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CLASSROOM FURNITURE

Technical Notes



Educational Facilities Development Service
of the
UNESCO REGIONAL OFFICE FOR EDUCATION
IN ASIA AND OCEANIA
Bangkok, Thailand

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Classroom Furniture

PREFACE

ARISBR receives many requests for copies of working drawings of the various types of classroom furniture which have been developed by the Institute and because of the wide interest shown, it is thought worthwhile to publish the essential detailed information required for the manufacture of the furniture. The dimensioned drawings will provide sufficient details for a carpenter or joiner whether in his own small workshop or in a factory, to set out and assemble the furniture without difficulty.

The other purpose of these technical notes is to draw attention to these functional and economical designs and to stimulate awareness in the need to provide well designed and properly sized furniture for schools.

BACKGROUND

Wood is the most commonly used material for classroom furniture because of its low cost and ready availability. If it is properly seasoned and worked by a skillful joiner, wood is the most suitable material for the production of large quantities of classroom furniture that are being manufactured annually in the Region.

Unfortunately, however, the demand for classroom furniture is so heavy that in many countries there is often no time to season the wood used and, indeed, rarely time for exercise of the skilled craftsmanship that is essential to the production of good furniture. This, coupled with the rough treatment given to school chairs and desks by healthy, energetic children results in rapid loosening of joints and subsequent damage, particularly to chairs.

As it is neither possible to reduce the demand for furniture, nor to expect it to be less roughly handled by the children, it becomes important to design sturdy chairs and desks which can be made of unseasoned or partly seasoned wood by carpenters using a minimum of skill and working for maximum output.

The first of a series of classroom furniture designed to satisfy these stringent requirements was developed by a UNESCO Consultant, Mr. J. Gammelgaard, assigned to the Asian Regional Institute for School Building Research. The desk and chair which were constructed are illustrated in Plates 6 and 7. These units were subjected to prolonged field trials in some countries in the Region and the results of these trials show that both items will withstand rough treatment without falling apart and that they are functionally well suited to the purpose for which they were designed.

Ceylon has now accepted the "Gammelgaard" type desk and chair as its new standard unit for supply to all schools. Indonesia and the Punjab (India) have also embarked on large scale production of the "Gammelgaard" desk and chair.

DESIGN AND COST CRITERIA

The design criteria for wood furniture to meet both the conditions outlined above and the requirements for teaching and learning are:

- (a) the range of furniture provided should fit the body sizes of Asian children aged 5 to 18 years.
- (b) the desk must have a working surface adequate for the normal classroom tasks of reading and writing.
- (c) storage space needed for books, pencils and the like, should *not* be between the desk top and the knees.
- (d) the desk should be completely stable - it should be possible for a child to work on it without over-turning it.
- (e) the chair should provide good lumbar support and should be designed so that it is virtually impossible, when sitting, to "rock" backwards on the two rear legs and thus to loosen the joints.

- (f) recess joints should be avoided and the desk and chair should be made of flat, unrecessed pieces of wood only.
- (g) joining of the pieces should be by nailing or screwing and in addition adhesive.
- (h) the wood should not be a species which easily splits when nailed or screwed. The desk top should have a hard surface.
- (i) the chair and the desk should be easy to repair locally.
- (j) furniture should, if possible be stackable.

If costs are to be reduced the following criteria are important:

- (a) the component pieces of wood should be in as few different sizes as possible. The standardization of widths and thicknesses will facilitate the machining operations.
- (b) the design should be such as to lend itself to factory or cottage production, or a combination of the two (e.g. factory-cut components, shipped to areas near to or to the schools themselves and the components assembled locally or by the students).
- (c) the design should be such that the students can make the furniture themselves in the school workshop as part of their programmed work or as a co-curricular activity thus giving them an introduction to good design and production methods and adding meaning to their curricular work on the production of chairs (Plate 1).

The furniture dimensions given here are based on the results of a very large number of body measurements of children from Ceylon, India, Pakistan, the Philippines and Thailand. The similarities between the samples actually measured are significant enough to suggest that the dimensions may be used in other countries of the Region as long as no locally collected anthropometric data are available.^{1/}

^{1/}See Occasional Papers Nos. 3, 4, 5, 6, 8, 14, 15 and 16.

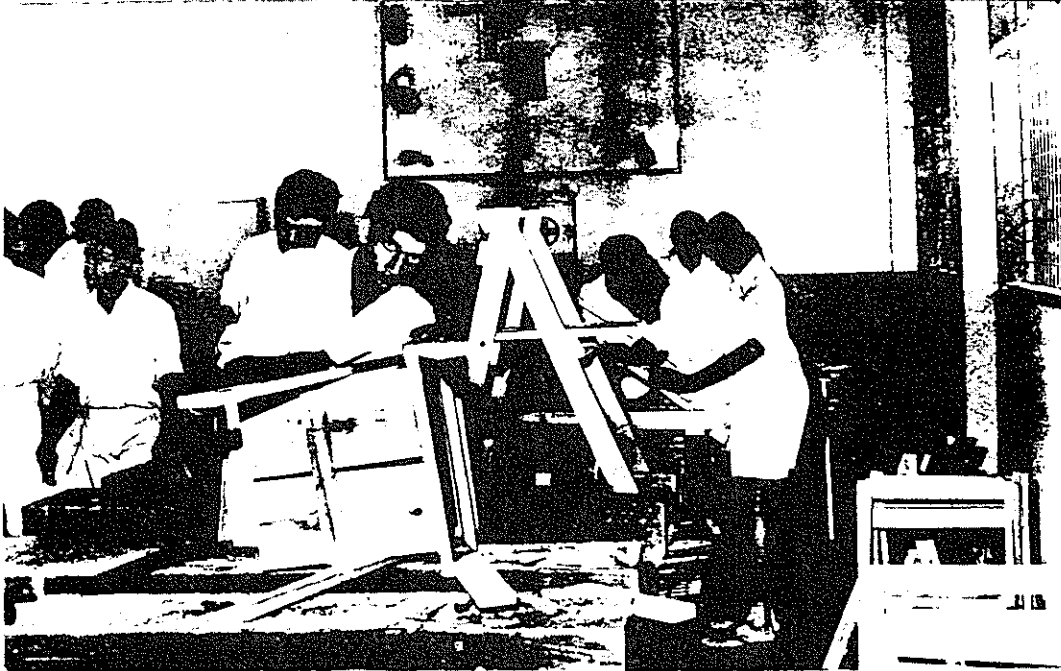


Plate 1. *Students in their school workshop assembling chairs.*

DISTRIBUTION OF RANGE OF FURNITURE

The numbers of chairs and desks of each size required for a particular class of children will vary from country to country, depending on the age range of the children in the class. The important point is to select furniture for the youngest significant age group in the class. Larger children can always comfortably use furniture which is slightly too small for them but smaller children will always be uncomfortable in furniture that is slightly too large.

Table 1, indicates the possible range in the distribution by size of the desks and chairs required in each grade. Although it would be ideal to provide a range of furniture as indicated in the Table, such an ideal situation is far from reality in most countries in the Region. It is therefore recommended that at least two but preferably, three, sizes should be provided. These would be Code Type B,C and E. For primary Grade 1 and pre-primary Grades it is recommended that the 6 seater table with stools be provided, (Plate 10 and Plates 11a & 11b).

Grade	A g e	Desk and Chair type code					Total per Class
		B	C	D	E	F	
II	6	28	15	2			45
II	7	19	20	6			45
IV	8	14	18	10	3		45
V	9	7	20	12	6		45
VI	10	3	19	16	7		45
VII	11		16	17	12		45
VIII	12		7	26	7		40
IX	13		3	26	11		40
X	14			20	20		40
XI	15			4	32	4	40
XII	16				8	32	40
TOTALS		71	118	139	106	36	470

TABLE 1. *Numbers of chairs and desks required in each Grade (to include provision for over-age children) in a single stream school.*

DIMENSIONS

It will be seen that some dimensions are described as nominal. In these instances the actual dimension will be dependent on the finished size of the timber, e.g. the width of the seat board of the chair, type B, is shown as 15.2 cm nominal but by the time the board has been milled, its finished width may be reduced to 14.7 cm but these dimensions are not so critical as the height of the chair seat or the height of the chair back rails and any discrepancies in the widths of the seat can be taken up by increasing or decreasing the gap between the two boards.

SIZES OF TIMBER

The wide variation in milling practices throughout the Region and the absence of grading rules for timber in many countries present a minor difficulty in detailing the drawings.

Some countries may convert a log into boards, the cross section sizes of which are slightly larger than specified, i.e. a 15.2 cm x 2.5 cm board may be sawn to sizes approximately 15.5 cm x 2.8 cm. Other countries may saw the timber to hold the specified sizes i.e. a 15.2 cm x 2.5 cm board will measure 15.2 cm x 2.5 cm and other countries may saw the timber to finish slightly less than the specified sizes. The sawn size of timber will obviously affect its finished size (i.e. after planing), and it is for these reasons and to provide a tolerance for milling practices to avoid an unnecessary waste of timber in providing over-sized timber that some dimensions are marked as "nominal" and the sections of timber described as out-of.

For example, the seat board to chair Type B is described as out of 15.2 cm x 2.5 cm and shown as 15.2 cm nominal. In this case it has been assumed that the sawn timber will hold the size of 15.2 cm x 2.5 cm and that its finished size will be 14.7 cm x 2 cm. Similarly, the width of the desk top Type B is dimensioned as 38 cm nominal and the component parts indicate that it can be made up from three, 12.7 cm x 2.5 cm boards, each 55 cm long. Whereas there is no difficulty in keeping to the dimensions of 55 cm in the length of the board, the width of the desk top may vary as the finished width of the board (after planing), varies. The desk top, may in fact finish 36.6 cm wide (3 x 12.2 cm)

It is considered that this variation of 1.4 cm in the width of the desk top, is acceptable and will avoid the use of different widths of boards or oversized board which may possibly add to the cost.

An important criteria, if costs are to be kept as low as possible, is that the component pieces of wood should be in as few different sizes as possible as this will facilitate both activities of milling and assembly.

All furniture, with the exception of the laboratory bench, has been designed so that it can be made up from boards of standard thickness of 2.5 cm and it has been taken that the standard finished thickness will be 2.2 cm.

It will also be observed that the leg framing of the desks are made up from sections of wood which are half the width of the boards making the desk top. A standard nominal width and thickness of board can be milled and then simply sawn down the middle to make the leg framing thus avoiding the necessity of ordering non-stock widths of boards.

SETTING OUT

Before proceeding with the production of the furniture it would be advisable to set out each piece of furniture to full size. The setting out can be done on a piece of plywood or hardboard (Plate 2), or even on the floor of the workshop (Plate 3).

Using the setting out boards, templates can be made of the component parts (Plate 4) which in turn can be used for making the cutting lines on the lengths of timber (Plate 5). The use of the templates will speed up the process of setting out and will assist in maintaining a high degree of accuracy in cutting to lengths and the angles of the splay cutting.

