



सत्यमेव जयते

भारतीय राष्ट्रीय राजमार्ग प्राधिकरण

(सड़क परिवहन और राजमार्ग मंत्रालय, भारत सरकार)

National Highways Authority of India

(Ministry of Road Transport and Highways, Government of India)

जी-5 एवं 6, सेक्टर-10, द्वारका, नई दिल्ली - 110 075 • G-5 & 6, Sector-10, Dwarka, New Delhi-110075

दूरभाष/Phone : 91-11-25074100 / 25074200



भाराराप्रा/ नीति दिशानिर्देश / मानक दस्तावेज/ 2026 नीति परिपत्र सं. 11.91 / 2026 दिनांक 21st अप्रैल, 2026

{(ई-ऑफिस फाइल सं. आरएमडीआईवी/3/2026-एचओयू डिवीजन (कम्प्युटर सं. 312079 पर लिया गया निर्णय)}

NHAI/ Policy Guidelines/ Standard Documents /2026

Policy Circular No. 11.91 / 2026 dated 21st April, 2026

{(Decision taken on E-Office File No. RMDIV/3/2026-HOUDivision (Comp No. 312079)}

विषय: फ्लेक्सिबल फुटपाथों पर फॉलिंग वेट डिफ्लेक्टोमीटर (एफ़डबल्यूडी) सर्वेक्षण करने और एकत्रित एफ़डबल्यूडी आंकड़ों की प्रविष्टि के विश्लेषण के लिए मानक संचालन प्रक्रिया (एसओपी) के संदर्भ में।

Sub: Standard Operating Procedure (SOP) for conducting Falling Weight Deflectometer (FWD) surveys on Flexible Pavements and analysis of collected FWD data - reg:

सड़कों की संरचनात्मक मजबूती का आकलन, उनकी स्थिति को समझने और उनका टिकाऊपन सुनिश्चित करने के लिए अत्यंत महत्वपूर्ण है। फॉलिंग वेट डिफ्लेक्टोमीटर (एफ़डबल्यूडी) परीक्षण सड़क की संरचनात्मक क्षमता निर्धारित करने में एक महत्वपूर्ण उपकरण है, जो बिटुमिनस परतों के नीचे छिपी उन खामियों का पता लगाने में सहायक होता है जो सामान्यतः आंखों से दिखाई नहीं देतीं। समय के साथ, अनुकूलित और आंकड़ा-आधारित अनुरक्षण और पुनर्वास रणनीतियों को विकसित करने के लिए एफ़डबल्यूडी आंकड़े और उसके विश्लेषण पर निर्भरता काफी बढ़ गई है।

The structural strength assessment of Pavement is crucial for understanding their condition and ensuring their longevity. The Falling Weight Deflectometer (FWD) test serves as a vital tool in determining Pavement Structural Capacity allowing detection of failures beneath the bituminous layers that are not visible to the naked eye. Over time, reliance on FWD data and its analysis has grown significantly to develop optimized, data-driven maintenance and rehabilitation strategies.

2. यद्यपि, यह देखा गया कि फील्ड यूनिटों को एफ़डबल्यूडी डेटा की व्याख्या और विश्लेषण में कई चुनौतियों का सामना करना पड़ रहा था, जिनका वर्तमान आईआरसी विनिर्देशों/संबंधित कोड/मैनुअल में पर्याप्त रूप से समाधान नहीं किया गया है। इन अनसुलझे मुद्दों के कारण फुटपाथ की स्थिति और शेष जीवन की अस्पष्ट, असंगत और कभी-कभी विरोधाभासी व्याख्याएं होती हैं, जिससे फुटपाथ के अनुरक्षण और पुनर्वास में एफ़डबल्यूडी आंकड़े की प्रभावशीलता सीमित हो जाती है।

However, it was observed that several challenges were being faced by Field Units in the interpretation and analysis of FWD data which are not addressed adequately in the current IRC specifications/ Relevant Codes/ Manual. These unresolved issues lead to ambiguous, inconsistent and sometimes contradictory interpretations of Pavement Condition and remaining life limiting the effectiveness of FWD data in guiding Pavement Maintenance and rehabilitation.

