2025-2026 Fall AE303 PH-1

Res. Asst. Burak ÇİFTCİOĞLU

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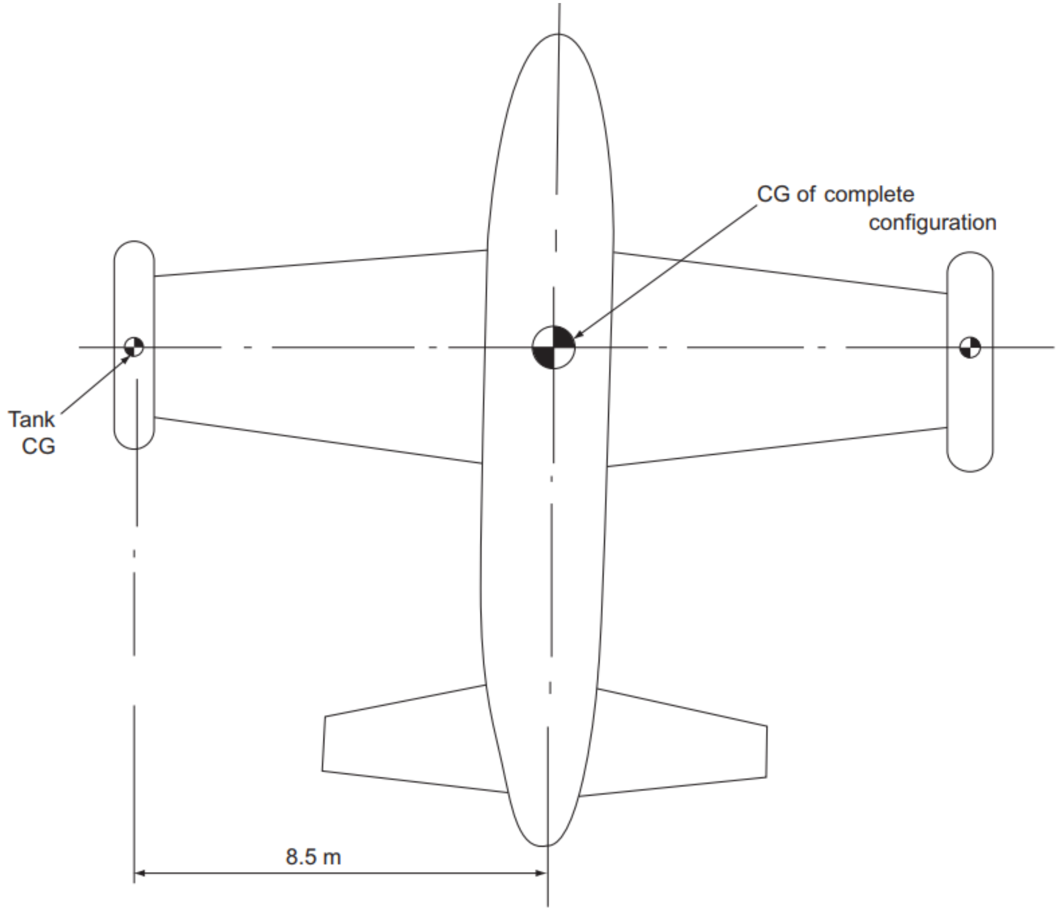
Figure shows the plan view of an aircraft with wing-tip drop tanks, each of which, when full, weighs 15,575 N and has a radius of gyration in the yaw plane of 0.6 m about its own center of gravity. The aircraft is in steady level flight at 260 m/s and has a total weight of 169,000 N with tip tanks full. The radius of gyration in yaw of the aircraft without its tip tanks is 2.5 m and the drag coefficient of the complete configuration is 0.02 (based on a wing area of 60 m^2) of which 8 percent is due to each tip tank. If, at the instant of release, only one tank is dropped, calculate the total reaction force and moment on the mounting of the remaining tip tank. Take $\rho = 1.223$ kg/ m^3.

