UC-1 Twin Bee

Dave Unwin goes flying (and floating) in this amazing amphibian.

As I began to add power and taxi out of our parking spot Dennis grinned at me and said, "the hardest thing about this machine is taxiing on the ground. In fact," he continued, " if you can get it to the runway you can probably fly it!" I was soon to discover how true this was!

I just love water flying, so on a recent trip to Florida I visited the well-known Jack Brown's Seaplane Base at Winter Haven, with a view to sampling one of the most odd-looking aircraft to ever fly (or float) the Twin Bee. When we arrived it was rather foggy, so while we waited for it to clear I took the opportunity to study the Twin Bee closely.

I've always been fascinated by the myriad (and often contradictory) problems posed by designing an amphibious flying machine. For example, as the machine is intended to be operated in three different mediums (air, land and water) a considerable number of variables need to be factored into the equation. These include lift and drag (both aerodynamic and hydrodynamic), and

The Twin Bee surged up onto the 'step' and began to accelerate. *(All Steve Fletcher)*

not only the centre of gravity but also the centre of buoyancy. All of the above affect the performance and handling – sometimes significantly. For example, the features that make for a seaworthy ship do not really lend themselves to the creation of an airworthy aircraft. The location of the step, design of the chines and deadrise angle of the bow, all have a profound influence on how well it will float – and fly! Excessive drag – both aerodynamic and hydrodynamic – are the 'Achilles Hull' (groan) of all flying-boats.

My mentor for the day, Dennis Kochan soon arrived, and showed me the salient points to look out for during the pre-flight. It is quite a big aircraft, standing more than three metres tall, and is also very interesting, as it is built around the 1947 Republic RC-3 Seabee. This was a four-seater, powered by a single Franklin 215hp air-cooled in-line engine fitted with a 'pusher' propeller. Despite being fitted with increasingly more powerful engines, it was always underpowered. Then in 1960 the

"Water take offs are extremely exhilarating"

United Consultant Corporation of Massachusetts began examining the possibilities of building a multi-engine amphibious aircraft. However, rather than pursue the arduous route of designing and certifying an entirely new machine, chief designer Joe Gigante decided to extensively modify the RC-3. As Republic had built more than 1,000 Seabees the type was readily available, and using mostly remanufactured Seabee components would obviously help control costs.

A pair of tractor engines replaced the single pusher; it was made longer, featured a larger wingspan and a fifth seat was added. The result was the rather cumbersome looking contraption that was standing before me! Unsurprisingly, serious CG-related stability issues plagued the aircraft, and these were only resolved when an aft-mounted auxiliary fuel tank was added. UCC produced 24 between 1966 and 1987, with N65NE being the 23rd (and the fifth one operated by Jack Brown's). The Twin Bee was the last multi-

engine amphibian built in the US, and there are eight currently airworthy.

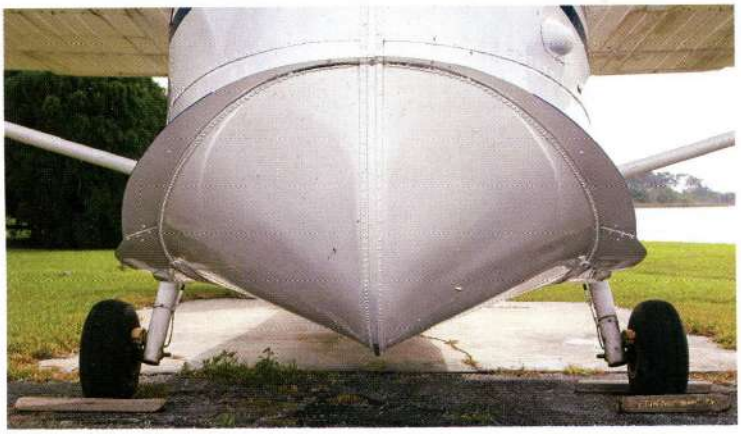
The deep, single-step hull is constructed from aluminium sheets held together by large solid rivets, and incorporates six watertight compartments beneath the cabin floor. It does look rather odd, as the fuselage incorporates a 0.9 metre 'plug' immediately aft of the cabin. As you can imagine, changing from one pusher engine to two tractors radically altered the CG, and necessitated a more powerful rudder for single-engine operations. The fuselage 'plug' increased the rudder's arm (and thus its moment) and helped restore the CG. To enhance the nautical theme, the cabin features two delightful portholes.

