OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

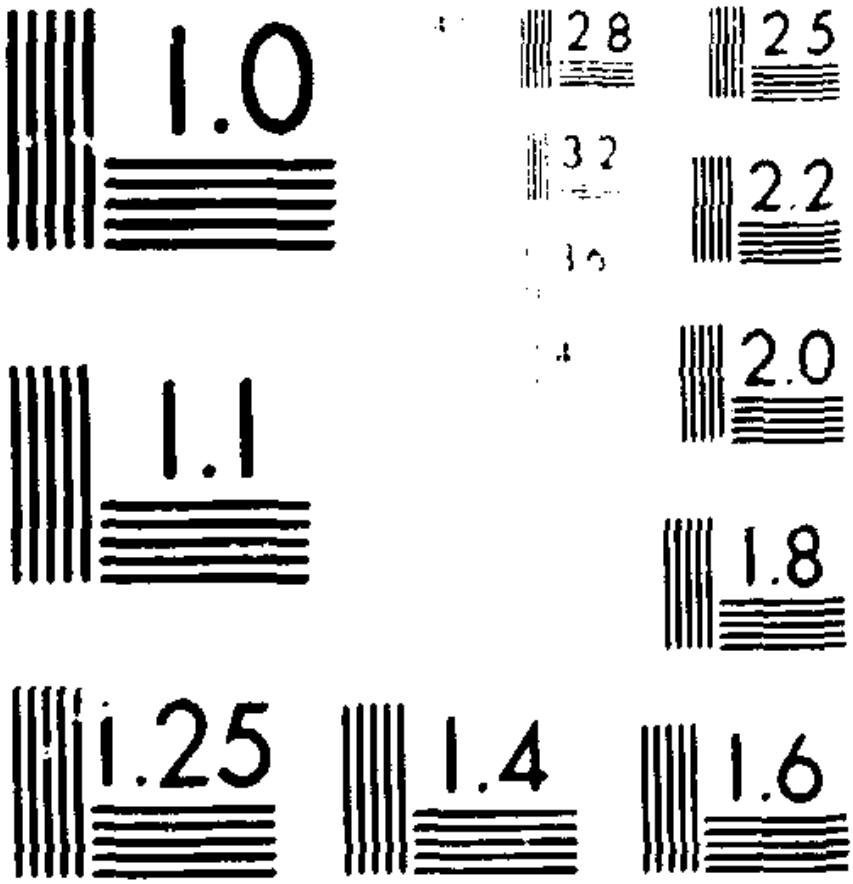
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org


1.0
2.8
2.5
3.2
2.2
2.0
1.1
1.8
1.25
1.4
1.6

09968

Distr.
LIMITED

ID/WG.302/3
16 November 1979

ENGLISH

United Nations Industrial Development Organization

Seminar on Furniture and Joinery Industries
Lahti, Finland, 6 - 25 August 1979

Furniture Design and Dimensioning for Serial Production*

by

Mauri Laatikainen**

* The views expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Designer and Interior Architect, Lahti, Finland

id.79-9191

The pursuit of comfort is probably the most important starting point when designing objects closely related to man's living and environment. In order to obtain this goal various ways and means have been used in different periods and under different cultural influences. Evidence of this are, among others, the various stages of Western history of style. Even today it is hardly likely that we have completely got rid of some kind of idealization of the old. From the designer's point of view, it is therefore important to concentrate on such means to obtain comfort as originate from man himself: his build and characteristics. To such basic data the designer can then add national or traditional ideas according to his own experience and skills.

Choosing a human being as a basis for establishing the principles of design involves certain difficulties. There are various kinds of compromises in regard to man and his environment concerning his comfort and safety. We can also say that man per se is the result of several compromises. For example standing or sitting upright are postures found fairly late in the history of human evolution. That results in all kinds of weaknesses and a tendency to illnesses due to strains. We also have to note that man functions best when either moving, a little tense (in sports), or quite relaxed and immobile (playing chess). Thus the posture best suited to creative thinking is a reclining position. Drawing and writing are done best in a sitting position. Except for some vocations, people in general sit a lot. Our automated era requires less and less standing up, even when switching on another channel on TV. Thus it has been rightly claimed that we are living in a "sit-down-culture".

Man as a basis of measurements and definitions is an old concept. Ever since man made his first rough tools there have been various definitions of units(see fig. 1). Besides using limbs as measurements, there are also some more indefinite units, such as step,

fathom, stone's throw, day's journey, etc.

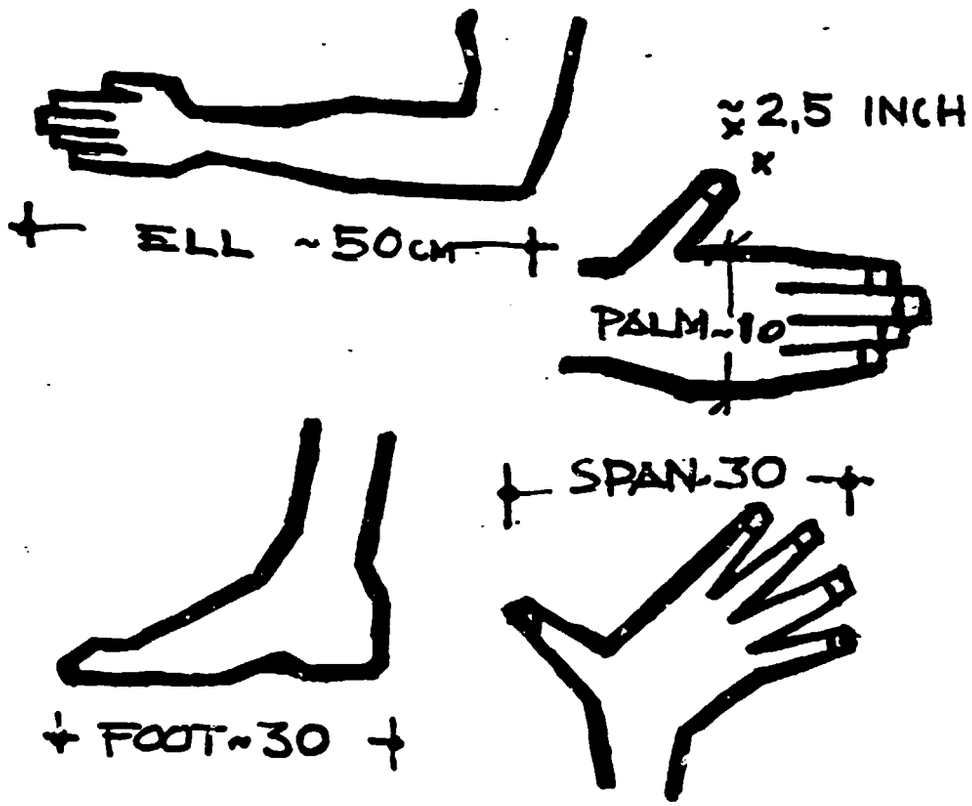


Figure 1 Some traditional dimensions, based on the human body (centimeters per unit)

The modern scientific way of measuring the size and proportions of the human body is called anthropometry (Greek anthropos = man, metria = measuring). A complementing modern branch of science is ergonomics, Besides the measurements of man it observes his muscular strength, endurance, different tolerances as well as defines ideal values for them. It also pays attention to the time consumed.

There are only few reliable surveys of the measurements of man available. The difficulty is, in addition to the high cost, that the results become obsolete in a few years. The human race is continuously growing, the addition to average height being several centimeters every ten years. The data and graphs needed in designing should contain all kinds of information. Besides representing two sexes, we also represent different sizes and races. It is easier to correct and specify clearly subdivided material when the task so requires. A good anthropometric survey must contain data about tall, average and small male and female adults as well as children. The best tables present the data necessary for designing our most common objects. In some cases even the special requirements of invalids have been presented.

Examples of tables defining sizes are given in figures 2 to 5. A common method to divide people into size groups is to use percentiles. They are values representing the percentage of people at or below a certain measurement; For example 2.5 percent of males are 164 cm or less. 50 persent or half of males are 175 cm or less. Of all the males measured, 97.5 percent are 188 cm, or smaller than 188 cm. Accordingly, there are only 2.5 percent males taller than that. For the designer it is important to direct the dimensions of the object he is designing to the correct size group. In general objects are dimensioned so as to fit best the average size. Therefore, in designing it is not necessary to accomodate the groups representing the small people, (less than 2.5 percent of the total), or the tall people, (also less than 2.5 percent of the total), This is the so-called "5-percent rule".

