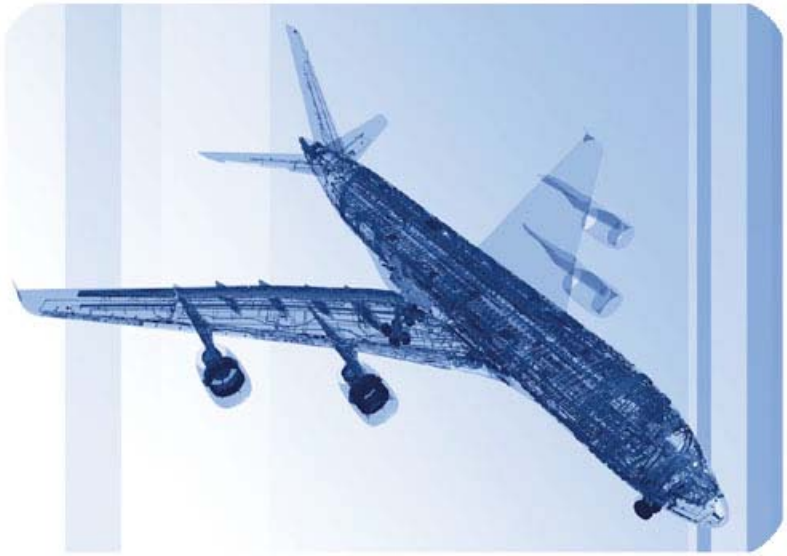
# APPLICATIONS of the ENGINEERING in the AERONAUTICS

**PRESENTED BY: José Juan Jareño Diz-Lois**



# The Consortium

Date of foundation: July 10, 2000

Foundation companies: Aerospatiale Matra SA
CASA (Construcciones Aeronaúticas SA)
DaimlerChrysler Aerospace AG

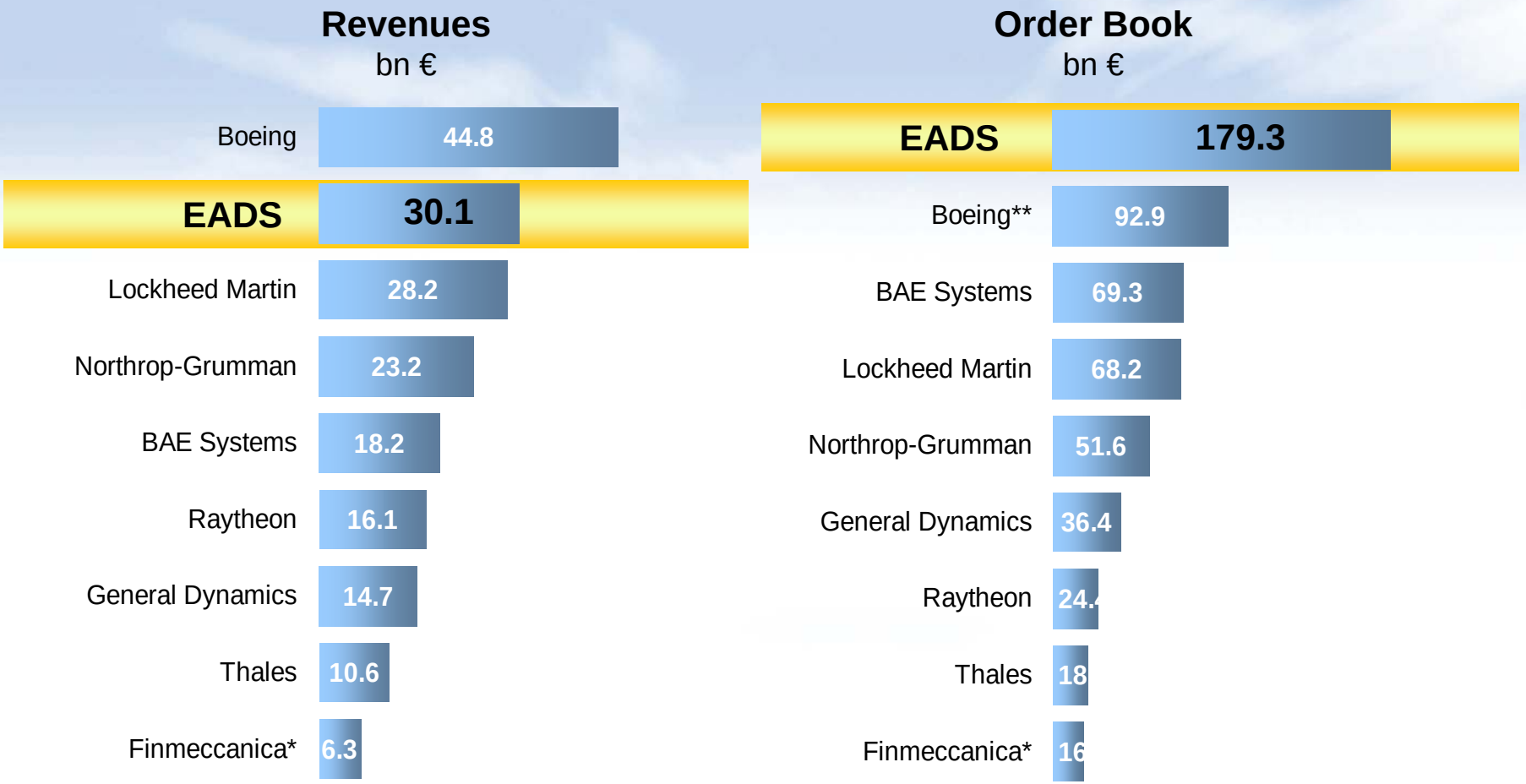
Gerhard Schröder | José María Aznar | Lionel Jospin

The heads of government in 2000 confirm the extension of EADS to integrate the three bounding partners

EADS today is the second-largest group in the global aerospace and defence industry, with a unique range of products and services

