Process of Design *over Time*

Reinventing the designer in yourself

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From: Different Sources

Oxford 2013

Starting Point:

An eye for mathematics where it is visible, even if it is barely visible

Curious to find more math than meets the eye

Because your intuition tells you this is the case

Easier if it is based on personal experiences

Helps it you are exited about these experiences

And think it should be shared knowledge

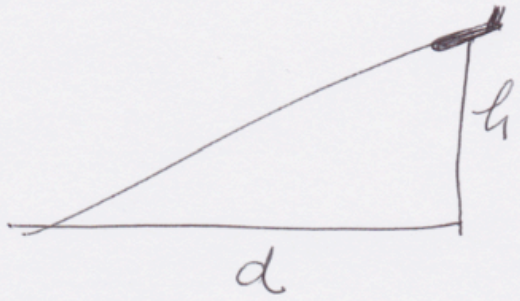
Even for your mother

And then it helps tremendously if you think you can help someone, so…. There is the teacher who thinks her students hate trigonometry…..

She asks you during a boring meeting: can't you think of something?

(1978)

How about something called the glide ratio:



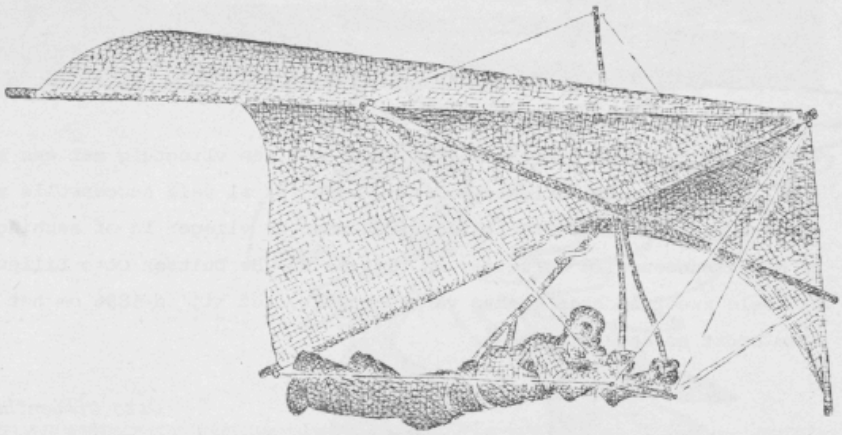
If a sailplane has a glide-ratio of 1:30 it means it flies a distance of 30 km if it is 1 km high. It is really used to compare gliders.
(and just the tangent, right?)

Jc

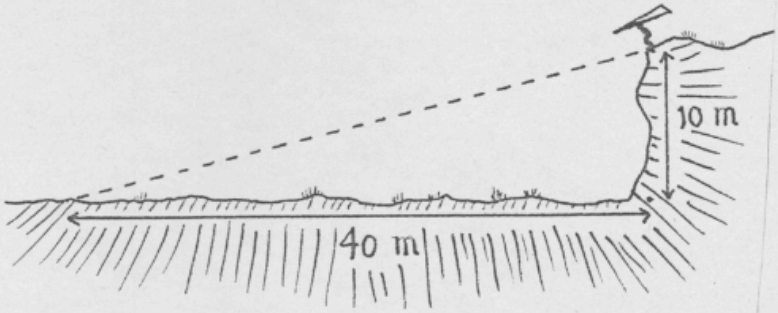
And you send this little note back…..

So:

Tegenwoordig is dit soort zweefvliegen weer erg populair aan het worden. In Nederland niet zó, omdat wij geen mooie hoge rotsen hebben om vanaf te springen, maar in Duitsland, Oostenrijk, de Verenigde Staten en Australië is het "hang-gliding" zeer populair.



Bij de meest simpele vorm wordt gebruik gemaakt van een soort driehoekige vlieger. Deze worden vaak zelf gebouwd.
Bij een eerste proefvlucht wordt natuurlijk niet te veel risico genomen.
Dus wordt er b.v. vanaf een slechts 10 m hoge rots gesprongen.
Het resultaat is dat het "ding" zo'n 40 meter ver vliegt. Dus:



Als deze vlucht succesvol verloopt besluit de bouwer vanaf 20 m te springen.

