

Transportation Engineering -II
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Lecture - 13
Rail fastenings

I welcome you back to the lectures series of transportation engineering 2 course material. In today's lecture we will be discussing rail fastenings. So far what we have discussed is the different type of components which are used in the construction of any railway track. In these components we have already seen or discussed rails, sleepers and ballast. In today's lecture we will be looking at the various fastenings which are used to fix the rail with sleepers. In the case of sleepers we already seen that there are different types of sleepers available to us and therefore there are different fastenings which are available, which can be used to connect rail with all these types of sleepers. So in the today's lecture we will be looking at track fittings, rail to rail fittings, rail to sleeper fittings.

We will be starting with the different types of fastenings and these different types of fastenings; the first one is rail to rail joining. As we have seen in the case of any track there are different sections which are composed of the rails which are manufactured in specified length. Therefore there is going to be connectivity between these rails to rails. Then the another category is the rail to wooden sleeper fittings. As we have seen that the sleepers are of different types the old type of sleepers which have been used for wooden sleepers, therefore the fittings which are required to connect rails with the wooden sleepers will be seen. Then there are rails to steel trough sleepers. This is another category of sleepers which are already being discussed. Then there is a connectivity of rail to CI sleepers. So these are all metals sleepers which are being connected to the rails. Then there are elastic fastenings. So in these cases of fastenings we have conventional fastenings and elastic fastenings, so there will be 2 categories in which we will be discussing these. Basically all the fastenings which will be discussing prior to elastic fastenings will fall in the category of conventional fastenings and they will be related to rail to rail joining, or rail to wooden sleeper joining, or rail to steel trough sleeper joining, or rail to CI sleeper joining.

In the case of rail to rail joining we will be looking at fish plates, bolts and nuts. These are the fastenings or the fixtures which are used to connect the one rail with the another rail. In the case of rail to wooden sleeper fittings we will be discussing dog spike, fang bolts, screw spikes, bearing plates. We have a lot more other fittings also but these are some of the important fittings which we will be discussing. Then in the case of rail to steel trough sleepers we will be discussing the loose jaws, keys and liners. We have already seen in the previous lectures we have discussed about sleepers in the case of steel trough sleepers or CI pot sleepers there are different categories loose jar category or log off category are there. So therefore, all those categories to fix rail with the sleepers we require jaws as well as keys. So we will discuss these types of fastenings in today's lecture.

Then in the case of CI sleepers the another thing which is being used to connect the tie bar with the pot type of sleepers was cotters, so the tie bars cotters will be seen and then in the case of the elastic fastenings there are large number of elastic fastenings available to us nowadays. We will be looking at the elastic fastenings like elastic or pandrol clip, the IRN 202 clip; this is the Indian railway number clip which is being produced by the RDSO and the railway ministry. The rubber pads, HM fastenings MCI insert and nylon liners. So in this case we will be starting with the very first category that is rail to rail fastenings.

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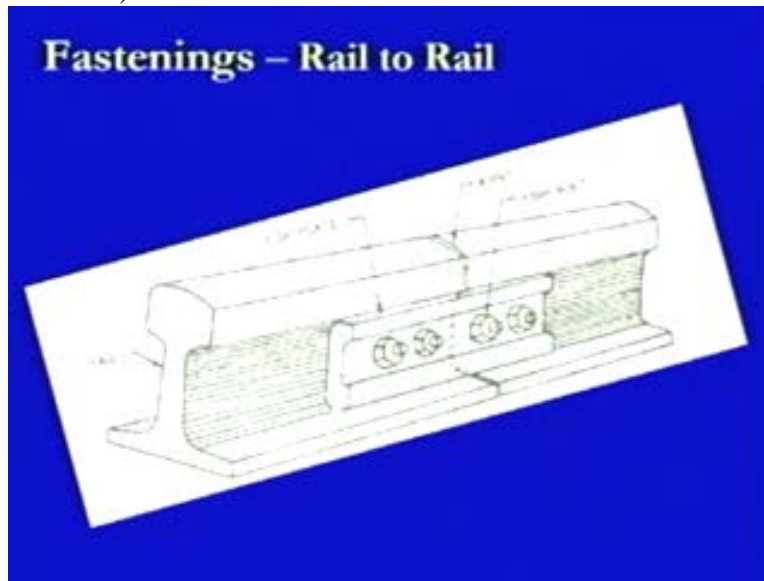
In the case of rail to rail fastenings the most important and the primary fastenings which is being used is fish plates. Now this fish plate is designated as IRS T dash 1 oblige 57. This is the designation number of fish plates in the overall technical grocery of Indian railway. So as soon as anybody related to the railways is being given this number the person can understand that we are talking about fish plates. There is no need of giving the other specification of that fish plate as soon as the number has been specified. Now in this fish plate they require certain strength, we have seen that when the two rail sections have been joined together and fish plate have the function to perform to keep those rails jointed with each other at the same time to maintain the level also and they also try to imparts more stability and strength to the joint which is otherwise is the point of the weakness. So in that sense it should have some amount of strength available to it. So here we are talking about the strength, this is, UTS which is ultimate tensile strength. The minimum level it should be 58 to 67 kg per mm square.

Then there is the tendency of deformation under the loads so there is the tendency of the deformation under the thermal stresses and in that case the elongation may be there and the minimum elongation required in this case is 20 percent. The sectional area of the fish plates should be equal to the sectional area of the rail section. In the case of rail section the overall sectional area will be the composition of the railway head, web and the foot. On the basis of that total sectional area we have to find out the area of the fish plate and

design it accordingly and in the overall condition the strength of the fish plate is around 55 percent of the strength of the rail section.

