

Technical Note
On
Rock Cutting and Tunnels on Khandala
- Karjat Railway Line

सिपक्कु माता मदी रसा नः



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INTRODUCTION

The 25 Km long Khandala - Karjat Rail line in Maharashtra, India is part of 77 Km. long Bombay - Pune broad gauge railway line. It is a ghat section on 1 in 37 ruling gradient. The total length of the railway line is perched on the most difficult terrain consisting of three lines, i.e., down road, middle road and up road. There are as many as 52 tunnels along the route covering a total track length of 16.853 kms inside the tunnels. About 22 percent track is inside the tunnels and about 68.50 percent track is on curves and mostly about 83 percent on steep gradient of 1 in 50 and above. This speaks of how much difficult the Railway Track operation is in Khandala - Karjat section.

INSPECTION OF TUNNELS

The tunnels are inspected in details once in a year after monsoon and before monsoon. The detailed inspection of a tunnel includes examination of :

A. *Portal at either end*

This inspection is done to ascertain whether there are any sign of slips in the slopes above the portals; whether the masonry is in any way cracked, shaken or bulging and signs of movement are apparent. Catch water drains above the portals are drained away and not allowed to percolate into the tunnel or behind the portal masonry.

B. Section of tunnel in relation to moving dimensions.

It is ascertained that dimensions of the tunnel section or straight and curved portions conform to the diagrams given in the schedule of dimensions.

C. Tunnel wall, lining and roofing

(a) Lined section

To ascertain whether the lining is in satisfactory condition, seepage through joints in the masonry is looked for. If there is any hydraulic pressure, indicated by persistent seepage, it is relieved by providing suitable weep holes which are cleaned periodically. Doubtful masonry is tapped to detect "dummy" places. Cracks in the masonry are marked by red paint and, telltales placed at their extremities and serially numbered to detect extension. Pointing of the masonry should be examined for its condition.

(b) Unlined Section

In order to ascertain the soundness of the unlined portion, doubtful places such as loose projections are tapped and hollow sounding portions or loose rocks are removed.

D. Drainage

Side drains are periodically cleaned in order to ascertain whether they are adequate and are functioning properly.

E. Refuges

Their inspection is necessary to ascertain whether these are well maintained and free from vegetation and other growth.

F. Ventilation shafts

These are required to ascertain whether these are adequately maintained and free from vegetation and other growth.

G. Lighting equipment and special tools

It is necessary to ascertain whether lighting equipment and special tools are in a state of good repair.

H. Track

It should be ascertained, if the track is in good line and level, including the approaches. Fastenings should be particularly examined for

corrosion. Level pillars and reference marks indicating the correct level and alignment shall be checked periodically. Renewal should be carried out as and when required on high priority.

It is essential that engineer-in-charge inspects all the tunnels once a year before the monsoon. He must record the results in the tunnel inspection register. This register should have (i) tunnel number (ii) length (iii) brief particular of soil met with (iv) details of portals (v) details of lining (vi) ventilation (vii) lighting (viii) drainage (ix) minimum height above rail level along two centre line of track and (x) minimum distance from centre line of track. This register must have previous history. The engineer-in-charge will write date of inspection, condition of tunnel at the time of inspection and, action taken on the previous remarks.

TRACK MAINTENANCE AND RENEWAL IN TUNNELS

Some tunnels have lights while some are without light. All tunnels are mostly on curves having maximum angle 5°. The length of the largest tunnel is 2.5 km. There is no space for taking out the old sleepers and inserting the new sleepers. Due to poor visibility, gangmen are always at alert and disturbed. Protection man with hand flags and HS lamps with detonators and whistles are kept at either side at a distance of 600 m and 1200 m from work site.

TRACK RENEWAL

Track renewal work is very difficult inside the tunnel. Deep screening of ballast is done by sieving the ballast on the screens. Screens are placed on trolley refuges and man refuge, as there is no place near track for doing this work. New sleeper insertion is also difficult as width of tunnel creates a restraint. Old sleepers are taken out of tunnel. Thus, the overall progress of track renewal work is very slow. Old 90 lb rail and steel trough sleeper are being replaced by 60 kg/52 kg rail with monoblock concrete sleepers.

