

11-04 (1300)  
279  
N. E. RLY,  
GORAKHPUR.  
December 15, 1993

**CE's P.Way Circular No. 78 of 1993.**  
(No.W/275/07A/4A)

**Sub: Manual laying of pre-stressed Concrete Sleepers.**

1. Concrete sleepers are heavy (weigh about 270 kg) and manual handling is not only difficult but may even cause damage to the sleepers. That is why, manual laying will not normally be adopted except in exceptional circumstances with the approval of CTR (para 1405 and 1407 of PWM refer). Following broad guidelines may be kept in view while carrying out the work.

**2. Deep Screening Of Ballast(Prior to TSR Works) :**

Due to presence of bad formation, ballast attrition, excessive rainfall and dropping of ashes, etc., ballast gets choked up and track drainage is impaired. In such situation, it becomes necessary to screen the entire ballast right upto the formation level/sub-ballast level to ensure proper drainage of track. It is stipulated in para 238 of PWM that deep screening should be carried out by providing full ballast cushion prior to (i) CTR/TSR work and (ii) converting existing track, fish plated or SWR into LWR/CWR. In order to derive full benefit of heavy track structure provided by the concrete sleepers and the elastic fastenings, it is desirable that the existing SWR track should also be converted into LWR whenever relaying with concrete sleepers is planned. It is therefore, obligatory that before carrying out TSR with PSC sleepers, deep screening should be planned.

**3. Survey For Laying Of Concrete Sleepers.**

3.1 **Preparation of L-section :** Before commencement of the work it is necessary to survey the section. A longitudinal section of the track should be taken indicating the rail levels at every 30 M, as also at changes of grades, obligatory points like culverts, bridges, over line structures, tunnels, level crossings, signal gantries, points & crossings, etc

In station yard, on run through line, cross section at every 50 M should be taken and plotted indicating the platform levels, rail levels and clearance to underside of over line structures.

3.2 **Lifting of track Required for Renewals with PSC sleepers :**  
It may be noted that the thickness of the monoblock prestressed concrete sleepers below rail seat is 210 mm. Thus the difference between the thickness of the concrete sleeper and the wooden sleeper is about 80 mm.

11-2

The existing depth of caked up ballast cushion (excluding sub-ballast, if any) on the BG route of NE Railway is found to vary between 150 mm and 200 mm. Taking an average thickness of 175 mm of the existing ballast cushion, the depth of the clean ballast cushion available under the bottom of concrete sleeper, after deep screening, shall be about 95 mm. See sketch No. 1.

The requirement of ballast cushion below the bottom of the PSC sleepers is 300 mm. As it is not desirable to cut into the formation during deep screening, lifting of track by about 210 mm is inevitable while laying concrete sleepers.

- 3.3 Depth Of Ballast cushion at site : The actual depth of ballast cushion available at site should be carefully assessed in TP during the survey in order to decide the final rail level to accommodate the increased (i) thickness of the concrete sleepers, and (ii) requirement of ballast cushion.
- 3.4 Fixing of final rail level by DEN : It is not necessarily the intention that the original longitudinal section of the line should be restored. The possibility of eliminating humps, dips and unevenness in the existing L-section may be kept in view. On the basis of the longitudinal and cross section, the final rail level will be decided by the Divisional Engineer. Please refer para 238(2) of PWM.
- 3.5 Preparation of estimates : The estimate for laying of concrete sleepers should inter alia include deep screening and full ballasting, conversion of SWR into LWR, as also provision of track survey mentioned above.

#### 4. Preliminary Works:

- 4.1 Pre-ballasting : Having decided upon the final rail level, the quantity of ballast that will be required in every 100 M length of the track should be approximately worked out. The quantity of ballast, that has to be run out, should be decided in advance. It would be more economical to train out about 40 to 50% requirement of additional ballast ahead of the deep screening and TSR Work. This quantity should be sufficient to permit about 200 mm general lift of the track to ensure the required depth of ballast cushion below the bottom of the concrete sleeper and part of the ballast required in the shoulder to ensure proper packing under the sleeper.
- 4.2 Cess should be widened and brought to correct level, relation to final rail level, where-ever required.
- 4.3 Pegs should be provided at intervals of 30 M to indicate the final rail levels.
- 4.4 Slewing of curves should be done in advance.

11-3-229 (2)

4.5 The existing sleeper density on the BG route is  $M + 4$  (1300 sleepers per km). While relaying with the concrete sleepers on BG trunk route, the sleeper density shall be kept as  $M + 7$  (1540 sleepers per km). As the average spacing of the wooden sleepers is reduced from 78 cm to 65 cm, the revised marking of the concrete sleepers should be made on both the rails. See sketch No. 1.

4.6 Concrete sleepers should be unloaded in advance at the site of the work.

#### 5.0 Manual Handling Of Concrete Sleepers.

5.1 Loading and unloading : Concrete sleepers shall be placed perpendicular to the length of the BFR. Manual unloading shall be done sleeper by sleeper. Wooden sleeper provided with hooks at the top of end for gripping the side of the BFR shall be used as ramps for sliding the sleepers down to the cess level. Damage by over-running shall be prevented by placing the lower ends of the ramps either inside an old motor truck tyre or between gunny bags filled with wooden shavings and the sleepers allowed to move down the ramps. Two men shall stand on the cess with crow bars planted into cess and control the downward sliding of the concrete sleepers. Para 1407 of P.W.M. refers.

5.2 After unloading, the sleepers shall be placed on the cess approximately alongside final position. Individual concrete sleepers may be transported conveniently on rail dolly according to RDSO's drawing no. MA 3031.

#### 6. Manual Laying Of Concrete Sleeper :

6.1 General: Manual laying of concrete sleeper should be planned alongwith deep screening. The work will be done under the supervision of an official not lower in rank than PWI Gr. III. PWI incharge, AEN/DEN shall frequently inspect the site of work to exercise proper control on the quality of work being done. In the initial stages of starting of the work they will personally involve themselves in ensuring that proper procedures are followed at the site of work. The detailed procedure outlined in para 238 (2) (e) of P.Way manual should be strictly followed for deep screening operations.

6.2 The procedure outlined below is for general guidance of the field staff for manual laying of concrete sleepers. However, responsibility for ensuring safety of track and proper quality of work done, at various stages squarely devolves on the supervisory official and the sectional AEN/DEN.

Stage I : The ballast should be removed from space 'A' and 'B' on either side of sleeper. 1. down to the formation level and wooden blocks shall be provided to support the rail for passing trains. Proper wedges shall be kept at site for the purpose. See sketch No. 2A.

11-9

Stage II : Ballast Core under sleeper '1' is broken and the ballast removed down to final formation/sub-ballast level.

Stage III : The sleeper '1' should be removed. The concrete sleeper should be carefully inserted into the channel. While jacking the sleeper by crow bar for fixing it to the rail seat it may be ensured that the edge of the sleeper is not damaged and ERCs are not overstressed.

Stage IV : The ballast should be screened and placed back under concrete sleeper '1', which may be packed.

Stage V : Wooden block from space 'A' should then be removed.

