

PROJET CATIA

• AILE MIRAGE 2000



X



Rayan CHENNAOUI – Nima KASHANI – Antoine ROMINGER – Clément PEVILLER



01.

Notre projet

02.

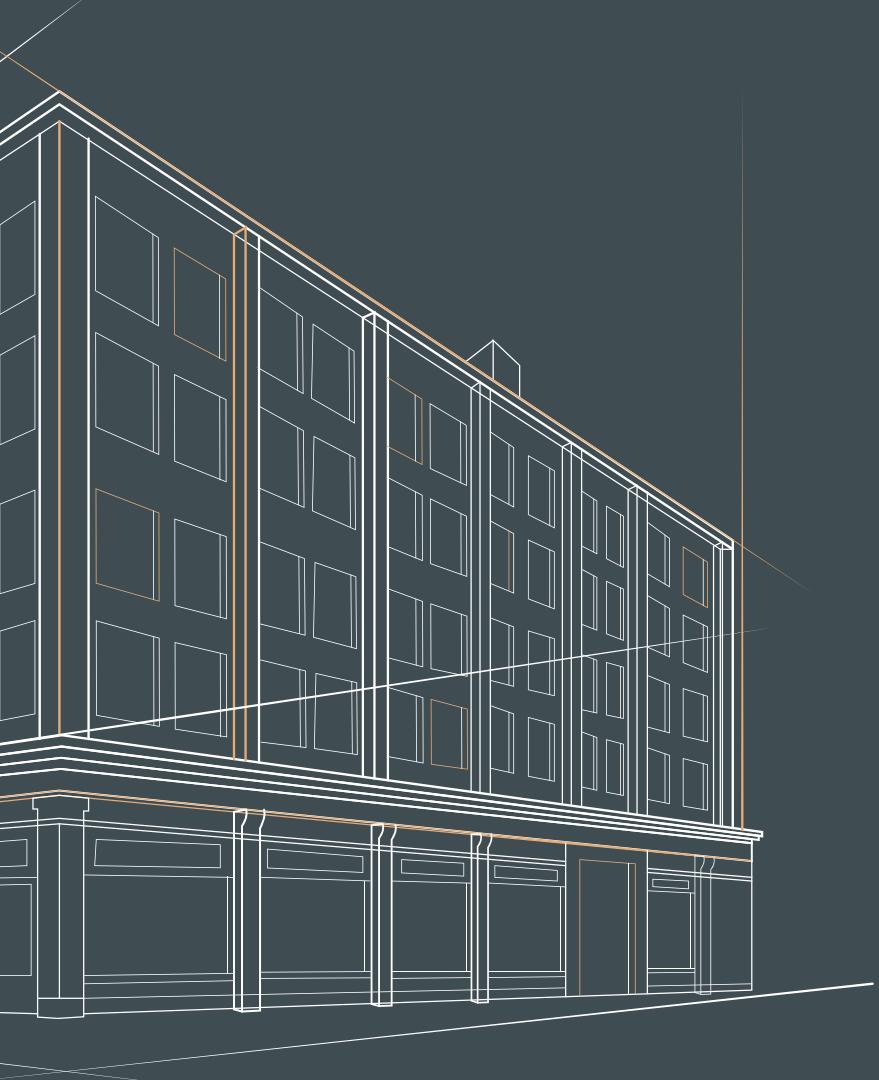
Organisation

03.

Assemblage

04.

Etude mécanique



01

Introduction & Présentation du projet

Notre projet



Conçu aux alentour de 1970

En service depuis 1984

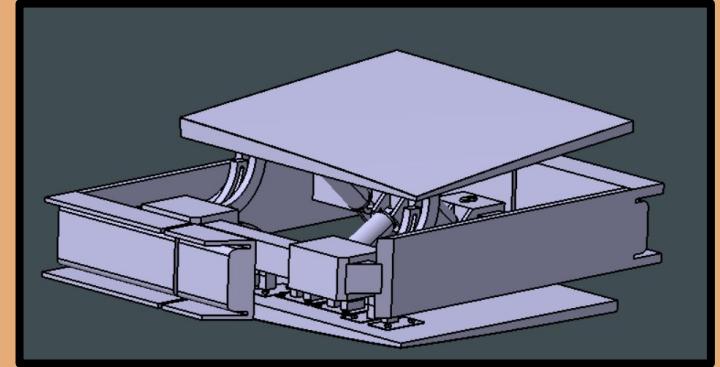
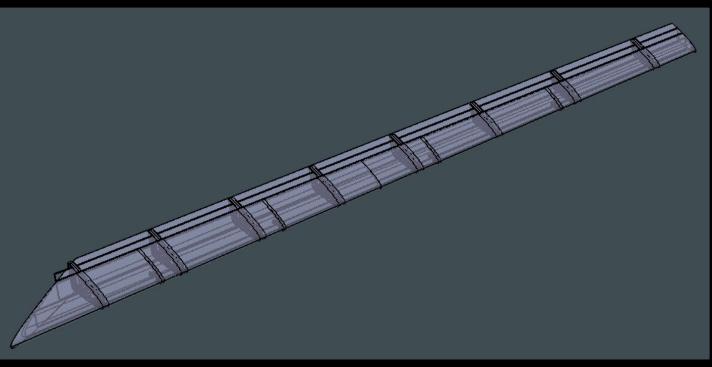
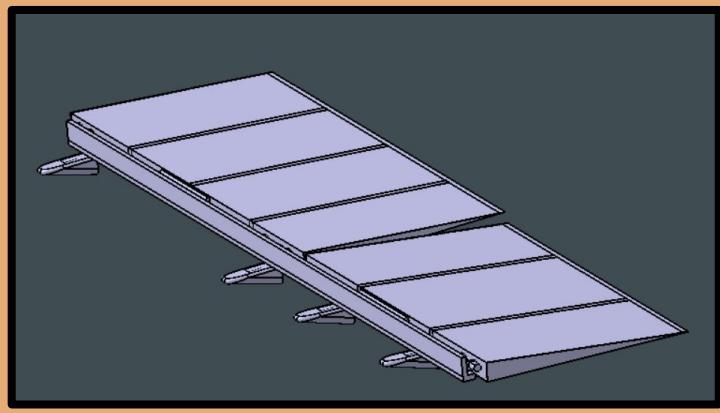
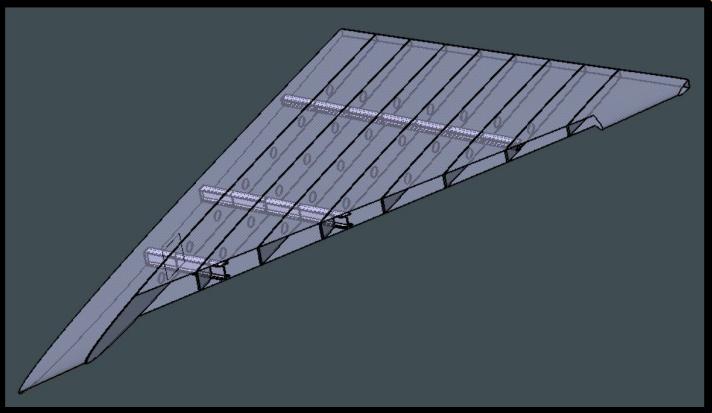
601 exemplaires construits