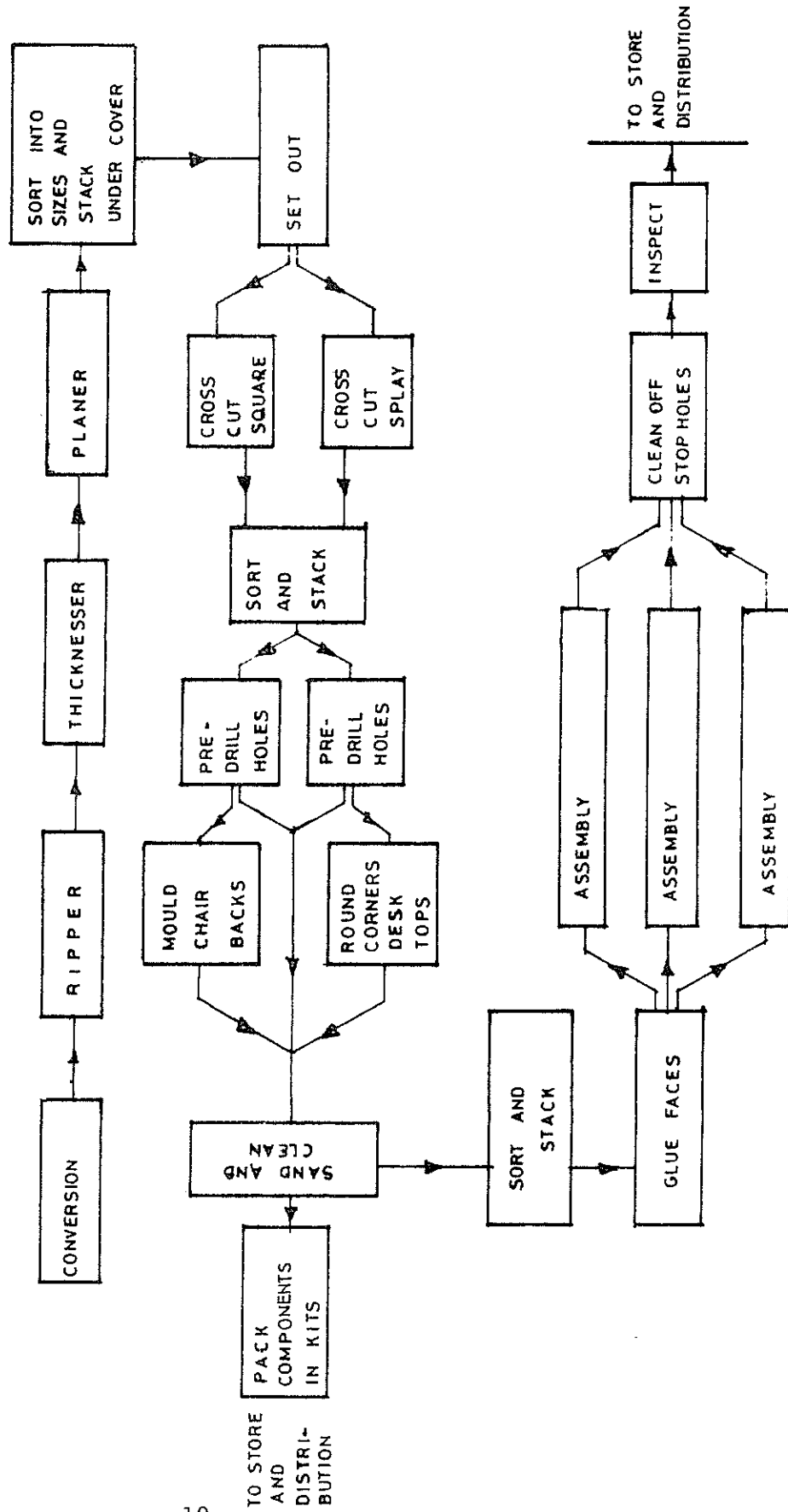
ASSEMBLY

The design of the furniture lends itself to a production line method and even in a cottage workshop, assembly work will be speeded up and simplified if it is undertaken in a systematic manner. The flow diagram (Figure 1) illustrates a sequence of events.

One very important factor, and which is so often over-looked is that all timber, before and after cutting to size, should be properly protected and stacked. All too often one sees cut and dressed timber left in the open and exposed to the weather. It is equally important, of course, that the finished article is properly stacked and protected. Lack of protection from the weather of the finished timber or the finished article is a major cause of deterioration of joining items.

It is essential that all joints and contact surfaces are first coated with a suitable adhesive before they are nailed or screwed into position.

FIGURE 1
 SUGGESTED FLOW DIAGRAM FOR PRODUCTION AND
 ASSEMBLY OF FURNITURE



A Polyvinyl Acetate Emulsion has been successfully used in Ceylon and other countries. This type of adhesive is normally available in all countries in the Region. The adhesive should be used strictly in accordance with the manufacturer's instructions and it is advisable that the manufacturer's chemist be consulted before any large scale use is made of the adhesive as certain woods such as Teak and Pine, contain natural oils, which, if allowed to accumulate on the surface may reduce bond strength.

This adhesive is not expensive and its use would add less than the equivalent of three US cents to the cost of any unit of furniture.

Another essential is to select a type of timber which does not easily split on nailing or screwing, and as a further precaution the component parts should be pre-drilled before being nailed or screwed.

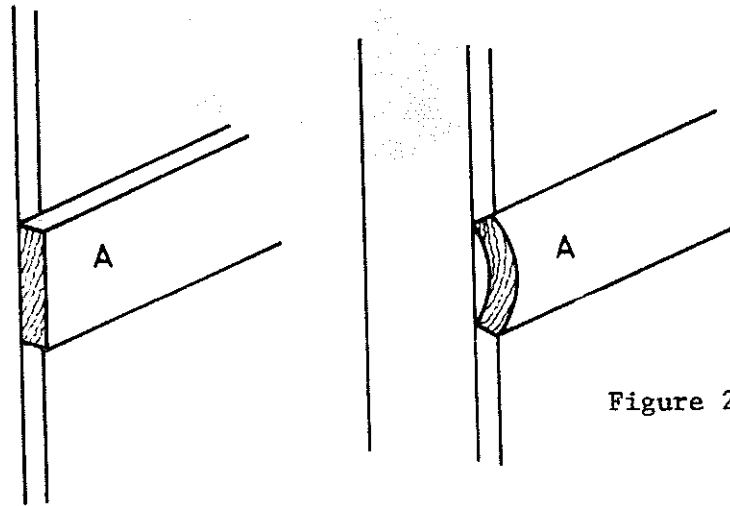


Figure 2.

Where unseasoned timber is used in a warm dry climate with great differences in relative humidity, the movement of the timber could cause damage in the joints (Figure 2).

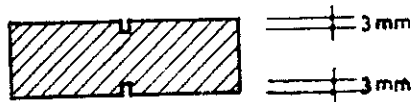
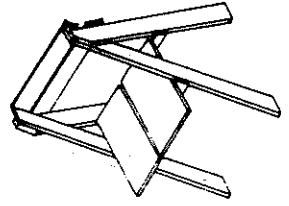
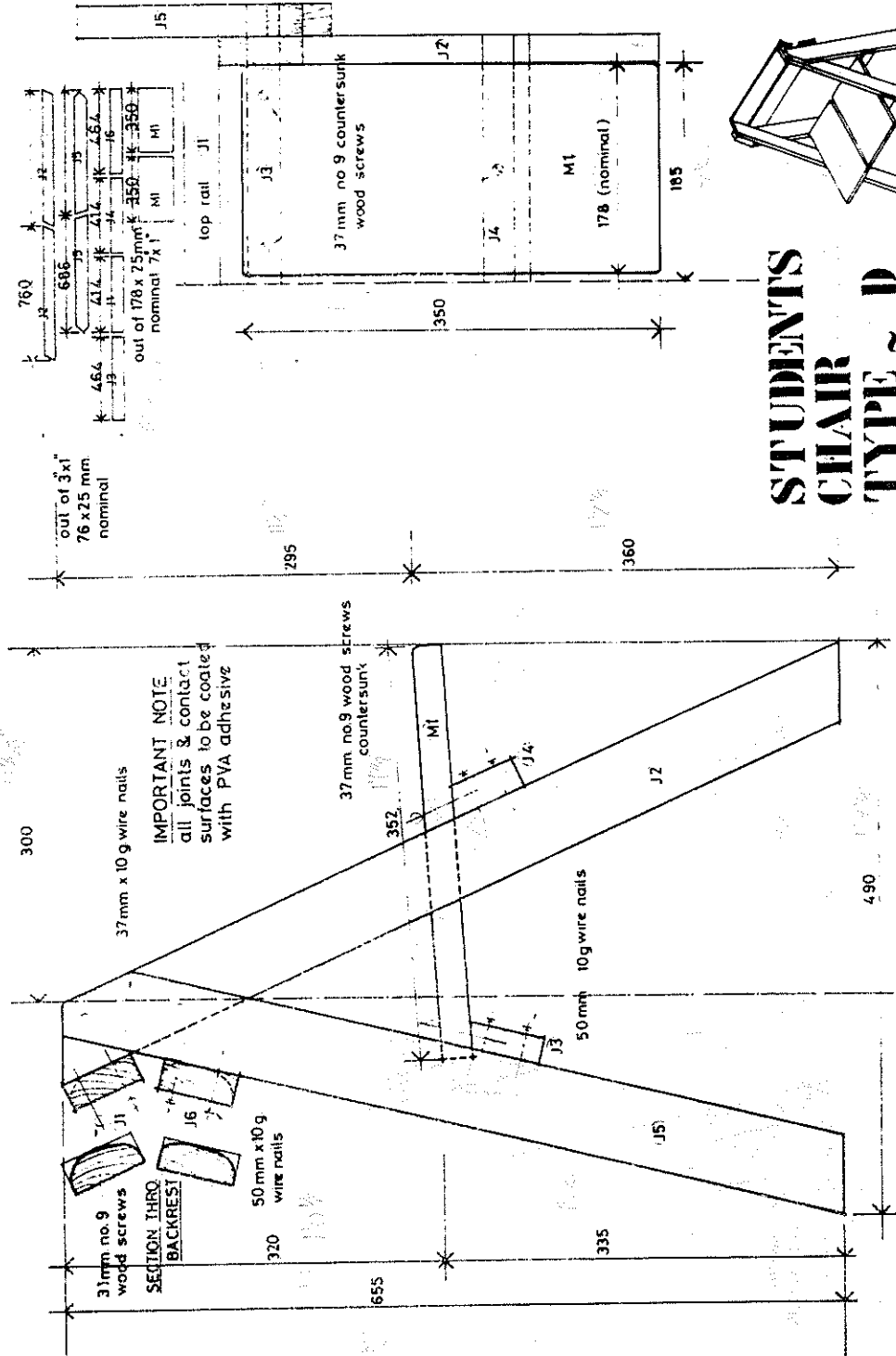


Figure 3.

The forces applied on the joints can be reduced by saw-cuts (3 mm depth) on either side of planks A. (Figure 3).

