

# Training documents for the HelicopterSchool (V1.0)

## Introduction

Hello everyone, my name is Bernhard and I would like to give you an insight into the real world of helicopters.

I myself was a helicopter pilot in the "Bundeswehr" (German Armed Forces) on the UH 1-D (including IFR) and a flight instructor on the AL II in basic helicopter training.

In this basic helicopter training, students (without any previous experience) are taught the tools they need to obtain their license after 100 hours of training. In comparison, the civil PPL H training only takes around 40 hours.

The basics of helicopter flying are explained in various topics and suitable exercises are provided to improve your performance. What you put into practice is up to you. Everyone can take part and decide individually on the intensity and duration of their participation.

Even now: create a flight log in which you note down the hours and the content of your flying. Believe me, it's worth it and you will concentrate more on the exercises. It doesn't matter which helicopter you are flying.

When you start with a topic, read up on it and do the exercises.

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## Chapter 1: Requirements for the helicopter flight in the simulator - coordination of arms and legs

Let's start by looking at the real helicopter world and compare it with the simulator world.

### Basics

The control of a helicopter always takes place under the SIMULTANEOUS use of

- Stick (selective blade adjustment)
- Pitch (collective pitch control)
- Pedals (control of the tail rotor for torque compensation and rotation around the vertical axis)

This means that any change to one control element ALWAYS requires a simultaneous reaction to the other control elements. This

simultaneity also means that you cannot pull the pitch, see what happens and then compensate with the stick or pedals.

An example:

You are flying at a constant altitude at a constant speed. If you now pull the pitch, the helicopter will

a) slows down

b) it climbs and

c) it will turn against the direction of rotation of the rotor.

Solution: Pulling the pitch means both pedals to the left (same direction as the rotor turns) AND stick forward to maintain altitude. You cannot prevent this: The helicopter speeds up and the kts display increases. But that should have been the point if you pull the pitch in a constant straight flight.

What this means when hovering will be explained in one of the next chapters.

What you have to do without in the simulator is the "popometer", or rather the "feeling in your body" - unless you have a motion simulator.

When flying helicopters in the simulator, try to make your stick as long as possible. Why? The stick of the UH1D is around 47 cm high from the ground to the lower edge of the handle. Now move this stick 2 cm to one side. Now do this (or imagine it) with a handle that sits directly on the base. You will surely recognize the difference in the control impulse at the base.

No question: you can also steer with a handle directly on the base. But don't be surprised if you can't steer the buck sensitively or if you think you're at a rodeo when hovering. This has NOTHING(!) to do with your flying skills!

If you adjust the path of your pitch, you will also be grateful for a few centimetres more travel. The pitch control will then be more "forgiving". But this is a matter of taste and a question of how jittery your helicopter is.

In reality, the pedals do not have a return spring and therefore do not "jump" back to a zero position. The same applies to the stick. Once the rotor is up to speed, it's like trying to put a wooden spoon into an empty soup pot.

For our "training", concentrate now or in the next few days on your controls, the vario, the altimeter, the IAS (airspeed indicator), the bubble in the turn and bank indicator (gliders have a thread) and the climb and dive indicator (ft/min). You can forget about all the other instruments at the moment. For the hover

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controls, the vario, the altimeter, the IAS (airspeed indicator), the bubble in the turn and bank indicator (gliders have a thread) and the climb and dive indicator (ft/min). You can forget about all other instruments at the moment. For hovering you only need your controls.

### **Exercise for arm-leg coordination:**

Sit on a chair. Somewhere, not at the simulator controls. Let your left arm hang down, place your right forearm on your right thigh and stretch your legs. It doesn't matter whether they are fully extended or not at the moment. Now visualize the direction in which your rotor blades are turning. (presumably to the left when viewed from below)

Here we go!

Pull the pitch, push the stick forward at the same time and press the left pedal at the same time. That is one movement! Watch yourself as you do this. It doesn't matter how big your movements are. Do it again and again: pull left, push right forward and press left pedal. The opposite movement is inevitable: press the pitch, push the stick towards your body and press the right pedal.

Practice it over and over again. Make big movements and then small and tiny ones from time to time. Concentrate on the pitch and see what the stick and pedals do. Concentrate on the stick and see what the pitch and pedals do and concentrate on pressing the pedals and see if the pitch and stick make the right movement. If I ask you to push the stick forward and the pitch goes up at the same time as the left pedal is pressed without you having to think about it, you've done it.

