A300-600R - AAL587
PUBLIC HEARING

LE12 - Nodal Loads Process

Issue 1.0- 02/10/2002

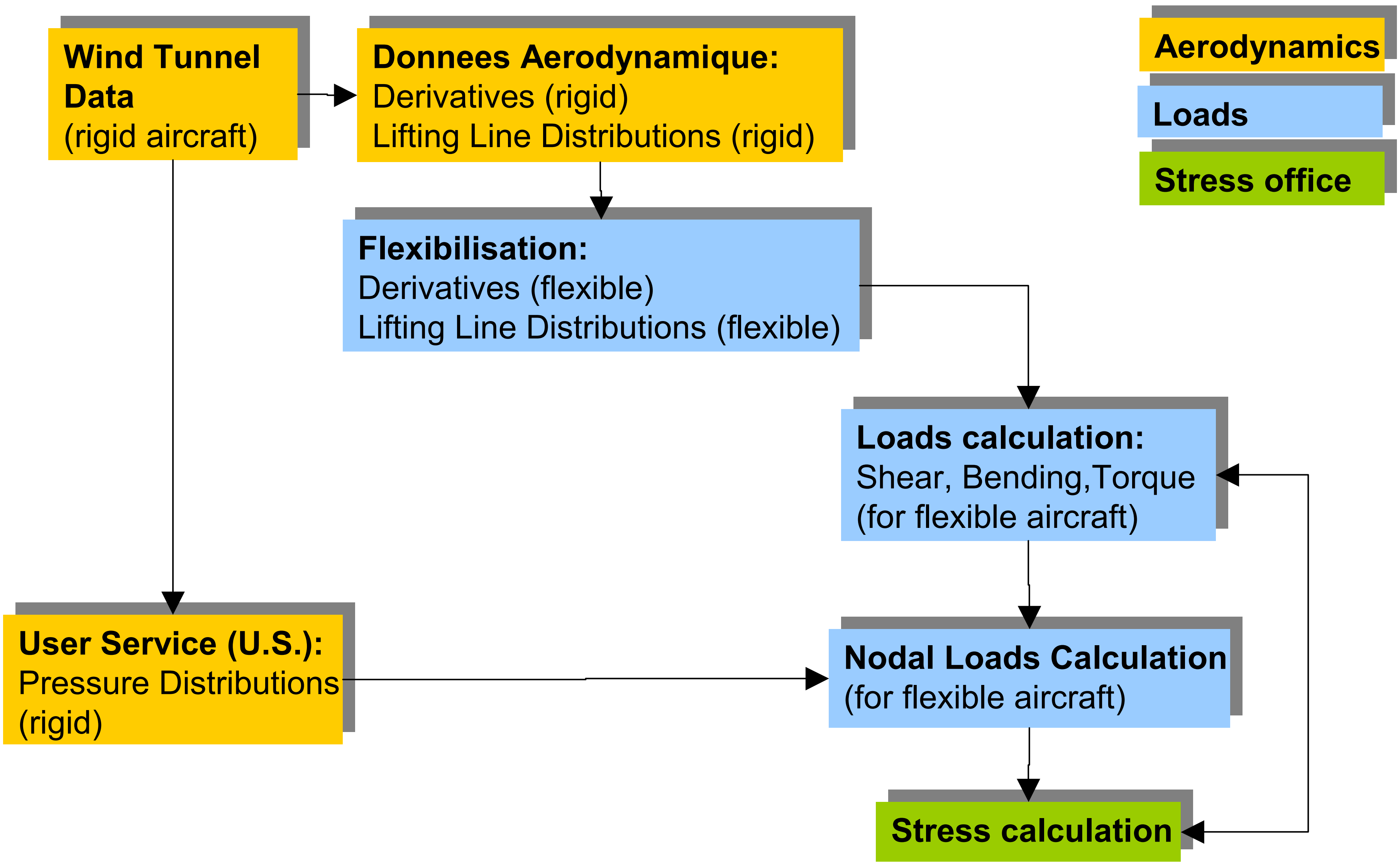
Nodal loads Process

- **Content:**
  - General Overview
  - Donnees Aerodynamique
  - Flexibilisation
  - Loads Calculation
  - User Service
  - Nodal Loads Calculation

