

Raising the Lift Coefficient by Sixty Per Cent Lowers the Stall Speed by Twenty

— Taking the maximum lift coefficient from **1.5** to **2.5**, a factor of **1.6667**, takes the stall speed only from **99.3694** to **76.9712** km/h, a factor of **0.7746** — because it acts through a square root — and **0.4518** at **25** degrees is worse than **1.2990** at **10** — [Paper 458]

Yuuki YAMAGISHI (山岸 勇輝)
Yamagishi Complexity Torus Lab, Japan
September 2026

— *From thinking to syncing.* —

Abstract

Fit a high-lift device and you fly correspondingly slower—so it is thought. This paper shows that the lift coefficient acts on the stall speed only through a square root—a factor of **1.6667** buys a drop of **22.5** per cent. No new theorem or law is claimed. First, the thin-aerofoil lift slope is **0.109662** per degree, matching the standard value (Section 2). Second, the theoretical **1.6449** at 15 degrees exceeds the real maximum of **1.5** (Section 2). Third, this is the core of the paper. A factor of **1.6667** in the maximum lift coefficient gives only a factor of **0.7746** in stall speed (Section 3). Fourth, **0.4518** at 25 degrees is worse than **1.2990** at 10 (Section 2). Fifth, the computed stall speed of **99.3694** km/h agrees with the published **94.4520** for a Cessna 172 to within **5.21** per cent (Section 3). Sixth, the separator is whether the effect is linear or through a square root (Section 4). **Keywords:** lift coefficient, stall speed, wing, thin aerofoil theory.

Scope of this paper (scope note): No new theorem or law is claimed—thin-aerofoil theory, stall, the maximum lift coefficient and the stall-speed formula are all standard. No wing is designed—aerofoil section, planform and the type of high-lift device are not the subject. No piloting is discussed—nothing here describes procedure or judgement in flight. Post-stall behaviour is excluded—spins, tip stall and recovery are not the subject; only the fall in lift coefficient is shown. The post-stall curve is a model—sinusoidal to 15 degrees and exponentially decaying beyond, chosen to show that a peak exists, not measured. Compressibility and Reynolds number are excluded—the maximum lift coefficient shifts at high speed and on small models, and is not treated. Relation to earlier papers: Paper 457 showed that the cold wins only when two temperature coefficients differ—there too, the size of an exponent settled the answer. Paper 300 showed that common root and distinct root can be decided—“improving the lift coefficient” and “improving the stall speed” are distinct roots by that criterion. Paper 454 showed that a cubic load still needs only a linear width—there too, an exponent defeated intuition. Paper 390 showed that a sailing craft can outrun the wind and stated in its scope note that it would not enter stall—this paper takes that reserved seat. What is added is giving the lift slope as 0.109662 and checking it against the standard value, tabulating the lift coefficient at five angles to show the peak, giving the stall speed as 99.3694 km/h and checking it against a published figure, giving the effect of the high-lift device as 0.7746, and placing the separator at linear versus square root.

1. Notation and the Question

Setting: In thin-aerofoil theory the lift coefficient rises linearly with the angle of attack α in radians,

$$C_L = 2\pi\alpha$$

A real wing levels off before the stall angle α_s , reaches a maximum $C_{L,\max}$ and then falls. The lowest speed at which an aircraft of wing loading W/S can hold level flight, the stall speed, is

$$v_s = \sqrt{\frac{2(W/S)}{\rho C_{L,\max}}}$$

Below, $\alpha_s = 15$ degrees, $C_{L,\max} = 1.5$, $W/S = 700 \text{ N/m}^2$ and $\rho = 1.225 \text{ kg/m}^3$.

Observation 1.1

Fit a high-lift device and you fly correspondingly slower—so it is thought. A higher coefficient gives the same lift at a lower speed—and the direction is right.

Observation 1.2

But lift goes as the square of the speed. So the coefficient acts through a square root—not linearly.

Question: Raise the coefficient by how much, and the speed falls by how much.

2. The Maximum Lift Coefficient Is Not at the Maximum Angle

Computation 2.1: Take the lift slope from thin-aerofoil theory.

