3.4.1 Mission Profiles

For passenger-carrying designs mission profiles must be used that are more complex that that given in the book. Three typical mission profiles for passenger-carrying aircraft are for

- NBAA (National Business Aircraft Association) rules for business jets
- FAR Part 121.639 for domestic operations for commercial aircraft
- FAR Part 121.645 for international operations for commercial aircraft.

In the Breguet range equation, use the cruise sfc (suggested values are in Raymer Table 3.3) appropriate to the engine you have selected. Assume loiter (i.e., Hold) is at 10,000 ft and 250 knots equivalent airspeed (KEAS). In the endurance equation use a loiter sfc that is 105% of the cruise sfc.

NBAA Operations

NBAA reserves requirements appear to be open to interpretation. The mission profile may be assumed to be as shown in Fig. 3.4.1.1

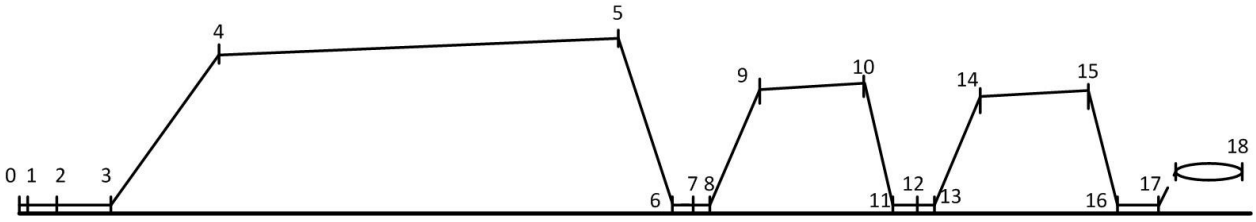

Fig. 3.4.1.1 NBAA Mission Profile

The suggested weight fractions that can be used are:

Segment		$W_{final}/W_{initial}$	Value
1	Engine start and warm-up	W_1/W_0	0.99
2	Taxi	W_2/W_1	0.99
3	Takeoff	W_3/W_2	0.995
4	Accelerate and climb to cruise altitude	W_4/W_3	0.98
5	Cruise (using the Breguet range equation (3.5)). Assume cruise range is total mission range	W_5/W_4	
6	Descend	W_6/W_5	0.99
7	Land	W_7/W_6	0.99
8	Takeoff	W_8/W_8	0.995
9	Climb	W_9/W_8	0.98
10	Cruise for 10% of mission range (use range equation). (This is a slight simplification)	W_{10}/W_9	
11	Descend	W_{11}/W_{10}	0.99
12	Land	W_{12}/W_{11}	0.99
13	Takeoff	W_{13}/W_{12}	0.995
14	Climb	W_{14}/W_{13}	0.98
15	Fly to alternate (use range equation)	W_{15}/W_{14}	
16	Descend	W_{16}/W_{15}	0.99
17	Land	W_{17}/W_{16}	0.992
18	Hold for 30 minutes at alternate (use endurance equation (3.7))	W_{18}/W_{17}	

For this mission profile $W_{zf}/W_{to} = W_{18}/W_0$. Available operating weight empty is then defined as $W_{oe} = W_{zf} - W_{payload}$.

FAR Part 121 Domestic Operations

The domestic flight profile as defined in FAR Part 121 is as follows:

§ 121.639 Fuel supply: All domestic operations.

No person may dispatch or take off an airplane unless it has enough fuel—

(a) To fly to the airport to which it is dispatched;

(b) Thereafter, to fly to and land at the most distant alternate airport (where required) for the airport to which dispatched; and

(c) Thereafter, to fly for 45 minutes at normal cruising fuel consumption or, for certificate holders who are authorized to conduct day VFR operations in their operations specifications and who are operating nontransport category airplanes type certificated after December 31, 1964, to fly for 30 minutes at normal cruising fuel consumption for day VFR operations.

