Transportation Engineering-II
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Lecture - 8
Creep in Rails

Dear students, I welcome you back to the lecture series of transportation engineering 2 course material. So far we have discussed about different aspects of railway engineering including the various gauges in use, the history of the Indian railways and the various stress, strains or bending moments in the different component of the tracks, the permanent way and then finally we have also discussed about the rails. Now today's lecture is a based on the creep in rails. This is one specific feature in rails which happens because of certain aspects. We will be looking at all those aspects in today's lecture. The lecture has be aligned with the creep in rails ,that is, defining the creep, the effect of creep in the rails, the theories of creep, the creep indicators, the methods to reduce creep.

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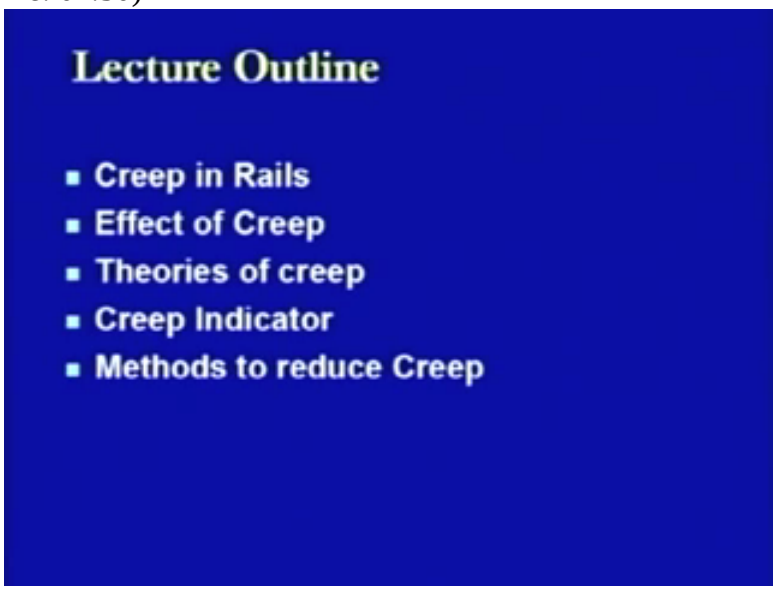

So we start with the definition of creep. The creep can be defined as the longitudinal movement of rails in a track. In the case of the rails as we seen discussed previously also they are being fastened with the sleepers using different fastenings and therefore they are assumed to be static in nature, but there are certain reasons due to which these rails start moving in certain direction and that movement in the longitudinal direction is termed as creep.

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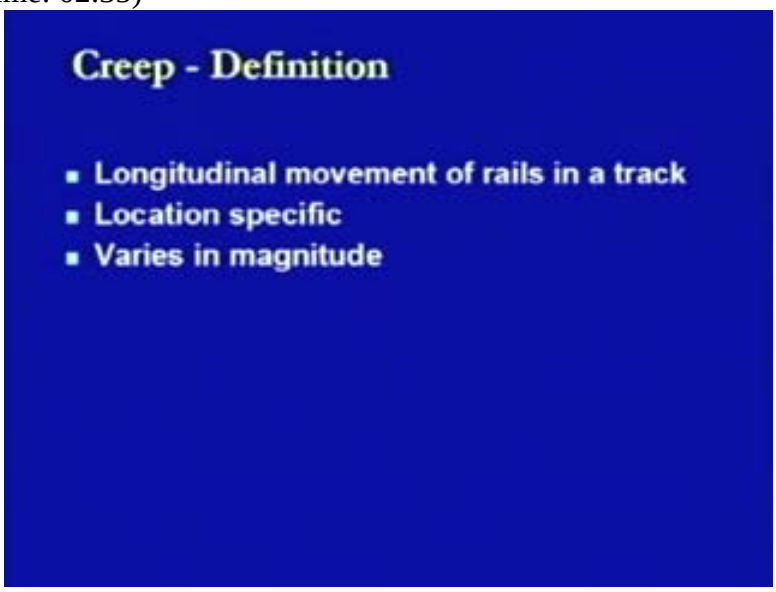

Now this creep is location specific. We may not found a creep, that is the longitudinal movement of the rails happening along whole of the length of the railway track. It is mostly being found only at a certain specific location and that reason may be because of certain things. We were looking at all those reasons, of course, during the course of the lecture.

Another thing is that whatever is the magnitude of the creep at one point is not necessarily is the same at the other point. Of course, there are number of factors which are affecting, which are causing this phenomenon. Therefore, what we found is that the total amount of creep which is happening at any location per unit time period will be differing. So it means whatever longitudinal movements is happening at any of the section of the rail may not be necessarily happening at the other section and at the same time may not be happening with the same gravity or with the same amount as it is happening in other section. Therefore, we have to curb this creep of the rail sections and we have to look at different factors which may be causing all those creeps.

Now, how we are going to find out whether there is creep in this rail section or there is not any creep in this rail section. So there are certain indicators which we can look at. The one thing is that there is a closing of joints in the direction of creep. What happens is that if there is one rail section which is moving in the forward direction then the other rail section which is not being affected because of the creep it will remain in its position.

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Now both the rail sections have been jointed by a joint using fish plates and bolts. At that location what we have found is that the first rail is trying to move in to that gap which is being provided at this joint and that is how the closing of the joint will happen in the direction of creep. Another aspect is that there may be an opening of joint at point from where the creep starts; just it is another end of rail section which is moving. At one end of rail section it is trying to close the joint at which it is being jointed with the other rail section whereas when it is trying to move in one direction obviously on the other end of that rail section it will try to open out. Therefore there are 2 things which happens simultaneously; at one end it is closing the joint and at other end it is opening the joint.

Another indicator which has been observed is scrapping or scratching marks on the rail flanges or the webs due to spike head. Now what happens is as we have discussed the rail sections are being fastened to sleepers and the spike head is one of the fastener which tries to fix the rail section to the sleeper. Now if there is any movement in the rail section the spike head tries to remain in its position and because it is awaiting with the flange or the web of the rail section it will start putting the scrapping or the scratching mark on that section because of the movement of the rail and if we found that there is any scratching mark on the rail section or there is some material which has scrapped down because of the relative movement of the 2 things that is the spike head which remains in its positions and the rail section which is moving we can easily understand that there is some creep happening in this section. So these are some of the ways by which we can easily identify during the periodical maintenance checks that the creep has started in some of the sections of the rail or the track.

Now what will happen because of these movements of the rails? There are certain things which will be happening; one is that there will be an opening or jamming of the joints. Now these are the 2 different aspects which will be happening and they belongs to the 2 reasons which we have just discussed.

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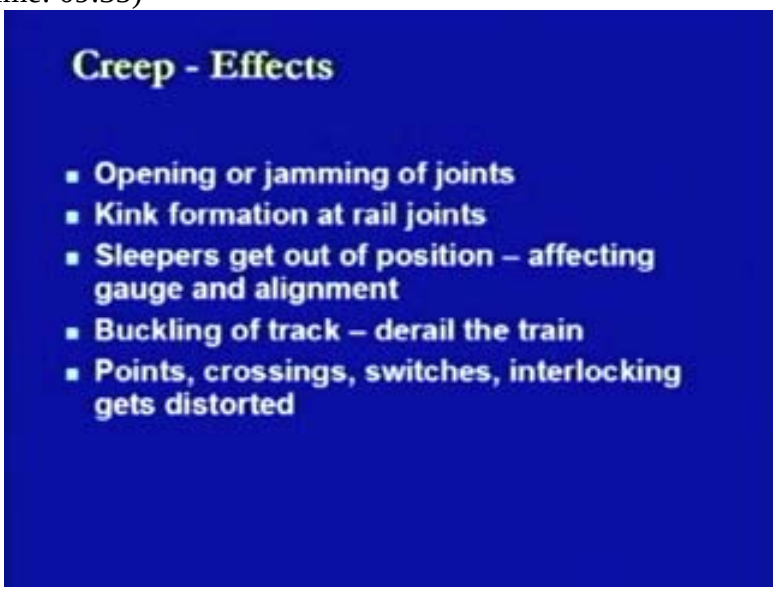

As the rail is moving it is trying to open out the joint at one end whereas it is trying to close the joint at the other end. Therefore, this is one of the effects which of the creep, that is, it will be opening the joint or it will be jamming the joint means it will just try to abort the 2 rail sections with each other and therefore the joints will not be there or there will be a problem associated with the movement of the rails with respect to the some other stresses.