# Competitive Position

**Based on 2003 average exchange rates €/$: 1.128 €/£: 0.691**




* Aerospace and defence activities

** Commercial aviation based on catalogue prices for EADS, contractual prices for Boeing

# A Global Leader

EADS
European Aeronautic Defence and Space Company

AIRBUS Commercial Aircraft


No.1

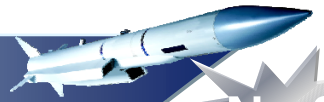
Helicopters

No.1

Commercial Launch Vehicles

No.1

Missile Systems



No.2

Satellites

No.3

Mil.Transport Aircraft

No.3

Military Aircraft

No.4



AIRBUS

# EADS Structure

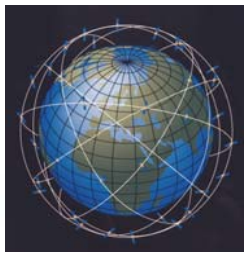
## Airbus



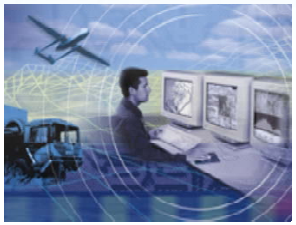

## Military Transport

## Aeronautics

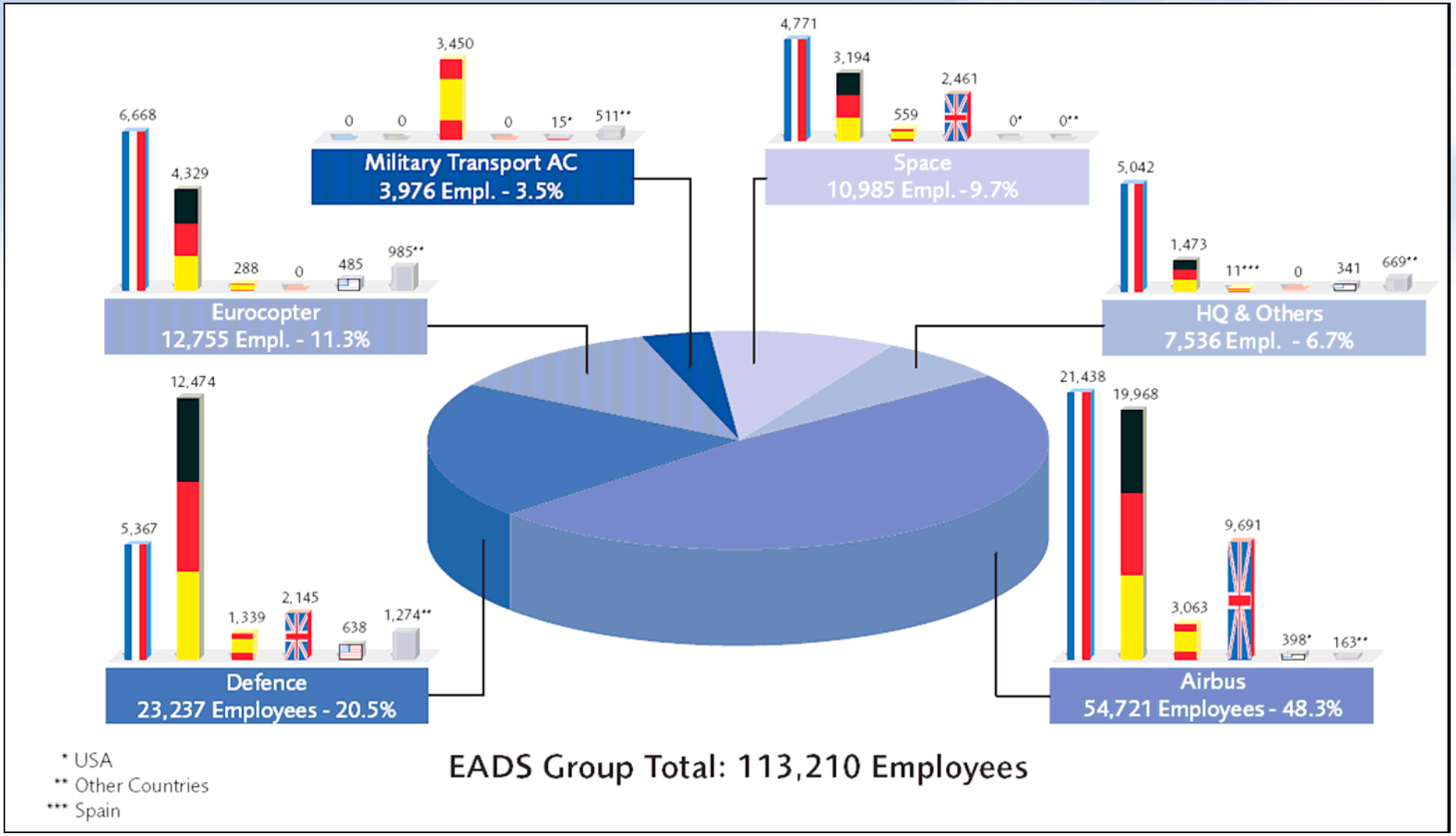

## EADS SPACE



## Defence



# EADS-Employees by Divisions **as 2005**




**Total Spain 8700 Employees**

# Global Presence

a world of cultural diversity

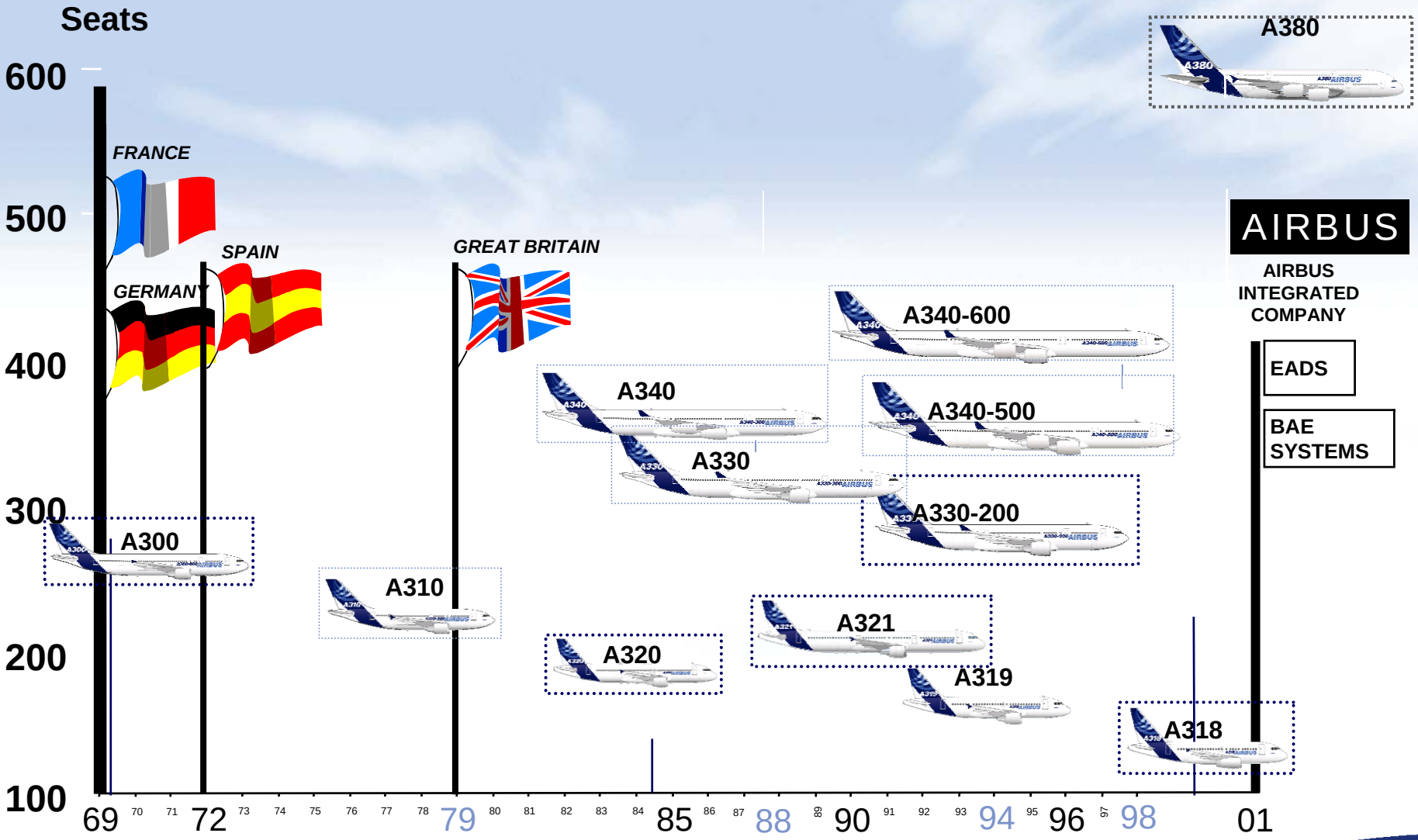



AIRBUS

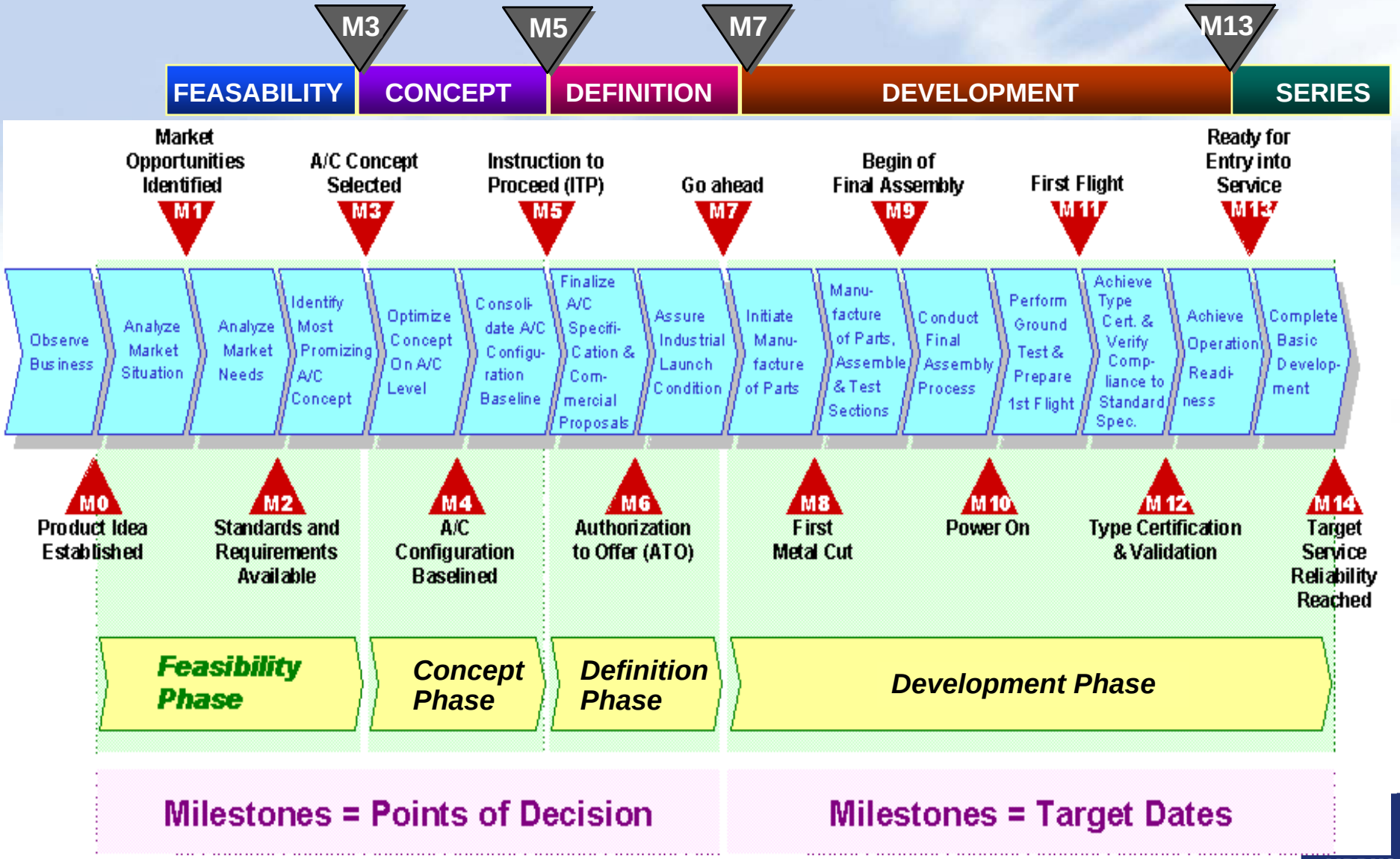
# Welcome

## to the world of Airbus

# Airbus 2005 – Current Programmes



# DEVELOP NEW AIRCRAFT PROCESS MILESTONES PLANIFICATION



# AIRCRAFT DEVELOPMENT

I. STRUCTURE

II. SYSTEMS

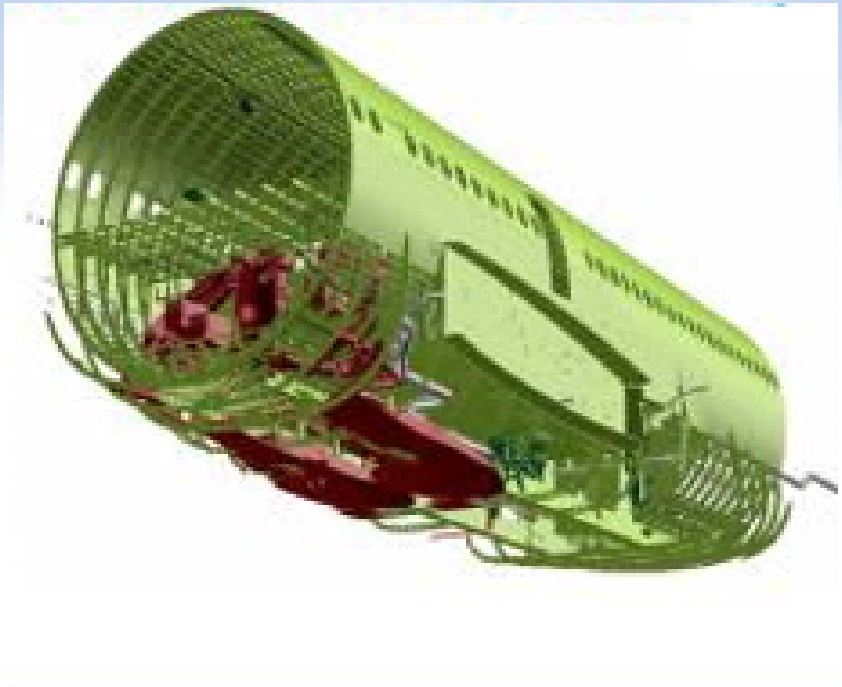
III. CABIN CONFIGURATION

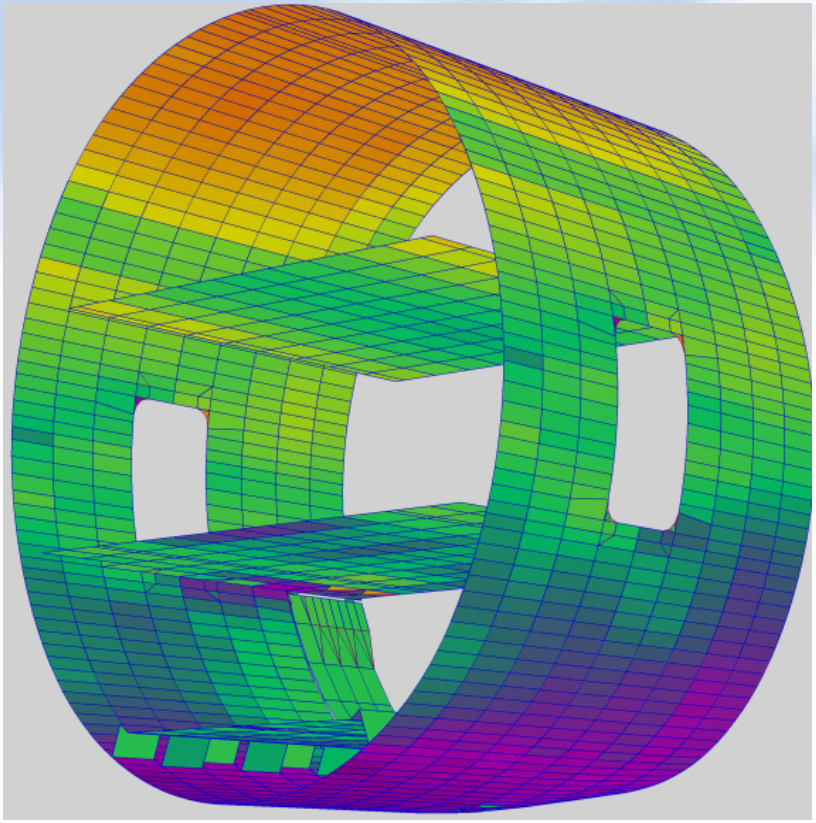
IV. ENGINES

In the development of an aircraft the following points have a high importance for the design:

- Materials selection (metallic and non metallic)
- Manufacturing
- Standard parts (mechanics, systems, electrics)
- Corrosion prevention
- Requirements and specifications, weight, costs,…
- Testing
- Resources (work sharing)

# STRUCTURE

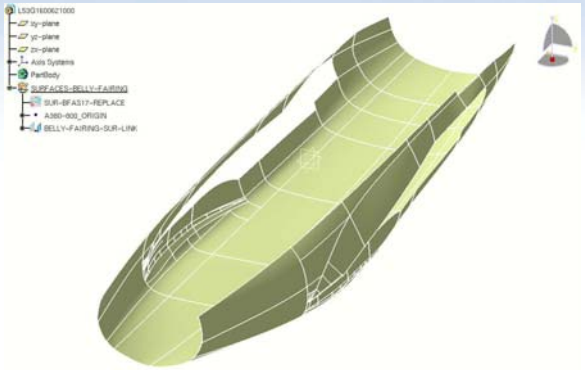




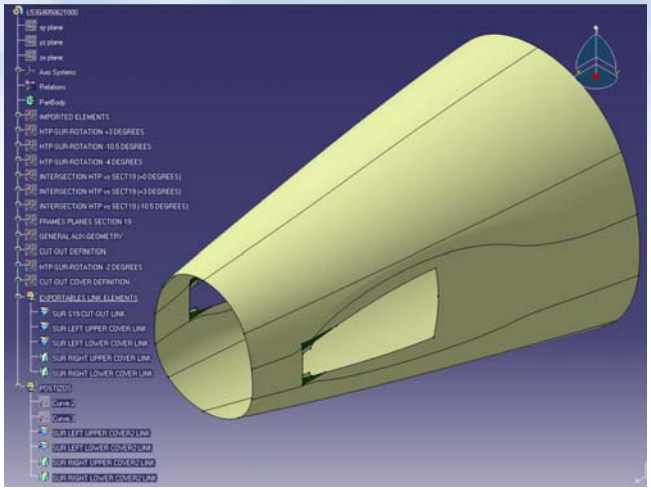
# AERODYNAMIC SURFACES

Aerodynamic shape  of the A/C for getting flight and performances requirements (lift, drag, noise, speed, etc.)

