DESIGN AND FABRICATION OF AN EDGE - CUTTING MACHINE FOR TILES AT VPG HONING INDUSTRIES LTD.,

A PROJECT REPORT
SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF

BACHELOR OF ENGINEERING
IN
MECHANICAL ENGINEERING

By
N. SIVAKUMAR
S. KUMAR
T. SARAVANAN

GUIDED BY
Mr. D. KARTHIKAYEAN B.E., M.B.A., M.I.S.T.E.

DEPARTMENT OF MECHANICAL ENGINEERING
Kumaraguru College Of Technology
Coimbatore - 641 006.

1991

DEPARTMENT OF MECHANICAL ENGINEERING

Kumaraguru College of Technology

COIMBATORE-641 006

CERTIFICATE

This is certify that the report entitled

"DESIGN AND FABRICATION OF AN EDGE-CUTTING MACHINE FOR TILES"

has been submitted by

Mr. ....

in partial fulfilment for the award of Bachelor of Engineering in the

"MECHANICAL ENGINEERING"

branch of the Bharathiar University, Coimbatore

during the academic year 1990-91

22/x/91

Guide

Head of the Department

Certified that the canditate was examined by us in the project work viva-voce examination held on .... and the university register number was ____________________

Internal Examiner

External Examiner

TNGST No 230341 dt 21-7-75
C S T No. 299775 dt 21-7-75

V P G HONING INDUSTRIES

PHONE: 74356

A. S. VARADHARAJAN
BE MSc (Engg) MIE
PROPRIETOR

7/7A, Avanashi Road Chinniampalayam Coimbatore-641 062

DATE: 91.02.18.

C E R T I F I C A T E

This is to certify that the following students

1) Mr. N. SIVAKUMAR
2) Mr. S. KUMAR
3) Mr. T. SARAVANAN

Final year B.E. (Mechanical) of Kumaraguru College of Technology, had done their project on "DESIGN AND FABRICATION OF EDGE CUTTING MACHINE FOR TILES" under the sponsorship and guidance of our firm during the year 1990-91. They have completed the project successfully. They have taken sincere efforts and shown keen interest in completing the above project. We wish them success in all their future endeavour.

PROPRIETOR.

ACKNOWLEDGEMENT

We wish to record our immense appreciation and deep felt gratitude to **Mr.A.S.VARADHARAJAN,B.E., M.Sc.(Engg).,** M.I.E.,Proprietor, V.P.G. HONING INDUSTRIES LTD., for permitting us to undertake this project for their industry and allowing us to collect relevant data and use their machinery.

We accord ourselves the privilege of thanking **Mr.D.KARTHIKEYAN,B.E.,M.B.A.,M.I.S.T.E.,** for his valuable suggestions, encouragement and interest in this project. We consider our association with him as a most rewarding experience.

We express our thanks to Prof. **ALI UDDIN ANSARI, M.E.,Ph.D.,** Head of the MECHANICAL ENGINEERING DEPARTMENT for the facilities provided.

We are extremely grateful to our principal **Prof.P. PALANIVELU, B.E.,M.Sc.(Engg), F.I.E., M.I.S.T.E., M.I.S., P.R.S.,** whose keen and sustained interest in the project has been a moral boost to us.

We thank all the staff members of Mechanical Engineering Department for their valuable suggestions.

CONTENTS

SYNOPSIS

The aim of the project is to design and fabricate a cutting machine for the purpose of cutting the edges of tiles upto 25mm thickness.

Presently the edge cutting of **tiles** is carried out by machines which are operated manually. The depth of cut, feed and cutter speed are monitored manually. Present means of clamping the tiles is a major problem and are not satisfactory. Hence in case of range scale production of standard dimensioned tiles, time consumption is high and finishing is not good.

Under these circumstances, we were offered the project of designing this machine by V.P.G HONING INDUSTRIES LTD. In this machine the clamping is done by pneumatic cylinders of stroke length 10mm which are mounted on M.S.Plate above the bed. The cutter remains stationary and the table is moved by a hydraulic cylinder for a stroke length of 900mm. The cutter is rotated by means of a 5.5 KW electric motor through belt drive. The table moves on dove tailed guideways. The machine is quite compact and simple in arrangement. The pneumatic and hydraulic cylinders are controlled by limit switches thus automating the machine.

INTRODUCTION

The progress in technical field extends the scope of application of tiles. Tiles are primarily used for floor decoration and in exterior building construction. In order to meet the increasing demand, it was not only necessary to rationalize the production of tiles but also to increase the production of tiles eliminating the errors due to human intervention.

ABOUT THE MATERIAL TO BE CUT

Tiles are stone slabs which occur naturally as composite of minerals. Tiles play a major role in construction due to their strength, durability, architectural adoptability and aesthetic satisfaction. There are two principal branches of natural-stone industry. Dimension stone and crushed stone. We are concerned with dimension stones. Dimension stones are blocks (or) slabs of stone processed to specifications of size, shape and surface finish. The largest volume today lies in the use of slabs varying from 1 to 4 inches in thickness.

Natural stones are composed of tightly interlocking crystals of one (or) more minerals and sedimentary rocks composed of cemented mineral grains in which the cement may (or) may not be of the same compositions.

The major groups of natural stones are

GRANITE

A visibly crystalline rock made of silicate minerals, primarily feldspar and quartz. Commercially granite refers to all stones geologically defined as plutonic, igneous and gneissic.

MARBLE

A generally visible crystalline carbonate rock. However microcrystalline rocks such as onyx, travertine, and serpentine are usually included by the trade as long as they can take a polish.

LIME STONE

A sedimentary rock composed of calcium or magnesium carbonate grains in a carbonate mix.

SAND STONE

A sedimentary rock composed chiefly of cemented sand - sired quartz grains. In the trade, quartzites are usually grouped with sand stones, although these rocks tend to fracture through, rather than round the grains.

SLATE

A fine grained rock characterized by marked cleavages by which the rock can be split easily into relatively thin slabs. Slate is used for roofing tiles.

ABOUT THE CUTTING MATERIAL

Diamond impregnated steel segments are used as cutting material. These segments are joined around a steel blank. The number of segments around the circular cutter depends upon the diameter of the cutter. Diamond, because of its high modulus of elasticity, chemical inertness and exceptionally high hardness, is idle for obtaining fine surface finish and accuracy. Polycrystalline diamond of minimum thickness 0.5mm is bonded to a tungsten carbide substrate. These segments are brazed around a steel blank. Cutting speeds for diamond should be as high as possible, the speed being limited by the on set of vibrations. Feeds should be low in the order of 0.02 to 0.1 mm/sec.

PRESENT TREND

The machine is similar to hand milling machine. The arbor which houses the spindle is fixed horizontally to a vertical column. The drive to the spindle is given at one of its end through belt drive. The cutter is connected to the another end of the shaft. Only one edge of the tile is sawed at a time. The bed is momented on two rails by connecting wheels at the four ends of the bed. The bed is moved manually. In some cases lead screw arrangements is used for moving the bed.

INNOVATION

Both the edges of the tile is sawed using double cutter. The cutter is mounted on both sides of the arbor. The distance between the cutter can be varried from 300mm to 450mm. The drive is given at the centre of the spindle. The bed is moved on dove tailed guide ways by a hydraulic cylinder having a stroke length of 900mm. The feed is controlled using a flow control valve. Tile is clamped by pneumatic cylinder of stroke length 20mm. The pneumatic and hydraulic cylinders are operated using limit switches. Thus we have automated the machine by achieving higher degree of mechanization in which human labour is replaced by mechanical and electrical means.

ADVANTAGES

i) The processing operations required for a tile becomes faster and thereby a large number of pieces can be worked in a shorter time thus increasing the productivity.

ii) The sawing of the tile edges is completed in one pass.

iii) The cutting operations are done uniformly and effectively which results in better accuracy and finish.

iv) Vibration of the machine is reduced by using channels for main beam and columns. The machine is mounted on a concrete bed.

v) Eliminates human error.

DESCRIPTION

The machine is simple in construction and involves minimum number of parts. The main beam which holds the arbor at its centre is mounted on two vertical supporting columns. Each column is made of two channels welded together facing each other. The top and bottom portions are closed with mild steel plate. Ribs are welded to the bottom of the supporting column to hold it rigidly.

The motor is mounted on the main beam so that the motor pulley lies above the centre of the beam. The arbor is fixed to the main beam at its centre by bolts. The spindle is held in its position inside the arbor with the help of bearings. Lock nuts and oil seals are provided to hold the bearing and stop oil leakage.

The cutters are mounted at the two sides of the arbor on the spindle. The cutters are held rigidly by placing flanges on both sides of the cutter and tightening them by castle nuts which are threaded to the ends of the shaft. Water is used as coolent and its sprayed on the edges of the cutter by steel pipes welded to the cutter cover.

The table is moved on dove tailed guideways. A mild steel plate of dimensions 750 x 110 x 15mm is bend at both the ends and fixed to the table by bolts. Pneumatic cylinders are fitted on the M.S.Plate so that the piston movement is vertical.

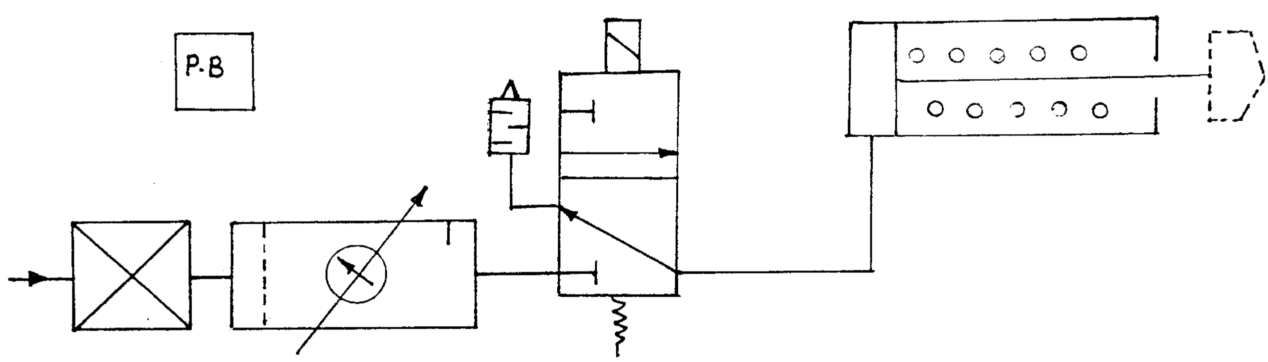
The guideways are fixed to stationary bed by counter sink bolts. The stationary bed is placed on a concrete bed.

OPERATION

Initially the tile is placed on the table so that the length of the tile is parallel to table movement. When the push button is pressed, the three pneumatic cylinders. Clamp the tile rigidly. Now the directional control valve of the hydraulic cylinder is activated from its neutral position. The fluid passes into the head end chamber of the cylinder thus moving the table. Simultaneously the motor is on and the cutters rotate through belt drive. As the tile comes in contact with the cutter edge, the material at that portion of the tile is sheared off. The maximum depth of cut is 25mm. The feed is controlled by a flow control valve which depends on the depth of cut. Once the edges of tiles is sawed completely, the direction of fluid flow into the hydraulic cylinder is changed thus retracking the path. The speed of retraction is about 8 times the speed of working stroke. As the retraction of the table is completed the pneumatic cylinders are deactivated thus unclamping the tile. Now the finished tile is removed from the table. The machine is ready for the next cycle.

THE PNEUMATIC CLAMPING SYSTEM

The system comprises of a circuit which has three cylinders mounted above the table. They are controlled by directional control valve operated by a push button. The operating pressure is about 4 bar. The cylinders are single acting spring return. The connections are made as shown below

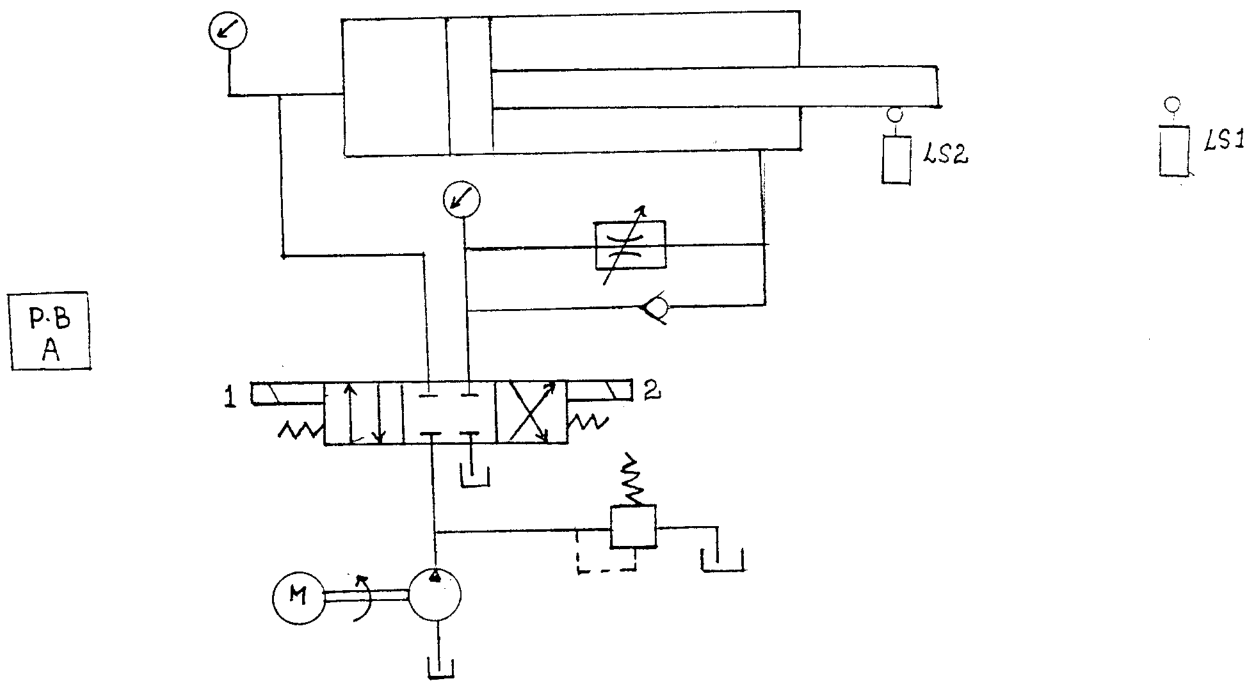


Pressing the push button A, the directional Control Valve is activated which makes the air flow from the power pack to the cap end of the cylinders.

