Fundamental of Welding Science and Technology

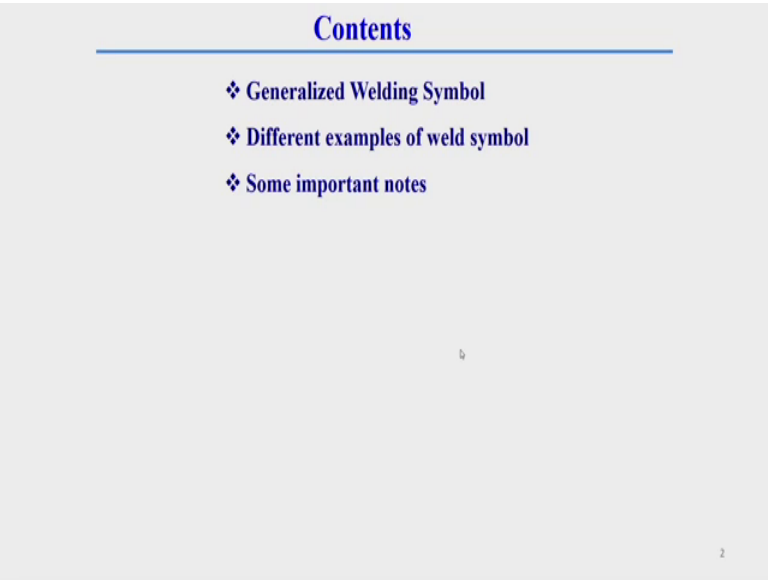
Prof. Dr. Pankaj Biswas
Department of Mechanical Engineering
Indian Institute of Technology, Guwahati

Module – 02
Lecture - 04
Welding symbol

Today I am going to deliver lecture on Welding Symbol. Last class we have seen that what are the different parts of a welding joints. And we have seen different important operation and we have seen also different important application of differentpart of welding symbol. We have also seen that what is the importance of welding symbol in welding industry. Today I will deliver a lecture on Welding Symbol. Actually this Welding Symbol is very much essential part once you will be in industry thereyou will be given a drawing sheet.

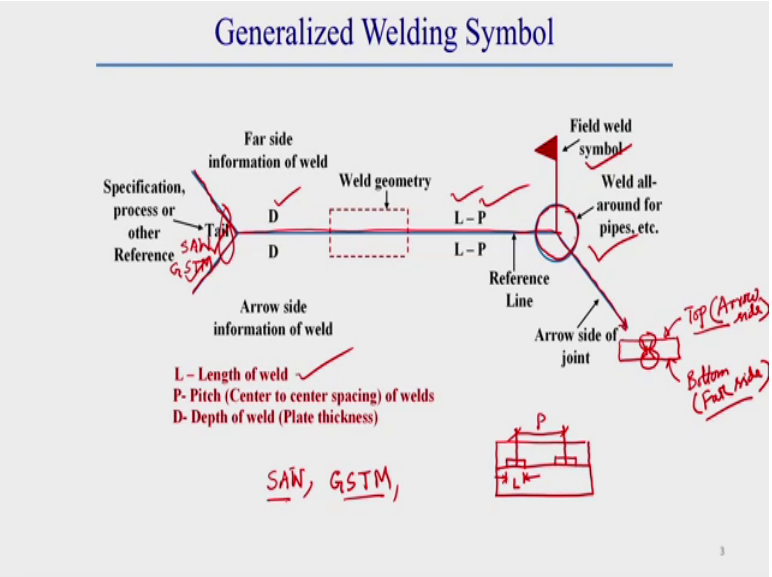
To see this drawing sheet itself we have to understand what are the different welding operation is required to do. So, for once you have knowledge on welding symbol then only you will be able to because in this drawing there will be provided only some symbols of welding. So, to see this welding symbol itself we have to recognise what you have to do. So, it is a very important parameter and it is a very important thing for a manufacturing industry to know about welding symbol.

(Refer Slide Time: 01:41)



Here generally this is the content of this present lecture. Here I will explain a generalized welding symbol first, then different examples of welding symbols and different application of welding symbols also I will show. And some important notes also here I will provide regarding welding symbol and I will explain at the end what will be the next lecture plan.

(Refer Slide Time: 02:10)



This is generally represent the welding symbol. Actually here generally this is a generalized welding symbol here I am showing. One things you can say this line whatever the line here it is showing that is from this arrow line actually from here to here this line actually this line this line whatever the line it is showing, this line generally called the reference line. Generally the in this reference lines which is main requirement for a welding symbol. So, in this reference line there is two side.

One is bottom side and another is top side. This bottom side one is called arrow side. And this top side of this reference line is called far side. Now, generally whatever the different things will be given bottom of this reference line that is generally the details of arrow side. And whatever the things given top of this difference line that is the details of far side. Now, here we should know what is arrow side and what is far side.

Actually arrow side means let us this is a plate this is a plate where we have to do the welding. So, what happens here this the here the arrow is generally facing top this let this is top side top side and let this is bottom side this is bottom side of this plate. So, here

generally this arrow is facing on top side. So, that side this is called generally arrow side this top side is called here arrow side arrow side. Whereas, the bottom side here generally opposite to the opposite to this arrow side is called generally far side opposite to this order side called far side.

So, whatever the information will be given whatever the information will be given top side bottom side of this reference line that will be the details of arrow side. And whatever the information given on other side; that means top side of this reference line that is the details about the far side details. Let us see here we are interested to do a welding where we have to do welding on both side. Let us top side we have to do some welding operation here and bottom side also we have to do some welding operation.

So, detail about this top side will be given generally below this reference line and detail about this bottom side or far side will be given above this reference line. In this reference line here generally the main element in a welding symbol are this terms D, L and P this is the main element of a welding symbol. Here, D is the depth of a weld for a part this depth is considered as the thickness of the plate.

This D is this generally considered this is a generalized weld symbol detail about this welding symbol also I will explain gradually in subsequent slides. So, here D is called depth of weld in case of butt weld this is the plate thickness. In this middle region here the detail about welding geometry will be given. What is welding geometry that also I will show in subsequent slides.

And what is L here generally L is the length of weld; that means, how much length of weld we are doing and P is the called piece of weld piece of weld means piece of weld means let us this is a this is a plate where we have to do some welding. Let us say we are doing some welding after that we make a gap and here after that here another welding we have done. So, what happened piece of welding means centre of these weld to centre of this weld. So, the distance between these two centre position of this weld is called piece of the weld.

So, this is generally represent piece where is L, L is the this length of individual portion of the weld this is length of the weld. Now here, there is given some field symbol also here this is this is generally field symbol field symbol generally provided once we are going to install the welding techniques in industry. There generally this field symbol is

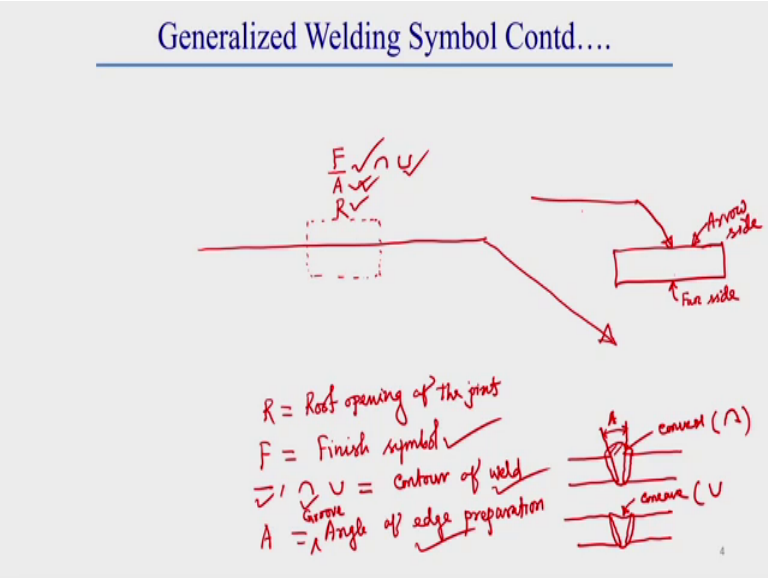
required to use. And sometimes we provided in this in this reference line some sort of circle in this field symbol region that is this types of circle also sometimes we provide.

These circle generally provide once the starting position of weld and finishing position of the weld is same generally especially for pipe welding; that means, around the pipe. General once we do the welding it start from a location and it is return back to after completion of weld in weld in same locations. That is why in case of pipes welding generally this weld all around symbol is required to use. Now, sometimes also we will see that at the in this weld sometimes also we use some tail in this reference line. This tail is this is called the tail of reference line.

Generally in inside this tail we provide the specification process or other reference like; or reference is some welding we will do by submerged arc welding. Let us we are doing some welding by submerged arc welding. Let us some sort of operation we have to do GSTM some operation let us we have to do. So, these are all reference; that means, what types of welding we are going to use and let us we have also use some a specification a specified electrode. So, all the details we will be given generally at this tail region.

