# OPTIMAL STRUCTURAL SOLUTIONS

"Creating Optimal Solutions"

Advanced Composite Structures Design & Manufacture

Capacities & Past Experience

March, 2016

# Capabilities - Engineering

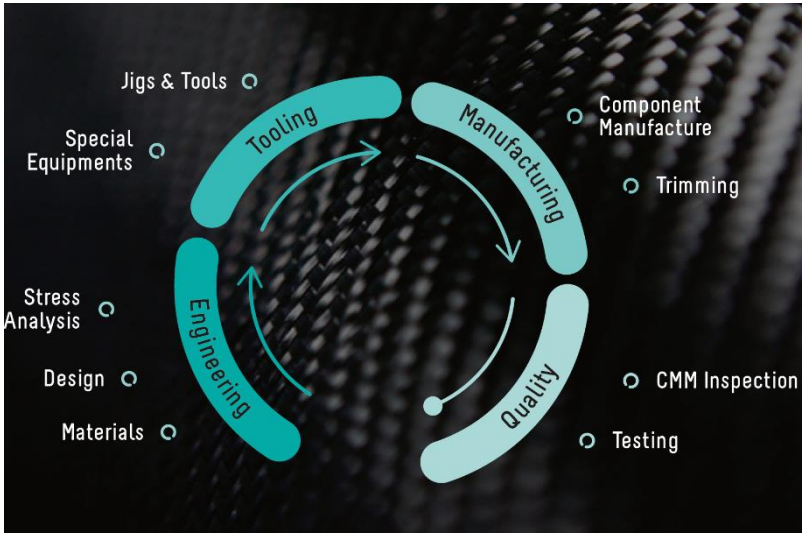
OPTIMAL STRUCTURAL SOLUTIONS

Engineering team capabilities:

- Design (CAD),
- Stress Analysis (FEA),
- Methods & Processes.

Knowledge/Experience in:

- Composite and metallic components design & stress analysis,
- Materials qualification and testing,
- Certification support,
- Non-conformances analysis,
- FAI campaigns support,
- Production processes development.




Solutions from Design till Production Support

# Capabilities - Tooling

OPTIMAL STRUCTURAL SOLUTIONS

Tooling for composite components:

- Laminations tools,
  - Steel, INVAR, Aluminium,
  - Carbon fibre (180 DegC),
  - Composite for low temperature cures,
  - Tooling board for prototypes.
- Trimming tools:
  - Vacuum or clamps based,
- Core stabilization tools,
- Control tools.

Jigs:

- Assembly jigs,
- Drilling jigs and templates,
- Handling carts,
- Special equipment.

Turn-Key or Built to Print

Internal capacity suitable for tooling up to 12 meters in length

Close to 1000 tools manufactured

Capacity for more than 300 tools per year

# Installed Capacity

OPTIMAL STRUCTURAL SOLUTIONS

Engineering:

- •Fully equipped design office,
- •Minimum of 9 CATIA stations,
- •FEA capacity, Nastran and ABAQUS.

Manufacturing:

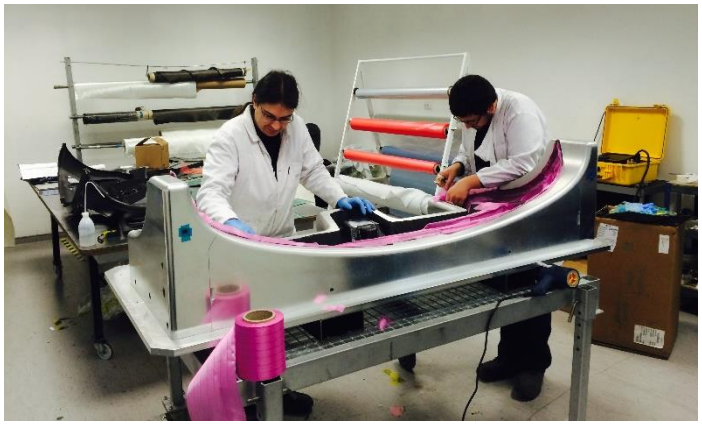
- •3 facilities, Cascais, Marinha Grande and Oxford in the UK,
- •Six large 5 axis CNC machines:
  - JOBS: 12600x3500x1200 mm,
  - JOBS: 4500x3500x1200 mm,
  - Gentiger: 2500x1800x900 mm,
  - CMS ARES: 4800x1800x1200 mm,
  - 2xCMS ANTARES: 2500x1800x1200mm,
- •Five large 3 axis CNC machines,
- •Autoclave D1.5x3.0m,
- •Curing ovens,
- •API Laser tracker,
- •ROMMER CMM inspection arm,


# Installed Capacity

OPTIMAL STRUCTURAL SOLUTIONS


# Installed Capacity

OPTIMAL STRUCTURAL SOLUTIONS

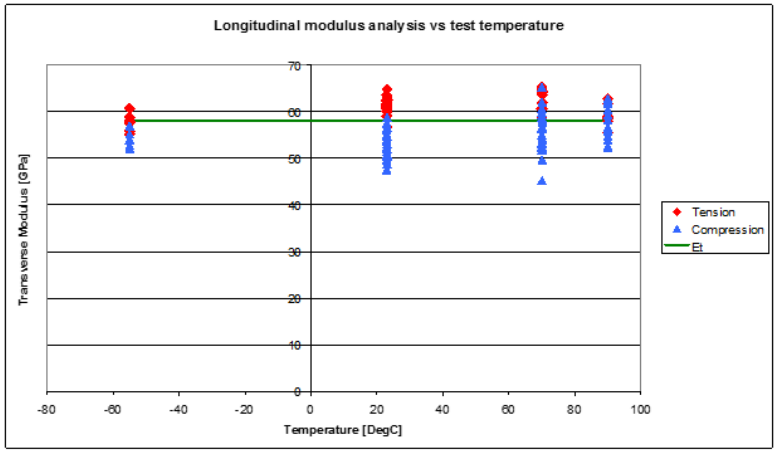
# Previous Projects - Aeronautics

Project: AIRBUS OoA material qualification

Year: 2009-2012

OPTIMALs tasks:

- Definition of OaA composite material qualification test campaign (MTM44),
- Support to test campaign,
- Data analysis, towards generation of design values and methods validation,
- Material used for A320 and A350 aircraft families.