Another thing is that there can be a kink formation at the rail joints. Now if the another rail to which the previous rail is trying to come and closing the joint is not moving then what will happen is there will be a sort of a kink which will get created at the joint of the 2 rail sections and this kink is a point of uncomfortablity. When the train moves, when the wheel moves at this location there will be a sort of a jerk being induced and because of this jerk there will be discomfort which will happen to the passengers in the wagons or the compartments. So the kink formation is, of course, not required thing in any of the rail section. We have to remove whatever the kinks are there by a certain smooth joining conditions.

Then another aspect is that because the rail is being fastened or fixed to the sleepers and if the rail tries to move out in one direction then it will create a problem to the sleepers also. In that case if the creep is quite heavy then the sleepers will start coming out of their location or position and they will be shifting relatively along with the rail sections and if this is happening then this is going to create a problem to the gauge. It will also create a problem to the alignment. So both have the conditions of quite a difficult conditions, they are going to create an effect in terms of total operations of the train and the safety of the movement of the trains from that section. So we have to look into consideration this one. If there is heavy creep and if there is such type of movement happening of all the components then that needs to be rectified.

Another aspect is that there can be buckling of the track. Now when there is a buckling of the track means it is trying to buckle out in one direction because it has got jammed in one location and still there is a creep keep on going and there is no place where the rail can move out then obviously it will start buckling in the outward direction. Now when it is trying to buckle in the outward direction it is going to create an effect on the gauge and the alignment again and this type of a condition is more hazardous in terms of that it may cause the derailment of the trains. So therefore, if a very heavy sort of a creep is happening in any of the section and it is going to jam the joints and finally coming towards the buckling stage it is going to be a worst sort of a condition on the track.

Another aspect related to these creep is that that point and crossings or switches or interlocking which gets distorted. Now points, crossing, switches or interlocking, these are the aspects which are used for the turning of the train from one track to another track. Now if there is a movement of the rail then obviously whatever points or crossing are being provided or the locations of the switches being provided or there is an interlocking aspects of these points and crossings with signals then everything get distorted and if everything is getting distorted in that sense then there is going to be hazardous condition in terms of the movement of the train from one track to another track or the movement of the train on the same track with the signals operating on that. So this is another safety hazard in terms of the movement of the creep and its effect.

Further there are some more things which will happen. Now the fish plates and bolts which are used at the joints where the 2 rail sections have been jointed together and if there is the movement of the rail section with respect to the another rail section which is jointed then obviously there will be smashing of the fish plates and the bolts.

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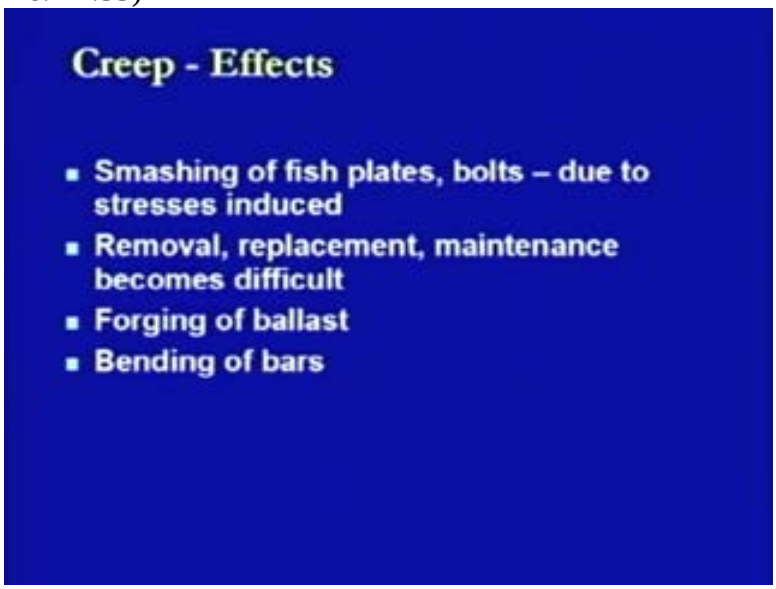

Because what will happen is that when the fish plates and the bolts will try to remain in their position because of no movement in the rail section but in the another rail section because there is a movement it will tries to create stresses and when this stresses become

much heavier this induced stresses will start smashing the fish plates or the bolts there may be cracking which will start from the point of hole at which the bolt have been placed and finally it may propagate towards the outer sides and this type of thing happening then fish plates will come out of their position and there will be no joint remain the section.

Then the next aspect is the removal or the replacement and the maintenance becomes difficult. Now whatever materials need to be maintained; now at this location where the 2 rail sections are averting each other. We have different types of things which can be removed. It may be either rail sections, it may be the fastenings which have been used or it may be the sleepers which have been provided at the bottom. If there is any removal or replacement requirement at that location or if a periodical maintenance has to be carried out then all of these things become difficult because there is no gap being placed between the 2 rail sections or there has been a distortion in the position of different components. In all these conditions we found that the maintenance cannot be performed as such. Then there is forging of ballast. Forging of ballast means that because there is some movement of the rail along with some movement of the sleepers because the heavy creep is being induced, the ballast will start coming out and it will get start accumulating at one place and when that sort of a condition is happening that is what is the forging of ballast will be there. Then bending of bars is another effect of the creeps. Whatever bars have been provided which have been used to connect at certain locations some of the things they will start bending out because of the movement of the rail sections in the longitudinal direction.

Now looking at this creep there are different theories which have been postulated by different researchers. They found in all there are three major theories. The first theory is termed as the wave theory.

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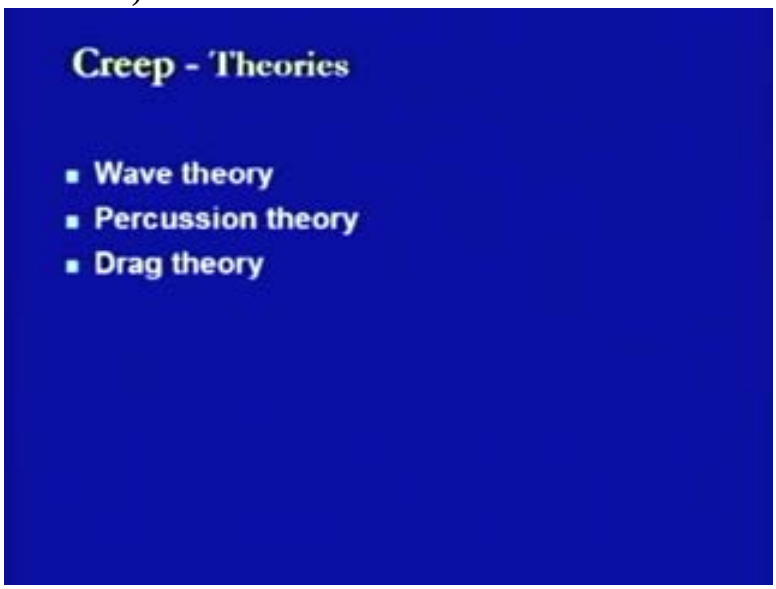

Another theory is termed as percussion theory and the next theory is termed as drag theory. These are the three major theories along with some associated features or regions which have been provided or given by the experienced persons or researchers who have worked with the creep. We will be looking at all these theories and along with those associated features in the continuation of these this lecture.

