B.TECH./BE II YEAR

MANUFACTURING TECHNOLOGY LABORATORY-I
DEPARTMENT OF MECHANICAL ENGINEERING
AMU, ALIGARH
MEC2930/EMEC2930

EXPERIMENT No: 1

Name. Pranay Singh .S. No. 14 Section. A2MB
College No. 21MEB448 Enrol. No. GL2254
Date of Experiment. 12/11/2022 Date of Submission 26/11/2022

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OBJECT:

a) To categories the given components into:
   (i) Magnetic and non-magnetic materials;
   (ii) Metallic and non-metallic materials;
   (iii) Thermoplastics and thermo-sets; and
   (iv) Ferrous and non-ferrous materials.

b) To identify the ferrous alloys through spark and sound tests

EQUIPMENTS/TOOLS USED:

S. No.	Name	Specification	Make
1.	Bench Grinder	RPM 1950 (1/4 HP)	Wolf
2.	Magnet	NA	Made in India
3.	File	12 inch Double cut	J.K.
4.	Scale	30cm	Ajanta

PROCEDURE

1. Physical test

   a. Hold one single piece of the test specimen.

   b. Note the colour of the specimen.

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OBSERVATIONS:

(a) Physical Tests

S. No.	Sample specimen	Specimen name	Colour of specimen	Relative density (High/medium/low)	Effect of heat test (Deforms Y/N)	Magnetic test	Remark
1	A	Brass	Yellow	High	N	N	Non-Ferrous
2	B	Copper	Red	High	N	N	Non-Ferrous
3	C	Aluminium	White	Low	N	N	Non-Ferrous
4	D	Ferrous	Grey	High	N	Y	Ferrous
5	E	Synthetic	Variable	Low	Y	N	Non-Ferrous

(b) Spark Tests:

S. No.	Sample steel	Specimen name	Colour of spark	Length of spark (mm)	Span (mm)	Type of Star	Sound	Remark
1	A	Low Carbon	Yellow	450	60	Thick	Medium Metallic	Longest length
2	B	Medium Carbon	Dull Yellow	320	80	Medium	Medium Pitched ring	length less than low C.S.
3	C	High Carbon	Orange	300	100	Thin	High Pitched ring	Large span
4	D	Grey Cast Iron	Reddish Yellow	210	35	Stretched	Heavily Sound	Smallest span but greater than tool steel
5	E	Tool Steel	Dull Yellow	100	15	No	Less-than Low Carbon steel	Smallest Spark
6	F	Stainless Steel	Bright	110	25	Arrow type	High econess Pitched	Length in b/w High C.S. & Low Carbon steel

RESULT AND DISCUSSION:

1. Discuss the effect of C-content on the characteristics of spark generated.
2. Discuss sound test used for determination of steel samples.

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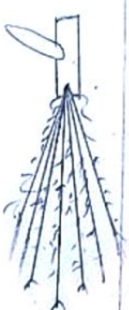
	Length	Span	Colour	Star formation
-carbon steel 	450mm	60mm	Yellow	Yes (thick)
Medium Carbon Steel 	280mm.	80mm	Dull Yellow	Yes (Medium)
High-carbon steel 	300mm	70mm	Orange	Yes (thin)
Grey Cast Iron 	210mm	35mm	Reddish Yellow	Yes (stretched)
Tool steel 	100mm	15mm	Dull Yellow	No

14/11/22

Stainless Steel	length	Span	Colour	Star formation
	110 mm	25 mm	Bright	Yes (Arrow type)

Result & Discussion

1. Discuss the effect of C-content on the characteristics of spark generated.

Sol^n: We can see from the table of spark test, the carbon content in the steel can be easily determined on the basis of span length.

As the carbon content increases the length of span decreases.

$$\text{As, } \quad C\text{-content} \propto \frac{1}{\text{Length of span}}$$

In the steels containing around 0.1% carbon, the carbon ray burst is distinctly visible, normally as the terminal forked tongue, with the appearance of the forced torque, the stream is brightened throughout. The true series burst of springs, typical of this type of steel first appears in steels containing around 0-15%. carbon. The simplest form of the series burst is consisting of a no. of simple 0-15%.. The length of the series burst is increased and buds and then stars burst is increased in no. as the carbon content is increased.

(1) Effect of sound test on the determination of steel sample:

Sol: The characteristics of sound for the given steels depends on the carbon content.

As in the table, low carbon steel bound a medium metallic ring, i.e, echo sound produced like a vibration with high frequency.

In the medium carbon steel, a medium pitched sound echos a little, and for the high carbon steel, a high pitched sound produces with no echo, sound gets disappears soon.

So, as the carbon content varies sound produced where hit the ground also varies.

Also different metals produce different sounds.

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B.TECH./B.E. II YEAR

MEC2930/EMEC2930

EXPERIMENT NO. - 2

YS 12/11/22

Name: PRANAY SINGH S. No.: 14 Section: A2MB

College No.: 21MEB448 Enrol. No.: GL2254

Date of Experiment: 11/11/2022 Date of Submission: 12/11/2022

OBJECT:

a) To determine the electrode consumption rate (ECR) at various current densities for electric arc welding process.

b) To study the quality of the weld.nent by joining metallic components of different thickness at various current densities.

EQUIPMENTS/TOOLS USED:

S. No.	Name	Specification	Make
1	Electric arc welding Machine	Current - 25-300A Voltage - 80-100V	—
2	Consumable Electrode	length = 350 mm	Made in India
3	Bench Vice	5 inch Parallel jaws	Made in India
4	12 double cut bastard file	6-8 teeth Size 12 inch	Made in India

PROCEDURE

1. Measure the length and diameter of core of an electrode.
2. Hold the electrode with the electrode holder.
3. Note down the voltage and ampere of the current to flow through the work piece.
4. Switch on the step down transformer.

OBSERVATIONS:

Electrode diameter (d): ....3.15 mm.......

Electrode length (l): ......340 mm......

Observation Table A:

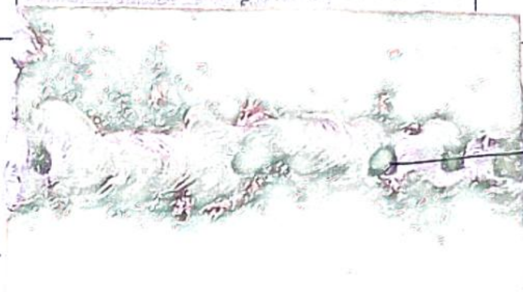
S. No.	Electrode length (mm)			time (s)	ECR (mm^3/s)P	I (A)	Current density ρ_I (A/mm^2)	Remark
	l_i	l_f	(l_i - l_f)					
1.	340	256	84	40	14.07	64	8.22	
2	340	245	95	40	18.5	94	12.06	
3	340	238	102	35	22.7	125	16.05	
4	340	145	195	44	34.52	150	19.25	
5	340	190	150	32	36.51	182	23.36	
6.	340	135	205	38	42.02	200	25.67	

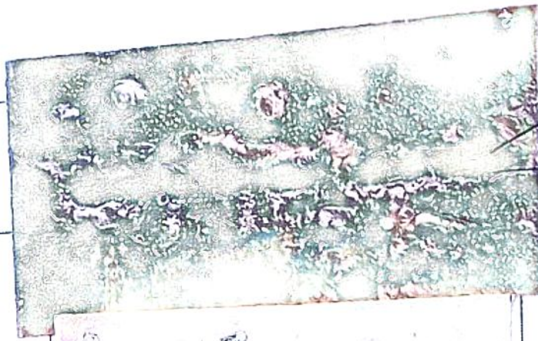
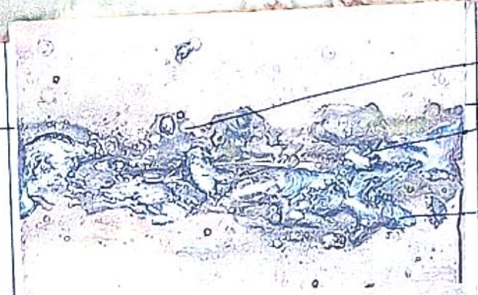
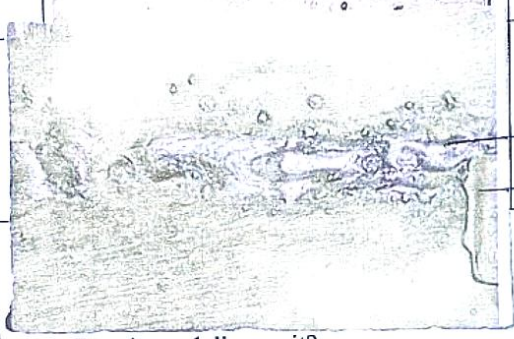
(14)

11.11.22

Observation Table B:

Welding time (t): ____________sec **Length of weldment (L):**_______

S.No.	Dimensions of Component (width×thickness) (in mm)	Current Density ρ_I (A/mm^2)	Photograph of the Weldment	Observation (Defect)
1.	25×3	0.85		Low penetration Cracks
2.	25×6	0.63		Holes Less Defects Better welding
3.	25×3	1.67		Cracks overlapping

4.	25×6	1		uneven welding, Holes, Excessive reinforcement
5.	25×3	2.43		spatter, Burnt, overlap
6.	25×6	1.34		Porosity, spatter

RESULT AND DISCUSSION:

1. Plot the graph of ECR Vs Current Density and discuss it?
2. Comment on the quality of weldments and discuss the observations made.
3. Discuss the ECR for 3mm/5mm MS plates keeping welding time constant and find out the best value of current.

Calculations

Electrode diameter (d) = 3.15 mm
Electrode length (l) = 350 mm

1. $l_i - l_f = 84$ mm, time = 40 s, $I = 64$ A

$$ECR = \frac{\left(\frac{\pi}{4}\right) d^2 (l_i - l_f)}{t} = \frac{\frac{\pi}{4} \times (3.15)^2 \times 84}{40} = 14.87 \text{ mm}^3/\text{s}$$

$$\delta_I = \frac{\text{Current}}{\text{Area}} = \frac{64}{\frac{\pi}{4} d^2} = 8.22 \text{ A/mm}^2$$

2. $l_i - l_f = 95$ mm, time = 40 s, $I = 94$ A

$$ECR = \frac{\frac{\pi}{4} \times (3.15)^2 \times 95}{40} = 18.5 \text{ mm}^3/\text{s}$$

$$\delta_I = \frac{I}{A} = \frac{94}{\frac{\pi}{4} \times d^2} = 12.06 \text{ A/mm}^2$$

Give one Sample Cal

3. $l_i - l_f = 102$ mm, time = 35 s, $I = 125$ A

$$ECR = \frac{\frac{\pi}{4} \times (3.15)^2 \times 102}{35} = 22.7 \text{ mm}^3/\text{s}$$

$$\delta_I = \frac{I}{A} = 16.05 \text{ A/mm}^2$$

4. $l_i - l_f = 195$ mm, time = 44 s, $I = 150$ A

$$ECR = \frac{\frac{\pi}{4} \times (3.15)^2 \times 195}{44} = 34.52 \text{ mm}^3/\text{s}$$