That means, what types of welding procedures submerged arc welding like GSTM some sort of a specifications that is one some sort of specification. On other things we have to provide that things we have to provide in this tail region. Once there will not be any specification or any types of reference then we need not to apply this. That means, we can avoid is tail region; that means, we can eliminate this tail region. Now we will see what are the different welding geometry part in this region. That we will see just I will show you that things in next slide.

(Refer Slide Time: 08:50)



Here let us let this is a welding symbol, this is a reference line in this middle region. In this middle region general all the specification or all the details of joint geometry is provided. Like generally here generally it is represent you can say it is represented like this F A and R and after this F there is generally used a line for this line can be other type also that I will show in details. Here F A R is provided, what is F represent?

Here F represents the finish of weld. That means, finish of weld or this F is represent finish symbol this F represent because first we have to provide the finish symbol of weld F represent. What is A? This line this after A A after F generally we provided the horizontal line or sometime this can be concave line or this can be convex line or this can be concave line. So, this can be a horizontal line this can be a convex contour or this can be a concave contour also.

This second part of this weld represent the contour of weld contour of weld. What does it means? Means once we do the welding once we do the welding let us we are doing some butt welding. In this butt welding if the contour this contour of the weld can be sometimes let the contour of the weld become less. So, here what types of contour we got a top side we got a generally convex type shape.

So, what happen in this case we have to provide generally this convex contour of the weld if the weld is like this. Sometimes generally we can get a weld which can be concave type also. Let us say we get a for sometime it is required to have some weld

contour which can be some sometimes this types of shapes. That means, which shape can be this types also. Then we have to provide generally this concave shape this type shape once it is this types shape this type this is concave contour of the weld concave shape of weld.

This is generally convex shape of the weld here generally shape of the weld is convex in nature. Here generally that is why this contour shape is look like this. Here generally contour shape is look like this. Once this shape of is flat; that means, it is or it is generally if it is flat in nature then generally there a straight line is required to use. And then generally this R is another important aspect here, this R A is called this A is called angle of edge preparation.

This is angle of edge preparation edge preparation. Or you can say this is generally called groove angle A is called groove angle groove angle of edge preparation. So, it is generally depends generally what happens here what will be the what will be the what should be the edge preparation angle. what should be the edge preparation angle? That is generally given after this contour of weld after this contour of weld generally this angle of edge preparation is required to put.

And this R part represent this R represent root opening of the weld. That means root opening of the joint root opening R represent the root opening of the joint. This joint geometry details generally provide in this way. So, if first part of this if in a symbol the first part if with the all this parameter if it will be given, generally this first part represent the finish of symbol finish symbol. Second part represent contour symbol; that means, second part this horizontal line concave or convex symbols convex symbol generally represent the contour of weld symbol.

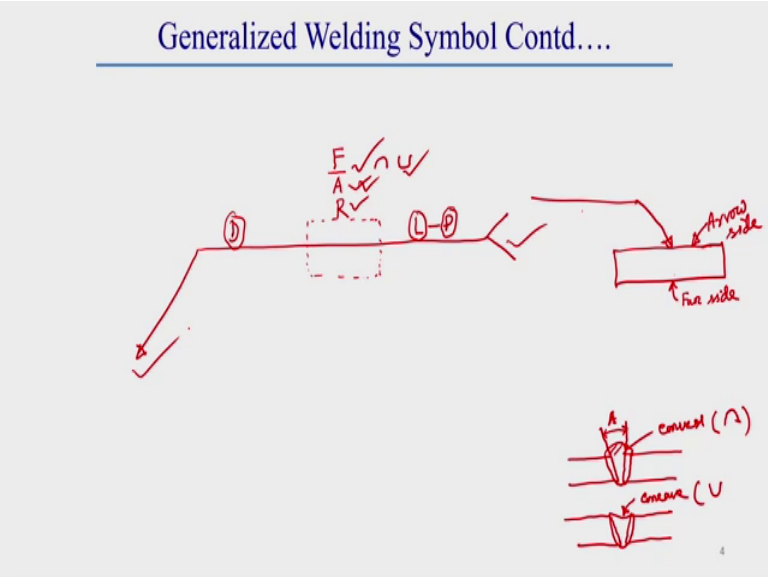
And this A represent the angle of edge preparation; that means, groove angle of edge preparation and R represent the root opening part of this of a weld joint. So, the if this things is given top of this reference line generally this we have these information will be provided this information generally will be provided. If it is generally given top side of the this thing then what happens this all the things will be in far side. That means, let us here this is a here let us we have to do the welding then here let us arrow is provided.

So, arrow side this side is called generally arrow side. So, arrow side details will be given generally bottom of this reference line bottom of this reference line. So, whatever

the things will be given top side of this reference line that we have to do this side of the; that means, this is far side far side of the weld. So, here generally this whatever the information will be given that we have to do in this side; that means, bottom side of this welded plate. Now this if this thing is given bottom side of this reference line that means, if is F A R is given bottom side of this reference line; that means, this information we have to provide topside. That means, this arrow side this arrow side this information we have to provide this arrow side of the weld plate. Now, here some other things also we have seen here if the reference generally what we have also seen. So, this is the generally generalized weld symbol and it is different component of weld symbols.

So, based on this information generally we can get idea about what we have to do and actual practical application. Now we will see what are the other important things is available here. Here is the very other important things also you should now here that we will that I will explain in subsequent slides as well as here are also some other information also I will provide. Here one things you keep it in mind, here what we have seen?

(Refer Slide Time: 15:35)



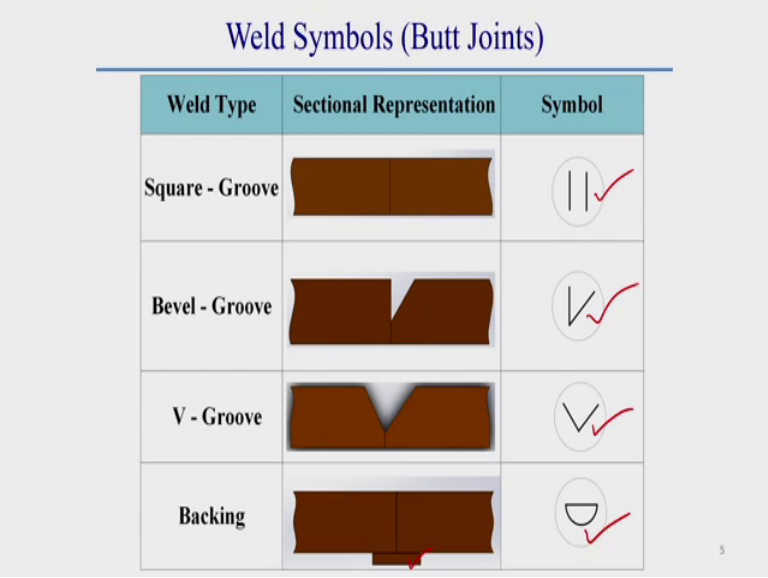
Here generally D and here length of weld and P is given. So, this generally sometimes what happens here there is a there is a generally tail of this weld. Now this tail is required to provide one some a specification is given. If the specification is not given then we

need not to provide. That means, this tail part we can eliminate. Now let us so a specification if it will be given then only we can provide we have to provide this tail.

Now let us if this tail and arrow if it is shift from this side to this side let us this tail shift this side and arrow shift this side. Then also whatever the element will be there; that means, is left side general of this joint geometry left side of this joint geometry will be there group of weld symbol. Then here will be length of L symbol and here will be the P (Refer Time: 16:30) symbol. So, the their information if the arrow is in this side if the; that means, if this tail and arrow is interchanged then the element of this weld symbol will not be changed.

That means, whatever the weld welding element of a weld symbol are there it does not depends on depends on it is change of tail and arrow, this information we should know. Now we will see in details about this what are the different symbols generally use for different types of edge preparation or welding operation.

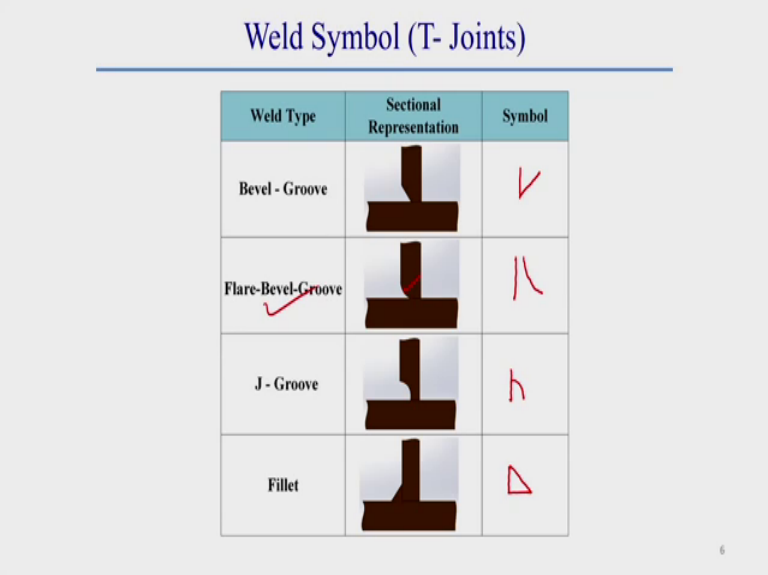
(Refer Slide Time: 17:05)



Like in case of butt welding actually here the symbol of this butt welding is like two parallel line. In case of a bevel groove in case of a bevel groove the weld symbol is look like a bevel shape; that means, a bevel types of shape. In case of a V groove the symbol of weld is look like a V shape.

