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Flexible pavement evaluation by falling weight deflectometer test using IIT-Pave and KGP Back Software

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ABSTRACT

It is now possible to regularly apply an analytical-empirical (or mechanistic) method of structural pavement evaluation because to the rapid development of technology and software over the past ten years. It is described how to determine the modulus of each structural layer in a pavement system. These moduli are determined non-destructively and in situ under conditions very similar to those caused by heavy traffic. The method is analyzed using empirical evidence, and some practical examples are given to illustrate its use. An analytical-empirical approach is recommended for the structural design of pavement systems. An "analytical method" or a "mechanistic method," as it has an important empirical component, is often referred to as such, and therefore the term "Analysisal-Empirical" is more appropriate. FWD test has been conducted at the designated sites, with KGP Back software being used to analyze the results (IRC 115-2014), and IIT-Pave software verifying the design.

Keyword: *FWD, Strain, IIT-Pave, KGP Back.*

1. INTRODUCTION

In order to improve pavement life and performance, a thorough investigation of every component of the pavement is required. By assessing important factors such as structural suitability, functional suitability, drainage suitability, material durability, shoulder strength, etc., the condition of the pavement can be ascertained. Due to a paucity of pavement evaluation studies, pavement performance is subpar and failure occurs well before the specified life. One of the most important components of any roadway system is the pavement. Even though roadway pavement is meant to last for 15 to 20 years, it is already deteriorating. Due to the harsh climate, roads, and highways in India, particularly in the north, the pavements typically deteriorate prematurely and in ways that are different from those in more temperate parts of the world. Furthermore, due to poor quality control during construction, high axle loads, and little maintenance funds, pavements frequently experience rapid failures.

In order to decide whether to strengthen the pavement, it is crucial to comprehend the pattern of pavement deterioration. Keep in mind that the pavement's remaining lifespan depends on a number of variables, including traffic, the surrounding environment, and the weather. The pattern of the pavement's remaining life's degeneration is shown in the thesis. The FWD test is used in the thesis to estimate the pavement's remaining useful life. To determine how much longer the flexible pavement will last, the FWD test is performed three times on the same pavement at regular intervals.

Six KDOT asphalt projects' FWD data and DCP results were analyzed in order to establish a link between the DCP values and FWD-back estimated sub grade moduli. Following this investigation, the following findings can be made:
Existing relationship between the DCP values acquired from the DCP check and CBR and amongst CBR and subgrade moduli delivered about modulus values that fluctuated usually along the project length. These relationships seemed to be temperamental for generally high CBRs or low DCP values.

The regression equation link modulus calculated from FWD and DCP values provides another way to handle the conversion of DCP results. The method is robust and reliable for applications in bitumen forms and should increase the effectiveness of DCP as an accurate, versatile and more cost-effective field-testing method.

This paper presents a technique based on the analysis of FWD data between traffic and non-traffic paths to determine the deterioration and rutting capability of the unbonded aggregate layer of a flexible pavement compared to subgrade damage. This method was effectively applied to the FAA's NAPTF First Round Adjustable Asphalt Test Surface to demonstrate that analyzed HWD test information indicated that extended base damage caused in NAPTF airport pavement layers during traffic was caused in part by load migration from the applied equipment.

Considering the adjustment of BDI and BCI values for traffic routes and non-traffic routes using the proposed FWD-HWD testing and data analysis method is very important for detecting damaged areas in asphalt frames. The system is particularly suitable for use on asphalt pavements with thick granular base-subsoil layers in order to examine the degradation and rutting damage capabilities of the unbound aggregate layer compared to the subsoil. However, a large proportion of these models are shown to be relevant to specific traffic situations or environmental conditions, thus requiring models that can work well under fluctuating conditions. This paper provides a point-by-point review of various pavement performance models to examine the impact of factors related to pavement material, environmental conditions, traffic type and traffic volume, and to identify limitations and gaps in existing knowledge in such models.

Over time, flexible pads can become damaged due to redundant axle loads. Therefore, it is important to evaluate this type of bitumen to recommend thickness modifications. In this work, NH-218 **(Bijapur to Hubballi)** is selected for study. FWD testing conducted in selected areas and tests. The results were decomposed using KGP-Back programming as per IRC 115-2014 and the design was verified through IIT-Pave programming. Conditions 6.3 and 6.5 specified in IRC 37-2012 are used to determine the appropriate loads (later compared with the loads determined by IIT-Pave). Depending on the KGP backside and IIT paving results, different thicknesses are recommended. This article discusses the importance of KGP reverse programming in determining asphalt correction thickness. This study draws the following conclusions.