$$\delta_I = \frac{I}{A} = 19.25 \text{ A/mm}^2$$

5. $l_i - l_f = 150$ mm, time = 32 s, $I = 182$ A

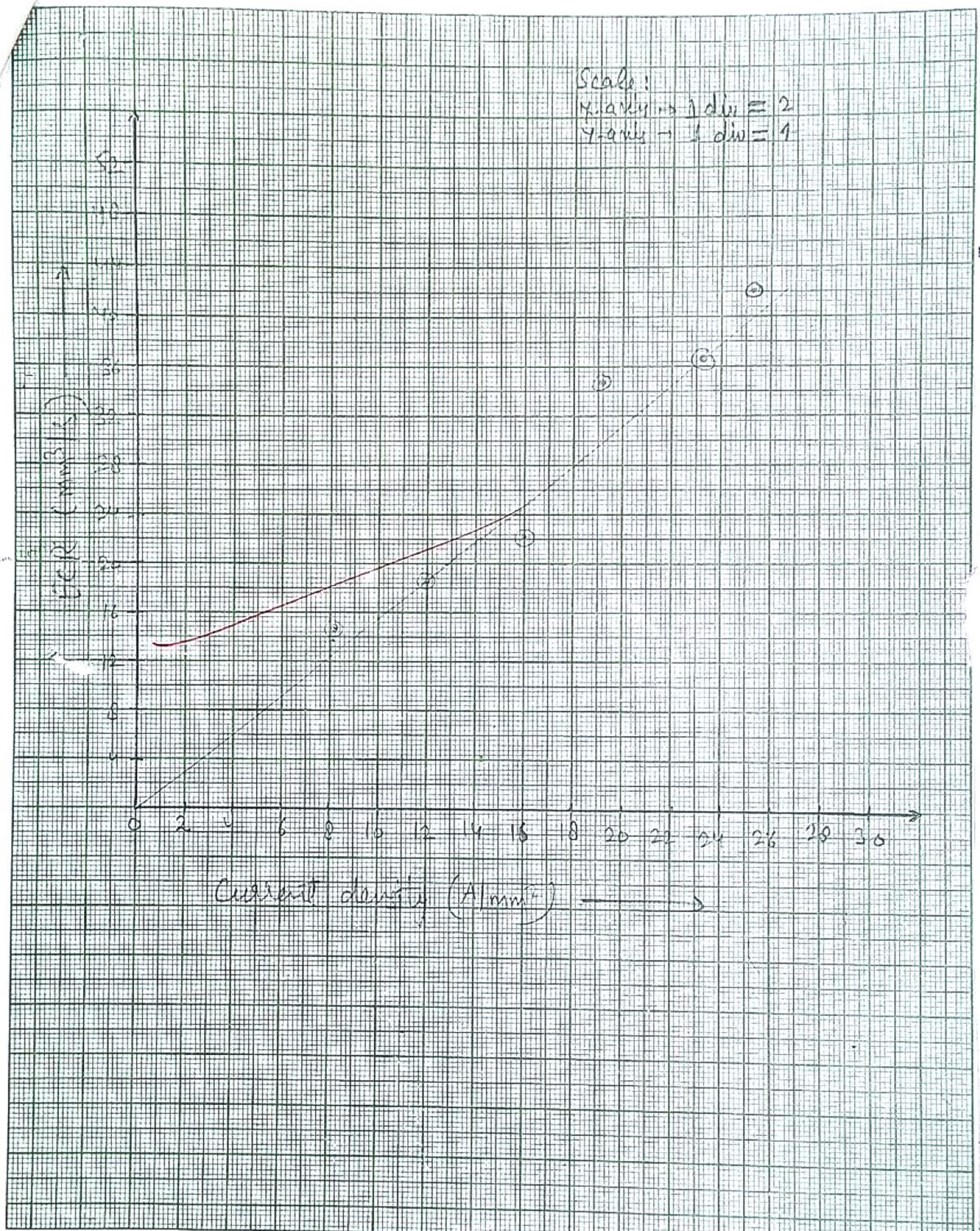
$$ECR = \frac{\frac{\pi}{4} \times (3.15)^2 \times 150}{32} = 36.51 \text{ mm}^3/\text{s}$$

$$\delta_I = \frac{I}{A} = 23.36 \text{ A/mm}^2$$

6. $l_i - l_f = 205$ mm, time $= 38$ s, $\bar{I} = 200$ A

$$ECR = \frac{\pi}{4} \times \frac{(l_i - l_f) \times d^2}{t} = 42.02 \text{ mm}^3/\text{s}$$

$$J_I = \frac{\bar{I}}{A} = \frac{200}{\frac{\pi}{4} \times d^2} = 25.67 \text{ A/mm}^2$$


Scale:
X-axis → 1 div = 2
Y-axis → 1 div = 1
Current density (A/mm²)

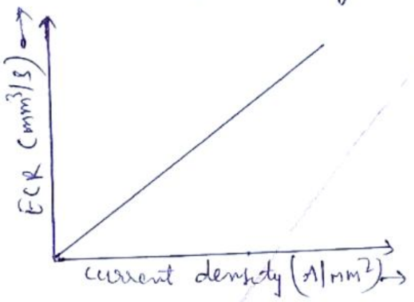
Result & Discussion

1. Plot the graph of ECR vs current density and discuss it.

Sol: After analysing the graph b/w ECR and current density it is observed that on increasing the current the electrode consumption rate (ECR) increases and vice-versa.
Hence we can conclude that the ECR is directly proportional to the current density.

$$ECR \propto \text{current density}$$

This can be shown on graph by a straight line.



2. Discuss the ECR for 3mm/5mm MS plate keeping welding time constant and find out the best value of current.

Solⁿ:- Increasing welding time causes high head input to weld zone and extending weld nugget.
As we increase the time the electrode on the job welds more smoothly and tightly.

2. Comment on the quality of weldment and discuss?

Solⁿ:- (a) Welding is not done properly there are cracks and breakage on the joint. At 64 A current workpiece was not welded thoroughly. Low penetration was observed because heat generated is low at low current.

(b) At 94 A, welding was better. Holes are observed in this weldment, there some spatters were observed due to low heat generated.

(c). At 125A cracks were observed. There were overlapping on weldment area.

(d) At 150 A, uneven welding is observed. Welding is not done properly. There were some holes on this area. In this excessive reinforcement was also observed.

(e) At 182 A, spatters were observed. Overlapping was also there. Burnt portion is also seen.

(f) At 200 A, porosity is observed on the weldment area. There were some also spatters on weldment area.

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EXPERIMENT NO. - 3

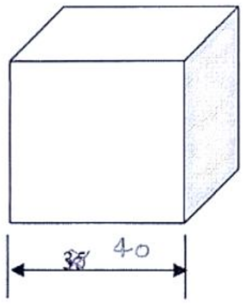
Name: PRANAY SINGH S. No.: 14 Section: A2MB

College No.: 21MEB448 Enrol. No.: GL2254

Date of Experiment: 27/09/2022 Date of Submission: 03/10/22

OBJECT: To design and produce patterns for the given engineering products incorporating the shrinkage & draft allowances:

(i) Single piece solid type (Figure 1);
(ii) Spilt pattern (Figure 1)



Figures 1: All dimensions are in mm.

EQUIPMENTS/TOOLS USED:

S. No.	Name	Specification	Make
1.	Double Cut Flat File	12 inch	J.K
2.	Carpentary benchvise	—	—
3.	Teak Wood	45×45×45 mm	
4.	Steel Scale	30 cm	Ajanta Steel
5.	Pencil	H Grade	Apsara

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SAFETY PRECAUTIONS

1. Each student should use apron while performing the experiment.
2. The operator should not use loose clothing while turning.
3. No one should touch the rotating devices work while rotating.
4. Fingers etc should be kept away from the edge of a chisel / blade of jack plane.
5. Work should be hold firmly while drilling / reaming.
6. The force to hold the work should be more (if required) when the drill bit approaches the end.

OBSERVATIONS:

Dimensions of solid/split pattern (Cubic)

Product No.	Required dimension of the product (D_1) (mm)			Dimension of Pattern (D_2) (mm)			Percentage allowance = $\left[\frac{D_1 \approx D_2}{D_1}\right] \times 100$
	L (mm)	W (mm)	H (mm)	L (mm)	W (mm)	H (mm)	Remarks
1.	~~35~~ 40	~~35~~ 40	~~35~~ 40	43.64	43.64	40.8	9.1%, 9.1%, 2%
2.	40	40	40	42.22	42.22	40.8	5.5%, 5.5%, 2%
3.							
4.							

1. Single piece solid type
2. Split pattern

27/9/22

Sample Calculations

(A) For Single piece solid pattern

* Required length of product $L_1 = 40$ mm

Shrinkage allowance = 2% of L_1 = 2% of 40 mm

$= \frac{40}{100} \times 2 = 0.8$ mm So, $40 + 0.8 = 40.8$ mm

Draft allowance = 2 degree = $40.8 \times \tan 2'$

$= 1.42$ mm

Total draft allowance = $2 \times 1.42 = 2.84$ mm

So, Total length of pattern = $40 + 0.8 + 2.84 = 43.64$ mm

$L_2 = 43.64$ mm

* Similarly for width (W)

Required width of product $W_1 = 40$mm

Shrinkage allowance = 2% of W_1 = 2% of 40

$= \frac{40}{100} \times 2 = 0.8$ mm So, $40 + 0.8 = 40.8$ mm

Draft allowance = 2 degree = $40.8 \times \tan 2 = 1.42$ mm

Total draft allowance = $2 \times 1.42 = 2.84$ mm

Total required width of pattern = $40 + 0.8 + 2.84 = 43.64$ mm

$W_2 = 43.64$ mm

For Height (H)

* Required height of product $H_1 = 40$ mm

In height only shrinkage allowance and no draft allowance

Shrinkage allowance = 2% of H_1 = 2% of 40 mm

$= \frac{40}{100} \times 2 = 0.8$mm So, Required height of pattern is $H_2 = 40 + 0.8 = 40.8$ mm

$H_2 = 40.8$ mm

(i) Percentage deviation along length (L) =

$$\left[\frac{\text{Length of the pattern} - \text{Req. length of Product}}{\text{Req. length of the product}}\right] \times 100$$

$$= \frac{L_2 - L_1}{L_1} \times 100 \Rightarrow \frac{43.64 - 40}{40} \times 100 = 9.1\%$$

(ii) Percentage deviation along width (W) =

$$\left[\frac{\text{Width of the pattern} - \text{Req. width of Product}}{\text{Req. } \cancel{\text{length}} \text{ width of the Product}}\right] \times 100$$

$$= \frac{W_2 - W_1}{W_1} \times 100 = \frac{43.64 - 40}{40} \times 100 = 9.1\%$$

(iii) Percentage deviation along height (H) =

$$\left[\frac{\text{Height of the pattern} - \text{Req. height of product}}{\text{Req. height of the product}}\right] \times 100$$

$$= \frac{H_2 - H_1}{H_1} \times 100 = \frac{40.8 - 40}{40} \times 100 = 2\%$$

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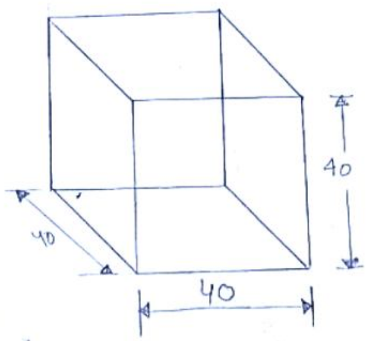
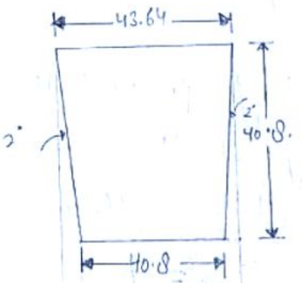




Single Piece Solid Pattern

(B) For Split piece pattern

* For length(l)

Required length of Product $L_1 = 40mm$

Shrinkage allowance $= 2\%$ of $L_1 = 2\%$ of $40mm$

$= \frac{2}{100} \times 40 = 0.8 mm$

So, we have $40 + 0.8 = 40.8 mm$

* For width(w)

Required width of product $w_1 = 40mm$

Shrinkage allowance $= 2\%$ of $w_1 = 2\%$ of $40mm$

$= \frac{2}{100} \times 40 = 0.8mm$, So, total width $= 40 + 0.8 = 40.8 mm$

Now, draft allowance, 2 degree $= \tan 2 \times 20.4 = 0.71 mm$

Total draft allowance in width $= 2 \times 0.71 = 1.42 mm$

So, Req. width of pattern $w_2 = 40 + 0.8 + 1.42 = 42.22mm$

$w_2 = 42.22 mm$

* For height(H)

Required height of the product $H_1 = 40 mm$

Shrinkage allowance $= 2\%$ of $H_1 = 2\%$ of $40 mm$

$= \frac{2}{100} \times 40 = 0.8 mm$. So, total height $= 40 + 0.8 = 40.8 mm = H_2$

But for taking draft allowance we use height $\frac{40.8}{2} = 20.4 mm$

Because, the height is splited in 2 parts.

