Gaspar García, CFD portfolio

Tandem Ahmed bodies: steady RANS follows the drag trend, not the close-gap values

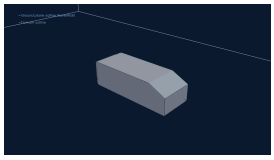
Caveated

Updated 2026-11-14

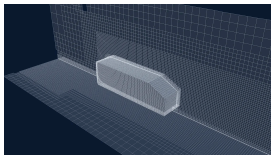
Objective. Compute the drag of a 75 %-scale Ahmed body (25° slant) alone and in a two-car line at eight gaps with steady RANS, and compare the drag-ratio trend with wind-tunnel data.

Parameters

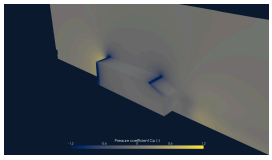
Reynolds number (free-stream speed, body length)	1.8×10^6
Free-stream speed	34.48276 m/s
Body length (75 % of the Ahmed body)	0.783 m
Reference area (frontal)	0.063018 m^2
Ground clearance	37.5 mm
Fluid	Incompressible air, kinematic viscosity 1.5e-05 m^2/s (assumed air at about 20 °C)
Solver	OpenFOAM v2412, simpleFoam (steady, SIMPLEC)
Turbulence model	k-omega SST



1 Geometry



2 Mesh

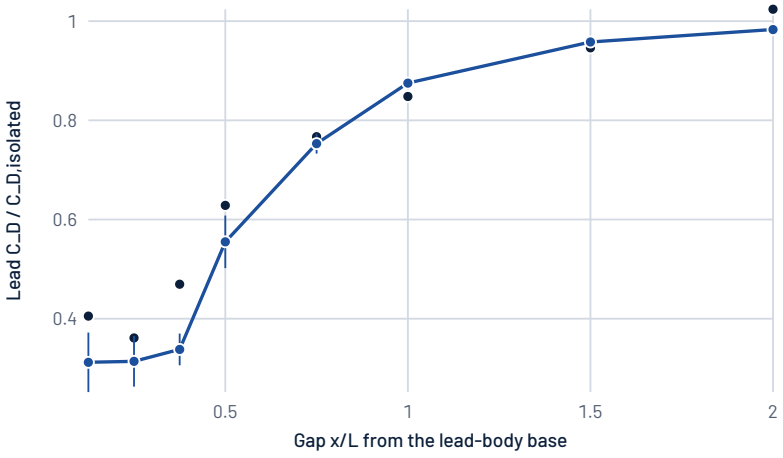


3 Results

Comparison with experiment

Quantity	Experiment	Simulation	Signed difference
Isolated Cd, against Pagliarella 2009 (Table 4.1, same Reynolds number)	0.30	0.2798	−6.7 %
Isolated Cd, against Meile 2011 (full scale)	0.299	0.2798	−6.4 %
Lead ratio, x/L 0.375 (late window)	0.469	0.338	−28.0 %
Lead ratio, x/L 0.5 (start-dependent, see below)	0.628	0.555	−12 %

Lead C_D / C_D,isolated against Gap x/L from the lead-body base



● Experiment (Pagliarella 2009, Fig. 4.1a, digitised)

—● Simulation, k-omega SST (bars: iterative scatter)

Verdict

The isolated Cd is 0.2798, 6 to 7 % below two experimental values, on one mesh with no numerical uncertainty. The tandem trend is reproduced, but the lead body is 12 to 28 % low at close gaps and the one grid ladder did not converge: a comparison, not a validation.

Limits

- One mesh per case; the four-grid ladder at x/L 0.5 did not converge, so no band is given anywhere.
- Bars on the simulation are iterative scatter; the x/L 0.5 lead ratio ranges over 0.495 to 0.557 with start and mesh.
- Extended checkMesh fails three checks on every mesh; stings and wall boundary layers not modelled.

1. R. M. Pagliarella (2009), "On the Aerodynamic Performance of Automotive Vehicle Platoons Featuring Pre and Post-Critical Leading Forms", PhD thesis, School of Aerospace, Mechanical and Manufacturing Engineering, RMIT University. Table 4.1 (isolated Cd) and Fig. 4.1a (tandem drag ratios, digitised by me).
2. W. Meile, G. Brenn, A. Reppenhagen, B. Lechner, A. Fuchs (2011), "Experiments and numerical simulations on the aerodynamics of the Ahmed body", CFD Letters 3(1). Fig. 4a (Cd and Cl at the highest Reynolds number).
3. L. Eça and M. Hoekstra (2014), least-squares procedure for grid-convergence uncertainty, Journal of Computational Physics; used through the shared GCI tool.

Full page with sources, mesh and numerical accuracy: /cases/ahmed-25/. Every number is checked against its source file.