I have to do this exercise to you, because we are in the simulator and not in the air (or on the ground), where you can experience all this practically and an instructor can intervene at any time. You don't need to think about it in nature.

If you don't know and can't handle this simultaneity in hover flight, you will throw the helicopter away.

The last major difference between the simulator and the real thing is that you don't need to be afraid of the ground in the simulator and yes, this also means no fear of death if the helicopter slips away from you. In real life, beginners experience this fear and are sometimes completely stiff and tense.

Motivation: Beginners do their first solo after 5 hours. Pick up - put down, pick up - put down. Let's not talk about how I feel as a teacher standing outside. So far, EVERYONE has managed it.

Do this exercise as often as you can think of. Just a few minutes on a regular basis is enough: Pull pitch, push stick, kick left leg ... and backwards: pull stick, press pitch, kick right leg and

always at the same time.

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## **Chapter 2: Hovering flight (pick up, set down, diagonal, across, backwards, turn)**

### **A few thoughts in advance:**

The young student pilot (m/f/d) has - at least with the German Armed Forces - been given a 1 1/2 hour familiarization flight. Here he was shown what to expect and how exciting it can be. There are also said to have been instructors who pushed the students to their physical (stomach) limits. Now then. After this introductory flight, the student will spend the next 10 (in words: ten) hours in the hover square with their instructor to learn how to hover. I consider hovering and the hover square to be the ultimate at the beginning of helicopter flying. Why? Hovering is always necessary in helicopter flying. It starts with hovering when picking up before take-off and ends when setting down after landing. External loads, rescue flying, winches, landings on slopes ... I can't really think of a situation in which hovering is not needed. So it makes sense to devote a lot of time to the subject.

The helicopter simulator pilots have a decisive advantage: you don't need to be afraid of the ground. Why do I say that? EVERY student would "kill themselves" in the first two hours of learning to hover. It is a completely natural human reaction to approach the ground uncontrollably, to pull the pitch in a panic for safety and out of fear of impact.

If he does this, a deadly spiral begins: Pitch maximally high, helicopter rears up at the front. Torque pulls the tail against the direction of rotation of the rotor ... the attempt to hold back leads to maximum movements in the controls. The pitch is no longer released as a handle, you don't know what to do with the pedals and the stick moves from one corner to the other.

In such a situation, there is nothing more to be gained for the student. Without an instructor next to them, we would now have a fatal flying accident.

### **Picking up and setting down**

**Picking up exercise1:** Start your helicopter, sit relaxed at the controls and slowly pull the pitch until the helicopter becomes "light" but continues to touch the ground. At this point, lower the pitch again.

It is important that you aim at a reference point far in front of the helicopter nose when softening the helicopter. This will make it easier for you to recognize tendencies etc.

Now you perceive tendencies. Does the helicopter want to move

forward? Does it want to turn to the left or right? Remember, every helicopter has different feet (landing gear or landing gear or even floats) and also has a different center of gravity. I remember the AL II, which always touched down first with the skid landing gear at the rear right. So the right rear was always the last point to touch the ground on take-off.

**Picking up exercise2:** Slowly pull the pitch again and use the stick and pedals to compensate for the tendencies you have noticed. DO NOT LIFT OFF!

It may frustrate you, but the required control impulses on the stick are minimal. Try to compensate for the tendencies. The pitch only softens the helicopter. The pedals only want to know whether the helicopter is turning left or right. The stick always steers against the tendencies of the helicopter in the soft phase. If it wants to go forward, pull the stick back and so on.

When you have the feeling that everything has calmed down, slowly pull the pitch a little further. Just enough so that the helicopter leaves the ground and you can check how well you were able to compensate for the tendencies when softening.

Now I have to appoint you as your own flight instructor, because only you can recognize your own progress and weak points.

Pay attention to the controls, your deflections will probably be oversized. This is unnecessary!

As long as you don't start flying and you are still in some kind of hover, you will have the least corrections to the pitch. So don't bother him too much.

### **Setting down:**

As soon as you are more or less stationary with your helicopter in the air and can hold this position for at least 3 seconds, slowly lower your pitch. As soon as your helicopter touches the ground for the first(!) time, consistently push it down to the ground. At this point, it's not about beauty prizes.

So that you don't get bored: Relax from your ankles to your facial muscles. Reflect on what you did well on your last attempt and start again. Again and again, pick up - hold - set down - relax - reflect - pick up - hold - set down.

How seriously you do the whole thing is entirely up to you.

