The key to Starship’s docile handling lies in the foreplane, and in particular its unique variable-geometry design. Rutan’s homebuilt canards have unswept, high-aspect-ratio foreplanes to minimise drag, but they do not have to cope with the increased nose-down pitching moment generated by wing flaps, essential to Starship’s field performance.

In the cruise, Starship’s foreplane is swept back 30° to minimise drag. Simultaneously with extension of the wing Fowler flaps, the foreplane is swept to 4° forward, increasing its span and shifting its aerodynamic centre forward to balance flap deployment. This eliminates flap pitching moment, to the benefit of passenger comfort.

Foreplane-forward, the aircraft can safely maintain lower take-off and landing speeds and so meet Beech’s objective that the Starship be able to operate out of the same 3,000ft runways as the King Air. This will enable the aircraft to operate out of 94 per cent of US airfields, Beech points out, many of which are closed to business jets which cannot meet the rejected take-off performance of turboprops.

The two-position Fowler flaps are interconnected with the variable-geometry foreplane, with four electric motors for the flaps and one for the foreplane, and an automatic monitoring system which shuts down all five in the event of a failure, so preventing any unintentional combination of flap and foreplane position. The pilot simply has a two-position switch which simultaneously controls flap extension and foreplane sweep.

Another important handling bonus is the substantially reduced engine-out asymmetry, says Beech. There is no conventional fin to act as a large sounding board transmitting propeller noise to the cabin, so the engines can be mounted close to the centreline. The rudder-equipped winglets, meanwhile, are as far from the engines as is possible and operate in undisturbed airflow away from the fuselage to provide “superb” directional control, says Beech.

The Starship design is inevitably a compromise. Because the foreplane stalls first the wing is unlikely to achieve more than 90 per cent of its lifting potential. This increases wing size required, as does

A Starship is born

Three forms of carbonfibre are used in construction of the Beech Starship—woven cloth, unidirectional tape, and filament. The cloth and tape are prepreged with epoxy resin (prepreg) and are used in the layup of components including the wing and fuselage. The cloth is a plain 0°/90° weave while the tape is laid at ±45° to the fabric.

A problem which has always exercised designers of all-composite aircraft is lightning strike protection. The problem is twofold: to dissipate the lightning strike itself before it causes physical damage; and to protect the aircraft’s avionics from the destructive voltages induced by the strike. In a metal airframe the aluminium skin provides the necessary protection, but carbonfibre is an extremely poor conductor.

To provide conduction equivalent to a metallic airframe, therefore, Beech has incorporated a fine aluminium mesh into the outermost carbonfibre layer. The fine aluminium wires are incorporated into the fabric itself, interwoven at 3mm intervals. This protective layer is capable of dissipating four times the strength of a lightning bolt with only cosmetic damage, claims Beech. Additional measures include providing conduction strips between panels and further protecting the avionics. As a result Beech believes Starship’s lightning-strike protection equals or surpasses that of a conventional metal aircraft.

Beech is evaluating two methods of fuselage construction—traditional layup and filament winding. Layup is slow, labour-intensive, but well known. Machine winding, first used for rocket motor casings in the 1960s, is fast, and cheaper, but Beech is so far disappointed with the efficiency of the process.

It takes about 24hr and 900 miles of carbonfibre to filament-wind a Starship fuselage, compared with about a week to layup the same component by hand.