Stage VI : The ballast from space 'C' down to the formation level should be removed and, after screening, be placed in space 'A'. The rail in space 'C' should be supported on wooden block. Sketch No. 2B refers.

Stage VII : Ballast core under sleeper '2' is broken and ballast removed down to formation level.

Stage VIII : The sleeper '2' may be replaced by concrete sleepers.

Stage IX : Screened ballast should be provided under concrete sleeper '2' and the sleeper be packed.

Stage X : The ballast from space 'D' down to formation level should be removed and, after screening, be placed in space 'B'. Wooden block should be removed from space 'B' and placed to support the rail in space 'D'.

Stage XI : The ballast from under sleeper '3' should be removed, and so on till the specified number of sleepers are relaid with concrete sleepers.

6.3 The following points should be kept in view while doing the work:

- (i) It should be ensured that when ballast is being removed from any sleeper, invariably there are atleast four fully supported sleepers between it and the next sleepers worked upon.
- (ii) The work should be done under a specified restricted speed of 20 kmph.
- (iii) Proper lookout men should be posted on either side of the work site to warn the work men of an approaching train.
- (iv) Sufficient number of wooden blocks with wedges should be available at site to support the rail.

- (v) To ensure that deep screening is carried out to uniform depth. Wooden measure as per Sketch No. 3 may be provided at the site of work in sufficient number. This measure could also be used for determining correct cess level in relation to rail level.
- (vi) The sieve shall be 1 metre wide and 1.2 metres long with square mesh of 20 mm. These shall be placed inclined to the cess so that the screened much rolls down the slope of bank and does not mix up with the clean ballast.
- (vii) It should be ensured that packing, cross level and rail run off are satisfactory before closing day's work. No rail should be left supported on the wooden blocks at the close of day's work.
- (viii) As far as possible, uniform spacing of PSC sleepers for LWR track should be planned at the time of TSR to ensure higher output of machine packing for the short period during which the ballast bed is consolidated and normal sectional speed is restored before SWR track is converted into LWR, the rail joint may be supported on a good released wooden sleeper and properly spiked with four spikes to prevent damage to the rail ends.

Where there is gap of more than three months between TSR and LWR conversion, prior permission of THOD may be obtained to modify the uniform spacing of concrete sleepers. Where it is not possible to convert SWR into LWR as per extant instructions, sleeper spacing for SWR track may be adopted at the time of relaying.

## 7. Lifting Of The Track :

7.1 As stipulated in para 233 (3) of PWM, lifting should not exceed 75 mm at a time so as to allow proper consolidation. Since a total of 3 lifts of about 75 mm each will be required, first lift may be provided on day 2 (deep screening and manual relaying of concrete sleeper having been done on day 1, followed by 2 subsequent lifts on day 3 and day 4 (refer Sketch No. 4). The track should be lifted to the final rail level as indicated by the rail level pegs fixed at 30 M intervals.

2 For lifting of the track, one of the following two alternatives can be adopted.

- (a) Lifting by non-infringing jacks : The available jacks are of two types, mechanical and hydraulic. Both the jacks are of 10 tonnes capacity. A feed back may be provided which of the two types of jacks has been found to be more serviceable in the field so that its procurement can be standardised.

11-6

The two rails should be lifted together to avoid minimum cross level variation. A minimum of 4 jacks may be employed for the lifting operation. 2 jacks may be placed under each rail. After the track is lifted by the jack, the adjoining 3 to 4 sleepers on either side should be properly packed to the required level. See sketch No. 5.

Thereafter, the jacks should be shifted to the next position after a gap of 3-4 sleepers. The process of packing of the lifted sleepers to the required level may be repeated till the previous day's work is completed (e.g. 0.1 Km/day).

- (b) Lifting by crow-bar: Till such time the lifting operation with jacks gets organised in the field, lifting of the track can also be carried out by means of crow bars.

In this method, 6 crow bars, 3 on opposite side of each rail, are employed for lifting of the track. The method is shown in sketch No. 5. The crow bars get reaction from the wooden blocks on which metal plate of appropriate slope & thickness is provided to prevent slipping of crow bars. After lifting of the track, as a result of the lever action of the crow bars, the sleepers marked 1, 2, 3, 4 in sketch No. 5 are packed to the required level. Thereafter the crow bar gang moves to next position as shown in the sketch. As a result, sleeper No. 5, 6, 7, 8 and 9 get lifted to the desired level. Process is repeated thereafter.

At the end of each day's lifting operation proper runoff grade may be provided which shall not be steeper than 25 mm in one rail length of 13 m (e.g. 1-25 mm variation in longitudinal levels from sleeper to sleeper). Kutchha packing may be provided before closing the work for the day, ensuring that the cross level variation and the twist in the track are within permissible limits.

The work should be carried out on a banner flag after duly protecting the track. Proper look out men, equipped with hand signal flags, should be provided on either side so that they can warn the work men at site of approaching train. They should be provided with hooters or long whistles to warn the workmen at site.

While lifting the track, it shall be ensured that the cross level variation is kept within prescribed limits so that in case of warning of an approaching train, the work can be temporarily suspended and the train allowed to pass safely.

#### Assessment of Requirement of Ballast For Pre/post Ballasting Operation

It would be seen from the sketch No. 6A that the amount of ballast available after deep screening of the existing caked up ballast (varying from 150 mm to 200 mm) should be of the order of 0.7 cum/m.

8.2 The final requirement of ballast for SWR track with PSC sleepers is about 2 cum/m (sketch No. 6C). For LWR track, the requirement of ballast is of the order of 2.16 cum/m (sketch no. 6D). Thus, the total additional requirement of ballast after deep screening will vary from 1.4 to 1.5 cum/m.

8.3 As mentioned earlier in para 4.1, about 40% 50% of the total additional requirement of ballast should be unloaded at site before taking up the work of deep screening and TSR. About 0.6 to 0.7 cum/m of ballast may therefore be unloaded at the site in advance as a pre ballasting operation, to permit lifting of the track to the final rail level.

8.4 As soon as possible after deep screening the balance quantity of ballast at about 0.8 cum/m may be unloaded at the site to permit machine packing and for restoring maximum sectional speed of the section.

9. Length of track under speed restriction:

9.1 It would be seen from sketch No. 7 that for a rate of progress of 0.1 km per day, the length of the track under various speed restrictions will be as under:

| Day | Length of track                                           | Activity | Speed restriction |
|-----|-----------------------------------------------------------|----------|-------------------|
| 1   | Deep screening and TSR                                    | A        | 20 kmph           |
| 2   | First lift of track (75 mm)                               | B        | 20 kmph           |
| 3   | Second lift of track (75 mm)                              | C        | 20 kmph           |
| 4   | Third lift of track (75 mm)                               | D        | 20 kmph           |
| 5   | First manual packing                                      | E        | 20 kmph           |
| 6   | Second manual packing                                     | F        | 20 kmph           |
| 7   | Unloading of remainder of ballast, & picking up of slacks |          | 50 kmph           |
| 8   | do                                                        | do       | 50 kmph           |
| 9   | do                                                        | do       | 50 kmph           |
| 10  | First machine packing                                     | G        | 50 kmph           |
| 11  | Picking up of slacks & consolidation of ballast bed       |          | 75 kmph           |
| 12  | do                                                        |          | 75 kmph           |
| 13  | do                                                        |          | 75 kmph           |
| 14  | Second machine packing                                    | H        | 75 kmph           |
| 15  | Restoration of normal speed                               |          | 100 kmph          |

9.2 Thus, there will be a speed restriction of 20 kmph 50 kmph and 75 kmph over a length of 0.6 km, 0.4 km and 0.4 km respectively for a total period of 14 days.