# Previous Projects - Aeronautics

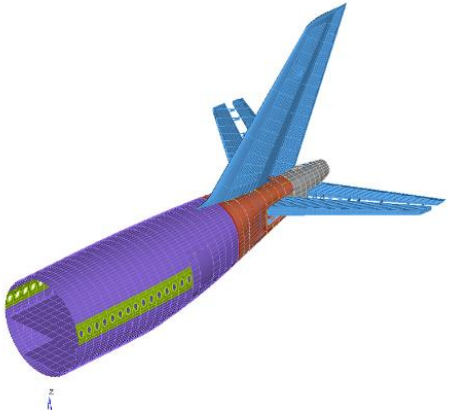
Project: A350 S19 Stress Analysis

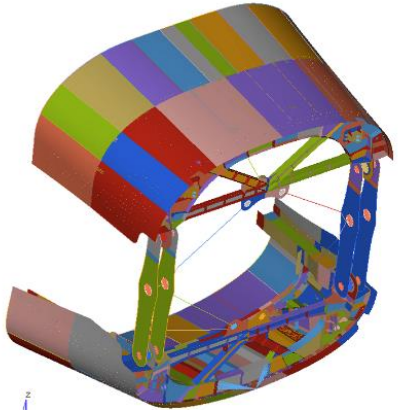
End Client: AIRBUS

Year: 2011

OPTIMALs tasks:

- •Support to A350 certification campaign,
- •GFEM and DFEM modification/generation and analysis,
- •Non-Conformances studies,
- •Stress verifications based on ISAMI, or empirical calculations.



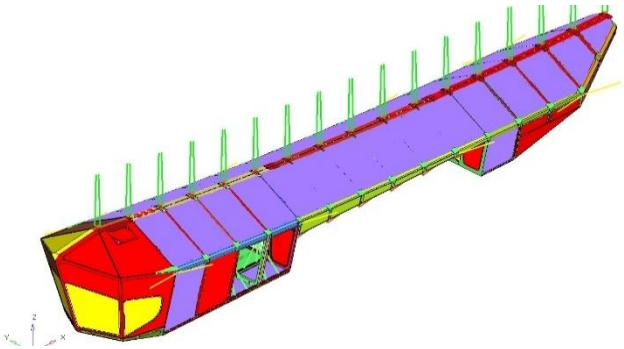
# Previous Projects - Aeronautics

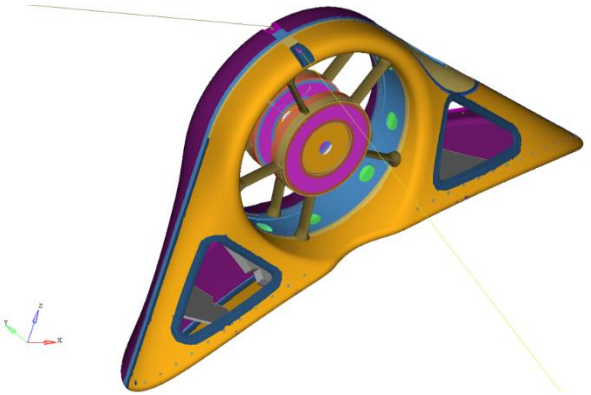
Project: Northrop Grumman LEMV

Year: 2011

OPTIMALs tasks:

- Stress analysis of major composite structures:
  - Payload Beam,
  - Vanes,
  - Bow Thruster,
  - Mission Module,
  - Fuel Module.
- Support from preliminary design till 1st flight certification



# Previous Projects - Aeronautics

Project: Embraer KC-390

Year: 2013

OPTIMAL tasks:

- Support to CAD design activities of sponson and fuselage metallic & composite structures,
- Support to FEA analysis of sponson composite structures.

# Previous Projects - Aeronautics

Project: FP7-CleanSky Fatigue Test

Year: 2009-2012

OPTIMALs tasks:

- •FP7 project coordination,
- •Develop representative aircraft fuselage panel with integrated ribs, for Structural Health Monitoring testing,
- •Panel manufacturing.

# Previous Projects - Aeronautics

Project: NHIndustries NH90

Year: 2009

OPTIMAL tasks:

- Design and manufacture of lamination and trimming tools.

# Previous Projects - Aeronautics

Project: Falcon 7X

Year: 2009

OPTIMAL tasks:

- Design and manufacture of lamination and trimming tools.


# Previous Projects - Aeronautics

Project: Embraer KC-390 sponson tooling

Year: 2012

OPTIMAL tasks:

- Design and manufacture of lamination and trimming tools,
- 350 tools workpackage.

# Previous Projects - Aeronautics

Project: Embraer KC-390 fuselage tooling

Year: 2014

OPTIMAL tasks:

- Design and manufacture of lamination tools.

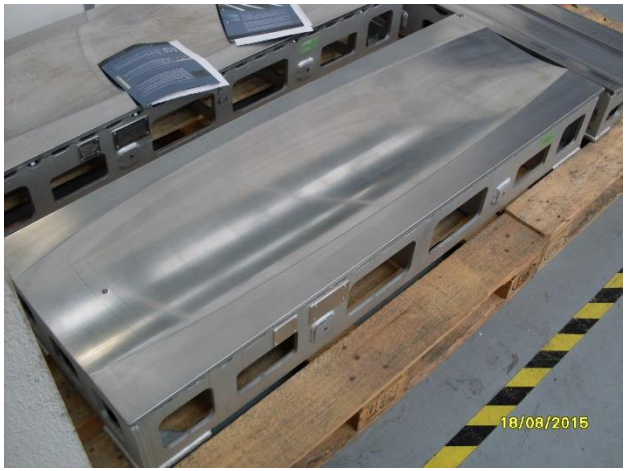

# Previous Projects - Aeronautics

Project: Embraer Legacy 450/500 Tooling I

Year: 2013

OPTIMAL tasks:

- •Design and manufacture of lamination and trimming tools
- •One of the largest CFRP lamination tools used in Embraer´s programs (tailcone),
- •Various metallic lamination and trimming tools.