This is the type of fish plates which are generally in use. Here we see that this is the fish plate which is sort of channel shape like this c is there whereas in this case it is having a shape of curvilinear condition and it can be termed as a sort of dumbbell shape. Both the type of fish plates are in use on specific location as well as for the different type of rail section which are again I available to us which have already being discussed when we started with the rails.

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Now this is another typical view where the connectivity of one rail section with the another rail section has been shown here and this is the joint. So this is one rail section on this side another rail section on this side and here we can see that fish plates are being provided you can see the fish plate is being provided. So this is the channel shape fish plate which is provided on this side and there are two holes which are provided on the either of the side of this joint. So in this composition we have 2 plates because one plate will be provided on the other side this is the inner side of the gauge space of the rail and the one fish plate is provided on the outer side of the rail. So at one particular joint there will be 2 fish plates and 4 bolts and 4 nuts. So this is the total assembly which will be there as far as the requirement of material is concerned for any one joint.

Then this is another view of the rail to rail joining and in this case this is the sectional view of this one. We have the rail section is being placed like this and on this rail section then we are placing the fish plates. Here we can see that this is the fish plate which is abating at this location like this so the shape of the fish plate is being provided in this form and then at this level of also it has to be provided in the way so that it rest on the foot of the rail section and this is another side of the fish plate, these are the 2 fish plates which have been used and they have been jointed by a same bolt. So this is the bolt and this is the nut, the bolt is passing from one fish plate going through rail section and then

coming to the other side and it is being fastened with the nut. So in this case if there is any looseness at this level whether it is because of the size of the hole or because it is these nuts or bolts are not being fastened in a tight condition then there will be a relative movement of the rail section as soon as there is a load which is passing from the top of it. So that is why it is important to have the tight condition of all the 4 bolts which are provided on the these space plates and we can see that this is the 44.7 kg rail which is being shown here along with its dimensions and in this case this is 1 is to 4 slope at which this fish plate is being cut in this size so that gets fits in with this rail section.

As soon as it gets fit in with this rail section here we can assume that whatever load is coming from the top at this location will get distributed not only through the whap section of this rail like this to the foot of the rail section but also get transferred through this section as well as this section and will come back to the bottom. In that sense if we assume that there is no loads which is being transferred through this section that is the web of the rail then 50 percent of the load will get transferred to this one and fifty percent of the load will get transferred to this one and that is the reason why this is fish plates they are suppose to have 55 percent of the strength of the rail section. So when we are using 2 fish plates it is more than 100 percent strength of the rail sections and that is how it is survives without breaking.

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Now another type of connectivity between the rail to rail section is the combination fish plate. The combination fish plates joins 2 different rails sections. There are certain condition or locations where the two rail section which have been joined together not of size or sectional area. So in that case we have to use a combination fish plates. In the case of combination fish plates there will be additional thickening of the joint, the elimination of expansion gap will be there and the fish plates marked as right in or right out. This is instead of r is out and left in out depending up on direction from lighter rail to the heavier rail. It means when we are using 2 different rail sections obviously there is going to be a difference in the sectional area as well as the sectional weight of those rail sections. So in

that sense one rail section which is having a lesser weight will be termed as a lighter rail another rail section will be termed as heavier rail. Now based on the location of the lighter rail with respect to heavier rail the fish plates are designated as right in or right out, left in or left out.

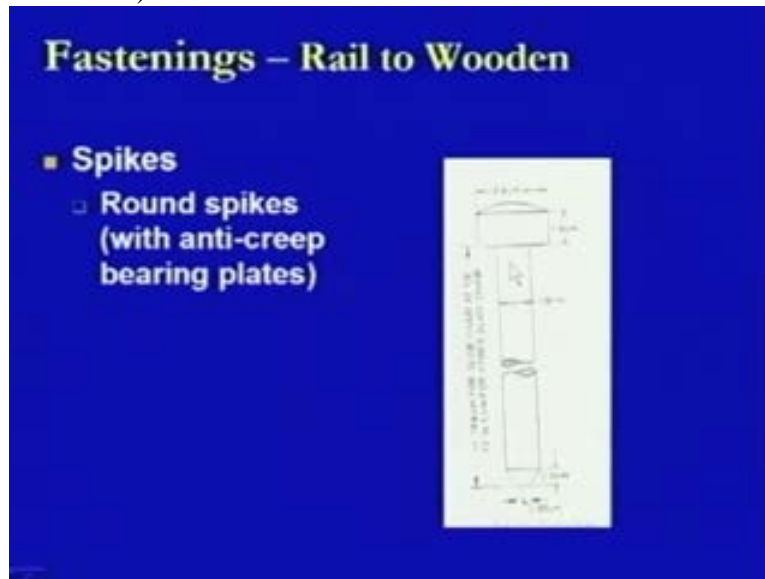
Now in this case we can see the diagram that this is the combination plate there this is bigger section, this is the rail section which is provided by the dotted lines like this and this is another section which is the lighter rail section and both these sections have been joined together. Now in the normal condition where the one rail section is being jointed with the another rail sections a gap is allowed between those two rail sections but in this case there is no gap is being provided, it means they are betting each other. Now in this case there is one fish plate which is used here and this is another fish plate which has been used here. So when we are in this form then this fish will go on the other side of the rail section, this fish plate is coming on the other side of the rail section. That is how there is a overlapping in this much area so these lines this is end of one fish plate and this shows another fish plate which is coming from this direction. So in that sense there is overlapping of the area what we found is there is additional thickening at the joint section like this, this is additional thickness at this level and additional thickness at this level and this is the normal thickness of fish plate on this side and normal thickness of a fish plate on the other side.