0.109662 per degree.

Observation 2.2

It matches the standard “about 0.11 per degree”. An independent check—only 2π per radian converted to degrees, but it lands on the textbook value.

Observation 2.3

Yet the theoretical 1.6449 at 15 degrees exceeds the real maximum of 1.5. The linear extrapolation has broken—this is where one leaves thin-aerofoil theory.

Computation 2.4: Take the real lift coefficient at five angles.

Angle of attack [deg]	Lift coefficient
5	0.7500
10	1.2990
15	1.5000
20	0.8232
25	0.4518

Observation 2.5

The peak is exactly at the stall angle.1.5000 at 15 degrees—beyond it the curve falls.

Observation 2.6

0.4518 at 25 degrees is worse than 1.2990 at 10.Two and a half times the angle, a third of the coefficient —“pull and it rises” has inverted.

3. A Factor of 1.6667 Buys a Factor of 0.7746

Computation 3.1: Take the stall speed at two maximum lift coefficients.

$C_{L,max}$	Stall speed [m/s]	[km/h]
1.5 (flaps up)	27.6026	99.3694
2.5 (flaps down)	21.3809	76.9712

Observation 3.2

99.3694 km/h agrees with the published 94.4520 for a Cessna 172 to within 5.21 per cent.A check against an independent known value—here I first put the range at “100 to 140 km/h” and was wrong; the computed 99.3694 fell outside it.

Observation 3.3

A factor of **1.6667** in the coefficient gives only **0.7746** in the speed.A drop of 22.5 per cent—a 66.7 per cent improvement buying 22.5.

Observation 3.4

The ratio matches $\sqrt{2.5/1.5} = 1.290994449$. To within 10^{-9} relative—the square root is confirmed numerically.

Observation 3.5

Doubling the wing loading multiplies the stall speed by $\sqrt{2}$. A square root here too—heavier gives only 1.41 times, and lighter only 0.71.

Observation 3.6

So halving the stall speed would need four times the coefficient. From 1.5 to 6.0—beyond the reach of ordinary high-lift devices.

4. The Separator

The separator: is the effect linear, or through a square root.

Observation 4.1

Linear, and effort returns in full. 1.67 times in gives 1.67 times out—easy to estimate.

Observation 4.2

Through a square root, and only half of it returns. In logarithms the coefficient is $\frac{1}{2}$ —a large improvement buys a small effect.

Observation 4.3

These are distinct roots by the criterion of Paper 300. Both are called “an improvement in performance”—one a coefficient, one the square root of that coefficient.

Observation 4.4

This stands where Paper 454 stands. There, a cubic load still needed only a linear width—here, 1.67 times the coefficient gives only 0.77 times the speed. In both, an exponent defeats intuition.

Observation 4.5

It overlaps Paper 457 as well. There, the relative size of two temperature coefficients settled the answer—here the size of one exponent settles the effect. In both, missing the exponent means misreading the quantity.

Observation 4.6

It fills the seat reserved by Paper 390. There, a sailing craft was shown to outrun the wind, with the scope note stating that stall would not be entered—this paper takes that seat.

Observation 4.7

To be honest—the post-stall curve is a model. Sinusoidal to 15 degrees and exponentially decaying beyond—the value 0.4518 depends on that model; the conclusion that a peak exists and the curve falls beyond it does not.

5. Roll Call and Closing

1. The lift slope is 0.109662 per degree (Computation 2.1): matches the standard.
2. The theoretical 1.6449 at 15 (Observation 2.3): exceeds the real 1.5.
3. The peak is 1.5000 at 15 (Computation 2.4): exactly at the stall angle.
4. 0.4518 at 25 degrees (Computation 2.4): worse than at 10.
5. Stall speed 99.3694 km/h (Computation 3.1): 5.21 % from a Cessna 172.
6. 76.9712 km/h with flaps (Computation 3.1): the core.
7. 1.6667 in gives 0.7746 out (Observation 3.3): a drop of 22.5 %.
8. Matches $\sqrt{2.5/1.5}$ (Observation 3.4): a square root.
9. Halving would need four times (Observation 3.6): out of reach.

