Weight and Balance

Introduction

- Weight and Balance refers to the control of the aircraft's total weight and the location of the Center of Gravity (CG).
- Operating over-weight and outside of the center of gravity's limits can lead to loss of control and accidents.
- There are several ways to calculate weight and balance (graph, table, computational).
- This MUST be completed before each flight as per the FAR (91.103).

Weight Control

- Any weight on board in the aircraft that increases its weight is undesirable for performance.
- An overloaded airplane may not get off the ground!
- Weight changes during the flight as fuel is burnt.

Weight Control

Weight will have the following effect:

- ✓ Higher takeoff speed
- ✓ Longer takeoff run
- ✓ Reduced rate and angle of climb
- ✓ Lower maximum altitude
- ✓ Shorter Range
- ✓ Reduced cruising speed
- ✓ Reduced maneuverability
- ✓ Higher stalling speed
- ✓ High approach and landing speed
- ✓ Longer landing roll
- ✓ Excessive weight on the nose wheel or tail wheel

Balance Control

- Balance control refers to the location of the CG.
- It is important to the stability and safety of the flight.
- It can relate to the CG location along each of the aircraft's axes, but we will mainly focus on the longitudinal axis.
- The CG must remain within certain limits, called the "envelope".
- A forward CG leads to a nose-heavy aircraft and vice-versa.
- Properly loading the aircraft (fuel, occupants, bags) is key to proper balance.

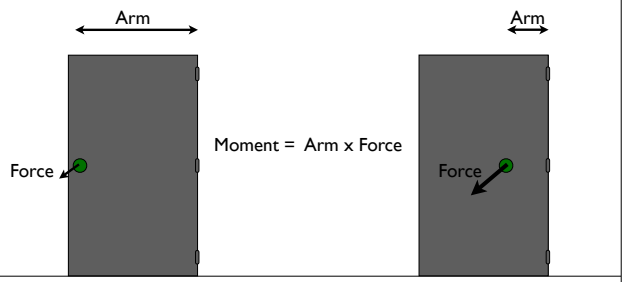
Terms and Definitions

- Center of Gravity (CG): the point at which, if a string was attached, the object would be in equilibrium. The point at which WEIGHT is applied.
- Center of Pressure (CP): the point at which LIFT is applied.
- CG Limits: the specified forward and aft CG points within which the CG must be located.
- CG Range: distance between the CG limits.

Terms and Definitions

- Arm (A): the distance between the CG and where a force is applied.
- Datum: imaginary vertical line from which all arms are measured.
- Station: the location of an object in relationship to the datum (similar to the arm)
- Moment (M): the efficiency of a force. Calculated as:

Moment = Arm x Force



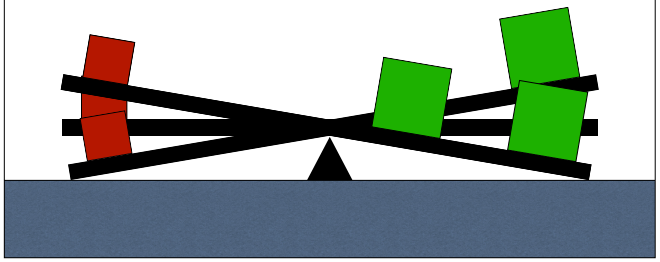
Long arm means small force necessary.

Small arm means large force necessary.

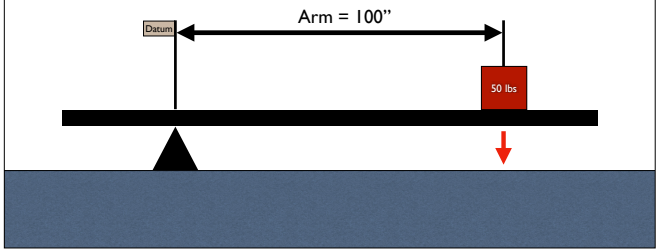
Terms and Definitions

- Standard Empty Weight: airframe, engine, all fixed operating equipment, hydraulic fluid, unusable fuel, and full engine oil.
- Basic Empty Weight: Standard Empty Weight + Weight of optional equipment installed.
- Payload: the weight of occupants, cargo, and baggage.
- Fuel load: only includes usable fuel.
- Useful load: weight of occupants, baggage, usable fuel (payload + fuel load).
- Maximum gross weight: basic empty weight + max useful load.

Moment and Moment Arm



Weight x Arm = Moment
50 lbs x 100 in = 5,000 in-lb



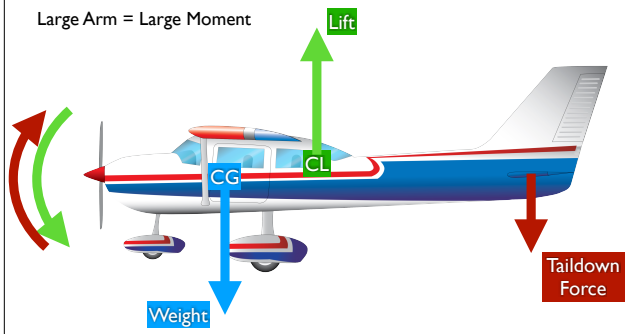
Weight and Balance Restrictions

- Each aircraft has different limits that must not be exceeded.
- They can be found in the Airplane Flying Manual (AFM) or Pilot Operating Handbook (POH).
- Temperature, elevation, and humidity affect weight restrictions because they affect performance.
- Other factors such as runway condition (surface, slope, length) and meteorological factors must also be taken into account.

