

27 WELDING DEFECTS

27.1 Porosity and blow holes, 27.2 Slag inclusion, 27.3 Incomplete fusion and penetration, 27.4 Cracks, 27.5 Distortion, 27.6 Spatter, 27.7 Poor weld bead appearance, 27.8 Undercutting, 27.9 Overlapping.

27.1 POROSITY AND BLOW HOLES

Porosity is a group of small voids, which will be generated in the weld bead, when gases will get entrapped in the weld bead. These gases may be produced due to electrode coating ingredients, oil, rust, dust etc. The solubility of the gases reduces as the metal temperature cools down and thus the dissolved gases are liberated from the liquid metal until it starts to freeze. Blow holes are comparatively large gas cavities as compared to porosity.

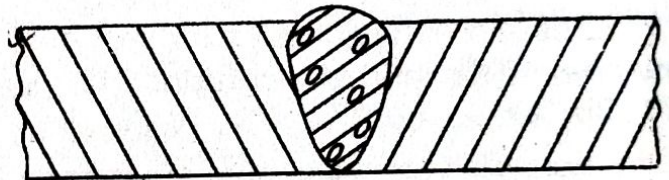


Fig. 27.1. Porosity.

CAUSES	REMEDIES
<ul style="list-style-type: none"> (i) High welding speed. (ii) Dirty base metal. (iii) Electrode with damp and damaged coating. (iv) <u>Improper arc length, welding current, welding technique.</u> (v) Excessive hydrogen, nitrogen or oxygen in welding atmosphere. 	<ul style="list-style-type: none"> (i) Reduced welding speed, to allow time for gases to escape. (ii) Clean the base metal properly. (iii) Proper electrode should be used. (iv) Use proper arc length, welding current and welding techniques. (v) Use filler metal having high contents of deoxidizers.

27.2 SLAG INCLUSION

Flux used in welding reacts with impurities and forms a slag. If this slag is mixed with weld bead, that defect is called slag inclusion so slag inclusions are compounds such as oxides, fluxes and electrode coating materials that are trapped

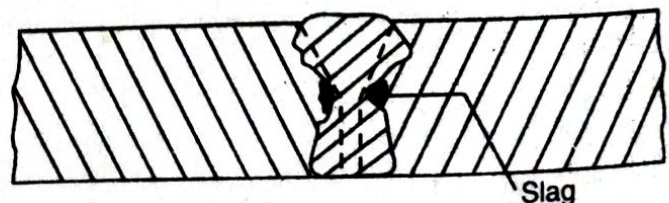


Fig. 27.2. Slag Inclusion.

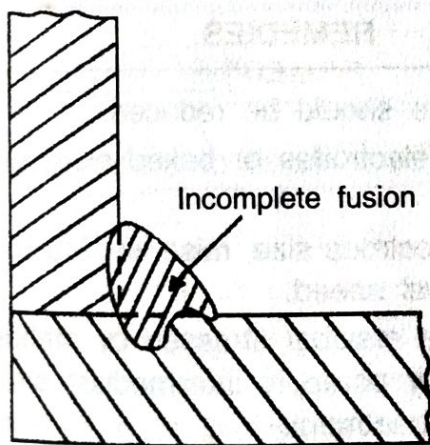
in the weld zone. If shielding gases are ineffective during welding, contamination from the environment may also contribute to such inclusions.

CAUSES	REMEDIES
<ul style="list-style-type: none"> (i) Slag removal is not proper. (ii) Longer arc length. (iii) Less electrode angle, slow speed and too large electrode. (iv) Oxide inclusions. (v) Entrapped pieces of electrode covering. (vi) Improper joint design. 	<ul style="list-style-type: none"> (i) Clean surface and previous weld bead properly. (ii) Use proper arc lengths. (iii) Use more electrode angle, more speed and small electrode. (iv) Providing proper gas shielding. (v) Use fresh and proper electrode. (vi) Redesigning the joint so as to permit sufficient space for proper manipulation of the puddle of molten weld metal.

