Titltrotor Aerodynamics. A short overview:

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Basic idea

The simple idea behind the tiltrotor construciton is that the combination of an regular fixed wing airplane and a helicopter would result in an aircraft with a yet unreached flight envelope. It could provide high cruise speed, low fuel consumption, a low noise level and would be able to access every air- or heliport.
First attempt to build such an crossover have been made long ago but it wasn't until the XV-15 and V-22 that the so obviouse concept resulted in a

The information provided below describes the Bell-Boeing V-22 Osprey military tiltrotor aircraft but the key concepts apply to all tiltrotor systems.

Transition

During the transition phase both hubs rotate by 90 degree to face forward for maximum speed. The aircrafts wing has to compensate the decresing lift of the rotor systems.

V22Conversion.tiff ¬

Plane configuration

When flown in plane configuration the Osprey behaves exactly like a regular airplane. The oversized propellors reduce the required engine power to 85% which results in a more quite cruise.

175608_V22PlaneConfig.tiff ¬

Helicopter configuration

With the hubs pointing upwards the Osprey acts like a helicopter. Because both rotors are rotating with an opposite spin there is no need for a tail rotor and yaw compensation.

V22HeliConfig.tiff ¬

Problems:

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Flight control

Now one of the main problems is that between the two extrems (plane *vs* heli) there is an unlimited range of configurations where the flight control system has to ensure that the tiltrotor won't drop like a stone and remains controlable in a natural fashion.

Aerodynamics

Besides the problem mentioned above the V-22 has to use rotor blades which provide good performance within both configurations.

This lead to a design where each blade is twisted by almost 45 degree.
Since both rotor operate very close to each other it is necessary to take into account that the turbulences created by one blade can/will affect the other. With the V-22 RC-model this turned out to be a very nasty problem since a small model is affected even heavier.

Structural setup & Dimensions of the V-22 Osprey:

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V22Dimensions.tiff ¬

Dimensions, external

· Length, fuselage - 57.33 ft (17.48 m)
· Width, rotors turning - 83.83 ft (25.55 m)
· Length, stowed - 62.58 ft (19.08 m)
· Width, stowed - 18.42 ft (5.61 m)
· Width, horizontal stabilizer - 18.42 ft (5.61 m)
· Height, nacelles fully vertical - 22.08 ft (6.73 m)
· Height, vertical stabilizer - 17.65 ft (5.38 m)

Dimensions, internal

· Length, maximum - 24.17 ft (7.37 m)
· Width, maximum - 5.92 ft (1.80 m)

· Height, maximum - 6.00 ft (1.83 m)

Weights

· Empty 33,140 lb (15,032 kg)
· Takeoff, vertical, maximum 47,500 lb (21,546 kg)
· Takeoff, short running, maximum 55,000 lb (24,948 kg)
· Takeoff, self-deploy mission 60,500 lb (27,443 kg)
· Cargo hook, single 10,000 lb (4,536 kg)
· Cargo hook, dual 15,000 lb (6,804 kg)

Engines

· Manufacturer - Allison Gas Turbine Division
· Model - Two T406-AD-400
· Maximum and Intermediate - 6,150 shp (4,586 kW)

Transmissions

· Takeoff (USMC) - 4,570 shp (3,408 kW)
· Takeoff (USN) - 4,970 shp (3,706 kW)
· Takeoff (USAF) - 4,970 shp (3,706 kW)
· One engine inoperative - 5,920 shp (4,415 kW)

Rotor System

· Blades per hub - three
· Construction - graphite/fiberglass
· Tip speed - 661.9 fps (201.75 mps)
· Diameter - 38 ft (11.58 m)

· Blade area - 261.52 square feet (24.30 square meters)
· Disc area 2,268 square feet (210.70 square meters)
· Blade folding - automatic, powered

Performance

· Maximum speed at sea level - 275 kt (510 km/hr)
· Vertical rate of climb at sea level - 1,090 ft/min (332 m/min)
· Maximum rate of climb at sea level - 2,320 ft/min (707 m/min)
· Service ceiling - 26,000 ft (7,925 m)
· Service ceiling with one engine inoperable - 11,300 ft (3,444 m)
· Hover out of ground effect - 14,200 ft (4,328 m)

Range

· Amphibious assault - 515 nmi 954 km
· Maximum self-deployment - 2,100 nmi 3,892 km

Accommodations

· Cockpit, crew seats - two
· Cabin, troopseats/litters - 24/12

Fuel capacity

· Sponsons = 1,228 gal (4,649 L)
· Wing = 787 gal (2,979 L)
· Auxiliary, self-deployment = 2,436 gal (9,221 L)

V22Description.tiff ¬

The "Wing Stow" and "Blade Fold" system enables the Osprey to consume a very limited amount of space...which could be interesting to commercial customers too.

V-22 RC Modell

Scan:

build by:

Bell Boeing 609

In August 1955, BellÂs initial tiltrotor design, the single-engine XV-3, made its initial hover. Three years later, the XV-3

BellBoenig609.Paris.tiff ¬

the efforts in the late 1940s a

aximum Takeoff Gross Weight 16,000 Pounds

at cruise speeds up to 275 knots and at ranges up to 750 nautical miles