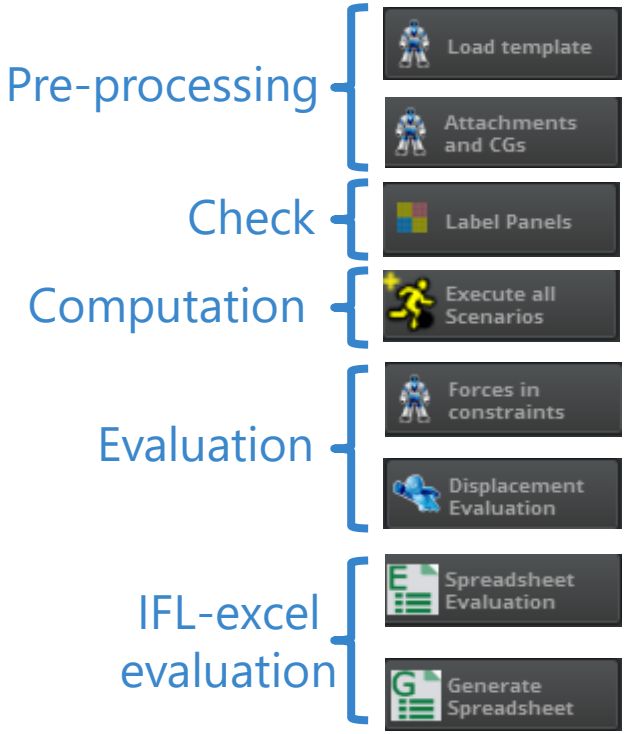
Using scripting to create and evaluate composite models in MSC Apex

Lukas.horak@safrangroup.com

Custom tools and macros

Added new functions and functionality to default MSC APEX

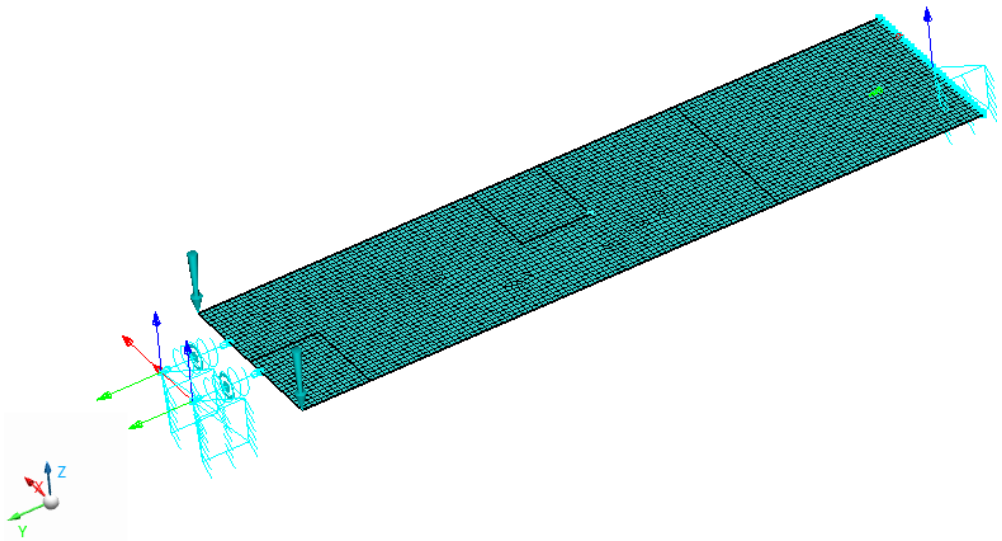
- All was done in programming language python with overlap to VBA and vbs.
- Modelling composite workflow was improved in all steps from creating, checking to evaluating.
- Interface Load Evaluation was incorporated from FEMAP to MSC APEX.
- Many In-house solution to enhance efficiency, reduce errors, and improve visualization
- Apex API Reference



Sample model

Simple representative Cantilever plate

- Fully fixed on one side
- Loaded by two point forces
- Supported with two springs on other side
- 4 composite zones

