Recruiting pupils for Aeromodelling

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Recruiting pupils for Aeromodelling

- Why work with young talents ?
- New opportunities in Germany - School clubs
- Model building and Flight training
  - Indoor flying as training method
  - appropriate model designs
  - results of the training method
- Practical application of the teaching material in physics
  - movement patterns (steady motion, uniformly accelerated motion)
  - cruise flight and take-off process
  - efficiency of the drive system
- summary

Recruiting pupils for Aeromodelling

- shortage of young members
  - exists in most clubs
  - is not only a cosmetic problem

- without young members in a club
  - there is the risk of ageing
  - it might get unguided
  - sooner or later it will fall appart

Recruiting pupils for Aeromodelling

Analysis in 2000 → 2010:

- the former propaganda has lost its effectiveness: newspaper articles, homepage, club presentation events with model building at events (e.g. airport festival)

der „Fluglehrer" Andreas Lorenz und Hans Langenhagen die Steuerkünste erlernt sind. Meist folgt dann auch bald der Wunsch, bei Wettbewerben mitzufliegen, und dies nicht nur auf den von uns veranstalteten, sondern auch bei überregionalen Wettkämpfen. So haben auch in diesem Jahr zum Lilienthal-Wettbewerb in Sachsen-Anhalt Robin Anton, Stanley Haufe, Christoph Wolff und Tilmann Elle erste und zweite Plätze in mehreren Modellflug-Klassen nach Hause gebracht.

Der Modellflug ist aber auch hervorragend geeignet, Kinder und Jugendliche an technisch-naturwissenschaftliche Themen heranzuführen. Häufig ergeben sich bei seiner Ausübung Fragestellungen, deren Bearbeitung für eine Teilnahme am Jugend-forscht-Wettbewerb geeignet ist. Und was könnte die Anwendung schulischen Wissens besser mit der Praxis verknüpfen als die Lösung hobbybasierter Aufgaben? Die Erfahrung über die letzten Jahre zeigt darüber hinaus: ist die Freude an diesen Dingen erst einmal da, so verfliegt sie so schnell nicht wieder – häufig wird von den ehemaligen Schülern eine entsprechende berufliche Ausbildung gewählt.

Die Vergleichsfliegen führen wir in den Klassen Elektro-Motorsegler und Thermiksegler durch

A new attempt: Working groups in schools

- GanzTagsAngebot (GTA) = schooling
  - after three trial lessons: duty to visit the working group for a half year
  - presence control like in the classroom
  - short progress reports 4 times per school year

  → best possibility for contact with students

- for example: Modellflug Club Rossendorf e.V.
  - program runs in a nearby located High School in Dresden since Sept 2009
  - at start: 2 students of the 5th grade participated
  - in present SY 2015/16: in total 16 students participate
    (4x5th, 6x6th, 3x8th,1x9th grade)

→ from those participants: 5 became members of our club

Schooling-Program of the first years

Styropor glider → Ba_glider (Opitec) → Free Flight model (Aeronaut) →Motor glider

- several students built a motor glider
  → that worked well
- training with the mot gliders on our flying field → that did not work well

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Schooling-Experients of the first years

– building program okay, but flight training did not worked out:

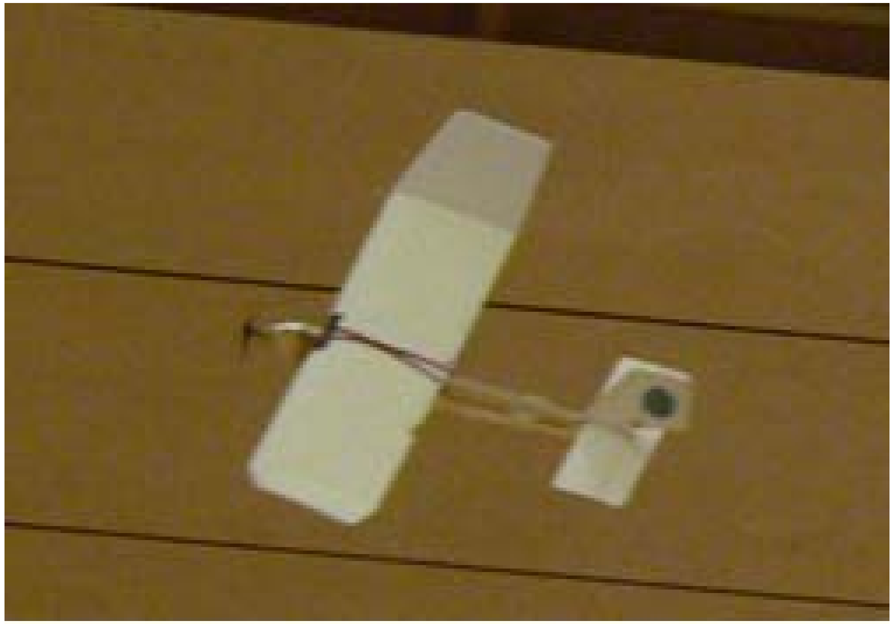
– on the GTA-day the weather was not always good

– a continuous training was not possible

→ low efficiency: only small progress in control quality during a long period of time:

$$\eta = \frac{\textbf{achieved quality of control}}{\textbf{invested time}} \ll 1$$

alternative: indoor flying as training method?



→ not a teaching in indoor aerobatics flight (F3P) !!

A: flight training immediately after school lessons in gym

D: limited flight space

Q: indoor flying nevertheless a workable solution?

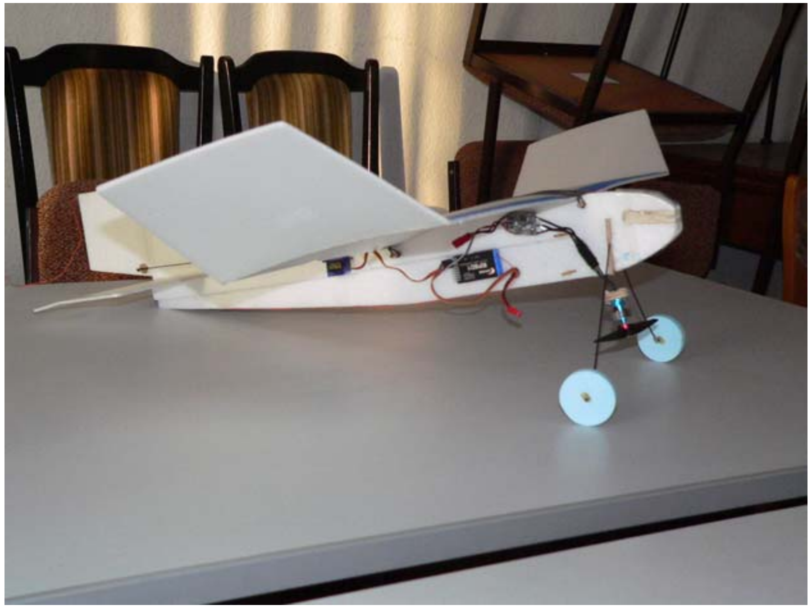
alternative: indoor flying as training method?