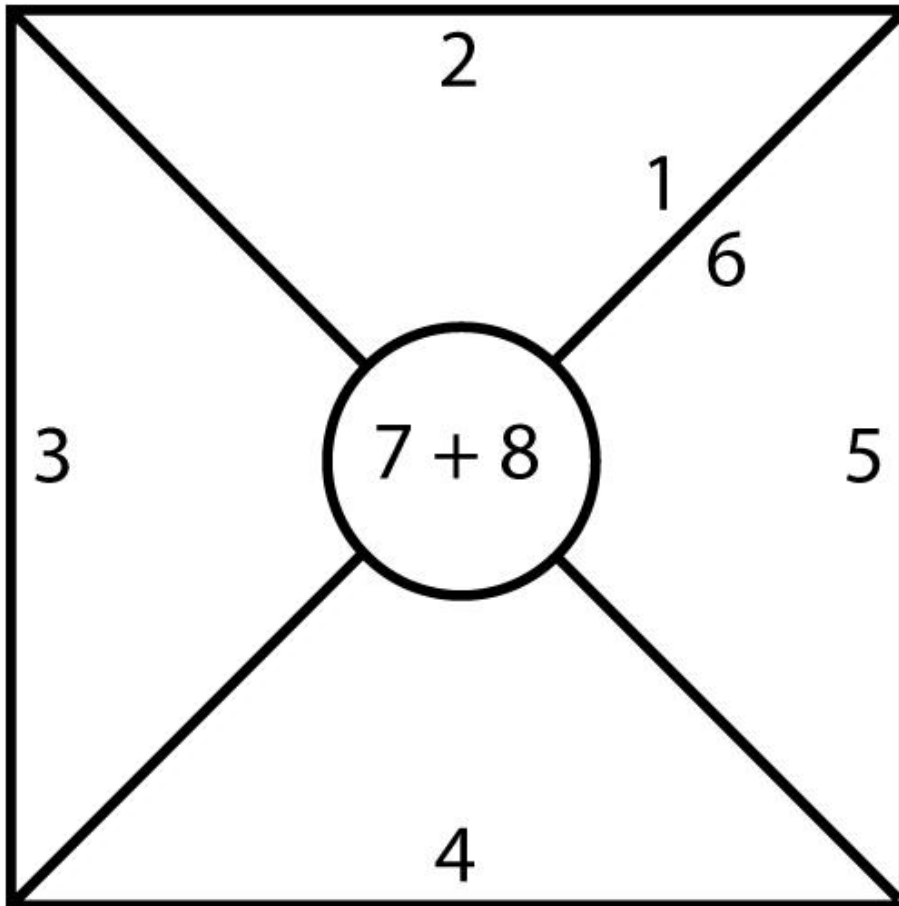
My recommendation: Do it for 45 minutes at a time in 3 sessions, i.e. 3x45 minutes. Write your hover hours in your flight log.

Up to this point you have the basics of hovering when picking up and setting down. What happens next in the hover square depends on how well you can pick up, hover on the spot and set down.

### **Hover exercises of all kinds**

The hover exercises take place in a hover square. The helicopter nose always points in the same direction, in this case upwards or northwards.

Here is a possible hover exercise:



Pick up

1 = diagonally to the front right

2 = sideways to the left

3 = backwards (at double height)

4 = sideways to the right

5 = forwards

6 = backwards to the rear left to the center  
(at double height)

7 = normal height 360° turn right

8 = normal height 360° turn left

Set down and park

Afterwards:

Dry your flying suit, see a physiotherapist for stiffness and have a frustrating beer from 6pm :-)

My recommendation is that you look at the paths of the square and practically memorize them. It's only from the center to the front and then counterclockwise back again.

And a few more basic tips:

- Hovering is like learning to ride a bike - at some point it will click.

- Challenge yourself, but don't overtax yourself. If you notice that you are cramping up, take a short break.
- You are welcome to hover faster and slower at times. But don't go flying.
- Be your own teacher and keep telling yourself: "Small coordinated movements".
- Take off vertically from the hover and allow yourself a slight forward tendency the next time you take off.

And now have fun.

Give yourself a good 6 flying hours for this whole hovering topic. It sounds boring, but it's worth it. You will need all the skills involved in hovering for the next steps.

## **Chapter 3: Climb, descent, turns, speed change - elements of the aerodrome circuit**

### **A look back**

By now you've got hovering down pat and know that hovering is THE flight condition that makes the helicopter so unique. Sure, a Harrier can do it too, but there are other reasons for taking off vertically in a jet.