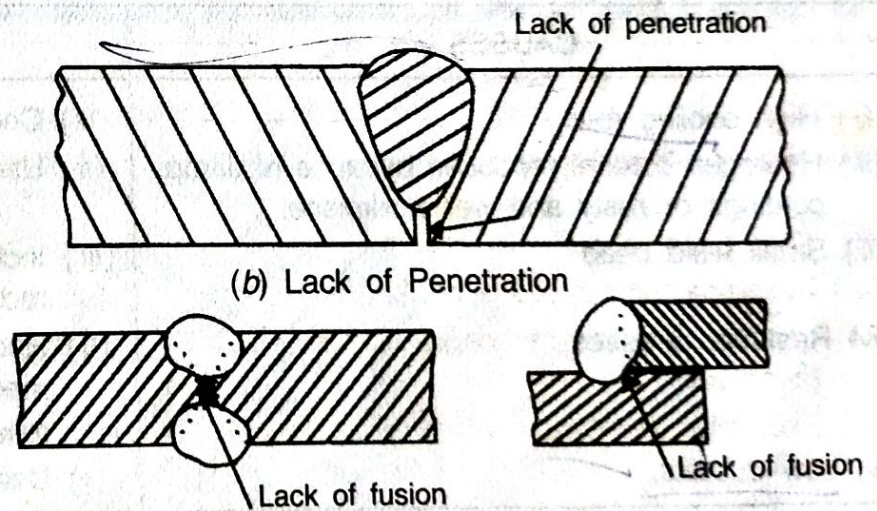
27.3 INCOMPLETE FUSION AND PENETRATION

If the molten metal does not mix (fuse) properly with the base metal that defect is called incomplete fusion (or lack of fusion). This produces the poor weld beads.

Incomplete penetration occurs when the depth of the welded joint is insufficient (Penetration is the distance from base plate top surface to the maximum extent of the weld nugget).



(a) Incomplete Fusion



(c) Lack of Fusion

Fig. 27.3.

CAUSES	REMEDIES
<ul style="list-style-type: none"> (i) Less arc current. (ii) Faster arc travel speed. (iii) Longer arc length. (iv) Electrode diameter too large. (v) Improper electrode position. (vi) Improper joint design. 	<ul style="list-style-type: none"> (i) Use proper arc current (or more comparatively). (ii) Use less arc travel speed. (iii) Use shorter arc lengths. (iv) Use small electrodes. (v) Maintain proper electrode position. (vi) Change or redesign the joint.

27.4 CRACKS

Cracks may occur in various locations and directions in the weld area. Cracks may appear in the crater, under bead, base metal, weld metal or in the root. Cracks are classified as hot or cold. Hot cracks occur while the joint is still at elevated temperatures. Cold cracks develop after the weld metal has solidified.