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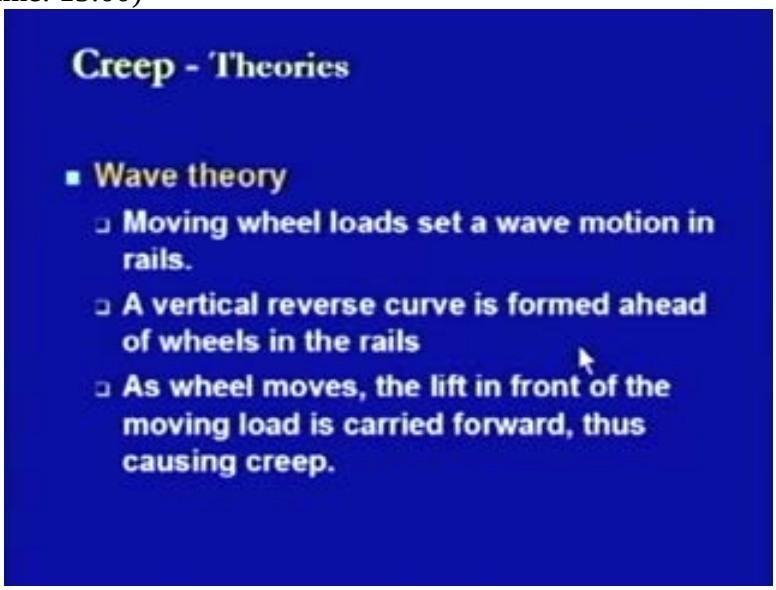

Starting with the first theory, the wave theory. The wave theory says that there are certain moving wheels and these loads set a wave motion in the rails. Now whatever wheels are moving on the rail section obviously they are putting the load, they are transferring loads from the top to the rail section. Now when this load is being transferred to the rail section it says that some sort of a wave motion will get induced because of this loading coming from the top. Now what happens is a vertical reverse curve is formed ahead of wheels in the rails. At the point of location application of the load the rails will get depressed or deformed or deflected in the downward direction. When this are getting deflected or deformed in the downward direction, that is, deflection is there then what will happen is a vertical reverse curve will get formed. So if we take this rail section in a continuous form, it will be acting as a vertical reverse curve. We were looking at this aspect in the diagrammatic form also and then as the wheel moves this reverse curve will be moving which is there in the front of the moving load, it will be carried forward.

Now when this reverse curve is being carried forward it will cause the creep of the rail because the rail will start trying to move in the forward direction and this is what the wave theory says. Now in this diagram what we are seeing is that this is the rail section and this rail section is being jointed with another rail section at this point with the help of the fish plates and the fish bolts, that is, these bolts which have been provided here and at the bottom the sleepers have been provided.

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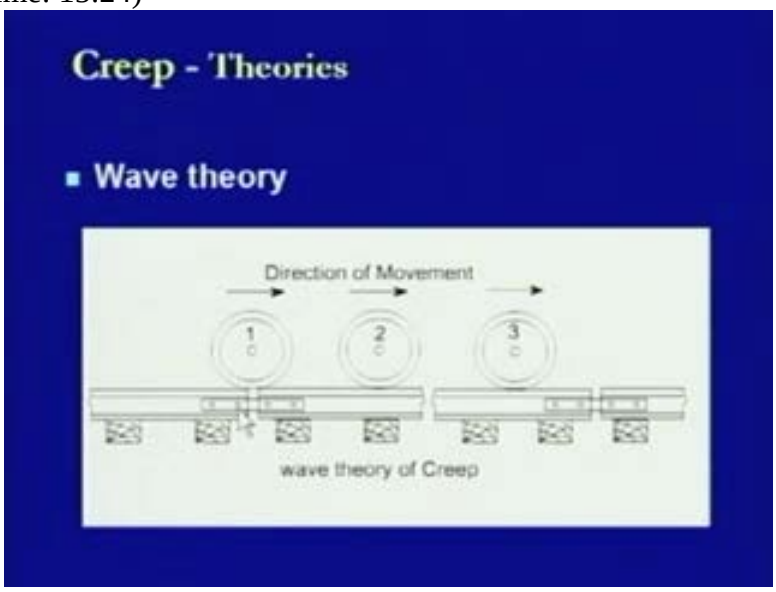

Now when there is number of wheels which are moving in this particular direction then what is going to be the effect of these wheels it is to be seen. Now what we see is that, now this is a condition which is happening because of a single wheel. Now this single wheel is being placed here and whatever load is being transferred this load is transferred at this position.

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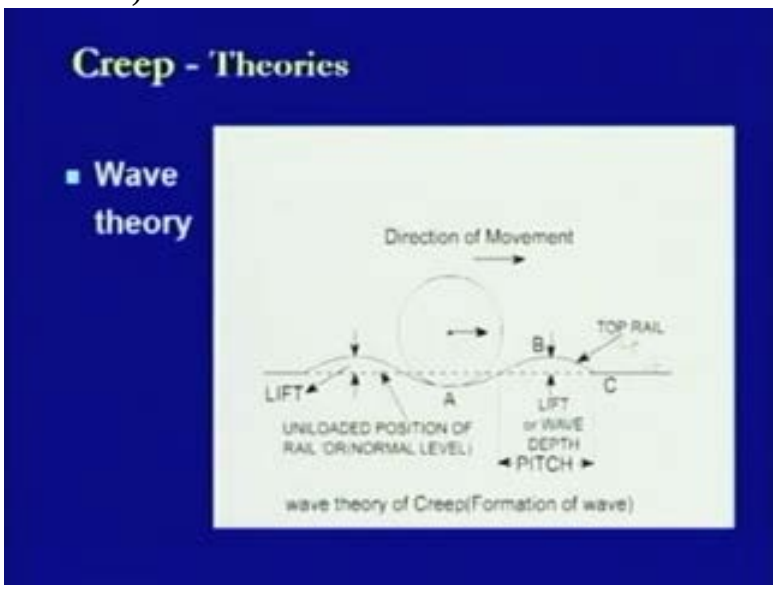

This is the normal rail level at this point. The dotted line is showing the normal level of the rail at which this wheel was placed. Now because of the loading condition there is this much deflection being caused in the rail section. So the rail section has boned down like this at point A that is the point of application of the loading. Now when this has gone down in this form what is going to happen is a reverse curve gets formed like this.

This is a reverse curve; it is having a reverse curvature on this side as well as on this side. This curvature is having a point of center on this direction whereas this curvature is having a point of center in this direction, that is why this is a reverse curve condition. So we have a reverse curve here and in this reverse curve just before this wheel section, that is, at this location and just as well as in the front of this wheel at this location what we are finding is that the this rail section is going above the normal level of the rail. Now when this rail section is going above the normal level of the rail then this is what is the amount of lift which will be there with respect to the normal rail section whereas this is the amount of depression which will be there at this location because of the loading condition due to this wheel. So the distance between this point and this one is termed as the pitch whereas this is the total overall depth is taken from this point to this point so that will be the depth of total by which this rail section is going to be deflected and we have to look at this wave depth as well as we have to look at the pitch section. So any uni loaded position of the rail is there then this is the condition. That the same thing will be happening with the rest of the wheels which are placed on the rail section. So it means at number of locations the same type of phenomena will be happening.

Now as soon as this wheel starts moving in the forward direction what will happen is that this sort of a reverse curve condition will start moving in the forward direction longitudinally and due to this movement of this section which is being shown here in this curve form, the creep will be induced. Now if there are numbers of rails which are moving in this direction and all of those wheels are going to create the same kind of effect then obviously the total amount of movement will be induced because of all the wheels on that rail section is going to be the total amount of creep which will be induced in this section. So this is how the wave is formed in the case of wave theory.

Now in the case of the wave theory, what we have seen is that the wave action is going to be affected by the 2 type of parameters.

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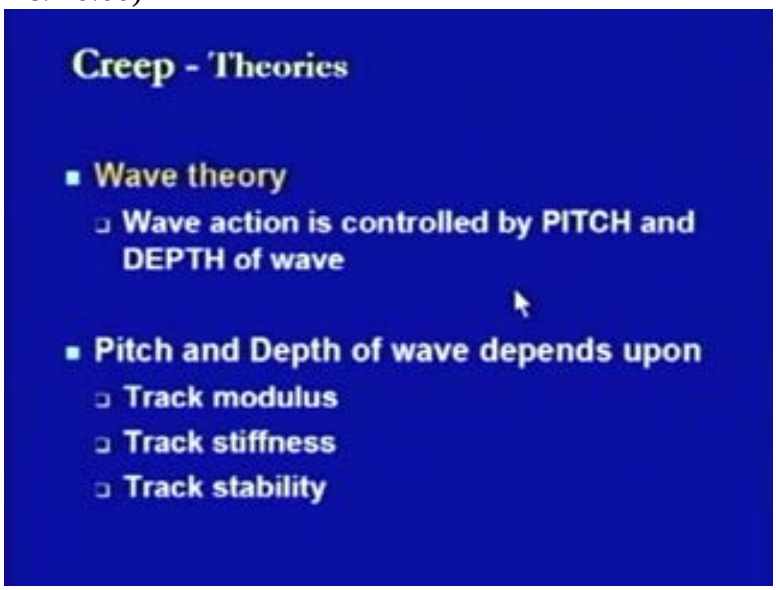

One is the pitch of the wave another one is the depth of the wave. Now if we can control this pitch of the wave and we can control the depth of the wave, that is, the total amount of deflection which is being created in the positive and negative direction as well as the amount by which it has moved in the forward direction that is the pitch, then obviously the whole of the creep can be controlled. So that is why these 2 factors are going to be the sort of a controlling factor for the creep in the wave theory. Now this pitch and depth is going to depend on certain factors. Now those factors are track modulus, track stiffness and track stability. Now what does it mean is, now if we are looking at this depth or if we are looking at the pitch, just assume a condition where we have the sleepers being provided very closely to each other below the rail section.