Below: **The fuselage incorporates a 0.9 metre 'plug' immediately aft of the cabin.**

Bottom: **The single-step hull is quite deep. Note the wide track undercarriage.**

The engines are 180hp Lycoming IO-360s, which turn Hartzell constant-speed props.

The tough undercarriage uses oleo-pneumatic struts for shock absorption.



As mentioned earlier, a considerable amount of original Seabee parts are utilised on the Twin Bee. For example, Seabee wings are used for the outer panels, while the inner sections carry the two fuel-injected Lycoming IO-360s. These produce 180hp each, and turn two-blade constant-speed Hartzell props. They are fed from the original 321-litre Seabee fuel tank, which is located in the keel compartment below the rear cabin floor. An auxiliary 60-litre fuel tank is installed just below the tailplane. However, it is not permissible to make a water landing with it empty,

"Excessive drag is the 'Achilles Hull' of all flying boats"

due to centre of buoyancy issues.

The wings are shoulder-mounted, strut-braced and have a wingspan of 13.3m, 1.82 greater than a Seabee. Corrugated aluminium is used for the wing skins, while the trailing edges are dominated by large, hydraulically-actuated single-slotted flaps, which have a range of 0 to +30°

Initially I thought that – unlike the rest of the aircraft – the wing floats, didn't look terribly robust. In fact, they are specially engineered to break off should they be overstressed. They carry small mirrors, to enable the position of the undercarriage to be checked.

The next thing that struck me was how tall the aircraft is when it's on its wheels.

Top Right: **The hardest thing about this machine is taxiing on the ground.**

Above Right: **The cabin features two delightful portholes!**

In fact, the undercarriage is worthy of further comment, as it is rather curious. The mainwheels are actuated hydraulically, and pivot backward through about 135° while the tailwheel simply swivels sideways mechanically. I imagine that this arrangement doesn't do much for drag reduction, although it does get the wheels out of the water. On the plus side, the undercarriage does look pretty tough, with shock absorption on the mainwheels being provided by oleo-pneumatic struts.

Moving towards the tall tail, I noticed the fin is quite large, and carries a horn-balanced rudder. There is no water rudder. The tailplane is mounted at the base of the fin, and carries good-sized elevators; there are cable actuated trim-tabs on the elevator and rudder. I was particularly interested in the size of the elevator trim-tabs, as it seemed likely that having the engines mounted quite high would produce significant changes in pitch whenever the throttles were adjusted, due to the high thrust line. As we continued the pre-flight inspection Dennis explained that the aircraft really vibrates, so it is important to ensure that everything is tight and secure. He also warned me to look closely for cracks in the exhausts (a known Twin Bee weakness) and that I should always

The taxi and landing lights are in the port wing's leading edge.

check carefully for corrosion, although it isn't too bad on fresh water.

Pre-flight completed, it was time to 'go aboard ship'. Entry to the cabin is via doors on either side, while the bulbous bow incorporates a 'docking door' on the right (strictly speaking, 'starboard') side. The cabin doors are hinged at the back, and Dennis emphasised that it was critical that all the latches (each door has three) were secure. If the doors open in flight, they will inevitably blow aft into the propellers, which is clearly far from desirable. To emphasise this, there are warning lights that indicate if the doors are locked or unlocked.

Having settled into my seat I found that the cockpit layout was unusual – and definitely required some thought.

All the flight instruments and most of the other gauges and avionics are located directly in front of the pilot in a freestanding binnacle. However, the tachometers, manifold pressure, fuel flow and CHT gauges are mounted above the windscreen.

Immediately aft of these instruments are the throttles, propeller levers and mixture controls. These are all located in the roof as this shortens the control runs to the wing-mounted engines. Also mounted in the roof are the handles for the rudder and elevator trimmers, trim position indicators and alternate air selectors. The starboard side of the cockpit is clear, to provide access to the docking door.

A beefy transverse bar, similar to a Twin Otter's, carries the big control wheels, and although the rudder pedals are fixed, the comfortable seats adjust over a good range.

