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Supersonic Viking Transport (SVT)

Abstract

The aim of the designing SVT is to design a supersonic aircraft that can cruise at supersonic speed having less deleterious impact on the environment. The design of this aircraft features two Turbo ramjet engines attached to the fuselage, variable swept wings, canards, and a spike mounted at the front of the aircraft to reduce sonic boom. For noise reduction on airport SVT offers turbo ramjet engine (variable cycle jet engine), and variable swept wings. As for fuel efficiency, SVT offers turbo-ramjet which is a two-in-one engine. Secondly, it offers variable swept wings which increase lift and reduce thrust necessary for takeoff, and also help to make SVT more fuel efficient. Thirdly, light weight body and other features i.e. the canards and the placement of turbo ramjet near the fuselage also make the aircraft more fuel efficient. For reducing the sonic boom SVT is equipped with a 20ft long spike mounted at the front, which is adopted from one of the NASA's own program "Quiet Spike". Another feature to reduce the boom is the adjustable wing span (variable swept wings). As for cruise emission, one of the major components of this aircraft is double annular combustor (DAC) which is very helpful in reducing emission. Finally, to sustain supersonic speeds an aircraft engine must also be able to deal with high temperature and for this reason this aircraft's engines are made up of light weight Nickel crystal with ceramic coating.

