17

ROAD WORK

17.1 INTRODUCTION

In order to connect one place to another, the entire width of the land is made pucca or solid. This is called road. The management of its construction is called road work. It is classified according to the density and design of the traffic, such as National highways, state highways, district roads, village roads, etc.

17.2 OBJECTIVES

After going through this lesson you will be able to:

- describe various types of roads;
- explain the process of preparing premix in the bitumen roads;
- describe the special precautions to be taken while constructing the roads made of cement concrete.

17.3 WIDTH OF ROADS

Engineers generally decide the thickness of various layers and materials used for the roads, after deep studies. Its classification such as national/state roads etc should also be in accordance with the standards as set by the organization which are installed by central government.

17.4 FORMATION LEVEL OF THE ROADS

Before making Pucca roads, roads are made in level throughout its width and

reached upto that level on which the pucca road is to be built. This level is called formation level. The processes upto to this level of work are the same as already described in the lesson named as Earthwork Cutting and Filling (Chapter 5).

The time taken for building the upper layer should be minimum one year and the land is prepared before hand so that the layer becomes hard completely. This is the case if machines are not used for filling the soil and specified compaction tests are not performed.

Main parts of the roads

1. **Sub Base:** After the formation level of the road the first layer is called sub base. Its main objective is to protect the sub grade from the possibilities of getting damaged during construction work. Its materials is slightly of different quality than the base material.
2. **Base:** It transfers the traffic load uniformly on the soil. It is made through the process of making the soil strong. This soil may be stone dust or soil made by other processes.
3. **Upper layer:** This is called surfacing, which is made by bitumen concrete or stone chips which are compacted by water. This gets eroded or broken while the traffic moves and it can be easily repaired without removing the lower layers.

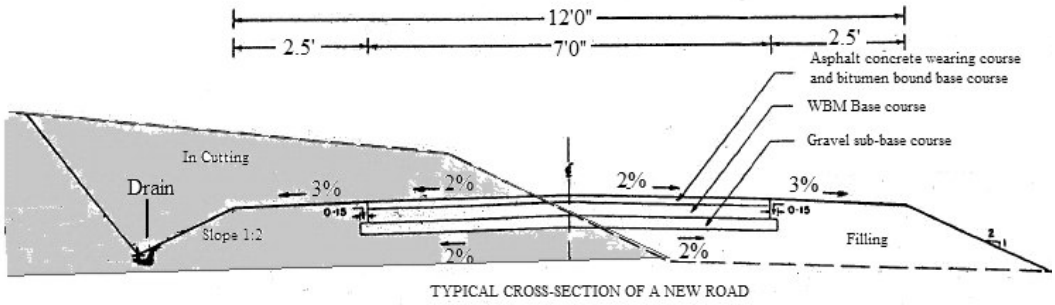

Fig. 17.1: A typical cross section of the road

17.5 PREPARATION FOR SUB GRADE

In order to make the surface, embankment is leveled up to the specified level which is equal to the width of the soling. This level has been finalized for the formation level of the road and it is equal to the total depth of sub base (if it

exists), soling and wearing coat. All the foreign particles must be removed from this. The weak points should be repaired which arise due to unorganized water outlet, traffic or any other reasons.

Compaction: Compaction of subgrade should be done by the road roller. Water should be sprayed uniformly on the subgrade one day before the rolling. During the rolling, if any part goes down, then it is filled with soil and roller is moved again over that place. According to the instructions given by the engineer, all the soft, unwanted and extra soil should be removed and the place is repaired after removal.

If the CBR (California Bearing Ratio) value of soil below the sub grade is less than 11.0 tonne per square metre, then at that place, deep, uneven material should be made available for the sub base. For this *Murram, Bajri, Shingal* and other materials are used. The thickness of subbase should be according to the Engineer's orders. In any case it should not be less than 15 cm. Sub base should be prepared on the entire width. The width of sub base should be 60 cm more than the width of the subgrade.

When the subgrade is made of black cotton soil due to capillary rise of water extra precautions are required to be taken. In that case thin sub base should be made below the base, out of *Murram* or coarse sand. This sub base will be of stone or boulder soling and roller should be moved over this after spraying water.

