GAP
Good Aviation Practice

Secure your aircraft

CAA
CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Contents

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Introduction

It's common to experience strong wing conditions at aerodromes around New Zealand, particularly during the spring and early summer months. Although weather services try to provide plenty of warning when stormy or hazardous conditions are on the way, it's not always possible to predict exactly when they might arrive.

High winds can cause damage to unsecured, or inadequately secured, aircraft. In extreme circumstances, aircraft can be damaged beyond repair.

Because New Zealand's weather can be changeable, you should always ensure your aircraft is secured when parked outside.

This GAP booklet provides advice on how to correctly secure your aircraft, to ensure it remains protected from damage in unpredictable weather.

It also gives advice for operators on good communication and practice regarding tiedown procedures.

It's important that you regularly practise tiedown procedures for your aircraft, so you're prepared when stormy weather arrives.

However, it's not only stormy weather than can cause damage. You may need to secure your aircraft during any period it is unsupervised, to avoid the potential threat of inadvertent slipstream or downwash damage from other aircraft.

Photo courtesy of Wanaka Helicopters

If possible, secure your aircraft in a storm-proof hangar or other suitable shelter.

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Where to park your aircraft

If stormy weather is headed your way, the best protection for your aircraft may be to fly it out of the area, if there is sufficient warning time.

If it's not possible to leave the area, the next best option is to secure your aircraft in a storm-proof hangar or other suitable shelter.

If appropriate hangarage isn't available, the remaining option is to tie down your aircraft securely in a suitable location.

Ideally, this means securing your aircraft to fixed tiedown points. Many aerodromes around New Zealand, however, only have a limited number of places available for securing aircraft to fixed tiedown points. These may be reserved for local aircraft, so make sure you check with the aerodrome owner before tying down your own aircraft.

If a fixed tiedown point isn't available, find a sheltered place to park your aircraft. This could be a natural depression in the ground, the lee of a building, or shelterbelt of trees. Ask locals for their opinion on the best place to park. Sometimes the seemingly logical place may actually be unsuitable, because of localised wind effects.

Strong eddies can form around buildings, and aircraft could be damaged by flying debris or lee-turbulence. This can cause sustained vibrations and unusual vertical and horizontal loads (Figure 1).

If you can't find a suitable sheltered place, it may be possible to park a vehicle in front of your aircraft. This will serve as an extra tiedown point, as well as helping to break up the airflow over the aircraft.

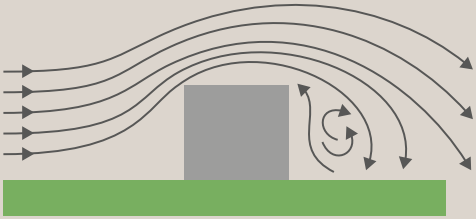


Figure 1 – Basic flow pattern around a sharp-edged building. In the lee of the building, the velocity of the wind flow is less than on the windward side, but it is more turbulent and unpredictable.

Types of tiedowns

Permanent anchor points

The location of tiedowns is usually indicated by either white or yellow paint, painted tyres, or crushed stone surrounding the anchor point. There are normally three anchor points provided.

The spacing of tiedown points should allow for ample wingtip clearance between aircraft. This distance is generally equal to the major axis (wingspan or fuselage length) of the largest aircraft, plus three metres. The tiedown anchor eye should not protrude more than 2.5cm above the ground.

Fixed tiedown anchors for single engine aircraft should provide a minimum holding power or strength of approximately 1400kg each. The type of anchors in use depends on the type of parking area – for example, a concrete paved surface, a bituminous paved surface, or an unpaved grass area.

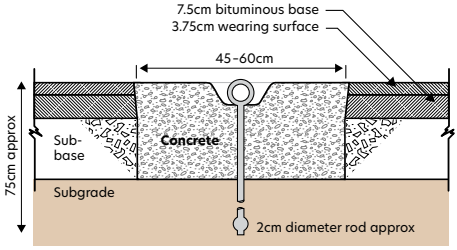


Figure 2 – Tiedown anchors for bituminous paved areas.