The piston of the cylinder extends thus clamping the tile at three points. Rubber pads are attached to the end of piston rod. Thus the clamping force is applied on a larger area effectively. When cutting operation is completed and when the table occupies its original position, the directional Control Valve is deactivated thus letting the air from the cap end of the cylinders to be vented. This operation unclamps the finished tile.

HYDRAULIC TABLE MOVEMENT SYSTEM

The system comprises of a meter - out circuit. A double acting cylinder is used to move the table. The power pack of the hydraulic circuit consists of a unidirectional, fixed displacement pump coupled with a unidirectional motor. A three position, four connection, solenoid operated, directional Control Valve is included in the circuit at the tank line A flow Control Valve and a check valve are connected to the rod end chamber of the cylinder. The flow Control Valve maintains the desired pressure across the orifice and provides resistance to flow. The maximum allowable system pressure (which occurs at maximum negative load) limits the forward. pressure, thus limiting the capacity of the machine. The operating pressure is about 20 Kg/cm^2. A Check Valve is provided for a return flow around the Valve in the circuit. The circuit diagram is shown below.



Pressing push button A, solenoid 1 of the directional Control Valve is activated, which allows the fluid to the cap end of the cylinder. The flow Control Valve installed in the rod end chamber of the cylinder line limits the fluid flow through it

NOMENCLATURE

MAIN BEAM & SUPPORTING COLUMN

R_A, R_B	Reaction force on supporting column, Kg.
Z	Section modulus, cm^3
M	Max. bending moment, Kg-mm
f_y	Max. yield stress N/mm^2
Bending, σ_b	Permissible bending stress, N/mm^2
L	Length of the column
W	Total load, Kg.

SHAFT

M	Bending moment, Kg-m
T	Twisting moment, Kg-m
N	Speed of the shaft, rpm.
P	Power transmitted, H.P.
w	Total load acting on the shaft, Kg
f_s	Static shear strength, Kg/cm^2
f_b	Static bending strength, Kg/cm^2
$f_b(max)$	Maximum bending strength, Kg/cm^2
K_m	Combined shock and fatigue factor for bending
K_t	Combined shcok and fatigue factor for torsion
d	Diameter of the shaft mm.

NOMEN CLATURE

BEARING

C	- Basic dynamic load rating Kgf.
C_o	- Basic static load rating Kgf
E	- Diameter of outer ring raceway, mm
f_a	- Factor for nature of loading
f_b	- Factor for bearing internal dimensions
F_a	- Actual axial load, Kgf
$F_{q\ max}$	- Maximum permissible axial load, kgf.
F_r	- Actual radial load Kgf
L	- Nominal life, millions of revolutions
L_h	- Nominal life, hours
h	- Rotational speed
P	- Equivalent dynamic bearing load Kgf
P_o	- Equivalent static bearing load Kgf
X	- Radial factor for dynamic load
Y	- Axial factor for dynamic load
D_w	- Rolling element diameter,mm
F_a	- Axial load, Kgf
F_r	- Radial load, Kgf

V - BELT

C	- Centre distance, mm
d	- Pitch diameter of smaller pulley, mm
D	- Pitch diameter of larger pulley, mm

F_a - Correction factor according to services

F_c - Correction factor for arc of contact

i - Speed ratio

K_w - Rating of V belts, Kw taking into account additional power per belt for given speed ratio.

L - Pitch length of the belt, mm

n - Rotational speed of low speed shaft, rpm

N - Rotational speed of high speed shaft, rpm

N_b - Number of Belts

P_t - Power to be transmitted, Kw

V - Velocity of the belt, m/sec

θ - Arc of contact, degrees

FORCE ANALYSIS

FROM MARKS HAND BOOK FOR MECHANICAL ENGINEERS

Shear strength of the tiles $= 2.5 \times 10^2$ Psi

$= 2.5 \times 10^2 \times 0.070307$

$= \underline{\underline{17.58\ Kg/cm^2}}$

Shear strength $= \frac{\text{Shear force}}{\text{Shear area}}$

Depth of cut E $=$ 2.5cm

Cutting edge thickness $=$ 0.28 m

$17.58 = \frac{\text{Shear force}}{2.5 \times 0.28}$

Shear force $= \underline{\underline{12.304}}$ Kgf

Torque required $=$ Shear force x radius of cutter

$= 12.304 \times 0.15$

$= \underline{\underline{1.846}}$ kg-m

Since two cutter are used

Total torque required $= 1.846 \times 2 = \underline{\underline{3.692}}$ kgm

Required motor power $= \frac{2\pi NT}{4500} = \frac{2\pi \times 1440 \times 3.692}{4500}$

$= 7.4$ Hp $\simeq$ 7.5 HP

Motor power $= \underline{\underline{5.5}}$ Kw

Material to be machined : TILES

Operation : SLAB MILLING

Cutting Tool material : DIAMOND IMPREGNATED STEEL SEGMENTS

Spindle material : EN8

FROM CMTI HAND BOOK

Tangential cutting force component = $\frac{19.5 \times 10^{6}\,kw}{D_2 n}$

Diameter of the cutter (D_2) = 300mm

Power transmitted to the spindle(kw) = 5.5 kw

R.P.M. of the spindle(n) = 1910 R.P.M.

$\therefore$ Tangential cutting force (P_z) = $\frac{19.5 \times 10^{6} \times 5.5}{300 \times 1910}$

= 187.2 N

Axial component = $0.15 \times P_z$

= 0.15×187.2

= 28.08 N

Radial component = $0.55 \times P_z$

= 0.55×187.2

= 103 N

Turning moment due to tangential cutting force M_t = $\frac{187.2 \times 0.300}{2}$

= 28.1 N-m.

DESIGN

Design of an engineering product is made with the intention of manufacturing it economically. In many cases empirical equations based on experimental results have been used. In some cases, slight modifications have been necessary for the ease of fabrication. The factors like assembly of various parts, replacement of worm parts, allowance for wear, precision for lubrication etc have been considered. While designing the machine. The following parts of the machine have been designed.

DESIGN OF MAIN BEAM

DESIGN OF SUPPORTING COLUMN

DESIGN OF SHAFT

DESIGN OF V-BELT

DESIGN OF BEARING

DESIGN OF BOLTS

DESIGN OF PNEUMATIC ELEMETNS

DESIGN OF HYDRAULIC ELEMENTS

SELECTION OF OIL SEALS, LOCK NUT, HOUSING CAP

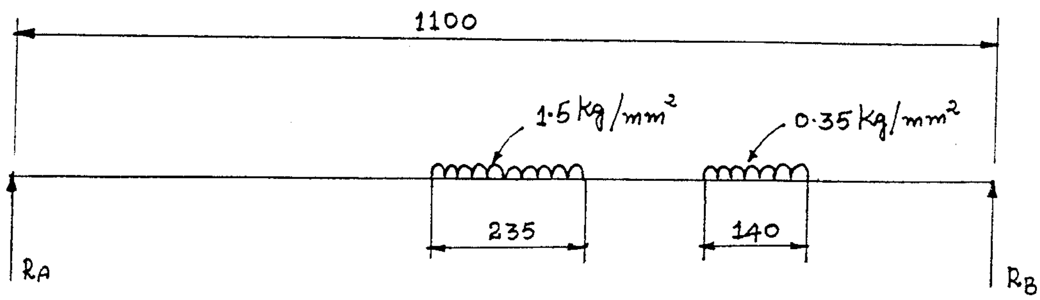
SELECTION OF DOVETAILED GUIDEWAYS.

DESIGN OF MAIN BEAM

Main beam is made up of a single channel supported at both the ends by columns. The various forces acting on the beam is shown below.

The weight of the arbor, shaft, cutter, directly act upon the centre of the beam. The cutting force and twisting moment due to motor drive also acts on the beam.

The beam has to withstand the force acted upon due to the movement of the stone against the cutter. The following free body diagram shows the various forces acting on the beam.



Reaction, R_A = 1.5 x 235 x 550 + 0.35 x 140 x 341/1100

R_A = 178 Kg

$R_A + R_B$ = 15 x 23.5 + 3.5 x 14

R_B = 401.5 - 178 = 223.5 Kg.

Moment at E = 178 x 432.5/2 = 38492.5 kg-mm

Moment at C = 178 x 550 - 1.5 (117.5 x 117.5/2)

= 87598.12 Kg-mm

Moment at G = 223.5 x 441

= 91653 Kg-mm

Moment at H = 223.5 x 341 - 0.35 x 70 x 70/2

= 75356 Kg-mm.

Maximum bending moment is at G,

M = 91653 Kg-mm

Taking factor of safety = 3

Therefore M = 274959 Kg-mm

Permissible bending stress = $\overline{\sigma}_b$ = 0.66 f_y

Yield stress of rolled steel, f_y = 250 N/mm^2

σ_b = 165 N/mm^2

Required section modulus, Z = $\frac{M}{\sigma_b} = \frac{2.8 \times 10^5 \times 10}{165}$

Z = 16.97 cm^3

Since the width of the arbor is 135mm. We select ISLC 150 so that the arbor may be fixed to the channel rigidly.

Allowable section modulus = 92.9 cm^3

92.9 cm^3 > 16.97 m^3

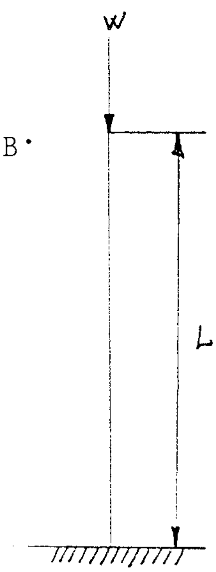
Hence design is safe.

From IS steel structural code book we select ISLC 150.

DESIGN OF SUPPORTING COLUMNS

The columns are also made by two channels facing each other.

$$R_B > R_A$$



Hence design of vertical channel section for R_B.

Total load acting on the channel W = 223.5 Kg

Maximum bending moment M = WL

= 223.5 x 700

= 1.56×10^5 Kg-mm

Yield stress of rolled steel f_y = 250 N/mm^2

Permissible bending stress, $_b$ = 0.66 f_y

= 0.66 x 250

= 165 N/mm^2

Required section modulus, Z req.= M/ b = $\frac{1.5 \quad x\ 10\ x\ 10}{1 \quad 5}$

= 9.07 cm^3

Taking factor of safety

Design section modulus Z = 37.2 cm^3

From IS steel structures code book we select ISLC 100.

CALCULATION FOR STABILITY IN BUCKLING

From RANKINES FORMULA FOR BUCKLING

$$P_{cr} = \frac{F_c A}{1+\alpha\ (L/K)^2}$$

P_{cr} - Crippling load

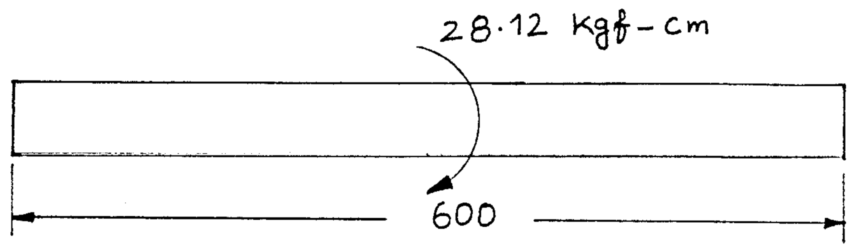
DESIGN OF SHAFT

The cutter can be placed at 150mm and 225mm from the centre of the spindle. We design the shaft taking the centre distance between the cutter as 450mm.

The shaft is subjected to combined twisting moment and bending moment

TWISTING MOMENT

Due to the belt drive of the shaft, a twist force occur at the centre of the spindle.



Power at the spindle (P) = 7.5 hp.

R.P.M of the spindle(N) = 1910

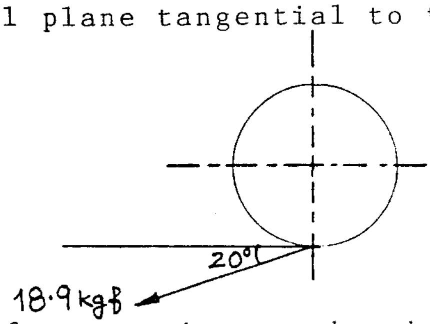
Therefore Twisting moment acting on the spindle(T) $= \dfrac{P \times 4500}{2\pi N}$

$= \dfrac{7.5 \times 4500}{2 \times \pi \times 1910}$

= 2812.3 Kgf-mm

BENDING MOMENT

A force of 18.9Kgf acts at an angle of 20^{o} to the horizontal plane tangential to the cutter:



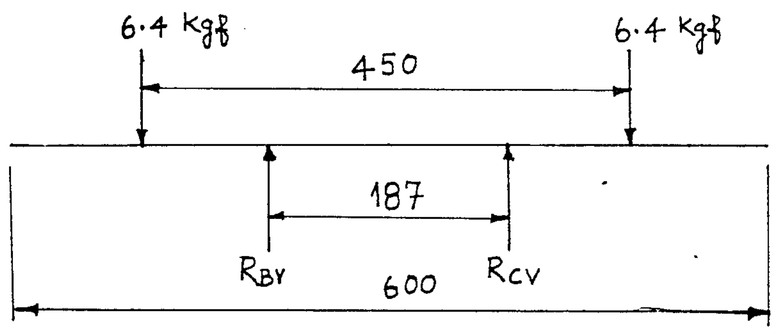
Vertical force acting on the shaft = 18.9 sin 20^{o}

= 6.4 kgf

Horizontal force acting on the shaft = 18.9 cos20^{o}

= 17.6 kgf

The vertical load diagram is shown below



$R_{BV} + R_{CV} = 12.8$ kgf

Taking moment about C, 6.4 x 131.5 + R_{CV} x 18.7

= 6.4 x 318.5

R_{CV} = 12.8 - 6.4

= 6.4 kgf.