Now when we are having this lighter rail and this is the heavier rail so the direction in which we will be looking at these fish plates in this direction. So this is the arrow which showing the direction. When you look on these fish plates on this direction we have this as a right hand side this as left hand side. So this is outer side and this is righter outer fish plate and this is right inner fish plate. Similarly this is left inner fish plate and left outer fish plate likewise these needs to be designated, and that is how there also are placed jointed together. So again we are using 4 bolts; 1 bolt is going in this fish plate and this is no overlapping area here similarly there is no overlapping here and then 2 bolts will be coming through the additional thickness area and this is how it is being connected.

Now we come to the another category of connectivity, that is, between rails and sleepers. In the case of rails and sleepers the previous type of sleepers which have been in use are wooden sleepers still there are some sections where the wooden sleepers are going in use. So we have to look at those fastenings which have been used to connect the wooden sleepers and the rails and this connectivity is the first one is of important is the spike. There are different types of spikes available. Under those spike there is dog spike, dog spike is this is the diagram which tries to give the dimension as well as the shape of the dog spikes. Here what we found is the shape of this one is some thing like this so this is just similar to the face of the dog whereas this is back side of this one. If you look at this section from this direction then you will find that it is it will look like this way. So looking at this section only the name has been given as dog spike. So it has this conical surface at the bottom through which it will be inserted to the wooden surface. It is hammered from the top and then it goes because of this conical surface initially it will take penetration condition and then through that penetration it will be going inside into the wooden sleeper. So this is how the dog spike work.

This is another view of the dog spike where again this is going like this and this and we have little more conical surface in this one whereas in this one it is truncated conical surface so that is little blunt at the bottom. Then under this spike condition another type of the spike is the round spikes. This round spikes is the mostly used with anti creep bearing plate. These anti creep condition we have seen when we have talked about the creep in rails where the rails moved in the longitudinal direction so these are the round spikes which are used with anti creep bearing plate so as to keep those rail sections in place.

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This is the diagram of round spike. Here what we found is this remains the similar to the dog spike as we have seen in the previous diagram. It also has the truncated cone at the bottom but at the top it is being provided with the cap and this is how this is stuck at the level and when it is inserted into a hole then it is working like bolt. So the top of the bolt is like this only, so it will be abating to the surface so that it remains in place. The hole is being inserted in bearing plate as well as it will be inserted into the bottom of the foot of the rail section through which it will pass and fasten the rail with the wooden sleepers.

Then another category in the case of spike is fang bolts. These fang bolts are mostly used for the slide chairs or the sleepers connectivity under switches. Now these slide chairs switches they are the terminologies or the devices which are mostly used at the places where the direction change of track is to be provided and those locations are turned as points and crossings. When the points and crossings will be discussed will be taking up the switch is there and the side chairs or the equipments which allows to rail to move in a certain direction so that connectivity between one track to the other track can be provided. So in these cases where the slider chairs or switches are provided fang bolts are used. This diagram shows different types of fang bolts which are available. We can see the shape of these fang bolts, most of the fang bolts they are having almost similar sort of design only thing with the changes are coming at the top, this is one thing in some of the

cases the switches which are provided they are of different value. Here there are more of similar conditions, here they are projected one. These are the differences in all these.

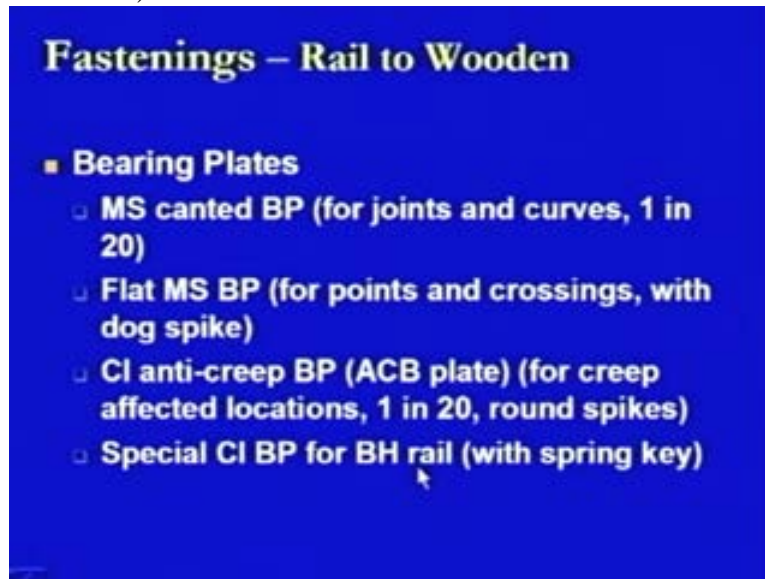
Then there is another aspect which is termed as screw spike. Now these screw spike. This screw spike is also have available in 2 types one is the plate screw another one is the rail screw. Most of the time these are used in high speed trunk routes. What happens in the previous type of the spike which we have seen so far is that with the jerks or with the loads which are being transmitted through them slowly and slowly they start getting in and out and in that sense if we are using those type of spike in the high speed trunk routes then the periodical maintain requirements increases. Therefore, instead of those type of spikes we use screw spikes and because of the screwing nature they have a tendency to remain in position and they are not getting ins and out again and again. In the case of the plate screw we are using a plate along with this spike or the screw that is why the name plate screw is being given where the rail screw is the spike of the screw which is directly fitted with the rail section just through its hole. In this case these are again of similar sort of condition like as we have seen in the case of the bolt; this is the one diagram where the screw spike has been shown. Here instead of the bolts the only difference which comes all these screws they are coming up to the top of this one. So that when it is inserted inside then through this hole it will get connected to the top most surface of the rail section and still it will maintain tightly the fitting of that rail sections with the wooden sleepers so there will not be any loosing effect because of this much amount of screwing is being provided.

