Marine Construction and Welding
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Module No. # 01
Lecture No. # 18
Steel Material Preparation

Instead of talking about ultimate goal, I think let us talk about steel material preparation because ultimate goal for a person is to attain the ultimate bliss; you understand what does it means by that? That means, from where you have come, you end up there; where from you have come any idea? Then, it goes to that fundamental question where from the universe. There are lot of theories but my theory is, if you take 0 in the middle you go right where do you end (( )) say plus infinity; you go left where do you end (( )) minus infinity. So, basically plus and minus infinity probably they are meeting at one point to maintain equilibrium, positive charge and negative charge should balance.

See, if I assume that to be some kind of charge, so it should balance that means, they should be together at a neutral state so that can be the starting point or 0 can be the starting point, probably 0 is the starting point. So, wherever you go you end up again at the same place that means, from one everything has formed again it will end at that one. So, that is a ultimate goal but, temporary interim ultimate goal is to get a good job - that will take some million years to reach to that point - but interim goal is to get a good job, get a good placement, good salary, good status so that is available.

Now, you can burgle for that but for that you will have to have some interest in that subject that is how. Anyways, we had been taking about various things about structural items.

Now, let us come to the material with which these are built, so that is steel though ship building there are various types of materials are used. As far as the main hull construction is concerned as well as the super structure it can be steel, it can be fiber glass composite, it can be aluminum, it can be titanium certain things can be stainless steel - I mean - different variety of steel even it can be wood for that matter of fact in some places people have used Ferro cement.

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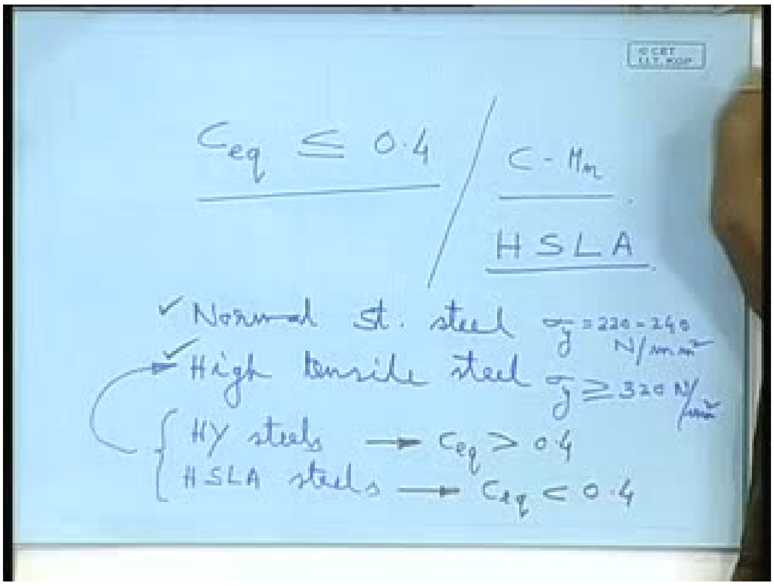

So, there are various materials can be used for various applications, for the time being we will concentrate only on steel. Now, steel is very vague word because there are 100 and 1000 types of steels. The steels which we generally use is low carbon manganese steel kind of alloy steel where the carbon content and the alloying elements are kept at a lower level, such that some parameter called carbon equivalent which remains below 0.4.

The carbon equivalent - there is some parameter where it has referred to as carbon equivalent - we try to keep it less than equal to 0.4, because if you can achieve that it has been found out that steels having carbon equivalent less than 0.4 gives you better weldability - you can weld it easily. If it is greater than 0.4 then welding is difficult; difficult means, it is not question of difficult to melt it or fuse it but you weld it, it cracks for some other reasons. Anyway, we talk about primary steels which are low carbon manganese steels.

Putting different alloying elements subjecting it to different heat treatments we can get higher mechanical properties. We can get those high tensile steels still keeping the carbon equivalent low, so we get steels called HSLA - High Strength Low Alloy steels.

So, one way of telling is that normal strength steel and another is high tensile steel. Normal strength steel means, steels whose yield point - yield stress - is of the order of around 220 to 240, what unit? Mega Pascal.

Well, Mega Pascal yes or Newton's per millimeter square. I somehow feel more comfortable with this unit than Mega Pascal. Anyway, high tensile steel is where the yield strength is greater than and equal to around 320 Newton's per millimeter square. Any steel having yield point stress 320 and above are referred to as high tensile steels. They are also at times referred to as high yielding steels which are in short they are written as HY steels - High Yielding steels. Also, we have talked about HSLA steel, so what is the difference between these two? Both these are high tensile steels.

Though, in ship building and in offshore platform building construction, I believe around 80 to 85 percent of the steels used will be normal strength steel. In some specific cases - specific requirement - we will go for higher tensile steels. For the simple reason that higher tensile steels only will use where we have - what do you call - weight restriction.

What is the use of using higher tensile steel, why do we use? Reason is, it can sustain higher level of stress or in other words, I can keep the scantlings down the thickness of the plate, thus dimension of the sections I can keep it low for the same given load. If I use a normal strength steel for the same given load, the plate thickness if it works out to be 16 millimeter using a sufficiently high strength steel that thickness may come down to 12 millimeter, so I have a weight saving.

So, wherever there is a restriction in weight, like if you want to have a higher speed you need to bring down the weight of a vessel. So, in such specific requirement of reducing the weight then only you go for high tensile steel otherwise not. Otherwise, if there is no weight restriction I use normal strength steel, the weight will be heavier let it be. If it does not affect my functionality, if it does not affect my cargo carrying capacity, it is better to use normal strength, for the simple reason they are cheaper.

First reason is they are cheaper than the high tensile steels; second reason is they are less prone to fatigue failure that is, the one important aspect. Normal strength steels are less prone to fatigue failure; fatigue failure is nothing but a kind of failure which is initiated through a crack formation. A crack is formed and eventually leads to a catastrophic failure that is less probable in case of normal strength steel.

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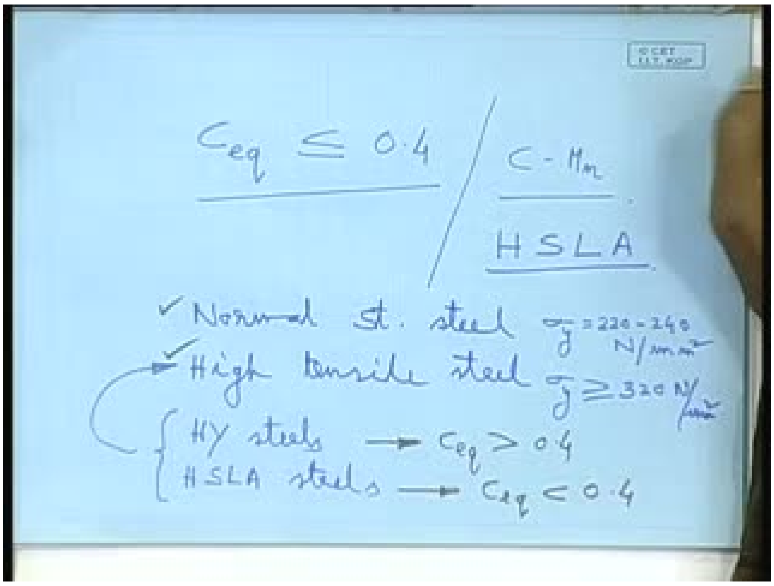

Anyway but still for example, submarine you will rather go for high tensile steel, because the kind of loading they are being used - I mean - it is being subjected to a severe hydrostatic pressure whereas, a floating ship displacement craft if I use high tensile steel - very high tensile steel - what would be the result? Result will be that weight will be less definitely and section dimensions will be less.