Nodal loads Process

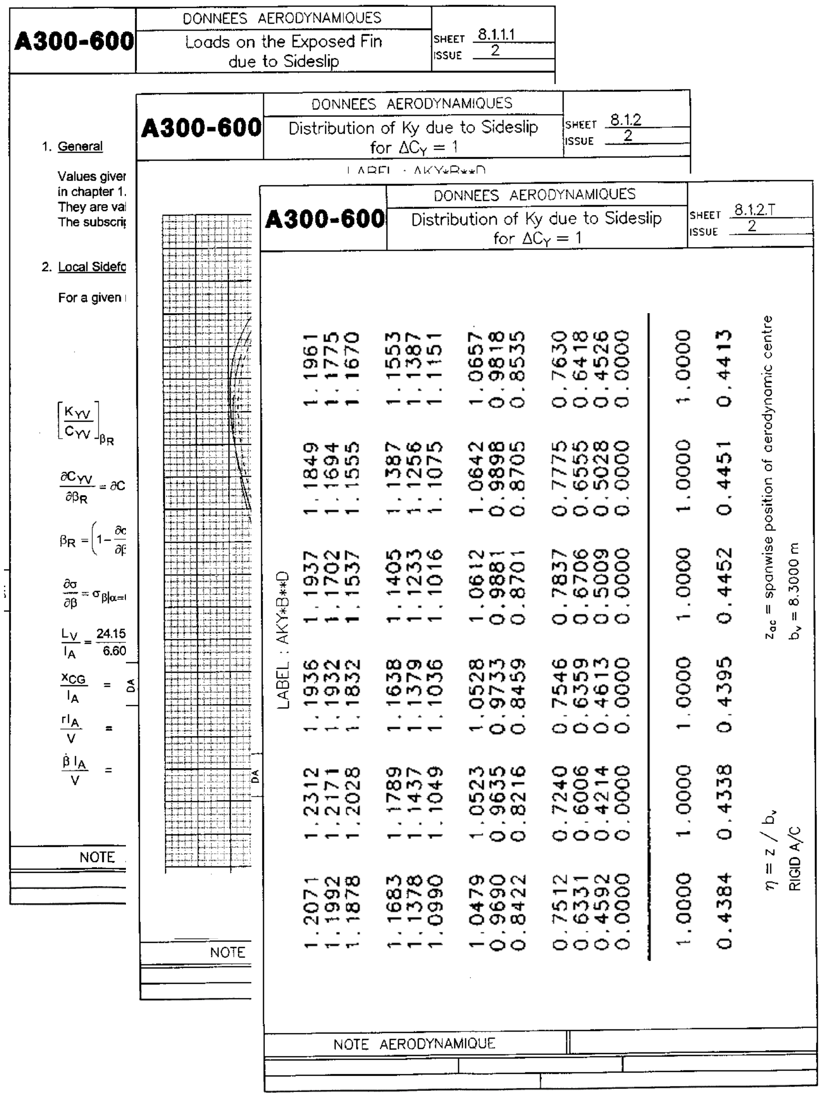
General overview:

Legend:



Nodal loads Process

Donnees Aerodynamique: (rigid aircraft)



A300-600 | DONNEES AERODYNAMIQUES | Loads on the Exposed Fin due to Sideslip | SHEET 8.1.1.1 | ISSUE 2

A300-600 | DONNEES AERODYNAMIQUES | Distribution of Ky due to Sideslip for $\Delta C_Y = 1$ | SHEET 8.1.2 | ISSUE 2

A300-600 | DONNEES AERODYNAMIQUES | Distribution of Ky due to Sideslip for $\Delta C_Y = 1$ | SHEET 8.1.2.T | ISSUE 2