We know that Bending Moment at A and D,

$$M_{AV} = M_{DV} = 0$$

B.M at B, $M_{BV} = R_{AV} \times 131.5 = 6.4 \times 131.5$

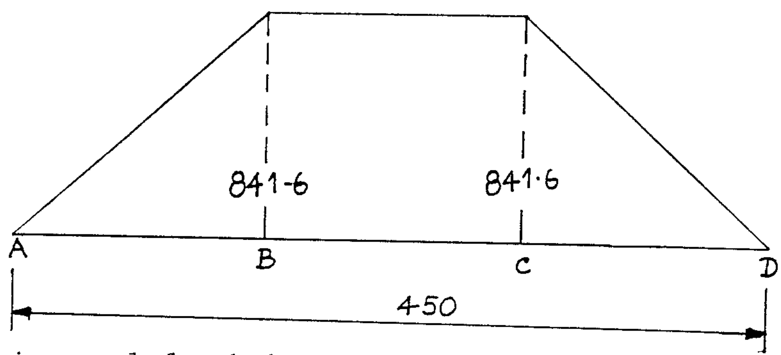
$= 841.6$ Kg-mm

B.M at C, $M_{CV} = R_{DV} \times 131.5 = 6.4 \times 131.5$

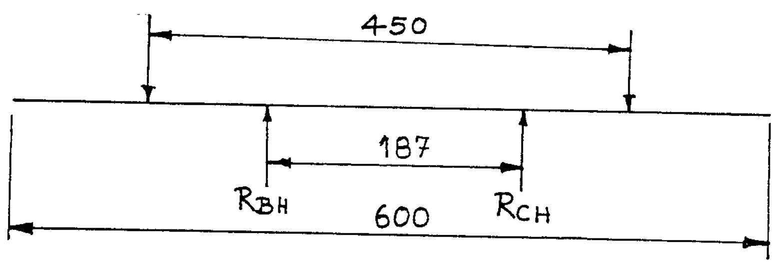
$= 841.6$ Kg-mm

Maximum Vertical Bending Moment $M_V = 841.6$ Kg-mm.

The bending moment diagram for Vertical loading is shown below.



The horizontal load diagram is shown below.



$$R_{BH} + R_{CH} = 35.2 \text{ Kgf}$$

Taking moment about C, $17.6 \times 131.5 + R_{CH} \times 18.7$

$= 17.6 \times 318.5$

$R_{CH} = 17.6$Kgf, $R_{BH} = 35.2 - 17.6 = 17.6$ Kgf.

We know that Bending moment at A and D, $M_{AH} = M_{DH} = 0$

B.M. at B, $M_{BH} = R_{BH} \times 131.5 = 17.6 \times 131.5$

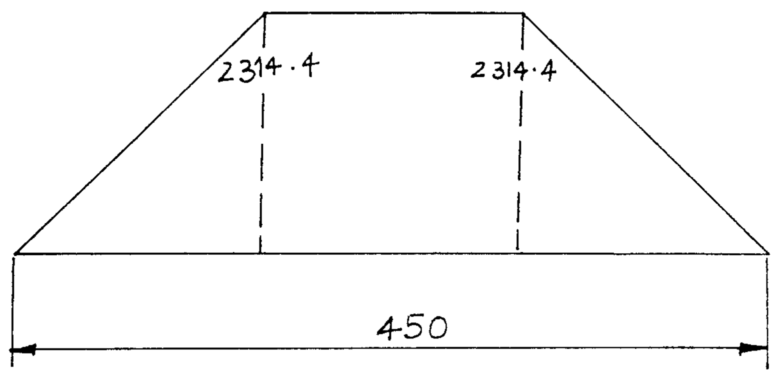
$= 2314.4$ Kg-mm

B.M at C, $M_{CH} = M_{CH} \times 131.5 = 17.6 \times 131.5$

$= 2314.4$ Kg-mm.

Maximum Bending Moment $M_H = 2314.4$ Kg-mm.

The bending moment diagram for Horizontal loading is shown below.



Resultant Bending Moment (M) $= \sqrt{M_V^2 + M_H^2}$

$= \sqrt{(2314.4)^2 + (841.6)^2}$

$= 2462.6$ Kg-mm.

The maximum normal stress in the shaft

$$f_b(max) = 1/2\ (f_b + \sqrt{(f_b)^2 + 4(f_s)^2})$$

From P.S.G. DESIGN DATA BOOK

For carbon steels

Allowable bending stress $(f_b) = 4.5$ Kg/mm^2

Allowable shear stress (f_s) = 2.5 Kg/mm^2

$f_b(max)$ = $1/2\ (4.5 + \sqrt{(4.5)^2+4(2.5)^2}$

= 5.6 Kg/mm^2

Equivalent Bending Moment M_c = $1/2(K_m M + \sqrt{K_m M^2 + K_t T^2})$

Combined shock and fatigue factor for bending (K_m)=3

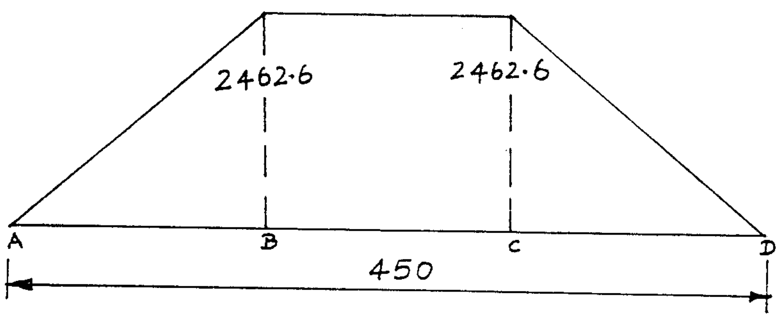
Combined shock and fatigue for torsion(K_t) = 2.5

Equivalent Bending Moment M_c = 1/2(3x24 2. +

$\sqrt{(3 \times 2462.6)^2+(2.5 \times 2812)^2}$

= 7805.15 Kg-mm

The equivalent bending moment diagram is shown below.



We know that the equivalent twising moment $= \frac{\pi}{32} \times f_{b(max)} \times d^3$

$= 1/2(K_m M + \sqrt{K_m M^2 + K_t T^2})$

$$d^3 = \frac{7805.15 \times 32}{\pi \times 5.6} = 1419\ .9, \quad d = 24.2\text{mm}.$$

Taking factor of safety, we select standard shaft diameter from R_{20} series.

Therefore the minimum dia. of the shaft = 45mm.

DESIGN OF BEARING

The bearing is subjected to combined axial and radial load hence we choose taper roller bearings.

Tangential cutting force, P_z = 6120 N/v

Power at the spindle, N = 5.5 kw

cutting speed V = πDN/1000

∴ Diameter of the cutter, D = 300 mm

Revolution per minute, N = 1910

∵ Cutting speed, V = π x 300 x 1590/1000

= 1800 m/min.

∴ Tangential cutting force, P_z = 6120 x 5.5/1800

= 18.6 Kgf

Axial component, F_a = 0.25 P_z = 0.25 x 18.6

= 4.67 Kgf

Radial component, F_r = 0.55 P_z = 0.55 x 18.6

= 10.284 Kgf.

The weight of the shaft, cutter and pulley will also act radially. The weight of the stone and the bed will also be acting against the cutter radially.

Coefficient of friction between the mating parts of the dove-tailed guideways = 0.3

∴ Radial component due to stone and bed = 150 x 0.3

= 45 Kgf.

Radial component due to weight of shaft, cutter and pulley $= 10 + 2 + 2$

$= 14$ Kgf.

$\therefore$ Total radial component, F_R $= 45+14+12.35$

$= 69.28$ Kgf

$F_a/F_R = 5.62/69.28$

$= 0.088$

The axial load is negligible.

Assume $e = 0.4$

$\therefore F_a/F_R < e$ $\quad | \because X = 1;\ Y=0 |$

Equivalent dynamic bearing load, $P = (XF_R + YF_a)S$

$= 1 \times 69.28$

$= 69.28$ Kgf.

Take service factor $(S) = 4$

Therefore $P = 69.28 \times 4$

$= 277.12$ Kgf.

Dynamic capacity, $C = (L/L_o)^{1/k} P$

At 1900 rpm and a life of 30,000 hrs $C/P = 11$.

Therefore Dynamic load capacity rating $= 277.12 \times 11$

$= 3048.32$ Kgf

Since the required inner dia of the bearing is 55mm. We select IS designation 55KB22 taper roller bearing.

The basic dynamic load rating of the selected bearing = 700Kgf.

$\therefore 3048.32 < 6700$ Kgf.

Hence design is safe.

V - BELT DESIGN

1. Speed Ratio, $i = \dot{N}/n = 1910/1440$

   $= 1.33$

   Pitch Diameter of the spindle pulley = 112mm.

2. Pitch diameter of larger pulley, $D = i \times d$

   $= 1.104 \times 112$

   $= 149$mm.

3. Belt speed, V $= 3.14 \times d \times N/60{,}000$

   $= 3.14 \times 112 \times 1910/60{,}000$

   $= 11.2$ m/sec.

   Centre distance (C) = 270mm

4. Pitch length of the belt, L $= 2C + 1.57(D+d)+(D-d)^2/4C$

   $= 2 \times 270 + 1.57(149+112)$
   $+(149-112)^2/4\times270$

   $= 951.04$ mm

5. Arc of contract, $\theta = 2\cos^{-1}(\frac{D-d}{2C})$ $= 2\cos^{-1}(149-112/2\times270)$

   $= 172.14^{o}$

6. Number of belts, $N_b = P_t \times F_a/Kw \times F_c \times F_d$
   FROM CMTI HAND BOOK

   F_a = Service correction factor

   = 1

   F_c = Length of correction factor

   = 0.87

F_d = Correction factor for arc of contact(A section belt)

= 0.98

P_t = Power to be transmitted

= 5.5 kw

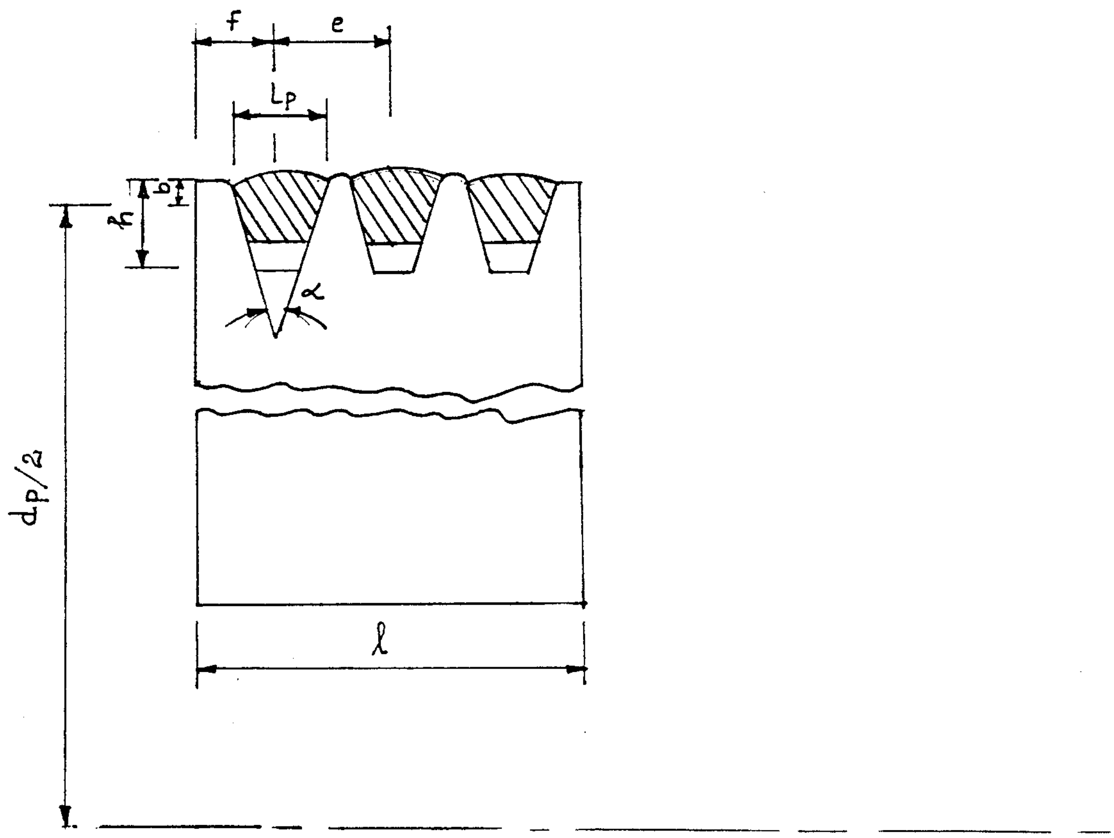
K_w = Rating of V-belt

= 2.16 at 1600 rpm, 112 dia and 13mm wide.

Therefore N_b = 5.5 x 1/2.1 x 0.87 x 0.98

= 2.87 3 belts.

SELECTION OF PULLEY



b = Minimum distance down to pitch line

= 3.3mm

l_p = Pitch width

= 11mm

A = Angle

= $35^{o} \pm 5^{o}$

h = Minimum depth below pitch line

= 8.7mm

e = Centre to centre distance of the grove

= 15mm $\pm$ 0.3mm

f = Edge of the pulley to first grove centre

= 10mm.

l = Length of the pulley

= 50mm

d_p = Pitch diameter of the pulley.

	d_p	A
Motor pulley	149	$38^{o} \pm 1/2^{o}$
Spindle pulley	112	$35^{o} \pm 1/2^{o}$

DESIGN OF HEXAGONAL BOLTS

BOLT MATERIAL - C45

The main beam is connected to the supporting columns at both the ends by bolts.

The total load acting on the botls includes the weight of the arbor, shaft, cutter, pulley, bearings motor and cutting force.

Total number of bolts = 8

Calculated total load = 402 Kgf.

Shear force acting on a single bolt $= \frac{\text{Total Load}}{\text{Total number of bolts}}$

$= \frac{402}{8}$

= 50.25 Kgf/bolt

Shear area of the bolt $= \pi/4 \; d^2$

Max. Stress on the bolt $= \frac{\text{Shear force}}{\text{Shear area}}$

<u>FROM CMTI HAND BOOK</u>

Shear stress for C-45 steel hardend and tempered $= 9.5 Kgf/mm^2$

Diameter of the bolt $= \sqrt{\frac{50.25 \times 8}{\pi \times 9.5}}$

= 3.67mm

Taking Factor of safety 1.6

We select standard bolt size M6

The arbor is connected to the channel by bolts.