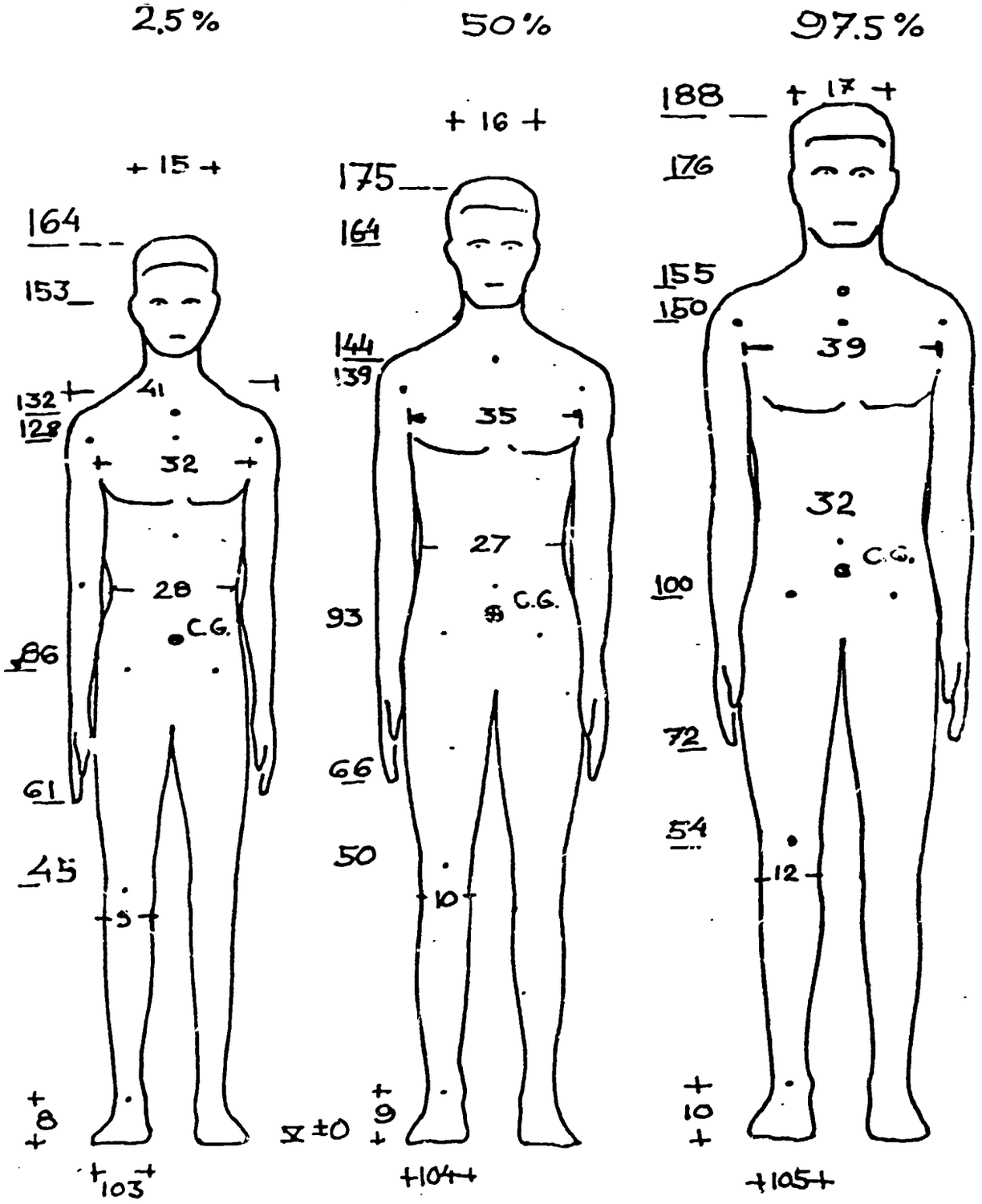


Figure 2: Some dimensions of adult males (in cm)
(a) smallest (except for smallest 2.5 percent of population)
(b) average
(c) largest (except for top 2.5 percent of population)

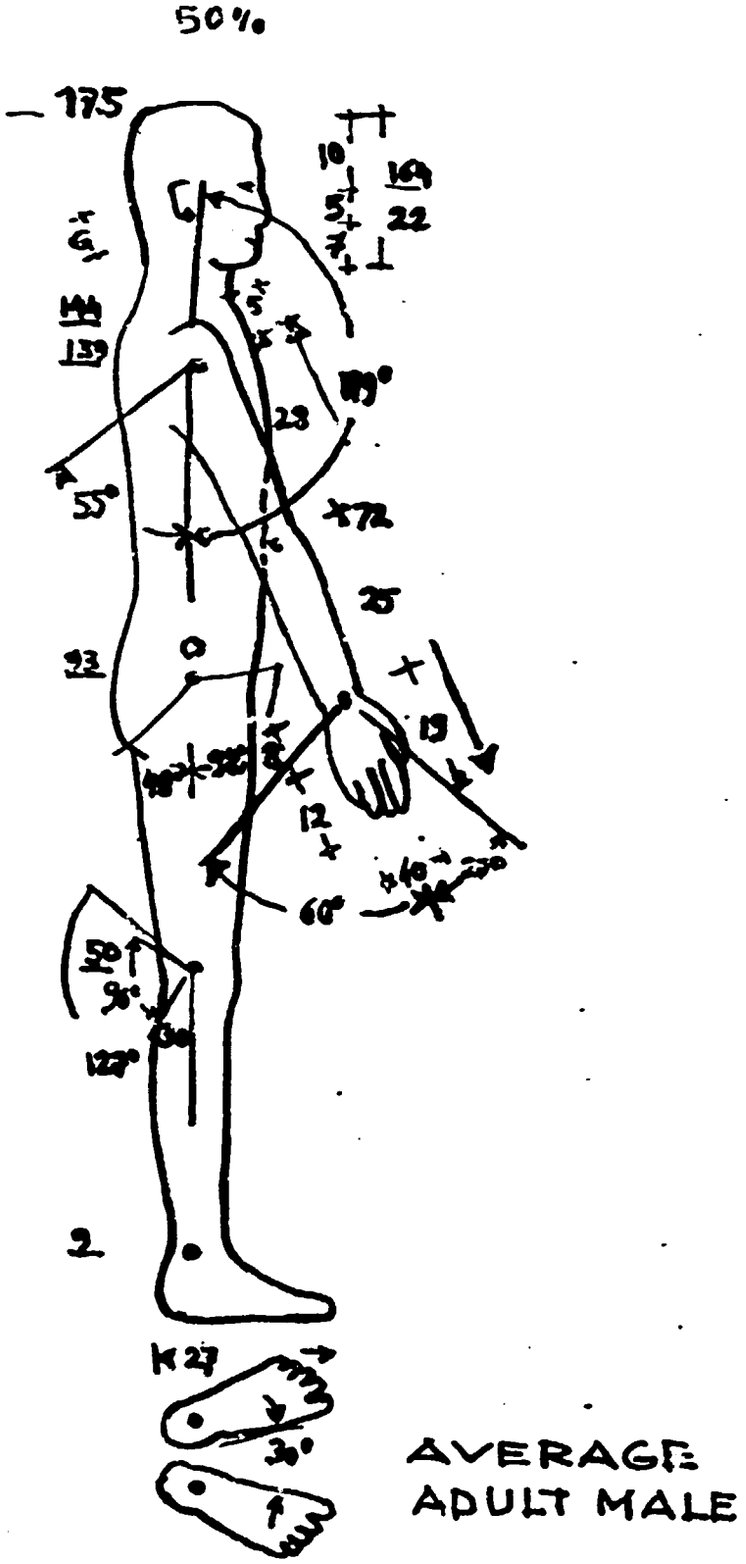


Figure 3: Some dimensions of the average adult male. (in cm)