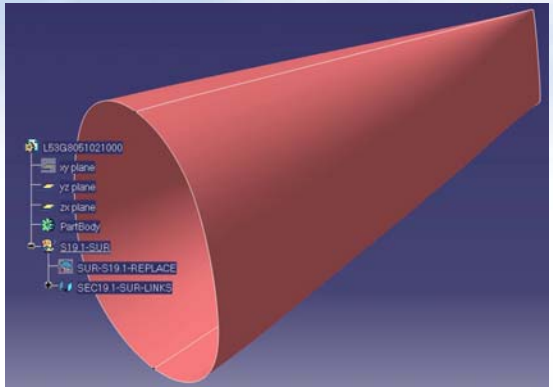
**A380 Belly Fairing**



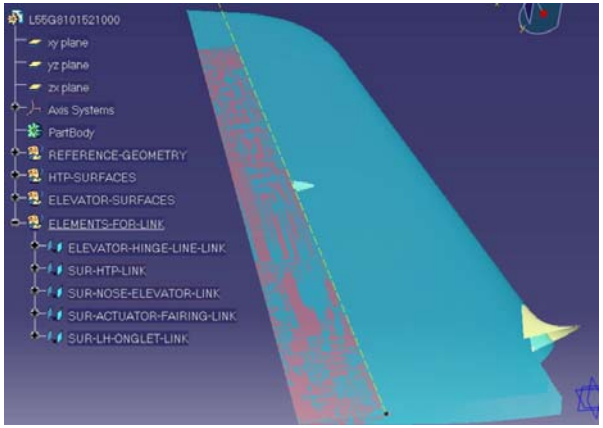

**A380 Section 19**



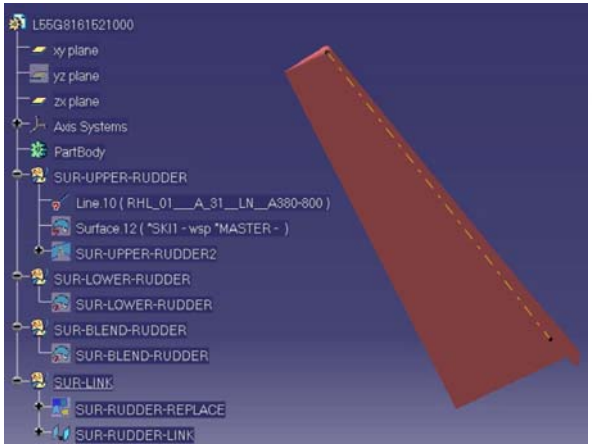

**A380 Section 19.1**



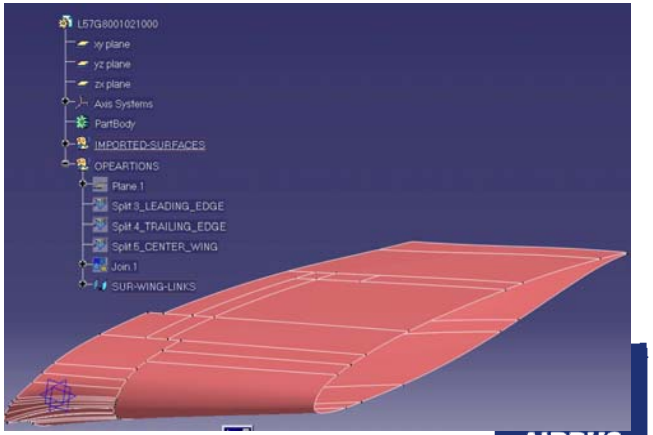

**A380 HTP**




**A380 Rudder**

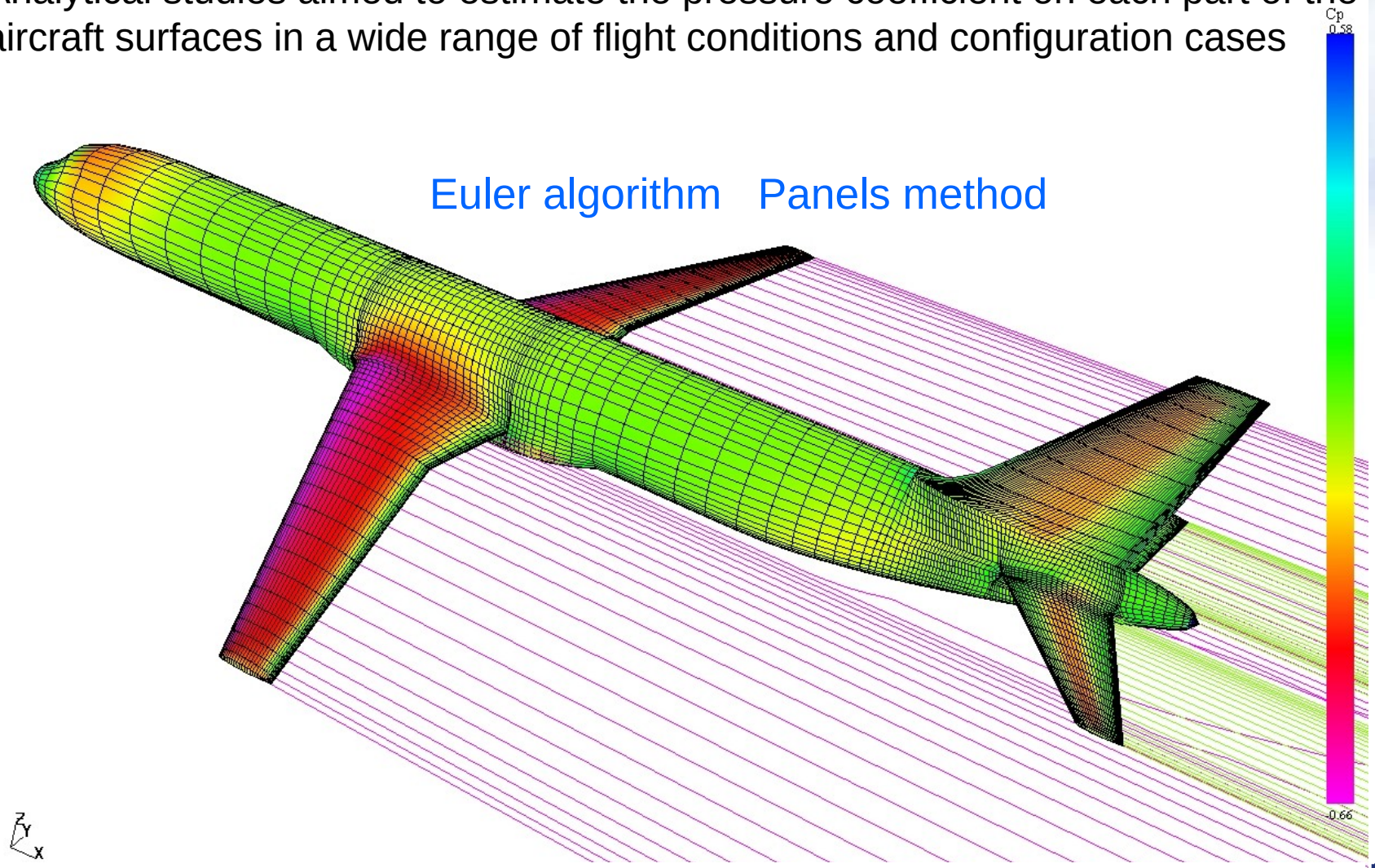



**A380 Wing**



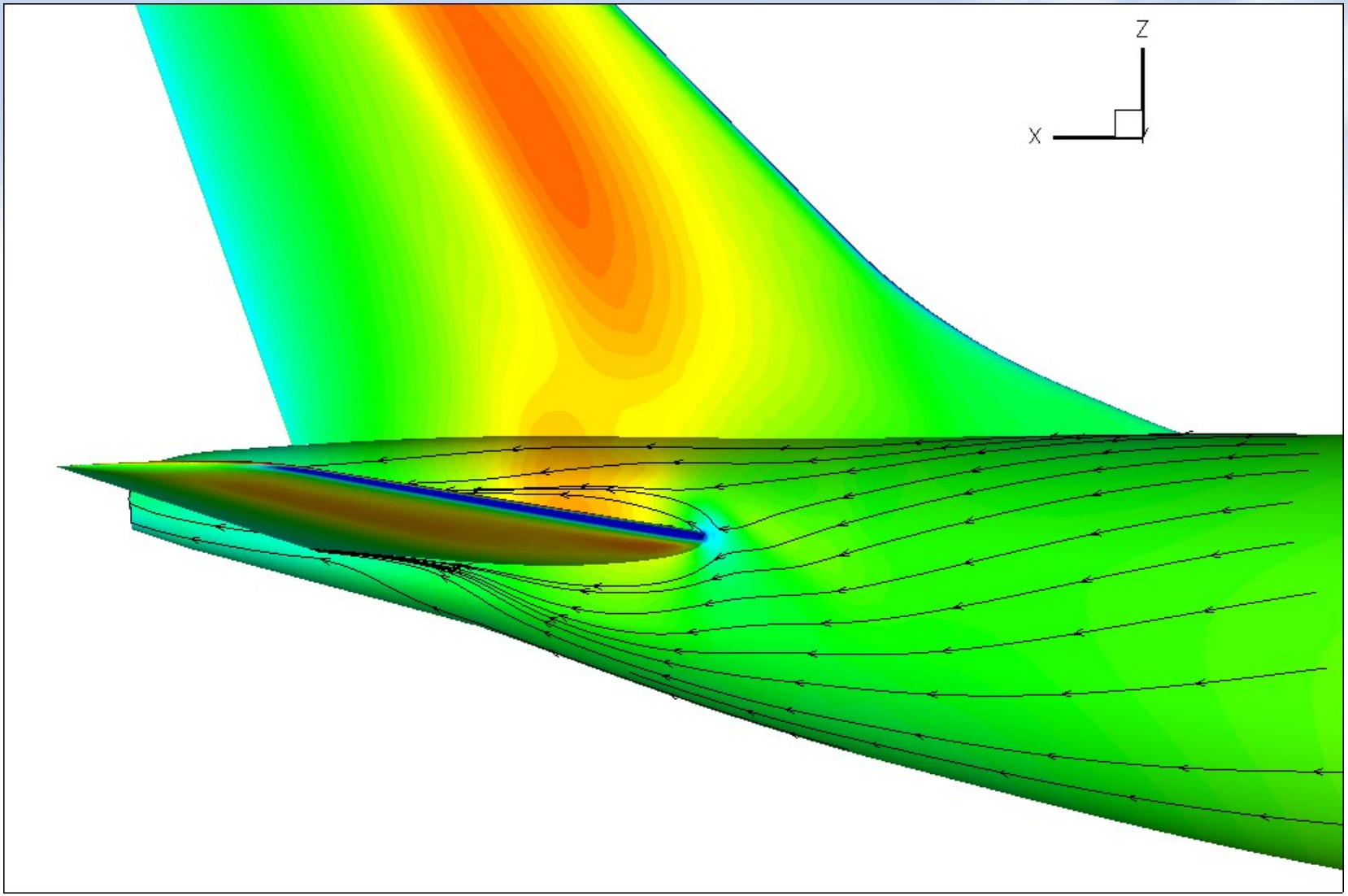
# PRESSURES DISTRIBUTION

Analytical studies aimed to estimate the pressure coefficient on each part of the aircraft surfaces in a wide range of flight conditions and configuration cases



# PRESSURES DISTRIBUTION

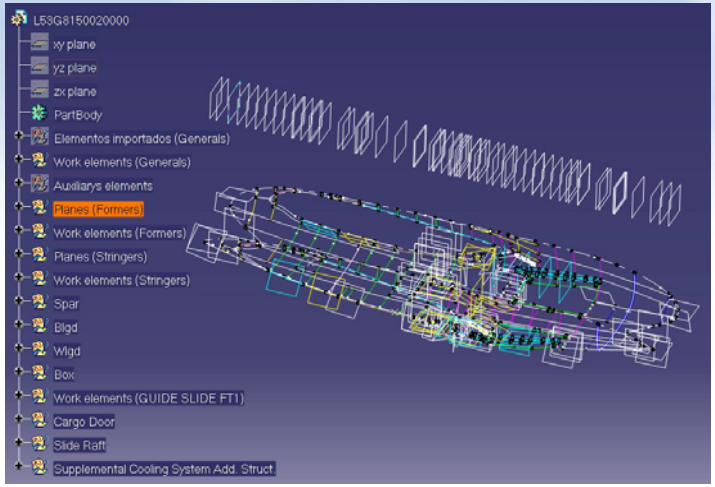
## RANS (Reynolds Averaged Navier-Stokes) Method



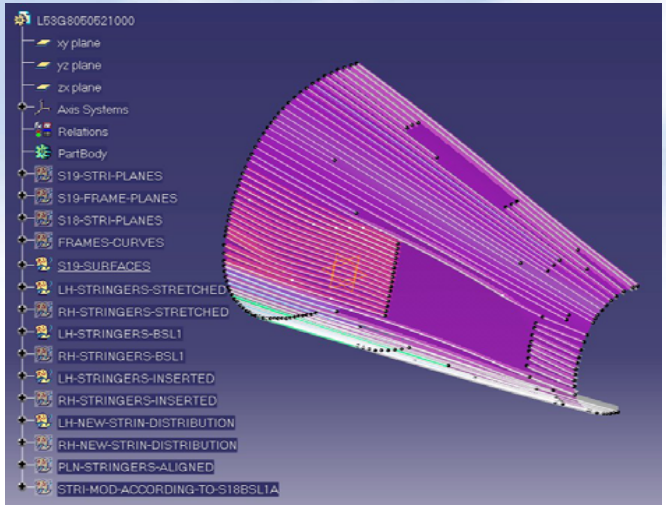
# STRUCTURAL ARRANGEMENT

Geometrical references of aircraft external and internal shapes, and the major co-ordinate systems and datum lines

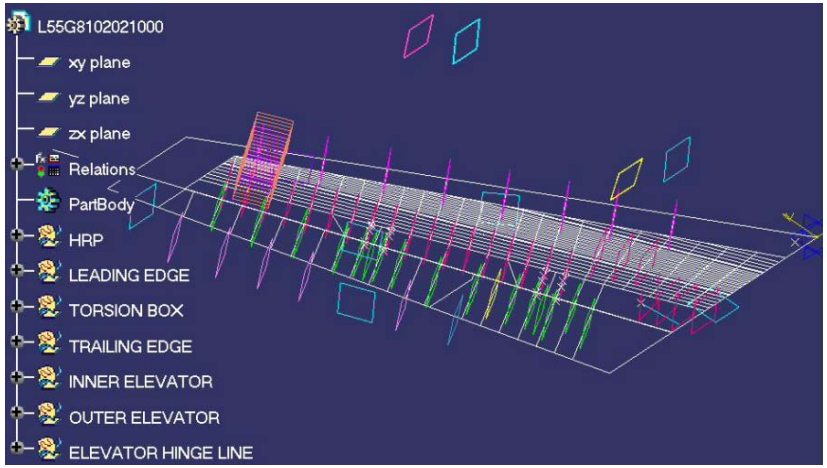
**A380 Belly Fairing**



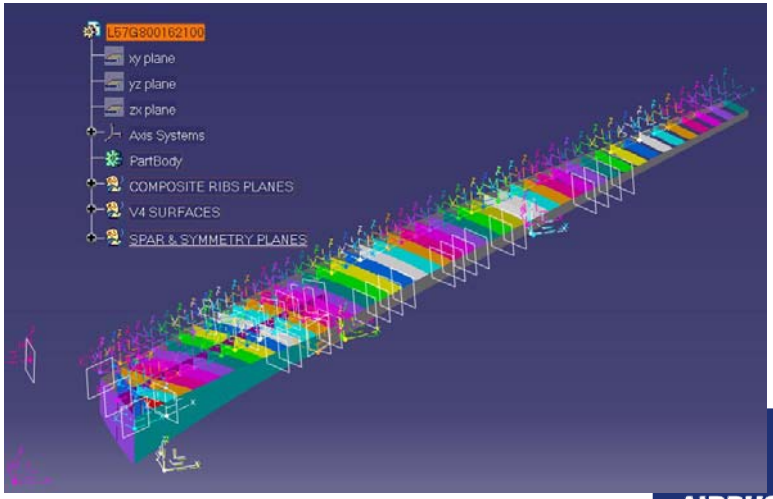

**A380 Section 19**




**A380 HTP**



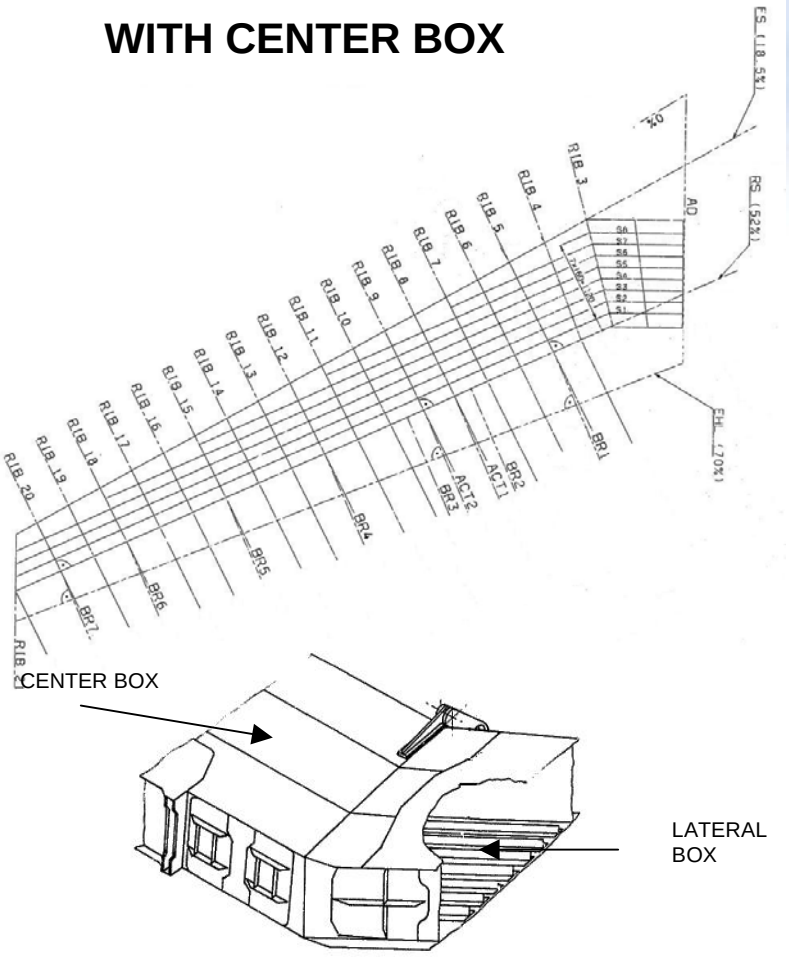

**A380 Wing**



# DESIGN STUDIES AND ALTERNATIVES

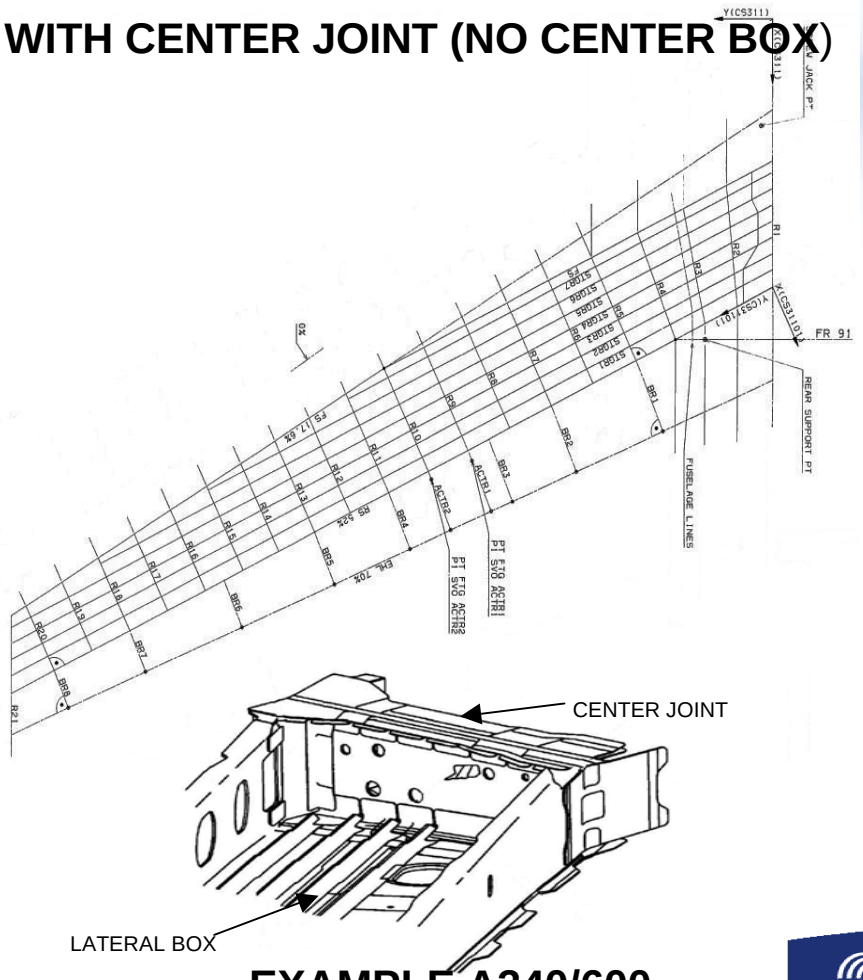
Different possibilities of a technical solution to be evaluated by the involved departments that meet one or several requirements which aim at defining the optimised solution at the lower cost in the shortest time.