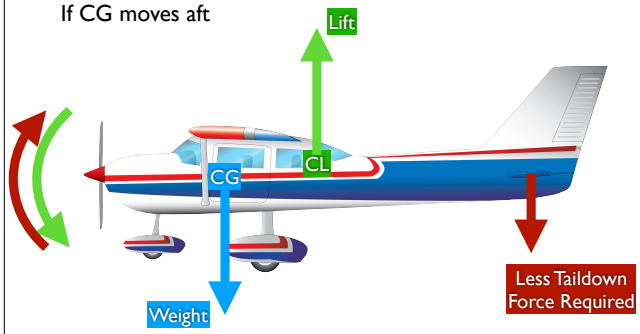
Effect of CG location

- The location of the Center of Gravity (CG) in relationship to the Center of Pressure (CP) affects the aircraft's performance.
- CG location affects how much tail down force is required to counteract the nose down moment.
- Moment is created when a force is applied away from the CG.

Large Arm = Large Moment

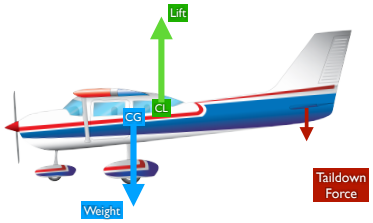


If CG moves aft



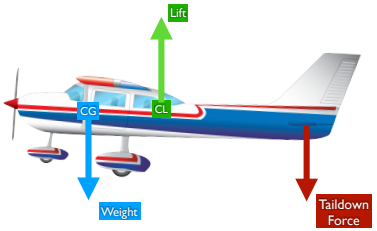
Effect of Aft CG

- ✓ Higher Cruise Speed
- ✓ Increased Range
- ✓ Shorter Takeoff Distance
- ✓ Decreased Stability
- ✓ Possibly Uncontrollable
- ✓ Over Rotation on Takeoff
- ✓ Over Flaring on Landing
- ✓ Lower Stall Speed



Effect of Forward CG

- ✓ Slower Cruise Speed
- ✓ Decreased Range
- ✓ Longer Takeoff Distance
- ✓ Increased Stability
- ✓ Easier Stall Recovery
- ✓ Difficulty Flaring
- ✓ Higher Stall Speed



W&B Computations

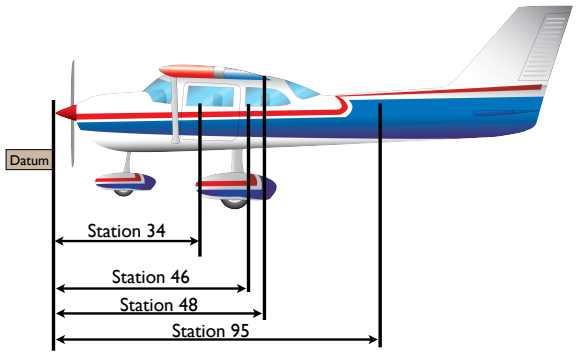
- Computations are different based on the aircraft manufacturer.
- There are three methods to compute weight and balance:
  - ✓ Computational method
  - ✓ Graph method
  - ✓ Table method
- The goal is the same for all methods: determine the CG positions on the ramp, before take off, and before landing.
- There are a lot of questions in the test about this!

Computational Method

- For each of the "stations" in the plane, we are calculating the moments based on weights and arms.
- This typically includes front and rear seat, baggage compartment, and fuel.
- The goal is to make sure that:
  - ✓ the weight is within limits,
  - ✓ the CG is within the envelope.
- Remember: **Moment = Weight x Arm** (station)

Computational Method

	Weight	Station	Moment
Basic Empty Weight	1,467		57,300
Front Seat	340		
Rear Seat	300		
Fuel (gallons)	40 gallons 40 x 6 = 240 lb		
Baggage Area	20		
Ramp **Weight, CG, Moment**	*2,367*		



Computational Method

	Weight	Station	Moment
Basic Empty Weight	1,467		57,300
Front Seat			11,560
Rear Seat			13,800
Fuel (gallons)			11,520
Baggage Area	20	x 95 =	1,900
Ramp Weight, CG, Moment	2,367	40.6	96,080

$$\frac{96{,}080}{2{,}367} = 40.6$$

Not done yet…

- Does the weight exceed the maximum weight?
  - ✓ Max gross weight is 3,400 pounds.
  - ✓ Ramp weight is 2,367 pounds.
- Is the CG within the envelope?
  - ✓ CG limits are 38 to 45.
  - ✓ Calculated CG is 40.6, within the envelope.

Computational Method with CX-3

- We can solve this type of exercise using the CX-3 flight computer.
- Let's take a look and see if we can get the same answers.

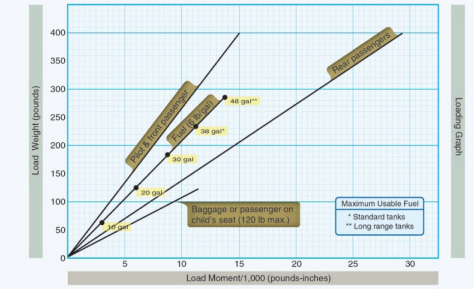
Computational Method

	Weight	Station	Moment
Basic Empty Weight	1,467		57,300
Front Seat	340	34	
Rear Seat	300	46	
Fuel (gallons)	40 gallons	48	
Baggage Area	20	95	
Ramp Weight, CG, Moment	2,367	40.6	96,080

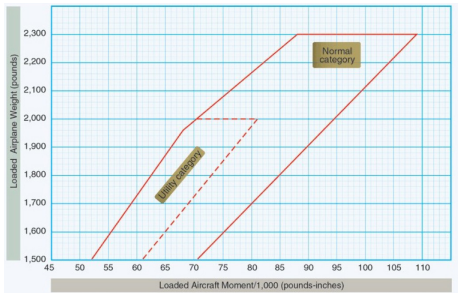
Graph Method

- With graph method, the idea is similar to the computational method, except you use a graph to compute the moments, instead of using a multiplication.
- The graph method will have two graphs:
  - ✓ One to determine the moment for each station,
  - ✓ One to determine whether the aircraft's weight and CG are within limits.

