

Kontron FOCUS 2023 Ipari Digitalizációs Nap

Altair Hyperworks analízis szoftver a repülőgépiparban.

Diehl felhasználói tapasztalatok

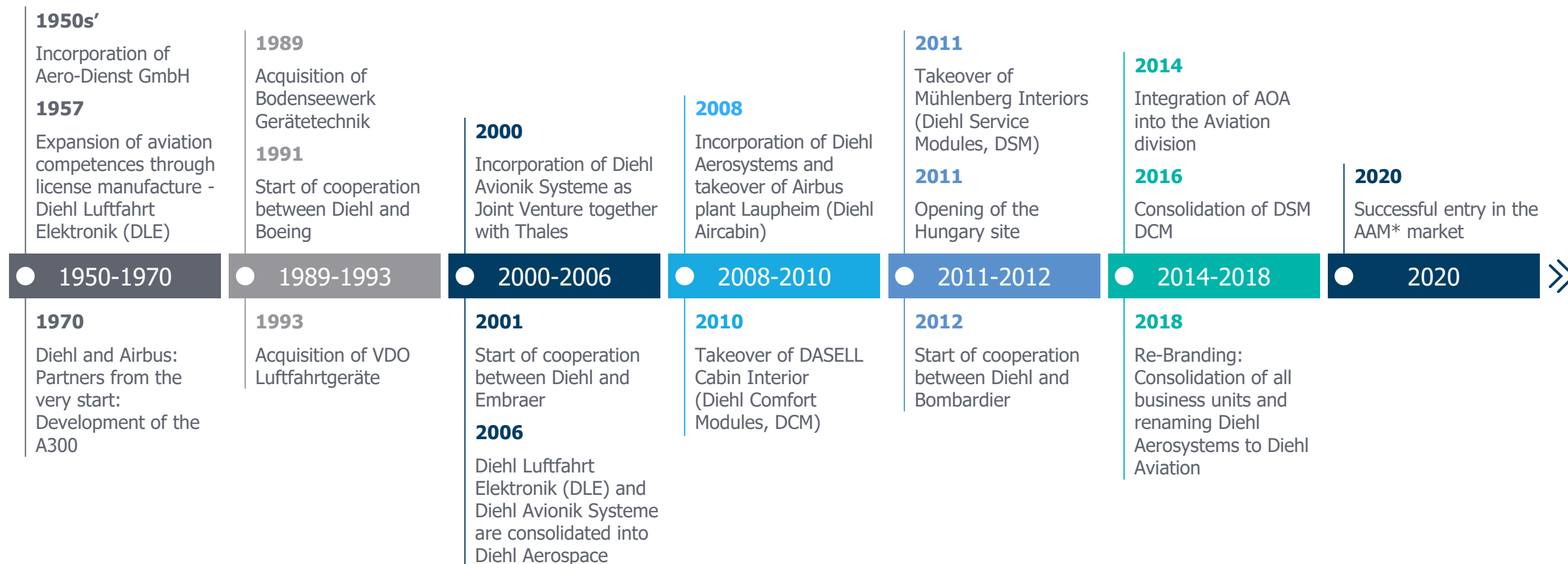
Imre Kállai - Head of Engineering

15.06.2023

VALUE TO THE SKY

Timeline

History of Diehl Aviation



*Advanced Air Mobility

The Diehl Group

5 Corporate Divisions

DIEHL
Aviation

DIEHL

family-owned
since 1902



Turnover
€ 3,167 m



Employees
16,135



Head Office
Nürnberg

DIEHL
Aviation



€ 757 m

4,440

Laupheim

DIEHL
Metall



€ 863 m

2,821

Röthenbach

DIEHL
Controls



€ 550 m

3,687

Wangen

DIEHL
Defence



€ 660 m

2,904

Überlingen

DIEHL
Metering



€ 322 m

1,695

Ansbach

According to the Diehl Annual Report 2021

Our locations

3 continents | 8 countries | 19 cities



Civil Product Range

Strategic business segments (SBS)

Aircraft Systems



Cabin Interiors



Supply Systems



Upgrade Solutions



Avionics
Cabin Systems

DIEHL
Aerospace

Interiors
Monuments
Air Distribution

Water Supply & Waste
Systems
Fire Protection
Air Management
Oxygen Supply

Customer Retrofit Solutions
across all SBS products
Integrated Cabin Solutions
Integration & Certification

AVIONICS

- Cockpit & Flight Control Systems
- Modular Platforms & Utilities

DIEHL
Aerospace



CABIN SYSTEMS

- Cabin Lighting Systems
- Cabin Interior Functions
- Cabin Area Network System & Services

DIEHL
Aerospace



Diehl Aerospace is a Joint Diehl Thales Company

(Shares: Diehl Aviation 51% | Thales 49%)

INTERIORS

- Lining
- Hatracks
- CRC | Crew Rest Compartments



MONUMENTS

- Lavatories
- GCE | General Cabin Equipment
- Galleys



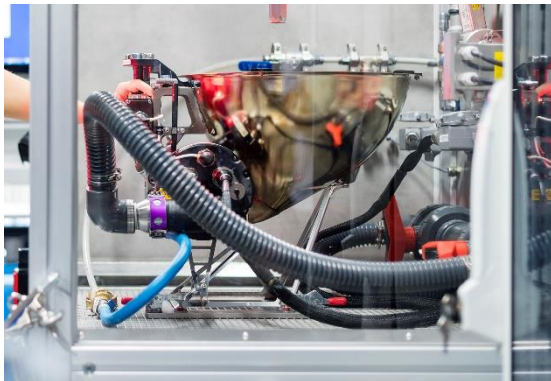
AIR DISTRIBUTION

- Ducting
- Air Outlets
- High Pressure
- Mixers



WATER SUPPLY & WASTE SYSTEMS

- Potable Water & Waste Tanks
- Water Treatment & Heaters
- Toilet Assemblies
- Vacuum Generators
- Galley Waste Disposal Units
- Indication & Control Panels



FIRE PROTECTION

- Smoke Detection Systems
- Fire Suppression Systems



AIR MANAGEMENT

- Fans
- Humidifiers/Dryers
- Cooling Systems
- Heaters



OXYGEN SUPPLY

- Universal Oxygen Generator
- Passenger Oxygen Box



Integrated Cabin Solutions incl. Consulting | Integration | Certification e.g. for the following product groups:

CABIN INTERIORS

- Closets/Stowages/Partitions
- Galleys/Bar Units
- Lavatories/Lavatory Upgrade Kits
- Lining/Overhead Bins
- Special Monuments



AIRCRAFT SYSTEMS

- Cabin Mood Lighting Systems
- Emergency Lighting Power Supplies
- Lighting Applications
- Main Cabin Lighting
- Smart Surface Illuminations



