Jukka Tervamäki 2.7.1989

N-15GX Gyrocopter accident.

Place: Tampere Pirkkala Airport in Finland.
Date: June 16, 1989
Weather: Good weather with clear skies, minimal wind, no severe gusts.
Pilot: Emerson Grooters, nationality: Norwegian (born in Texas)
Experience: Over 600 hrs of fixed wing time, 2 hrs of 2-seat gyroglider training in England, no gyrocopter experience. The accident flight was the first trial around the pattern. Permission from Finnish board of Civil Aviation for 40 hrs of flight testing of the machine on Pirkkala Airport.
Aircraft: Ken Brock KB-3 gyrocopter, bought as a kit from the factory in USA and assembled in Finland by the pilot. Rotor blades of fiberglass/epoxy construction with aluminium spar. Engine Rotax 532 with three bladed wooden propeller. The aircraft was built into the experimental-category and registered in USA.
Accident: The pilot had a purpose to make short hops with the machine on runway but instead took off and started to fly around the pattern. A few minutes after the take off rotor blades hit the propeller and tail, the machine inverted and hit the ground sideways with the engine, propeller and rotor totally stopped killing the pilot immediately.

The investigation of the accident has revealed the following conclusions (the authors opinions only):

1. An American born Norwegian pilot assembled an aircraft from American kit in Finland into USA registation and made a fatal accident in Finland.
2. The pilot had a lot of fixed wing time but very little gyroglider training and no gyrocopter experience.
3. The pilot took no advantage of the large experience of autogyros and autogyro flying in Finland. There was a very throrough 2 day rotary wing training course and symposium in Räyskälä, Finland during the last winter where all the Finnish autogyro- and helicopter builders and pilots were present.
4. The accident was a typical porpoising accident many of which have happened in USA and other countries over the past 30 years to the Bensen B-8M type autogyros of which the KB-3 is a further development.
5. There has been earlier one similar, fatal gyrocopter accident in Finland which happened to an Bensen type B-8M gyrocopter on Pori airfield almost exactly 20 years ago. All the relevant data of the accident is also identical. The pilot had 1400 hrs of fixed wing time. The machine started porpoising and crashed during one of the pilots first flights around the pattern.
6. The author has also seen one such accident happening in England about 17 years ago during the Fahrnborough Airshow, where one of Englands most famous test pilots at the time, P.W.Judge flew and crashed a Wallis autogyro because of porpoising.
7. There is one important common factor in all these accidents: None of these autogyros or gyrocopters had a horizontal stabilizer:

The bensen B-8M had a small metal plate under the propeller, which, however, was far too small and too near the center of gravity to have any effect on the static or dynamic stability of the machine. It also had no true airfoil. The KB-3and the Wallis WA-116 autogyro (at the time of accident) had no horizontal tail surfaces at all.

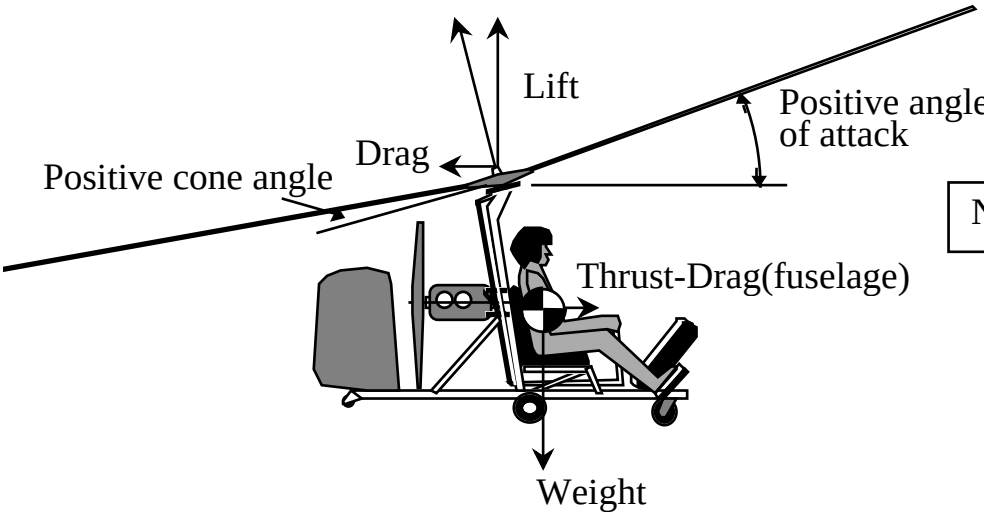
8. The above facts can be compared to FAA certified autogyros of pre- and post WWII period all of which have a large horizontal stabilizer. Good examples are Umbaugh/Air&Space 18-A and McCulloch J-2. After the above mentioned accident Mr. Wallis also installed a horizontal stabilizer into all of his later machines.
9. The author has designed and built several autogyros and has flown them with and without horizontal stabilizers. With this experience and having also studied theoretically the autogyro static and dynamic stability he became convinced already 20 years ago of the importance of the horizontal stabilizer in autogyros and therefore designed a large V-tail into his ATE-3 autogyro and an even larger H-type tail into the JT-5 autogyro. In both cases the result was statically and dynamically stable flying characteristics even at high speeds. Therefore, the concluding remarks can be summarized as follows:

10. A gyrocopter with an offset gimbal rotor head is statically stable without a horizontal stabilizer but has low damping in pitch and is quite sensitive to fly needing only small control imputs. Experienced pilots like Ken Brock himself can perform a very impressive air show program with this type of a machine, but in the hands of an inexperienced one it is a deadly thing.
11. Fixed wing pilots, used to a statically and dynamically very stable machine needing large control imputs, are unaware of the sensitive gyrocopter and easily overcontrol the machine which all too often leads to a porpoising flight with a negative g flying condition. At this point the gyrocopter looses the control completely, the rotor RPM slows down with the blades going to a negative flapping angle and hitting the propeller and vertical tail. The faster the gyrocopter flies, the more sensitive it is to control, if there is no horizontal stabilizer.
High speed also means low rotor angle of attack and this, combined tocontrol sensitivity, brings the machine close to the edge of negative g.
12. On the opposite, an autogyro with a sufficiently large horizontal stabilizer has more damping in pitch making it less sensitive to large control imputs even at high speeds. The stabilizer also creates a downward force adding static stability and loading the rotor. Therefore an unintended negative g condition, overcontrol and porpoising is less possible.
However, the horizontal stabilizer will not prevent a negative g-maneuver (if the pilot so wants), wich is dangerous to helicopters as well, especially with a teetering rotor (as some accidents in the past have shown). Therefore, it is always necessary in autogyro flight training to point out the importance of positive g-maneuvers even when the machines are equipped with a horizontal stabilizer.
13. The author therefore recomends, that all the autogyros which are built or flown in Finland in the future must have a horizontal stabilizer with big enough tail volume to make them easier to fly for fixed wing pilots and beginners as well. If the kit builders are not willing to design and include them in their products, suitable ones can be designed and tested in Finland.