Total Load acting on the bolts = 352.5 Kgf

Number of bolts used = 4

Shear Load acting on each bolt = $\frac{\text{Total Load}}{\text{Number of Bolts}}$

$= \frac{352.5}{4} = 88.125$ Kgf/bolt

Shear area of the bolt $= \frac{\pi d^2}{4}$

Maximum stress on the bolt $= \frac{\text{Shear force}}{\text{Shear area}}$

FROM CMTI HAND BOOK

Shear stress for C-45 steel hardeded and tempered = 9.5 Kgf/mm^2

Diameter of the bolt $= \sqrt{\frac{88.125 \times 4}{\pi \times 9.5}} = 3.44$mm.

Taking Factor of safety 1.7

We select standard Bolt size M6

DESIGN OF PNEUMATIC ELEMENTS

Total dead load to be holded = Weight of the stone..

= 23.35 Kg.

The cutting force also acts on the pneumatic cylinder.

Therefore cutting force acting on the stone = 22.5 Kgf.

Total force required by the piston to hold the stone = 22.5 + 23.35

= 45.85 Kgf.

Taking factor of safety = 1.25

Total force required by the piston to hold the stone = 45.85 x 1.25

= 57.31 Kgf.

Force/unit area of the piston = 4 Kgf/cm^2

$\therefore$ Required area of the piston = $\frac{57.31}{4}$

= 14.33 cm^2

$\therefore$ Dia of the piston = $(14.33 \times 4/\pi)^{1/2}$ = 4.27 cm.

Therefore select standard dia of the piston = 5cm.

THICKNESS OF CYLINDER WALL

From Machine design R.K. Jain.

Thickness of cylinder wall (t) = $\frac{P_{max} \times D}{2S_c} + K$

Maximum Hoop Stress (S_c) = 350 Kgf/cm^2

Reboring factor (K) = 1.25

Maximum gas pressure (P_{max}) = $6\ Kgf/cm^2$

Thickness of cylinder wall(t) = $\frac{6 \times 6.3}{2 \text{ X } 350} + 0.15$

= 0.204 CM

= 2.04 mm

Taking factor of safety, we choose the minimum thickness of cylinder wall (t) = 5mm.

THICKNESS OF PISTON HEAD

Diameter of the piston head = 50mm

Max. gas pressure (P_{max}) = $6\ Kgf/cm^2$

For C-45 Allowable stress in bending = $450\ Kg/cm^2$

Thickness of the piston head (t) = $\sqrt{\frac{3PD^2}{16\ S_t}}$

t = $\sqrt{\frac{3 \times 6 \times 6.3^2}{16 \times 450}}$

= 0.315 mm

Taking factor of safety = 4

We select thickness of the piston load = 10mm.

DESIGN OF HYDRAULIC ELEMENTS

Total dead load to be moved = Weight of the moving bed + weight of the stone.

= 137 + 23.35

= 160.35 Kg

Coefficient of friction = 0.3

∴ Total dead load to be moved = 160.35 x 0.3

= 48.1 Kg

The cutting force will act against the bed movement. The hydraulic cylinder must overcome this force also.

The cutting force acting against the bed movement = 17.6Kgf

Therefore load to be moved by the cylinder = 65.7 Kgf

Factor of safely = 3

Number of piston = 1.

Total force to be exerted by the piston = 197 Kg/m^2

∴ Required area of the piston = 197/20

= 9.85 cm^2

Dia of the piston = $\left(\frac{9.85 \times 4}{\Pi}\right)^{1/2}$

= 3.5 cm

We choose standard dia of the piston = 4cm.

SELECTION OF CASTLE NUTS

Castle nuts are used at the ends of the shaft to hold the cutter between the flanges rigidily.

FROM PSG DESIGN DATA BOOK

We select castle nuts black grade (M45)

d = (M45)

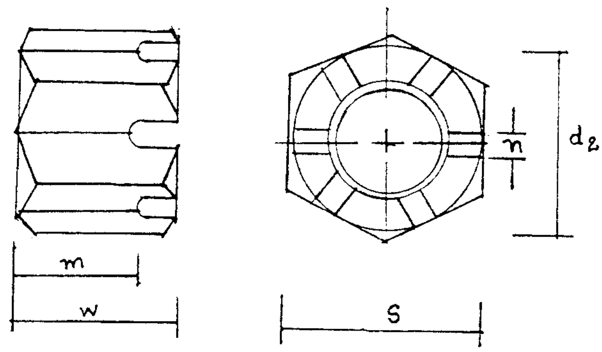
d_2 = 62

Width of the nut w = 48

m = 36

n = 9

s = 70



SELECTION OF OIL SEALS

Oil seals prevent the leakages through the gaps between the moving and stationary parts. Oil seals made of leather are used. We select oil seal

TYPE A

Inside diameter = 80mm

Nominal bore diameter of the housing = 100mm

Width of the oil seal b = 8 $\pm$ 0.2mm.

LOCK NUT DIMENSION

Lock nut holds the bearing rigidly and prevents it from slipping from its position.

Minimum inside diameter of the lock nut	=	M53
Outside diameter	=	80mm
Number of lock nuts	=	2

HOUSING CAP

The bearing cap was machined by us using a cast iron blank of outer diameter 120mm.

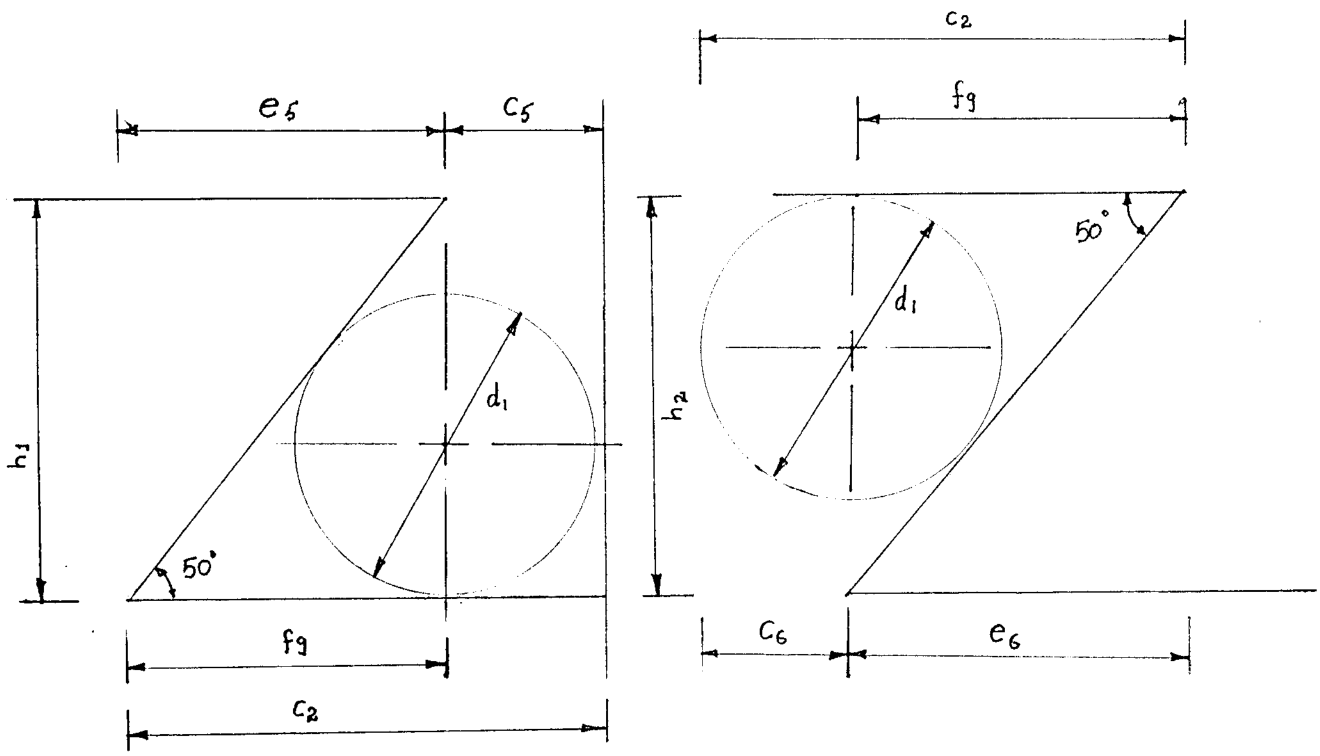
Total thickness (t)	=	16 mm
Outside bore diameter(D)	=	100mm
Inside bore diameter (d)	=	84mm
Outside bore thickness	=	8 $\pm$ 0.2mm
Inside bore thickness(t_2)	=	5mm

32

SELECTION OF DOVE TAIL GUIDEWAYS

FROM PSG DESIGN DATA BOOK

We select the dove tailed guideways having the following dimensions as shown in the figure.



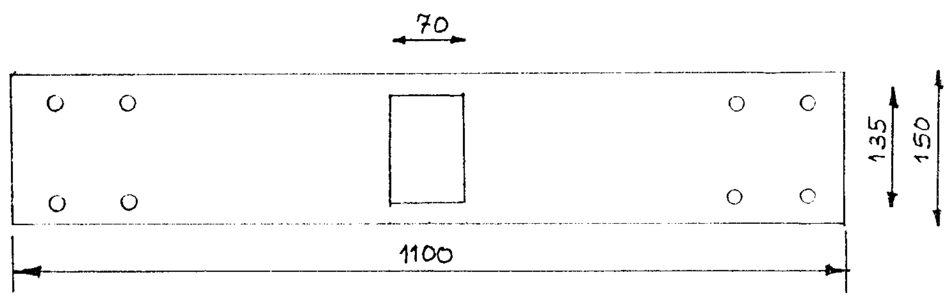
h_1	h_2	d_1	c_2	c_5	c_6	e_5	e_6	f_9
50	51.6	40	62.89	20.93	19.26	41.96	43.29	42.89

FABRICATION

COMPONENT NAME	:	Main beam
MATERIAL	:	M.S.
QUANTITY	:	1
MACHINES REQUIRED	:	Gas cutting machine, Welding machine.

PROCEDURE

As per design we select ISLC150 having depth of section 150mm. We cut the channel for a length of 800mm using gas cutting machine. Now we file the edges of the channel along the cross section to get a smooth finish. With the help of the vertical drilling machine holes of Ø 20mm are drilled on the top section of the channel. The points were the drilling operation had been carried out is shown in the diagram. Taps are used for cutting threads inside the holes.



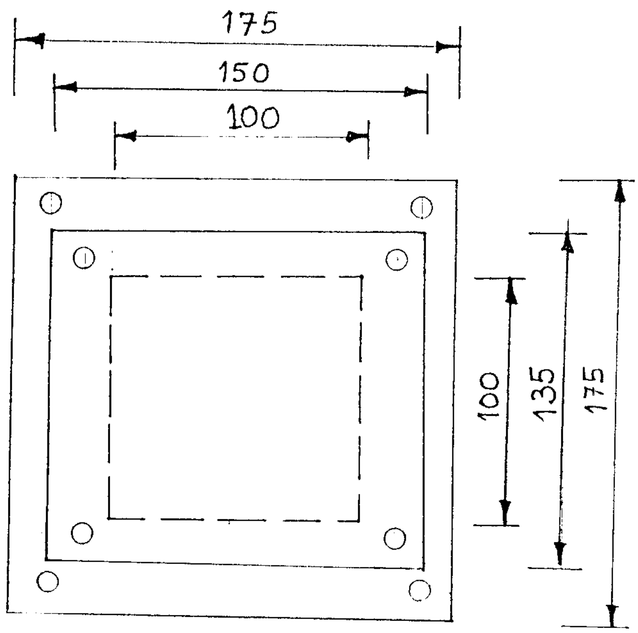
A section of dimension 135 x 70 mm is cut from the top portion of the channel using a gas cutting machine along its depth to facilitate the belt movement.

COMPONENT NAME	:	SUPPORTING COLUMN
MATERIAL	:	M.S.
QUANTITY	:	2
MACHINES REQUIRED	:	GAS CUTTING MACHINE, WELDING MACHINE.

PROCEDURE

As per design we choose channel ISLC 100. The channel is cut for a length of 75mm. Two channels of same dimensions are placed face to face and the flanges of both the channels are welded along its length using electric are welding. The form of weld is single V-butt. The edges along the cross-section of the channels are fillet welded to get a levelled surface. Mild steel plate of dimensions 130 x 130 x 20mm is placed above the levelled surface and welded at the mating points. The form of weld is fillet weld. Using a drilling machine holes of Ø mm is drilled at the four corners of the M.S plates.

The supporting column is mounted on concrete bed with a M.S. plate at the bottom and fitted M with 10 bolts. Drills are made at the points shown in figure below.



COMPONENT NAME : ARBOR

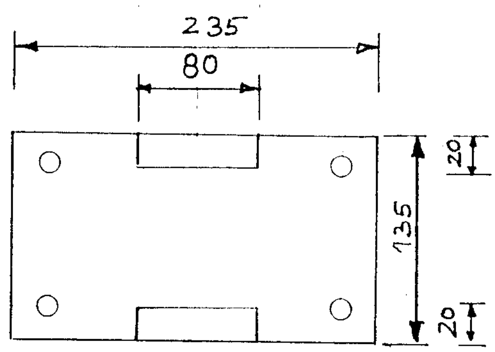
MATERIAL : C.I.

QUANTITY : 1

MACHINES USED : ENGINE LATHE AND DRILLING MACHINE.

PROCEDURE

As per drawing No.3 we make a pattern made of teak wood with the help of the pattern maker. The pattern was made of 3 separate components. Machining allowances were given at appropriate places. During casting, core was placed to make a hole for shaft. Casting was made with the help of cope and drag. Using an engine lathe, we bore the shaft housing for Ø 100mm and 40mm length, rest of the length we bore for Ø 60mm. The boring operation was carried out by boring tool which is supported between the centre and made to revolve. Hole of Ø 24mm were drilled at points on the top of the arbor using a vertical drilling machine at points shown below.



Using taps, threads are cut inside the holes for fixing the arbor with the main beam using bolts.

COMPONENT NAME	:	SHAFT
MATERIAL	:	EN8
QUANTITY	:	1
MACHINES REQUIRED	:	ENGINE LATHE

PROCEDURE

Shaft of standard Ø 60mm was purchased for a length of 600mm the cylindrical surface of the shaft was reduced for Ø 57mm to the whole length by straight turning. Finish turning is carried out for a depth of 0.1mm. Leaving 80mm from the centre on both sides of the shaft, then we take a step turning for Ø 55mm, Ø 53mm, Ø 51mm, Ø 50mm for a length of 27mm, 10mm, 20mm, 163 mm respectively. Thread cutting operation is carried out for a length of 10mm, On 53mm Ø step cut. The pitch of the thread is 1mm. Helical groves are produced on the edges of the shaft is taken at the centre of the shaft along its axis by slot milling.

