A tiresome problem: V-tail and EWD

Eckart Müller

At irregular intervals I meet in the RC-Network.de -FORUM Cries for helpless pilot pilots who fail or despair when determining the EWD of their V-tail model. Of course, I do not know why this is so, I can only guess. But ultimately, the "why" is irrelevant, energetic help is required.

In order not only to convey a "recipe" based on the motto: "Take one ...", but to promote an understanding of the context, one can not approach the problem directly, but must accept a small detour who later (hopefully) facilitates understanding.

Anyone who sets out to determine an EWD knows what it is all about: measuring distances, calculating angles and an angle difference. There are now countless aids, mechanical equipment, software solutions and instructions to come to "on foot" to a result. Therefore it is superfluous to lose even more words about it. That should be known.

An important condition for a reliable measurement of the EWD is not to change the position of the model between the individual measurements. In this regard, it is often stressed that it is completely irrelevant how the model is positioned. It could be confidently put absolutely arbitrarily on a flat surface. In principle, this statement is correct, provided that all the resulting peculiarities are taken into account. Whether it is expedient, however, is another matter.

Everyone knows this picture:

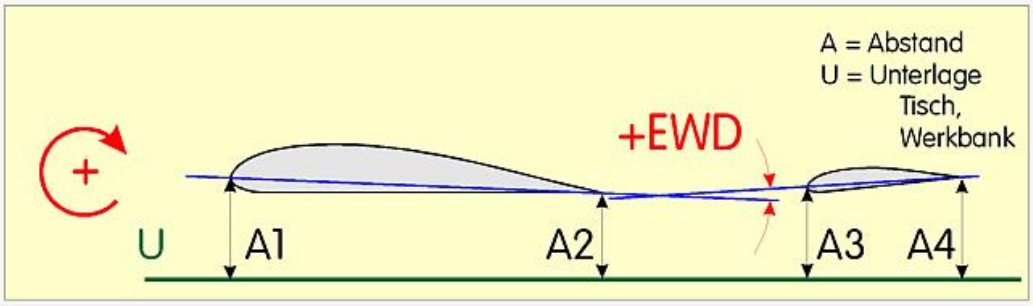


Image 1

Here, as an example, a model with cross tail has been used. And so far everyone should know how the EWD is determined. It is still the measurement of the distances A3 and A4 between nose and tail of the tail to the reference surface (pad, table, etc.), in order to finally calculate the tail angle.

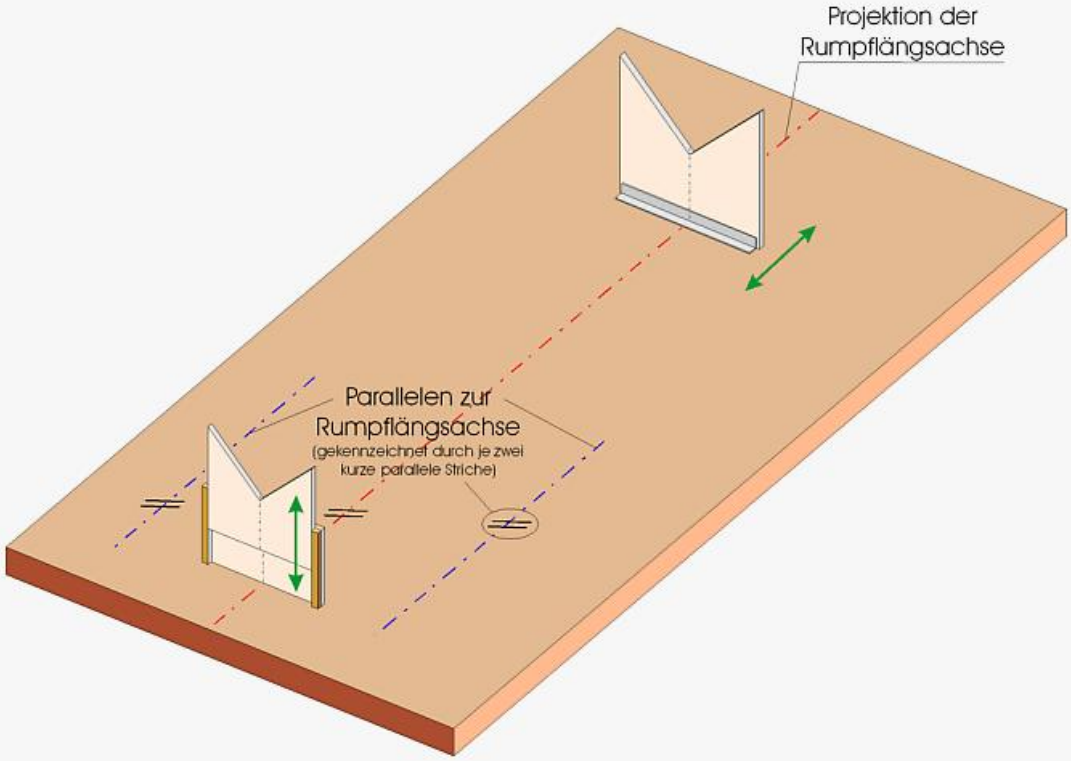
What is actually going to change if you are dealing with a V-tail unit instead of a familiar cross or T-tail? The somewhat provocative answer is: NOTHING!
Sure, that sounds startling, but it is so ...!