For suitable asphalt overlay structures, FWD test results should be analyzed using KGP to ensure the prominent presence of asphalt Current shifts can be taken into account for smart and efficient planning. In view of this study, it is inclined to conclude that FWD can be used as a device to evaluate the quality of BT and granular layer substrates for development and supports the asphalt.
Some of the most important developments of the past 50 years consider design/evaluation of flexible or flexible pavements a brief literature overview includes:
Empirical Analyses;
Mechanistic- Empirical (M-E) Flexible Pavement
Design Methodologies,
Non-Destructive Pavement Testing
The first empirical methods for flexible pavement design date to the mid-1920s when the first soil classifications were developed. One of the first to be published was the Public Roads (PR) soil classification system [5]. In 1929, The California Department of Highways developed a method utilizing the California Bearing Ratio (CBR) strength test [6]. The CBR method relates the CBR value of a material to the thickness required to provide subsurface shear protection fail.

The calculated thickness is defined for the standard ballast used to define the CBR test. In addition to this mechanical approach, an empirical element is used to define which values of calculated stress, strain and deflection will cause pavement failure.
The relationship between physical phenomena and pavement failure is described by empirically derived equations that calculate the number of loading cycles until failure. MEPDG was designed to update the 1993 AASHTO Pavement Structural Design Guidelines, which were primarily based on empirical observations from AASHO road testing [7,8] Started in the 1950s.

A structural response was first considered as a quantitative measure of the pavement's structural capacity, which involved measuring vertical deflection on the surface. A few techniques were formulated using the theory of elasticity for soil mass. These techniques use a threshold for the maximum surface vertical deflection to determine the thickness of the layer. In 1947, the Kansas State Highway Commission created the first publication that utilized Boussinesq's equation and restricted sub-grade deflection to 2 degrees. What is the measurement of 54 mm? The U.S. was established in 1953 at a later time. What is the definition of "S"? Using Burmister's two-layer elastic theory, the Navy limited surface deflection to 6 degrees. The measurement is 35 mm. Other methods were introduced over time, such as tests for strength, among others. In the calculation of new pavement structures and overlays, resilient modulus has been employed to establish connections between strength and deflection limits. [1958] Due to the ease of measuring deflection in the field, these techniques were highly sought after by professionals. Excessive stress and strain are the root cause of pavement failure, not deflection.

Methodology
The deflectometer survey procedure for pavement deflection surveys involves detecting falling weight.
By pre-identifying test point locations, the project section was divided into sub-sections based on visual pavement condition survey and test pit data.
Test was not executed at approaches to existing structures and at locations where the bituminous surface had stripped off and granular layers were visible.

IRC: 115 was the method used for testing. The laptop triggers the motion by raising the mass to a predetermined height, exerting an impact on the pavement and producing directional acceleration that generates kinetic energy of 40 kN (+/- 4 n) while maintaining traction. This impact leads to deflection, which is then recorded in the system automatically. The procedure is repeated if the appropriate information has been acquired

Measurement is made every hour to determine the pavement temperature and its correction factor for the bituminous layer's temperatures. After the field investigation and test, the data obtained from the Deflection survey is normalized to 40 KN after completion of the process.IRC 115 is used to determine the required parameters and then normalize the Data, which in turn yields the pavement layer modulus for calculation by KGPBACK software. Following the correction factors, we will utilize back calculated moduli of bituminous and granular layers obtained from software analysis: The modulus of the bituminous layer at a temperature of "T1" °C can be estimated by simply adjusting the back-calculated modulus from dummy deflection survey performed at T2 0 rpm and using the equation:
ET1 = λxET2
Where, λ= Temperature correction factor, is given by,
λ= (1-0.238 ln(T1)) / (1-0.238 ln(T2))
Where,
ET1= back-calculated modulus (MPa) at temperature T1°C
ET2= back-calculated modulus (MPa) at temperature T2°C
Correction for Seasonal Variation
Following equations are used for seasonal corrections: Esub_mon = 3.351x(Esub_win)0.7688 - 28.9 Esub_mon = 0.8554x(Esub_sum) - 8.461
Egran_mon=-0.0003x(Egran_sum)2+0.9584x(Egran_su m-32.98
Egran_mon= 10.5523x(Egran_win)0.624 - 113.857 Where,
Esub_mon = subgrade modulus in monsoon (MPa) Esub_win= subgrade modulus in winter (MPa) Esub_sum = subgrade modulus in summer (MPa) Egran_mon= granular layer modulus in monsoon (MPa) Egran_win= granular layer modulus in winter (MPa) Egran_sum = granular layer modulus in summer (MPa).

Remaining Life Calculation
The remaining life is calculated using IITPAVE software.

Performance Models

IRC: 115-2014 [9] will be used to analyze pavement performance, specifically for rutting and fatigue cracking, by applying the following performance models.

Fatigue in bituminous layer

$$\mathbf{Nf = 0.711 \times 10^{-4} \times (1/\varepsilon t)^{3.89} \times (1/MR)^{0.854}}$$

Where,

Nf = Fatigue life in standard axle load repetitions

εt = Maximum allowable tensile strain at the bottom ofbituminous layer

MR = Resilient modulus of bituminous mix, MPa

Rutting in subgrade

$$\mathbf{Nr = 1.41 \times 10^{-8} \times (1/\varepsilon v)^{4.5337}}$$

Where,

Nr = Rutting life in standard axle load repetitions

εv = Maximum allowable vertical strain at the top ofSubgrade layer

2. COLLECTION AND TESTING of DATA

The examination focused on **SH-12A (S-2)** in the area spanning **Km 79 to 108.**

Traffic study involves traffic investigation that includes classified information on traffic volume, axle load, and speed. **Table 01** demonstrates how the Million Standard Axle has been calculated using the Classified Traffic Volume Count and AXLE Load Survey.

