SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF AGRICULTURAL ENGINEERING

19AGE307-ERGONOMICS OF FARM MACHINERY AND IMPLEMENTS

UNIT II - ANTHROPOMETRY

TOPIC IV : ANALYSIS OF ANTHROPOMETRIC DATA

MEASUREMENT OF ANTHROPOMETRIC DATA

There are very few studies available on anthropometric data on agricultural workers, again which are mainly case studies and involving only male workers.

Therefore, a comprehensive data base involving 79 body dimensions and 16 strength parameters of at least 1000 agricultural workers (male : female :: 70% : 30%) as formulated by the ICAR is a major step towards future machinery design and development and also for modification in design of the existing machinery.

ANALYSIS OF ANTHROPOMETRIC DATA

- Human being must not only fit spatially in a man task system, but must also be able to move in the work space.
- With the aid of anthropometric data we can provide an optimum work space layout, including good posture, contributing to considerable decrease in work load and an improvement in the performance.
- Normally, during collection of human engineering data skip the first and last five percentile.
- Thus while designing a seat; it should be designed to accommodate a reasonable range of individuals, usually from 5^{th} to 95^{th} percentiles.
- Lower percentile values of seat height and seat depth should be taken.

ANALYSIS OF ANTHROPOMETRIC DATA

For Indian agricultural workers including male and female workers, the stature would vary from 1350 mm to 1830 mm, thus the range would be 1830-1350=480 mm. according to the formula given by Raghavrao (1983), the standard deviation can be estimated from range as follows:

$$S = \frac{\sqrt{(Range)2}}{36}$$

$$S = \frac{\sqrt{(480)2}}{36} = 80 \text{ mm}$$

ANALYSIS OF ANTHROPOMETRIC DATA

- It is defined as the ratio of weight of a person to his /her height squared (Keys, 1972)

$$BMI = \frac{Weight}{(Height)^2}$$

- Beside these two, there are two other characteristics of the distribution. These are Asymmetry also known as skewness (β) and Kurtosis or Peakedness (β_2).

- The skewness (β_1):

$$\beta_1 = \frac{m_3}{(\sqrt{m2})^3} = \frac{\text{Third moment about the mean}}{(S.D.)^3}$$

Kurtosis (β_2):

$$(\beta_2) = \frac{m_4}{m_2^2} - 3 = \frac{m_4}{(S.D)^2} - 3$$

ANALYSIS OF ANTHROPOMETRIC DATA

For normal distribution, the value of β_1 as well as $_{\beta 2}$ would be 0 to give the idea of distribution of mass data for different dimensions; the values of β_1 and β_2 have been calculated and given in here.

Sr. No.	Dimension	Definition	Usefulness
1.	Weight	Body weight as measured on a calibrated weighing scale.	General body description.
2.	Stature	The vertical distance from the standing surface to the vertex of the head when the subject stands erect and looks straight forward.	General body description, work place designs.
3.	Vertical reach	The vertical distance from the standing surface to the height of middle finger when arm hand and fingers are extended vertically.	Workplace layout, design of controls.
4.	Vertical grip reach	The vertical distance from the standing surface to the height of the pointer held horizontal to the subject's fist when the arm is maximally extended upward. The subject stands erect andlooks straight forward.	Workplace layout design of controls.
5.	Eye height	The vertical distance from the standing surface to the external canthus of the eye when the subject stands erect and looks straight forward.	Design of controls and displays.
6.	Acromial height	The vertical distances from the standing surface to the acromion. The subject stands erect and looks straight forward.	General body description, work place layout, body linkages for deciding feeding chute height, for lifting studies for use in force application studies.
7.	Elbow height	The vertical distance from the standing surface to the top of the radiale when the subject stands erect and looks straight.	General body description work-place layout, body linkages.
8.	Olecranon height	The vertical distance from the standing surface to the height of the undersurface of the elbow measured with the arm flexed 90^0 and the upeer arm vertical. The subject stands erect andlooks straight forward.	Workplace layout body linkages, platform height for work to be done in standing posture like in workshop, kitchen etc.
9.	Illiocrystale height	The vertical distance from the standing surface to the top of the ilium in the mid axillary plane. The subject stands erect and looks straight forward. This is also known	Body linkages, safety harness design, safety belt design material