Then another category of fastenings which are used in the case of wooden sleepers are bearing plates. Bearing plates are mostly provided because the whatever rail we have been using like the dumbbell shaped rail, or double headed rails, or bull headed rail, or flat footed rails as soon as the load comes from the top there is the tendency of the force to go inside the wooden surface. So it will start penetrating it and there will be wearing of the surface of that wooden sleeper at the location where the rail is being placed. So as to remove or eliminate this type of condition the bearing plates are provided. These bearing plates available in different form there are mild steel canted bearing plates. Canted bearing plates is the plate where 1 in 20 slope is provided because rails have to be provided at this slope so that coning of the wheel which is being done there is no problem because of the coning of the wheel and the rail section is being provided and mostly these MS canted bearing plates they are provided on joints or on the curves.

Then there is another category that is flatter mild steel bearing plates. In the flat mild steel bearing plates these are provided for points and crossings where the turning of the track is allowed and they are provided with dog spike. Then there is cast iron anti creep bearing plates is also termed as ACB plates and this is provided on all those locations where the creep is the possibility. Again in these cases the 1 in 20 slopes is provided at the bottom so as to seat the rail sections and round spikes are used in these cases instead of the dog spike. Then there are some special cost iron BP plates for used bull headed rails and in this case of bull headed rails we have seen the head of the rail is bigger as compared to the foot of the rail and they are used with spring keys. So we have different

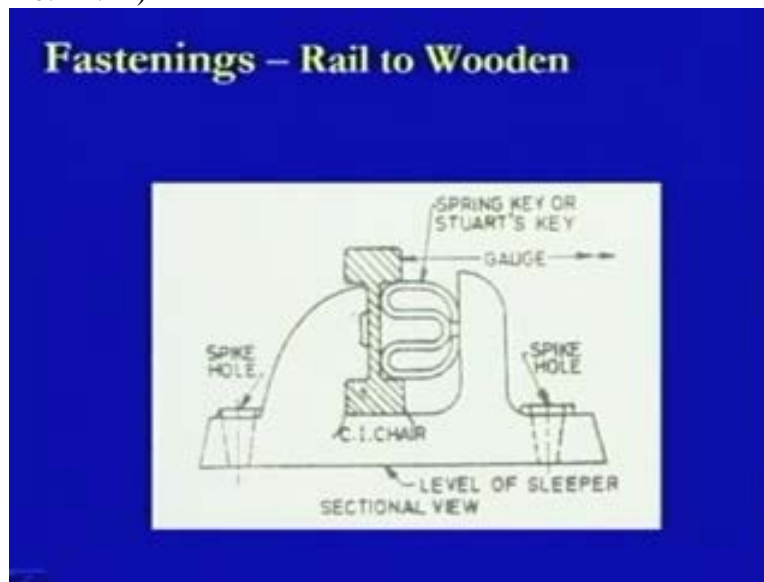
assemblies available and we have to use the combinations of those assemblies wherever they have to be used specifically.

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Then this is the diagram where the cantitative plate is being shown. We can see that there is a slope at this level where there is more thickness, here there is lesser thickness. Therefore the cantitative is being provided. The cantitative 1 in 20 and soon as the 1 in 20 cantitative is provided the wheels are also having the cant of 1 in 20 so there by using this we will be having the total connectivity at the top most surface of this rail head sections with the wheels which are moving on those rail sections and here we can see the dog spike also very clear. This is the dog spike which is being provided and this is getting inserted through this bearing plate and then finally here at this level there is a sleeper so it goes into the sleeper like this. Similarly on this side it is going into the through this bearing plates at this level into the sleeper like this. This is how it is creating a pressure so as to keep this rail section in its position. So in this diagram we can see the dog spike as well as the bearing plates. This another type of bearing plate along provided with the chair and in this case what we can see is this is the bottom most part and this is specifically being used for the bull headed or double headed rail sections. You can see there is a difference between this rail section and this rail sections.

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Here the rail section is having flat foot like this whereas in this section we are having both the head as well as foot of similar nature. So in this section what we have to do is that we have to use spring key, this is the spring key. This spring is provided like this and because of its springing it will maintain the rail section in location. So this is because of this thing that this rail section is just sitting at this one. This assembly is termed as chair. So this is cast iron chair and here there is a hole through which the spike has to be inserted. So this is the spike hole, we can have the rounded spike at this level we can see that this is the thickness as being shown here so this is the rounded part of the spike so this is inserted inside like this. Similarly it is being inserted inside like this. So these are the assemblies which are available in the case of rail to wooden sleepers connectivity.