COMPONENT NAME : CIRUCLAR SLITTING SAW

MATERIAL : DIAMOND IMPREGNATED STEEL SEGMENTS AROUND A STEEL BLANK.

QUANTITY : 2

The cutter was purchased from Bhukhanvala Diamond Tools Pvt. Ltd.,. The specifications of the cutter is

CATALOGUE NUMBER : BDT 300N

SEGMENT SPACING : NARROW

NOMINAL DIA D : 350 MM

CUTTER WIDTH T : 2.8

DEPTH OF DIAMOND X : 5.0

OVERALL DEPTH OF SEGMENT X_1 = 7.5

SEGMENT LENGTH L_2 = 40

SAW BLANK THICKNESS E= 1.8

NUMBER OF SEGMENT = 21.

COMPONENT NAME : STATIONARY BED

MATERIAL : C.I.

QUANTITY : 1

MACHINES REQUIRED : MILLING MACHINE

PROCEDURE

The pattern was madeby teak wood and ply wood. Ribs were given at the bottom of the bed to give adequate strength. Slots of dimensions 69 x 4 were made to reduce the weight of the bed. While pouring the molten metal during casting the piece, weights were placed above the cope to prevent it from lifting. There is no machining operations carried out on the stationary bed. Hotels of Ø 6mm are drilled at the top of the bed to fix the guideways.

COMPONENT	:	GUIDE WAYS
MATERIAL	:	C.I.
QUANTITY	:	2
MACHINES REQUIRED	:	SHAPING MACHINES, DRILLING MACHINE.

PROCEDURE :

The pattern is made without the dove tail guideway. After casting the piece dove tail is machined with the help of a shaping machine. An angular cut of 50^{o} is made to the vertical plane. The work is set on the table and the vertical slide is swiveled to required angle. The apron is then further swiveled away from the work so that the tool will clear the work so that the tool will clear the work during return stroke. Down feed is given by rotating down feed screw. 10 holes for Ø 20mm were made on the base of the guideways. Counter boring is done for Ø 20mm and depth 5.5 mm to fix the guideways with the stationary bed using counter sink bolts. Hand taps are used for making threads inside the holes.

COMPONENT NAME	:	MOVING TABLE
MATERIAL	:	C.I
QUANTITY	:	1
MACHINES REQUIRED	:	SHAPING MACHINE, DRILLING MACHINE.

PROCEDURE :

The pattern was made of plywood an teak wood. Slots were given on the top to ensure complete cutting of the tiles while operation. The dove tail portion was machined after casting by shaping machine. Holes of Ø 10mm are drilled at the ends of the bed to fix the channel which supports the pneumatic cylinders used for clamping the tiles. Provisions are made at the bottom of the bed to connect the piston rod of the hydraulic cylinder to it.

COMPONENT NAME	:	PNEUMATIC CYLINDER
MATERIAL	:	CAST IRON
QUANTITY	:	3
MACHINES REQUIRED	:	LATHE, DRILLING MACHINE, GRIDING MACHINE.
DRG NO.	:	

PROCEDURE :

The pneumatic cylinder is cast by injection moulding. Now the inside bore are smooth finished with a tolerance of $^{+0.05}_{-0.00}$ mm. This tolerance is attained by grinding the internal bore of the cylinder and deburring it. A hole of Ø 11 x 12 mm is made on the side wall of the cylinder and threaded for a depth of 10mm. The thread dimension is 1/4" BSP. Holes of dia Ø 9 x 49mm are drilled on the four corners of the cylinder .

COMPONENT NAME : PISTON ROD

MATERIAL : BRASS

QUANTITY : 3

MACHIENS REQUIRED : LATHE, DRILLING MACHINE, GRINDING MACHINE.

DRG. NO. :

BRASS piece having dimensions Ø 65 x 40mm is turned in a lathe for 27mm length and a depth of 49mm. A grove of Ø 51mm and width 7mm is taken on the piston head. A step cut for Ø 58 and Ø 63 are taken on the piston head diametrically. A hole of m8 x 1.25 is threaded for a depth of 12mm at the end of the piston rod. The surface of the piston are smooth finished with a tolerance of $^{+0.2}_{-0.0}$ mm. using grinding machine.

COMPONENT NAME : END COVER

MATERIAL : BRASS

QUANTITY : 3

MACHINES REQUIRED : LATHE, DRILLING MACHINE, GRINDING MACHINE.

DRG NO. :

Brass piece of dimension Ø 65 x 15 mm is turned for a length of 8mm and 20mm depth diametrically. A hole of Ø 16 mm with a tolarence of $^{+0.03}_{-0.00}$ mm is drilled and super finished using grinding machine. A hole of Ø 3mm is drilled for exhausting the air in the rod end chamber of the cylinders. Four holes are drilled on the end cover for placing spring for retraction of the piston rod.

BILL OF MATERIALS

S.NO.	DESCRIPTION	MATERIAL	QUANTITY (IN NOS.)
1.	COLUMN(SUPPORTING)	ROLLED STEEL	2
2.	MAIN BEAM	ROLLED STEEL	1
3.	ARBOR	C.I.	1
4.	SHAFT	EN 8	1
5.	CUTTER(CIRCULAR)	DIAMOND IMPREGE NATED STEEL BLADES	2
6.	TAPPER ROLLER BEARING	SKF	2
7.	CUTTER COVER	M.S	2
8.	OIL SEAL	RUBBER	2
9.	BUSH(SHAFT)	GUN METAL	2
10.	FLANGE(CUTTER)	M.S	4
11.	PULLEY	C.I	2
12.	DOVETAIL BED	C.I.	1
13.	DOVETAIL GUIDEWAYS	C.I.	2
14.	STATIONARY BED	C.I.	1
15.	MOTOR	7.5 H.P KIRLOSKAR	1
16.	MOTOR HOUSING	M.S	1
17.	HYDRAULIC CYLINDER	VICKERS	1
18.	NUTS & BOLTS	STEEL BOLTS	34
19.	FLOW CONTROL VALVE	VICKERS 3-POSITION, FOUR WAY	1
20.	HOUSING CAP	C.I.	2

21. CASTLE NUT	M.S.	2
22. PNEUMATIC CYLINDER HOUSING	M.S	1
<u>PNEUMATIC ELEMENTS</u>		
23. CYLINDER	C.I.	3
24. PISTON ROD	BRASS	3
25. U-SEAL	RUBBER	3
26. CIRCLIP	STEEL	3
27. END COVER	BRASS	3
28. SPRING	STEEL	12

PROCESS CHART

S.NO.	COMPONENT	MATERIAL	OPERATION	MACHINE USED
1.	SUPPORTING COLUMN	M.S.	GAS CUTTING & WELDING	GAS CUTTING MACHINE ELECTRIC ARC WELDING MACHINE.
2.	MAIN BEAM	M.S.	GAS CUTTING	GAS CUTTING MACHINE.
3.	ARBOR	C.I.	BORING, DRILLING	LATHE.
4.	SHAFT	EN 8	FACING, TURNING, THREAD CUTTING, KEY WAY MILLING	LATHE, MILLING MACHINE.
5.	CIRCULAR CUTTER	DIAMOND IMPRE-GENATED STEEL	PURCHASED READY MADE	-
6.	TAPPER ROLLER BEARIN		PURCHASED READY MADE	-
7.	OIL SEAL	RUBBER	PURCHASED READY MADE	-
8.	SHAFT BUSH	GUN METAL	TURNING, COUNTER BORING	LATHE
9.	CUTTER FLANGE	M.S.	TAPER TURNING, FACING, BORING	LATHE

10.	PULLEY	C.I.	TAPER TURNNG FILING, BORING, SLOTTING	LATHE SLOTTING
11.	DOVETAIL BED	C.I.	SHAPING	SHAPING MACHINE
12.	DOVETAIL GUIDEWAYS	C.I.	SHAPING, DRILLING	SHAPING MACHINE DRILLING MACHINE
13.	STATIONARY BED	C.I.	DRILLING	DRILLING MACHINE
14.	MOTOR		PURCHASED READY MADE	
15.	MOTOR HOUSING	M.S	TURNING, DRILLING & WELDING	LATHE, DRILLING MACHINE, EEECTRIC ARC WELDING.
16.	HYDRAULIC CYLINDER		PURCHASED READY-MADE	
17.	NUTS & BOLTS		PURCHASED READY-MADE	
18.	PNEUMATIL ELEMENTS			
18.	CYLINDER	C.I.	DRILLING, BORING	LATHE
19.	PISTON ROD	BRASS	TURNING	LATHE
20.	U-SEAL	RUBBER	PURCHASED READYMADE	
21.	CIRCLIP	STEEL	PURCHASED READY-MADE	
22.	END COVER	BRASS	TURNING, COUNTER BORING	LATHE
23.	SPRING	SPRING STEEL.	PURCHASED READY-MADE	

COST ESTIMATION

FABRICATED COMPONENTS

S.NO.	COMPONENT	MATERIAL	QUANTITY	WEIGHT (Kgs)	MATERIAL COST (Rs)	MACHINES USED	MACHINING TIME (HRS)	MACHINING (Rs)	TOTAL (Rs)
1.	MAIN BEAM	ROLLED STEEL	1	11.5	154	GAS CUTTING	1/2	75	229
2.	SUPPORTING COLUMN	ROLLED STEEL	2	23	267	GAS CUTTING WELDING	3/4	150	417
3.	ARBOR	C.I.	1	24.3	292	LATHE, DRILLING	1	25	317
4.	SHAFT	EN 8	1	10	300	LATHE	1	15	315
5.	PULLEY	C.I	2	3	36	LATHE	2	30	132
6.	DOVETAIL BED	C.I	1	137	1644	SHAPPING, DRILLING	2	60	1704
7.	DOVETAIL GUIDE WAYS	C.I	2	193	2316	SHAPPING, DRILLING	2	60	2376
8.	STATIONARY BED	C.I.	1	609	7308	DRILLING	1/2	10	7318
9.	HOUSING CAP	C.I.	2	2	10	LATHE	1	15	15
10.	PNEUMATIC CYLINDER	C.I.	3	1.75	25	LATHE DRILLING MACHINE	1	80	100

11.	PISTON ROD	BRASS	3	0.75	60	LATHE DRILLING MACHINE	1	100	160
12.	END COVER	BRASS	3	0.50	50	LATHE DRILLING MACHINE	0.75	70	120

PATTERN MAKING COST - 3000

ASSEMBLY COST - 1500

TOTAL COST

PURCHASED ITEMS

S.No.	Component	Material	Quantity	Total Cost (Rs)
1.	Circular cutter	Diamond IPM Steel	2	10,000
2.	Oil seat	Rubber	4	20
3.	Shaft brush	Gun metal	2	40
4.	Cutter flange	M.S	4	300
5.	Motor	7.5 H.P	1	8500
6.	Motor housing	M.S.	1	200
7.	Nuts and bolts	Steel bolts	34	150
8.	Housing cap	C.I	2	15
9.	Flow Control Valve	Vickers 3 P-4W	1	
10.	Hydraulic Cylinder	Vickers 900 mm stroke	1	
11.	Circlip	Steel	3	30
12.	U - Seal	Rubber	3	45
13.	Spring	Steel	12	350

CONCLUSION

THE AFTER CLAP

The installation of this machine can bring about the following advantages.

The setting time for the tile is reduced thus increasing production rate.

The table movement is steady, hence smooth edge cutting of the tiles.

Effective clamping of the tile, reduces vibrations of the tile.

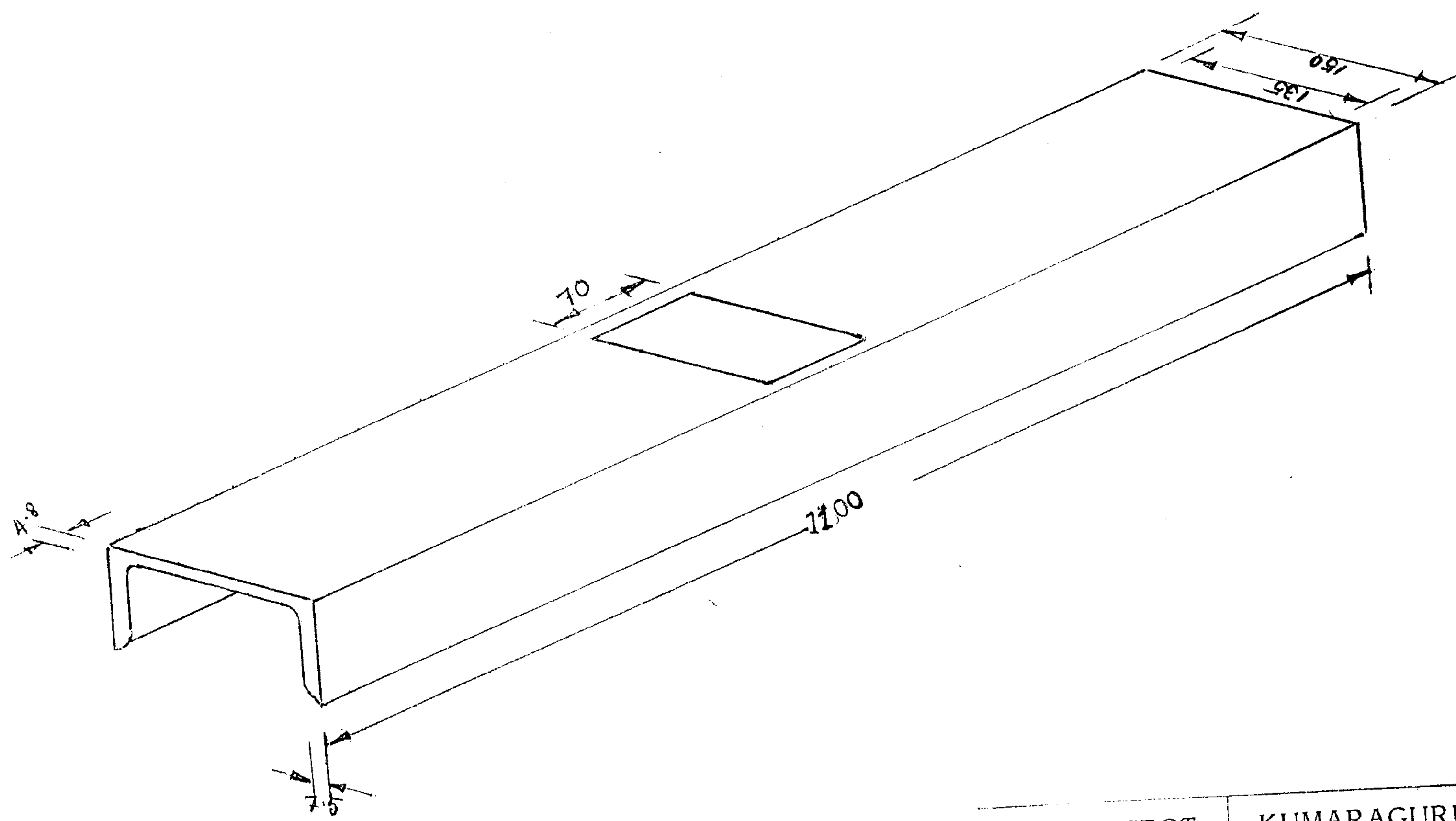
The finishing of the tiles is very good.