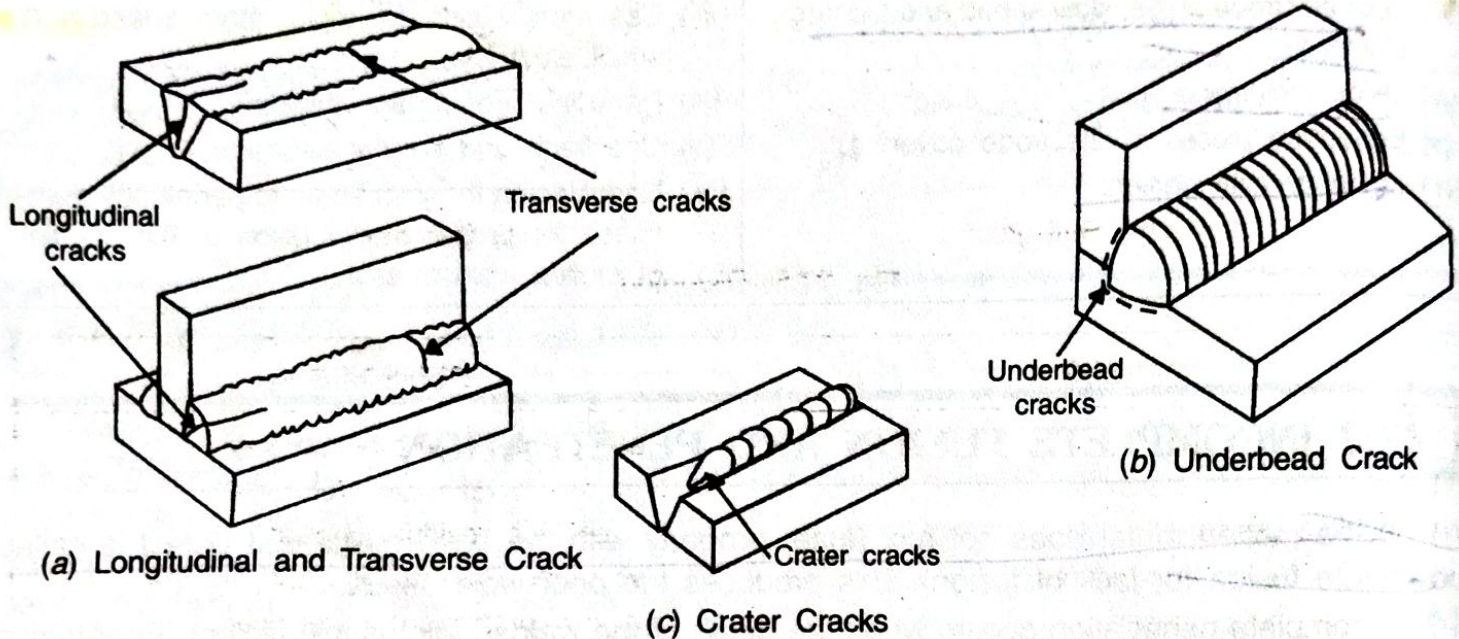
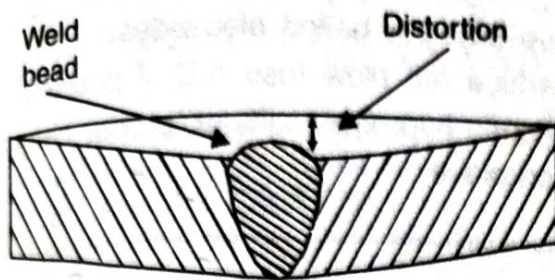


Fig. 27.4.

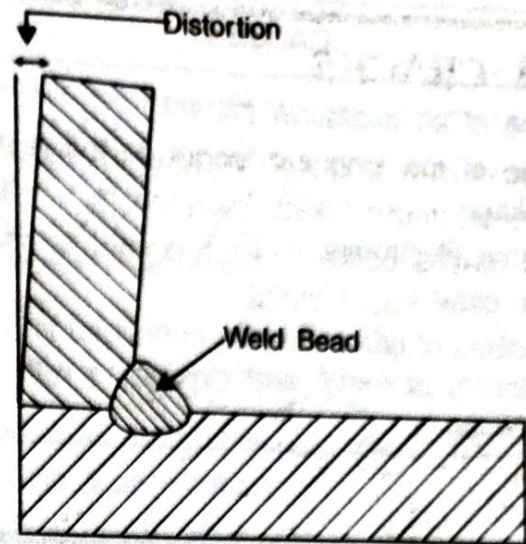
CAUSES	REMEDIES
<ul style="list-style-type: none"> (i) High cooling rate. (ii) Hydrogen content produced because of damp coatings or rusty and wet workpiece. (iii) Small weld bead (iv) Residual stresses (v) Low ductility. 	<ul style="list-style-type: none"> (i) Cooling rate should be reduced. (ii) Use fresh electrodes or baked electrodes. (iii) Increase electrode size, raise welding current, reduce travel speed. (iv) Reduce the residual stresses by preheat or mechanically or apply intermediate stresses relief heat treatment. (v) Use preheat, anneal the base metal.

27.5 DISTORTION

Distortion is the change in shape and difference between the positions of the two plates before welding and after welding.



(a) Distorted Butt Joint



(b) Distorted T Joint

Fig. 27.5. Distortion.

CAUSES	REMEDIES
<ul style="list-style-type: none"> (i) High cooling rate. (ii) Small diameter electrode. (iii) Residual stress. (iv) Poor clamping and fixtures. (v) Slow arc travel speed. 	<ul style="list-style-type: none"> (i) Cooling rate should be reduced. (ii) Use proper diameter electrode. (iii) Reduce the residual stresses. (iv) Use proper clamps, jigs and fixtures. (v) Maintain proper arc travel speed.