## WITH CENTER BOX




**EXAMPLE A330/340**

## WITH CENTER JOINT (NO CENTER BOX)

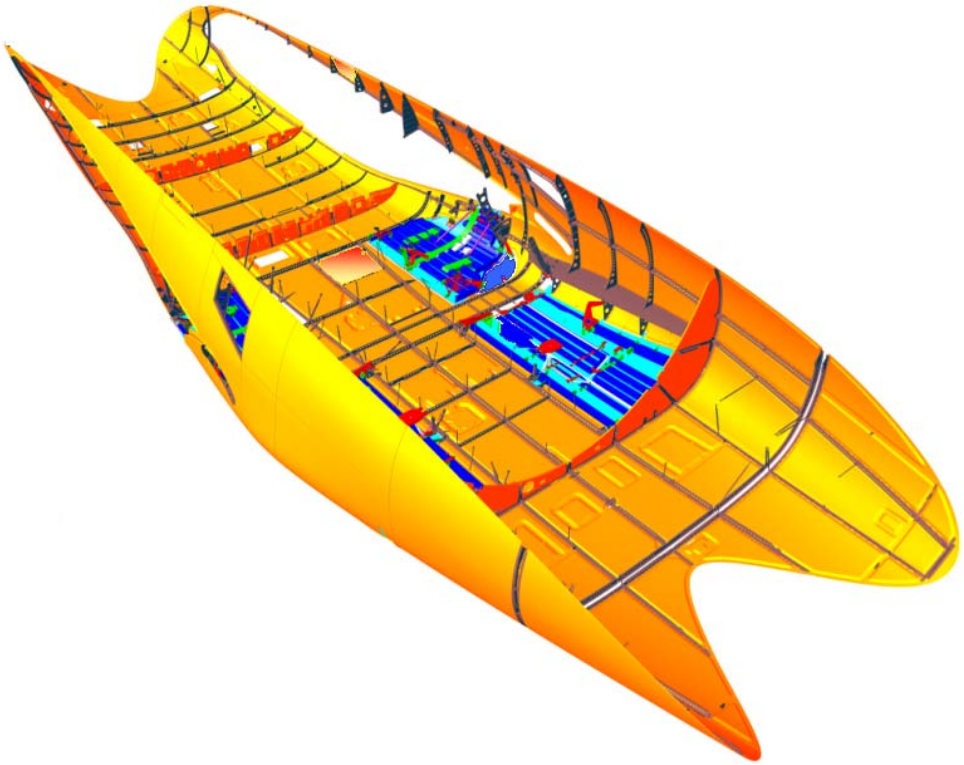



**EXAMPLE A340/600**

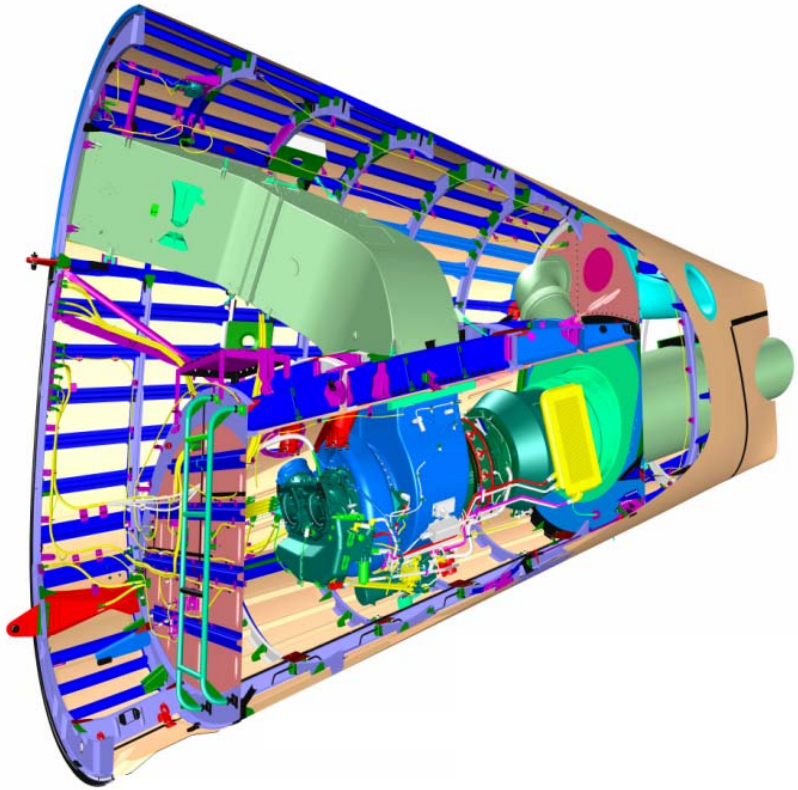
# SPACE ALLOCATION MOCK-UP

Simplified envelope volumes for structure and system parts (including installation) allowing to allocate space between structures and systems and to validate structure and systems architectures

**A380 Belly Fairing**

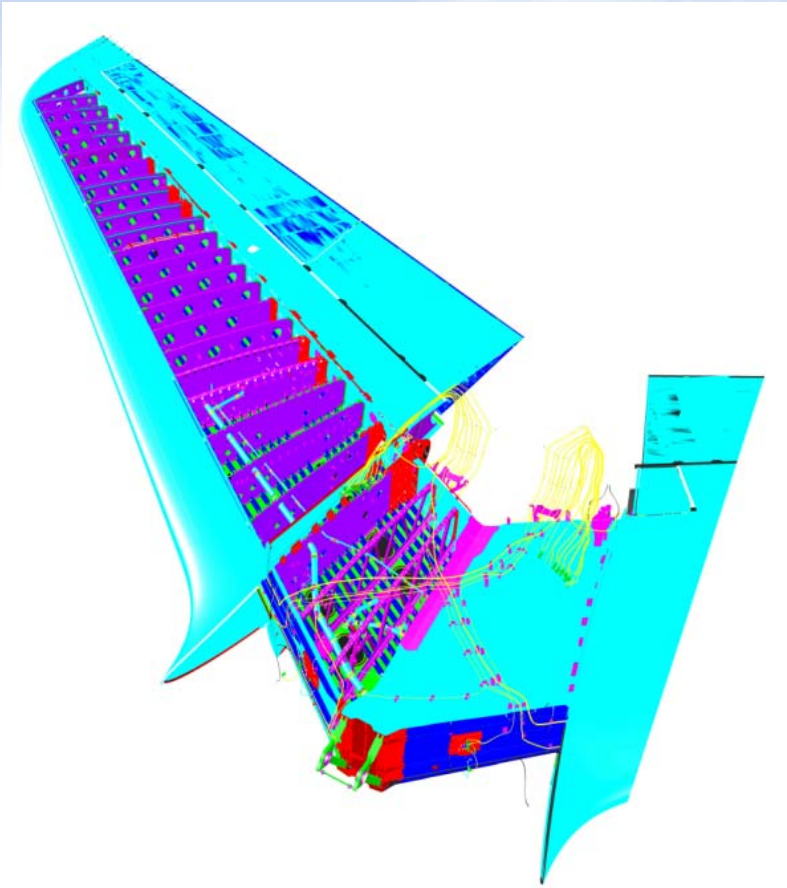


**A380 Section 19.1**

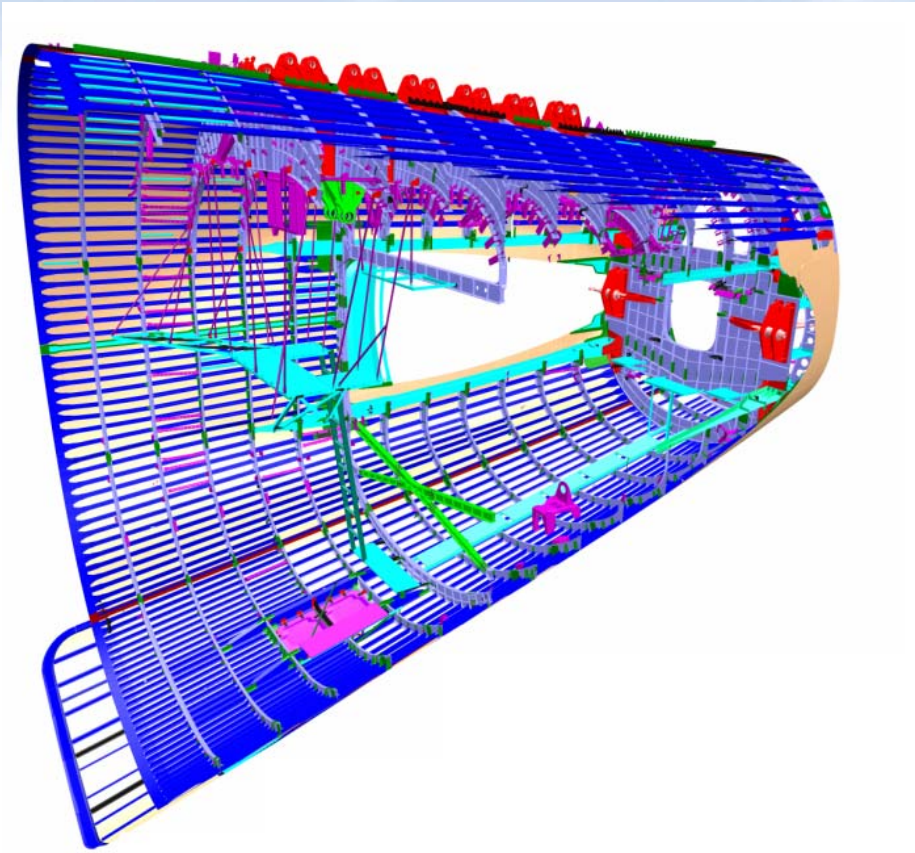


# SPACE ALLOCATION MOCK-UP

**A380 HTP**

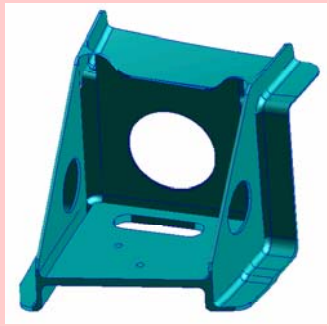


**A380 Section 19**



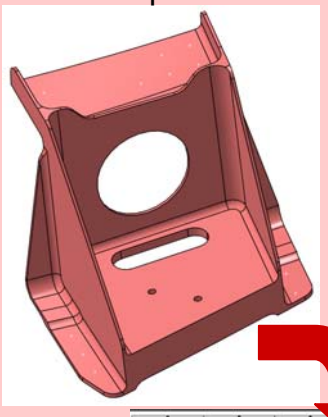
# DESIGN - STRESS Design loop (Metallic or CFRP parts)