LABEL : AKY*B**D

1.2071	1.2312	1.1936	1.1937	1.1849	1.1961
1.1992	1.2171	1.1932	1.1702	1.1694	1.1775
1.1878	1.2028	1.1832	1.1537	1.1555	1.1670
1.1683	1.1789	1.1638	1.1405	1.1387	1.1553
1.1378	1.1437	1.1379	1.1233	1.1256	1.1387
1.0990	1.1049	1.1036	1.1016	1.1075	1.1151
1.0479	1.0523	1.0528	1.0612	1.0642	1.0657
0.9690	0.9635	0.9733	0.9881	0.9898	0.9818
0.8422	0.8216	0.8459	0.8701	0.8705	0.8535
0.7512	0.7240	0.7546	0.7837	0.7775	0.7630
0.6331	0.6006	0.6359	0.6706	0.6555	0.6418
0.4592	0.4214	0.4613	0.5009	0.5028	0.4526
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.4384	0.4338	0.4395	0.4452	0.4451	0.4413

$\eta = z / b_v$

RIGID A/C

z_{ac} = spanwise position of aerodynamic centre

$b_v = 8.3000$ m

NOTE AERODYNAMIQUE

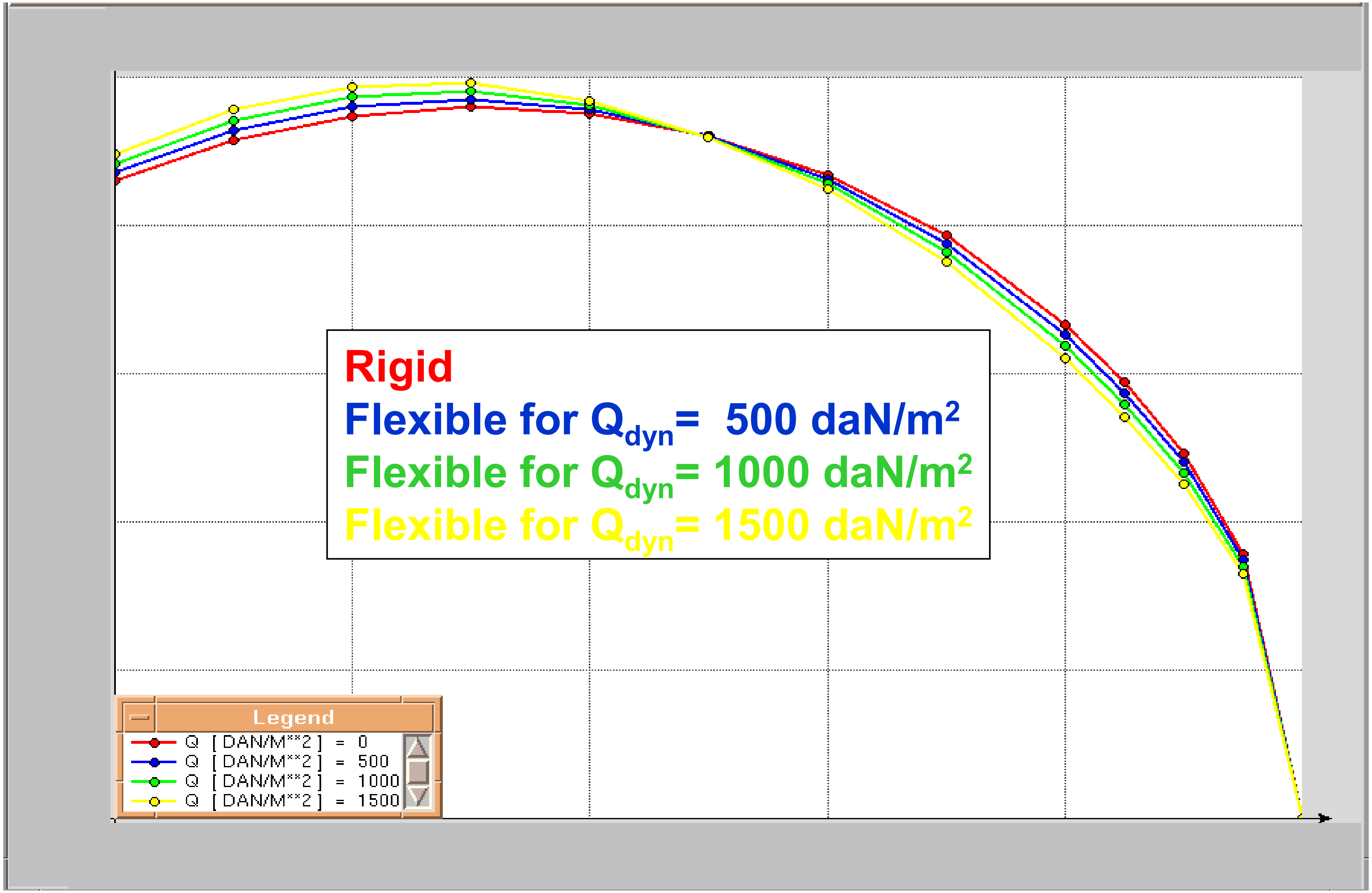
Donnees Aerodynamique consists of approximately 1000 data-sheets.