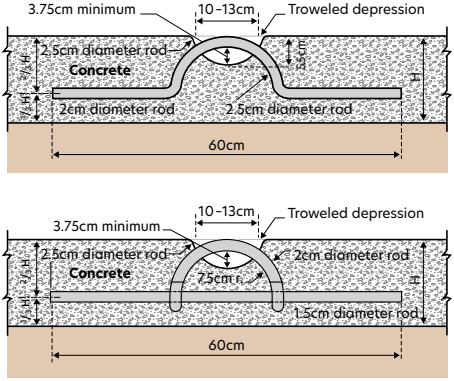


Figure 3 – Tiedown anchors for concrete paved areas.

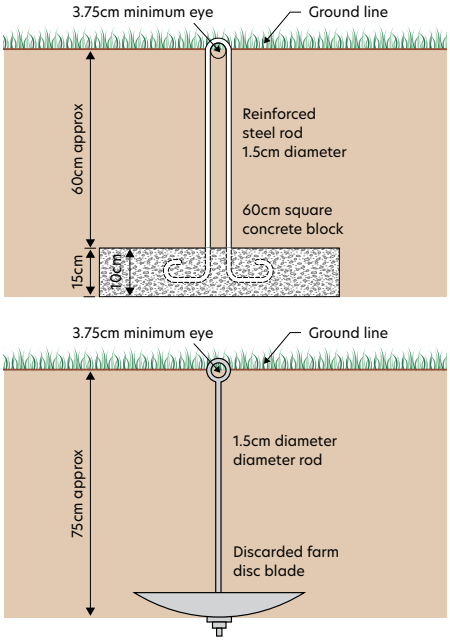


Figure 4 – Tiedown anchors for turfed areas.

Photo courtesy of Wanaka Helicopters

Take care when choosing where you'll picket your aircraft.

Parallel cables

Some aerodromes use continuous lengths of parallel wire ropes, passed through u-bolt anchors and fastened at the ends of the line with wire rope clips. The distance between the wire ropes will depend upon the types of aircraft that will use the tiedown area.

Tiedown chains (or ropes) are attached to the wire rope with roundpin galvanised anchor shackles. Where ropes are used, a metal thimble protects the rope from wear on the wire. This allows the tiedown chains to 'float' along the wire rope, and gives a variable distance between anchor points, so that a variety of aircraft can use a vertical tiedown without loss of space. The vertical anchors and the flex in the wire rope significantly reduce impact loads that may occur during gusty wind conditions.

Pickets

If permanent tiedown facilities aren't available, you'll need to use your own set of pickets. It's a good idea to carry a set of pickets with you, in case you are stuck at a remote aerodrome with no other way to secure your aircraft.

Figure 5 shows the two types of pickets most commonly in use for grass areas.

Your picket set should include six (or eight) steel stakes, three (or four) crossover tubes, and three ropes of appropriate length – all stowed in a bag. You'll also need a mallet or hammer.

Remember to include the pickets in your weight and balance calculations, and ensure they're well-secured in the aircraft before flight. Stow them carefully so they don't become a problem during turbulence.

Take care when choosing where you'll picket your aircraft. Pickets can pull out under strain if the ground is soft, or becomes wet. The coiled type is difficult to get into stoney ground, and may be more likely to pull out in soft ground. The cross-over type of pickets are the most suitable, as they're more likely to stay in the ground, even if it becomes wet. The underwing ropes should be led to points outboard and forward of the underwing attachment point. Hammer pickets all the way into the ground, always in front of the wing.

Once you're ready to go flying again, remove the pickets from the ground and take them away with you, to ensure other taxiing aircraft don't run them over. If you have to leave the pickets in the ground, ensure the rope is wound around the pickets to make them more visible to other taxiing aircraft.

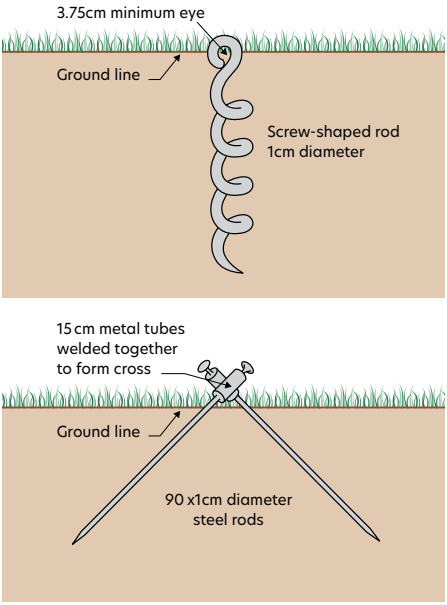


Figure 5 – Two types of pickets most commonly used for grass areas.

