Introduction to Aircraft Design
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Lecture – 45
Estimation of Engine Parameters

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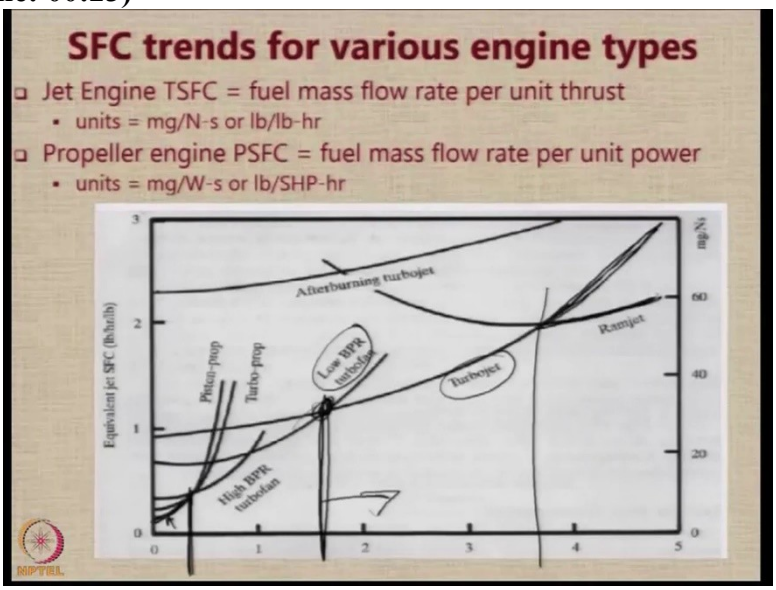

Let us also look at how do you get the SFC values in cruise and loiter. Again, we have to take records to historical data. The SFC values, this is again the chart from Raymer's textbook where the equivalent jet SFC values are plotted against the Mach number for various types of aircraft and with this chart you can get a rough idea, but this is just an indication. So, this chart actually helps you decide which kind of engine is to be used.

Depending on the Mach number we can depending on the cruise Mach number or the Loiter Mach number that you want the aircraft to achieve, you should select the type. For example, this is a nice intersection where low bypass turbofan and turbo jets they roughly have a crossover. So, at Mach numbers beyond around 1.8 it will be better to go for turbo jets because they are going to have a lower value of the SFC.

Similarly, when you go to around 3.7, 3.8 Mach number, you will start seeing that the turbo jets are going to have an increasing trend in SFC whereas then the Ram jets are going to become more economical. So, depending on which kind of Mach number you are going to follow for low speed aircraft you can see up to Mach number of around 0.4 piston prop turboprop are, after Mach number 0.4 you start seeing turbo props becoming better below that

the piston props have a much lower. So the lowest SFC is for the piston props, this is the line for them.

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Typical SFC values (SI system)

Typical Jet SFC (mg/N-s)	Cruise	Loiter
Pure turbojet	25.5	22.7
Low-bypass turbofan	22.7	10.9
High-bypass turbofan	14.1	11.3

Typical C_{power} (mg/W-s)	Cruise	Loiter
Piston prop (fixed pitch)	0.068	0.085
Piston prop (variable pitch)	0.068	0.085
Turboprop	0.085	0.101

But you know this chart actually helps you decide what powerplant to use typical values of SFC in SI system which is in milligrams per newton second this particular unit milligrams per newton second is used because the numbers which come out are easy to mention and talk about rather than saying 0.000255 or some such very small number. When you work in milligrams per newton second, you get number like 25, 30, 14, 15 which are easy to talk about.

So, if you do not have any idea about typically what you will be getting you can assume these values, these are realistic numbers and if you have a piston prop or turboprop aircraft in mind, in these aircraft, the typical values of the SFC based on power or called as power SFC in milligram per watt second, tend to be as listed here.

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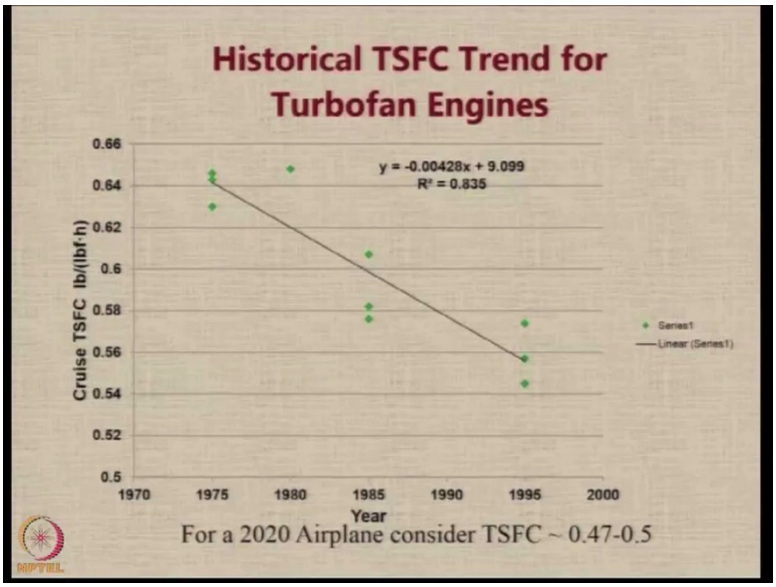

So, this particular chart is quite useful to start off and this has come from the Ramer's text book. Professor Scott Eberhardt has plotted the historical TSFC trends for turbofan engines. And you notice that consistently the TSFC is going to is reducing. So, this indicates that as the year progresses SFCs are coming down.

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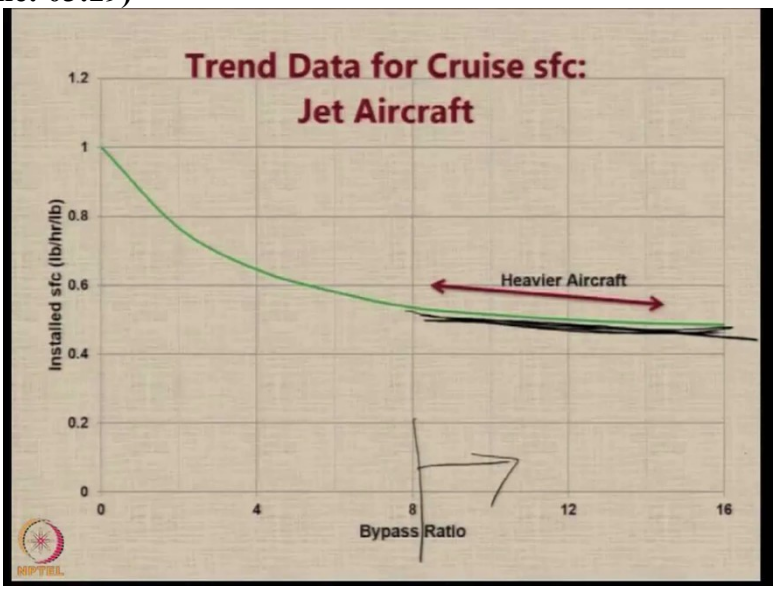

But if you look at the data for cruise SFC trending in aircraft, we see that we are now slowly reaching some kind of flattening if you have a bypass ratio beyond 8, so up to 8 bypass ratio they are slowly come down after the bypass ratio of 8 to 10 they start to becoming flat. Thanks for your attention. We will now move to the next section.