▶ 1. Hoever zal hij nu kunnen vliegen?

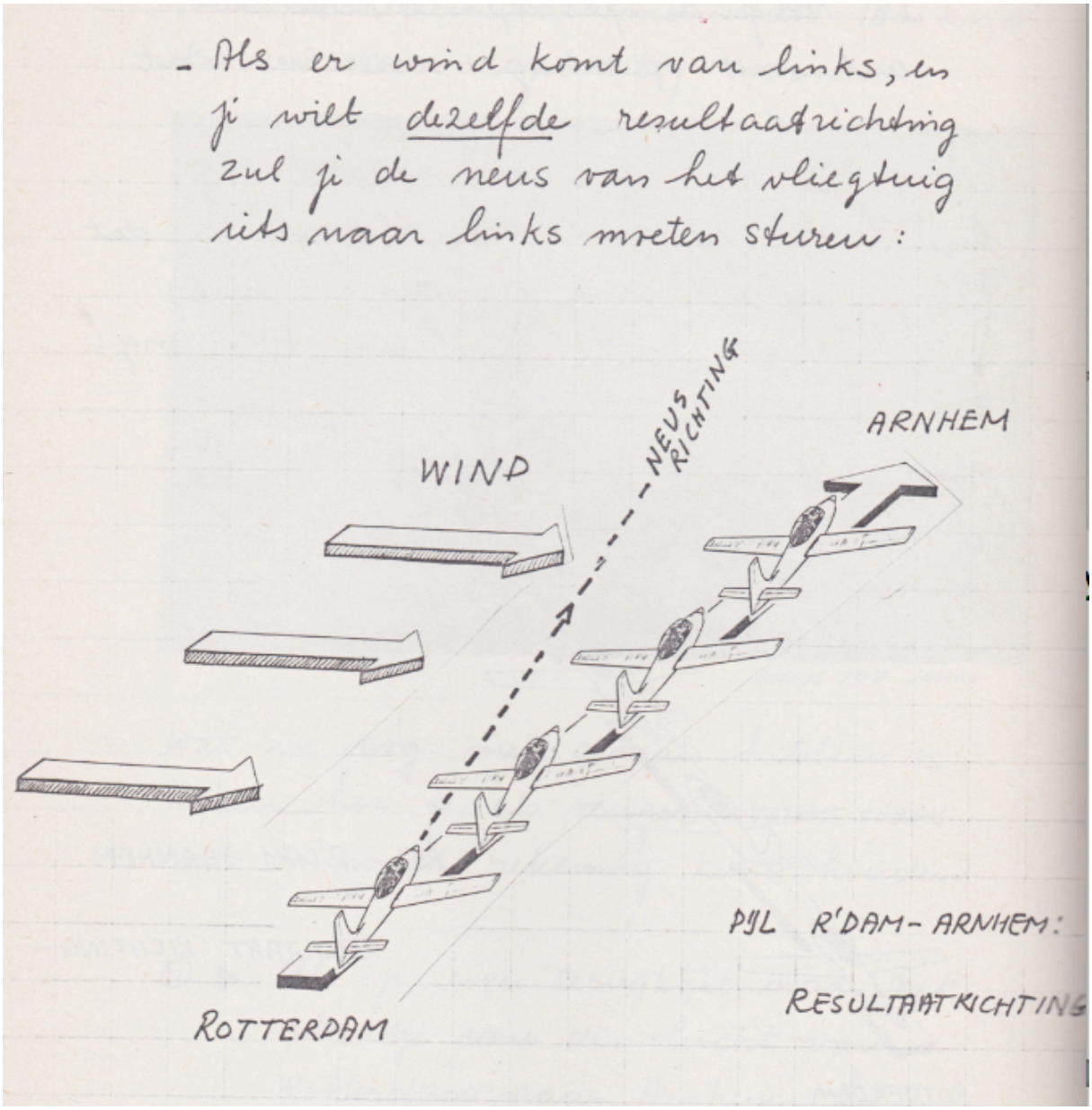
Vervolgens vanaf 50 m en tenslotte vanaf 100 m.