# Previous Projects - Aeronautics

Project: Embraer Legacy 450/500 Tooling II

Year: 2013

OPTIMAL tasks:

- •Design and manufacture of lamination and trimming tools
- •One of the largest CFRP lamination tools used in Embraer´s programs (tailcone),
- •Various metallic lamination and trimming tools.

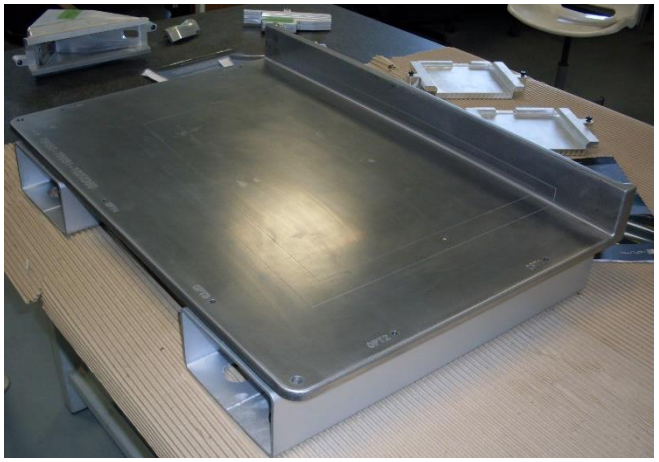

# Previous Projects - Aeronautics

Project: Sikorsky S76 tooling

Year: 2014

OPTIMAL tasks:

- Design and manufacture of lamination and trimming tools
- 130 tools package.

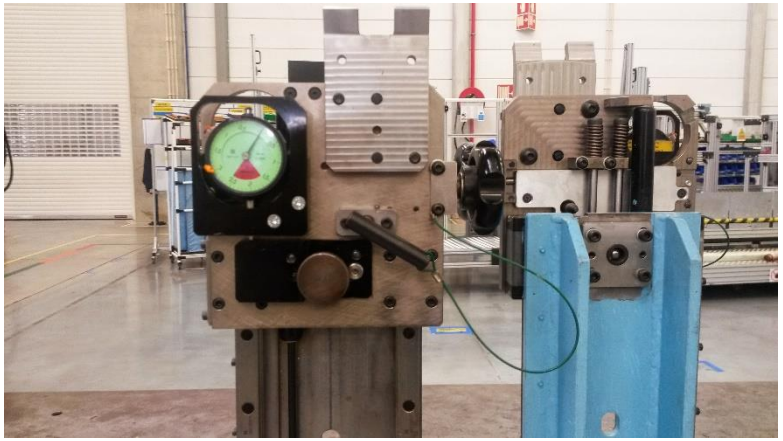
# Previous Projects - Aeronautics

Project: Embraer Legacy 450/500 Line Modifications

Year: 2015

OPTIMAL tasks:

- Design and implementation of comprehensive modifications in wings production line,
- Modifications implemented with ongoing workload to minimize production impact.



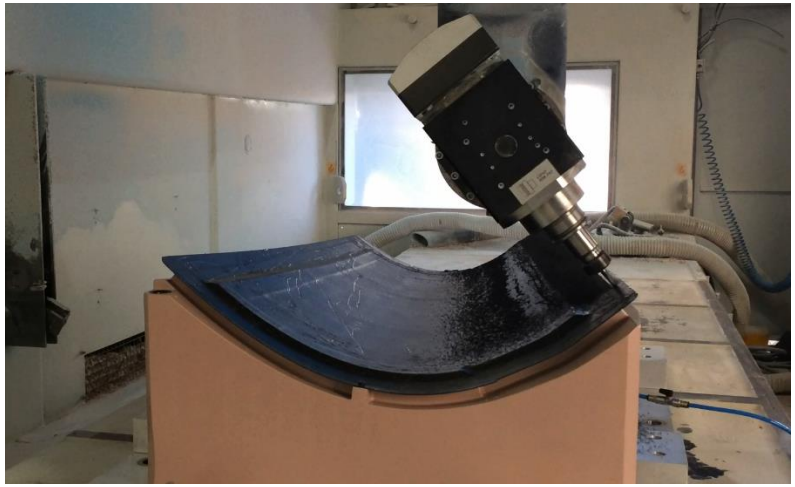
# Previous Projects - Aeronautics

Project: Airbus A400M CFRP Trimming

Year: 2015

OPTIMAL tasks:

- Trimming of carbon fiber panels
- Manufacturing of trimming tools,
- AS9100 certified process,
- AIRBUS certified.



# Previous Projects - Aeronautics

Project: Embraer E2 and Legacy 450/500 ducts tooling

Year: 2014

OPTIMAL tasks:

- Design and manufacturing of salt molds, trimming and assembly tools.

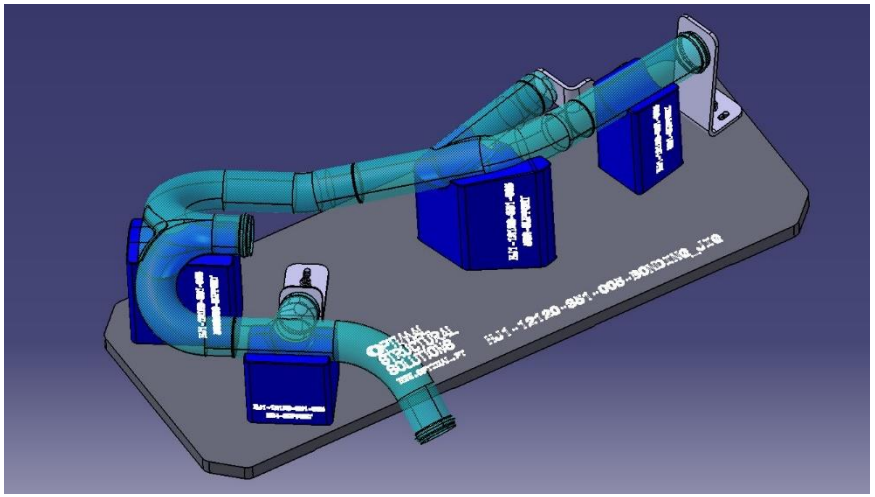
# Previous Projects - Aeronautics

Project: Hondajet ducts tooling

Year: 2015

OPTIMAL tasks:

- Design and manufacturing of salt molds, trimming and assembly tools.