Now if this type of condition is happening obviously this depth of the wave can be controlled because whatever is the load which is coming from the top is not unsupported and it will be directly transferred to the sleeper. Now as soon as it is directly transferred to the sleeper then there will not be any deformation or deflection being created at that location. So that is how the total depth of the wave will be controlled and if there is no depth of the wave it is eliminated or being minimized then in that case this pitch will also get minimized or eliminated. It means we have to look at certain conditions by which the track modulus can be increased. the track modulus as we have discussed previously when we discussed about the stresses and resistances in the permanent way sections and its components. We have observed that this is one parameter which tries to define the strength of the track. So, it means that when we are trying to find out or while you are trying to discuss the strength of the track and if there are certain ways by which the strength of the track or the track modulus can be increased then obviously we can reduce or we can control the pitch or the depth of the wheel.

Another aspect is the track stiffness. The track stiffness is another thing like it defines in terms of the resistance towards the deformations or the resistance toward the deflections. That is what can be used here in terms of when we are talking about the depth of the wave or if we are talking about the pitch of the wave. So if the track is stiff enough if we are using the rail sections which are more heavier if we are using the rail sections which have much of strength at the same time we are using the supporting systems like sleepers or the ballast cushions which have been provided of the material which are having much more stiffness as compared to the normal condition then in that case the total stiffness of the track will increase. Unless this total stiffness of the track is increasing then it will not allow or it will resist any deformation in that section because of the loads which are coming from the top. Therefore in that case there will not be any depth of the wave or there will not be any pitch and both the things will get controlled.

The last aspect which is going to create an effect is the track stability. The track stability is related towards the safety point of the operation of the trains or the wagons on the track. Now in this case if the track is stable enough, if all the things which have been provided remain in their position, they are not losing out their location. Then in that case there all chances that we can reduce or we can control further the pitch and depth. So it means if these are the three things. If we can control these three things then we provide the components in such a way that they enhance all these three properties, that is,

modulus, stiffness and stability. Then we can for some point of time or for a certain amount we can reduce the creep or we can reduce the total amount of gap for pitch of the wave which is being induced. Now in this case so control of wave action is going to happen by the certain things in field like we can use angular and heavy ballast.

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This is from the supporting condition as we have discussed that we have to increase that track stability or we have to increase the track modulus. So what we can do is we can use heavy ballast which is more angular in shape. Angular is required because as soon as the ballast is angular or the stones are angular they will start fitting in with each other and if they are starting fitting in with each other then they will try to transfer the load through their point of contact from one stone aggregate to another stone aggregate. If this is the thing which is happening then the load will get transferred to a much wider area. So this is why the angular stone for ballast is required.

Another thing is the lesser sleeper spacing. Just before only I have discussed that if we provide the number of sleepers which have been placed very closed to each other then in that case there will not be any possibility of a deformation getting induced because of the load in the rail section. So this is what we are talking here, if we have a lesser sleeper spacing or in other words if we increase the sleeper density, that is, the number of sleepers being provided per rail length. Then also we can control the amount of wave action but obviously there is certain amount of spacing which needs to be provided whatever is the condition and in that sense it is not possible to have the sleepers provided aborting each other.

The next thing is the bigger rail section. Now this point also we have discussed just before when we have tried to discuss the track modulus or stiffness. If we have a bigger rail section then obviously it is going to be much heavier and much stiffer and if it is going to be much stiffer and heavier then the deformation induced because of the loads will be lower. So that is how it will control the wave action.

Further point is thus increasing the stiffness of track. Now this increasing the stiffness of track means we have to use certain measures by which like in the case of very good type of fastenings which are which can take the loads of a very large amount. If you use those one and we provide and just connect the rail sections with the sleepers by using those one probably the stiffness of the track can be increased. So these are the some of the ways by which we can control the wave action in the wave theory.

Now we look at another theory that is percussion theory. The percussion theory states that the creep is due to impact of wheels at the rail end ahead at joints. Now this theory also is talking in terms of joints, what it says is that there are 2 rail sections which have been jointed together using fish plates and the fish bolts.

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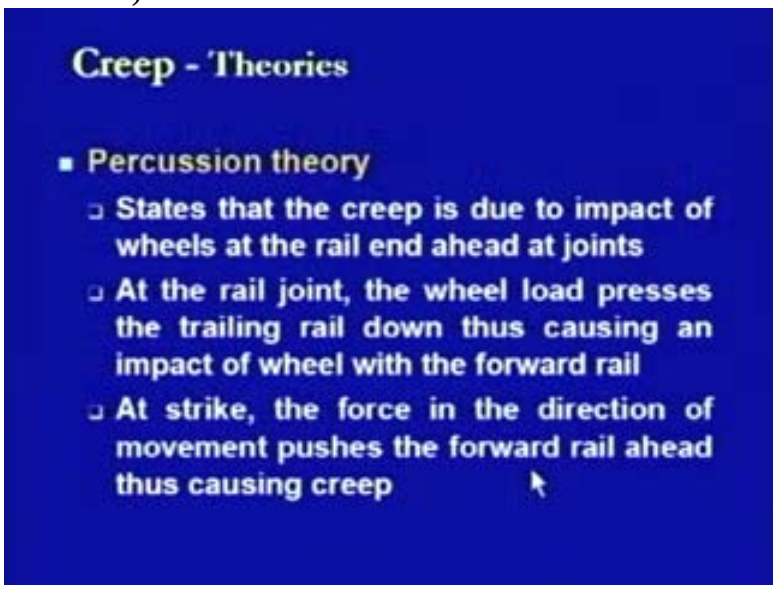

At this location as soon as any wheel comes it will strike on the rail section which is placed in the forward direction. So if it is going to strike at the rail end of the rail which is provided in the forward direction then that rail will move in the forward direction because of a horizontal component of the thrust and this is the reason due to which the creep will get induced in the rail section. So at the rail joint the wheel load presses the trailing rail down thus causing an impact of wheel with the forward rail. So this is the reason which will be causing the creep in the rail section. So at the strike, the force in the direction of the movement pushes the forward rail ahead thus causing creep. So as soon as there is this strike, strike means as soon as there is a force which is coming at the end of the rail section in the forward direction and then we resolve this force in the horizontal component and in the vertical component then the horizontal component will induce the creep whereas the vertical component will depress that rail end section in the downward direction and this is what we have seen in the previous lecture where we have talked about the hogged rails.

Further in the case of the percussion theory that this resultant of the vertical load and the forward force causes battering of the rail end of the forward rail and that is what is the hogging of the rail is.

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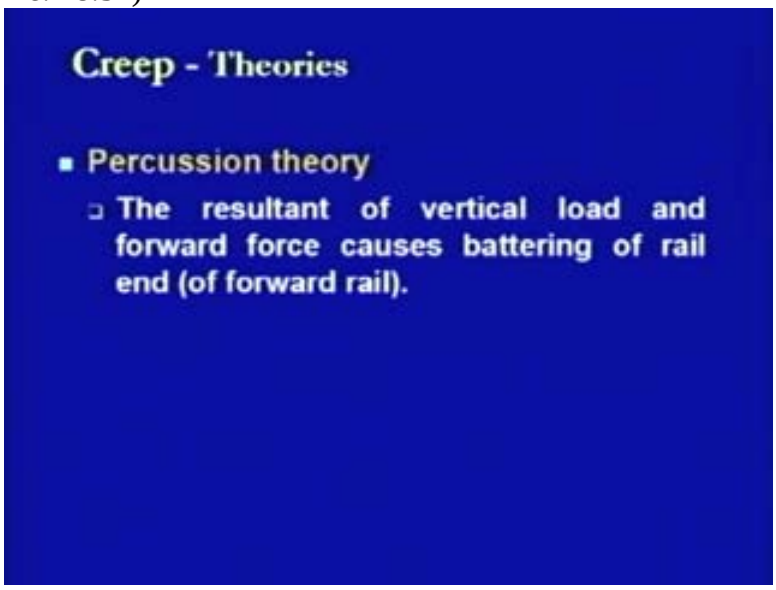

Now in this diagram we are looking at the same aspect. In this case this is one rail section which is being jointed along this rail section using the fish plates and the bolts. This is a wheel which has come to this location.

