# Topology In Action

**Optimised Engineering Design 2016**

Williams Conference Centre

31st April 2016




# *Today you will see…*

- Demonstration of diverse applications of optimisation, with a focus on Topology.
- Examples from across industries, applicable to all types of structures (large, small, material type).
- A number of applications which have been physically made and can be seen here today.
- How optimisation is an essential part of GRM using different software:
  - Genesis
  - TruForm  for Abaqus
  - TruForm  SW for Solidworks
  - GTAM/GSAM for ANSYS Mechanical

# *Topology Examples*

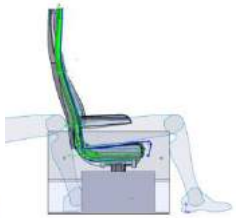
- HITACHI Cantilever Pedestal
- BMW Z3 Rear Wing Stay
- PILBEAM Upright Top
- BCIT Downhill Bike Crown

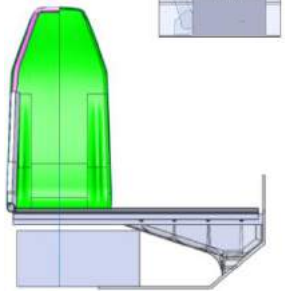


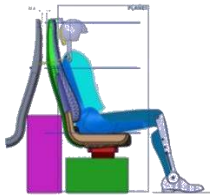

HITACHI CANTILEVER PEDESTAL

# HITACHI Cantilever Pedestal

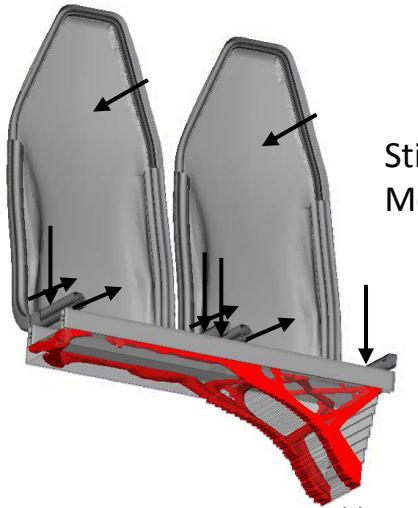
Package Space Definition





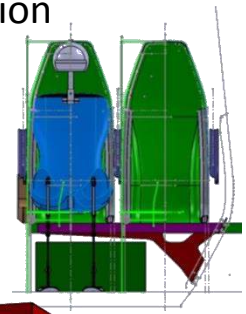


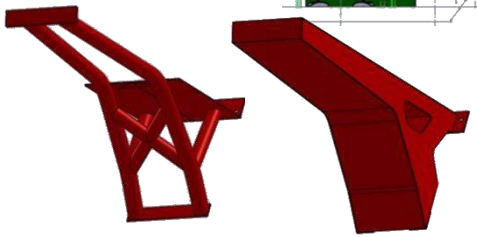
Topology optimisation



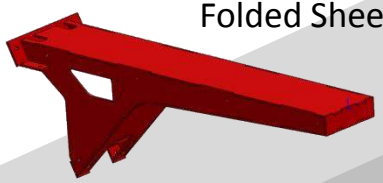
Stiffness & Modal

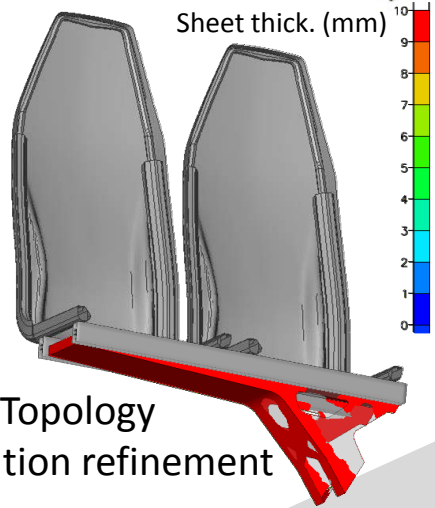
Design Interpretation





Folded Sheet






Sizing & Topology optimisation refinement

Final Design

# ROADSPORTS Z3 REAR WING STAY

# *BMW Z3 Wing Stay*

## BACKGROUND

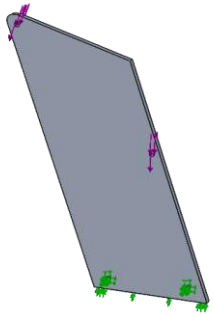
- Evolution 3 of wing stay design optimised using TruForm SW
  - Evolution 1 = Fixed frame
  - Evolution 2 = Adjustable frame with rear mounted adjustment
  - **Evolution 3 = Adjustable frame with front mounted adjustment**

## OBJECTIVES

- Rapidly identify optimal load path layout to support wing under aero loads for the chosen assembly configuration

# *BMW Z3 Wing Stay*

Package Space & Loads Definition in **SolidWorks**



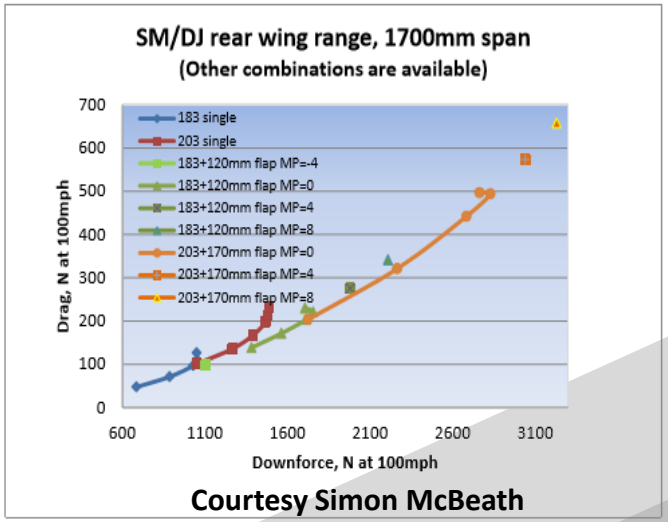
Topology optimisation using **TruForm SW**