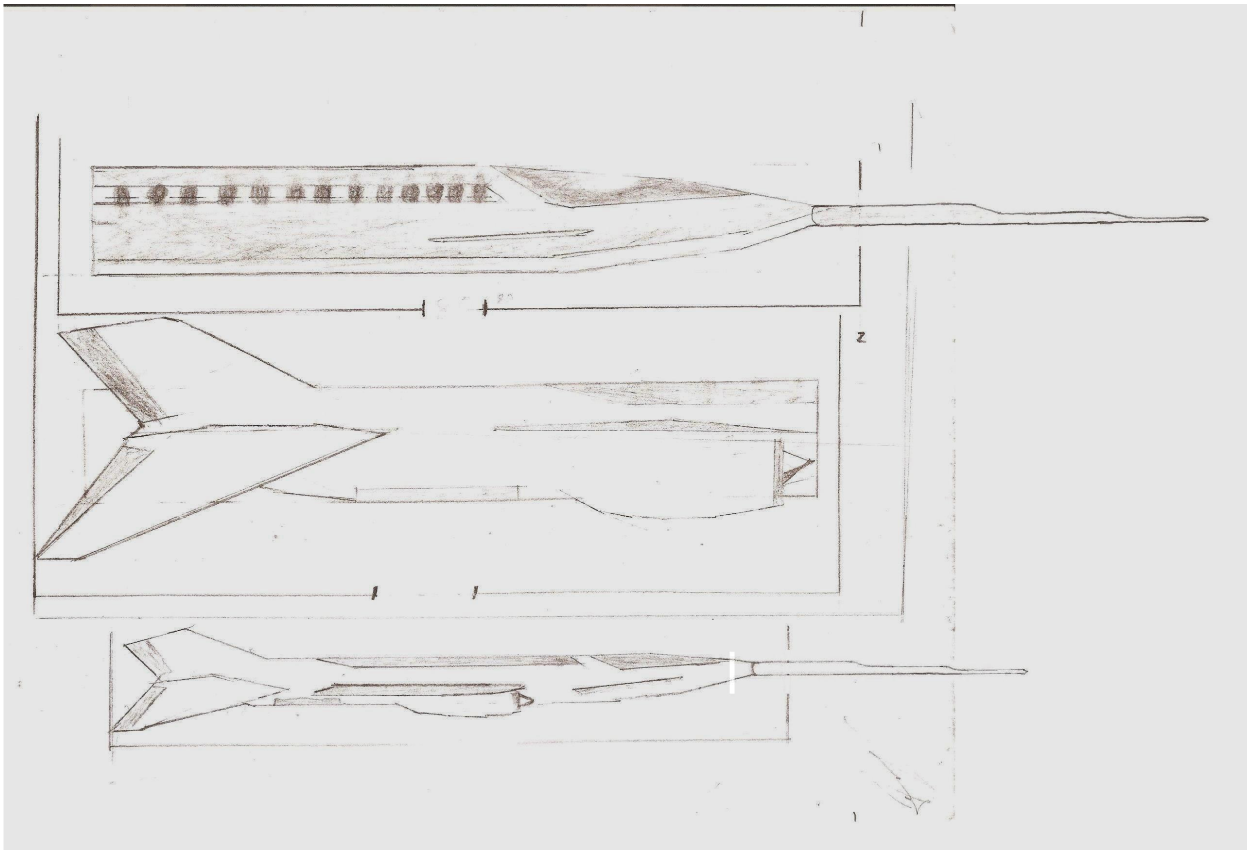

Figure 1 Side view of SVT (with Quiet spike, turbo ramjet & other aerodynamics)

Sonic boom

Sonic Boom is an aspect that needs to be very well considered when making a supersonic jet. Many supersonic transport programs have been terminated because the transports were unbearably noisy when they passed over towns and cities. Therefore, it is very important for a future supersonic aircraft to be not too noisy when traveling at supersonic speeds. Opposite of a very popular belief, it actually will not help if the aircraft approached the sound barrier at high altitudes. Many tests have been conducted using several different aircrafts, and the outcomes have consistently been the same: the height of the aircraft does not have an effect on how noisy the jet will be perceived on the ground below. Take the Xb-70 Valkyrie for an example, at an altitude of 70,000 ft, sonic boom was still a problem. However, there are still other things that can very effectively help reduce the noise created by the sonic boom. One of the most innovative things that the Supersonic Viking Transport (SVT) offers that can help to greatly lower the sonic boom noise is the concept of variable swept wings. Wing span has a tremendous affect on the sonic boom. The wider the wingspan is the greater the boom is created; therefore, being able to control the wing span can help to reduce the effect of sonic booms. With variable wings, the jet may sweep the wings whenever necessary. That, in effect, will reduce the wingspan which, in turn, will reduce the noise generated by the sonic boom. In addition, the quiet spike in front of SVT will also help to cut down the effects of sonic boom. The twenty feet rod attached to the front of the aircraft will help dissipate the pressure that builds up in front of the jet, and thus it will help generate a quieter boom (up to one-third quieter).

Airport noise

SVT is equipped with turbo- ramjet which is two in one engine. But how does this jet engine help SVT to reduce airport noise? Since SVT will use a variable cycle jet engine, it will allow the aircraft to reduce the noise. Second future that will to reduce noise during the takeoffs and landings is the SVT's aerodynamics. This aircraft has variable swept wings which will allow this aircraft to land and takeoff at low speed and break the sound barrier at high altitudes. While in the air the Quite Spike will help to reduce the sonic boom by one- third. Furthermore aerodynamics that will help SVT to be a successful supersonic aircraft are the Canards that will help prevent instability and turbulence (especially at high altitude) and propelling nozzles.

Cruise Emissions

Emissions from supersonic aircraft are another major obstacle for supersonic aircraft because it has great impact on the environment. So what are the solutions? SVT is not just designed to cruise at supersonic speed, but it designed to cruise at supersonic speed with having less impact on the environment. One of the first solutions is that SVT is going to use Double annular combustor (DAC) with an emissions index of about 5 (i.e., 5 g of NO_x produced for every kilogram of fuel burned).

The combustor is coated with thin layer of ceramic for thermal protection. The DAC will allow keeping the NO_x within the acceptable limit. But combustor also produces water, which is another ingredient that is harmful for the ozone layer. So SVT has other three choices of methods to solve this problem. First is emitting the water in form of large droplets/ice particles or any other form so that water could settle in the troposphere. Second method is removing and the collecting (until can be released in the troposphere) the water that has been give out from the emission. And the third method is using chemicals reactions to generate thrust. Another way that SVT will emission is that it will cruise at 50,000ft to 54,000ft. The reason behind this is that supersonic aircrafts can increase the radioactive forcing by factor of 5 or so by cruising at low altitude, which in turn can help to reduce ozone depletion to some extent.

