Raymer ch3

dropped (how?)
* # missiles · W missile

$$W_0 = \cancel{W_{crew}}^{\to 0} + W_{pay} + W_{fuel} + W_e$$

$$W_0 = W_{pay} + \left(\frac{W_f}{W_0}\right) W_0 + \left(\frac{W_e}{W_0}\right) W_0$$

$$W_0 = \frac{W_{pay}}{1 - \left(\frac{W_f}{W_0}\right) - \left(\frac{W_e}{W_0}\right)}$$

$\left(\frac{W_f}{W_0}\right) - \left(\frac{W_e}{W_0}\right) \to 0.6$ fig 3.1

$$\frac{W_e}{W_0} = A W_0^{\,C} \cancel{K_{vs}}^{\,1}$$ table 3.1

$A = 2.34 \quad C = -0.13$

Raymer Ch6
better one (6.3.2, table 6.1) (ft, lb, s)
empty weight:

$$\frac{W_e}{W_0} = \left(a + b W_0^{C_1} AR^{C_2} \left(\frac{T}{W_0}\right)^{C_3} \left(\frac{W_0}{S}\right)^{C_4} M_{max}^{C_5}\right) K_{vs}^{\,1}$$

jet fighter (6.1 eq, tab 6.1 Raymer coefs)

$a = -0.02 \quad b = 2.16 \quad C_1 = -0.10 \quad C_2 = 0.20$

$C_3 = 0.04 \quad C_4 = -0.10 \quad C_5 = 0.08$

or: get 6+ baseline planes, use Matlab for a, b, c_n

sizing vars: $\frac{W_0}{S}$, $\frac{T}{W_0}$, AR, others M_{max} — trade study these

$\frac{W_0}{S}$ → constraint diagram; $\frac{T}{W_0}$ → reqs; AR → concept

fuel weight: $W_f = \left(\sum_1^{6.7} W_{f_i}\right)(1+k)$ (k: 0.06 = 5% loss + 1% trap)

*fix for explicit 30 min reserve segment → k=0.01?

$W_{f_i} = \left(1 - \frac{W_i}{W_{i-1}}\right) W_{i-1}$

segments (general):

taxi & takeoff $W_i/W_{i+1} = 0.98$ 6.8 (ref)

climb $W_i/W_{i-1} = \begin{cases} 1.0065 - 0.0325M & M < 1 \\ 0.991 - 0.007M - 0.01M^2 & M \geq 1 \end{cases}$ 6.9, 6.10 (M_{cruise})

(x2) cruise $W_i/W_{i-1} = \exp\left[\frac{-RC}{V(L/D)_{cruise}}\right]$ (RC from reqs; SFC 3.3) 6.11

breguet range eq → $L=W \rightarrow \frac{L}{D} = \frac{1}{qC_{D_0}/(W/S) + (W/S)\frac{1}{q\pi e AR}}$ 6.13

endurance eq

loiter $W_i/W_{i-1} = \exp\left[\frac{-E}{L/D}\right]$ (E from endurance reqs; SFC) eq 6.14

$\frac{1}{2}\rho V_{cruise}^2$? $= \rho(alt)$

(max) L/D assume const ?

$$d_{dash} = \frac{R_{dash}}{V_{max}} = 100\,nmi = \frac{R_{dash}}{M_{max}\sqrt{\gamma RT}} \quad \text{reqs}$$

$$\rightarrow \text{dash } \frac{W_i}{W_{i-1}} = 1 - C\left(\frac{T}{W}\right) d_{dash} \qquad = T(alt)$$

≈ 0.95

eq 6.16

known-time burn → distance

combat (# turns)

$$d_{combat} = \frac{2\pi (\#\,turns)}{\dot{\psi}}$$

6.17

turn rate (°/s) reqs? -//-

needed(?)

5.17: $\dot{\psi} = \frac{g\sqrt{n^2-1}}{V}$

6.18: $n = \left(\frac{L}{W}\right)\left(\frac{L}{D}\right)$ load factor

$n \le n_{max}$ (req)

↓ 6.20, 19

$$\frac{qC_{L,max}}{W/S} = \frac{1}{q\frac{C_{D_0}}{n(W/S)} + n\frac{W/S}{q\pi AR e}}$$ 6.21

$$\rightarrow \frac{W_i}{W_{i-1}} = 1 - C\left(\frac{T}{W}\right) d_{combat} \approx 0.97$$

descend $W_i/W_{i-1} = 0.990 - 0.995$ (6.22)

land/taxi $W_i/W_{i-1} = 0.992 - 0.997$ (6.23)

reserve: loiter w/ $E_{reserve}$

Sizing vars:

- # missiles
- W_0/S constraint diagram
- T/W_0 reqs
- AR concept
- M_{max} reqs
- M_{cruise}
- C
- h_{cruise} reqs → T, ρ
- e concept
- $L/D_{max/loiter}$
- ψ reqs
- C_{D_0} concept

V_{cruise}, V_{max} → q

h_{cruise} design

C_{D_0} component buildup

Mission-specific:

- R
- h

? need both ?

- E
- R_{dash}
- X_{turns}
- $E_{reserve}$