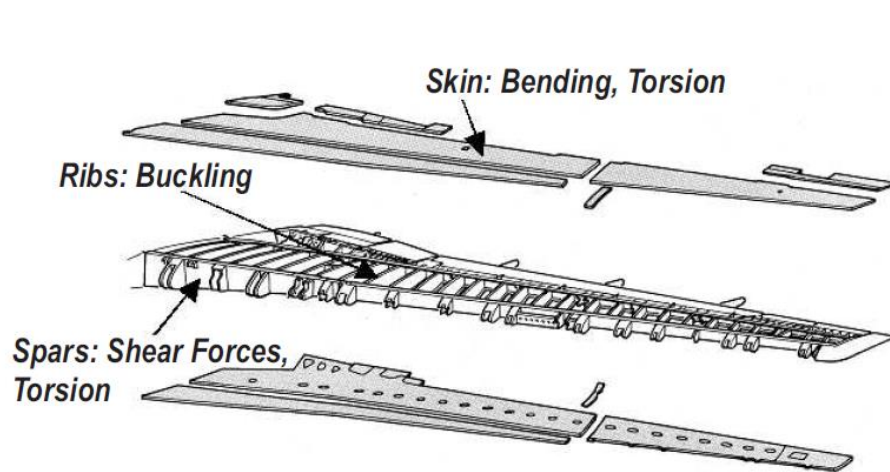


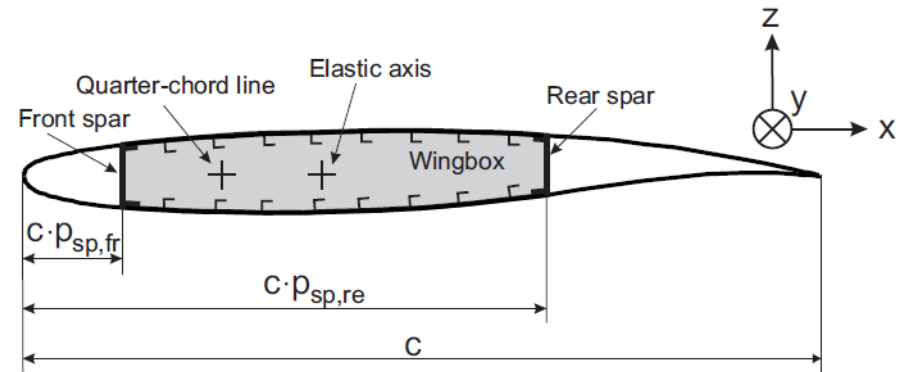
Aeroelasticity.