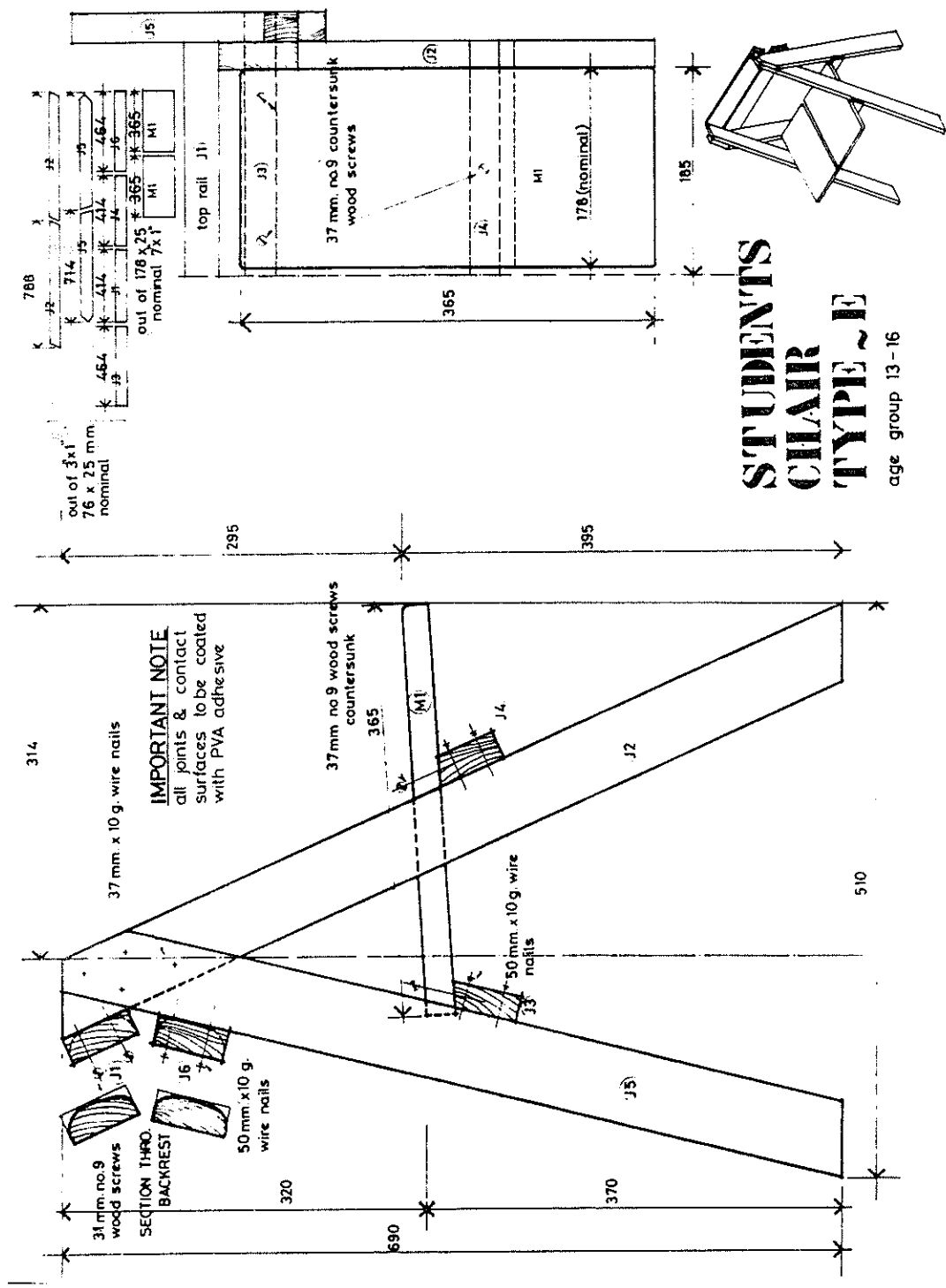
Chair





STUDENTS CHAIR TYPE ~ D

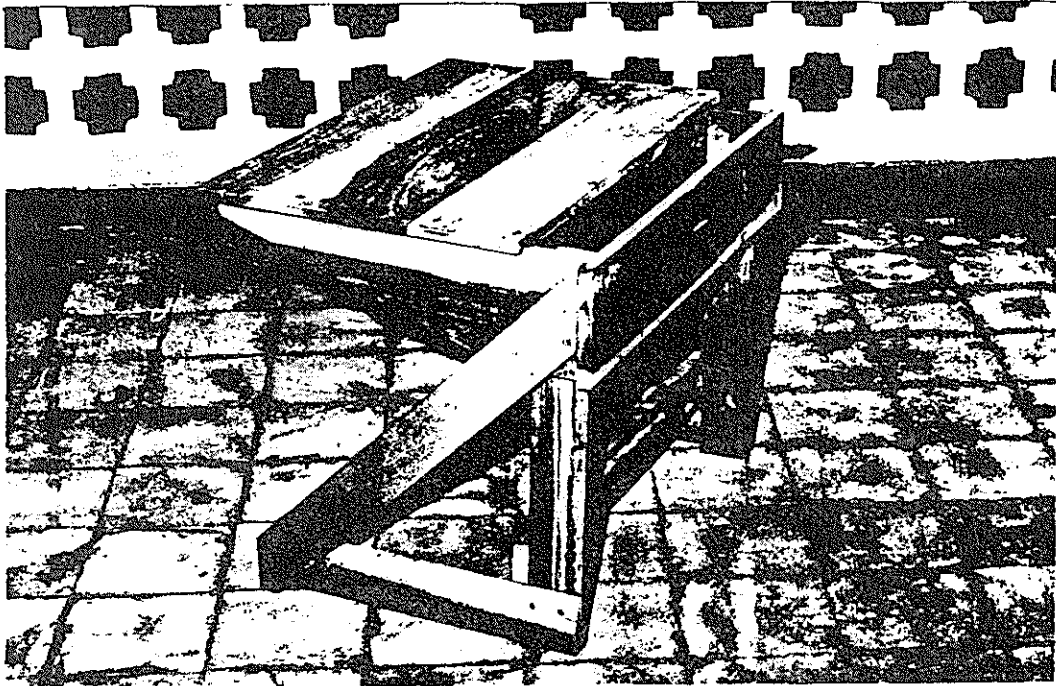
age group 11-14

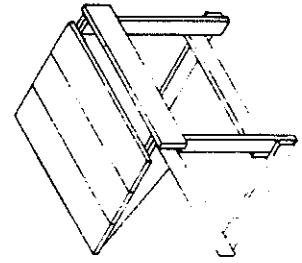


STUDENTS CHAIR TYPE JE

age group 13-16

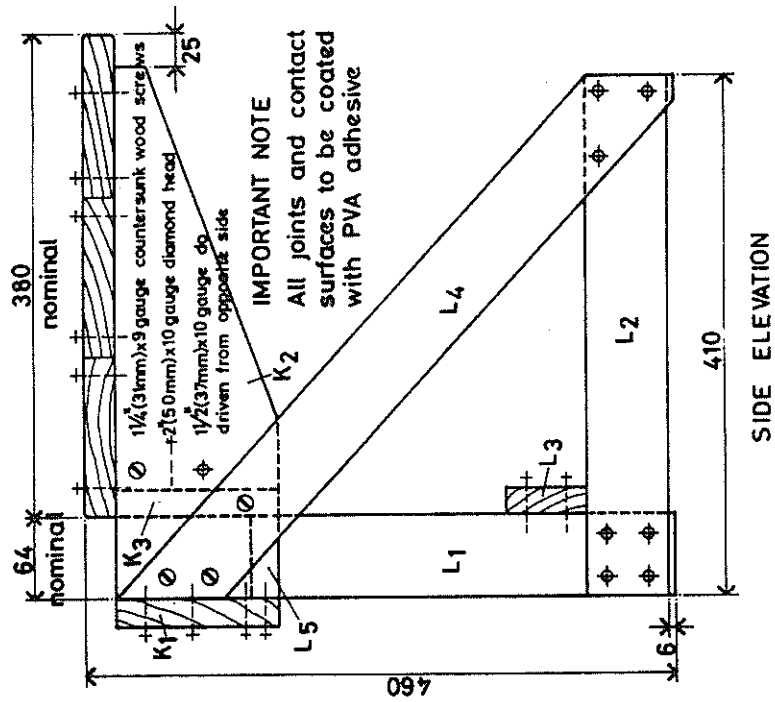
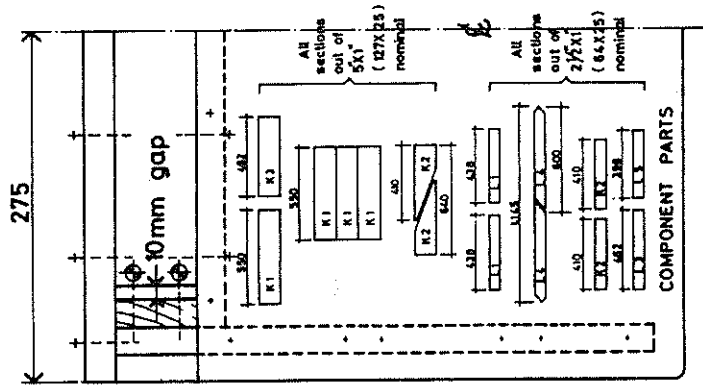
Single Desk



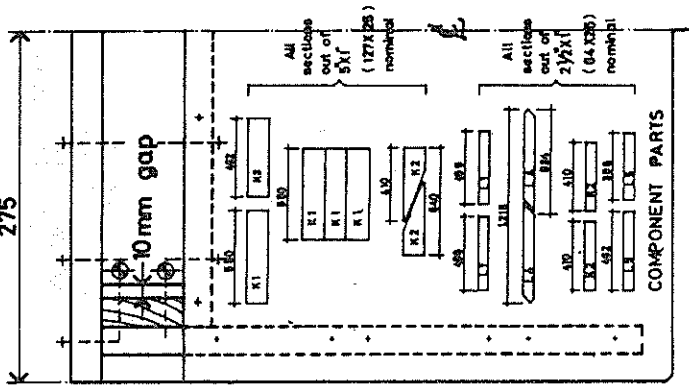


STUDENT DESK TYPE B (SINGLE)