Hence, draft allowance, 2 degree which will be $= 20.4 \times \tan 2^\circ$

$= 20.4 \times \tan 2 = 0.71 mm$

~~Total~~ Length draft allowance in length $= 2 \times 0.71 = 1.42 mm$

Required length of pattern $= 40 + 0.8 + 1.42 = 42.22 mm$

$L_2 = 42.22 mm$

(i) Percentage deviation along length (L) =

$$\left[\frac{\text{Length of the pattern} - \text{Req. length of the product}}{\text{Req. length of the product}}\right] \times 100$$

$$= \frac{L_2 - L_1}{L_1} \times 100 = \frac{42.22-40}{40} \times 100 = \underline{5.55\%}$$

(ii) Percentage deviation along width (W) =

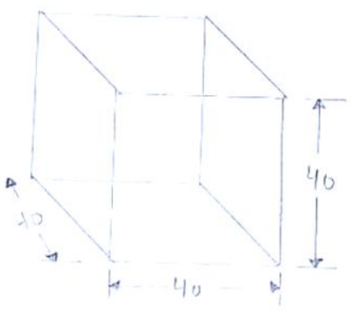
$$\left[\frac{\text{Length of pattern} - \text{Req. length of the product}}{\text{Req. length of the product}}\right] \times 100$$

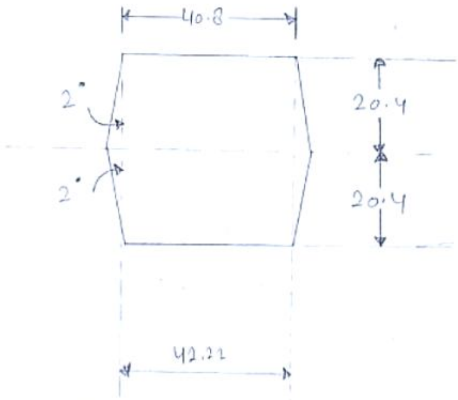
$$= \frac{W_2 - W_1}{W_1} \times 100 = \frac{42.22-40}{40} \times 100 = \underline{5.55\%}$$

(iii) Percentage deviation along Height (H) =

$$\left[\frac{\text{Height of the pattern} - \text{Req. height of the product}}{\text{Req. height of the product}}\right] \times 100$$

$$= \frac{H_2 - H_1}{H_1} \times 100 = \frac{40.8-40}{40} \times 100 = \underline{2\%}$$





Split piece pattern

Result and Discussion

Q1 - Significance of providing allowances in mechanical engineering products.

A - We know, a pattern is a replica of the object to be cast. However, the object to be cast and the pattern is not exactly the same i.e. there are certain modifications. In order to compensate for any dimensional changes which will happen during cooling process, allowances are usually made in the pattern. Therefore, a pattern is always somewhat larger than its final job to be produced so that it compensates the material lost during the cooling process and machining process as a consquences of which, the final job is of the required dimensions as required even after suffering losses in the manufacturing phase.

The various allowances introduced while preparing a pattern are namely as follows:

* Shrinkage Allowance → (a) Liquid Shrinkage (b) Solid Shrinkage
* Machining Allowance * Draft Allowance
* Distortion Allowance * Shake/Rapping Allowance

Q2 - Discuss the observations as per the given table:

A:- From the observation table, we observe that it is very important to consider various allowances while designing the pattern so that the product obtained after casting has the dimensions required by us after going through all the losses and compensating the losses in the manufacturing phase.

Shaking and Machining allowances are very important in a pattern, failure to which will result in a smaller product that the required one.

We also observe that percentage deviation is more in single piece pattern as compared to split pattern. Hence, dimensions are to be managed more in case of a single-piece pattern as compared to those of split pattern.

Q3- Why do we provide shrinkage allowances? Discuss the significance of solid & liquid shrinkage allowances in metal casting.

Ans:- Shrinkage is defined as reducting in the dimension of the cast during the cooling or solidification process. The magnitude of shrinkage varies from material to material but it is a general property of all materials. Shrinkage allowances are provided in the pattern to compensate the shrink to some extent due to metal shrinkage property at the time of cooling.

Liquid shrinkage => This allowance is provided in the pattern to compensate the reduction in volume when the metal changes from liquid state to solid state. Riser which feed the liquid metal to the casting is provided in the mould to compensate this type of shrinkage.

Solid shrinkage => This allowance is provided in the pattern to compensate the reduction in volume caused when metal loses its temperature in solid state. Shrink rule is used to compensate solid shrinkage depending on the material contraction state.

Q4- What is the significance of providing "Drafting allowance" and "Rapping allowancy"?

Ans:- Draft allowance => When the pattern is removed from the mould, the parallel surface to the dirn at which the pattern is withdrawn gets damaged and gets converted into slightly tapped surfacy.

Shake/Rapping allowance => When the pattern is to be removed from the sand of casting, the pattern will have to be shaken slightly to remove it from the sand and this will cause a slight increase in dimension of casting.

To compensate this increase in dimension, the patterns are made slightly smaller from casting i.e. this allowance is always negative. This change in dimension of pattern is known as rapping allowancy.

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EXPERIMENT NO. - 4

Name: PRANAY SINGH S. No.: 14 Section: A2MB

College No.: 21MEB448 Enrol. No.: GL2254

Date of Experiment: 01/10/2022 Date of Submission: 05/11/2022

OBJECT: To perform the following experiments in Sand Testing Lab:

a) Determine the affect of ramming on various properties of moulding sand.
   - (i) Moisture Content;
   - (ii) Permeability Number;
   - (iii) Hardness of Sand Mould;
   - (iv) Crushing and Shearing Strength of the Sand Mould; and

b) Find out:
   - (i) Clay Content; and
   - (ii) AFS Grain Fineness Number of the given Moulding Sand

EQUIPMENTS/TOOLS USED:

S. No.	Name	Specification	Make
1.	Physical Balance	10 mg - 50 g	
2.	Lab oven	250° C	Yorko
3.	Sieve Shaker	0.05 mm - 2 mm	Mody Testing Instrument Baroda
4.	Hand Rammer	5 kg ramming force	"
5.	Universal strength Tester	0.01 - 1.0 kg/cm²	"
6.	Permeability meter	1 No - 90 No.	"
7.	Green Mould Hardness tester	1 - 100 No.	Millhard

PRODUCT MATERIAL:

SAFETY PRECAUTIONS

1. Each student should use apron while performing the experiment.
2. Proper alignment of split pattern.
3. Sprinkle parting sand uniformly throughout between (i) cope and drag and (ii) pattern and moulding sand.
4. Ramming should be uniform and with uniform pressure.

OBSERVATIONS:

(A) Effect of moulding parameters on the properties of moulding sand.

S. No.	Number of Rams	Moisture Content	Permeability	Hardness	Crushing strength	Shear strength
1.						
2.	3	7.3%	20	34	0.21	0.06
3.						
1.						
2.	7	7.3%	15	47	0.29	0.09
3.						
1.						
2.	11	7.3%	8	56	0.26	0.07
3.						
1.						
2.						

RRKhan
01/10/2021

(B) **Moisture content**

Weight of moulding sand = 20 grams

Weight of dried sand = 18.54 grams

Percentage of moisture = 7.3 %

X **Clay content**

Weight of dry moulding sand = 50 grams

Weight of washed sand = grams

Percentage of clay = %

(B) **AFS Grain fineness number**

Sample 1:

Type of Sand: Silica Sand **Weight of Sand:** 50 **gm**

S. No.	Sieves-size (Microns)	% of sand retained "p_i"	Factor "f_i"	Product of column 2 and column 3 "$p_i f_i$"
1	2057	0	4	0
2	1680	0	5	0
3	1003	0.10	9	0.90
4	710	0.38	16	6.08
5	500	0.78	26	20.28
6	355	5.24	36	188.64
7	250	31.38	46	1443.48
8	150	38.04	70	2662.8
9	105	15.84	100	1584

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10	75	3.72	145	539.4
11	53	3.38	200	676
12	Pan	1.14	300	342
	Total ∑	100		7463.58

Sample 2:

Type of Sand: Badarpur **Weight of Sand:** 50 **gm**

S. No.	Sieves-size (Microns)	% of sand retained "p_i"	Factor "f_i"	Product of column 2 and column 3 "p_if_i"
1	2057	2.24	4	8.96
2	1680	2.68	5	13.4
3	1003	13.04	9	117.36
4	710	16.92	16	270.72
5	500	15.44	26	401.44
6	355	26	36	936
7	250	18.04	46	829.84
8	150	3.46	70	242.2
9	105	0.28	100	28
10	75	0.62	145	89.9
11	53	0.84	200	168
12	Pan	0.44	300	132

	Total $\sum$	100		3237.82

$$\text{AFS grain fineness number} = \frac{\sum_i pifi}{\sum_i pi}$$

RESULT AND DISCUSSION:

Q1. Draw a graph between Sieves-size (Microns) verses percentage of sand retained.

Q2. Draw graphs between:

- Number of Rams vs Permeability
- Number of Rams vs Hardness
- Number of Rams vs Crushing Strength
- Number of Rams vs Shear Strength

Q3. Discuss the graphs drawn. Discuss their effects on sand casting.

Q4. Compare and discuss the significance of AFS Grain Fineness Number on casting.

Calculations

=> Moisture content

Weight of moulding sand = 20 gm
Weight of dried sand = 18.54 gm

Percentage of moisture = $\frac{20-18.54}{20} \times 100\% = 7.3\%$

=> AFS Grain Fineness Number

Sample 1 :-

$\Sigma p_i = 0+0+0.10+0.38+0.78+5.24+31.38+38.04+15.84+3.72+3.38+1.14 = 100$

$\Sigma p_i = 100$

$\Sigma p_i f_i = 0+0+0.90+6.08+20.28+188.64+1443.48+2662.8+1584+539.4+676+342$

$\Sigma p_i f_i = 7463.58$

AFS grain fineness number = $\frac{\Sigma p_i f_i}{\Sigma p_i} = \frac{7463.58}{100}$

$\boxed{\text{AFS No.} = 74.64}$

Sample 2

$\Sigma p_i = 2.24 + 2.68 + 13.04 + 16.92 + 15.44 + 26 + 18.04 + 3.46 + 0.28$
$+ 0.62 + 0.84 + 0.44 = 100$