So, it may result in lower stiffness and lead to a deformation of the entire vessel. The whole vessel may get deformed, may get bent under its own weight, because the stiffness is less. It is something like an equivalent analogy would be, you take say 1 meter long bar; two bars you take one having high modulus another having less modulus or one having high stiffness another less stiffness, if I hold like this the one having less stiffness will sag, which one will sag? The one which is having lesser modulus of elasticity leading to lesser stiffness of the material will sag under its own weight; another will remain straight, so that could be a problem.

So, if that is a problem then you will have to put sufficient stiffening material to make it stiff, such that it does not deflect beyond permissible limits, so what it will result into? Whatever weight savings you had because of high tensile steel that is lost. That is why in fact for cargo carrying vessels and merchant vessels we do not go for high tensile steels; it is all normal strength steels. Whereas, in case of submarine it is subjected to hydrostatic pressure load, so there question of that stiffness of deflection is not there it is a different kind of load is coming it is not a bending load so high tensile steel is a good proposition. We are talking a little bit about material before we go for a steel material preparation. So, here we see that normal strength steel and then the high tensile steel, it again has high yielding steels as well as HSLA steels.

They are nothing but both are having same similar kind of strength but high yielding steels generally have carbon equivalent greater than 0.4 whereas HSLA steels will have carbon equivalence less than 0.4, that is the main difference.

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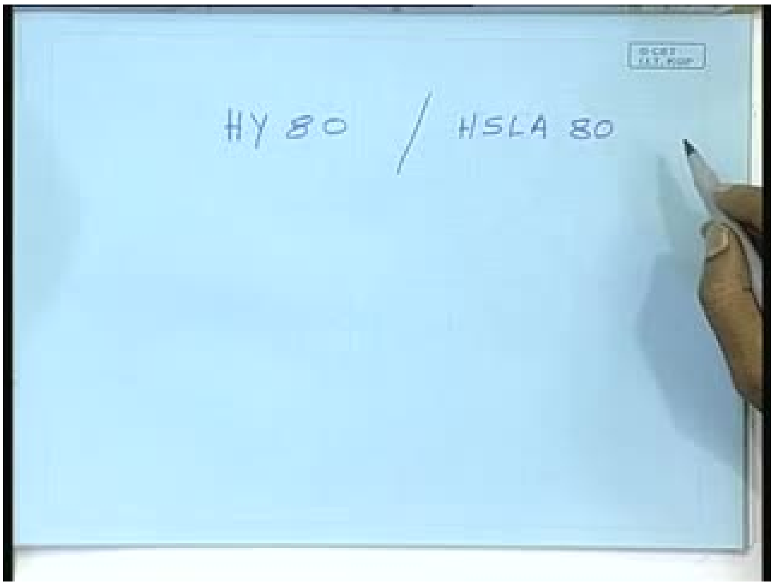

Physically with mechanical properties both are somewhat similar; generally these steels are designated in this fashion. Say, HY 80 or HSLA 80 this is nothing but high yielding steel, yield stress is 800 Newton‘s per millimeter square; high strength low alloy steel, yield point is 800. Imagine our normal strength steel is hardly 240, this is 800 substantially strong. There are HSLA 100 means 1000 Newton’s per millimeter square very strong steels.

So, the difference between HY 80 and HSLA 80, fundamental difference is that for this carbon equivalent will be much more than 0.4 here carbon equivalent will be still less than 0.4. So, high yielding steels are difficult to weld by conventional welding methods, because you do it through a conventional welding method which is used for normal strength steel this will again crack, you will weld it after the weld has cooled down or during its cooling down it will crack that means, you cannot weld.

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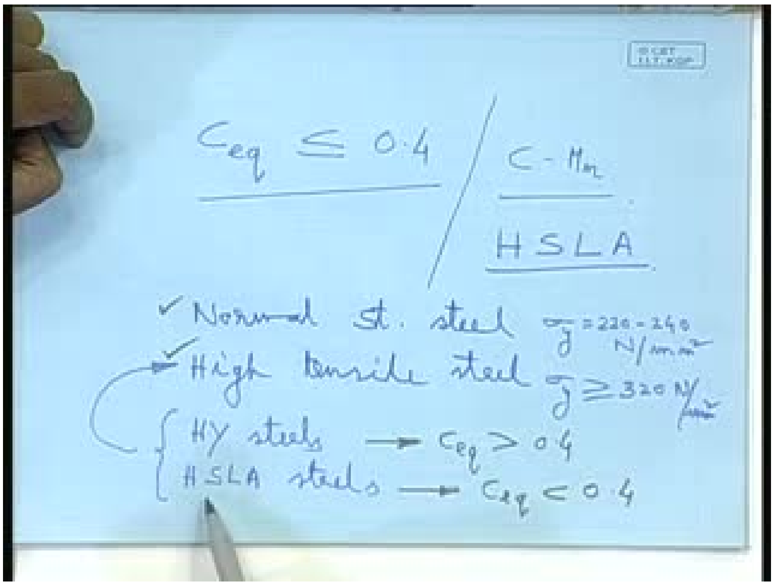

That is why it says that if carbon equivalent is more than 0.4 the steel is not weldable, that is how it is set - it is not weldable or weldability is poor. That is how later years this HSLA was developed which gives you the same mechanical properties as those of HY steels, but improves the fabrication quality. That means, the carbon equivalent with the method it was made that the alloying content were kept low thereby, carbon equivalent is less. Carbon equivalent means, carbon and another alloying elements equivalent to carbon that is how this term. So, HSLA steel carbon equivalent is low and it is easily weldable that means, you can weld it easily, the conventional technique as you implement in case of normal strength steels.

That is what the HSLA steel obviously all this are at a cost, HSLA steel is very expensive because you have all the benefits, you have the strength as well as you have weldability, low carbon equivalent. So, it is more expensive than the HY steels but for construction point of view naturally preferred would be HSLA, wherever you use higher tensile steels.

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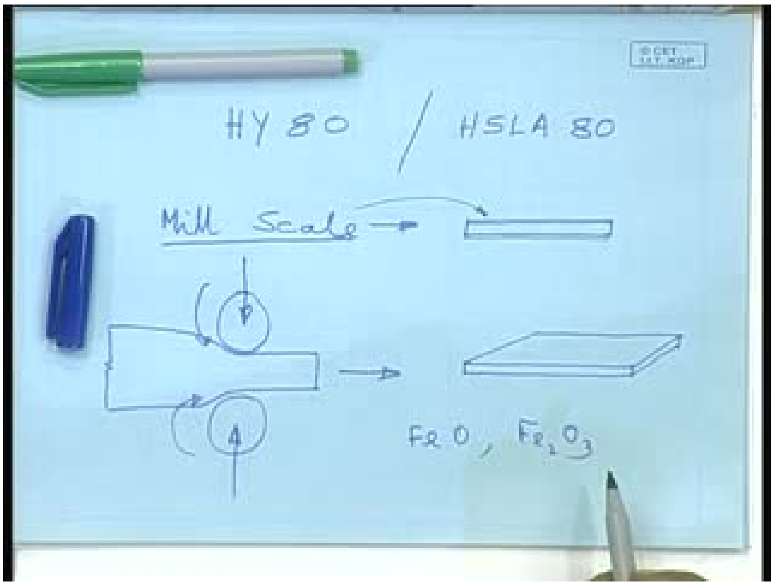

Anyway, whether it is a normal strength steel or higher tensile steel or high yielding steel or HSLA steel, all steels as it comes to the ship building yard we get it in form of rolled plates. Those rolled steel plates they come with a coating on top of the steel plate that coating formed in the process of manufacturing the plates, that coating is referred to as mill scale. This is essentially nothing but you have the steel plate over which as if there is a layer, it is covered with a thin layer on both the sides which is referred to as mill scale.