## DESIGN

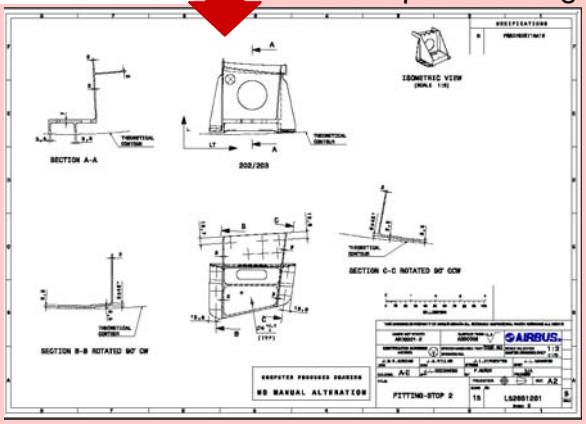


Design concept

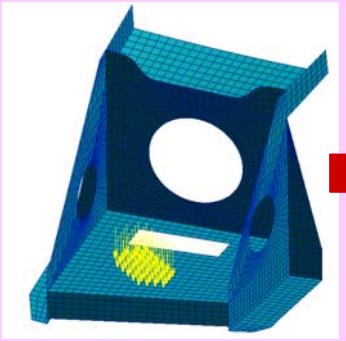
Definitive part



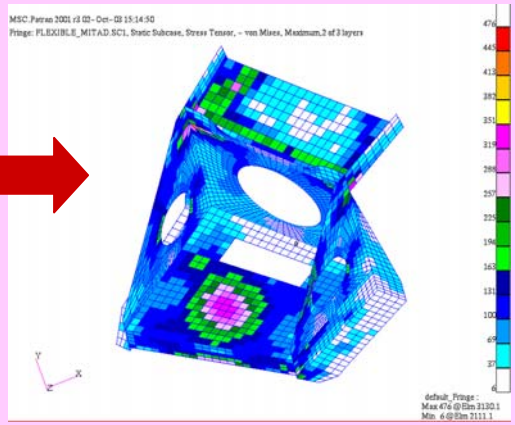
Official part drawing



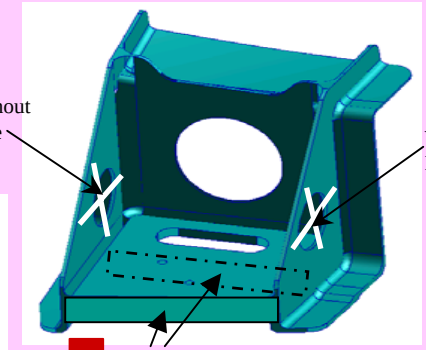

## STRESS



FEM with loads



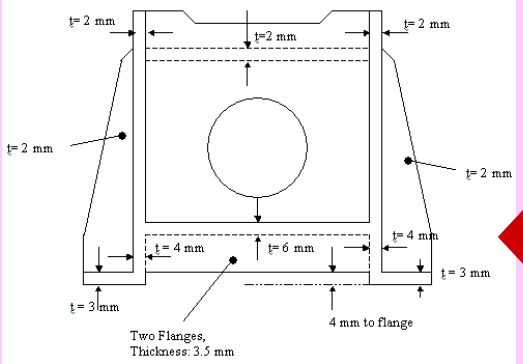
Stress results



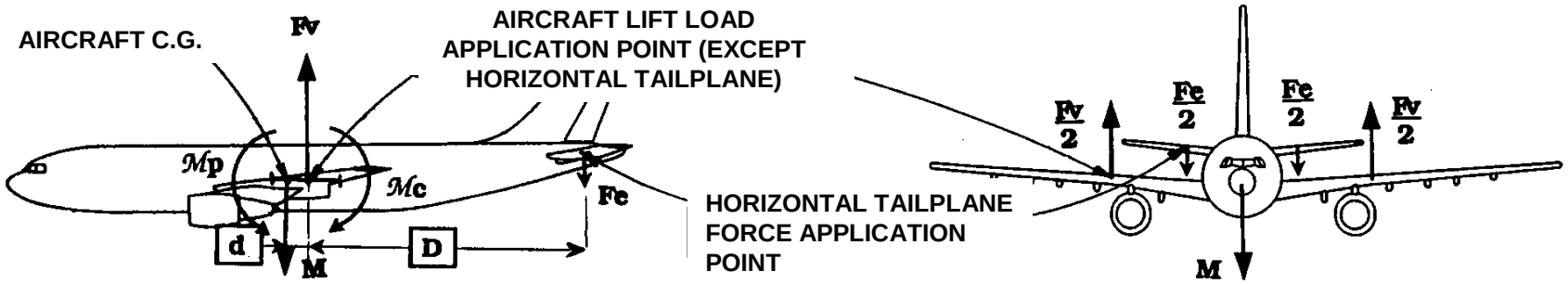

Two new Flanges:
thickness = 3.5 mm

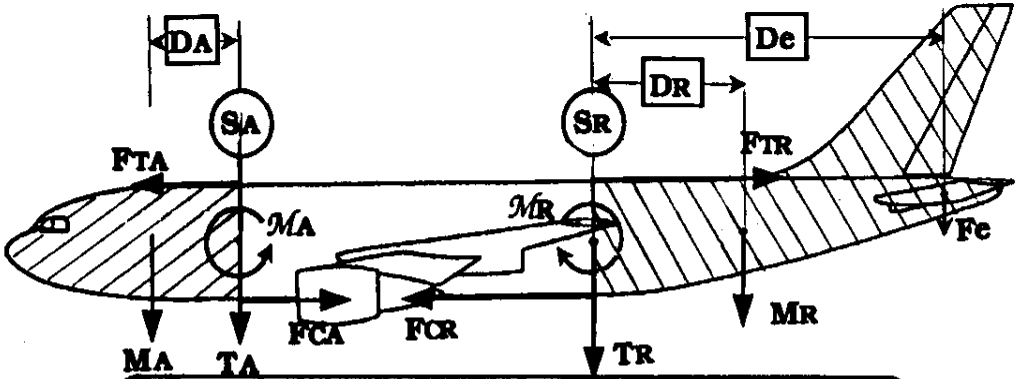
New proposal

New dimensioning



## GENERAL AIRCRAFT BALANCE




MA : TOTAL FUSELAGE WEIGHT FWD OF SA

MR : TOTAL FUSELAGE WEIGHT AFT OF SR

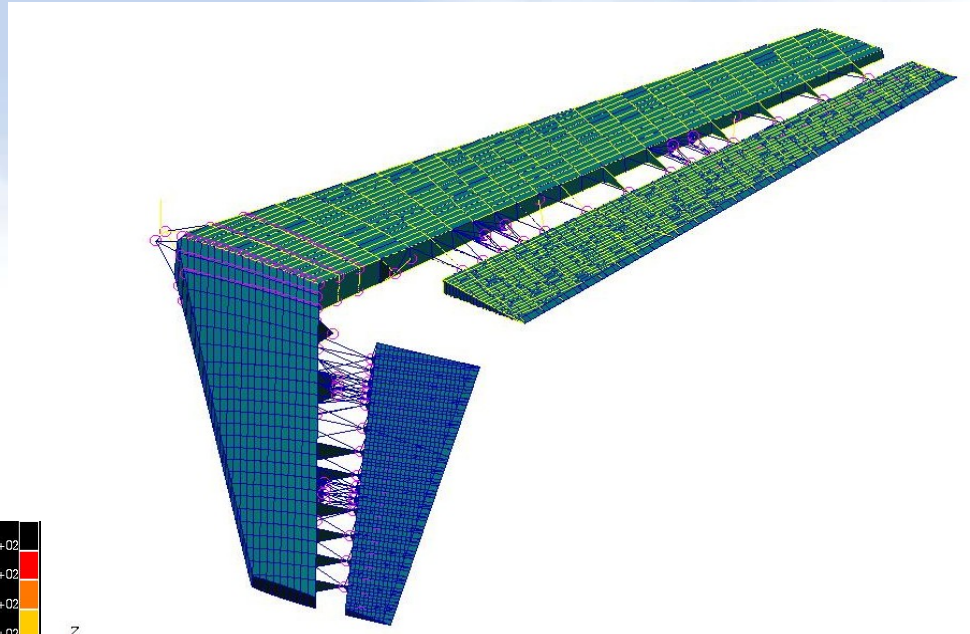
$\mathcal{M}_A = D_A \times M_A$ & $T_A = M_A$

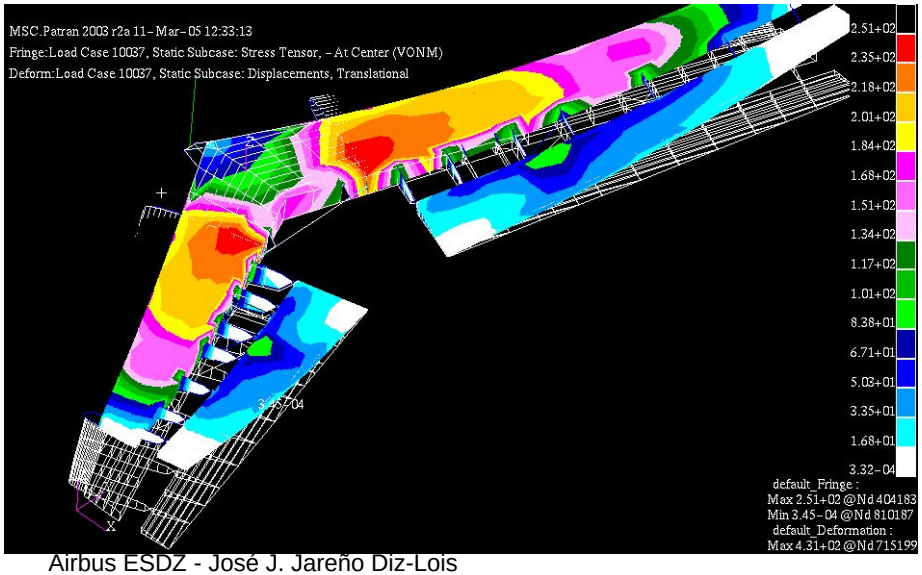
$\mathcal{M}_R = D_R \times M_R + D_e \times F_e$ & $T_R = M_R + F_e$

# FEM AND STRESS ANALISYS

Model of one A/C component simulating its geometry, materials properties, types of attachment, constraints, etc

**TYPICAL HTP**
**PRELIMINARY FEM**

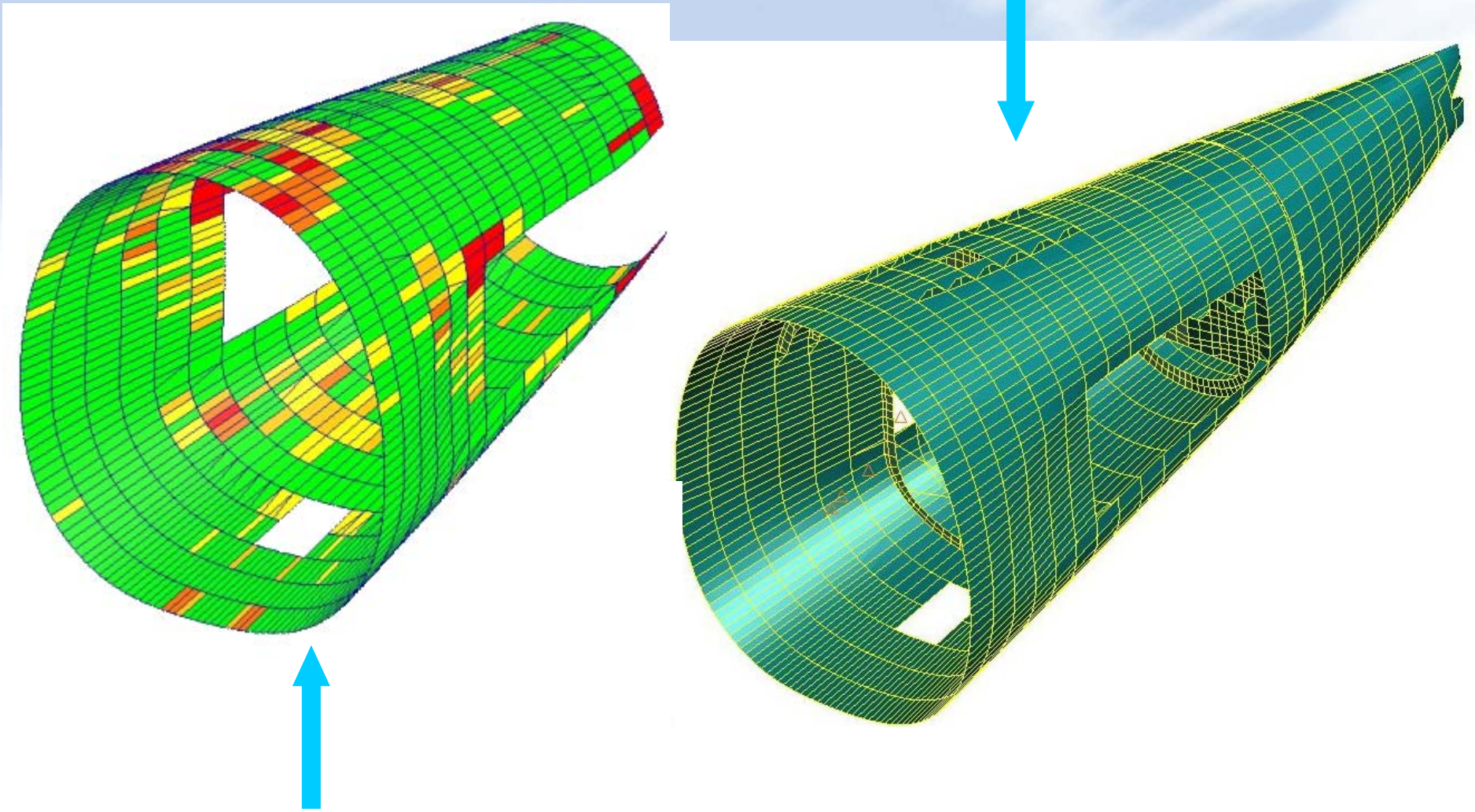





**HTP STRESS ANALISYS**

# FEM AND STRESS ANALISYS

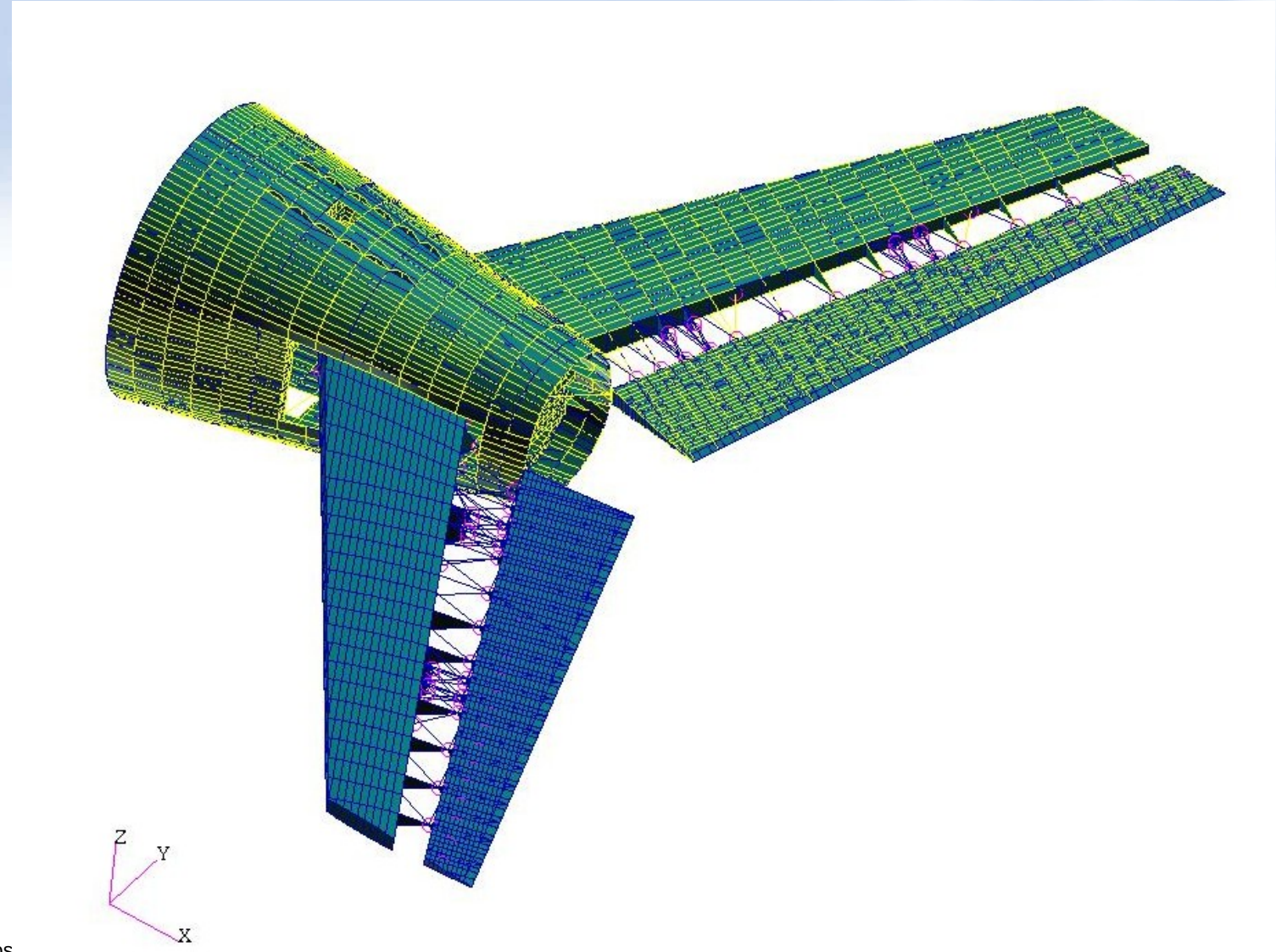
## SECTION 19 AND 19.1. FINITE ELEMENT MODEL (FEM)



## PRELIMINARY RESERVE FACTOR ANALYSIS (IMPACT OF A NEW LOAD LOOP)

# FEM AND STRESS ANALISYS

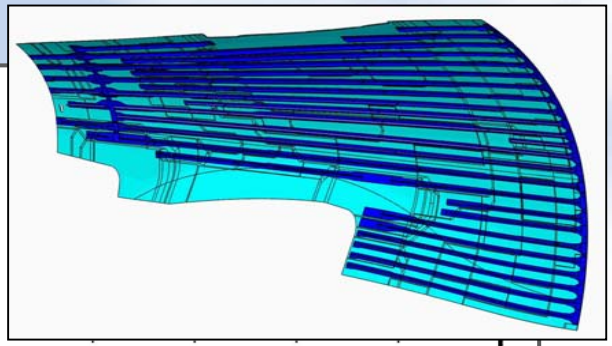
## HTP AND SECTION 19. FINITE ELEMENT MODEL (FEM)



# PRELIMINARY SIZING (A380 Example)

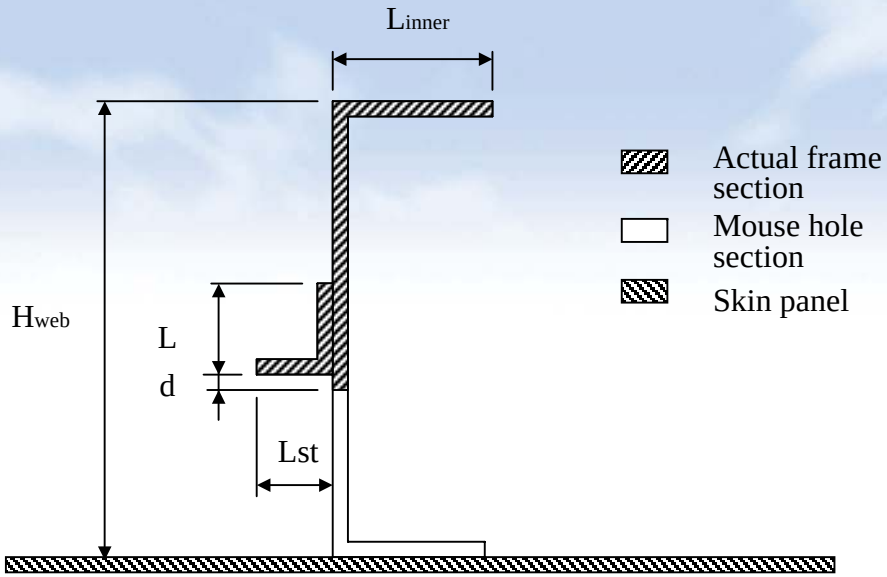
## Section 19 Lateral Upper panel thickness distribution

Baseline providing minimum data (basic dimensions and thickness) to start production of 3D models