- required attributes of the model
  - slow flying □ reaction time of the teacher !?
  - robust toward impacts on wall and on ground
  - docile controllable and comparable with motor glider flight properties
  - low costs in building, material also from do-it-your-self-market

- Realisation
  - airfoil curved surface like Gö417a: fmax = 6%, camax = 1 @Re=40000, $\Lambda = \infty$
  - lightweight construction by using EPP and Styropor
  - no traction operation $\rightarrow$ pusher configuration

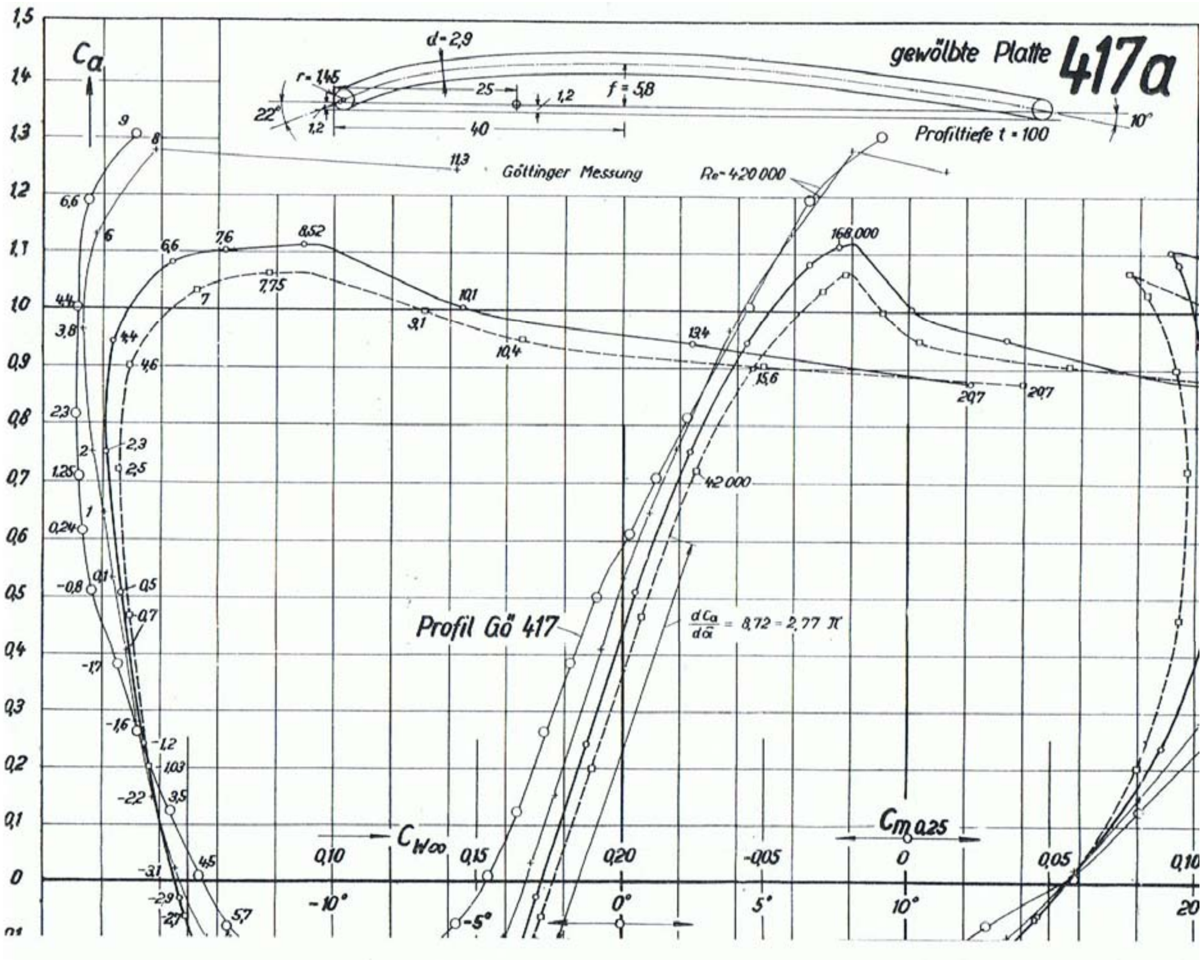
alternative: indoor flying as training method?

traction propulsion causes damages on prop or/and motor or model



→ the drive must be protected by using pusher propulsion!!

