Hard facing

Objectives: At the end of this lesson you shall be able to
- **explain the necessity of hard facing**
- **describe the method of preparation for hard facing**
- **describe the various hard facing alloys**
- **explain the advantages of hard facing.**

Necessity of hard facing: This operation consists of depositing a layer of harder metal on a softer base metal in order to provide a surface having special properties such as toughness, hardness and resistance to abrasion, heat and corrosion.

This is also done to build up worn out areas of a hardened component due to long and continuous use and make them as good as new with low cost and quickly.

Preparation: Clean the surface of the part to be hard faced, by grinding, machining, filing, chipping or sand blasting until it is free from dirt, scale etc.

Remove sharp corners which melt easily or get oxidized.

Hard facing alloys

Different groups of materials used for hard facing are:

– Ferrous alloy group
– Non-ferrous alloy group
– Diamond substitute group

Ferrous alloy group: This group comprises welding electrodes having an iron base alloyed with chromium, manganese, molybdenum, nickel, zirconium, boron and silicon.

Non-ferrous alloy group: This group consists of welding electrodes which are alloys of chromium, tungsten, cobalt and molybdenum and some times small quantities of iron.

Diamond substitute group: This group composed of carbides of tungsten, tantalum, titanium and boron and the borides of chromium is so called because its hard facing materials approach the hardness of a diamond.

Hard facing electrodes are designed on the basis of hardness of their weld deposits as follows. (table)

Typical deposit composition for high temperature service
Deposit composition %

Type	C	Mn	Si	Cr	Ti	Mo	W	Co	V	Ni
A	6.0	2.7	1.0	13.0	5.2	-	-	-	-	-
B	4.6	1.0	1.1	27.0	-	3.5	-	-	-	-
C	3.0	1.3	0.81	8.3	1.5	-	-	-	-	-
D	2.0	-	-	29.0	-	-	12.0	51	-	-
E	1.6	1.8	0.9	5.8	4.2	0.5	-	-	0.4	-
F	0.7	-	-	27.0	-	-	4.5	62	-	-
G	1.75	1.0	1.5	30.0	-	1.5	-	-	-	3
H	0.8	0.5	0.65	4.0	-	8.0	1.2	-	1.0	-
I	1.9	1.5	0.60	7.4	4.6	1.4	-	-	-	-
J	4.5	0.75	0.80	28.0	-	-	-	-	-	-
K	4.2	1.7	0.10	5.0	6.8	-	-	-	-	-
L	3.1	3.1	1.7	15.0	-	-	-	-	-	-

NOTE: A to H are manual electrodes; I to L are flux-cored wires.

Type	Hardness BHN
A	250-280
B	350-380
C	280-320
D	600-625

Electrodes commercially available:

Indian Oxygen: Stellite Grade 1, Stellite Grade 6, Stellite Grade 12, Duriod 1, 2, 3.

Larsen and Toubro Ltd

Eutectrode - 2 (AC-DC)

Advani Orlikon - Citorail I to IV Citomangan, Supersist etc.

Application: Chromium and tungsten carbide electrodes are used for severe abrasion - resistance.

High carbon type electrodes are used for moderate abrasion and impact resistance.

Stainless steel electrodes are used for severe impact and moderately severe abrasion resistance.

Hard facing with MMAW process: Clean the surface thoroughly and arrange the work in a flat position.

Preheat to about 95°-150°C.

Use only enough amperage to provide sufficient heat to maintain the arc. Avoid high current and short arc length.

This is very important to prevent dilution of the deposit with the base metal.

Use the stringer or slight weaving technique holding a medium arc.

Deposit 25 to 50 mm long beads not wider than twice the diameter of the electrode.

Allow the work to cool between each deposit of beads.

Stagger the deposits to prevent building up of high heat at only one spot.

Chip the slag between passes.

Slow cooling by covering the job with sand or ashes or slaked lime is to be done.