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3. तदनुसार, फ्लेक्सिबल फुटपाथों पर फॉलिंग वेट डिफ्लेक्टोमीटर (एफडब्ल्यूडी) सर्वेक्षण करने और एकत्रित एफडब्ल्यूडी आंकड़ों के विश्लेषण के लिए एक मानक संचालन प्रक्रिया (एसओपी) को अंतिम रूप दे दिया गया है। यह एसओपी फ्लेक्सिबल फुटपाथों की संरचनात्मक अखंडता के मूल्यांकन के लिए एक मानकीकृत पद्धति स्थापित करती है। विशिष्ट परीक्षण अंतराल, लोडिंग अनुक्रम और अनिवार्य पर्यावरणीय स्थितियों को परिभाषित करके, यह एसओपी सुनिश्चित करती है कि फुटपाथ परत की कठोरता का यथास्थान निर्धारण तीव्र और दोहराने योग्य हो। इसके अलावा, यह जटिल बैक-कैलकुलेशन और विश्लेषण के लिए एक संरचित ढांचा प्रदान करेगी, जिससे कच्चे विक्षेपण आंकड़ों को गतिशील मापांक, अवशिष्ट जीवन और आवश्यक सुदृढीकरण आवश्यकताओं के विश्वसनीय अनुमानों में परिवर्तित किया जा सकेगा।

Accordingly, a Standard Operating Procedure (SOP) for conducting Falling Weight Deflectometer (FWD) surveys on Flexible Pavements and analysis of collected FWD data has been finalised. The SOP establishes a standardized methodology for evaluating the structural integrity of flexible pavements. By defining specific testing intervals, loading sequences and mandatory environmental conditions, the SOP ensures that the in-situ characterization of pavement layer stiffness is both rapid and repeatable. Furthermore, it will provide a structured framework for complex back-calculation and analysis, transforming raw deflection data into reliable estimates of dynamic moduli, residual life and necessary reinforcement requirements.

4. फ्लेक्सिबल फुटपाथों पर फॉलिंग वेट डिफ्लेक्टोमीटर (एफडब्ल्यूडी) सर्वेक्षण आयोजित करने और एकत्रित एफडब्ल्यूडी आंकड़ों के विश्लेषण के लिए मानक संचालन प्रक्रिया (एसओपी) को कार्यान्वयन हेतु **अनुलग्नक-1** के रूप में संलग्न किया गया है।

The Standard Operating Procedure (SOP) for for conducting Falling Weight Deflectometer (FWD) surveys on flexible pavements and analysis of collected FWD data is enclosed herewith as **Annexure-I** for implementation.

5. यह सक्षम प्राधिकारी के अनुमोदन से जारी किया जाता है।

This issues with the approval of Competent Authority.

संलग्नक: यथोपरी।

Encl.: As stated above.

(सीएस. संजय कुमार पटेल/ CS. Sanjay Kumar Patel)

प्रभारी मुख्य महाप्रबंधक(समन्वय) (i/c) Chief General Manager (Coord.)

प्रति/ To:

भाराराप्रा मुख्यालय/आरओ/पीआईयू/सीएमयू/साइट कार्यालयों के सभी अधिकारी।
All Officers of NHAI HQ/ ROs/ PIUs/ CMUs/ Site Offices.

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PPS to Secretary, MoRTH for Kind Information.

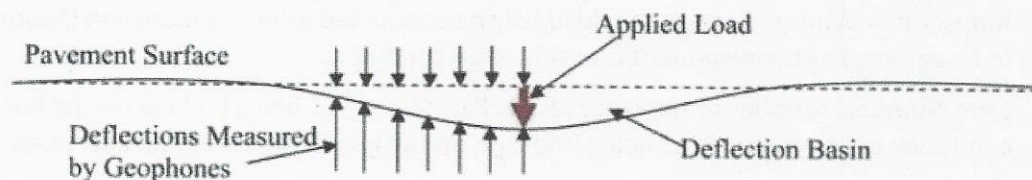
STANDARD OPERATING PROCEDURE (SOP) FOR CONDUCTING FALLING WEIGHT DEFLECTOMETER (FWD) SURVEYS ON FLEXIBLE PAVEMENTS AND ANALYSIS OF COLLECTED DATA

General Description

The Falling Weight Deflectometer (FWD) is a non-destructive testing (NDT) device. The FWD has been widely used in pavement engineering to evaluate pavement structural condition. The FWD plays a crucial role in selecting optimum pavement maintenance and rehabilitation strategies. The FWD is a tool used to achieve rapid and repeatable in-situ characterization of the pavement layer stiffness.