slow speed – how to achieve? Estimation v_{min}



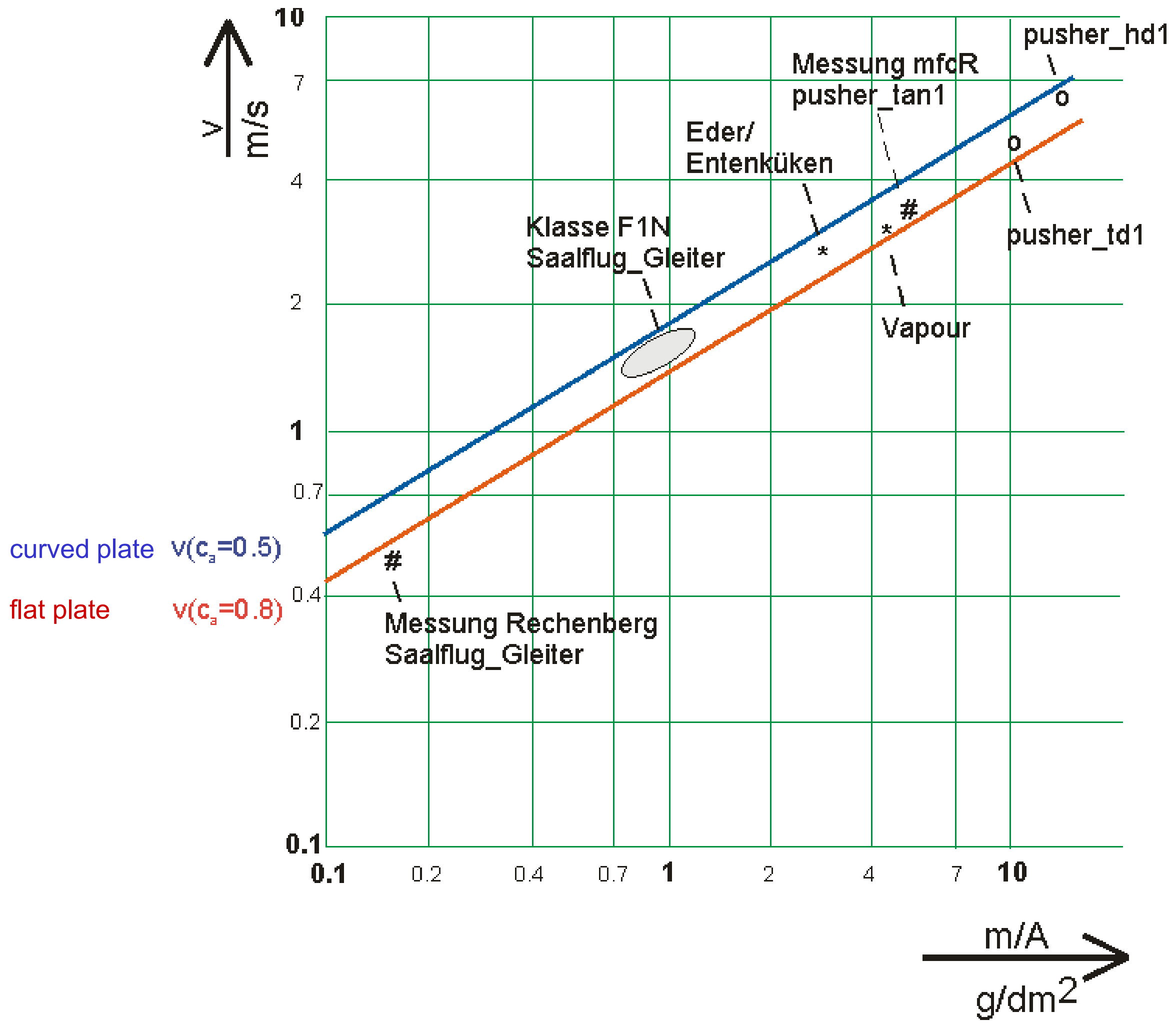
The polar curves are measured down to Re = 42000;
in comparison:
Re = lµ*v*70
= 200mm*5m/s*70
= 70000 > 42000

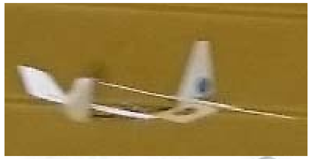
$$v_{min} = \sqrt{\frac{mass \cdot g}{\frac{\rho}{2} \cdot AF \cdot camax}}$$

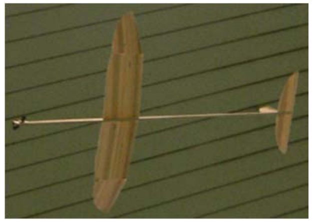
Camax = 0,8;
m = 170gr;
AF = 16,4qdm

-> vmin = 4,5m/s

classifcation v_{min} versus mass/A







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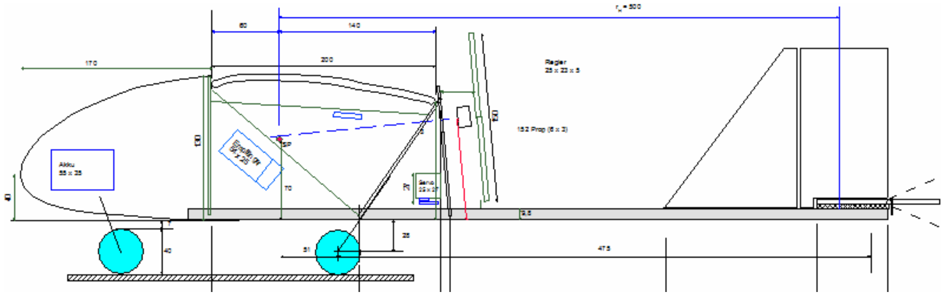
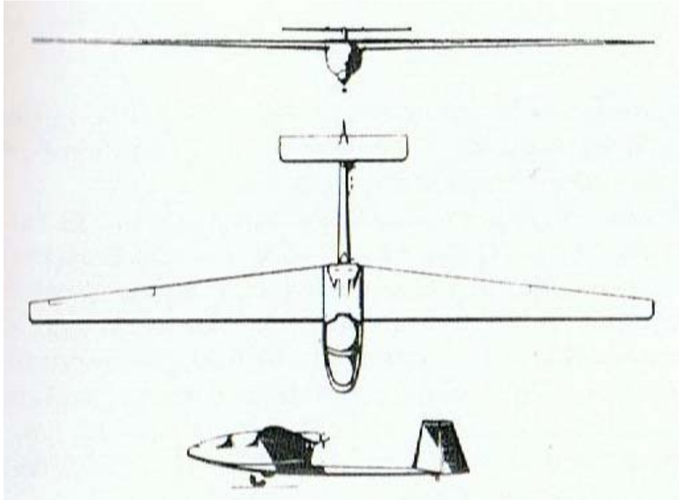
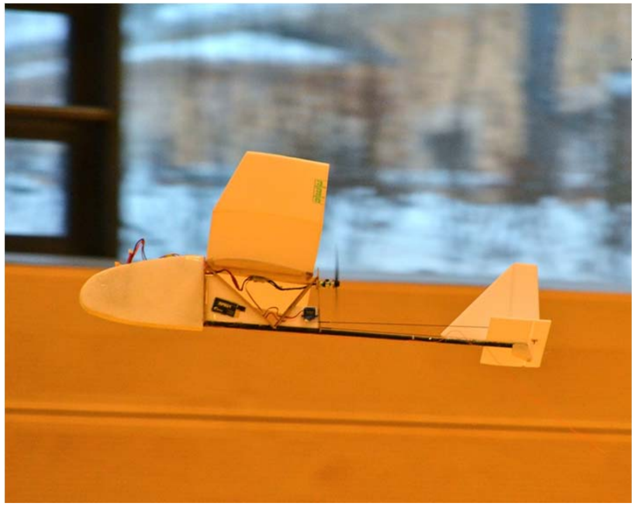
suitable pusher propulsion configurations:

- inspired by the motor glider OGAR/CZ





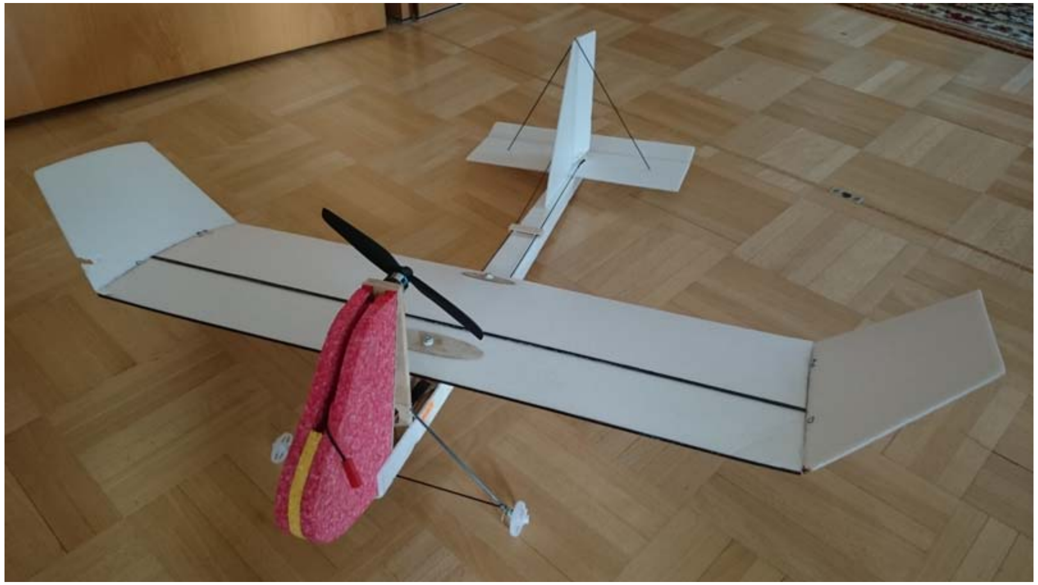


A: prop and motor are protected, the hall‘s walls will spared; docile controllable;

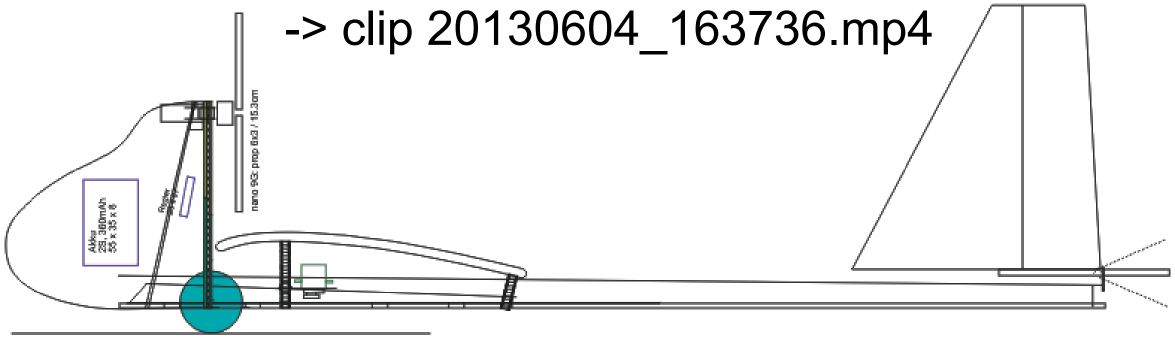
D: mass = 220g
m/A = 13,5g/dm2
->v ≈ 6m/s too high!

suitable pusher propulsion configurations:

- bringing forward the motor behind the nose → low wing monoplane



-> clip 20130604_163736.mp4



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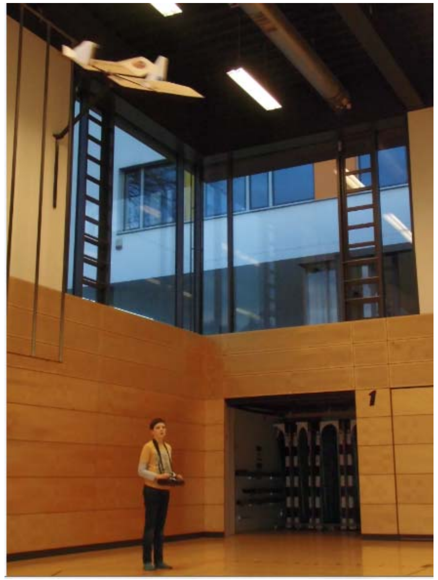
A: m = 170g
m/A = 10,6g/dm2
->v ≈ 4,2m/s good!
model still robust and
docile controllable
D: fuselage's assembly a
little bit complicated

geeignete pusher-Varianten:

- Reduction of m/A by enlargement the elevator‘s area (→tandem-config)



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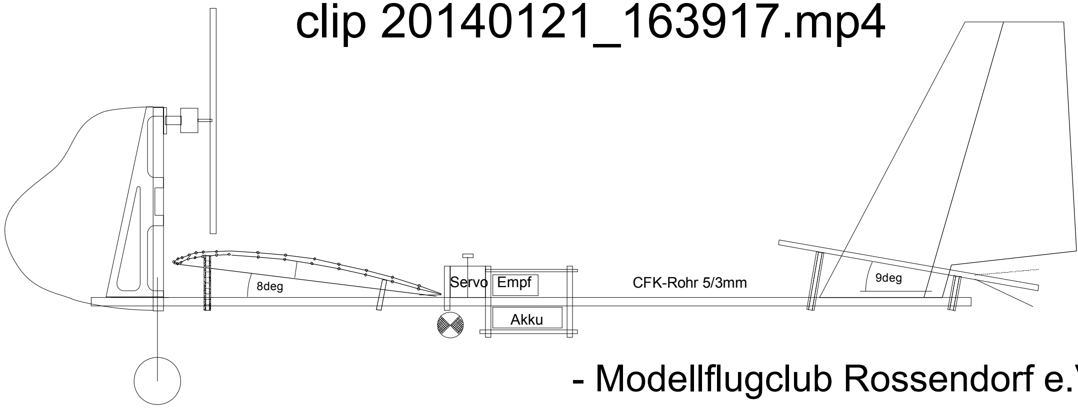

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A: mass = 120g
m/A = 7g/dm2
->v ≈ 3,5m/s – better !
assembling very simple,
modell still robust and
docile controllable

D: not found

Is indoor flying usable for RC-training?