As you can see the name mill scale means, the some scale has formed in the rolling mill how this steels are formed they are essentially hot rolled from bigger ingots. That means, suppose you are making HSLA 40 steels, so basically what you will do? You will produce composition of HSLA 40; means whatever alloying elements are needed or normal strengths whatever. You take it out in the form of ingot from the steel plant after all that process of alloying, de-oxidation and whatever manufacturing process of steel you get the ingots. Ingots will have a square shape and that will be passed subsequently through a series of rollers, such that you end up at the last rolling mill where you have the required thickness.

So, from a huge ingot you bring it down to thin plate thin means, it can be 4, 5, 10, 15, 80, 40 millimeter whatever different thickness you roll it out. So, the entire process is hot rolling; hot rolling means, when the ingot is hot at a temperature of 800 plus degree centigrade, it is red hot, so what happens then at that temperature you are putting it into substantial pressure and rolling it out. Schematically it may look something like this, so the ingot is under tremendous pressure the rollers are rolling and it is squeezed out as if. So, there will be set of such rollers till you get the final thickness and this is being done at elevated temperature.

So, what happens to the surface apart from the whole thing is getting squeezed - getting thinned out - because steel is a malleable material - had it been a build material this would not have possible - it is a malleable material, so you can make this operation. So what will happen to the surface when finally I get the steel plate out to my desired thickness? Suppose, this steel plate has come out like this, so what I have on the surface? There will be oxidation taking place because of that it was at high temperature exposed to open atmosphere, thus there will be oxide layer forming on the surface and it is under pressure.

So, in the process that layer of oxide will be firmly bounded to the plate surface that layer is referred to as mill scale. So, mill scale is nothing but essentially a combination of Fe O and Fe 2 O 3 all that. Mill scale is nothing but the oxide layer what forms during the fabrication of the plate during the rolling of the plate in the steel plants, so this forms.

Now, you know the steel plate has been formed it lies there and then it is delivered to the ship yard as and when you buy it, it is brought in ship or railways or truck whatever and it will be dumped in your steel stockyard. So, the plate comes with this layer built-in, this mill scale layer is there and also it may absorb moisture in the process some H 2 O also goes in there can be some hydrated oxides forming all those things will happen, but what we will have is a steel plate having layer of mill scale that is what it is that means, from that point we start.

Now, why we talked so much about this mill scale? Because this mill scale temporarily till the time it came to the yard it actually gets protection to the steel surface. Means, further corrosion or rusting as we call it further oxidation did not take place it did protect so that way it has a positive role to play.

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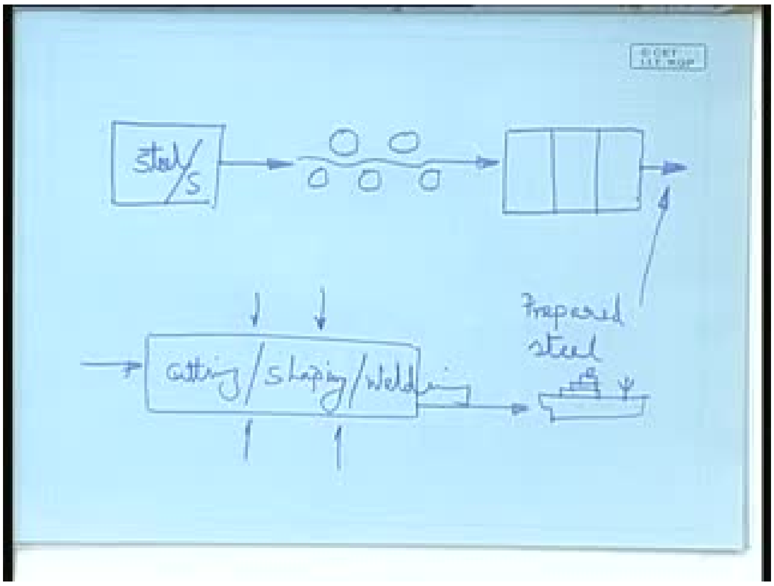

The next stage of operation in a ship building is, you have the steel stock here from there the material is supplied; it goes to a rolling machine. Then enters a chamber where some operations are carried out and we get the finished prepared steel or I can say processed steel or prepared steel means, ready for subsequent cutting and fabrication operations. That means, at this stage from here all the other operations start. Basically, all operations I am showing in one block that is essentially cutting, shaping, welding and to this they are necessary inputs coming in as that of other in a very simple way, we can see all the activities, here I have elaborated it, here I have clubbed everything this is the actual fabrication work.

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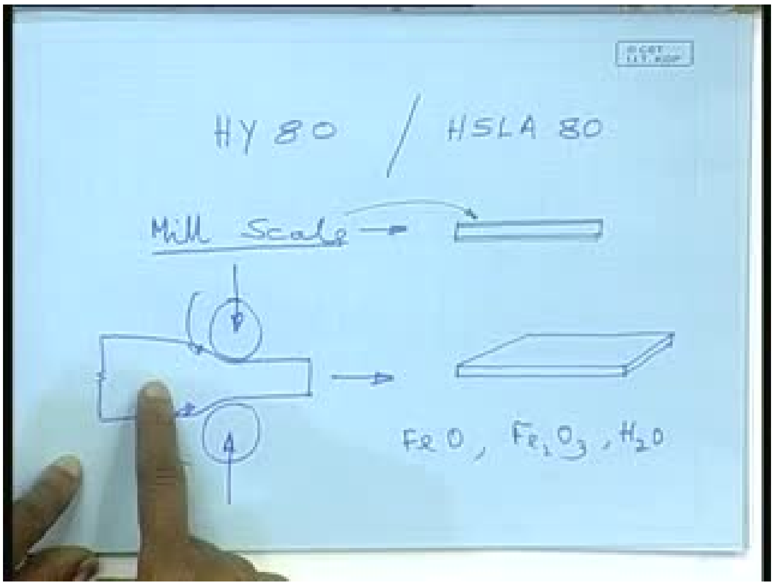

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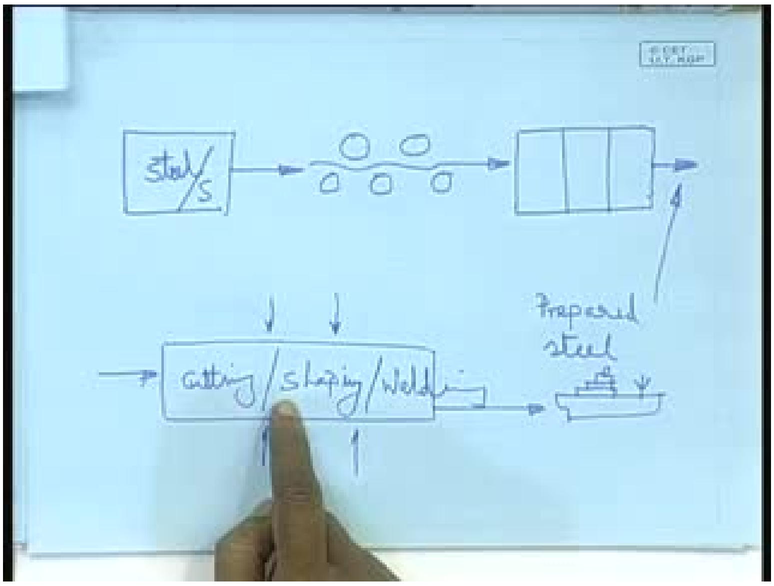

In this zone I am doing the actual steel fabrication, steel fabrication is not steel making, this I was talking about steel making. By steel fabrication we understand that the steel plates are there ready to use; ready to use means, what we do in fabrication we will have to cut them to the required size and we have to bend them to the required shape if required for example your ship's bow you want to fabricate, so there will be bent plates needed then what I have to do I will have to put them together weld them so you get the ship hull and simultaneously do other works which I have referred to by this arrow putting the engine in, fitting the air conditioner, the piping pumps, machineries everything super structure and finally, you get the ship.