# PRELIMINARY SIZING (A380 Example)

## Section 19 composite frame

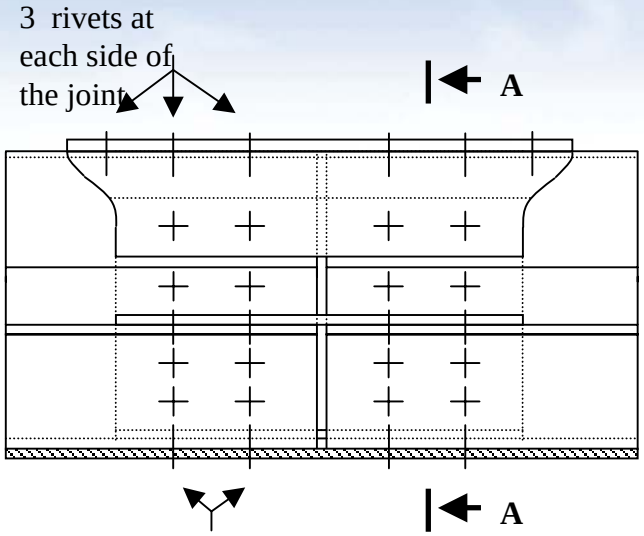


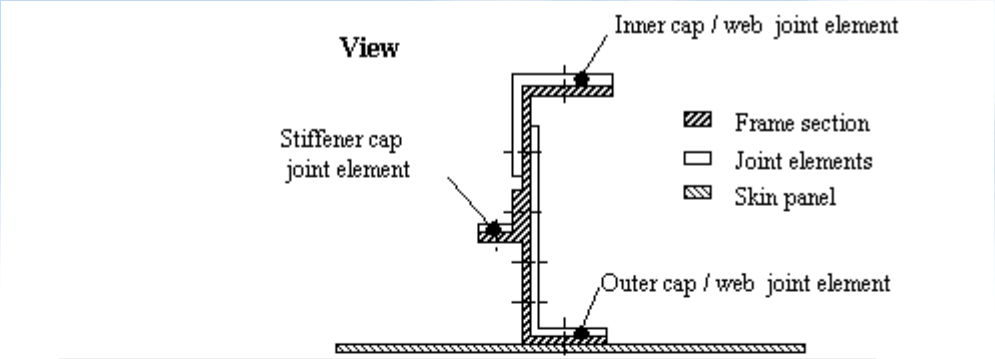

| LOWER PART | | | |
|---|---|---|---|
| Zone | H web (mm) | L inner (mm) | L st (mm) |
| Split 2 - ST 66 | | | |
| ST 66 - ST 67 | | | |
| ST 67 - ST 75 | | | |

| LOWER PART | | | |
|---|---|---|---|
| Zone | Basic Lay-up | Inner Cap Lay-up | Stiffener Cap Lay-up |
| Split 2 - ST 75 | | | |

# PRELIMINARY SIZING (A380 Example)

## Section 19 metallic frames joint



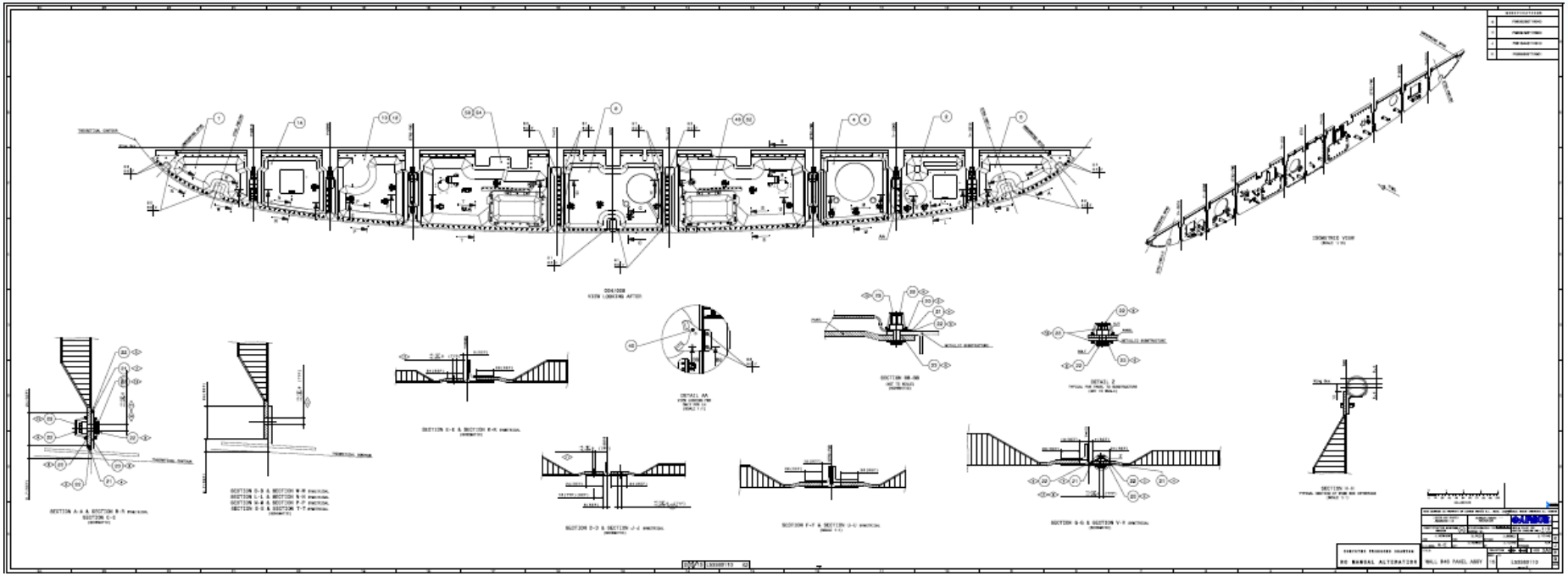

| FRAME 109 | | |
|---|---|---|
| SPLIT SECTION 4 | | |
| | D (mm) | |
| Outer cap / web joint element | | |
| Stiffener cap joint element | | |
| Inner cap / web joint element | Inner Cap joint | |
| | D (mm) | |
| | Web joint | |
| | D (mm) | |
| | Outer cap skin joint | |
| | D (mm) | |

| FRAME 109 | |
|---|---|
| SPLIT SECTION 4 | |
| | t (mm) |
| Outer cap / web joint element | |
| Stiffener cap joint element | |
| Inner cap / web joint element | |

# DESIGN PRINCIPLES

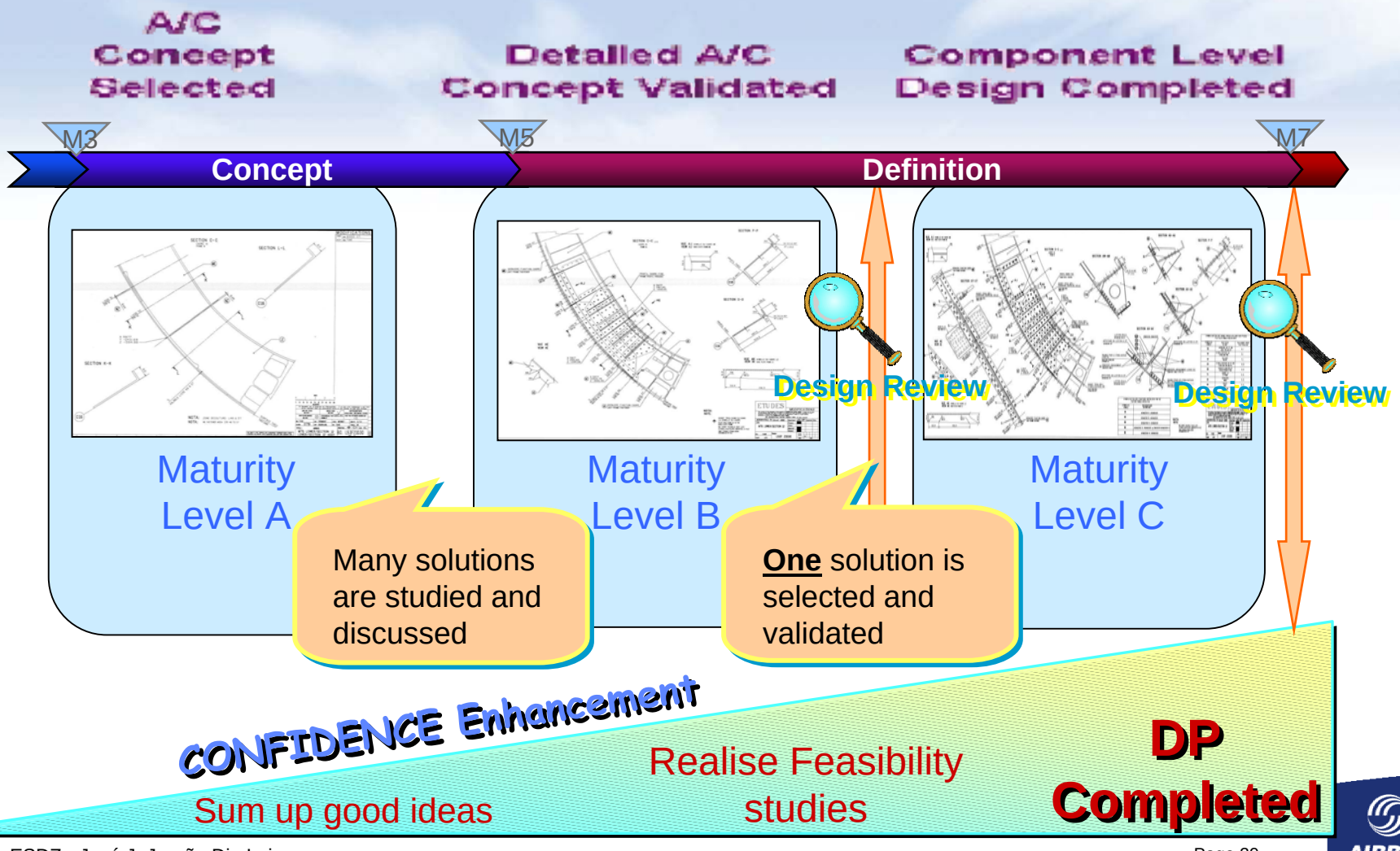
Technical solutions to the A/C that meets the applicable requirements.

It presents **detailed** information in order to demonstrate that the design fulfil all the requirements (stress, production, economy, reparability, supportability,…) and to enable the validation of the design by all the stake holders through a maturity process

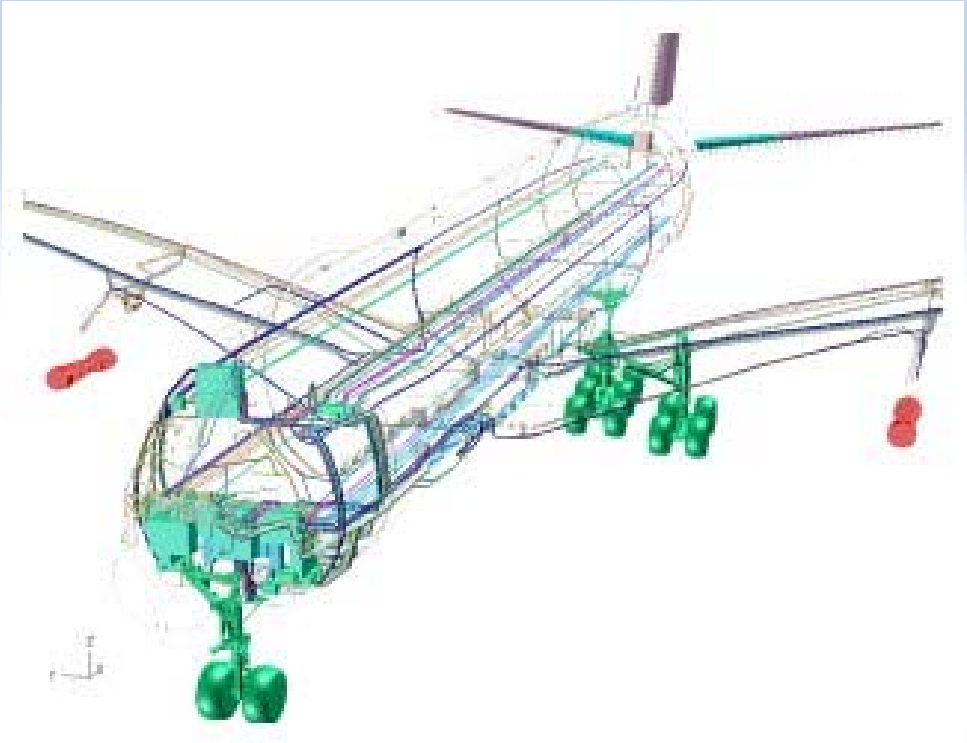


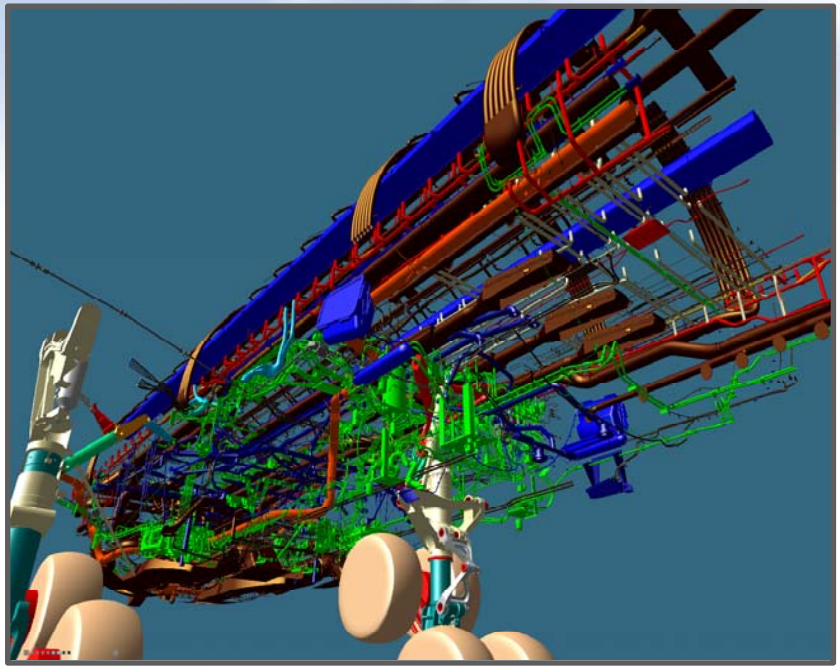
# DESIGN PRINCIPLES (Maturity levels A, B, C)

Maturities provide information about the progress status (real and planned) of a definition, and consequently about the level of confidence in the proposed solution.