Most of the switches for the electrical services are located at the bottom of the panel, with some circuit breakers mounted in two long rows in the centre console and the rest in a narrow vertical strip that drops down from the far left of the instrument panel. Aft of the centre console are the fuel shut-off

"We fell backwards off the step in a great spume of spray"

valves, then the hydraulic hand pump and the tailwheel lock/unlock. On either side of the hand pump are the flap and undercarriage selectors. These levers simply move through slots in the cabin floor, and are essentially two-way valves.

To extend the flaps or lower the wheels all you do is put the relevant selector in the required position and then press the red button on the yoke to activate the hydraulic motor. Raising the undercarriage uses the same procedure, although to retract the flaps in flight simply put the selector to 'up' – the force produced by a 70-knot 'wind' will blow them up.

Although a token effort has been made to differentiate between these two levers (the undercarriage's has a round top, while the flap's is square) it was

Top: **The fin is quite large, and carries a horn-balanced rudder.**

Above: **Corrugated aluminium is used for the wing skins.**

Above Left: **The tailwheel castors but is not steerable. It is locked for take-off and landing.**

At 90kts indicated, fuel flow was around 75 litres an hour.

interesting to note that their directions of movement are contrary to accepted practice as they are both set back to fly, and forward to land.

Both fuel-injected Lycomings started eagerly and I was soon taxiing the Twin Bee gingerly up the narrow ramp from the seaplane base to Winter Haven airport. The tailwheel castors but is not steerable, so all steering is by differential braking and power. I was amazed that there aren't any brakes on the instructor's side. The tailwheel is locked for take-off and landing.

As I began the long taxi to the active runway I soon became aware that Dennis wasn't joking about it being a bit of a beast on the ground, it's quite an unwieldy machine. It was pretty breezy and that big fin caught the wind, so much so that I was soon struggling to avoid 'weather cocking'. Just to complicate things further, the brakes are rather indifferent (due to being constantly immersed in water) and have a tendency to fade. All this combined to create the hardest machine I have ever taxied. Initially, all went as well as could be expected, and I was (mostly) keeping in the middle of the taxiway.

However, just as I thought I was starting to master it, it humiliated me. I turned cautiously onto another taxiway, and across the wind. Dennis said "watch out, it'll try to go round on you" - and it did. In a graceful pirouette the nose swung almost 90° left. I jumped on the brakes and we stopped with the nose almost at right angles to the centreline, with one wheel barely on the concrete and perilously close to

UC-1 TWIN BEE

DIMENSIONS		
LENGTH	9.5m	31ft 3in
HEIGHT	3.07m	10ft 1in
WING SPAN	13.3.m	43ft 8in
WING AREA	20.9m²	225sq ft
WEIGHTS AND LOADINGS		
EMPTY WEIGHT	1,134kg	2,500lb
MAX AUW	1,724kg	3,800lb
USEFUL LOAD	590kg	1,300lb
WING LOADING	82.48kg/m²	16.88lb/sq ft
POWER LOADING	6.43kg/kW	10.55lb/hp
FUEL CAPACITY	382lit	84 Imp gal
PERFORMANCE		
VNE	144kts	267km/h
CRUISE	95kts	176km/h
STALL	45kts	83km/h
CLIMB RATE	500ft/min	2.54m/sec
CLIMB RATE (single engine)	Negligible!	
SERVICE CEILING	19,000ft	5,791m
SERVICE CEILING (single engine)	3,900ft	1,189m

ENGINES

2 x Lycoming IO-360 B1-D air-cooled flat-fours, producing 180hp (134kW) each at 2,700rpm

PROPELLERS

Hartzell metal two-blade constant speed

MANUFACTURER

United Consultant Corporation, Norwood, Massachusetts

OPERATOR

Jack Brown's Seaplane Base, Winter Haven, Florida
Tel: 001 863 9562243, Fax: 001 863 9563242
Email: seaplane@gate.net, Web: www.gate.net/~seaplane

All the flight instruments and most of the other gauges and avionics are located directly in front of the pilot in a freestanding binnacle. The starboard side of the cockpit is clear, to provide access to the docking door.


FUEL PUMPS ON
FUEL VALVES ON
GEAR CHECKED/3
MIXTURE RICH
PROPS HIGH
FLAPS SET

taxiway light! Judicious use of left hrottle and right brake extricated me om my predicament, although almost amaging something before we'd even ot to the runway definitely rattled ne. I was mortified, although Dennis ppeared unconcerned and waved away ny embarrassed apology.