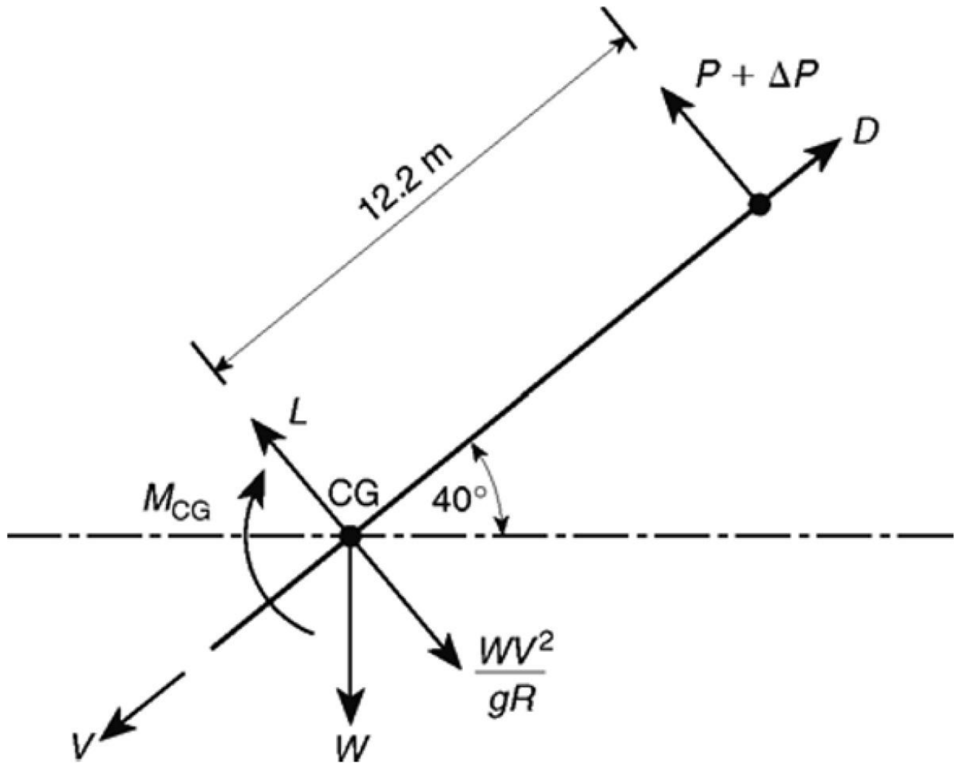
Note: Neglect the change in position of the CG due to the dropping of the one fuel tank.

Ans. R = 4371.35 N   M = 201.05 kN . m



An aircraft weighing 238,000 N has wings 88.5 m^2 in area, for which C_D =0.0075+0.045 C_L^2. The extra-to-wing drag coefficient based on wing area is 0.0128 and the pitching moment coefficient for all parts excluding the tailplane about an axis through the CG is given by C_M . c = (0.427C_L – 0.061) m. The radius from the CG to the line of action of the tail lift may be taken as constant at 12.2 m. The moment of inertia of the aircraft for pitching is 204,000 kg m^2. During a pull-out from a dive with zero thrust at 215 m/s EAS when the flight path is at 40^o to the horizontal, the radius of curvature is 1525 m. Calculate the maneuver load factor CG, the forward inertia coefficient and the tail lift.
Note: Assume zero angle of attack.

Ans. n = 3.856, f = -0.37 , P = 18925 N (After two iterations)



P.14.9 A tail-first supersonic airliner, whose essential geometry is shown in Fig. P.14.9, flies at 610 m/s true airspeed at an altitude of 18,300 m. Assuming that thrust and drag forces act in the same straight line, calculate the tail lift in steady straight and level flight.

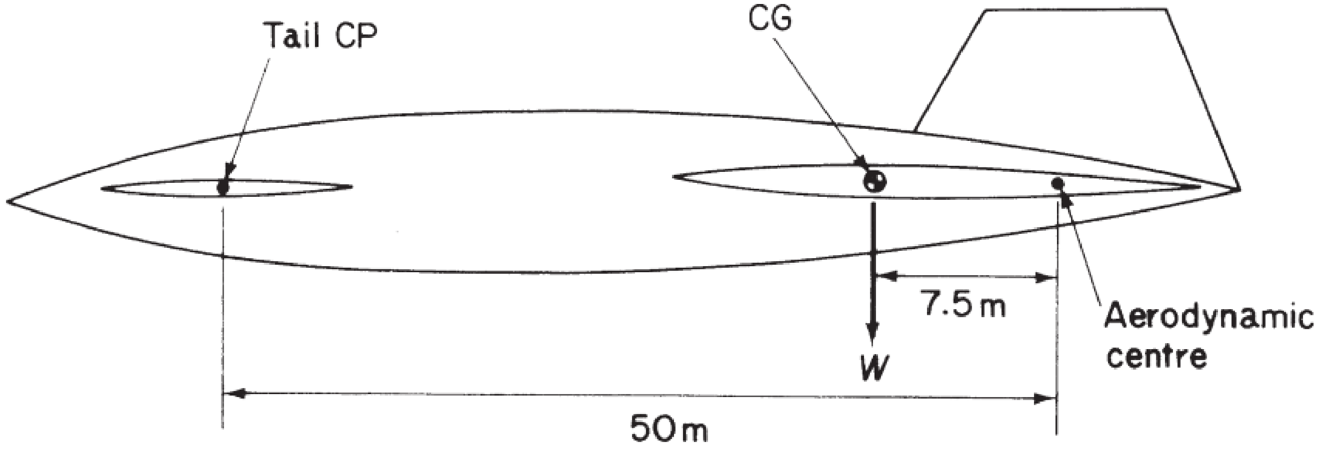
If, at the same altitude, the aircraft encounters a sharp-edged vertical upgust of 18 m/s true airspeed, calculate the changes in the lift and tail load and also the resultant load factor n.