These descibe the aircraft in general.

For the Vertical Tailplane approximately 20 data-sheets are available.

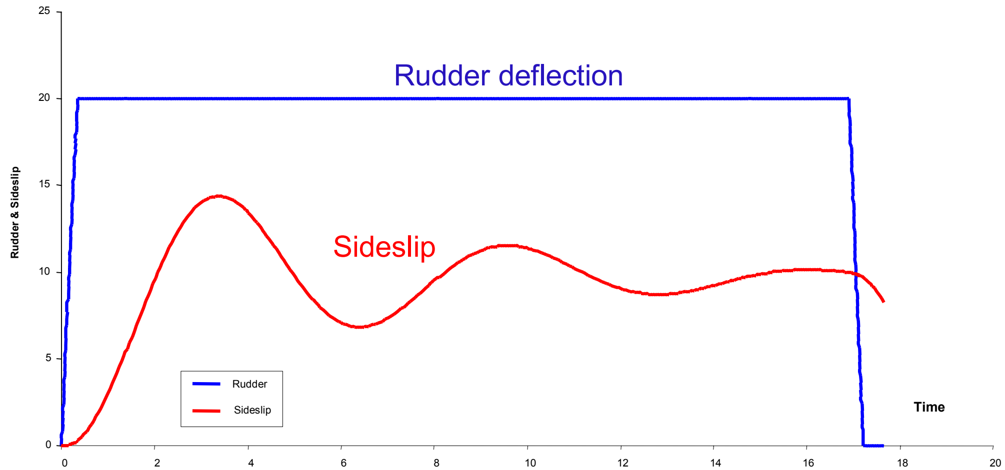
Nodal loads Process

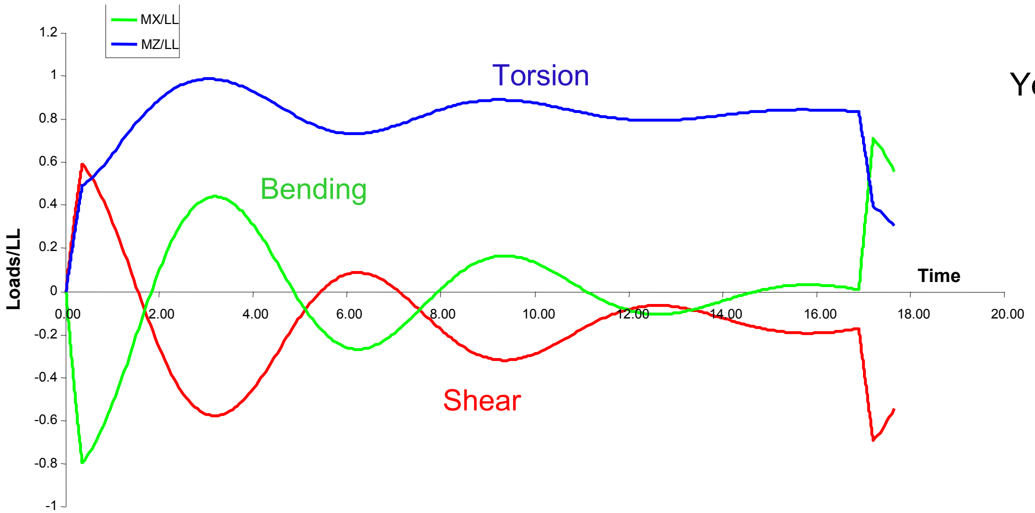
Flexibilisation: (Distribution)