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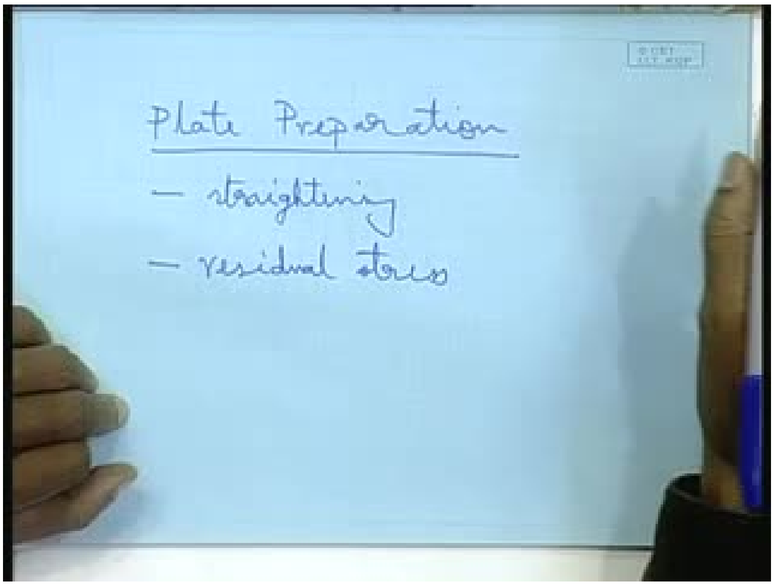

Before it comes here, so work starts with the steel material here you start with the hull fabrication. So, for the hull how the work goes from the steel stockyard you take the plate, make it ready for these operations cutting, shaping, welding operations. So, what is done here is something called plate preparation that means you will have to prepare the plate for construction. Plate preparation you will have to do because you have got the raw steel plates from steel plant, you will have to prepare them so that they become good for subsequent usage and finally, will be well for the product - good for the product. So, something called plate preparation so what we need to prepare there.

Sir, in welding not possible not to melt scale the steel

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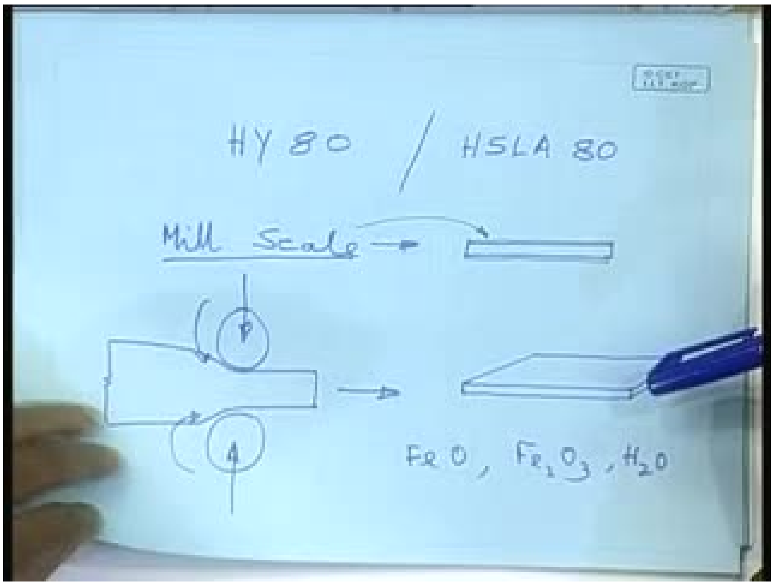

No it is not whether it is possible or not, we will just come to that why this preparation we are doing - some preparation - because we have seen what we are getting the plate raw material as it with some mill scale, I have not said one more thing but in addition to mill scale we may have is the plate may remain distorted means, not absolutely flat for the simple reason, it has been handled many times in the steel plant it has been lifted and loaded on trailer, transported again lifted by crane, again unloaded again lifted by some crane and loaded for further operations in the shipyard. So, the plate may have deformed or bent, so before we start working on the plate I need it flat straight because that is my datum.

In a two dimension I know the shape, I know the dimension then I cut it to the required size and then I shape it and give it a 3D shape as per my hull form, so I need it flat. So, that means preparation is needed; one is for straightening, there might be some deformation, so I need to straighten. Another aspect which is not visible that needs to be removed that is residual stress. In the process of fabrication of the steel plate and also subsequent handling as it can impart deformations also it may impart residual stresses it is very likely that the plate will have certain level of residual stress and as you know residual stress as such does not do any harm.

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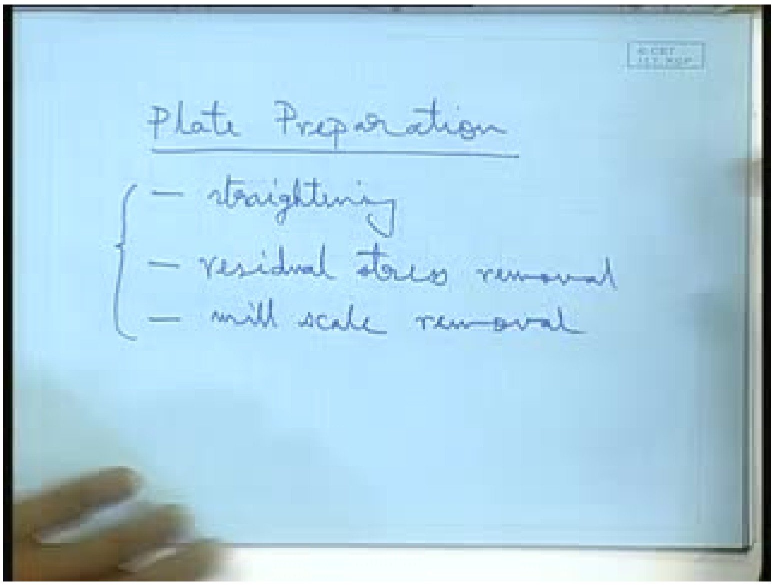

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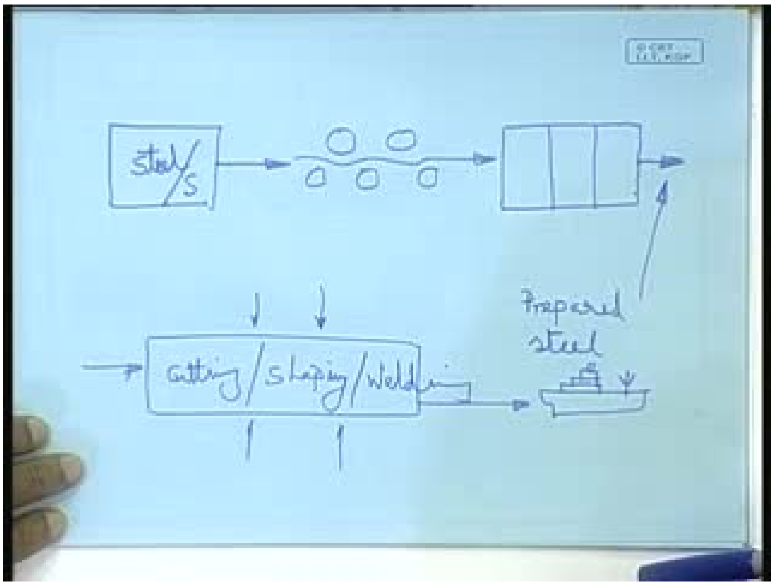

Apparently, it does not do any harm because at some part of the plate will be in tension, some other part will be equal in compression, so it neutralizes. But, if it remains then what happens? Subsequent operation, the stress level may get changed and it may lead to deformation of the plate, may lead to lessening of the fatigue life, so all such things may happen, so it is preferable to remove the residual stress. So, straightening is required, residual stress removal is required and then, I would say mill scale removal is also required. So, plate preparation will involve these three operations. Once these three operations are done then, the plate is ready for putting into this sequence of activities cutting, shaping, welding and finally to the final shape, so this is what plate preparation.

