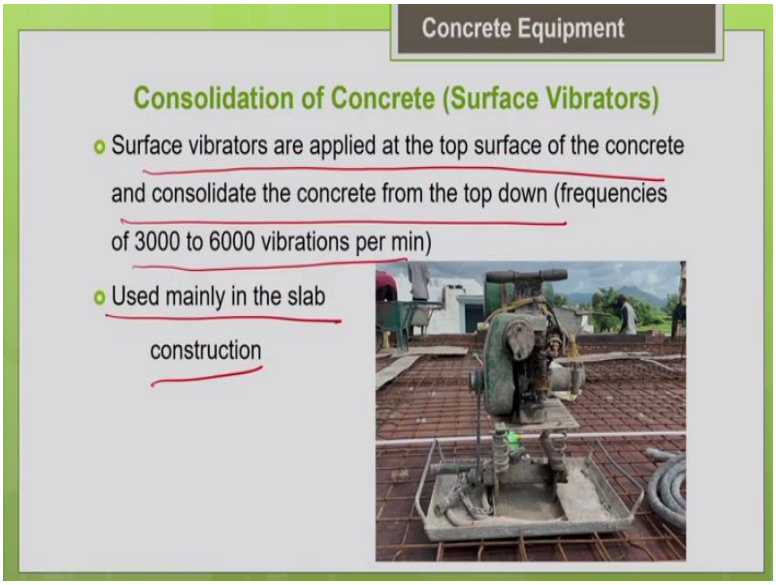

Now, let us move on to the surface vibrators. So, let us see how to do the consolidation of the concrete using surface vibrators. So, these vibrators as the name indicates the vibration is applied at the surface of the concrete and from the surface the vibration will be transferred throughout the entire depth of the concrete. So, generally speaking the internal vibrators are the best one.

They are more effective, because we are directly applying the consolidation at the actual layer of concrete where the vibration is needed. But here the vibration is getting transferred from the surface to the entire depth of the concrete in the case of surface vibrators. So, that is why internal vibrators are the most effective one when compared to the other type of vibrators. But in some cases we cannot use the internal vibrators.

Say for example, if the slab thickness is very small and if your the casing or the head of the needle vibrator is not completely immersed in this slab because the thickness of the slab is very small. So, in that case we cannot use a needle vibrator for such thin slabs. On a similar note if the reinforcement is very much congested, it is densely reinforced slab. So, it is very difficult to find the spacing.

It is very difficult to insert the vibrator in between the reinforcing bars. So, in that case also it is not possible to use the internal vibrators in slabs where it is very densely reinforced. So, in those cases, we go for the surface vibrators. So, wherever internal vibrators are not possible where it is not feasible to use internal vibrators, then we go for other form of vibrators like surface vibrators.

So, these are mostly used in the slab construction. So, you can see that the surface vibrators are applied at the top surface of the concrete. And it consolidates the concrete from top down. And when you compare it with the frequency of the internal vibrator, you can see here the frequency range is only 3,000 to 6,000 vibrations per minute. But your needle vibrators are having very high frequency as high as more than 12,000 vibrations per minute.

So, this frequency range is also only average for the surface vibrator. So, here what we can see? Here, this is a picture of the plate type surface vibrator. It resembles a plate. So, it is a plate type surface vibrator more commonly used for the slabs.

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So, another type of surface vibrator is screed type vibrator vibrating screed. Screed in the sense it is a kind of finishing operation. Screeding refers to the finishing operation. In this vibrator, what we do is we do the finishing as well as the consolidation together. So, you can see the picture. So, it is doing the screeding job as well as the consolidation together. That means screeding is nothing but just removes excess layer of concrete on the top surface of the concrete and level it.

So, that is the preliminary step of finishing of concrete. So, it removes the excess layer of concrete on the surface of concrete and bring it to your right level. You level it. That is what is screeding. So, you are doing screeding as well as consolidation together using this vibrating screed. So, this picture also shows the same thing. So, you can see that they are removing the,

they are leveling the concrete. They are finishing the concrete as well as they are doing the consolidation.

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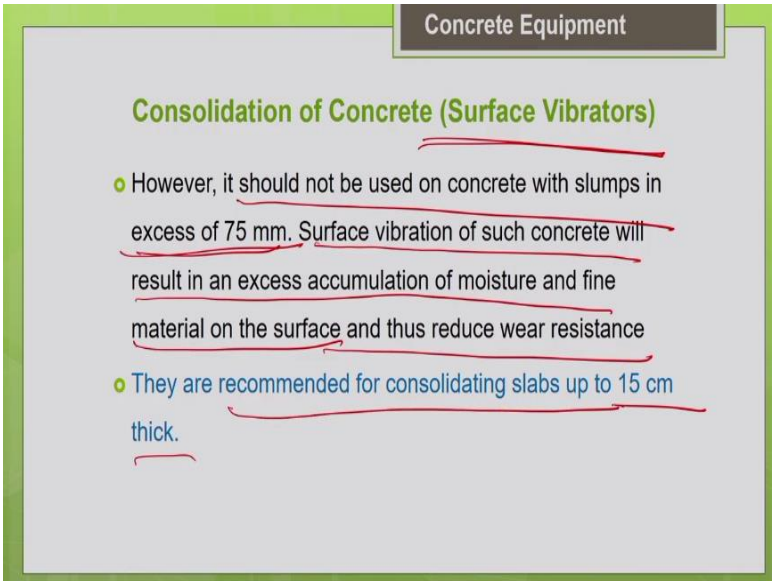