# Previous Projects - Aeronautics

Project: Embraer E2 IML, OML, Root drilling templates

Year: 2014

OPTIMAL tasks:

- Manufacture of drilling templates.

# Previous Projects - Aeronautics

Project: Embraer KC-390 fuselage drilling templates

Year: 2015

OPTIMAL tasks:

- Design and manufacture of drilling templates
- 104 templates in 7 weeks.

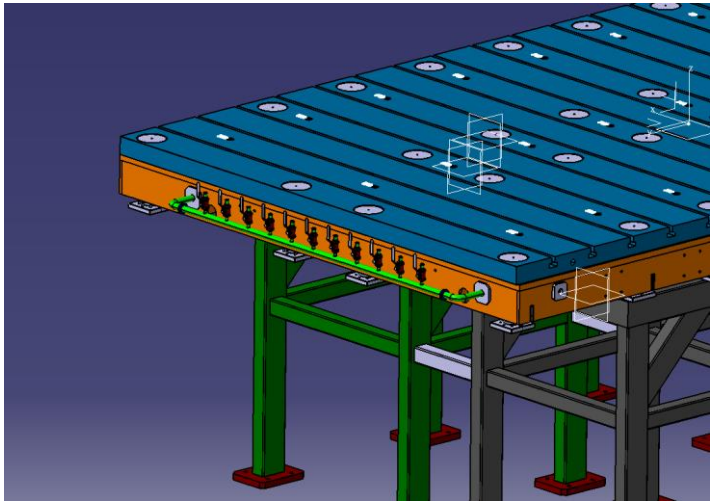
# Previous Projects - Aeronautics

Project: Embraer table for FLOW machine

Year: 2014

OPTIMAL tasks:

- Design, manufacturing and installation stainless steel table for trimming operations.



# Previous Projects - Aeronautics

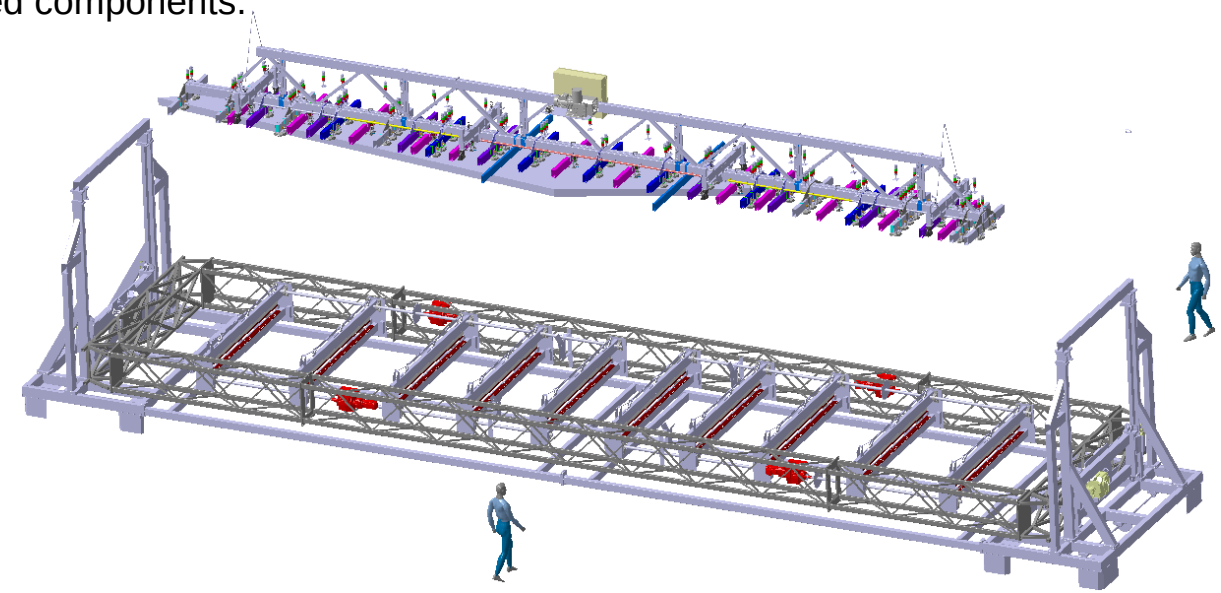
OPTIMAL STRUCTURAL SOLUTIONS

Project: Embraer automated handling system for large CNC machined parts

Year: 2016

OPTIMAL tasks:

- Design, manufacturing and installation, of and automated system to handle large CNC machined components.