Graph Method



Graph Method

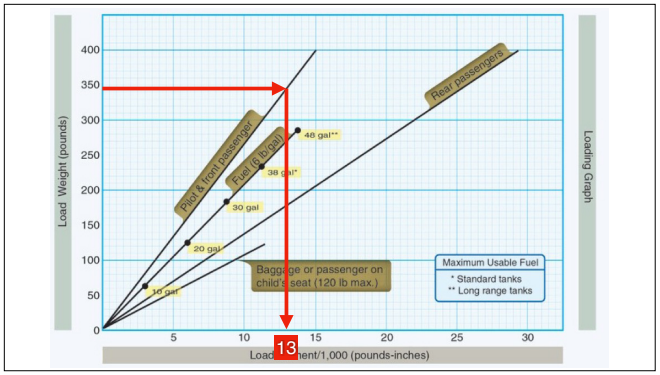


Graph Method

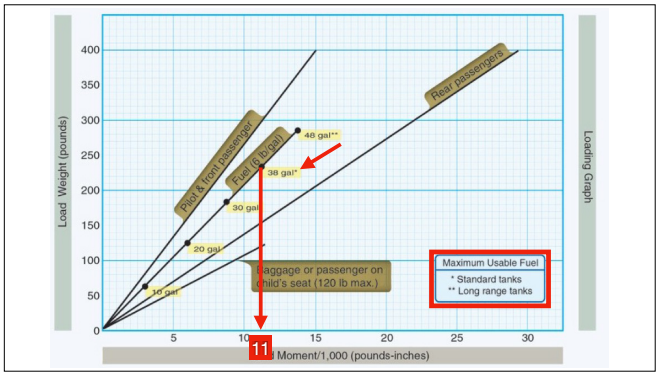
Determine the moment with the following data:

	WEIGHT (LB)	MOM/1000
Empty weight	1,350	51.5
Pilot and front passenger	340	
Fuel (std tanks)	—	
Oil, 8 qt.	—	—

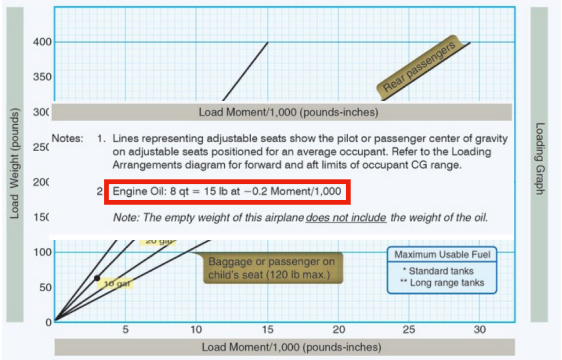
	Weight	Station	Moment (/1000)
Basic Empty Weight	1,350		51.5
Pilot and front passenger	340		??
Fuel (std tanks)			
Oil, 8 qt.			
Ramp			



	Weight	Station	Moment (/1000)
Basic Empty Weight	1,350		51.5
Pilot and front passenger	340		13
Fuel (std tanks)	??		??
Oil, 8 qt.			
Ramp			



	Weight	Station	Moment (/1000)
Basic Empty Weight	1,350		51.5
Pilot and front passenger	340		13
Fuel (std tanks)	38 x 6 = 228		11
Oil, 8 qt.	??		??
Ramp			



	Weight	Station	Moment (/1000)
Basic Empty Weight	1,350		51.5
Pilot and front passenger	340		13
Fuel (std tanks)	38x6= 228		11
Oil, 8 qt.	15		-0.2
Ramp	1,933		75.3

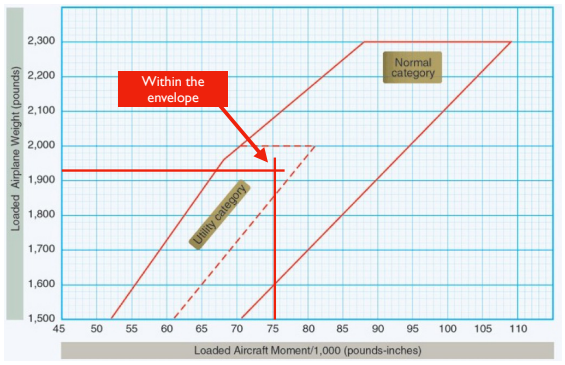


Table Method

- A table contains a list of moments based on weight for each station.
- Another table shows moment limits based on aircraft weight.
- Weight are usually in increments of 10 pounds.
- Easy to use if the weight are rounded, otherwise requires interpolation.

Useful load weights and moments

Baggage or 5th seat occupant ARM 140		Occupants: Front seats ARM 85		Occupants: Rear seats ARM 121	
Weight	Moment 100	Weight	Moment 100	Weight	Moment 100
10	14	120	102	120	145
20	28	130	110	130	157
30	42	140	119	140	169
40	56	150	128	150	182
50	70	160	136	160	194
60	84	170	144	170	206
70	98	180	153	180	218
80	112	190	162	190	230
90	126	200	170	200	242
100	140				
110	154				
120	168				
130	182				
140	196				
150	210				
160	224				
170	238				
180	252				
190	266				
200	280				

Usable fuel: Main wing tanks ARM 75		
Gallons	Weight	Moment 100
5	30	22
10	60	45
15	90	68
20	120	90
25	150	112
30	180	135
35	210	158
40	240	180

Moment limits vs weight (continued)