So, one thing to be noted here is this surface vibrators should not be used for a concrete with a very high workability above 75 mm. If the workability is above 75 mm for such high workable concrete mixes, we are not supposed to use surface vibration. So, what will be the major issue is when we do surface vibration for such highly workable concrete mixes, there are more chances for segregation, so, like water and thin layer of paste will come to the top surface of the concrete.

So, when we use the surface vibrators, so, that will make surface layer weak. So, particularly for the floor slabs where the surface strength is very important where the wear resistance is very important. So, we should be very careful regarding this kind of segregation. These kind of segregation should not happen. So, that is why we are not supposed to use the surface vibrators for concrete with the high workability above 75 mm.

So, the surface vibrators should not be used on concrete with slump in excess of 75 mm. Surface vibration of such concrete will result in excess accumulation of moisture and fine material on the surface. That is what is segregation, separation of water and find paste on the top surface of the concrete. So, that will reduce this surface strength of the slab or it will reduce the wear resistance of your slab.

So, that is why we are not recommending surface vibrators for workability above 75 mm. And one more thing to note that is the vibration transfer will be effective only for a depth of 150 mm. So, they are recommended for consolidating slabs up to 150 mm thick. Beyond that the transfer will not happen effectively.

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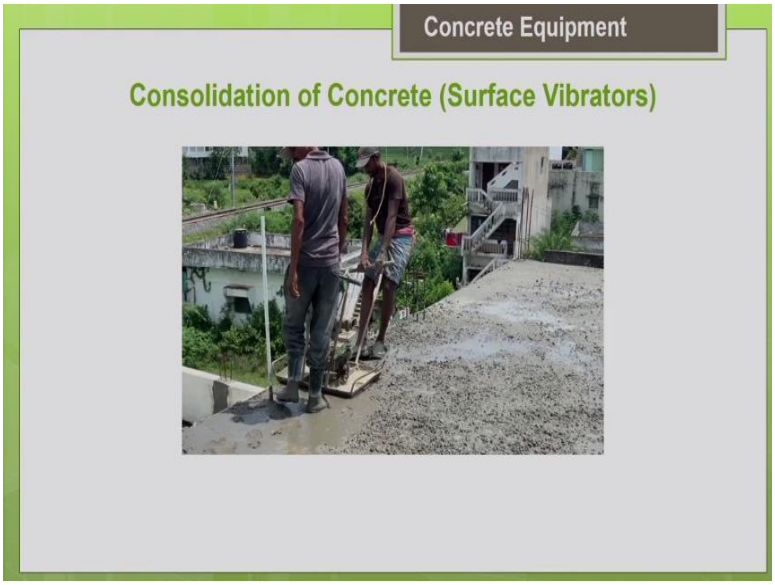

So, this picture also shows how the plate type surface vibrator is used for the slab consolidation.

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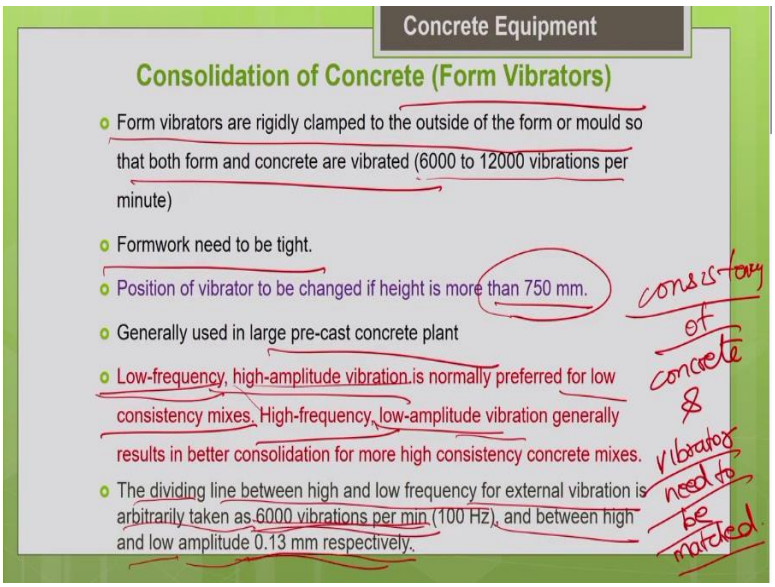

The next type of vibrator we are going to discuss is about the form vibrators. So, these are external type of vibrators. So, basically you are going to clamp your vibrator to the formwork. So, the formwork will vibrate and the vibrations will be transferred from the formwork to the concrete inside. So, this is also an indirect method of vibration. So, obviously, there will be some loss in transfer.