Then in this case this is another similar sort of condition but with different type of connectivities. Here what we have seen is instead of spring this is one see the angle which is coming out of the bearing plate section and then at this level the connectivity is provided using the bolts and the nuts and in this case to what happens is this is the condition for points and crossings where this rail section has a tendency to move so this rail section can move to this side or it can move to this side. So this is the distance which is shown here by this distance the rail section can move this way or this way. When this rail section moves this way or it moves to this way depending on there is another gauge space of the rail section is being provided on this side it will get connected get to the another rail sections. So as soon as the rail section get connected to the another rail section it allows the change of direction of any train. So this is used at those locations where the change in direction of the train is to be provided. So that is why it is termed as chair and slide chair condition so there is chair being provided here and due to this arrangement it has a tendency to slide. So that is why it is chair and slide chair arrangement. Now we come to another category of connectivities. This category of connectivity is between rail and steel sleepers. Here the first thing which is to be used is the loose jaw. Loose jaw is used to there is a spring steel loose jaws with keys. There is

no problem of damaging these type of loose jaws and there is cracking or deforming is also is not there and they are easily replaceable.

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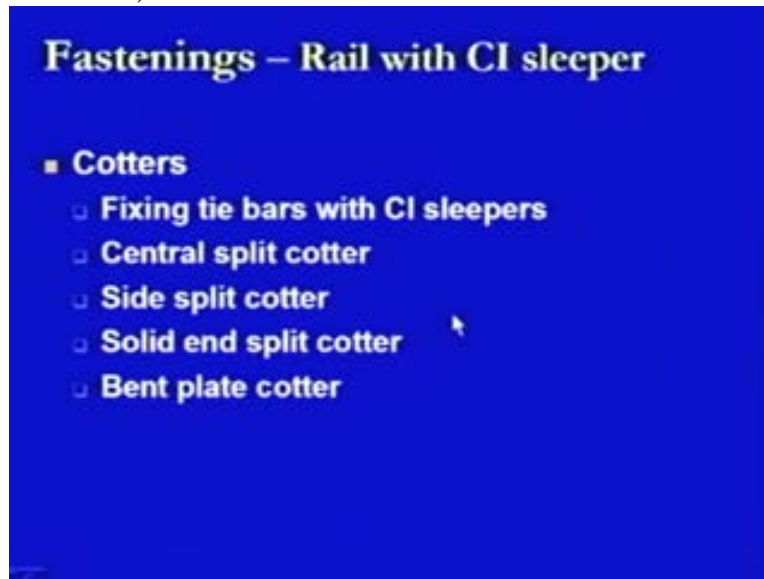


These loose jaws are provided with the keys. This is the diagram of the loose jaw. This will go below the rail surface and at this level it is trying to provide the lateral stabilities so that the rail section is not falling away. So this is the type of the loose jaw provided and along with these loose jaws the keys are used there are different types of keys there is some keys which are one way keys and then some keys which are two way keys. In the case of two way key this is taper at angle of 1 in 32 and they are generally used the steel trough sleepers or the pot sleepers or the CST 9 sleepers. Now in the case when we have seen the diagrams of trough sleepers or pot sleepers or CST 9 sleepers we have seen that there was a location where the key has been inserted. So this is the type of the keys, this is the longitudinal section or taper longitudinal section which is provided a value of 1 in 32 and it is square or rectangular at both the ends.

Then there is another thing which is at times used is the rubber coated or an epoxy coated fish plates. This rubber coated or epoxy coated fish plate is used on insulated joint these coatings get damaged quite early. Then in the similar category of rail steel sleepers there is another type of liner which tries to again fasten or keep the connectivity of the rail along with the rail steel sleepers in position and this is known as Mota Singh liner. Mota Singh has been an employee of Indian railways and on the basis of his experience he devised one liner and with his name it is being termed as Mota Singh liner. This is used for loose jar so as to overcome the problem of elongated holes. What happens in this case that once the loose jaws are provided and the holes through which some other fixtures have been inserted slowly and slowly start becoming elongated or bigger and as soon as this happens then there is loosing effect which comes into the overall pictures. So as to remove that one Mota Singh devised the one liner and this is the shape of that liner. This is another diagram which shows the same thing from the other direction. This is one

design which is being specified and standardized on Indian railways and is known in the name of Mota Singh.

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Now another fastening which is used in the case of connectivity of the railway section the CI sleepers are cotters. Cotters are used to fix the tie bars with the CI sleepers and there are different type of cotters; we have the central split cotters, we have the side split cotter, central split cotters is being placed at the central location and whereas the side split is being cut at the side so as to insert into the tie bar or fix with the CI sleeper and there is another type of cotter which is solid end split cotter and then there is bent plate cotter. Then there is tie bars that is mild steel tie bar which is used to connect the two sleepers which are provided below the 2 rail sections used in the same gauge. This holds the 2 plates of CST 9 sleeper together and its dimensions are length 2720 mm and section is 50 mm by 13 mm.

Now we come to the elastic fastenings so far whatever fastenings we have seen they are termed as a conventional fastenings and these conventional fastenings are used in general with the wooden sleepers with the as we have seen with the metal sleepers but elastic fastenings are the fastenings which can be used not only with all these wooden sleepers or the metal sleepers but they are also used with the concrete sleepers. In these elastic fastenings there are certain requirements we will look at those requirements now. The very first thing is we should have adequate toe load. The toe load is the position where it is transferring the load from the top to the bottom surface. So if it is not having the capacity to take up the load then it is going to break down or will crack. So in that case it will not be fulfilling the function for which they have been provided. Therefore, all these elastic fastenings most of the time they are divided and designed designated with certain toe load. Then this should have sufficient elasticity to absorb shocks and vibrations as from the word itself we understand that these are elastic fastenings means they have the tendency that they should be able to absorb shocks and vibrations and still they should come back to the normal orientation in which they have been provided.