A lightweight set of pickets utilising stainless steel rods and twisted shackles stored in a plastic (downpipe) tube.

Ropes

Use ropes rated for 1400kg of dynamic load or more. Nylon or other synthetic rope is better than natural fibres, which shrink when wet and are more susceptible to rot.

Check the type and condition of your tiedown rope. Nylon or dacron rope is recommended.

You should also check the type of rope. A soft, slippery rope can be stronger and easier to splice, but it won't wear as well without chafing gear, and is more likely to unlay (untwist) than a firm 'locked up' rope. Multifilament (fine filament) polypropylene looks like nylon, but it isn't as strong. Spun, or stapled, nylon and dacron aren't as strong as ropes made from continuous filaments, but they are less slippery, and easier to grasp.

You can also use manufactured tiedowns (straps with end fittings and a ratcheting tightener). These are manufactured to varying load standards. Carefully inspect how the hardware might behave under repeated cycles of tightening and loosening with significant rocking and gusts. Open hooks or S-clips, held in place simply under tension, should never be used, because they come off easily when tension is relaxed.

Regularly check your tiedown ropes, and ensure they remain in good condition.

Custom-made tiedowns may work fine, but it's best to use tried-and-true designs and materials. Don't undo and re-fit the ends yourself, as splices and stitching are usually the weakest links.

Avoid using chains alone. Without elasticity, sudden shock loads during a gust can be catastrophic. Chain and rope combinations can work, but the rope must always be the part attached to the aircraft.

Dog-chain type clips should not be used when picketing, as they are not strong enough.

If you do use chains, secure them without slack, and make sure all fittings are equally strong. Dog-chain type clips aren't strong enough, so use proper, round-pin, stainless steel or galvanised iron shackles.

Regularly check your tiedown ropes, and ensure they remain in good condition. If you're worried about their strength, then you can 'double up' with other ropes to give extra certainty.

Securing your aircraft

After selecting a suitable tiedown site, secure your aircraft. Make sure to use three-point tiedowns, allowing adequate wingtip clearance from other aircraft. Make sure any adjacent aircraft are also securely tied down.

Position

Your aircraft should be parked and tied down into wind, or as nearly into wind as possible. If you're leaving your aircraft for longer than a few days, study the weather forecast for the expected prevailing wind direction. Alternatively, check on the status of your aircraft regularly.

There are various opinions as to whether a tailwheel aircraft should be tied down tail into wind. Remember, your aircraft is designed to meet the airflow head-on, and flying control surfaces can be easily damaged if control locks aren't in place when the aircraft is parked tail into wind. This type of aircraft also has a tendency to weathercock when on the ground, so if it's parked tail into wind (and not properly secured), it could be blown over, if rotated into wind by a sudden gust.

In winds above 30kts, it's safer to park the aircraft into wind and dig around the mainwheels. This will lower the aircraft, and reduce the angle of attack of the wings. It'll also have the effect of chocking the wheels.

Another method is to raise the tail to the level flight position. The device which supports the tail must be strong enough to support the aircraft weight and the wing loads. It should be securely tied down, and the tail of the aircraft must be securely tied to it.

Always check the surrounding area for other items that could be a danger, such as flying debris.

Controls

Controls should be locked or tied to prevent them banging against the stops and causing damage to hinges, cables, or pulleys.

For tricycle undercarriage aircraft, secure the ailerons, rudder, and elevator in the neutral position.

If internal gust-locks aren't fitted, use external control surface locks, or secure the control column firmly. This is commonly done using the seatbelts, but using bungee cords is more effective.

When using external surface locks, ensure they have a red streamer or other means of reminding you to remove them before flight.

Photo courtesy of Southern Lakes Helicopters

When using external surface locks, ensure they have a red streamer or other means of reminding you to remove them before flight.

Tailwheel aircraft should have elevators locked in the **up** position when facing into wind. Unless the tail has been raised to the flying position, then it should be secured in the neutral position. If a tailwheel aircraft is parked tail-into-wind, then the elevator should be secured in the **down** position.