Labour required is reduced to 50%.

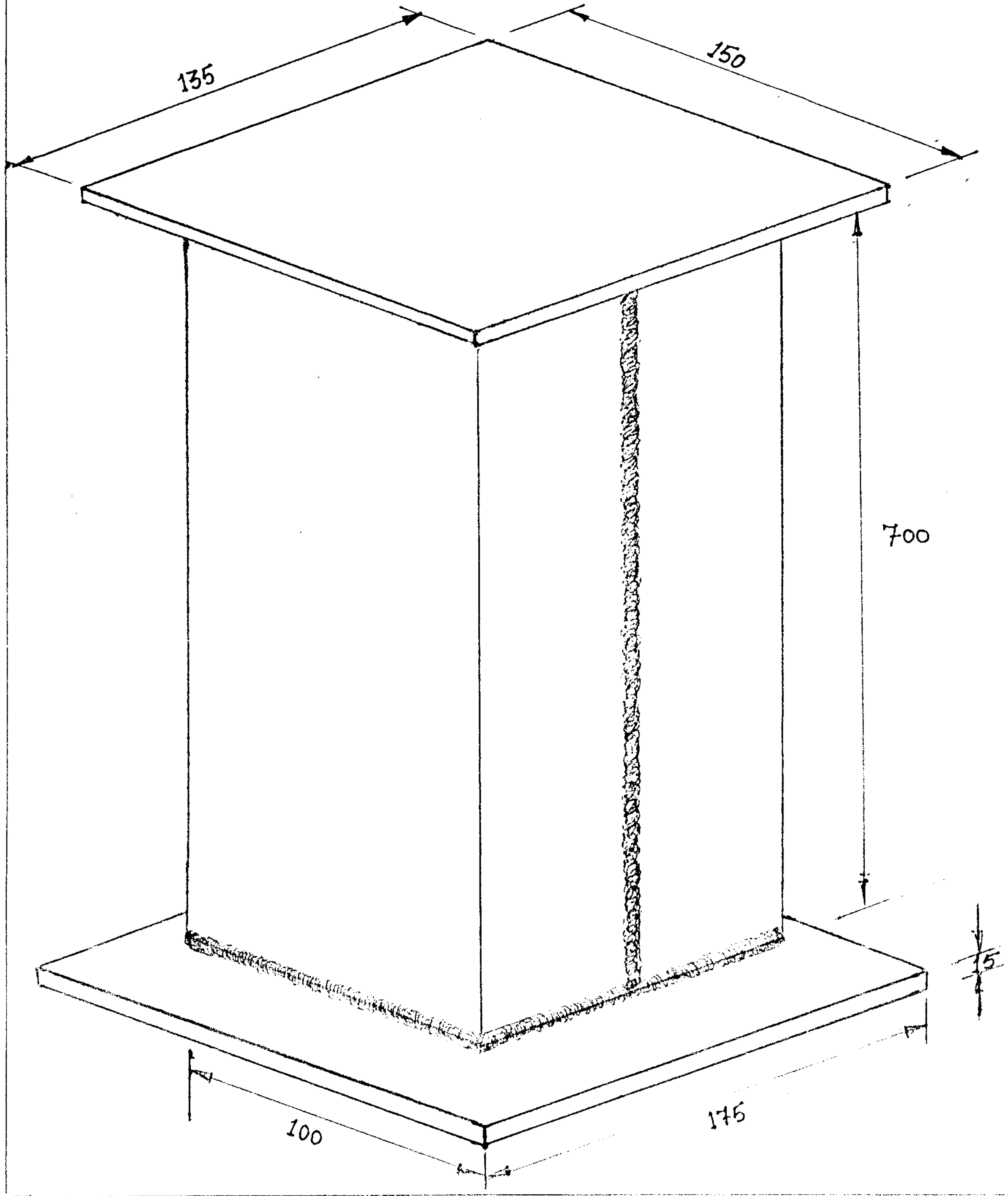
The vertical movement of the bed is eliminated.

LIMITATIONS :

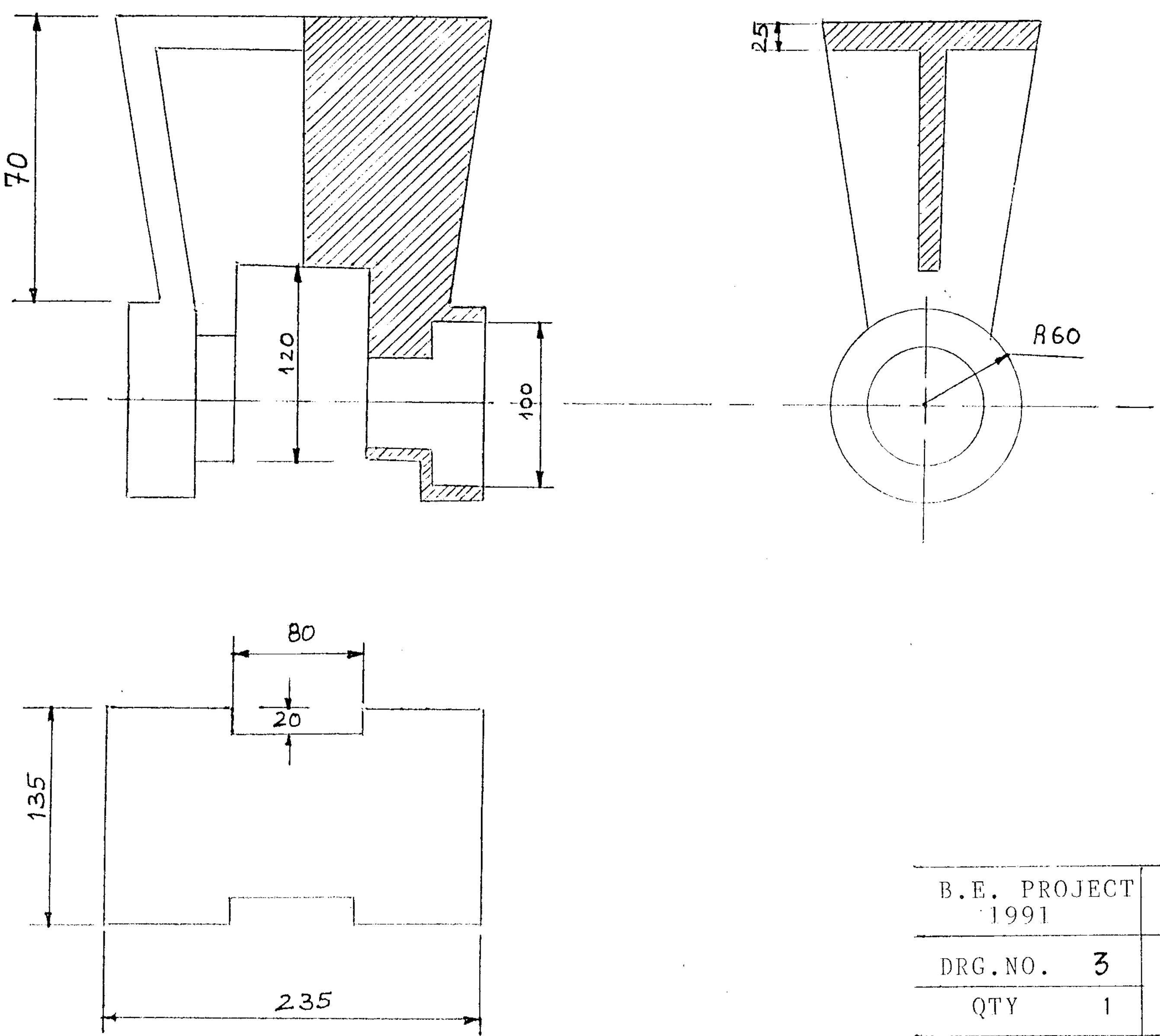
1. The machine cannot cut tiles having thickness more than 25mm.
2. The machine can cut only tiles having minimum breadth of 300mm and maximum length of 900mm.
3. The loading of the tile involves labour.



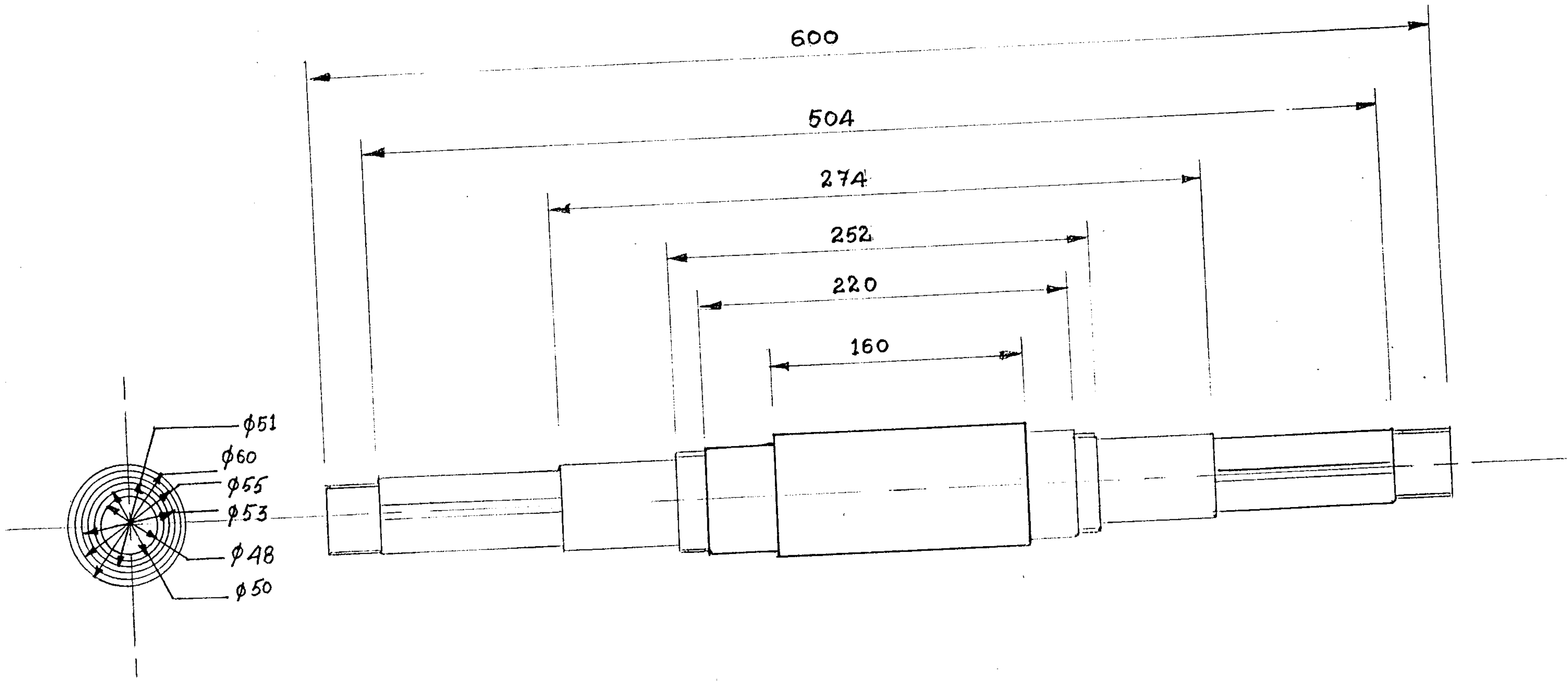
B.E. PROJECT 1991	KUMARAGURU COLLEGE OF TECHNOLOGY CBE-6		
DRG. NO 1	MAIN BEAM		
QTY 1			
DRN S. Kumar	SCALE 1:7	◎	MAT Steel
APR			



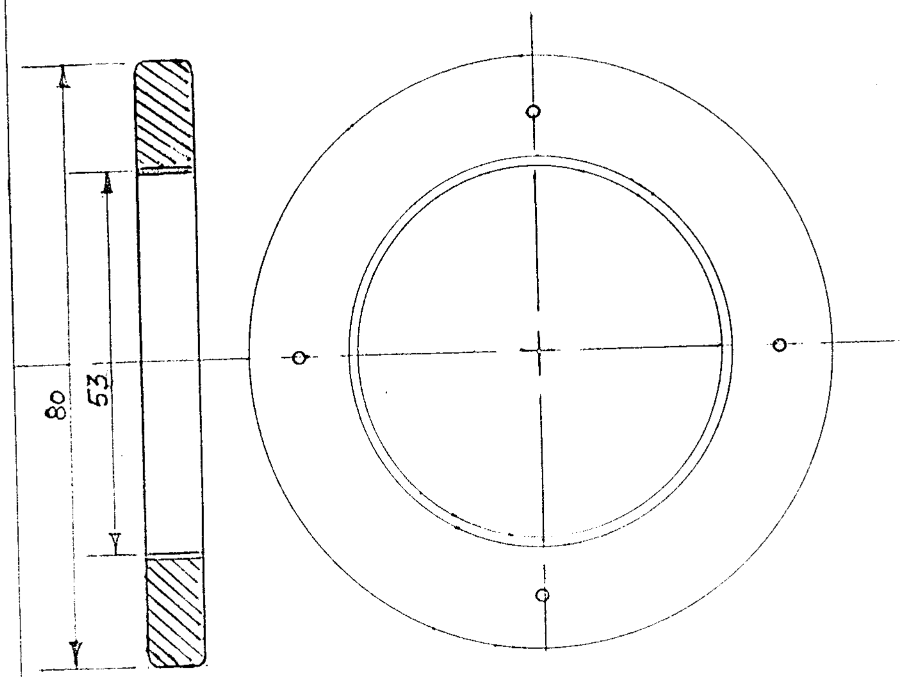
B.E. PROJECT 1990-91 DRG NO 2	KUMARAGURU COLLEGE OF TECHNOLOGY CBE-6		
QTY 2	SUPPORTING COLUMN		
DRN S. Kumar	SCALE		MAT
APR	1:6		Steel



