GOVERNMENT OF INDIA
MINISTRY OF RAILWAY

STATIC AND FATIGUE TESTING OF PRESTRESSED CONCRETE SLEEPER OF NEW DESIGN TO DRAWING NO. T-5476 ON CONVENTIONAL PULSATOR MACHINE

Report No. TM-32

(September 2000)

TRACK MACHINE AND MONITORING DIRECTORATE
RESEARCH DESIGN AND STANDARD ORGANISATION
LUCKNOW- 226011

FORWARD

This report is based on the tests conducted by the Track Machine and Monitoring Directorate/RDSO. Although every care has been taken for recording data accurately and analyzing it objectively, the view expressed in this report are subject to modification from time to time, in the light of fresh data. Further, they do not necessarily represent the views of the Ministry of Railways (Railway Board), Government of India.

DHARM SINGH
Executive Director(TM&M)

C. P. GUPTA
Joint Director (TM)

CONTENTS

1.0 INTRODUCTION

Track Design Directorate has evolved a new economical design of BG PSC sleeper for 60 Kg rail by bringing down the quantity of HTS strand from 18 to 16 nos. and improving the grade of concrete from normally adopted M55 to M60. The objective of this testing was to carry out the static and fatigue tests on this sleeper.

Track directorate vide note No. CT/SRC/3/2/FPT dated 1/9/97 advised the test scheme, which was modified, vide note no. CT/SRC/3/2/FPT dated 24/8/98. As per the test scheme, three rail seats of full size sleeper were to be tested for static and dynamic loading each on conventional pulsator machine. Accordingly the work was planned and testing was carried out from 21/6/99 to 24/1/2000.

2.0 TESTING ARRANGEMENT AND PROCEDURE

Schematic testing arrangement is indicated in annexure "A". As advised by Track Directorate vide note CT/SRC/3/2/FPT dated 10/6/99, the span of sleeper and frequency of the vertical dynamic loading was kept 650 mm and 260 cpm respectively.

One rail seat of each of the sleeper was to be subjected to static load that was gradually increased till a fine crack appeared from the bottom of the sleeper below the rail seat bottom for an approximate height of 15mm. This load was to be recorded. After this the same rail seat was to be subjected to dynamic loading up to two million cycles or failure, which ever is earlier. The growth of crack during dynamic testing was to be observed and after completion of 2.0 million cycles, if sleeper did not fail, the same was again subjected to gradually increasing static load till failure and corresponding failure load was to be recorded.

The other rail seat of the same sleeper was to be subjected to gradually increased static load till first crack appeared and then till failure of the sleepers. The loads corresponding to initiation of crack and failure were to be recorded.

Total three sleepers i.e. six rail seats were to be tested in this manner.

08111

3.0 LOADING PARAMETERS

The load, corresponding span and other testing parameters adopted for dynamic testing are as under

Sl. No.	Span for testing (mm.)	Vertical Load (Tons)		Nos. of Rail Seats tested	Frequency of Dynamic Load (cpm)	Total Nos. of cycles tested
		Max	Min			
1	650	18.5	2.5	Three	260	2.0 Million

4.0 TEST RESULTS AND OBSERVATIONS

4.1 SLEEPER NO 1 (Job No. TL/99/147)

(a) Dynamic Testing

First rail seat (Rail Seat "A") of the sleeper was subjected to gradually increased static load. The cracking from the bottom of sleeper below the rail seat started at 23.2 Tonnes. The position of cracks at this load on both the faces of sleeper (east and west face) is indicated in annexure I/1. Subsequently, the above rail seat was tested for dynamic loading as per the scheme. Though the sleeper did not fracture up to 2.0 million cycles, growth of the crack was observed. The position of cracks after 2.0 million cycles of testing is indicated in annexure I/2. Subsequent to dynamic testing, gradually increased static load was again applied on this rail seat up to 31 Tonnes. Further static load could not be applied due to static loading capacity of machine being limited to 32 tones. However neither the sleeper fractured nor any further crack growth was noticed.

(b) Static Testing

Second rail seat of the sleeper was subjected to gradually increased static load and cracking of the sleeper was found to start at 26.2 tonnes. After this, the load was further increased up to 31 Tonnes but sleeper did not fracture, though crack on one face of the sleeper increased in height. The position of cracks at 26.2 Tonnes of load and 31 tonnes is indicated in annexure I/3

08112

4.2 SLEEPER NO 2 (Job No. TL/99/148)

(a) Dynamic Testing

Application of gradually increasing static load on one of the rail seat (Rail Seat "A") indicated the cracking from bottom of the sleeper below the rail seat at 24 Tonnes. The position of cracks at this load on both the faces of sleeper (east and west face) is indicated in annexure II/1. After this, dynamic testing on this rail seat was carried out. Though sleeper did not fracture up 2.0 million cycles, growth of the crack was observed. The position of cracks after 2.0 million cycles is indicated in annexure II/2. Subsequent to dynamic testing, gradually increased static load was again applied on this rail seat up to 31 Tonnes. However sleeper did not fractured up to this load.

(b) Static Testing

Second rail seat of the sleeper was subjected to gradually increased static load and cracking of the sleeper was found to start at 22 Tonnes for west face and 23 Tonnes for east face. After this, the load was further increased up to 31 Tonnes but sleeper did not fracture though cracks on both the faces of the sleeper increased in height. The position of cracks at 22/23 Tonnes and 31 Tonnes is indicated in annexure II/3

4.3 SLEEPER NO 3 (Job No. TL/99/149)

(a) Dynamic Testing

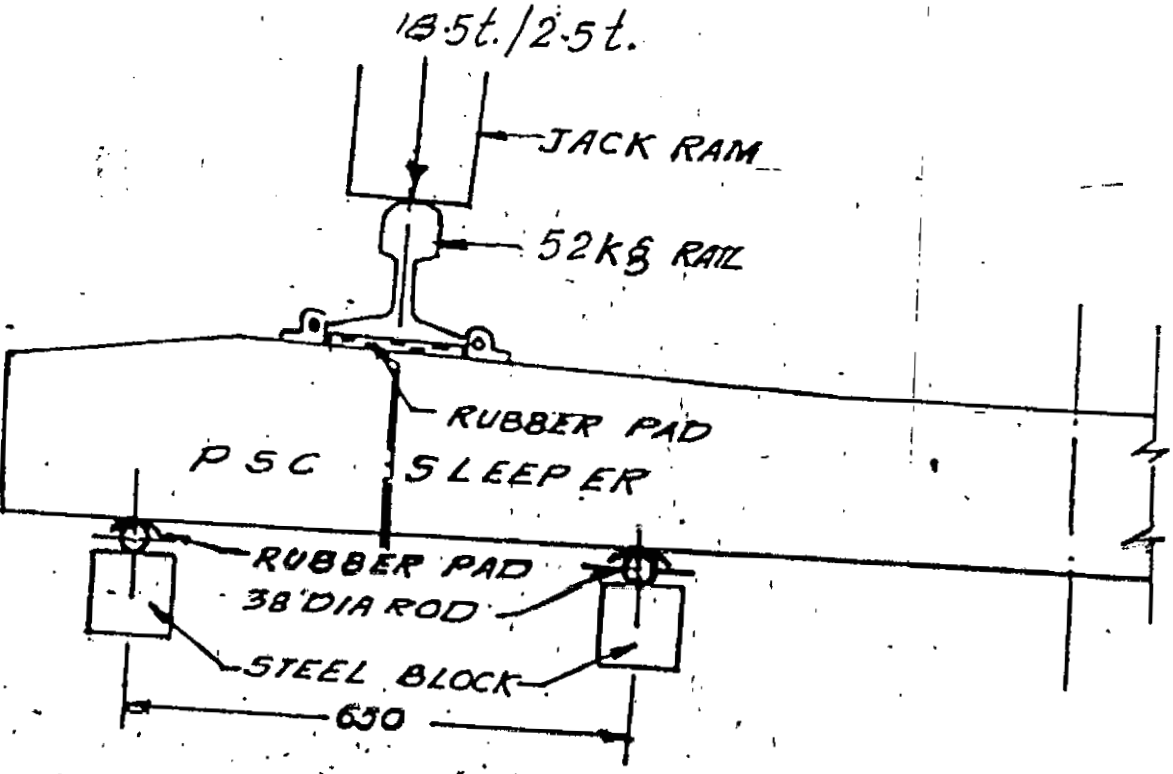
Application of gradually increased static load on one of the rail seat (Rail Seat "A") indicated the cracking from the bottom of sleeper at 22 Tonnes on west face. On east face cracking near the support was observed at this load. The position of cracks at this load on both the faces of sleeper (east and west face) is indicated in annexure III/1. After this, dynamic testing on this rail seat was carried out up to 2.0 million cycles. Though sleeper did not fracture up 2.0 million cycles, growth of crack was observed. The position of cracks after 2.0 million cycles is indicated in annexure III/2. Subsequent to dynamic testing, gradually increased static load was again applied on this rail seat up to 31 Tonnes. However, sleeper did not fracture up to this load.