So, that is why the internal vibrators are the best because there is a direct transfer of vibration to the concrete. So, here the vibrator is clamped to the formwork. From the formwork, the vibration is transferred to the concrete inside. So, this is indirect method of transfer. So, form vibrators are rigidly clamped to the outside of the form or the mould. So, that both the form and the concrete are vibrated.

So, here you can see the frequency ranges 6,000 to 12,000 vibrations per minute. And one more thing to be noted here is the formwork should be very tight. So, if the formwork is not tight, when you vibrate the formwork itself concrete will start leaking from the formwork. That is why you should make sure that the formwork should be very tight, so, before you vibrate it.

And another thing is these vibrations are also effective only for a particular height only, say up to 750 mm. Say if you are going to use this form vibrators for a very deep column or a tall column, you have to keep changing the position of the vibrator. So, it is effective only up to 750 mm. So, after that, we have to keep changing shifting the position of the vibrator along the depth of the column.

So, mostly these kind of vibrators you can see that it is used in factories or the precast concrete plants. Sometimes we also use it to supplement the internal vibration. So, as I told you, why do we go for this kind of indirect methods? Because the direct method of the internal vibration or the needle vibrators are not feasible in certain cases, because the section is very thin or the section is densely reinforced or the reinforcement is very much congested that they cannot insert by vibrator inside. In those cases only we go for these kind of indirect methods or external form vibrator. Sometimes what we do is in addition to the internal vibration we supplement it by adding this external vibration also. That is also possible. And another important thing to be kept in mind is always the consistency of the concrete and the vibrator need to be matched.

Say if your concrete is very stiff. It is going to be a very dry mix. So, in this case amount of consolidation efforts needed is more when compared to mix with high consistency. For a flowing concrete, the amount of consolidation efforts needed is less. So, the amount of consolidation efforts needed depends upon the consistency of the concrete. So, the consistency of the concrete and the vibrator we have to match it.

So, another important thing is the frequency and the amplitude of the vibration needed. That also depends upon the consistency of your concrete only because that is only going to govern your efficiency of your vibration. So, basically for dry mixes, which has low consistency obviously the spacing between the particles will be more because there will be a lot of voids in the dry mixes.

In stiff mixes or low consistency mixes, there will be lot of voids. The spacing between the particles will be more. In that case, we need a higher amplitude. Amplitude refers to the magnitude of the motion. We need a higher amplitude to cover the distance or cover the spacing between the particles. So, generally when we go for high amplitude we go for low frequency.

So, for low consistency mixes, we prefer high amplitude vibration and low frequency vibration. On a similar note for a high consistency mixes, we can go for low amplitude and high frequency vibration. So, these are the general guidelines to match the vibrator with the consistency of the concrete. For stiff mixes, better go for higher amplitude and low frequency. And for high consistency mixes, go for lower amplitude and high frequency.

So, on this high and low frequency, I have just discussed qualitatively. So, what is the dividing line in quantitative terms between high amplitude and low amplitude and between high frequency and low frequency? So, generally the frequency more than 6,000 vibrations per minute we call it as high frequency. Lesser than 6,000 vibrations per minute, we call it as low frequency.

Similarly, amplitude more than 0.13 mm, we call it as high amplitude. And less than 0.13 mm, we call it as low amplitude. So, this is a dividing line. So, dividing line between high and low frequency for external vibration is arbitrarily taken as 6,000 vibrations per minute and between high and low amplitude is 0.13 mm.

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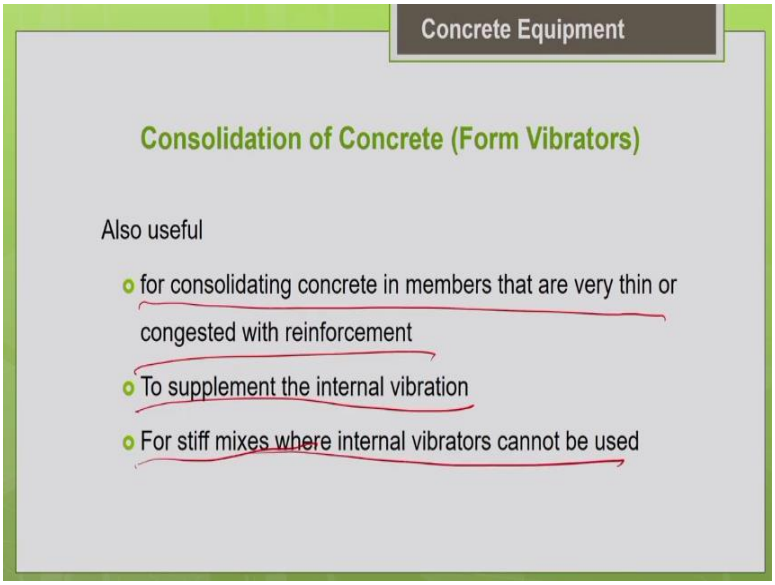