Cruise speed 1.6 -1.8 mach

Cruise speed is yet another very important aspect that needs to be considered when designing the supersonic transport of the future. First of all, because the aircraft is supersonic it is very important for it to be able to **sustain** supersonic speeds. Many of SVT's features in addition to its ramjet engine will help it sustain speed of approximately 1.8 mach. Firstly, SVT is very aerodynamic. Secondly, it is very light. Its graphite-epoxy body translates that it will be very light, which will be very important in helping it to sustain supersonic speeds. Additionally, when SVT's variable swept wings will swept back right when it reaches a high enough altitude, it will greatly help to reduce drag, and thus help SVT to also attain high speeds. In addition, when wings are swept back and the center of gravity also shifts back (due to supersonic speeds), the significance of canards will only increase. If it were not for canards, the jet would become very unstable (because the wings are swept back) and it would only hinder the jet from maintaining high speeds. Also, SVT will use the fuel in a unique way. It will pump the fuel from the back of the jet to the front to maintain a constant center of gravity. Last but not least, SVT's ramjet engine will also help it to sustain high speeds. Ramjet engines are use especially just for high speeds, so they will be very important aspect of SVT.

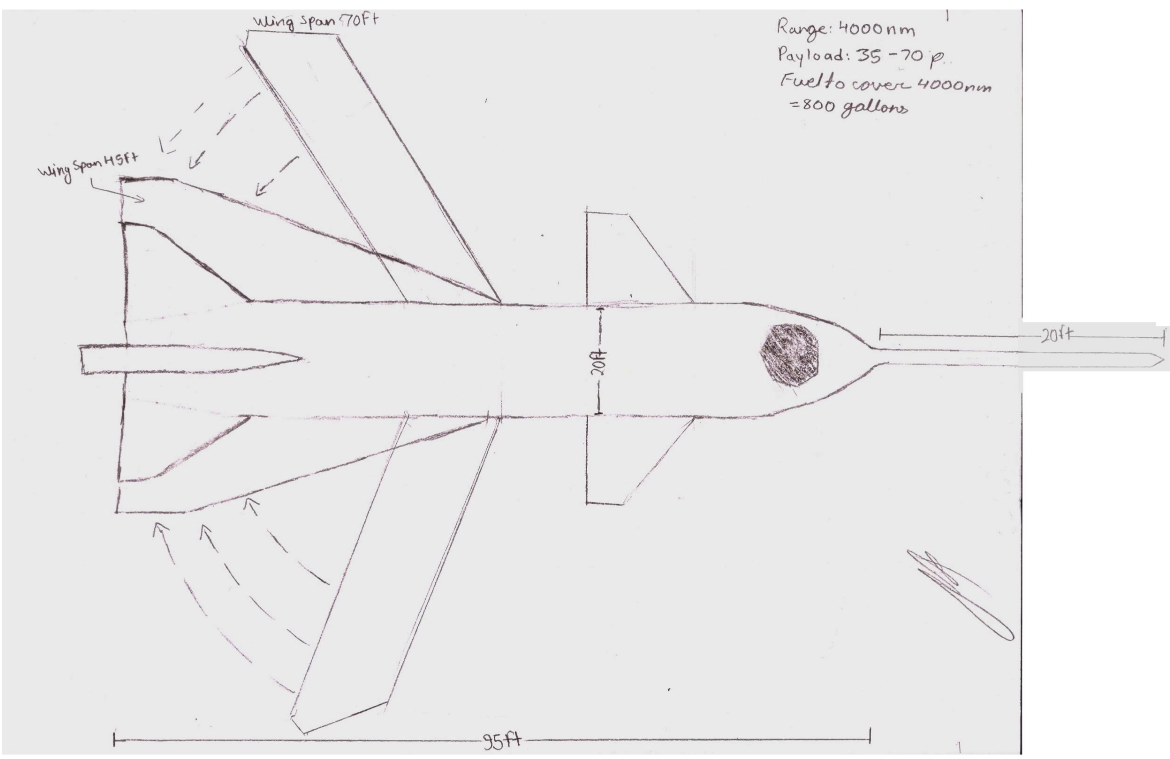

Figure 2 Top down view of SVT, Showing the variable swept wings and spike.