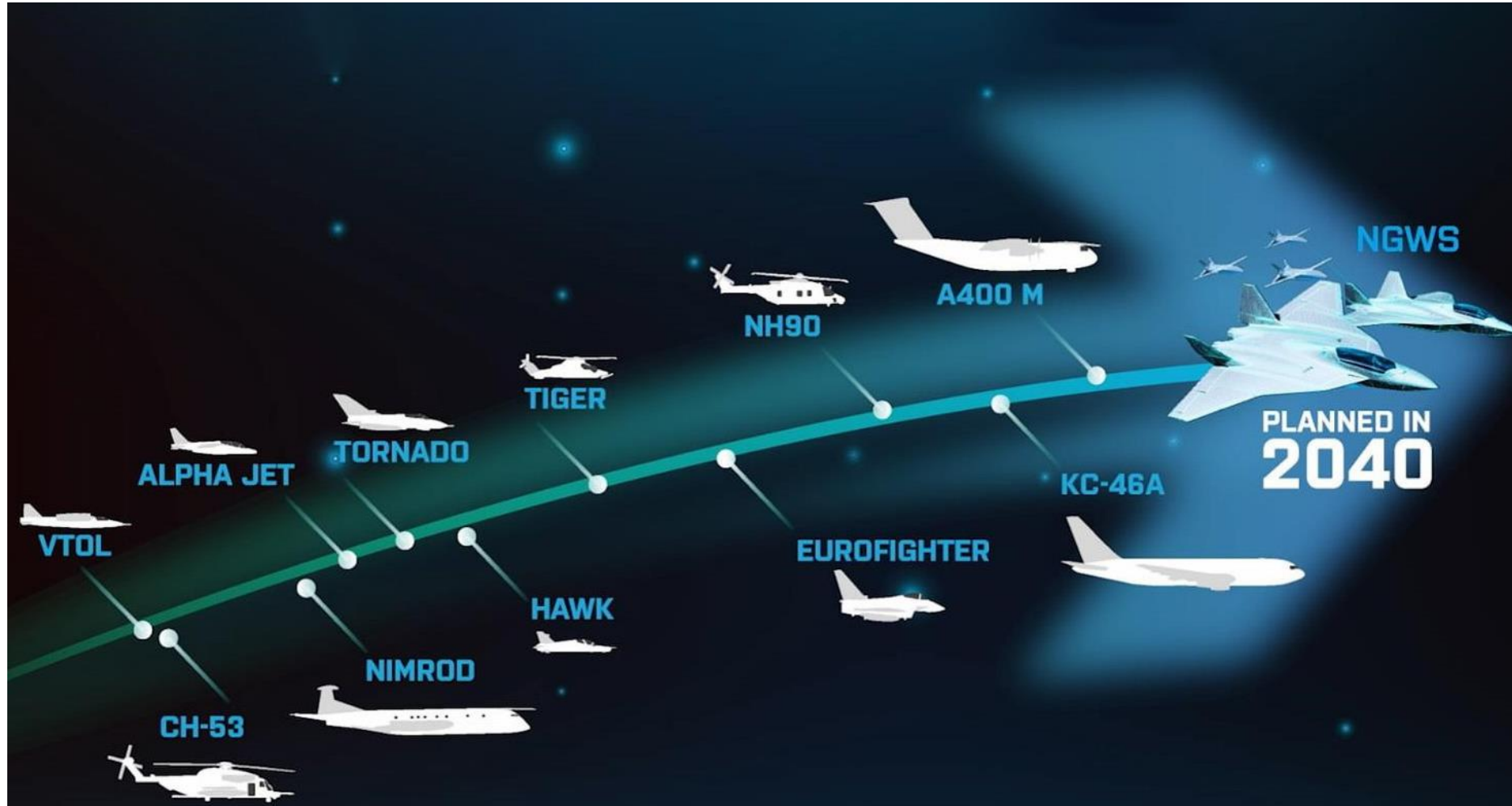
SUPPLY SYSTEMS

- Fire and Smoke Detectors
- Galley Cooling Units
- Lavatory Equipment
- Oxygen Supplies
- Touchless and Hygienic Features



Military Portfolio & Expertise

Strong partner to the armed forces for decades



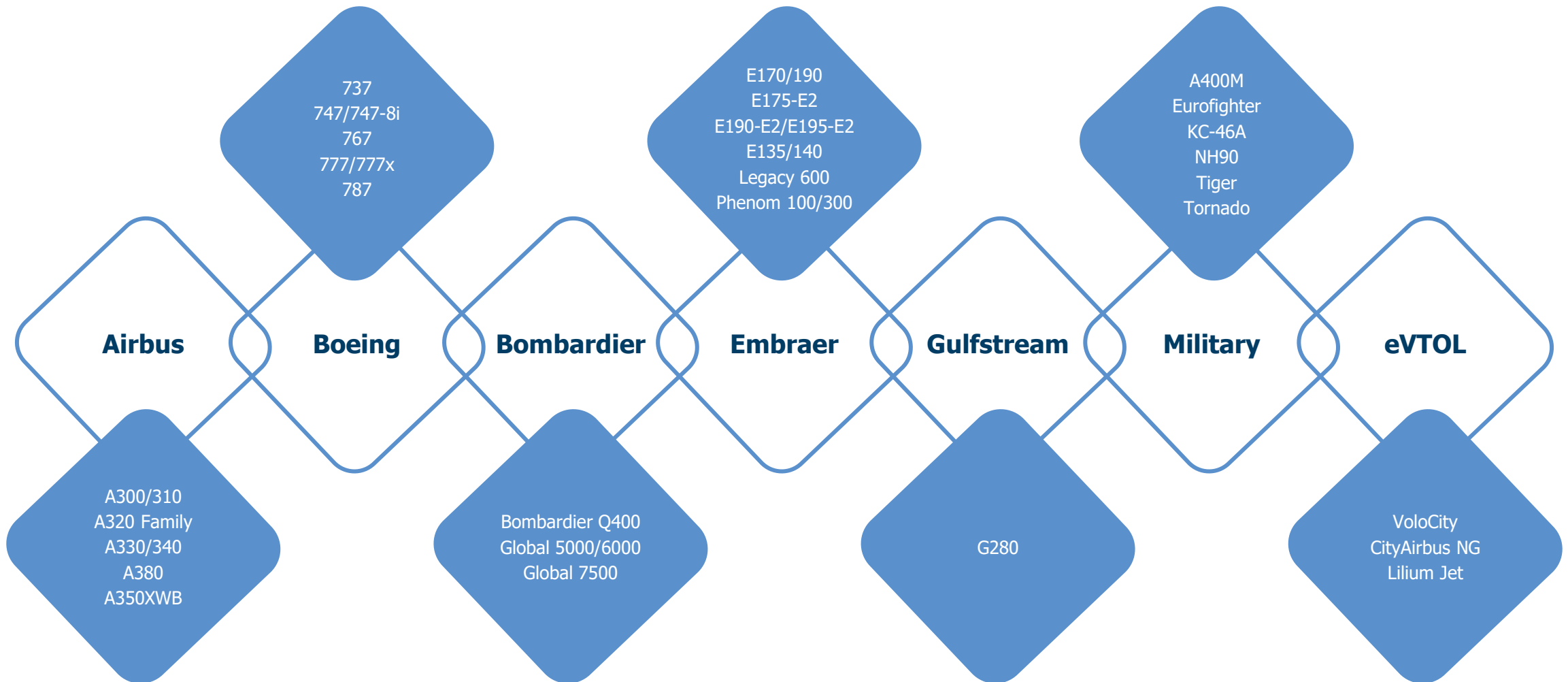
Military Portfolio & Expertise



- Fighter Aircraft
- Helicopters
- Transport & Special Mission Aircraft
- Future Combat Air System
- Modular Platforms & Utilities
- Cockpit & Flight Control Systems
- NVIS/IR Mission Lighting

Customers and platforms

At a glance



ECO EFFICIENCY Sustainable Technology



**BALANCE AND
RESPONSIBILITY**

SMART CABIN Interoperable. Scalable. Extendable.



**A SMART CABIN
JOURNEY**

ADVANCED AIR MOBILITY New Markets



**FLOAT ELEGANTLY TO YOUR
DESTINATION**



VALUE TO THE SKY

At Diehl Aviation we are providing value to the sky with **best-in-class solutions** for aviation and air mobility. With their enthusiasm and creativity, **our employees** create this value **every single day** – for our customers, for passengers around the world, for our partners, for safety, for our environment. And for generations to come.

Stress Requirements

What do the products have to withstand?