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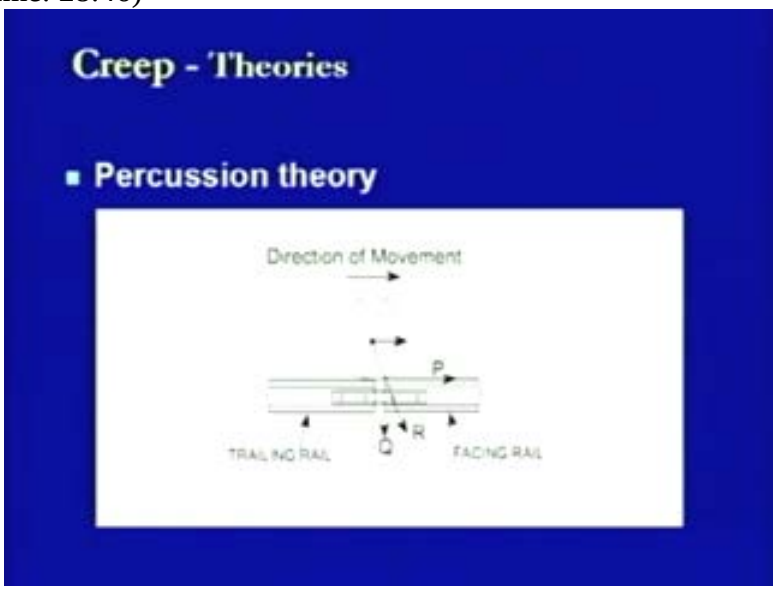

Now as soon as the wheel circumference of this wheel touches the end of this rail end it will be putting an impact in terms of this force R at this point so at the point of this

contact of the wheel and the rail section in the forward direction there will be an impact force which will be acting in this inclined direction like this. Now if we take the 2 components of this one because this rail section is moving in this direction. So we will be having a component P which will be in the longitudinal direction, that is, the movement of the wheel and we have one another component Q which will be working in the downward direction like this one. Then in this case this component P will try to move this rail section in the forward direction. So this trailing rail section will try to remain at the same location whereas this rail section will start moving in this direction. So, if this is the case which is happening then obviously this joint will start getting open out because this will remain at this location, this is moving forward. So this is what is termed as opening of the joint.

Now when this opening of joint will be created this fish bolts they will try to resist the movement of this rail section in the forward direction. Now when this fish bolts they are trying to resist this movement or these 2 fish bolts they are trying to resist the movement of this rail section in this direction obviously there is a concentration of stresses at these locations, that is locations of these fish bolts or holes and if they become excessive then they may cause tearing of the fish plate at this location in this direction. So there can be some tearing in this one and that is how it will get smashed out. This is what we have discussed previously in the case of the effect of the creep.

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So in the case of the percussion theory, what we found is that the creep is going to increase due to certain reason because we are talking about the joint at which the striking of the wheel is happening. So what are those factors which can create an effect at this joint will be taken into consideration. Now these factors are; there can be the weak and loose fish bolts where the fish bolts are not properly fitted or there has been some looseness being left in that one. Then obviously they will allow the movement of the rail section. Another thing is that the fish plates if they are old enough and they have started to worn out, then in that case also they will not be having sufficient strength so as to keep

the rail sections in place. So this may be another reason due to which the creep can happen in the rail sections.

Then the next aspect is the loose packing the load. the ballast cushion which is being provided at bottom if that is not being compacted sufficiently and it is being placed in a loose condition then it will reduce the total stiffness of the track. So in that case also the creep will increase. Further there will be a wide joint expansion gap. In that case also what happens is that in this case if the 2 rails have been jointed together but the gap provided between the rail sections is quite wide then the wheel which is coming at the top of the rail section which will have sufficient resistance at which it is going to strike on the forward rail section. So if the gap is more, this type of effect will also be more whereas if the gap is lesser then it is more or less of a continuous sort of a surface being provided and therefore in that case the striking behavior of the wheel on the rail section will not be there.

Another aspect is the heavy axle loads which are moving at a faster speed. Now if the axle loads are quite lower or the speeds are quite low in both the conditions the impact which is going to be created at the rail end will be quite less but if the loads are heavier and at the same time these loads are moving at a much faster speed then total amount of impact energy which is going to be transferred with the point of contact of the wheel with the forward rail section which will be much heavier and if because of this large amount of energy which is going to be transferred at this point of the contact, the horizontal component will also become large and in that sense the total amount of creep induced in the rail section will also be more.

Now another theory related to creep is drag theory. The drag theory says that it relates to the motion of a locomotive and the motion of the wagons. What it tries to say is that the driving wheel of the locomotive causes backward thrust and it tries to push the rail of the track backward.

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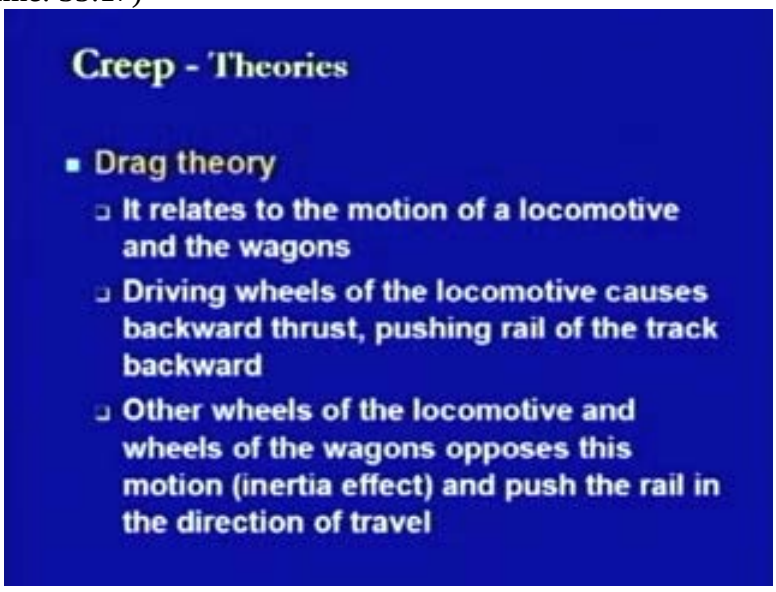

Here what we are trying to assume is a condition that the total drive in force is being provided to the locomotives and the wagons have been attest to it will just follow the movement which is being caused or induced by the locomotive. In this case the tractive effort will be coming through the driving wheels of the locomotive and this tractive effort acts in the backward direction. Now as we have seen in the case of the percussion theory where the impact force is acting in the forward direction, it is a reverse of that one where the tractive force will be acting in the backward direction. When we take this tractive force which is acting in the backward direction coming in inclined position it will be having again 2 components of which one component will be in the opposite direction to the longitudinal movement of the wheels and due to this reason this thrust will try to push the rails in the backward direction.

Another condition is the wagons which have been provided at the back of the locomotive. Now these wagons tries to remain in its position because of the Newton's law and therefore they will try to resist by providing a force which is acting in the forward direction and in this case when we again resolve this force in 2 components there will be one component which will be acting in the longitudinal direction, in the direction of the movement of the wheels. So therefore we have 2 forces; one is the force due to tractive force which is acting in the backward direction and another is the force due to wagons which are opposing the motion due to inertial effect which tries to push the rail in the forward direction or in direction of travel. Now whatever is the force which is larger will create or induce the creep in that direction. So if the force which is caused due to tractive effort is more then it is going to create the creep in the backward direction whereas if the force due to wagons is more then it is going to create a creep in the forward direction.