# SYSTEMS





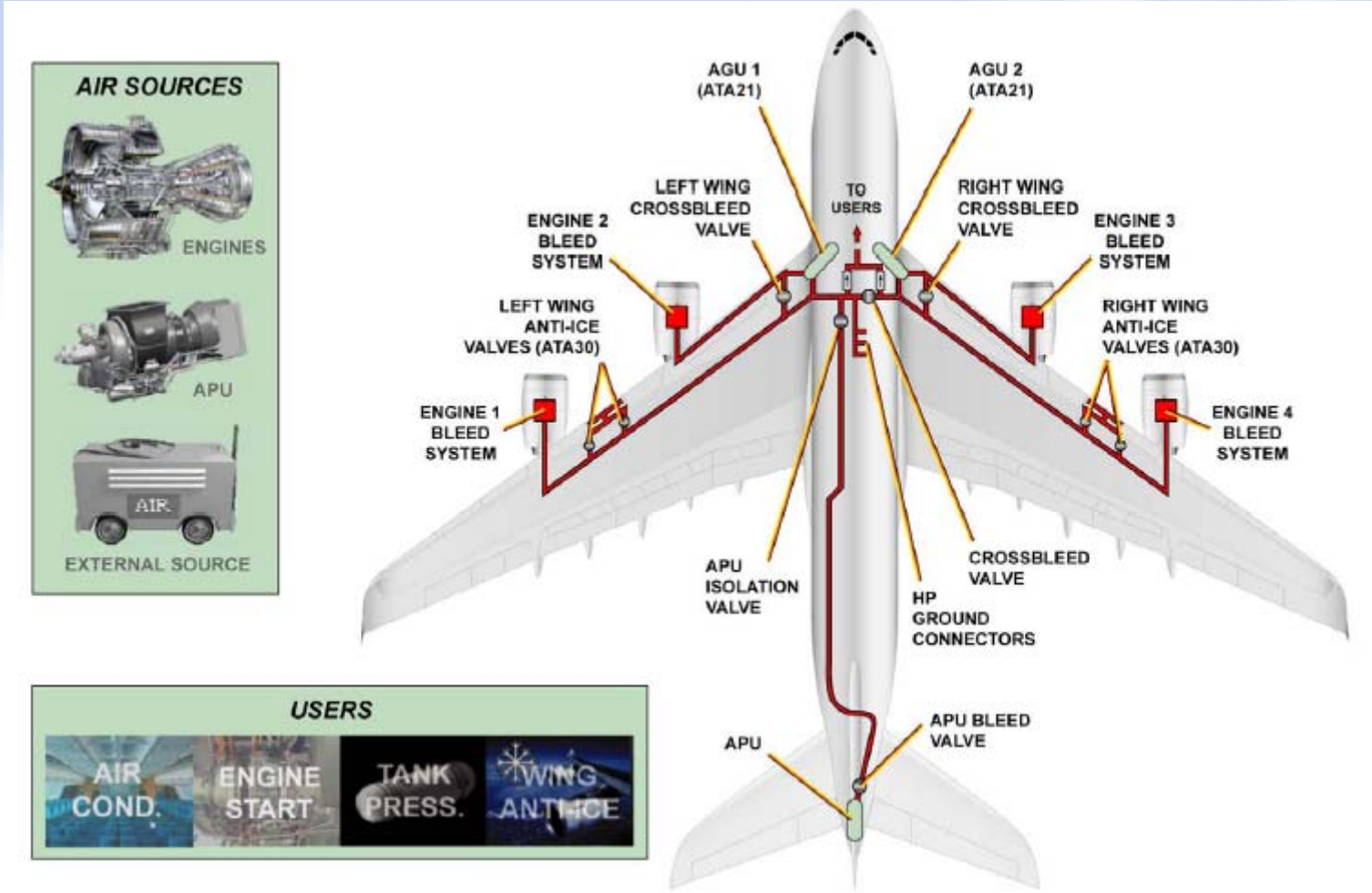
# SYSTEMS and EQUIPMENT LAY-OUT DEFINITION

Location of systems components on the structure, like fuel, water, hydraulic pipes, mechanical commands (rods, cables, etc.), electrical harnesses, etc. The attachment of those components to structure (brackets) is also part of Systems Lay-out.

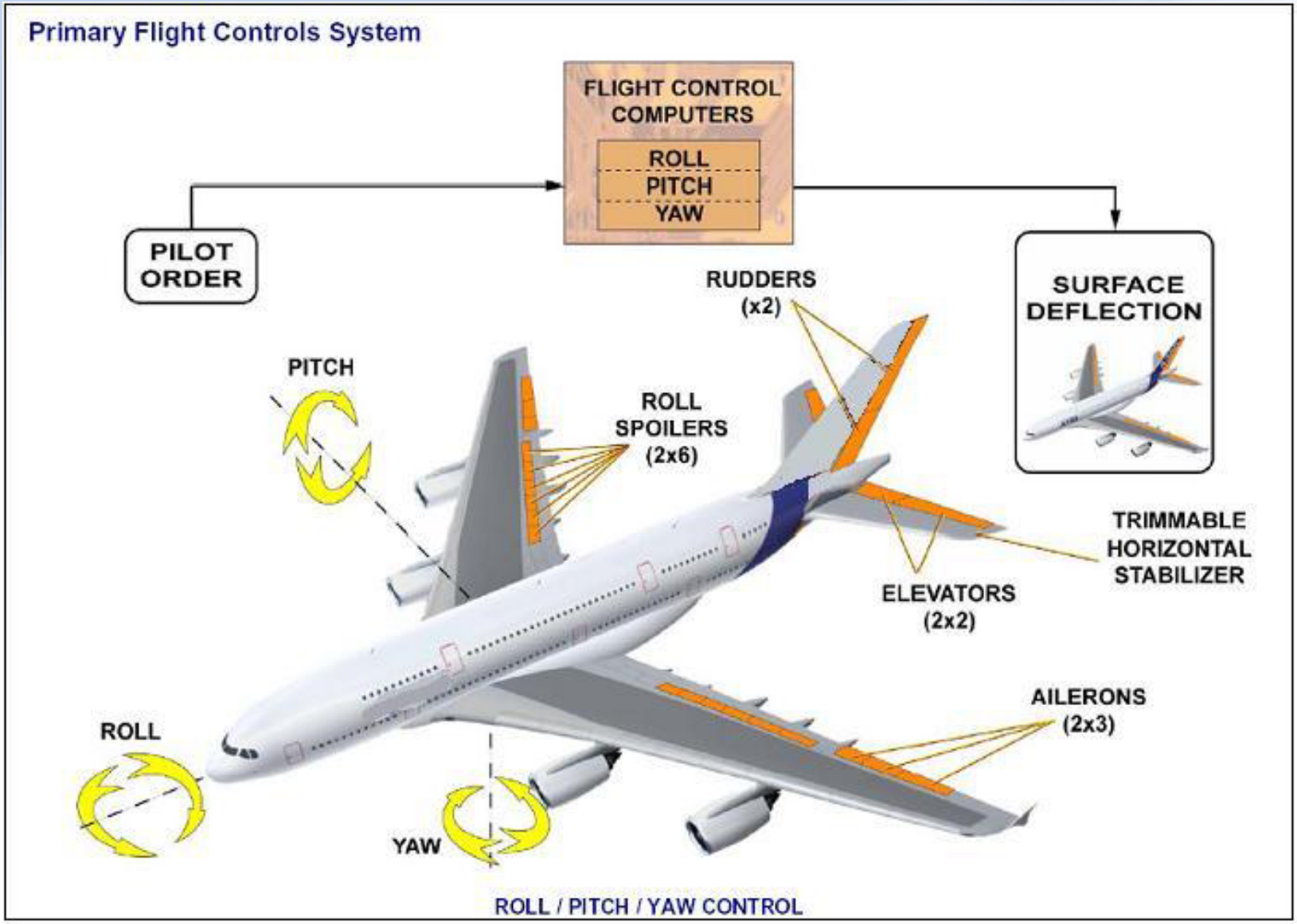
ATA 21. AIR CONDITIONING/VENTILATION
ATA 25. SUPPLEMENTAL COOLING
ATA 27. FLIGHT CONTROLS
ATA 28. FUEL
ATA 29. HYDRAULICS
ATA 32. LANDING GEARS
ATA 33. LIGHTS
ATA 36. BLEED
ATA 38. WATER & WASTE
ATA 25 & 38. DRAINAGE
ATA 92. ELECTRICS

Location of equipments on the structure, like landing gears, electronic bays, electric/hydraulic/pneumatic equipments, actuators, etc. The linking elements between them are part of the Systems Installation

# BLEED AIR

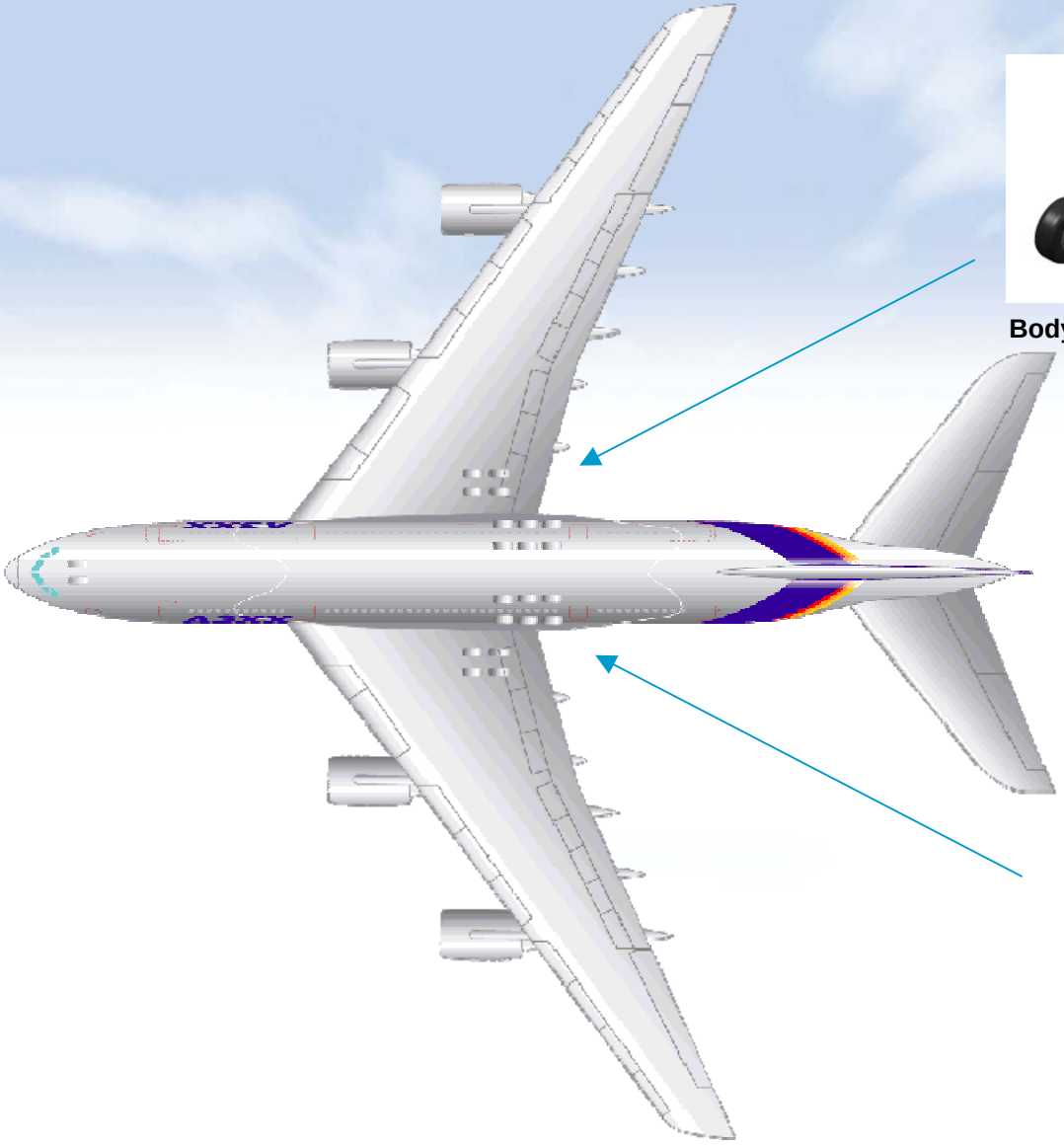

AIR SOURCES
ENGINES
APU
AIR
EXTERNAL SOURCE
AGU 1 (ATA21)
AGU 2 (ATA21)
LEFT WING CROSSBLEED VALVE
TO USERS
RIGHT WING CROSSBLEED VALVE
ENGINE 2 BLEED SYSTEM
ENGINE 3 BLEED SYSTEM
LEFT WING ANTI-ICE VALVES (ATA30)
RIGHT WING ANTI-ICE VALVES (ATA30)
ENGINE 1 BLEED SYSTEM
ENGINE 4 BLEED SYSTEM
APU ISOLATION VALVE
CROSSBLEED VALVE
HP GROUND CONNECTORS
APU
APU BLEED VALVE
USERS
AIR COND.
ENGINE START
TANK PRESS.
WING ANTI-ICE