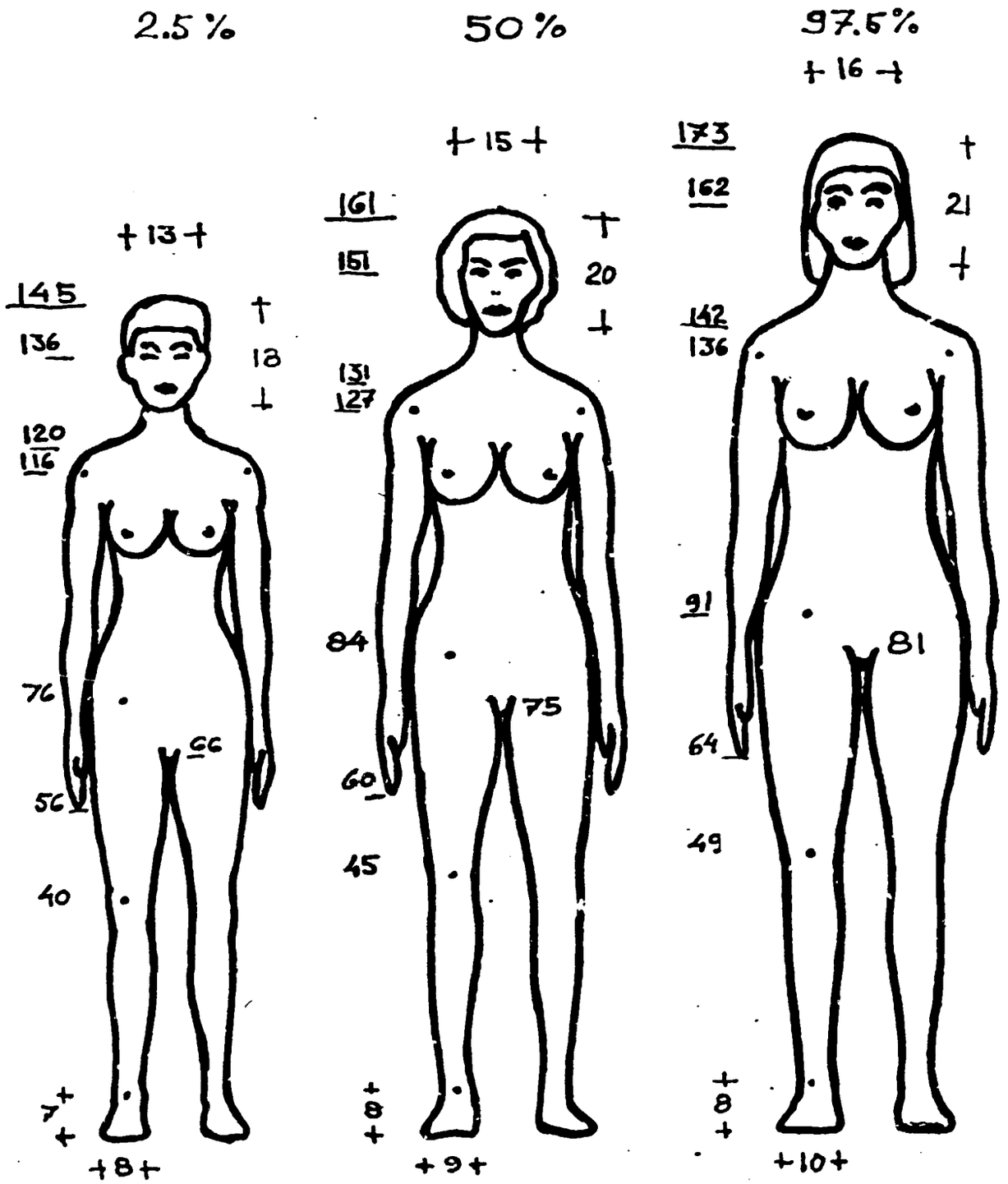


Figure 4: Some dimensions of average adult female (in cm)
(a) smallest (except for smallest 2.5 percent of population)
(b) average
(c) largest (except for top 2.5 percent of population)

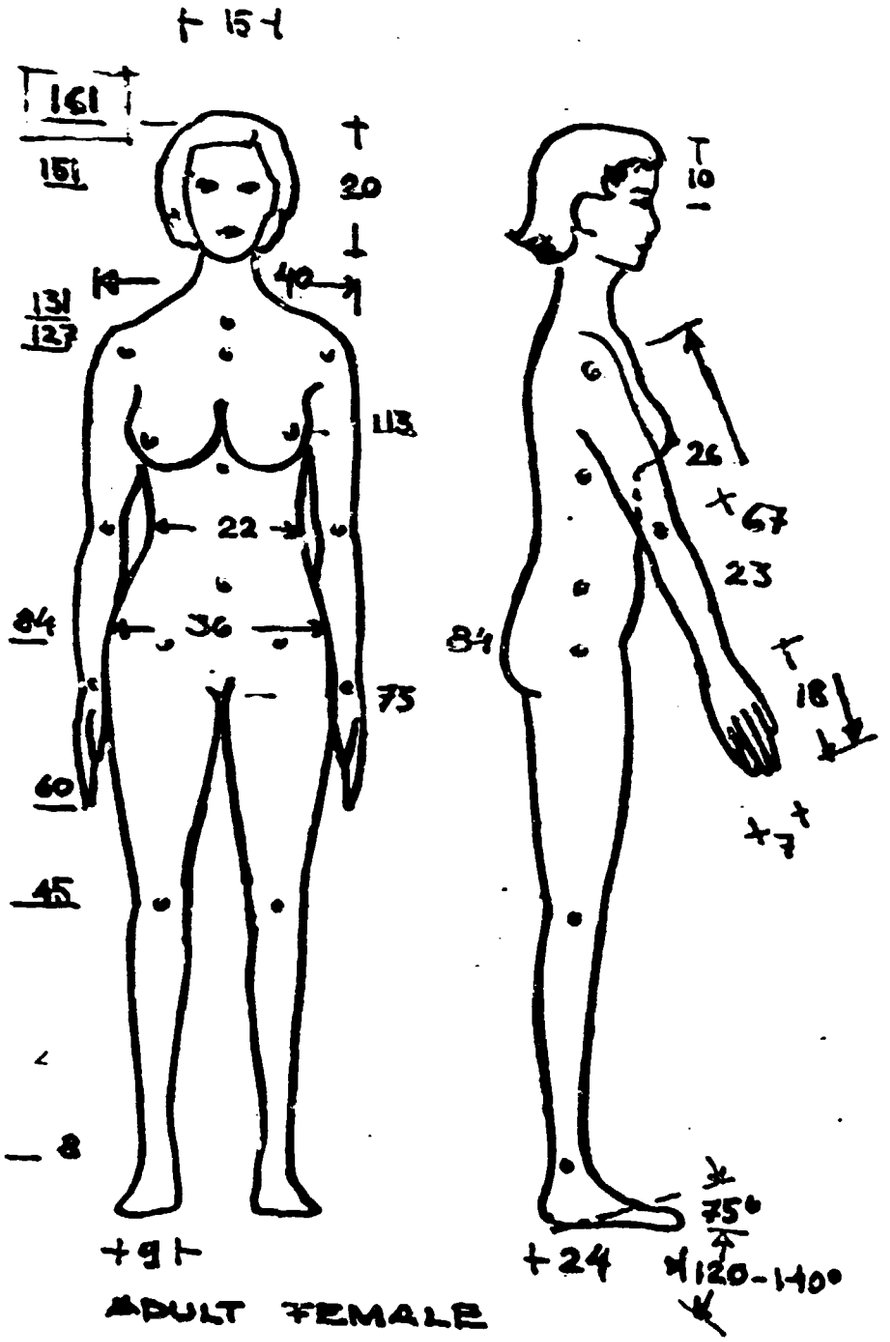
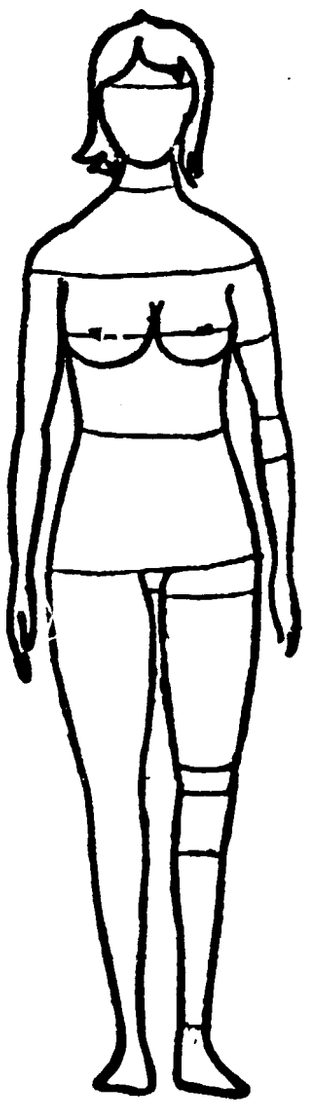


Figure 5: Some dimensions of the average adult female, in cm.

Tables can provide data resulting from our being three-dimensional (see figure 6.). Such data is needed for example when designing clothing or objects connected with the use of space. Figures 7 and 8 indicate respectively the recommended working posture of an average adult male and female when sitting. Of course, the nature of the job can bring about significant special needs, in which case the dimensioning has to be revised.



	SEX	2.5%	50%	97.5%
HEAD	M	54.1	56.4	58.7
	F	51.8	54.9	57.9
NECK	M	34.8	37.6	40.9
	F	32.5	35.1	37.8
SHOULDER	M	107.4	116.3	125.5
	F	90.4	98.0	108.2
CHEST	M	88.9	98.3	108.7
BUST	F	91.9	95.8	100.1
UPPER ARM	M	28.4	32.3	35.8
	F	26.9	29.0	30.7
WAIST	M	75.4	86.9	100.3
	F	72.4	74.2	80.3
ELBOW	M	28.4	31.2	34.8
	F	25.7	28.2	31.2
FOREARM	M	26.7	29.2	32.0
	F	24.4	26.2	27.7
HIP	M	88.6	97.8	107.4
	F	93.2	100.8	105.9
UPPE THIGH	M	50.8	58.7	66.0
	F	53.3	59.2	63.0
LOWERTHIGH	M	35.1	39.4	43.9
KNEE (SIT)	M	36.1	39.4	43.2
	F	35.6	38.1	41.9
CALF	M	33.8	37.3	40.6
	F	32.8	35.8	39.4
ANKLE	M	20.3	22.1	23.9
	F	19.6	21.8	23.6

Figure 6: Circular dimensions (in cm)