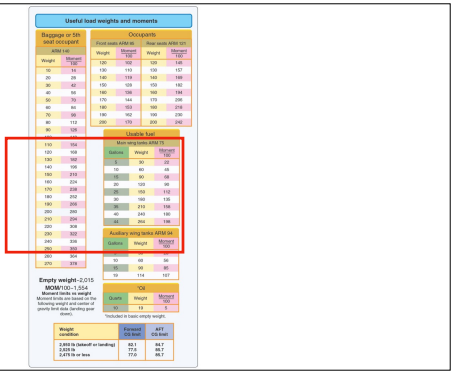
Weight	Minimum Moment 100	Maximum Moment 100	Weight	Minimum Moment 100	Maximum Moment 100
2,100	1,617	1,800	2,500	1,932	2,143
2,110	1,625	1,808	2,510	1,942	2,151
2,120	1,632	1,817	2,520	1,953	2,160
2,130	1,640	1,825	2,530	1,963	2,168
2,140	1,648	1,834	2,540	1,974	2,176
2,150	1,656	1,843	2,550	1,984	2,184
2,160	1,663	1,851	2,560	1,995	2,192
2,170	1,671	1,860	2,570	2,005	2,200
2,180	1,679	1,868	2,580	2,016	2,208
2,190	1,686	1,877	2,590	2,026	2,216
2,200	1,694	1,885	2,600	2,037	2,224
2,210	1,702	1,894	2,610	2,048	2,232
2,220	1,709	1,903	2,620	2,058	2,239
2,230	1,717	1,911	2,630	2,069	2,247
2,240	1,725	1,920	2,640	2,080	2,255
2,250	1,733	1,928	2,650	2,090	2,263
2,260	1,740	1,937	2,660	2,101	2,271
2,270	1,748	1,945	2,670	2,112	2,279
2,280	1,756	1,954	2,680	2,123	2,287
2,290	1,763	1,963	2,690	2,133	2,295
2,300	1,771	1,971	2,700	2,144	2,303
2,310	1,779	1,980	2,710	2,155	2,311
2,320	1,786	1,988	2,720	2,166	2,319
2,330	1,794	1,997	2,730	2,177	2,326

Table Method

Determine if the airplane weight and balance is within limits:

- Front seat occupants 340 lb
- Rear seat occupants 295 lb
- Fuel (main wing tanks) 44 gal
- Baggage 56 lb

	Weight	Station	Moment (/1000)
Basic Empty Weight	??		??
Front Seat Occupants	340		
Rear Seat Occupants	295		
Fuel (main wing banks)	44 gal		
Baggage	56		
Ramp			



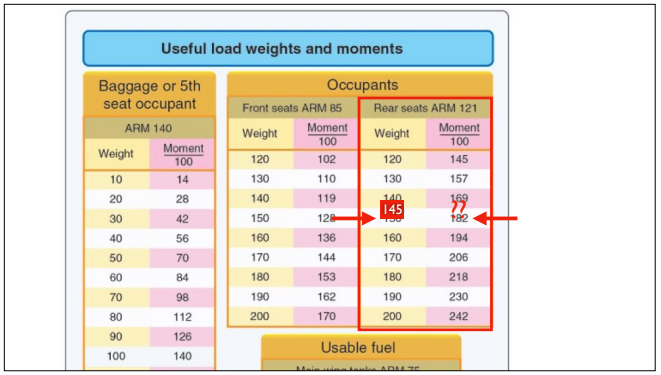
	Weight	Station	Moment (/100)
Basic Empty Weight	2,015		1,554
Front Seat Occupants	340		??
Rear Seat Occupants	295		
Fuel (main wing banks)	44 gal		
Baggage	56		
Ramp			

Useful load weights and moments

Baggage or 5th seat occupant		Occupants			
		Front seats ARM 85		Rear seats ARM 121	
ARM 140					
Weight	Moment / 100	Weight	Moment / 100	Weight	Moment / 100
10	14	120	102	120	145
20	28	130	110	130	157
30	42	140	119	140	169
40	56	150	128	150	182
50	70	160	136	160	194
60	84	170	144	170	206
70	98	180	153	180	218
80	112	190	162	190	230
90	126	200	170	200	242
100	140				

Usable fuel

	Weight	Station	Moment (/100)
Basic Empty Weight	2,015		1,554
Front Seat Occupants	340		170+119 = 289
Rear Seat Occupants	295		??
Fuel (main wing banks)	44 gal		
Baggage	56		
Ramp			

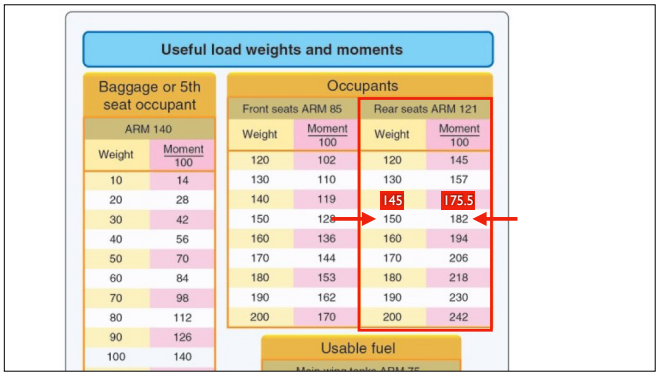


Interpolation

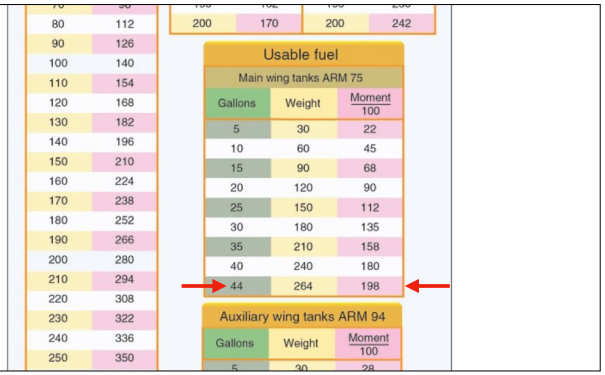
Weight	Moment
140	169
145	169+6.5=175.5
150	182

10 → 5 → 13 → x

$$\frac{5}{10} = \frac{x}{13} \qquad x = \frac{5 \times 13}{10} = \frac{65}{10} = 6.5$$



