A THEORECTICAL INSIGHT INTO THE CONCEPT OF FUTURE SUPERSONIC TRANSPORT

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Abstract— Supersonic transport are sophisticated aircrafts used to transport passengers greater than the speed of sound(in excess of 1.5 mach).These transports cut time into half, helping growing business, economics, and increasing globalization. The Concorde, a product of BAC Systems and Aerospatiale, completed commercial journeys in half the time taken by other commercial aircrafts. This gave the airliner's operators an edge in commercial operations compared to other traditional aircrafts. Apart from that, people always prefer to fly in fast sophisticated aircrafts in luxury. Hence the SST's was always preferred by the public for intercontinental flights. However Supersonic Transports incorporate complex structural designs in aircraft construction. As a Result, the cost amounts to billions of dollars to construct such aircrafts which is only economically viable for the very richest countries. Supersonic Transports also generates excessive noise especially during Takeoff and Landing .which is deemed uncomfortable to people living in proximity to the runway .This Excessive noise is termed as "SONIC BOOM". The Concorde, most notably the most favorite supersonic transport in the 80's and 90's dominated the airline industry. But its makers had to subside a heavy amount to actually run these aircrafts thus suffering losses. he Concorde crash in 2000 also marked the grave of the first generation SST's and presently there are no operating supersonic transport in commercial service despite plans and extensive design studies. This paper will observe the feasibility of Future Supersonic Transport and give a theoretical insight on SST's of the future which will be faster, better, more efficient and cost effective compared to the earlier Concorde aircrafts. Design Details and Aircraft performance are shown in detail.

Keywords— Supersonic Aircraft, Latest Technology in Aeronautic Field.

I. INTRODUCTION

The first generation aircrafts are called as supersonic transports the idea of travelling in supersonic speed (Mach>1). Commercial transport at supersonic speed has been a reality since 1976, and it has been a greater technical success. Up to date Concorde and Tupolev-Tu-144 are the only SST aircrafts, were Tu-144 was in June 1978 and it was last flown in 1999 by NASA and Concord was introduced as an commercial aircraft in October 2003 and last airborne operation on November 26, 2003



SUPERSONIC COMMERCIAL AIRCRAFTS

CONCORDE



Fig 2 – CONCORDE DURING TAKE OFF CONCORDE DEVELOPMENT

The idea of the Concorde project date to the early 1950, when Arnold Hall, director of the Royal Aircraft Establishment (RAE) asked Morien Morgan to form a committee to study the supersonic transport (SST) concept. In February 1954 the first group met was held for concord project and delivered their final report in April 1955. At the time the challenging part is to reduce the drag and it was known that the drag at supersonic speeds is difficult to reduce and it was strongly related to the span of the wing and this led to us a short span wing, because short span generates little lift at a low speed which resulted in extremely long take-off runs and frightendingly high landing speeds. This required enormous engine power to lift off from existing runways, and to provide the fuel needed so the SST team came up with a different wing design Johanna Weber and Dietrich Küchemann

at RAE, they published a report on new wing design platform know as the "slender delta" concept. Weber and Marcel who worked in delta wing flow character the fact that delta wings can produce strong vortexes on their upper surfaces at high angles of attack. The vortex will lower the air pressure and cause lift to be greatly increased. Küchemann's and Weber's ideas changed the entire nature of the supersonic. Where the delta wing design as already existed in that time there were not much different using slender delta concept. Weber noted that the lift from the vortex was increased by the length of the wing it had to operate over, which suggested that the effect would be maximized by extending the wing along the fuselage as far as possible. Such a layout would still have good supersonic performance inherent to the short span, while also offering reasonable takeoff and landing speeds using vortex generation.

II. DESIGN OF CONCORDE

Concorde was the first air-liner to have a (in this case, analogue) fly-by-wire flight-control system; the avionics system the Concorde used was unique because it was the first commercial aircraft to employ hybrid circuits the principal designer for the project was Pierre Satre Concorde pioneered the following technologies:

For high speed and optimization of flight:
Double delta (ogee/ogival) shaped wings
Variable engine air intake ramp system controlled by digital computers.

Super cruise capability
Thrust-by-wire engines, predecessor of today's FADEC controlled engines
Droop-nose section for better landing visibility

For weight-saving and enhanced performance:

Mainly aluminum construction for low weight and conventional manufacture (higher speeds would have ruled out aluminum)
Full-regime autopilot and auto throttle allowing "hands of" control of the aircraft from climb out to landing

Droop nose:
Concorde's drooping nose, developed enabled the aircraft to switch between being streamlined to reduce drag and achieve optimum aerodynamic efficiency, and not obstructing the pilot's view during taxi, takeoff, and landing operations. Due to the high angle of attack, the long pointed nose ob-strutted the view and necessitated the capability to droop. The droop nose was accompanied by a moving visor that retracted into the nose prior to being lowered. When the nose was raised to horizontal, the visor would rise in front of the cockpit windscreen for aerodynamic streamlining.