If there is a backing bar or backing a strip is required to use to prevent this melt through generally that cases generally we are our well said. That means, our for representing this backing this backing symbol is provided like this is generally a semicircular types of shape. Now we will see what is the weld symbol for a fillet weld.

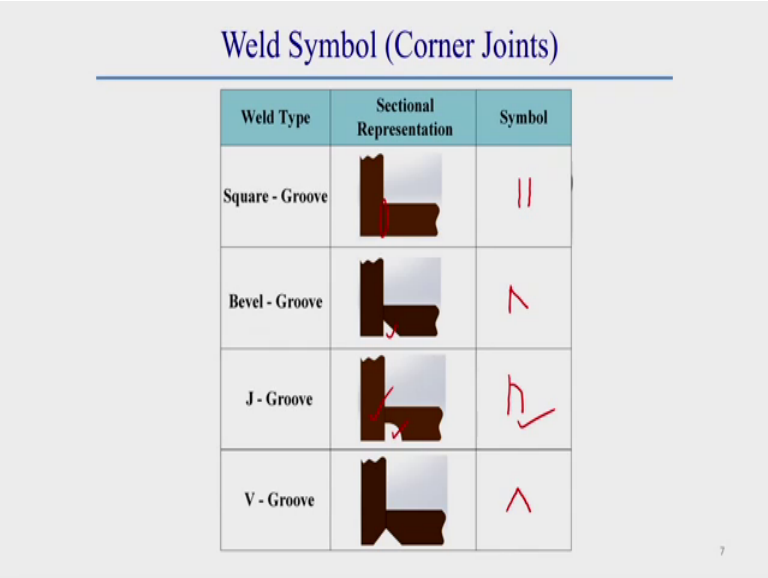
(Refer Slide Time: 17:53)



Now, for fillet weld also if it is a bevel groove generally this weld symbol is look like this is generally weld symbol for a bevel groove for a fillet weld. If it is a flare types bevel groove; that means, here some flaring is done in a for this case generally this weld symbol is look like this. That means, here also some flare shape is there, this is the flare symbol that means the flare bevel groove symbol.

If it is a J weld that means, if it is a J groove weld then the weld symbol this J groove symbol generally it is look like J. And if it is a fillet weld generally in case of fillet weld symbol which is a which is look like a triangular in shape. So, this is generally for fillet welding also this types of weld symbol generally used.

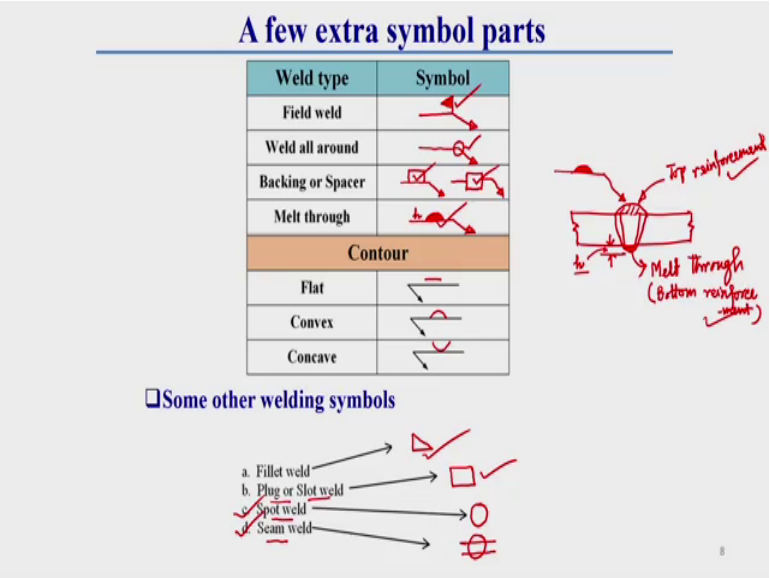
(Refer Slide Time: 18:48)



There here general what we do in case of generally corner joint. In case of corner joint here generally we are doing butt welding. So, here symbol of the weld will be what about the symbol generally used for butt weld similar symbols here also generally is used. If it is a generally bevel groove in case of a corner joint if it is a bevel groove then generally the symbol is also here generally here bevel group is made. So, if the symbol of this weld is generally like this; that means, like inverted V here depending upon this shape of the bevel here the symbol is like this.

If it is a generally J groove there we can see the symbol of this weld is like, this is for this and this symbol is here this types of this edge preparations we made. So, that is why this symbol is like this. If it is a V groove for J corner joint here generally the symbol is like inverted V. Now we will get different information about weld symbol.

(Refer Slide Time: 19:50)



Like what happens here generally how the field symbol is represented a few extra symbol which we should know. For field symbol field symbol represented in a weld symbol by a flag like shape element. Generally this types of shape if it will be there flag like shape is there then only then this is called field symbol this is called field symbol. Now let us we are interested to do welding all around the like for pipe welding let us we are interested to do welding all around. That means, the starting point and endpoint of the weld is same, then generally this is represented as this is represented as generally here there will be a weld symbol.

And generally in this field symbol region we have to provide a circle circular types of shape. This is generally called weld all around. Sometimes we can use already I have told you; that means, backing and especially if somewhere there in will be use backing then what happens here generally backing symbol generally provided other side of the weld. That is why for backing symbol it is represented like this. If it is a spacer generally then there is a spacer is represented in a welding symbol like this. So, this is generally a spacer this is generally backing of weld.

Now, melt through how it is representing in a welding symbol. If some sort of cases there is melt through is required in this cases generally this melt through is represented in a welding symbol generally other side of the joint it is represent far side or other side of the joint here I am showing how it is look like melt through generally representing in a

weld symbol. Generally melt through occurs through which side melt through means let us we are doing a butt welding operation.

If we do a butt welding operation so then generally let us say we are doing some butt welding operation here. So, if we do the butt welding then there is a some sort of thing like this we get a bit shape like this we get a bit shape like this. Generally here each of the part we should know. Here we see here some sort of portion here this portion; that means, in bottom sides some extra molten material is come out this portion generally represent called as melt through. This is sometimes required there is some specific range of this melt through height.

This there is some specific this is generally required for a strength requirement of a welded joint. So, this melt through also sometimes called as bottom reinforcement bottom reinforcement this melt through generally also sometimes called bottom reinforcement. This bottom reinforcement generally have a specific height. So, if it is within this a specific height then this is acceptable. If it is within acceptable limit of this specific height then this is good for welding. If it is generally excess then this is a defect types of thing in case of a weld defect in the sense here generally molten material requirement will be more and what happens there is a chances of extra weld material requirement in this case.

So, generally these melt through have a specific height let us h. Now top of this weld also you see top of the weld also there is some excess of material from the surface of the top surface of the weld plate. This excess of material generally is called top reinforcement. This is generally called top reinforcement.

These top reinforcement and bottom reinforcement generally is a required part actually this is a means essential part of a weld joint. So, this joint is generally required for extent requirement of a welded joint so this is sometimes required. Now generally this melt through which is generally the molten material come out from the bottom side of the weld is called generally melt through. This melt through in case of a weld symbol is a specified.

Generally it is if this is arrow if this is a arrow. So, this generally this melt through is occur other side of this arrow the or we can say far side of this arrow. So, melt through generally we have to represent in other side. Other side in the sense here generally other

side is bottom side of this reference side other side is top side of this reference line. And this melt through generally represented is like this and we should fill with we should fill with this is a generally field contour we should represented and we should represented by field colour generally this contour they this melt through is represented with field contour ship.

That means this melt through represented like a convex shape where which is this gap is filled by the gas these gap should be filled actually. So, this is generally melt through this is reference is melt through generally this melt through is a specified by a height we should this height we should put left side of this weld joint.

That means, here generally this height is we have to put here. Yes, generally this height is out left side of this melt through symbol this is generally melt through symbol this filled convex shape and this melt through height is representing left side of this melt through symbol. Now, the contour of flat convex and concave I have already explained in case of generally in case in a weld symbol this flat weld symbol means if this reinforce top reinforcement is not there then this is called generally flat weld symbol.