Example (Airbus): Maximum Ultimate Inertia Load Factors for D1 A350 XWB:

1. Fire (non-toxic smoke)
2. Inertia Load
3. Rapid Decompression Load
4. Windmilling
5. Abuse Load / Handling Load

Load Direction	To comply with	Emergency Landing Condition	Max. Flight and / or Landing Loads
Rearward (RWD)	2.7g	1.5g	2.7g
Forward (FWD)	9.0g	9.0g	3.5g
Sideward (SWD)	3.0g	3.0g	2.0g
Upward (UPW)	4.5g	3.0g	4.5g
Downward (DWN)	8.8g	6.0g	8.8g

g: gravity load



Battery fire



Rapid Decompression Load



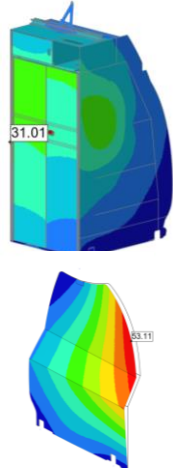
Windmilling



Abuse Load

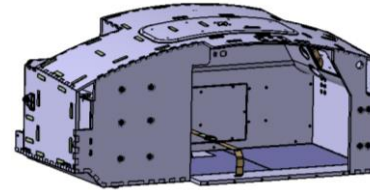
GCE

- Stowage, Partition
- FEM modelling and analysis
- SSR, ILA, SCA, TP, TR, WR reports
- Weight calculation



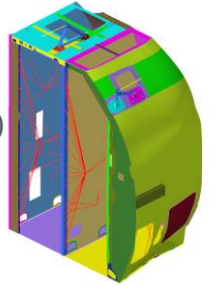
CRC

- FCRC, CCRC
- FEM modelling and analysis
- SSR, SS-S, TR, TD reports
- Weight calculation



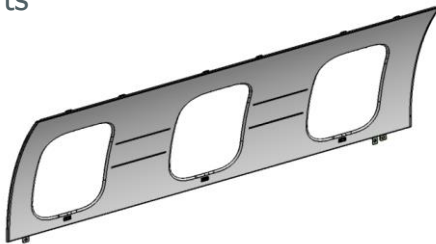
Lavatory

- SAA projects (Single and Block Lavatories)
- FEM modelling and analysis
- SSR reports
- (Weight calculation to be taken over)



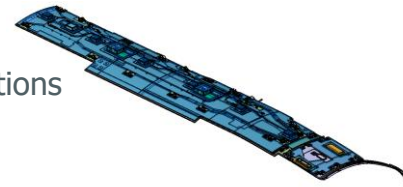
Lining

- F2F, OHSC
- WR, WP, ILA reports
- Weight calculation
- Inspection plan



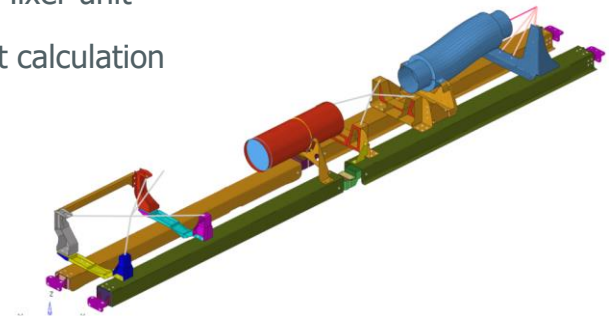
Bombardier

- SW, PSU, SPSU, Curtain, Headliner, Transition panel
- WR reports
- SVCD, weight calculations



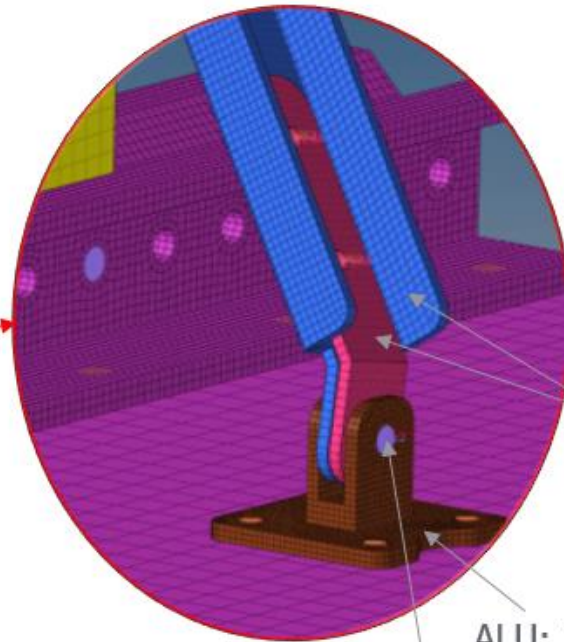
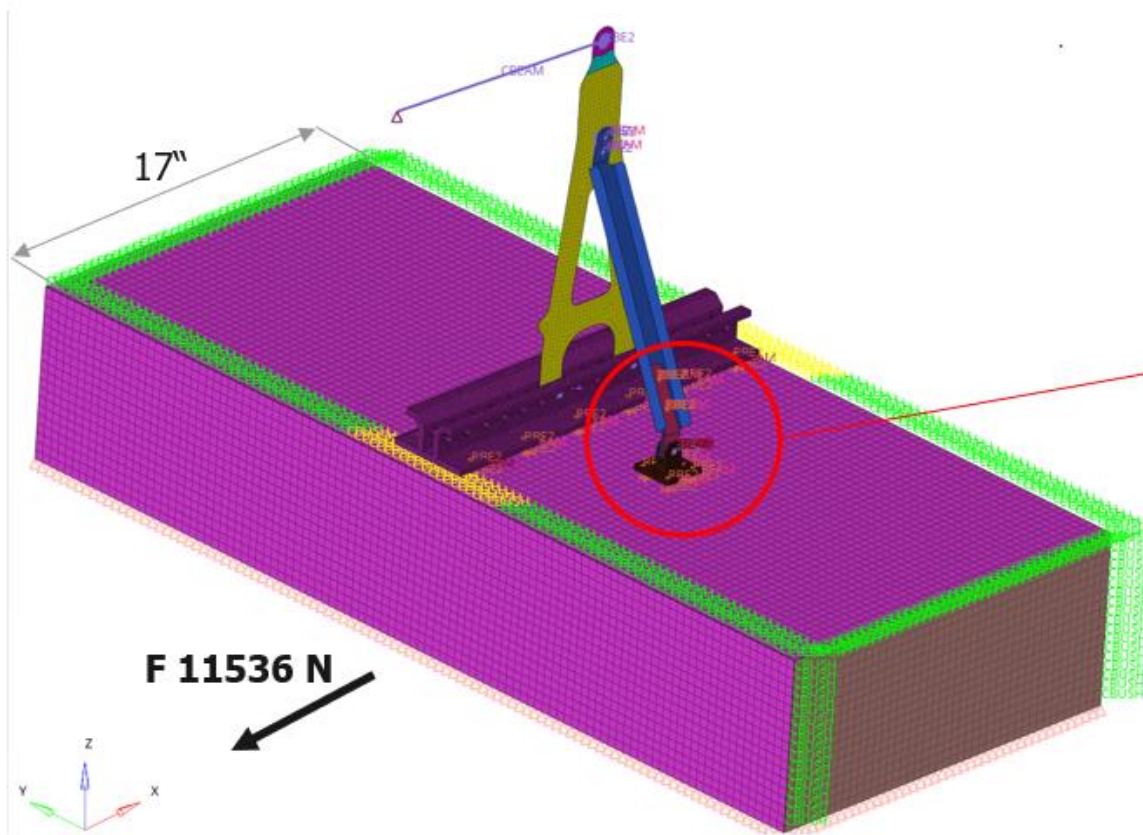
Klima

