

P8 – 0140 – 00037S
Pilot's cg location



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1 SUMMARY

Pilot is one of the heaviest single elements in this aircraft. And it is only semirigid. Bones and joints, like knee, pelvis etc define geometry of pilot.

Mass and center of gravity of separate parts of human body is taken from Dreyfuss Humanscale document.

Initial design was done using Poser software, and with it, position and posture of pilots was fixed.

A then 2D human manikin was created.

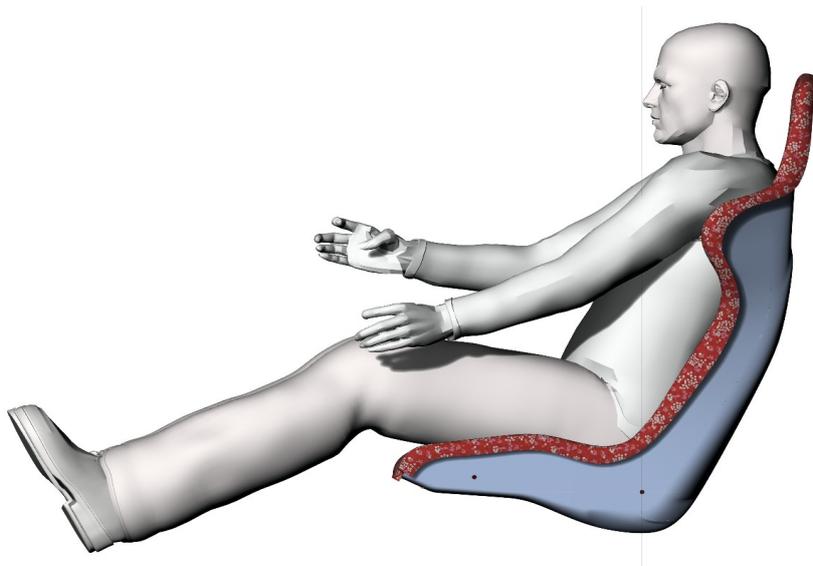
From the manikin, center of gravity of body parts were measured and cg of whole body was calculated.

The 2D manikin and spreadsheet of calculation are attached.

2 POSER MODEL

Poser (any version) is handy when designing cockpit. All controls can be positioned and space reserved for human pilot using it.

This was the final posture of pilot sitting in the selected seat.



Pilot was 184 cm tall.

3 MANIKIN

Manikin was created to represent large man (97,5%).

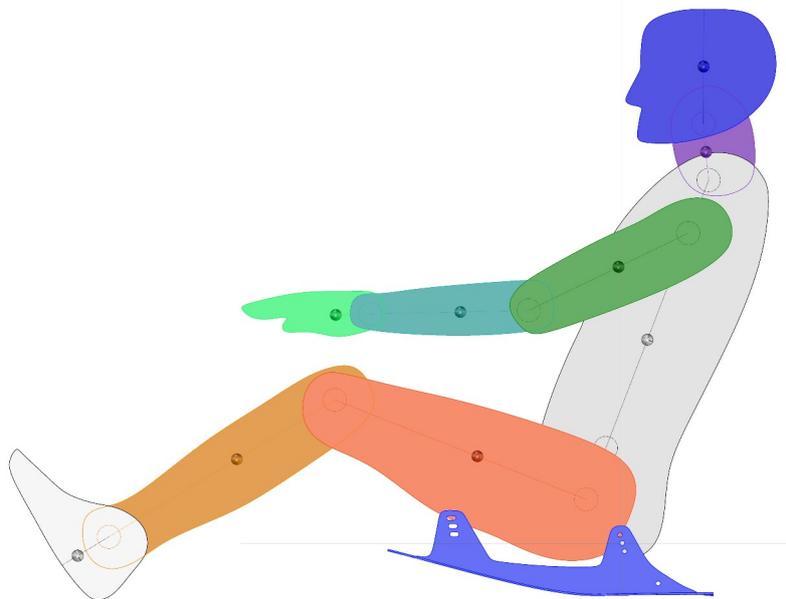
Central trunk is rigid, but in good sitting position it is very near that.