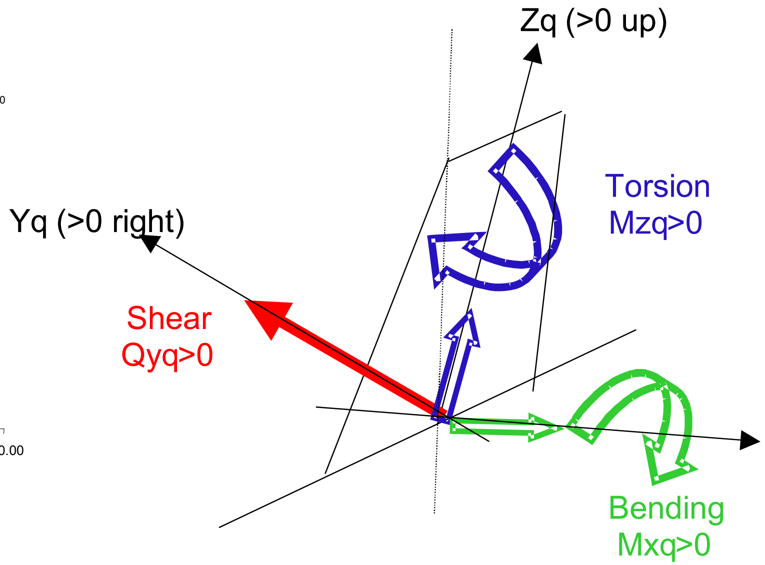


Nodal loads Process

Loads Calculation: Shear, Bending, Torque for the flexible aircraft

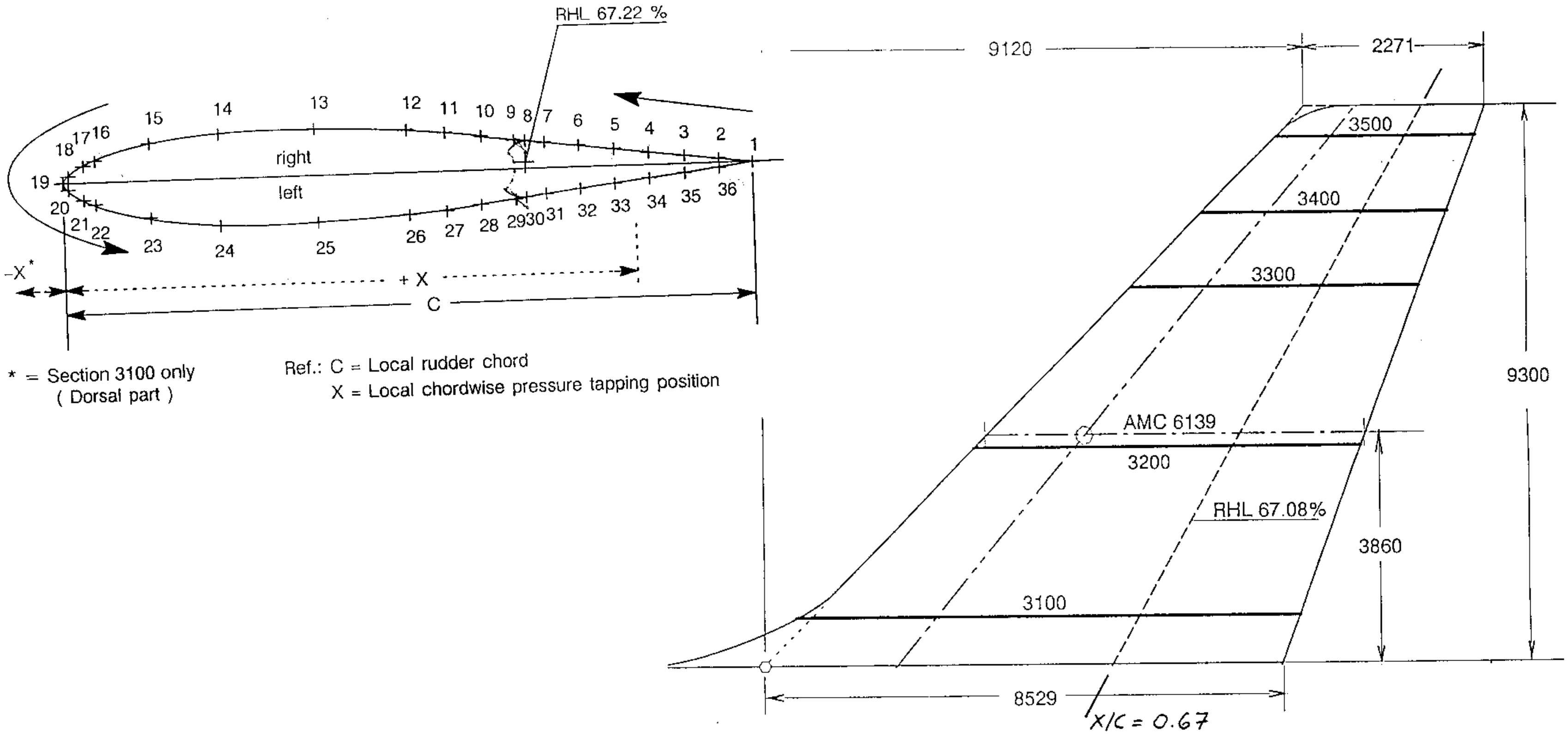