▶ 2. Hoever komt hij in de laatste 2 gevallen?

Just to please her you design something. Very personal. She likes it, so you continue…..

(1978)

The teaching experiment went well, so you know the next question: More? Handwritten into the classroom, about vectors, not even in the curriculum:



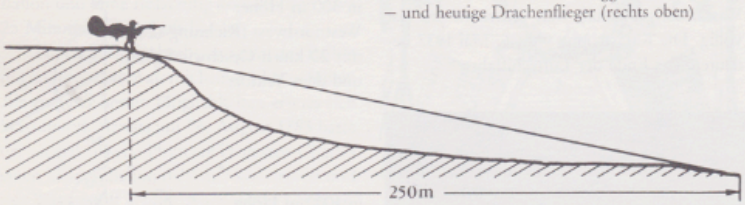
This very personal design was considered ‘worthy’ of becoming an official Fi publication in 1980. It got attention from the Germans:

Ballons sind leichter als Luft. Aber richtiges Fliegen ist erst Fliegen mit einem Gerät, das schwerer als Luft ist, mit einem Flugzeug. Einer der berühmtesten Flieger aus der Frühzeit des Fliegens war Otto Lilienthal. In der Zeit von 1883 bis 1896 unternahm er 2500 Flüge mit einem Drachenflieger.

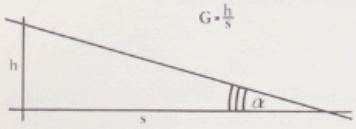
Er startete auf den Rhinower Bergen bei Berlin und es gelang ihm, Flugstrecken von mehr als 250 Metern zu erzielen.

⑨ Eines Tages flog er aus einer Höhe von 25 Metern 185 Meter weit. Mit diesem Ergebnis unzufrieden veränderte er das Fluggerät und unternahm einen neuen Versuch. Aus einer Höhe von 20 Metern überflog er eine Strecke von 155 Metern. Ist das Flugzeug besser geworden?

Otto Lilienthal auf seinem Fluggerät
– und heutige Drachenflieger (rechts oben)



Eine Möglichkeit, die Leistungen von Drachenfliegern und Segelflugzeugen zu vergleichen, ist das Gleitverhältnis:



Bei einem Gleitverhältnis von 1 : 10 erreicht ein Flugzeug bei 1 km Höhenverlust 10 km Flugweite, wenn Wind und Thermik nicht berücksichtigt werden.

⑩ Ein Drachenflieger hat ein Gleitverhältnis von 1 : 14. Welche Flugweite erreicht er aus einer Höhe von 60 Metern?
Der Winkel α heißt der Gleitwinkel. Für moderne Drachenflieger liegt der Wert des Gleitwinkels bei ungefähr 8°.

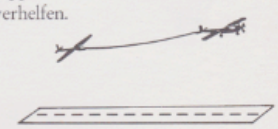
⑪ Bestimme das Gleitverhältnis eines Drachenfliegers durch eine maßstabsgerechte Zeichnung.
Fülle die Tabelle aus:

Gleitwinkel:	8°				
Gleitverhältnis: . . .					
Höhe	10 m	25 m	100 m		
Flugstrecke				245 m	1 km

⑫ Ein zweisitziges Segelflugzeug hat ein Gleitverhältnis von D = 0,033.
a) Wie weit kann es fliegen, wenn es auf 500 m, 1000 m, 3000 m Höhe gebracht wird?
Dabei fliegt es mit einer Geschwindigkeit von 105 km/h.
Wie lange dauern diese Flüge?
b) Es soll eine Strecke von 50 km fliegen.
Von welcher Höhe muß es starten (kein Wind, keine Thermik).

Natürlich muß ein Segelflieger, ehe er eine Strecke fliegen kann, zuerst in die Höhe gebracht werden. Er kann sich dazu von einem Motoflugzeug hochschleppen lassen.

Eine andere Möglichkeit ist der Start mit einer Seilwinde. An einem rund 1200 m langen Schleppseil kann die Winde ihm zu 500 m Höhe verhelfen.



Mathematik Lehren 1984

It can be found in almost all Dutch Textbooks.