Table. 01: Summary of Projected MSA

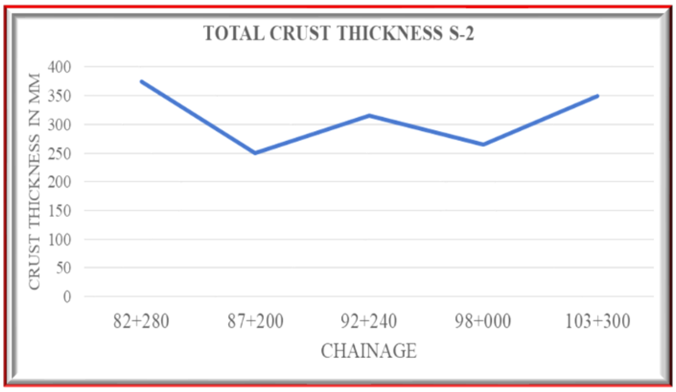
Location	ing Chainage(Km)		Design MSA
	From	To	20 Years
S-2-Maur Mandi	79	108.8	52

Pavement Layer Configuration

To create a linear multi-layered pavement model, it is necessary to know the material types and thicknesses of layers. The road's crust thickness is indicated in **Table 02** and **Fig 01.**

Fig. 01. Existing Pavement Layer of SH-12A

S. No.	Chainage	Side	BT	WBM	Bricks	TOTAL
1	82+280	RHS	190.00	105.00	80.00	375.00
2	87+200	LHS	105.00	65.00	80.00	250.00
3	92+240	RHS	155.00	80.00	80.00	315.00
4	98+000	LHS	105.00	80.00	80.00	265.00
5	103+300	RHS	190.00	80.00	80.00	350.00



FWD Data Presentation

The graphical presentation of the deflections collected at regular interval shown **Fig. 02. To Fig. 04.** Shows.

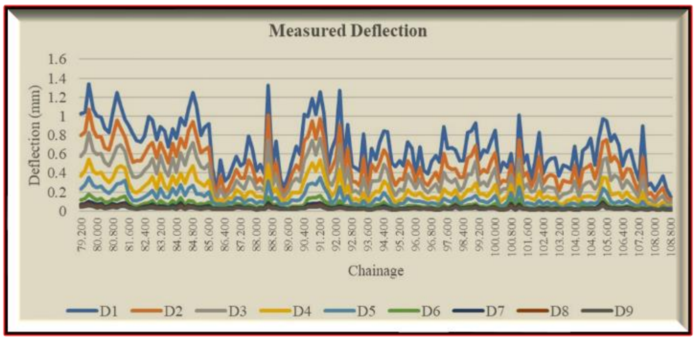


Fig.02. Deflection Collected for the 1st Time

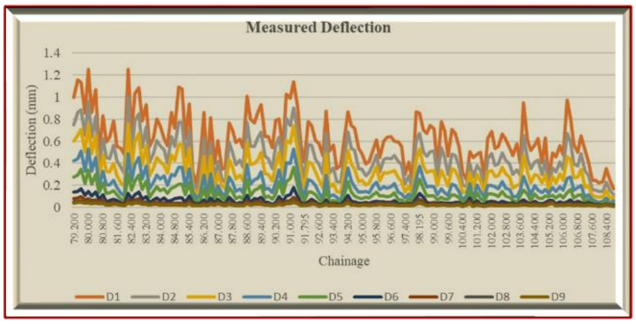


Fig.03. Deflection Collected for the 2nd Time

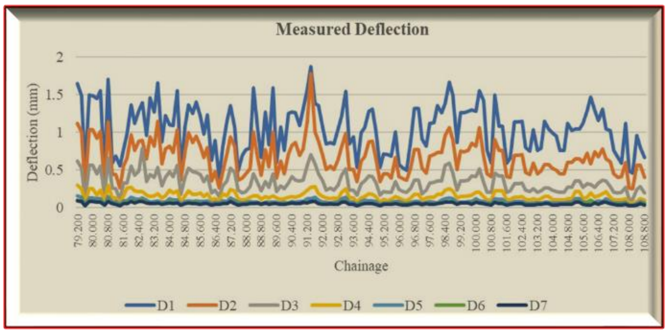


Fig. 04. Deflection Collected for the 3rd Time

The collected deflection is averaged out to make 7 sections for the analysis purpose. The averaged deflection is shown in **Table. 03 to Table. 05.**

Table.03: Summary of Average Deflection (First Collection)