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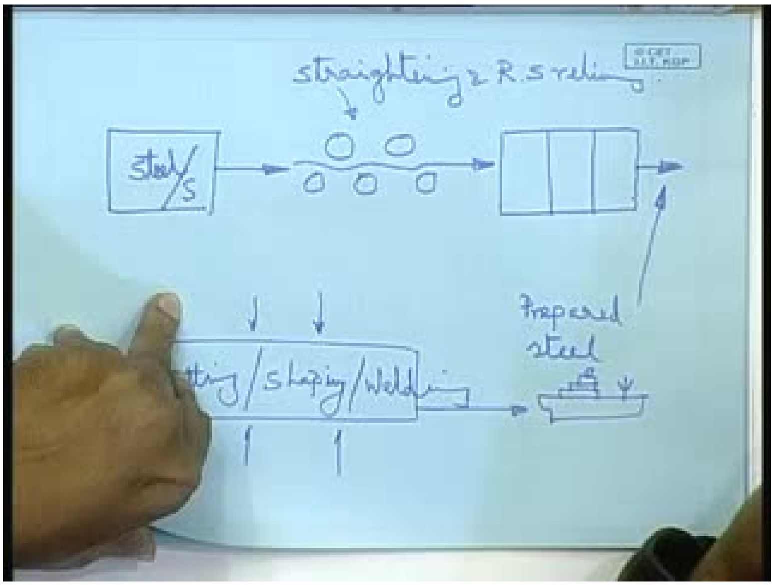

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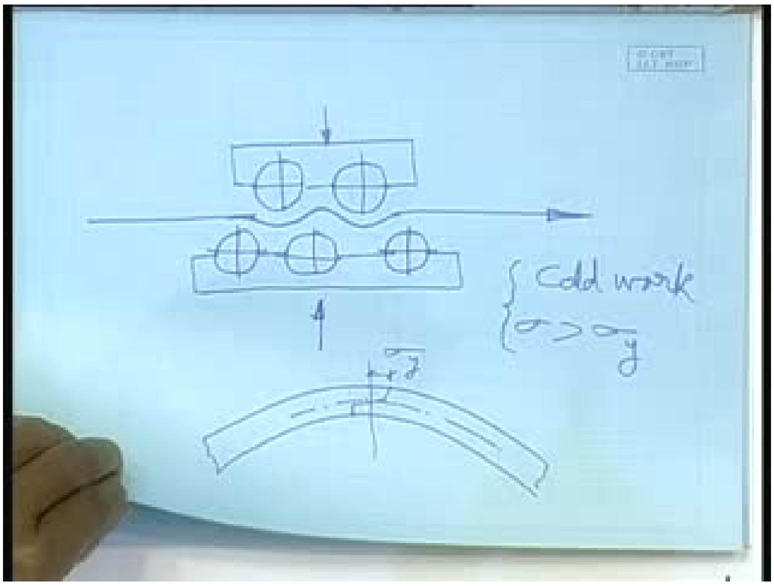

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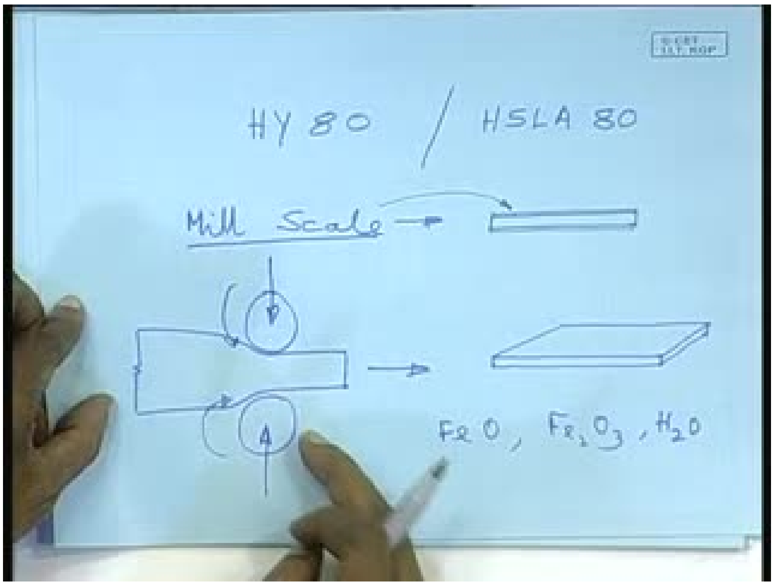

I have shown here this area, when I pass the plate through these rollers that is essentially straightening being done; straightening as well as stress relieving and residual stress relieving. What I am drawing here is a 5 roller machine; this is something different here, only two rollers applying sufficient pressure to squeeze it down to the required thickness. Here two sets of rollers and also necessary force should be applied; these are all connected such that they can be together. Necessary force can be applied such that when the plate comes as it enters, this roller bends it down, the middle roller bends it up and again, it bends down and ultimate result is it comes out flat.

This middle roller is pushing it up this one is pushing it down, so essentially the plate is being subjected to a stress level much beyond the elastic limit. These deformations are large deformations means the plate is physically getting substantially bent. In the cross section the stress level - if this is your neutral axis - stress level would look somewhat like this, what does that means what I have tried to draw? That means, this is yield point stress, so the all most the entire section has yielded.

That means, almost along the entire thickness the top part was in tension, the bottom part in compression. In the next sequence it is just reverses, so I have given you a three stress reversal in the process, so what I am doing this is being done at a room temperature. So, this is a kind of a cold work I imparting to it, stress level is exceeding the yield point stress in the plate, so through a cold work with stress level exceeding yield point stress your residual stress gets removed, because residual stress generally is of the order of yield point stress. So, I exceed that stress and I do it several times in this case I have done 5 times, sorry, not 5 times 3 times, I can do it 20 times depending on my requirement.

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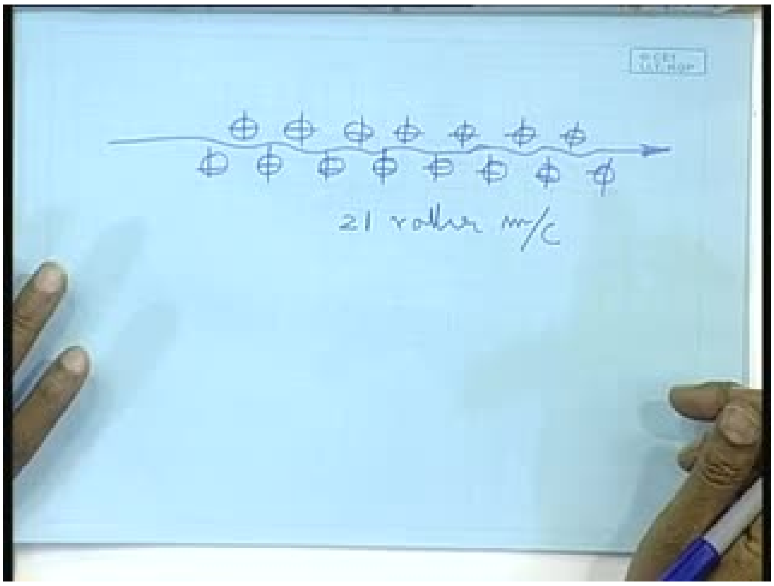

That means there are machines where you have several rollers and the same rolling operation as stress relieving and straightening operation is done. So, in this case what will happen, it will go like this - I mean - almost as if anyway several times. So, this is a 5 roller machine, this can be a 21 roller machine what is the difference? Difference is that for thick plates I can use less number of rolls; for thinner plates I need to do it more number of times.

That means, if I have a say 6 millimeter plate to be straightened and stress relieved you may need to do this operation of bending it in this direction again in the opposite direction, several times more compared to a plate of 20 millimeter thickness. A thicker plate requires straightening machine with less number of rollers, thinner plates require with more number of rollers. Generally, up to 10 millimeter thick plates a 21 roller machine is required whereas, for say 16 millimeter and above a 5 roller machine will do.