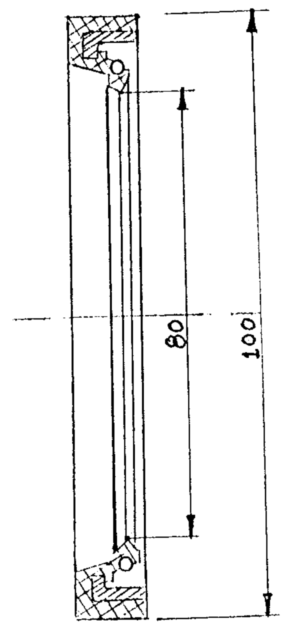
B.E. PROJECT 1991	KUMARAGURU COLLEGE OF TECHNOLOGY CBE-6		
DRG.NO. 3	ARBOR		
QTY 1			
DRN N.Sivakumar.	SCALE 1:4		MAT C.I
APR 18/2			



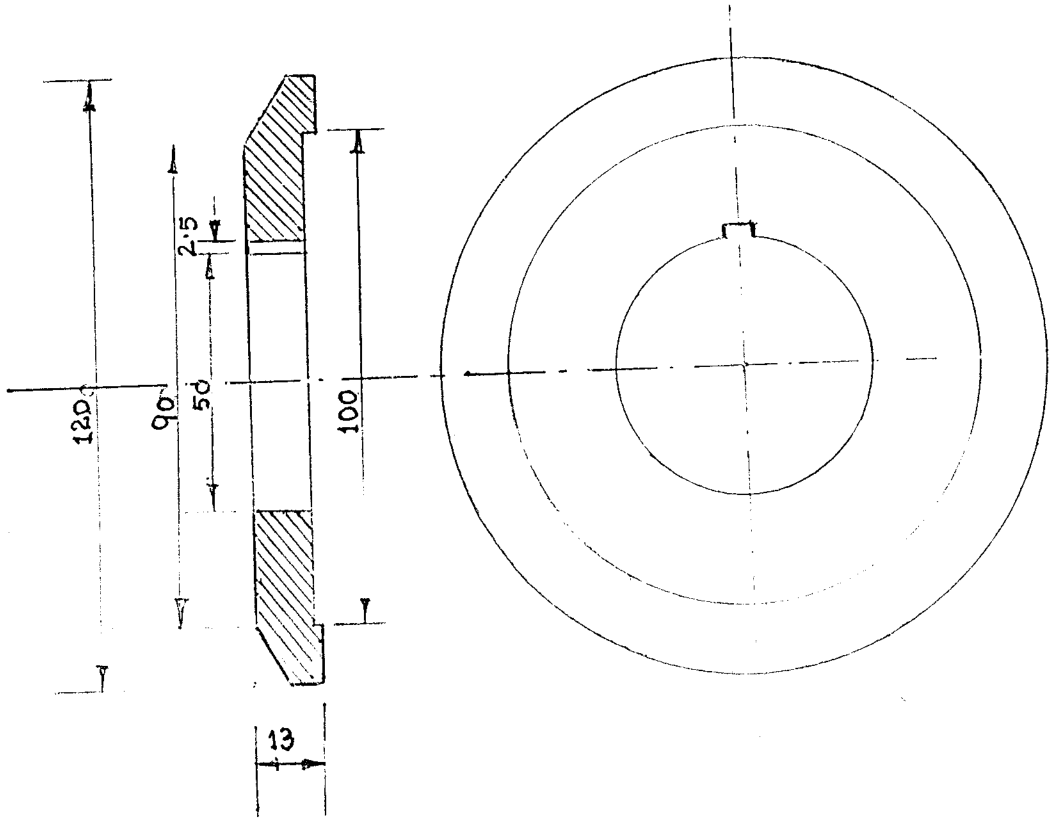
B.E.PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE - 6
DRG NO 4	SHAFT
QTY 1	
DRN S. Kumar	SCALE 1:3	MAT EN8
APR	



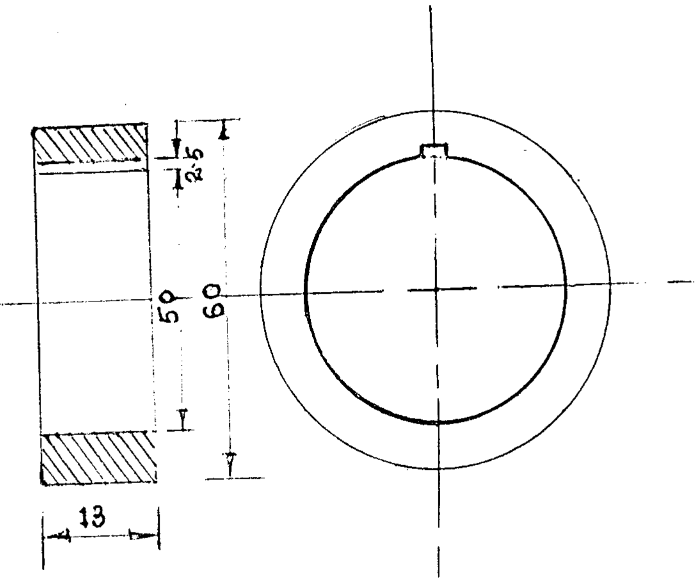
B.E.PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE - 6			
DRG NO 5	LOCKNUT			
QTY 4				
DRN S. kumar	SCALE		MAT	
APR	1:1		STEEL	



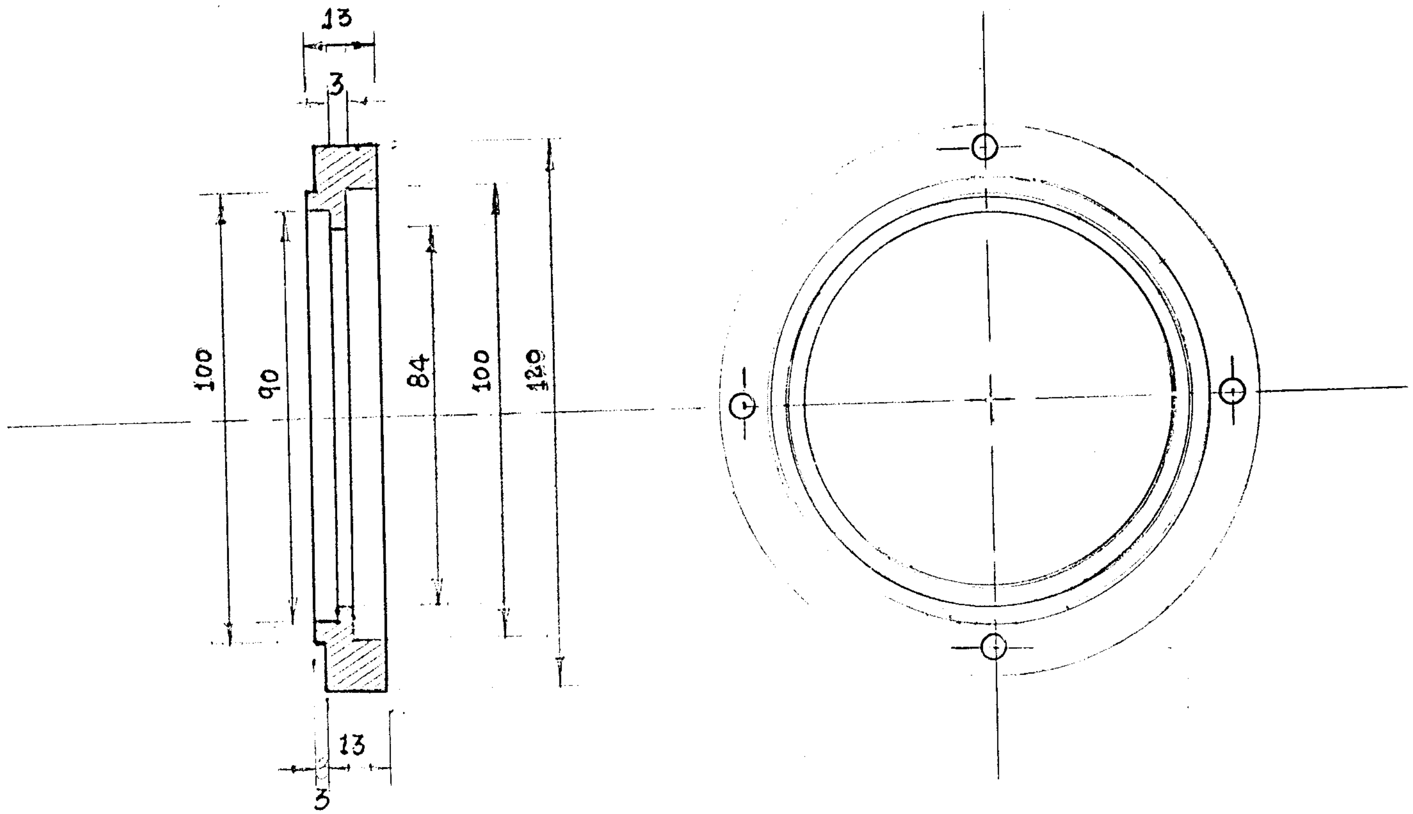
B.E.PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE - 6		
DRG NO 6	OIL SEAL		
QTY 2			
DRN S. kumar	SCALE		MAT
APR	1:1		RUBBER



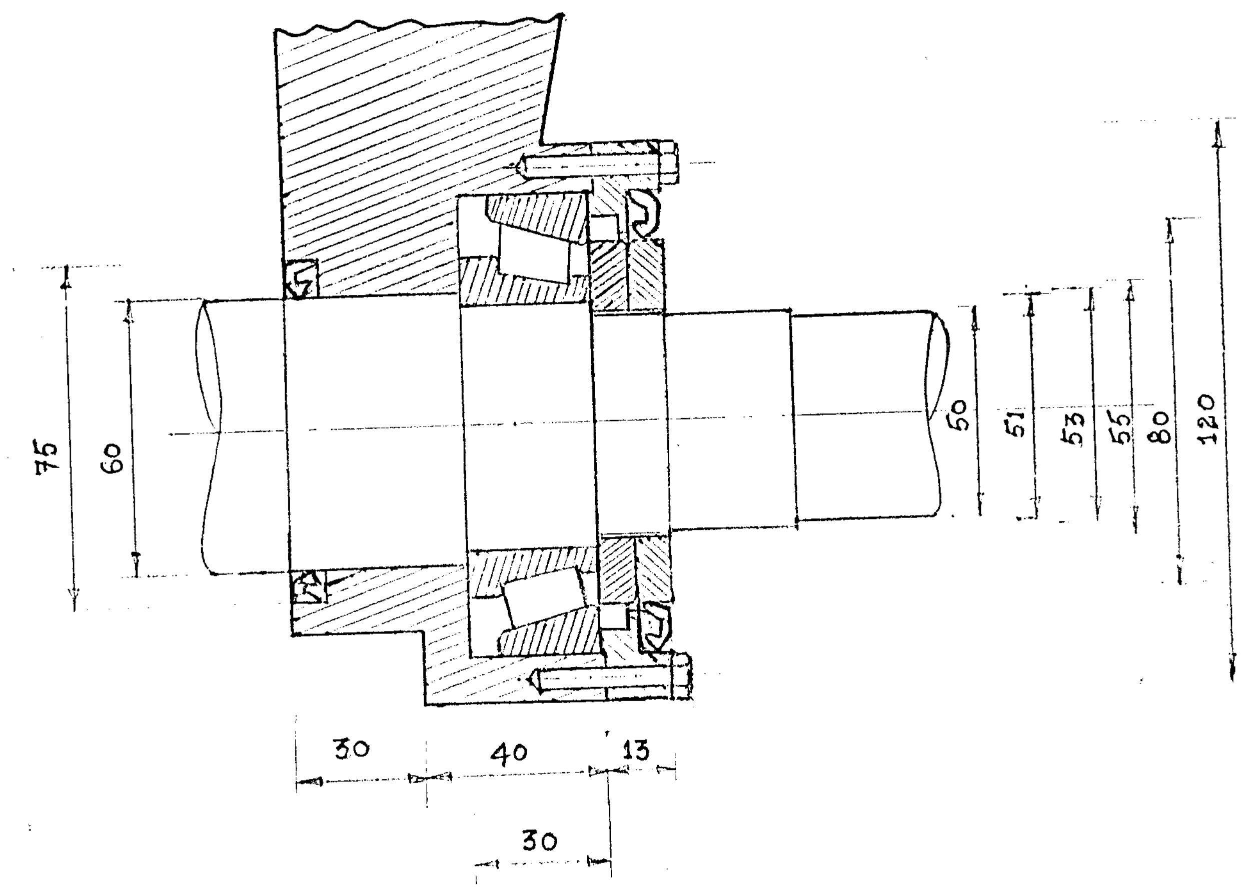
B..E.PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE-6		
DRG NO 7	FLANGE		
QTY 4			
DRN : S. Kumar	SCALE 1:1·5		MAT M·S
APR			