Chainage (Km)		Distance from Load Centre (mm)								
		0	200	300	450	600	900	1200	1500	1800
From	To	D1	D2	D3	D4	D5	D6	D7	D8	D9
79.2	80	1.10	0.87	0.66	0.43	0.28	0.14	0.08	0.06	0.05
80	85	0.92	0.70	0.52	0.33	0.20	0.09	0.06	0.04	0.03
85	90	0.56	0.40	0.30	0.19	0.12	0.06	0.04	0.03	0.02
90	95	0.75	0.55	0.40	0.25	0.15	0.07	0.04	0.03	0.03
95	100	0.63	0.44	0.31	0.18	0.11	0.05	0.03	0.03	0.02
100	105	0.54	0.37	0.25	0.15	0.09	0.04	0.03	0.02	0.02
105	108.8	0.53	0.37	0.25	0.14	0.08	0.04	0.03	0.02	0.02

Table.04: Summary of Average Deflection (Second Collection)

Chainage (Km)		Distance from Load Centre (mm)								
		0	200	300	450	600	900	1200	1500	1800
From	To	D1	D2	D3	D4	D5	D6	D7	D8	D9
79.2	80	1.08	0.82	0.64	0.45	0.29	0.14	0.08	0.05	0.04
80	85	0.77	0.57	0.43	0.28	0.17	0.08	0.05	0.03	0.03
85	90	0.64	0.46	0.33	0.21	0.13	0.06	0.04	0.03	0.02
90	95	0.68	0.50	0.35	0.22	0.13	0.06	0.04	0.03	0.02
95	100	0.59	0.42	0.29	0.18	0.10	0.05	0.03	0.02	0.02
100	105	0.53	0.37	0.26	0.16	0.10	0.04	0.03	0.02	0.02
105	108.8	0.44	0.31	0.22	0.13	0.08	0.04	0.03	0.02	0.02

Table. 05: Summary of Average Deflection (ThirdCollection)

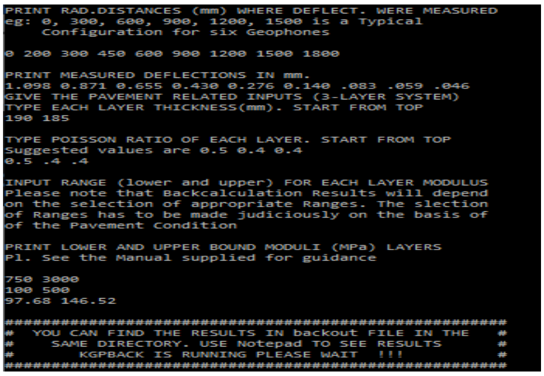
Chainage (Km)		Distance from Load Centre (mm)						
		0	200	500	900	1400	1900	2400
From	To	D1	D2	D3	D4	D5	D6	D7
79.2	80	1.33	0.89	0.47	0.22	0.12	0.08	0.07
80	85	1.12	0.75	0.41	0.18	0.09	0.06	0.06
85	90	0.98	0.63	0.32	0.15	0.07	0.05	0.05
90	95	1.13	0.75	0.36	0.16	0.08	0.06	0.05
95	100	1.07	0.66	0.32	0.15	0.08	0.06	0.05
100	105	0.98	0.58	0.28	0.13	0.07	0.05	0.04
105	108.8	0.96	0.55	0.26	0.13	0.07	0.06	0.05

Table. 06: Input Parameters for KGPBACK Software

Parameters	Values	
Single Wheel Load (N)	40000	
Contact Pressure (Mpa)	0.56 (As per IRC: 115 and IRC 37)	
Number of deflections measuring	7 or 9	
Radial distance between each geophones (mm)	0 200 500 900 1400 1900 2400 0 200 300 450 600 900 1200 1500 1800	
Measured Deflections (mm)	Normalized defections obtained after normalization of field data	
Pavement Layer Thickness	As per Table 5.5	
Poisson's ratio values	0.5 0.4 0.4 (bituminous layer, granular layers & subgrade as per IRC: 115-2014)	
Moduli range (as per IRC:115 2014 guidelines)	BT Layer	750 to 3000
	Granular layers	100 to 500
	Subgrade	As per

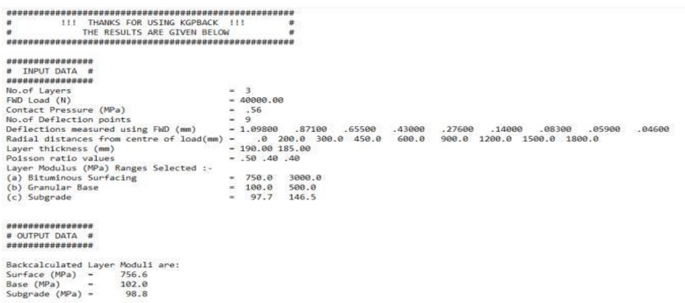
Back Calculation of Layer Moduli (KGPBACK)