	Weight	Station	Moment (/100)
Basic Empty Weight	2,015		1,554
Front Seat Occupants	340		170+119 = 289
Rear Seat Occupants	295		182+176 = 358
Fuel (main wing banks)	44 gal		??
Baggage	56		
Ramp			



80	112
90	126
100	140
110	154
120	168
130	182
140	196
150	210
160	224
170	238
180	252
190	266
200	280
210	294
220	308
230	322
240	336
250	350

200	170	200	242

Usable fuel

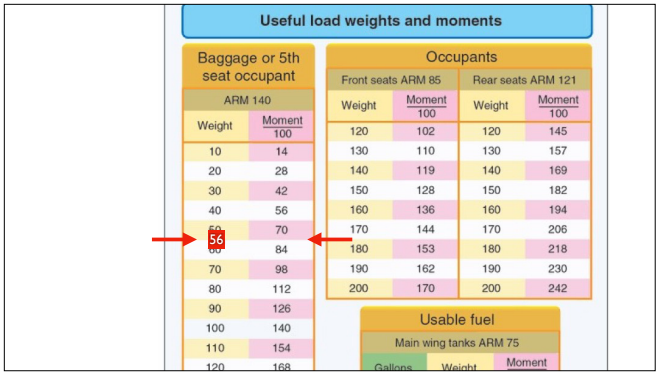
Main wing tanks ARM 75

Gallons	Weight	Moment / 100
5	30	22
10	60	45
15	90	68
20	120	90
25	150	112
30	180	135
35	210	158
40	240	180
44	264	198

Auxiliary wing tanks ARM 94

Gallons	Weight	Moment / 100
5	30	28

	Weight	Station	Moment (/100)
Basic Empty Weight	2,015		1,554
Front Seat Occupants	340		170+119 = 289
Rear Seat Occupants	295		182+176 = 358
Fuel (main wing banks)	44 gal = 264 lbs		198
Baggage	56		??
Ramp			



Useful load weights and moments

Baggage or 5th seat occupant — ARM 140

Weight	Moment / 100
10	14
20	28
30	42
40	56
50	70
56	84
70	98
80	112
90	126
100	140
110	154
120	168

Occupants

Front seats ARM 85		Rear seats ARM 121	
Weight	Moment / 100	Weight	Moment / 100
120	102	120	145
130	110	130	157
140	119	140	169
150	128	150	182
160	136	160	194
170	144	170	206
180	153	180	218
190	162	190	230
200	170	200	242

Usable fuel — Main wing tanks ARM 75

Gallons	Weight	Moment

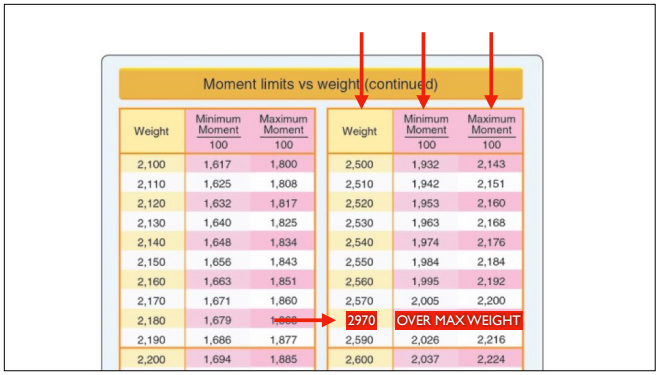
Interpolation

Weight	Moment
50	70
56	70 + 8.4=78.4
60	84

10 — 6 — x — 14

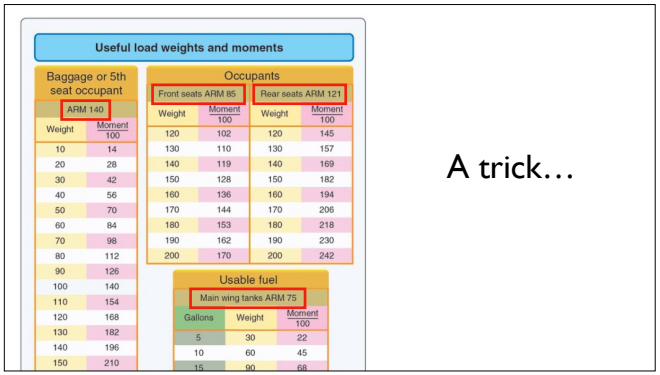
$$\frac{6}{10} = \frac{x}{14} \qquad x = \frac{6 \times 14}{10} = \frac{84}{10} = 8.4$$

	Weight	Station	Moment (/100)
Basic Empty Weight	2,015		1,554
Front Seat Occupants	340		170+119 = 289
Rear Seat Occupants	295		182+176 = 358
Fuel (main wing banks)	44 gal = 264 lbs		198
Baggage	56		??
Ramp	2,970		2,477



Moment limits vs weight (continued)

Weight	Minimum Moment 100	Maximum Moment 100	Weight	Minimum Moment 100	Maximum Moment 100
2,100	1,617	1,800	2,500	1,932	2,143
2,110	1,625	1,808	2,510	1,942	2,151
2,120	1,632	1,817	2,520	1,953	2,160
2,130	1,640	1,825	2,530	1,963	2,168
2,140	1,648	1,834	2,540	1,974	2,176
2,150	1,656	1,843	2,550	1,984	2,184
2,160	1,663	1,851	2,560	1,995	2,192
2,170	1,671	1,860	2,570	2,005	2,200
2,180	1,679	1,868	2970	OVER MAX WEIGHT	
2,190	1,686	1,877	2,590	2,026	2,216
2,200	1,694	1,885	2,600	2,037	2,224



Useful load weights and moments

Baggage or 5th seat occupant — ARM 140

Weight	Moment 100
10	14
20	28
30	42
40	56
50	70
60	84
70	98
80	112
90	126
100	140
110	154
120	168
130	182
140	196
150	210