- Duct, Mixer unit
- Weight calculation



FEM analysis in the aerospace industry

Bracket position and material optimization



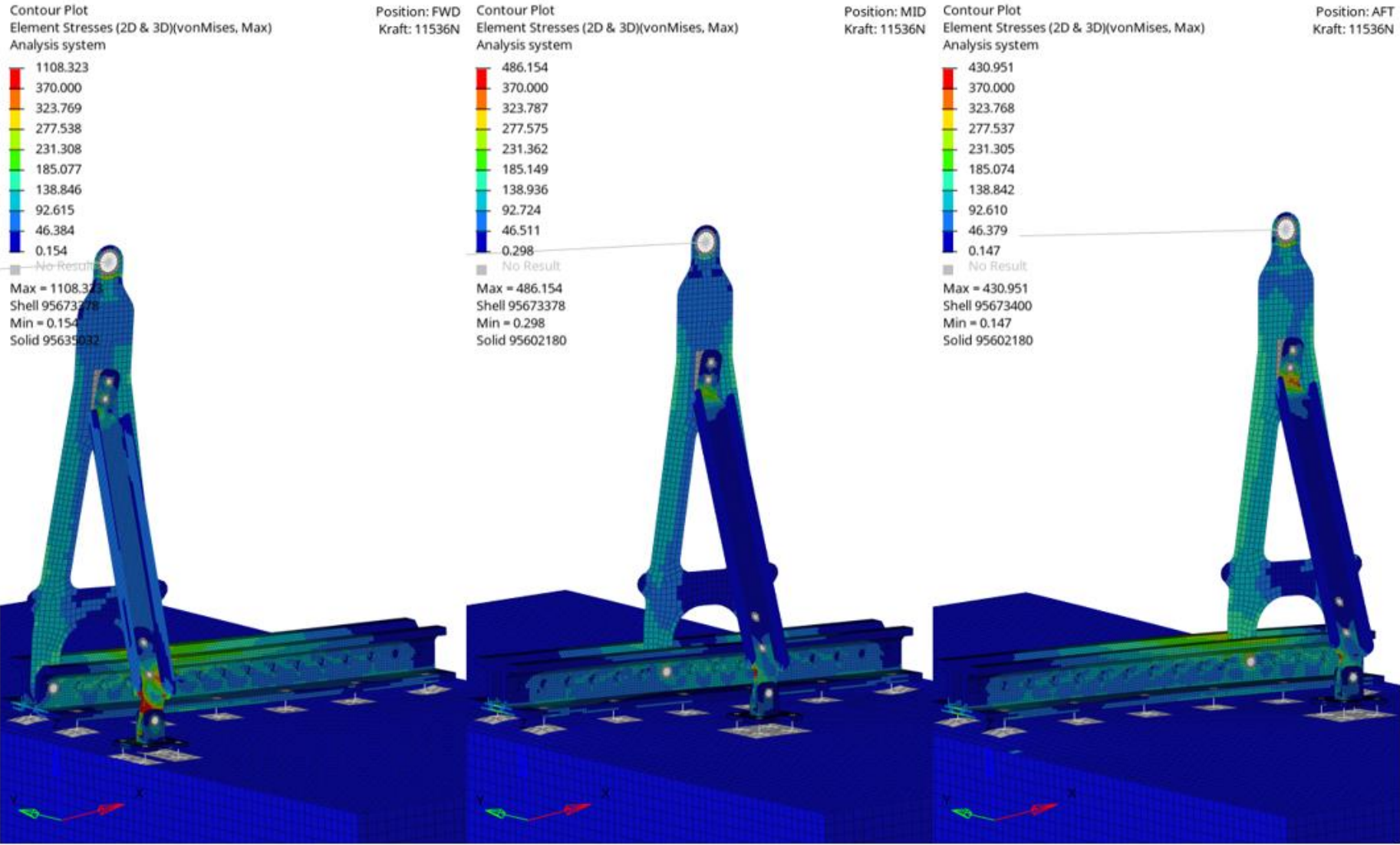
CBEAM [Stahl, 6.35mm]



Module	Software/Hardware	Version
Pushrod Konzept	Preprocessing: HyperMesh	V2019.1
	Solver: <u>OptiStruct [Non-Linear]</u>	V2019.1
	Postprocessing: HyperView	V2019.1
	Windows	10