The number of layers will vary from job to job. But it should be noted that the first layer deposited on mild steel is diluted by the 'pick-up' from the plate. (i.e. the soft mild steel from base metal will mix with the hard deposited metal and therefore the I layer will have less hardness.

It is never advisable to make more than three layers because such a mass of metal may crack in service or during deposition.

Advantages of hard facing

Longer life of wearing parts (2 to 20 times, depending on the type of service).

Increased mechanical operating efficiency.

Reduced idle time of plant.

Use of reconditioned worn out parts instead of costly new replacement parts.

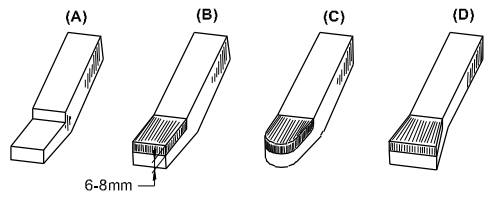
Reduced labour costs because of fewer replacements.

Greater independence during periods of replacement of parts when there is a shortage.

Applications

Different hard-faced products are illustrated in Figs 1 to 9.

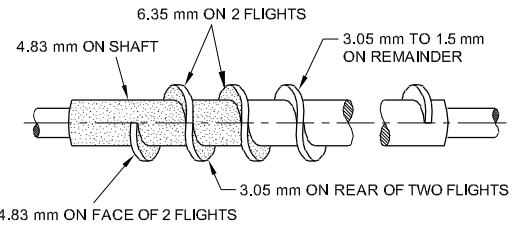
Fig 1



BUILDING A CUTTING TIP ON MILD STEEL SHANK
ALTERNATIVE WAYS OF FINISHING BY GRINDING

WLN25103111

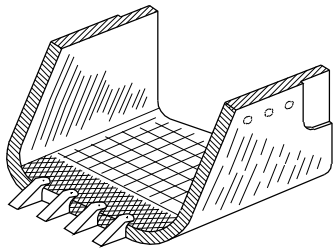
Fig 2



CONTROL OF HARD FACING
DEPOSIT ON A CEMENT CONVEYOR SCREW

WLN25103112

Fig 3



HARD FACING SHOVEL BUCKET FRONTS

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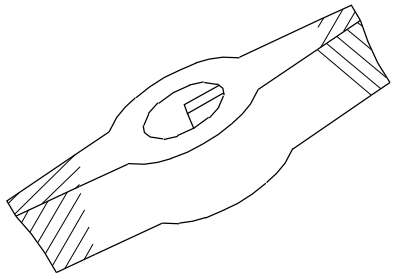
Fig 4



HARD FACING FEEDER BLADES

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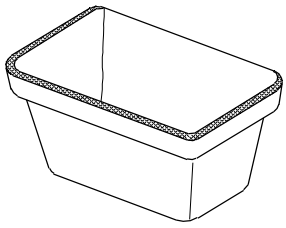
Fig 5



HARD FACING ELEVATOR BUCKET LIPS

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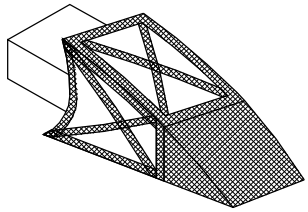
Fig 6



HARD FACING SHOVEL BUCKET TEETH

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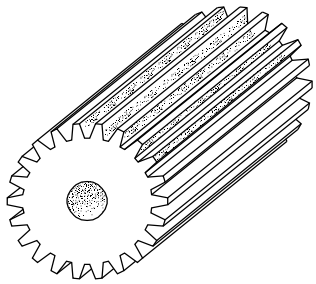
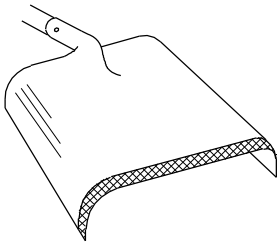
Fig 7



HARD FACING GEAR TEETH (PINION GEARS)