After the aircraft is properly located, lock the nosewheel or the tailwheel in the fore-and-aft position, apply the park brake, and chock the main wheels fore and aft.

Ensure that hi-vis ribbons on tail rotor chocks stand out well.

Photo: CAA

Chock the main wheels.

Photo: CAA

If internal gust-locks are not fitted, use external control locks, or secure the control column firmly.

Photo courtesy of Wanaka Helicopters

Pitot tubes should be covered to prevent the ingress of windblown dust and dirt. Remember to remove the cover before flight.

Doors and other openings

Make sure all doors, windows, and hatches are closed properly. Cover engine openings (intake and exhaust) for both reciprocating and turbine engines, as well as pitot-static tubes, to prevent entry of foreign matter.

Aircraft covers

Aircraft covers can provide some protection. When spreading covers out to dry after they've been out in the rain, make sure they don't become FOD (foreign object debris) by storing them away from other aircraft. Secure any flapping tie leads.

Extra security measures

One extra measure you can take is to top up your fuel tank, to provide mass and added stability in gusts. Always double-check the security and sealing of fuel tank caps, to avoid any water getting in. If the filler cap sealing is in doubt, then you can place adhesive tape, such as duct tape, over the cap area.

You could also deflate the tyres of your aircraft as an extreme measure, to reduce the tendency for the aircraft to bounce in gusty conditions.

Tying down

You should only tie ropes to the aircraft mooring points provided. Never tie a rope to a strut, as the rope may slip to a point where even slight pressure may bend the strut. Look after tiedown rings carefully, to prevent rust and corrosion weakening them.


Photo courtesy of the US Air Force

For aircraft parked for long periods at coastal aerodromes, the salty air will increase the chances of corrosion occurring. Have your tiedown rings checked regularly, and wash down your aircraft with fresh water frequently.

Place your aircraft so that underwing ropes can be led to pickets or tiedown points one metre outboard, and two metres forward of the underwing attachment point.

On tricycle undercarriage aircraft, secure the middle of a length of rope to the tiedown ring under the tail section. Then, pull each end of the rope away at an angle of 45 degrees and secure it to ground anchors.

If extreme weather is expected, tie down the nosewheel as well. This is to avoid the front of the aircraft lifting in the gusts. Take care when securing the nosewheel. If fitted, the rope should go through the nose gear tiedown ring.

Take particular care when securing tailwheel aircraft. Some flight manuals specify certain steps to be taken for maximum protection, such as tying the tailwheel tiedown rope around the tailwheel gear spring, then securing it to the ground.

When tying ropes, draw them tight (not stretched) and then back them off a few centimetres. Too much slack allows the aircraft to jerk against the ropes, while a rope that's too tight can put inverted-flight stresses on the aircraft, which may not be designed to absorb such loads.


Photo: CAA

Tiedown ropes should only be tied to the aircraft tiedown rings.

Wing spoilers

The problem of wing lift from the wind can be overcome, to some extent, by using spoiler boards placed span-wise along the top of the wing. If the anticipated winds will exceed the aircraft lift-off speed of the aircraft wings, the makeshift spoilers should run the entire length of the wings.

Spoiler boards are constructed from timber lengths of 50x50mm, with several 10mm holes drilled at frequent intervals. A strip of 25mm foam rubber is then glued to the underside, for friction and wing surface protection. Lengths of nylon or rubberised shock cord, threaded through the holes and around the wing's leading and trailing edges, tied together underneath the wing, hold the spoiler firmly in place. Before tying, place pieces of foam rubber as a buffer to prevent chafing damage.

The position of the spoiler should be located at about 25 percent of the chord length aft of the leading edge. (Figure 6).

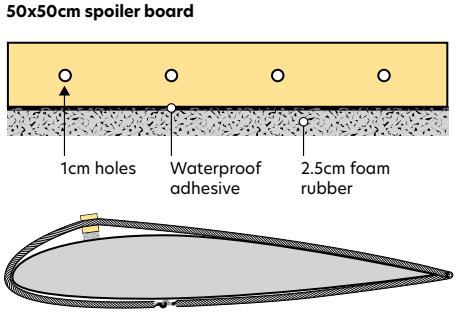


Figure 6 - Spoiler boards should be positioned at about the 25 percent chord point.