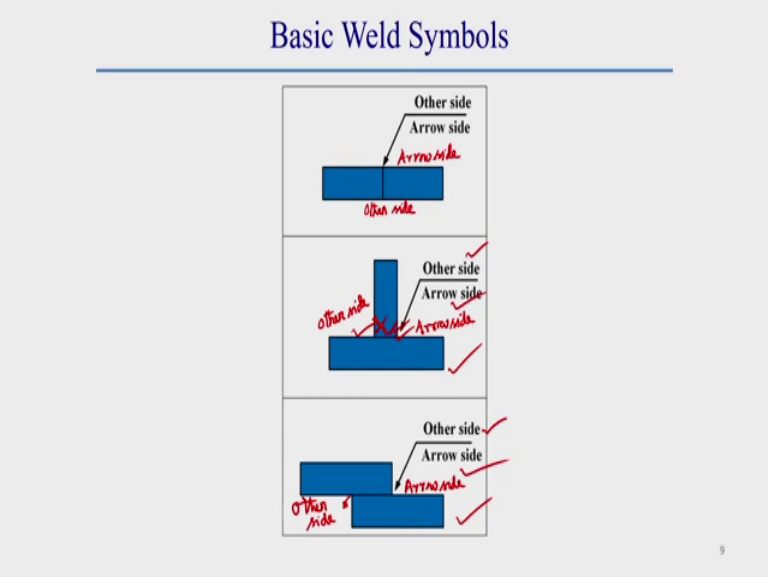
This is generally represented by a horizontal line, if it is a convex shape it is a convex shape generally this is represented in the weld symbol like a convex contour. And if it is a concave shape generally this contour is represented in weld symbol like a concave shape. Here, some other welding symbol also we should know generally we have already seen that butt weld symbol how it is look like fillet weld symbol also we have we have seen in case of fillet weld symbols we have send.

It generally represented by a triangular shape then what should be the symbol of plug or slot welding generally plug of slot welding is generally represented by a rectangular box. This is generally if it is a plug weld or slot welding then this is the plug or slot welding it is generally used for it is generally used for lap weld joint. Generally there this type of weld symbol; that means, a rectangular box we should once we will be in a welding symbol there we have to do either plug or slot welding.

If it is a spot welding; that means, for a spot welding generally for a spot welding generally it is represented by a circular symbol. If it is a seam welding; that means, this D then generally this welding symbol is generally represented by a circular shape with two horizontal line. So, this is generally different lot of important symbol this is

generally different weld symbol used in welding industry or welding technology. Now we will see different example and different other important parameter of welding symbol.

(Refer Slide Time: 28:14)



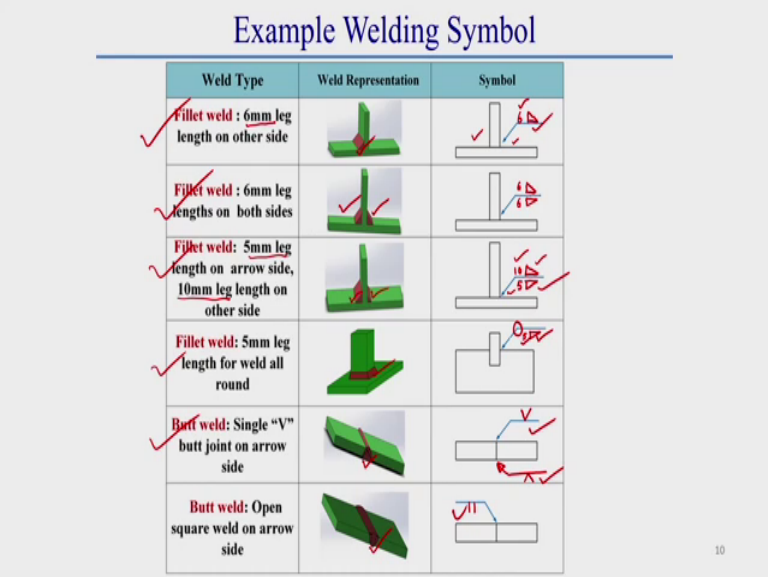
Like here, one things we should know here let us some information let us in a welding symbol here other side is top side and arrow side is this. So, for a butt joint what is other side see this other side is generally here it is bottom side of the this is generally other side or bottom side of the weld plate. And this arrow side is generally top side of the this top of side of the weld plate. Now here generally let this is the symbol is given which one is here other side and which one is here arrow side.

Here arrow side generally arrow side is this side and other side is this side; that means, here whatever the information will be given this is generally arrow side and this is generally other side. That means, other side information; that means, whatever the work we have to do let us here we have to do some bevel angle here let us we have to do some other bevel angle the different bevel angle. So, whatever the information here will be that will be given generally this arrow side and whatever the information will be given here this will be given generally other side of this weld joint.

Now here in this in this lap joint general which one is other side and which one is arrow side arrow side means where the arrow is generally facing. So, here the arrow side is this side. And what is the other side here the other side is generally this side is called other

side. This side is other side this is arrow side. So, this information we should know. So, in case butt welding arrow side other side we got idea in case of T welding or fillet welding generally arrow side or other side and in case of lap joint also what is arrow side and other side that information also what we got.

(Refer Slide Time: 30:13)



Now, we will do some example actually once we do some example of this weld joint then it will be very clear to us. Let us this is a welding operation that then first case here generally let us in a T joint we did a fillet welding whose leg length is 6; that means, 6 millimetre leg length lets. So, let us here this side I am interested to put the welding symbol. So, if this side we will put the welding symbol then what will be the welding symbol here.

So, the generally here this side is called at this side is generally arrow side and this side is generally far side. So, far side information far side information generally where we have to put we have to put top side of the well joint. So, generally here the welding is done based on this welding symbol where the welding is done generally other side. That means, or far side of this weld joint. So, here generally the how the welding symbol will be where the welding symbol will be a fillet shape a fillet welding generally we have done here a fillet welding have done here whose generally whose leg length generally we have to provide left side of this fillet joint.

Generally have leg length is how much? 6. So, the symbol will be the symbol will; that means, once it is given in a weld symbol the triangular shape and this 6 triangular shape and some number 6 left side of this triangular shape. Then by seeing this two symbol itself we can able to do the weld what should be the welding operation in we can easily able to do. So, the in this case the welding operation we have to do in other side of the welding which have a leg length of 6 mm.

Let us another example the second example, here generally here generally both arrow side as well as far side we have we did the welding operation. So, what should be the welding symbol for this case? Here generally both side we did 6 millimetre leg length fillet welding. So, here also we have to draw a fillet weld symbol bottom side also we have to draw a fillet weld symbol. So, top and bottom side we have to do a fillet weld symbol. After that we have done here? We have done the length of both the weld leg length of both the weld generally here is 6 so here is also 6.

Now let us in this case the third case we did the welding operation where one side is different leg length 5 millimetre leg length; that means, arrow side generally leg length is 5 mm and other side generally leg length is 10 m m. So, what will be the welding symbol here? Here the welding symbol will be here generally arrow side means bottom side this is the arrow side weld symbol what is the leg length of this thing? This leg length of this thing is 5 mm. So, here we have to put 5 now other side also we did a fillet welding that welding symbol also triangular in nature and what is what should be the size of this weld generally size of this weld is 10 mm. So, here generally left side of this weld symbol there we put 10. So, if we see this number and symbol then what should be the welding operation what should be the welding operation that we can easily be able to understand from this symbol.

Now here generally fillet welding we did for a this fourth example here generally a fillet welding is done around a entire structure. Like here around the entire structure generally we did a fillet welding for this region what should be the welding symbol. Here generally first of all here generally we have to provide the weld all around symbol because here the welding starting point and end point same; that means, or all around the structure we did the welding. So, all around symbol we have to provide after that we have to provide what you have to provide generally 5 mm leg length 5 mm leg length and this is a fillet weld also.

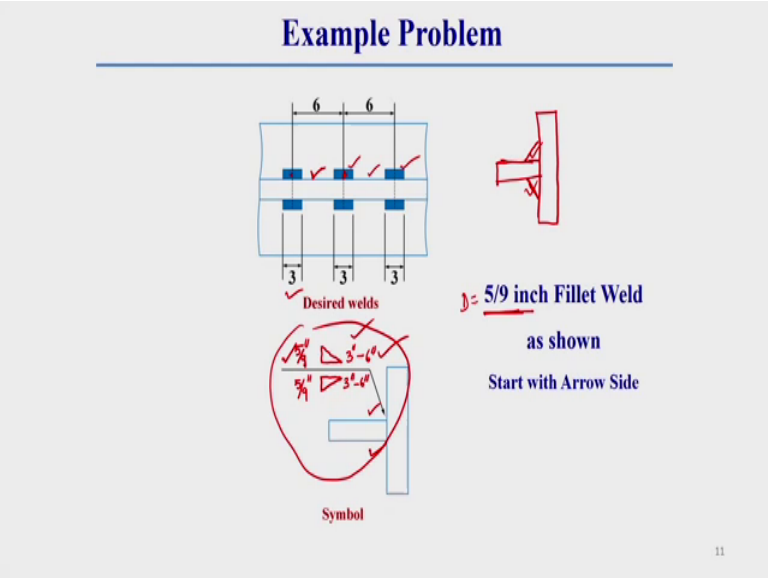
So, generally in this case we have to provide arrow side weld arrow side we have to provide the weld symbol in arrow side and we have to put the leg length left side of this weld symbol. So, here a fillet welding is done and this leg length is 5 mm and it is provided. Now in this case in this fifth example here generally single V and which is done which is done generally opposite side of the arrow. Here you see here generally welding is done this thing V welding is done other side of the arrow.