The principle

The FWD applies a transient impulse load simulating the dynamic load from a vehicle to the pavement surface. The pavement response (vertical deformation or deflection) at various distances from the loading plate are measured by a series of geophone sensors.



Using the deflection data, the following can be estimated:

- Dynamic E Moduli
- Residual Life
- Reinforcement Requirements

Frequency of FWD Survey:

Sl. No.	Scenario	Condition/ Trigger	Testing frequency
1.	Routine Monitoring	Latest NSV shows no functional pavement failures (Roughness, Rutting, Cracking within the permissible limits as per CA for more than 80% of the Lane length Surveyed)	Every 3 years.
2.	Early Warning	Latest NSV indicates moderate deterioration or localized failures (Roughness, Rutting, Cracking within the permissible limits as per CA for 50% to 80% of the Lane length Surveyed)	Every 1 years.
3.	Immediate Requirement	Significant pavement failure detected by Latest NSV (Roughness, Rutting, Cracking within the permissible limits as per CA for less than 50% of the Lane length Surveyed)	Immediately
4.	Project Transition	Change in O&M Contract, Handover, or shift to new modes (e.g. PBMC, STMC, Extra Widening, Strengthening, etc.)	Once before preparation of estimation.

Note: FWD Survey should not be performed on a newly constructed roads for 2 years and for overlay roads 1 years.

Section A: Project Identification and Survey Details

The following parameters need to be collected before conducting FWD Survey in the site:

1. **NH Number**- New National Highway number
2. **Section Code**- Code indicating starting and ending locations of section
3. **Survey Date**- Date of the survey
4. **Direction**- Direction of survey
 - a. Increasing (chainage)
 - b. Decreasing (chainage)
5. **Season**: Specify the season in which the FWD testing is being performed i.e., Summer, Monsoon or Winter. Surveys should ideally be conducted after the monsoon (September to November) as the pavement is in saturated condition.
6. **Lane Number**: Number of the lane: L1, L2, R1, R2, etc., L1 being 1st lane on the left from centreline of carriageway, L2 being 2nd lane on the left from center line and so on
7. **Pavement Condition**: Classify the Pavement into Good/ Fair/ Poor category based on the condition given in IRC 115 and latest NSV survey report, if available. Refer Table given below for reference.

Table 1 Criteria for Classification of Pavement Sections

Classification	Pavement Condition
Good	Isolated cracks of less than 3.0 mm width in less than 5% area of total paved surface AND average rut depth less than 10 mm
Fair	Isolated or interconnected cracks of less than 3.0 mm width in 5 to 20% area of total paved surface AND/OR average rut depth between 10 to 20 mm
Poor	Wide interconnected cracking of more than 3.0 mm width in 5 to 20% area (include area of patching and raveling in this) of paved area OR cracking of any type in more than 20% area of paved surface AND/OR average rut depth of more than 20 mm

8. **Interval of Conducting of FWD Test**: To ensure uniform data density across varying pavement conditions, the testing intervals for the FWD survey shall be standardized at 200 m if possible for Good/Fair/Poor Sections.

Note: It is advisable to perform rectification works for pavement sections with severe localized failures before FWD survey.

9. **Thickness of each layer, CBR of Sub-Grade Layer**: Find out the thickness of each layer and CBR of Sub-Grade by conducting test pits, cores, DCP (Dynamic Cone Penetrometer) tests and any other laboratory tests conducted. The spacing of the test should be every 5 Kms.

It is also directed to consider data incorporated during the original pavement design and any other past test data performed in the survey stretch, if any.

Note: It is mandatory that all test pits are backfilled with granular material duly compacted with hand rammer and reinstated with meticulous care.

10. **Chainage**- Chainage of every Test point (in km) is to be recorded.