Now in this case what is going to happen is that this is more than the effect of the driving wheels because that is the combined effect of the wagons or force which is being induced by those wagons.

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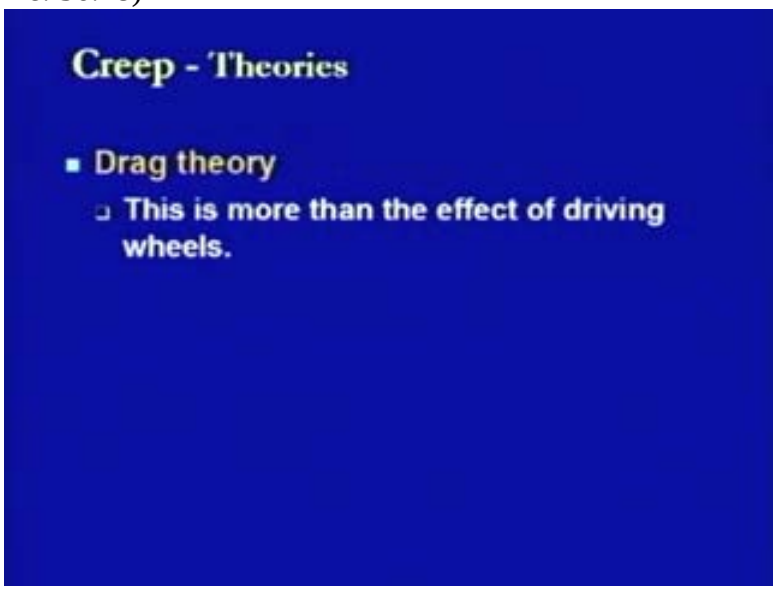

Now there are some more reasons which have been stated which cause the creep in the rail sections. The one of the reason is the starting, accelerating, slowing or stopping of the wheels.

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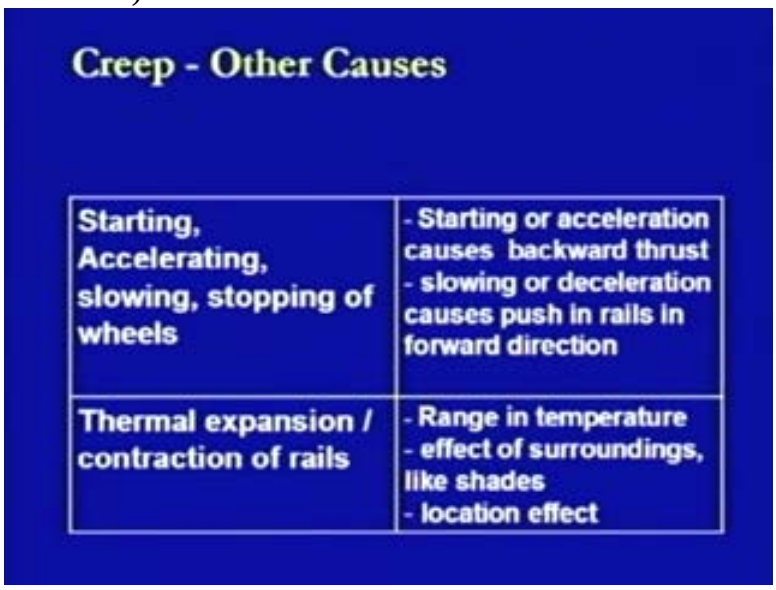

These are the 4 things which can happen during the operation of the any of the rolling stock. Now when the rolling stock is starting as we have seen it tries to cause certain movement in the forward as well as the backward direction. The same is the condition with the accelerating one because it is trying to accelerate from a speed v1 to v2. Therefore, again it will be pushing the track in the backward direction as well as the driving wheels are concerned and the rest of the wheels again will try to move in the forward direction the rail section. Similarly, when we are from a movement if we are going to stop and there is a sudden application of the brake or if we are going to slow down then also there is an application of the brake. Then this application of the brake coming through driving wheels will be in the forward direction which will be having a component in the forward direction and it will try to induce the creep in the forward direction. So it means starting or accelerating causes the backward thrust where the slowing or de acceleration causes push in the rails in the forward direction.

The another aspect is thermal expansion or contraction of rails. As we have seen that the rails are laid at a certain temperature and if the surrounding temperature is lower than that one or it is more than that one, in both the cases there will be relative movement of the rail section and that is what is known as the thermal movement of the rails, may be expansion or may be contraction. So it is going to be affected by the range of the temperature which can be there and it is also going to be affected by the surrounding conditions that is whether there is position any placement or shades etcetera or it may be also effect have its effect in terms of the location at which that section is being provided. So these will also create a movement and this movement will be in the any of the direction may be in the forward direction or the backward direction.

One more aspect is the unbalanced traffic. Now what happens is that on all the tracks if we connecting a city A with a city B and city A is the point of production of certain commodities and city B is the point of consumption of those commodities then there will be a flow of these commodities from city A to city B.

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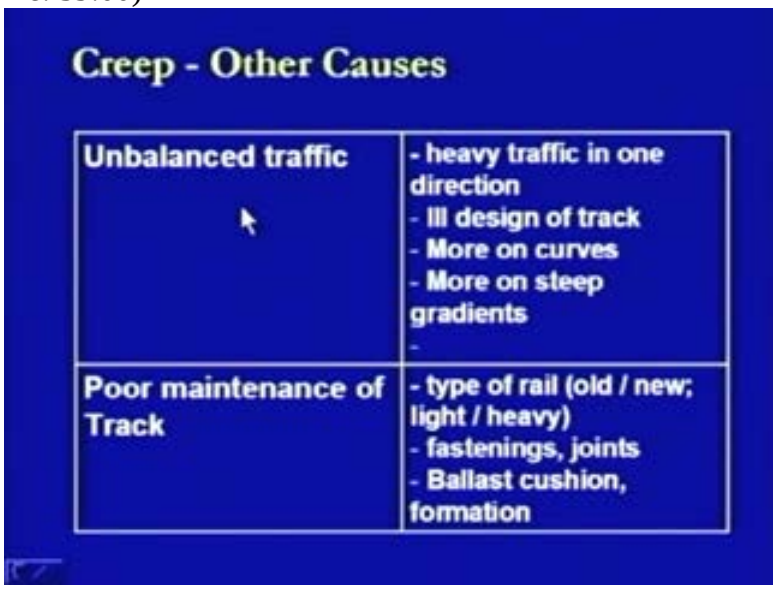

In that case the train or the freight which will be moved through rolling stock which will be much heavier in the direction of movement from A to B whereas in the case of the movement from B to A if there is no such commodity which needs to be transferred back then it will be coming as empty load. It means that it is going to be an unbalanced traffic condition in the 2 directions. So if there is an creep which is being induced in one direction of travel there is no traffic which can just nullify that creep while moving from the opposite direction and due to this reason the creep will keep on increasing in that one direction. What is being observed is that this unbalanced traffic causes the creep because of further the ill design of the track and it is being observed to be more on the 2 specific aspects of the track that is where the curves are being provided or where there the gradients are being provided. More or less steeper are the gradients, it means more force is to be applied in the forward direction so as to move the train on these gradients or if the train is coming down grade then more applications of brakes will be there and due to both of the reasons there will be the creep in the rail.

Further, as we have seen in the case of the percussion theory the poor maintenance of track also causes the creep. Here we are talking about the type of the rail sections whether the rail sections are old, or whether they are new, or whether the rail sections are light, or whether they are heavy. On the basis of these combinations whether the heavy sections have been used or the lower sections have been used they are going to create its effect. All of these factors basically like the fastenings, the joints, the ballast cushion or the formation all of these factors are going to create an effect on the stability and stiffness of

the track. So therefore in this case if the track is not being maintained properly then obviously it is going to create an effect and it will be in terms of creep.

The next point comes is that how we can measure the creep? The measurement of the creep as being shown in this diagram what we found is that this is sleeper on which the rail sections have been placed and there is one post which is provided at this location and there is another post which is provided at this location.