Some knotting terms

- A ***bend*** is used to join two ropes.
- A ***hitch*** is used to tie to an object.
- The ***bight*** is the curve or loop of a rope when its direction is changed from that of a straight line. Any point within this curvature is said to be in the bight.
- The ***strength*** of a knot is the force required to break a rope containing the knot.
- The ***security*** of a knot is related to the force required to make the knot slip or change to an unwanted form.
- ***Whipping*** is a series of turns of sail twine or similar. It's used to lash the end of a rope to prevent fraying.
- A ***splice*** is a semi-permanent joining of ropes or making an eye by interweaving strands at the bitter end. Splicing requires significant skill and manufactured splices are recommended.

Tiedown knots

The weakest link in the tiedown can be the knot that is tied. Ideally, the knot should neither slip nor loosen, and it should be easy to undo.

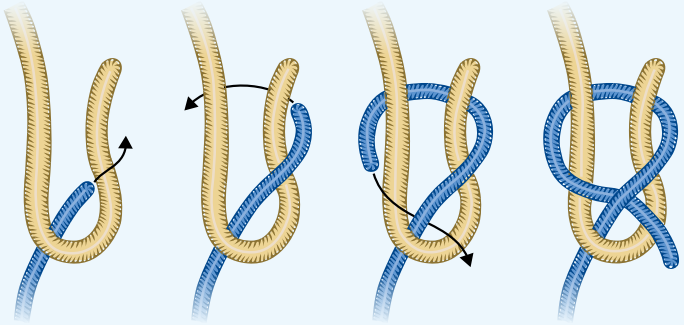
A knot can fail in three ways: it can come undone through vibration and general movement when there is little load on it, it can pull out when a load is initially applied, or it can break under load. Any break usually occurs where the rope enters the knot.

The ultimate strength of a knot is a matter of design - some knots are naturally stronger than others. Security, on the other hand, can often be improved by the way the knot is dressed (finished off). But making a knot more secure may also make it more difficult to undo, so there's little point in making a knot as secure as possible - only as secure as necessary.

Sheetbend

The sheetbend is the most accepted knot for joining two ropes together, particularly if the ropes are different sizes. The thicker rope of the two is used to form a bight. The thinner rope is passed up through the bight, around the back, and then tucked under itself.

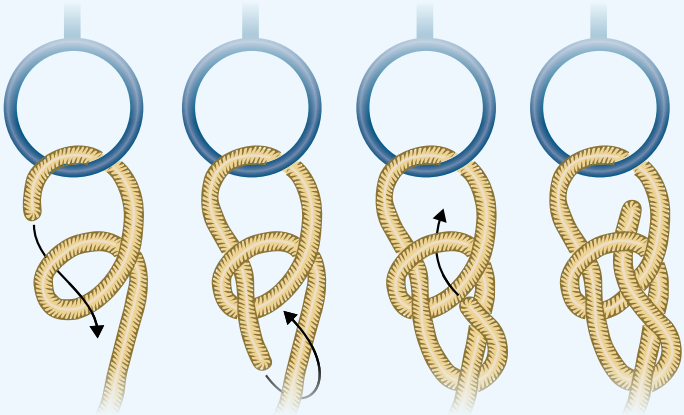
Tie this knot with the ends of the ropes coming off the same side of the knot. Don't tie with the ends coming off the opposite sides of the bend. This is known as the lefthanded sheetbend. Avoid this type of knot, as it isn't as secure.



Bowline

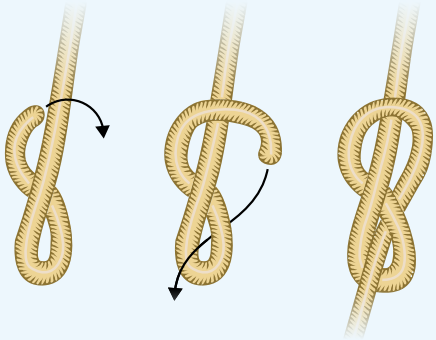
The bowline is one of the simplest ways of putting a fixed loop in the end of a rope. It's easy to tie and untie, doesn't slip or jam, and has a high breaking strength. A bowline is a good way to secure a rope to a tiedown ring, and to attach the tiedown rope to the ground anchors. For added security, finish the knot with a stop knot, such as a figure of eight, to prevent the bowline slipping.