Answer: YES! For example:

- 4 School-pupils took part at the end of the 5th grad in a model flyer camp
- after 2h practising time 3 of them were able to control motor gliders with span of 2 … 3m
- also they could take part on the compet/electric class at the end of week



-> beginner training via Indoor flying is worth doing!!

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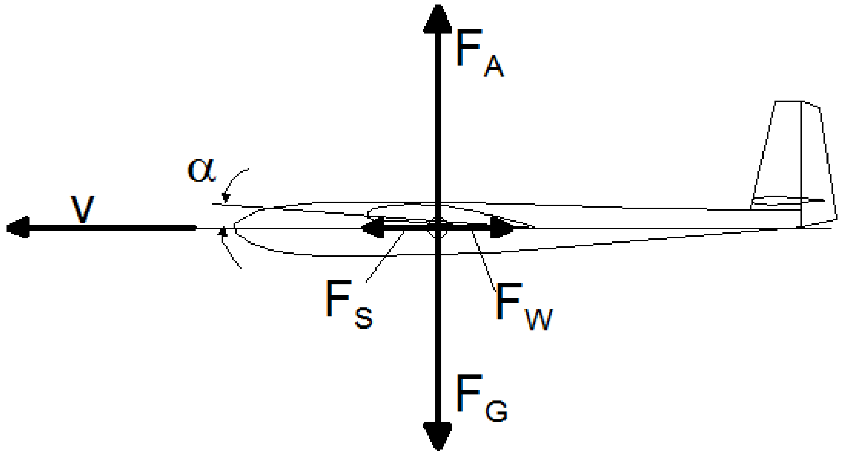
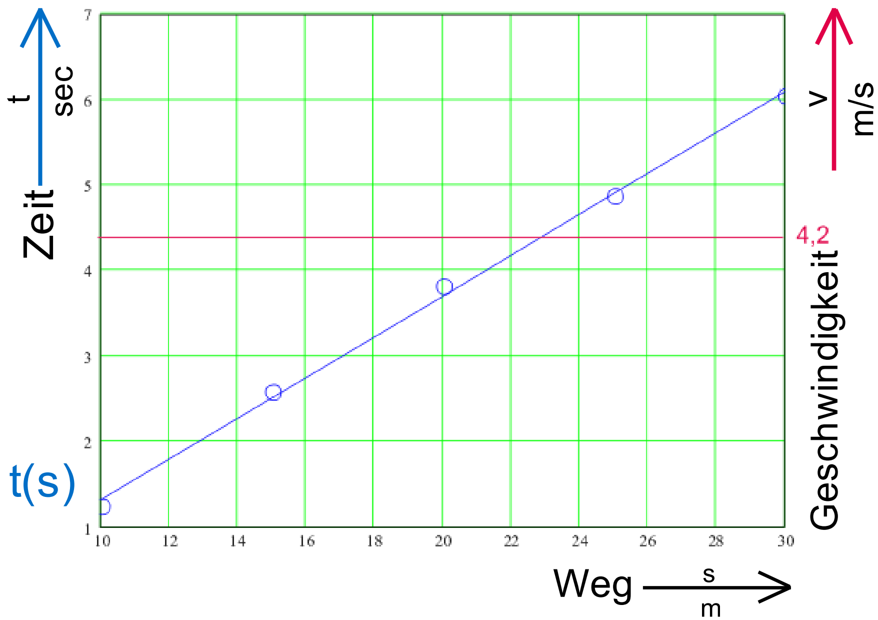
Linking to School Physics

- model in flight are moved bodies
- take-off process:
  - uniformly accelerated motion
  - $v \neq const$ (increase)
- cruising flight:
  - steady movement
  - $v = const$

Linking to School Physics

- Cruising flight: v = const,
- measurement: time-acquisition over path marks with the help of pupils





mit v_sl=4,2m/sec:

$$c_{a\_sl} = \frac{2 \cdot m \cdot g}{(v_{\_sl})^2 \cdot A_F \cdot \rho} = 0{,}94$$

→Lift coefficient can be calculated

→ determination of coordinate point_1 on polar curve

Linking to School Physics

determination of operating point_1 on the polar curve:

$$c_{a\_sl} = 0{,}94$$

inclusion of further drag coefficients:

$$c_{w\_sl} = c_{wp\_sl} + \frac{c_{a\_sl}^{\ 2}}{2 \cdot \pi \cdot \Lambda} + c_{ws}$$