WLN25103 17

Fig 8



HARD FACING KILN SCOOP SHOVELS

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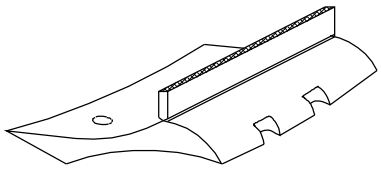
Fig 9



HARD FACING TRACTOR GROUSERS

WLN25103 19

Surfacing/Metal build up

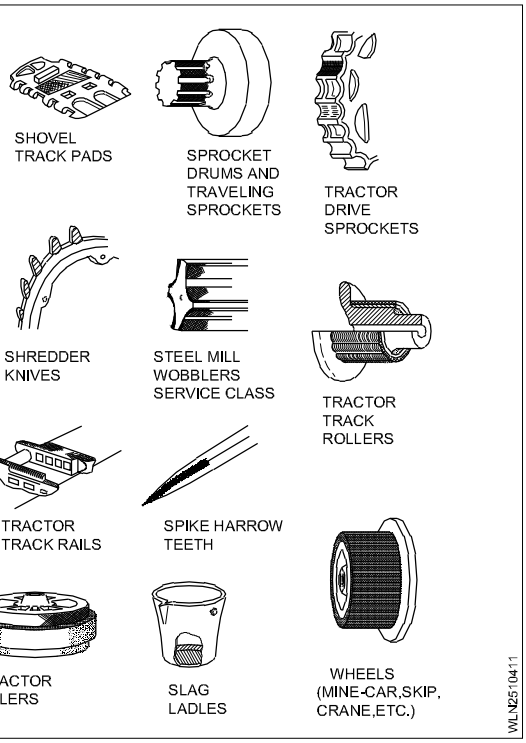
Objectives: At the end of this lesson you shall be able to
- **explain the purpose of surfacing/metal build up**
- **describe the different applications of surfacing**
- **describe the factors that cause wear**
- **describe the method of surfacing by the M.M.A.W. process**
- **state the different surfacing methods.**

Purpose of surfacing/metal build up: Surfacing/metal build up is done to build up worn out parts whose dimensions have been reduced and make them as good as new and obtain the required properties.

Application

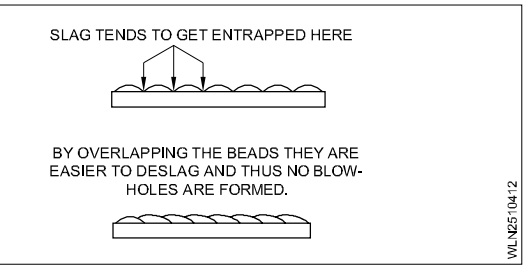
To repair worn out shafts, gears and other parts, (Fig 1) surfacing might be the only way to solve the problem since new parts may not be available any longer. Surfacing is done to modify a part's surface so as to improve its performance.

Fig 1



Weld beads running across the surface of a roller can improve its gripping or driving action. (Fig 2)

Fig 2



Causes of wear

There are six different factors that cause wear or affect the parts.

Abrasion is the grinding or scratching action of hard particles that cause wear.

Erosion is the wear caused by liquids or gases striking metal parts at high speed.

Impact is a blow or series of blows that can cause the metal to deform, fracture or peel off in pieces.

Corrosion is a chemical or electrochemical attack on a surface.

Rust is caused by oxidation.

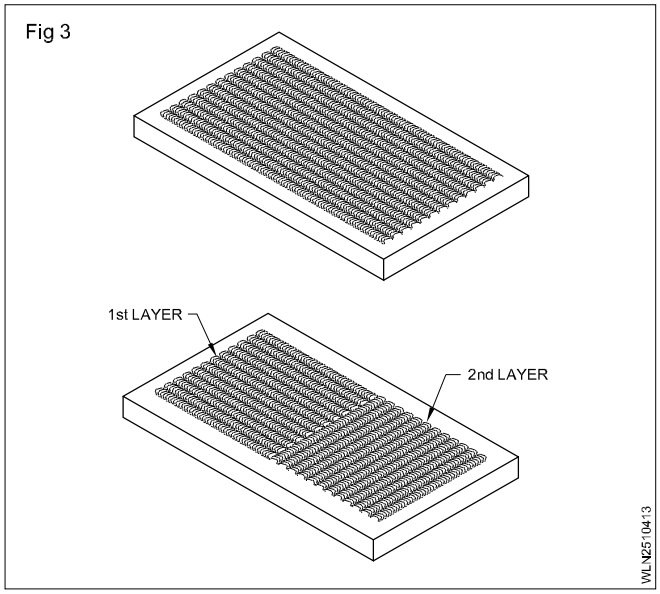
Heat softens the metal which reduces the metal's resistance to abrasion and corrosion.