Using normalized Data, other required parameters as given in **Table. 06** are used in KGPBACK software, and pavement layer modulus is obtained.



```
PRINT RAD.DISTANCES (mm) WHERE DEFLECT. WERE MEASURED
eg: 0, 300, 600, 900, 1200, 1500 is a Typical
    Configuration for six Geophones

0 200 300 450 600 900 1200 1500 1800

PRINT MEASURED DEFLECTIONS IN mm.
1.098 0.871 0.655 0.430 0.276 0.140 .083 .059 .046
GIVE THE PAVEMENT RELATED INPUTS (3-LAYER SYSTEM)
TYPE EACH LAYER THICKNESS(mm). START FROM TOP
190 185

TYPE POISSON RATIO OF EACH LAYER. START FROM TOP
Suggested values are 0.5 0.4 0.4
0.5 .4 .4

INPUT RANGE (lower and upper) FOR EACH LAYER MODULUS
Please note that Backcalculation Results will depend
on the selection of appropriate Ranges. The slection
of Ranges has to be made judiciously on the basis of
of the Pavement Condition

PRINT LOWER AND UPPER BOUND MODULI (MPa) LAYERS
Pl. See the Manual supplied for guidance

750 3000
100 500
97.68 146.52

############################################################
#  YOU CAN FIND THE RESULTS IN backout FILE IN THE         #
#    SAME DIRECTORY. USE Notepad TO SEE RESULTS            #
#       KGPBACK IS RUNNING PLEASE WAIT  !!!                #
############################################################
```

Fig. 5. Input window of the KGPBACK



```
#####################################################
#       !!!  THANKS FOR USING KGPBACK  !!!          #
#            THE RESULTS ARE GIVEN BELOW            #
#####################################################

################
#  INPUT DATA  #
################
No.of Layers                               =  3
FWD Load (N)                               = 40000.00
Contact Pressure (MPa)                     =  .56
No.of Deflection points                    =  9
Deflections measured using FWD (mm)        = 1.09800  .87100  .65500  .43000  .27600  .14000  .08300  .05900  .04600
Radial distances from centre of load(mm)   =    .0  200.0  300.0  450.0  600.0  900.0  1200.0  1500.0  1800.0
Layer thickness (mm)                       = 190.00 185.00
Poisson ratio values                       = .50 .40 .40
Layer Modulus (MPa) Ranges Selected :-
(a) Bituminous Surfacing                   =  750.0   3000.0
(b) Granular Base                          =  100.0   500.0
(c) Subgrade                               =   97.7   146.5

################
# OUTPUT DATA  #
################

Backcalculated Layer Moduli are:
Surface (MPa)   -     756.6
Base (MPa)      -     102.0
Subgrade (MPa) -       98.8
```

Fig. 6. Output window of the KGPBACK

The sample input and output of the KGPBACK is shown in **Fig. 05. and Fig. 06.**

Using the inputs given in **Table. 06** the back calculated Moduli of each layer is calculated and presented in **Table. 07 to Table. 09** and in **Fig. 07. to Fig. 09.**

Table.07: Back Calculated Moduli for the First Collection

Chainage	Back Calculated Moduli (MPa)		
	tuminous Layer	ranular Base	Subgrade
79.200-80.000	757	102	99
80.000-85.000	761	100	146
85.000-90.000	1740	100	217
90.000-95.000	763	100	190
95.000-100.000	1258	100	23
100.000-105.000	763	102	280
105.000-108.800	781	100	247

Fig.07. Back Calculated Moduli of the First Collection

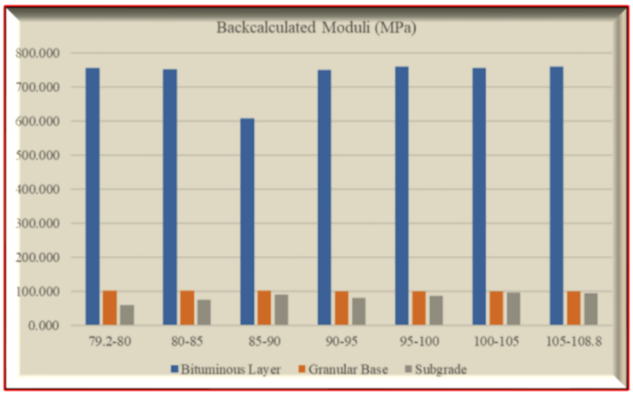


Table. 08: Back Calculated Moduli for the Second

Chainage	Back Calculated Moduli (MPa)		
	Bituminous	Granular	Subgrade
79.200-80.000	2989	496	156
80.000-85.000	750	100	175
85.000-90.000	1203	100	229
90.000-95.000	761	101	212
95.000-100.000	1177	100	252
100.000-105.000	763	102	294
105.000-108.800	750	101	287