It is tacitly assumed for cross and T-tail units, although it has almost no significance here for the measurement. For V-tailings, however, this becomes an indispensable condition: *Measure parallel to the longitudinal axis of the fuselage (or its projection into the plan view plane, generally table, workbench, etc.)!* **This does not mean that the hull has to be aligned exactly horizontally. Deviations from the horizontal are eliminated in the calculation "automatically"!**

Unfortunately, the fuselage longitudinal axis is only an imaginary line that has never been observed in nature (at any rate no one is known to have ever encountered the longitudinal axis of its model in the fuselage). Therefore, it is quite costly to make a parallel to an invisible axis, especially when dealing with hulls where, with the best will, there is no flat surface.

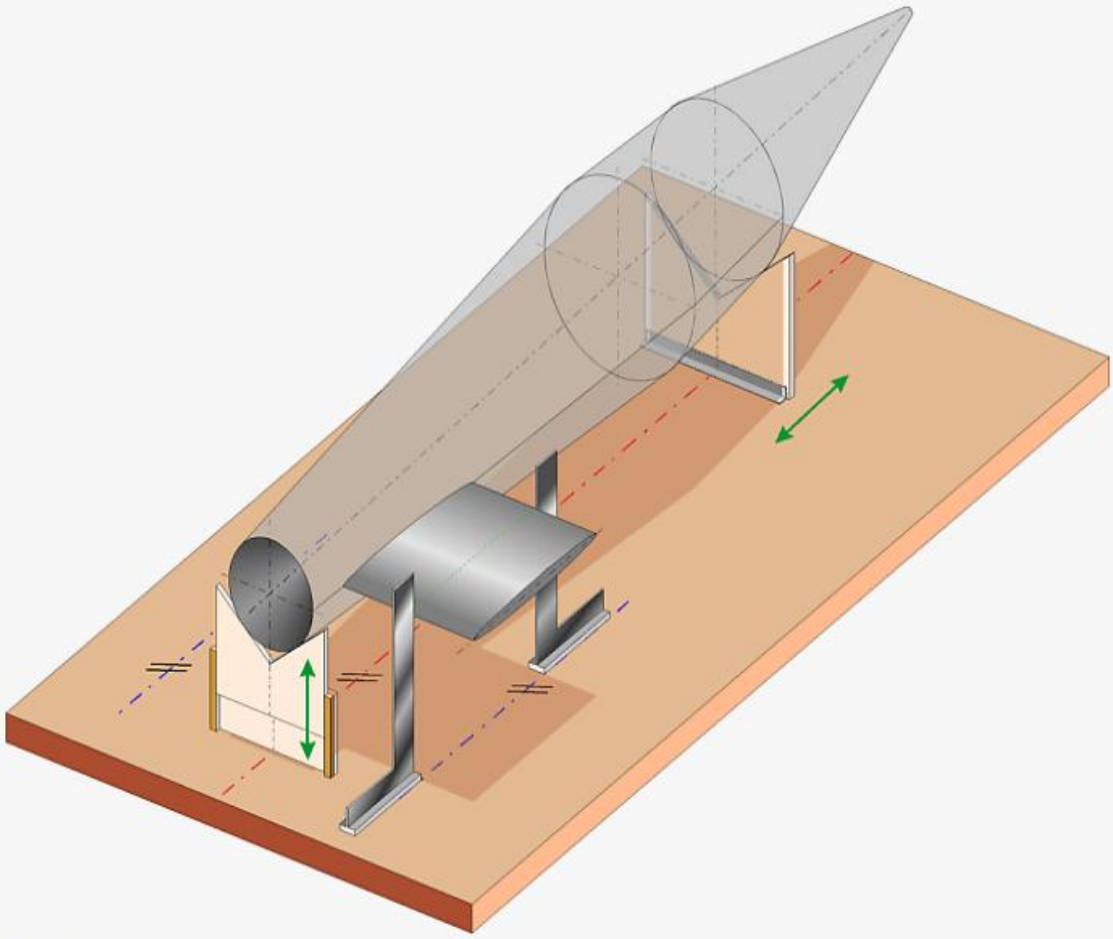
Therefore, I prefer to fix the model on a flat plate using two V-shaped bearing plates. These boards are positioned on a previously torn common centerline. One of the two boards is adjustable in height. The second board can be adjusted longitudinally to the hull length. So you get with little effort a universal hull storage, which has not only proven itself in the measurement of models, but also performs well in any assembly work (self-adhesive foam strips in the V-shaped cut outs secure the hull in addition to unintentional twisting).

Advantage: The fuselage always aligns with its longitudinal axis, almost "automatic", parallel to the recorded centerline.
Disadvantage: The production costs a little time and work the first time. But you can reuse the device but for all the following models.