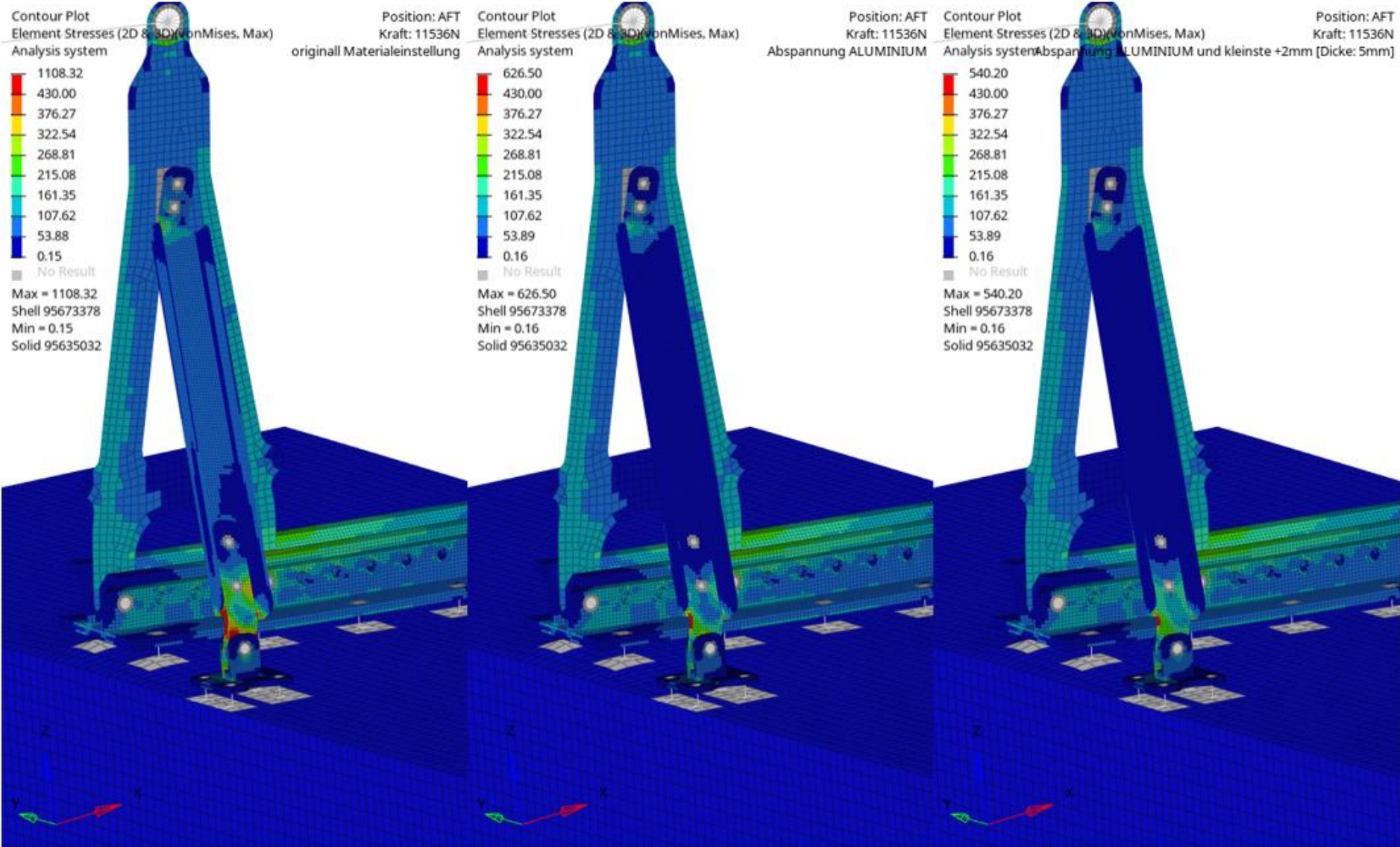
FEM analysis in the aerospace industry

Bracket position and material optimization



FEM analysis in the aerospace industry

Bracket position and material optimization



FEM analysis in the aerospace industry

Partition Upper Attachment

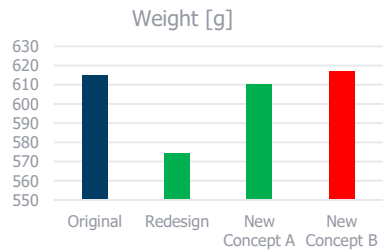
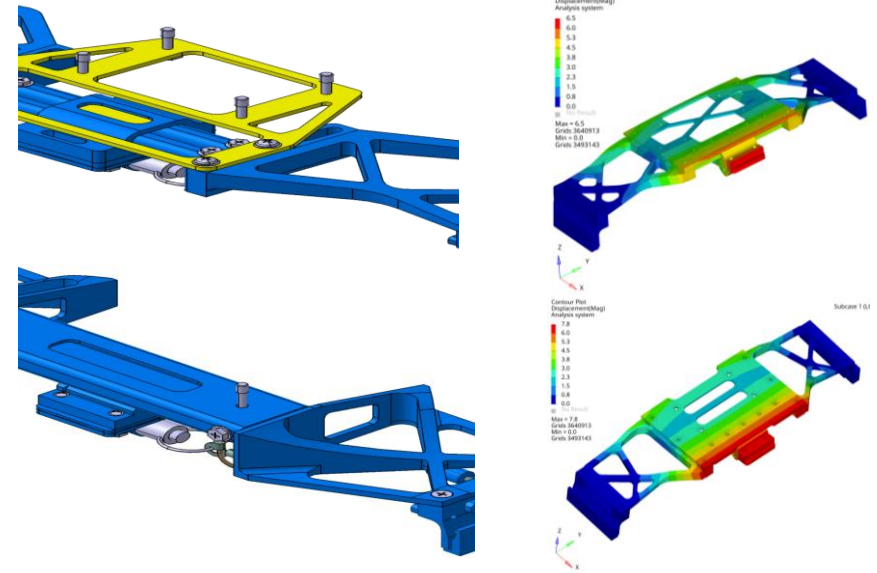
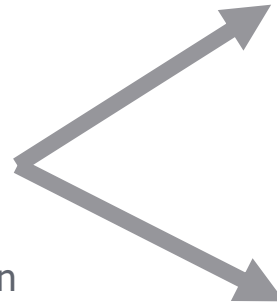
Failure during FACC OHSC test



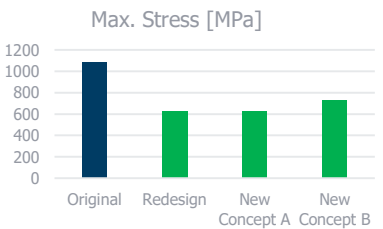
Improve and optimize stress/weight ratio



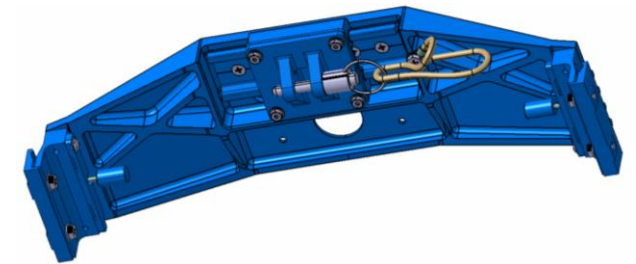
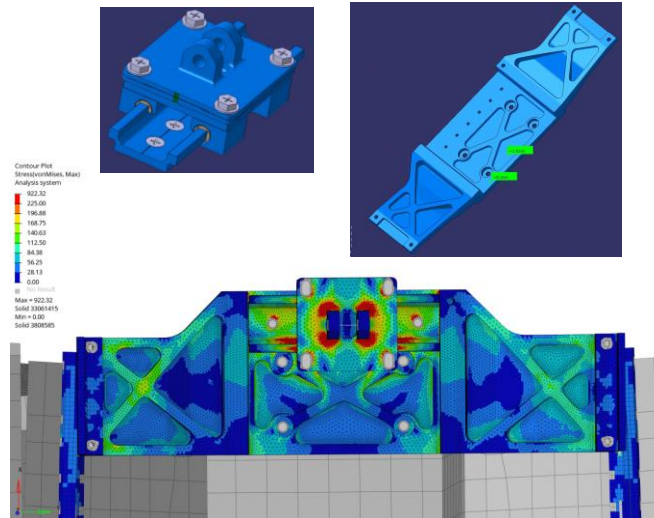
Two design teams were established.
Task:
to create a new concept and a re-design solution



Design optimized in terms of stress, weight and cost!



Meanwhile new JCR with a new/biggest partition.
New load limit:
6kN -> 7,6kN!



New design was created based on previous analyzes and experiences according the new conditions.

The test was successful!

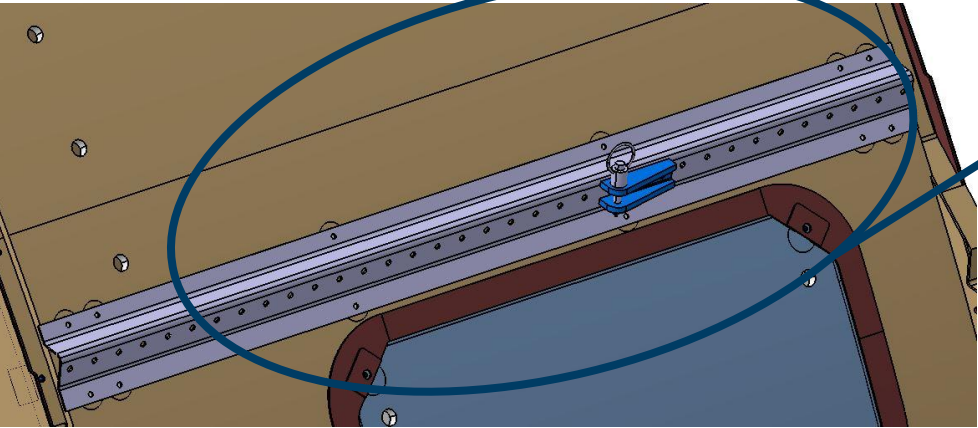
New upper attachment is **released!**

The lavatory unit and its attachments

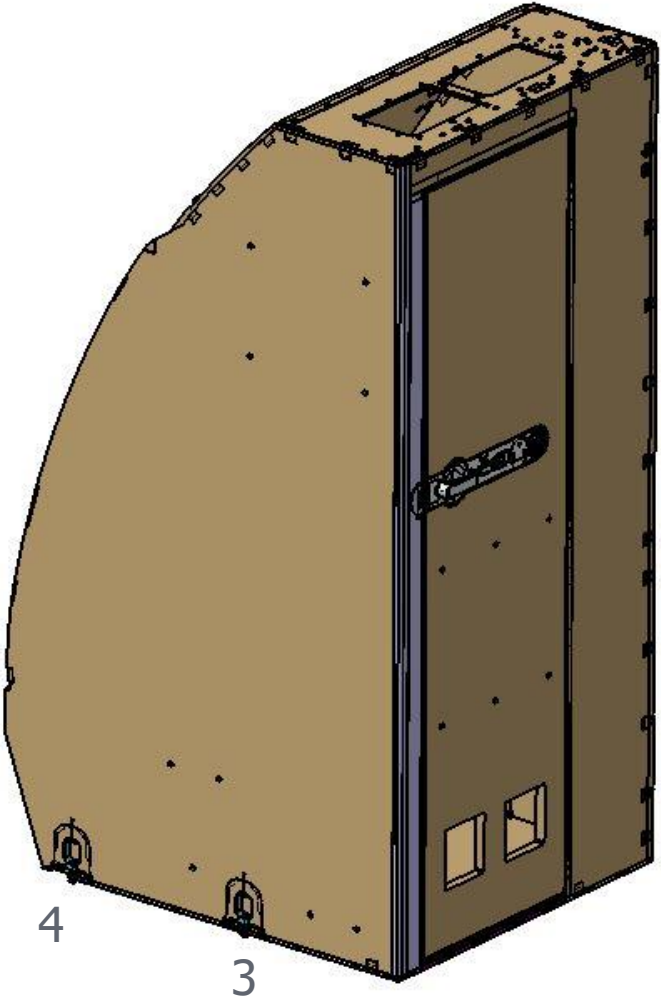
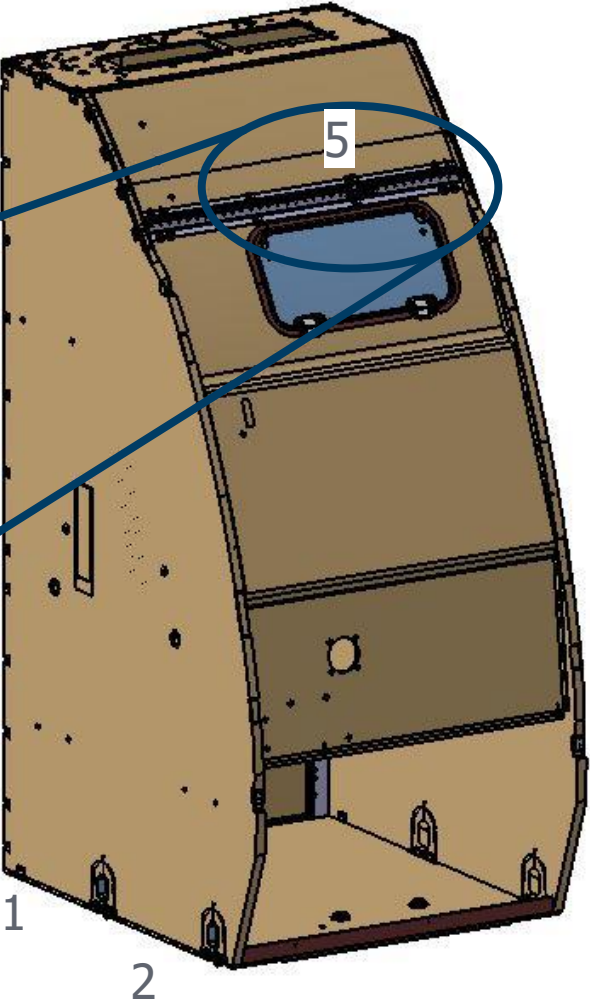
Current attachments in 5 points: 4 bottom, 1 top