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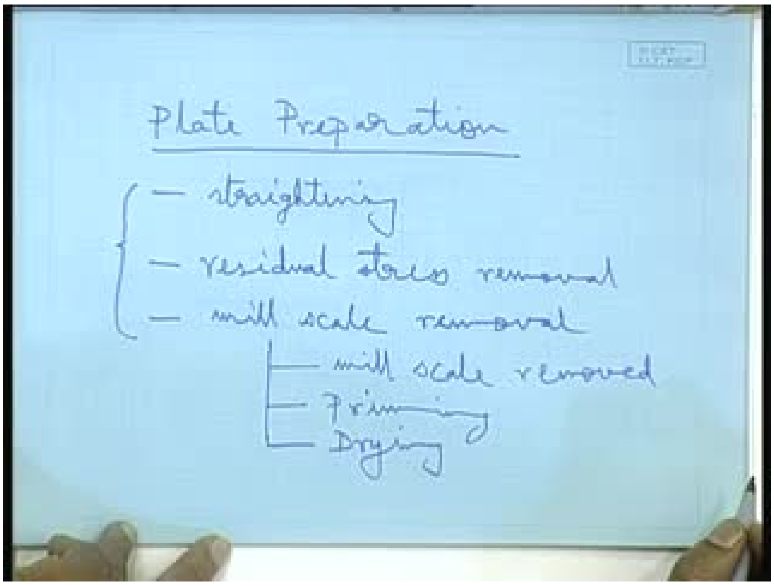

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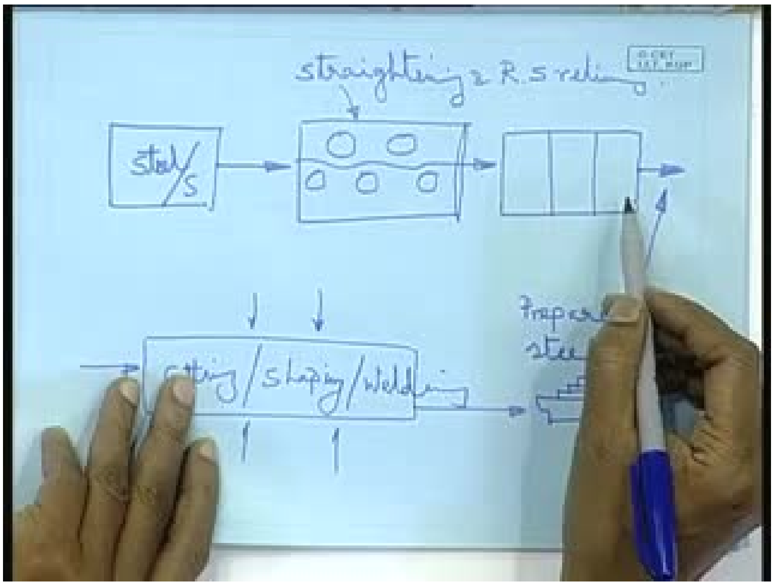

So, very first operation in the entire process which is referred to as plate preparation, under that plate preparation we have sub activities are straightening, stress relieving and then once that is done, it is directly fed to this next activity. The next activity is mill scale removal, so these are taken together in plate preparation.

So, what you do in this mill scale removal? Here again, if I see mill scale is removed. In the operation of straightening and residual stress removal are being done simultaneously, the process is such that both the things are taken care of by one operation passing it through those rollers - straightening machine. It comes out flat from that then it immediately enters in next chamber wherein mill scale is removed.

Now, what will happen if the mill scale is removed, what physically happens? Physically what happens is you get a very bright steel surface, with the mill scale the steel surface was dull because that was the oxide, it has a dull color and it is already oxide so no more further oxidation, no more rusting; rusting is nothing but oxidation, so it remains as it is.

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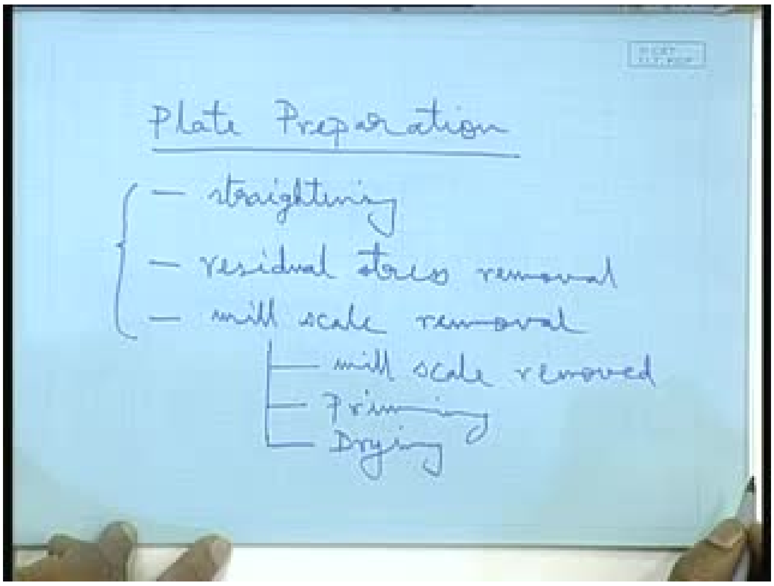

Now, the moment I forcibly remove that scale I get a very bright shining surface really shining surface that is a pure steel surface, but if I keep it like that again it will rust immediately, so I need to protect it, so some kind of painting which is referred to as priming.

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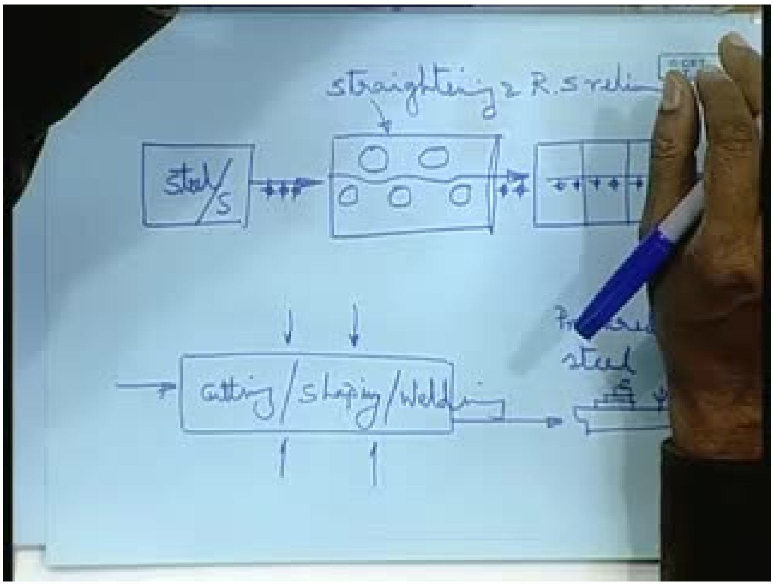

So, priming is done once priming is done. Now, all these operations can be automated that means, as you can see here these are fed through roller conveyors, you put it on a roller conveyor it rolls, the plate goes in, it is again all basically rollers, so it goes out, again here you have the transporter, a roller conveyor it goes in inside also, so it is a continuous automatic process.

The plate is just moving from the steel stock head, with the help of a crane you lifted the plate and put it on a material handing device, the device is roller conveyor. You have seen conveyor belts carrying coal or sand or ore, so it can be just roller like; some of you - I mean - in airport you have seen where those things are taken. So, it is nothing but the rollers are powered if it rolls whatever is there on top it will move simply, but it is a very effective means of material handling.