The 20 mm sphere in parts is the cg location of that part. In the table below, length is distance between joints.

Basic dimension and mass of parts was:

total mass 92 kg

| | mass portion | [kg] | Length [m] | CG dist from joint from Trunk | |
|------------|-----------------|------|------------|-------------------------------|-------|
| Head | 7,10 % | 6,5 | 0,196 | 50,00 % | 0,098 |
| Neck | 2,50 % | 2,3 | 0,097 | 50,00 % | 0,049 |
| Trunk | 45,80 % | 42,1 | 0,488 | 50,00 % | 0,244 |
| Upper arms | 6,60 % | 6,1 | 0,302 | 43,60 % | 0,132 |
| Forearms | 3,80 % | 3,5 | 0,269 | 43,00 % | 0,116 |
| Hands | 1,30 % | 1,2 | 0,211 | 28,00 % | 0,059 |
| Thighs | 21,00 % | 19,3 | 0,46 | 43,30 % | 0,199 |
| Legs | 9,00 % | 8,3 | 0,45 | 43,30 % | 0,195 |
| Feet | 2,90 % | 2,7 | 0,094 | 66,00 % | 0,062 |

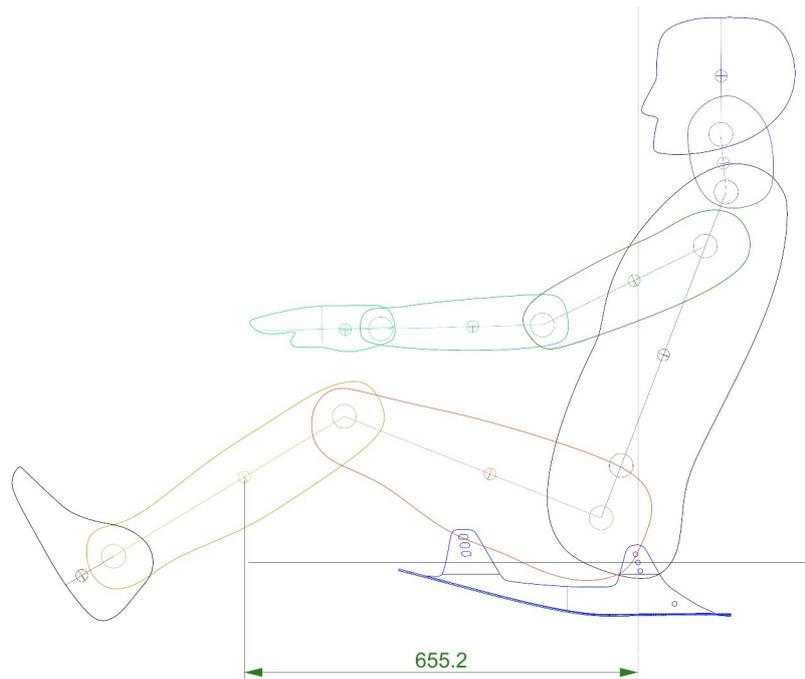


Reference datum for cg calculations was selected to be seats rear fixing holes. The middle hole. Those thin lines are vertical and horizontal lines through it.

Reference datum can be any known point.

4 MEASURING ARMS

Horizontal distance of all parts is measured. Picture below is distance from datum to leg center of gravity. As this is forward of datum, arm value is taken as negative.