Planned attachments:
4 points at the bottom

Purpose: To make the lavatory installation easier, faster thus reducing costs

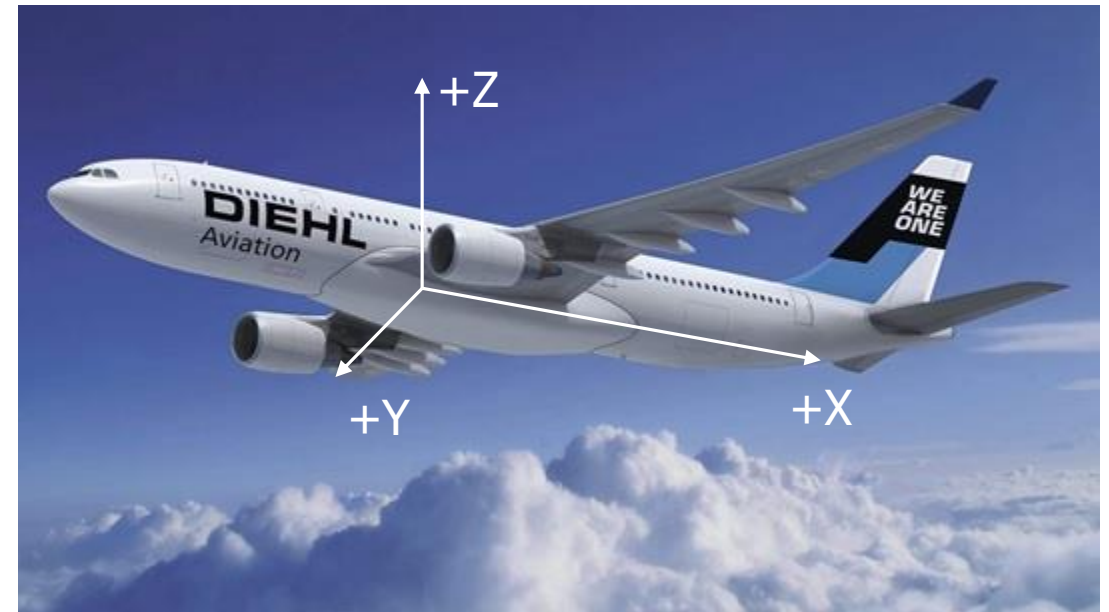


The upper attachment



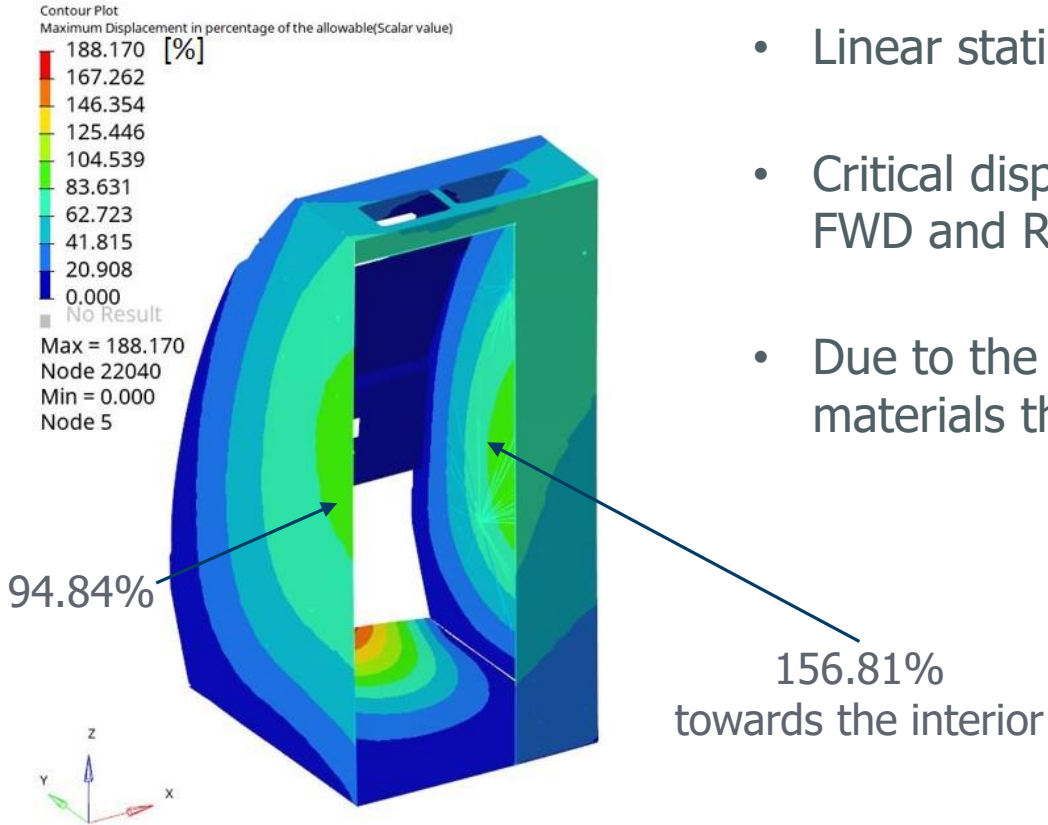
Requirements

- **EASA CS 25.561 requirements:**
 - **Loads:**
 - **UWD: 3.0g (Upward)**
 - **FWD: -9.0g (Forward)**
 - **SWD: $\pm 3.0g$ (Sideward)**
 - **DWD: -6.0g (Downward)**
 - **RWD: 1.5g (Rearward)**
 - **Reserve factor of interface loads: 1.33**
- **Other requirements:**
 - **Maximal displacement**
 - **Maximal stresses in each panel**
 - **Maximal interface loads in X-, Y- and Z directions**