With the flaps set to 20° and all hecks completed, I rolled out onto he runway, carefully lined up the win Bee with the centreline and let it lowly roll forward to ensure we were traight. I led with the left throttle and somewhat jerkily brought the power in, as the throttles felt very stiff. Despite being well below the 1,724kg MAUW the acceleration was quite leisurely, although at least I experienced no difficulty keeping straight as the airspeed increased. Having picked up the tailwheel at about 30kts, I waited until the needle of the ASI reached 60, then applied gentle backpressure to the yoke and we lifted off.

As the last of the runway vanished beneath the nose, I pulled the undercarriage lever to 'up' and pressed the hydraulic pump button. I then pulled the flap lever back, and waited for the airflow to blow them up. As the flaps retracted there was a fairly significant change in pitch, which should have been easily countered by deft application of the powerful trimmer. Unfortunately I wound it the wrong way, and was suddenly massively out of trim! Prompt winding in the other direction restored some semblance of order, but it was another blow to my self-assurance. This was not going well.

I then eased the power and prop levers back to 25/25, levelled out at 1,000ft and set off for nearby Lake Ariana, where photographer Fletch was waiting on the dock. Within minutes we're approaching the lake and Dennis takes control, sets us smoothly down and then performs some superb 'splash 'n' goes'.

The small mirrors in the floats enable the position of the undercarriage to be checked.

"If you can get it to the runway you can probably fly it!"

With the photo session completed, Dennis indicated that I should take us out. I've been watching his actions very carefully, and also paying close attention while he's been explaining his control inputs. Being painfully aware that I'd already cocked up twice, I was eager to redeem myself.

As we approached the lee shore I turned the Twin Bee around, and waited for it to weathercock directly into the wind. Having completed the pre-take

The bulbous bow incorporates a 'docking door' on the starboard side.

checks, I pulled the yoke right back and applied full right aileron. (The engine's torque has a tendency to roll the hull in the water, and this must be countered by applying opposite aileron. Failure to do this means you drag the port float through the water, which slows acceleration). I then took a deep breath, led with the left throttle slightly and brought the power in.

As the float came up out of the water I centralised the ailerons and began to reduce the backpressure. The nose dropped down to about four degrees as the Twin Bee surged up onto the 'step' and began to accelerate. I find water take offs extremely exhilarating. As you accelerate across the water the hull seems to be taking a terrible pounding, and it's always very tempting to try to 'pull' the aircraft off the water. However, this is a temptation that must be resisted.

As Dennis had already demonstrated, the trick to taking off from water is that you must maintain the correct attitude, and not try to rotate the aircraft. If you do, you'll actually have a longer take-off run, because as the nose pitches up, everything aft of the centre of

The flap and undercarriage selectors are on either side of the hydraulic hand pump.

Above: The throttles, propeller levers and mixture controls are all located in the roof, along with the rudder and elevator trimmers, trim position indicators and alternate air selectors.

Right: A considerable number of original Seabee parts are utilised on the Twin Bee.

pressure pitches down, forcing more of the hull into the water. This increases drag and actually decreases the rate of acceleration. The key is to keep a constant heading with the nose at the correct attitude and the wings level. It'll fly when it's ready. That said, on rough water you do sometimes wonder just how much more of a beating it (and you) can take! A good analogy is to imagine driving really fast across the furrows of a ploughed field.

Then in one magic second the pounding stops, the wing takes the weight and you're flying! I held the Twin Bee down low so we could accelerate in 'ground effect' to the 'blue line' speed of 70kts, before slowly easing up into the climb and raising the flaps. I then placed the nose on the horizon, drew the power and props back to 25/25 and set course for the next lake. I was very pleased with how well the take-off had gone, and Dennis was complimentary.

I now began to explore the general handling more fully. Almost straightaway I was impressed by how solid and stable the Twin Bee felt, although I didn't have time to make a thorough evaluation before we began to approach the next lake. All the primary controls are cable operated, and there is quite a lot of 'slop' in the control circuits. Although the aeroplane is reasonably responsive, the controls are quite heavy, and require large inputs. It does feel quite ponderous. I guess it is what it is - a flying houseboat! On the plus side - the visibility is great.