Age group: 6-9



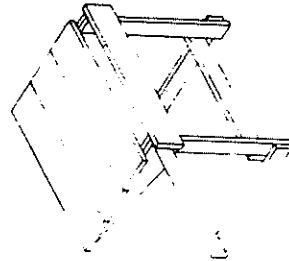
16 1/2



HALF PLAN

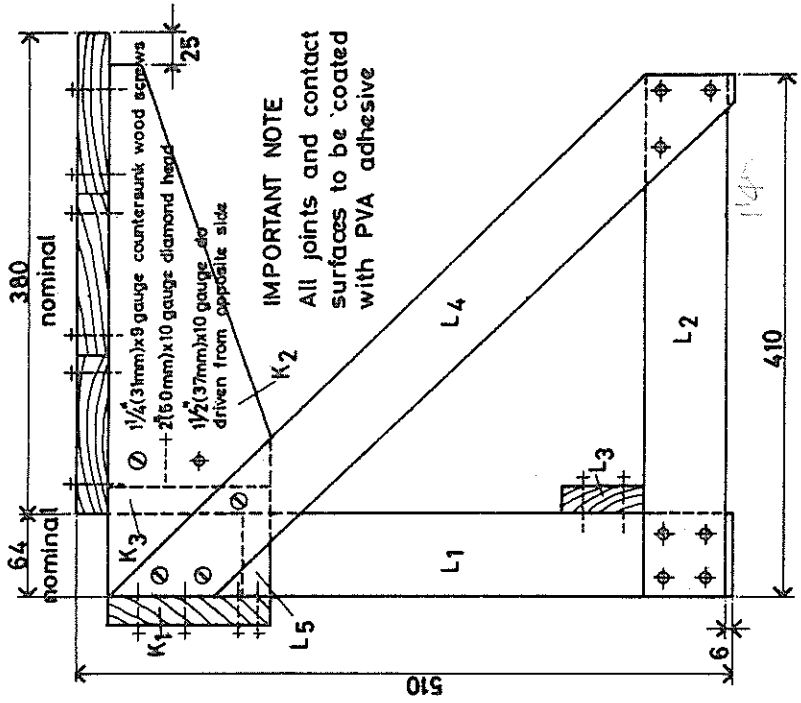
STUDENT DESK TYPE C (SINGLE)

Age group 9-12

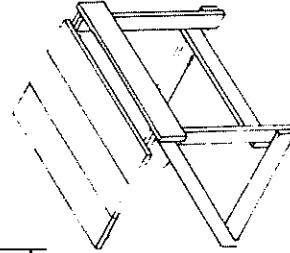
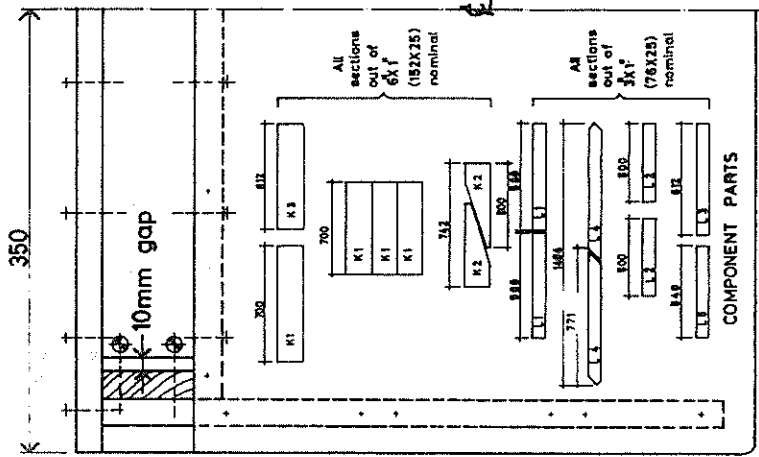


18

2 1/4



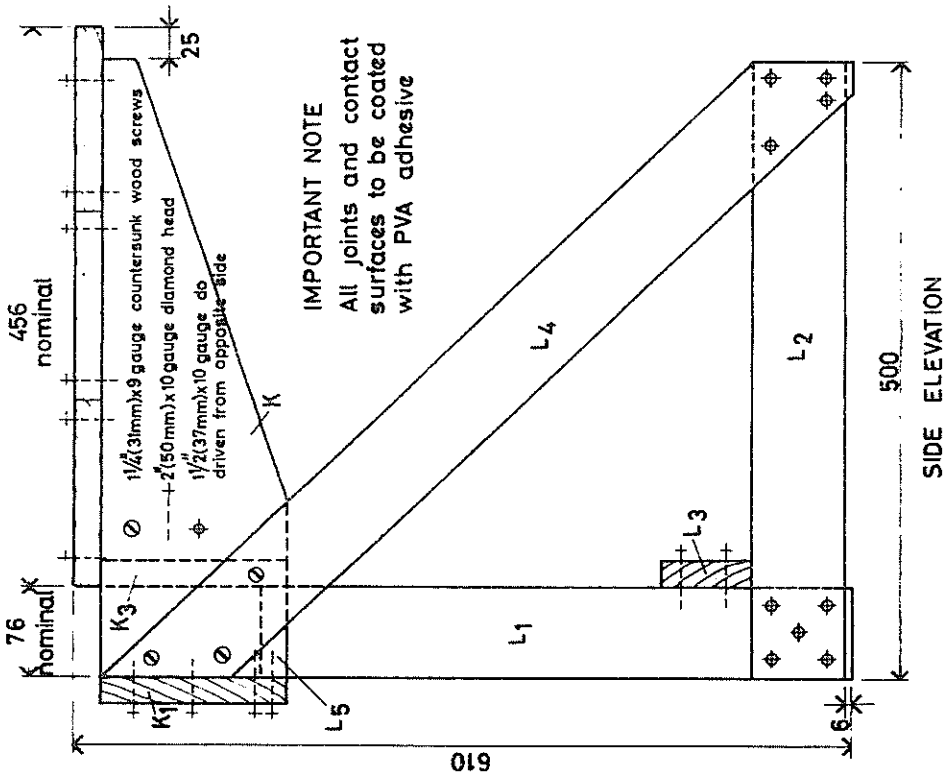
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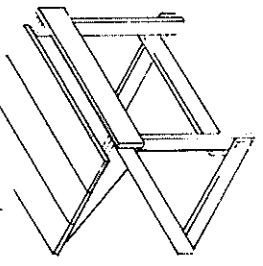
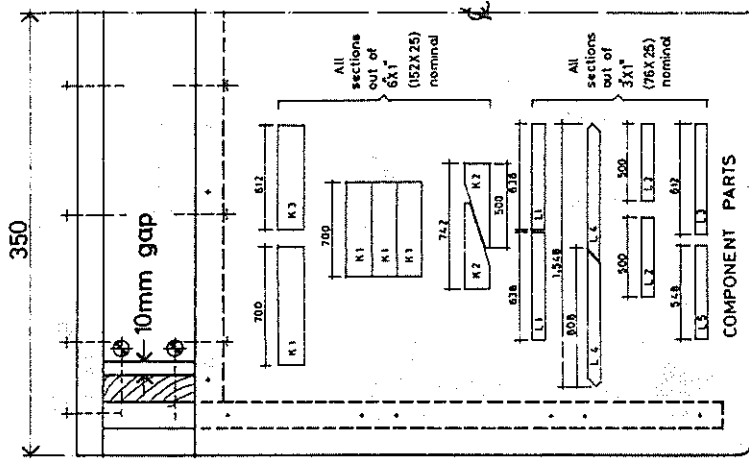


STUDENT DESK TYPE E (SINGLE)

Age group 13-16

HALF PLAN



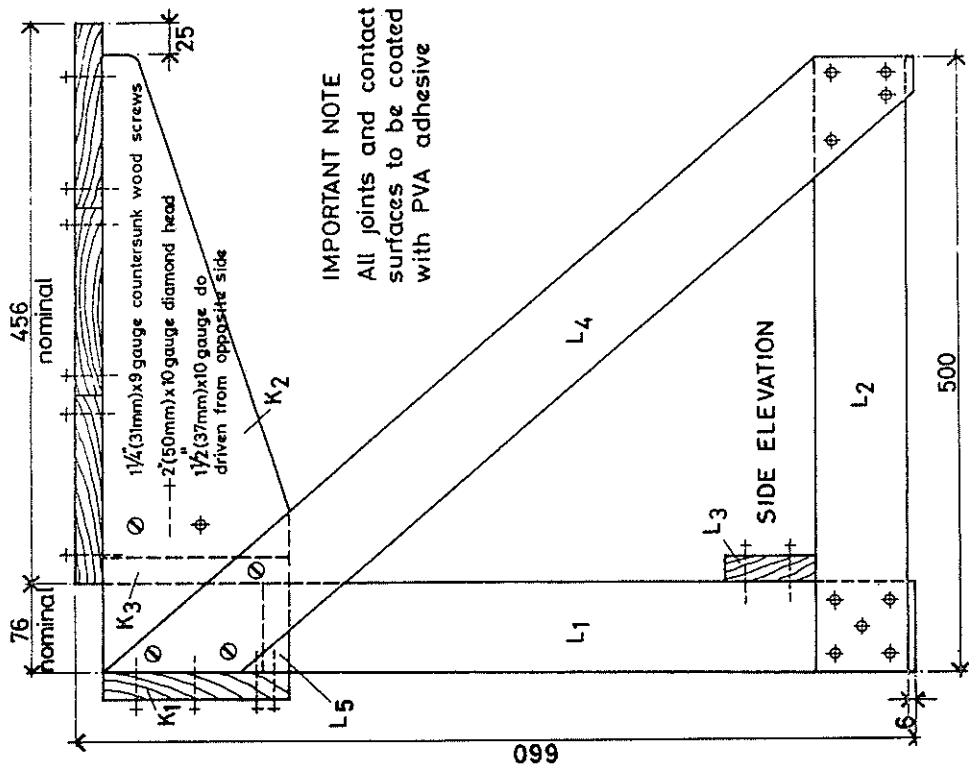


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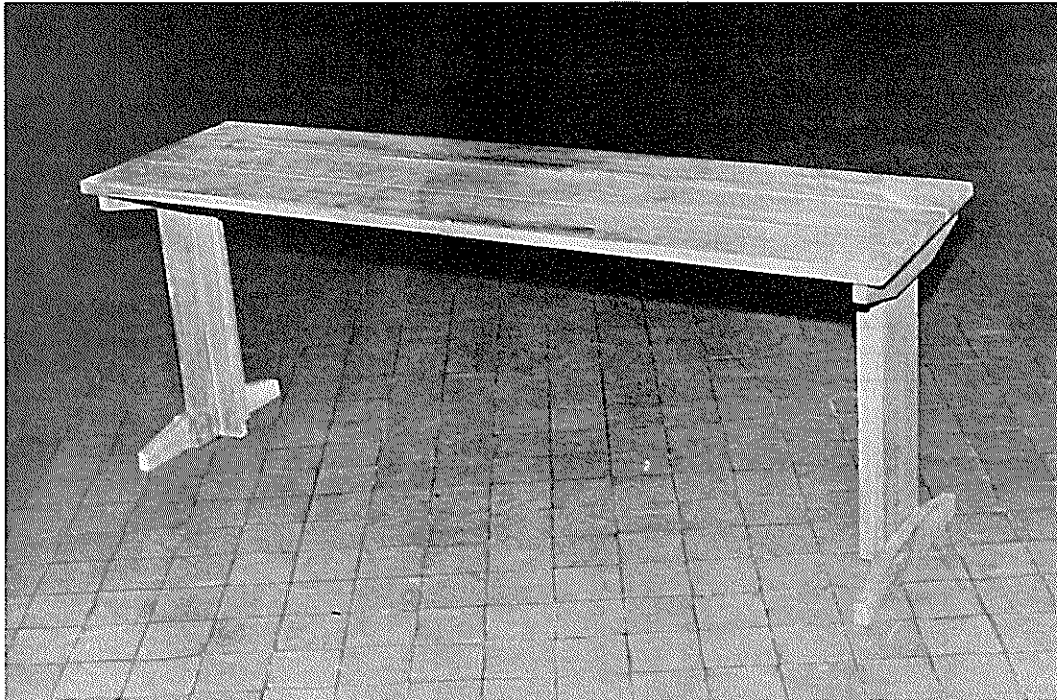
STUDENT DESK