Friction on the surface of the metal results from the metals rubbing together under pressure with little or no lubrication.

Method of surfacing / Metal build up

Padding: A plate of 10 mm mild steel about 150 mm square is used for padding. A series of parallel beads are laid side by side across the surface of the plate so as to slightly overlap one another. If the beads are laid side by side with no overlap, the slag becomes entrapped in the line where the beads meet, making it difficult to be removed and causing blow holes. (Fig 3)

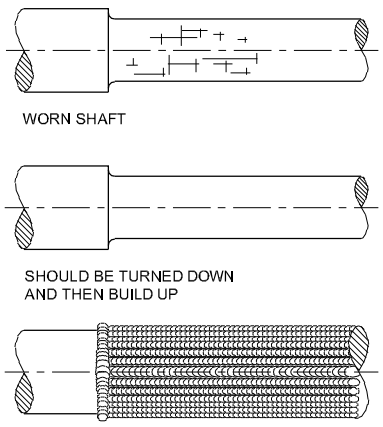
Fig 3



Each bead is de–slagged before the next is laid.

After thoroughly cleaning and brushing all the slag and impurities from the layer, another layer is deposited on the top of this with the beads at right angles to those of the first layer. (Fig 4)

Fig 4



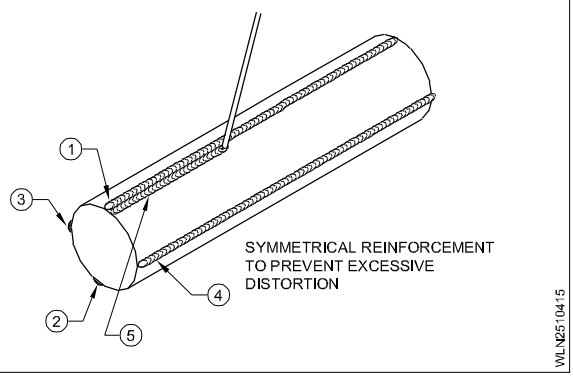
This can be continued for several layers and the pad finished.

Building up shafts: In the case of shafts worn out with small wear, such as 1 mm, it is evident that if the shafts are built up and then turned down again, the thickness of the deposited metal remaining is very small, and the bearing surface will be practically on the line of fusion.

It is advisable to turn the shaft further by 1 mm.

Bring the bearing surface well into the deposited metal. This will give much better service. (Fig 5)

Fig 5



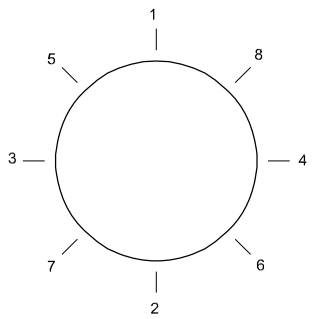
Welding deposition

Deposit beads along the side parallel to the axis.

Use a medium arc with stringer beads.

Deposit the run as shown in Fig 6 on the opposite sides, 1, 2, 3 and 4 to equalise the stresses. Complete the job depositing symmetrically.

Fig 6



Surfacing methods

– Oxy-acetylene method
– Shielded metal arc method
– Submerged arc method
– MIG welding method
– TIG welding method
– Plasma arc welding method

Oxy-acetylene welding method

Oxy-acetylene method has great usefulness for smooth, precise and extremely high quality surfacing deposits.