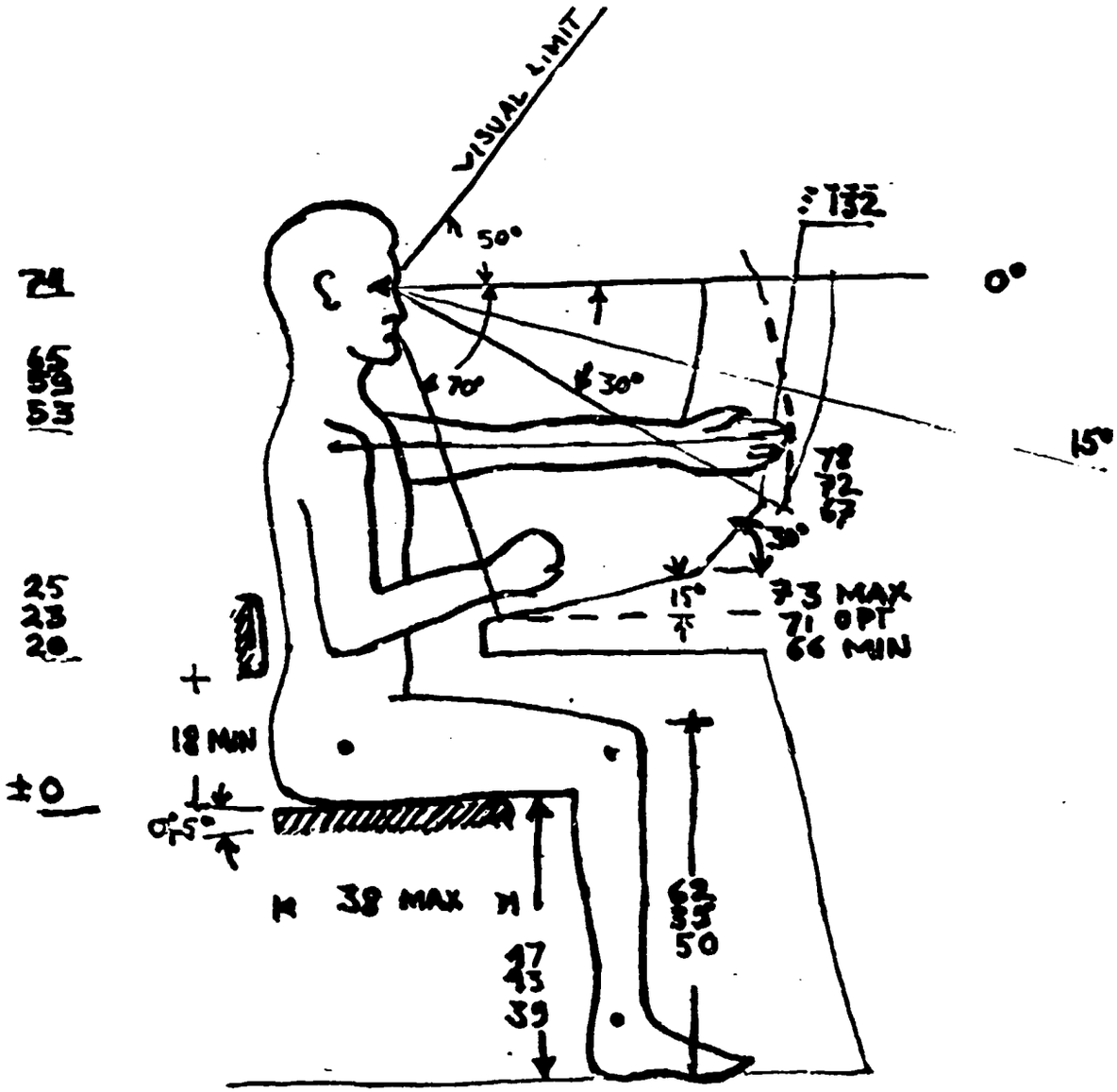


Figure 7: Recommended working posture for an average adult male, when sitting (in cm)

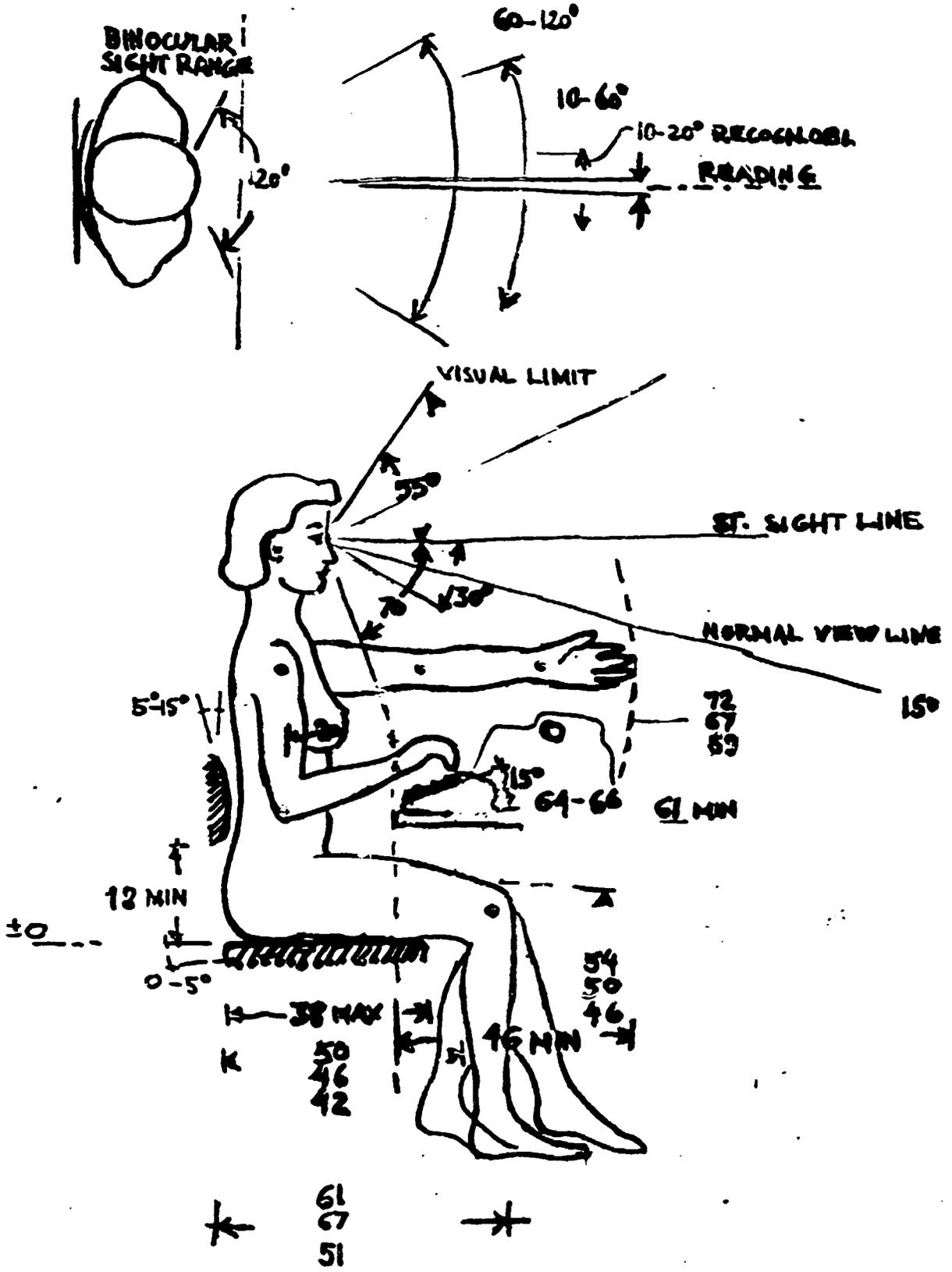


Figure 8: Recommended working posture for an average adult female, when sitting. (in cm)

As noted earlier, sitting is a very characteristic posture of man. Due to wrong habits or faulty design we can cause ourselves severe health hazards. Figures 9 and 10 show some examples of faulty design and dimensioning, whose effects on the sitting comfort are obvious even after a short period of time. Even slight correction of balance due to the wear or faults in the seat can be felt months or even years later as pain on the overall back area.