They should hold the gauge and they should maintain the track that is the another thing with respect to the fastenings, not only with respect to these fastenings whatever fastenings need to be used obviously this is one requirement which should be fulfilled that those fastenings should hold the gauge as well as maintain the track. They should resist lateral forces whatever lateral forces are coming because there are different type of force as we have seen when we discuss resistances and we discuss the stresses in that sense these elastic fastenings should be able to take up all the type of forces and space with the lateral forces. They should be fit and forget type means the maintenance requirements should be as less as possible. Once we have fitted then we should be able to forget that we have fitted something. They should be reusable, they should be cheap and should have long life. Then the another thing is that they should be universal type and sabotage free that means the person should not be able to take it out as and when they feel it to doing so especially in the case of those tracks which are passing through the remote area or where there is no safety provision is being taken up, cannot be taken up so they should get fit into the overall system in such a way that is it is not easy to take them out for anybody who is not as skilled label is not having the device to take it out in that form for maintenance purposes.

Now we start with the different types of elastic fastenings. The first type of elastic fastenings which we are discussing is the pandrol or the elastic clip which is having different number and here we are discussing the PR 401 clip, this is pandrol 401 clip. This clip is fit and forget type which is one of the requirements of elastic fastenings. Once we have fitted and then for a long period of time there is no requirement of doing anything to this type of pandrol clip. The toe load is being designated as 710 kg and at this toe load it has the normal deflection of 11.4 mm so whatever load is coming from the top on these fastenings obviously some deflection may take place because of the loading and this is what is the value is being defining for the amount of load which can take up. They are universal in nature means they can be used at any locations with any type of connectivity so that is why they are universal.

They use two more fixtures along with it one is the base plate and another is CI inserts. The base plate we have already discussed the base plate is the similar type of plate as we have discussed regarding the bearing plate. The only difference in this case is that it is rectangular plate with uniform thickness is being provided or at time this is provided with the groups, we will be looking at this type of fixtures further. Similarly the CI inserts the cast irons inserts are there which are used as to connect these clips to the sleepers at the bottom. So through base plates using CI inserts this will be fitted in. In these cases because of this higher value of toe load and the deflections if it is there and the inserts everything what is happens is that the lateral stages if there is any problem or there is requirement of maintaining a gauge or adjusting it then it becomes little difficult. First of all we have to take out the clip and then only that the gauge adjustment can be done easily. The point contact causes indentation to the rail foot, this is another problem or you can see a sort of this advantage in the case of pandrol clip. Here because of the shape of the pandrol clip it happens to be touching the rail section at one or two locations

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Fastenings – Elastic: Types

- **Pandrol / Elastic clip (PR 401 clip)**
 - **Fit and forget type**
 - **Toe load 710 kg for nominal deflection of 11.4 mm**
 - **Universal**
 - **Use base plate and CI inserts**
 - **Gauge adjustment difficult**
 - **Point contact causes indentation on rail foot**

and wherever it is touching the rail sections at the rail foot the load is going to be transferred to the that point only due to this reason there are all changes of getting the rail section indented at this location. So this is one problem associated with this one and at times this point where the indentation had happened may become the point of bearing of the surface and another problem associated with the pandrol clips is they are theft prone, people can them out very easily because only the CI inserts have to be taken out and as soon as the inserts have been taken out then we can easily take out the pandrol clips.

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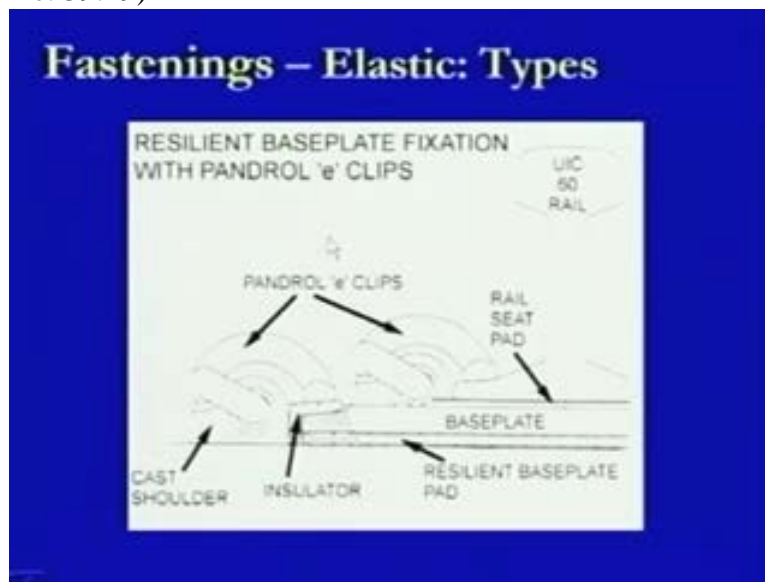
Fastenings – Elastic: Types



This is one photograph where the pandrol clip has been shown and this is another one where we can easily see that the shape of the thing which is provided at the bottom through which the clip is moving is like this and there is plate is being provided here and

this section is coming and putting the toe load of 700 something kilograms at this position. So this is because of this shape it is in a position to put up this much pressure at this location and that is how it tries to maintain this rail section into position. Here you can see another diagram, another this photograph where the clearly this rail section is being shown. Here there is sleeper being provided and through this sleeper we have use this clip. So this is the location at which this is putting the pressure and the pressure is so heavy that this rail section cannot move from its location. So this pressure is to be created while fixing these pandrol clips in this location. This pandrol clip at this location is going inside this section like this way, this is going inside here in this form and if you take out this one then everything is out. So therefore that is why it is theft prone condition in the pandrol clips.