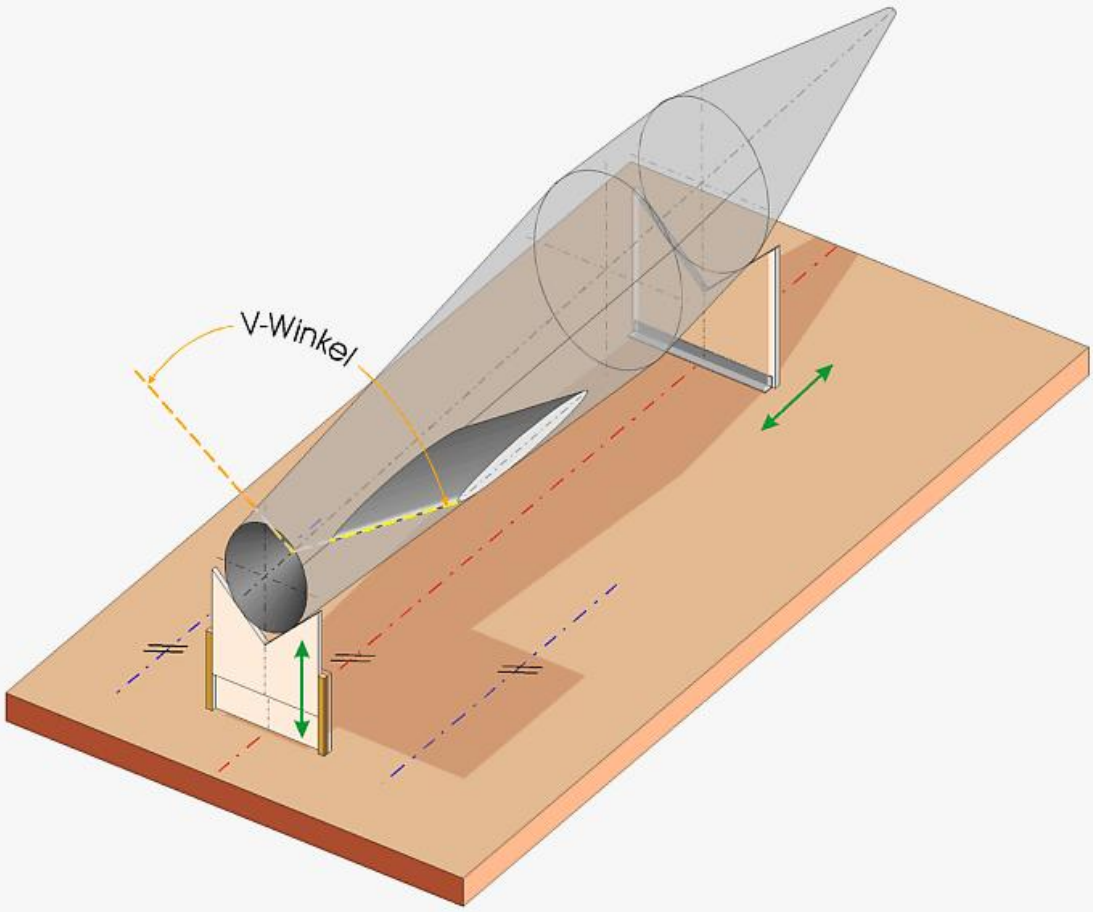
picture 2

The crucial point is the parallels to the fuselage longitudinal axis. In the case of cross and T-tail systems, parallel measurement is less important, although errors may also occur here if this is not observed.



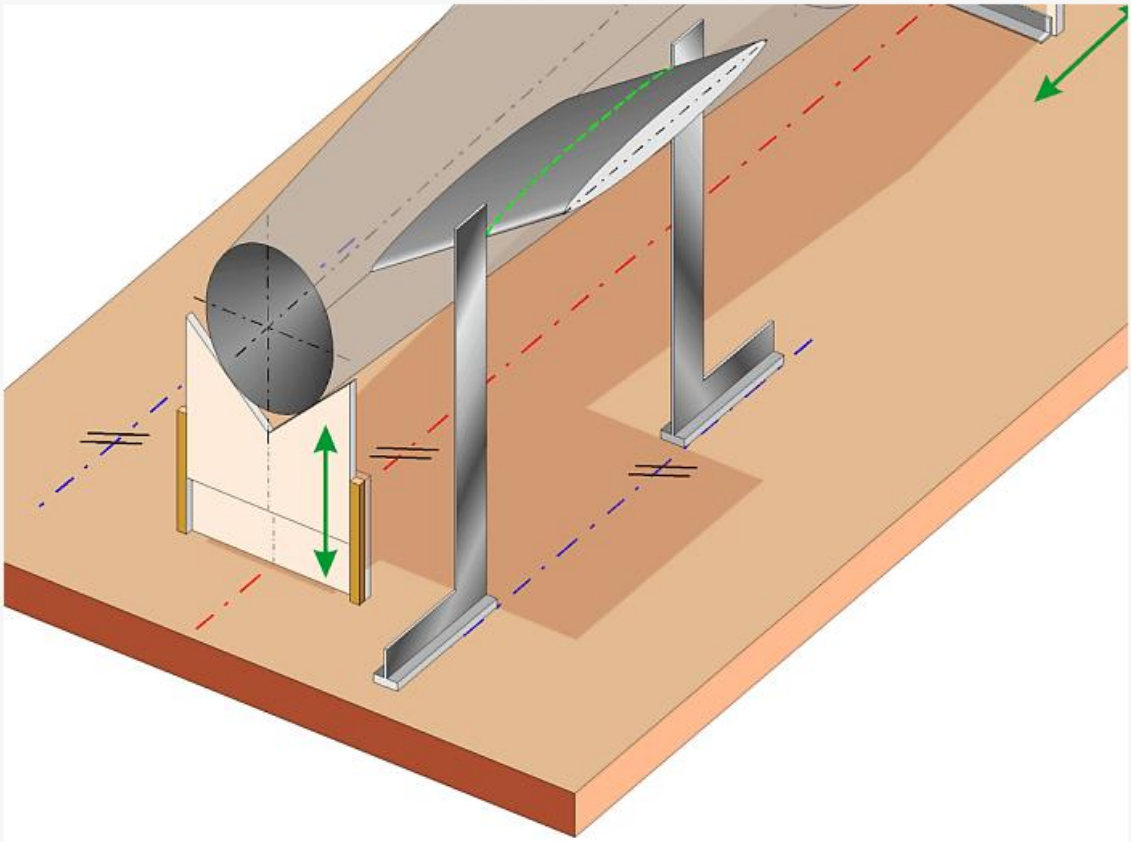
picture 3

However, the deviations are generally so small that they are within the range of measurement accuracy. This is no longer the case with V-tail units. Even small inaccuracies lead, as shown below by an example, to considerable measurement errors.