08113

(b) Static Testing

Second rail seat of the above sleeper was subjected to gradually increased static load and cracking of the sleeper was found to start at 19.2 T. After this, the load was further increased up to 31 Tonnes but sleeper did not fracture though cracks on both the faces of the sleeper increased in height. The position of cracks at 19.2 Tonnes and 31 Tonnes is indicated in annexure III/3

ANNEXURE -A



CONVENTIONAL FATIGUE LOADING ON PSC SLEEPER UNDER PULSATOR (DRG.No.RDSO/T-5476)

08114

ALL DIMENSIONS ARE IN MILLIMETRES

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/147

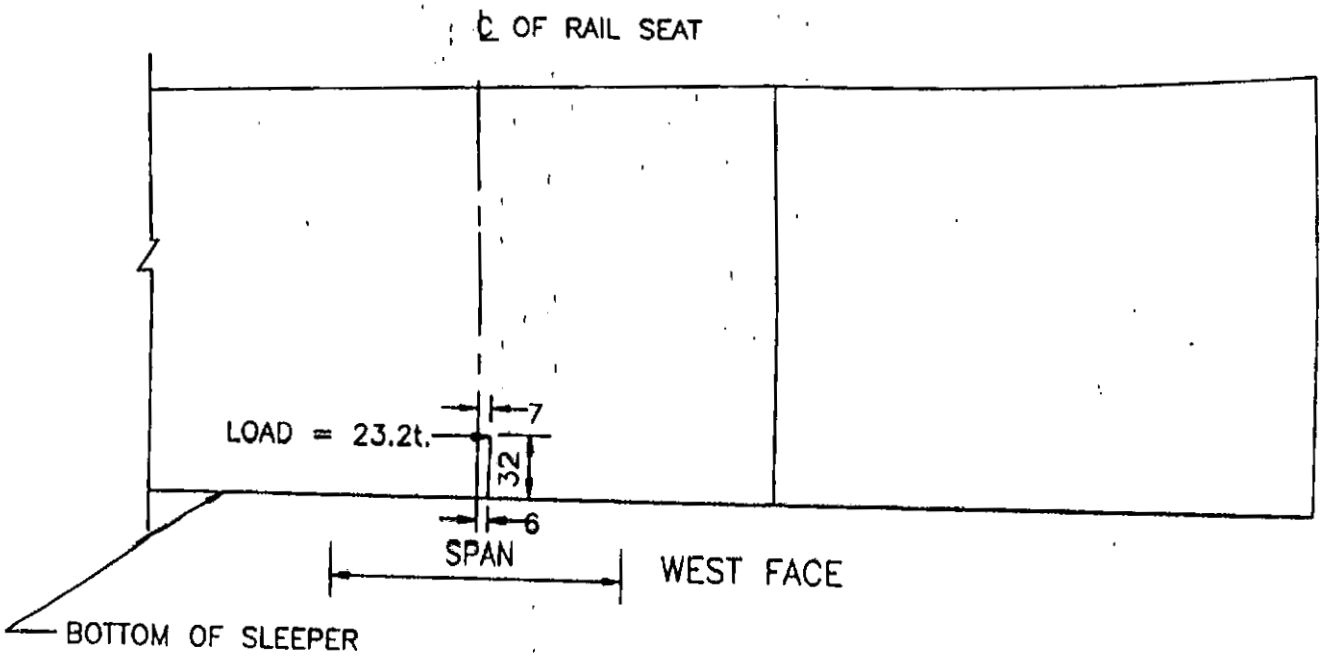
LOAD:- 23.2t.

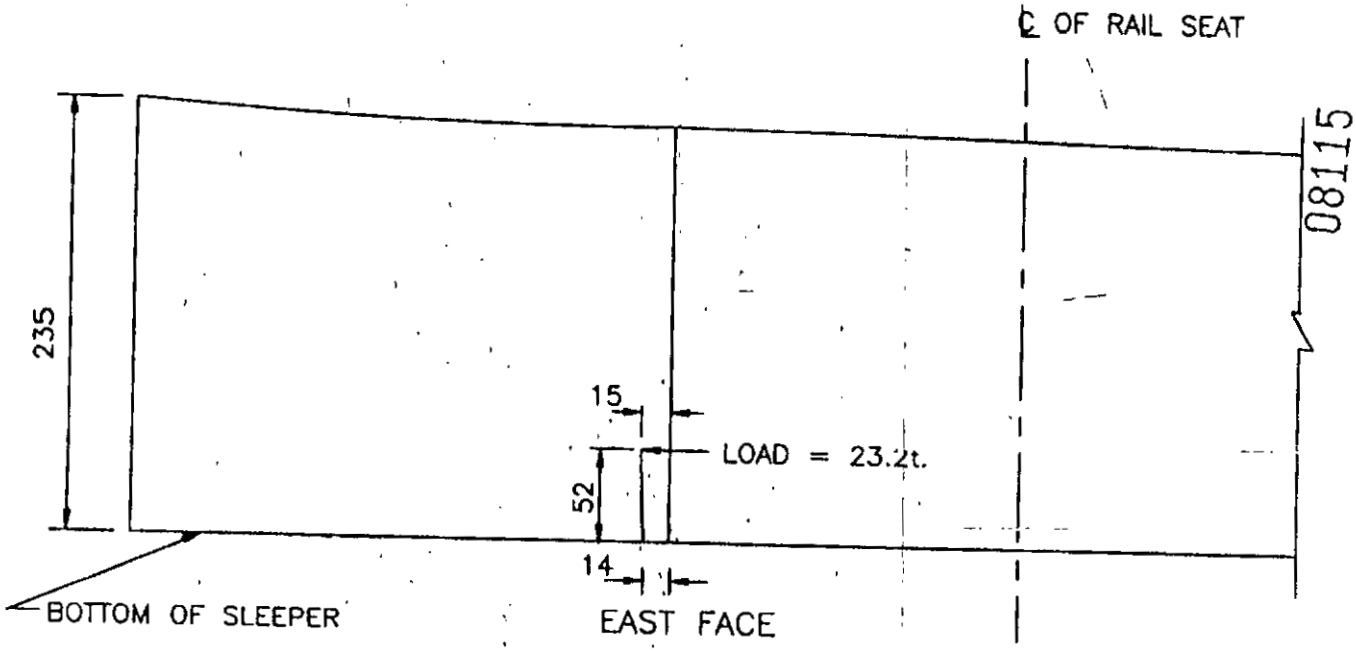
SLEEPER No.:- 1

SPAN:- 650mm.