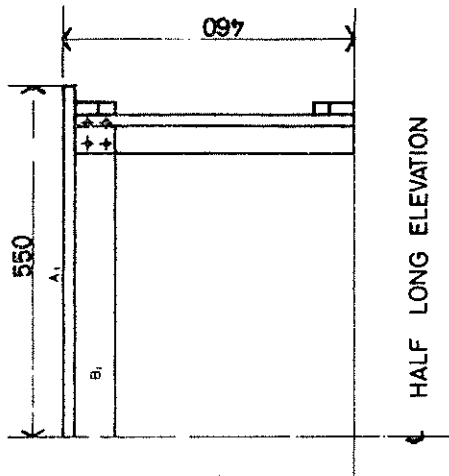
TYPE F (SINGLE)

Age group 16+ Adult

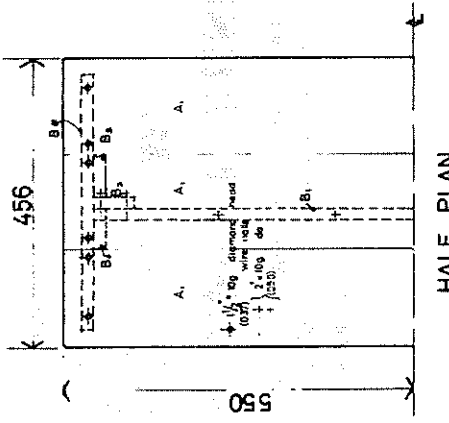


Double Desk Mark 1

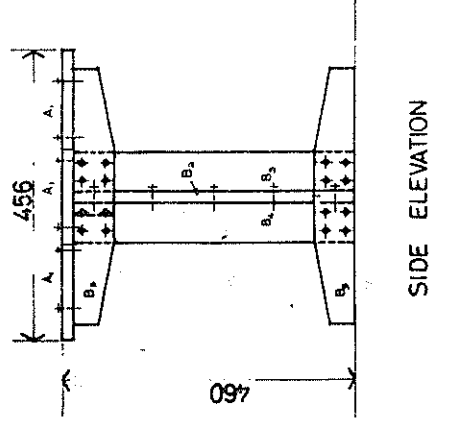




HALF LONG ELEVATION



HALF PLAN



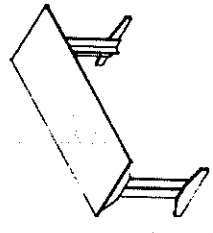
SIDE ELEVATION

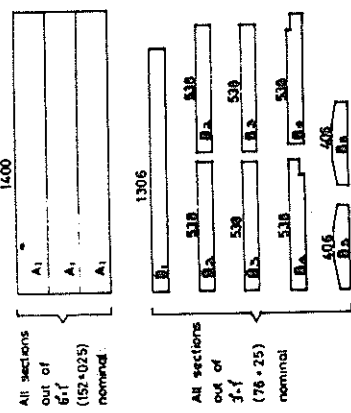
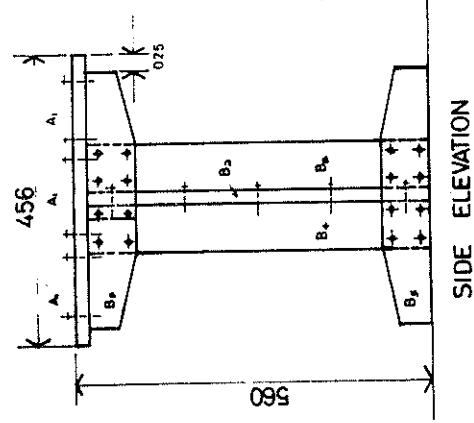
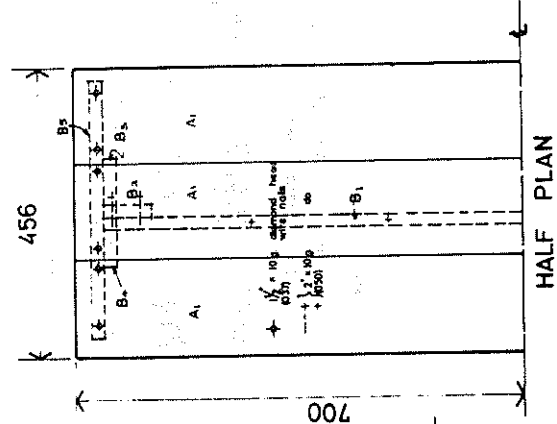
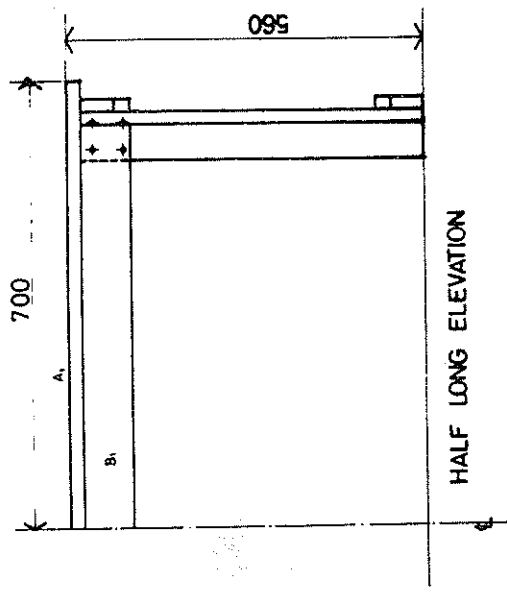
All sections out of 6:1 (182=025) nominal	A ₁	1100
	A ₁	
	A ₁	
All sections out of 2 1/2" x 1" (63x25) nominal	B ₁	1015
	B ₂	538
	B ₂	538
	B ₂	538
	B ₂	538
	B ₂	538
	B ₂	406
	B ₂	406

IMPORTANT NOTE
All joints and contact surfaces
to be coated with PVA adhesive

STUDENT DESK DOUBLE MK 1 TYPE B

AGE GROUP 6-9

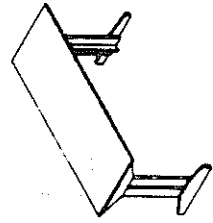


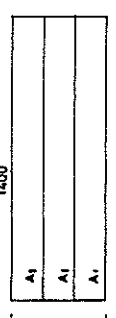
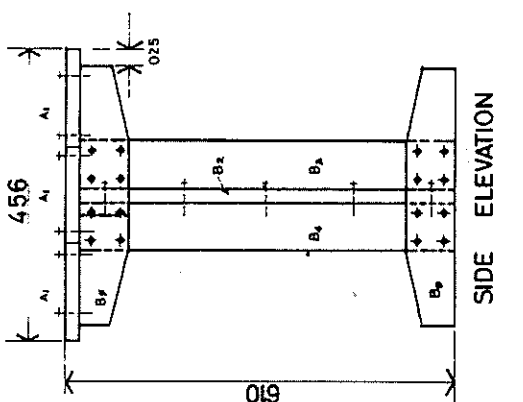
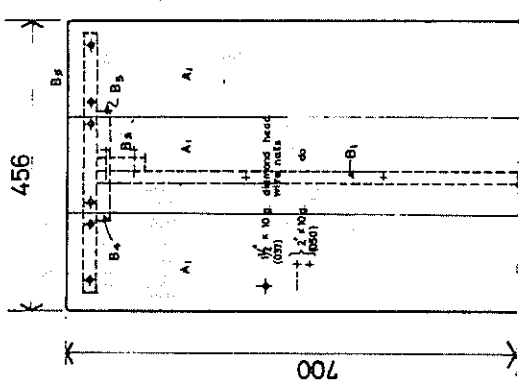
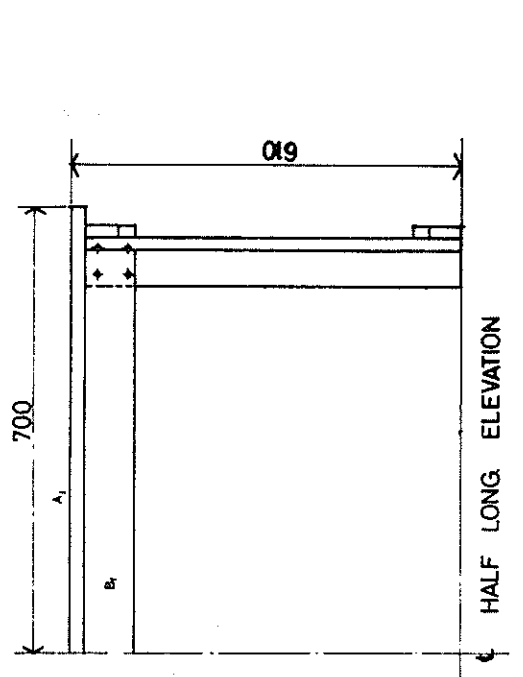


IMPORTANT NOTE
 All joints and contact surfaces to be coated with PVA adhesive

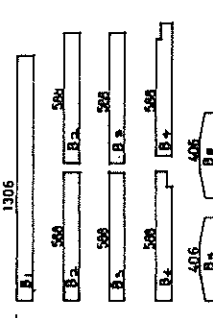
**STUDENT DESK
 DOUBLE MK 1
 TYPE D**

AGE GROUP 11-14





All sections
out of
6" x
78 x 0.25
nominal

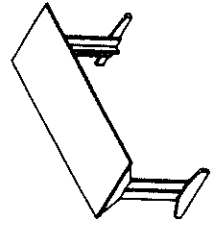


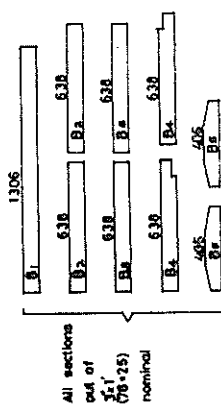
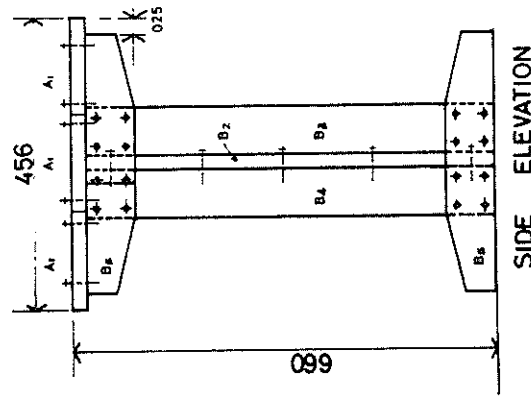
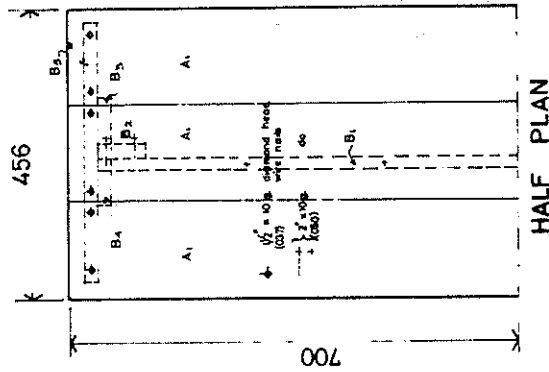
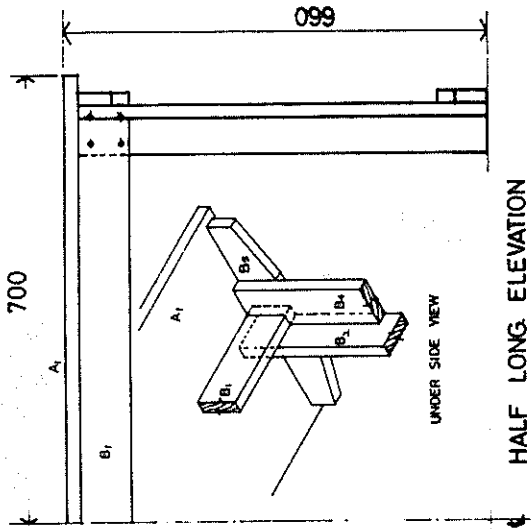
All sections
out of
3" x
78 x 2.5
nominal