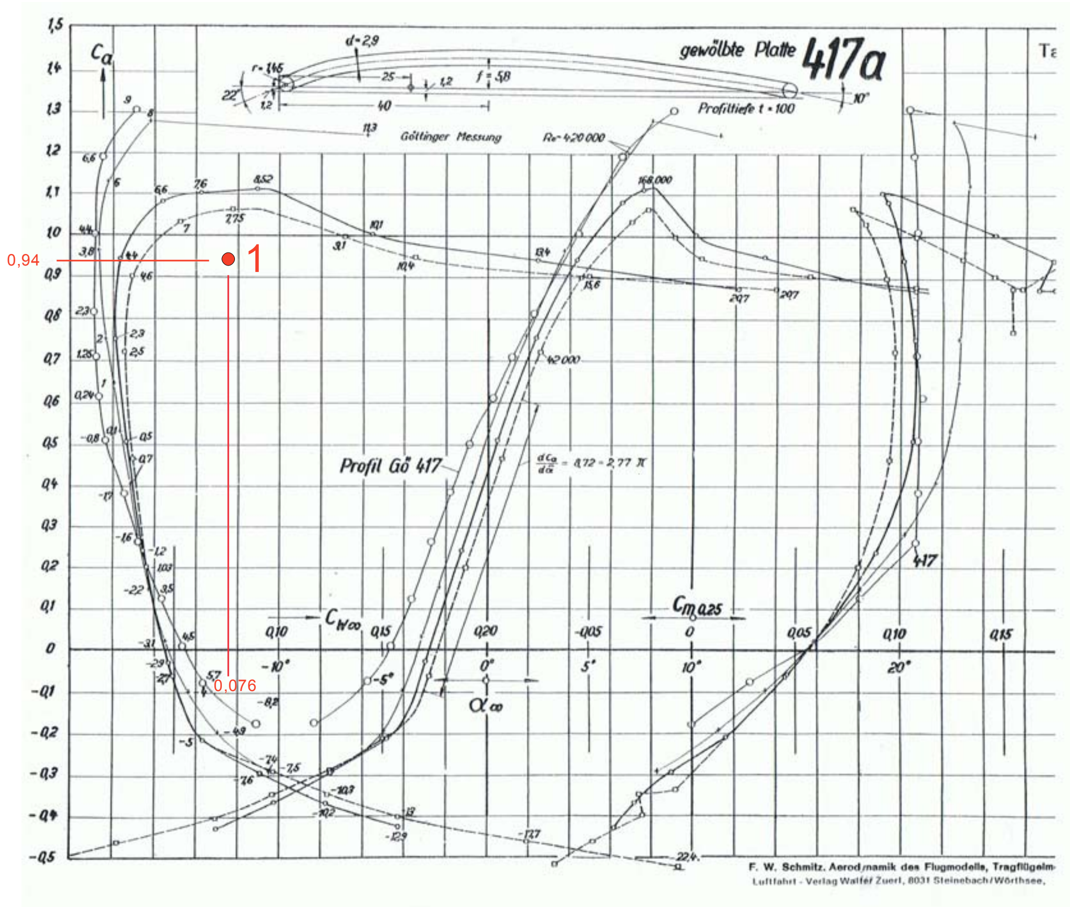
$$= 0{,}076$$

→we determined the operating point_1

→the Drag force is:

$$F_{w\_sl} = \frac{\rho}{2} \cdot v_{sl}^{\ 2} \cdot c_{w\_sl} \cdot A$$

$$= 0{,}13\text{N}$$

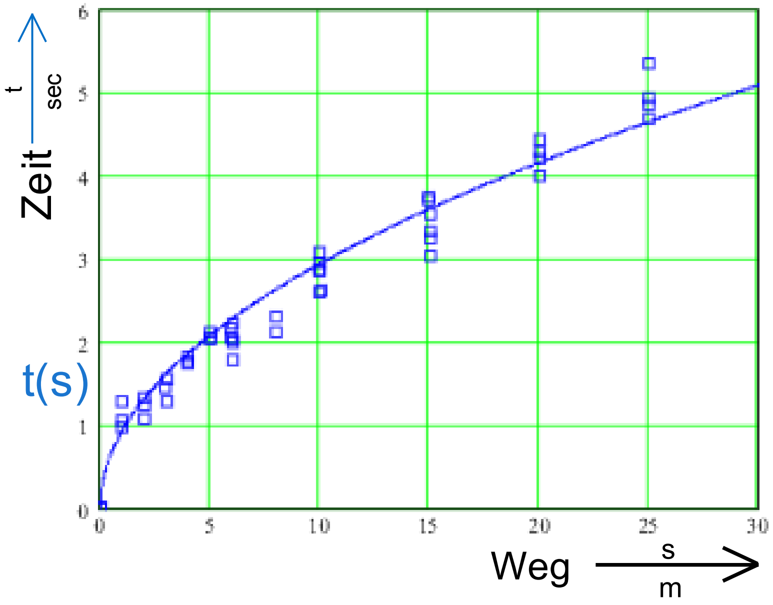


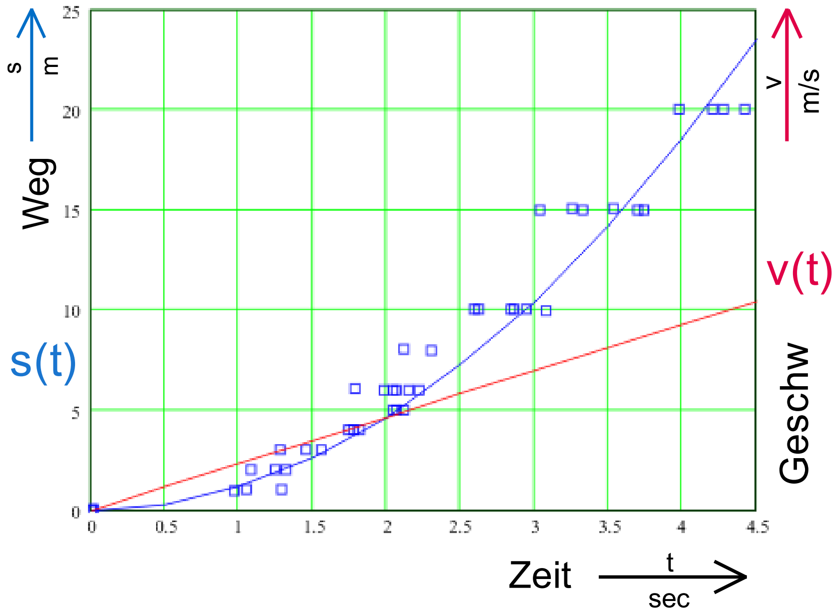
Linking to School Physics

- take-off process: v ≠ const,
- measurement of the accelerated phase over path marks with the help of pupils

measurement: t = f(s) ⟹ calculation: inverse funktion s = g(t)

find out the value „a“ for acceleration: $s(t) = \frac{a}{2} \cdot t^2$ →interpolation trough the points