More math became visible:

4 Geef aan hoeveel radialen de volgende hoeken zijn (Je mag π in je antwoord laten staan).
10°; 30°; 45°; 60°; 90°; 135°; 180°; 270°; 300°; $x°$.

5 a Geef aan hoeveel graden de volgende hoeken zijn:
$\frac{3}{4}\pi$; $\frac{2}{3}\pi$; $\frac{1}{6}\pi$; $\frac{1}{9}\pi$; $1\frac{1}{2}\pi$; $1\frac{5}{6}\pi$; $t\,\pi$ radialen.
b Geef aan hoeveel π radialen de volgende hoeken zijn:
45°; 180°; 210°; 270°; 60°; 33°; 107°; 62°.

Zodra het vliegtuig gaat bewegen, hetzij op de grond, hetzij in de lucht, beschrijft de propellertip een ruimtelijke kromme. In fig. 3 is die baan van één propellertip getekend.

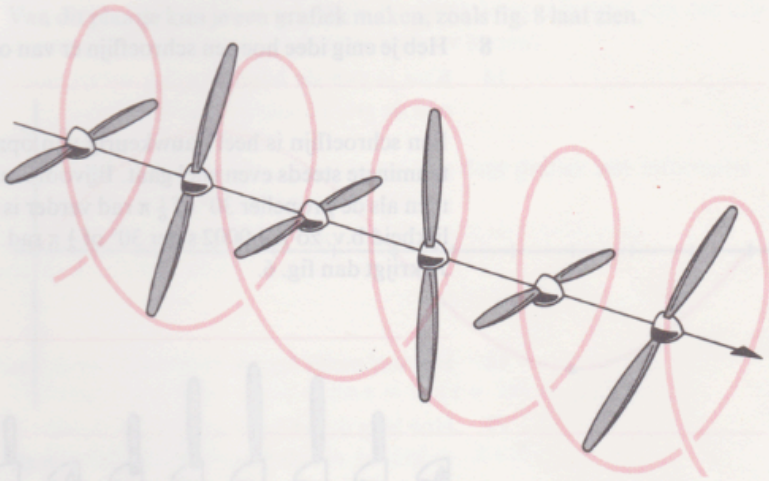


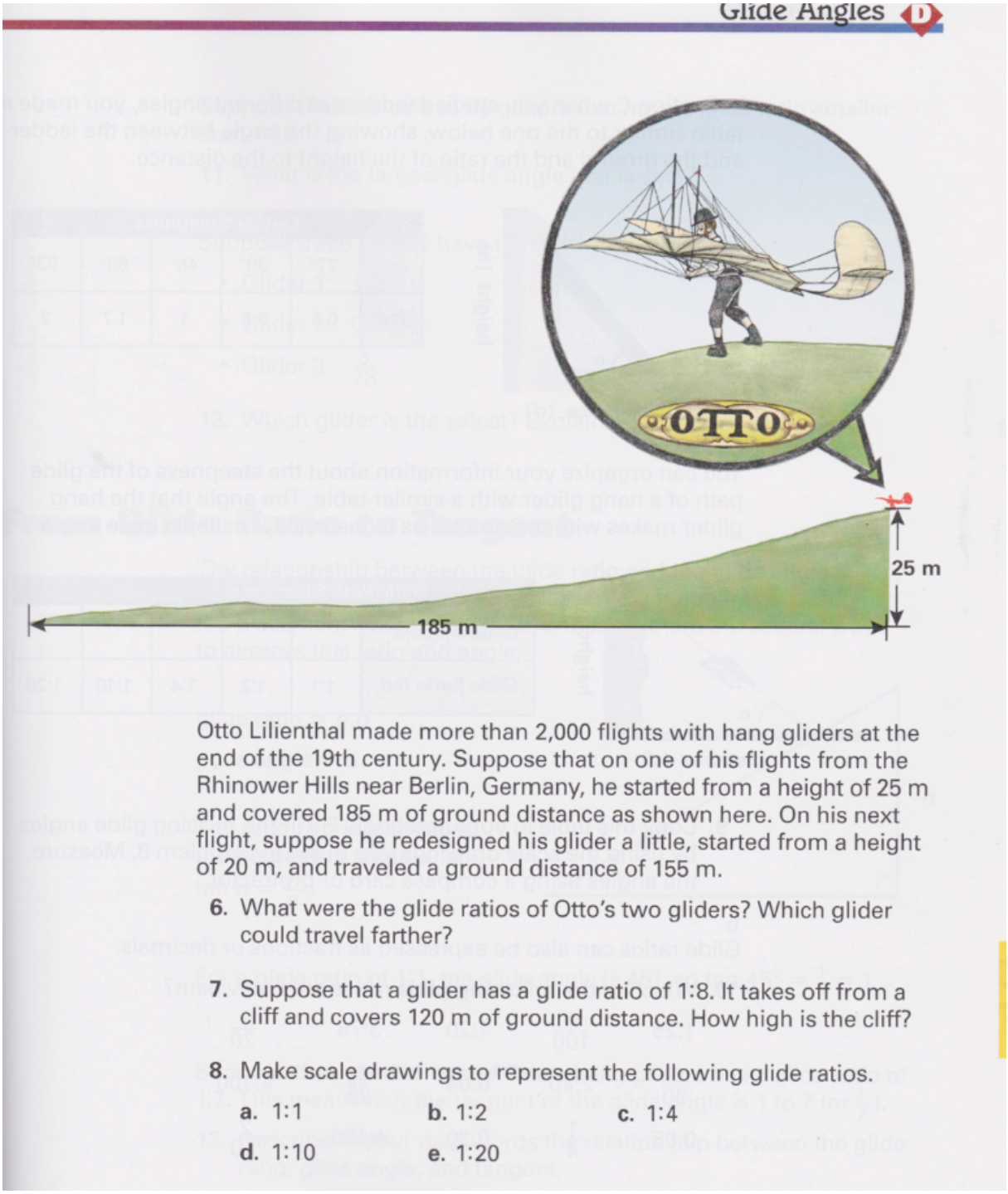
fig. 3

De zo ontstane kromme wordt 'schroeflijn' genoemd. Deze schroeflijn is in het echt nauwelijks te zien. Maar onder bepaalde atmosferische omstandigheden wèl, zoals duidelijk blijkt uit fig. 4.