N-15GX Gyrocopter Accident

Tampere-Pirkkala , June 16.1989

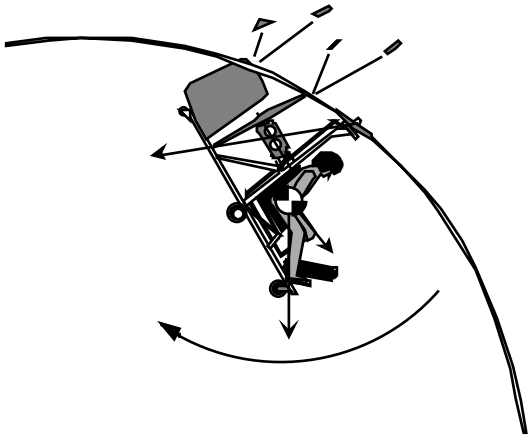
J.Tervamäki 4.7.1989

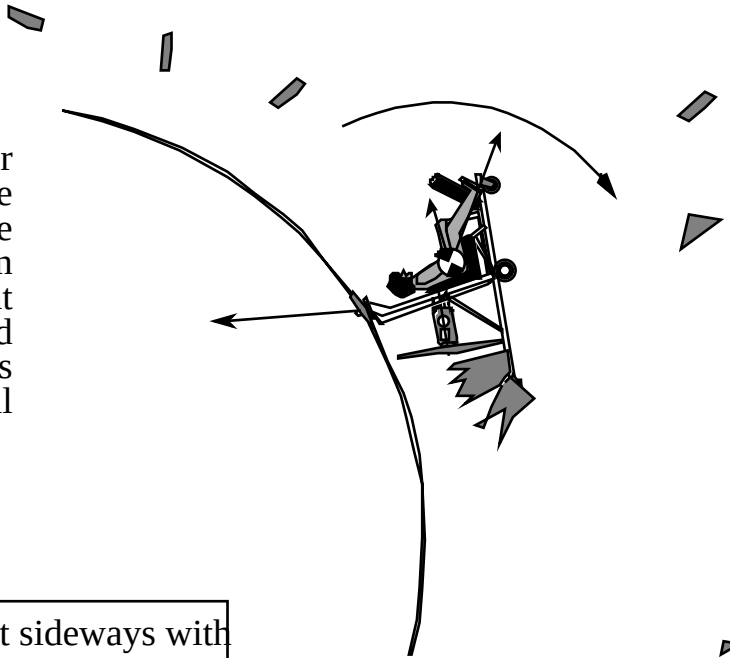


Normal cruise condition

Negative-G condition
after PIO and porpoising

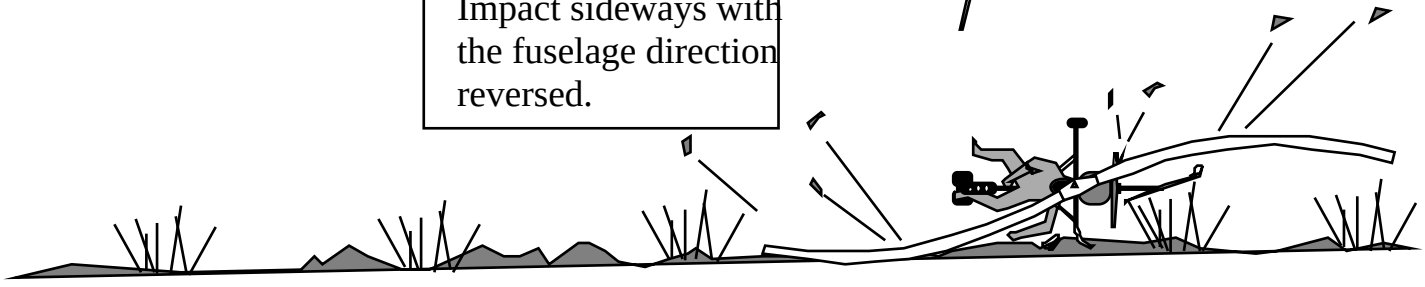
Negative angle of attack results in low RPM and large negative blade cone angle, rotor is hitting the flapping stops and finally rotor blades hit the vertical tail and propeller





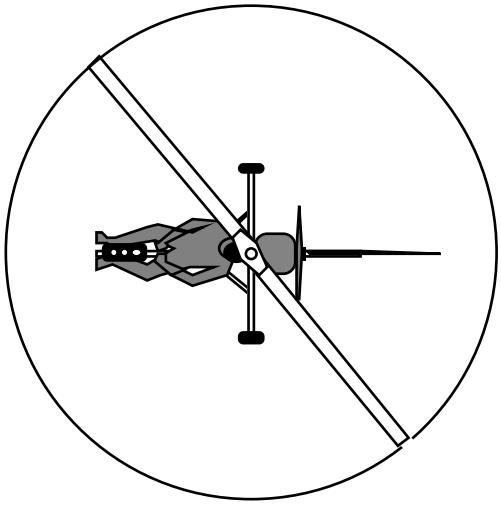
The eye witnesses were quite far and could not describe exactly the tumbling movements of the gyrocopter but in the final position the blades were highly bent upwards, a proof of low RPM and high velocity. Gyrocopter parts and pieces were scattered all around the place.

Impact sideways with the fuselage direction reversed.