# Previous Projects - Automotive

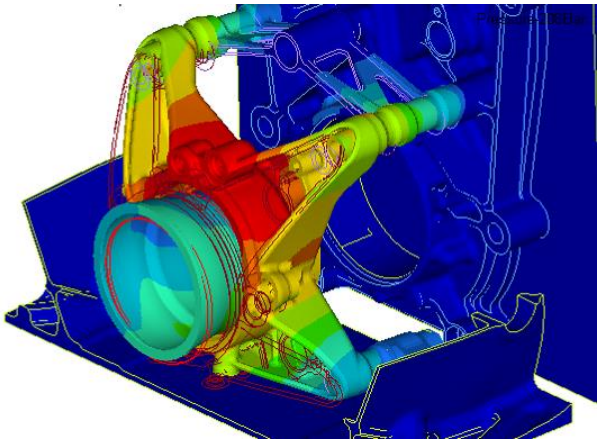
OPTIMAL STRUCTURAL SOLUTIONS

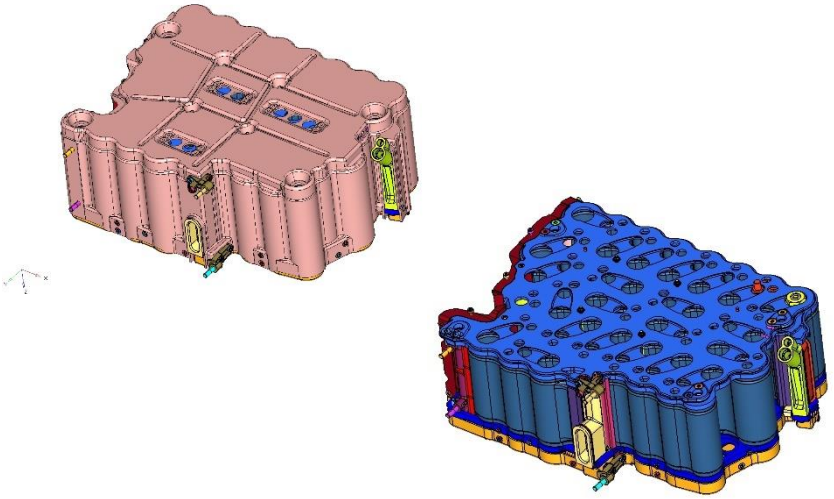
Project: Renault F1 vehicle stress analysis

Year: 2011-12

OPTIMALs tasks:

- Various stress analysis activities for the F1 vehicle,
- Mainly composite structures, but also metallic.





# Previous Projects - Automotive

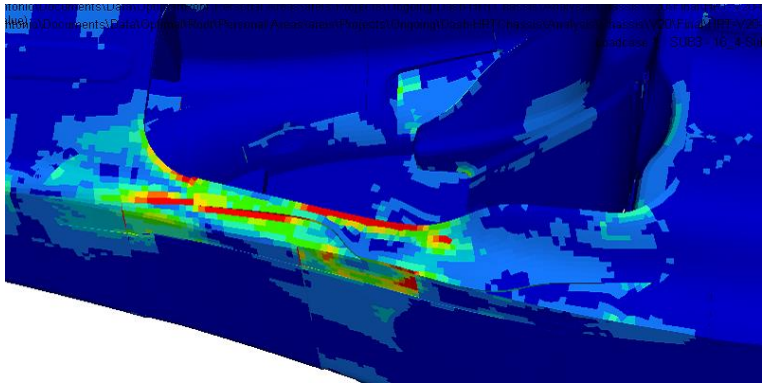
OPTIMAL STRUCTURAL SOLUTIONS

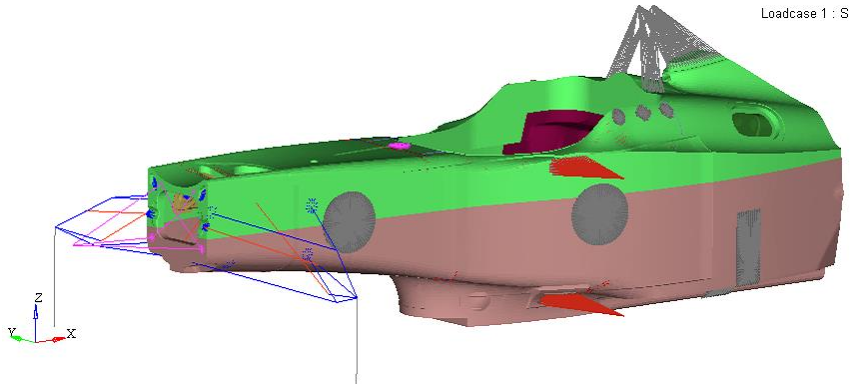
Project: HRT F1 monocoque and crash structures

Year: 2011-12

OPTIMALs tasks:

- Stress analysis and laminate definition of HRT F1 monocoque,
- Crash structures development,
- Responsibility for structural homologation campaign with the FiA.



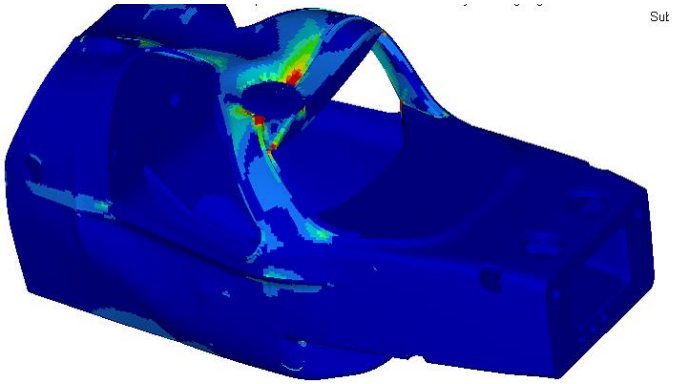
# Previous Projects - Automotive

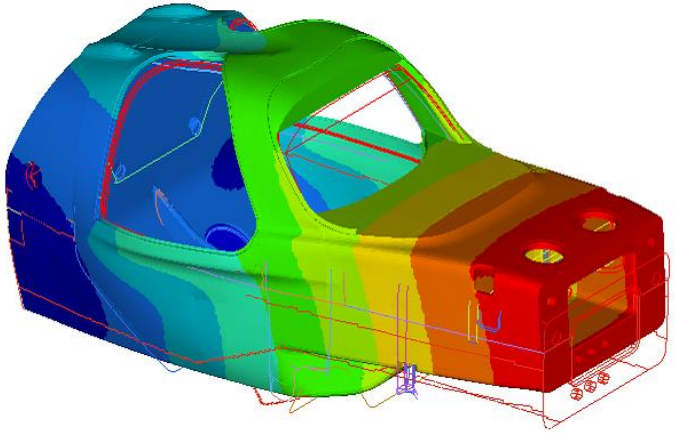
Project: Lotus LMP2 monocoque

Year: 2012

OPTIMAL tasks:

- Stress analysis and laminate definition of Lotus LMP2 monocoque,
- Front impact structure design & FEA,
- Responsibility for structural homologation campaign with the FiA.