Picture 4

The setting angle measurement on the tail unit *must be made in the ground plane parallel to the longitudinal axis of the fuselage* . The blue dotted line must therefore be parallel to the red dot-dashed center line (projection of the fuselage longitudinal axis)! Because the green line on the tail is the projection of the blue dotted line on the tail half.
Why that?

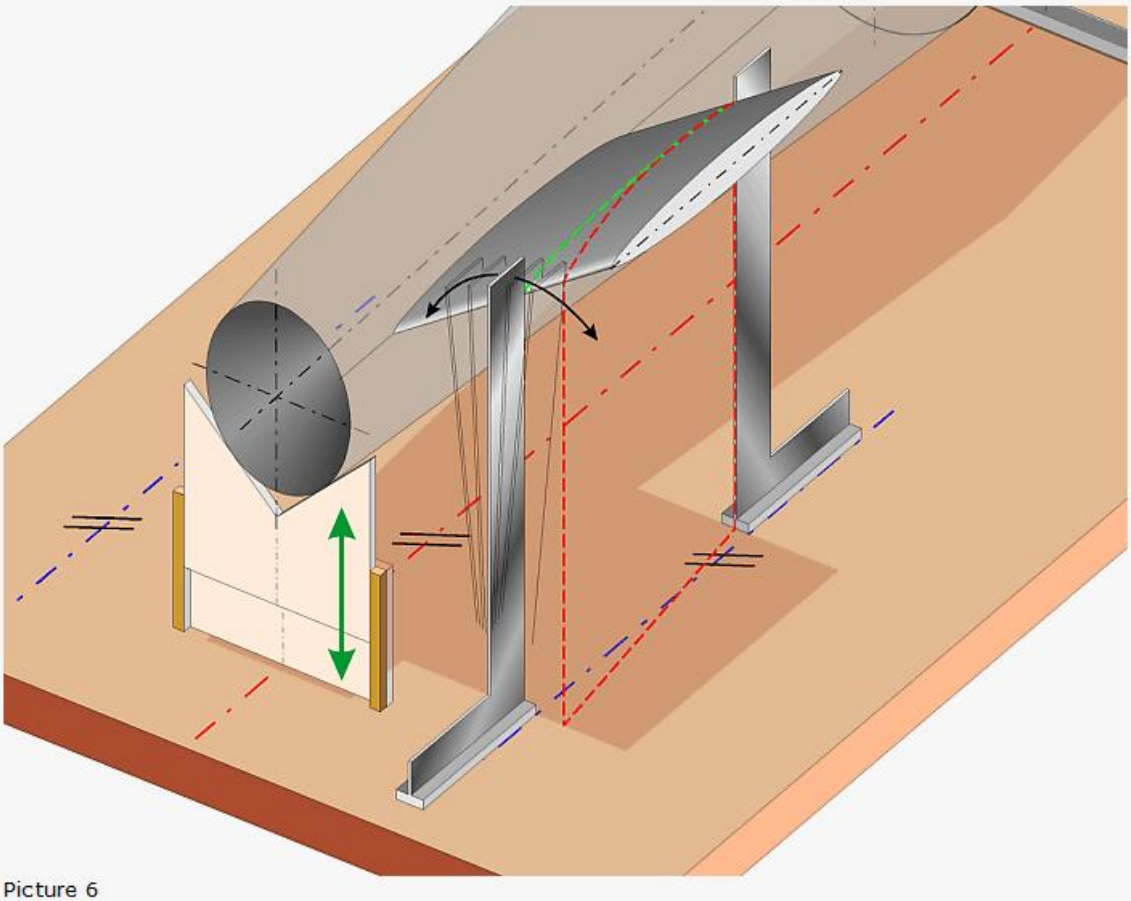


Picture 5

A small numerical example illustrates the reason for this requirement:

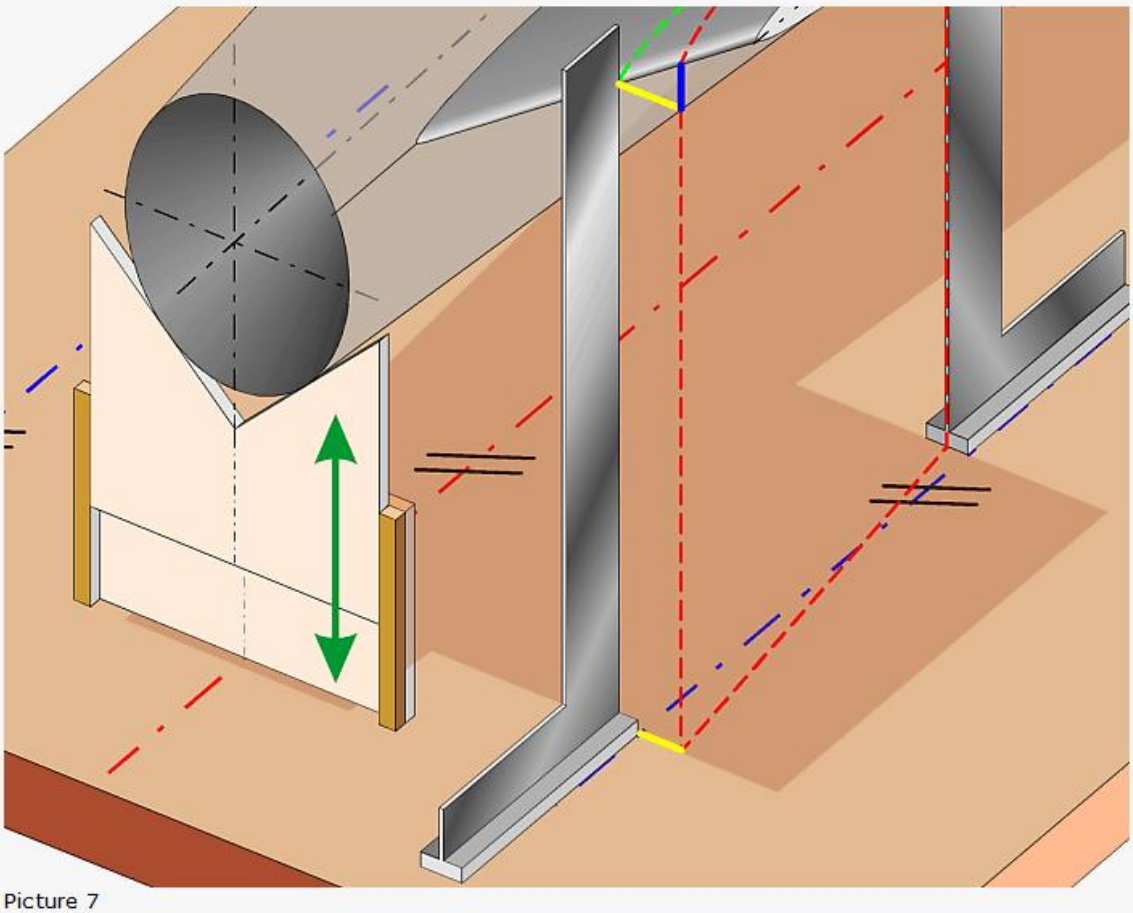
Given is a V-tail with a V-angle of 110 ° and a constant Leitwerkstiefe of 130mm.
The actual setting angle is 0 °.

The assumed deviation from the parallels is 5mm at the nose or tail end of the tail (yellow line, Figure 7).

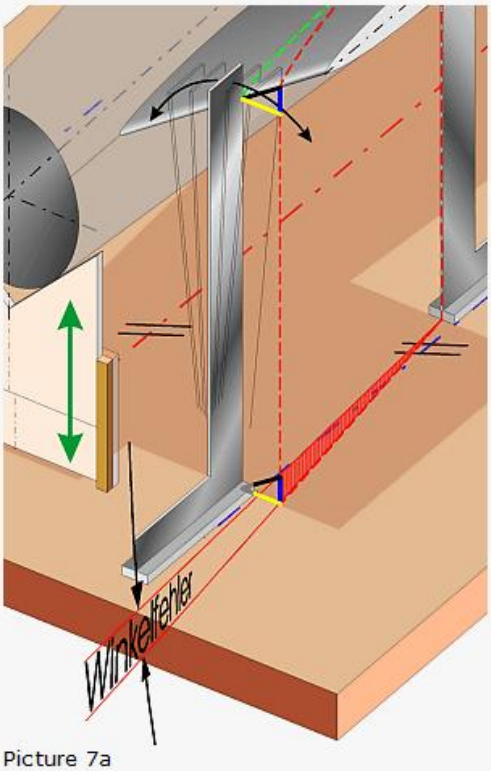


Picture 6

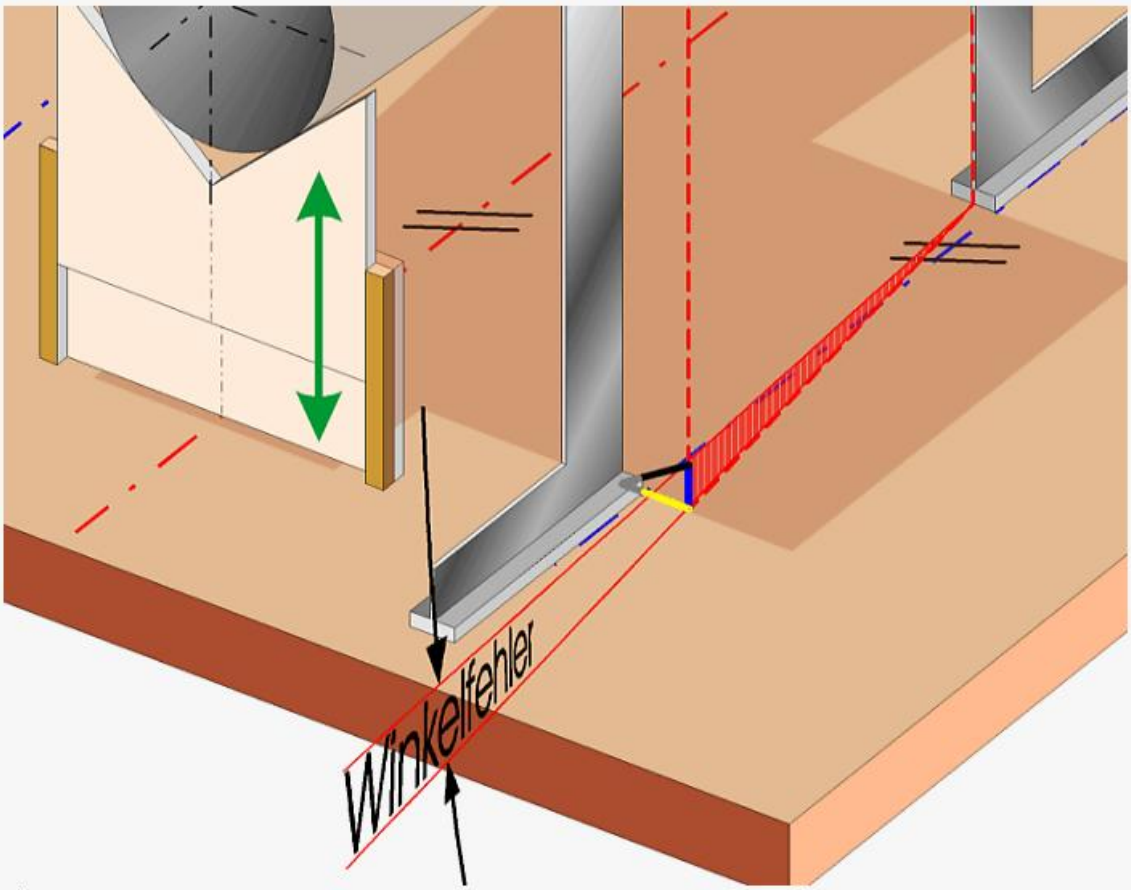
This could be z. B. go back to a non-parallel scribing the blue dot-dash line or to a not exactly perpendicular angle (Figure 6).