The speed restriction over such a length should result in a loss of running time of about 6 to 8 minutes depending on the speed of the train operating in the section.

(5)

270  
11-5Miscellaneous works :

12.1 Miscellaneous works such as widening of the gess to accommodate the increased ballast cushion for the PSC sleepers, unloading of the PSC sleepers from the rakes, unloading of ballast from ballast train etc. should also be planned simultaneously with the work of deep screening and TSK. As these works may not be of a continuous nature, the same should be planned by diverting the regular labour engaged in deep screening and TSK work.

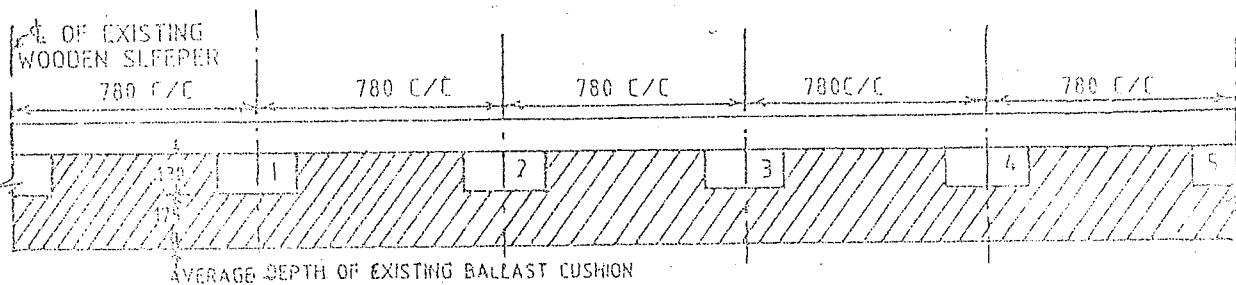
2.2 As far as possible, conversion of SWR track into LK should be planned soon after the track is stabilized and full section speed is restored. For this purpose, end cropping of the rails and welding of joints should be planned well in advance so that full benefit of the heavier track structure can be obtained. Extant instructions in regard to approval of the LK and the procedures to be adopted for end cropping of the rails and exercising requisite quality control on welding of the rails should be strictly followed.

(M M Goyal,  
CHIEF ENGINEER)

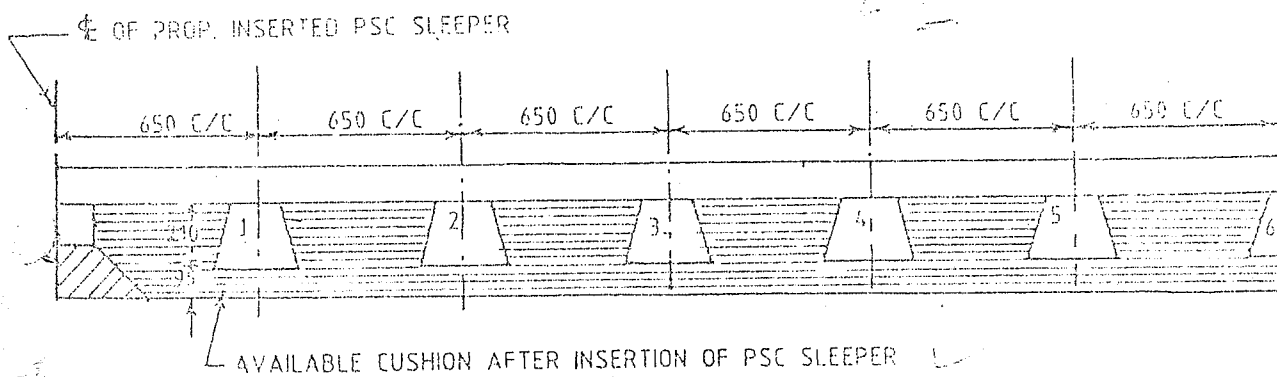
SKETCH NO. 1

# SLEEPER SPACING AND BALLAST CUSHION

## EXISTING AND PROPOSED AFTER TSR



## WOODEN SLEEPER DENSITY M+4 (SWP)



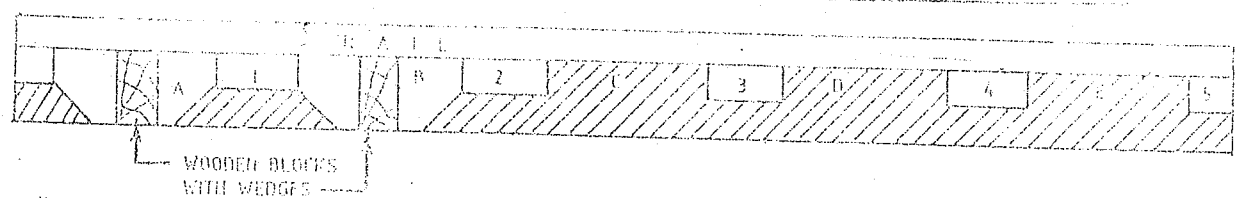
## CONCRETE SLEEPER DENSITY M+7 (LWR)

### NOTE:-

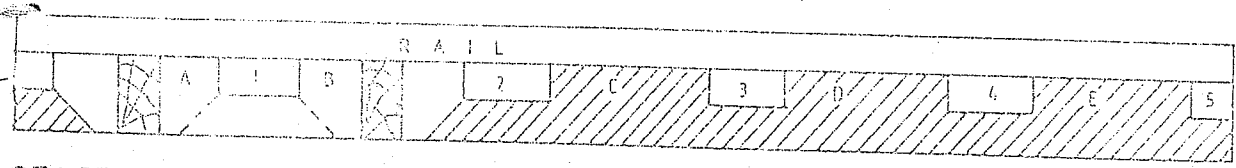
1. IT IS DESIRABLE TO MAINTAIN UNIFORM SPACING (M+7 SLEEPER DENSITY) FOR LWR FOR EASE OF M/C PACKING AND TO AVOID SHIFTING OF SLEEPERS LATER.
2. THE TIME GAP OF CONVERSION INTO LWR SHALL BE KEPT TO A MINIMUM
3. TILL SUCH TIME SWP IS CONVERTED INTO LWR, THE RAIL JOINT MAY BE SUPPORTED ON A GOOD RELEASED WOODEN SLEEPER AND HELD IN POSITION BY 4 SPIKES.