Advantages

Very thin layers of weld metal can be applied. Can be easily made to flow to the corners and edges of the job. This method is smooth, precise and is of extremely high quality.

Grooves can be filled. But this is very slow process.

Shielded metal arc welding

The equipment required for this method is the same as used for manual metal arc welding.

In plant training/project work

Objective: At the end of this lesson you shall be able to
- **prepare utility jobs as per drawings given.**

Project work for students

1 Fabrication for metal rack (as per drawing)

2 Fabrication of cylinder trolley (as per drawing)

3 Fabrication of welding fixture (as per drawing)

Students are expected to write following details in brief and fabricate all above jobs.

a Project name

b Material specification and thickness

c Name of the part (s)

d Job sequence

e Skill sequence

f Time availed for completion

g Inspection

- Visual
- Dimentions
- Fillet sizes etc.

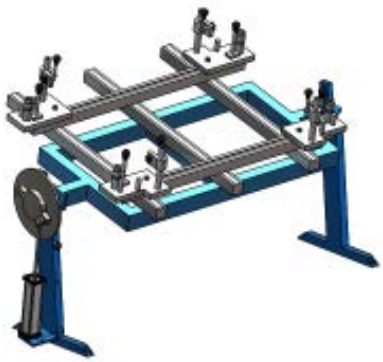
h Method of controlling distortion

k Remarks/assessment

The instructor to guide the further project work for training purpose

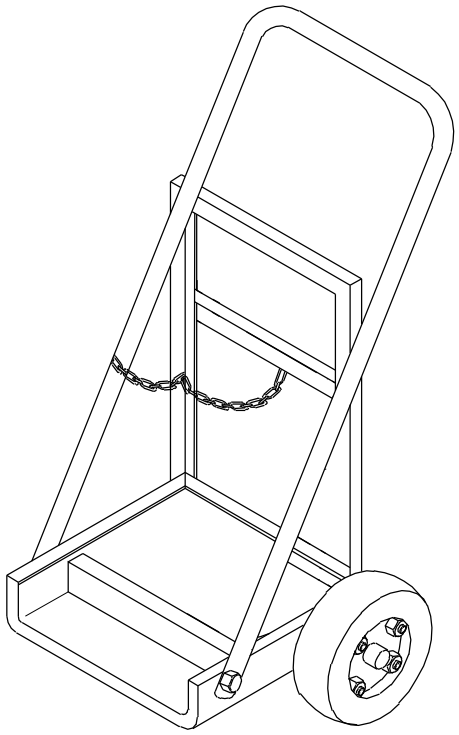
Cylinder trolley with chain provision for locking

Single



Welding fixture

Fig 2



DOUBLE

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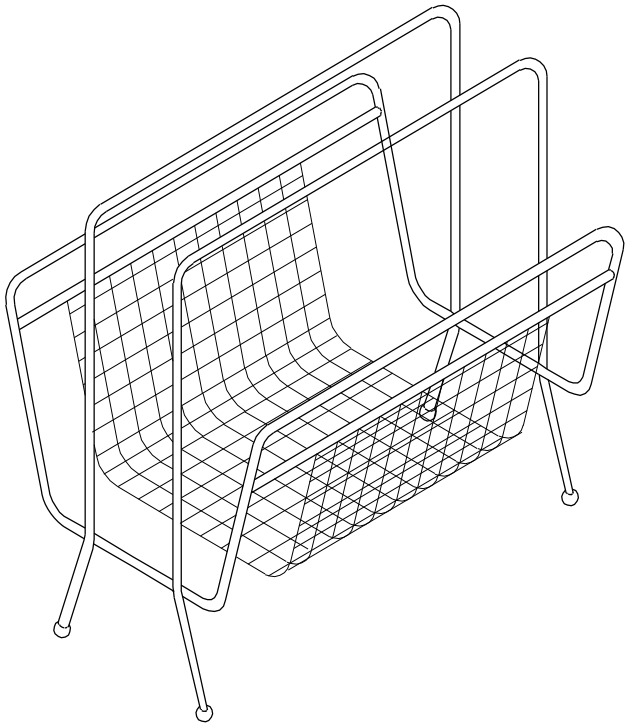