To tie a bowline, form a small loop, pass the free end of the knot up through the loop, around behind the standing part of the rope, and back down through the loop. Make sure the end of the rope exits the knot on the inside of the loop. If it doesn't, re-tie the knot, so it will be secure.



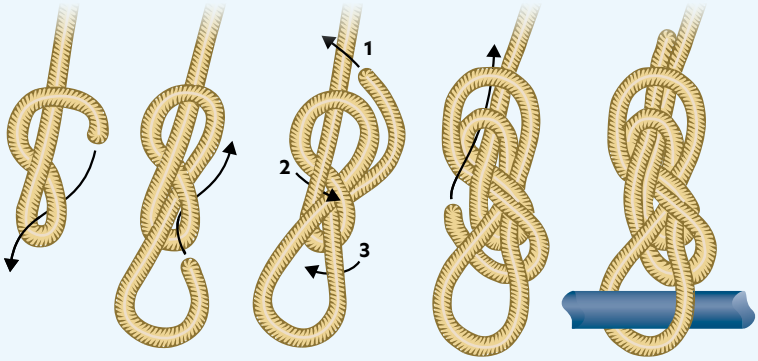
Single figure of eight

The single figure of eight is a useful stop knot to temporarily bulk out the end of a rope. The finished knot looks like its name. It's useful to temporarily stop the ends of a rope fraying before it is whipped.



Double figure of eight

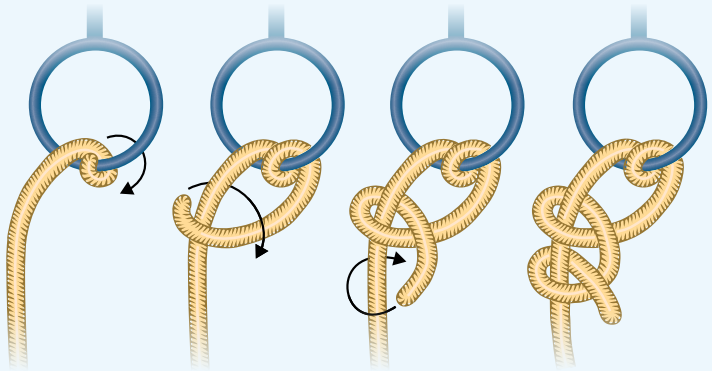
The double figure of eight knot builds a non-slip loop at the end of a rope. To tie, begin with a single figure eight knot near the end of the rope, loop the end of the rope around the carabiner or harness straps, and retrace the figure eight.



Round turn and two half hitches

A round turn and two half hitches is used to secure a rope to a pole or ring, or to start or finish a lashing. It's a good knot for securing a rope to the tiedown ring, and is commonly used by pilots. While it's easy to tie, it can be harder to untie, especially when the rope is wet.

To tie, pass the running end of the rope over the pole or through the ring twice. Then pass the running end over the standing part of the rope, and tuck it back up and under itself, forming a half hitch. Repeat this for a second half hitch.



Multi-engine aircraft

Most multi-engine aircraft are heavier, generate more lift, and therefore need stronger tiedowns. Don't rely on the aircraft's weight to protect it from damage by storm winds.

Light twin anchors should provide a minimum strength of 1800kg or more each.

Make sure you tie down and chock multi-engine aeroplanes when leaving them unattended for any length of time. Use gust-locks to protect control surfaces. They should be bright and bold, so as not to be missed during preflight inspections. Consider having a cockpit location or checklist to ensure all are removed. If the landing gear uses down lock safety pins, insert these when securing the aircraft.

Multi-engine aircraft should be tied down and chocked - do not rely on the aircraft's weight to protect it from damage by windstorms.

Helicopters

On the ground, helicopters are particularly susceptible to structural damage from storm-force winds. However, they do have the advantage of being able to seek shelter more readily, and smaller helicopters can tuck into places not accessible to fixed-wing aircraft.

If hangarage is available, then you should use it. If hangarage isn't available, then you should move helicopters to a sheltered position and tie them down securely. Helicopters that are tied down properly can withstand winds of 55-65kt, but anything above this will likely result in some damage.

When securing a helicopter against wind damage, follow the guidelines below.