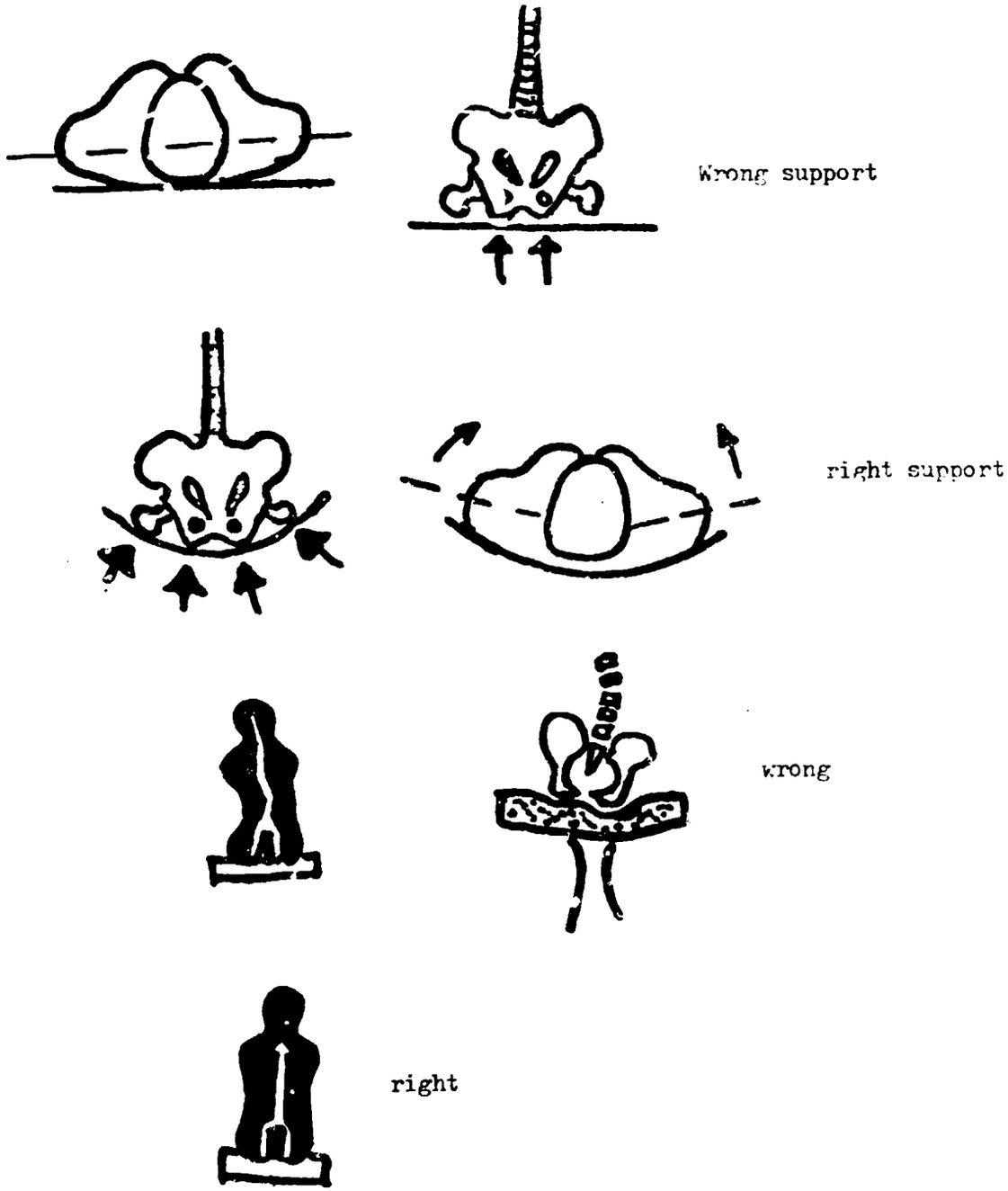


Figure 9: Effect of wrong and right support in sitting.

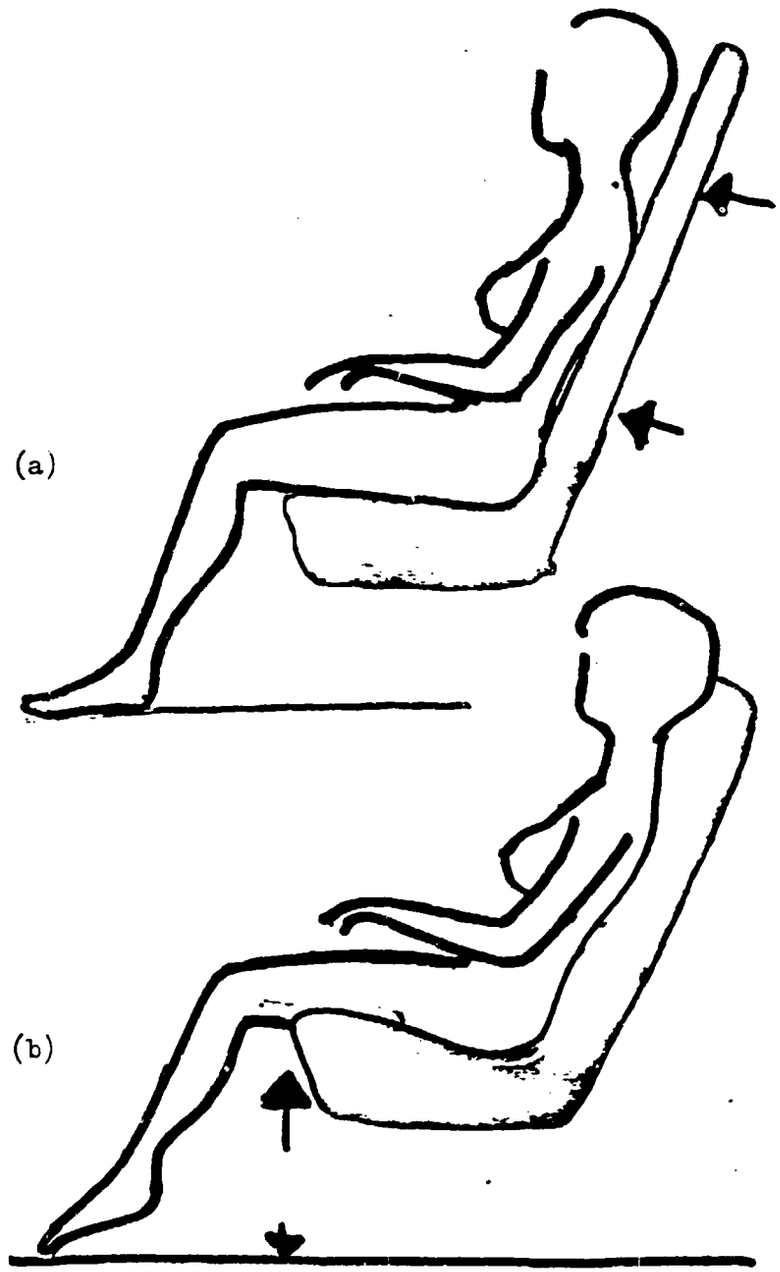


Figure 10: Position: seated
support from chair,
(a) wrong
(b) right

A typical "hanging" sitting posture of a tired person stretches his back and forces the vertebral laminae outwards. (Figure 11). All too often the person dealing with the results is the surgeon.

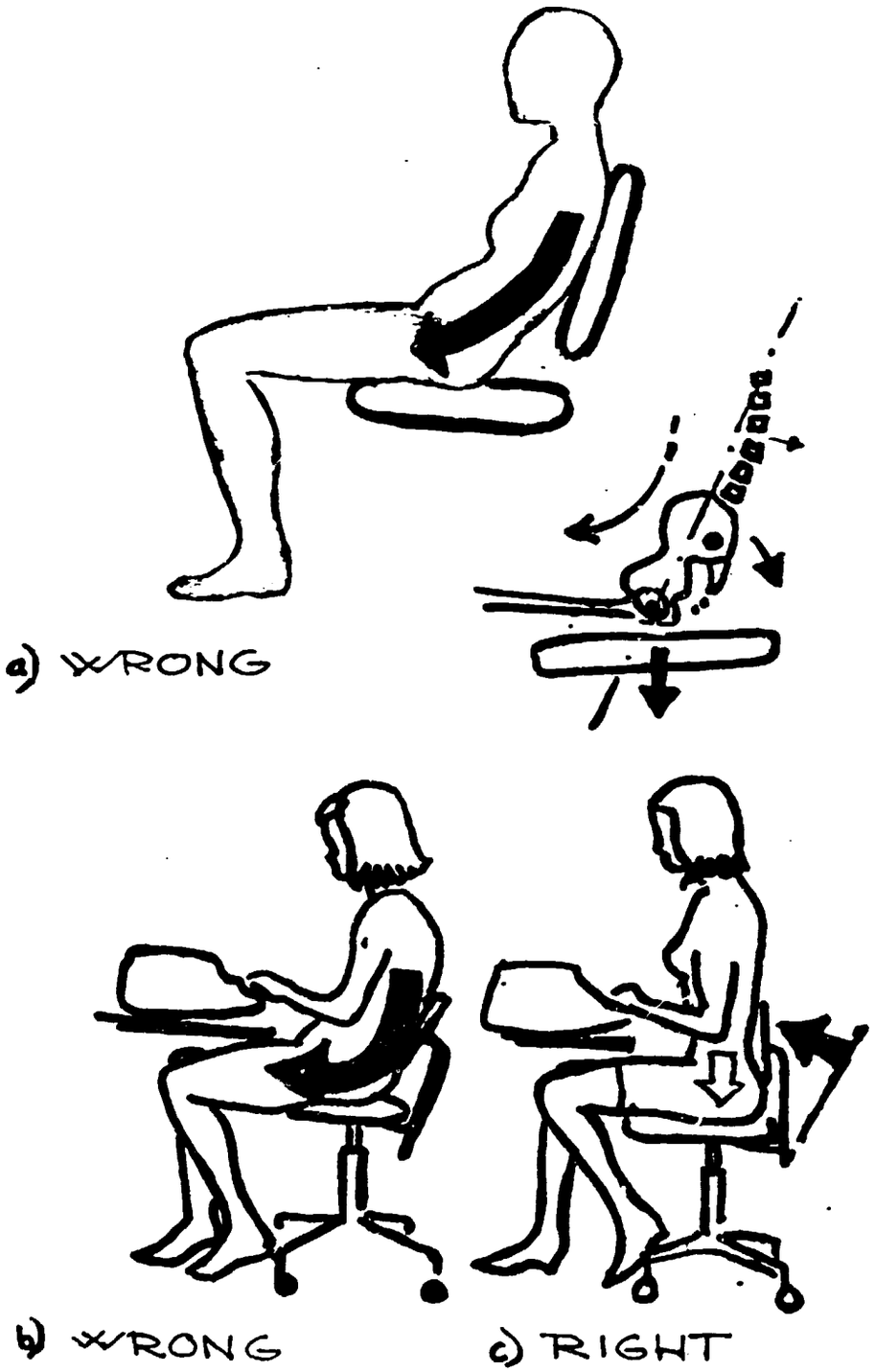


Figure 11: (a) "Hanging" sitting posture of a tired person, wrong (b); and right (c); sitting postures for a secretary

Figures 12, 13 and 14 show typical dimensioning examples of an arm-chair and work chairs. In this connection, good design also includes ample adjustment possibilities. It is also important that the materials breathe, but on the other hand softness is not necessary, except maybe for the dealer.