So, the steel plate goes through this straightening operation, straightaway it goes out instead of dumping it, again it goes on a conveyor system enters this chamber. I have drawn three chambers purposely, so in this the mill scale is removed. Central chamber, it is primed since it is a continuous process; primed means, a kind of a paint is being put it should dry up.

So, this is a drying chamber simple and it comes out ready plate - ready material. So that is what the entire operation of plate preparation straightening is, residual stress removal and mill scale removal.

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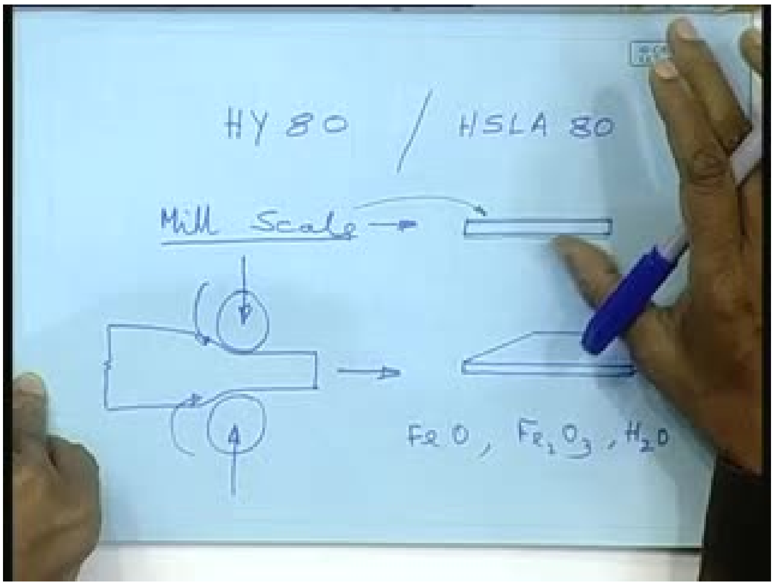

There are various methods we have seen that how straightening and residual stress removal is done, it is simple how mill scale is removed. We will talk about what are the various methods, but the question still remains why do we remove it, what is the problem if it was there? Because, I told it protects the plate, I need not do that priming and drying, automatically it is protecting. So, it is removed because, as I have said that because of the process of manufacturing, this oxide layers forms and the bonding of the oxide layer with the plate is very strong, it has a very strong bonding but over period that bonding becomes weak.

This is also a very interesting phenomenon, over period this bonding becomes weak. If the bonding becomes weak what will happen? It will peel off, the plate is standing there and suddenly, you will find that a small chunk falls off - the chunk of that oxide layer. Physically, if you keep the plate standing like this for good number of months, one day you will find lot of duct has accumulated at the base of the plate, what has basically happened? That this chunks have fallen and got accumulated there so that is the problem.

So, if you do not remove the mill scale and built the ship eventually, apart from problem of welding. In welding what may happen? The weld deposit may get contaminated with this oxide, so before welding I have to scrape that surface thoroughly to remove any mill scale if it is there.

So, welding is only one small problem, bigger problem is that you built the entire hull or the entire structure whatever you are building and then, you will have to put it in service and the service condition is rather a corrosive environment, so one of the means of protection is painting. One of the most effective means of corrosion prevention is by providing a paint film that is painting the surface. By painting the surface what you basically do? We avoid the contact of the corrosive medium, in general that is.

That corrosive medium consists of oxygen, water electrolyte and what not. In general, corrosive medium that is one way of looking at it, other way of looking at it is by painting. Essentially, I have made a film - a barrier - between the structure and the corrosive medium. I have insulated the structure from the corrosive medium; insulated against what? Well against corrosion, how? Again by insulating the corrosion current cannot flow or in other words, just insulated it. So, it will be well protected, that insulation it depend on the life of that insulating material or will depend on the life of the paint film how long it lasts.

Now, if mill scale is not removed then what will happen? After some time the mill scale will get peeled off allowing the plain film. So, your pain may be of the highest quality, the film whatever it has found because of the paint after drying or curing that has a required thickness and required addition with the scale surface, but the whole scale gets peeled off, that is actually the problem. So, the entire purpose of corrosion prevision through painting goes waste, because it will get peeled off along with the paint film, it this bound to get peeled off, so that is the thing. With time automatically this bondage between the mill scale as well as the plates and the plate’s surface reduces.

So, that is why what we should do is we remove it at the beginning and then give a suitable protection, that protection is the primer coat of paint which is applied. When the construction is complete, then over the primer coat we provide additional layers of painting depending on the requirement. So, that paint coat will remain how long it will remain? That will depend on the life of the paint film, the quality of the paint, not on the quality of the steel or any such thing; previously it was on the quality of the surface.

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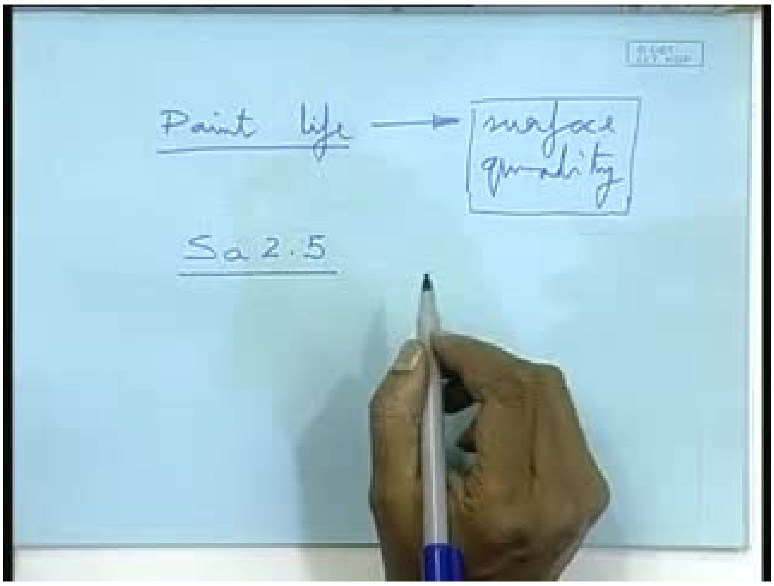

So, the paint life depends on the quality of the surface, because your paint life is one of the important aspects why it is important? Because, if the paint life is poor then you will have more corrosion. If you have more corrosion means, your operating cost goes up - the ship owners operating cost - why? One of the aspect is the hull surface becomes rough, the resistance increases, power requirement increases, fuel consumption increases. Second aspect is that it is corroding means you will have to dry off the vessel, clean the surface and then repaint it all that cost money. If the corrosion is too much you will have to replace the plate, you will have to put a new plate, you will have to cut out that corroded part and put a fresh new plate, all these are very expensive.

So, you lose money means the paint you have applied was supposed to protect the ship hull for 5 years that means your calculations are like that. You know for 5 years you have implemented this corrosion prevention mechanism, so for 5 years this will be the case. Now, if it is not properly done and that 5 year will be done will remain properly protected provided the paint film lasts that long, it will last that long provided the proper surface preparation has been done otherwise, the paint film life will be reduced it may get reduced to 3 years then again you will lose.

So, the paint life depends on the surface quality over which it is being laid, the paint is being applied and there are other aspects also depending on humidity, temperature, thickness of layer are those other aspects, but for the time being on the surface quality.

So, what is that surface quality how we achieve? That is what we achieve through plate preparation that decides the surface quality we achieve through plate preparation. What is the general thing we get? After the surface is cleaned or the surface is cleaned of the mill scale, I told that we get a shining surface that shining surface gives us a quality of their, how you are removing it, by which method and how effectively, all that? It leads to different quality of the surface that quality is not only that how effectively the scale has been removed that is one; other is how smooth the surface is.

So, those are referred to has some standard which is Sa 2.5, this standard refers to surface smoothness, to the standard of Sa 2.5. This is a scale goes from - I believe - 1 to 5, it is somewhere in between, as you go higher it becomes more and more smooth, but we need somewhere in between Sa 2.5 is a good quality of surface finish.