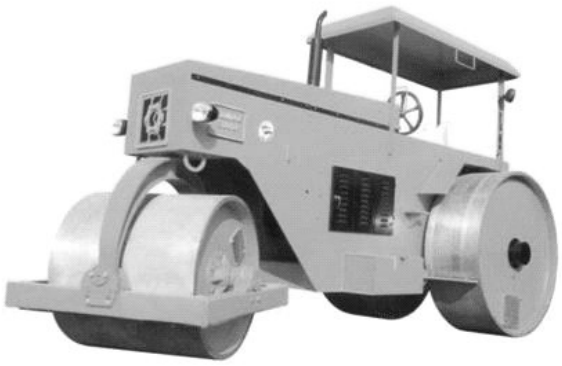

Fig. 17.2: Road Roller

Normally soling coat is always laid but only those places are left where the road is on the hard soil surface or big stones.

Soling should be made of those boulder or stones which are fitted on the road sides. Grading stone, Ballast, hard stone, hard laterite stone, first class bricks

(pucca bricks), over burned bricks (jhama bricks) or any other such type of material is also used to make the soling according to the instruction given by the Engineer.

Width of Soling coat: If the Engineer has not given any orders then it should be 30 cm i.e. 15 cm on each sides more than the wearing coat.

Material: The materials which are used for water bound macadam roads are road stone, screening, binding material such as *Murram* or soil and sand for finishing.

Screening: These are the smallest stones (6-12 mm) and these are pieces of wearing stone. The main job of these stone is to fill the gaps completely. Its quantity varies from 9.5 m cube to 13.5 m cube per 1000 square metre.

Boulder: In any measurement these are not less than 15 cm and not more than 22.5 cm. The bigger size than this specified size is rejected. This is a common rule made for the labourers and contractors.

Stone Ballast: This will be same as wearing coat and if convenient, it may be of bigger size.

Compaction of layer: Soaling stone is fitted on the sides and it is hand packed. It is kept over the subgrade. The widest part of the stone is set towards the lower side and pairs are matched, the inter spaces between the stone are filled with small stones so that empty spaces are fitted completely. This is done at the same time as keeping the soaling stone not before or later.

After packing, the surface is tested according to the approved design. Small or big empty spaces are again filled through packing. After this soaling is dry rolled starting from corner towards the centre. Rolling is continued till strong surface is reached i.e. the wheel impression stop appearing on the road after rolling. Surface is tested again by the template and its compaction is corrected by small stones or grids.

In case of boulders, soaling is repaired by hands and all the empty spaces are filled with small stones and packed tightly. After this dry rolling is done by the road roller on the soaling. The surface is made strong by putting shingal or Bajri

on the surface. Slope is made towards both sides starting from the middle. Empty spaces are never filled with soil.

If brick ballasts are used, then building layer like wearing coat and compaction work should be done.

Cushion: On the top of the soaling, 25 mm thick murram layer (or a layer of small stones or laterite stones) is built but those places are left where the soaling is made of laterite, stone or hard murram. In those places water is sprayed and for brick soaling, it is rolled lightly for laying the wearing coat and cushion surface is rolled with the hand roller.

17.6 TYPES OF ROADS

17.6.1 Water Bound Macadam Wearing Course

Normally the wearing surface itself takes the load of the wheels and then the load is transferred on the lower surfaces. Therefore this should be sufficiently strong so that it can bear the traffic load without getting damaged.

After rolling the thickness of wearing coat should be 11.5 cm. For the first time this thickness should be from 7.5 cm to 11.5 cm or according to the drawing details.

Camber

Camber is the slope which is given from the middle of the road towards both sides. This is done in the ratio of 1: 48 or as ordered by the Engineer.