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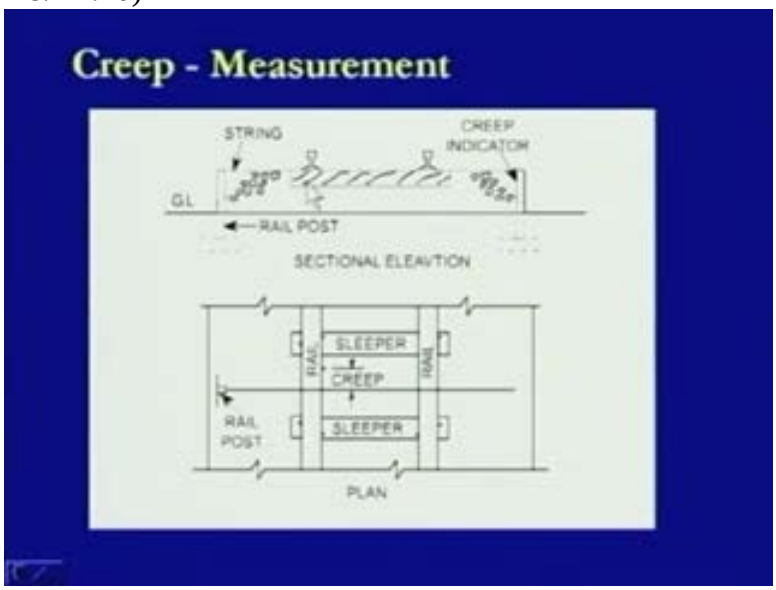

This 2 are being jointed together by using a string. So this is known as the creep indicator. So what is happening, now we can see in the plan here these are the 2 rail sections being provided and these are the sleepers under these 2 rail sections are resting. Here this is the rail post and this is the string which is passing like this and these are being passed at the bottom of the rail section. Now as soon as there is a creep at any point, now at this point where this string is being placed a mark is made on the rail section here. Now if there is any creep in this rail section, or in this rail section, if there is a creep in this rail section in this direction then what will happen is that this mark will start moving along this scale in this direction and there will be certain distance by which this mark has moved from the string. So whatever is this distance which is being moved with respect to this string is the creep in the rail section and this creep is to be measured in terms of per month, that is, how much amount of creep is being induced per month and then this is how it keeps on going.

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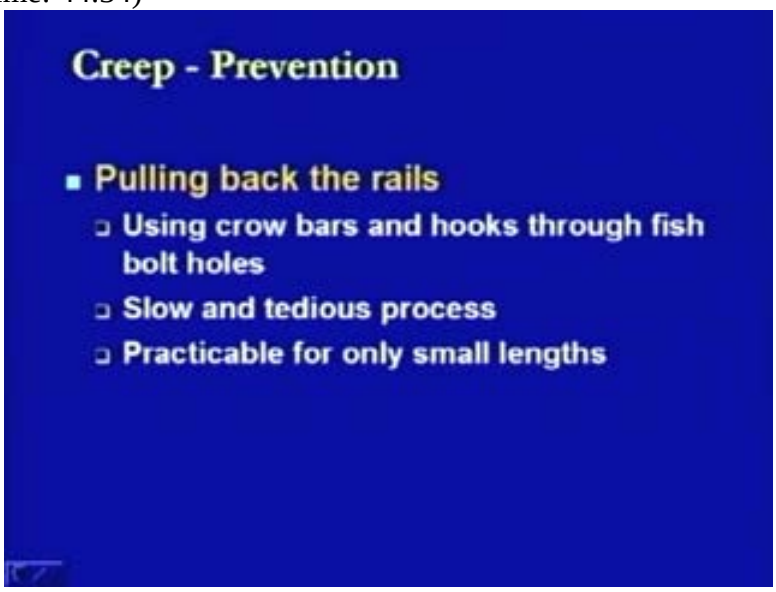

So how we can prevent the creep? Now there are different ways by which it can be done. One thing is that pulling back the rails. In the case of pulling back the rails what we are going to do is that first of all we have to remove the fish plates and the fish bolts. Once we have removed this fish plates and fish bolts then we use some of the equipments which are the crow bar and hooks. Using these crow bar and hooks what we do is that this hooks is placed in the hole which is being created for the fish bolt and then using the crow bars we try to pull the rail section back. Now the rail section which we have seen it is having a very very heavy load as we have seen that it is generally of 13 meter length and for 1 meter length the weight of the rail section varies from 50 to 60 kg. Then it means the total amount of weight of a rail section is very high.

So looking at that aspect if we have to manually use the hooks and the crow bars and try to pull back the rail section then this is going to be very slow and tedious process. It is a very difficult situation where we require a large amount of manpower and also we require large amount of energy to do that. So therefore, it is practicable only for those conditions where there is a small length in which the creep has been induced but if it is being induced in a much larger section then it is not possible to pull back whole of this section by using crow bars and hooks.

Another way of preventing the creep is the use of steel sleepers. In the case of steel sleepers it is being found that the steel sleepers they are the best in preventing the creep. The reason is that there can be jointed in such a way to the rail section that they try to keep the movement in tact at that location itself.

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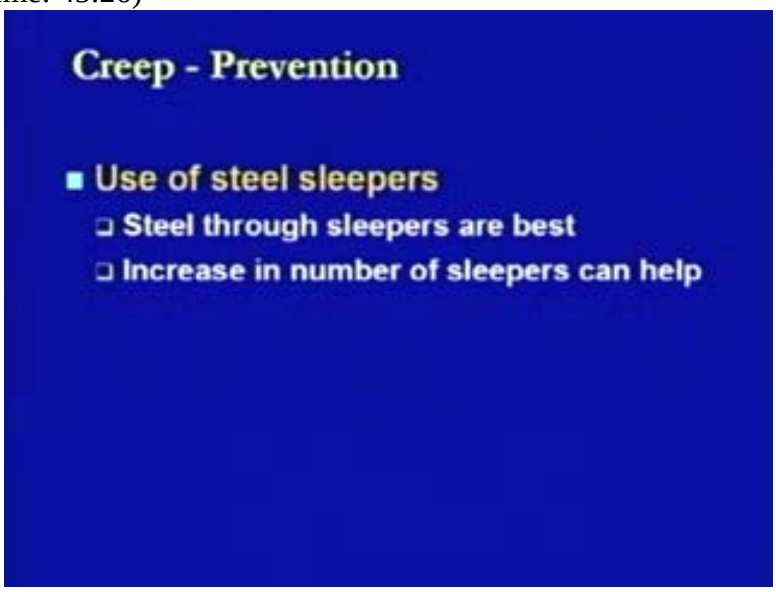

Now if we increase the number of sleepers then also the creep can be reduced. So that is another way as we have discussed previously too that we can reduce the creep. Further, there are some specific devices. If we use those specific devices then also we can reduce the creep. These devices are anchors or anti-creepers. Anchors or anti-creepers means by the word itself we can understand this anchor has come from the marine transportation where the ships have been using the anchor so as to remain in standstill condition in the water by throwing the anchors in the water.

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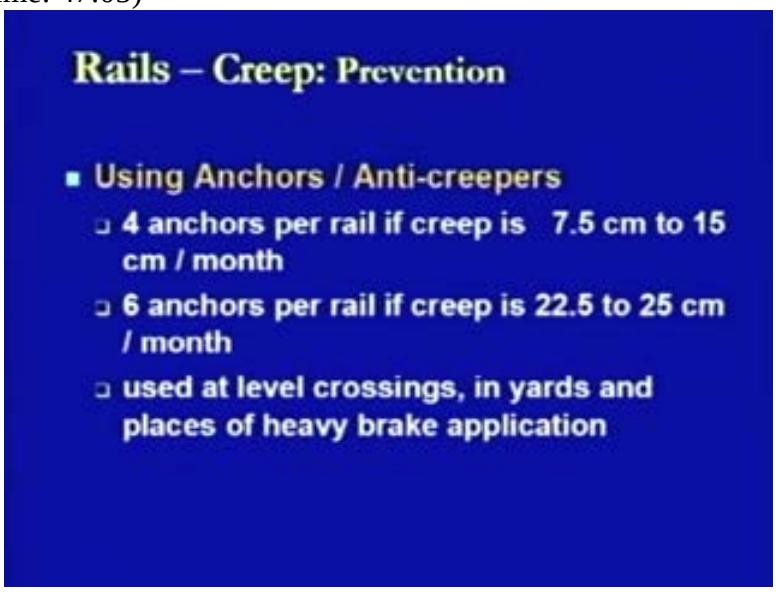

Now these anchors will go down to the bottom of that location where the ship is standing and it will just hit bottom of the sea and it will struck there. So that was the phenomenon which was used in the case of anchors. Now the same type of anchors is used in the case

of the rails but in a different form. They are also termed as anti-creepers because they are trying to resist the creep in the rails. Now these anchors generally they are provided as 4 anchors per rail length. If the creep is 7.5 centimeters to 15 centimeter per month whereas if the creep is from twenty 2.5 centimeters to 25 centimeters per month then 6 anchors per rail are used and they are used at the level crossings, they are used in the yards and they are used at places of heavy brake application.