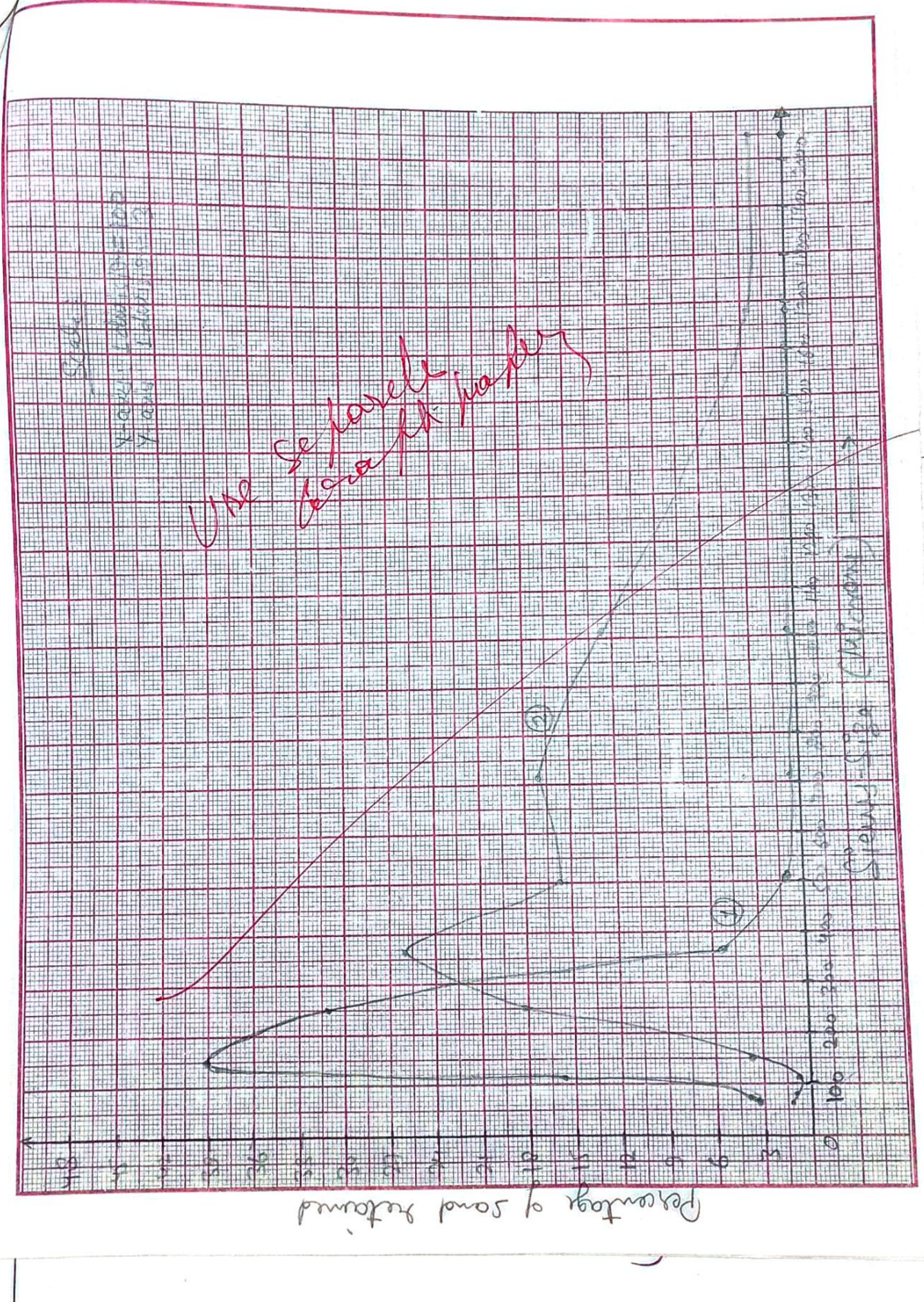
$\Sigma p_i = 100$

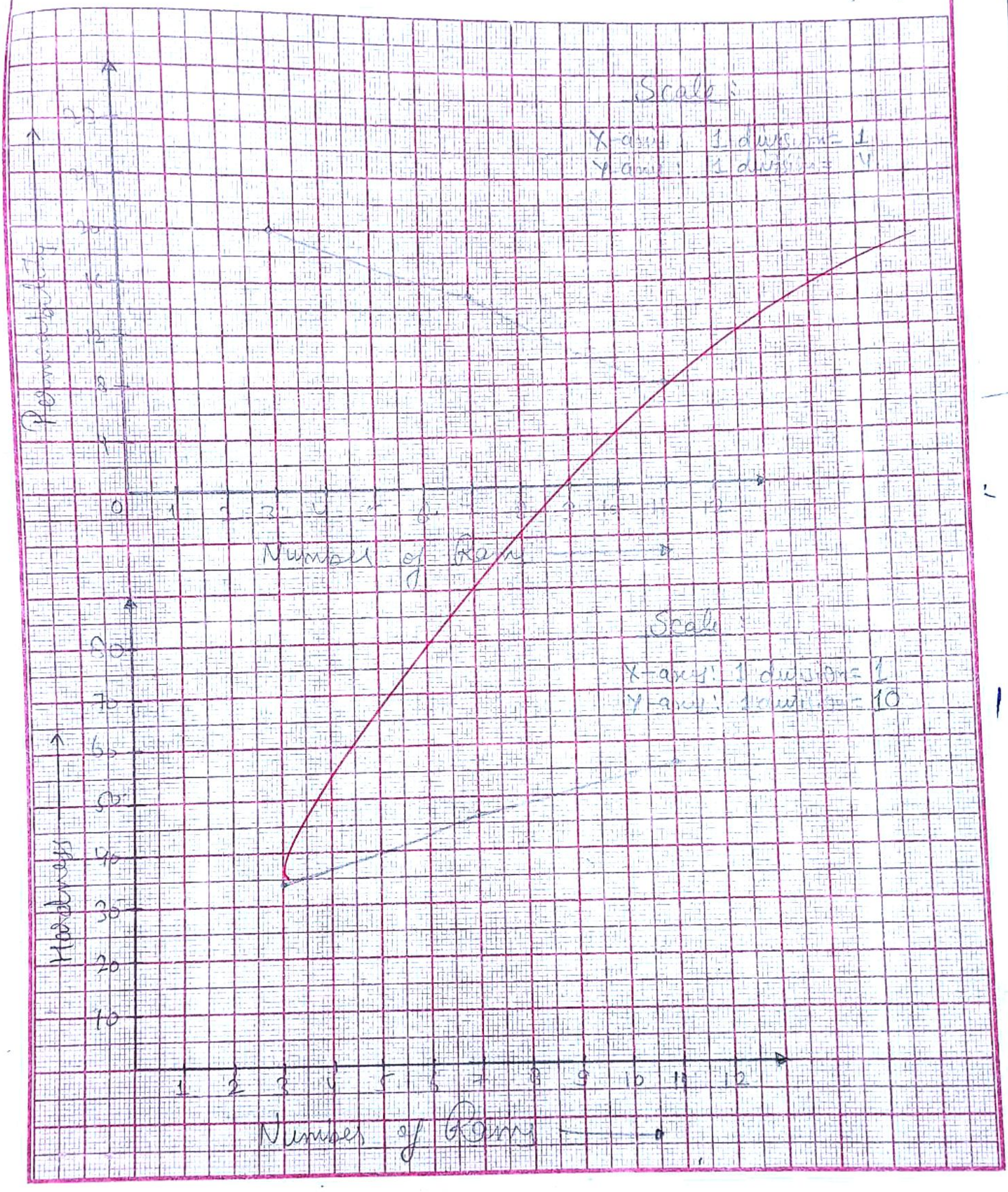
$\Sigma p_i f_i = 8.96 + 13.4 + 117.36 + 270.72 + 401.44 + 936 + 829.84$
$+ 242.2 + 28 + 89.9 + 168 + 132$

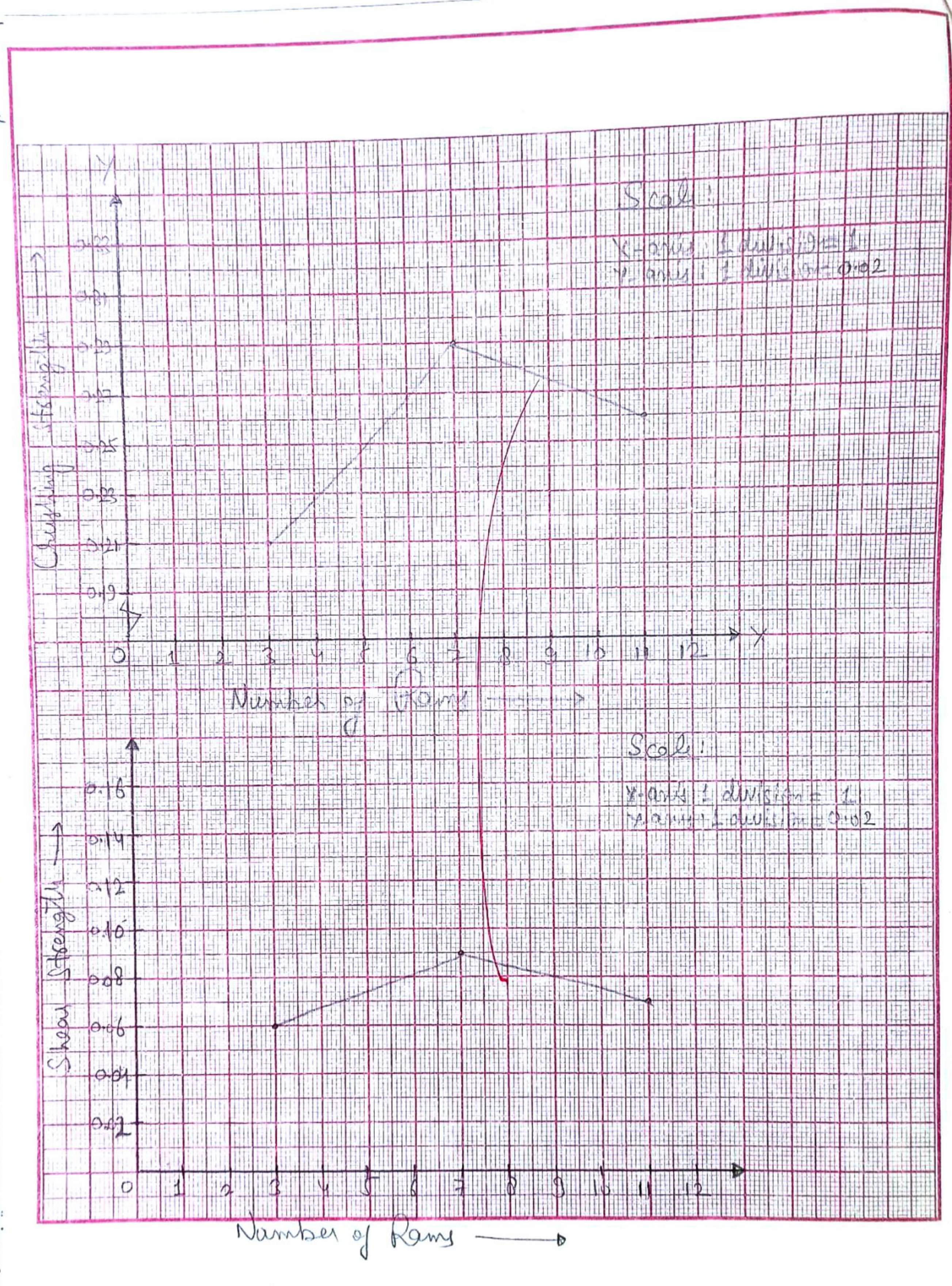
$\Sigma p_i f_i = 3237.82$

AFS Grain fineness No. $= \dfrac{\Sigma p_i f_i}{\Sigma p_i} = \dfrac{3237.82}{100}$

$\boxed{\text{AFS No.} = 32.37}$


Use separate graph paper
Percentage of sand retained
Sieve size (Micron)


Scale :
X-axis : 1 division = 1
Y-axis : 1 division = 1
Number of Rams
Scale :
X-axis : 1 division = 1
Y-axis : 1 division = 10
Hardness
Number of Rams


Scale:
X-axis 1 division = 1
Y-axis 1 division = 0.02
Crushing Strength
Number of Rams
Scale:
X-axis 1 division = 1
Y-axis 1 division = 0.02
Shear Strength
Number of Rams

Ques 3 → Discuss the graph drawn, Discuss their effect on Sand casting.

⇒ No. of Rams vs Permeability Graph

On observing the graph, we can conclude that, the permeability is inversely proportional to no. of rams. Hence greater the no. of rams lower the permeability and vice-versa.

⇒ No. of Rams vs Hardness graph

By looking at the graph it can be concluded that the hardness is directly proportional to numbers of rams. In the beginning hardness rapidly increases with increase in number of rams. Hardness of mould can be increased by increasing the no. of rams.

⇒ No. of Rams vs Crushing strength graph

The graph concludes that, the crushing strength of mould can be increased by increasing the no. of rams, but upto certain finite value. After so much of intense ramming the crushing strength seems to be saturating.

⇒ No. of Rams vs Shearing strength graph

The mould have low shearing strength, it increases with increase in no. of ramming, but like crushing strength it also seems to be saturated at some point.

Ques 4 - Compare and discuss the significance of AFS Grain Fineness number on casting.

Sol:- AFS Grain Fineness number is the standard for reporting the grain size. AFS stands for 'American Foundry Society'. The number is calculated from the size distribution, which is determined by standard ASTM series. AFS number gets bigger as the average size decreases.

The significance of the AFS grain fineness number can be described to the fact that this value is proportional with no. of grains per unit of weight and with the specific surface area of sand.

Calculating the grain fineness number gives an estimate of the average sieve-size of a sand sample. Many properties of moulding sand depends on the grain size and distribution of sand particle. Small size enhances mould strength, but large grain size is more permeable. Large grain size results in comparatively lower surface finish but higher permeability and fine grain size results in better surface finish, but low permeability.

AFS Not Significance not explain

- incorrect graph
- 'n' cal's are incorrect

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12/12/22

MANUFACTURING TECHNOLOGY LABORATORY-I

DEPARTMENT OF MECHANICAL ENGINEERING
AMU, ALIGARH
B.TECH./B.E. II YEAR

MEC2930/EMEC2930

EXPERIMENT NO. – 1

Name: Pranay Singh S. No.: 14 Section: A2MB

College No.: 21MEB448 Enrol. No.: GL2254

Date of Experiment: 03/12/2022 Date of Submission: 10/12/2022

OBJECT: To study the effect of forces on the lateral & longitudinal deformation during forging of the given component.

EQUIPMENTS/TOOLS USED:

S. No.	Name	Specification	Make
1.	Hydraulic Press	200 Ton	Rajco.
2.	Vernier Caliper	6 inch digital	Mitutoyo Japan
3.	Bench Vice	4 inch parallel Jaw	—
4.	Hand hacksaw	12 inches blade	—
5.	File	12" double cut file	J.K.