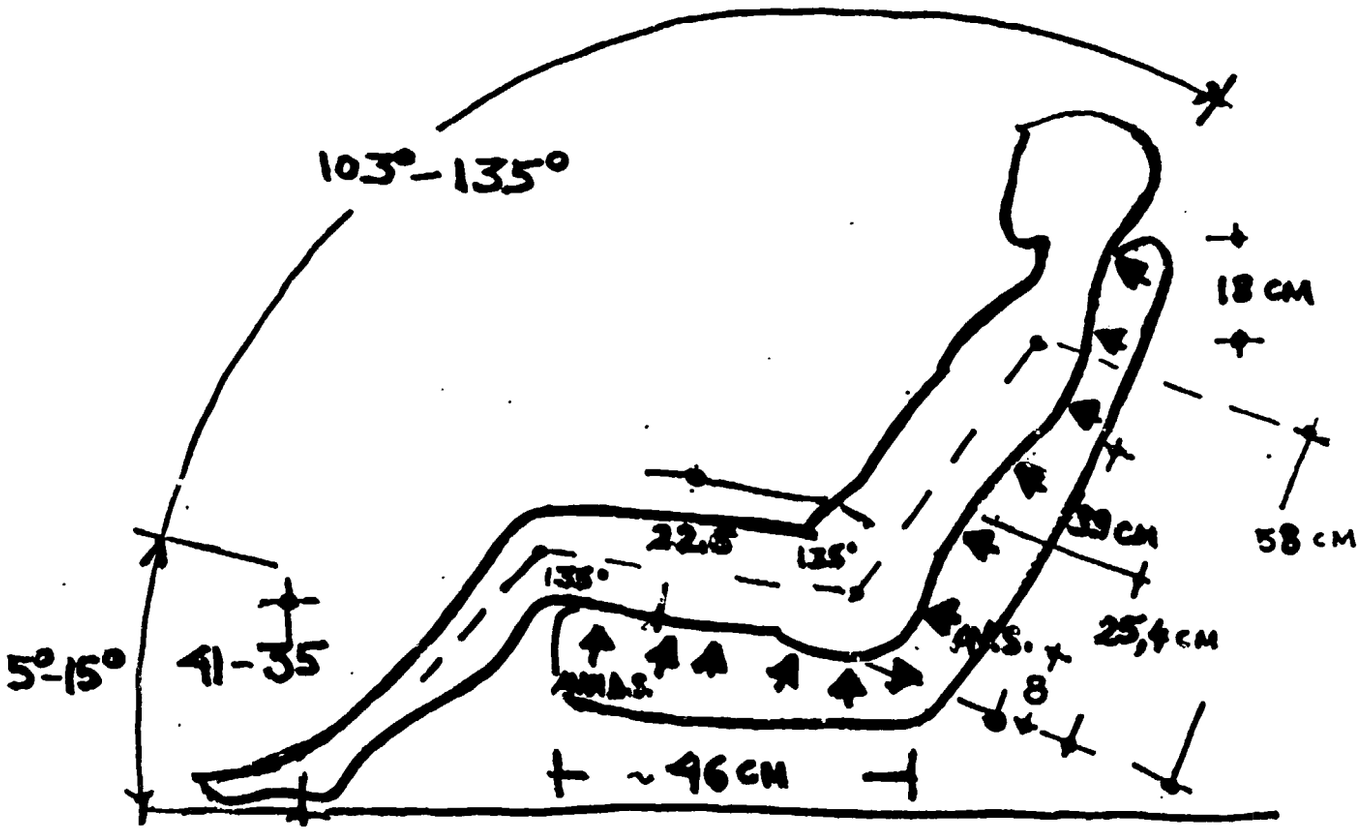


Figure 12: Typical dimensioning example of an arm chair for rest. (in cm)

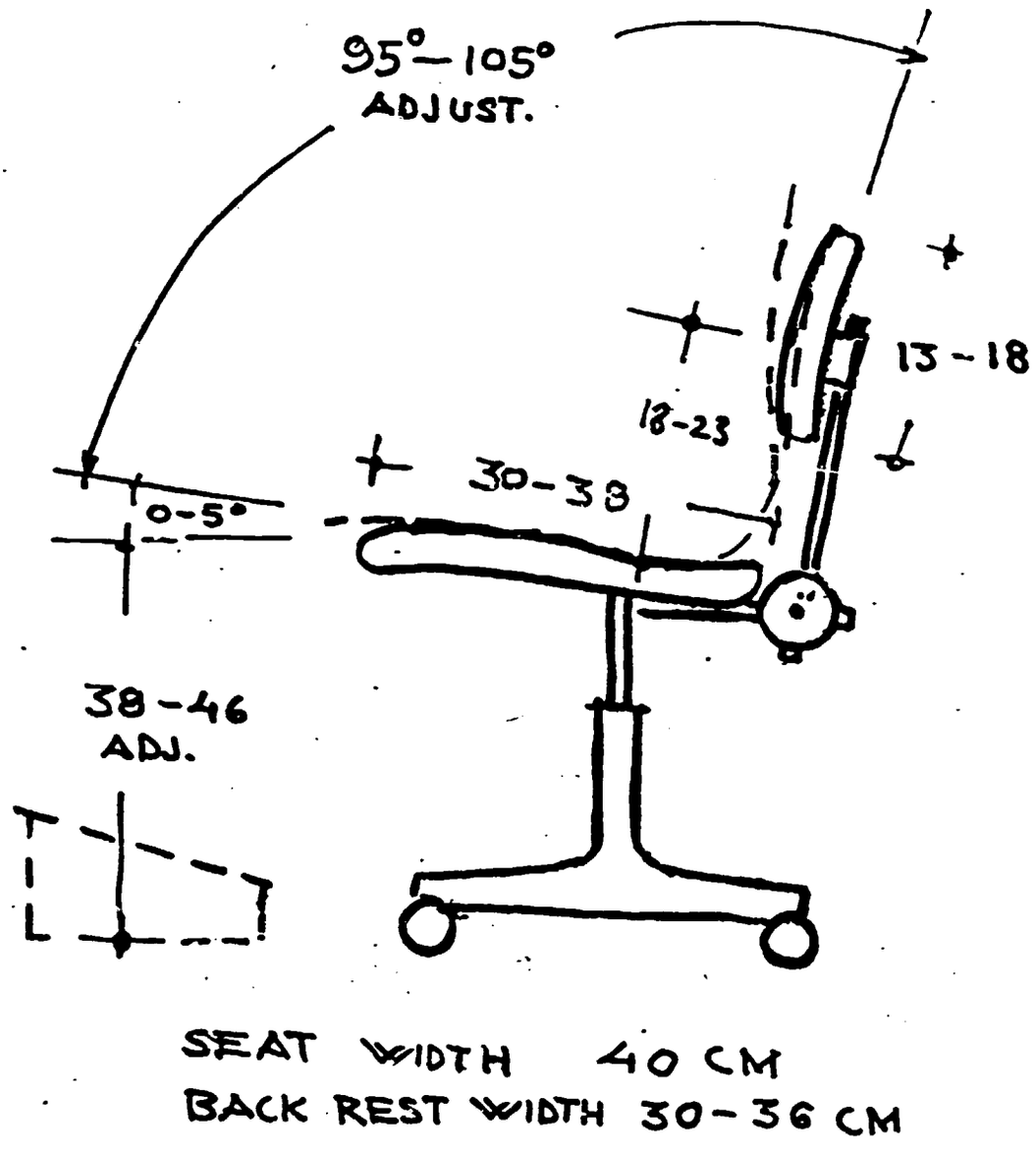


Figure 13: Typical dimensioning examples for a work chair (in cm)