So, here generally V welding we have done other side of this arrow that is why what should be the welding symbol here at the this is generally other side of a other side is top side of the reference line. So, other side we have to put a V weld symbol. In this case in this case if we put the weld symbol here in this case if we put the weld symbol here general this V groove weld symbol will be put generally bottom side actually bottom side of this reference line.

If we put this welding symbol bottom side of this plate it should be like this if you put the reference line top side of this weld or the weld symbol will be top side of the reference line. Now here generally a butt welding is done for a square group here we see here generally a square group is made there we did a butt welding. So, here generally we have to generally this is done on arrow side this a square group and welding is done from arrow side. That is why this arrow side generally we have to provide a square weld symbol.

This is generally a square weld symbol see this different example of welding symbol. So, once we generally in industry only this types of arrow will be provided and some symbol will be provided in a drawing. To see this arrow and it is symbol generally you have to recognise what are the operation you have to perform in actual case. So, once you have idea on welding symbol then only you will be able to do this thing in practice.

(Refer Slide Time: 36:36)



Now, we will see different different example of this welding operation. Like let us say this is a example of welding operation where generally this let us some sort of welding we have done This is generally what happens some sort of welding after that we provide some gap and after that again some welding is done. After that again some a (Refer Time: 36:54) after that again some other welding is done. This types of welding is generally termed as intermittent welding.

This is generally is this is intermittent welding means it is not a continuous welding continuous welding because if there will not be any gap between these two weld then this is called generally as continuous weld. But here generally gas is provided in between two weld this is this types of welding is called intermittent welding. Now let us see some sort of welding here we made this welding length is this is welding length is 3 mm and length between this centre of these weld and centre of this weld is 6 mm.

So, here the information is given and generally here what are the fillet size of this weld generally fillet size of the weld; that means, here we did some fillet welding. Actually here how the welding is done if we see the side view of these things then we can get what types of welding operation here it is performed the welding operation here it is performed which is fillet welding generally. Here we provided both side fillet welding to it which is intermittent in nature this flat welding have a size is 5 by 9 inch. That means,

fillet weld size generally this fillet weld size is specified by its leg length or sometimes it is generally represented generally specified by it is leg length generally a fillet weld.

So, let us this fillet weld size is 5 by 9 inch. So, generally the size of weld so, what are the welding operation here we have to for this case both side of this both side of this fillet joint both side of this T joint generally we did fillet welding this side and this side we did the fillet welding. So, what should be the welding symbol here? So, what should be the welding symbol here for this case weld generally here generally this side is this side what about the welding is done the other side; that means, this is generally other side whatever the we did other side also the same welding is done.

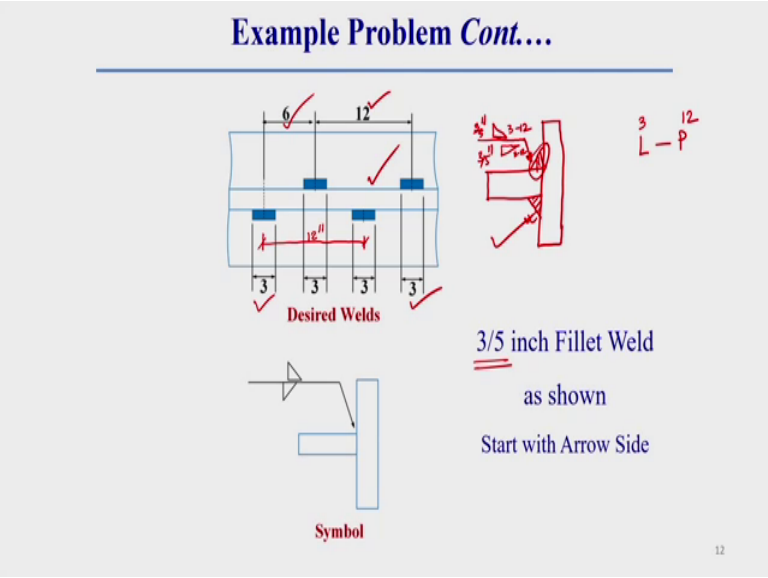
So, here what should be the welding symbol here generally both side both side generally first of all we will provide is the welding symbol. What types of welding symbol here it is this welding symbol generally triangular in nature; that means, fillet welding. So, it is a triangular shape. So, both side generally fillet welding is done. So, both side there will be triangular shape. Now here generally the size of the weld is given generally the size of the weld is provided left side of this fillet welding the from the first generalized weld symbol I have explained about in details what should be the weld size and other things that I have already explained.

That means D, D is actually represented as this D is actually represented as weld size. So, this D generally where we have to put we have to put left side of this weld symbol. So, here generally what we have to put, here we have to put the size of this weld symbol that is 5 by 9 inch. So, this we have to put both top and bottom because size of the weld both top and bottom is same. So, this size we put now here generally what we have to put in right side generally we have to put L minus P. So, length of the weld and piece of the weld.

So, here length of the weld for each for each piece of weld si[ze]- length is 3 inch. So, here generally these we have to put first L is 3 inch and P is generally here we have to put P is how much this P is the distance between centre of subsequent two weld where the piece length is subsequent to weld distance is 6 mm 6 inch. So, here generally it should be this. So, here generally L minus P is; that means, L naught minus P L and P value is weld size is 3 inch and piece size is 6 inch.

Similarly, in bottom side also; that means, in similarly in arrow side also similar types of welding operation is done. So, here also this will be 3 inch and this will be 6 inch. Now these information generally this whatever the drawing here I made this whatever the whatever the symbol here I made. So, this information generally will be given in your drawing sheet to see this information this this and this value what will be the welding shape what will be the welding length. And what should be that distance between two weld that we can easily be able to understand because if we know the welding symbol detail this is one example.

(Refer Slide Time: 41:46)



Now, we will go for different different example let us another example here I am showing just here you see to both side we did fillet welding, but one weld start from little bit ahead of the bottom side first weld let us ta[lk]- let us other side this is also a type of fillet weld where we made if we see the side view of these thing here also we will get generally here we did some fillet welding and here we did some fillet welding here and here this side and this side generally we did the fillet welding. But here you see this is generally here we provided the arrow here we provided the arrow.

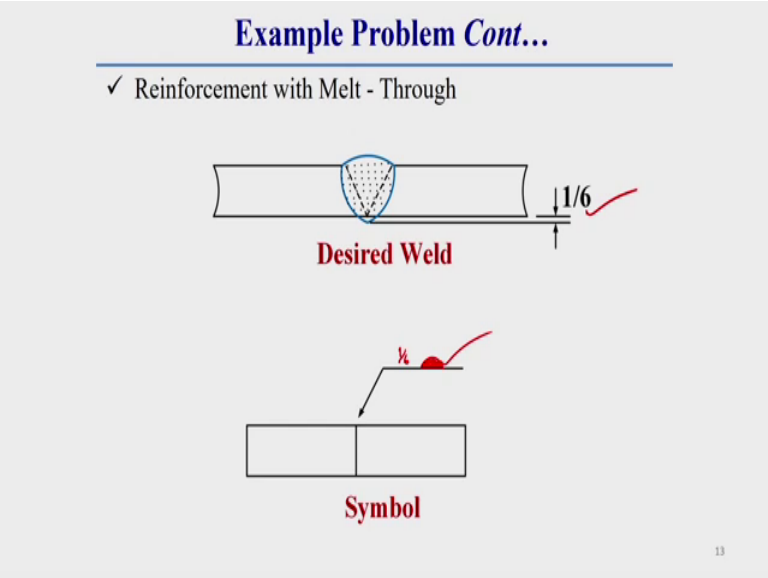
So, whatever the information whatever the information will be required for this side whatever the information will be given for this side. That means, this side this information will be on bottom side of this weld and this information; that means, this other side whatever the things we did this information will be given top side of this weld.

Here general topside the subsequent central line distance between two weld is here generally subsequent weld distance between subsequent distance between two centre of two different weld is 12 inch. And the weld size of this is 3 inch this is given the other side also this other side is also the weld length is 3 m the 3 inch.

But the distance between two centre the where the distance between two centre is generally from this centre through this centre we can easily be able to calculate also will be also 12 inch. This centre to this centre will be 12 inch because here to here to here this distance is 6 mm. Similarly from this centre to this centre will be 6. So, total will be 12 inch. Now, you we see that here both side length of weld and P piece of weld is same. So, this length of weld is 3 and peace of weld is also 12. But here one things we can observe here that one weld will start little bit ahead of the other side other side weld that is why generally here we should put the weld symbol.