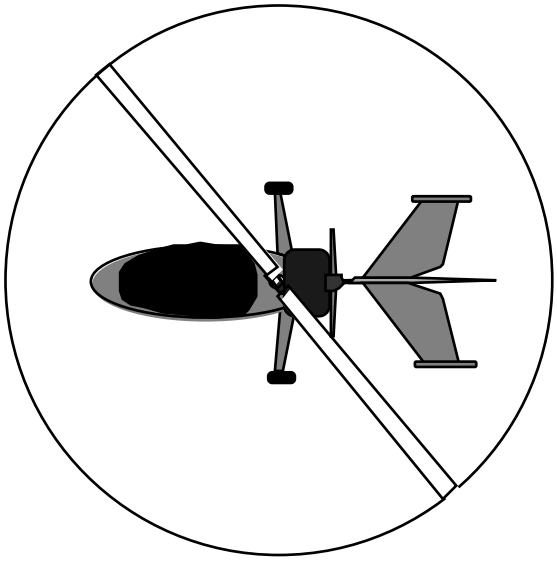
Ken Brock KB-3

No horizontal tail
Tail volume =0



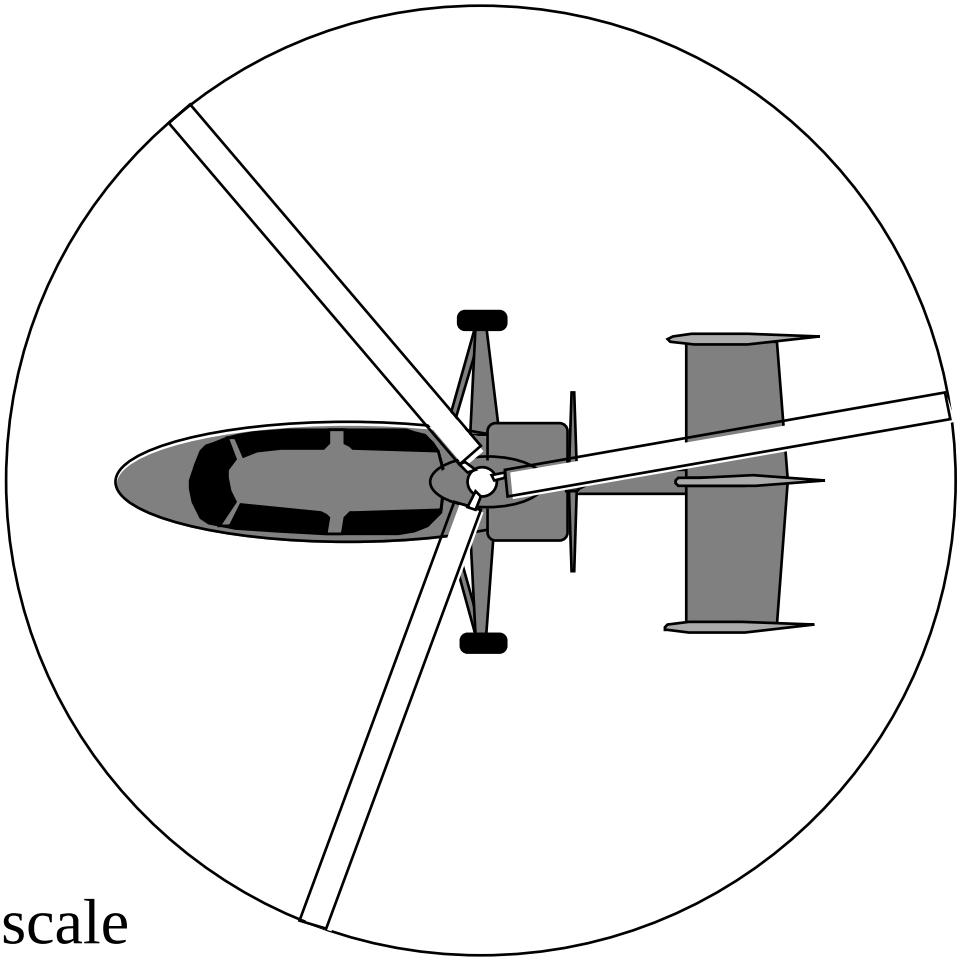
Tervamäki JT-5

Horizontal tail area 0,9 sq.meters
Tail volume about 1,2 cu.meters
Triple vertical tail adds to
the horizontal tail aspect ratio