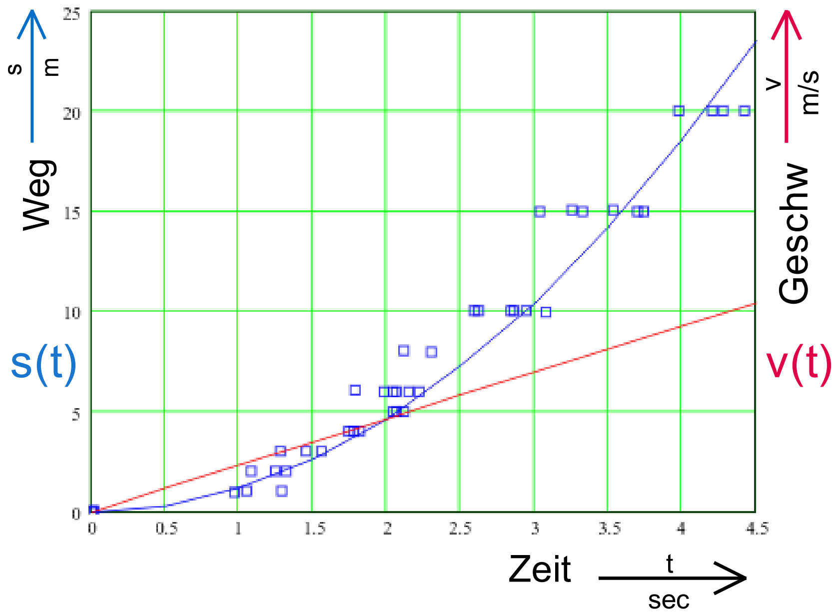




Linking to School Physics

- take-off process: $v \neq$ const, calculation:

interpolation give the value for acceleration “a“ in: $s(t) = \frac{a}{2} \cdot t^2$ $a = 2.3 \cdot \frac{m}{s^2}$



we get the thrust force in acceleration phase: $Fs\_b = m \cdot a$

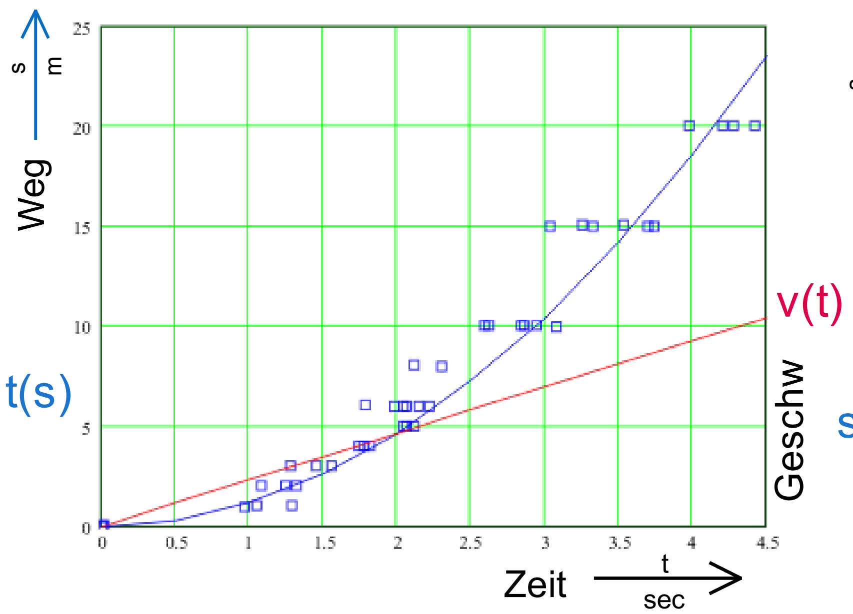
with mass $m = 0.17 \cdot kg$ $Fs\_b = 0,4N$

in comparison:
static thrust Fs_st = 0.8N

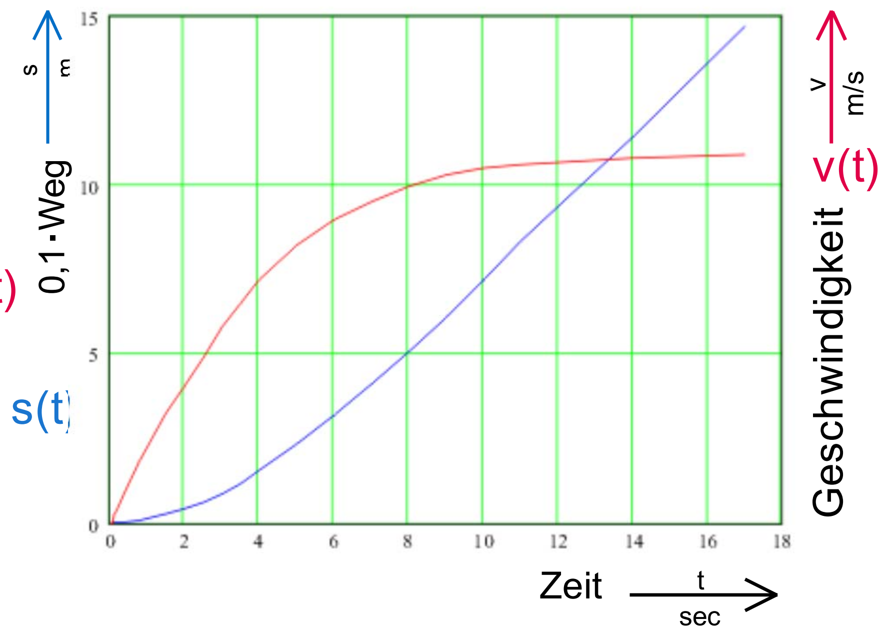
Linking to School Physics

- take-off process in total: from $v \neq const$ until $v = const$

measurement: $t = f(s)$ ⟹ calculation: solving DEQ = g(t)