Nodal loads Process

User Service:



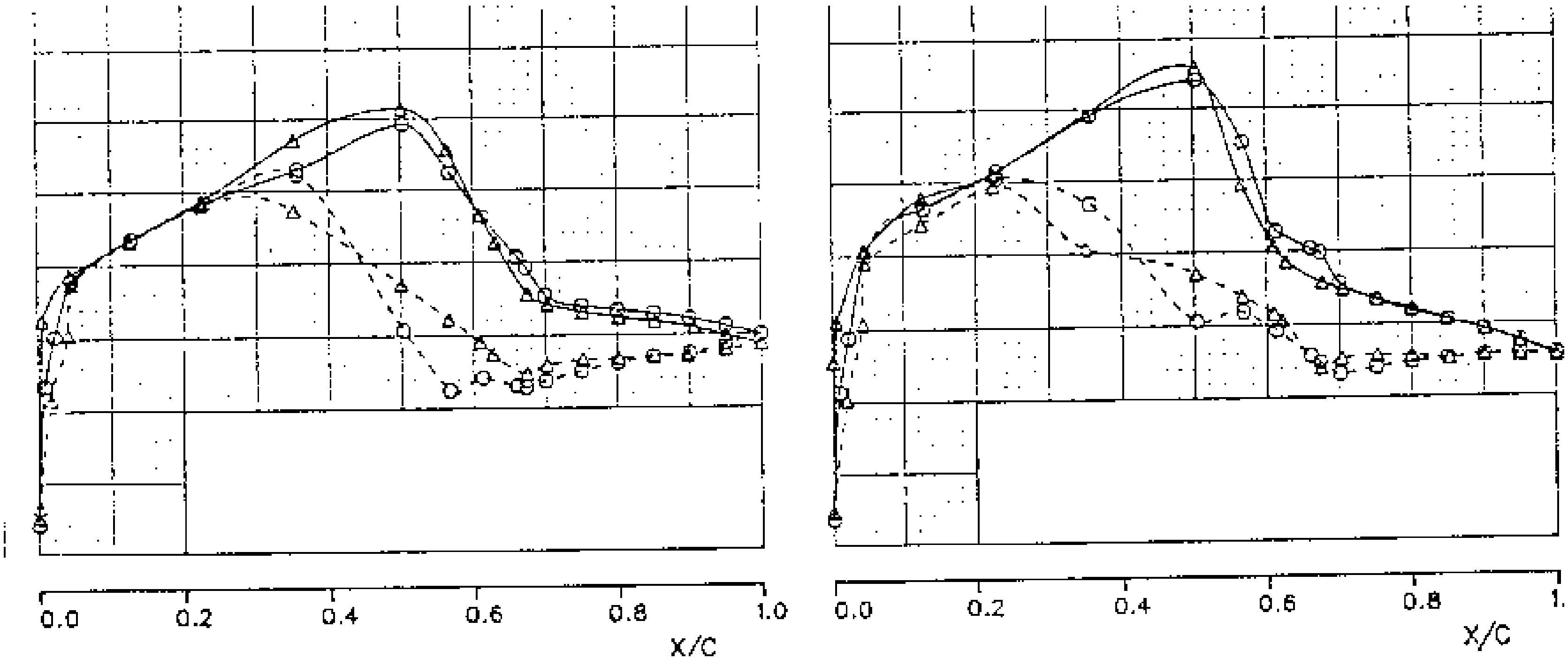
Vertical tailplane pressure given by User Service are those measured for a rigid aircraft.