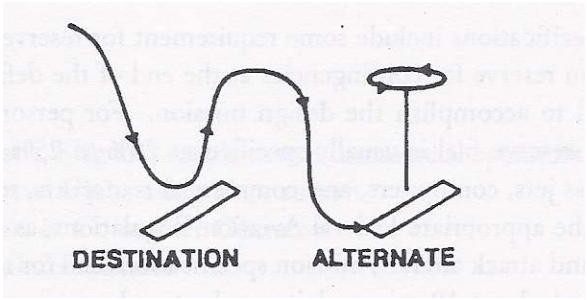

Figure 3.4.1.2 Domestic Reserves

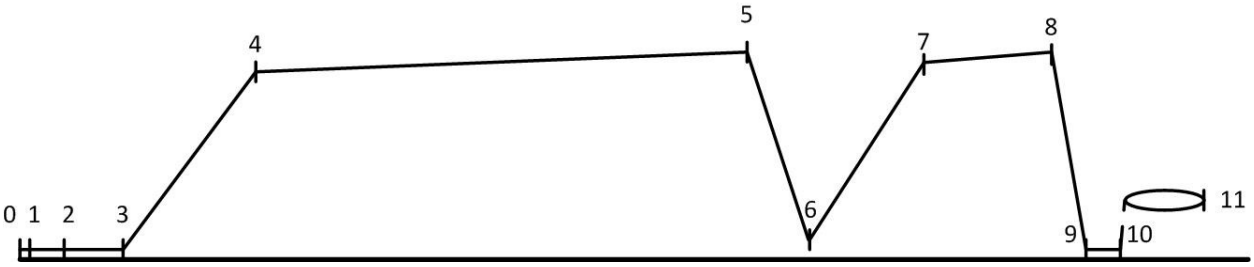

Figure 3.4.1.3 FAR Part 121 Domestic Operations

Assume instrument flight rules (IFR) operations, i.e. 45 minute hold at alternate airport. Assume the most distant alternate airport is 100 nm away from the airport to which dispatched. The suggested weight fractions that you should use for your design are:

Segment		$W_{final}/W_{initial}$	Value
1	Engine start and warm-up	W_1/W_0	0.99
2	Taxi	W_2/W_1	0.99
3	Takeoff	W_3/W_2	0.995
4	Accelerate and climb to cruise altitude	W_4/W_3	0.98
5	Cruise (using the Breguet range equation (3.5)). Assume cruise range is total mission range	W_5/W_4	
6	Descend	W_6/W_5	0.99
7	Climb	W_7/W_6	0.98
8	Fly to alternate (use range equation)	W_8/W_7	
9	Descend	W_9/W_8	0.99
10	Land and taxi in	W_{10}/W_9	0.992
11	Hold for 45 minutes at alternate (use endurance equation (3.7))	W_{11}/W_{10}	

For this mission profile $W_{zf}/W_{to} = W_{11}/W_0$. Available operating weight empty is then defined as $W_{oe} = W_{zf} - W_{payload}$.

FAR Part 121 International Operations

Mission profile requirements for international operations are as follows:

§ 121.645 Fuel supply: Turbine-engine powered airplanes, other than turbo propeller: Flag and supplemental operations.

(a) Any flag operation within the 48 contiguous United States and the District of Columbia may use the fuel requirements of §121.639.

(b) For any certificate holder conducting flag or supplemental operations outside the 48 contiguous United States and the District of Columbia, unless authorized by the Administrator in the operations specifications, no person may release for flight or takeoff a turbine-engine powered airplane (other than a turbo-propeller powered airplane) unless, considering wind and other weather conditions expected, it has enough fuel—

(1) To fly to and land at the airport to which it is released;

(2) After that, to fly for a period of 10 percent of the total time required to fly from the airport of departure to, and land at, the airport to which it was released;

(3) After that, to fly to and land at the most distant alternate airport specified in the flight release, if an alternate is required; and

(4) After that, to fly for 30 minutes at holding speed at 1,500 feet above the alternate airport (or the destination airport if no alternate is required) under standard temperature conditions.

(c) No person may release a turbine-engine powered airplane (other than a turbo-propeller airplane) to an airport for which an alternate is not specified under §121.621(a)(2) or §121.623(b) unless it has enough fuel, considering wind and other weather conditions expected, to fly to that airport and thereafter to fly for at least two hours at normal cruising fuel consumption.

(d) The Administrator may amend the operations specifications of a certificate holder conducting flag or supplemental operations to require more fuel than any of the minimums stated in paragraph (a) or (b) of this section if he finds that additional fuel is necessary on a particular route in the interest of safety.