I strongly recommend that you practise hovering at every opportunity. If you want to land with a helicopter on a ship's landing field and have difficulties with hovering, the fun factor drops significantly. And at this point, one of my favorite topics: The seating position. Take a look at pictures of helicopter cockpits on the internet. You will notice this again and again:

- If you sit normally, your hand is enough to pitch without having to bend. Every pitch movement comes from the biceps.
- The grip of the stick is there so that you can rest your forearm on your thigh.
- And with every helicopter, the stick goes all the way to the ground.

If you can optimize your simulator in this direction for helicopter flying, you will give yourself great pleasure because you will gain a huge increase in precision.

### **Climbing, sinking, curves, speed change**

Now I could give you an epic briefing on how to fly the aerodrome circuit. The advantage: Everything is included in the aerodrome circuit. Disadvantage: My descriptions become too complex. Ergo: I break the circuit down into sections with lots of individual exercises.

This means that you can decide for yourself when you want to try to fly the individual sections in a complete circuit.

Here is an overview of the circuit. Recommendation: Google "flying a circuit". The purpose of the aerodrome circuit is basically to implement the motto "One after the other". The course control thus creates safety for everyone.

The course round consists of 5 parts: The T/O (TakeOff) leg, the Crosswind leg, the Downwind leg, the Base leg and the Final leg. Leg means as much as partial section. There are clearly defined "maneuvers" in each leg. T/O leg = start with climb 500 ft/min and 60 KIAS, then left turn into the crosswind leg, climb to 500 ft/Gnd. At 500 ft continue with 80 KIAS, left turn into the downwind leg. Shortly before turning base, reduce speed to 60 KIAS, then descend to 300 ft/Gnd. In extension of the runway left turn into the final leg. Continue to reduce altitude and speed to the defined landing point.

The exercise:

Position your helicopter in the direction of take-off. No matter where you do this. The important thing is that you need a visual reference so that you can maintain the direction without stress. This can be the runway, but it can also be a village or something else. You don't need the compass.

Now go into hovering flight. Push the stick slightly forward. At the same time, pull the pitch moderately. Now hold the helicopter in the direction of flight and observe what happens.

- The heli climbs.
- The vario indicates a positive climb.
- The airspeed increases.
- Your grin increases.

Perfect. You have made a clean start.

Continue this climb until you have an indication of 60 kts. Try to stubbornly maintain 60 kts. Now you will notice that you have more power than you need for 60kts. You will therefore inevitably continue to climb. Now set exactly the power you need for a horizontal flight (Vario 0). Try, try, try. Then enjoy the moment when you see and feel the consequences of power on speed and altitude.

Now you can "play". You have 60 kts and vario 0 - i.e. level flight. Remember your current altitude. Leave the pitch alone and accelerate by only moving the stick forward. Very slowly! You will get faster (60 ... 65 ... 70 ... 75 ... 80 kts) and the helicopter loses altitude ... very good. And now reduce the speed again using only the stick. Smooth, very slowly ... 75 ... 70 ... 65 ... 60 kts You don't need pitch for this. The vario goes from minus to 0. You have your 60 kts again but have lost altitude. Never mind. Now reduce your speed using only the stick. You are climbing again. Climb until you have reached your initial altitude again and



accelerate back to 60 kts. And everything is as it was.

Great

Keep "playing" with the conversion of speed into climb and descent until you get fed up or your government wants to see you again.

Ok, let's end this exercise with a challenge for you:

Fly at an altitude of 300 ft above ground at 60 kts. Horizontal flight.

Reduce the power (pitch).

At the same time you have to take the stick back a little.

Try to reduce the speed evenly.

Descend at a maximum of 200ft/min. Correct again and again with sensitive pitch movements.

Now it's time to set the helicopter down on the ground at a controlled forward speed.

How fast is up to you and, if necessary, your "muffensausen". When you touch the ground, reduce the pitch completely downwards.

### **Summary**

In this section of the exercise you will learn how to change speed and altitude with little control input.

It is important to start with a slight forward movement and then power.

### **Altitude change in climb and descent - even in curves**

In the last session, you experienced what happens when you "nail" the pitch and only play with the stick. Every change in the flight position means a rise or fall with the same pitch position.

Today we turn the tables and (more or less) nail down the stick and work with the pitch and, of course, with the pedals. But you've already got that down pat.