In the early 80's new territory in aviation were worthy of trying out.

(1984)

And, much later, the glide ratio was reinvented for use in Mathematics in Context



Glide Angles D

Otto Lilienthal made more than 2,000 flights with hang gliders at the end of the 19th century. Suppose that on one of his flights from the Rhinower Hills near Berlin, Germany, he started from a height of 25 m and covered 185 m of ground distance as shown here. On his next flight, suppose he redesigned his glider a little, started from a height of 20 m, and traveled a ground distance of 155 m.

6. What were the glide ratios of Otto's two gliders? Which glider could travel farther?

7. Suppose that a glider has a glide ratio of 1:8. It takes off from a cliff and covers 120 m of ground distance. How high is the cliff?

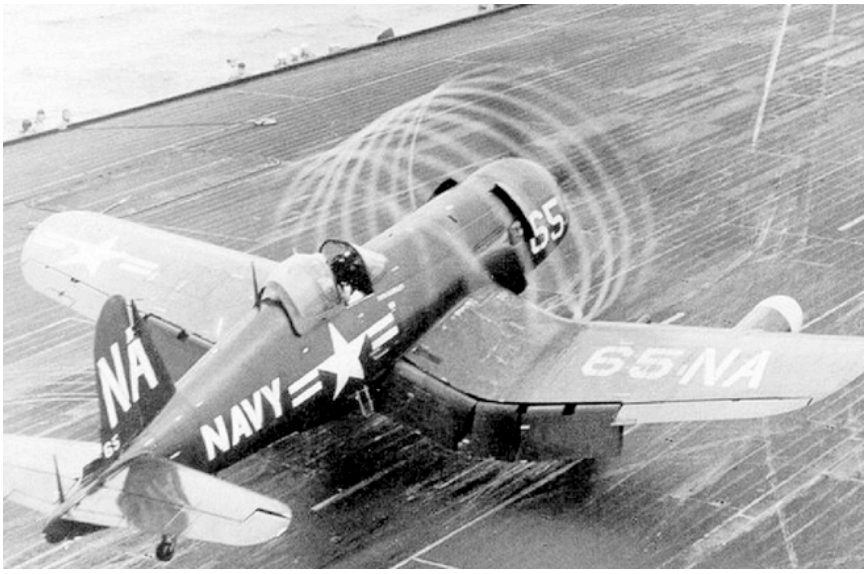
8. Make scale drawings to represent the following glide ratios.