Dennis pointed out the next lake so I turned downwind, checked in the mirrors that the wheels were still up and had a good look at the water. Having reduced power to 18ins MP and lowered a bit of flap, I carefully retrimmed and studied the wind streaks on the surface. On base leg I drew a bit more power off and added a bit more flap, then turned onto final and extended them fully. Although a typical approach speed is 70kts, Dennis recommended 75 to give a bit of a cushion. One thing you don't want to do in a Twin Bee is get on the wrong side of the drag curve.

With the power pulled back to 12 inches I pushed the prop levers forward, then levelled off just above the lake and waited. As the keel kissed the waves I released just a hint of backpressure, then as the water took the weight

"Subtle transference of weight from wing to water"

drew the power off and eased the yoke back. As the Twin Bee slid backwards off the step to a foaming stop I grinned broadly, and remembered to start breathing again. "Very nice," said Dennis. I'd redeemed myself, and with my confidence returning began to enjoy the Twin Bee more and more.

The next two 'splash 'n' goes' were good, so I asked Dennis to resist the temptation to advise for the third one, unless disaster was imminent. Laughing, he agreed. Initially all went well, with a smooth take-off and accurate circuit. However, I'm so eager to impress that I tried to hold off too long. This meant we touched down with the nose slightly high, which produced a small skip and a laugh from Dennis. Annoyingly, during the take-off run I released the backpressure too early, and we porpoised slightly. Unwilling to admit defeat, I turned downwind for another go. This went well. I felt the sweet, sizzling kiss as the keel touched the waves, then the hull was soon hissing through the water.

As we planed smoothly along I drew off the last of the power, eased the yoke aft and we fell backwards off the step in a great spume of spray. There's no doubt about it - the subtle and sublime transference of weight from wing to water is profoundly gratifying when it all comes together. Yoke back

Note that when retracted the mainwheels pivot backward behind the struts, while the tailwheel simply swivels sideways.

with full right aileron; I smoothly eased the throttles forward. The muted murmuring of the motors swelled to a roar, water cascaded up and over the nose as the Twin Bee surged up onto the step and began skimming across the surface. With the throttles on the stops (full ahead both!) we gathered speed. Behind us, our wake became an ever-widening vee as our machine prepared to transform itself from a vessel to an aircraft. I could feel that the wing was taking the weight, and then we were flying again. Magic!

As we climbed away I noted that the VSI was only indicating about 500ft/min, but that's about as good as it gets. When climbing, the best technique is to simply set 25/25, then put the nose on the horizon and accept the rate this gives. It's safe to say that it doesn't have the 'Vx Factor'! Trying to climb on one engine must be a real 'seat chomping' experience!

On the way back to Winter Haven I completed my assessment of the control and stability. During the stick-free checks I had to revise my initial impression of the Twin Bee being very stable, as despite our forward CG it did feel only just stable in pitch. It was positive in yaw and neutral in roll. Slow flight revealed benign - albeit heavy - handling, although I feel sure that you could quickly wind up with an excessive sink rate if you weren't careful. And of course, landing with excessive sink on water could end with a truly sinking feeling!

A quick look at the cruise on the way back to Winter Haven showed that at 90kts indicated, fuel flow was around 75 litres an hour. This gives the Twin Bee a range of about 300nm, plus 30 minutes' reserve.

Back at Winter Haven I pushed the undercarriage selector to 'down' and pressed the little red button to activate the hydraulic pump. After about 45 seconds I checked for the green light, and then looked in the mirrors. On final, Dennis reminded me to flare much higher than during a water landing, as the wheels hang about half a metre below the hull. Despite heeding Dennis's advice, I still touched before I meant too, but the undercarriage simply soaked it up. The taxi back across the airport and down the ramp was just as tense as it was on the way out, and I was amazed at how calm Dennis was - particularly as we trundled down the steep ramp. He really is remarkably easy-going, and an excellent instructor.

In conclusion, I absolutely loved flying the Twin Bee, despite the lack of power. Weird looking, slow, noisy and thirsty it may be - but it is amphibious. And that goes a long way in my book!

Above: **The Twin Bee is certainly odd-looking, as the features that make for a seaworthy ship do not really lend themselves to the creation of an airworthy aircraft.**

Full Ahead both!