11. **Latitude**: Latitude of every survey point is to be recorded.

12. **Longitude**: Longitude of every survey point is to be recorded.

Sample Data

Section A: Project Identification and Survey Details								
S.no	Side (LHS/RHS)	Lane	Time	Chainage	Pavement Condition	4-day Soaked CBR (%)	Thickness of each layers	
							Bituminous Layer Thickness	Base Layer Thickness
1	LHS	Inner	15-11-2023 06:42:32	180.097	Good	18.7	190	470
2	LHS	Inner	15-11-2023 06:44:39	180.296	Good	18.7	190	470
3	LHS	Inner	15-11-2023 06:58:46	180.508	Good	18.7	190	470
4	LHS	Inner	15-11-2023 06:59:57	180.702	Good	18.7	190	470
5	LHS	Inner	15-11-2023 07:01:08	180.925	Good	18.7	190	470

Section B: Test Loading and Deflection Measurements

The FWD data has to be collected as per the IRC 115:2014 and is mentioned below:

1. Prepare the FWD unit for deflection testing
2. Bring the FWD to a stopped position at the beginning of the test section making sure the pavement surface where the testing is going to be conducted must be free from surface defects and centered on the outer wheel path (or specific position), and take a measurement by applying load using following sequence:
 - a. One settling drop to ensure proper contact.
 - b. Three drops with an applied load of 40 KN \pm 10% (or Specified Load).

Note: It is advised to not conduct FWD Survey if the surface is in wet condition.

The following parameters needs to be collected during FWD Survey in the site:

1. **Stress/Contact Pressure:** Vertical stress applied on the pavement surface by FWD load plate.
2. **Standard Load:** Standard vertical load applied by the FWD weight system during test.
3. **Deflection:** deflection values measured at geophones/deflection sensors placed at specific distances from the center of the FWD load plate. Also, Specify the distance from the center of the plate.

Note: Nine (9) deflection geophones/deflection sensors configuration shall be used for better accuracy and reliability.

4. **Air Temperature:** Ambient air temperature at the time of FWD testing.
5. **Surface Temperature:** Temperature of the asphalt pavement surface is to be measured once in every 1 Km. It is advisable to conduct FWD testing to a controlled temperature range (near to Standard Temperature i.e. 35°C) to ensure data uniformity and reliable analysis. Detailed table for selecting pavement temperature is given below:

Category	Pavement Temperature	Air Temperature	Impact on Testing Reliability
Good	25 to 40° C	15 to 30° C	Minimal correction factors required; High confidence in backcalculated modulus.
Fair	20 to 25° C and 40 to 45° C	10 to 15° C and 30 to 40° C	Dependency on correction factor is more.
Poor	Less than 20° C and More than 45° C	Less than 10° C and More than 40° C	Needs to be cross checked what standard temperature was considered during design. Also needs to be cautious while selecting the range of bituminous layers.

Section B: Test Loading and Deflection Measurements										
Load(N)	Stress(MPa)	Measured Deflections at various sensors								
		D0 (mm) 0 mm	D1 (mm) 200 mm	D2 (mm) 300 mm	D3 (mm) 450 mm	D4 (mm) 600 mm	D5 (mm) 900 mm	D6 (mm) 1200 mm	D7 (mm) 1500 mm	D8 (mm) 1800 mm
40000	0.56	0.19628	0.14510	0.11984	0.11559	0.09705	0.06850	0.04503	0.03833	0.03110
40000	0.56	0.19516	0.14505	0.11767	0.11372	0.09829	0.06780	0.04610	0.03651	0.02472
40000	0.56	0.18220	0.15171	0.10084	0.06948	0.06291	0.04932	0.04332	0.03337	0.02577
40000	0.56	0.18773	0.15871	0.11849	0.08939	0.06449	0.05804	0.04949	0.03429	0.02280
40000	0.56	0.19070	0.14656	0.10752	0.07224	0.06328	0.05103	0.04674	0.03242	0.02108