Here we go, lots of exercises and few explanations:

#### **Exercise 1:**

Hover flight (it should be 1 minute. Even 5 minutes, because ATC is still drinking coffee and the T/O clearance is not yet there)

#### **Exercise 2:**

From the hover, stick forward and add power for the climb at 500 ft/min and 60 kts (correct power if necessary)

#### **Exercise 3:**

At 500 ft above the ground, move the stick forward and accelerate to 80 kts. Hold 500 ft and 80 kts. At least 2 minutes.

**Exercise 4:**

Now climb at 500 ft/min to 1000 ft but KEEP your 80 kts.

**Exercise 5:**

Now you are at 1000 ft. Rest up by simply flying at 1000ft 80 kts. If you've made it this far, it's child's play for you. We are still in the warm-up program for the turn with climbing and descending.

**Exercise 6:**

Okay. Let's continue. You are at 1000ft with 80 kts. Now climb to 2000ft at 500 ft/min and 80 kts. If you do everything right, you will need exactly 2 minutes. Remember: 80 kts!

**Exercise 7:**

Perfect, now fly a 180° turn, i.e. exactly in the opposite direction. Keep the 80 kts and stay at 2000 ft.

Attention, multi motion is now the order of the day. As soon as you enter the turn smoothly and want to fly the turn with little bank, you will automatically lose altitude. This means a little more pitch, a little more pedal and because you are giving more pitch, you also need a slight pressure on the stick so that the mill does not straighten up and you climb and/or slow down. But who am I telling, you already know all that. Take your time for the turn. Fly it very flat to make your life easier. All clear? At some point you'll be on the opposite course (doesn't have to be accurate to the degree) and still have your 80 kts and be at 2000 ft.

**Exercise 8:**

Good work so far. You can now practise as you wish. Left turns and right turns, climbing and descending at constant speed and climbing and descending only by changing speed at constant power. If you feel like having a coffee during this session and no longer feel like practicing, then it's time for the last exercise.

**Exercise 9:**

- You are still at 2000ft and have 80kts on the clock.
- Now initiate a descent with 500 ft/min at 80 kts.
- At 1500ft continue to descend at 500ft/min but now start to reduce speed to 60kts.
- at 1000 ft you should have your values stable: 500 ft/min descent and 60 kts
- Now it gets really exciting: keep your sink rate and speed stable. Imagine this: The ground is the same for the helicopter as a red light is for your car. In other words, we neither drive through a red light, nor do we slam the helicopter onto the ground!
- When you have reached 300 ft above the ground, reduce your sink rate and reduce your speed continuously. Ideally, you should have a sink rate and 0 speed when hovering. As an exception, you may also have 0 at the moment of touchdown.

- What you are doing right now is like "riding down" on a glider - a preliminary exercise for precision landings.

You should do these exercises again and again. At the beginning it makes sense to imagine the profile of the flight and memorize it. It is better to know what you are going to do than to constantly interrupt the flight and/or put down the VR. You should spend 2-3 hours on these exercises. It gets better and better. Believe me.

## **The steep curves**

What you have learned so far is actually half the battle. You can and know:

- Picking up
- Set down
- Hovering in all directions
- the effects of stick movements on the flight attitude
- the effects on the flight attitude during pitch movements
- picking up and reducing speed without changing altitude
- controlled climb and descent
- continuous speed reduction with simultaneous reduction in altitude (sliding down the "glide slope")

My God, how I would love to be a fly on the wall and look over your shoulders.

Okay, let's take a look at the steep turns.

It's all quite undramatic if you have at least understood the previous exercises and can manage them reasonably well.

Steep turns are turns beyond 20° bank. The turn and bank indicator will tell you how much this is. The special feature of banked turns is that the helicopter loses a lot of altitude when entering a banked turn if you do not assist with the pitch at the same time.

It's getting a bit complicated for me now, because as a teacher I would show you one, you do it and I could support you where there are still problems.

Let's try a few exercises anyway:

First of all:

When I say turn, I always mean 180, so you can fly along the runway on one side and back on the other side of the runway in the simulator.

The professionals among you will, of course, combine the turns with the compass. 210° in one direction and 030° back again or 345° there and 165° back again. It's really easy (you don't need to calculate the opposite course, there's a simple trick, see separate document [CompassTrick.pdf](#)).

**Exercise 1:**

Initial situation: 80 kts/IAS, 500 ft above Gnd. First fly a flat turn. Hold altitude and speed.

**Exercise 2:**

Increase the lean angle from bend to bend, maintain speed and height.