The slope height gets bigger towards the middle from both ends of the roads across the entire width of the road. This is called camber. According to this the water falling on the roads flows away towards the sides (See fig. 17.3)

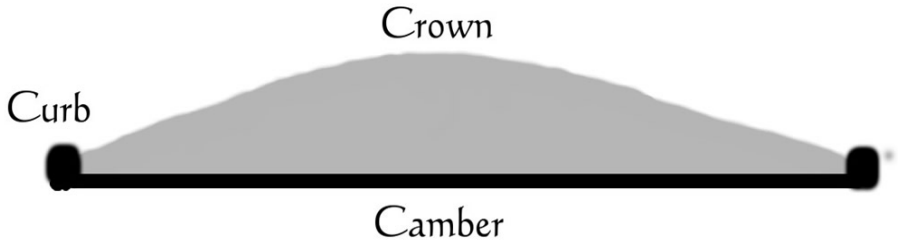

Fig. 17.3: Camber of the road

If the old water bound macadam road is to be converted into metalled road, then first the road surface is completely cleaned with wire brushes and then two walls of soil are made on both sides of the road which are 15 cm high (no extra payment is made for this). In between these two walls, metal (rodi) filled in baskets are sprayed by moving in circles. Two wooden dyes are made to measure its thickness in which camber is also provided and metal is sprayed is the panels of 15 × 15 metres.

For compaction, first dry rolling is done in which the roller moves from two sides towards the centre. In order to see that the rolling is complete or not, it must be seen that on the solid surface, wheel impression or road roller impressions should not appear and if a 25 mm piece of Gitti is kept infront of the roller then it should be broken into powder. If it gets inserted into the road, then the rolling is not complete. Camber should also be checked side by side.

After spraying metal which is of size 50 to 75 mm, screening with size 6 to 12 mm is also sprayed over this. Spraying of screening and rolling by the roller should go side by side till the mixing of incrasing and metal stops.

Rolling with water: Roller is moved on the road after spraying water along with some binding material which may be soil or murram and it is put in 6 to 12 mm thickness. After the movement of roller for some time a slurry is prepared which fills the small spaces on the surface with the roller. After this extra slurry is removed. After drying, the surface is cleaned with broom. At the time of rolling, it is necessary that half of the width is rolled at a time and then the other half is taken. Thus water bound macadam road is prepared.

17.6.2 Application of one coat of bitumen on the surface of water bound macadam Road

Binder: Approved bitumen is called binder which binds. Generally two types of binders are used. People usually call all black binding material as coaltar but coaltar is obtained by factional distillation of the coal extracted from the mines where as asphalt is obtained by refining crude oil. Both are called Bitumin in local language.

Blindage: 12 mm stone grit which is spread on the road after painting by bitumen, is known as blindage. Before using, it is put in blocks on the roads sides after measuing through boxes.

Preparing the surface: If there are pits on the road (water bound) then they are cleaned and made into a square, then bitumen is spread, 40 mm ballast is filled and it is tampered by an iron rod to make the surface smooth. Payment for this is made separately.

The surface of water bound macadam road is first cleaned by iron brushes, then bitumen which is heated upto 170 cg temperature, is sprayed through pressurized sprinklers. After this ballasting is done i.e. 12 mm grit is filled in the basket and it is sprayed on the bitumen by throwing. Remember that ballasting should be done immediately after the hot bitumen spray. When ballasting is completed in a specific area, then it is pressed by power road roller. After 24 hours, the road prepared in this way is opened for traffic.

17.6.3 Premix Carpet with hot Bitumin

An approved quality of bitumen which means binder along with 10-12 mm grade of boulders is found in this. Grit or boulder blocks are put at some distance from the road where bitumen is mixed with it and brought on the road surface. All the processes which are told earlier will be used here, such as cleaning the surface of water bound macadam road, filling the bits by 25 mm size of boulders and making it into a leveled surface separately.

Tack coat: After cleaning the surface, Bitumin is put on the surface through sprinkler. It is put on the basis of 7.5 to 10 kg square metre on a new surface and 5 to 7.5 kg per 10 square metre on the prepared surface. This is called Tack coat. Premix carpet is put over this.

Preparing the mix: Grit is put into drum mixers after filling it in to wooden or iron boxes. After this bitumen is boiled upto the specified temperature. Then boiling bitumen is put in the mixer drum and the mix is prepared. Remember that no pieces of stone chips should remain lose without bitumen. Mix so prepared is brought to the working surface through small hand driven carts and sprayed on it. It is put on the surface upto a thickness which is more than the carpet, so that after the movement of the roller, the required thickness of carpet can be obtained. These days, this job is done by Paver machines, in which even if the thickness of carpet varies at various places, the upper layer is absolutely plain.