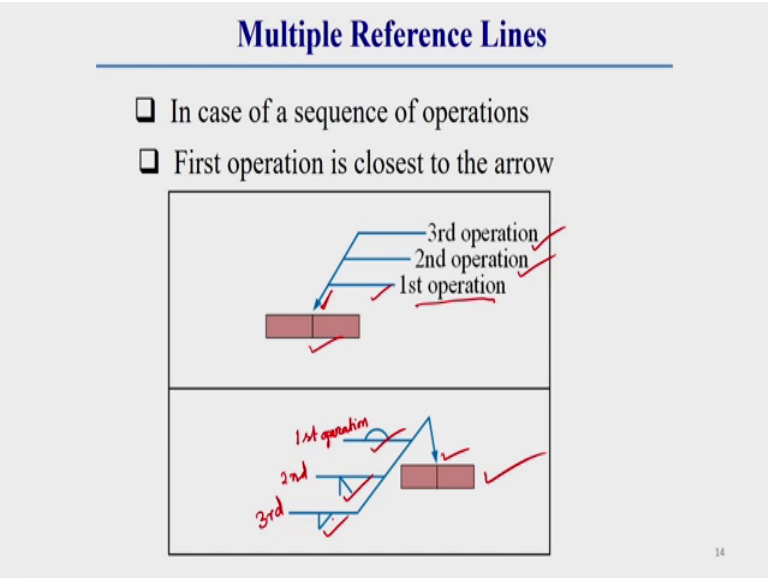
Generally one is start little bit so other side is this side. So, generally here other side is this side. So, you we see this as this other side weld is other side weld is started before this first weld that is why we have to put this weld symbol little bit ahead of this arrow side weld symbol. So, here how what will be the parameter here. So, here this weld symbol is both side is fillet symbol and triangular in shape. And here generally we have to put this 3 minus 12 here also we have to put 3 minus 12 not minus 3 12 top side this L is 3 and piece is 12 here also 3 dash 12 bottom side also 3 dash 12 we have to put and left side of this weld symbol generally here weld symbol size is 3 by 5 inch this weld symbol size weld size will be we have to provide left side of this weld symbol both the side. Generally 3 by 5 inch we made. So, 3 by 5 inch both top side and bottom side we have to provide. So, what happens? So, we got the idea how to draw a weld symbol if it is subjected to intermittent welding or continuous welding that idea and all if we know this what should be the size of weld then we can easily be able to draw the different different types of weld symbol and according to this information we can we able to do what should be the operation we have to perform and actual case that also we can be able to do.

(Refer Slide Time: 45:48)



Now, we will see this already I have told you generally reinforcement and melt through is represented the generally in other side of the weld symbol which is look like this. This already I have which is look like convex shapes field convex shape. And this size of this melt through generally represented size of the melt through should represent left side of the left side of the weld symbol. That means melt through symbol here 1 by 6 we have to put left side of this melt through symbol.

(Refer Slide Time: 46:30)



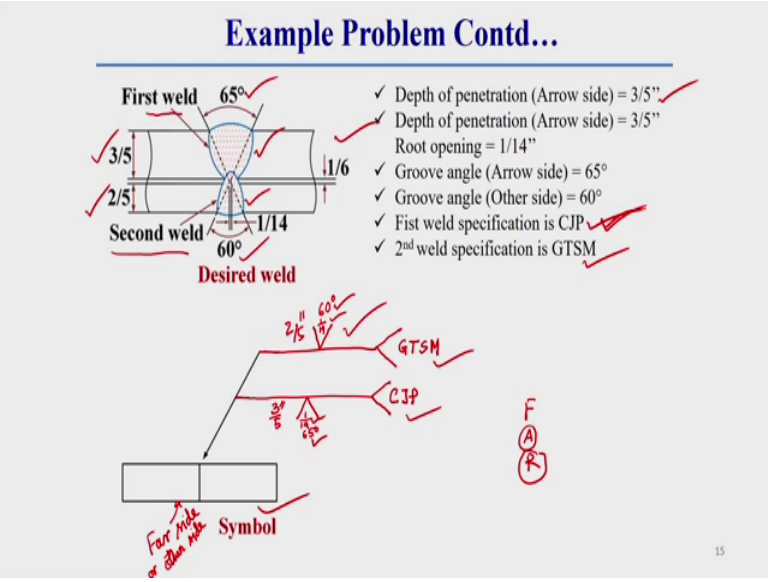
Now, lot of other information also is enough now in case of in some cases in industry there can be multiple operation of welding in a single structure. So, there generally let us in a single structure let us we have to perform in a particular location. Let us we have to perform different sequence of operation. Generally, how to represent that sequence of operation. Generally that sequence of operation is represented let us in a particular butt welding there is three operation is required to do let this is a butt weld here. Generally we have to do some butt welding or some sequence of welding we have to do here generally how to represent this weld symbol.

Generally this is represented by if there is three operation generally there will be three horizontal line which is first operation should be closest to the arrow. That means, whatever the operation first we have to provide whatever the operation we have to do that we have to provide closest to this arrow position. So, similarly generally this second operation another horizontal line we have to draw and another operation whatever the operation we have to do this we have to first then if there will be another operation then third operation for that another horizontal line we have to draw and we have to do the third operation like here I have drawn a welding symbol here which should be first operation which should be second operation and which should be third operation.

Here this first operation I have already told you which generally closest to this arrow. So, in closest to this arrow generally which symbol is there closest to this arrow this symbol is there. So, this is generally will be this will be your first operation this will be your first operation. Now this then what will be the second operation after that whatever the horizontal line will be there this will be the second and this will be the third operation.

Subsequently if there is four five different types of operation is required for a particular case or for a particular geometry. Then there is generally another horizontal line we have to put and we have to put the detail symbol like here. Generally we did some melt through then some bevel angle the bevel welding operation then some let us fillet welding operation.

(Refer Slide Time: 48:53)



Now, we will see a example of this multiple reference line and what will be the welding symbol for a multiple operation of a multiple operation of a welding proce[ss]- ah. What should be the welding symbol for a multiple operation. Let us this is a geometry of multiple welding operation here let us here on si[de]- top side generally we did some welding operation which have different joint geometry and bottom side also we did some operation which have some other joint geometry.

Let us top side it has a bevel angle is sixty five here bottom side bevel angle is 60. So, here generally let the first operation is done. Let the first operation is done at top side this first weld it is given and second operation is done bottom side after that bottom side second operation is done. So, here generally root opening also given. So, how to draw the welding symbol here in this case how to draw the welding symbol. So, first operation for first operation detail we have to provide where we have to draw a horizontal line here closest to this arrow closest to the arrow. Generally close to arrow we have to draw a horizontal line.

In this horizontal line generally in this horizontal line generally first operation is done where here. Here generally this arrow what should be the arrow side this is generally arrow side and this bottom side is generally far side or this far side also sometimes called other side. I have already told you other side arrow side far side or other side. Now here generally how what should be the welding symbol for this two different welding

operation. So, first operation then first horizontal line I did so here generally the detailed specification should be given bottom side here. Generally bevel angle is done in arrow side this angle is given generally bevel angel is done in this arrow side given as 65 degree. And it has a root opening of 1 by 14.

Because we know there is used there is used. So, here generally two information it is given here. So, two information is a given here in the sense here generally this F A R so first far. So, far generally angle is coming then generally root opening is coming here also generally first angle is come. Then after that generally this root opening is provided. So, here this a specification of this welding operation here is some a specification is given for this welding operation this is a specification of this welding operation. This full form of CJP generally is complete joint performance this is a term generally used in welding industry that is CJP that is called complete joint penetration.

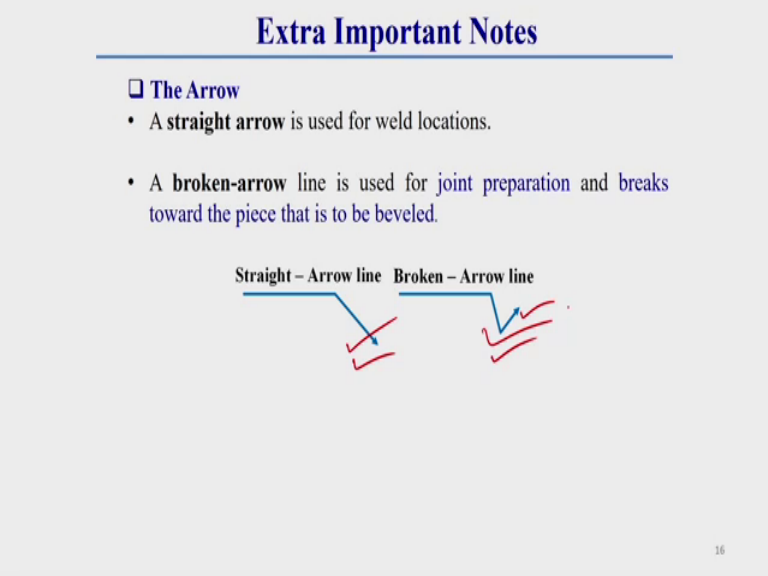
So, the a specification of first weld is CJP where as in second operation the a specification is GTSM. Generally some terms used for welding industries GTSM generally it is full form is gouge to sound metal this full form of this thing gouge to sound metal. So, if this types of a specification will be given then for that case we have to generally first welding operation there is a specification is given. So, there we have to provide the tail in this tail generally we have provide this CJP a specification.

This is the once we see this thing then what should be the first operation that we can easily be able to do that. That means, there should be 65 degree weld group angle and there should be 1 by 14 is generally root opening. Now for second operation generally another line we have to draw generally second operation is done here is also some a specification is given. So, so for this a specification generally we have to draw a tail. So, inside this tail we have to provide this a specification detail.