AIRBUS

Nodal loads Process

User Service:

Local pressures at two spanwise stations.



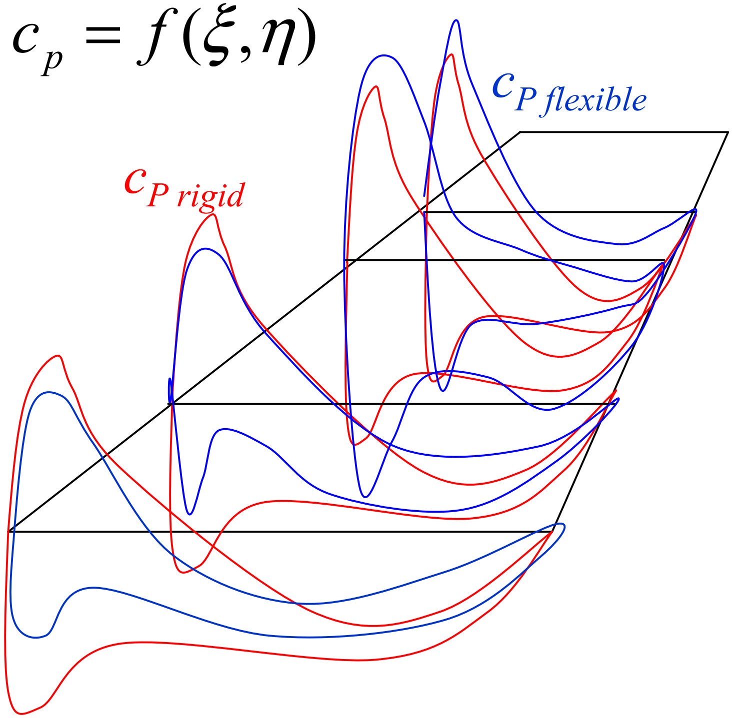
User Service guarantees that all pressures lead to load/lift-distributions as given in Donnes Aerodynamique (rigid aircraft).

A balance of rigid pressures and loads is mandatory.

Nodal loads Process

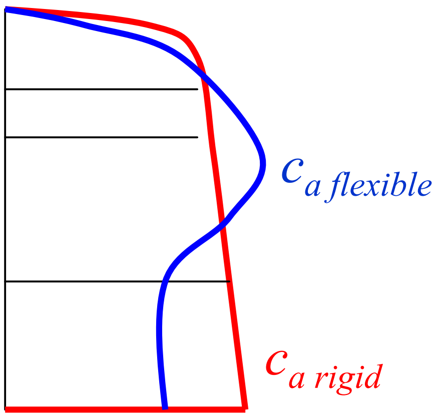
Nodal Loads Calculation: Pressure Modification