# FLIGHT CONTROLS



# LANDING GEAR

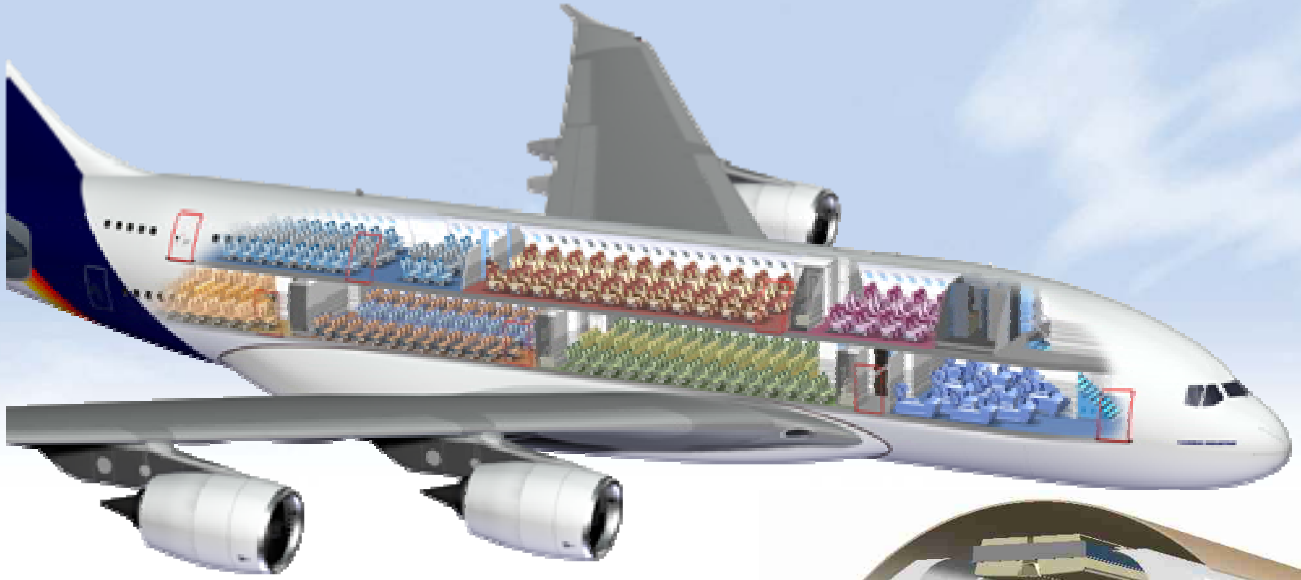
**Nose landing gear**

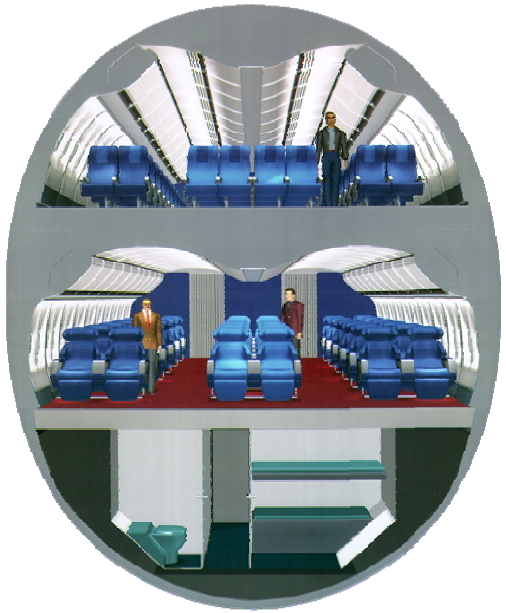


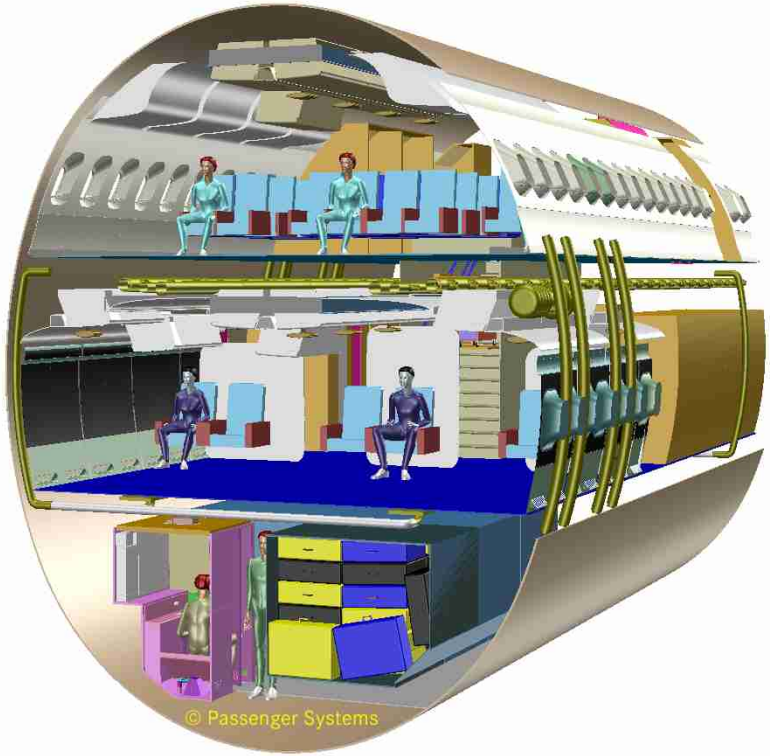
**Body landing gear**

**Wing landing gear**

# CABIN CONFIGURATION

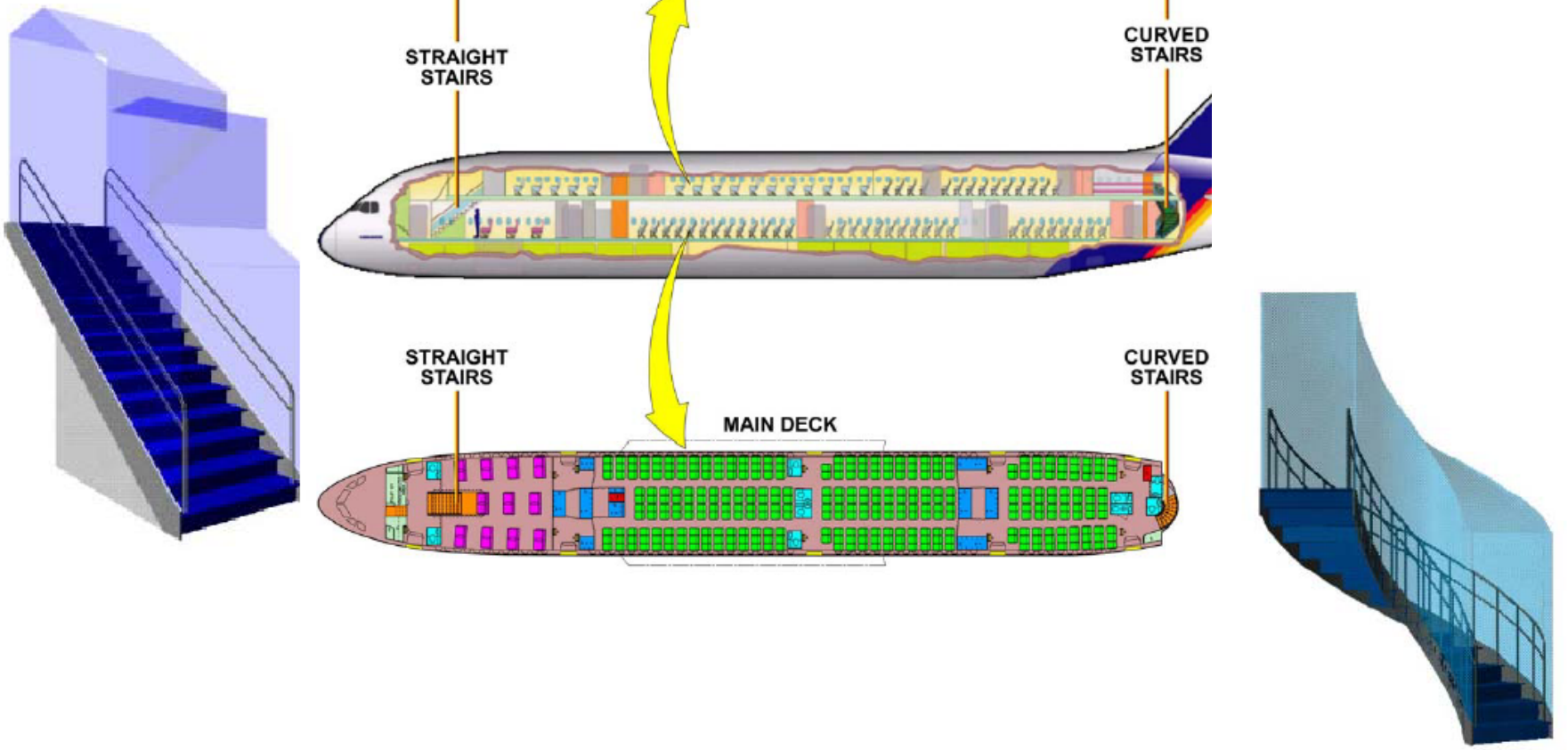




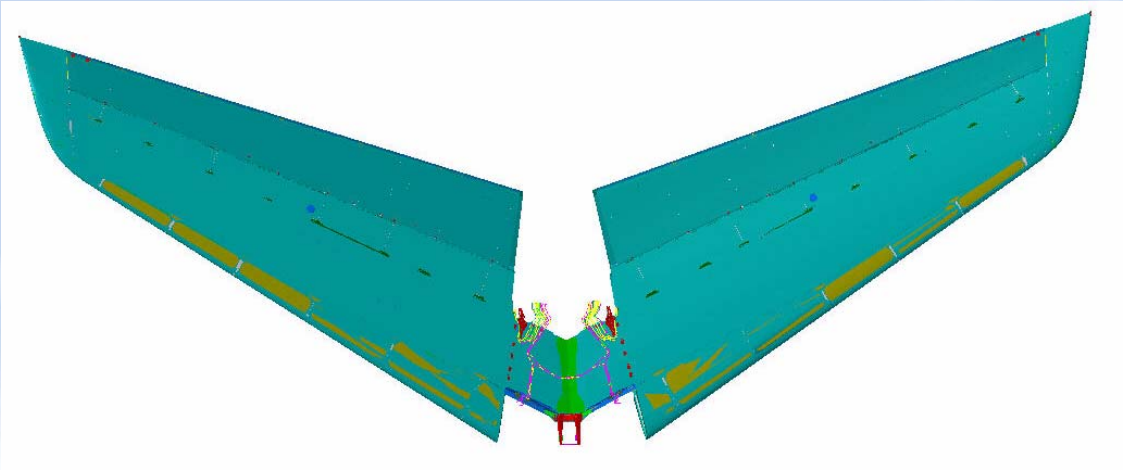


# CABIN CONFIGURATION

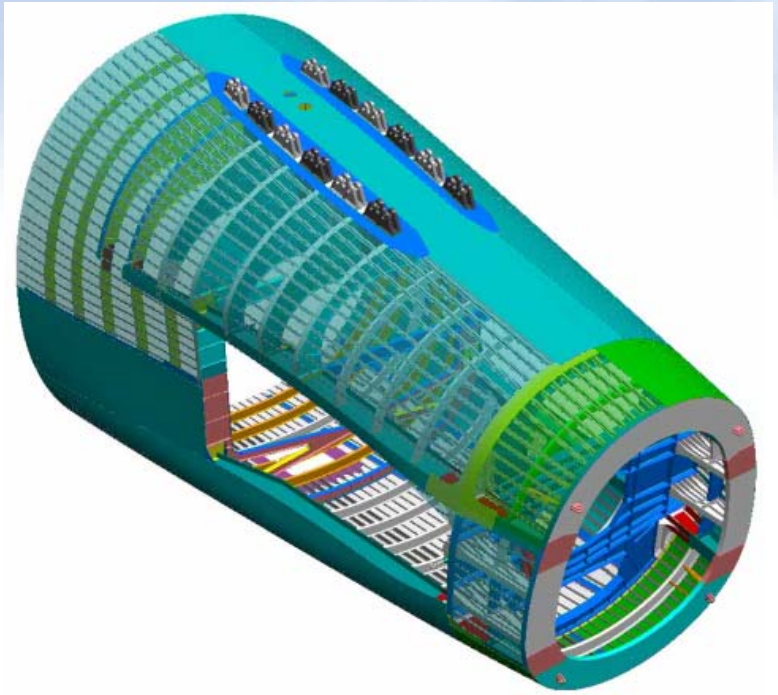
## Passenger Compartment

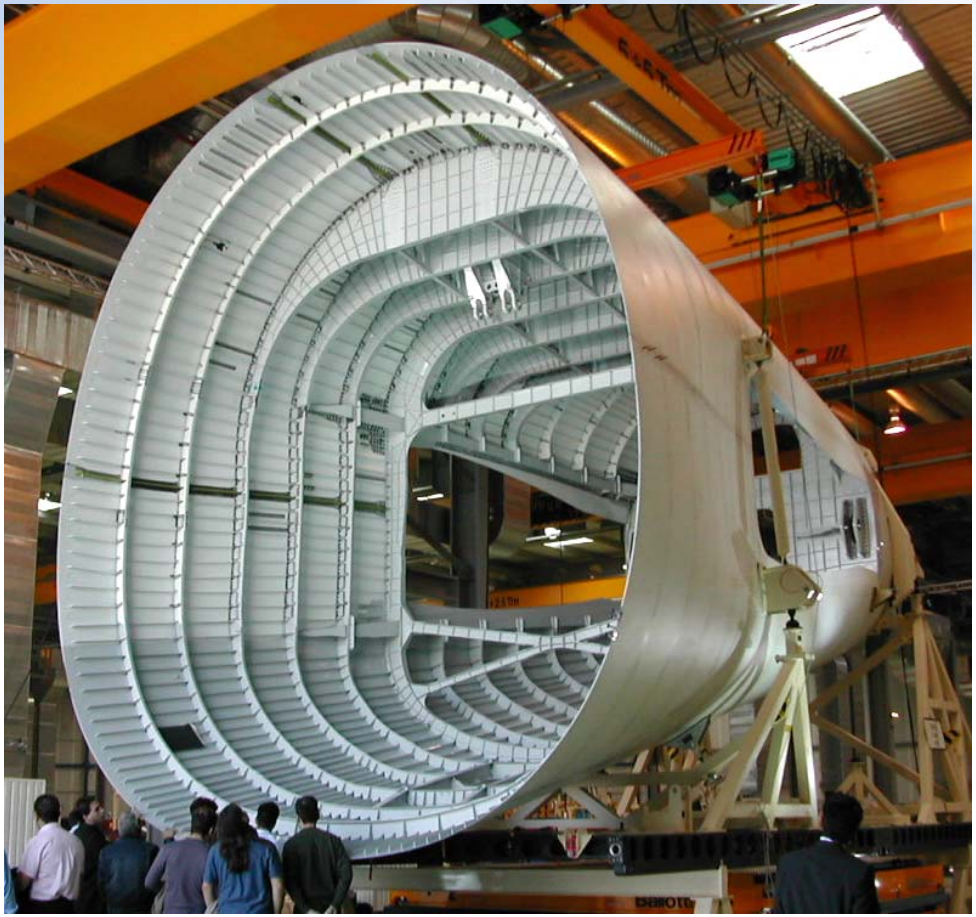


# HTP A380

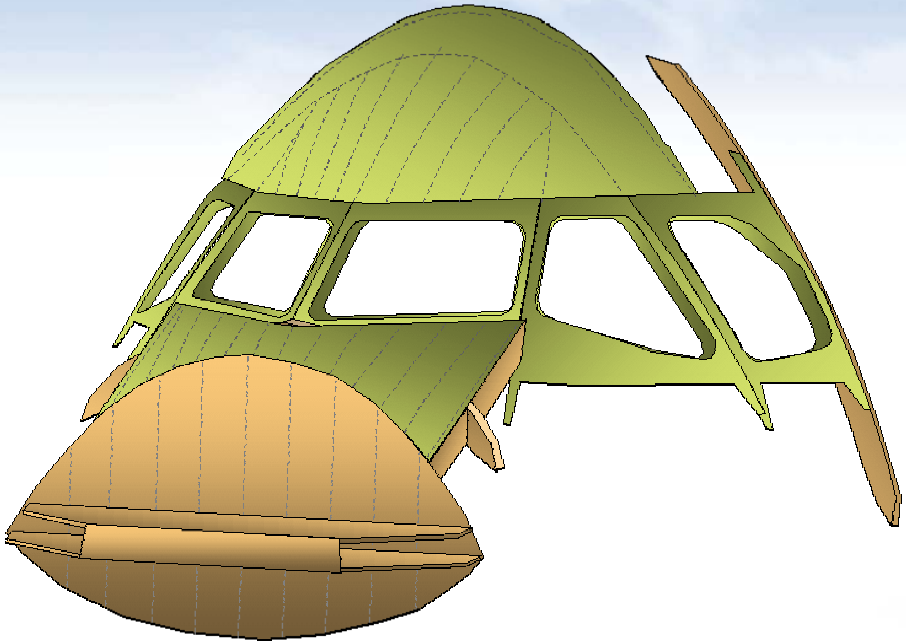


# S19 A380

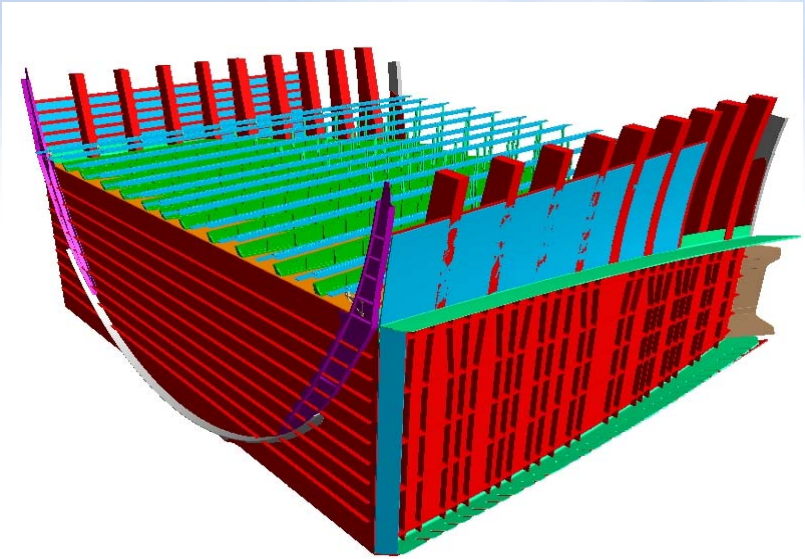




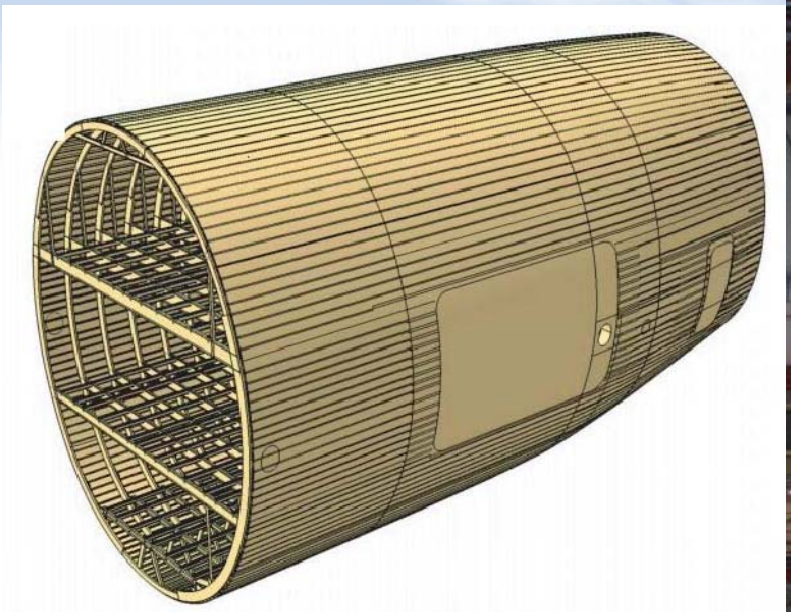
# COCKPIT A380



# WING BOX BODY A380



# S18 A380



# A380

# A380

# Thank you

## for your attention

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