MONSOON PRECAUTIONS

Although throughout the year hill gangs and tunnel gangs carry out inspection of loose boulders, loose earth/rock etc. dropping the same during traffic and power block, the following actions are taken by these gangs specially before monsoon.

(a) Rock Cutting

Figure 1 and 2 show rock cutting section of Khandala - Karjat Ghat on one side hill and other side valley and, on both side hills respectively.

It can be seen that Khandala - Karjat section is mostly in cutting. Cuttings are as deep as 30 meter. Rock slope is mostly 1:8 and at some places vertical also. During February and March months hill gangs (about 25 workers) do survey of loose boulders on rock slope. These workman carry with them all the necessary equipment for hauging themselves, hammer, paint etc. They put a mark at the location of loose boulder as well as at the bottom of slope near track so that boulder removing gang can recognise the place. During April and May months massive traffic and power block of two hours to three hours duration are arranged. A special train with three to four empty wagons with tool van having compressor, pavement breaker etc. is taken in the section. An explosive magazine has also been built at a safe distance. Boulders/rock mass is detonated and removed during two or three hours power block only. Before the on set of monsoon complete dropping and removing of loose rock mass and boulders is done.

(b) Tunnels

Tunnel gangs attend all tunnels after inspection of P-way inspector. This inspection is done after monsoon. From October to March this gang does the compliance of items of inspection note. Any major work of repair to concrete of portals or lining of tunnels as one tunnel is lined in some portion, other tunnels are unlined, is executed by inspector of works. The engineer-in-charge inspects tunnels in the months of February and his inspection items are also complied by tunnel gang before the on set of monsoon.

WATCH AND WARD

Even after thorough attention to tunnels and rock cutting, the chances of sinkage of track, dropping of boulders, landside, breaching of bridge approaches can not be ruled out. So, at most vulnerable location permanent huts with posting of round the clock Ghat watchman are manned. These locations are mostly near tunnels. During monsoon, vulnerable location are increased as slippage of earth mass or sinkage of track on bridge approaches is much prone during this period. Round the clock the huts are manned with Ghat watchmen. These watchmen are provided with safety equipments like whistle, detonators, red and green hand flags, hand signal lamps, a note book etc.

A system for ensuring that Ghat watchman is at site without fail, has been made. As per this system Ghat watchman before coming to site will get his note book initialed by the nearby assistant station master. While going back from duty he will get initialed by assistant station master of nearby station.

MONSOON PATROLLING

Figures 3 and 4 show the monsoon patrolman movement on single line and double line. All block section, i.e., station to station are covered under monsoon patrolling. Before entry of mail or express train, the full length is to be checked by monsoon patrolman. These patrolman also possess all safety equipments so that during emergency, protection of track and stopping of train can be done. The monsoon patrolman also initial on the note book of Ghat watchman to ensure that he is at alert. Monsoon patrolman also gets his note book initialed during "ON" and "OFF" duty as per prescribed timing. Thus, during monsoon complete Ghat section is kept under watch by monsoon patrolman. But this patrolling is done only during night. Ghat watchmen guard vulnerable locations during day and night.

The engineer-in-charge and P-Way inspector frequently inspect the track by push trolley during day and night for checking the bridges, tunnels, cuttings, banks, viaducts, station building etc. and they also check general awareness and alertness of monsoon patrolman and Ghat watchman on duty.

A booklet on monsoon precautions is prepared having following details:

1. Details of vulnerable locations with chainage, detail of cause i.e. boulder or land slide or subsidence of bank etc.
2. Details of railway affecting tanks and railway affecting works near the railway line. These tanks and works are jointly inspected by railway officers and irrigation engineers.
3. Monsoon patrolling charts, name of patrolman with their beat.
4. Details of boulders, special trains, date and period of traffic and power block and number of boulders dropped.
5. Tool and equipment van, arrangement of explosives, and compressor etc.
6. Wagons loaded with muck and boulders with their number, siding etc. stationed at Lonavala railway station.