ANALYSIS OF ANTHROPOMETRIC DATA

		as waist height.	handling height recommendation.
10.	Illiospinale height	The vertical distance from the standing surface to the height of the illiospinale. The subject stands erect and looks straight forward.	Body linkages safety harness design, safety belt design.
11.	Trochanteric height	The vertical distance from the standing surface to the height of the trochanterion. The subject stands erect and looks straight forward.	Body linkages, biomechanics study setting limit for leg lifting in sagital plane.
12.	Metacarpal III height	The vertical distances from the standing surface to the height of the knuckle where the middle finger joins the palm. Subject stands erect andlooks straight forward.	Control panel design, handle height of manual as well as animal drawn equipment handle height of manually operated rotary equipment.
13.	Knee height	The vertical distance from standing surface to the midpoint of knee cap. The subject stands erect andlooks straight forward.	Body linkages, work place design.
14.	Span	The distance between the tips of right and left middle fingers when the subject's arms are maximally extended laterally.	Work place design, design of controls.
15.	Span akimbo	The distance between the elbow point measured with the arms flexed and held horizontally palms down, fingers straight and together and palm and thumbs touching the chest at the nipple level.	Work place design, design of controls for material handling packages.
16.	Chest circumference	The circumferences of the torso measured at the nipple level. The subject stands erect and looks straight forward.	General body description health index, comparison of different populations, personal protective clothing design.
17.	Waist circumference	The circumference of the torso at the waist level. The subject stands erect and looks straight forward.	Personal protective clothing design, seat design harness design for backpack.
18.	Thigh circumference	The circumference of the upper leg measured as high in the crotch as possible.	General body description personal protective clothing design.
19.	Calf circumference	The maximum circumference of the gastrocnemius muscle in the lower leg. The subject stands erect and looks straight forward.	General body description personal clothing design, gumboot/safety shoe design.

Mean anthropometric and strength data of Male and Female Indian Agricultural Workers

		Male			Female	
	95th	**Mean**	**5th**	**95th**	**Mean**	**5th**
Weight (Kg)	68.9	54.7	40.4	59.1	46.3	33.55
Stature	1774	1633	1521	1615	1515	1414
Acromial height	1468	1362	1248	1353	1261	1196
Arm reach from the wall	921	838	756	848	773	681
Bi-acromial breadth	402	330	364	340	292	243
Bideltoid breadth	471	416	361	423	371	318
Calf circumference	367	312	310	353	292	230
Chest circumference	944	845	746	934	813	693
Chest depth	243	208	173	259	207	154
Coronoid fossa to hand length	439	392	345	400	357	314
Elbow- elbow breadth sitting	452	375	297	413	350	286
Elbow height	1115	1027	938	1037	960	883

Mean anthropometric and strength data of Male and Female Indian Agricultural Workers

Elbow rest height	266	214	162	259	208	158
Eye height	1636	1522	1409	1504	1403	1302
Foot breadth (ball of foot)	110	94	78	101	89	76
Foot length	269	245	221	243	227	212
Forearm hand length	503	453	408	462	417	378
Hand length	197	178	160	182	167	151
Head breadth	171	148	125	202	142	156
head length	205	185	166	202	179	156
Hip breadth sitting	364	311	258	355	302	249
Instep length	208	184	142	191	167	149
Knee height	530	472	415	488	438	388
Medial malleous height	96	80	63	92	74	56
Menton to top of the head	246	213	179	232	197	162
Metacarpal-III height	763	690	616	718	649	581
Olecranon height	1085	999	913	1011	936	861
Popliteal height sitting	468	417	367	441	391	342
Sitting Acromial height	645	568	492	597	529	461
Sitting eye height	812	726	640	743	771	599
Sitting height	916	830	744	847	775	702
Span	1832	1697	1562	1680	1551	1422
Span Akimbo	964	872	780	872	790	707
Trochanteric height	925	814	703	842	777	695
Vertical reach	2237	2080	1923	2063	1921	1778
Waist back length	510	443	375	447	385	367
Waist circumference	901	765	629	858	720	582

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Thank You