3/12/22

PROCEDURE

1. Each student should use apron while performing the experiment.
2. Cut a test specimen of desired dimension from a metal strip by using hand saw and bench vice.
3. File the specimen to make all its 6 faces flat.
4. Measure and note the dimensions of the specimen.
5. Note the zero correction of the main scale of the hydraulic press.

OBSERVATIONS:

Dimensions of the component:

Length: 24.84 mm

Breadth: 18.41 mm

Thickness: 6 mm

Load (Ton)	S. No	Force (N)	Area A_f (final) mm	True Stress N/mm² σ_T	Length (mm) L_i	L_f	True Strain ε_T	Width (mm) W_i	W_f	True Strain ε_T
10	1.	98100	556.84	176.17	24.84	27.11	0.087	18.41	20.54	0.109
15	2.	1,47,150	644.57	220.29	27.11	28.84	0.061	20.54	22.35	0.084
20	3.	1,96,200	741.44	264.62	28.84	30.14	0.044	22.35	24.6	0.096
25	4.	2,45,250	838.51	292.48	30.14	31.81	0.054	24.6	26.36	0.069
30	5.	2,94,300	946.41	310.96	31.81	32.68	0.027	26.36	28.96	0.094
35	6.	3,43,350	1023.85	335.35	32.68	33.97	0.038	28.96	30.14	0.039
	7.									
	8.									
	9.									
	10.									

True stress, $\sigma_T = \dfrac{F}{A_f}$ or, $\sigma_T = \sigma\,(1+\varepsilon)$

True strain $\varepsilon_T = \ln\dfrac{L_f}{L_i}$ or, $\varepsilon_T = \ln(1+\varepsilon)$

where L_f = successive values of the length as it changes

$\boldsymbol{\sigma_T = K\,.\,\varepsilon_T^{n}}$ where, n = strain hardening parameter, $0 \le n \le 1$

K = constant and depends on the type of material in N/mm²

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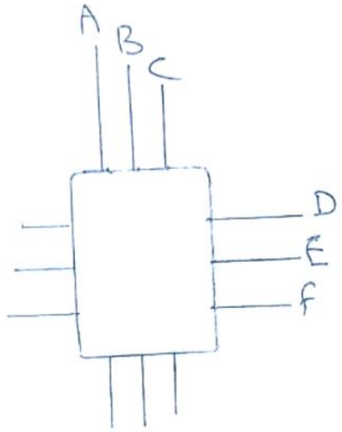
RESULT AND DISCUSSION:

1. Plot the true stress vs true strain graph showing the deformation phenomenon.
2. Plot the graph between log σ_T and log ε_T and find out value of strain hardening parameter 'n'.
3. Compare and comment the result obtained with standard curve.

S.No.	log σ_T	Length, log ϵ_T	Width, log ϵ_T
1.	2.24	-1.06	-0.96
2.	2.35	-1.21	-1.07
3.	2.42	-1.35	-1.01
4.	2.46	-1.26	-1.16
5.	2.49	-1.56	-1.02
6.	2.52	-1.42	-1.40

Initial reading



A = 24.84 mm
B = 24.84 mm
C = 24.84 mm
} 24.84

D = 18.30 mm
E = 18.54 mm
F = 18.41 mm
} 18.41

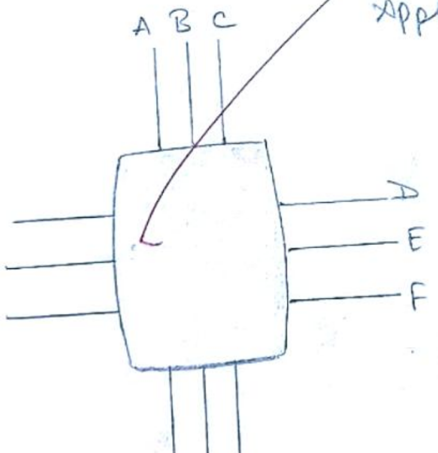
Applied load = 10 Ton

A = 27.06 mm
B = 27.18 mm
C = 27.11 mm
} 27.11

D = 20.37 mm
E = 20.67 mm
F = 20.60 mm
} 20.54

Final reading

Applied load = 15 Ton



A = 28.58 mm
B = 28.97 mm
C = 28.97 mm
} 28.84

D = 21.80 mm
E = 22.83 mm
F = 22.43 mm
} 22.35

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Sample Calculation

Taking reading 1

Load = 10 ton, Force = load × g = 10 × 1000 × 9.81

$\boxed{F = 98100}$ N

L_i = 24.84 mm, L_f = 27.11

w_i = 18.41 mm, W_f = 20.84

Final area = $L_f \times w_f$

$A_f = 27.11 \times 20.84$

$A_f = 556.84 \text{ mm}^2$

- True stress, $\sigma_T = \frac{Force}{A_f} = \frac{98100}{556.84} \Rightarrow \boxed{\sigma_T = 176.17 \text{ N/mm}^2}$

- True strain (length), $\epsilon_T = \ln\left(\frac{L_f}{L_i}\right) = \ln\left(\frac{27.11}{24.84}\right)$

  $\boxed{\epsilon_T = 0.087}$, $\boxed{\log \epsilon_T = -1.06}$

- True strain (width), $\epsilon_T = \ln\left(\frac{w_f}{w_i}\right) = \ln\left(\frac{20.84}{18.41}\right)$

  $\boxed{\epsilon_T = 0.109}$

  $\boxed{\log \epsilon_T = -0.96}$

Calculation for 'n'

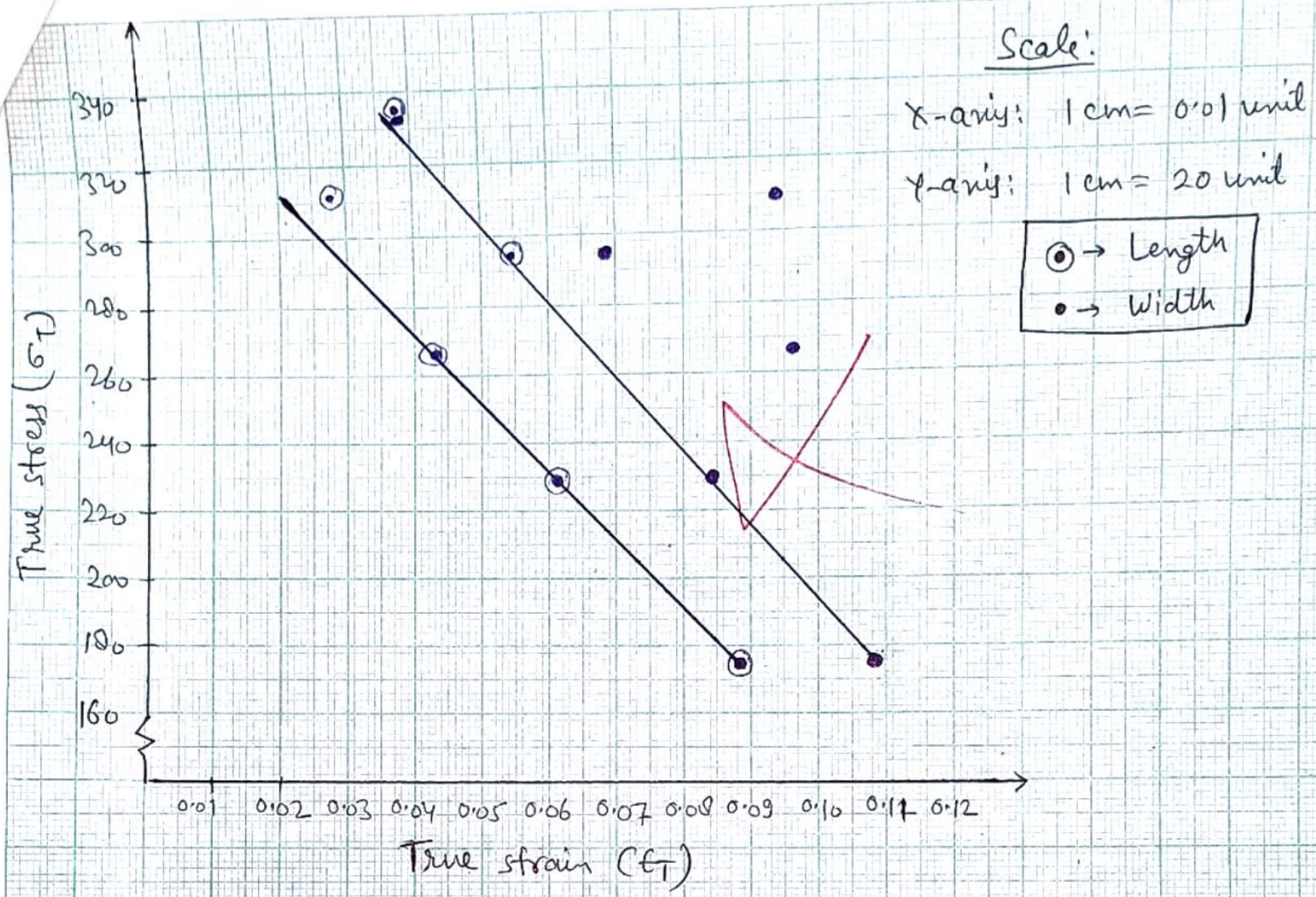
In ΔABC (length), slope = $\frac{y_2 - y_1}{x_2 - x_1} \Rightarrow n_1 = \frac{2.52 - 2.24}{-1.42 + 1.06} = \left|\frac{0.28}{0.36}\right|$

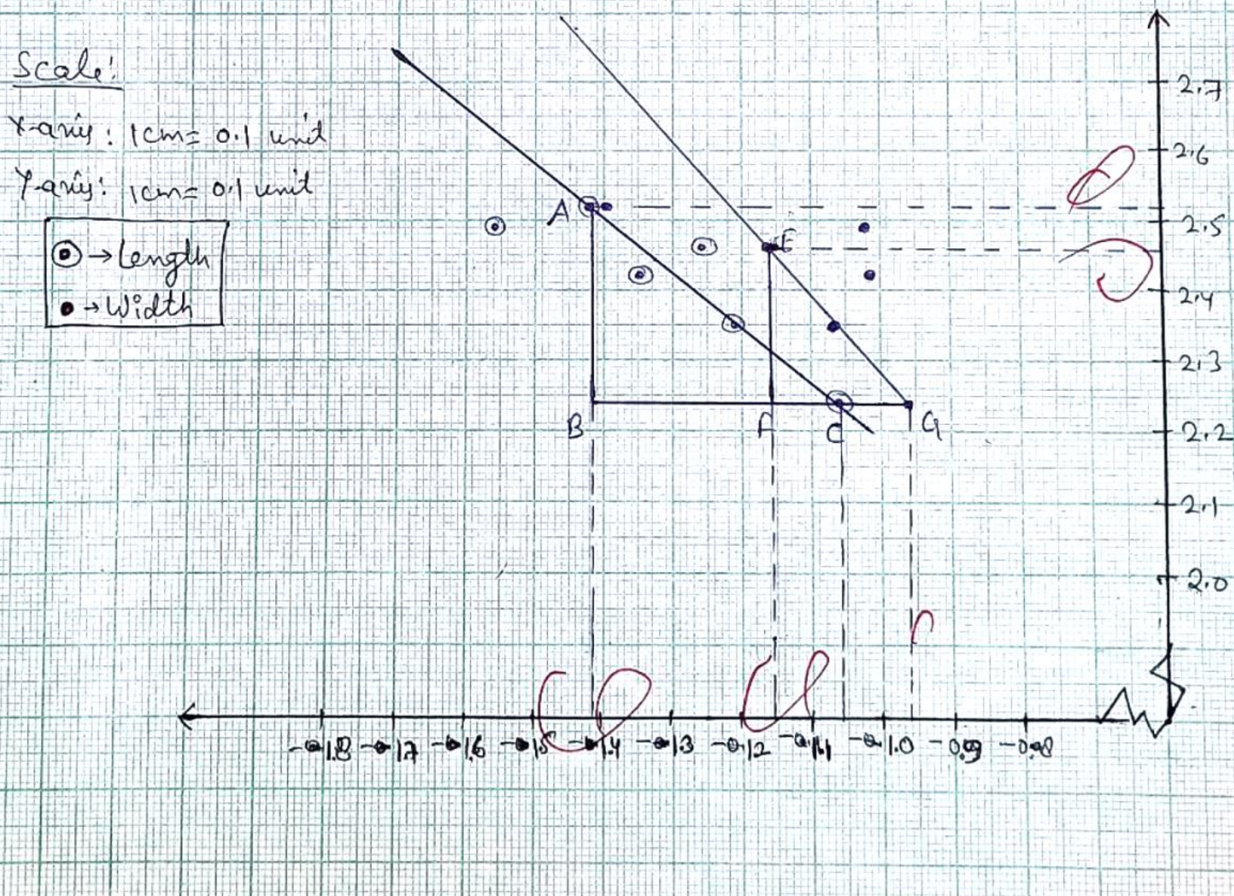
$\boxed{n_1 = 0.78}$

In ΔEFG (width)

$n_2 = \frac{2.46 - 2.24}{-1.16 + 0.96} = \frac{0.22}{0.2} \Rightarrow \boxed{n_2 = 1.1}$

$n = \frac{n_1 + n_2}{2} = \frac{0.78 + 1.1}{2} = \frac{1.88}{2} \Rightarrow \boxed{n = 0.94}$


Scale:
X-axis: 1 cm = 0.01 unit
Y-axis: 1 cm = 20 unit
⊙ → Length
• → Width
True stress (σT)
True strain (εT)
340
320
300
280
260
240
220
200
180
160
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12


Scale:
X-axis: 1cm = 0.1 unit
Y-axis: 1cm = 0.1 unit
⊙ → Length
• → Width
A
E
B
F
C
G
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
-1.8 -1.7 -1.6 -1.5 -1.4 -1.3 -1.2 -1.1 -1.0 -0.9 -0.8

Compare and comment the result obtained with standard curve.