Homework-01. Divergence

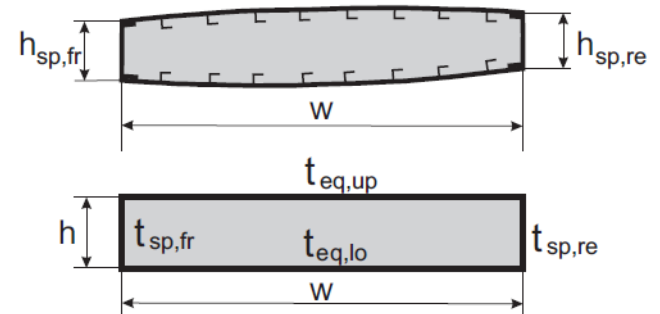
Héctor Climent
23-September 2022



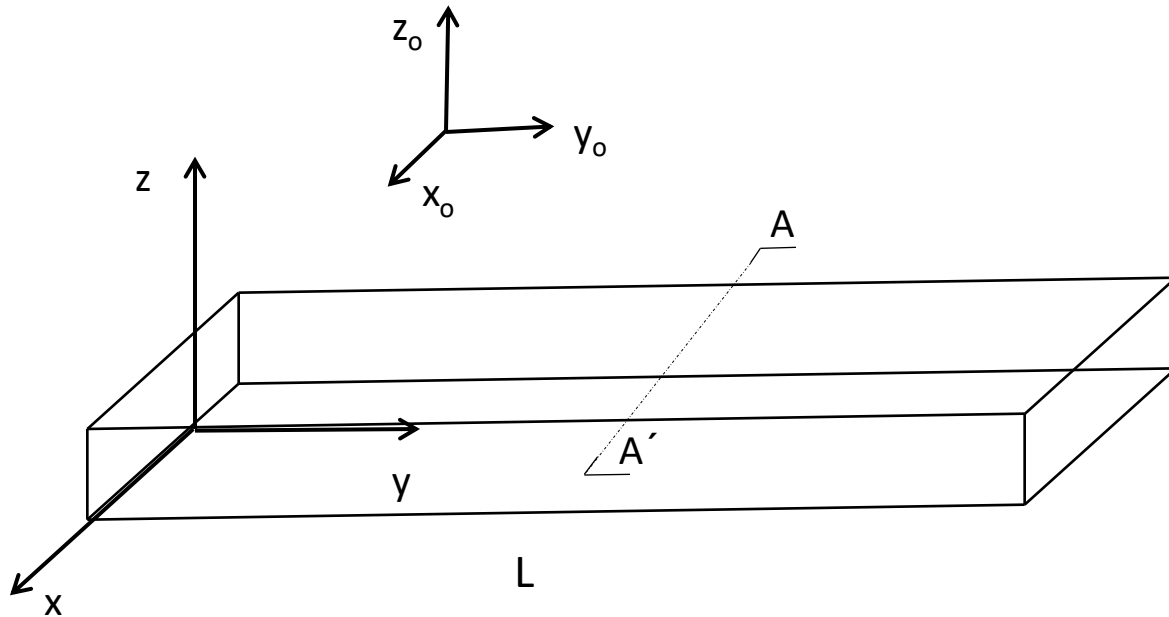
Major forces for different wing components (Megson, 2007)



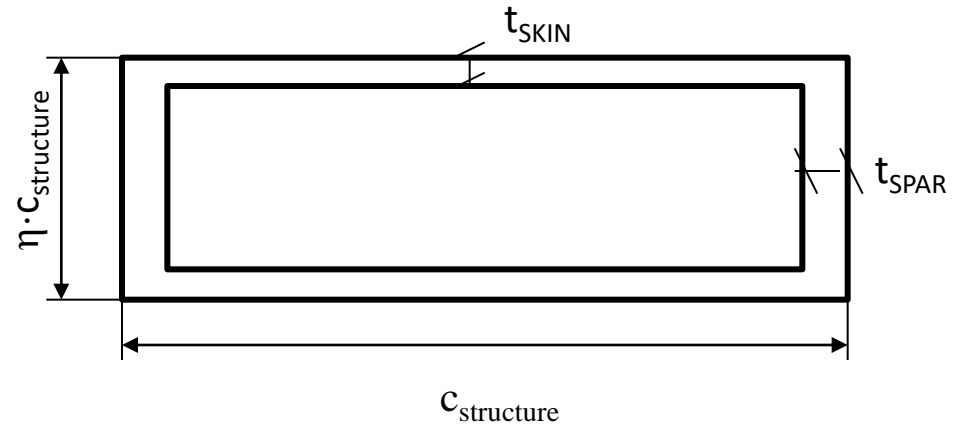
Cross-section of a typical wing



Simplification of the wingbox structure



Section A-A'



Initial data

- $C_{structure} = 2.5 \text{ m} = C \text{ of wing box}$
- $\eta = 0.1 \text{ \& } 0.2$
- $L = 10 \text{ m}$
- $E = 72000 \cdot 10^6 \text{ Pa}$ $\nu = 0.33$
- $G = 27100 \cdot 10^6 \text{ Pa}$
- $\rho = 2700 \text{ kg/m}^3$
- $t_{skin} = t$ (both upper & lower skin) ; $t_{spar} = 3t$ (both front & rear spar)

Tasks:

1) Assuming that:

- The wing is a continuous beam clamped at the wing root
- The only contribution to stiffness is from the wing box
- The mass is only the structural mass

Then obtain the thickness t to match the **3 first bending modes in table below for $\eta = 0.1$** (chordwise and torsion modes are shown only for completeness)