So, where do we use this form vibrators? Basically for thin sections as I told you where the internal vibration is not possible for a consolidating concrete in members that are very thin or congested with reinforcement where internal vibration is not possible. We go for form vibrators. And also in some cases to supplement the internal vibration in addition we can do the external vibration also.

For stiff mixes where internal vibrators cannot be used, so, one thing to be noted here is generally the internal vibration cannot be applied for very stiff mix. So, it will not be effective. So, for very stiff mixes, it is preferable to go for form vibrators. Accordingly you can select the amplitude of the vibration. You can go for high amplitude for very stiff mixes. And you can go for form vibrators instead of internal vibrators.

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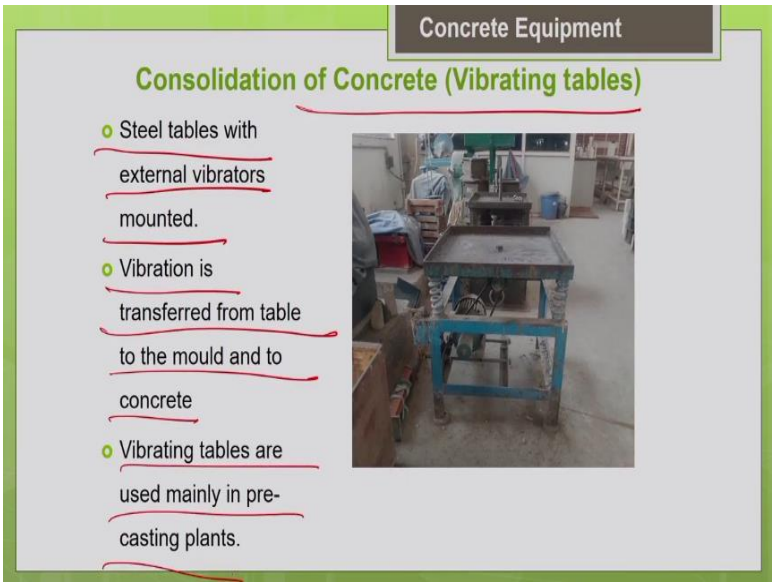

And the next one is the use of vibrating tables for consolidation. So, very commonly you could have seen this vibrating tables in the laboratories. So, in the concrete testing laboratories, you can see this vibrating tables. And it is also commonly seen in the factories like precast factories. So, you can see this vibrating tables. Basically these are steel tables with external vibrators mounted. So, the vibrators are mounted.

So, now the table will vibrate. From the table, the vibration is transferred to the mould. And from the mould, the vibration is transferred to the concrete inside the mould. So, this is also indirect way of transfer only. So, vibration is transferred from the table to the mould and then to the concrete inside the mould. Mostly you can see this usage in the pre-casting plants as well as in the concrete laboratories.

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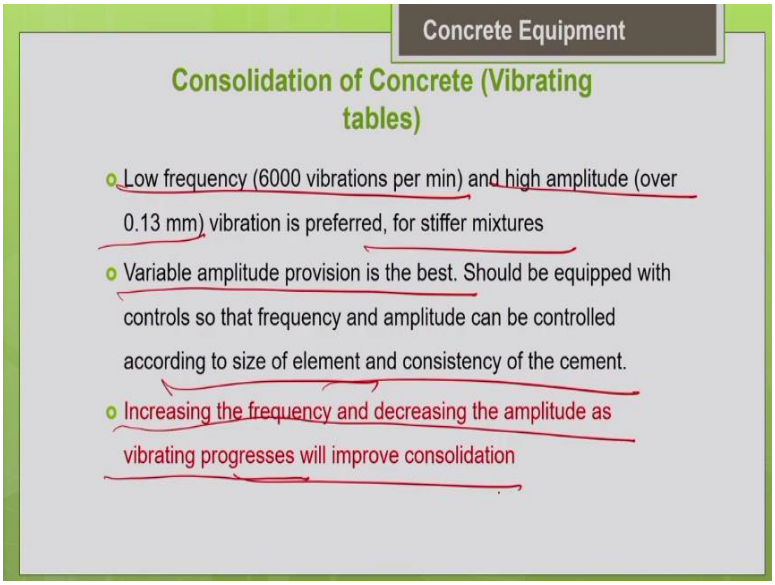

So, here also the same guideline you can apply. For stiffer mixes, go for higher amplitude. So, you go for high amplitude above 0.13 mm and you can go for low frequency less than 6,000 vibrations per minute. So, another thing is always it is preferable to have a vibrator where you have a control to manipulate the amplitude and the frequency so that you can match it corresponding to the consistency of the concrete.