General characteristics:-

- Crew: 3 (2 pilots and 1 flight engineer)
- Capacity: 92–120 passengers (128 in high-density layout)
- Length: 202ft 4in (61.66 m)
- Wingspan: 84ft 0in (25.6 m)
- Height: 40ft 0in (12.2 m)
- Fuselage internal length: 129 ft 0 in (39.32 m)
- Fuselage width: maximum of 9 ft 5 in (2.87 m) external 8 ft 7in (2.62 m) internal
- Fuselage height: maximum of 10 ft 10 in (3.30 m) external 6 ft 5 in (1.96 m) internal
- Empty weight: 173,500 lb (78,700 kg)
- Useful load: 245,000 lb (111,130 kg)
- Power plant: 4 × Rolls-Royce/SNECMA Olympus
- 593 Mk 610 Afterburning turbojets
- Dry thrust: 32,000 lbf (140 kN) each
- Thrust with afterburner: 38,050 lbf (169 kN) each
- Maximum fuel load: 210,940 lb (95,680 kg)
- Maximum taxiing weight: 412,000 lb (187,000 kg)

Performance:-

- Maximum speed: Mach 2.04 (≈1,354 mph, 2,179 km/h, 1,176 knots) at cruise altitude
- Cruise speed: Mach 2.02 (≈1,340 mph, 2,158 km/h, 1,164knots) at cruise altitude
- Range: 3,900 nmi (4,488.04 mi, 7,222.8 km)
- Service ceiling: 60,000 ft (18,300 m)
- Rate of climb: 5,000 ft/min (25.41 m/s)
- Lift-to-drag: Low speed– 3.94, Approach– 4.35, 250 kN, 10,000 ft– 9.27, Mach 0.94– 11.47, Mach 2.04– 7.14
- Fuel consumption: 46.85 lb/mi (13.2 kg/km) operating for maximum range
- Thrust/weight: 0.373
- Maximum nose tip temperature: 260 °F (127 °C)
- Runway requirement (with maximum load): 3,600 m (11,800ft)

III. TUPOLEV TU-144

The Tupolev tu-144 is the first commercial supersonic transport aircraft (sst). It is one of only two SSTs to enter commercial service, the other being the Anglo-French Concorde. The design was published by Tupolevokb, and its built by the Voronezh aircraft production association . The prototype first flew on 31 December 1968 near Moscow, two months before the first flight of Concorde. The Tu-144 first went supersonic on 5 June 1969, and on 26 May 1970 became the first commercial trans-port to exceed Mach 2. The aircraft was introduced into passenger service on 1 November

1977, almost two years after Concorde, be-cause of budget restrictions. In May 1978, another Tu-144 (an improved version, named Tu-144D).The Tu-144 lagged behind Concorde in areas such as braking and engine control. Concorde utilized an electronic engine control package from Lucas, which Tupolev was not permitted to purchase for the Tu-144 as it could also be used on military aircraft. Concorde's designers used airliner fuel as coolant for the cabin air conditioning and for the hydraulic system. Andrei N. Tupolev continued to improve the Tu-144 with upgrades and changes on the Tu-144 prototype. While both Concorde and the Tu-144 prototype had original delta wings, the Tu-144's wing lacked Concorde's conical camber. Production Tu-144s replaced this wing with a double delta wing including such conical camber, and they added a simple but practical device: two small retractable surfaces called Moustache canard, one on either side of the forward section on the aircraft, to increase lift at low speeds.
Moving the ailerons downward in a delta-wing aircraft increases the lift (force), but also pitches its nose downward. The canards cancel out this nose-downwards moment, thus reducing the landing speed of the production Tu-144s to 315– 333 km/h (196–207 mph; 170–180 kN), still faster than that of Concorde. The aircraft made a total of 27 flights during 1996 and 1997. Though regarded as a technical success, the project was cancelled for lack of funding in 1999.

SPECIFICATION:

Components	Expired SST Commersial Aircraft	
Tire pressure	207	lbs sq.inc
Wing span	84`	Ft
Thrust	32000	lbs
Height	37`	Ft
Length	204`	Ft
Engine	4* RollsRoyce Snecma Olympus 593 tubojet	
Cruising speed	1336	Mpa
Cruising Height	55000	Ft
Max. takeoff weight	408000	`lbs
Fuel capacity	119,500	liters
Fuel consumption	25,629	liters
Cost	€ 1.30	billion
Crew	3	nos
Capacity	140	nos

IV. FUTURE SST'S PROPOSAL

With Major airline manufacturers such as airbus trying to manufacture new state of the art Supersonic transport of the future by 2019, we have to check the feasibility of such aircrafts. The Concorde and the Tupolev had major drawbacks such as increased weight, Lift problems, Excessive Noise generation, and very low fuel efficiency. The Concorde especially was notorious for being a gas guzzler although it was admired as an engineering marvel by the aviation industry.
We propose that Future Supersonic aircrafts to be made of shape memory alloys or composite materials which have increased strength but weigh very less. This will solve lift problems. We also propose the engines of aircrafts to be fitted with shock absorbers and noise reducers near the turbines such that the intensity of sonic booms is reduced. Also with the increase in the manufacture of extremely powerful and fuel efficient engines can actually help the future SST's to be a reality very soon.

CONCLUSION

Supersonic transport has always been the fantasy of the airline industry and the envy of its competitors. A sudden commercial absence has only fuelled the need for a new aviation marvel to take to the skies. Our small contribution to the vast studies and research undertaken in this field will be accompanied by many comparative studies which will make us understand the limitations of the first generation SST's. This will help us to mitigate the issue and pave the way for a flawless new SST

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