IMPORTANT NOTE
All joints and contact surfaces
to be coated with PVA adhesive

STUDENT DESK DOUBLE MK 1 TYPE E

AGE GROUP 9-12



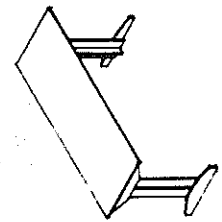


STUDENT DESK DOUBLE MK 1 TYPE F

AGE GROUP 16 + Adult

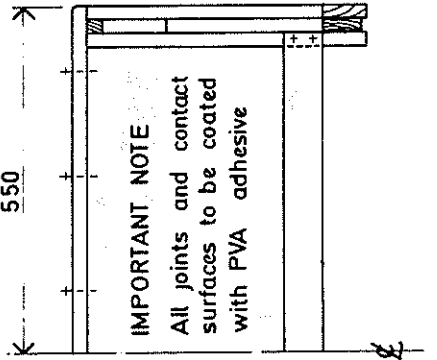
IMPORTANT NOTE

All joints and contact surfaces to be coated with PVA adhesive

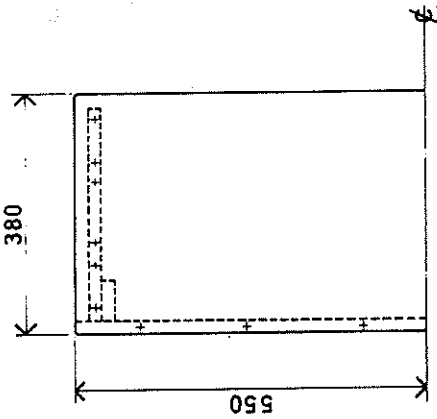


Double Desk Mark 2

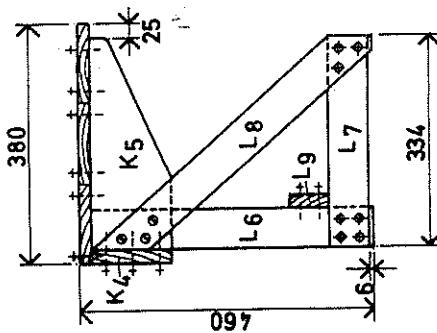




HALF ELEVATION

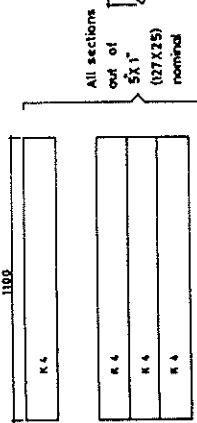
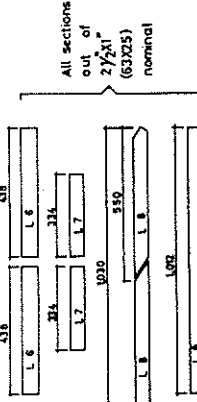


HALF PLAN



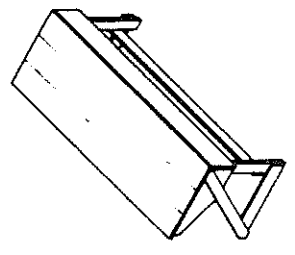
SIDE ELEVATION

- 1/4(31mm)x9 gauge countersunk wood screws
- + 2(50mm)x 10 gauge diamond head
- ◆ 1/4(37mm)x10 gauge do

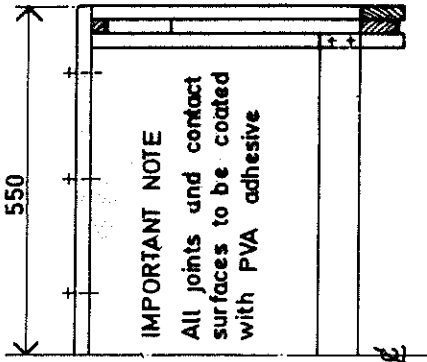


STUDENT DESK DOUBLE MK 2 TYPE B

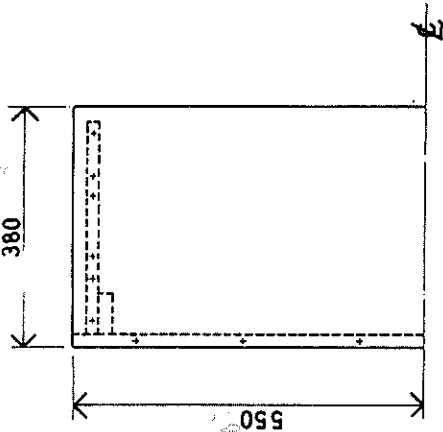
Age group 6-9



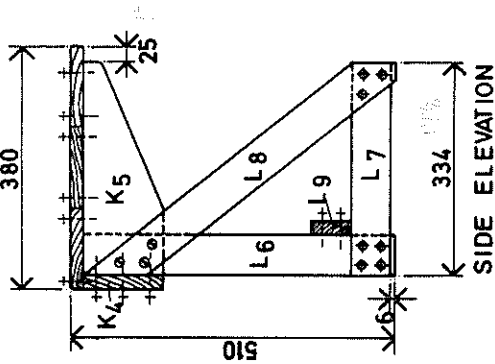
COMPONENT PARTS



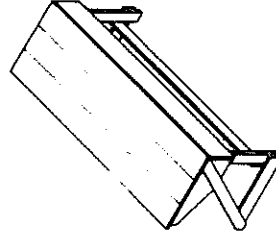
HALF ELEVATION



HALF PLAN

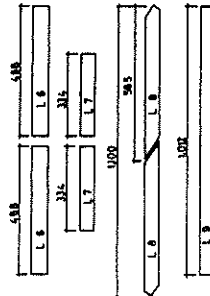


SIDE ELEVATION

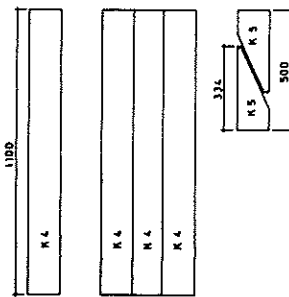


○ 1/4(3mm)x9 gauge countersunk wood screws
 ---+2(50mm)x10 gauge diamond head
 ◆ 1/4(37mm)x10 gauge do
 All sections out of 2 1/2" x 1" (63x25) nominal

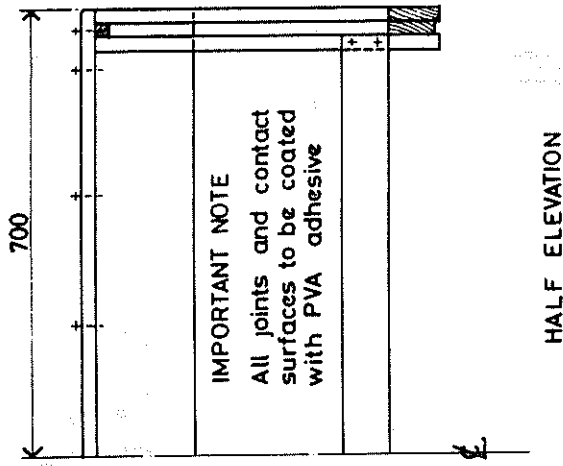
**STUDENT DESK
DOUBLE MK 2
TYPE C**
Age group 9-12



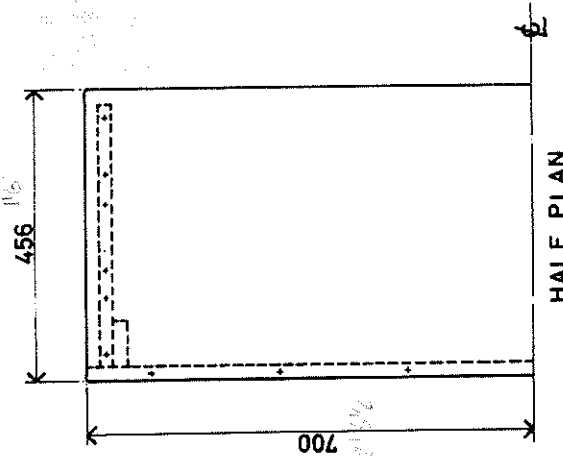
All sections out of 5" x 1" (127x25) nominal



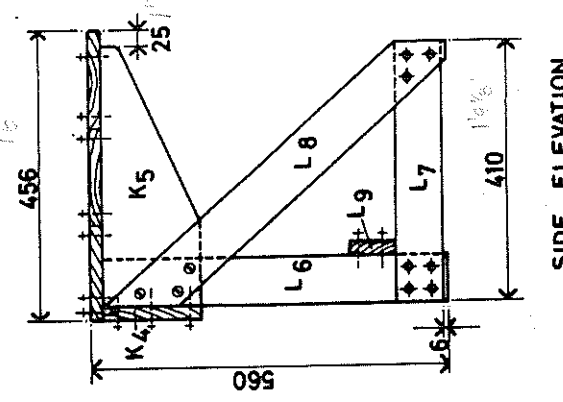
COMPONENT PARTS



HALF ELEVATION

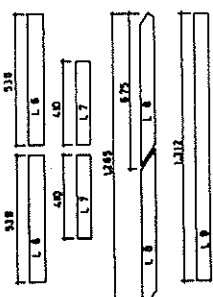


HALF PLAN

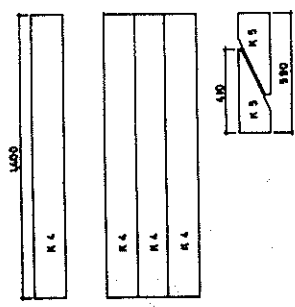


SIDE ELEVATION

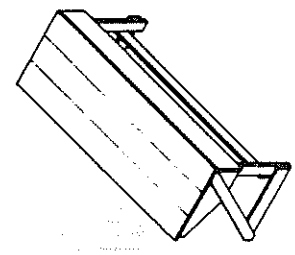
○ 1/4(31mm)x9 gauge countersunk wood screws
 --- 2(50mm)x10 gauge diamond head
 ⌀ 1/4(37mm)x10 gauge do
 All sections out of 3x1 nominal (76x25)