So, variable amplitude provision is the best. But in most of the project sites whatever needle vibrators what we use there we do not have such control. So, but in precast factories there are lot of modern devices modern vibrators where we have control over the amplitude and the frequency also. So, when we have control over the amplitude and frequency according to the

consistency of your concrete or according to the size of your element, you can manipulate the frequency and the amplitude and use it.

So, that is why it is preferable to choose a machine which gives you a control over amplitude and the frequency. And generally speaking for the concrete say when we start the consolidation you can see that initially there will be lot of voids between the particles before consolidation. So, there will be more spacing between the particles, but as you start consolidating as it gets consolidated the mortar will get the concrete will get liquefied.

So, as it gets liquefied you can see that the voids will get reduced. So, that is why to start with you should always start with a high amplitude so that you will be able to cover the spacing between the particles. But as the consolidation progresses you can keep reducing the amplitude and increasing the frequency. That is a general guideline. Increase the frequency and decrease the amplitude as the vibration progresses.

This will give you effective consolidation. So, this is the basic guideline. If you have the control over the frequency and the amplitude then you can do this way. Generally to start with, we should start with high amplitude. And as the consolidation progresses, you start reducing the amplitude and increase the frequency. So, that is how we can achieve effective consolidation.

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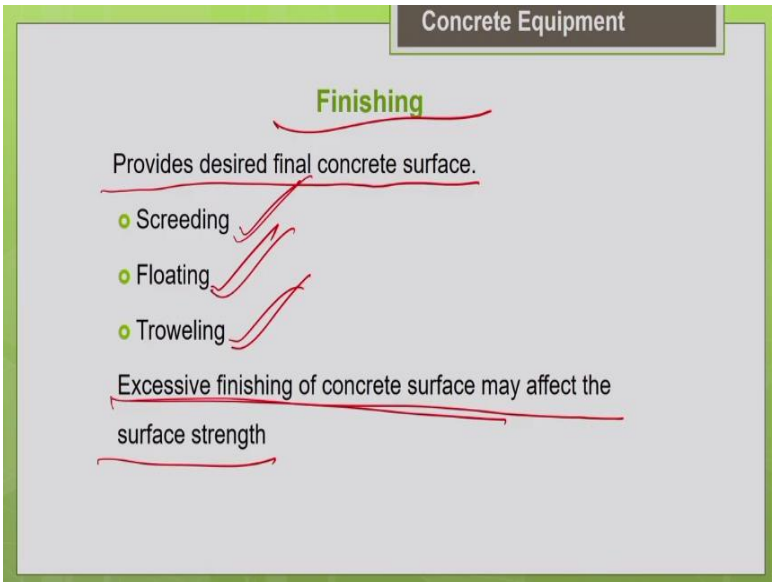

So, far we discussed about the consolidation. Now, we shall move on to the next step of the concrete making that is finishing of concrete. So, this is also a very important step. How much efforts you are going to put for finishing? It depends upon your requirement. What is the desired

surface texture? What is the desired smoothness you need? According to that you have to go for different stages of finishing.

So, this helps you to give you give the concrete the desired final concrete surface. So, but generally speaking, after consolidation, whatever efforts we do or whatever work we try to do with the concrete, it will generally harm the concrete. That is why after consolidation we should not try to do excessive finishing. So, very commonly in project sites, you can see that the finishers they try to manipulate the surface of the concrete by adding water and doing finishing so that they get a very good surface texture.

So, that is really a wrong practice. We should never do excessive finishing. We should not add water and try to manipulate the surface of the concrete to get the desired texture. So, never do excessive finishing of concrete, whatever minimum finishing that is needed to get your desired texture only that much should be done because it will harm the concrete. So, that is what is written here.

Excessive finishing of concrete surface may affect the surface strength. Particularly for the floor slabs where the surface strength and the wear resistance is very important, we should not manipulate the surface by adding water and you should not try to do the finishing operation. So, this finishing is usually done in stages. So, these are the different stages of finishing, screeding, floating and troweling.

So, generally, the actual time period for finishing is between initial setting time and final setting time. The actual window of finishing process is between the initial setting time and the final setting time. Generally as the concrete dries up, if you try to finish it, you will get the smooth texture very easily because if the concrete has not dried up and if there is some bleed water on the surface.

In that case your concrete will not be stiff enough to receive the texture you are trying to offer to it. So, only when the concrete dries up, it will be easy to smoothen it or polish it or harden it. So, that is why between every stage of finishing we should give some time interval. We should allow it to dry and then do it in stages so that it will be easy to smoothen it and polish it. So, let us discuss.