Occupants

Front seats ARM 85		Rear seats ARM 121	
Weight	Moment 100	Weight	Moment 100
120	102	120	145
130	110	130	157
140	119	140	169
150	128	150	182
160	136	160	194
170	144	170	206
180	153	180	218
190	162	190	230
200	170	200	242

Usable fuel — Main wing tanks ARM 75

Gallons	Weight	Moment 100
5	30	22
10	60	45
15	90	68

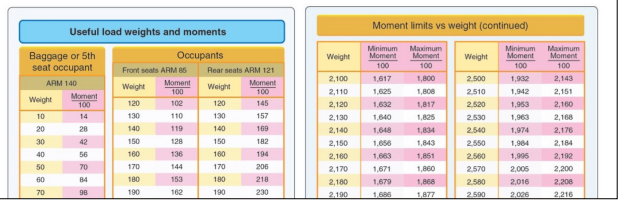
A trick…

Shifting, Adding, Removing Weight

- Several scenarios call for shifting, adding, removing weight.
  - ✓ Shifting weight in the event you are out of balance and need to move things around.
  - ✓ Adding weight if you are carrying a new passenger during a stop,
  - ✓ Removing weight if you are dropping off a passenger or baggage.
- Let's look at a scenario.

Weight Removal and Shifting

Upon landing, the front passenger (180 pounds) departs the airplane. A rear passenger (204 pounds) moves to the front passenger position. What effect does this have on the CG if the airplane weighed 2,690 pounds and the MOM/100 was 2,260 just prior to the passenger transfer?



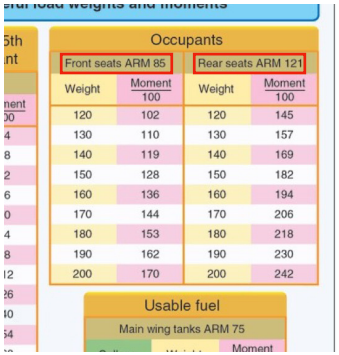
Useful load weights and moments

Baggage or 5th seat occupant ARM 140		Occupants Front seats ARM 85		Occupants Rear seats ARM 121	
Weight	Moment 100	Weight	Moment 100	Weight	Moment 100
10	14	120	102	120	145
20	28	130	110	130	157
30	42	140	119	140	169
40	56	150	128	150	182
50	70	160	136	160	194
60	84	170	144	170	206
70	98	180	153	180	218
		190	162	190	230

Moment limits vs weight (continued)

Weight	Minimum Moment 100	Maximum Moment 100	Weight	Minimum Moment 100	Maximum Moment 100
2,100	1,617	1,800	2,500	1,932	2,143
2,110	1,625	1,808	2,510	1,942	2,151
2,120	1,632	1,817	2,520	1,953	2,160
2,130	1,640	1,825	2,530	1,963	2,168
2,140	1,648	1,834	2,540	1,974	2,176
2,150	1,656	1,843	2,550	1,984	2,184
2,160	1,663	1,851	2,560	1,995	2,192
2,170	1,671	1,860	2,570	2,005	2,200
2,180	1,679	1,868	2,580	2,016	2,208
2,190	1,686	1,877	2,590	2,026	2,216

	Weight	Station	Moment
Ramp Info	2,690	84.0	226,000
Front Passenger Leaves	-180		
Rear Passenger leaves rear	-204		
Rear Passenger moves front	+204		
New Ramp Info			



Occupants

Front seats ARM 85		Rear seats ARM 121	
Weight	Moment 100	Weight	Moment 100
120	102	120	145
130	110	130	157
140	119	140	169
150	128	150	182
160	136	160	194
170	144	170	206
180	153	180	218
190	162	190	230
200	170	200	242

Usable fuel

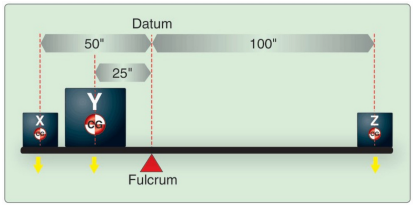
Main wing tanks ARM 75

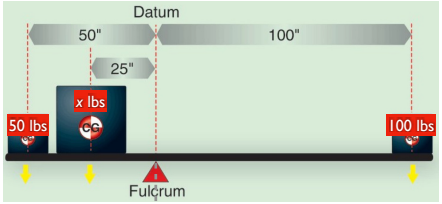
Moment

	Weight		Station		Moment
Ramp Info	2,690		84.0		226,000
Front Passenger Leaves	-180	x	85	=	-15,300
Rear Passenger leaves rear	-204	x	121	=	-24,684
Rear Passenger moves front	+204	x	85	=	17,340
New Ramp Info	**2,510**		**81.0**		**203,356**

Balancing Weights

- Point X = 50 lbs
- Point Z = 100 lbs
- Weight at Point Y to balance?





Total Moment Left of Fulcrum = Total Moment Right of Fulcrum

(50 lbs x 50") + (*x* lbs x 25") = 100 lbs x 100"

2,500 + 25*x* = 10,000

x = (10,000-2500)/25

x = 300 lbs

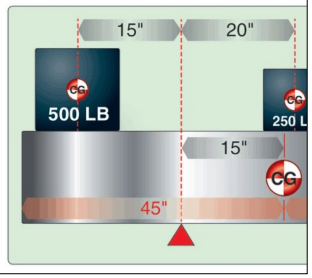
Typical FAA Question

(Refer to Figure 60.) How should the 500-pound weight be shifted to balance the plank on the fulcrum?