Elevons

Spoilers

Becs de bord
d'attaque



Assemblage final

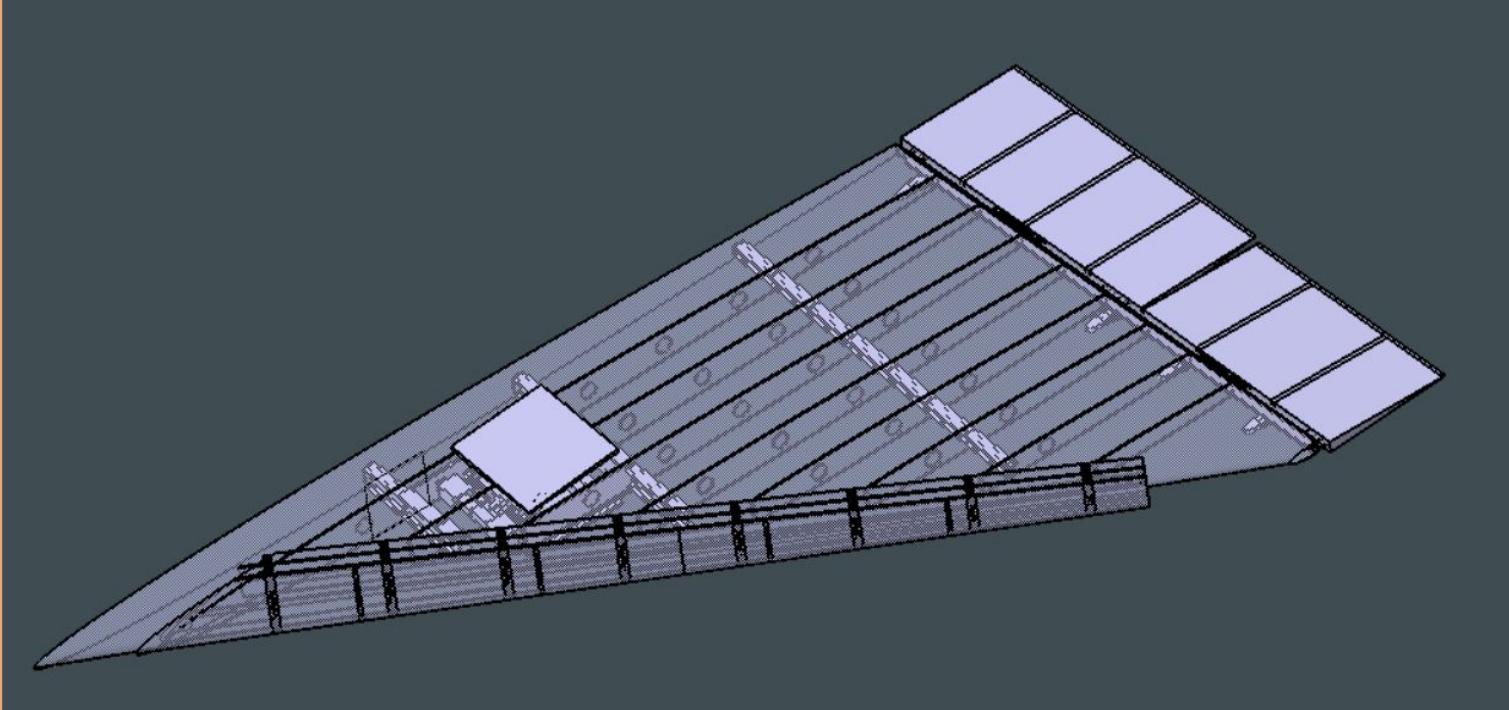
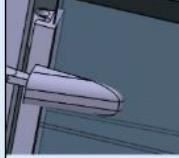
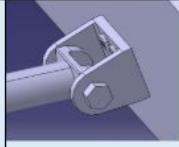
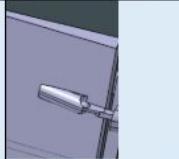
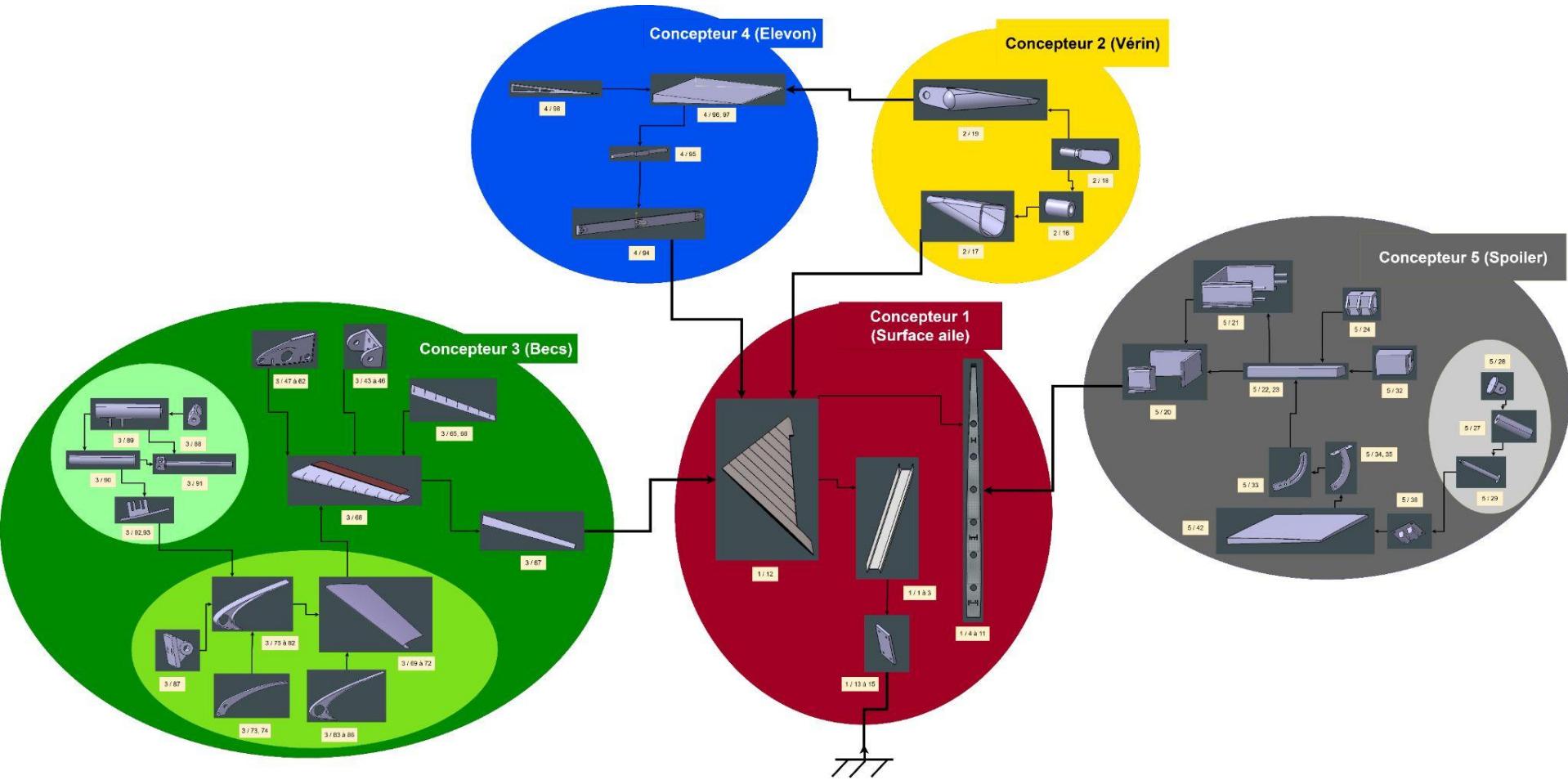