PROBLEMS IN REGULAR MAINTENANCE OF TUNNELS

Gangmen who attend railway track inside the tunnels face a number of problems such as :

1. The working time is less because when protection men whistles the gangmen have to go to nearby man refuge.
2. The removal of existing sleeper is difficult due to less working space. Poor light also causes problem.
3. Due to poor lighting, gangman cannot measure track parameters properly before and after attending the track. Similarly items like squaring of sleepers, aligning of track, checking fittings and packing of sleepers is also problematic. Due to poor light quality of all these operations, maintenance of track is poor so track requires frequent attention. Track being on a steep gradient of 1 in 37, creep of track is severe so pulling back of rails is to be done frequently. Scabbing and wheel worn on rails are too much due to accelerating the halted train on steep grade. In Ghat sections the speed of train is of the order of 55 kms per hour and so movement of material train is also a bottle-neck.

PROBLEMS IN MAINTENANCE OF ROCK CUTTINGS

Khandala - Karjat broad gauge rail line is on Bhor Ghat of Sayhadri range. Terrain is very difficult. Track passes through deep rock cuttings on longer patches on valleys a number of viaducts are to be maintained. Hill gang surveys all two cutting extensively for loose boulders and loose masses. Trees creating problems are cut. After identification of loose boulders/ loose mass these are dropped and removed under traffic and power blocks. But as the Ghat section is a bottle-neck for movement of traffic, the availability of required traffic and power block is difficult. Since hilly terrain is not connected by roads, movement of hill gang man from their huts to site is also difficult. They have to move on foot about 15 to 20 km every day. So, difficult approach of hilly section also creates problems to hill gang.