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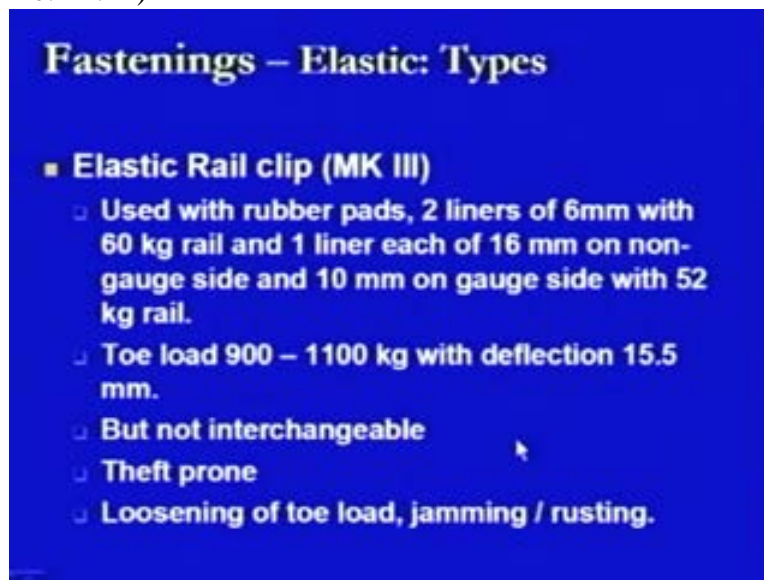
In this one what we have seen is this is the connectivity of the rail section where the base plate is also being used. Now when we are using base plate then we can see that 2 pandrol clips which have been used here; one pandrol clips is trying to fix the rail section on the base plate and that is why this is how it is being provided here and this is one pandrol clip and if the load is being transferred at this location that is how it remains in fixed condition and then at this location there is an insulator which is being used at this location and then load is being transferred at this one and this is the connectivity which is provided at the sleeper which is located at the bottom most here so this connectivity here. If you take of this connectivity here this the only thing which is connecting the clip with the sleeper and the base plate or the rail section.

There is another clip which is IRN 202 clip. This IRN 202 clip is devised by the Indian railways and there are different types of the clips. This clip has been given as IRN 202 clip which is mostly used for 2 block RCC sleepers and in this case we can see the toe load has been increased it has been made 1000 kg instead of 700 some kg for the pandrol clip and here the deflection was of the category of around 11 mm, here the deflection is 18.5 mm and these loading condition the higher deflection is being permitted in this case.

The creep resistance is 50 percent of the toe load. So heavy resistance is being offered this case to the creep and this is around 5500 kg. So as to connect this IRN clip 202 we require bolts and clamps and using these bolts and clamp then it can be kept in place. The removal of rail easy in this condition whereas in the case of the pandrol clip condition it is not that easy but the problem in this one is that they are not fit and forget type whereas the pandrol clip were fit and forget type. So there are some positive and some negative aspects associated here when we use IRN clips or when we use pandrol clip and they are costly because of the total section of the IRN clip.

The section of the IRN clip is such that it is almost twice of the section of the pandrol clip. So instead of one point where it is touching, the pandrol clip is touching, the IRN clip tries to touch at 2 locations and that is why which is heavier and there is also a problem of corrosion in the case of IRN 202 clips. Then there is another clip which is elastic rail clip MK 3. This is used where the rubber pads, these rubber pads are used as 2 liner of 6 mm thickness with 60 kg rail section and one liner each of 16 mm thickness on non gauge side and 10 mm thickness on gauge side with 52 kg rail section.

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Fastenings – Elastic: Types

- **Elastic Rail clip (MK III)**
 - Used with rubber pads, 2 liners of 6mm with 60 kg rail and 1 liner each of 16 mm on non-gauge side and 10 mm on gauge side with 52 kg rail.
 - Toe load 900 – 1100 kg with deflection 15.5 mm.
 - But not interchangeable
 - Theft prone
 - Loosening of toe load, jamming / rusting.

So what we see is the that depending on the type of the rail section we are using we have different types of the liners or the number of liners may also change in those cases and in this case the toe load is comparable to the toe load of the IRN 20 clip where it was 1000. Here it varies between 900 to 1100 kg but at this level also the deflection is permitted as lower than the IRN 202 clip, it is 15.5 mm. These are not interchangeable and they are also theft prone and the loosening of toe load is here and loosening of the toe load they are times they are also get jammed out or rusting may also take place in these cases. This is another diagram; here we can see the different types of the clips which are being used. Here it is coming in this way then it also puts a pressure on 2 locations. Here it is putting a pressure here as well as here at these 2 locations and this is foot of the rail section and here we are using the insulator at this one and this rail section is also using a rail pad, this is rail is being shown at this level. So this is one type of clip which is used. This is

another design where what we can say is this can be termed as almost twice of the other size and this is the type of the clip which is designed, this is IRN 202 clip something like this clip only.