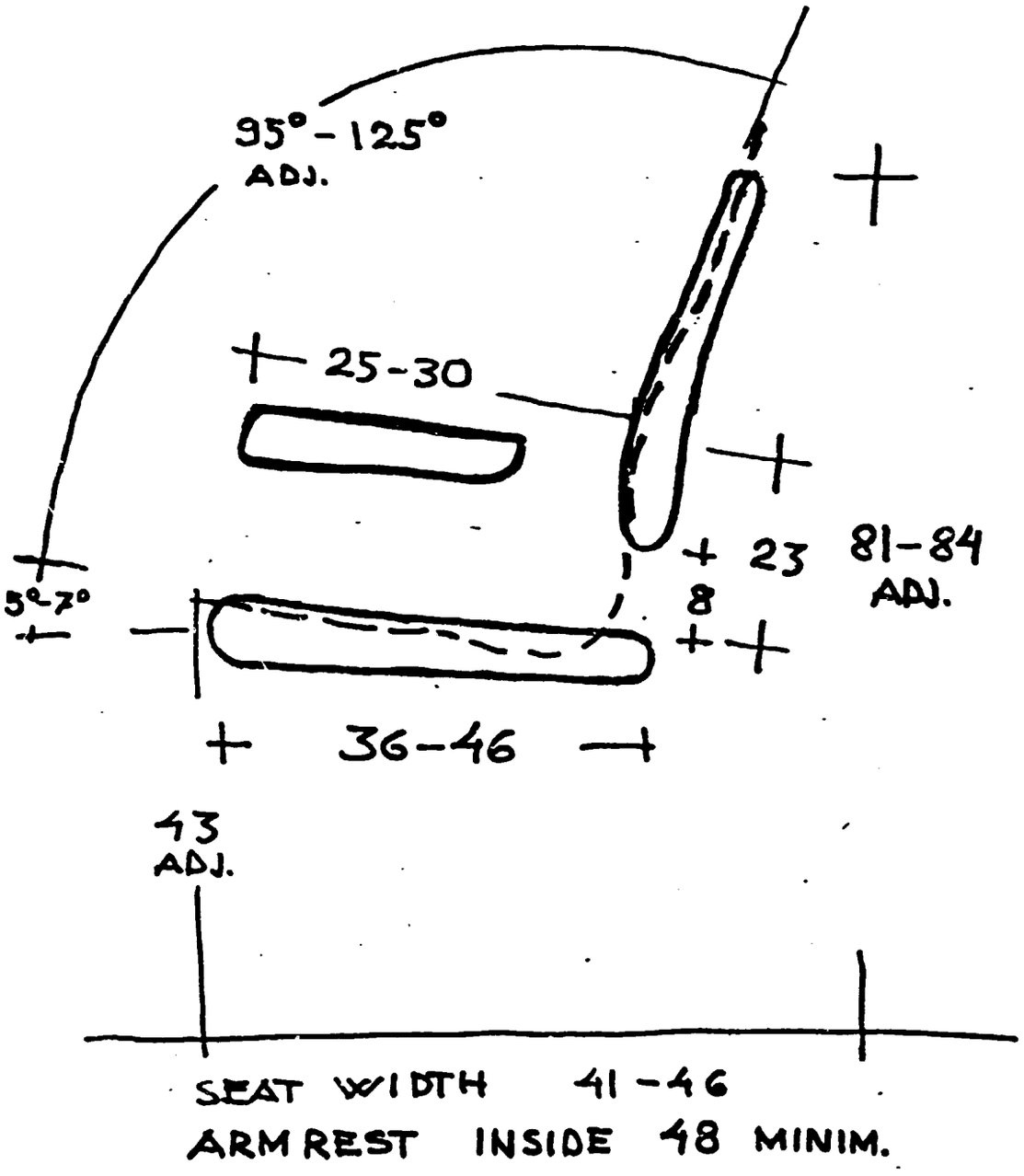


Figure 14: Typical dimensioning example for an arm chair and a work chair (in cm)

A situation resembling the working position is eating. A prerequisite for a pleasant dining atmospheere is the correct relationship between the table and the chair. Figure 15 shows the need for dimensioning (side elevation and top projection). The requirements set to a dining table are much the same as those set to a conference table. It is recommended to use a diagram (similar to Figure 15 'b') in both cases. The triangle ABC in that figure easily shows whether there is sufficient space available, irrespective of the size and shape of the table concerned. An example of this is Figure 16.

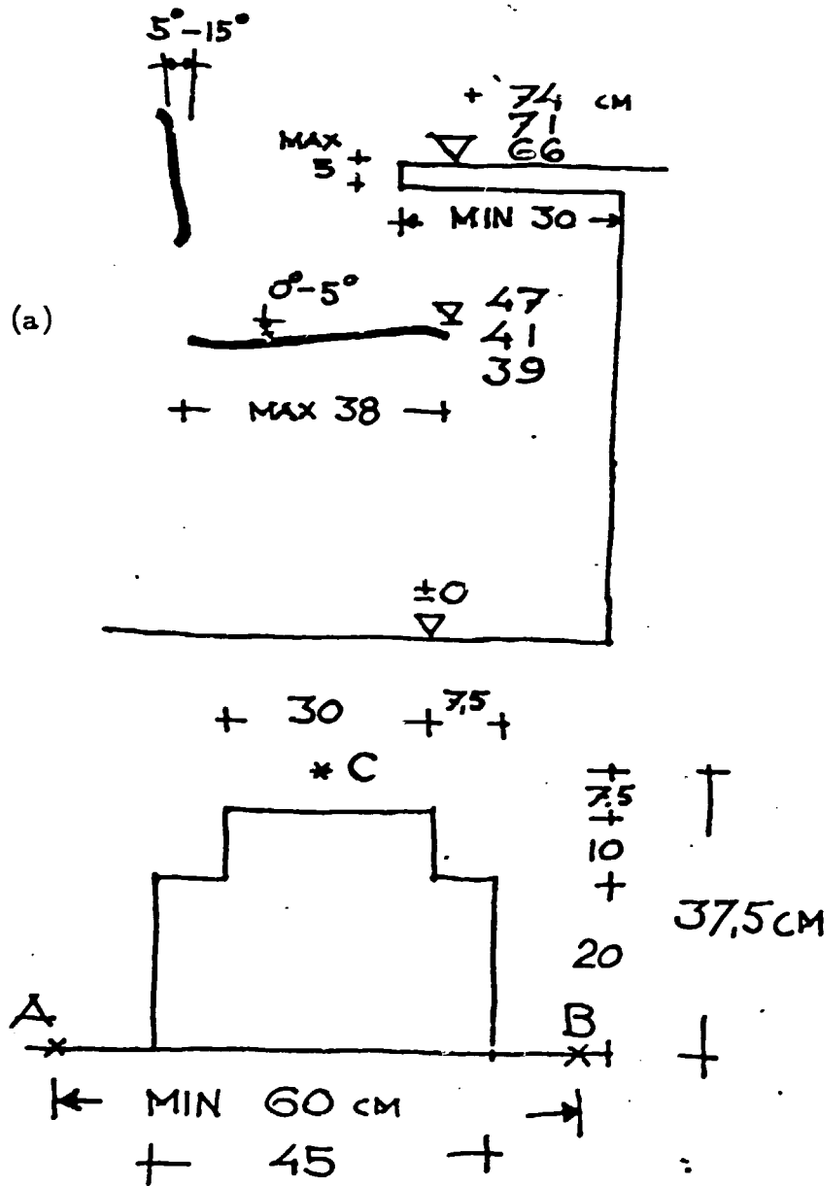


Figure 15: Dimensioning of chair and table for dining (in cm):
(a) side elevation
(b) top projection, showing knee-foot range

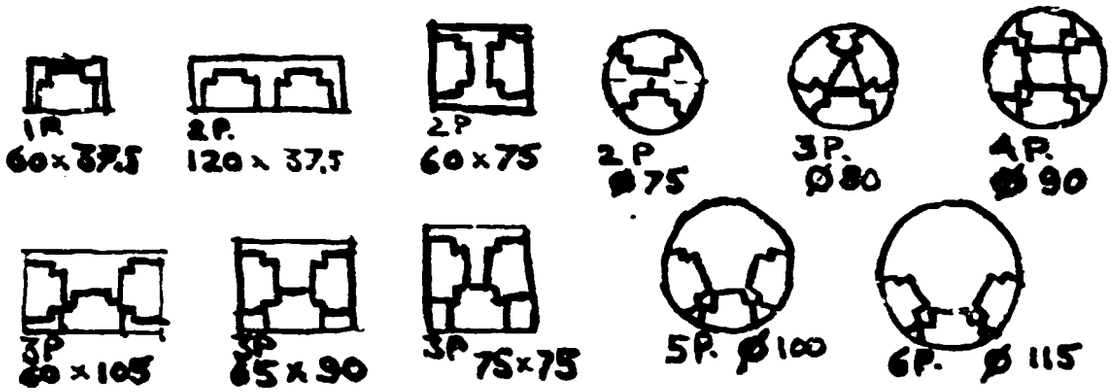


Figure 16: Space requirements for various sizes of dining and conference tables.

Often a well-deserved rest is spoiled by faulty design or dimensioning of the bed. We spend a considerable amount of our lives in bed. Also many pleasant features of family life are closely related to bed. Figure 17 indicates the nature of the support needed for our bodies in bed. The support has to be directed to certain structurally suitable places in us. It is quite wrong to hang in a hammocklike pit. Figure 18 shows ideal resilience, which provides the back with the best relaxation and rest.