Fuel efficiency

Fuel efficiency is another very important perspective that needs to be taken care of when designing the supersonic transport of the future. A fuel efficient jet will not only greatly help in that it will minimally affect the environment, but it will also be very economical. The SVT has various features that can greatly help fuel efficiency. Among the most important features is the graphite-epoxy body of the jet. The body to be made of this lightweight yet very stro substance means that the plane will be very light, and thus also very fuel efficient. In addition, SVT's use of JP-7 kerosene will also make the aircraft more fuel efficient. Its high flash point, and corrosion inhibitors (also serve as lubricants) and additives such as anti-oxidants in JP-7 that greatly help prevent the degradation of the jet, will tremendously help to increase the overall fuel efficiency. In addition, the reduced drag of SVT due to many of its features such as variable wings, position of its engines and canards will also help to increase the fuel efficiency. Variable wings will allow the wings to swept back as soon the jet reaches high altitudes. The sweeping back of the wings will help to reduce the drag which, in turn, will increase the fuel efficiency. In addition, the fact that the engines will be placed right on the side of the fuselage on both sides (Figure 2), and not on or underneath the wings, will also help to reduce the drag. In addition, the presence of a canard will greatly help the fuel efficiency. The canards will generate extensive amount of lift, thus reducing the load on the engines, and thus increasing the fuel efficiency. Most importantly, the turbo-ramjet engines will also help make SVT very fuel efficient. The turbo-ramjet engines will be sort of two-in-one engines in that the engines will be turbo jet till the aircraft passes the mach 1 barrier, then a semi-circular cone will push back into the air inlet, turning it into a very efficient ramjet engine. Because turbojet engines are not very efficient (since they compresses their own air), the SVT will not be using them for too long. Right after the jet passes the sound barrier, the ramjet engines, which automatically compress their own air with the help of the cone and the high speed of the aircraft, will take over, thus making the aircraft very fuel efficient.

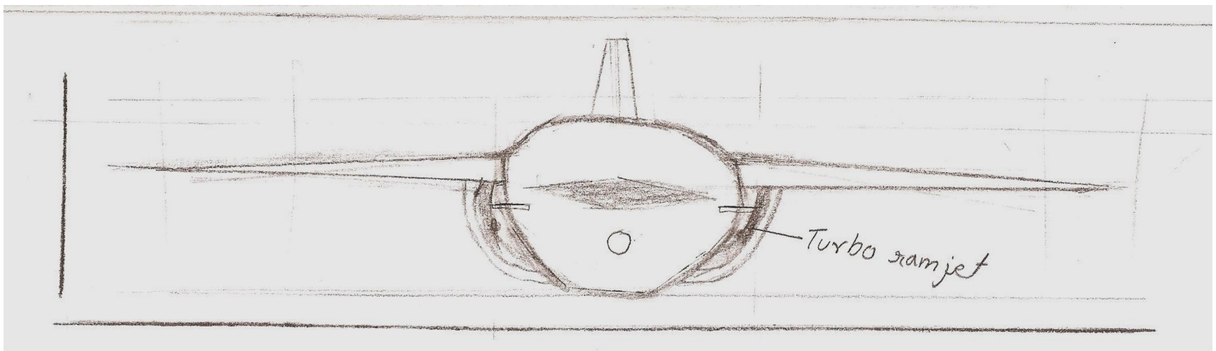

Figure 2 Front view of SVT showing the turbo ramjet attached to the Fuselage.

CONCLUSION

SVT offers all the things to meet supersonic aircraft needs. And it also offers ways to be environment friendly. It has capability to reach the goals that are needed for a successful commercial supersonic jet. This aircraft offers new ways to reduce the cruise emission. It is fuel efficient, has aerodynamics that will help to it to be at supersonic speeds with less degradation in performance. It is capable of carrying 60 – 70 passengers at supersonic speeds. It has ability to deal with the sonic booms, which in past have caused many supersonic transport programs to shutdown. The variable swept wings give the aircraft the ability to take off and land at low speed. The turbo ramjet (also used in blackbird) gives this aircraft performance of a jet fighter while being more fuel-efficient and putting less burden on the environment. Still, SVT is not perfect. More studies and experiments need to be conducted in several fields to further help SVT be more fuel – efficient, less noisy, etc.

First of all, airport noise is among the biggest problems. And the noise is mostly emitted through the nozzle of the engines; therefore, more studies need to be conducted with different materials to somehow help the nozzle absorb the noise. In addition, More fuel types also need to be studied upon to find the fuel that not only burns very efficiently, but also cleanly (to emit less pollution). Last but not least, NASA should also try to come up with more ways to reduce the sonic boom.

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