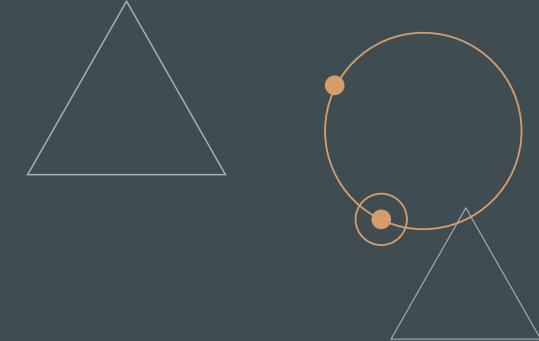
Table des pièces

1	Longeron 1	Part Design	CHENNAQUI	
2	Longeron 2	Part Design	CHENNAQUI	
3	Longeron 3	Part Design	CHENNAQUI	
4	Nervure 1	Part Design	CHENNAQUI	
5	Nervure 2	Part Design	CHENNAQUI	
6	Nervure 3	Part Design	CHENNAQUI	
7	Nervure 4	Part Design	CHENNAQUI	
8	Nervure 5	Part Design	CHENNAQUI	
9	Nervure 6	Part Design	CHENNAQUI	
10	Nervure 7	Part Design	CHENNAQUI	
11	Nervure 8	Part Design	CHENNAQUI	
12	Surface de l'aile	Part Design/ GSD	CHENNAQUI	
13	plaque_vis1	Part Design	CHENNAQUI	
14	plaque_vis2	Part Design	CHENNAQUI	
15	plaque_vis3	Part Design	CHENNAQUI	
16	Pièce verin 2 / vérin 2 V2	Part Design	KASHANI	
17	Cache verin	Part Design	KASHANI	
18	Flap	Part Design	KASHANI	
19	Support elevon	Part Design	KASHANI	
20	Boite	Part Design	PEVILLER	
21	Boite_male	Part Design	PEVILLER	
22	poutre_boite	Part Design	PEVILLER	
23	poutre_avant_boite	Part Design	PEVILLER	
24	attache_verin_poutre	Part Design	PEVILLER	
25	bouchon_verin	Part Design	PEVILLER	
26	jambes_verin	Part Design	PEVILLER	
27	verin	Part Design	PEVILLER	
28	bouchon_verin_intrados	Part Design	PEVILLER	
29	jambes_verin	Part Design	PEVILLER	
30	verin_intrados	Part Design	PEVILLER	
31	accroche_verin_plaque_spoiler	Part Design	PEVILLER	
32	base_gond_haut	Part Design	PEVILLER	
33	gond_haut	Part Design	PEVILLER	
34	gond_extension_haut_droit	Part Design	PEVILLER	
35	gond_extension_haut_gauche	Part Design	PEVILLER	
36	axe_gond	Part Design	PEVILLER	
37	embout_axe_gond	Part Design	PEVILLER	
38	plaque_extrados	Part Design/ GSD	PEVILLER	
39	base_gond_intrados	Part Design	PEVILLER	
40	gond_extension_haut_droit_intrados	Part Design	PEVILLER	
41	gond_extension_haut_gauche_intrados	Part Design	PEVILLER	
42	intrados	Part Design/ GSD	PEVILLER	
43	alle_ver1	Part Design/ GSD	ROMINGER	
44	alle_ver2	Part Design/ GSD	ROMINGER	
45	alle_ver3	Part Design/ GSD	ROMINGER	
46	alle_ver4	Part Design/ GSD	ROMINGER	
47	rail_alle4d	Part Design/ GSD	ROMINGER	
48	rail_alle2d	Part Design/ GSD	ROMINGER	
49	rail_alle3d	Part Design/ GSD	ROMINGER	
50	rail_alle4d	Part Design/ GSD	ROMINGER	
51	rail_alle5d	Part Design/ GSD	ROMINGER	
52	rail_alle6d	Part Design/ GSD	ROMINGER	
53	rail_alle7d	Part Design/ GSD	ROMINGER	
54	rail_alle8d	Part Design/ GSD	ROMINGER	
55	rail_alle1g	Part Design/ GSD	ROMINGER	
56	rail_alle2g	Part Design/ GSD	ROMINGER	
57	rail_alle3g	Part Design/ GSD	ROMINGER	
58	rail_alle4g	Part Design/ GSD	ROMINGER	
59	rail_alle5g	Part Design/ GSD	ROMINGER	