SKETCH 3A

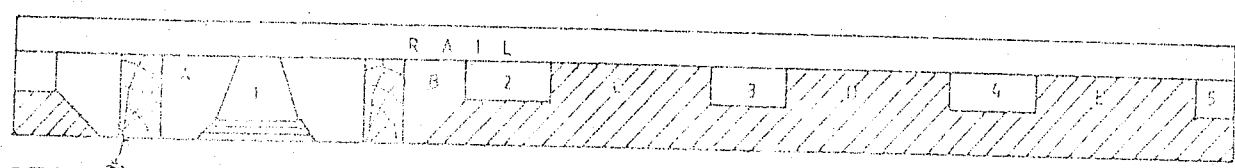
SEQUENCE OF OPERATIONS OF DEEP SCREENING & T&R



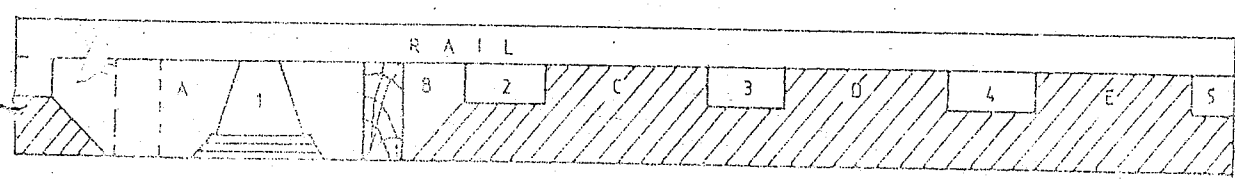
STAGE-1



STAGE-2



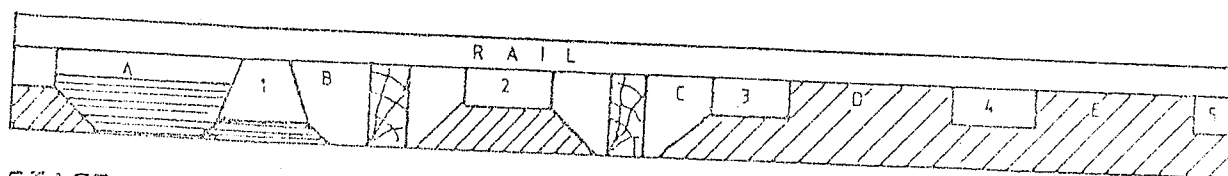
STAGE-3 & 4



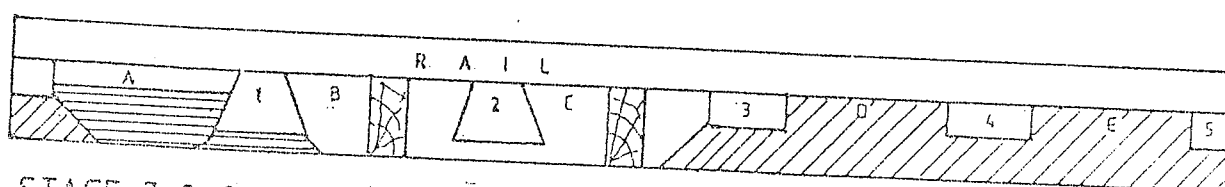
STAGE-5

LEGEND:-  
CAVED UP BALLAST  
BALLAST AFTER DEEP SCREENING

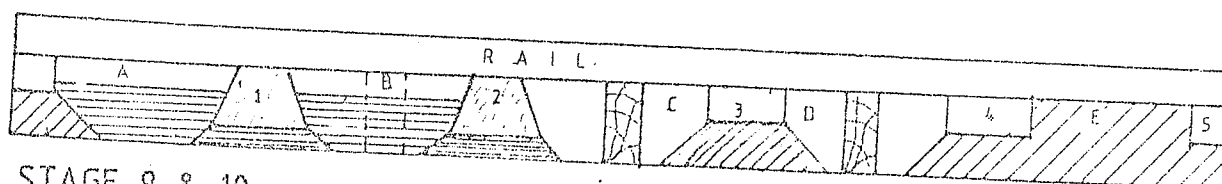
SKETCH No. 2B



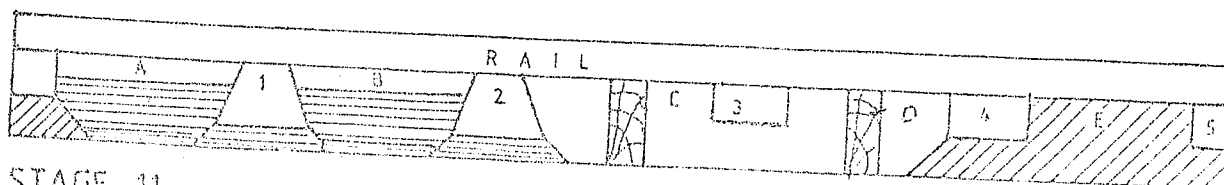
STAGE-6



STAGE-7 & 8



STAGE-9 & 10



STAGE-11

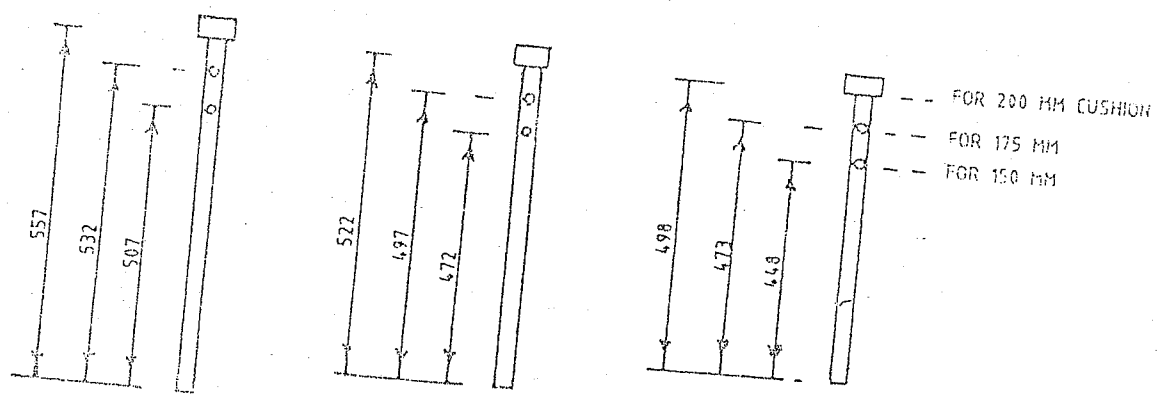
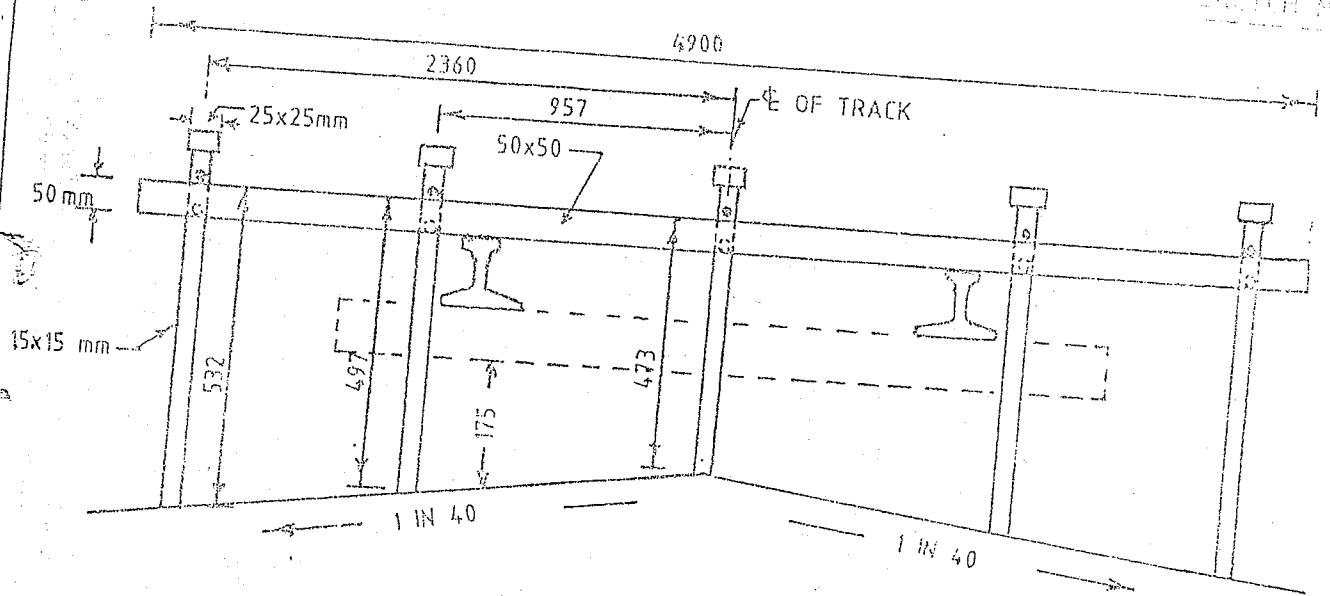
LEGEND:-