What are all the different steps of finishing one by one? So, the first thing we are going to discuss is the actual time of finishing.

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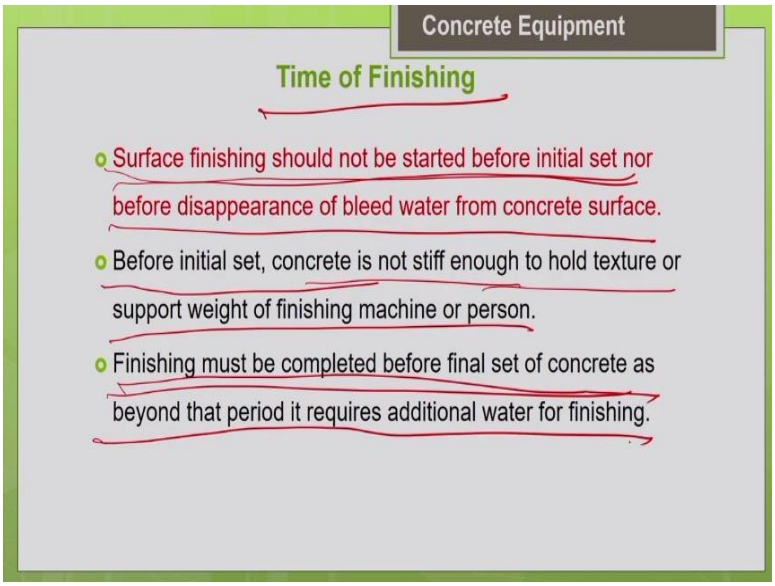

So, when should we start the finishing operation? The surface finishing should not be started before the initial set. So, before the concrete attains its initial set, we should not start the finishing. So, because your concrete will not be able to receive the texture what you are trying to offer. So, if there is some water on the surface and it is not dried up and it should have the strength to support the person who is standing for doing the finishing operation or it should have the strength to support the machines which are going to use for the finishing operation.

That is why we should not start the finishing operation before the initial setting of the concrete. Surface finishing should not be started before the initial set nor before the disappearance of the bleed water from the concrete surface. Only after the bleed water is completely evaporated, after that only you should start the finishing process. So, why? Because, before initial set, your concrete is not stiff enough to hold the texture, or support the weight of the finishing machine or the person who is going to do the finishing operation.

So, that is why before initial set do not try the finishing operation. After the initial set only you should start the finishing operation. And finishing must be completed before the final set of the concrete. So, after the final set of the concrete, if you try to do the finishing operation, you may have to add additional water then only you will be able to do. But adding the additional water and manipulating the surface of the concrete will definitely affect the surface strength of the concrete.

And it will affect the wear resistance of the concrete. So, that is why we should complete the finishing process before the final setting of concrete. As beyond that period, it requires additional water for finishing which is not advisable to do.

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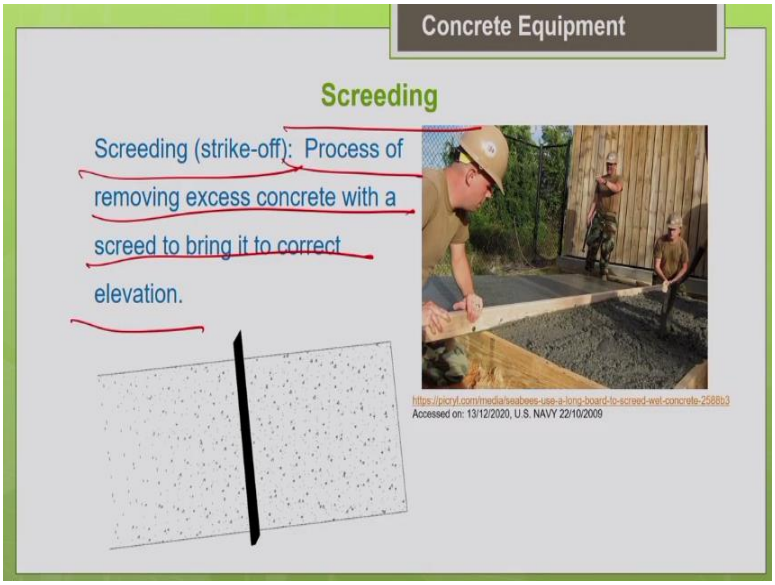

Now, let us see, what are all the different stages of the finishing of the concrete? The first step is screeding. Screeding is nothing but strike off. You can see the picture what they are doing. So, with the wooden screed, they are just trying to remove the excess concrete from the surface and level it to the right elevation or level it to a correct level. That is what they are trying to do here, so, the process of removing the excess concrete with a screed to bring it to a correct elevation.

So, this is the preliminary step in the finishing the first step in the finishing. Just remove the excess concrete on the surface with a wooden screed.