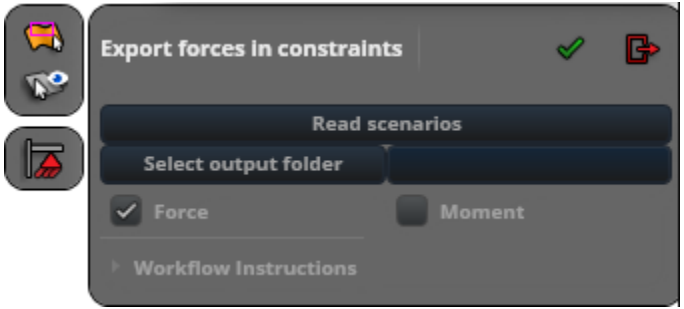


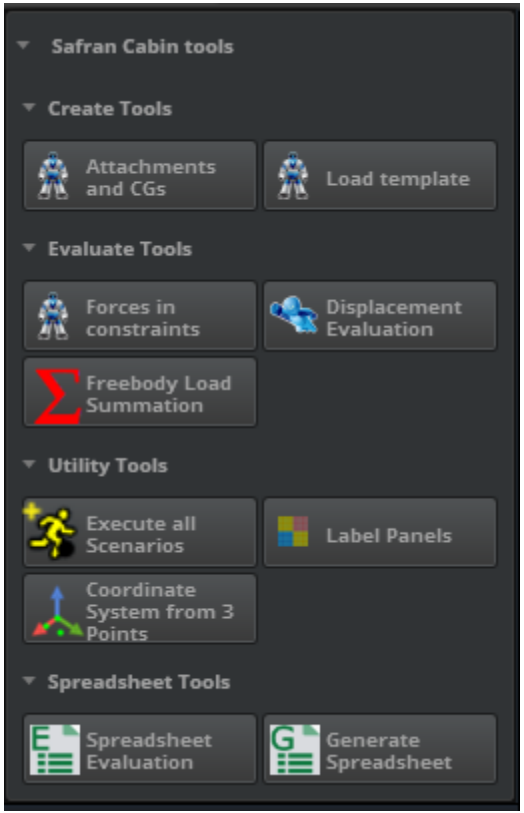
SAFRAN

Apex UI

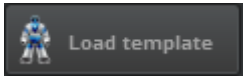
User friendly custom tools

- Visual environment
- Clear Instructions
- Great cutomization





Pre-processing



Load template

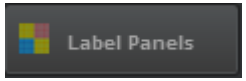
- Materials
- Composite Layup (sheet, stack)
- 3D/2D Element properties
- Scenarios, events

Attachments and CGs

- Loading predefined properties from input (excel, txt, …)
  - Nodes
  - Masses
  - Springs, Bushing

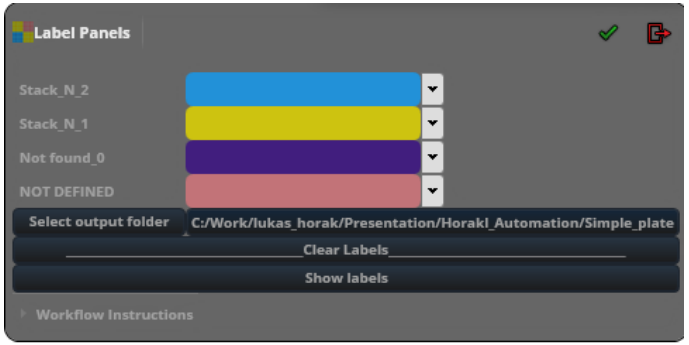
Fitting No.	Description	X[mm]	Y[mm]	Z[mm]	X rate [N/mm]	Y rate [N/mm]	Z rate [N/mm]
1 - 1	ST – Seat Track	8272.5	-265.0	-294.0	5000	5000	5000
2 - 2	ST – Seat Track	7542.5	-2292.0	-294.0	5000	5000	5000
3 - 3	ST – Seat Track	9923.5	-2292.0	-294.0	5000	5000	5000
4 - 4	ST – Seat Track	9923.5	-265.0	-294.0	5000	15000	5000

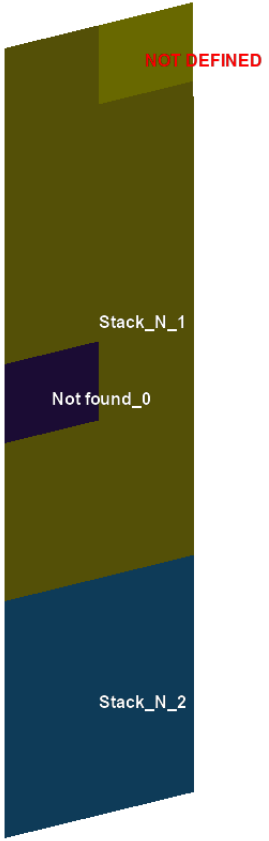
Check



Label Panels

- Colors zones by stack
- Enhanced visibility of not defined zones
- Renames Plies
  - Ply ID
  - Global ID
  - Material
  - Zone
  - Panel
- Load Global ID
  - Exist in API little difficult to follow

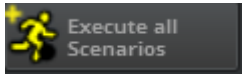




Sheet Name	Ply Name	Ply ID	Color	Material	Thickness	Angle
Compo...	Ply 3	3		Composite	0.000500 m	0.000000 °
Compo...	Ply 4	4		Composite	0.000500 m	0.000000 °
Core_5	Ply 5	5		Core	0.005000 m	0.000000 °
Compo...	Ply 6	6		Composite	0.000500 m	0.000000 °
Compo...	Ply 7	7		Composite	0.000500 m	0.000000 °
Compo...	Ply 8	8		Composite	0.000500 m	0.000000 °