60	rail_alle6g	Part Design/ GSD	ROMINGER	
61	rail_alle7g	Part Design/ GSD	ROMINGER	
62	rail_alle8g	Part Design/ GSD	ROMINGER	
63	long1	Part Design/ GSD	ROMINGER	
64	long2	Part Design/ GSD	ROMINGER	
65	plaque_liaison_aile	Part Design/ GSD	ROMINGER	
66	profil_liaison_aile	Part Design/ GSD	ROMINGER	
67	profil_bec1	Part Design/ GSD	ROMINGER	
68	profil_bec2	Part Design/ GSD	ROMINGER	
69	profil_bec1n1	Part Design/ GSD	ROMINGER	
70	profil_bec1n2	Part Design/ GSD	ROMINGER	
71	rail1	Part Design	ROMINGER	
72	rail2	Part Design	ROMINGER	
73	bec1	Part Design/ GSD	ROMINGER	
74	bec2	Part Design/ GSD	ROMINGER	
75	bec3	Part Design/ GSD	ROMINGER	
76	bec4	Part Design/ GSD	ROMINGER	
77	bec5	Part Design/ GSD	ROMINGER	
78	bec6	Part Design/ GSD	ROMINGER	
79	bec7	Part Design/ GSD	ROMINGER	
80	bec8	Part Design/ GSD	ROMINGER	
81	ver1	Part Design/ GSD	ROMINGER	
82	ver2	Part Design/ GSD	ROMINGER	
83	ver3	Part Design/ GSD	ROMINGER	
84	ver4	Part Design/ GSD	ROMINGER	
85	articulation_ver_bec	Part Design	ROMINGER	
86	fus_ver1	Part Design	ROMINGER	
87	fus_ver2	Part Design	ROMINGER	
88	mobile_ver1	Part Design	ROMINGER	
89	mobile_ver2	Part Design	ROMINGER	
90	profil_ver1	Part Design/ GSD	ROMINGER	
91	profil_ver2	Part Design/ GSD	ROMINGER	
92	profil_ver1	Part Design/ GSD	ROMINGER	
93	profil_ver2	Part Design/ GSD	ROMINGER	
94	elevon_1 (attache_elevon)	Part Design	CHENNAQUI	
95	tentative_elevon_support_elevon	Part Design	CHENNAQUI	
96	structure_externe_elevon_1	Part Design	KASHANI	
97	structure_externe_elevon_2	Part Design	KASHANI	
98	elevon	Part Design	KASHANI	

Table des interfaces

1	Interface 1/2	Encastrement	Surface de l'aile et le vérin hydraulique Aile : Longueur 6800mm et Largeur : 3550 mm Vérin : Longueur 450mm et Largeur : 85mm	
2	Interface 1/3	Pivot simple	Écrou-boulon	
3	Interface 1/4	Encastrement	Surface de l'aile et élévon	
4	Interface 2/4	Encastrement	Elévon et vérin	
5	Interface 1/5	Encastrement	Création de fixation male femelle au travers de la nervure et forme de la boîte adapté aux poutres	

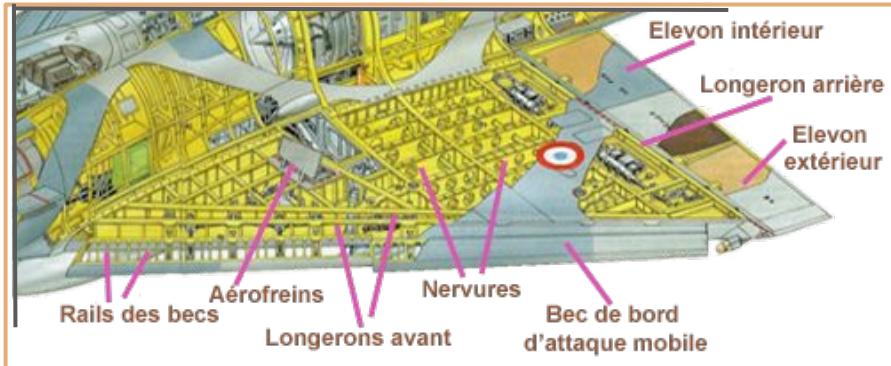




02

Organisation & Répartition des tâches

RÉPARTITION DES TÂCHES



Répartition en 4 groupes

- Structure interne
 - Elevons/ Vérin
 - Becs
 - Aérofrein

- # Mesures

 - Manque de données
 - Basée sur quelques croquis
 - Dimensions principales



PARTIE 1 – STRUCTURE INTERNE

Création de 2 lois

Création profil

Création surface

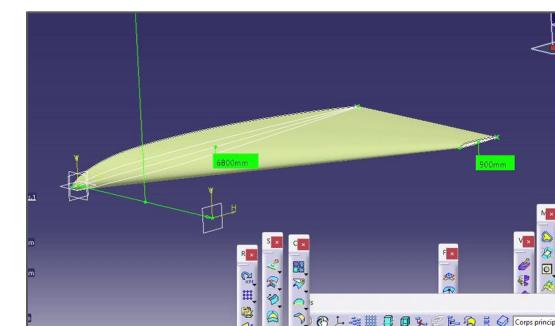
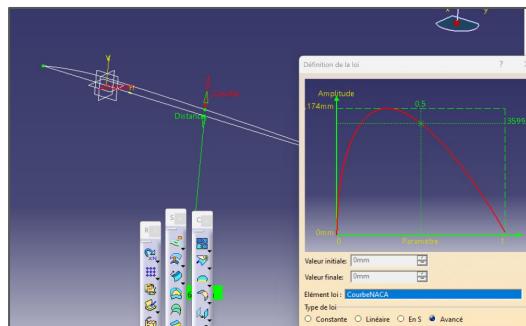
- Formule de l'épaisseur