- Position the helicopter's nose into prevailing wind.
- Position the helicopter further than a rotor-span distance from other aircraft.
- Apply control frictions with the cyclic in neutral and the collective fully down (bail on if fitted).
- Position the main rotor blades according to manufacturer instructions.
- Install tip covers on the main rotor, and fasten their ropes or straps to the applicable mooring points on the helicopter. Tension the lines appropriately (again, check your manual) using anti-slip knots. Too much slack allows the blades to flap in high winds, and too much bend can similarly stress your blades.
- Apply bubble covers. These can save you time clearing snow, and protect the windscreen from wind-driven grit and debris.

Regularly practise tiedown procedures for helicopters on a fine day, so you can be prepared when stormy weather arrives.

- Some tail rotors have a locking pin and/or a cover and separate tie-down to prevent excessive flapping. Tail rotor covers or lines should be bold, clean, and fit for purpose. Consider matching them with a cyclic cover to ensure they are not forgotten during a rapid start-up. Never wrap straps around the hub where they can be missed or forgotten.
- Close doors and windows, and ensure exterior access panels are secure. Install covers for engine openings and the pitot tube.

Most helicopter flight manuals have specific instructions for parking and mooring. Follow the manufacturer's instructions for your make and model of helicopter.

Floatplanes and skiplanes

Floatplanes and skiplanes should be secured in the same way as conventional fixed-wing aircraft – to tiedown anchors or 'deadmen' sunk under the water or snow.

For floatplanes, in addition to using underwater anchors, you can partially flood the floats of the aircraft for added stability in the water during windstorms. This technique can also be applied when the floatplane is tied down on land, in this case to provide added weight. Make sure you empty the floats before flying again.

If a severe storm is forecast, consider beaching the floatplane or transporting it to a hangar or more sheltered location to be tied down.

Secure skiplanes by packing soft snow around the skis, then pouring water on the snow, allowing the skis to freeze to the ice.

Secure floatplanes securely to a fixed anchor point.

iStock.com/wiesdie

After a storm

If your aircraft has been standing out in a storm, carry out a thorough preflight inspection.

Look for structural damage around control hinges and inspect wing skins at points where high loads could cause stress to the airframe. Check all hinges and controls for unusual slackness.

Pay attention to the undercarriage, as the aircraft may have been lifted momentarily and landed heavily. Aircraft can also be skewed on their pickets or chocks in extreme conditions, which can stress the undercarriage. If you suspect this has happened, have it checked by a licensed aircraft maintenance engineer.

Pay particular attention to fuel drains. Drain all sumps and check each sample. Shake the wingtips, and repeat the draining process. Remember to remove all covers, gust-locks, chocks, and picketing items before flying again.

Advice for operators

If you operate a flying business, it's important that all pilots are fully trained and regularly practise your tiedown procedures. Excellent communication, consistency, and a culture of expectations among all the pilots is crucial.

Talk regularly with your peers, and your staff, on the specifics of installing picketing items. Talk about when, why, and how to use each of the items, covering topics like wind speed and gusts, direction, length of time the aircraft will be tied down, and whether the aircraft will be monitored by a pilot or not.

Remember, pilots are likely to have differing opinions on the use of picketing items, so it's important to set out the expectations and rules of the company or club.

Establish a set and robust routine in how you or your company install and remove picketing items. Ensure this routine is done in the same way, every time, by all pilots involved in flying the aircraft.

Where practical, all picketing items should be the same across the fleet. Only the pilot should install or remove the picketing items, so they know what they've done. Ensure they aren't distracted while installing and removing these items.

Don't tie tail rotor chock ribbons around about the tail rotor hub, as this can make it harder to remember to remove them before flight.

Have a purpose-built witness indicator installed in your aircraft, somewhere that is very clear for the pilot to see, to prevent them flying with the picketing items still attached. In your procedure, the witness indicator should be 'first on, last off'.

Have an established routine for the final walk-around inspection once everything has been removed before flight.

Place a brightly coloured witness indicator over the cyclic, and remove this last before flight.

Photos courtesy of Southern Lakes Helicopters

Conclusion

It doesn't necessarily take storm-force winds to cause aircraft damage. To be prepared for New Zealand's changeable weather conditions, always ensure your aircraft is securely and correctly tied down.

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