The relevant data in the usual notation are as follows

$$
\begin{aligned}
\text{Wing: } S &= 280\text{m}^2, & \partial C_L/\partial\alpha &= 1.5,\\
\text{Tail: } S_T &= 28\text{m}^2, & \partial C_{L,T}/\partial\alpha &= 2.0,\\
\text{Weight } W &= 1{,}600{,}000\text{ N}, & &\\
C_{M,0} &= -0.01, & &\\
\text{Mean chord } \bar{c} &= 22.8\text{m} & &
\end{aligned}
$$

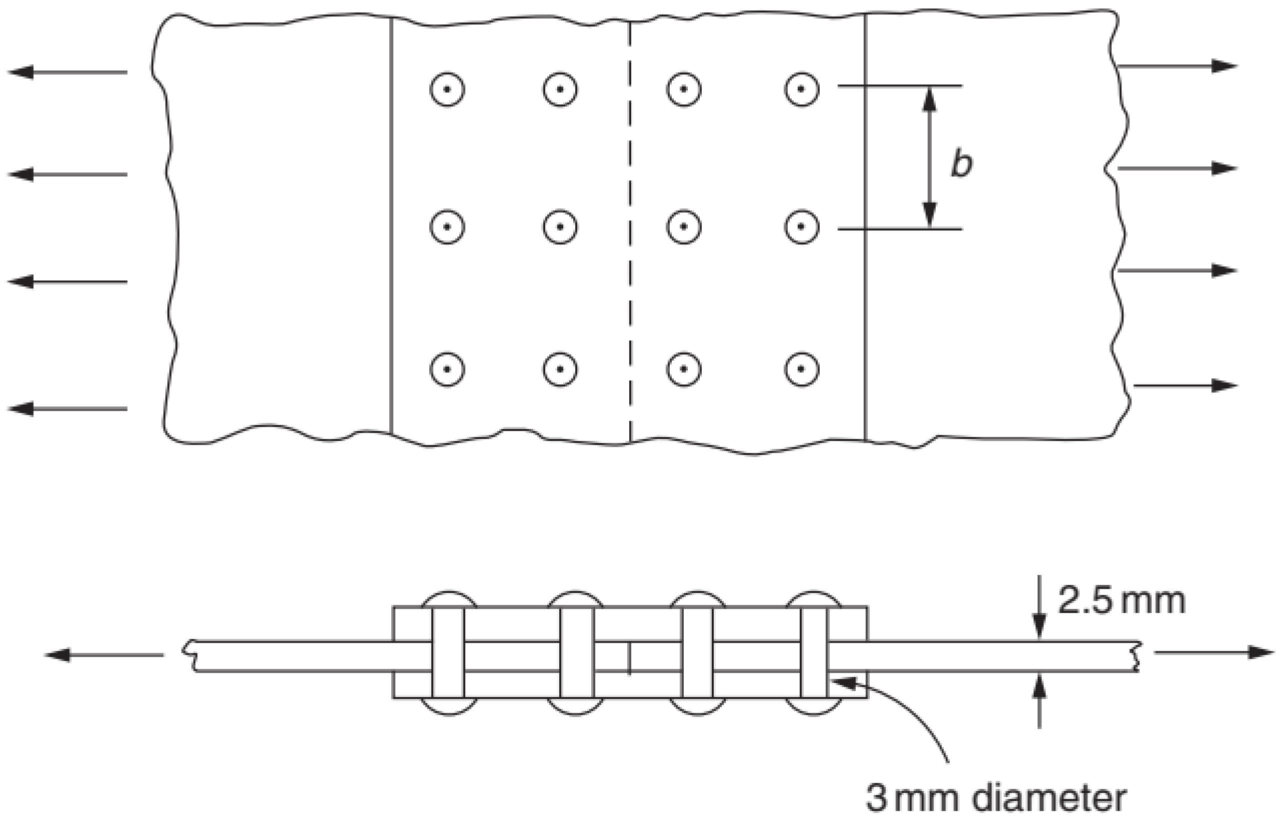
At 18,300 m, $\rho = 0.116\ \text{kg/m}^3$