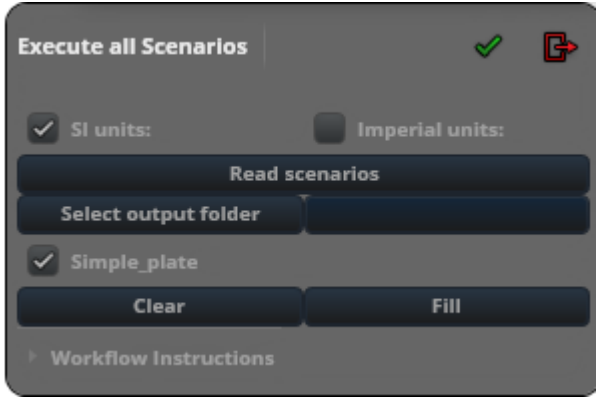
SAFRAN

Computation



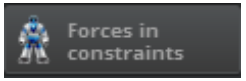
Execute all Scenarios

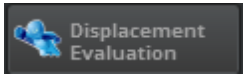
- Exports .bdf files
- Computes in external Nastran
- Import the results from .h5 file




```
<HDF5 file "template.h5" (mode r)>
├── INDEX
│   └── NASTRAN
│       └── RESULT
│           ├── ELEMENTAL
│           │   └── STRESS
│           │       ├── BAR (2)
│           │       ├── BUSH (2)
│           │       ├── QUAD4_COMP (2)
│           │       ├── QUAD_CN (2)
│           │       └── TRIA3_COMP (2)
│           └── NODAL
│               ├── APPLIED_LOAD (2)
│               ├── DISPLACEMENT (2)
│               ├── GRID_FORCE (2)
│               ├── MPC_FORCE (2)
│               └── SPC_FORCE (2)
└── NASTRAN
    ├── INPUT
    │   ├── CONSTRAINT
    │   │   ├── SPC (12)
    │   │   └── SPCADD
    │   │       ├── IDENTITY (2)
    │   │       └── S (16)
    │   ├── DOMAINS (1)  = (1, 0, 0, 0, 0)
    │   ├── ELEMENT
```

Evaluation



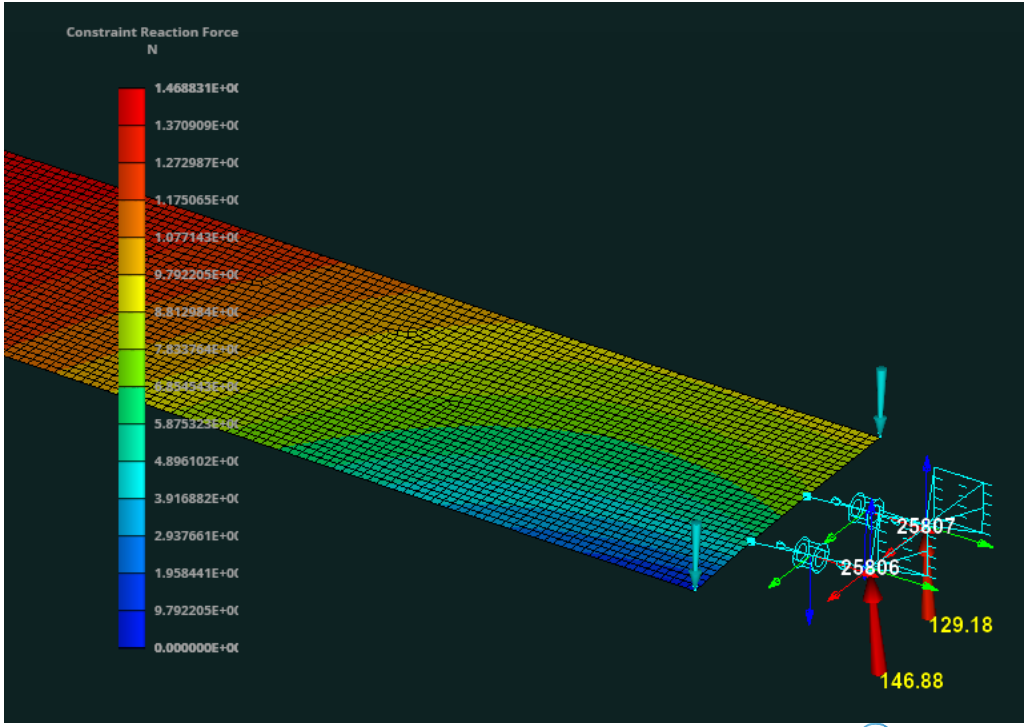


Forces in constraints

- Exports all forces in constraints
- Automatic selection

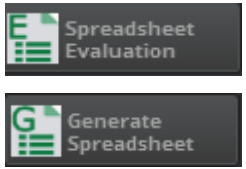
Displacement Evaluation

- Exports displacement in selected nodes
- Selection done in Pre-procesing



SAFRAN

Spreadsheet Evaluation



Generate Spreadsheet

- Copy spreadsheet file to specified folder

Spreadsheet Evaluation

- Complex evaluation of whole model
- Properties
  - Materials
  - Loads
  - Composite layup
  - etc…
- Results
  - Loads
  - Displacements
  - etc…

Conclusion

- Possibility to create comprehensive and easy to use custom tools

- Enhanced workflow with composite
- Check of model parameters
- Complex evaluation

Thank you for your attention