Section-C: Back calculation Inputs & Constraints

- Normalized Deflection:** Deflections measured at different locations of the homogeneous section are normalized for 40 kN.
- Poisson's Ratio:** Use values of Poisson's ratio as 0.5, 0.4, and 0.4 for Bituminous layer, Base layer and Sub-Grade layer respectively as specified in IRC 115:2014.
- Range of E Value:** Ranges of different layer moduli is given as input to KGPBACK for back-calculation. These ranges have to be selected judiciously by experienced pavement engineering taking into considerations the approximate age of pavement, visual assessment of the condition of bituminous layer, Marshall Stability Test and Static Indirect Tensile Strength Test of bituminous layer cores, climatic conditions prevailing at the time of deflection measurements and information available from test pits, cores of bituminous layers i.e. crack propagation (from bottom or from top and depth of crack) & de-lamination in the cores, DCP tests and laboratory tests conducted.

Note: The Marshall Stability Test and Static Indirect Tensile Strength Test for used for determination of E-values need to be performed only once in the stretch.

- Range of modulus value of existing subgrade:** To minimize variability, the subgrade modulus should be determined by considering the union of all three

IRC:115-2014 ranges given in the table below, ensuring that the most representative value is selected.

S. No.	Parameter	Range of E moduli
1.	Empirical Formula	20-100 MPa
2.	Based on Sub-Grade CBR	5*CBR – 20*CBR
3.	Based on Deflection data	$1.2*0.8*E_{subgrade} - 1.2*1.2*E_{subgrade}$ $E_{subgrade} = \frac{(1 - \mu^2) \cdot P}{3.14 \cdot r \cdot w}$ Where, E _{subgrade} = Subgrade Modulus (MPa) μ = Poisson's Ratio of Sub-Grade P = Applied Load(N) r = Average of radial distances (example 1200 mm, 1500 mm and 1800 mm w (mm) = average of surface deflections measured at 1200 mm, 1500 mm and 1800 mm (if available) radial distances.

- b. **Range of modulus value of existing base layers:** The range of modulus value as suggested in IRC 115:2014 is given in table below.

Sl. No.	Type of Base Layer	Range of Base layer
1.	WMM/WBM/GSB	100-500 MPa
2.	CTSB	100-600 MPa
3.	CTB with AIL or SAMI /Geogrids /RAP	100-800 MPa

- c. **Range of modulus value of bituminous layers:** The range of modulus value as suggested in IRC 115:2014 is

Bituminous Layer - thick layers without much cracking: 750 MPa to 3000 MPa

Bituminous Layer in distressed condition (Fair to Poor): 400 MPa to 1500 MPa

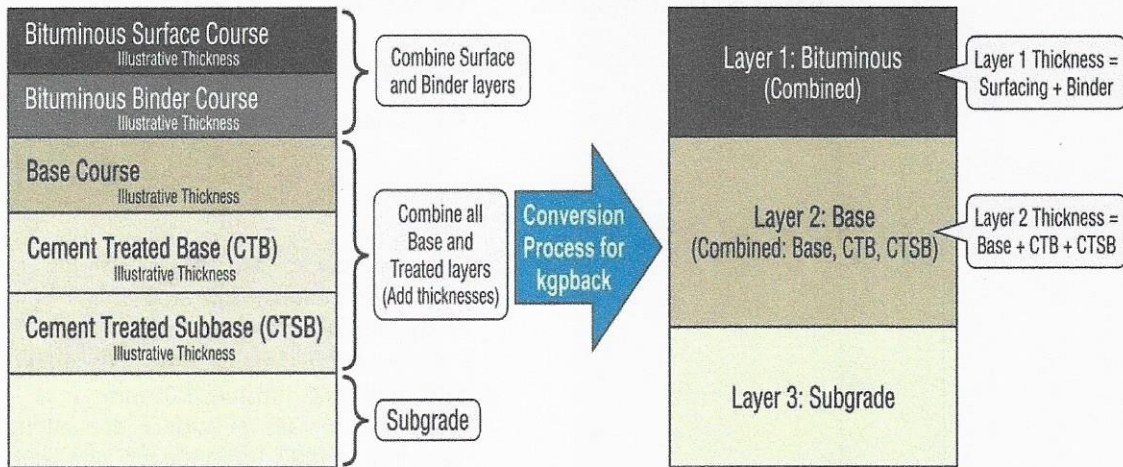
Section-C: Back calculation Inputs & Constraints					
Range of E values					
Bituminous Layer		Base Layer		Sub-Grade Layer	
Bit. E lower Range	Bit. E upper Range	Base E lower Range	Base E upper Range	Sub-Grade E lower Range	Sub-Grade E upper Range
750	3000	100	500	93.5	374.0
750	3000	100	500	93.5	374.0
750	3000	100	500	93.5	374.0