True stress is the applied load divided by the actual cross sectional area (the changing area with time) of material. The strain hardening component (n) determines how the metal behaves when it is being formed.
Materials that have higher n values have better formability than those with lower n values. When one plots the graph between true stress and true strain, there is a portion in which Hooke's law holds and it is similar to the stress-strain standard curve. But there is a portion in which hooke's law not holds and stress doesn't change much for increase in strain.
The first portion represents the elastic region and second portion represents the plastic region.
If we plot the graph between $\log(\sigma_T)$ and $\log(\epsilon_T)$, the slope gives the strain hardening parameter.

Labelling of sub-section of HAZ req

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MANUFACTURING TECHNOLOGY LABORATORY-I

DEPARTMENT OF MECHANICAL ENGINEERING
AMU, ALIGARH
B.TECH./B.E. II YEAR

MEC2930/EMEC2930

EXPERIMENT NO. - 2

Name: Pranay Singh S. No.: 14 Section: A2MB

College No.: 21MEB448 Enrol. No.: GL2254

Date of Experiment: 03/12/2022 Date of Submission: 10/12/2022

OBJECT: To identify the heat affected zone (HAZ) of the welded part through visual inspection method.

EQUIPMENTS/TOOLS USED:

S. No.	Name	Specification	Make
1.	Bench Vice	5" Jaw	LION
2.	File	12" Rough	J.K.
3.	Welding Machine	25-300 A	INDARC I.O.L.
4.	Electrode	3.15 mm ϕ	Victor

03.12.22

PROCEDURE

1. Measure the length and diameter of core of an electrode.
2. Hold the electrode with the electrode holder.
3. Note down the voltage and ampere of the current to flow through the work piece.
4. Switch on the step down transformer.
5. Strike the end of the electrode on a work piece to develop an arc.
6. Note the time at which the arc is struck.
7. Cease the flow of current by raising the electrode.

8. Note down the time of the cease of the current.
9. Change the voltage and ampere of current.
10. Repeat the experiment for each value of voltage and amperage.

SAFETY PRECAUTIONS

1. Each student should use apron while performing the experiment.
2. Use welding screen while welding the work pieces.
3. Keep the body away from the work piece while welding.
4. Don't use synthetic clothes in welding shop.

WORK MATERIAL:

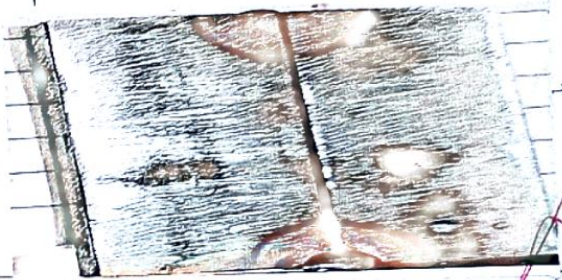
Type: Ferrous / Nonferrous

If ferrous, Mild steel / Medium C-steel / High C-steel

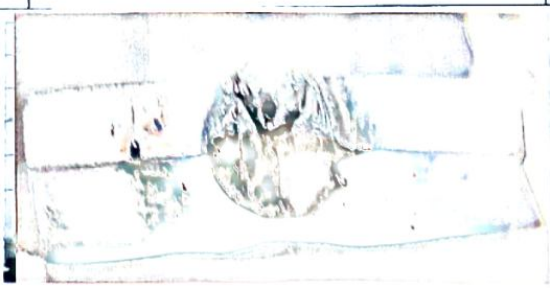
Size:

OBSERVATIONS:

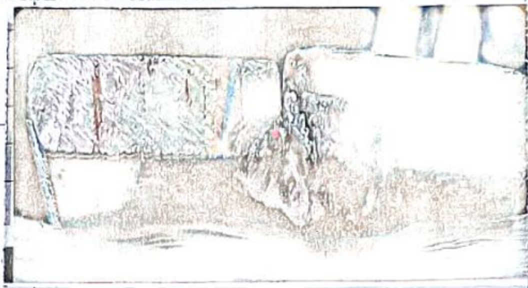
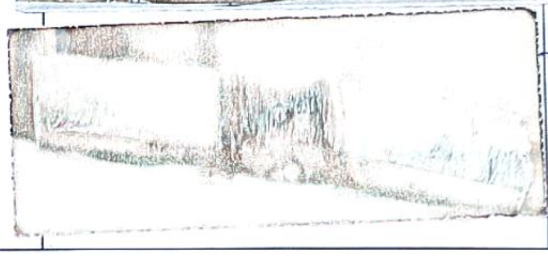
Heat Affected Zone (HAZ)

Specimen No.	Specimen Dimensions	Current Applied (I) (Amp.)	Photograph/Marking of the Welded Zones	Observations (HAZ)
1.	25×6	94		→ Welding is not so significant. → less penetration observed

M. Label the sub-sections of HAZ



HAZ can easily identified.

2.	25+6	125	 	Neither more nor less penetration is observed. →HAZ is observed.
3.	25+6	158	 	→Distortion is weldment. →Penetration is observed →HAZ can be seen more clearly.

RESULT AND DISCUSSION:

1. Explain the phenomena of developing HAZ.
2. Sketch the different Fusion-HAZ sub-sections observed by you and label them.
3. Comment on the result obtained.

Sub-section labelling required

Result and Discussion

Q. Explain the phenomenon of developing HAZ.

Sol: The heat affected zone or HAZ can be defined as the area between the Melted metal and base metal where microstructural changes occur.

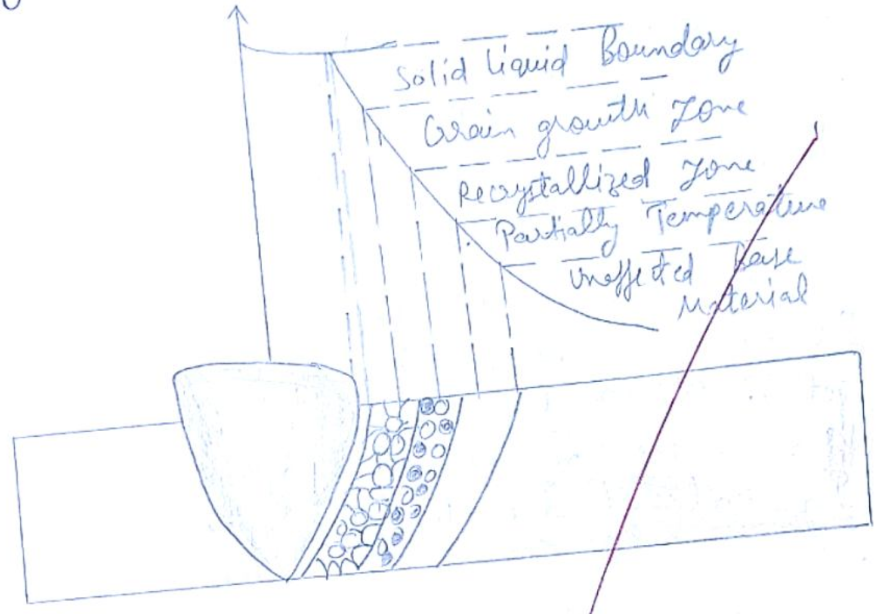
It is generated when a metal is subjected to very high temperatures (Example- Welding, Mechanical cutting, laser cutting, plasma cutting, etc.). This is the non-melted zone near the exact worked area. The mechanical properties of the heat affected zone are altered due to being exposed to high temperature.

A heat affected zone weakens the metal by reducing its mechanical strength and is the weakest section in a weldment. Depending on various factors like material properties, heat concentration, and intensity, welding or metal cutting process the HAZ area can vary in size and severity. During the welding or cutting, distinct HAZ areas are formed by use of different temperatures in the base metal.

A series of visible colored bands are generated known as heat tints. They are caused by the surface oxidation process specifically in stainless steel. However, these temperature causing the 'temper colors' are much lower temperatures then those which form the HAZ. Also, these colour bands can extend for some distance beyond the actual HAZ.

The extent and magnitude of property change spends primarily on the base material, the weld filler material, and the amount and concentration of heat input by the welding process.

Q2 - Sketch the different fusion HAZ subsection observed by you and label them.



Q3 - Comment on the result obtained.

Sol:- The table which is attached gives the qualitative analysis. It is visual inspection of HAZ means we noted the results by simply looking over a welded part.

We came to k/n that too low and too high currents causes defects in welding and affects its strength also.

The best value of current depends on the thickness of the electrode used to obtain an ideal weld.

MANUFACTURING TECHNOLOGY LABORATORY-I
DEPARTMENT OF MECHANICAL ENGINEERING
AMU, ALIGARH
B.TECH./B.E. II YEAR

3.5 SA

MEC2930/EMEC2930

EXPERIMENT NO. -3(a)

Name: PRANAY SINGH S. No.: 14 Section: A2MB.

College No.: 21MEB448 Enrol. No.: GL2254

Date of Experiment: 26/11/2022 Date of Submission: 02/12/2002

OBJECT:

a) To identify and study the various phases in microstructures of the following standard specimen:

(iv) ~~High Carbon~~ Steel; (i) Low Carbon Steel

(v) ~~Brass; &~~ (ii) Medium Carbon Steel

(vi) ~~Cast Iron~~. (iii) Bronze

MATERIAL & EQUIPMENTS/TOOLS USED:

S. No.	Name	Specification	Make
1.	Microscope	- ?	?
2.	Low Carbon Steel	-	-
3.	Medium Carbon Steel	-	-
4.	Bronze		

NAME OF DIFFERENT PHASES:

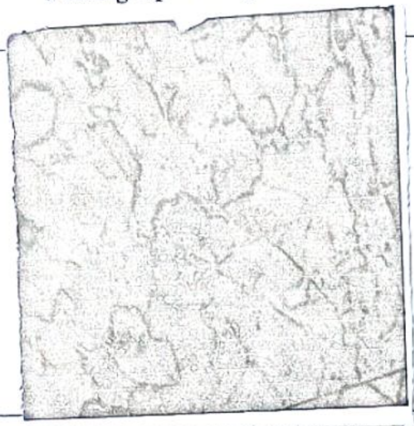
Ferrous metal → $\left.\begin{array}{l}\text{Low Carbon Steel}\\ \text{Medium Carbon Steel}\end{array}\right\} \rightarrow$ {Pearlite & Ferrite}

Non-ferrous metals Bronze

OBSERVATIONS

PASTE & LABEL A NEAT PHOTOGRAPH SHOWING VARIOUS PHASES PRESENT IN THE STANDARD SPECIMEN

STANDARD SPECIMEN

Specimen name	Photograph/Image with phases	Phases identified
Low Carbon Steel		Light phase- ferrite Dark phase- Pearlite
Medium Carbon Steel		Light phase- Ferrite Dark phase- Pearlite
Brasse		Phases- [Alpha + Beta Phases] B/w dendrite arms

Result & Discussion

Q1 - Discuss the findings of the above observations in detail and compare the results.