   a. 1:1 b. 1:2 c. 1:4

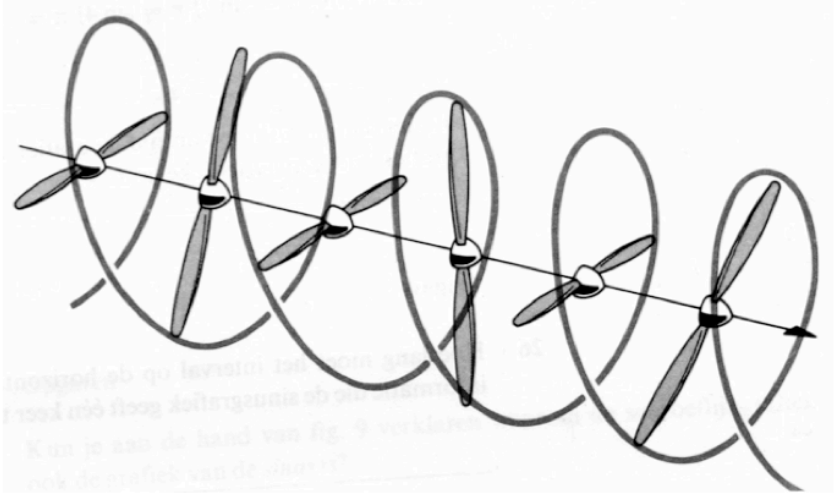
   d. 1:10 e. 1:20

This page: 2005

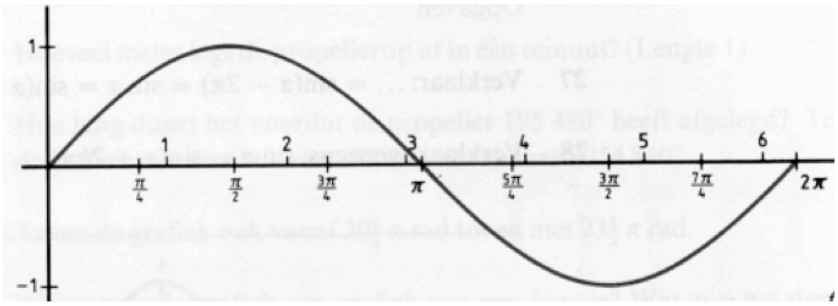
And the propeller tip curve may come back in 2014:



Of course with animation and videoclips because this is from the Pearson Common Core System of Courses (2014) for the iPad