27.6 SPATTER

Spatter refers to small particles of metals, which are scattered around the weld along its length.

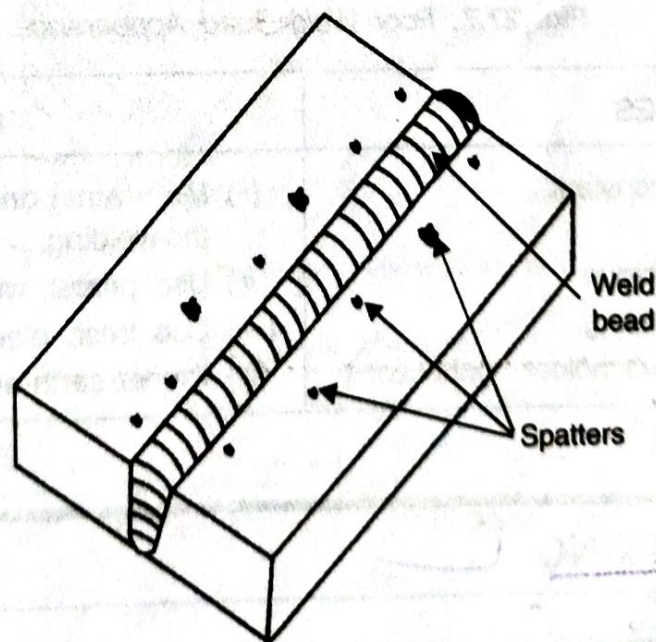


Fig. 27.6. Spatters.

CAUSES	REMEDIES
<ul style="list-style-type: none"> (i) Use of an excessive current. (ii) Use of too long arc length or too high arc voltage. (iii) Damp electrodes. (iv) Arc blow. (v) Bubbles of gas becoming entrapped in molten globules of metal and expanding with great violence. 	<ul style="list-style-type: none"> (i) Use proper welding current. (ii) Use proper arc length and lower arc voltage. (iii) Use fresh or baked electrodes. (iv) Reduce arc blow (use A.C. if possible). (v) Reduce hydrogen content, proper cleaning of workpiece.

27.7 POOR WELD BEAD APPEARANCE

If the weld bead deposited is not straight, width of bead is not constant, ripples are not consistent, then the weld bead is called poor.