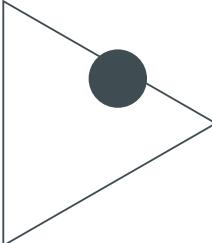
$$y_t = 5t \left[0.2969\sqrt{x} - 0.1260x - 0.3516x^2 + 0.2843x^3 - 0.1015x^4 \right]$$

- Formules cambrure

$$y_c = \begin{cases} \frac{m}{p^2} (2px - x^2), & 0 \leq x \leq p, \\ \frac{m}{(1-p)^2} ((1-2p) + 2px - x^2), & p \leq x \leq 1, \end{cases}$$

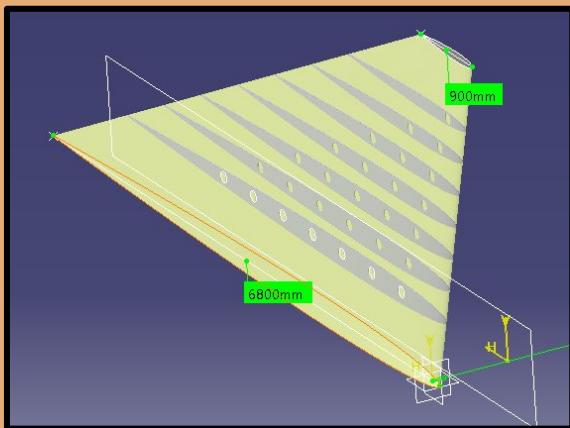
(p : cambrure maximale)



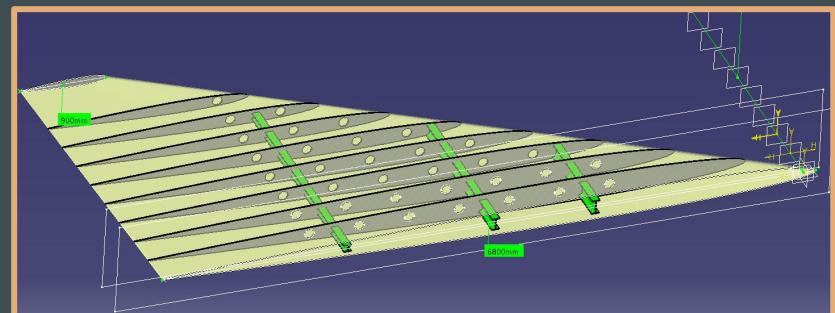


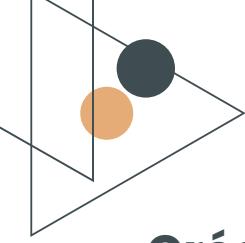
PARTIE 1 – STRUCTURE INTERNE

Création nervures



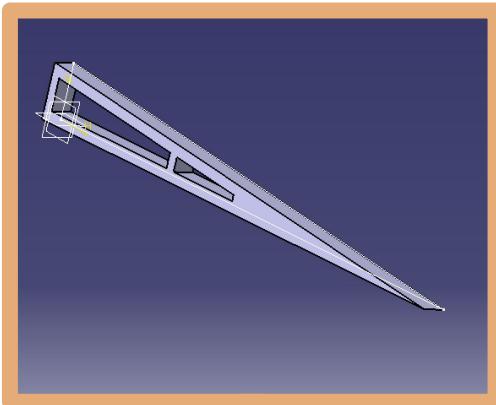
Création longerons



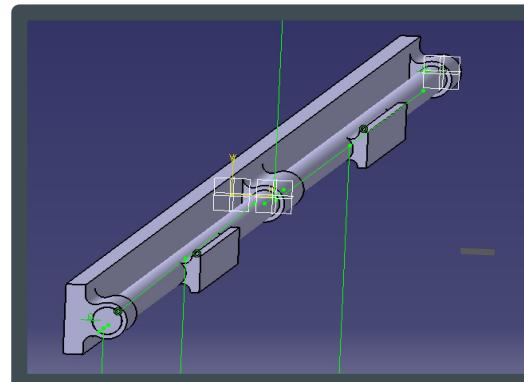


PARTIE 2 – ELEVONS

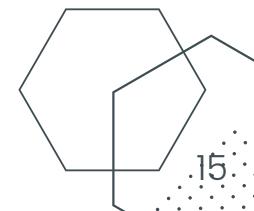
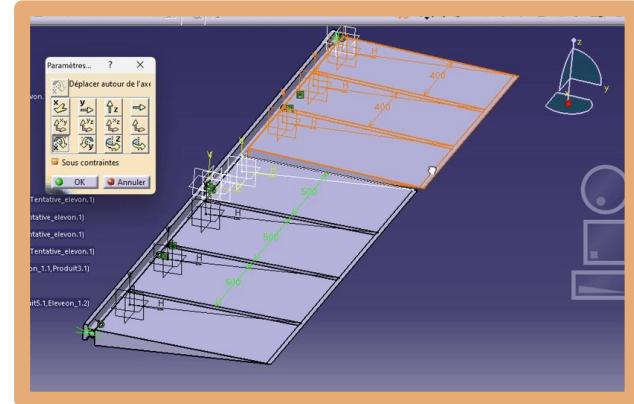
Création structure
interne