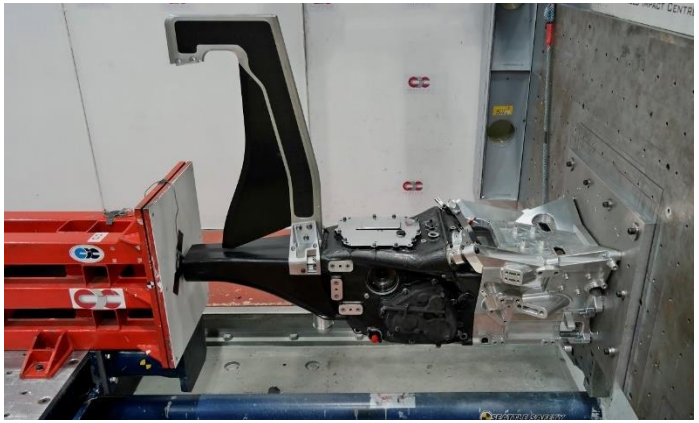
# Previous Projects - Automotive

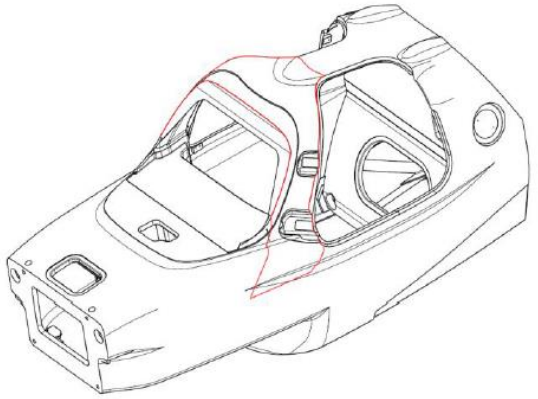
Project: Lotus LMP1 monocoque & RIS

Year: 2013

OPTIMAL tasks:

- Stress analysis and laminate definition of Lotus LMP1 monocoque,
- Rear impact structure design & FEA,
- Responsibility for structural homologation campaign with the FiA.



# Previous Projects - Automotive

Project: McLaren 570S RTM monocell chassis

Year: 2013

OPTIMAL tasks:

- Design optimization & conceptual studies,
- FEA model creation,
- Laminates definition & optimization,
- Ply-books release,
- Support to homologation campaign.

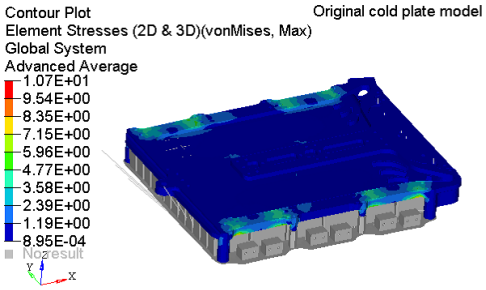

# Previous Projects - Automotive

Project: MAT Electronic device vibration

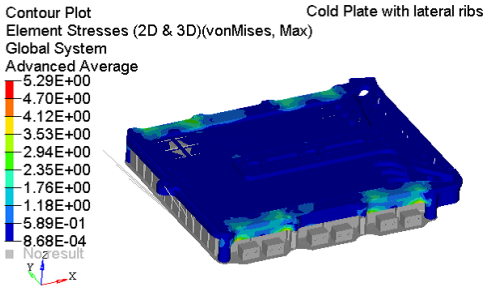
Year: 2013

OPTIMAL tasks:

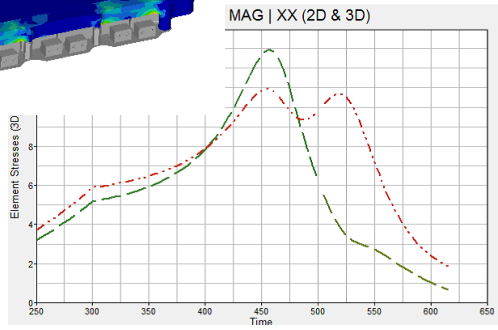
- FEA model creation,
- Vibration response analysis and model modifications.