Note: If Flexible Pavement contains Four layers or more then the extra layer i.e., CTB, CTSB, etc. in between needs to be combined in base layer (thickness of base layer is the addition of the thickness of all the layers which are being combined) and the range of base layer is to be given as given in the table above. This is an **interim solution** and will be updated in the future.



Original Multi-Layer Flexible Pavement

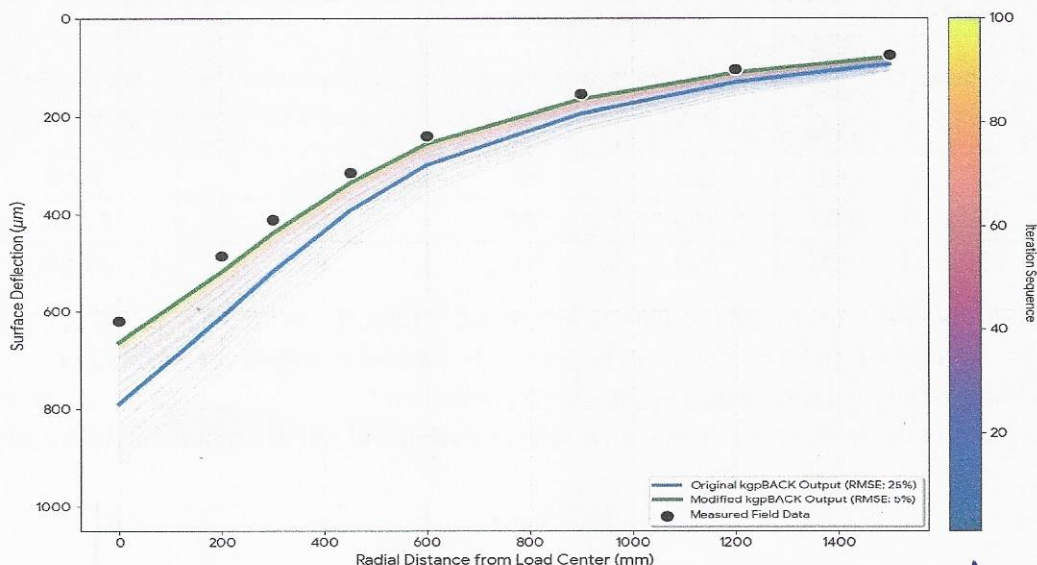
Simplified 3-Layer System for kgpback



Section-D: Back calculated Elastic Moduli & RMSE Error

1. **Back calculated Elastic Modulus Bituminous E1:** Elastic modulus of bituminous layer(s) computed by backcalculation software i.e., KGPback software by matching measured deflection bowl to theoretical model.
2. **Back calculated Elastic Modulus Granular E2:** Elastic modulus of granular base/sub-base layer computed by backcalculation software i.e., KGPback software by matching measured deflection bowl to theoretical model.
3. **Back calculated Elastic Modulus Sub-Grade E3:** Elastic modulus subgrade layer computed by backcalculation software by matching measured deflection bowl to theoretical model.
4. **RMSE Error:** To check the accuracy of Deflection data. RMSE Error needs to be calculated as per the methodology given below:

FWD Convergence Analysis: Original Vs Modified KgpBack Outputs



Step 1: Give the following input to IIT Pave:

- a. No. of Layer: 3
- b. E of each layer: As predicted by Kgpback.
- c. Poisson's ratio of each layer: Same as given in Kgpback
- d. Thickness of each layer
- e. Single wheel load
- f. Load: 40000(N)
- g. Stress: 0.56 MPa
- h. Number of Test point: Same as the number of Geophone and spacing should be same as the one used in the site.
 - i. Point 1: z=0, r=0
 - ii. Point 2: z=0, r=200
 - iii. Point 3: z=0, r=300
 - iv. Point 4: z=0, r=450
 - v. Point 5: z=0, r=600
 - vi. Point 6: z=0, r=900
 - vii. Point 7: z=0, r=1200
 - viii. Point 8: z=0, r=1500
 - ix. Point 9: z=0, r=1800

Note: The above 9 points are just for visualization. The points need to be same as per the geophone's setup used during the survey.