2) Estimate η to have the better match to table 2



$\eta = 0.1$

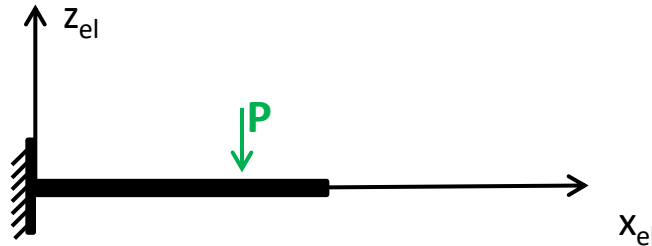
Mode	Frequency
1 st WB	3,47
2 nd WB	21,27
Chordwise	21,75
Torsion	22,57
3 rd WB	58,13

$\eta = ?$

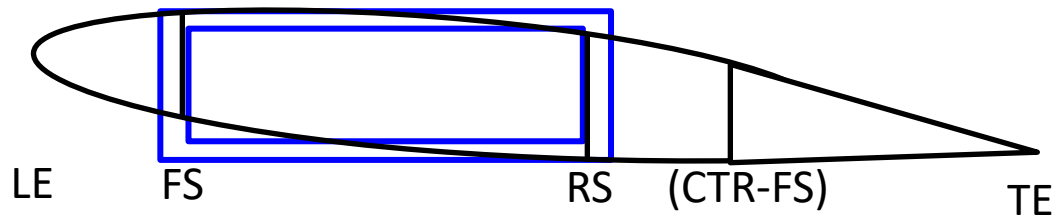
Mode	Frequency
1 st WB	6,74
Chordwise	22,95
Torsion	38,05
2 nd WB	40,71
3 rd WB	108,80

Tasks:

- 3) For $\eta=0.1$ obtain the K_T and K_B of the **section $\frac{3}{4}$** by applying unitary **vertical load** ($P \rightarrow \delta$) and **torsion moment** ($M \rightarrow \theta$) in that section

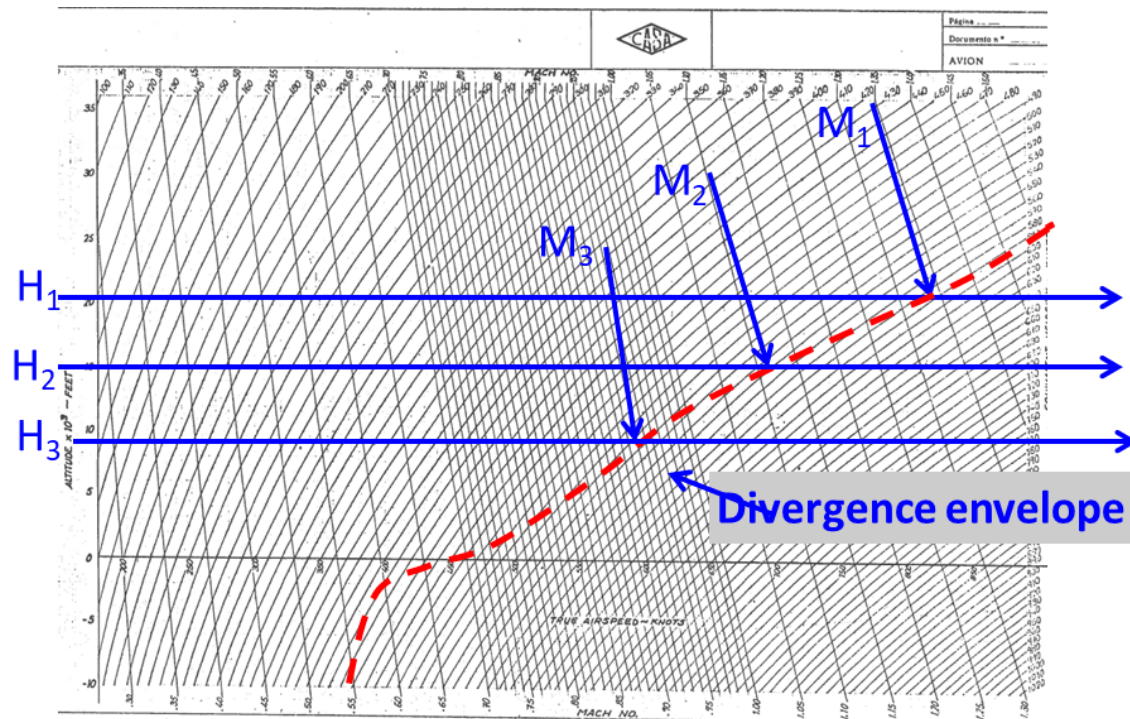


- 4) Assuming
- Profile chord = 6,25 m
 - Front Spar at 15% and Rear Spar at 55% (Then elastic axis at 35%)
 - Aero force applied at 25% then
 - e = distance from aerodynamic application point to elastic axis = 0.625 m
 - $C_{L\alpha} = 2\pi$; $e=0.625\text{m}$, $S=62.5\text{m}^2$, THEN obtain the incompressible divergence dynamic pressure and the corresponding speed (in KTAS) at sea level.