RAIL SEAT No.:- A

CRACKING AT STATIC LOAD BEFORE FATIGUE TESTING---





LL DIMENSIONS ARE IN MILLIMETRES

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/147

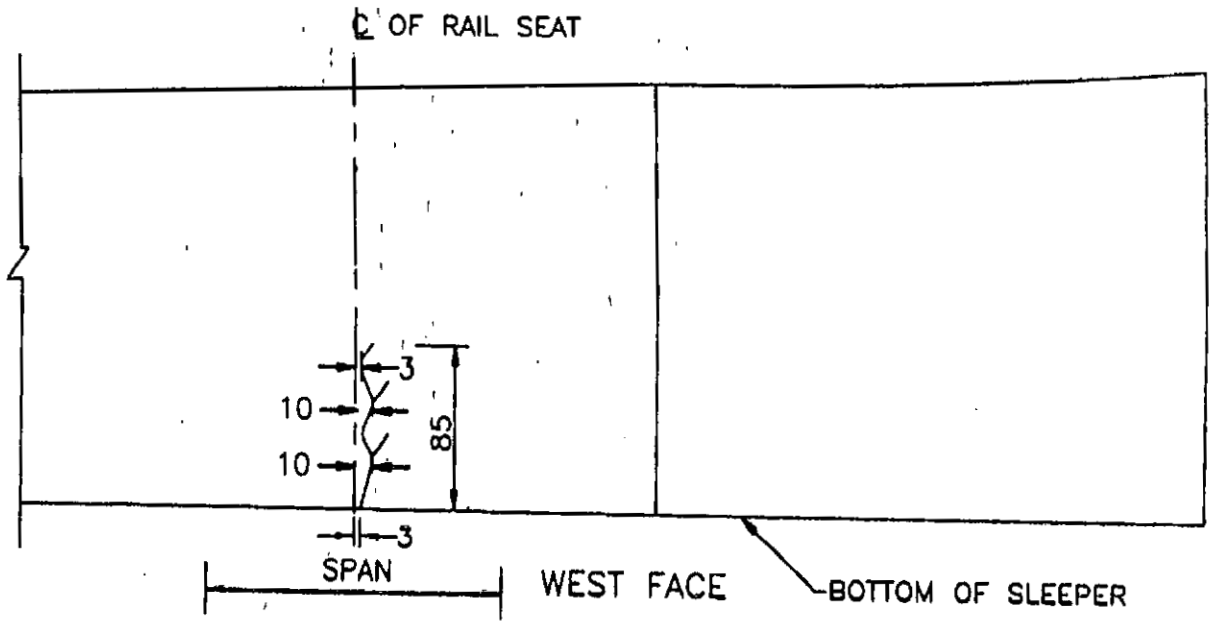
LOAD:- 18.5T(Max.) TO 2.5T(Min.)

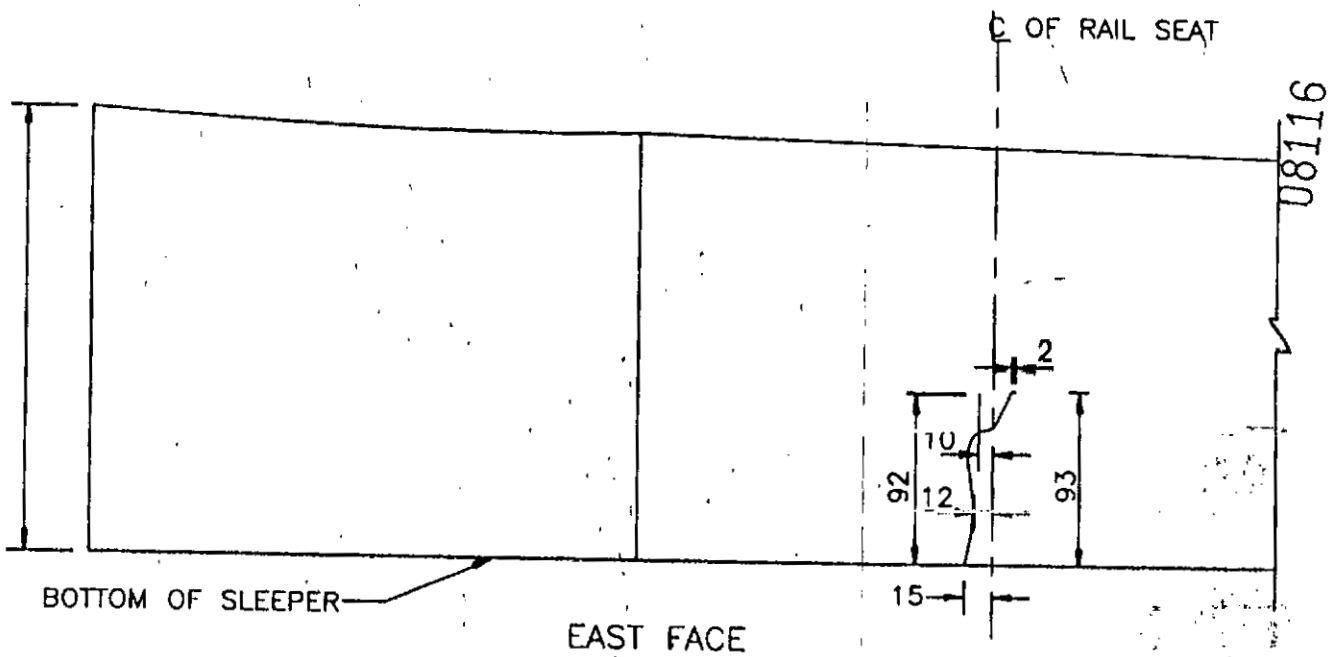
SLEEPER No.:- 1

SPAN:- 650MM.