You will see that the steeper the bend, the more power you need.

Now it gets tricky. Starting position 500ft and 80 kts.

**Exercise 3:**

Fly a flat turn with the stick WITHOUT power supply.

**Exercise 4:**

Your turns will become steeper and steeper WITHOUT power. Note how much height you lose each time.

After each exercise, return to the starting values and continue practicing.

As this is all too easy for you, do the whole thing with steep turns to the TOP.

Starting values as always: 500ft, 80 kts.

**Exercise 5:**

Take the pitch "under your arm" (pull up fully!) and now initiate a turn whose bank (bank angle) increases from turn to turn.

Try to maintain 80 kts. Observe what happens and how you manage the turns.

The last exercises for today:

If you have understood and successfully implemented it up to this point, you can do the rest: steep turns with the same line but decreasing speed. Complicated? No.

**Exercise 6:**

Starting position 500ft, 80kts. Stable flight attitude then initiate turn and at the same time "nose up". When you are back on the opposite course after the turn, see if or how much height and speed you have lost.

That's it for today. Now you have all the elements of the circuit. You can do it, even if you haven't flown a continuous circuit yet.

## **Chapter 4: Quickstop (quick stop without**

## loss of height)

**Stopping quickly at low altitude without gaining height, or in short: the quick stop!**

What is it all about?

When you are flying a helicopter, you will always find yourself in situations where you are forced to stop quickly. Of course, this is standard in military aviation, because

- a) you are traveling faster
- b) you fly according to the principle of "in fast, out fast" and
- c) cover is paramount.

So how does it work, the quick stop?

First of all, remember that you are traveling at **80 KIAS in 20 ft/GND**. (This will also be our standard for all future exercises).

The aim is to reduce the speed as quickly as possible and, once the speed has been reduced, to land the helicopter on the ground.

The way to do it:

### **Steps and exercises**

#### **1)**

With increasing experience you will know how much space/distance you need to bring your helicopter to a standstill with 80 KIAS. At the beginning you are still working without obstacles for this exercise. So choose open terrain or a runway, for example. Later on, your obstacles will be buildings, power lines, forest edges and anything that offers you visual protection. Of course, the quick stop is also part of the "emergency procedures", because if you have chips in the gearbox or an engine failure, you have to bring the helicopter to the ground in a controlled manner. So later you will be flying at 80 KIAS towards the edge of a forest or the corner of a house and stop THERE.

I should also mention that this will be an exercise to a) train your sense of distance in relation to speed and b) that the topic of "adapted speed" is also known in operational flying.

#### **2)**

Make a normal start, climb to 20 ft and accelerate to 80 KIAS. Now try to reduce the collective and pull the cyclic stick towards you at the same time. Caution: Pulling the stick back too quickly is called RISING, pulling the stick back too slowly is called DROPPING. The first is not nice but bearable, the second could be complicated as you have a tail rotor that doesn't like touching the ground. This can happen if you are too low and take the stick back too quickly.

So: Collective down, stick back and bring the helicopter to 0 KIAS at constant altitude. Just before you reach this state, bring the

stick forward again and increase the power on the collective. Why? You are still at 20 ft and don't want to "fall through". The maneuver at this point is called "catching".

### 3)

Actually, that's it already. Now it's your turn and you can practise what you're comfortable with.

- Try to come to a standstill faster or slower
- Do it at 30 ft and then go down to 10 ft
- Fly towards an obstacle and try to come to a standstill and land in front of the obstacle. If it was good enough, get closer.

### 4)

**The last exercise is only for the "insane" and those who really dare to do it:**

Fly at 80 KIAS at 20 ft/GND, reduce your speed as usual and make a turn shortly before coming to a standstill so that you can land against the direction of flight. This turn will be easier if you support it with the pedals. Make sure that you turn the helicopter on the same line that you came in on. This means no right/left deviation from the approach direction. This also means that you will come to a standstill .... just try it out.

Now it's time to stop. Practice, practice, practice.

Remember to keep practicing from the beginning. The more natural the exercises become, the more fun helicopter flying will be.

It's not nice to see simulator pilots just pulling a helicopter off the ground, quickly gaining altitude and speed because the hover is not intact.

With this in mind, have fun.

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I hope you enjoyed this flight, if so, please send feedback to p3d@andi20.ch . Please also send any error messages (spelling mistakes, incorrect information, etc.) to p3d@andi20.ch, I appreciate any feedback.