CENTRAL RAILWAY

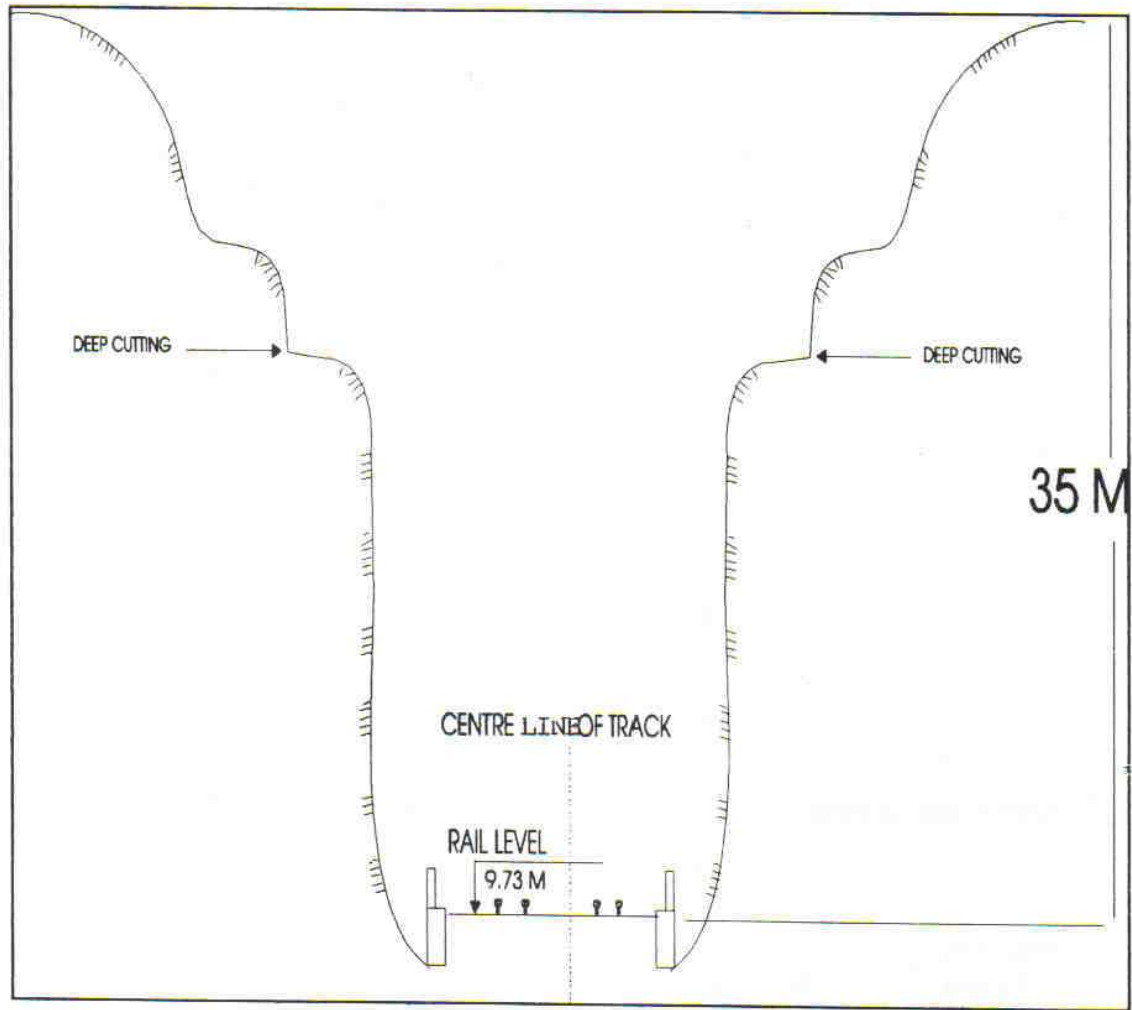


Fig. 1 TYPICAL CROSS SECTION OF DEEP CUTTING IN
KHANDALA - KARJAT SECTION
(Cutting on both side)