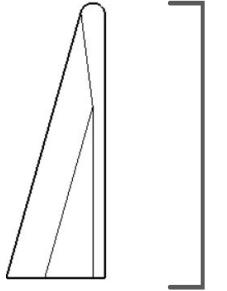


Création support
elevons



Création elevon &
assemblage





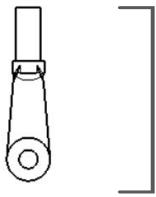
Support aile

Partie encastré avec la surface de l'aile

Le système hydraulique se trouve à l'intérieur

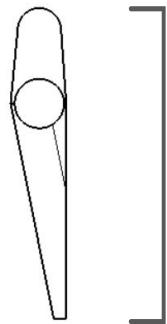


Support presse hydraulique



Presse hydraulique

Permet d'effectuer une translation de 45cm

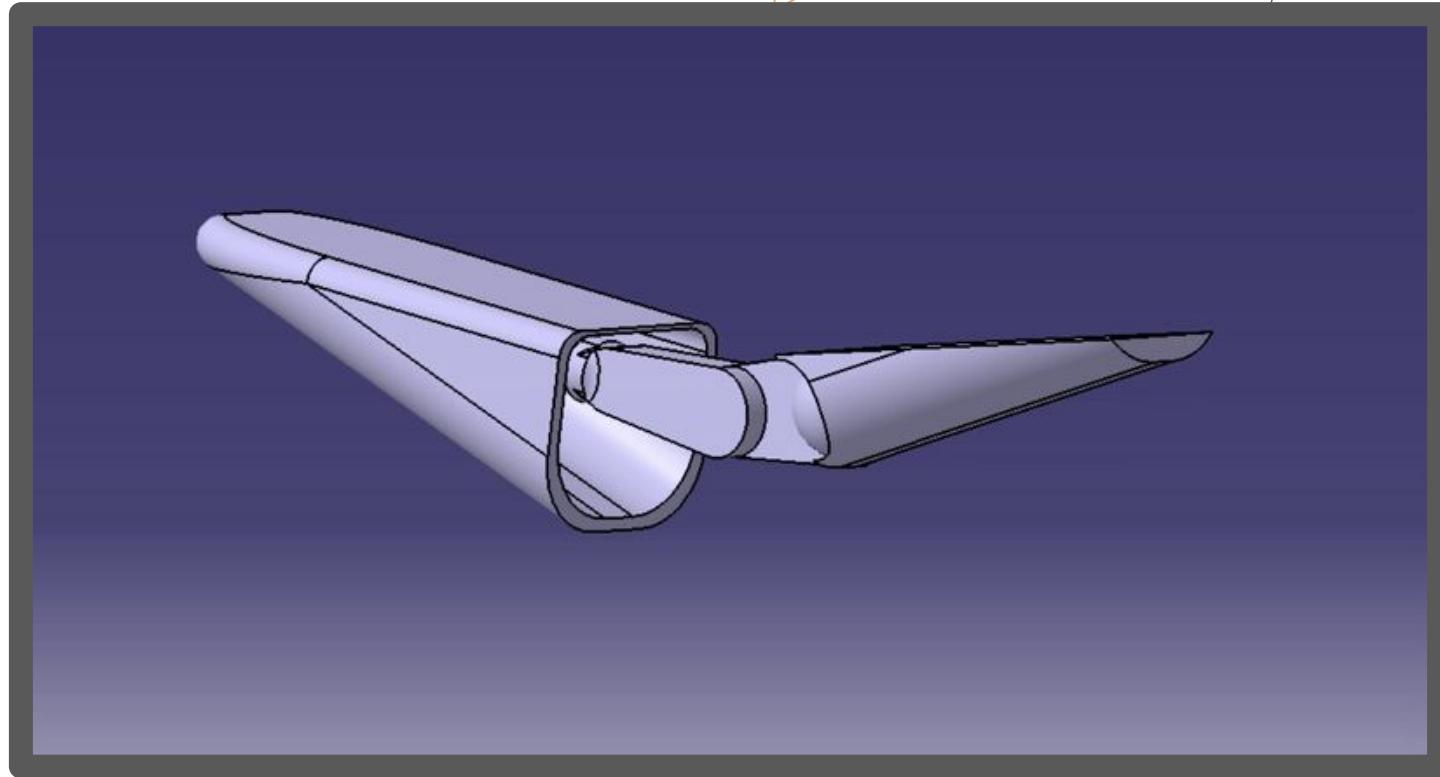


Support élévon

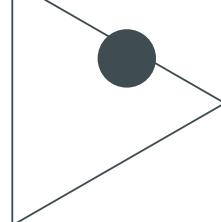
Partie encastré avec la surface de l'élevon

Permet d'effectuer une rotation de 32°

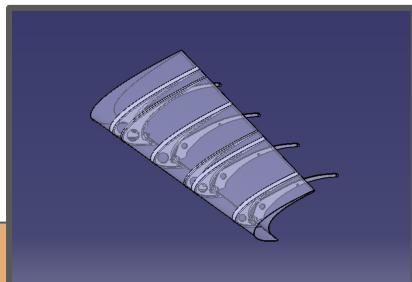
V
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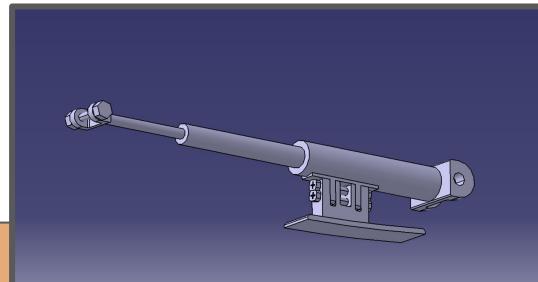


PARTIE 3 – BECS



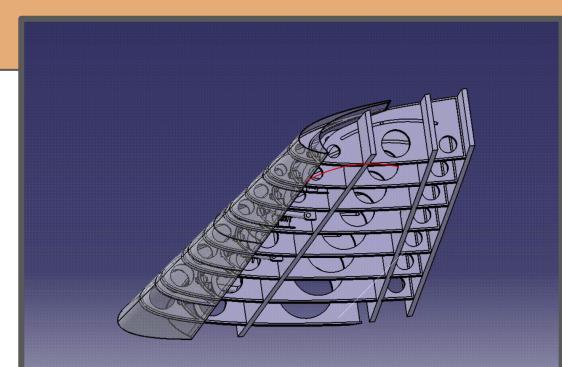
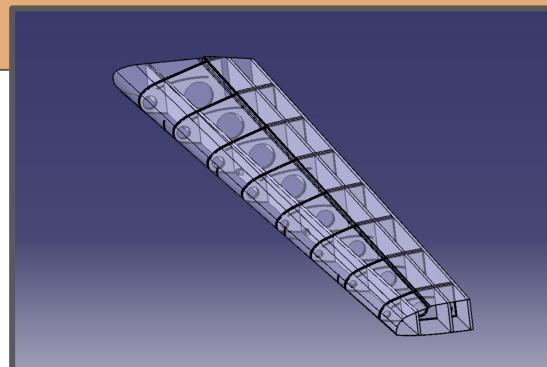
Becs