RAIL SEAT No.:- A

POSITION OF CRACK AFTER 2.0 MILLION CYCLES OF TESTING





ALL DIMENSIONS ARE IN MILLIMETRES

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/147

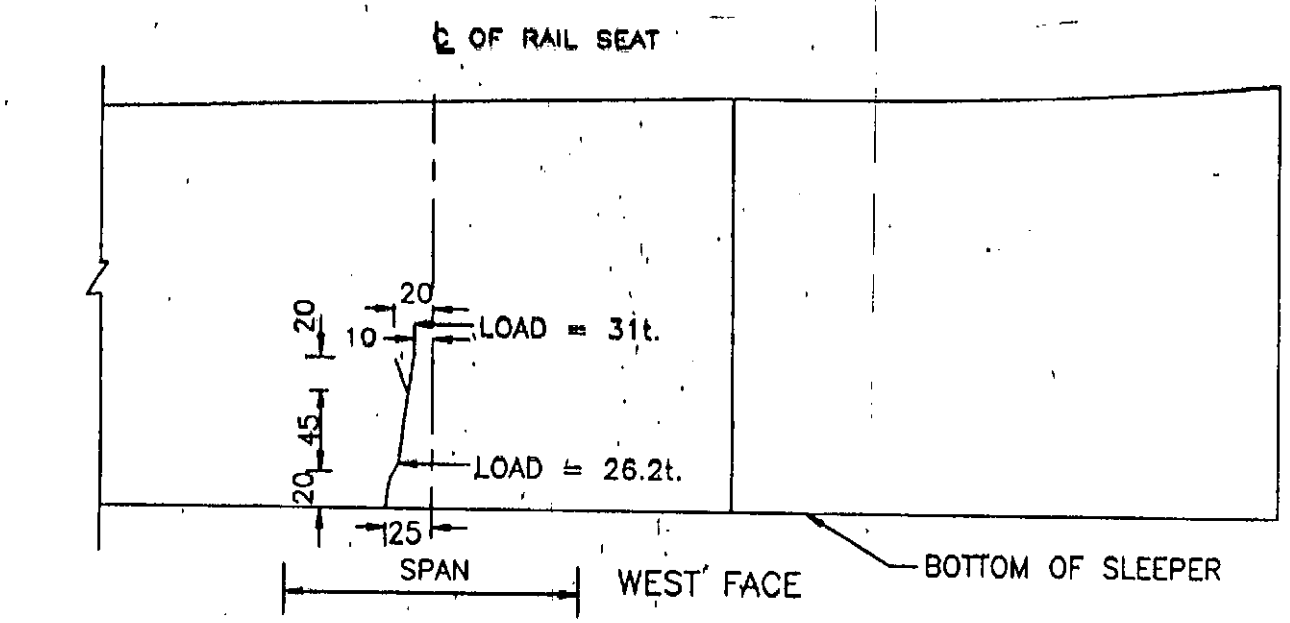
LOAD:- 26.2t TO 31t

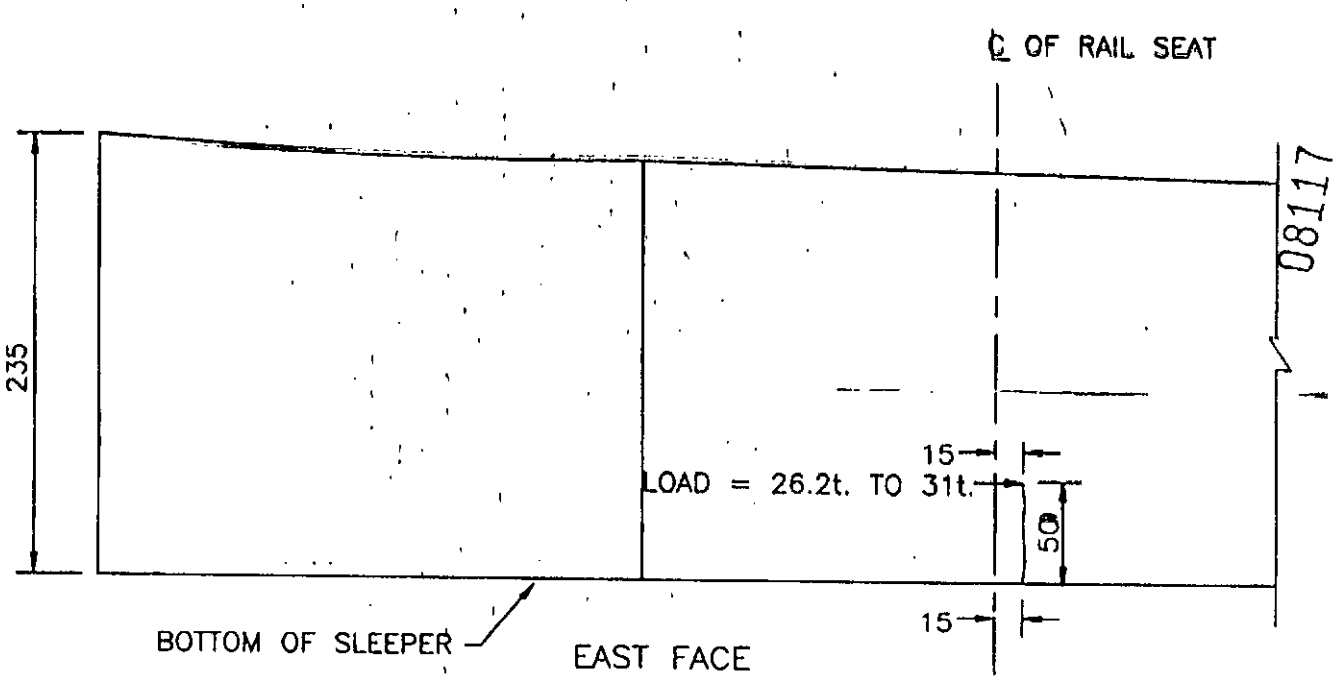
SLEEPER No.:- 1

SPAN:- 650MM

RAIL SEAT No.:- B

TESTING UNDER STATIC CONDITION





ALL DIMENSIONS ARE IN MILLIMETRES

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/148

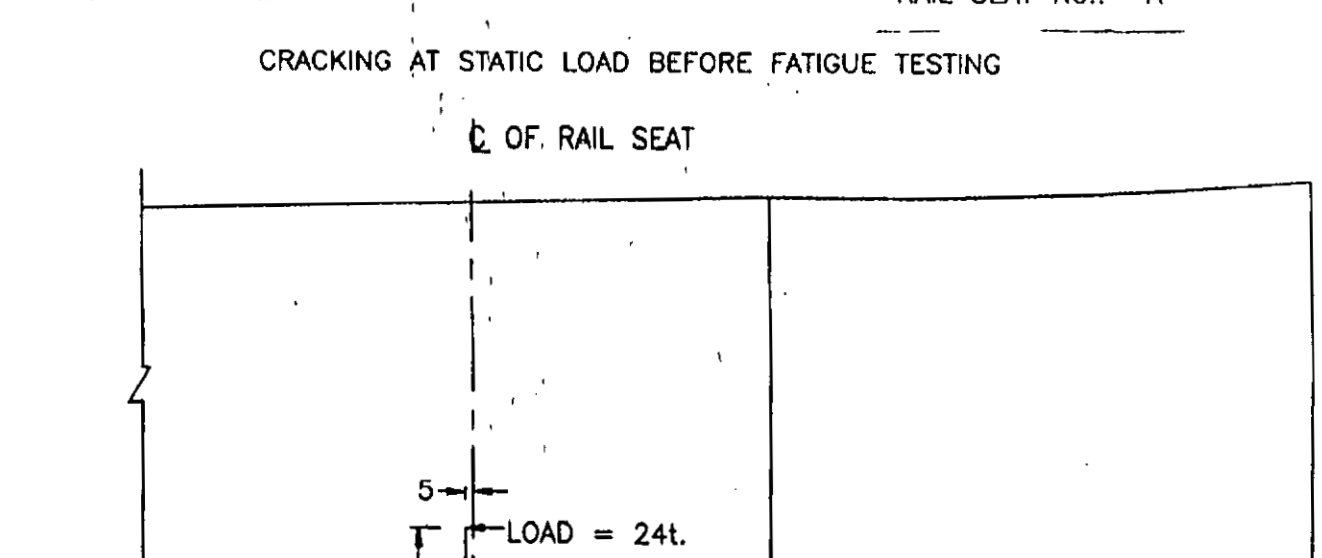
LOAD:- 24t.