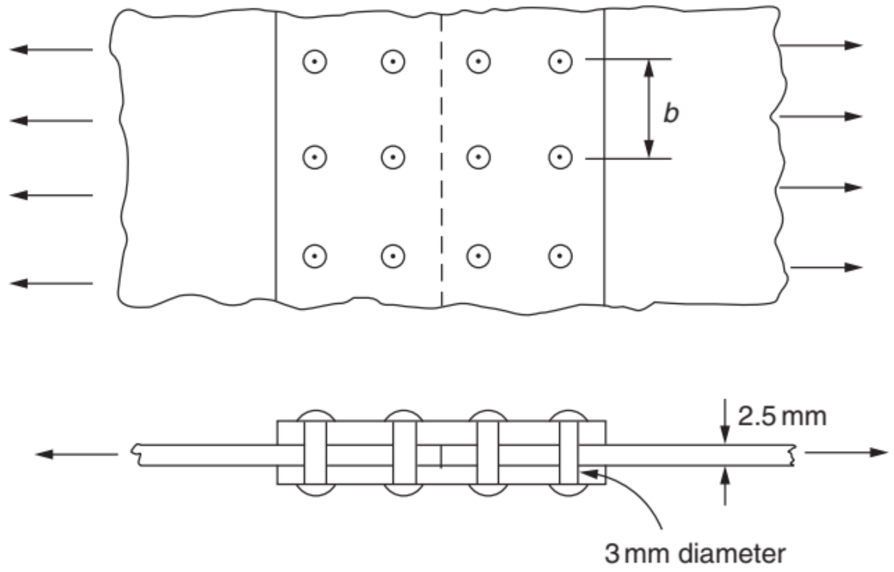
Answer: $P = 267{,}852$ N, $\Delta P = 36{,}257$ N, $\Delta L = 271{,}931$ N, $n = 1.19$



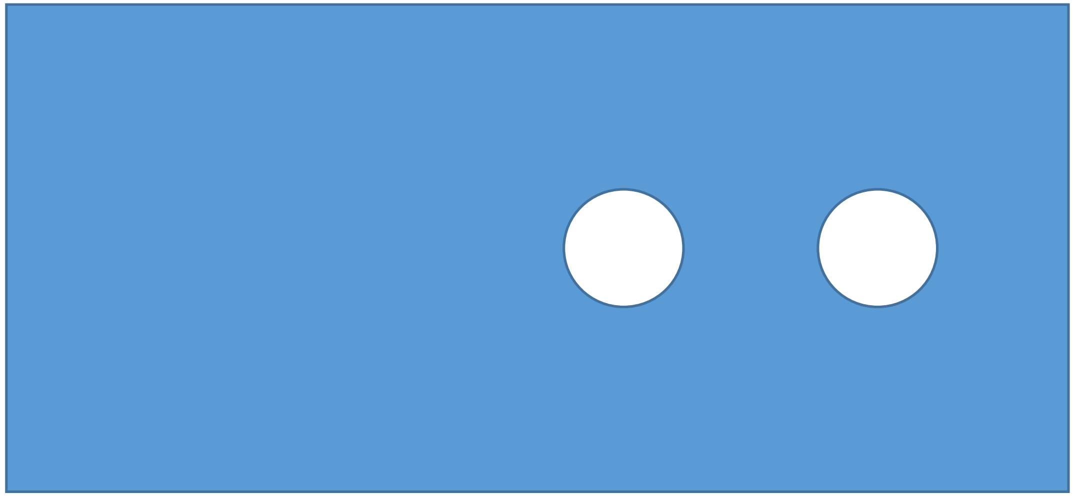
The double riveted butt joint shown in figure connects two plates, which are each 2.5 mm thick, the rivets have a diameter of 3 mm. If the failure strength of the rivets in shear is 370 N/ mm^2 and the ultimate tensile strength of the plate is 465 N/ mm^2, determine the necessary rivet pitch if the joint is to be designed so that failure due to shear in the rivets and failure due to tension in the plate occur simultaneously. Calculate also the joint efficiency.

Ans. P = 871.8 N/mm, η = 75 %

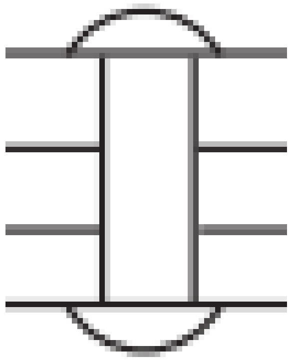




FBD for plate



FBD for one rivet



P.12.4. The rivet group shown in Fig. P.12.4 connects two narrow lengths of plate one of which carries a 15 kN load positioned as shown. If the ultimate shear strength of a rivet is 350 N/mm^2 and its failure strength in compression is 600 N/mm^2, determine the minimum allowable values of rivet diameter and plate thickness.

Answer: The rivet diameter is 4.2 mm, plate thickness is 1.93 mm.