Sol Low Carbon Steel - The photograph of low carbon steel shows the microstructure of low carbon steel and is taken by microscope. In undeformed state, coupled with slow cooling during solidification, low carbon steel will have microstructure consisting of: Pearlite & Ferrite.
Microstructure of low carbon steel, with light phase being the ferrite and the dark phase being pearlite.

Medium Carbon Steel - The photograph shows the microstructures of medium carbon steel and is taken by microscope.
In medium carbon steel normally 0.2% to 0.6% carbon is present.
So for microstructure of 0.2% carbon steel around 25% of area you will have pearlite (dark phase) & 75% of area will be of ferrite (bright phase).

~~Brass~~ Bronze - The photograph shows the microstructure of ~~brass~~ bronze.
It is composed of 60% copper and 40% ~~zinc~~ tin with some impurities of lead. The material is annealed by heating to 540 degrees centigrade and quenched in water. The microstructure shows dentritic pattern of alpha and beta grains.
The dentritic pattern has formed due to sudden cooling from the molten temperature.
The gaps in b/w the grains are voids formed in casting.

Q2- What are the preparations required to get different phases in micro-structure of any material?

Sol:- Preparations required following processes:-

Selecting:- Selecting a representative test sample to properly characterize the microstructure or the features of interest is a very important first step.

Sectioning:- Test samples are carefully sectioned to avoid altering or destroying the structure of the materials. If an abrasive saw is used, it is important to keep the sample cool with coolant or lubricant so it doesn't burn or overheat.

Mounting:- After the test sample is sectioned to a convenient size, it is mounted in a plastic or epoxy material to facilitate handling and the grinding and polishing steps. Mounting media must be compatible with the sample w.r.t. hardness and abrasion resistance.

Grinding:- Grinding follows mounting to remove the surface damage that occurred during the sectioning step and to provide a flat surface. Grinding generally involves the use of water lubricated abrasive wheels and the use of a series of progressively finer abrasive grits.

Polishing:- The polishing step removes the last thin layer of the deformed metal. It leaves a properly prepared sample, ready for examination of the unetched characteristics such as inclusion content or any porosity that may exist.

Etching:- The final step that might be used is etching to show the microstructure of the test sample. This step reveals features such as grain boundaries, twins and second phase particles not seen in the unetched sample.

MANUFACTURING TECHNOLOGY LABORATORY-I

DEPARTMENT OF MECHANICAL ENGINEERING
AMU, ALIGARH
B.TECH./B.E. II YEAR

MEC2930/EMEC2930

EXPERIMENT NO.- 3(b, c & d)

Name: PRANAY SINGH S. No.: 14 Section: A2MB

College No.: 21MEB448 Enrol. No.: GL2254

Date of Experiment: 26/11/2022 Date of Submission: 02/12/2022

OBJECT:

b) Determine the spring back factor of sheet metal using:
   i. V-block; and
   ii. Bending Die.

c) To study the effect of bending along and across the grains of the given sheet metal.

d) To perform non-destructive test (dye penetration) on a test specimen and comment on the results.

EQUIPMENTS/TOOLS USED:

S. No.	Name	Specification	Make
1.	Hand-Press	10 Ton	Batliboy Bombay
2.	Die-Punch	—	—
3.	V-Block	Bend angle-90°	—
4.	Cleaner, Penetrant, developer	-	Checkmate

PROCEDURE

Using die and punch assembly

1. Cut a predetermine size of metallic strip and measure the dimension.
2. Raise the ram of the holding press.
3. Properly align the specimen (metallic strip) on the vice of the die.
4. Set a proper clearance between die & punch.
5. Drive punch against specimen to it full length.
6. Raise the punch.

7. Take the punch out from the die.

8. Measure and note down dimensions of the cross-section at the bend obtained.

9. Repeat the experiment for various thickness of the strip.

Using V –Block

1. Repeat the experiments in the same way as done by using die and punch assembly.

2. Changing the alignment of the specimen perpendicular to the axis as performed in the step 1 above.

SAFETY PRECAUTIONS

1. Each student should use apron while performing the experiment.
2. Keep the finger away from die punch while moving it.
3. Move punch slowly after bending.
4. Remove the specimen only after raising punch at sufficient height and locking raised the punch before removing bend.

OBSERVATIONS:

Table A:

S. No.	Material w - Width t - Thickness	Direction of Grain and bend "Along /across"	Angle of die 'α_i'	Angle of bend 'α_f'	Spring back '$K_s = \alpha_i/\alpha_f$'	Remark (crack/fracture etc.)
1.	Mild Steel Strap W=1 inch, t=3 mm	Along	90°	90.2	0.997	No cracks/ failures
2.	M.S. Strip w=1 inch t=5 mm	Along	90'	88	1.023	No cracks/ failures
3.	M.S. Strip W=1 inch t = 5 mm	Along	90'	89	1.012	No cracks/ failure
4.	M.S. Strip w=1 inch t= 3 mm	Along	90'	91	0.989	No cracks/ failure
5.	M.S. Strip t=6 mm	Across	90'	158	0.57	Cracks/failure occurs because of the spring back

Ali 26/11

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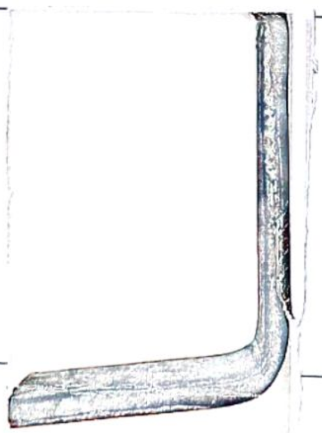
DYE PENETRATION TEST OF WELDMENT:

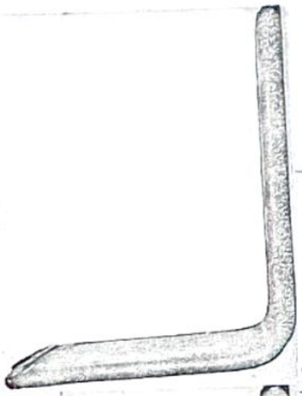
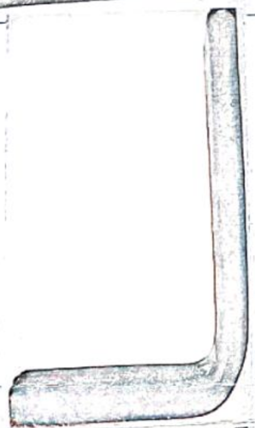
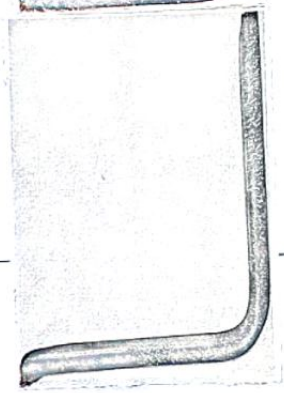
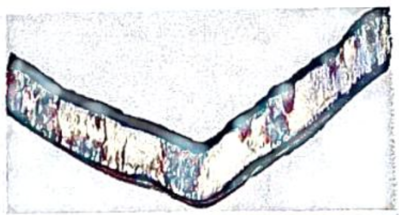
Dye penetrant inspection (DPI), also called liquid penetrant inspection (LPI) or penetrant testing (PT), is a widely applied and low-cost inspection method used to locate surface-breaking defects in all non-porous materials (metals, plastics, or ceramics). It is a non-destructive test. The penetrant may be applied to all non-ferrous materials and ferrous materials. LPI is used to detect casting, forging and welding surface defects such as hairline cracks, surface porosity, leaks in new products, and fatigue cracks on in-service components.

PROCEDURE:

1. Pre-clean the test piece or weldment.
2. Apply penetrant (any Water-Washable Fluorescent Penetrants etc.) and allow to soak possibly for 10 minutes (dwell time). Generally 5 to 30 minutes is considered for soaking time in the hairline flaws.
3. Remove excess penetrant. Rinse the test piece with water and let it dry (use cotton or any soft piece of cloth to rinse the weldment).
4. Apply developer and wait 10-30 minutes for development time (e.g.: non-aqueous wet developer, dry powder, water-suspendable, and water-soluble).
5. Observe/analyse the defects in the test piece or weldment. Inspect the defects under visible light (possibly ≥1000 lux) or UV light (≥1000μW/cm^2) with adequate intensity for visible dye penetrant.

Table B:

Specimen name and number	Photograph/ Image after bending/dye-penetration test	Remarks
Mild Steel Strip w= 1 inch t= 5mm		-ve spring back is observed $\theta < 90^\circ$

M.S. Strip W = 1 inch t = 3mm		+ve spring back is observed $\theta > 90'$
M.S. Strip W = 1 inch t = 5mm		-ve spring back is observed $\theta < 90'$
M.S. Strip W = 1 inch t = 3mm		+ve spring back is observed $\theta > 90'$
M.S. Strip W = 1 inch t = 6mm		+ve Spring back is observed $\theta > 90'$

Aluminium Plate rectangular t = 5 mm			We can see bright outling on the surface which shows that cracks are present in middle and some porosity

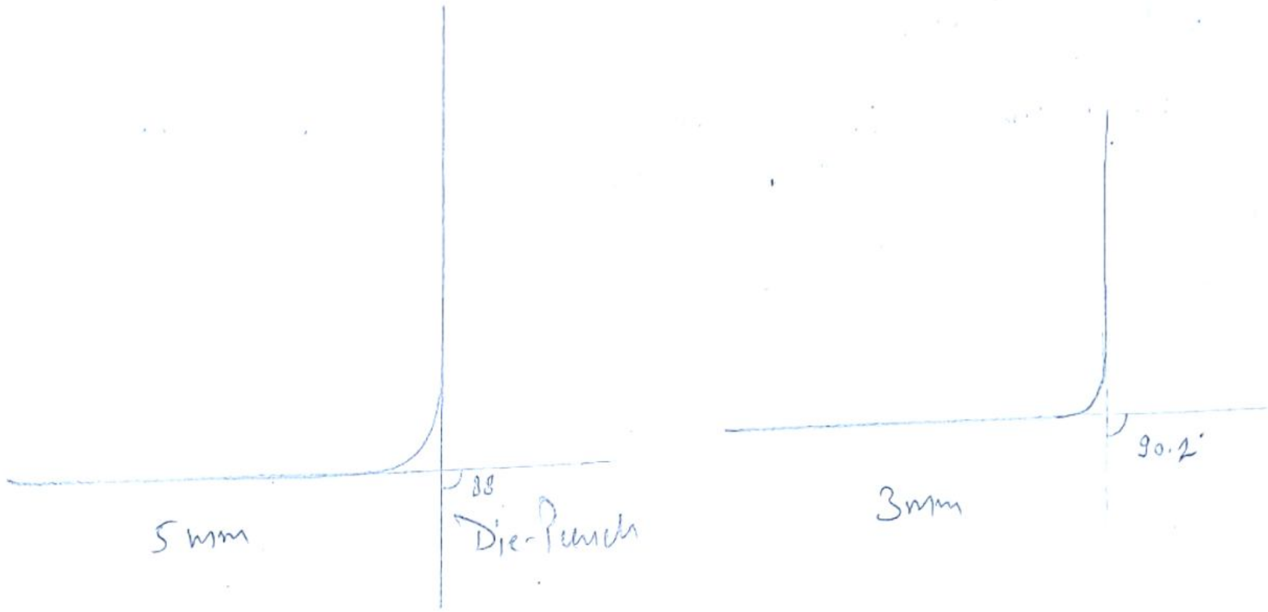
RESULT AND DISCUSSION:

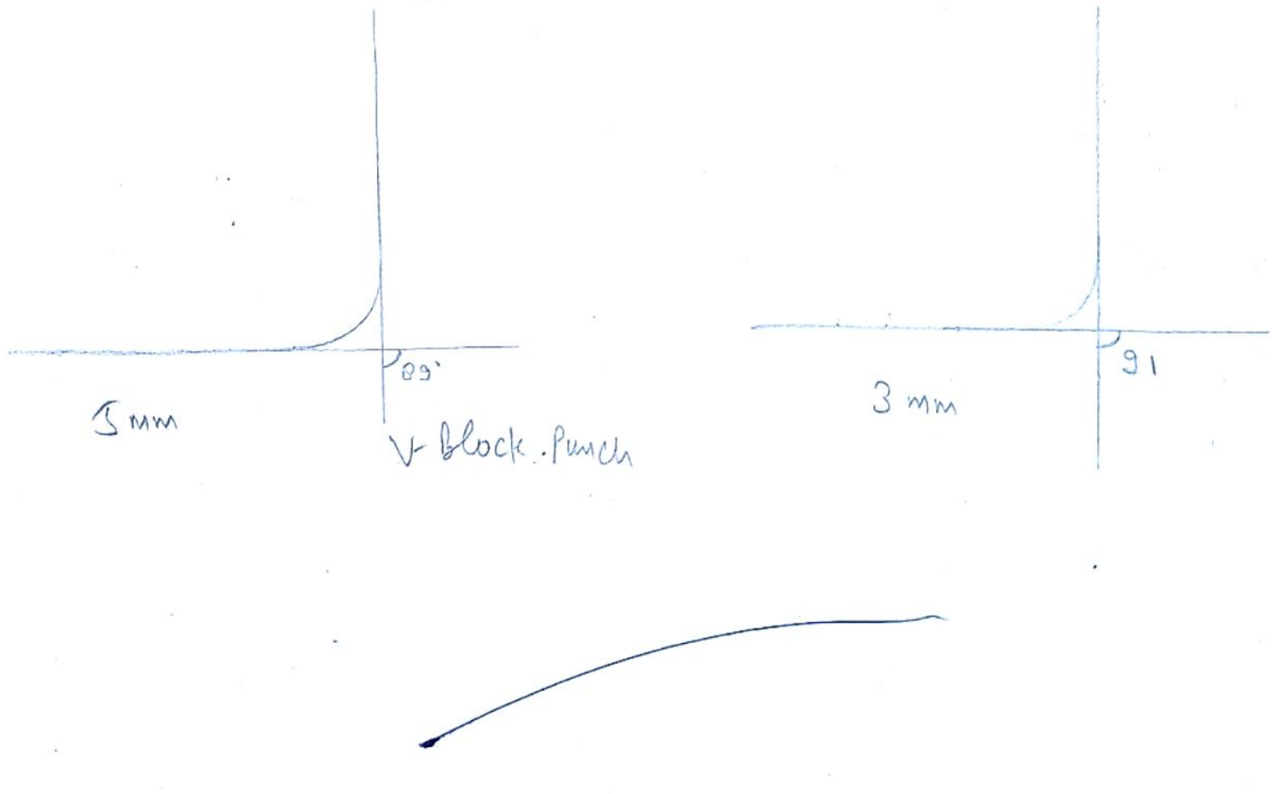
Q1. Discuss the results obtained from the above two tables (different die and punch assemblies).

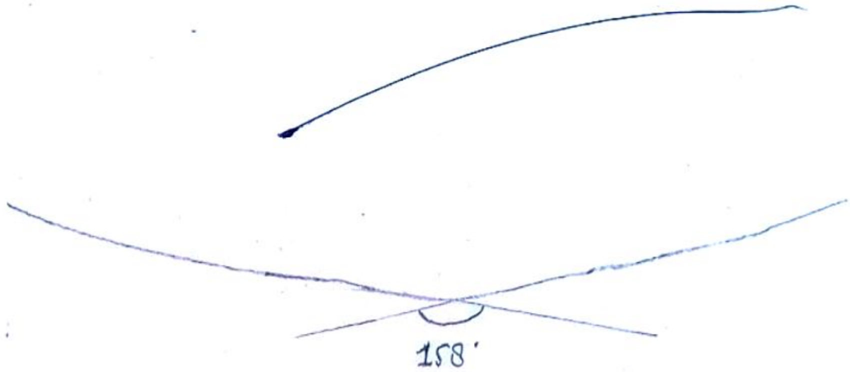
Q2. What observations you found after performing non-destructive test (dye penetration) on test specimen. List them.

Q3. Explain spring back phenomenon in the following cases:

a. V-block; and
b. Bending Die







V-Block (Across)

(K)

Result & Discussion

Q2. What observations you found after performing non-destructive test (dye penetration) on test specimen. List them.

Sol:- Dye penetrant inspection is the low cost inspection method which is used to check surface-breaking defects in all non-porous materials. This test is used to detect casting, forging and welding surface defects such as hairline cracks, surface porosity, leaks in new products (pipelines) and fatigue cracks. Some of the observations found-

1- A crack or similar opening will show a visible outline and tigid crack or a partially welded lap will show a broken line.

2- Cross porosity may produce large indications covering an outline area.

3- Area under inspection shall be observed during application of developer and at intervals during development time.

4- Very fine porosity will be indicated by Random dots.

5.- Depth of surface discontinuities may be correlated with the richness of colour and speed of bleeding of penetrant.

Results & Discussion

Q1- Discuss the results obtained from the above two tables (Different die and punch assemblies).

Sol - Table A-

We can clearly observe from this table that if we bend the metal along the direction of grain, then there is no problem of crack/failures. But if we bend across the grain direction, there are problems of cracks/failures and sheet will not bend beyond the angle at which cracks occur otherwise it will lead to failure of sheet metal.

Thickness of plate also plays an important factor.

Generally, spring back decrease with increasing sheet metal thicknesses.

Table B-

Dye penetration test is widely used to detect surface discontinuities like cracks, fractures, porosity, grinding defects, etc. Usually a crack will show a line and very fine porosities will be indicated by random dots. In the picture of specimen, we can see the penetrant which is deep red colour bleeding out against white background and visible outlines and dots are formed due to this. This confirms that there are cracks, porosity in specimen.

Q3 Explain spring back phenomenon in the following cases:

(a) V-Block

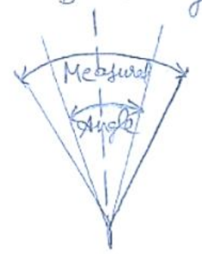
(b) Bending die

Sol:- Spring back occurs when a metal is bent and then tries to return to its original shape. The spring back factor, commonly denoted by K_s, is the relation b/w Initial and final angles. A spring back factor of $K_s = 1$ means there is no spring back, where a value of 0 means total spring back.

$$K_s = \frac{\text{Initial Angle}}{\text{Final Angle}}$$

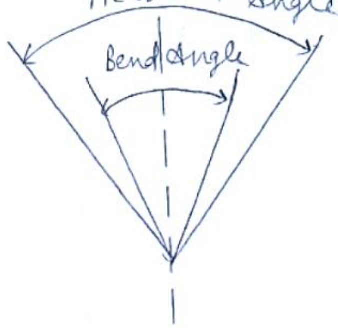
We can calculate spring back factor by bending sheet metal in
(a) V- Block (b) Bending Die

(a) <u>V-Block</u> - V block consists of a rectangular steel or cast iron block with 120° channel rotated 45 degrees from the sides, forming a V-shaped channel in the top.
When we bend the metal using V-Block, it shows negative spring back. That means the measured angle is lower than the desired bend angle.



This means the compressive residual stresses are dominant.

(b) <u>Bending Die</u> - Bending Die is a tool, which allows metal to be bent around it and defines the results shape of the bent metal.
When we bend the metal using bending die, it shows the positive spring ~~bloc~~ back. That means the measured angle is larger than the desired bend angle.
This means the tensile residual stresses are dominant.



MANUFACTURING TECHNOLOGY LABORATORY-I
DEPARTMENT OF MECHANICAL ENGINEERING
AMU, ALIGARH
B.TECH./B.E. II YEAR

MEC2930/EMEC2930

EXPERIMENT NO. - 4

B S.A.

Name: Pranay Singh S. No.: 14 Section: A2MB

College No.: 21MEB448 Enrol. No.: GL2254

Date of Experiment: 02/12/2022 Date of Submission: 10/12/2022

OBJECT: To produce the castings for different mould hardness (ramming intensities) and find out the defects.

EQUIPMENTS/TOOLS USED:

R R Khan 02/12/22

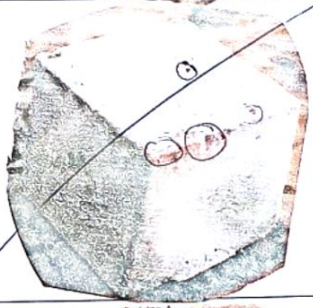
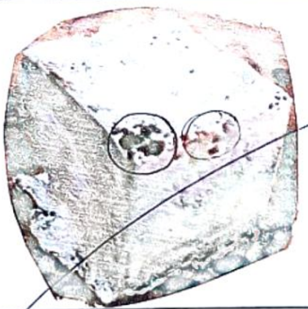
S. No.	Name	Specification	Make
1.	Pin rammer	M.S. & C.I.	India
2.	Butt rammer	M.S. & C.I.	India
3.	Strike off bar	Wooden	India
4.	Grate cutter	G.I sheet	India
5.	Drawspike	M.S. rod	India
6.	Moulding Box	C.I	India

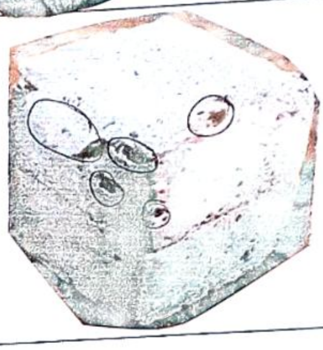
PROCEDURE

1. Put the pattern on the bench for moulding.
2. Put the drag on the bench for moulding.
3. Put the pattern on the bench and inside the drag.
4. Put moulding sand in the drag.
5. Rammed the sand to desire numbers of rams.
6. Put more moulding sand in the drag and rammed the moulding sand.
7. Continue the process till the height of the sand increase the height of the drag.

OBSERVATION TABLE:

Effect of moulding parameters (ramming intensities) on the castings

S. No.	Number of Rams	Mould Hardness	Photograph of the casting (locate the defects)	Name of defect(s) observed
1.	20			Swell
2.				Cracks
3.				Blister
1.				Cracks
2.				Blowholes
3.				Pinholes
1.	40			Penetration
2.				Porosity
3.				Cracks
1.				Pinholes
2.				Cracks
3.				Drop

1				Open holes Pinholes
2		60		Cracks
3				Porosity
1				Cracks
2				Shrinkage Pinholes
3				

RESULT AND DISCUSSION:

Q1. Discuss the findings of the above table.

Q2. Suggest remedial actions required to overcome these defects.

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Result & Discussion

Discuss the findings of the table.

Ans:- Various Defects were observed :

(a) Pinholes => These are nothing but small pinholes and occur either at or just below the casting surface.
Normally, these are formed in large members and are almost uniformly distributed in the excessive amount in the entire casting surface.

(b). Blowholes => Cavities formed due to escaping of hot gases from the matter metal. A controlled content of moisture and volatile constituents in the sand-mise also helps in avoiding blow holes.

(C) Penetration => If the mould sand surface is too soft and porous, the liquid metal may flow b/w the sand particles upto a distance into the mould. This causes rough porous projections and also their defects is called penetration.
The fusion of sand on a casting produces a rough gassy appearance.

(d) Swell => This defect is found on the vertical surface of the casting if the moulding sand on a casting surface is deformed by hydrostatic pressure caused by the high moisture content in the sound.

(e) Shrinkage :- A shrinkage cavity is a depression in a casting which occur during the solidification on process shrinkage porosity.

(f) Blister :- Blow which are partially covered by a min layer of casting.

(g) Drop :- An irregular shaped projection on the cope surface of a casting is called a drop. This is caused by dropping of sand from the cope or other overhanging projections into the moulds on adequate strength of the sand and use of proper ramming can help avoiding drops.

(h) Crack - Due to non-uniform cooling, non uniform shrinkage unwanted stress gets developed result in cracks.

Hence above casting defects can be observed in casted material. These casting defects are reduced by proper ramming and Cooling.

Q3- Suggest remedial actions required to overcome these defects.

Sol- Various remedials action for various defects:

(i) Blowholes, pinholes, Blister:-
- Increase the permeability
- Using dry sand mould
- Decreasing Pouring temperature
- Provide power venting

(ii) Drop, Swell:-
- Using sand having adequate strength
- Doing proper ramming
- Reinforce sand projections using nails or gaggers.

(iii) Crack:-
- chills, padding are used to regulate the heat transfer.

(iv) Shrinkage:
- By making proper riser design.

(v) Penetration:
- Use high strength small grain size, low permeability and hard ramming of sand.