Fig. 17.4: Paver machine

Consolidation: Consolidation is the process of pressing the spread boulders with roller. When Bitumin grit is spread on a good amount of area for premix carpeting, then compacting is done by rolling through the roller of 6 to 8 tonne weight. During the movement of the roller, its wheels are kept wet through wet sacks otherwise hot boulders stick to the wheels again and again.

Opening the road for traffic: 24 hours after the completion of rolling the road is opened for traffic.

17.6.6 Spreading Premix carpet on the road with cold bitumen

For this the coaltar which is used does not require any heating. All the processes in this case are same as were done in the case of hot bitumen mixing, and almost all the works are also same. The road is opened for traffic after 48 hours in this process.

Seal coat: The surface of premix carpet is cleaned is such a way that there should not remain any dampness or soil on it and no stone chips should come out of its surface. After this tack coat is put by hot bitumen through sprinkler. Above this just like premix, only bitumen and coarse sand or jeera rodi mix is spread as a layer of 6 mm thick and it is then rolled, so that the surface becomes smooth and water can not pass upto the lower layers. In this case the clearing and roller movement is done just like the earlier case. Seal coat is done with cold bitumen also, but the time gap in this case for opening the road for traffic must be minimum 48 hours.

17.7 BUILDING THE ROAD FROM CEMENT CONCRETE

The road which is constructed by laying cement concrete slabs is called cement concrete road. Up to 7.5 cm, it is called thin slab and above this it is called thick slab. These are layed by preparing a sub grade below this.

Materials: in the concrete road, cement, water, coarse aggregate i.e. coarse sand and stone chips are used in the same way as was explained in the concrete lesson.

Sub grade: A soaling or foundation is laid which should be of minimum 15 cm or as per the specified thickness. First the above sub grade is compacted by the road roller and then only the concrete slabs are laid down. Sub grade is completely made wet through water before 36 hours so that when putting the concrete, subgrade should not absorb its water. For constructing concrete rod, first iron channels are put on both sides of the road in the length and then concrete is poured. If the concrete slab is more than 10 mm thickness, then it is put in two layers. In order to press the concrete spread on the raod (for compacting) wooden rods are used which are 5 metre long and 20 cm thick. Similarly for testing the road camber, a wooden template is built.

Steel dyes should not be removed before 24 hours specially the side ones.

Mix: Unless it is strictly specified, the ratio for cement mix would be 1: 2: 4 by volume and not by weight, but cement is put measuring by sacks not by the peti or box.

Laying of concrete: As told earlier, concrete is laid in the iron dyes and in one day alternate dyes are kept empty, then after 5 days these empty dyes are filled with concrete.

Expansion joints are constructed at every 15 metre distance on the concrete roads. These are plain but joints made of 10 mm thick bitumen strips.

Curing: Big strips of jute or hasian cloth are stitched at both ends with bamboo and kept for 2 hours on the surface after making them wet. After this the wet clothes are spread on the surface. The surface is not allowed to get dry in any situation. Next day wet clothes are removed and soil bed are made on the road

with 15 cm thick soil which are of the size 15 m × 15 m and water is filled in these for 28 days. After this the soil is removed and the road is opened for traffic. Expansion joints are filled with tarfelt or as told by the Engineer, and on both sides of the road an edging is put which is about 2 feet wide. The purpose of this is to save the road edges from breaking. Stone strips are used in those places where they are available and they are replaced for bricks.

17.8 WHAT HAVE YOU LEARNT

- How many types of road are there?
- How classification of roads is done?
- How is a water bound Macadam Rod constructed?
- What is the process of doing premix carpet?
- What is the complete process of making cement concrete roads?

17.9 TERMINAL QUESTIONS

1. Explain the process of camber in the construction of water bound macadam roads.
2. What is difference between premix carpet and the work done manually?
3. Why are the dies used for making cement concrete roads?
4. Explain the complete process of putting tack coat. Also tell where they are used?