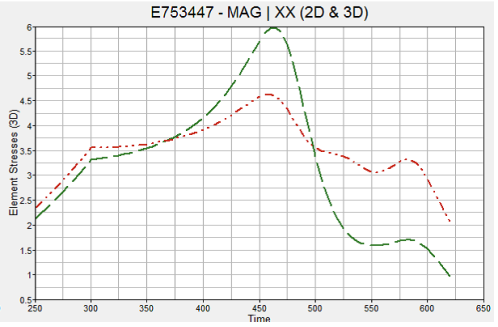




Original cold plate model




Cold Plate with lateral ribs



# Previous Projects - Automotive

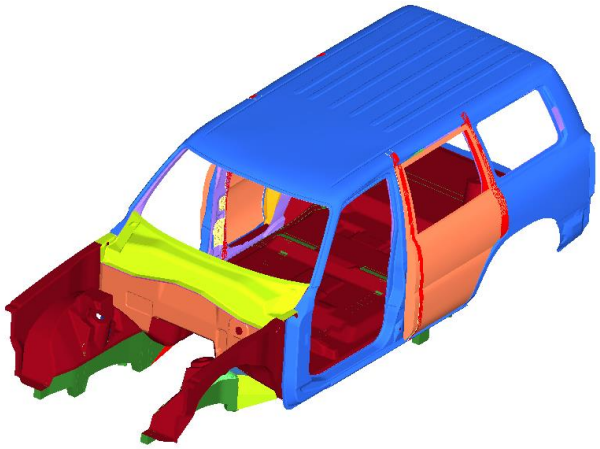
OPTIMAL STRUCTURAL SOLUTIONS

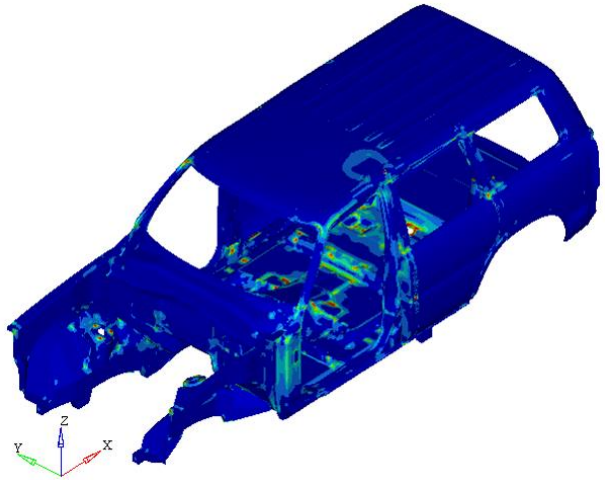
Project: Off-road vehicle composite chassis

Year: 2014

OPTIMAL tasks:

- Support to composite chassis definition,
- FEA model creation,
- Laminate optimization and plybook release.





# Previous Projects - Automotive

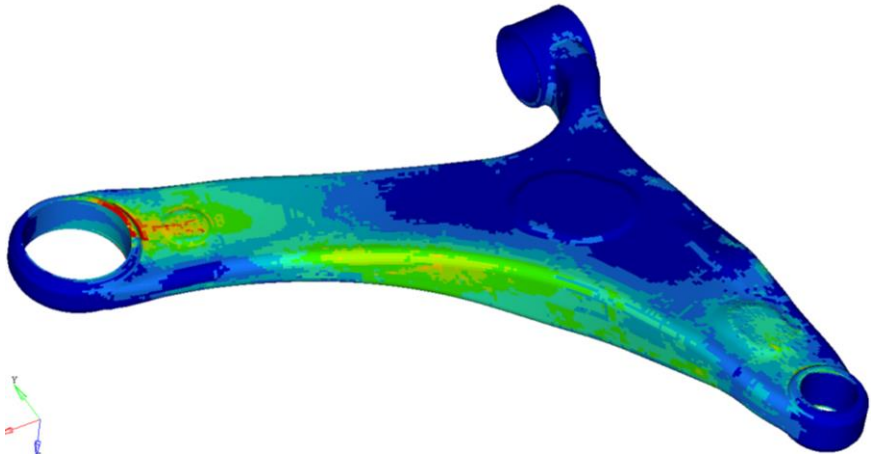
OPTIMAL STRUCTURAL SOLUTIONS

Project: Composite TCA development

Year: 2014

OPTIMAL tasks:

- Support to composite TCA concept definition,
- FEA model creation,
- Laminate optimization and plybook release.



# Previous Projects - Automotive

Project: ZENOS production tools

Year: 2014

OPTIMAL tasks:

- Design and manufacture of composite panels stamping tools.

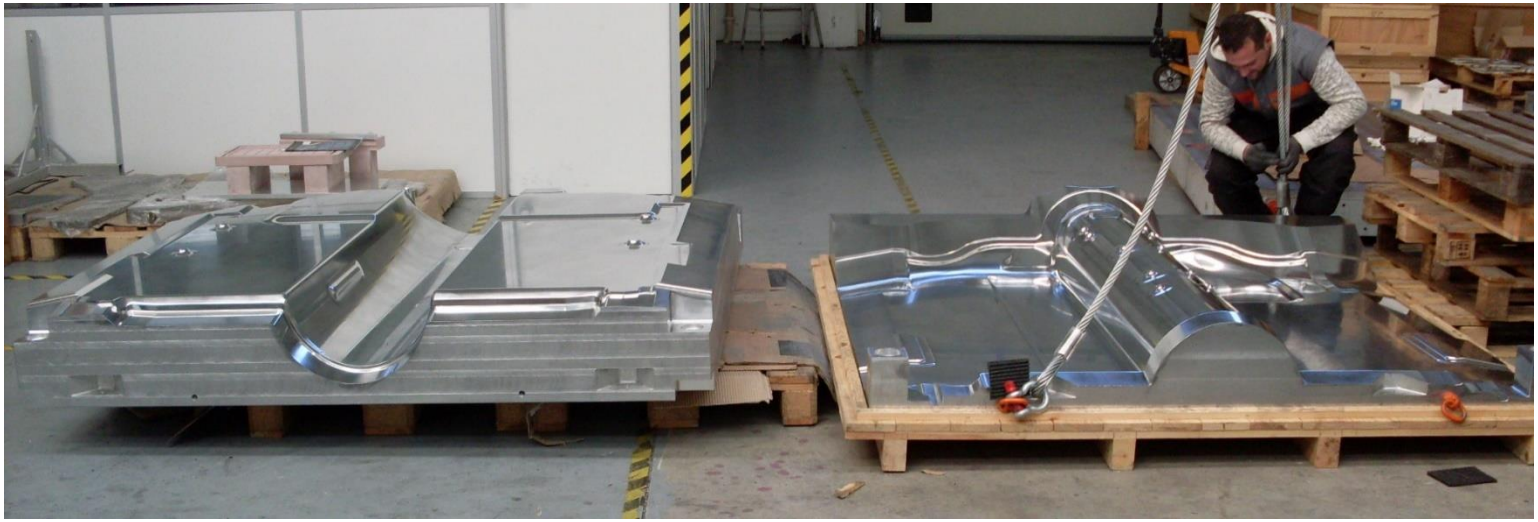
# Previous Projects - Automotive

Project: BMW i5 prototype tools

Year: 2014

OPTIMAL tasks:

- Design and manufacture of composite panels stamping tools.