All sections out of 6"x1" nominal (152x25)

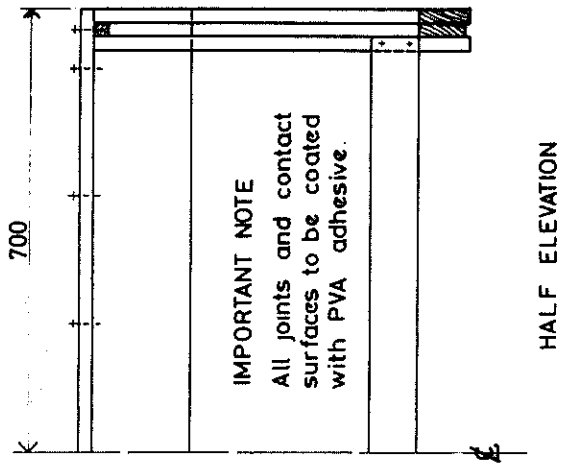


COMPONENT PARTS

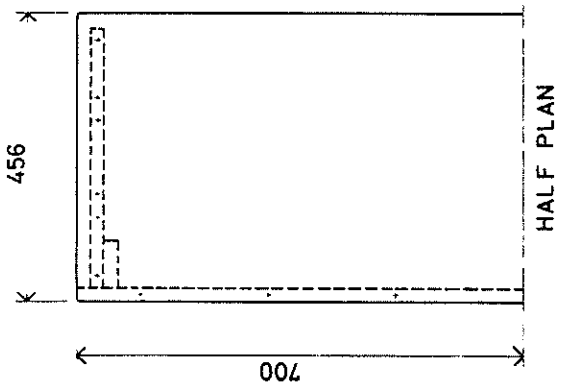


STUDENT DESK DOUBLE MK 2 TYPE 1D

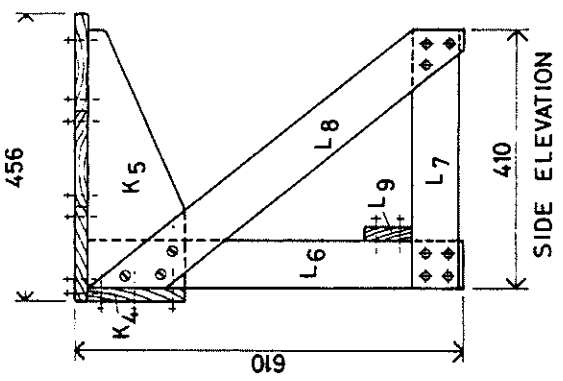
Age group 11-14



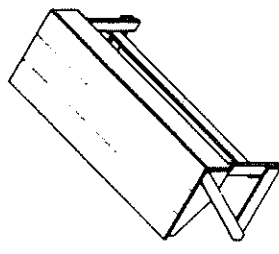
HALF ELEVATION



HALF PLAN



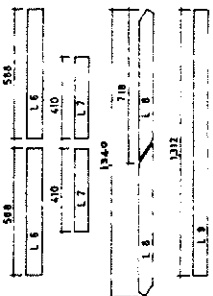
SIDE ELEVATION



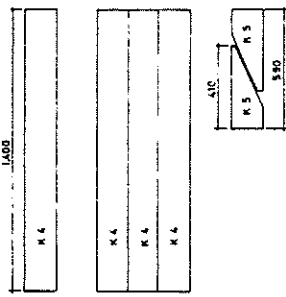
STUDENT DESK DOUBLE MK 2 TYPE E

Age group 13-16

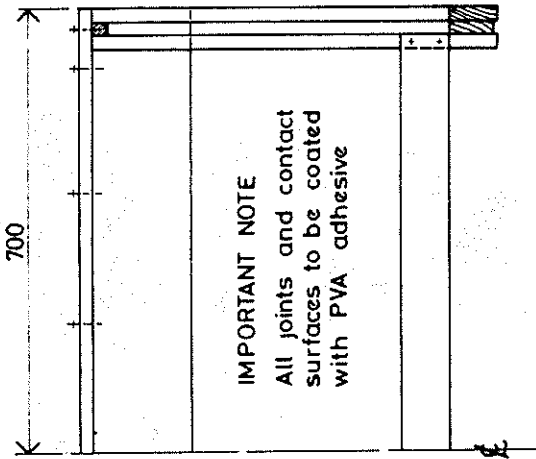
\varnothing $1\frac{1}{2}$ (31mm)x9 gauge countersunk wood screws
 \diamond 2 (50mm)x10 gauge diamond head
 \diamond $1\frac{1}{2}$ (37mm)x10 gauge do
 All sections out of 3X1 (76X25) nominal



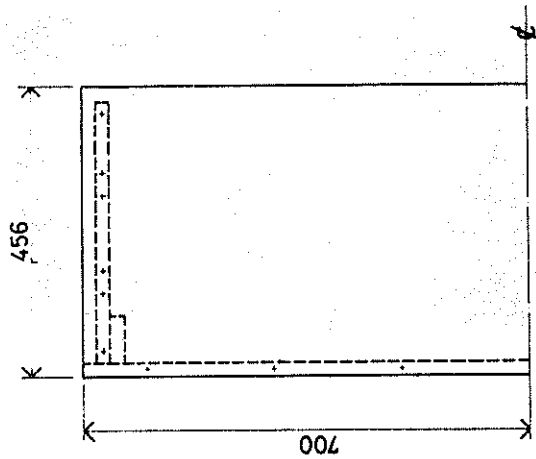
All sections out of 6"X 1" (152X25) nominal



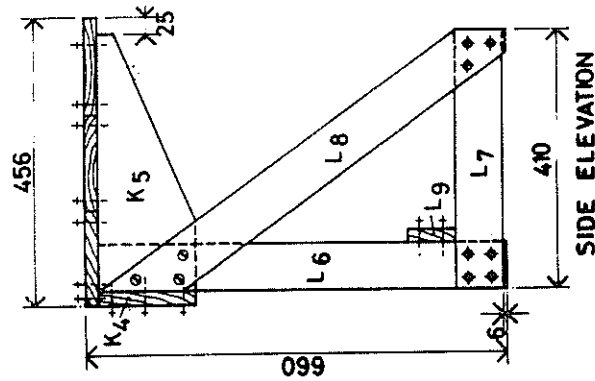
COMPONENT PARTS



HALF ELEVATION



HALF PLAN



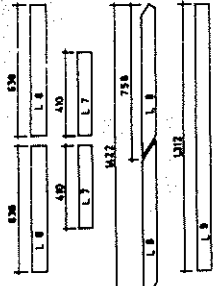
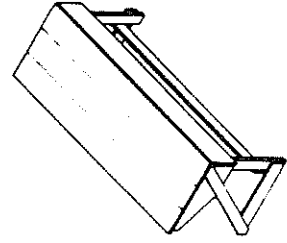
SIDE ELEVATION

\varnothing 1/4(31mm)x9 gauge countersunk wood screws
 ---+2(50mm)x 10 gauge diamond head
 ϕ 1/4(37mm)x10 gauge do
 driven from opposite side

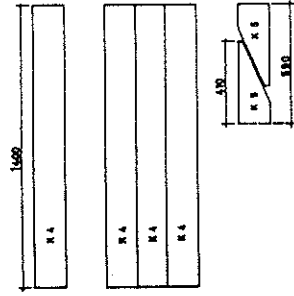
All sections
 out of
 3'x1'
 (76X25)
 nominal

STUDENT DESK DOUBLE MK 2 TYPE F

Age group 16 + Adult

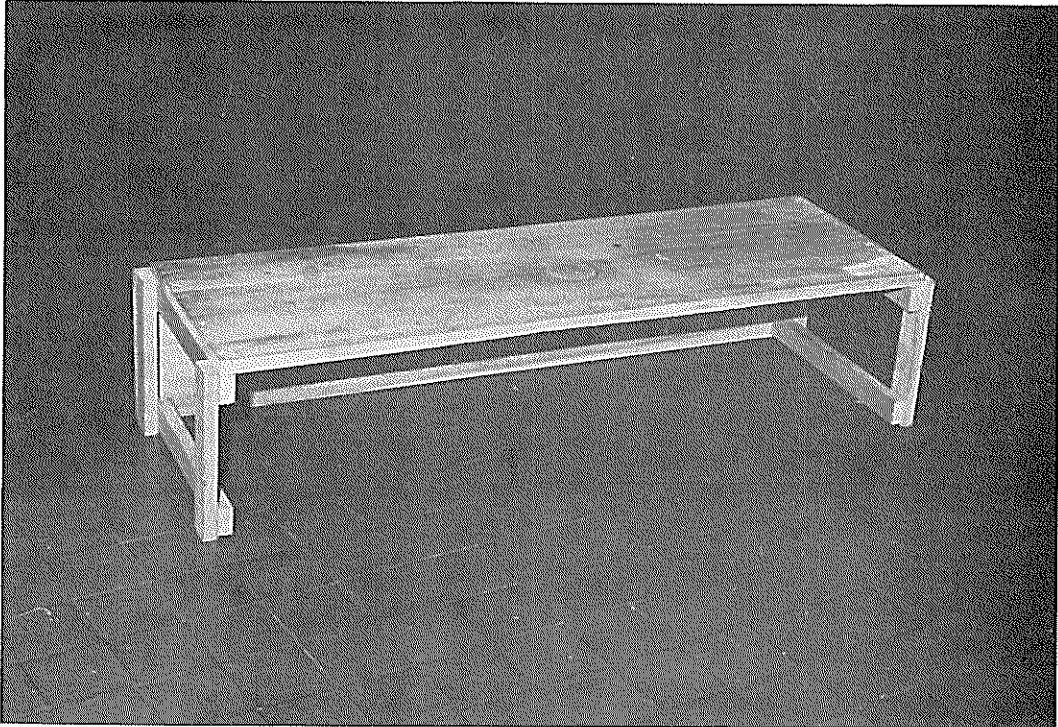


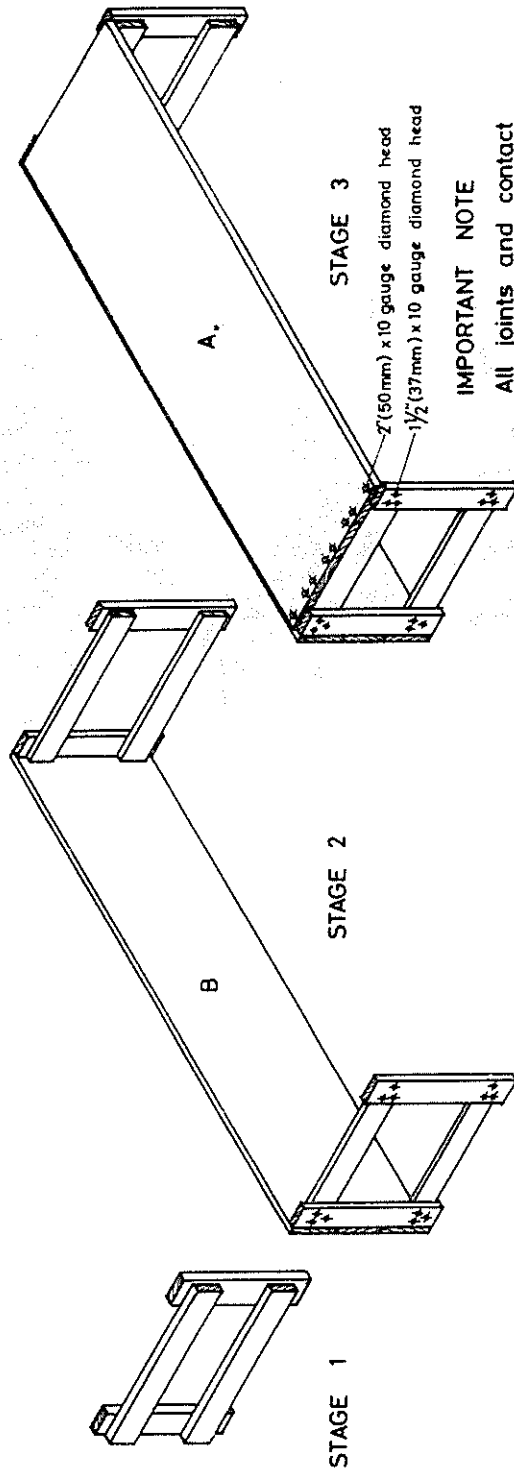
All sections
 out of
 6'x1'
 (152X25)
 nominal