That means GTSM we have to provide. So, to see this GTSM welder or welding expert can easily be able to understand what are the things they have to do. Here generally welding is done other side of this arrows the other side of this arrow. So, here generally the welding symbol will be other side; that means, or far side of this arrow. Here also a we will generally V groove is made this V groove have a generally angle is 60 degree and root opening is also 1 by 1 by here also root opening also 1 by 14 inch ok. So, if this is given if this is given in a drawing then what will be the welding operation we have to

perform that we can easily be able to understand here depth of penetration is 3 by 5 inch for generally arrow side and for other side other side generally other side generally depth of penetration is 2 by 5 inch. So, here this first operation your depth of penetration is given as 3 by 5 inch. So, here we have to write 3 by 5 inch and for second operation depth of penetration is 2 by 5 2 by 5 inch. So, here generally this is generally this should be generally 2 by 5 inch. So, to see this information itself what are the welding operation what are the joint preparation we have to do and what should what should be the reference we have to provide at everything to see this just to see this information itself we can do the all detail welding operation if we know the welding symbol in details.

(Refer Slide Time: 54:54)

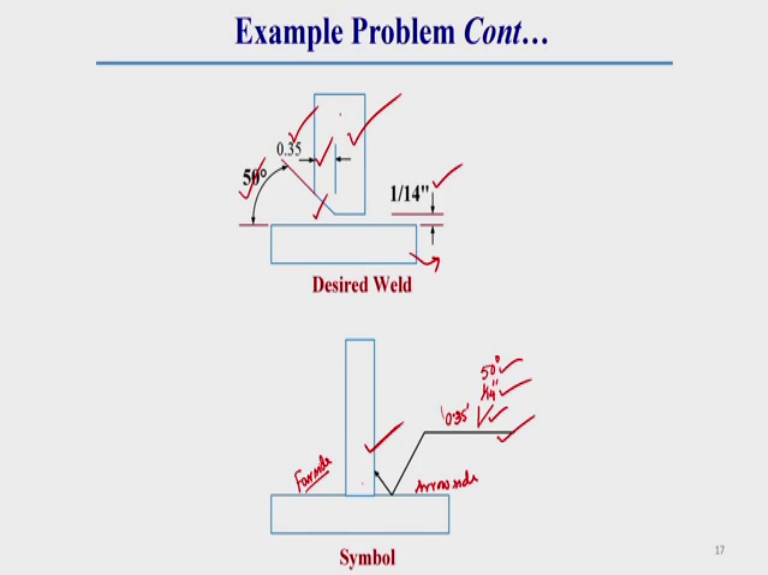


Now some other extra information we should know about welding symbol like in case of weld symbol there we will see two different types of reference line. Generally used one reference line is a straight another reference line generally broken types of reference line is used. A straight line generally used in welding this is generally this a straight arrow was once there is a straight arrow then this is used generally in direct field in the field of welding operation.

That means, in welding location where we have to do the welding on in welding location itself we have to provide this types of a straight arrow. But broken arrow generally used for joint preparation. This broken arrow generally used for joint preparation and these broken line break toward the piece that is to be bevelled. That means, this broken

direction should be in that piece where we have to make the angle angular S preparation or we have to make the bevelling operation that side. Generally this the broken arrow will go. Now once we will do some example of this thing then it will be very clear to you.

(Refer Slide Time: 55:58)



Let us let here we have to make some S preparation where we make a bevel angle of 50 degree. Here generally this depth of this bevel angle is 0.35. And here is a root opening of there should be a root opening of 1 by 14 inch how to represent this how to represent this thing in case of a weld symbol. Here generally let this types of S preparation this types of S preparation we have to do where we have to make a bevel angle and depth of depth of bevel we have to make and we have to make a root opening. So, how to do this thing. So here bevel angle we make in web of this T join. So, here generally this broken arrow should face on this broken arrow should face in this web.

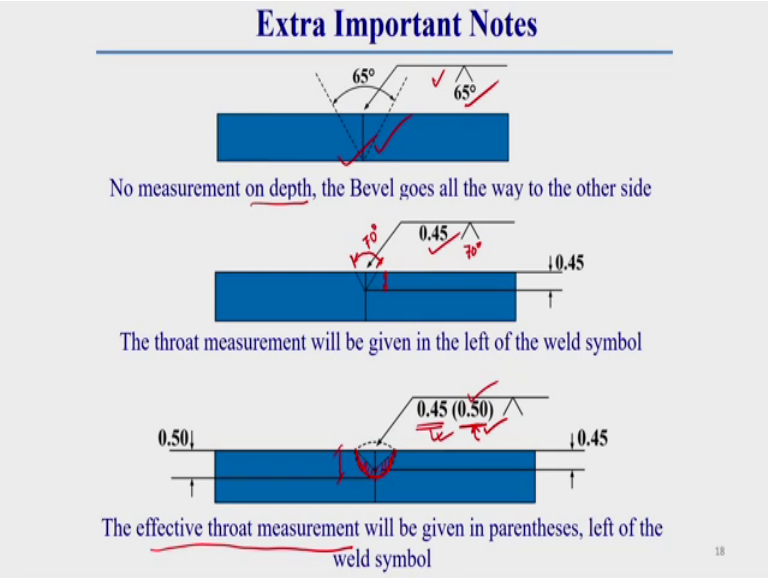
So, because in this web we have to make the S preparation you see this plan generally no S preparation is done. So, this that is why here generally this broken arrow I have explained already previously. This broken arrow symbol should be direction towards where we have to do the bevelling operation. Generally, here we have to do the bevelling operation. Now this bevelling operation we have done generally this is this side of this arrow this side this side arrow we this side generally we put the arrow that is why this is

called arrow side and this is called generally other side or far side. This is generally called other side or other side or far side.

So, here we did S preparation in far side; that means, this side we did the S preparation. So, they let this is the reference line what is far side far side means top of this thing top side of this reference line. So, far side generally what are the things we have to provide here, here we have to provide a provide a generally bevel S preparation which have a angle of 50 degree and which have a root opening of 1 by 14 inch 1 by 14 inch. So, 50 degree and 1 by 14 inch it is given where it is given if generally far side. So, that is why we put this S preparation symbol in top side and S preparation angle and root gap we provide here. And here this depth of the weld here generally depth of the weld is 0.35 this depth of the weld. We have to put here 0.35 in this side 0.35 inch we have to provide this side.

So, to see this broken arrow symbol what should be the S preparation we have to do in this way that we can easily be able to do. If this information will be given in a weld symbol to see this information what should be the S preparation we have to perform in this way that we can easily be able to do once we know the details of welding symbol.

(Refer Slide Time: 59:01)



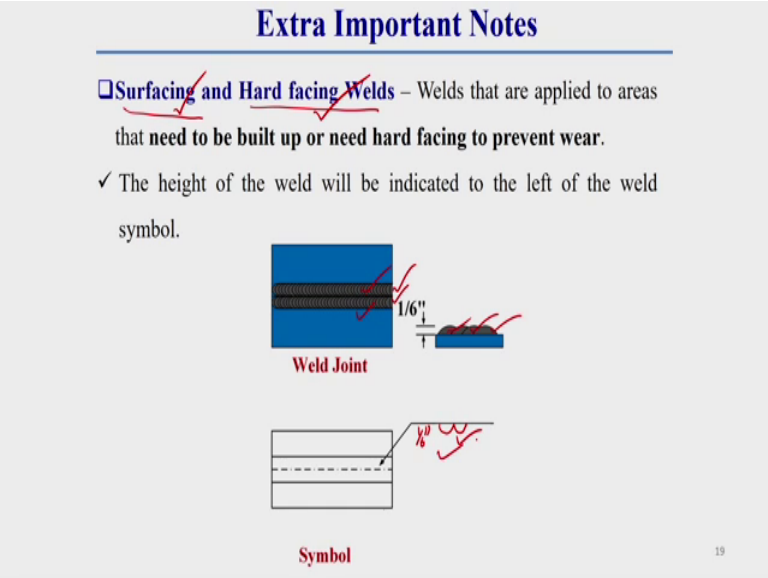
Now, some other information also we should know. Here if the bevel is prepared through the entire thickness of the plate if the bevel is prepared through the entire thickness of the plate. Generally in that case if the bevel is made through the thickness of the plate

generally that times the size of the weld size of the bevel we need not to put left side of the layer generally angle is sufficient to put that is why no measurement of depth is required in a symbol on this bevelling operation is performed through the entire thickness of the through the entire thickness of the weld. But if the bevelling operation is performed for a particular portion of the thickness of the weld like here generally.

Only this portion this much of portion bevelling operation is done. So, here generally let this angle of this bevel is let us 70 degree that the 70 degree angle. So, here generally we have to provide here that is angle as well as depth of the bevel operation after welding that whatever the depth of fusion we are getting. That means, from here to here depth of fusion once we do the welding some sort of base material also fused or melted this extra base material. So, for that generally here generally depth of fusion is considered till top of the these two fusion depth.