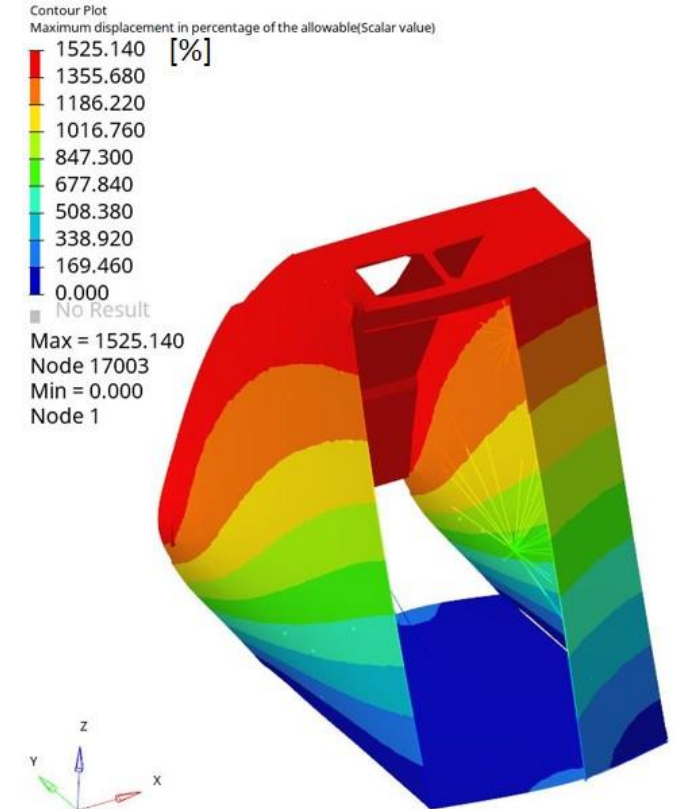


Lavatory without upper attachment Comparison with the 5-attachment-point lavatory

- Linear static FEM simulation
- Critical displacement and stress values in FWD and RWD cases.
- Due to the appearing stresses in the materials the structure breaks



Relative displacement of the 5-attachment lavatory unit due to FWD 9.0g



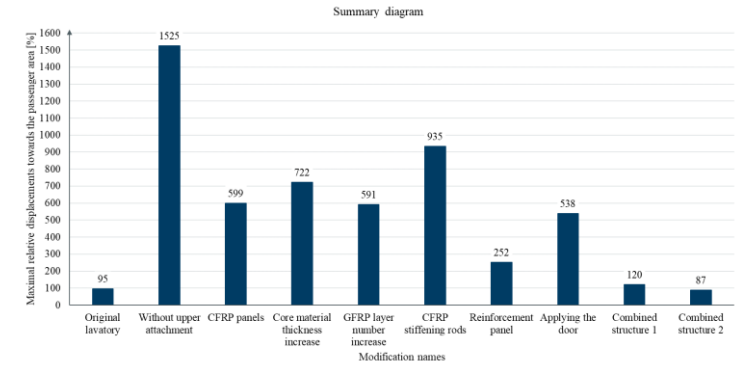
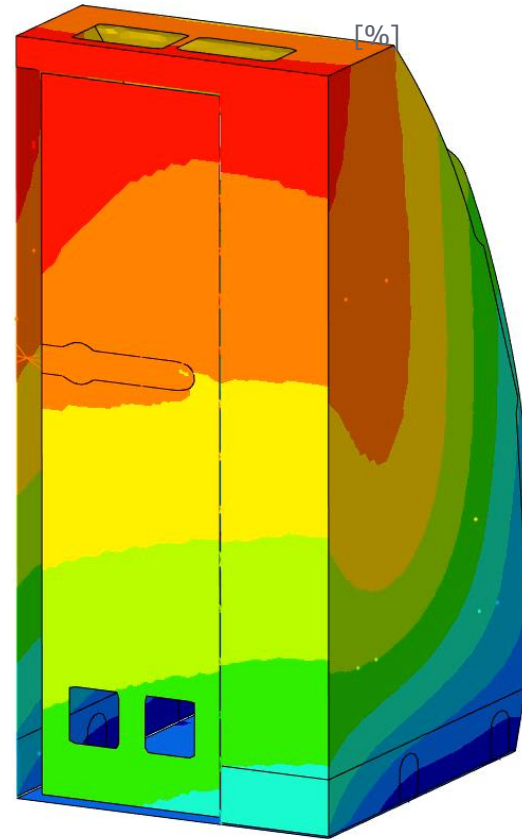
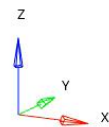
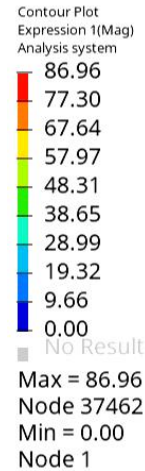
Relative displacement due to FWD 9.0g

Second combined structure

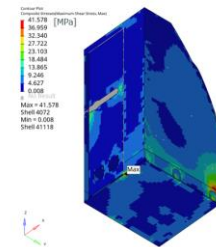
Combined effect of the door, reinforcement panel and panel thickness increase

- Maximal displacement: 86.96% (FWD load case)
- Minimum reserve factor: 1.52 (on the 4th attachment)
- Mass increase: 11.4 kg
- The door latch needs to be modified presumably

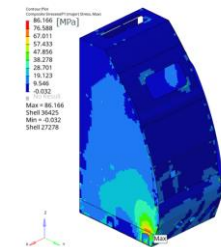
Relative displacement due to FWD 9.0g (deformation scale factor: 4)



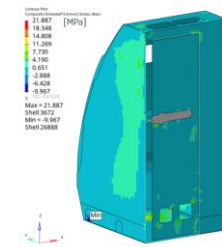
Maximal Shear stress



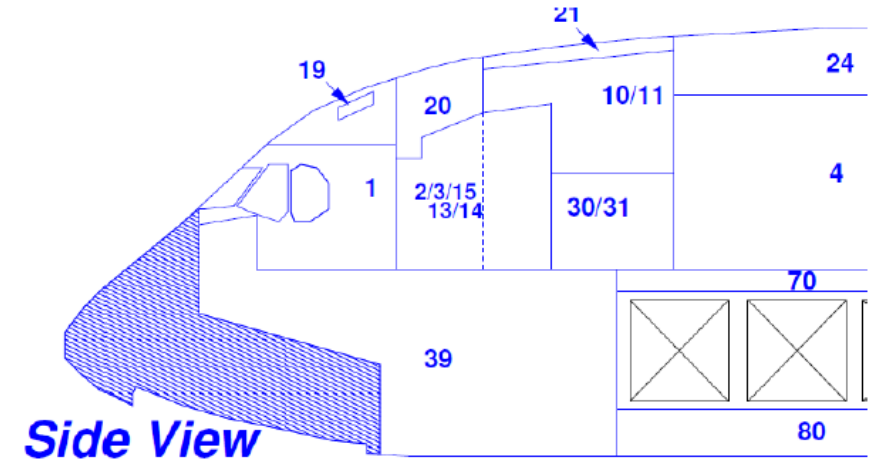
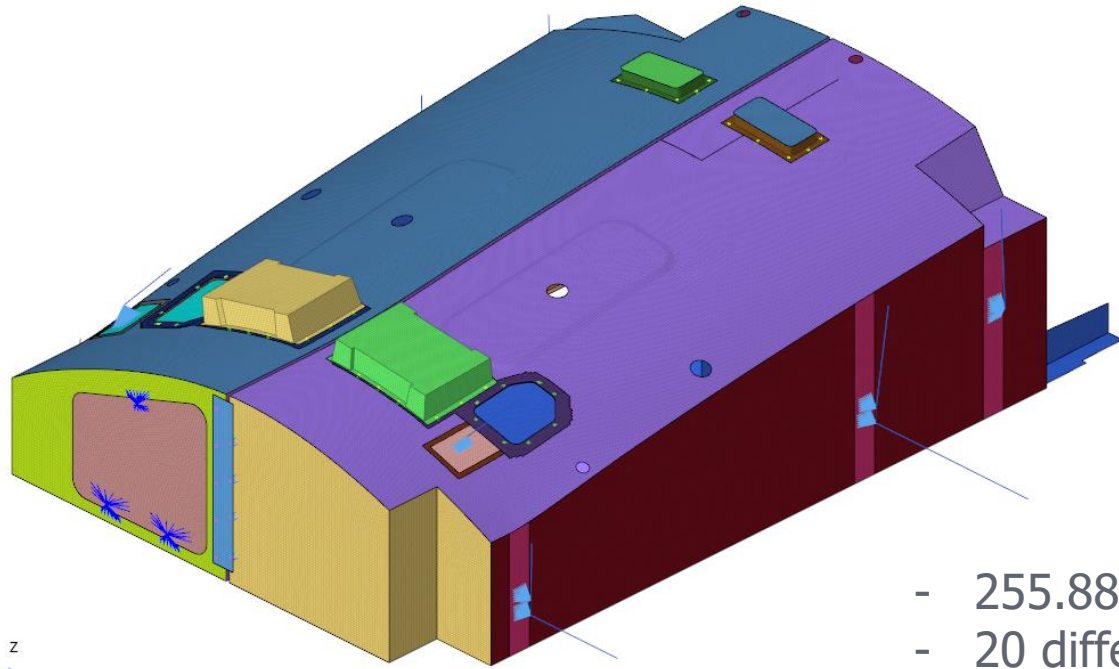
Maximal Tensile stress