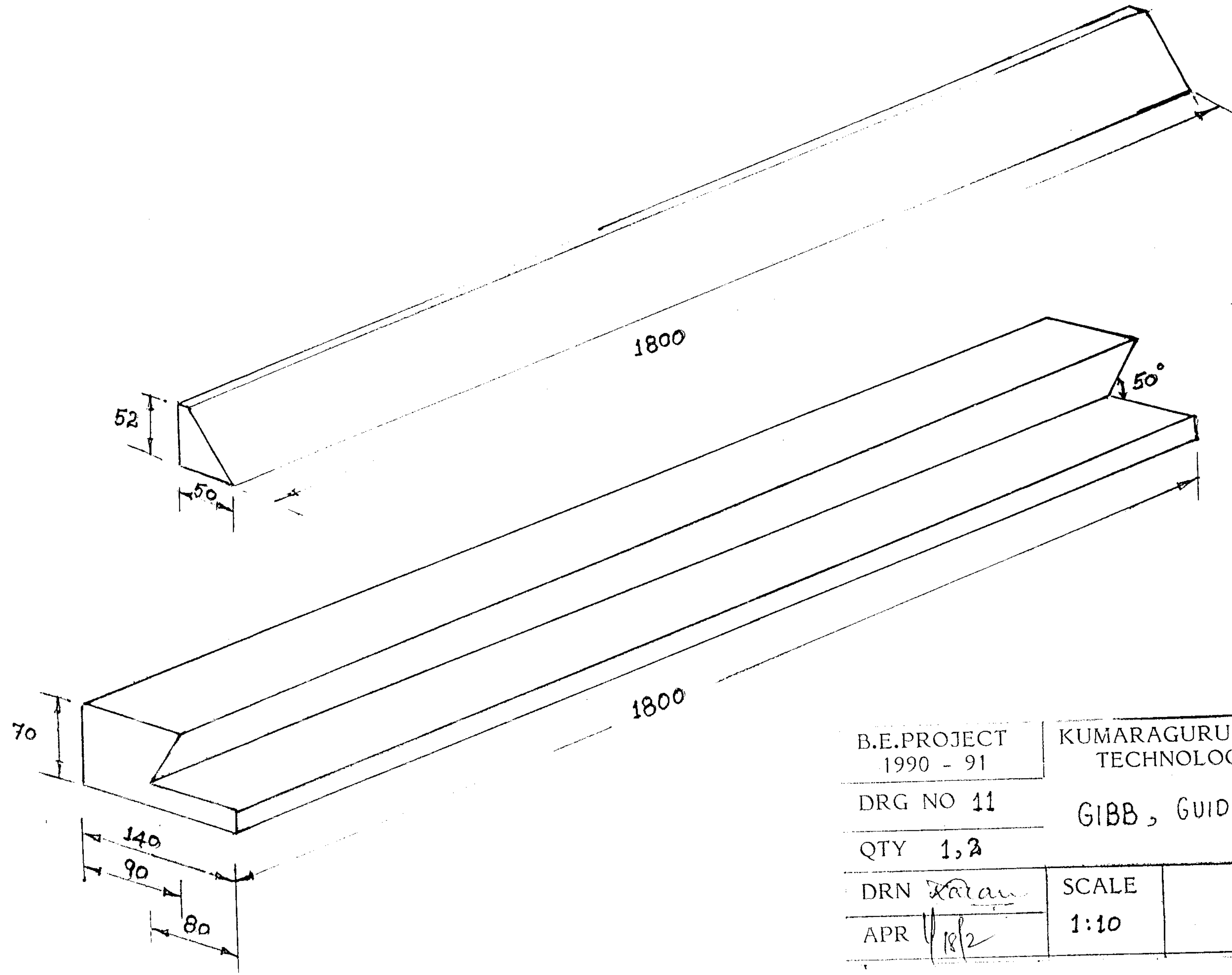
B.E.PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE - 6		
DRG NO 8	BUSH		
QTY 15			
DRN : S. Kumar	SCALE 1:1		MAT GUN METAL
APR			



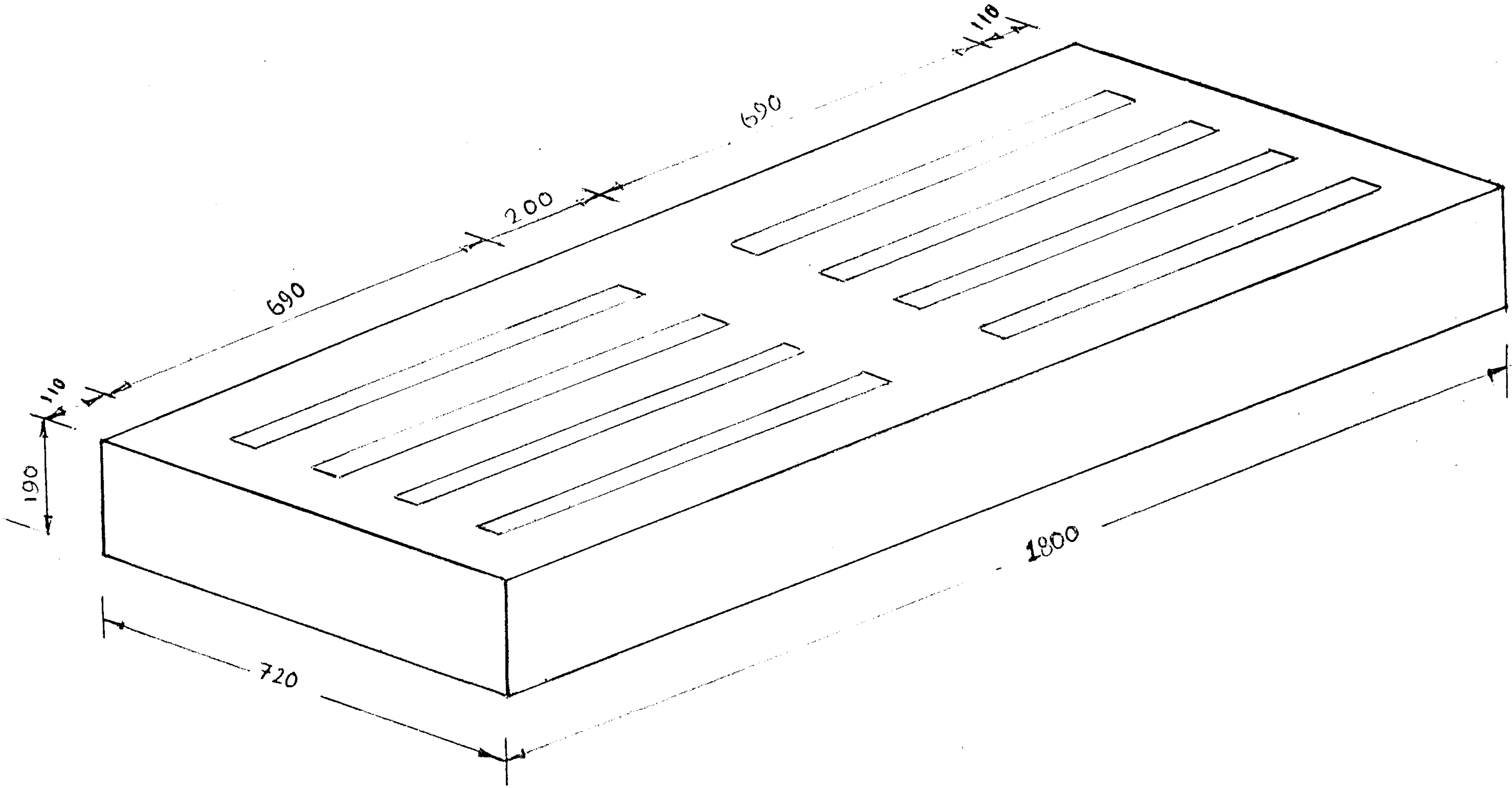
B.E.PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE Z- 6			
DRG NO 9	HOUSAING CAP			
QTY 2				
DRN : S. Kumar	SCALE			MAT
APR	1:1·5			C·I



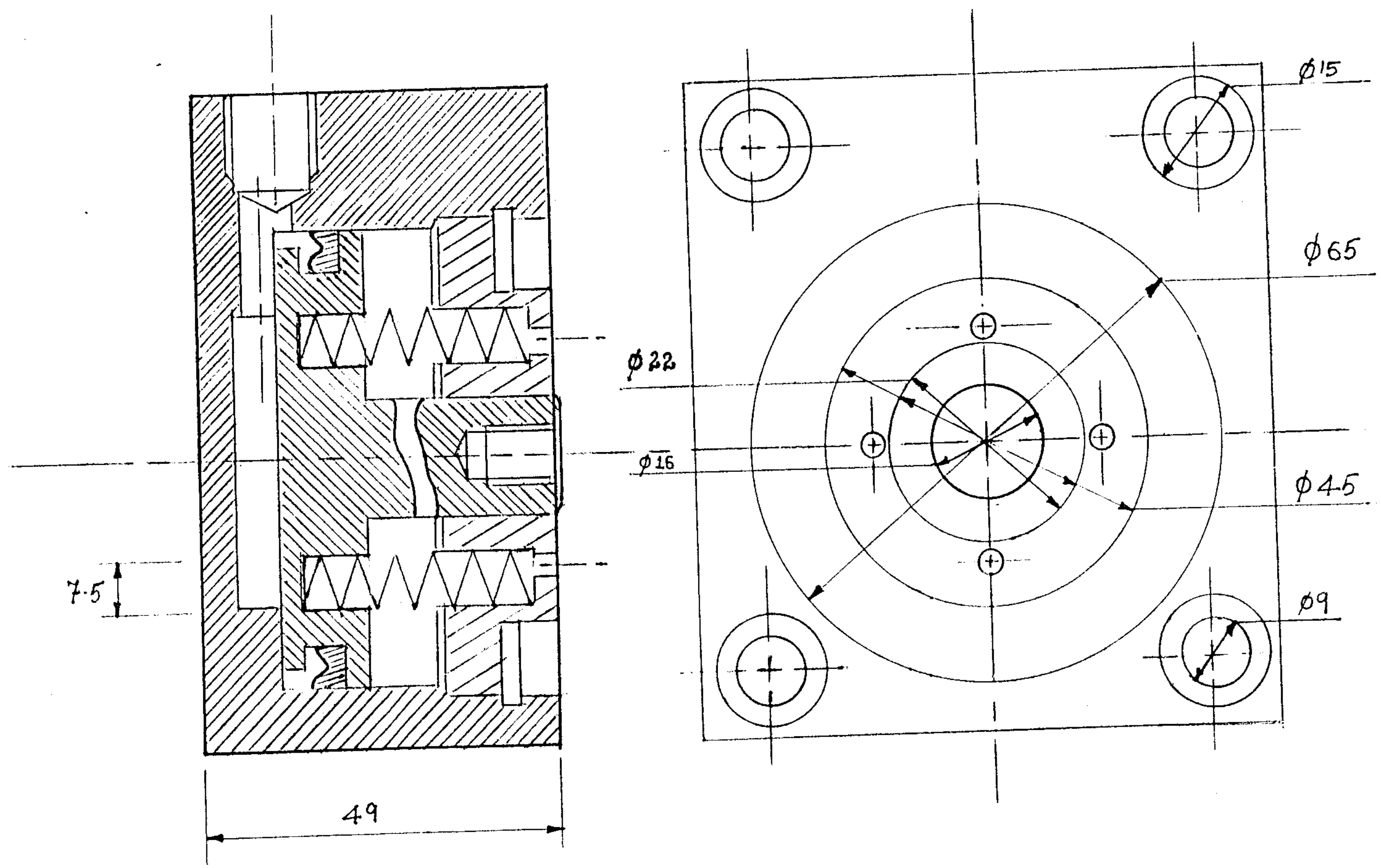
B.E.PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE - 6		
DRG NO 10	SPINDLE HOUSING ASSEMBLY		
QTY			
DRN S.Kumar	SCALE		MAT
APR	1:1·5		



B.E.PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE - 6		
DRG NO 11	GIBB, GUIDE WAYS		
QTY 1,2			
DRN Karan	SCALE		MAT
APR 18/2	1:10		C.I.



B.E. PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE-6		
DRG NO 13	STATIONARY BED		
QTY 1			
DRN	SCALE		MAT
APR /18/2	1:10		C.I.



B.E. PROJECT 1990 - 91	KUMARAGURU COLLEGE OF TECHNOLOGY CBE - 6		
DRG NO 17	PNEUMATIC CYLINDER (ASSEMBLY)		
QTY 3			
DRN N.Sivakumar	SCALE 1:1		MAT C.I BRASS
APR			

B I B L I O G R A P H Y

Machine tool design handbook -

CENTRAL MACHINE TOOL INSTITUTE (CMTI)

TATA Mc GRAW HILL

Design Data Book :

P S G INSTITUTION

Machine Design -

R.K. JAIN

Industrial Hydraulics -

JOHN PIPPENGER

TYLER HICKS Mc GRAW HILL

ABC's of pneumatic circuits - HARRY L. STEWART
JOHN M. STORER

EASI CUT - CATALOGUE

PART NO/.	DISCRIPTION	QTY	MTL	SIZE	REMARKS
	2. CASTLE NUTS	2	Steel	M45 X 48	Mounted to ends of the shaft
	3. HEXL NUTS & BOLTS	8	,,	M10 X 40	fixing the main beam & column
	4. ,,	4	,,	M10 X 50	,,
	5. ,,	8	,,	,,	
	6. COUNTER SING NUTS & BOLTS	12	,,	M6 X 75	fixing the guideways
	7. Stoted ,,	12	,,	M6 X 70	fixing the Gibb
	8. NUTS & BOLTS	4	,,	M10 X 40	
	9. ,,	2	,,	M8 X 50	fixing cutter cover
16.	DOVE TAIL GUIDE WAYS	2	C.I	casting	fixed to stationary bed
17.	MOVING TABLE	1	,,	,,	mounted on guide ways
18.	GIBB	1	,,	,,	fixed to moving table
19.	STATIONARY BED	1	,,	,,	placed on concrete bed
20.	PNEMATIC ELEMENTS				
	1. PISTON ROD	3	BRASS	Ø63 X 39	placed inside cylinder
	2. U-Seat	3	RUBBER	Ø63	fixed to piston rod
	3. CIRCLIP	3	Steel	Ø65 - B TYPE	Fixed on M.S plate
	4. END COVER	3	Brass	Ø65 X 15	
	5. SPRING	3	Steel	OD : Ø39, wire dia 3, N.C : 3½, F.L : 56	placed between piston rod and end cover
	6. CYLINDER	3	C.I	80 X 90 X 49	
21.	HYDRAULIC CYLINDER	1	—	Ø3.75 X 900	Mounted on stationary bed
22.	M.S Plate	1	M.S	700 X 120 X 15	mounted on moving table
23.	CUTTER COVER	2	M.S Sheet	Ø 350, W : 20	Fixed at main beam