Step 2: Get the Predicted Displacement Value from IIT Pave

Now in the output of IIT Pave. Note the DispZ value. This will become the **Predicted/Measured Displacement value**. The value collected from site will be treated as the **Actual Displacement value**.

Step 3: Calculate the RMSE Error

Calculate the RMSE Error as per the formula given below:

$$\%RMSE = \frac{100}{\bar{d}} \sqrt{\frac{\sum_{i=1}^n (d_{ci} - d_{mi})^2}{n}}$$

Where:

- d_{mi} = **Measured deflection** at the i^{th} sensor.
- d_{ci} = **Calculated (theoretical) deflection** at the i^{th} sensor (e.g., from IITPAVE).
- n = **Total number of sensors** (typically 6 to 9 in standard FWD setups).
- \bar{d} = **Mean of the measured deflections** across all sensors ($\frac{1}{n} \sum d_{mi}$).

Note: This process needs to be repeated for every test point. The process has been automated and the code will be also shared.

Acceptance Criteria on the basis of RMSE Error: Acceptance criteria given below is still in interim stage and the range will get redefined as more and more FWD results are collected from site.

RMSE% Range	Quality Rating	Action Required
< 5.0%	Excellent	Proceed; optimal fit
5.0-10.0%	Good/Acceptable	Proceed; standard for IRC projects
10.0-20.0%	Fair/Marginal	Review layer inputs; re-run if possible
> 20.0%	Poor/Unacceptable	Adjust initial moduli estimates; invalid fit

Section-D: Back calculated Elastic Moduli & RMSE Error			
Predicted Values			RMSE Using IITPAVE(%)
Bituminous (E1)	Base (E2)	Sub-Grade (E3)	
2997.8	386.2	190.3	7.16
2967.0	334.6	208.9	9.12
1803.5	499.2	245.1	11.46
1774.9	451.9	228.7	10.23
1447.2	496.5	249.2	9.32
3000.0	341.6	357.8	18.90
2876.8	500.0	373.7	49.70
1847.5	388.6	374.0	11.11

Section-E: Temperature & Seasonal Corrections

- Lambda (λ) (if required)-Temperature Correction Factor:** Multiplicative correction factor applied to bituminous layer modulus to normalize from test temperature to standard reference temperature i.e., 35° C in most cases. In colder areas and areas of altitude greater than 1 000 m where the average daily temperature is less than 20°C for more than 4 months in a year, the standard pavement temperature of 35°C will not apply. In the absence of adequate data about deflection performance relationship, it is recommended that deflection measurements in such areas be made when the ambient temperature is greater than 20°C. No temperature correction needs to be applied for backcalculated moduli of bituminous layers in this case. λ should be calculated as per the formula given in IRC 115:2014.

λ , temperature correction factor, is given as

$$\lambda = \frac{1 - 0.238 \ln T_1}{1 - 0.238 \ln T_2}$$

E_{T_1} = backcalculated modulus (MPa) at temperature T_1 (°C)

E_{T_2} = backcalculated modulus (MPa) at temperature T_2 (°C)

2. **Corrected Elastic Modulus** : Elastic layer modulus after applying temperature/seasonal correction to normalize to standard reference condition. The seasonal correction factor needs to be applied as per formula given in IRC 115:2014.

$$E_{sub_mon} = 3.351 * (E_{sub_win})^{0.7688} - 28.9$$

$$E_{sub_mon} = 0.8554 * (E_{sub_sum}) - 8.461$$

where,

E_{sub_mon} = subgrade modulus in monsoon (MPa)

E_{sub_win} = subgrade modulus in winter (MPa)