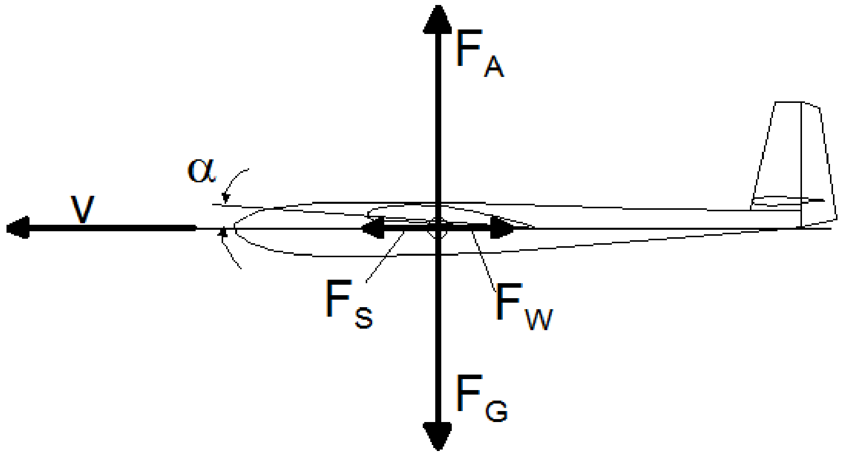
taking-off in the first seconds

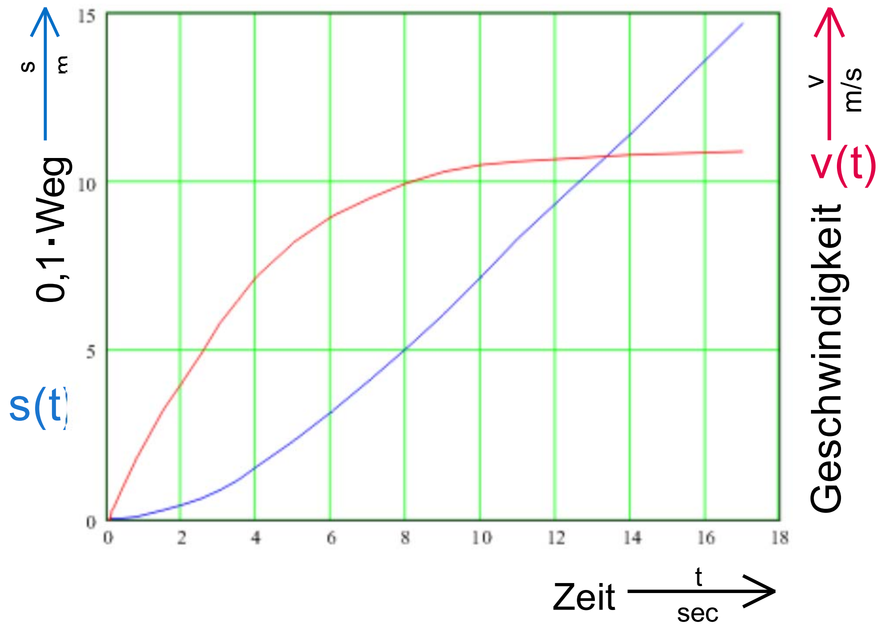


taking-off until $v = const$ for $t \geq 12sec$

Linking to School Physics

- Cruising flight: v = const, meassurement fast flight:





with v_fa=11m/sec:

$$c_{a\_fa} = \frac{2 \cdot m \cdot g}{(v_{\_fa})^2 \cdot A_F \cdot \rho} = 0,13$$

→ Lift coefficient can be calculated

→ determination of coordinate point_2 on polar curve

Linking to School Physics

determination of operating point_2 on the polar curve:

$ca\_fa = 0,13$

inclusion of further drag coefficients:

$$c_{w\_fa} = c_{wp\_fa} + c_{ws}$$

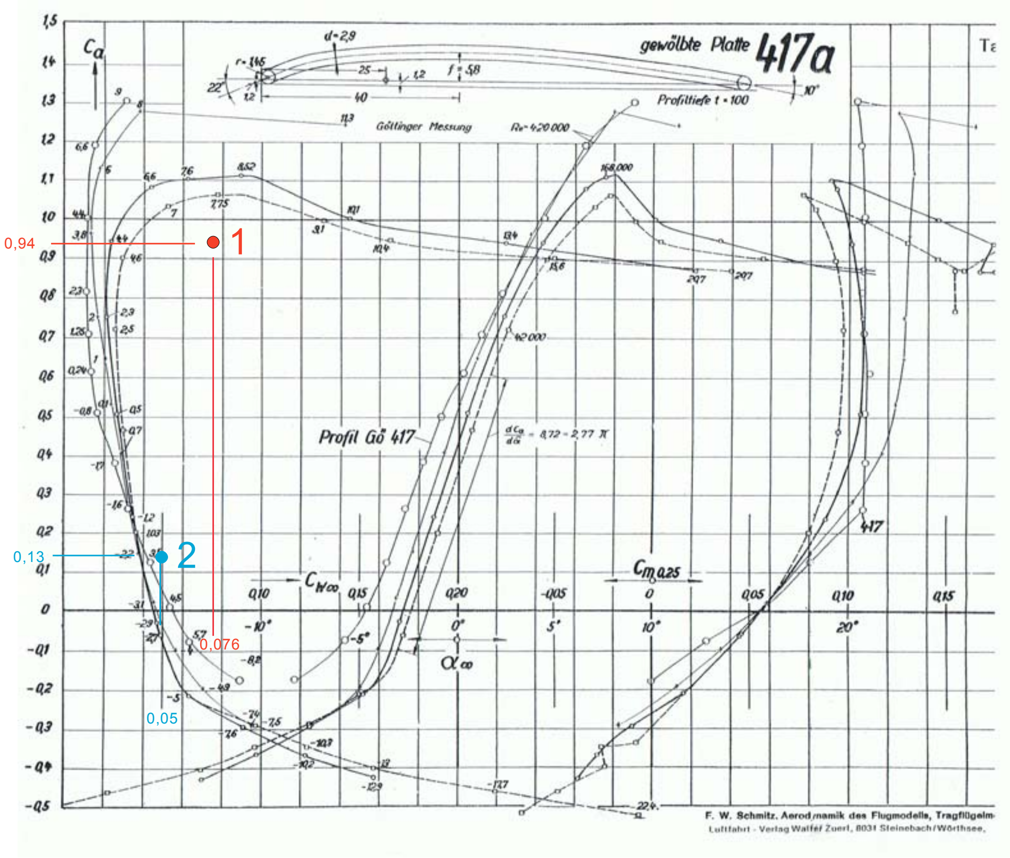
$$= 0{,}05$$

→we determined the operating point_2

the Drag force is:

$$F_{w\_fa} = \frac{\rho}{2} \cdot v_{fa}^{2} \cdot c_{w\_fa} \cdot A$$

$$= 0{,}6\mathrm{N}$$



Linking to School Physics

determine efficiency factor of propulsion, example fast flight

power output of the airscrew :

$$P_{mech\_fa} = v_{fa} \cdot F_{S\_fa} \quad = 6{,}5\text{W}$$

electrical input:

$$P_{el} = U_{acc} \cdot I_{acc} \quad = 21\text{W}$$

→ efficiency factor of driving system:

$$\eta_{ges\_fa} = \frac{P_{mech\_fa}}{P_{el\_fa}} \quad = 0{,}31$$

breakdown in individual components:

controller	electric motor	propeller
$\eta_{reg} = 0{,}95$	$\eta_{mot} = 0.85$	$\eta_{prop} = 0{,}4$

Summary

On an example could be shown, that we model aircraft flyer have a good chance to recruit pupils for our club in cooperation with a school.

Indoor flying has been proven successful to learn remote control operating.

The cooperation allows the practical application of the teaching material in physics.