AIR & SPACE 18-A

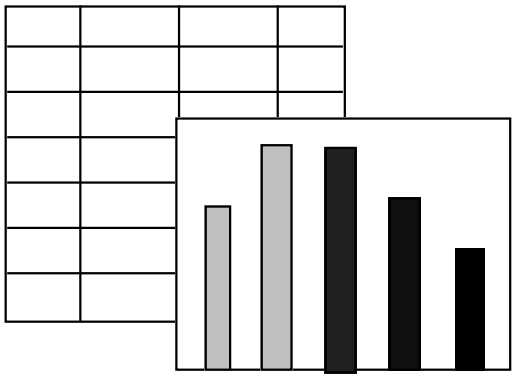
Large horizontal tail
(No numerical data available)
Triple vertical tail adds to
the horizontal tail aspect ratio



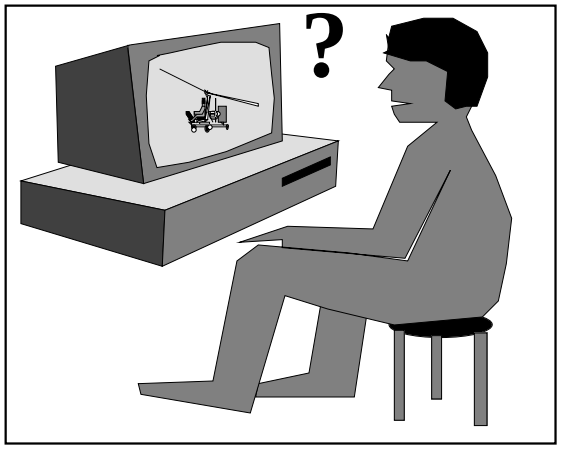
Drawings not to scale

Proposal for a Gyrocopter Stability Investigation program.

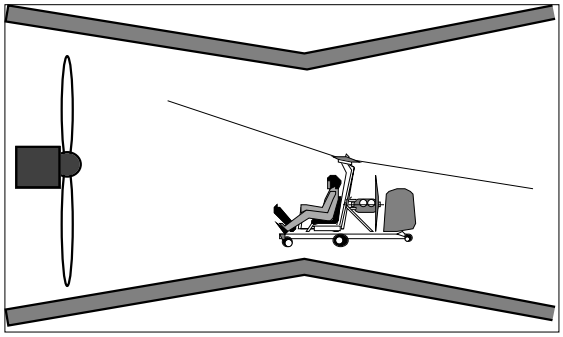
(JT 12.11.90)



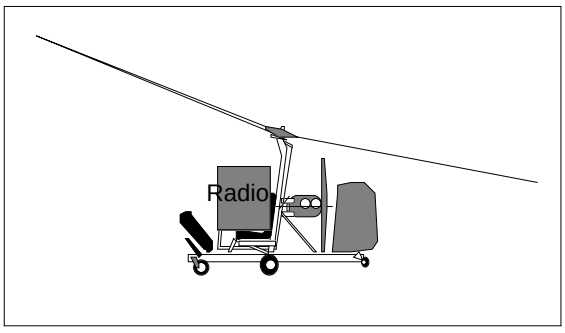
1. A throrough analysis of NTSB gyrocopter accident statistics of the past 30 years.



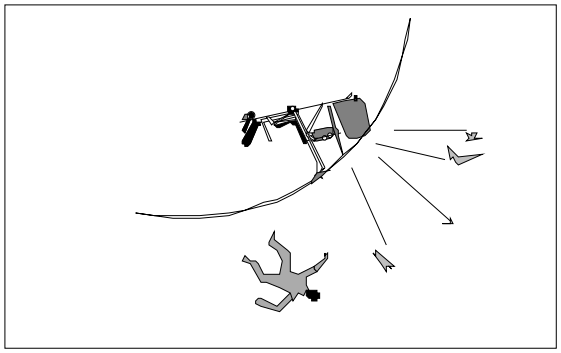
2. Computer calulation and simulation of gyrocopter stability with and without a horizontal stabiliser. A videotape or a disket of the results could be made available for homebuilders.



3. A full scale wind tunnel testing of a gyrocopter and measurements of its stability and control response with and without a horizontal stabiliser or.....



4. ...if no wind tunnels and funding are available for the purpose, test flight program with a radio controlled gyro-copter with and without a horizontal stabiliser (using a data logger and a chase plane to collect the data and make videotape of the gyrocopter response) or.....



5. ....if this is not possible, the same test flights at 10000 ft by a brave, voluntary test pilot carrying a parachute for himself and another for gyrocopter recovery.