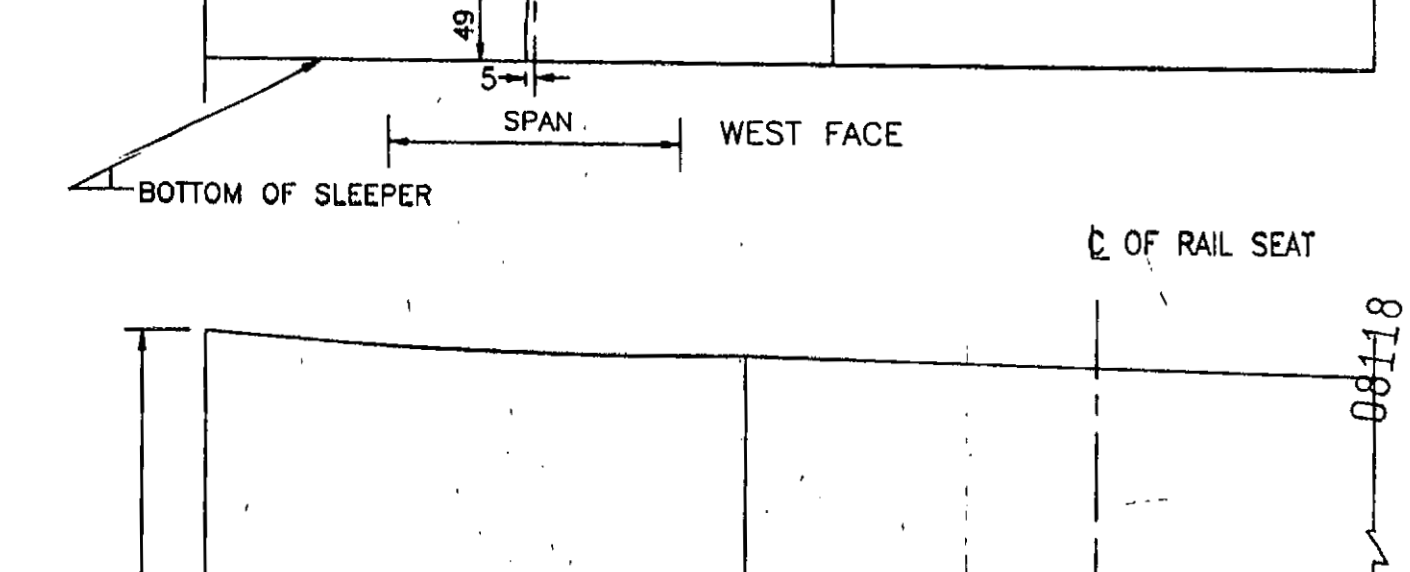
SLEEPER No.:- 2

SPAN:- 650MM

RAIL SEAT No.:- A

CRACKING AT STATIC LOAD BEFORE FATIGUE TESTING





ALL DIMENSIONS ARE IN MILLIMETRES

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/148

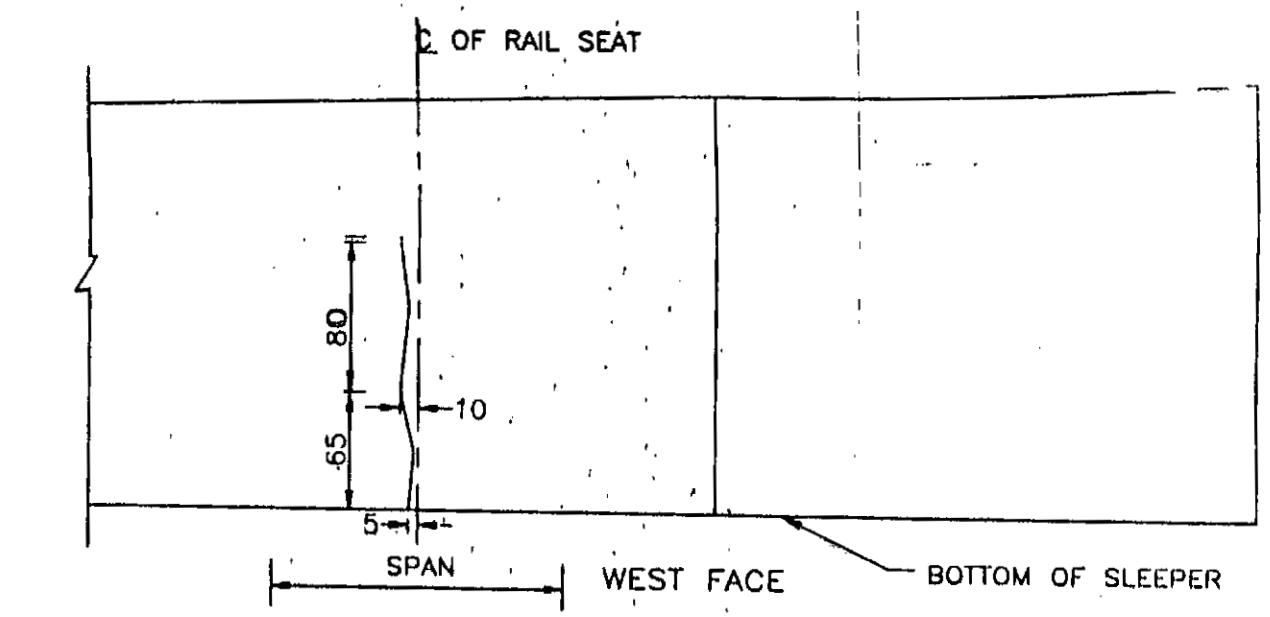
LOAD:- 18.5T(Max.) TO 2.5T(Min.)