Picture 7



Picture 7a

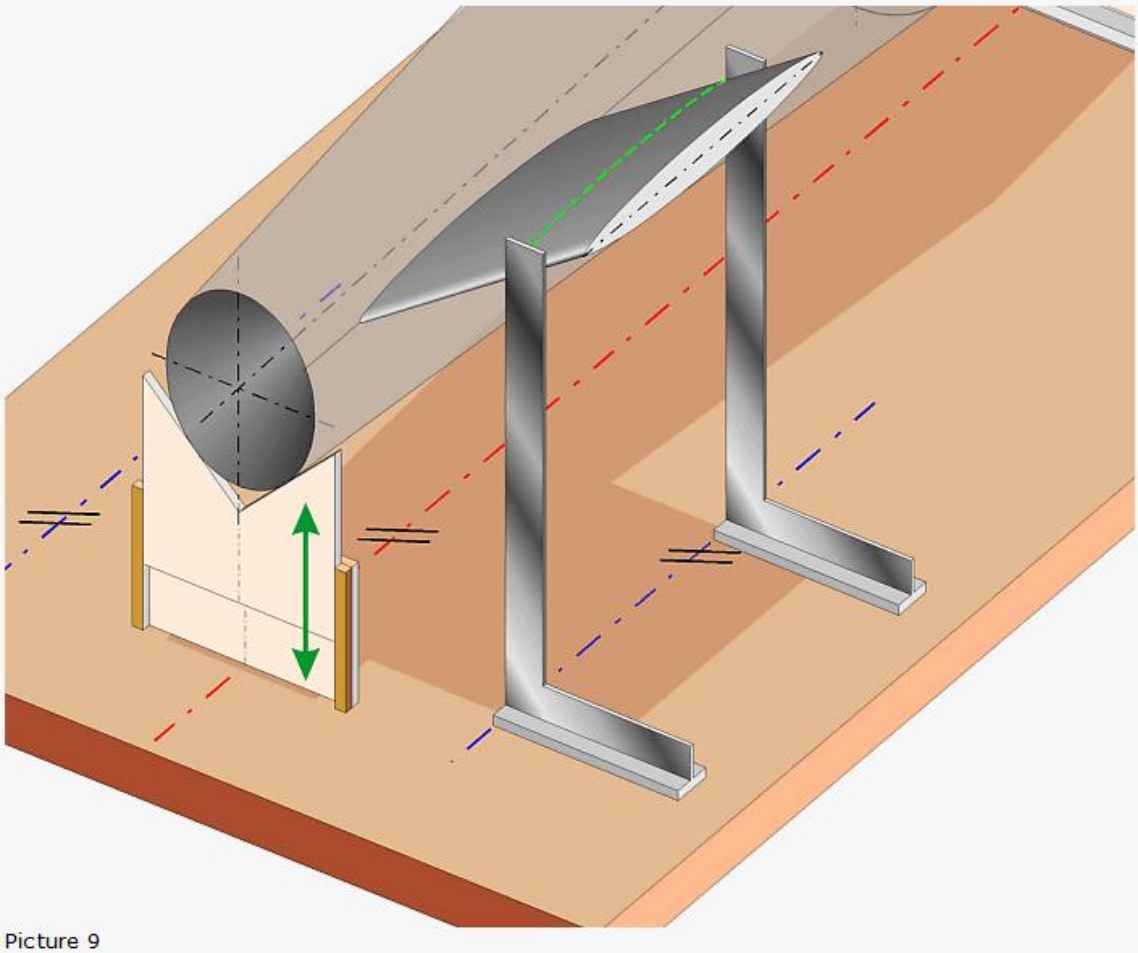


Picture 8

Under the above boundary conditions, instead of the correct value of 0 °, an apparent setting angle of approx. 1.5 ° is detected! The resulting angle error (Figure 8) is the result of the measurement error (short blue line in Figure 7). There is no need for any further comment.

And what are 5mm? For example, the slightest unevenness of the underlay can tilt the angle in one of the directions indicated by the black arrows (FIG. 6). Already one measures only crap!