COMPONENT PARTS

Squatting Table



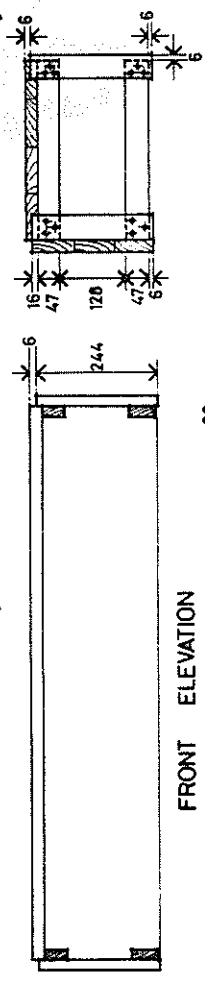


2'(50mm) x 10 gauge diamond head
 1/2'(37mm) x 10 gauge diamond head

IMPORTANT NOTE

All joints and contact surfaces to be coated with PVA adhesive

The top and side planks as shown A and B respectively in drawing to be in boards not exceeding 127mm (5") width
 All timbers 25mm nominal thick.



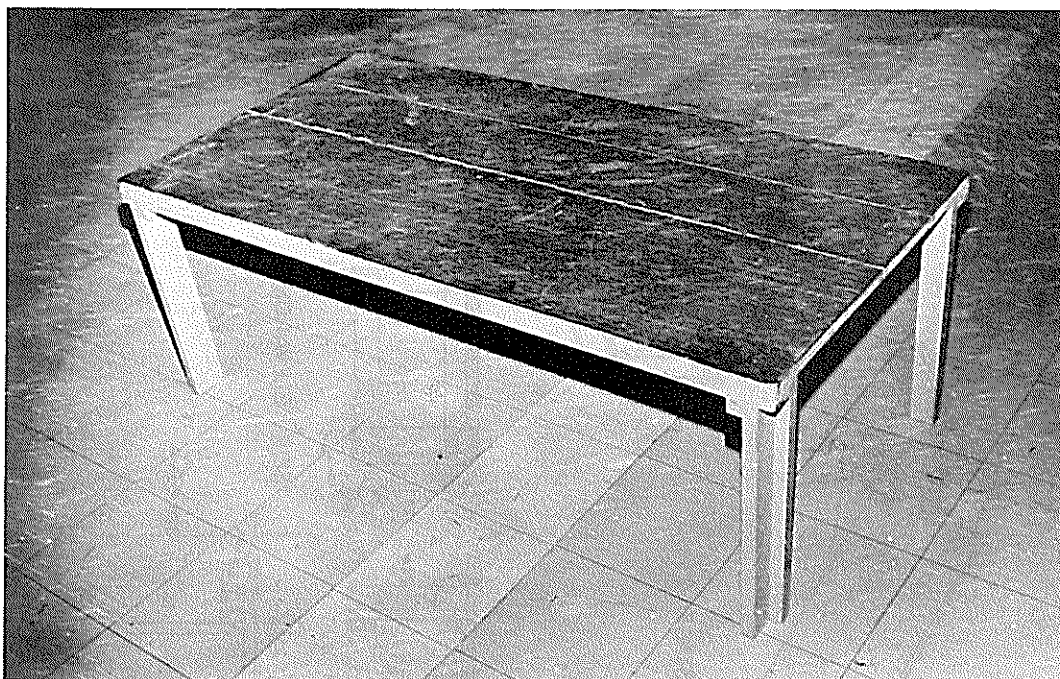
SIDE ELEVATION

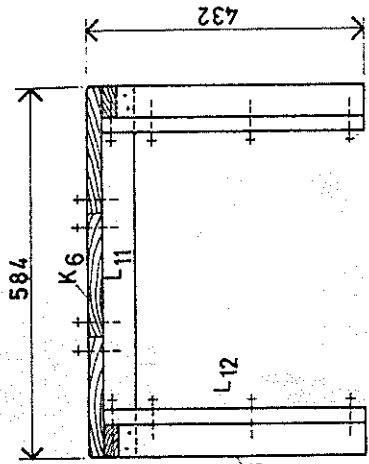
FRONT ELEVATION

SQUATTING TABLE

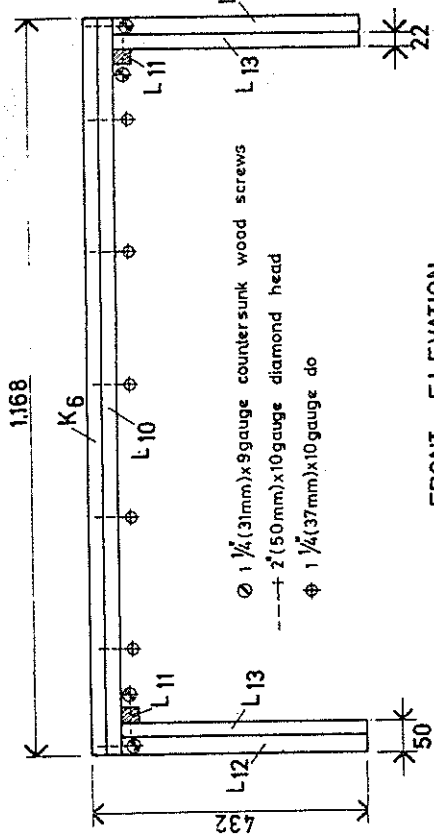
1100
 PLAN

6 Seater Table

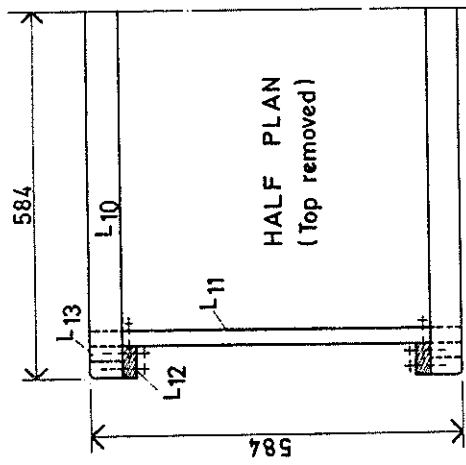




SIDE ELEVATION



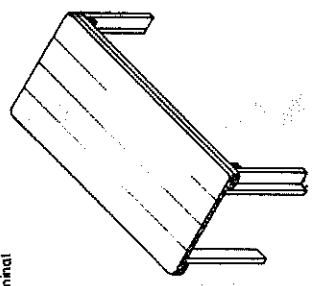
FRONT ELEVATION



HALF PLAN
(Top removed)

COMPONENT PARTS

1168	K 6	All sections out of 1168 nominal
1168	K 6	All sections out of 1168 nominal
584	K 6	All sections out of 584 nominal
584	K 6	All sections out of 584 nominal
50	L 10	All sections out of 50 nominal
50	L 10	All sections out of 50 nominal
432	L 12	All sections out of 432 nominal
432	L 12	All sections out of 432 nominal
432	L 13	All sections out of 432 nominal
432	L 13	All sections out of 432 nominal



6 SEATER TABLE

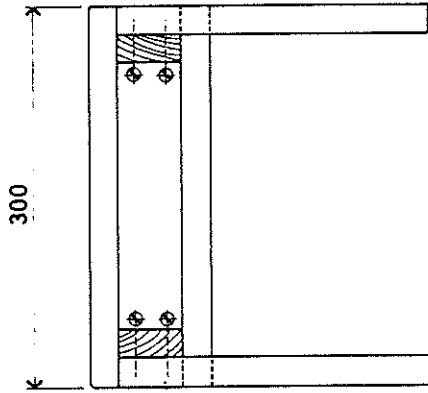
IMPORTANT NOTE
All joints and contact surfaces to be coated with PVA adhesive

Grade 1 (Primary)

Age group 6 & below

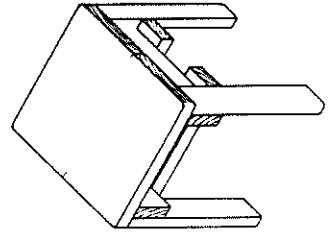
Stools for 6 Seater Table





FRONT ELEVATION

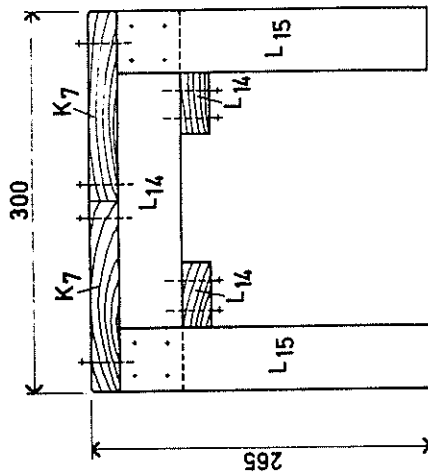
Ø 1/4(31mm)x9 gauge countersunk wood screws
 ---+---+Z(50mm)x 10 gauge diamond head



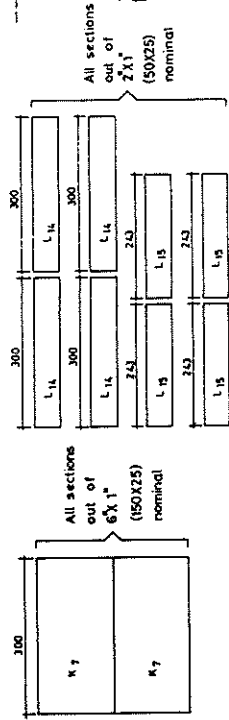
STOOL FOR 6 SEATER TABLE

Grade 1 (Primary)
 Age group 6 & below

IMPORTANT NOTE
 All joints and contact
 surfaces to be coated
 with PVA adhesive



SIDE ELEVATION



COMPONENT PARTS