E_{sub_sum} = Subgrade modulus in summer (MPa)

$$E_{gran_Mon} = - 0.0003 * (E_{gran_Sum})^2 + 0.9584 * (E_{gran_Sum}) - 32.989$$

$$E_{gran_Mon} = 10.5523 * (E_{gran_win})^{0.624} - 113.857$$

where,

E_{gran_mon} = granular layer modulus in monsoon (MPa)

E_{gran_win} = granular layer modulus in winter (MPa)

E_{gran_sum} = granular layer modulus in summer (MPa)

- Corrected Elastic Modulus Bituminous E1:** Bituminous layer modulus after applying temperature/seasonal correction to normalize to standard reference condition
- Corrected Elastic Modulus Granular E2:** Granular layer modulus after seasonal correction (if applicable)
- Corrected Elastic Modulus Sub-Grade E3:** Subgrade modulus after seasonal correction (if applicable)

Section-E: Temperature & Seasonal Corrections			
Lemda	Field Moduli After Temp & Seasonal Corrections		
	Bituminous (E1)	Base (E2)	Sub-Grade (E3)
0.73	2183.2	320.2	160.6
0.73	2169.6	283.0	174.7
0.74	1335.2	395.5	201.3
0.74	1314.0	364.9	189.4
0.74	1075.8	393.8	204.3

Section-F: Homogenous Section Analysis

1. **Homogeneous block limits:** Chainage range (From-To) of a homogeneous section where pavement structure and condition are similar, allowing application of single design moduli set. The analysis must be carried out in each lane km to get a consistent and uniform remaining life.
2. **Length:** Length of the homogeneous section where pavement structure and condition are similar, allowing application of single design moduli set. As per the above point, the length of each homogenous block should be 1 Km.
3. **Block-wise 15th percentile for Elastic moduli:** 15th percentile (lower bound characteristic value) of corrected elastic moduli across all test points within the homogeneous block.
 - a. **Block-wise 15th percentile for Bituminous Layer:** 15th percentile of corrected bituminous modulus E1 within the block.
 - b. **Block-wise 15th percentile for Granular Layer:** 15th percentile of corrected granular layer modulus E2 within the block.
 - c. **Block-wise 15th percentile for Sub-Grade Layer:** 15th percentile of subgrade modulus E3 within the block.

Section-F: Homogenous Section Analysis						
S.no	Chainage		Length (Km)	15th Percentile E Value		
	From	To		Bituminous Layer	Granular Layer	Subgrade
1	180.000	181.000	1.000	1218.70	305.29	169.05
2	181.000	182.000	1.000	1379.99	274.37	271.47
3	182.000	183.000	1.000	2208.35	275.42	250.13

Section G: Pavement Design & Analysis Results

1. **Fatigue Strain:** Critical horizontal tensile strain at the bottom of bituminous layer calculated using elastic multi-layer theory with the 15th percentile moduli and existing layer thicknesses. It should be calculated using the IIT Pave software.

2. **Rutting Strain:** Critical vertical compressive strain on top of subgrade layer calculated using multi-layer elastic theory. It should be calculated using the IIT Pave software.
3. **Fatigue Residual Life:** Remaining design life (in Million Standard Axles = MSA) the pavement can carry before reaching fatigue failure criterion of the bituminous layer, using current structure. It should be calculated using the equation given in IRC 115:2014.
4. **Rutting Residual Life:** Remaining design life (MSA) before reaching rutting failure criterion at subgrade, using current structure. It should be calculated using the equation given in IRC 115:2014.
5. **Remaining Life as per 90% Reliability:** Governing remaining design life (minimum of fatigue and rutting lives) adjusted for 90% reliability level.

Section G: Pavement Design & Analysis Results				
Fatigue Strain (mm)	Rutting Strain (mm)	Fatigue Residual Life (MSA)	Rutting Residual Life (MSA)	Remaining Life (MSA) as per 90% Reliability
0.0001862	0.0001489	53.25	3163.49	53.25
0.0001843	0.0001087	49.83	13175.44	49.83
0.0001374	0.0001045	104.54	15752.58	104.54

Section-H: Overlay Design

Note: If there is an overlay requirement in the stretch it has to be designed as per latest IRC 37 and IRC 115 guidelines.