10. The separator is linear or root (Observation 4.3): distinct roots by Paper 300.

Closing: Fit a high-lift device and you fly correspondingly slower—so it is thought—a higher coefficient gives the same lift at a lower speed, and the direction is right. But lift goes as the square of the speed, so the coefficient acts through a square root, not linearly. First, the maximum lift coefficient is not at the maximum angle—the thin-aerofoil lift slope is **0.109662** per degree, matching the standard “about 0.11”. Yet the theoretical 1.6449 at 15 degrees exceeds the real maximum of 1.5, so the linear extrapolation breaks here. The real coefficient rises through 0.7500 at 5 degrees, 1.2990 at 10 and **1.5000** at 15, then falls to 0.8232 at 20 and **0.4518** at 25. 0.4518 is worse than the 1.2990 at 10 degrees: two and a half times the angle for a third of the coefficient, so “pull and it rises” has inverted. And raising the coefficient lowers the speed only through a square root—**99.3694** km/h at $C_{L,max} = 1.5$ and **76.9712** at 2.5. 99.3694 agrees with the published 94.4520 for a Cessna 172 to within 5.21 per cent. Here I first put the range at “100 to 140 km/h” and was wrong; the computed value fell outside it. A factor of **1.6667** in the coefficient gives only **0.7746** in the speed—a 66.7 per cent improvement buying a 22.5 per cent drop. The ratio matches $\sqrt{2.5/1.5} = 1.290994449$ to within 10^{-9} relative, confirming the square root numerically. Doubling the wing loading multiplies the stall speed by $\sqrt{2}$, a square root here too. So halving the stall speed would need four times the coefficient, from 1.5 to 6.0, beyond the reach of ordinary high-lift devices. One thing separates them—is the effect linear, or through a square root. Linear, and effort returns in full: 1.67 times in gives 1.67 times out, and estimates are easy. Through a square root, and only half returns—in logarithms the coefficient is $\frac{1}{2}$, so a large improvement buys a small effect. They are distinct roots by the criterion of Paper 300, one a coefficient and one the square root of that coefficient. This stands where Paper 454 stands, where a cubic load still needed only a linear width: in both, an exponent defeats intuition. It overlaps Paper 457 too, where the relative size of two temperature coefficients settled the answer: in both, missing the exponent means misreading the quantity. And it fills the seat reserved by Paper 390, which showed a sailing craft outrunning the wind while stating in its scope note that stall would not be entered. To be honest—the post-stall curve is a model, sinusoidal to 15 degrees and exponentially decaying beyond. The value 0.4518 depends on that model; the conclusion that a peak exists and the curve falls beyond it does not.

References

1. Prandtl, L. (1918). *Tragflügeltheorie I. Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen*.
2. Abbott, I. H., & von Doenhoff, A. E. (1959). *Theory of Wing Sections*. Dover.
3. Anderson, J. D. (2016). *Fundamentals of Aerodynamics* (6th ed.). McGraw-Hill.
4. McCormick, B. W. (1995). *Aerodynamics, Aeronautics, and Flight Mechanics* (2nd ed.). Wiley.
5. Yamagishi, Y. (2026). *The Three Hundredth Census: Whether Two Things Share a Root Is Decidable* [Paper 300]. Zenodo. 10.5281/zenodo.22171914

6. Yamagishi, Y. (2026). *Going Faster Makes the Wind Stronger, Which Is Why a Sailing Craft Can Outrun the Wind* [Paper 390]. Zenodo. 10.5281/zenodo.22699203
7. Yamagishi, Y. (2026). *The Water Load Grows as the Square, and the Dam Only as the First Power* [Paper 454]. Zenodo. 10.5281/zenodo.22732989
8. Yamagishi, Y. (2026). *Trading Flavour for Speed Works Only When Two Temperature Coefficients Differ* [Paper 457]. Zenodo. 10.5281/zenodo.22733066

— *From thinking to syncing.* —

Yuuki YAMAGISHI (山岸 勇輝)

© 2026 Yamagishi Complexity Torus Lab, Japan · Licensed under Creative Commons Attribution 4.0 International (CC BY 4.0)