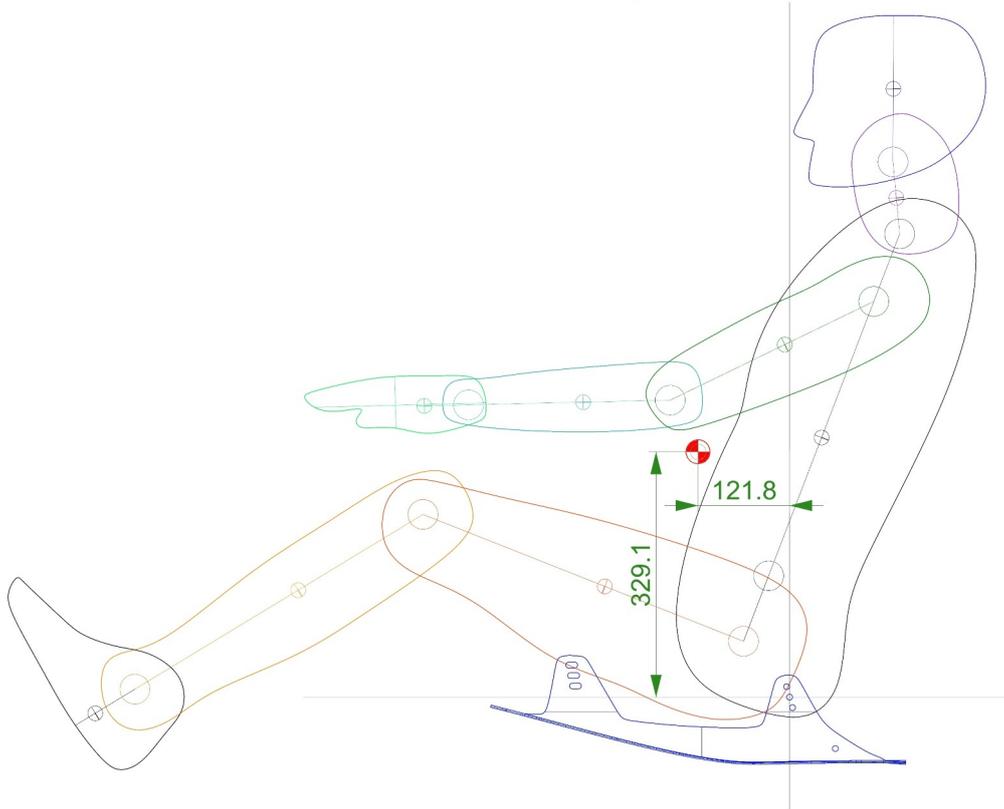
For vertical cg, same thing, but vertical dimensions.

5 CALCULATION OF CG

When all arms (at least horizontal) are taken, they are inserted into spreadsheet. Which makes "normal" center of gravity calculations.

| item | kg | Horizontal CG | | Vertical cg | |
|-------------------|------|----------------|----------|---------------|----------|
| | | arm [m] | Moment | arm [m] | Moment |
| Head | 6,5 | 0,1383 | 0,903 | 0,8163 | 5,332 |
| Neck | 2,3 | 0,1423 | 0,327 | 0,67 | 1,541 |
| Trunk | 42,1 | 0,0427 | 1,799 | 0,3484 | 14,680 |
| Upper arms | 6,1 | -0,0064 | -0,039 | 0,4731 | 2,873 |
| Forearms | 3,5 | -0,2751 | -0,962 | 0,3958 | 1,384 |
| Hands | 1,2 | -0,4871 | -0,583 | 0,3908 | 0,467 |
| Thighs | 19,3 | -0,2463 | -4,759 | 0,1486 | 2,871 |
| Legs | 8,3 | -0,6552 | -5,425 | 0,1436 | 1,189 |
| Feet | 2,7 | -0,9258 | -2,470 | -0,0216 | -0,058 |
| Sum of | 92 | | -11,207 | | 30,279 |
| center of gravity | | -0,1218 | m | 0,3291 | m |

This position is then inserted into drawing, and checked for blunders.



CG is in expected location, above belly button.

Then using location of reference datum transfer result to aircraft cg calculations.

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