Vhen the re-winged 737-X, as it became nown, was selected (mainly for commonality easons), the definition of the wing became one f the first priorities.

The new wing was designed for flight at peeds of up to Mach 0.82. An economical ruise speed of Mach 0.79 at a ceiling of 41,000ft 12,500m) is more likely in service, compared o around Mach 0.74 at 37,000ft for the current-eneration 737. To help gain a few more knots, 3oeing has designed a raked, low-drag wingtip imilar to the much larger tip of the 777.

Wing area is increased to 125m² (1,345ft²), rimarily through a 5.4m stretch in span which ; faired into the existing tip chord, and an ntirely new wingbox. The longer-range mis-ion required more fuel capacity, so the rear spar /as moved aft to provide extra volume. The ncreased span also meant newly designed xtended spars and redesigned fuel and surge anks. Each wing contains 4,900litres of fuel, aking total fuel volume (including a 16,230litre entre tank) to 26,036litres — giving roughly ,660km (990nm) of additional range (*see sys-ems description*).

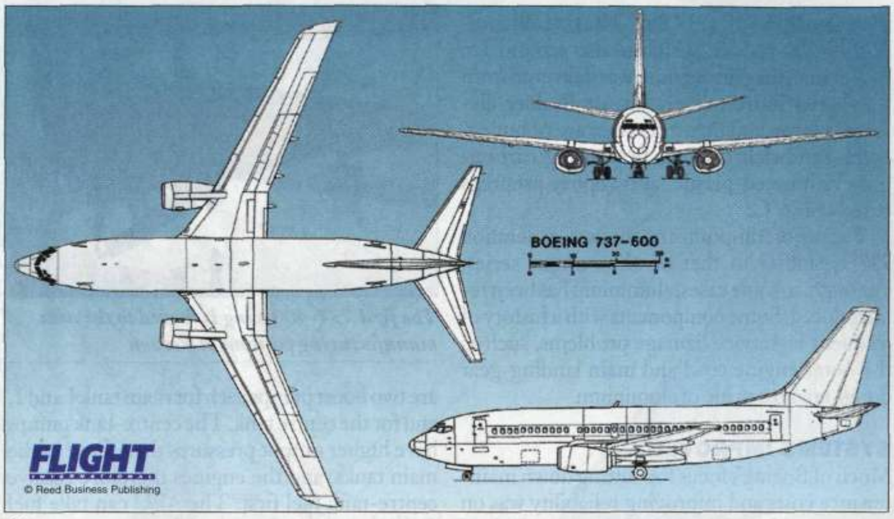
Chord is increased by 430mm which, togeth-r with the new aft-camber cross-sectional pro-le, gives a lower thickness-to-chord ratio than 1 the 1960s-vintage design of today's 737.

Despite the bigger wing, the designers main-ained maximum commonality with the current 1selage by keeping to the same side-of-body in location. A revised, low-drag aft wing-body omposite fairing fits around the wing root.

IO LEAKS

oeing took advantage of the wingbox redesign) address some nagging manufacturing and aintenance headaches with the traditional ing, such as leaking fuel tanks. New in-spar cins, stiffeners and ribs were designed and pro-uced from improved aluminium alloy used for e first time on the 777. The new design also ived weight. "All the in-spar ribs are fully achined, as opposed to being built-up. We ved literally thousands of fasteners [and] parts id weight, and we also saved on the tooling," ys Caton. The new tooling was designed sing an improved version of the Dassault ATIA computer-aided design and manufac-uring system. The tooling allows improved anufacturing tolerances and, in doing, cuts e risk of fuel leaks.

Some weight was also unexpectedly saved in e wing-design process as late as 1996, when ore sophisticated flutter-analysis techniques ecame available. The analysis showed that ing-skin thickness could be reduced aft of the igine pylon and part of the mass transferred itboard to an area near the tip. "It came out of owhere and we saved up to 80lb [36kg] on the 00 design, around 120lb on the -700, and 00lb on the -600," says Caton. Alcoa's new 55 alloy (which is also used on the 777 wing) used for its high compression-resistance in e upper wing surface, stiffeners and in-spar



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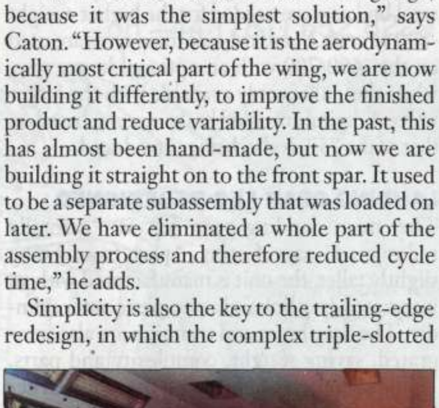
ribs. A 2000-series alloy, 2324, is used for the lower surface skin which is subjected to high tension loads.

REDESIGNED SLAT

The leading edge of the new wing is modified with a new Kruger flap and an additional slat outboard. The slat is based on a simpler design made up of fewer parts and is expected to stand up better to corrosion, particularly around the trailing-edge wedge of the slat on the upper surface. There are two leading-edge flaps inboard of each engine and four leading-edge slats outboard.

"We've retained the same basic leading edge, because it was the simplest solution," says Caton. "However, because it is the aerodynamically most critical part of the wing, we are now building it differently, to improve the finished product and reduce variability. In the past, this has almost been hand-made, but now we are building it straight on to the front spar. It used to be a separate subassembly that was loaded on later. We have eliminated a whole part of the assembly process and therefore reduced cycle time," he adds.

Simplicity is also the key to the trailing-edge redesign, in which the complex triple-slotted



Low-speed windtunnel testing for the new 737 was carried out by the UK Defence Research Agency

flap mechanism of the current wing is replaced with a more straightforward double-slotted design. "Again, we're talking about reduced parts and lower maintenance costs with this design," says Caton.

A hydraulic motor drives a flap power-drive gearbox to operate all the trailing-edge flaps via a torque-tube drive to ball-screw actuators. If the normal hydraulic systems fail, the flaps can be operated using electrical power. A load-relief system is built in to protect the trailing-edge flaps from excessive airloads. This will move the flaps up by one position if airspeed exceeds a set limit when the flaps are at 30°-40°.

Flap tracks, enclosed in new fairings, are made from stainless steel instead of the corrosion-prone high-strength carbon steel traditionally used. Composite ailerons are increased in span by 510mm, along with a proportionately increased trim tab.

The new-generation 737 has a similar engine nacelle/pylon design to that of the 777, for which Boeing has overall responsibility. As a result, the engine is supported at the wing by an attachment known as the R1 fitting, rather than being attached to the front and rear spars as on the current 737. "This helped us eliminate a fairing on the upper surface," Caton comments.

The dorsal fin and vertical stabiliser have been lengthened, and the span of the horizontal stabiliser increased to cope with the additional power of the CFM International CFM56-7B turbofans. Overall fin height off the ground has grown to 12.5m, compared with 11.1m for the current aircraft. The area of the vertical stabiliser increases to around 26.4m², some 5.5m² greater than that of the -300. The dorsal panels and fin trailing-edge fixed panels are of a honeycomb-sandwich construction, fabricated using a glassfibre-reinforced-plastic (GFRP) epoxy prepreg cured at 121°C. The tailcone panels are also made out of a honeycomb sandwich using GFRP epoxy prepregs cured at 176°C.

Horizontal-stabiliser span, meanwhile, has grown from 12.7m to 14.3m, while the area has