Fig. 08. Back Calculated Moduli of the Second Collection

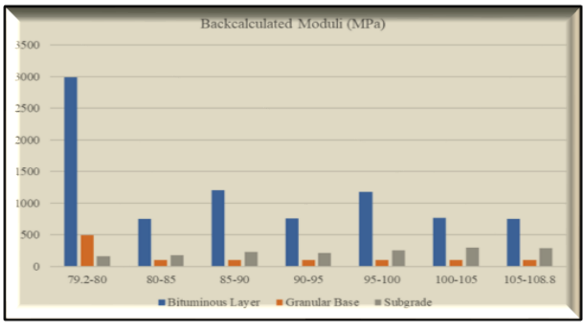
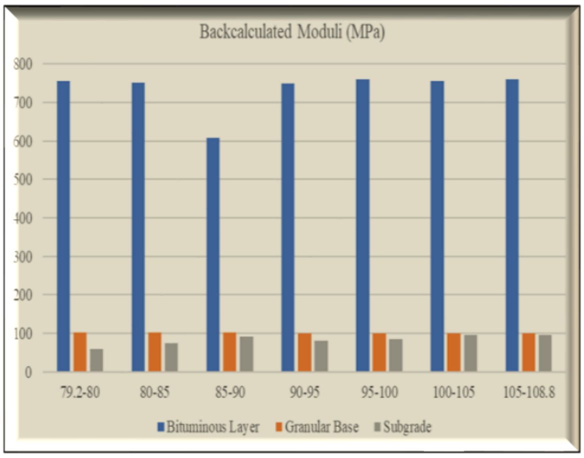


Table. 09: Back Calculated Moduli for the Third Collection

Chainage	Back Calculated Moduli (MPa)		
	tuminous Layer	ranular Base	Subgrade
79.200-80.000	757	102	60
80.000-85.000	752	102	74
85.000-90.000	608	102	91
90.000-95.000	750	100	81
95.000-100.000	761	100	86
100.000-105.000	757	100	97
105.000-108.800	761	100	95

Fig.09. Back Calculated of the Third Collection



The back calculated moduli of the bituminous & granular layers obtained from software analysis were applied with following correction factors.

- Pavement Temperature Correction Factor
- Correction for Seasonal Variation

The corrected moduli are given in **Table.010 to Table. 012 and Fig.010. to Fig. 012.**

Table. 010: Corrected Back Calculated Moduli for theFirst Collection

Chainage	Corrected Back Calculated Moduli (MPa)		
	tuminous Layer	ranular Base	Subgrade
79.200-80.000	757	75	86
80.000-85.000	761	73	126
85.000-90.000	1740	73	181
90.000-95.000	763	73	161
95.000-100.000	1258	73	8
100.000-105.000	763	75	226
105.000-108.800	781	73	202

Fig.10. Corrected Back Calculated Moduli of the FirstCollection

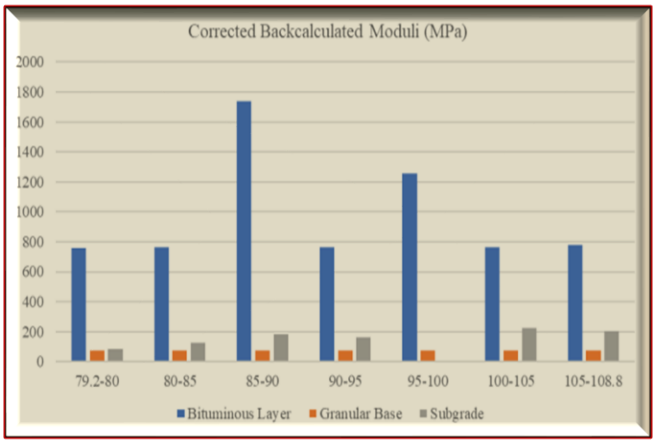


Table. 011: Corrected Back Calculated Moduli For the Second Collection

Chainage	Corrected Back Calculated Moduli (MPa)		
	tuminous Layer	ranularBase	Subgrade
79.200-80.000	2795	394	134
80.000-85.000	701	73	149
85.000-90.000	1125	73	189
90.000-95.000	712	74	177
95.000-100.000	1100	73	206
100.000-105.000	714	75	236
105.000-108.800	701	74	231

Fig. 11. Corrected Back Calculated Moduli of the SecondCollection

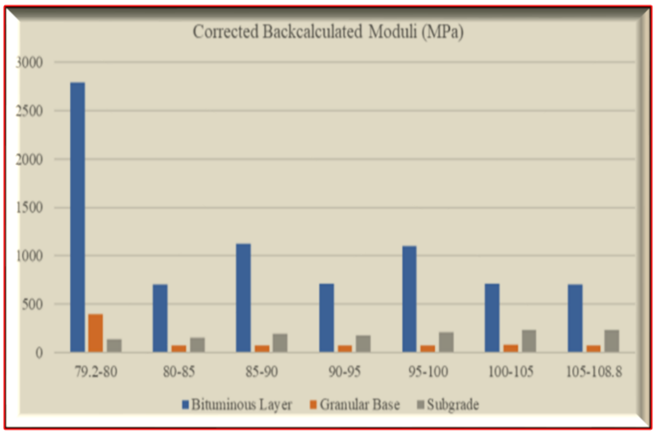
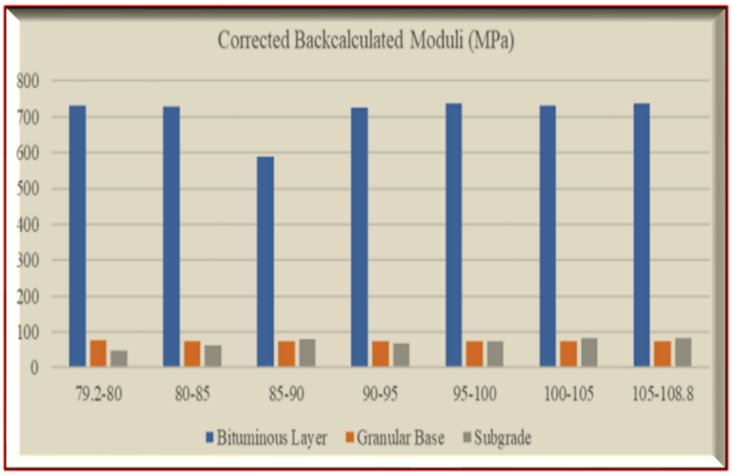