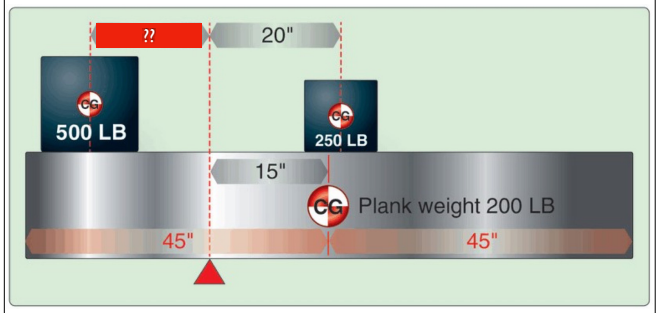
A. 1 inch to the left.

B. 1 inch to the right.

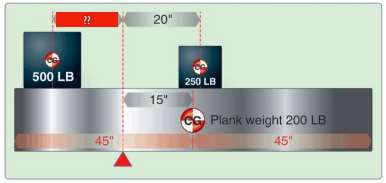
C. 4.5 inches to the right.



How should the 500-pound weight be shifted to balance the plank on the fulcrum?



How should the 500-pound weight be shifted to balance the plank on the fulcrum?



Total Moment Left of Fulcrum = Total Moment Right of Fulcrum

500 lbs x *x*" = (250 lbs x 20") + (200 lbs x 15")

x = (5,000 + 3,000)/500

x = 16"

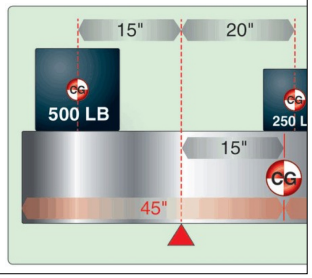
Typical FAA Question

(Refer to Figure 60.) How should the 500-pound weight be shifted to balance the plank on the fulcrum?

A. 1 inch to the left.

B. 1 inch to the right.

C. 4.5 inches to the right.



Typical FAA Question

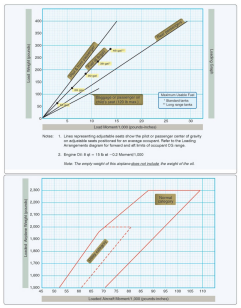
(Refer to Figure 34.) What is the maximum amount of baggage that may be loaded aboard the airplane for the CG to remain within the moment envelope

	WEIGHT (LB)	MOM/1000
Empty weight	1,350	51.5
Pilot and front passenger	250	---
Rear passengers	400	---
Baggage	---	---
Fuel, 30 gal.	---	---
Oil, 8 qt.	---	–0.2

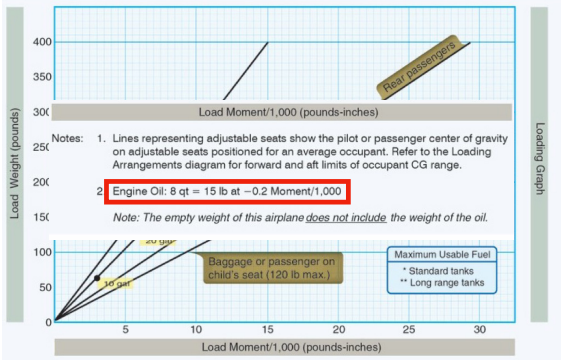
A. 105 pounds.

B. 110 pounds.

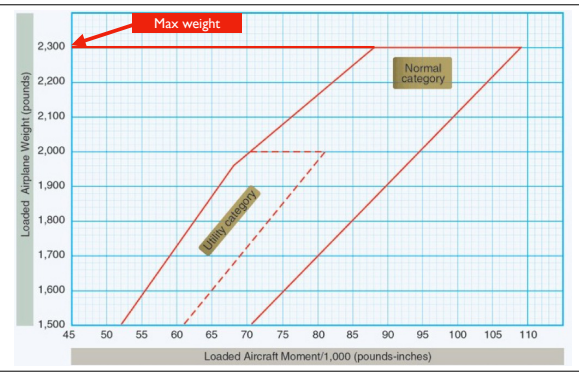
C. 120 pounds.



	Weight	Station	Moment (/1000)
Basic Empty Weight	1,350		51.5
Pilot and front passenger	250		
Rear passengers	400		
Fuel (30 gallons)	30x6= *180*		
Oil, 8 qt.			
Baggage	??		
Ramp			



	Weight	Station	Moment (/1000)
Basic Empty Weight	1,350		51.5
Pilot and front passenger	250		
Rear passengers	400		
Fuel (30 gallons)	30x6= 180		
Oil, 8 qt.	15		
Baggage	??		
Ramp			



	Weight	Station	Moment (/1000)
Basic Empty Weight	1,350		51.5
Pilot and front passenger	250		
Rear passengers	400		
Fuel (30 gallons)	30x6= 180		
Oil, 8 qt.	15		
Baggage	105		
Ramp	2,195 without bags	Max weight is 2,300	

Typical FAA Question

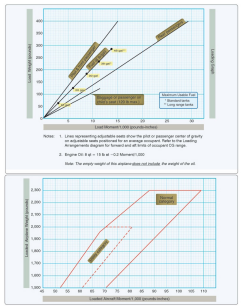
(Refer to Figure 34.) What is the maximum amount of baggage that may be loaded aboard the airplane for the CG to remain within the moment envelope

	WEIGHT (LB)	MOM/1000
Empty weight	1,350	51.5
Pilot and front passenger	250	---
Rear passengers	400	---
Baggage	---	---
Fuel, 30 gal.	---	---
Oil, 8 qt.	---	–0.2

A. 105 pounds.

B. 110 pounds.

C. 120 pounds.



Typical FAA Question

(Refer to Figure 32, Figure 33.) With the airplane loaded as follows, what action can be taken to balance the airplane?