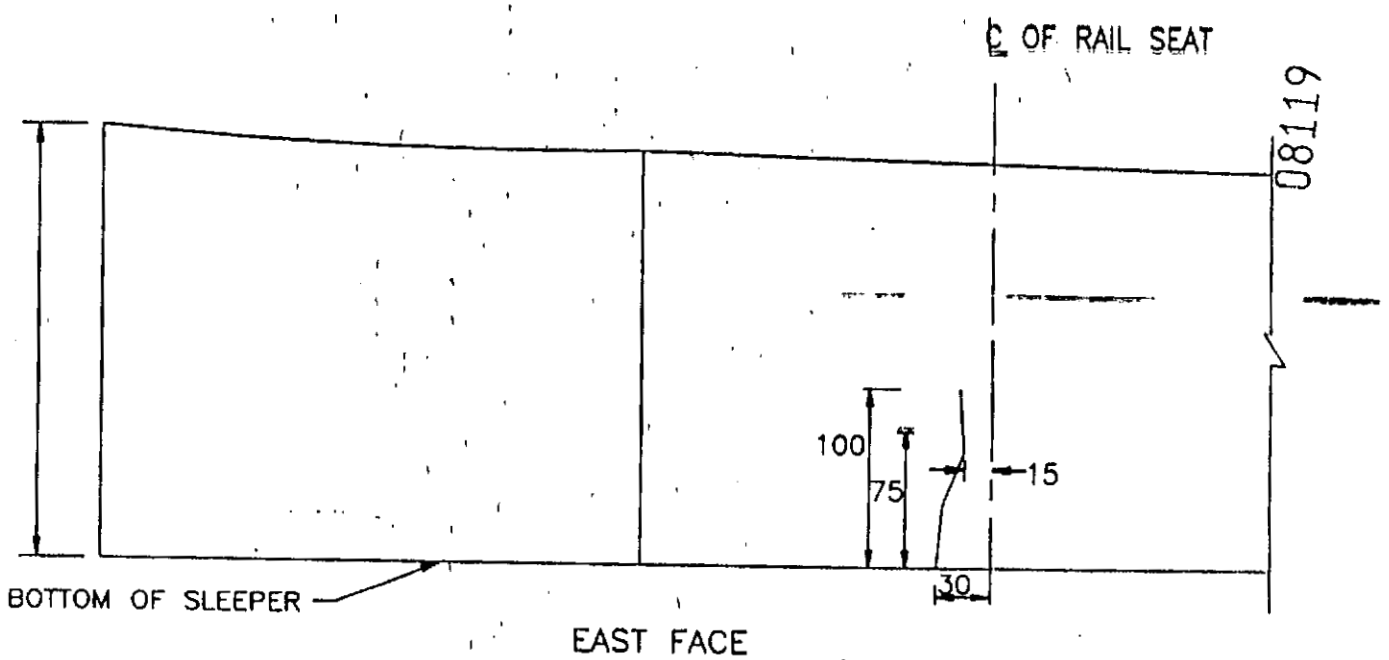
SLEEPER No.:- 2

SPAN:- 650MM

RAIL SEAT No.:- A

POSITION OF CRACK AFTER 2.0 MILLION CYCLES OF TESTING





DIMENSIONS ARE IN MILLIMETRES

ANNEXURE II/3

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/148

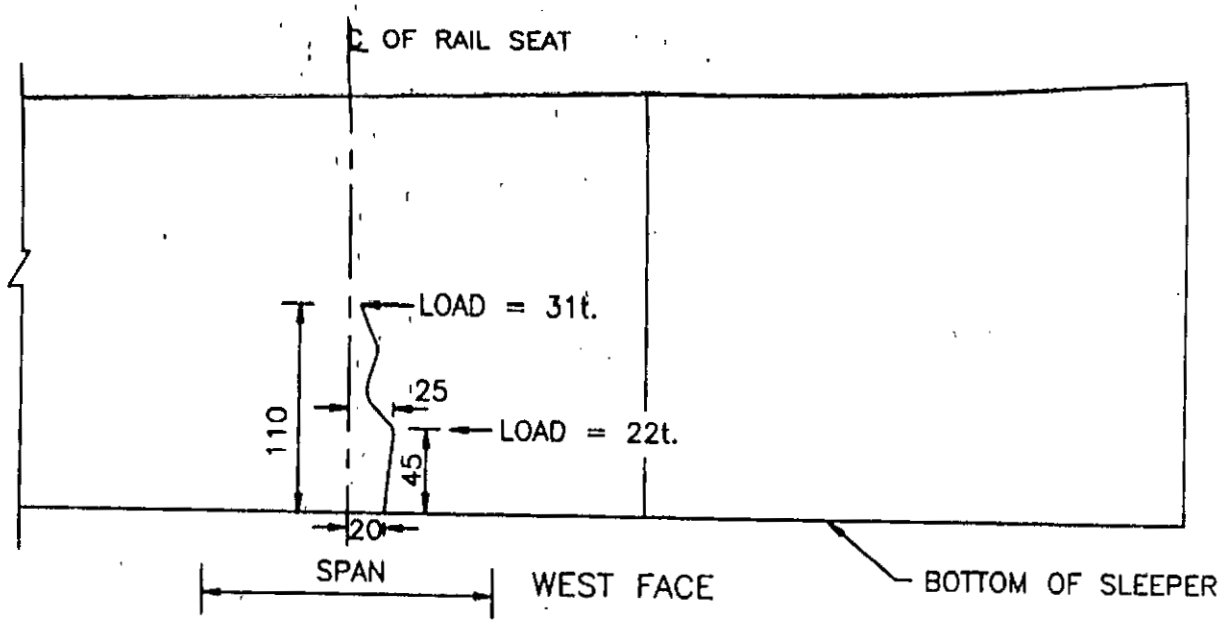
LOAD:- 22t. TO 31t.

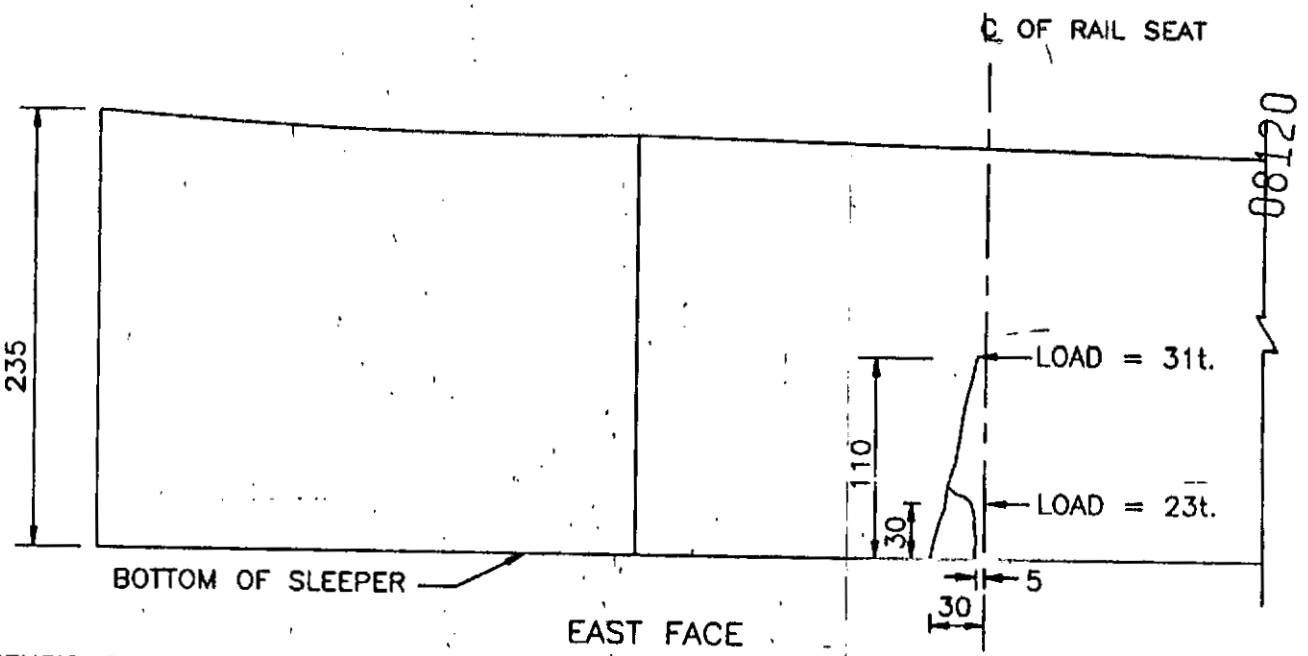
SLEEPER No.:- 2

SPAN:- 650MM

RAIL SEAT No.:- B

TESTING UNDER STATIC CONDITION





ALL DIMENSIONS ARE IN MILLIMETRES

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/149

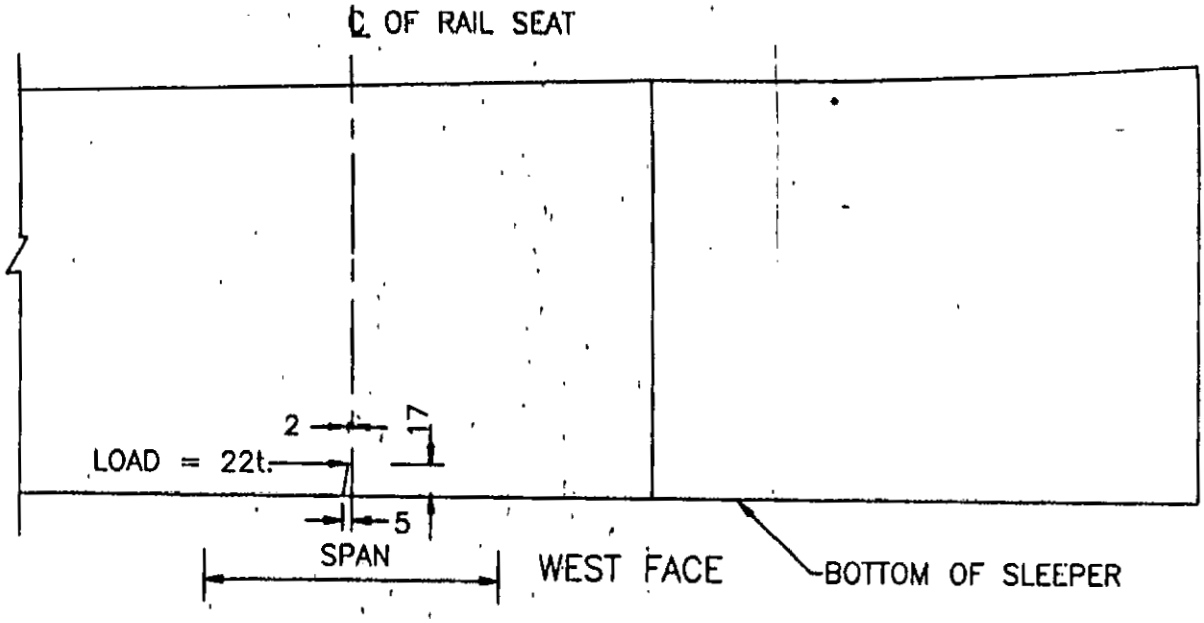
LOAD:- 22t.