 FAKED UP BALLAST

 BALLAST AFTER DEEP SCREENING

# MEASURING BOARD (PMB) FOR DEEP SCREENING AND CESS WIDENING

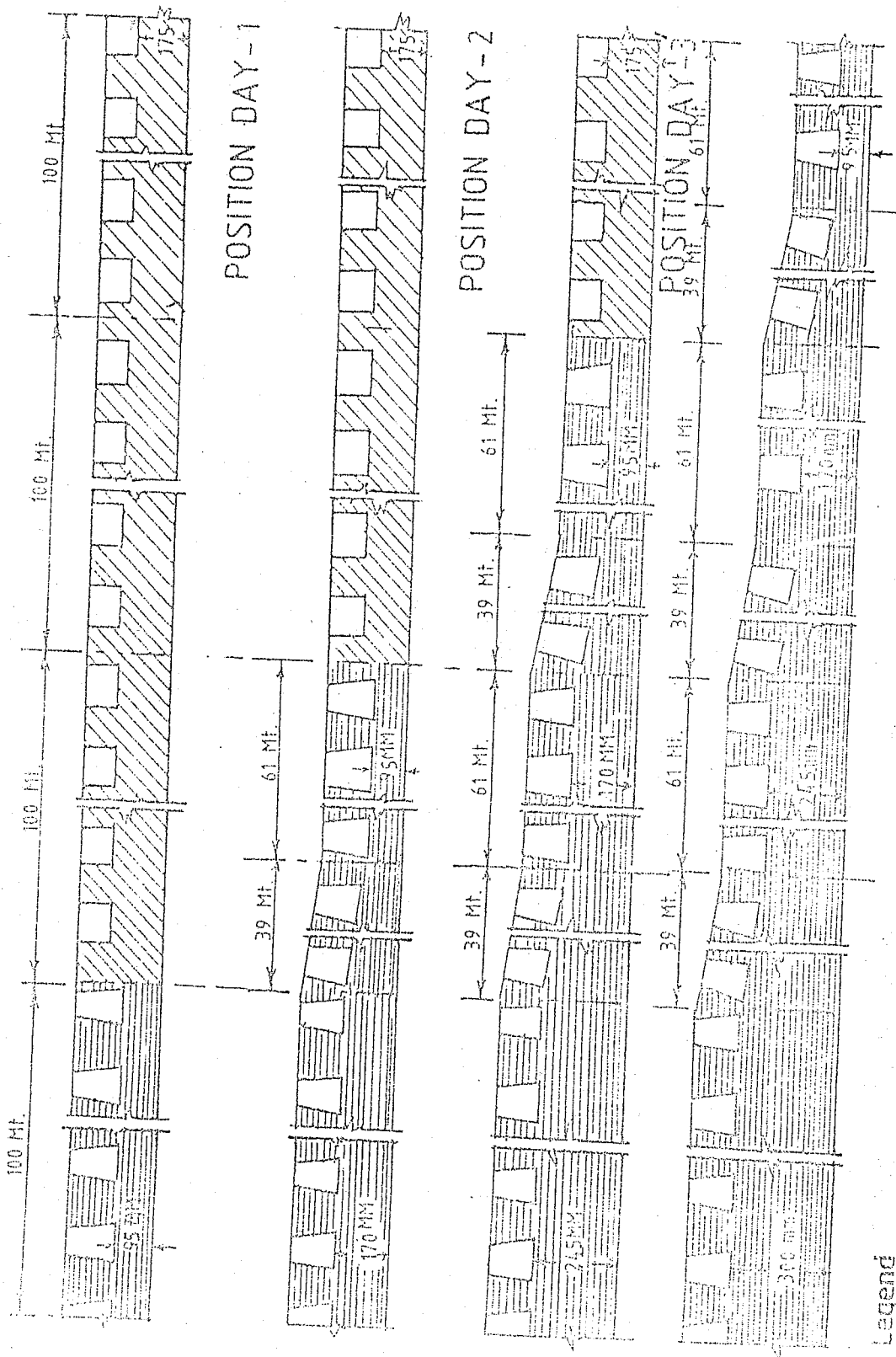
SKETCH PLAN



## SHOWING DETAILS OF ADJUSTMENT IN DEPTH OF EXCAVATION

SKETCH No. 4

LIFTING OF TRACK-PROVISION OF RUN OFF GRADE



POSITION DAY-4

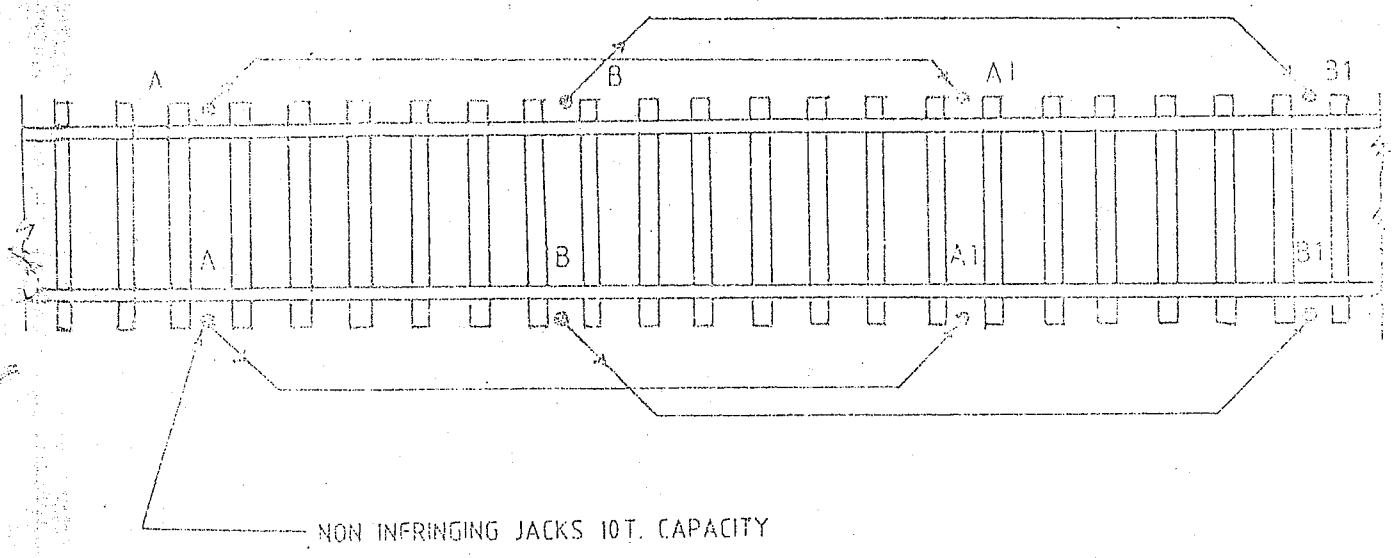
Legend  
Caked up BALLAST  
BALLAST AFTER DEEP SCREENING