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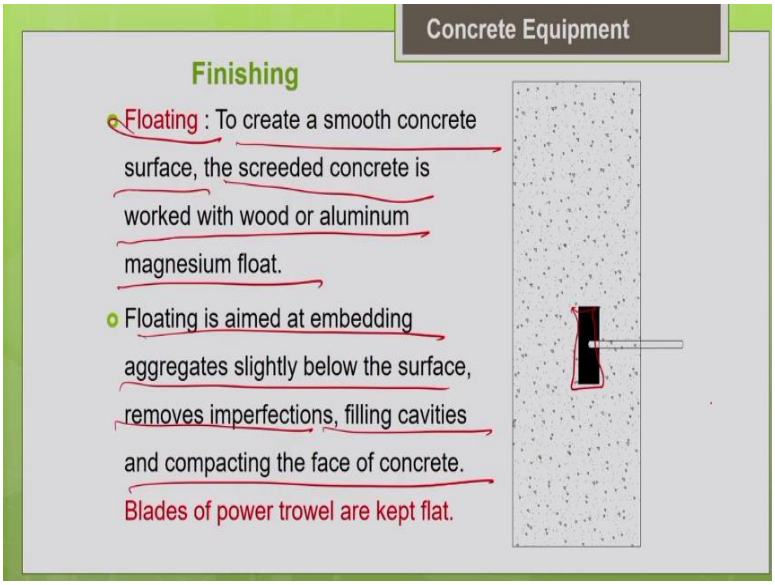

So, following screeding, the next stage is floating. So, always give some time interval between every stage of finishing and then do it. The main objective of floating is to create a smooth concrete surface. So, what you do is you either go for a wooden float like this or it may be even a metal one aluminum, magnesium, the metal floats are also available. So, with this metal float keep this blade flat and then smoothen the concrete surface.

So, the main objective is to smoothen it. And if there is any protruding aggregate, you just push it inside level it. If there are any undulations if there are any difference in the levels you can level it fill any cavities or voids. So, that is the main purpose of floating. So, what is the main purpose of floating? To create a smooth concrete surface. So, the screeded concrete is work with wood or aluminum magnesium float.

So, the main purpose is it is aimed at embedding the aggregate slightly below the surface you press it press the aggregates below the surface. Remove the imperfections. Fill any cavities if any. And compact the face of the concrete. When you do the floating job we always keep the blade flat and do it. So, either you can do it manually using this kind of tools, simple tools like a wooden float or a metal float. Or, there are also machines available to do it which we are going to discuss later.

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So, this picture again shows how the finishing operation is done with simple tools.

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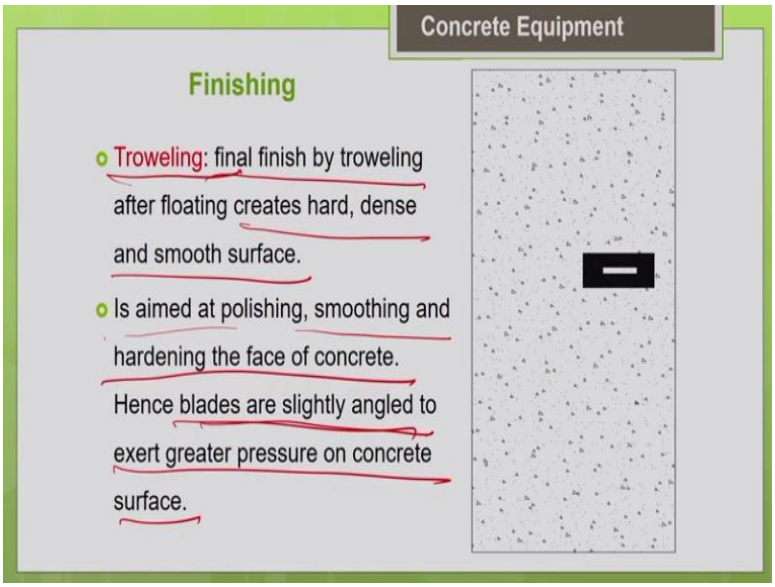

And the next step of the finishing is troweling. So, troweling, what you do? As I told you the finishing we are doing it in stages. So, troweling is also a floating only. But it refers to a different stage of floating. So, the final finish we call it as troweling. So, basically, the troweling is done after floating. So, manually when we do we are using the same tool only. But, since we are doing it in a delayed manner, so, by that time the concrete would have hardened.

So, in order to apply more pressure, we need to apply more pressure to smoothen it or hardened it. To, I mean to polish it. So, to apply more pressure, what we do is we have to slightly angle the blade and do it. That is a major difference between floating and troweling. So, the troweling

is done after some time. It is done at a delayed stage only. It is a final finishing. So, by that time the concrete would have dried up.