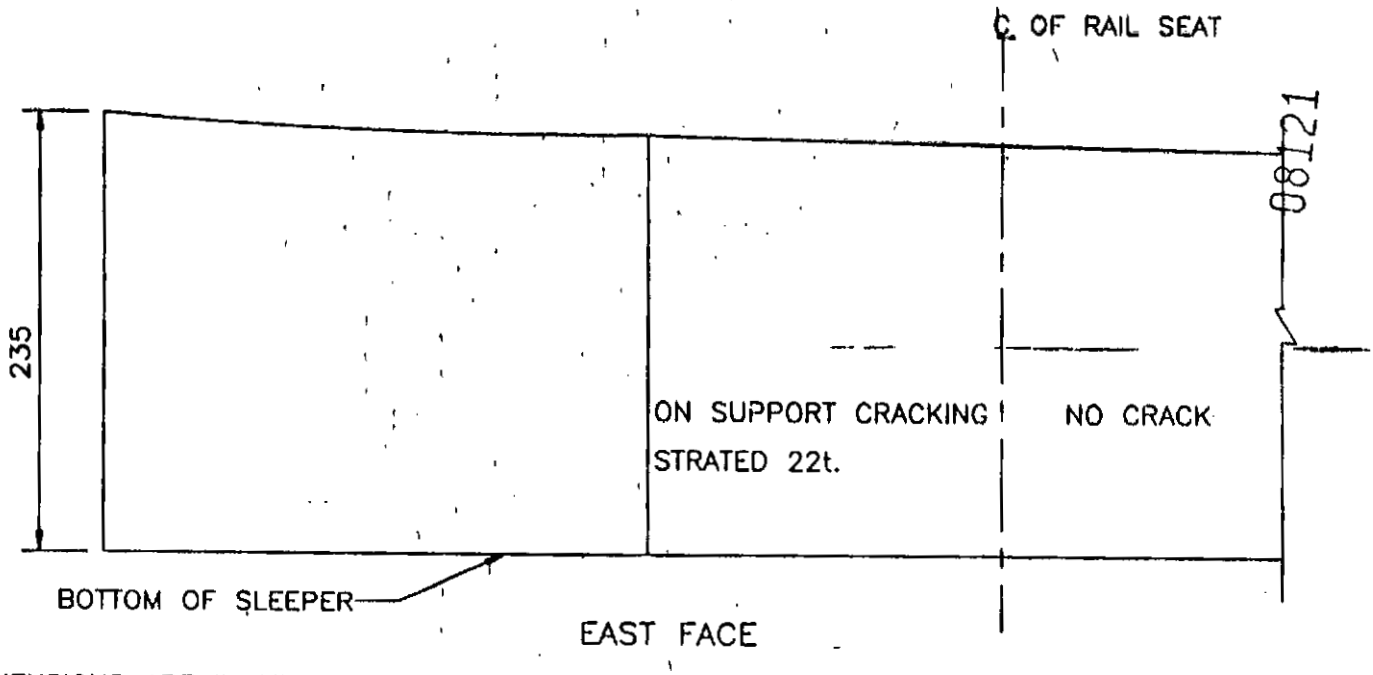
SLEEPER No.:- 3

SPAN:- 650MM.

RAIL SEAT No.:- A

CRACK AT STATIC LOAD BEFORE FATIGUE TESTING





ALL DIMENSIONS ARE IN MILLIMETRES

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/149

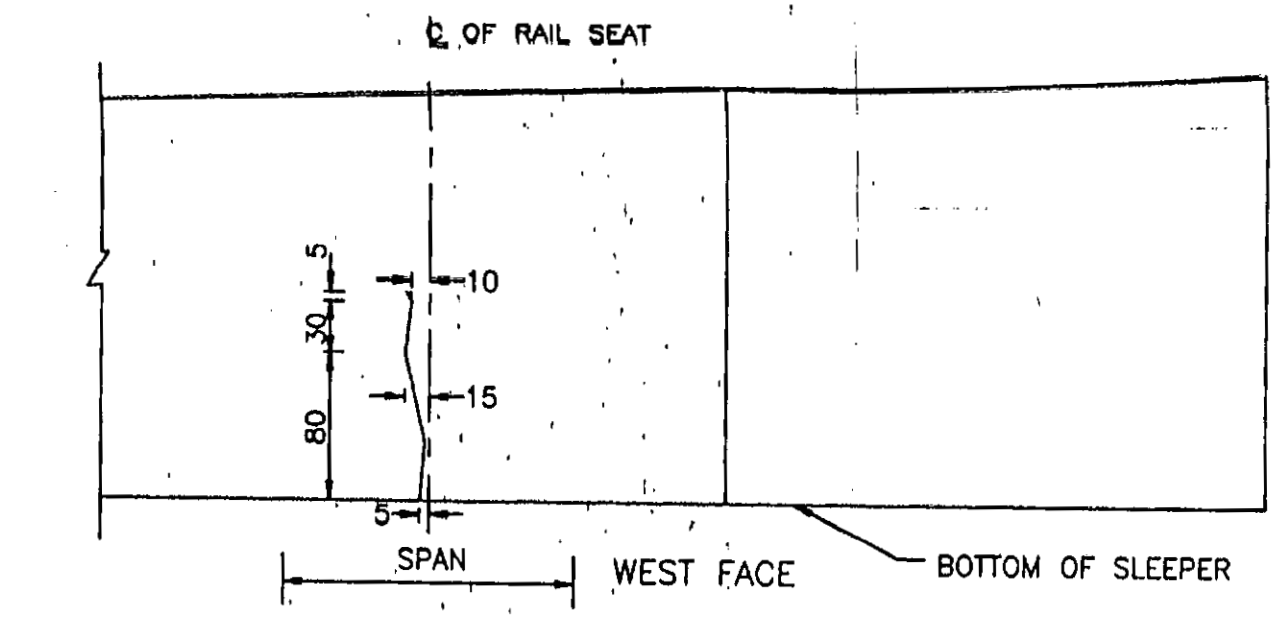
LOAD:- 18.5T(Max.) TO 2.5T(Min.)