Design Interpretation

Manufactured Part

**203 + end plate**

| Wing angle | Df, N | Drag, N | -L/D | Drag BHP |
|---|---|---|---|---|
| 4 | 1052.5 | 101.2 | 10.40 | 6.0 |
| 8 | 1266.6 | 135.9 | 9.32 | 8.1 |
| 12 | 1392.1 | 167.5 | 8.31 | 10.0 |
| 16 | 1468.4 | 198.5 | 7.40 | 11.8 |
| 18 | 1479.6 | 213.2 | 6.94 | 12.7 |
| 20 | 1488.4 | 230.7 | 6.45 | 13.7 |




**Courtesy Simon McBeath**

All design and optimisation processes within SolidWorks

Wing Mount Assembly Mass = 1.6kg

GRM OPTIMISED ENGINEERING DESIGN

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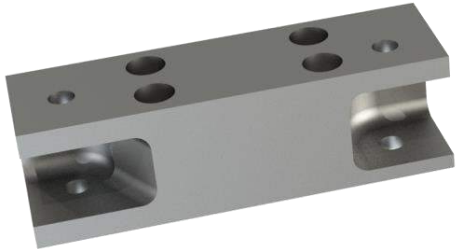
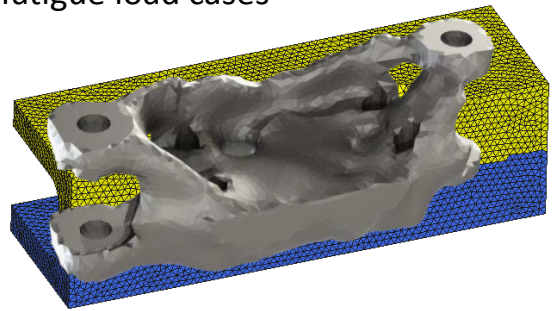
# PILBEAM UPRIGHT TOP

# *PILBEAM Upright Top*



Package
Space
Definition

Abuse event and
fatigue load cases

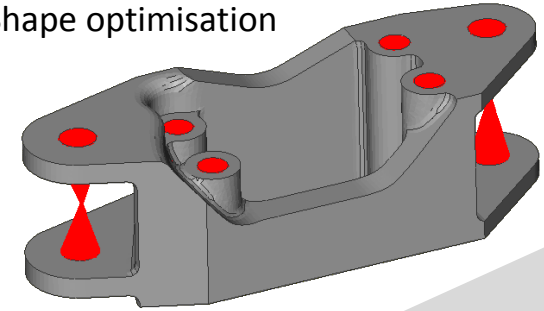


Stiffness and stress
constraints depending on
the load cases

Topology optimisation
result for multiple load
cases using Genesis

Design Interpretation &
New Baseline Analysis

Shape optimisation



Final Design
30% mass saving

Cycle 45Shape Change

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# DOWNHILL BIKE CROWN

Courtesy British Columbia Institute of Technology

# *BCIT Downhill Bike Crown*

- The British Columbia Institute of Technology undertook a study to design an integrated crown and stem for a downhill mountain bike.

- The aims are to:
  - eliminate the 4 bolts holding the stem on the crown of the current design
  - investigate a lighter geometry for the crown with stiffer & stronger performance using titanium material

BCIT

GRM OPTIMISED ENGINEERING DESIGN

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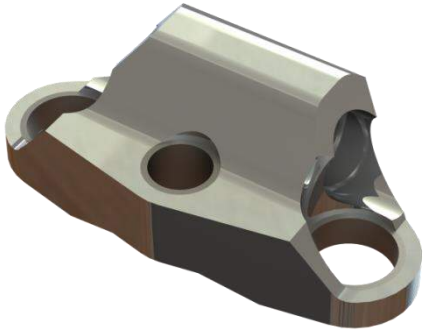
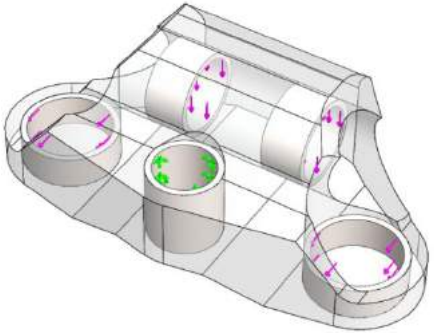
# BCIT Downhill Bike Crown



Package Space Creation in SolidWorks



Loads Definition

Topology optimisation using TruForm SW

3D printed Titanium Design

CNC Aluminium Design

**20% mass saving compared to original part while improving the stiffness and strength**

BCIT

GRM OPTIMISED ENGINEERING DESIGN

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# *Why Use Topology Optimisation?*

- Two possible goals: Reduce mass, Improve performance
- Available to anyone, no experience necessary
- Different tools available to suit your needs:
    - Genesis
    - TruForm  for Abaqus
    - TruForm  SW for Solidworks
    - GTAM/GSAM for ANSYS Mechanical
- GRM are always available to help and support your project!