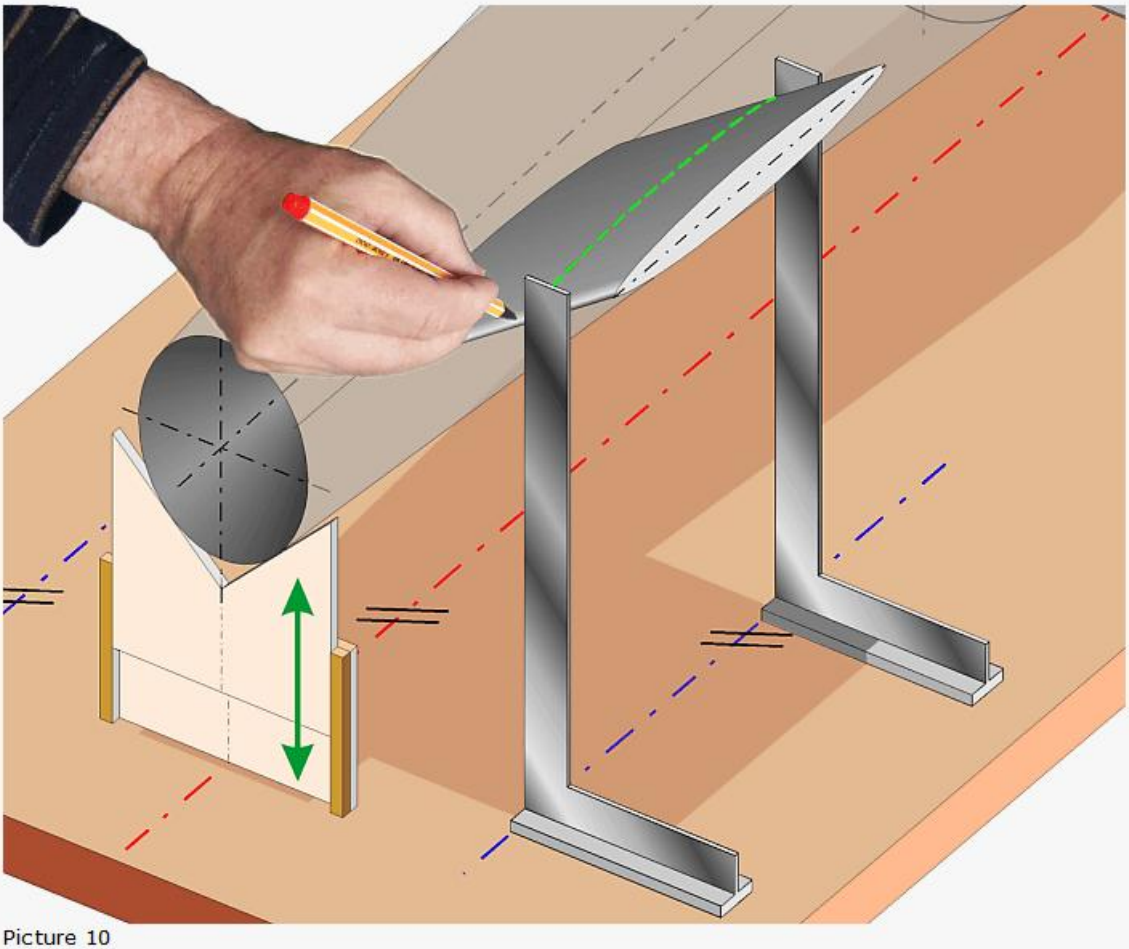
One could almost come to the conclusion that in this particular case a board as a base is actually completely unsuitable. A smoother, smoother surface would be desirable. But who owns a measuring table? So it is also recognizable that here Geo triangles or similar. Aids are completely unsuitable. Unless an additional triangle is used to control the perpendicular of the first triangle. Now it becomes clear that even the arrangement of the measuring aids is of considerable importance. But if one turns the angle turned by 90 ° (Figure 9), then reliably avoids at least the error source just described with their fatal consequences.



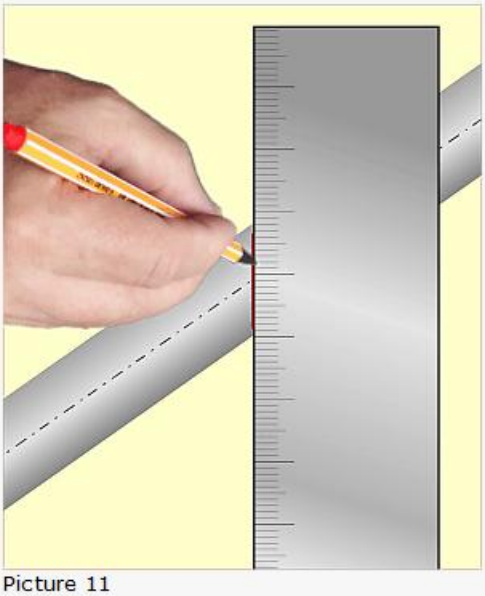
Picture 9

I do not want to conceal that this is another problem that is being dealt with again: It will now be more difficult to read the exact altitude. You have to look very closely to see where the nose and end bars touch the scale.