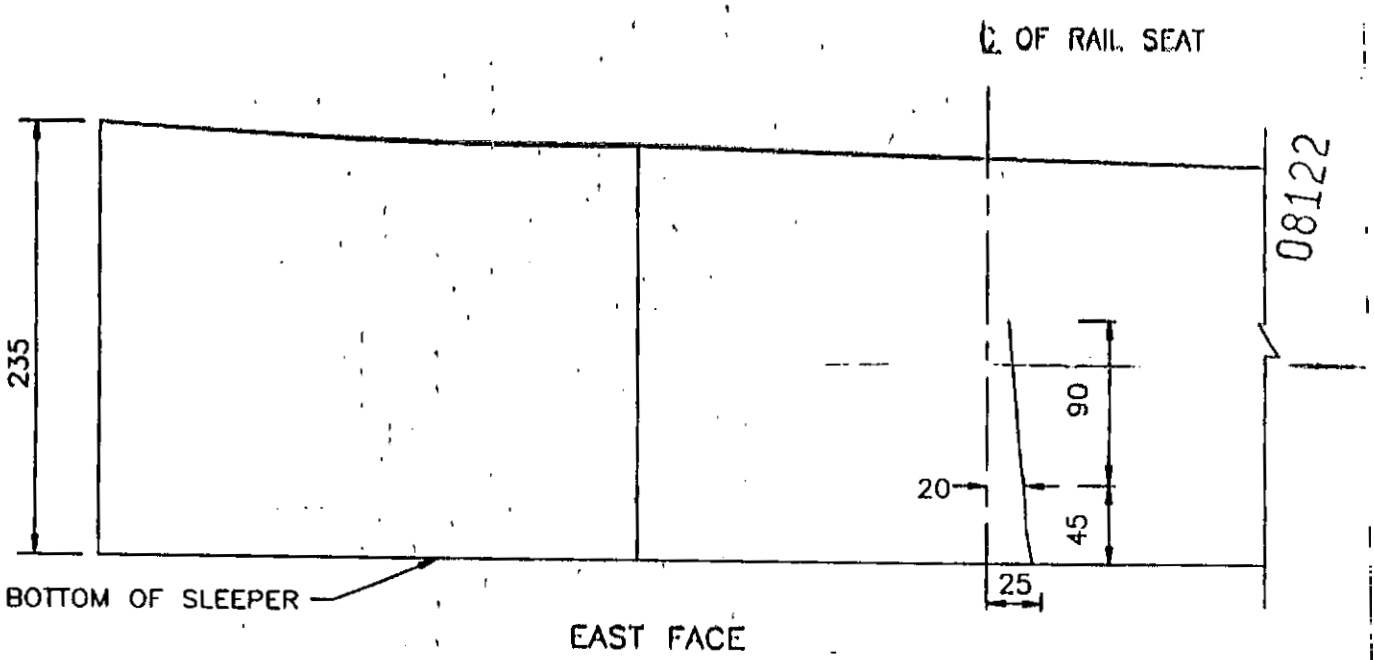
SLEEPER No.:- 3

SPAN:- 650MM

RAIL SEAT No.:- A

POSITION OF CRACK AFTER 2.0 MILLION CYCLES OF TESTING





ALL DIMENSIONS ARE IN MILLIMETRES

ANNEXURE III/3

SKETCH SHOWING THE CRACK PROPAGATION OF PRESTRESSED CONCRETE SLEEPER TO DRAWING No.RDSO/T-5476(UNDER PULSATOR)

JOB No.:- TL/99/149

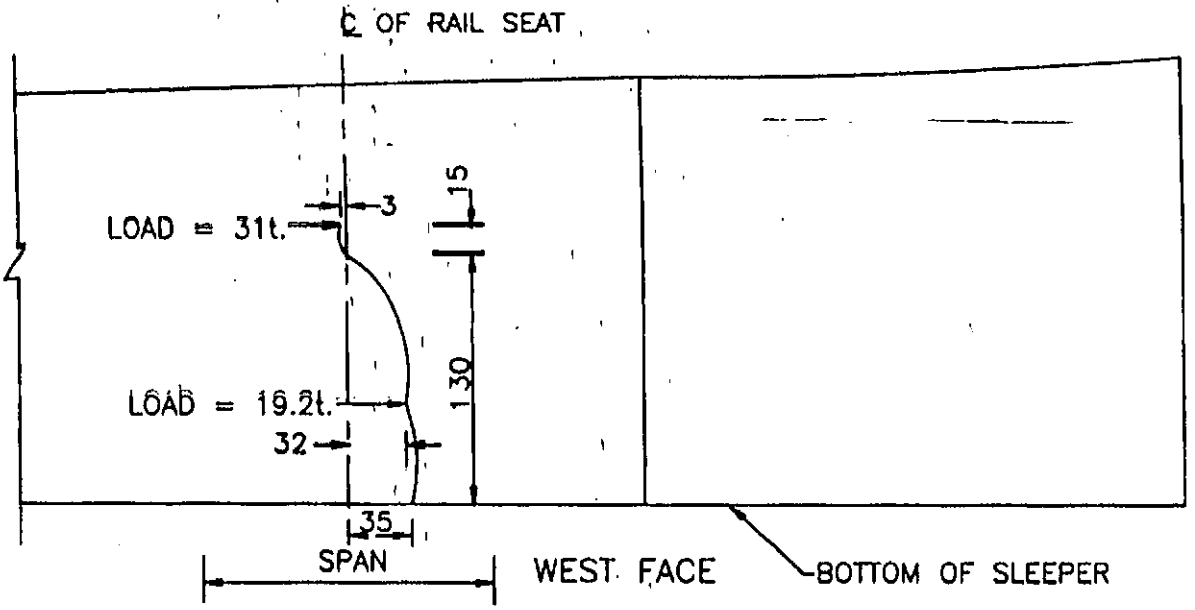
LOAD:- 19.2t.

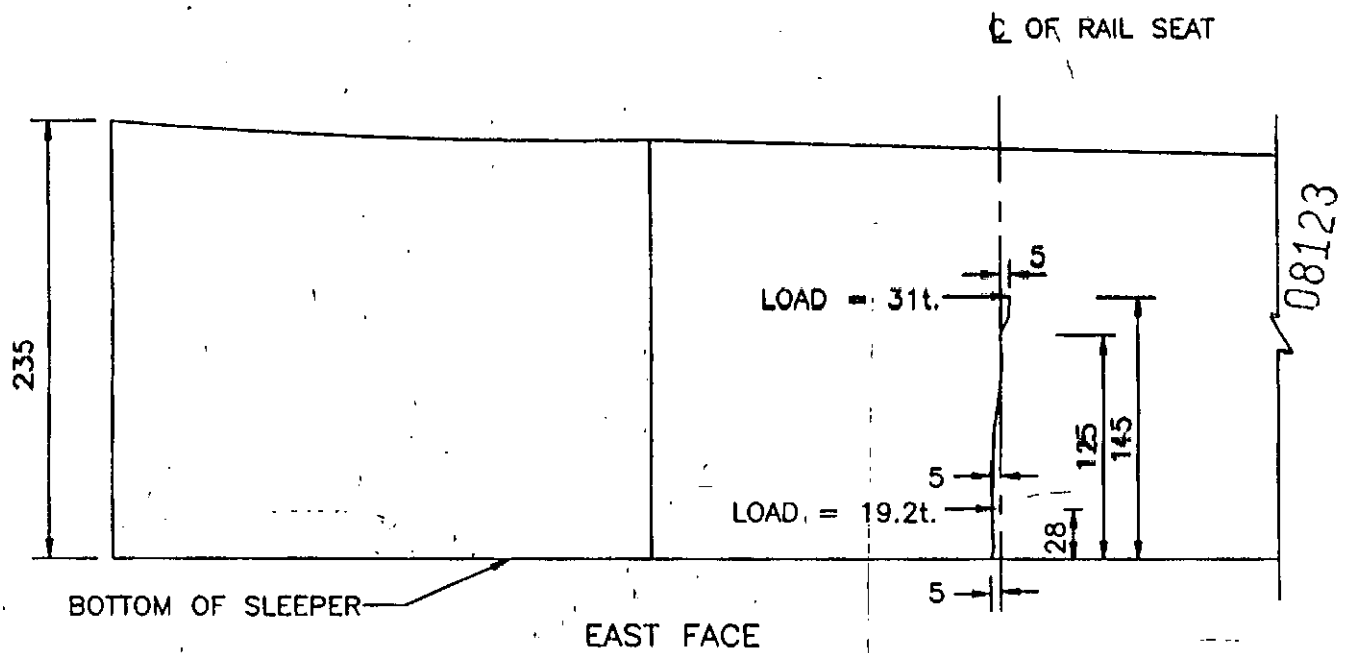
SLEEPER No.:- 3

SPAN:- 650MM.

RAIL SEAT No.:- B

TESTING UNDER STATIC CONDITION





ALL DIMENSIONS ARE IN MILLIMETRES

This report is based on the tests conducted on Conventional Pulsator Machine in Track Lab RDSO. Following officer/staff have been associated with conduct of tests and preparation of report under the guidance of Sri C. P. Gupta, JDTM-I

(1):	Sri Radhey Shyam	Assistant Research Engineer/Civil/TM
(2):	Sri Ram Autar	Chief Research Assistant/Civil/TM
(3):	Sri Jai Gobind	Junior Research Assistant/Civil/TM
(4):	Sri S. K. Bhattacharjee	Junior Research Assistant/Civil/TM
(5):	Sri O. P. Kapoor	Chief Design Assistant/TM