Then we have HM fastenings, HM fastenings is one type of fastenings which can be changed from one location to the other location and that is why the name of interchangeable fastenings has been given to this. This interchangeable fastening is having clip weight of 510 grams, the toe load is 1 ton or 1000 kg, it provides the dampening effect and resistance to the lateral movement. This is another thing in this one, so it helps out in the dampening the vibrations which are coming because of the movement of the rolling stock at the top of the rail section at the same time it also tries the movement of those sleepers of the rail sections in the lateral direction so they remain in its position. They are used with the grooved rubber pads, insulators plastic dowels and angled guide plates.

So these are the other necessary which needs to be used when the interchangeable fastenings are used on the rail sections but they maintain gauge. In this diagram what we see is this HM fastening, this HM fastenings is being shown like this. Though in this diagram because this is not a complete sort of diagram where we can easily shown to the curvatures of these fastenings which are coming. This is one point from where it is starting and this goes in this form and there is another point here like this it comes back by turning and comes at this location so this is the point where the foot of the rail section is starts and then we have the inserts, we can see the inserts easily here. This is insert provided here this is another insert is being provided here then there is plate being provided at this location and there is liner provided here so this is the dash condition they have the liner with the grooving is being used at this location.

This is another diagram where the similar conditions have been shown and here the base plate is flat in nature instead of this way and then this is again the clip with the insert being provided here. Then there is another type of clip which is termed as fast clip FD. This is one of the simplified systems for railway operating low or medium density operations. So far what clips we have seen they are mostly in use one the medium density to a higher density route section whereas in those cases the traffic is very less we can go for smaller version or simpler versions and one of that is fast clip or they are used for rail section of 50 kg or below and generally for speeds which are lesser than 120 kilometers per hour. We can see in this diagram this is one of the simple designs of the fast clip. This goes in this form like this so here there is connectivity through which it is going. This is point at which it is trying to put the pressure and that is why the toe load is getting transferred. This is another connectivity fixture which is to be used to fix in this place along with fixture which is used at this location like this.

Then the malleable CI inserts these are fixed directly to the concrete sleepers during manufacturing and they are of 2 types; one is the stem type and another is gate type. In the case of stem type this is for normal pretension concrete sleepers whereas the gate type is used for post tension concrete sleepers. In the case of this stem type it is 1.6 kg per piece whereas in the case of gate type the weight is 1.7 kg per piece. That is the

difference between the 2 types of the inserts available to us as we see that they are used for different type of the concrete sleepers. Pre tension means in this case the tension is being provided before the casting of the sleepers and once the sleeper has been casted then it is released and because of that releasing the stress comes and this concrete becomes the more compacted mass as well as the higher resistance. Whereas the post tension concrete sleeper is the condition where the tension in the strength through which the tension is provided is done in the later stage. This is the photograph of CI malleable inserts and through this one it is inserted in this hole provides the connectivity.

Then we have rubber pads. These rubber pads are provided at the bottom of the rail seats so as to absorb the shocks or so as to damp or absorb the vibrations which have been induced because of the movement of the rolling stock at higher speed at the top because of different other reasons as we have seen may be like surface regularity or may be at the locations where the joints have been provided. They also resist the lateral movement of the rail because of its tendency they will not allow the movement. They prevent abrasion of the bottom surface of the rail this is another important thing because of the rubbing action between the 2 types of the surfaces there are all chances that the abrasion may take place. So as soon as we have provided the rubber pads this chance of abrasion that is the removal of the surface material will not be there. Then they also work as electric insulations.

This is one diagram where we can see the rubber pads and this is another diagram where we can see how they are getting fixed in locations. So here this is at this location the pandrol is to be provided at this location similarly likewise and these are the grooves which are provided here. We can see the grooves are like this so this is the shape in which it is being provided so grooves are in this form so this is the rubber pad.

Then there are composite liners. These composite liners are provided with malleable CI or nylon components or with MS and nylon components. These are provided again so as to the same reason that is we have to absorb the vibration or the shocks which are coming. They are used along with base plates as well as these rubber pads which are taken up.

Then there are different types of liners which are available. Then another type of liners which is available glass filled nylon liner. In the case of this glass filled nylon liner these are used for track circuiting areas where the sections are subjected to severe corrosion because if we are using these malleable type of liners then they have the tendency to get corroded whereas these glass filled nylon liners are being used then they are not going to corroded here and that is why they are little more superior as compared to the normal type of liners which are used. Then they are single piece and as their corrosion free so they have higher life, this is another obvious reason. Then the final one is the GFC 66 liner. This GFC 66 liner this is rust free surface of rail with 1 in 6 slope of rail flange it is being provided. These are 6 mm in thickness and these are used with ERC clip these are elastic clips and they may damage to rusting or there is uneven seating or they may also get damage in the yards. These are again the glass filled composite liner; they are termed as 66 number liner.

So what we have seen is that there are different type of fastenings which we can use, we have already seen is that there are fastenings which are termed as a conventional fastenings or the fastenings which can be termed as a elastic fastenings depending on their nomenclature. Now within the conventional fastenings the fastenings are available so as to connect the rail sections with the wooden sleepers; the rail sections to the rail section, the rail section to the metallic sleeper like the steel track sleepers or the CI sleepers. In the case of elastic fastenings already we have seen there are certain requirements and the main thing which comes that when they are used to connect the rail sections with the sleepers the toe load and the deflection is the main design criteria for those type of fastenings. Another thing is that they are more universal in nature therefore they can be used at any locations whereas some of the conventional fastenings are such which can be used only one type of rail section or with some specific type of a sleeper. So that type of restriction is not there in the case of elastic fastenings. So with this one we stop in this lecture and I say good bye to you. Thank you.