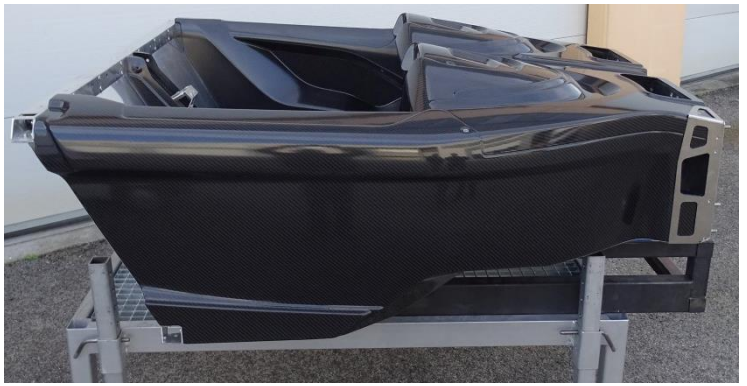
# Previous Projects - Automotive

Project: Elemental RP1 components manufacture

Year: 2014-2016

OPTIMAL tasks:

- Tooling design and manufacture,
- Components manufacturing,
- Industrialization.

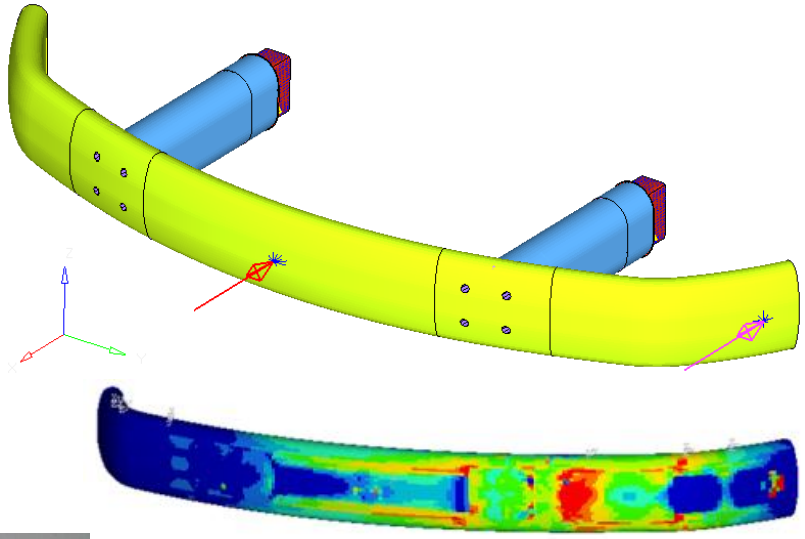
# Previous Projects - Automotive

Project: R&D composite front impact structure

Year: 2015

OPTIMAL tasks:

- Impact structures design,
- Cross beam design,
- Tooling and components manufacture,
- Impact testing.



# Previous Projects - Industrial

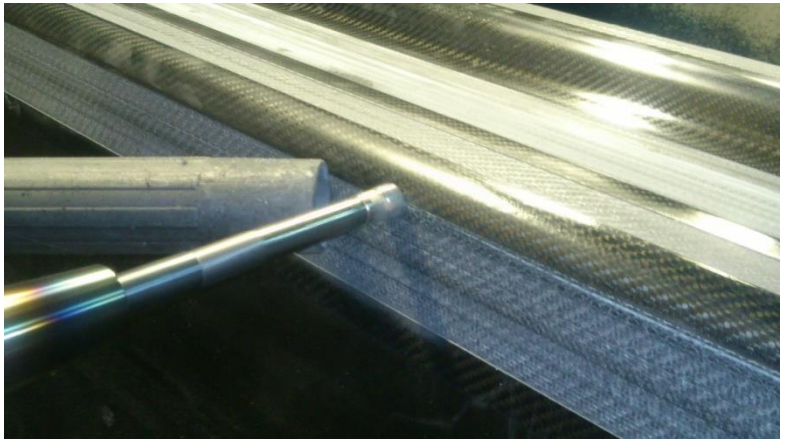
OPTIMAL STRUCTURAL SOLUTIONS

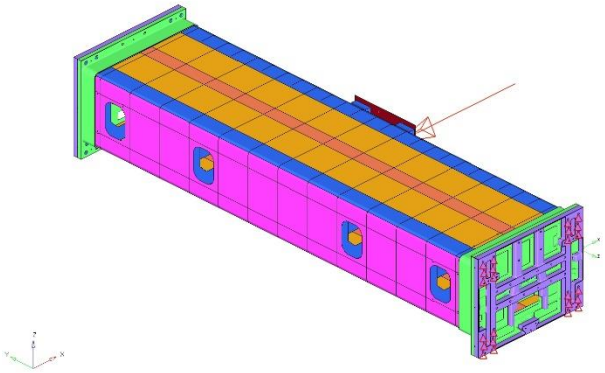
Project: Composite beam for laser cutting equipment

Year: 2013

OPTIMAL tasks:

- •Design and manufacture of a Y axis beam for a laser machine,
- •Material selection, component design, stress analysis and optimization
- •Tool design and manufacture,
- •Components manufacture.





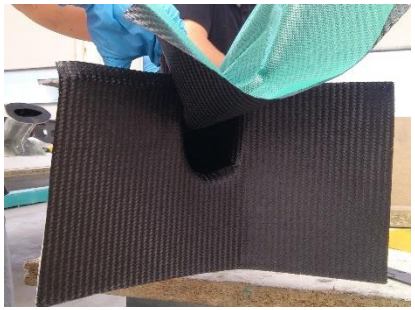
# Previous Projects - Nautical

Project: AC25 solid sail catamaran

Year: 2013

OPTIMAL tasks:

- Design of catamaran,
- Stress analysis and optimization,
- Tooling design and manufacturing,
- Components manufacturing,
- Assembly & Integration.



Rua de S. Francisco, 786 - Armazém CE
Parque Doroana
Adroana
2645 - 019 Alcabideche
Portugal

GPS: 38º 44' 26'' N; 9º 23' 22'' W

T: 00351 21 099 7788
F: 00351 21 099 7789
E-mail: info@optimal.pt

Web: www.optimal.pt