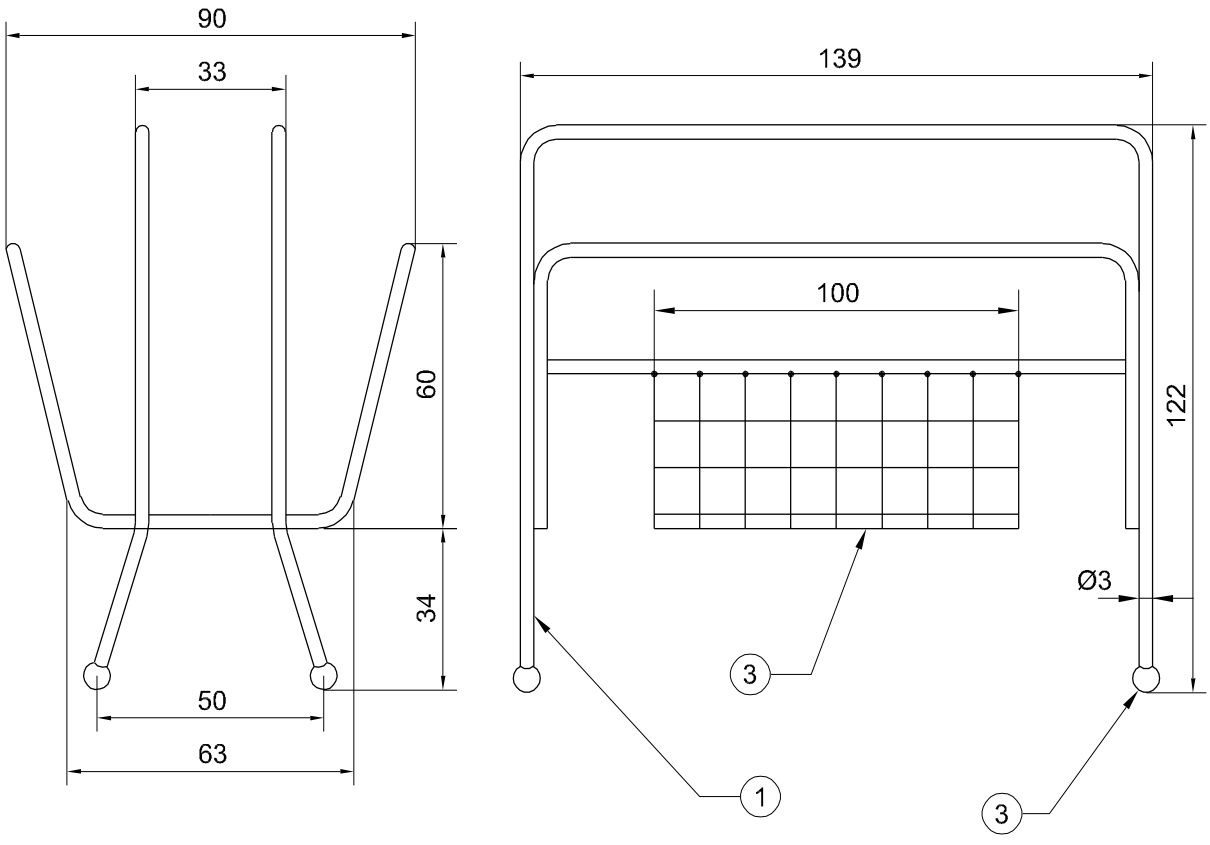

4	Ø8 BALL		Fe310		3	
1	WELD MESH 100 x 180		Fe310		2	
1	Ø3 - 1800		Fe310 - W		1	G - 65
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE	METAL RACK	TOLERANCE	TIME 10 Hrs
		WLN2510418	