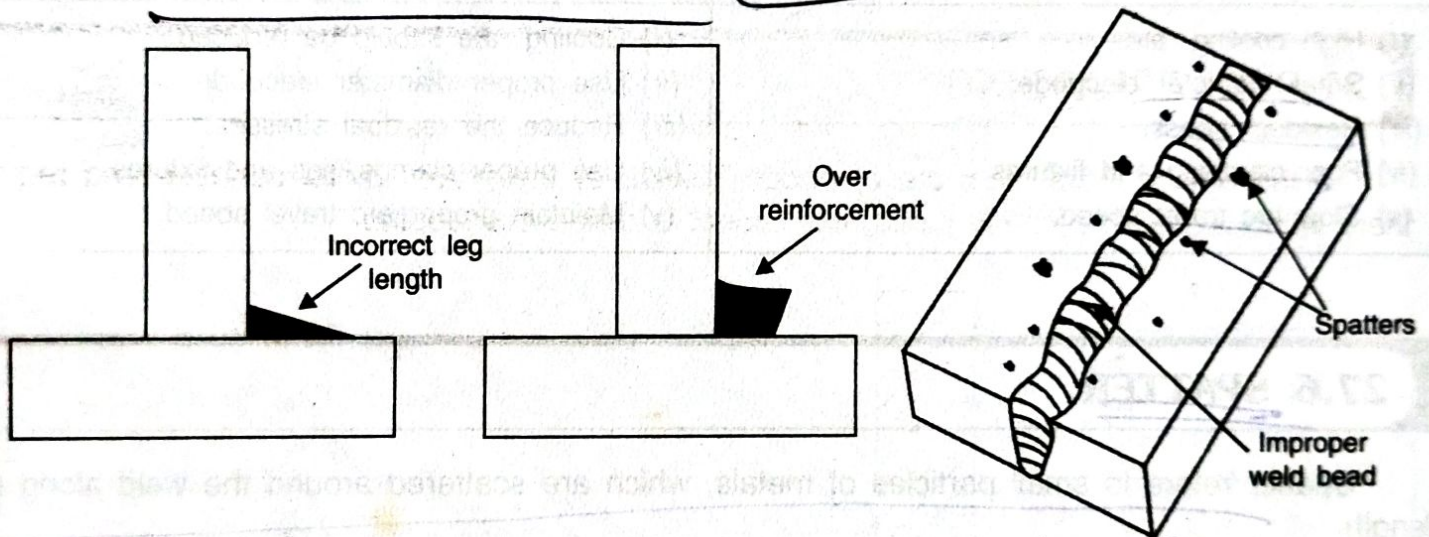


Fig. 27.7. Poor Weld Bead Appearance.

CAUSES	REMEDIES
<ul style="list-style-type: none"> (i) Arc length being not constant. (ii) Improper welding technique. (iii) Damaged electrode coating. (iv) Poor earth and electrode holder connections. 	<ul style="list-style-type: none"> (i) Maintain constant arc length throughout the welding. (ii) Use proper welding technique. (iii) Use fresh electrodes. (iv) Proper earth and electrode holder connections.

27.8 UNDERCUTTING

If the groove gets formed in the parent metal along the sides of the weld bead that is called undercutting. This weakens the weld.

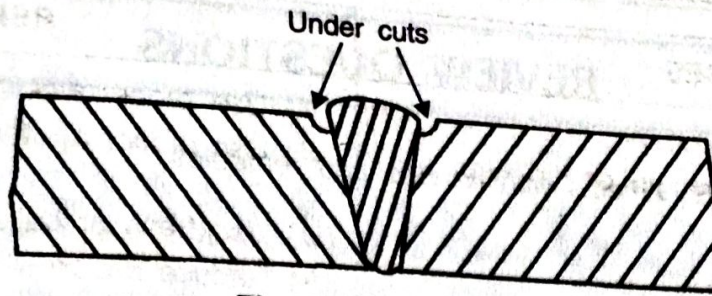


Fig. 27.8. Undercut.

CAUSES	REMEDIES
(i) Higher current. (ii) Too large electrode diameter. (iii) Excessive weaving. (iv) Faster arc travel speed.	(i) Use proper current. (ii) Use proper electrode. (iii) Weaving should be proper and as per requirement. (iv) Maintain proper arc travel speed.

27.9 OVERLAPPING

If the molten metal from the electrode flows over the parent metal surfaces and remains there without getting properly fused, that defect is called overlapping.

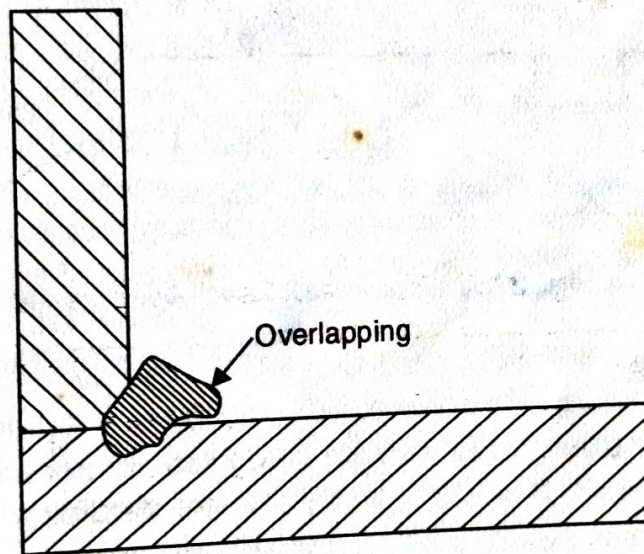


Fig. 27.9. Overlap.

CAUSES	REMEDIES
(i) Lower arc current. (ii) Slower arc travel speed. (iii) Improper joint geometry. (iv) Longer arc.	(i) Maintain and use proper arc current. (ii) Maintain proper arc travel speed. (iii) Use proper joint geometry. (iv) Use proper arcs.