→ Liaison côté aile



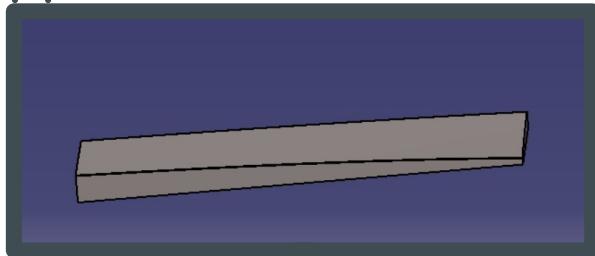
→ Verins

→ Assemblage
Aile-Becs

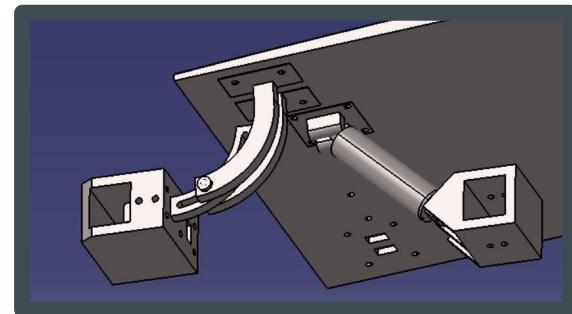


PARTIE 4 – SPOILER

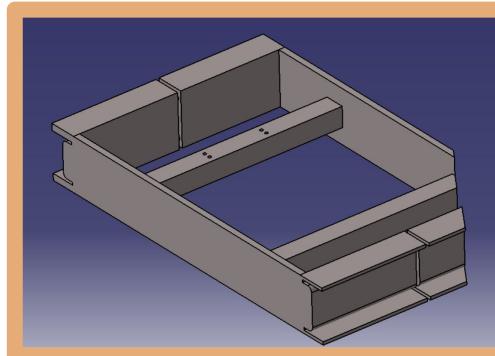
Découpe de l'aile



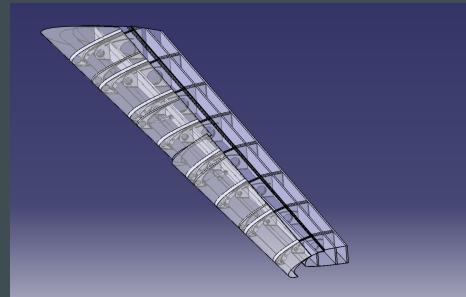
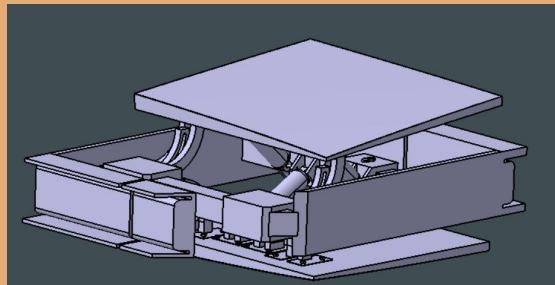
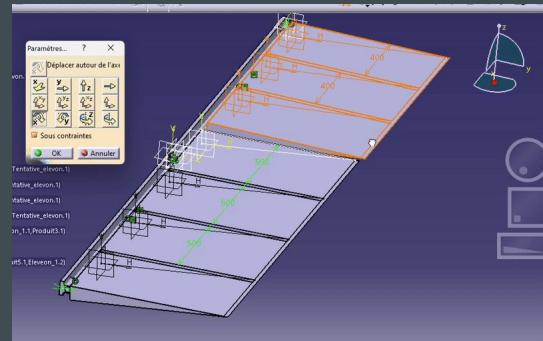
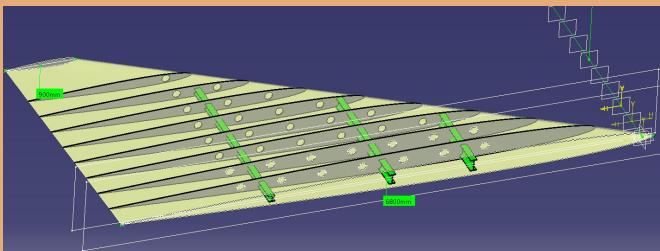
Design mécanisme



Design de la boîte



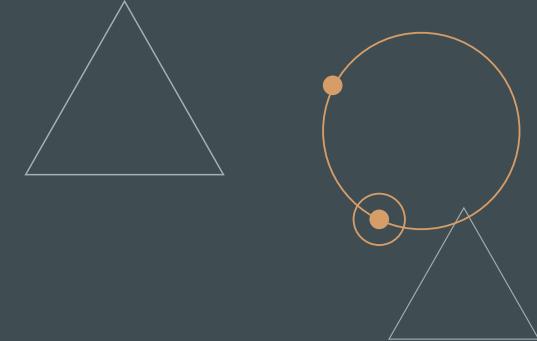
COORDINATION

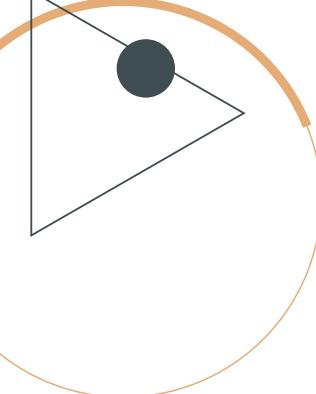




ASSEMBLAGE

03





ASSEMBLAGE

Techniques d'assemblage

- Contraintes surfacique
- Contrainte de distance

...