Tasks:

- 5) In a H vs TAS envelope, plot the MATCHED divergence boundary for h =sea level; h =+10000 ft; h =+20000 ft, h =+30000 ft
Obtain the compressible divergence speed (KTAS) at Sea Level



Deliverable:

- Each team should deliver **one and only one file** (PDF; DOC; PPT...)
- Please, do not upload compressed files
- File nomenclature TXX-name.pdf where XX is team number (table below):
- Delivery date: Friday 7th October 17:00

TEAM	Surname	First name	Surname	First name	Surname	First name
T01	ABEIJON DEVINE	GERARD SALU	TALAVERA SANCHEZ	ALEJANDRO	TANALTAY	MINA ESIN
T02	AHIJADO GARROTE	JAIME	ALVAREZ TESO	PABLO	SÁNCHEZ SAEZ	ALBERTO
T03	ALBALA PEDRERA	ÁLVARO NICO	DOMINGUEZ GUTIERREZ	ALVARO	PANADERO SAN MIGUEL	SERGIO
T04	ALFARO MORENO	JUAN	ROBLEDO MARTIN	ISAAC	RUIZ CERRAJERO	FERNANDO
T05	ALONSO BELTRAN	GUILLERMO	SALINAS FERNANDEZ	MIGUEL	SUAREZ PEREZ	JAIME
T06	ARIAS SUAREZ	JUAN	HERNÁNDEZ MEGÍA	VÍCTOR	MARTÍN JIMÉNEZ	LUCÍA
T07	BALLESTEROS MARTIN	PABLO	SANTOS GARCIA DE LA RIVA	PABLO	VIQUE MARQUEZ	JAIME
T08	BARRADO PEREZ	RUBEN	CAÑAMERO MOLINA	PABLO	GARCIA ARROJO	SERGIO
T09	BERLAN	MATHIEU PIE	DE LA PUENTE MOTA	FRANCISCO JAVIE	FONTAN RAMIREZ	FLAVIO
T10	BEVILACQUA GIMÉNEZ	GASTÓN	LOPEZ ALVAREZ	PEDRO	OLLERO JIMÉNEZ	SERGIO
T11	CONDE GARCIA	SERGIO	CORRAL SANZ	CARLOS	DE LA FUENTE GARCIA	MARIO
T12	COTOBAL GOMEZ	ADRIAN	DE GRACIA ROCA	JUAN PEDRO	GARCIA - VALCARCEL PATIÑ	JUAN
T13	EL KHATTABI VILCHEZ	ISMAEL	ROMERO GAMERO	DANIEL	WASIK ANDREASIK	HUBERT ROMAN
T14	ESCRIBANO RODRIGUEZ	CARLOS	HONAP	AUM SHRINIVAS		
T15	GARCÍA FERNÁNDEZ	ALEJANDRA	SAENZ-AZCUNAGA MARTINEZ	ALEJANDRO	SALIDO MALLO	PABLO
T16	GARCIA GALVEZ	OSCAR	MUÑOZ HERRERA	JESUS	VALENZUELA SEVILLA	JAVIER
T17	GARCÍA MARTÍN	JULIA	MARTINEZ TRAGACETE	MARINA	PINTOR PICALLO	JAIME
T18	HERRERIAS YAGÜES	MARIO	RUEDA GARCIA	DANIEL	VELASCO ALONSO	FELIPE
T19	LACAMBRA ASENSIO	LUCIA	TORLASCHI CANALEJO	CARLA	NAVARRO GONZALEZ	MARTIN
T20	MILAN CABRERA	FRANCISCO	PEÑA BERGUIO	PAULA	SERRANO DURAN	CARLOTA
T21	RODRIGUEZ GONZALEZ	ALVARO	SANJURJO BARRIO	ALICIA	VEGA VEGA	LUCIA