CENTRAL RAILWAY

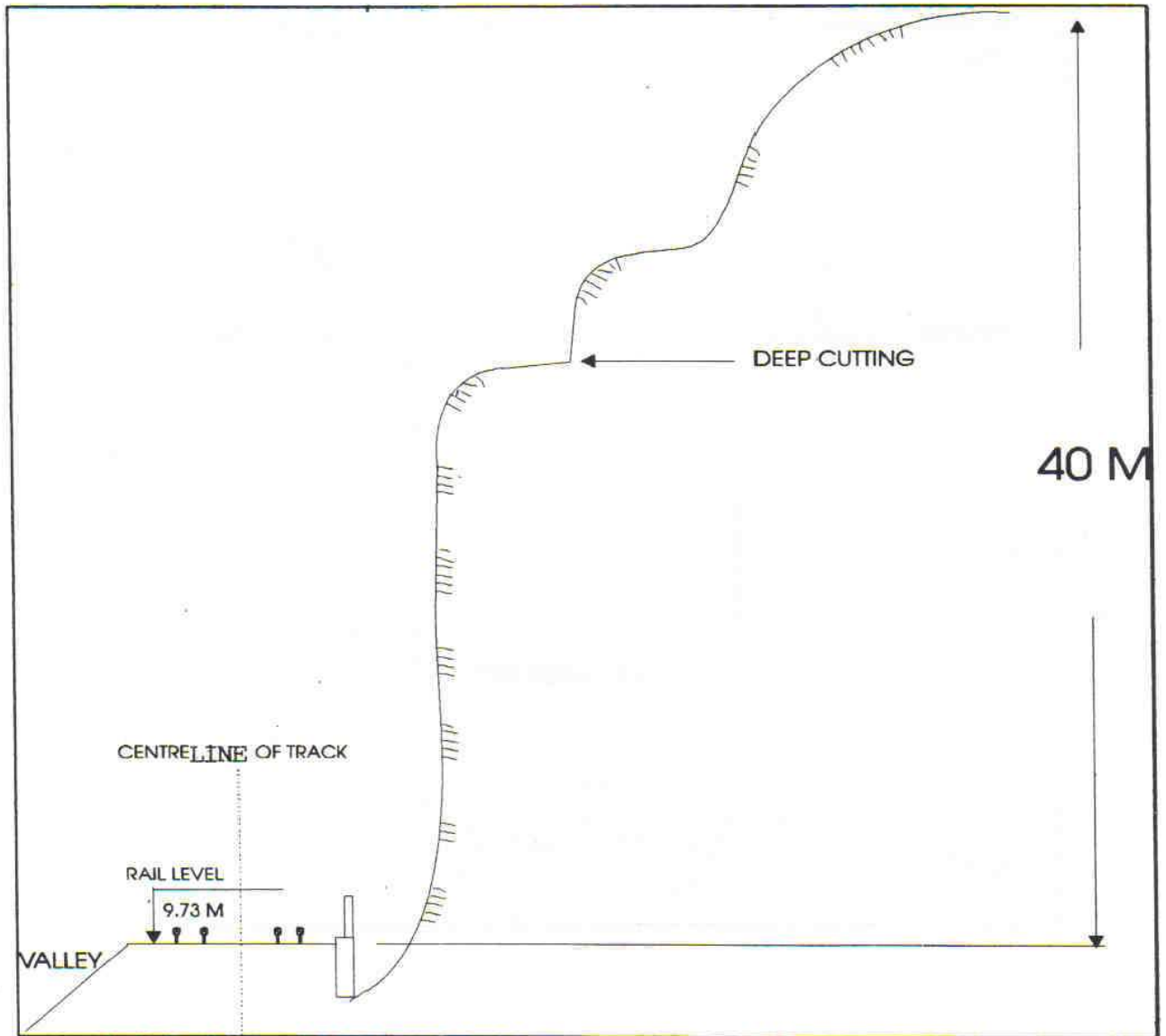
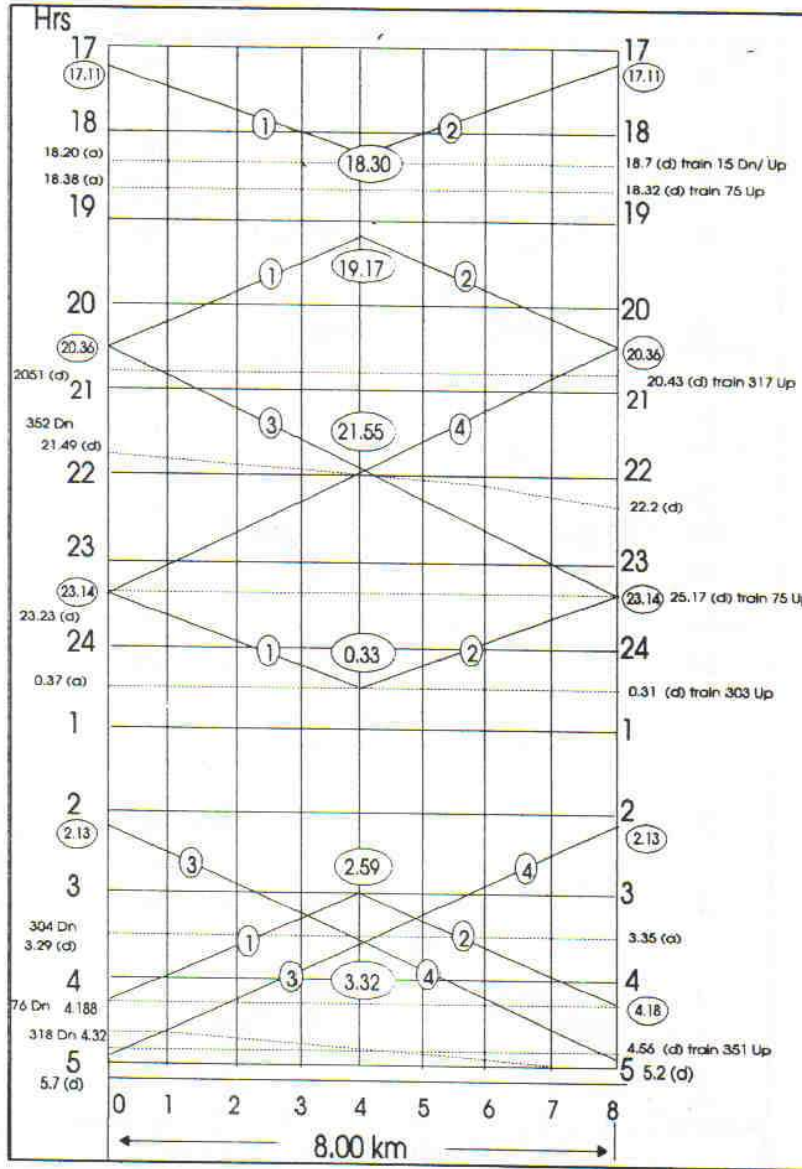