(e) For a supplemental operation within the 48 contiguous States and the District of Columbia with a turbine engine powered airplane the fuel requirements of §121.643 apply.

The use of the term "flag carrier" is somewhat archaic, since the term is no longer used except in the FARs. The term may be defined as follows:

Flag Carrier – Airline Flag Operations – A Flag Carrier is defined by the FAA as any scheduled operation conducted by any person operating any turbojet powered airplanes, or airplanes having a passenger-seat configuration of more than 9 passenger seats, excluding each crew member seat, or airplanes having a payload capacity of more than 7,500 lb. at the following locations between any point within the U.S. or any territory or possession of the US respectively, or between any point within the U.S. and any point outside the U.S. or between any point outside the U.S. and another point outside the U.S.

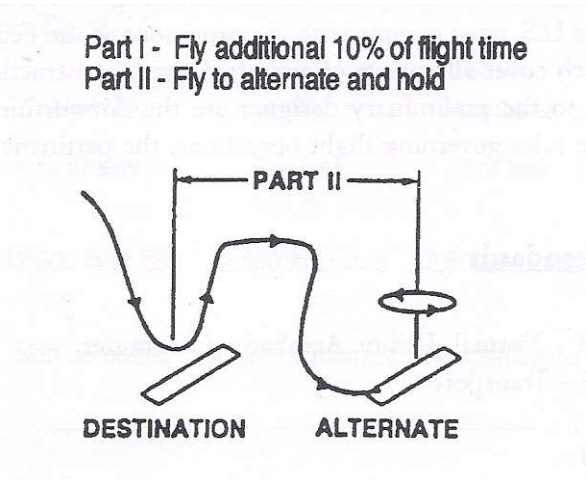

Figure 3.4.1.4 International Reserves

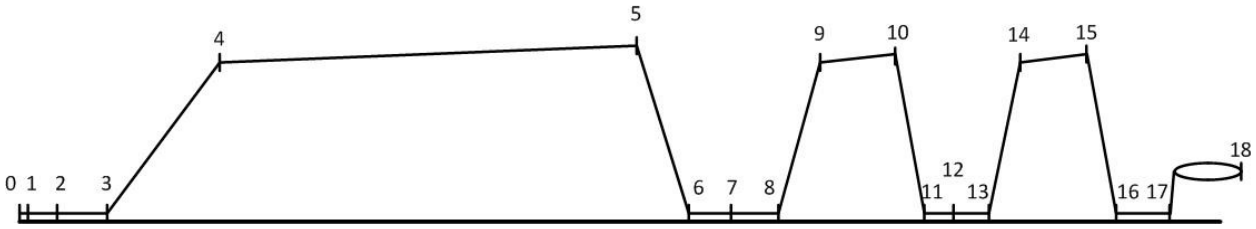

Figure 3.4.1.5 FAR Part 21 International Mission Profile

The suggested weight fractions that you should use for your design are:

Segment		$W_{final}/W_{initial}$	Value
1	Engine start and warm-up	W_1/W_0	0.99
2	Taxi	W_2/W_1	0.99
3	Takeoff	W_3/W_2	0.995
4	Accelerate and climb to cruise altitude	W_4/W_3	0.98
5	Cruise (using the Breguet range equation (3.5)). Assume cruise range is total mission range	W_5/W_4	
6	Descend	W_6/W_5	0.99
7	Land	W_7/W_6	0.99
8	Takeoff	W_8/W_8	0.995
9	Climb	W_9/W_8	0.98
10	Cruise for 10% of mission range (use range equation). (This is a slight simplification)	W_{10}/W_9	
11	Descend	W_{11}/W_{10}	0.99
12	Land	W_{12}/W_{11}	0.99
13	Takeoff	W_{13}/W_{12}	0.995
14	Climb	W_{14}/W_{13}	0.98
15	Fly to alternate (use range equation)	W_{15}/W_{14}	
16	Descend	W_{16}/W_{15}	0.99
17	Land	W_{17}/W_{16}	0.992
18	Hold for 30 minutes at alternate (use endurance equation (3.7))	W_{18}/W_{17}	

For this mission profile $W_{zf}/W_{to} = W_{18}/W_0$. Available operating weight empty is then defined as $W_{oe} = W_{zf} - W_{payload}$