So, that is how we see that the mill scale should be removed before you get into the actual fabrication operation, main reason for removing is that if you do not do that then immediate problem would be the welding means, welding you will be able do but there would be a possibility of more welding defects coming in the picture because of inclusion of this oxides. There will be sort of the weld deposit will be contaminated with the oxides if they are not removed, but that is not a serious problem because I can sum it and instantly remove it before the welding. Long term problem is the mill scale will peel off and it will be subjected to heavy corrosion, so that is the main problem, so mill scale should be removed.

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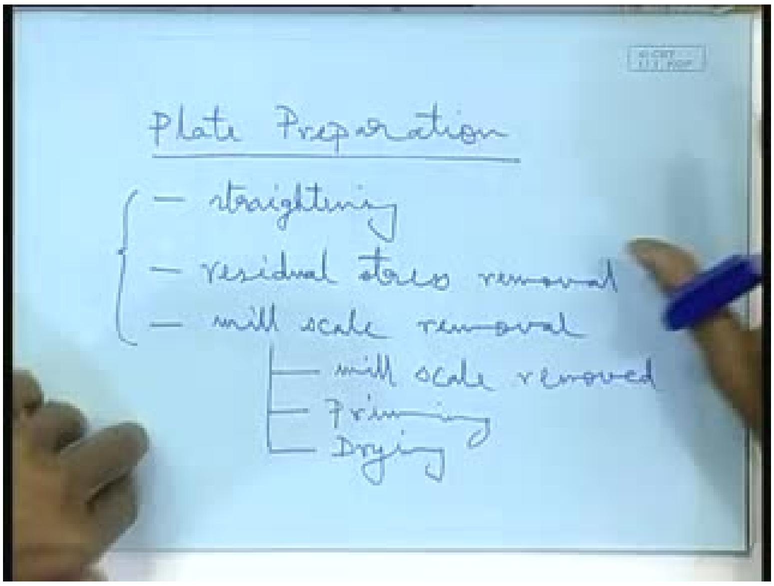

So, that is what that is done through the process of what you call plate preparation, it comes within that thing of plate preparation, it should be removed. Then, the whole operation can be done in a one go; you remove the scale, prime it and dry it.

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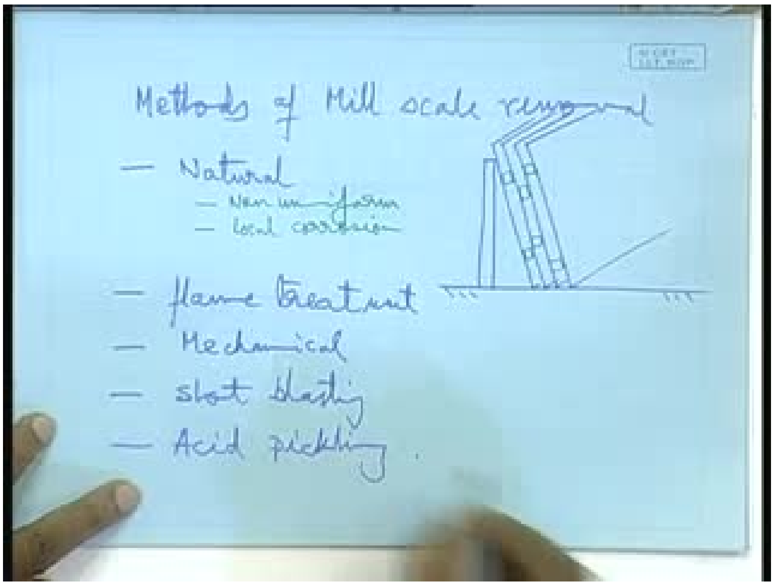

Next comes that how we actually remove it what are the methods? Tell me some of the methods from common sense; you can guess one method at least.

We can hammer it

No, through hammering it will not go, the bonding is quite strong.

Use of solvents.

Yes, one method could be is of solvents will give a good name to it, what is the first and foremost method could be?

Scaling and scraping it out.

Scraping is also not easy because I said the bonding is really strong it is not easy. First and foremost method could be natural descaling because I told with time, it peels off. I just stack the plates vertically I just keep them in a natural process it will peel off. So, first and foremost can be referred to as a natural process - natural method.

In the natural method what is done? Just imagine a situation like this, say this is my ground level some pillar is there and I have just stacked the steel plates like this, in between some wooden blocks. These are my steel plates which are separated by wooden blocks, so that they are not touching each other - isn't - you just keep them standing means basically, they are the plates like this standing.

So, in the process what happens? That means, you stack them in the stock yard and let them lie there in the open, so it will be subjected to your rain, your heat, your cold everything, in the day time it will get heated up, in the night it will cool down, if it rains it will be washed with the rain waters. So, that natural process as I said automatically it gets loosened and it will peel off, so keep it like 6 months, after 6 months you take it plates will be fairly cleaned, cleaned in the sense mill scale has got removed.

So, that could be one process - very crude process - but one process the basic drawback what you wanted to say is.

Is it uniform sir, is it in a uniform manner.

Yes, basic drawbacks would be it will not be uniform - non-uniform - so you cannot guarantee that 100 percent has got removed there will be local rusting taking place, local corrosion, because in some places it will get removed early, some other places later and the worst is some places it is bare steel just vicinity it is mill scale. So, it will form a galvanic cell and a galvanic corrosion will set in, so the place which is scale has peeled off, heavy corrosion will be there. So, after 6 months if you use really the steel or after 1 year even your steel will have lot of patches, some will be very clean which has got recently the scale has peeled off and because this bonding is not uniform, some may got peel off say after 2 months or after 3 months and so on so forth. So, the plate surface will not be smooth at all, so this is definitely not a good method, but this could be one method.

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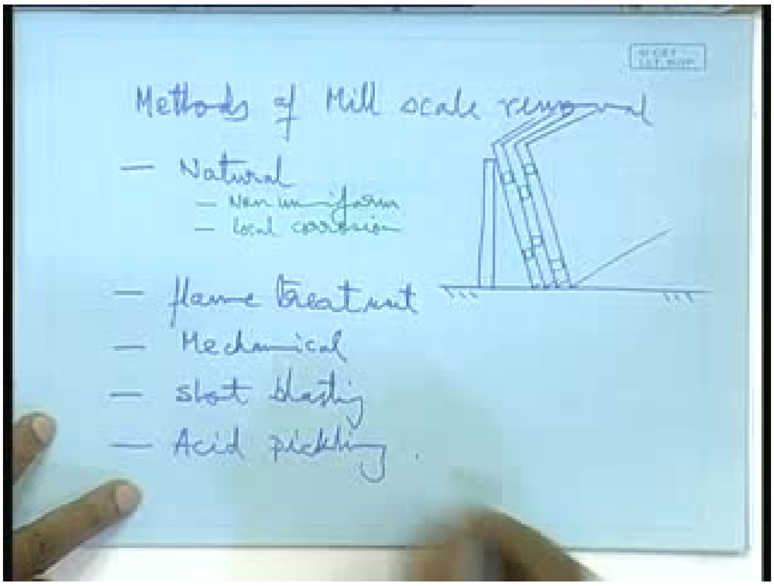

So, that is what the natural process is - I mean - one method in the sense those who cannot afford other method for him at least this is a method that is how though. This again it has other drawbacks that means, you will have to keep the plates lying like that for a substantial period of time that means, you will have to invest on the plates and you will have to buy the steel plate keep it unutilized, so that is also not a good business practice. That means you buy a thing and it remains idle, though it is not truly idle it is doing some operation but that operation is not very effective.

So, that is the natural process the other processes are flame treatment, mechanical means, shot blasting and that chemical you were telling some solvent is acid pickling. So, these are the 5 different avenues you have to remove the mill scales. We will talk about them in the next class how they are done and we will see their effectiveness which one is what.