Fig.2 TYPICAL CROSS SECTION OF DEEP CUTTING KHANDALA - KARJAT SECTION (Cutting one side and Valley on other side)



A TYPICAL MONSOON PETROL CHART FOR DOUBLE LINE BETWEEN KHANDALA - KARJAT SECTION (C.R.)

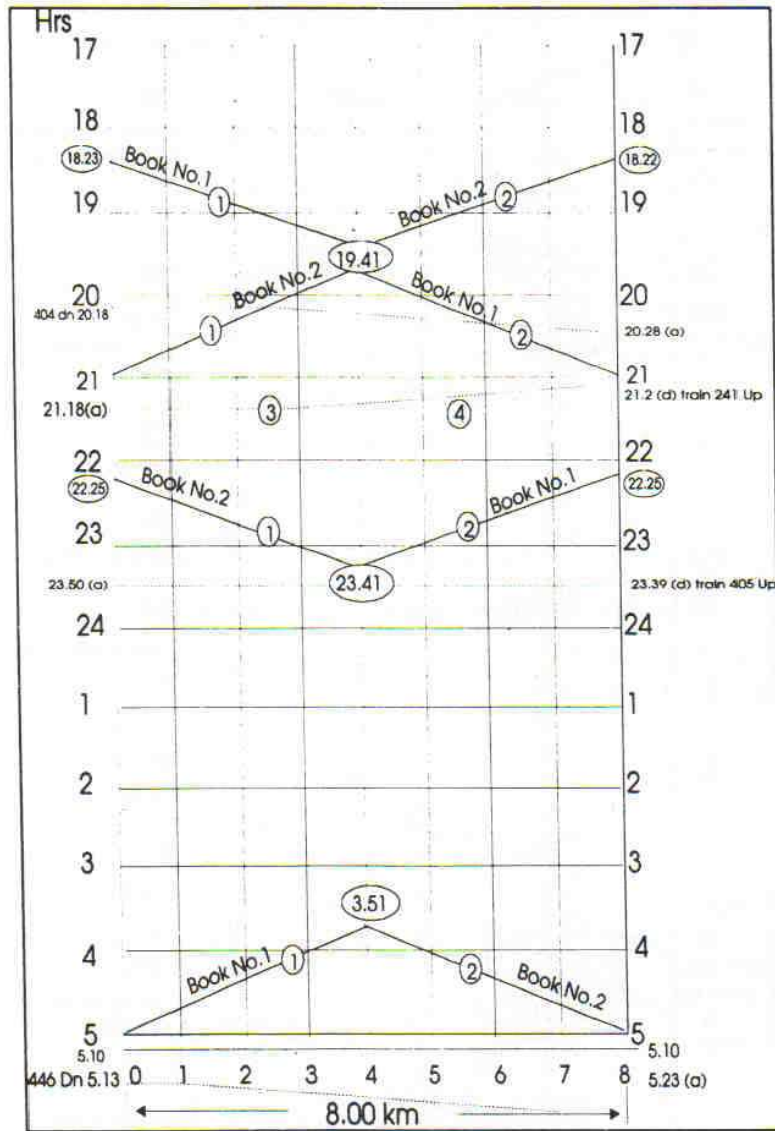


FIG. 4 MONSOON PATROL CHART MONKEY HILL - NAGNATH UP GHAT LINE (SINGLE)