So, this is generally called depth of fusion. So, this is sometimes called effective throat measurement this is also sometimes this depth of fusion also sometimes called effective throat measurement. Generally this effective throat fusion or effective throat measurement generally we have to provide at the parentheses side of the bevel depth. Generally whatever the weld penetration we are getting that we have to exact weld penetration or effective weld penetration we are getting that we have to provided we have to provide side of the side of this depth of bevel in between a parentheses that is like this that is like. So, here generally effective things is given here.

(Refer Slide Time: 61:14)



Now, some sort of cases we have seen in industry generally some sort of cases some operation we perform like surfacing operation or generally hard facing operation we generally used to do to prevent the surfacing and hard facing some operation we perform which is subjected to generally corrosion types of effect for that structure. Generally some types some sort of surfacing or hard facing we have to do. Surfacing or hard facing is a process by which in some low corrosion resistance material over the surface of low corrosion resistance material generally we provide some corrosion resistance layer material.

That corrosion resistance material may can be chromium nickel this types of means generally which have a high corrosion resistance. That generally this nickel material generally we provide over the surface of low corrosion resistance material like a mild steel or some other materials which has generally low corrosion resistance. So, over this because low corrosion resistance this mild steel generally have a lower cost and generally nickel chromium this types of material generally have higher cost that is why if we manufacture a product by for only for corrosion resistance only for corrosion resistance by using this what it is called chromium or nickel types of material nickel titanium or other types of material.

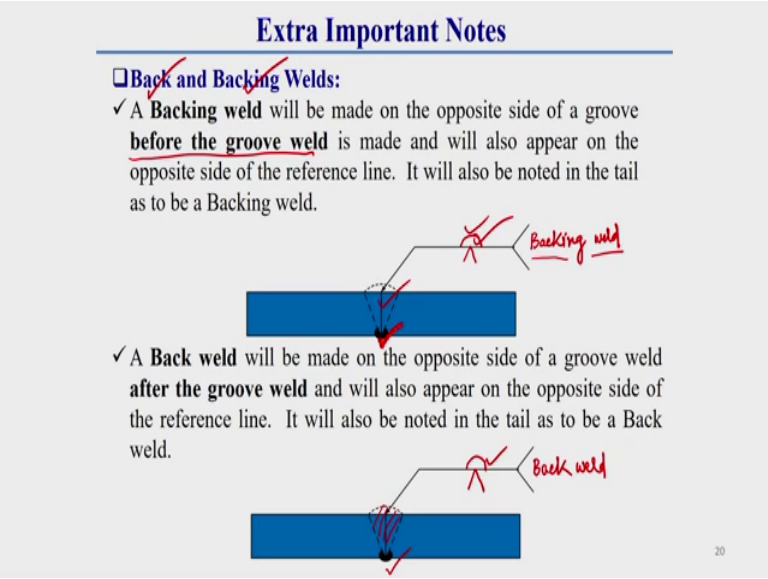
Then what happens this cost of that product will be very high for that reason generally to reduce the cost of that product especially we use some low cost material like mild steel

over that low cost material generally we provide some sort of high cost material like nickel titanium or chromium over the surface of this over the surface of this low cost material then as the surface is covered this high corrosion resistance material then this corrosion will be less in this a structure. So, it is life cycle and other things will be high and it is will be also cost effective for that reason generally two different types of operation we use to see in industry one is surfacing another one is hard facing operation. Generally this surfacing and hard facing operation also is represented by welding symbol.

Let us what happens here surfacing or hard facing means we have to provide the layer of corrosion resistance material over the low corrosion resistance material by depositing the metal over there like this types of deposition if we see the side of this thing we get the shape of this weld deposition like this. Now, how to represent these things in a weld symbol that also we should know. These thing generally represented this is a weld symbol let us top side we did this hard facing top and bottom side let us here top side things we are interested to represent.

So, top side how it will be generate top side here actually here top side is arrow side. So, here generally this two operation how we can represent this two operation we can represent like this and this side, the because had these two. So, here generally this things we provided here this symbol provided by contour and it is height is represented at the left side of the weld symbol ok. So, this we can do like this.

(Refer Slide Time: 64:40)



Now, in case of here so say some other information also here we should know. Generally this hard facing generally or surfacing generally symbol is represented by weld contour and it is height. Generally represented left side of this weld contour as it is done is arrow side that is why it side is provided bottom of this weld reference line. Now here generally some other information or some extra information once we will be in industry. There we will see generally some sort of welding operation we have to do before groove weld some sort of welding operation we have to do after groove weld.

So, based on this thing there is two different weld generally we can see in industry one is called back weld another one is called backing weld. A backing weld will be made on opposite side of a groove before the groove weld. Generally backing weld is done opposite side of this; that means, these operation first we have to do after this groove welding we have to do. So, this if this groove this if this other side welding. That means, if some welding operation backing weld.

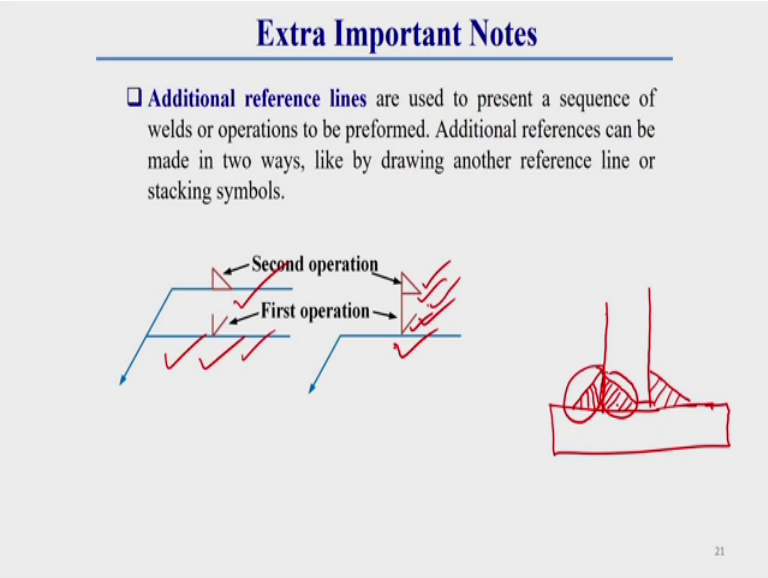
Generally made opposite side of the groove generally this [packing/backing] backing weld if this backing weld. If this weld is done before the groove weld then this is called generally backing weld. If this operation is done after the groove weld; that means, first of all this groove weld is ma[de]- done after that if this weld is done this other side welding is done then that is called back weld. So, always keep it in mind backing weld is done before the groove weld and back weld is done after the groove weld now how to

represent this backing weld and backing weld and back weld in a weld symbol that also we should know. Backing weld and back weld it is represented it is generally done other side of this arrow.

So, this backing weld generally represented like this other side and generally this backing weld symbol is look like this and this reference that means, in reference line we have to provide the we have to write here the whether it is backing or back weld. Here generally we have as we done the as we have done the backing weld that is why here we have to write in reference region or in the tail of this welding symbol as backing weld.

Now for back weld also similar things we have to do for back weld also see here generally this is backing weld this side generally groove weld we did. So, this is the symbol of this, this is the symbol of this backing weld generally. Similarly here also the symbol of this backing weld back weld is similar except at the tail we have to write as back weld back weld. Now here one things you keep it in mind what is the difference between this back weld and melt through in case of backing and back weld this contour is not filled with; that means, it is a empty contour. But in case of melt through there is generally filled contour is there.

(Refer Slide Time: 68:02)



Now, this is the last part of this weld symbol that where here generally some sort of cases I have already explained in detail about different welding sequence if we perform in same side of a welding joint then what should be the different operation. Let us for a

sequence of generally for a sequence of welding operation we can provide the in same side actually especially if it is in same side for a sequence of welding operation.

We can represent the welding symbol by two reference line two or multiple reference line or we can represent this welding symbol in a same line wave with symbol how it is that I am little bit explaining here. Let us in a T joint here, first we have to do butt weld after that let us we have to do fillet weld butt weld and fillet weld let us here we have to do butt weld first after that we have to do a fillet weld this. So, what happens if it is in same side for this case we can use a welding symbol which have a single vertical line with two different operation.

Like here generally butt welding is done in this side it is arrow side itself, in this arrow side itself we did some fillet welding also. So, if this types of thing is there generally there we can use this types of welding symbol of that means, in a single vertical line we can provide two three different whatever the number of operation is required to make if it is in same side if it is opposite sides then that cases generally we should use multiple reference line let us other side also we should do some let us this side also we should do some welding operation.

If we should do some welding operation in other side also in that case generally we should use we should use this multiple horizontal reference line ok. In this case generally this will not be applicable in this case. So, these all about today's lecture next class I will start on welding power sources.

What are the history of different welding power source, what are the different categories of welding power sources? We will see that what are the different advantages, what are the different drawbacks of different welding power sources in details in today's class because in tomorrow's class. So, so tomorrow I will start on lecture I will deliver a lecture on welding power sources.