104

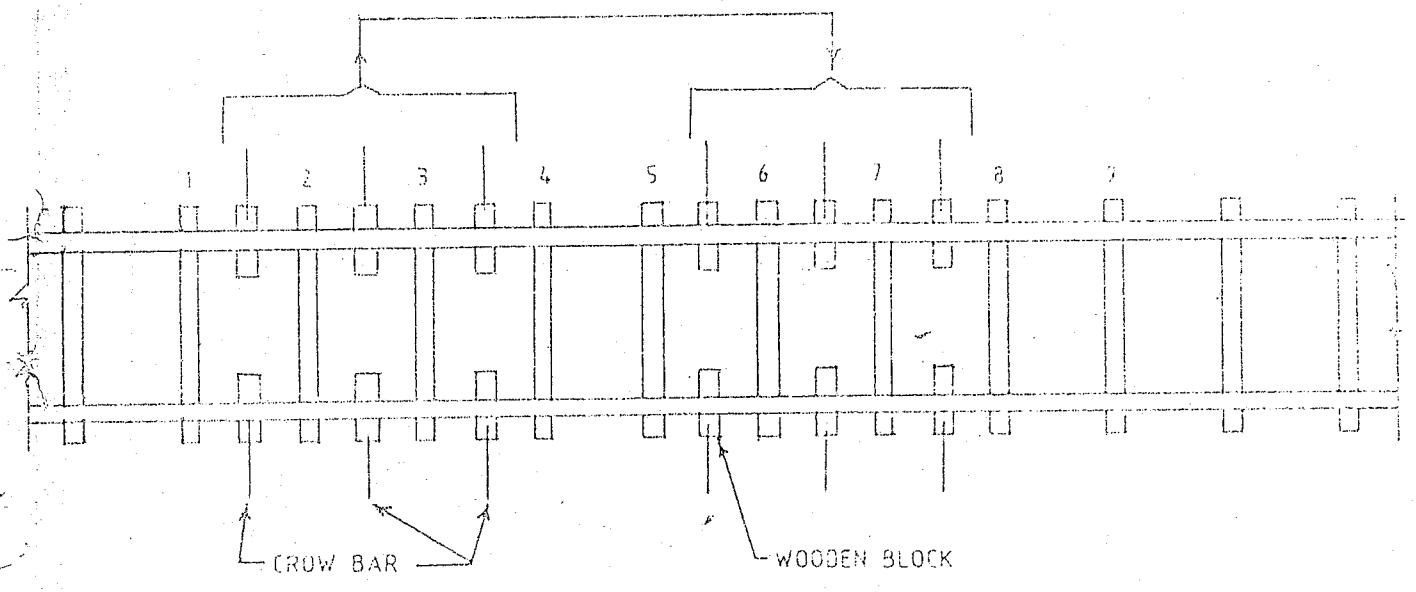
163

SKETCH No. 4

### LIFTING BY NON-INFRINGING JACKS

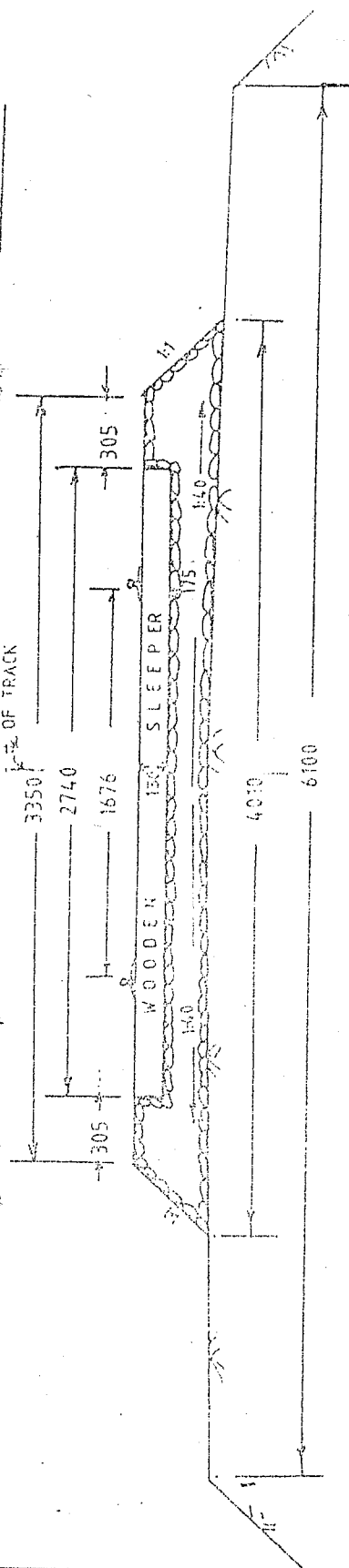


### LIFTING BY CROW BARS



SKETCH 6A

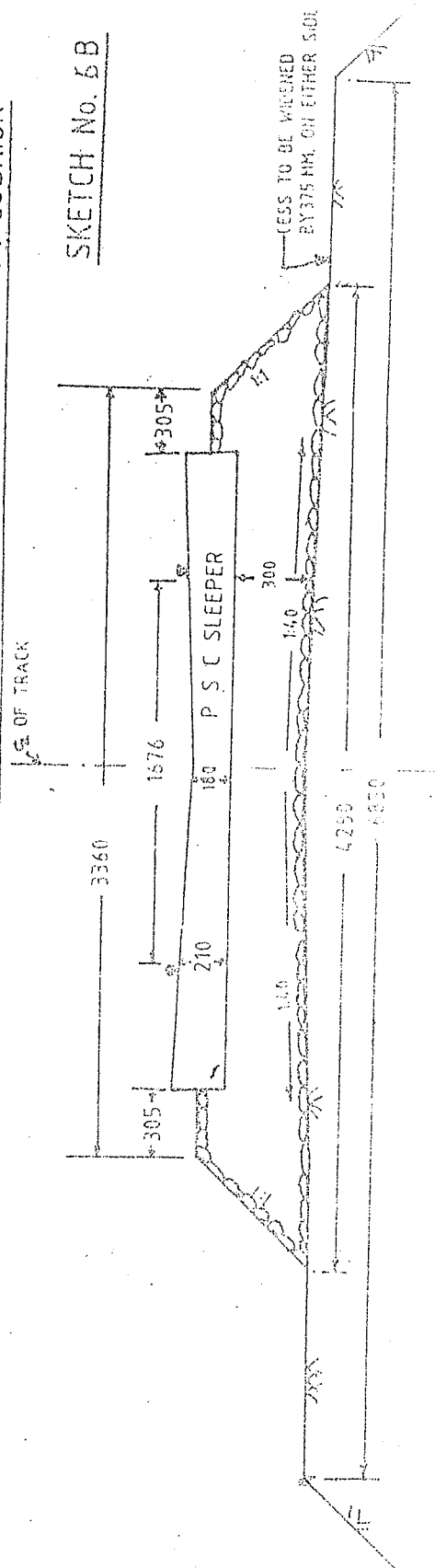
EXISTING BALLAST PROFILE AV. CUSHION - 175MM



NOTE:- BEFORE DEEP SCREENING AV. QTY. OF AVAILABLE/CANED BALLAST IS ABOUT 1.10 Cum/METRE. AFTER DEEP SCREENING AVAILABLE CLEAN BALLAST MAY BE ABOUT 0.7 Cum/METRE.