Table. 012: Corrected Back Calculated Moduli for theThird Collection

Chainage	Corrected Back calculated Moduli (MPa)		
	tuminous Layer	ranular Base	Subgrade
79.200-80.000	732	75	49
80.000-85.000	728	75	63
85.000-90.000	588	75	79
90.000-95.000	726	73	69
95.000-100.000	736	73	74
100.000-105.000	732	73	84
105.000-108.800	736	73	82

Fig. 12. Corrected Back Calculated Moduli of the Second Collection

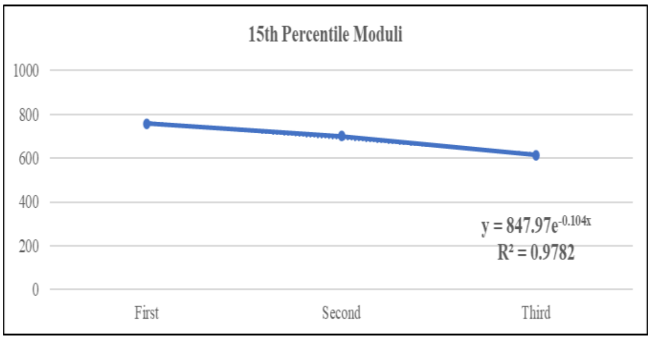


As per **IRC 115,** 15th percentile modulus (15% of the values will be less than this value) of each of the three layers should be considered for analysis of the remaining life. The 15th percentile modulus of each of the three layers is given in **Table. 013 and Fig. 013**. Shows the variation of the moduli in Bituminous Layer.

Table.013: 15th Percentile Modulus

	First Time Collection	Second Time Collection	Third Time Collection
15th Percentile Moduli of	757	701	615
15th Percentile Moduli of	73	73	73
15th Percentile Moduli of	23	137	52

Fig.013. 15th Percentile Moduli



Remaining Life Calculation

The structural analysis of the FWD deflection data is used to determine the design life of the pavement structures to withstand the predicted traffic load. It should however be kept in mind that these residual life estimates are essentially governed by the mechanistic characteristics of the pavement materials and the predicted traffic load. It is now a days becoming standard practice to use mechanistic-empirical methods for design and evaluation of pavements. In such an analytical approach the critical locations in a pavement structure are:

The horizontal strains at the bottom of a bituminouslayer
The vertical strain (deformation) at the top of unboundbase/sub base layers and the subgrade.
For calculating the remaining life, the horizontal strains and vertical strains is calculated by the IITPAVE. The remaining life is calculated using IITPAVE software using following input parameters as given in **Table. 014.**

Table. 014: Input Parameters for IITPAVE

Parameters	**Typical Values Adopted**
Number of layers (n)	3
Elastic Modules (E), in MPa	As per FWD Back-Calculation
Poisson's Ratio (μ)	0.5, 0.4, 0.4
Thickness of Layers (h), mm	161mm and 165mm (Average of the
Dual wheel load (N), Tyre	20000, 0.56

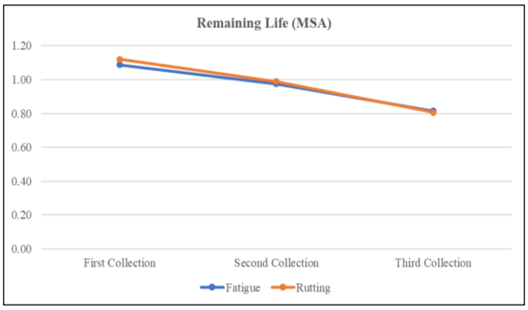
The remaining life of pavement in terms of fatigue life and rutting life using the above performance models are tabulatedin **Table. 015. Fig.014.** shows the variation in remaining life ofthe pavement over the period of time.

Table 0.15 Calculated Remaining Life of Pavement.

Table 0.15 Calculated Remaining Life of Pavement

	Remaining Life (MSA)	
	Fatigue	**Rutting**
First Collection	1.09	1.12
Second Collection	0.98	0.99
Third Collection	0.82	0.81

Fig.014. Variation in Remaining Life



The minimum of the Fatigue life and Rut life is remaining lifeof the pavement.