- Front seat occupants 411 lb
- Rear seat occupants 100 lb
- Main wing tanks 44 gal

A. Fill the auxiliary wing tanks.

B. Add a 100-pound weight to the baggage compartment.

C. Transfer 10 gallons of fuel from the main tanks to the auxiliary tanks.

	Weight	Station	Moment
Basic Empty Weight	2,015		155,400
Pilot and front passenger	411		
Rear seat occupants	100		
Main Wing Fuel (44 gal)			
Aux fuel tank			
Baggage			
Ramp			

Steps to solve

1. Calculate the CG location to figure out what is going on.
2. Determine what needs to happen to CG or Moment.
3. Determine which of the options will have the desired effect…

	Weight	Station	Moment
Basic Empty Weight	2,015		155,400
Pilot and front passenger	411		??
Rear seat occupants	100		??
Main Wing Fuel (44 gal)	44x6=264		??
Aux fuel tank			
Baggage			
Ramp	2,990		??

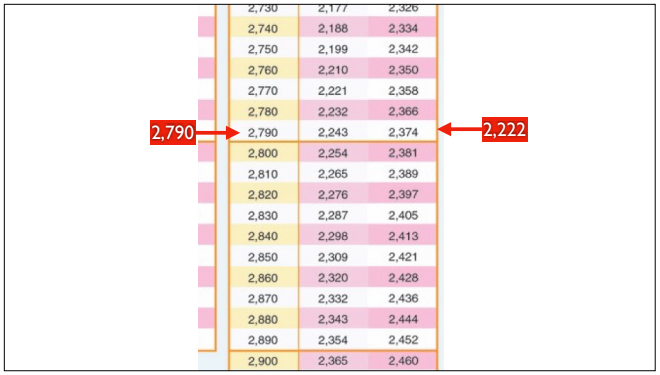
Occupants			
Front seats ARM 85		Rear seats ARM 121	
Weight	Moment / 100	Weight	Moment / 100
120	102	120	145
130	110	130	157
140	119	140	169
150	128	150	182
160	136	160	194
170	144	170	206
180	153	180	218
190	162	190	230
200	170	200	242

Usable fuel	
Main wing tanks ARM 75	
	Moment

	Weight	Station	Moment
Basic Empty Weight	2,015		155,400
Pilot and front passenger	411	85	34,935
Rear seat occupants	100	121	12,100
Main Wing Fuel (44 gal)	264	75	19,800
Aux fuel tank			
Baggage			
Ramp	2,790		222,235

Steps to solve

1. Calculate the CG location to figure out what is going on.
2. Determine what needs to happen to CG or Moment.
3. Determine which of the options will have the desired effect…



2,730	2,177	2,326
2,740	2,188	2,334
2,750	2,199	2,342
2,760	2,210	2,350
2,770	2,221	2,358
2,780	2,232	2,366
2,790	2,243	2,374
2,800	2,254	2,381
2,810	2,265	2,389
2,820	2,276	2,397
2,830	2,287	2,405
2,840	2,298	2,413
2,850	2,309	2,421
2,860	2,320	2,428
2,870	2,332	2,436
2,880	2,343	2,444
2,890	2,354	2,452
2,900	2,365	2,460

Steps to solve

1. Calculate the CG location to figure out what is going on.
2. Determine what needs to happen to CG or Moment.
3. Determine which of the options will have the desired effect…

A. Fill the auxiliary wing tanks.

Auxiliary wing tanks ARM 94		
Gallons	Weight	Moment / 100
5	30	28
10	60	56
15	90	85
19	114	107

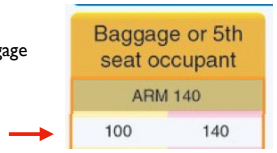
	Weight	Station	Moment
Basic Empty Weight	2,015		155,400
Pilot and front passenger	411	85	34,935
Rear seat occupants	100	121	12,100
Main Wing Fuel (44 gal)	264	75	19,800
Aux fuel tank	114		10,700
Baggage			
Ramp	2,904		232,935

2,850	2,309	2,421
2,860	2,320	2,428
2,870	2,332	2,436
2,880	2,343	2,444
2,890	2,354	2,452
2,900	2,365	2,460
2,910	2,377	2,468
2,920	2,388	2,475
2,930	2,399	2,483
2,940	2,411	2,491
2,950	2,422	2,499

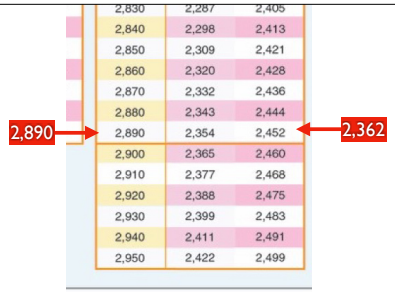
2,904 → 2,329 ←

Steps to solve

1. Calculate the CG location to figure out what is going on.
2. Determine what needs to happen to CG or Moment.
3. Determine which of the options will have the desired effect…
   A. ~~Fill the auxiliary wing tanks.~~
   B. Add a 100-pound weight to the baggage compartment.



	Weight	Station	Moment
Basic Empty Weight	2,015		155,400
Pilot and front passenger	411	85	34,935
Rear seat occupants	100	121	12,100
Main Wing Fuel (44 gal)	264	75	19,800
Aux fuel tank			
Baggage	100		14,000
Ramp	2,890		236,235



2,830	2,287	2,405
2,840	2,298	2,413
2,850	2,309	2,421
2,860	2,320	2,428
2,870	2,332	2,436
2,880	2,343	2,444
2,890	2,354	2,452
2,900	2,365	2,460
2,910	2,377	2,468
2,920	2,388	2,475
2,930	2,399	2,483
2,940	2,411	2,491
2,950	2,422	2,499

Typical FAA Question

(Refer to Figure 32, Figure 33.) With the airplane loaded as follows, what action can be taken to balance the airplane?

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- Rear seat occupants 100 lb
- Main wing tanks 44 gal

A. Fill the auxiliary wing tanks.

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C. Transfer 10 gallons of fuel from the main tanks to the auxiliary tanks.

Up Next

Performance and Limitations