# BALLAST PROFILE FOR CONCRETE SLEEPER AFTER LIFTING TO ACHIEVE 300MM CUSHION

SKETCH No. 2B

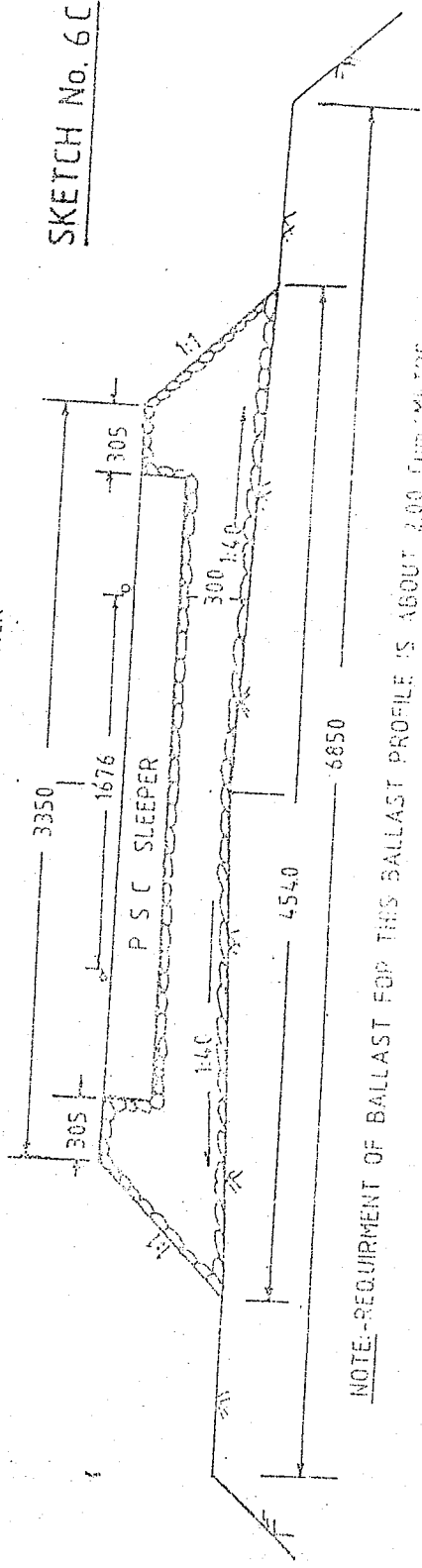


10

- THE PROBLEM IS THE ASSUMPTION THAT THE BALLAST IN THE CMB AND SHOULDER IS AVAILABLE ONLY UP TO 50% OF THE WEIGHT OF THE CEMENT.
- REQUIREMENT OF 100% FOR THE BALLAST PROPORTION IS ABOUT 15 CMB/HI.

BALLAS, PROFILE FOR CONCRETE SLEEPER. AV. CUSHION-300MM(SWR TRACK)