2. RESULTS AND DISCUSSIONS

General

As per the previous chapter's analysis and discussions, we have accomplished all that our research aims to achieve. This study aimed to examine the deterioration pattern of the flexible pavement by exploring its Moduli and Remaining Life resulting in clear data analysis results.

The sameobjective is achieved and can be seen **in Fig. 15. and Fig. 16** shows the decline in the Moduli value of the flexiblepavement with time

The Moduli value of the flexible pavement is shown to decrease over time. Nonetheless, Fig what is the correct response to this question? Demonstrates a consistent trajectory of pavement declination in the remaining life.

The Moduli value is directly linked to the pavement's strength, as per the analysis. The deterioration pattern is demonstrated by an exponential equation with an R2 value of 0.9782, simply enter the required number. The equation for deterioration is presented in the following manner.

$$y = 847.97e^{-0.104x}$$

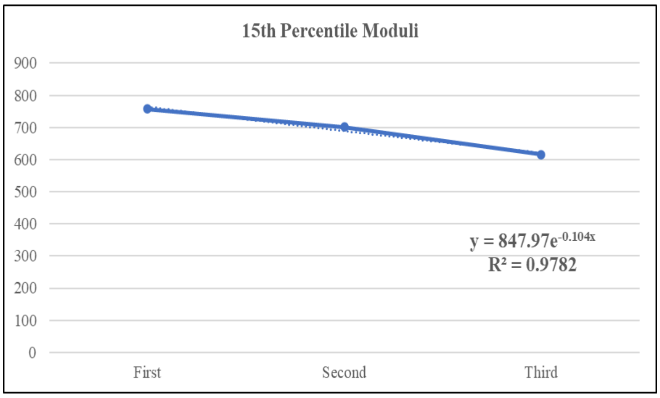


Fig. 015. Declination of the Moduli Value

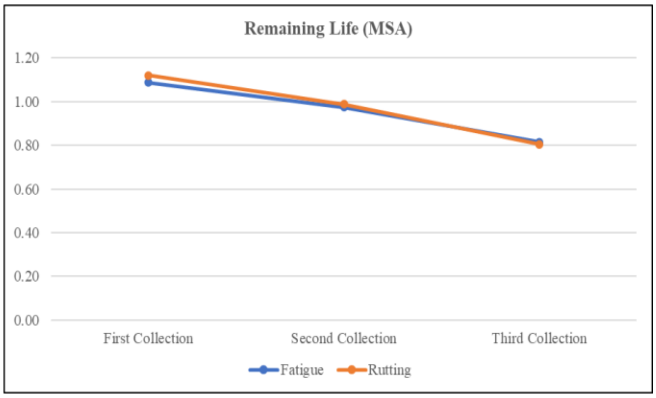


Fig. 016. Declination of Remaining Life

Recommendations, Limitations, and Potential Outcomes That May Result In a Particular Outcome?

- During pavement maintenance, it is important to carry out tasks in a proper manner and with the necessary time. The deflection test should be carried out at regular intervals to ensure the correct overlay is created. The pavement performance should be documented in a database over time to aid in developing unbiased performance models.
- The pavement's Moduli have deteriorated over time. As the Moduli declines, so does one's position of declination in terms of the remaining Life. Various factors, including traffic, material quality, and climate affect the decline in remaining life.
- The Moduli on the pavement has become worn out over time. The deterioration of the Moduli results in a reduction in life expectancy. Traffic, material quality, and the local climate all have an impact on the decline in remaining life.
- There are limited studies available in the country that reveals the actual results of these constructions in practice, which is not commonly used for analyzing and modeling their performance in real life. Various road conditions and data are necessary to develop a superior performance model.
- In the current study, the focus is on a single route, and the decay pattern is determined through an analysis of past trends. Nevertheless, the more genuine pattern of degradation can be developed by studying the different paths. The research can be expanded by changing the sub grade's temperature and CBR value.

The Summary And Conclusions Are Presented Below.

- In order to ensure economical and realistic designs, the FWd test results should be evaluated using KGP back for crust designs of flexible pavements to factor in the remaining life of existing layers.
- According to the findings of this study, FWD has potential to be utilized as a tool for evaluating both pavement construction and subgrade strength.
- Through analytical methods, the critical stresses or strains in the structure can be determined. The incorporation of seasonal temperature and moisture changes can be made easy by utilizing any design load or combination of design loads.
- Preparing a database for pavement performance over time is crucial to developing' more-than-twenty-years' to develop. The pavement's Moduli have deteriorated over time. As the Moduli declines, so does one's position of declination in terms of the remaining Life. Various factors, including traffic, material quality, and climate affect the decline in remaining life.
- A comprehensive analysis of road conditions and characteristics is necessary to develop a superior performance model.
- The Moduli value is directly linked to the pavement's strength, as per the analysis.

3. REFERENCES

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