Maximal Compressive stress



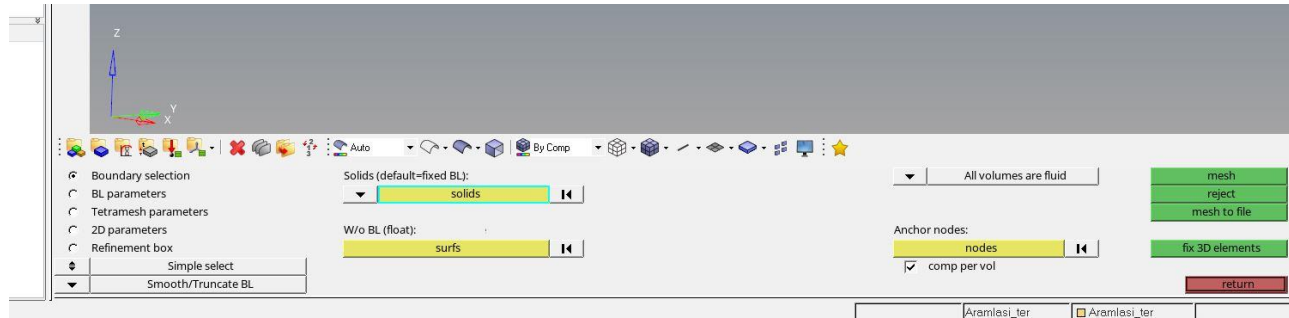
Stresses forming in the composite panels



- 255.888 number of elements (1D and 2D elements)
- 20 different load cases
- non-linear calculation (some last 1 day)
- 500kg panel weight
- bulletproof part
- A350 Sunrise project for the longest civilian flight in the world (Sydney - London) will fly approx. 20 hours - second half of 2025

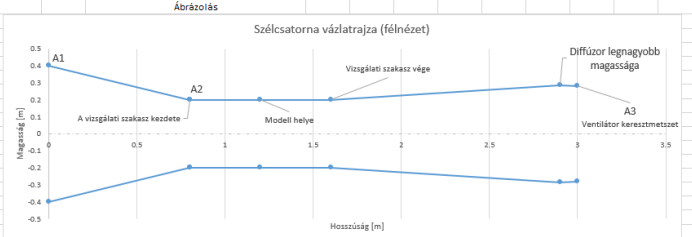
FEM analysis in the aerospace industry

AGORA WATCH Project – Wind chanel

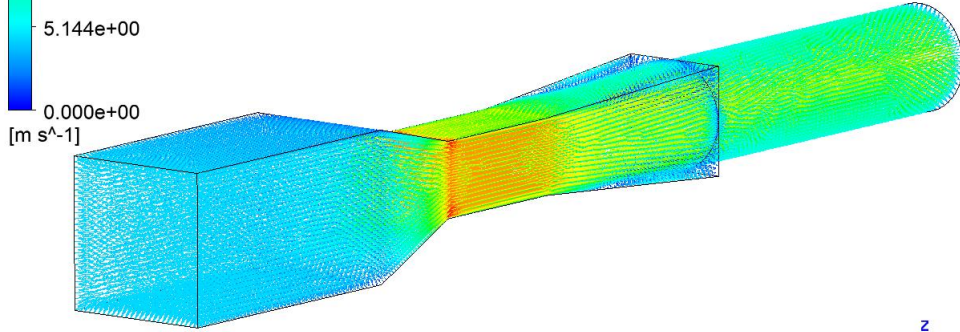
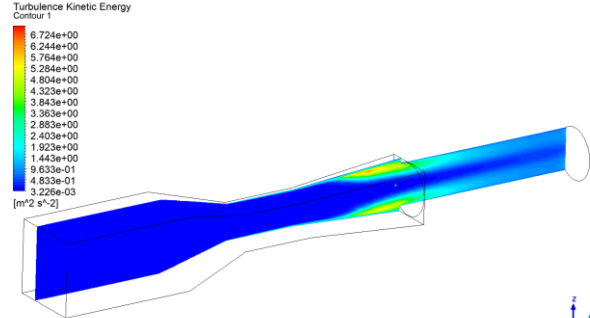
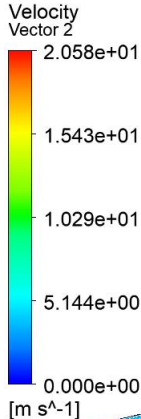


A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Szélcatorna vizsgálat és hasonlóság															
2		Nagyság	Kisminta													
3	Sebesség (v) [km/h]	30.72	61.44													
4	Sebesség (v) [m/s]	8.53	17.07													
5	Jellemző hossz (x) [m]	0.4	0.2													
6	Kicsinyítés	2.00														
7	Repülési magasság (h) [m]	0	0													
8	Levegő sűrűsége (ρ) [kg/m ³]	1.225	1.225													
9	Kinematikai viszkozitás (ν) [m ² /s]	1.46072E-05	1.46072E-05													
10	Reynolds szám vizsgálati minta	233,865														

Négyzet keresztmetszetű szélcatorna adatok	
12	Beeömlő keresztmetszet (A1) [m ²]
13	Sebesség (v1) [m/s]
14	Magasság (b1) [m]
15	Szélesség (a1) [m]
16	Szélesség (a2) [m]
17	Komfúzor hosszúság (l1) [m]
18	Komfúzor legkisebb keresztmetszet (A2) [m ²]
19	Sebesség (v=v2) [m/s]
20	Magasság (b2) [m]
21	Szélesség (a2) [m]
22	Modell helye A2-től számítva [m]
23	Reynolds szám a modell helyén
24	Határreteg vastagsága a modell helyén [m]
25	Vizsgálati szakasz hosszúság (l2) [m]
26	Reynolds szám a vizsgálati szakasz végén
27	Kismillő (ventilátor) keresztmetszet (A3) [m ²]
28	Sebesség (v3) [m/s]
29	Magasság (b3) [m]
30	Szélesség (a3) [m]
31	Diffúzor hosszúság (l3) [m]
32	Ventilátor átmérő (D) [m]
33	Tömegáram (m pont) [kg/s]
34	Térfogatáram (V pont) [m ³ /s]
35	Térfogatáram (V pont) [m ³ /m]
36	Kritikus Reynolds szám (CFD alapján)
37	
38	
39	Ventilátor típusa: DX 560/R/6-6/40/230 1F
40	Leírás: A V01-hez képest abban tér el, hogy a diffúzor a ventilátor C átmérőjéhez csatlakozik.



Arányok	Szög
Komfúzor magasság szűkülés (*)	14.04
Diffúzor magasság bővülés (*)	3.74



Thank you for your attention.

DIEHL AVIATION

Diehl Aviation is a division of Diehl Stiftung & Co. KG and combines all aviation activities of Diehl Group under one roof. In the aviation industry, Diehl Aviation - including Diehl Aerospace (a joint venture with Thales) - is a leading system supplier of aircraft system and cabin solutions. Diehl Aviation currently has more than 4,400 employees. Its clients include leading aircraft manufacturers Airbus, Boeing, Bombardier, Embraer, military partners, manufacturers of eVTOL aircraft as well as airlines and operators of commercial and business aircraft worldwide.

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VALUE TO THE SKY

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