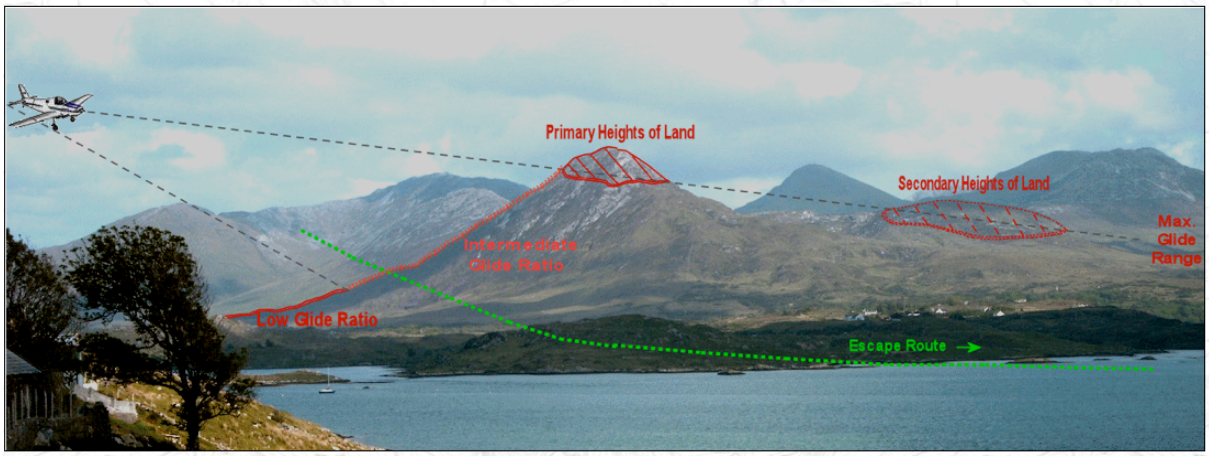


If you look from the side you will see a sinus:



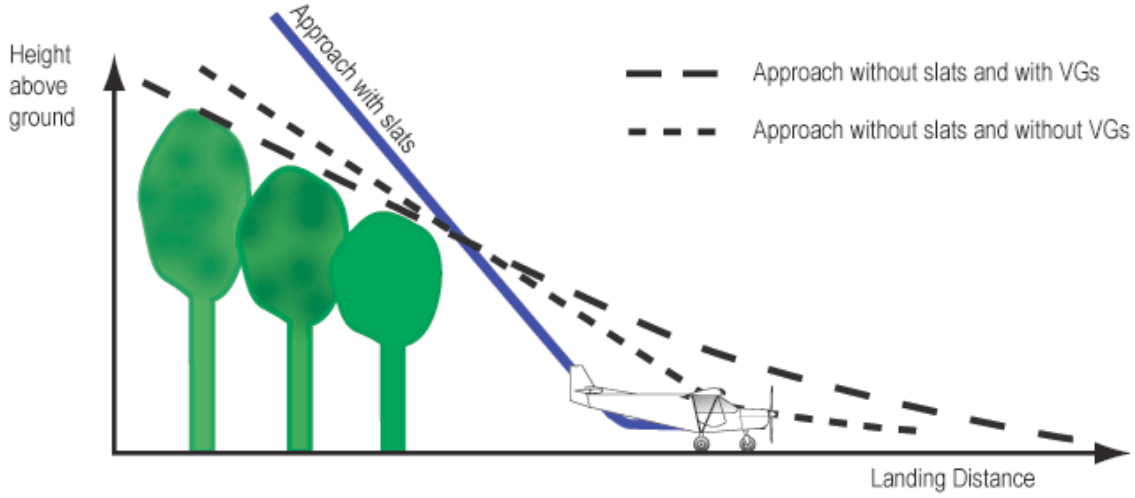
But the design goes on: always looking for the mathematics that is often there just to be seen. Quite often you cannot use it immediately as a designer, but your intuition tells you to keep these ideas. And use them later. Whether it is about Search and Rescues methods, using glide angles (2013):

http://sartechnology.ca/sartechnology/ST_AircraftCrashMap.htm



Or how to use slats to make a steep landing:

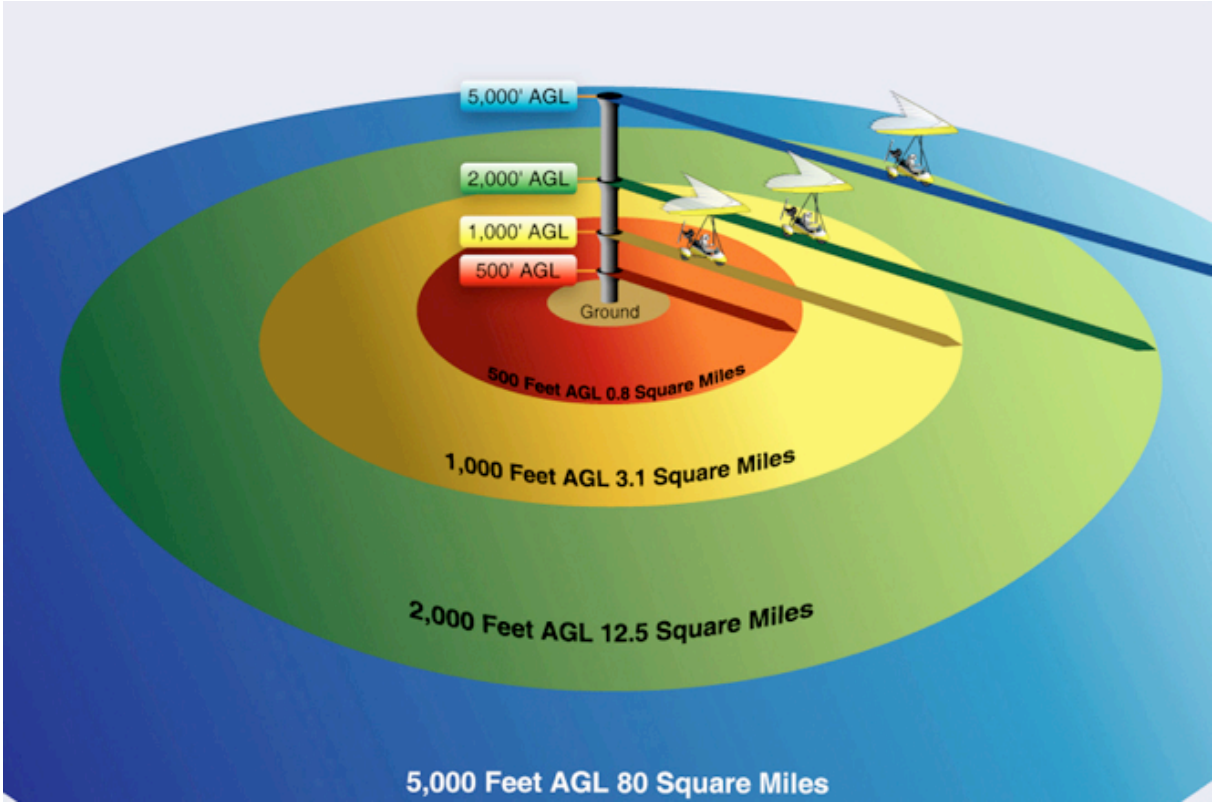
http://www.zenithair.com/stolch801/design/slats-vs-vg-design.html



Or very exciting:

The glide ratios of wing suits which are a scary 1 : 2.5. You really gets attention, especially since there are numerous flights available on YouTube.

http://trikepilot.beasportpilot.com/wp-content/blogs.dir/4/files/learn-trike/9-trike-glide-ratio.jpg



What is a wingsuit?

When looking at wingsuits, there are a lot of manufacturers and design variations. Bigger or smaller wings, and different air inlet and airfoil shapes. But the basic principle is always the same: a suit, with three wings between arms and legs. These wings inflate due to the relative wind, and form an airfoil. Shaped just like an airplane wing, it provides lift and enables the pilot to glide vast distances across the skies.

How far can you fly?

When looking at how well a wingsuit flies, we generally speak about the glide-ratio (or Lift vs Drag). This is a number that indicates the forward distance flown for every meter of altitude that is lost.
A wingsuit flown really well, has a glide ratio of about 2.5:1 (so 2.5 meters

forward, for every meter you drop).
When we skydive, we typically jump from 12.000 ft (4km) and open our main parachute at 3000 ft (1km). So we have a freefall of about 9000 ft (3km). At a glide-ratio of 2.5:1, this means we can cover about 7.5 km of distance. This distance can be even further if we are flying with the wind (downwind). Stamina is also a great factor, as it takes quite a bit of muscle strength to fly a wingsuit to its full capacity. That's why in general, the performance tends to be a bit lower on a full altitude skydive. People get better results on lower jumps, such as those performed within the sport of BASE jumping.

http://www.flylikebrick.com/wingsuit-faq.php

Or the famous glide flight from a Airbus:

An Air Transat 330 did glide to the Azores after the feul ran out over the Mid Atlantic. It flew 80 Nm without power from 30.000 ft. altitude and made a safe landing at an airbase on the island. That would mean a glideratio of about 16:1.

http://forum.condorsoaring.com/viewtopic.php?f=9&t=9900