$$c_p = f(\xi,\eta)$$



$$c_a = \int \Delta c_p d\xi$$

$$c_a = f(\eta)$$

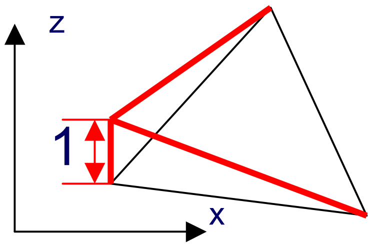


Method used: Least squares method written by William Rodden

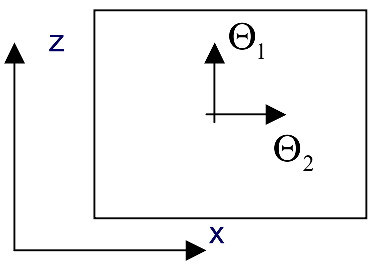
Nodal loads Process

Nodal Loads: Integration

Usage of Shape Functions leads to simple Integration Matrix



$$\lambda_1 + \lambda_2 + \lambda_3 = 1 \quad \Rightarrow \quad \underline{F} = \frac{A}{12} * \begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{bmatrix} * \underline{P}$$

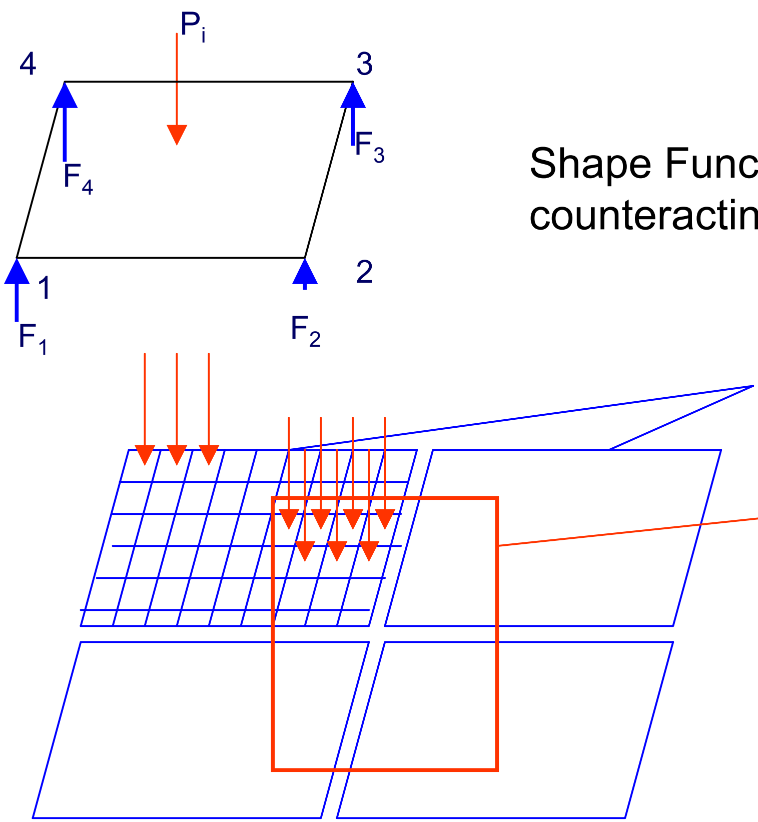


$$\begin{bmatrix} 1/4(1-\Theta_1)(1-\Theta_2) \\ 1/4(1+\Theta_1)(1-\Theta_2) \\ 1/4(1+\Theta_1)(1+\Theta_2) \\ 1/4(1-\Theta_1)(1+\Theta_2) \end{bmatrix} \quad \Rightarrow \quad \underline{F} = \frac{A}{36} * \begin{bmatrix} 4 & 2 & 1 & 2 \\ 2 & 4 & 2 & 1 \\ 1 & 2 & 4 & 2 \\ 2 & 1 & 2 & 4 \end{bmatrix} * \underline{P}$$

Results on Aero-Grid are Element Forces.

Nodal loads Process

Nodal Loads: Transformation



Shape Functions are used to interpolate an outer load to counteracting forces in the nodes of an element.

Patch of Aerogrid elements with strongly refined mesh

Element of Structure grid

Transformation from Aero- to Structure-Grid is done by a geometrical interpolation