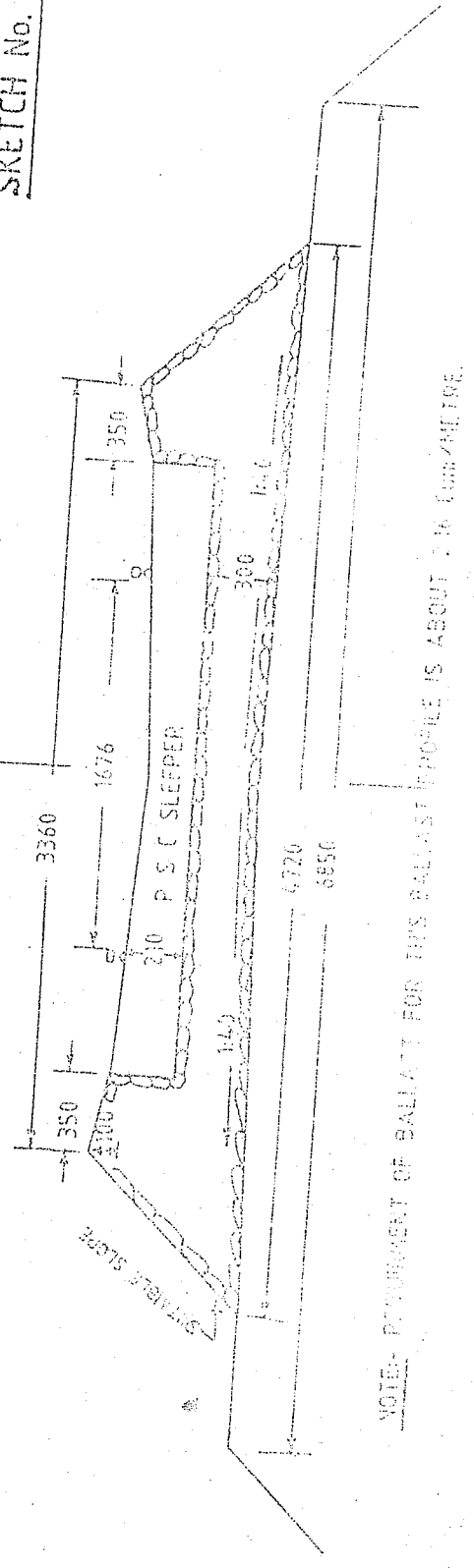
Case of TRACK



SKETCH No. 6C

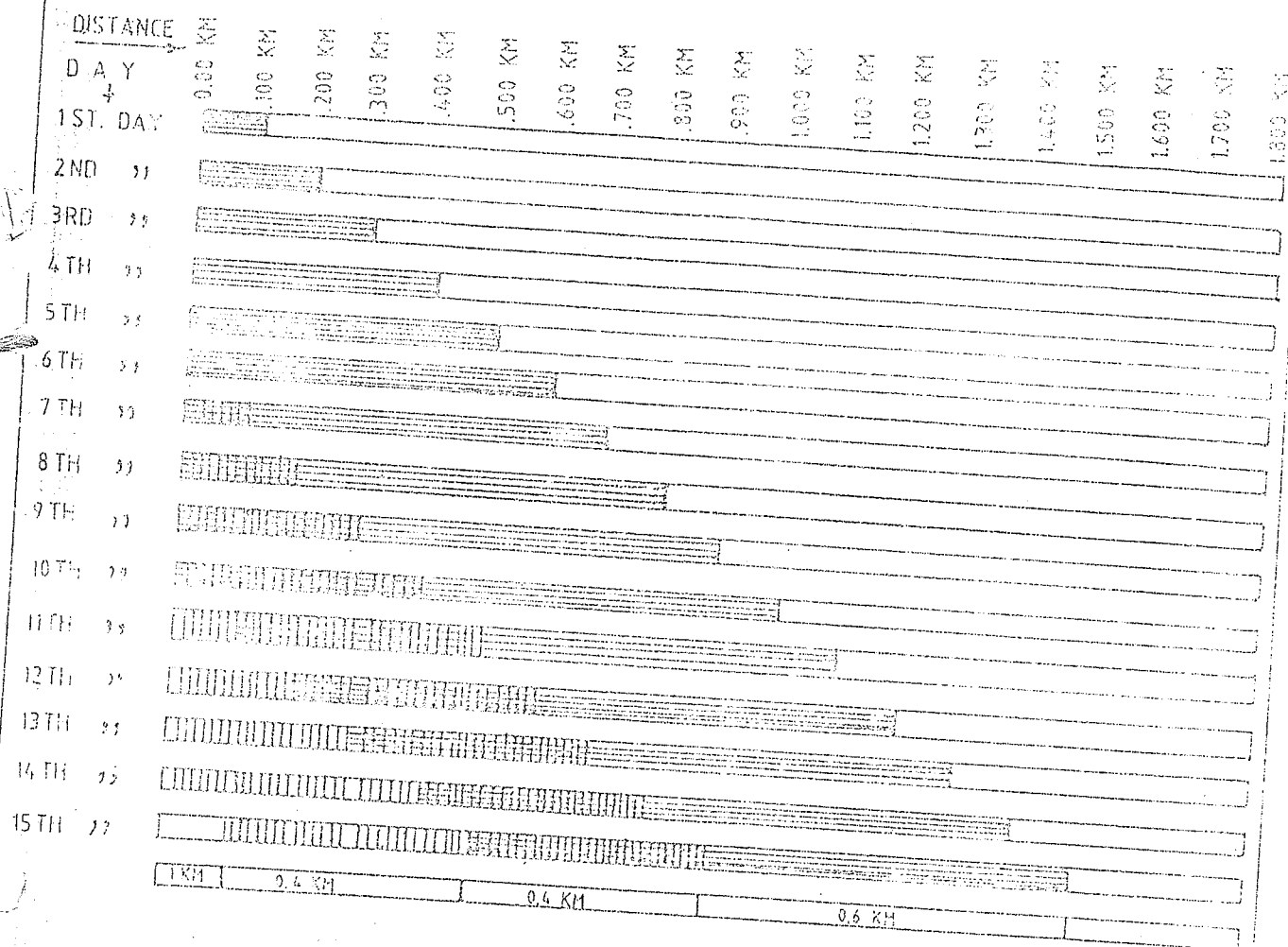
GENERAL BALLAST PROFILE FOR CONCRETE: AV. CUSHION=300(MLWR TRACK)

LE OF TRACK



SKETCH No. 60

# DEEP SCREENING AND TSR WITH PSC SLEEPERS LENGTH OF SPEED RESTRICTION



## LEGEND

- 20 KMPH SPEED SHOWN THUS.
- 50 KMPH
- 75 KMPH
- 100 KMPH/NORMAL

NOTE:- FOR SPEED RESTRICTION IN THE ABOVE LENGTH THE AVERAGE TIME LOSS WILL BE ABOUT 08 MINUTES

SKETCH No. 8

# DEEPSCREENING AND TSR WITH PSC SLEEPER

## DETAILS OF ACTIVITIES AND LABOUR REQUIREMENT FOR 0.1 KM PROGRESS PER DAY

| S.No. | ACTIVITY NAME | DETAIL OF ACTIVITY                                           | STRENGTH OF LABOUR ESTIMATED FOR THE ACTIVITY FOR 0.10 KM. LENGTH (APPROX) |
|-------|---------------|--------------------------------------------------------------|----------------------------------------------------------------------------|
| 1     | A             | DEEP SCREENING AND REPLACING WOODEN SLEEPER WITH PSC SLEEPER | 120                                                                        |
| 2     | B             | 1ST. LIFT OF 75 MM MANUALLY                                  | 25                                                                         |
| 3     | C             | 2ND. " " " "                                                 | 25                                                                         |
| 4     | D             | 3RD. " " " "                                                 | 25                                                                         |
| 5     | E             | 1ST. MANUAL PACKING                                          | 20                                                                         |
| 6     | F             | 2ND. " "                                                     | 20                                                                         |
| 7     | G             | 1ST. MACHINE PACKING                                         |                                                                            |
| 8     | H             | 2ND. " "                                                     |                                                                            |
| TOTAL |               |                                                              | 230                                                                        |

NOTE:- A GANG OF 4 PERSONS CAN CARRY OUT ON AN AVERAGE DEEP SCREENING OF A SLEEPER (40% SLEEPER DENSITY) AND INSERTION OF 5 PSC SLEEPERS (14% SLEEPER DENSITY) THUS 30 GANGS ARE REQUIRED TO ACHIEVE A PROGRESS OF 150 SLEEPERS / DAY (0.1 KM)

### DETAIL OF ACTIVITIES

|          |                 |
|----------|-----------------|
| 1st. DAY | A               |
| 2ND "    | B A             |
| 3RD "    | C B A           |
| 4TH "    | D C B A         |
| 5TH "    | E D C B A       |
| 6TH "    | F E D C B A     |
| 7TH "    | G F E D C B A   |
| 8TH "    | H G F E D C B A |
| 9TH "    |                 |
| 10TH "   |                 |
| 11TH "   |                 |
| 12TH "   |                 |
| 13TH "   |                 |
| 14TH "   |                 |