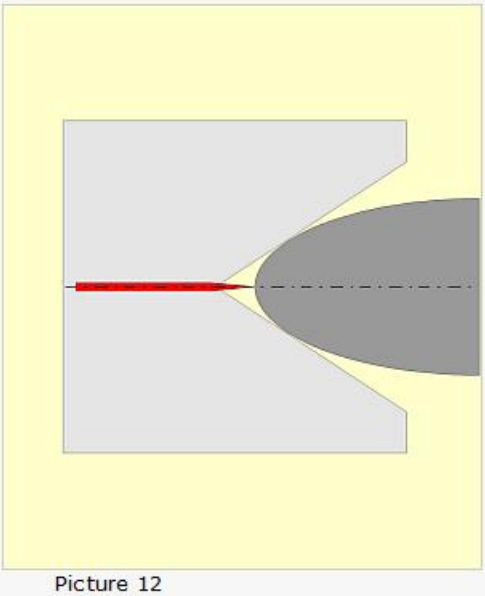
If it's popular, I would have a suggestion to make the right point reliable.
Take a pencil and mark the vertical on the leading edge of the nose (fig. 10, 11).



Picture 10



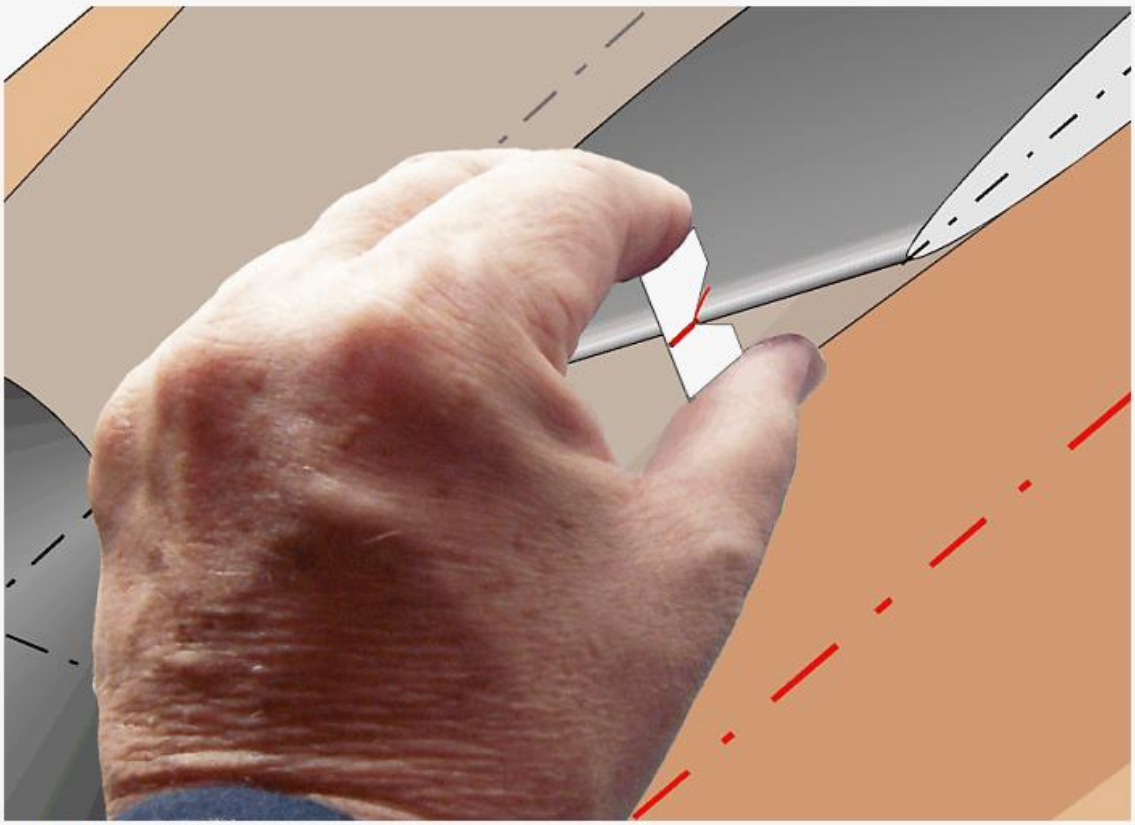
Picture 11



Picture 12

Next, make a "piekser" out of a piece of plastic or thin plywood and a shortened needle, similar to the one shown in Figure 12.

With this tool you always meet without difficulty the middle of the leading edge, which is well known in non-curved profiles is the point at which the chord begins. The inclination of the chord is finally what makes up the setting angle of the tailplane profile. And we want to finally determine that!



Picture 13

So after the decisive point has been reliably marked in this way, only the measurement of the distance A3 remains. This is no longer a difficulty at all, in which not much can be done wrong. The procedure is similar at the trailing edge of the tailplane. If it is a pendulum rudder, it must be ensured under all circumstances that the rudder can not move between the measurements. Somehow it has to be blocked, but reliable! The same applies to damped horizontal stabilizers. Set the rudder absolutely in the strak of the damping surface. So you can then measure V-tailings perfectly.
But please do not miss: The tail consists of two halves! Although I have shown only one page here for reasons of clarity, this does not mean that the second half can be neglected. On the contrary, differences in the setting angle of the two halves halves lead in a V-tail, in contrast to a cross or T-tail, inter alia, to an undesirable turn.

That's my suggestion for the problem. Certainly there are other possibilities that lead to the desired goal. Only the commercially available equipment I think for this particular case for relatively unsuitable because they do not take into account the special circumstances of the V-tail and their requirements very well.

In the face of all these inconveniences, the horror of some model airplanes before dealing with the setting angle of a V-tail is no longer very surprising. But with the necessary patience and the knowledge now available about the critical points, the measurement of a V-tail should have taken something of its horror.

WARNING! With so much effort and effort, even with an EWD that has been set to 100% on schedule and tested, there is no guarantee for optimal flight characteristics. The mutual flight-mechanical dependencies, for example between the center of gravity and the EWD, are too diverse for this, since the setting of a single parameter would suffice. Only careful flight helps!