Difficultés rencontrées

- Erreur de mesures
- Découpe de la nervure pour intégration du spoiler
- Fixation de l'élevon



Solutions

Redimensionnement



Recherche



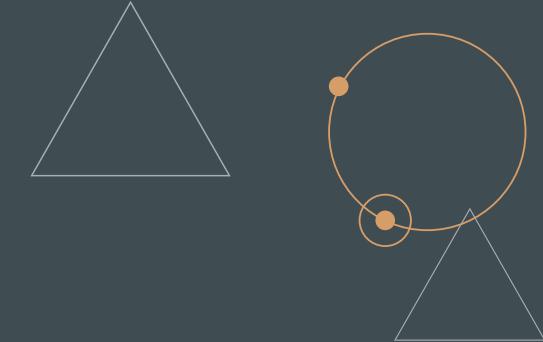
Nouveau design

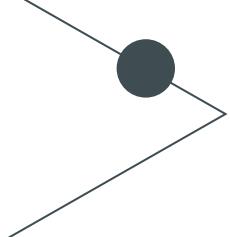




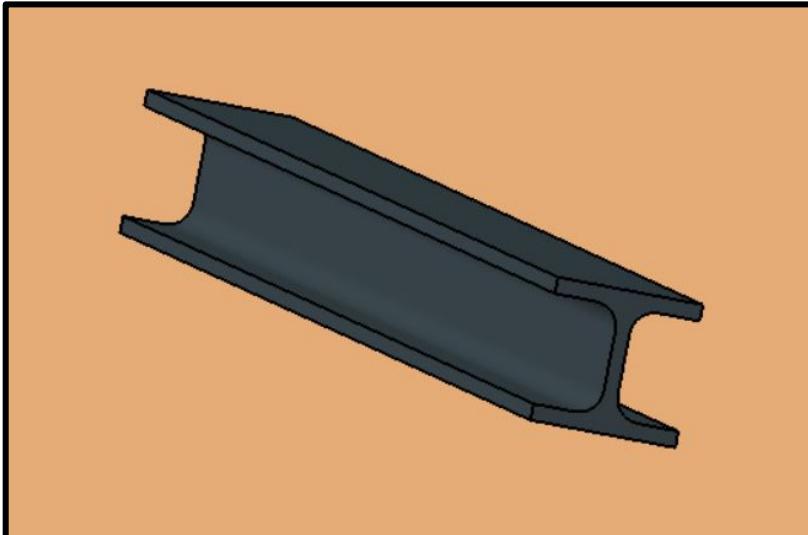
Etude de la tenue mécanique de l'aile

04





Choix du longeron



Dimensions

248,5 x 7,1 x 7,0

Masse de l'aile

~440 kg

Masse supportée

147 kg



Matériaux

Ti

Titane 45%

Module d'Young : 110 GPa
Coeff. de Poisson : 0,31
Densité : 4430 kg/m³

Al

Aluminium 35%

Module d'Young : 71,7 GPa
Coeff. de Poisson : 0,33
Densité : 2810 kg/m³

Ac

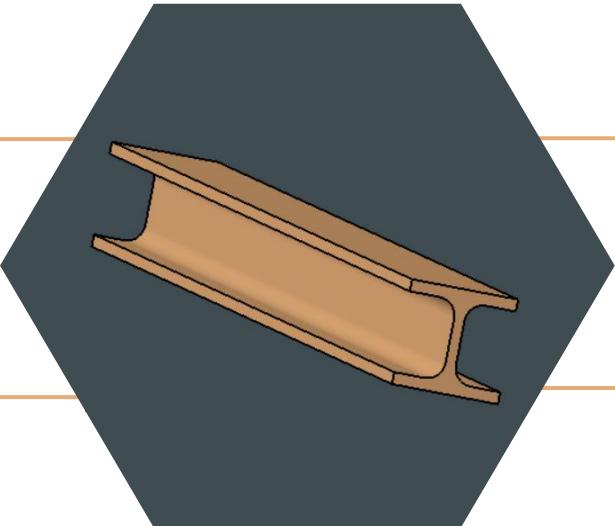
Acier 5%

Module d'Young : 200 GPa
Coeff. de Poisson : 0,29
Densité : 7800 kg/m³

Ca

Carbone 15%

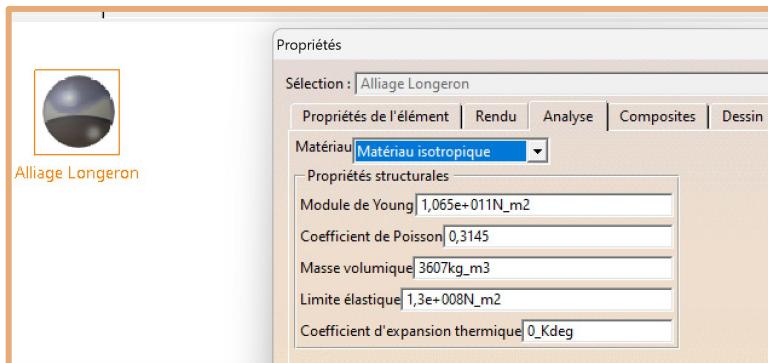
Module d'Young : 73 GPa
Coeff. de Poisson : 0,33
Densité : 1600 kg/m³



ETUDE CINÉMATIQUE

CREATION MATERIAU ADAPTÉ

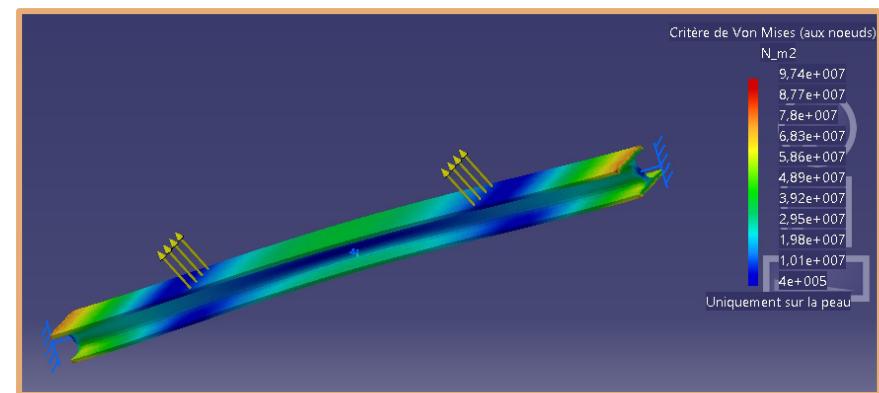
- $E = 106,45 \text{ Gpa}$
- $\text{Re} = 130 \text{ MPa}$
- $V = 0,3145$
- $\rho = 3607 \text{ kg/m}^3$



Limite élasticité : 130 MPa
Point le plus contraint : 97,4 MPa

CREATION MATERIAU ADAPTÉ

- Masse aile à vide : ~430/450kg
- Etude sur longeron principal (~200kg)
- Taille maillage : 2,5mm
- Étudié à 10G



Coefficient de sécurité 33,47%

Conclusion

Merci de nous avoir écouté.