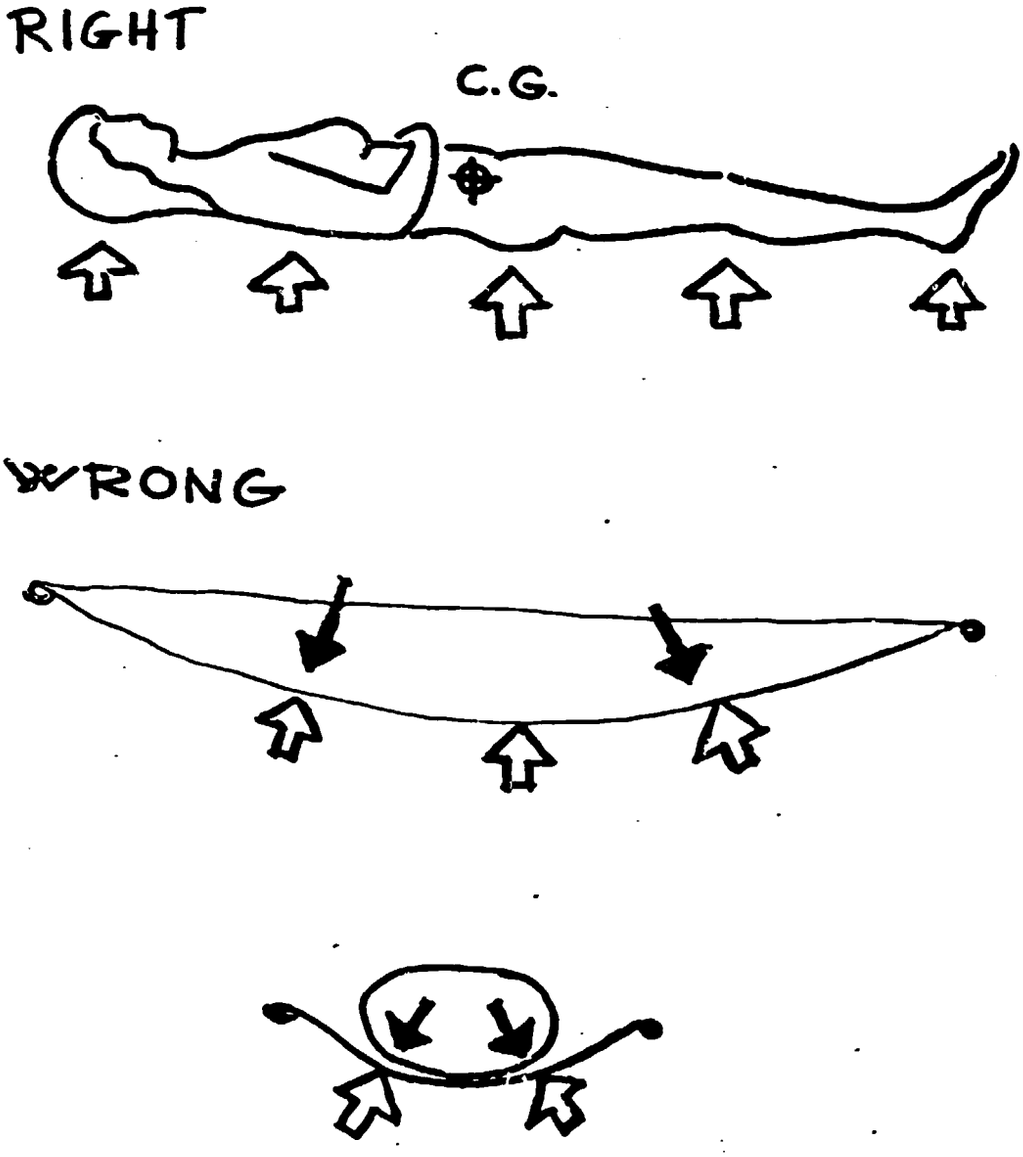


Figure 17: Nature of the support needed for a body in bed.

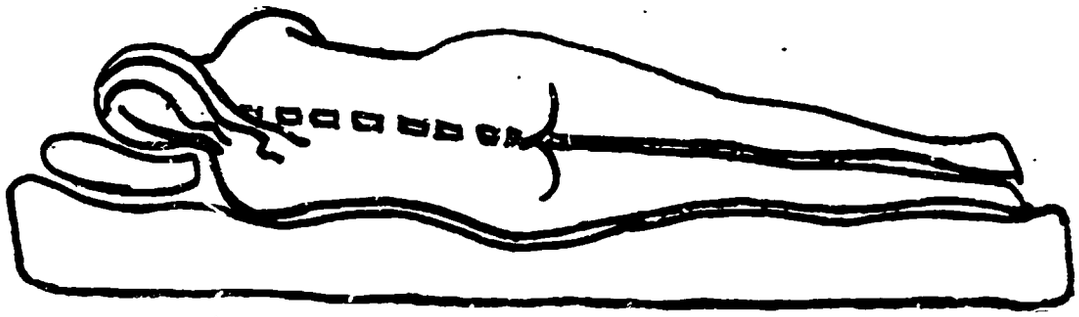


Figure 18: Bed support showing ideal resilience.

The reports of the numerous surveys on the sleeping facilities of people have alarmingly indicated that people still neglect the proper dimensioning of their beds. The situation, of course, varies in different countries. Figure 19 shows precise and valid starting points for dimensioning. Unfortunately, the corresponding dimensioning often remains a dream.

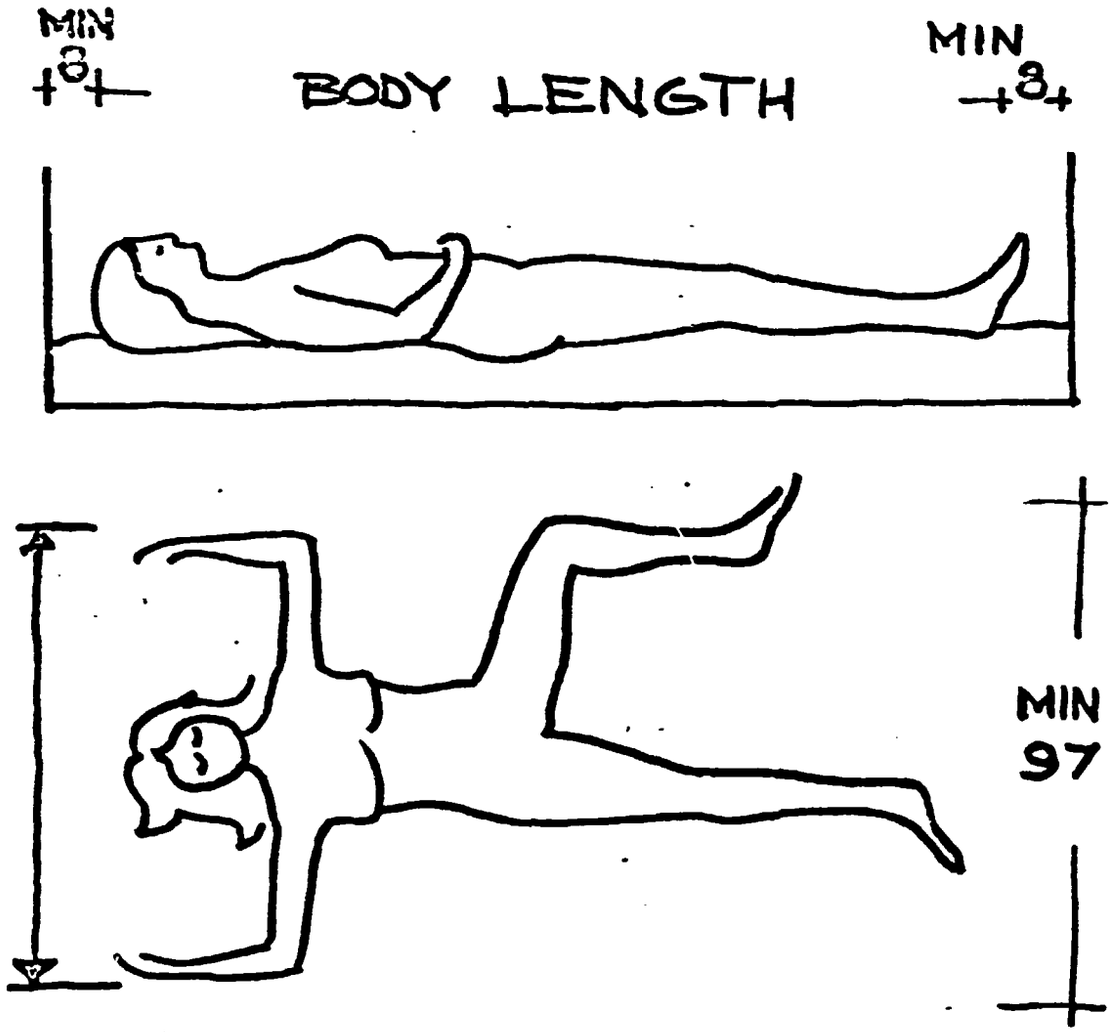


Figure 19: Bed dimensioning (in cm)

The responsibility of design in furniture for serial production is quite obvious if we consider the amount of harm and inconvenience caused by even a small error when repeated in thousands of pieces of furniture. Fortunately, a well-designed product, also repeated as thousands of copies, results in gratitude and happy feelings experienced, though not necessarily expressed, by its users.