Now all these locations which have been listed here they are the locations where we will find that there are most of the movements or the creeps will are going to be induced. As we have seen one of the reasons of the creeper is the starting of the train, or its breaking effort, or slowing down effort, or the accelerating effort. Now all of these things happen very near to the rail level crossings or in the yards or there are certain locations like the platform area of this station where the heavy brake applications will be there. So, on all these locations we have to provide anchors and these anchors have to be provided on the basis of total amount of the creep being induced but they are not used on bridges.

Now this is the diagram which is trying to show how the anchors can be placed. There are different ways of doing this. This is the direction of movement; one way is that we are providing the anchor at this location and this location then this alternate sleeper is being left.

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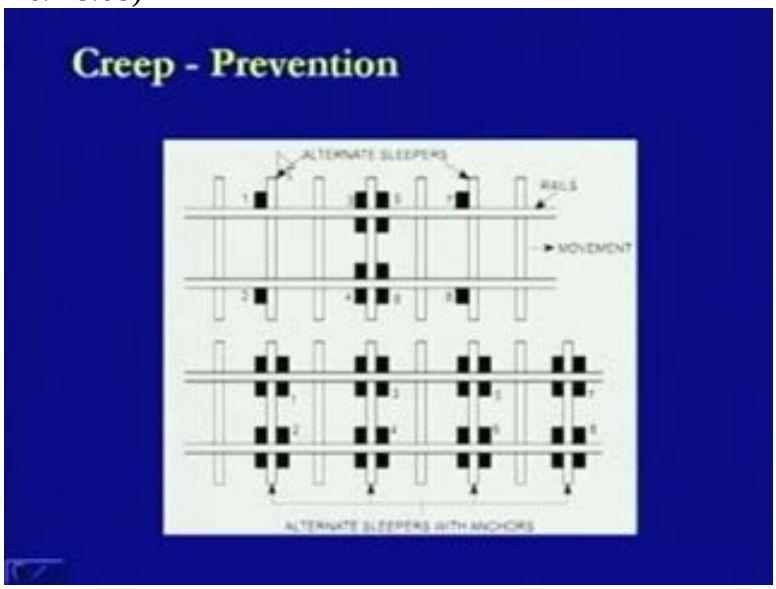

Then further the alternate sleepers on all the sides of the sleepers the anchors have been placed, that is, one anchor has been placed here, another has been placed here. The same way it is being placed from outer side and if it is more of the creep is there then obviously they have to be placed in this form and then there is another anchor which is placed at this location. Now, another way of doing the same type of thing is that we have tankers being placed on both the all the locations because there are chances of the creep getting induced in both the direction of the movement. Therefore, the anchors have been provided on this direction as well as in other direction and again these anchors are

provided on all the alternate sleepers. They are not being provided continuously. Further in the case of the anchors, these anchors need to be fastened to the foot of the rail.

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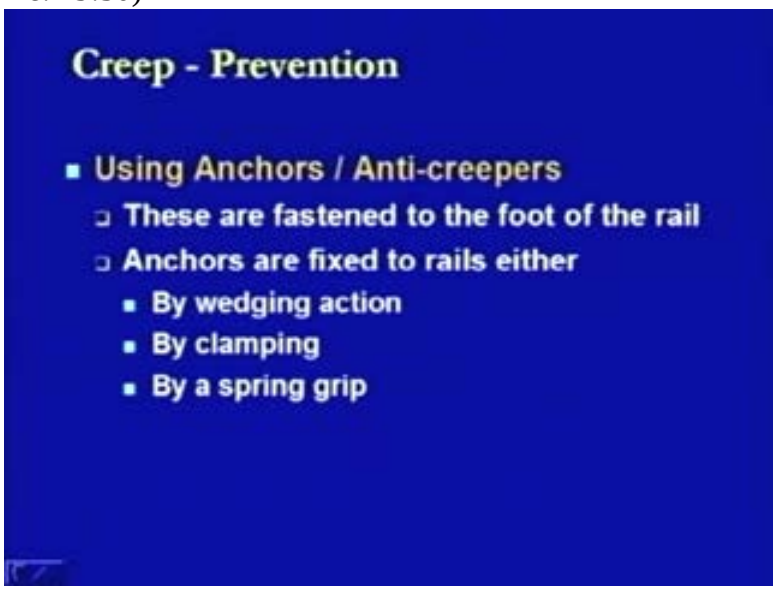

If they are not being anchored to the foot of the rail then they will not be transferring the load. If they are not transferring the load then they will not be in a position to resist the movement of the rail sections. Therefore, this is one of the important things which needs to be taken care off while providing the anchors or the anti-creepers. Now there are 3 different ways by which this can be done; one is by the wedging action, another is by clamping and the third is by spring grip. In the case of wedging action what is being done is that if the anchor is something like this one then at one location the wedge is being inserted and when this wedge is inserted it will provide the connectivity between the anchor with respect to the foot of the rail section and this is the way by which the loads will be transferred from one point to the another point.

In the case of the clamping what we do is the clamps are provided at the foot of rail section and so that this rail section is being kept in location and the third one is the spring grip condition. The spring grip condition is a type of an anchor in which using the springing action of the anchor the grip is maintained. We are not using any wedge in this case and because of this spring gap which is provided, because this anchor moves from one side to the other side of the rail section and by using the spring action it will be transferring the load. Now the next thing is that there are certain important points which needs to be remembered while making the rail and controlling that one.

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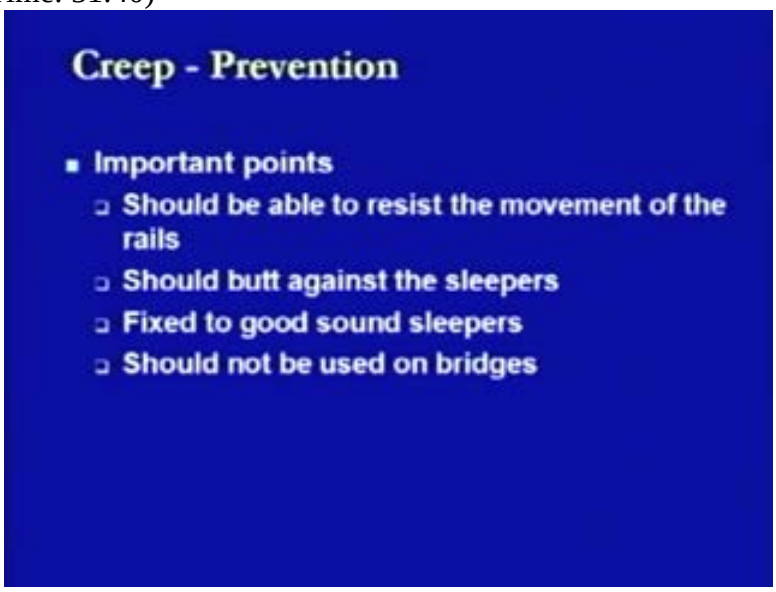

One is that it should be able to resist the movement of the rails whatever anchors we are trying to provide we should be able to resist that one we should not move forward along with the rail section. Then they should butt against the sleepers, as I have told that if they are not butting against the sleepers and they are not touching the rail sections then the load will not be transferred and therefore the resistance will not be improved and then they should be fixed to the good sound sleepers, that means the sleepers have to be checked what type of category of sleepers have been provided and they shall not be used on bridges.

So students this is all about the creep. What we have discussed today is the definition of the creep, the effects of the creep, certain theories which are tried to define the creep, the measurement of the creep and the prevention of creep. So we stop at this point and I say goodbye to you. Thank you.