And it would have attained its final set. So, it would be closer to its final setting. So, it would have hardened a little bit. So, that is why we need to apply more pressure to the concrete to obtain the desired smooth texture or the polished texture. So, for that, you have to angle the blade and use it. So, the same tool you just angle the blade. Troweling refers to final finish by troweling. It is just refers to final finish.

So, we do it after floating. So, the main objective is to create hard, dense and smooth surface. So, it is aimed at polishing, smoothening and hardening the face of the concrete. So, here you are keeping the blade slightly angled. Why do we angle the blade? Because we need to apply more pressure because the concrete is as little bit it has hardened. So, to attain that polishing, you need to apply more pressure. So, slightly angle the blade and use it.

To exert greater pressure on the concrete surface, you angle the blade and use it for troweling. So, these are all different stages of finishing.

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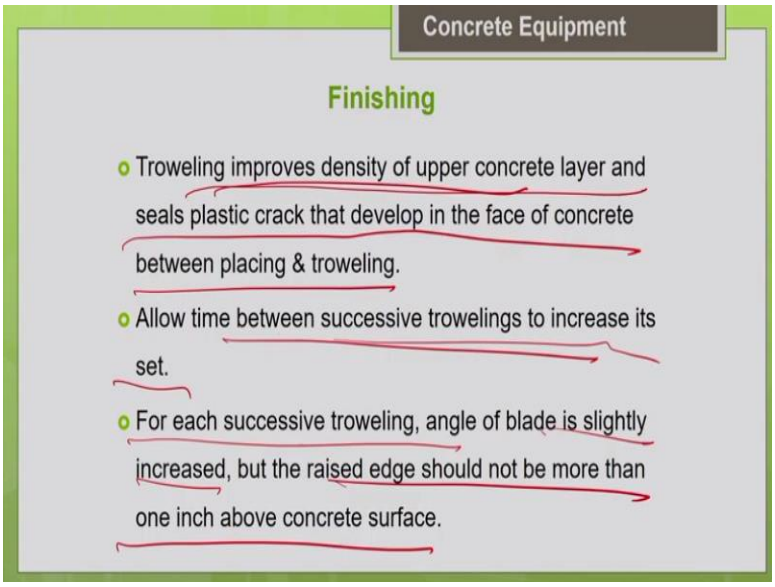

So, by troweling you can improve the quality of the upper layer of the concrete. You can improve the density of the upper layer of the concrete. If there is any crack plastic crack which is formed between the placing and the troweling. Those cracks can be filled any voids can be filled. So, troweling improves the density of the upper concrete layer and seals the plastic crack that develop in the face of the concrete between placing and troweling.

It helps to attain smoother and polished texture. So, as I mentioned earlier, allow time interval between successive finishing operations between successive trowelings to increase its sets. As the concrete dries up more and more, it is easy to smoothen and polish it. It will be stiffer enough to receive the texture which you are going to offer to it. For each successive troweling the angle of blade is slightly increased.

So, as I told you for every stage of finishing slightly increase the blades so that you can apply more pressure to the concrete. But one thing you should keep in mind that the raised edge of the blade should not be more than 1 inch above the concrete surface. So, beyond 1 inch it is likely to damage your concrete surface. So, you can keep on increasing the angle of the blade. But any case, you should make sure that the raised edge height should not be more than 1 inch above the concrete surface. So, beyond 1 inch it can it may affect your damage your concrete.

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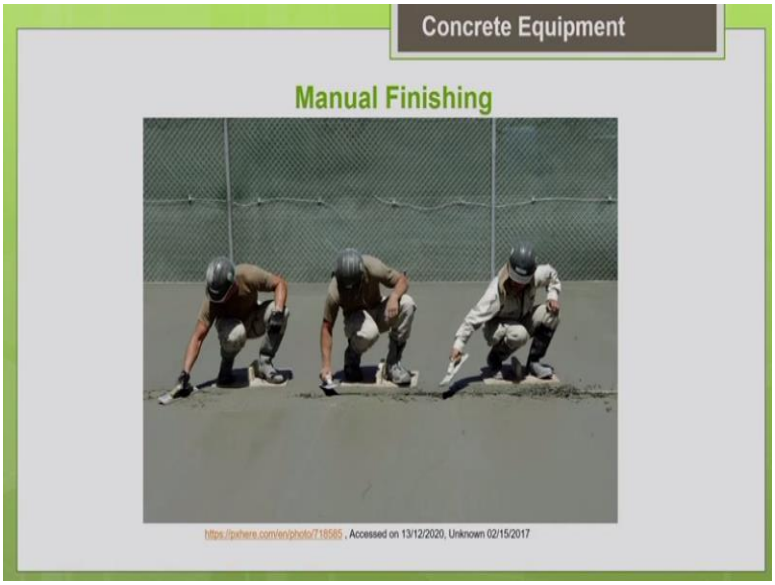

This picture again shows how the manual finishing is done with the simple tools. You can see.

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