

Analysis of A380 Transport



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Photo from "<http://popularmechanics.com/popmech/sci/0103STAVAP.html>"

Background Information

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- Commercial transport aircraft
 - Competing against Boeing 747-400 and 747x stretch, as well as the new stretched A340
- Largest civil aircraft ever designed
- Variants
 - 100 = 555 people / 182,980 lb
 - 200 = 656 people / 205,030 lb
 - F = 150t / 330,690 lb

Characteristics

- TOGW
 - 200 = 1,300,700 lb
 - F = 1,285,300 lb
- Swing
 - 8934 ft²
- W/S
 - 200 = 145.59 lb/ft²
 - F = 143.87 lb/ft²
- SR
 - .00246 @ M = .72
 - L/D = 12.142
- Thrust = 300,000 lb total
- T/W
 - 200 = .23065
 - F = .23341
- AR
 - 200 / F
 - 7.6735 wing
 - 4.6997 ht
- LE sweep = 33.5 deg
- Tail scrape = 11.5 deg

TOGW taken from www.airbus.com

Wing Loading (W/S) computed from TOGW/Swing, for each variant

There are 2 types of engines that are being looked at for implementation.

-Trent 900 from Rolls-Royce

-GP 7200 from Engine Alliance.

Tail Scrape angle is measured from 3 view in Interavia Oct 2000.

LE sweep angle taken from Aviation Week and Space Technology July 24, 2000

SR taken from FSR program, with assumption of .5 SFC for Trent 900 Engine

A380 vs. 747-X Stretch

Aircraft	A380-200	747-X Stretch
Passengers	555	522
Thrust	300,000 lb	272,000 lb
Span	261.8 ft	228.9 ft
Length	260.5 ft	264.3 ft
W/S	145.59 lb/ft ²	153 lb/ft ²
TOGW	1,300,000 lb	1,043,000 lb
TO Field Length	<11,000 ft	11,000 ft
Range	8,150 NM	7,785 NM

Systems and Control

- High-lift devices
 - 15 % of wing area
 - double slotted fowler flap design with LE slats
- Horizontal tail
 - $S_{ht} = 2314.8 \text{ ft}^2$
 - $B_{ht} = 104.28 \text{ ft}$
 - Elevator = 27 % of S_{ht}
- Vertical tail
 - $S_{vt} = 2421.9 \text{ ft}^2$
 - Rudder = 17.2 % of S_{vt}

Measurements for tail taken from Interavia Oct. 2000, 3 view.

High Lift Devices

Simple Fowler Flap information from Popular Mechanics
March 2001



Flaps and Slats extended on landing

Also winglets and landing gear visible.

Control

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- MAC wing = 60.93 ft from center line
– 37.495 ft
- MAC ht = 26.25 ft from center line
– 23.435 ft
- Vht = .761
- Vvt = .11399

$$\begin{aligned} V_{ht} &= (S_{ht} * L_t) / (Swing * MGC \text{ wing}) \\ &= (2314.8 * 110.14) / (8934 * 37.495) \end{aligned}$$

MAC wing and ht taken from geometry on 3 view in Interavia Oct. 2000

$$\begin{aligned} V_{vt} &= (S_{vt} * L_t) / (Swing * bwing) \\ &= (2421.9 * 110.1) / (8934 * 261.83) \end{aligned}$$

Stability and Engine Out

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- Longitudinal Stability
 - $H_n = .268785$
 - Static margin of .2687
 - 26.9% stable
- Engine Out (max rudder and –5deg bank)
 - Beta = -.8465 deg
 - Phi = 5 deg
 - Aileron Deflection = 1.99 deg
 - Available Yawing moment = 0.0329

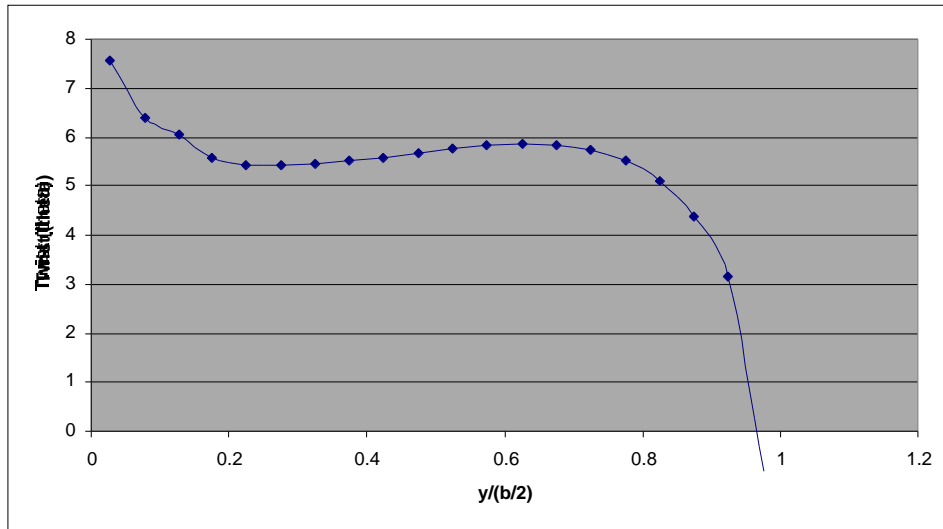
$H_n = .268785$ from Etkin and Reid

CG location is at the leading edge of the MAC from the picture (15deg) from landing gear

This gives a static margin of 26.87%

The engine out data was taken from the program LDstab

Twist Distribution



Twist taken from LAMDES program using wing alone configuration

This shows wash in at the root and wash out at the tip

Aero Penalty for 80 Meter Box

- $W/b =$
 - A380 = 4965.6 lb/ft
 - A340 = 3865 lb/ft
- $W/S =$
 - A380 = 145 lb/ft²
 - A340 = 170 lb/ft²
- Span should be
 - 335ft
- Larger AR from span, Lower wing area and drag

Larger span loading on the A380 is a direct result of the 80 meter gate box limit on the span of the aircraft. If the span were allowed to be any length, it would be best to keep the span load at about the same level as the A340, this would give it a span of about 335 ft. With a larger span there would be a larger Aspect Ratio and less wing area and therefore less drag on the wings, and better fuel economy.

Other interesting information

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- 4 floors for passengers and cargo
- Possible private cabins for customers
- European countries and Airbus are putting over \$11 billion into A380
- Will be assembled from parts manufactured in 4 countries (Germany, France, Spain, UK)
- Only one to be certified to fly into London, Heathrow Airport at night, due to noise requirements

A380 Internal View

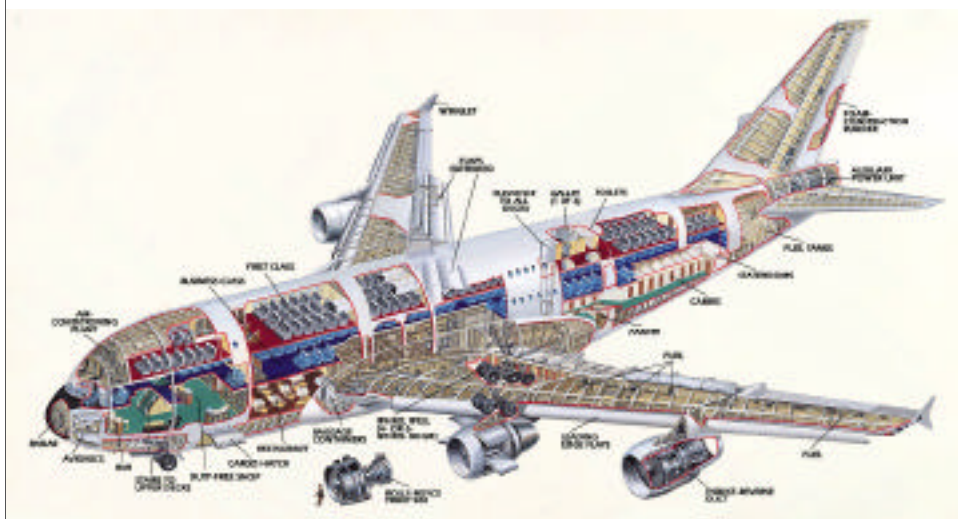


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QUESTIONS?

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References:

Interavia Business and Technology, Volume 55, Number 646, Oct. 2000

Popular Mechanics, March 2001

Flight International, 2-8 Jan. 2001, Number 4761, Volume 159

Aviation Week and Space Technology, Jan 1, 2001, Volume 154, Number 1

WWW.Airbus.com

WWW.Boeing.com