International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

DESIGN OF FLEXIBLE PAVEMENT BY USING RAP WASTAGE

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ABSTRACT

Effective pavement design is one of the most important aspects of project design. The pavement is the portion of the highway which is most obvious to the motorist. The condition and adequacy of the highway is often judged by the smoothness or roughness of the pavement. Deficient pavement conditions can result in increased user costs and travel delays, braking and fuel consumption, vehicle maintenance repairs and probability of increased crashes. The better the strength/stiffness quality of the materials the better would be the long-term performance of the pavement. Hence, the design of pavement should be focused on the efficient, most economical and effective use of existing materials to optimize their performance. The distressed pavements are left unmanaged and there is a need to rehabilitate the roads by using the environmentally sustainable techniques so as to develop it for future generations. The rehabilitation techniques can be developed by studying the types of distresses, material conditions and environment conditions. The paper presents the introduction to the problem, literature review on the subject, design of flexible pavements by using rap.

Keywords: Flexible pavement, rap wastage, sustainable.

1. INTRODUCTION

1.1 Problem Description

Now a days the importance of the pavement and its maintenance has been rapidly increasing due to the globalization and industrialization. But the increasing demand is not been met with the supply in an efficient manner due to the non sustainability of the resources. In India the network of roads is managed by the various government agencies under “Ministry of Road Transport and Highways” (MORTH). India's road network is gigantic and said to be only after the United States of America. But one of the striking underlying facts is the condition of the roads. It has been the case since 30 years.

Most of the roads were designed as single lane and quality of construction was also poor due to lack of supervision. The traffic volumes on the primary road system have seen tremendous increases over the last 20 years, leading to earlier-than-expected failures of highway pavements. The distressed pavements are left unmanaged and there is a need to rehabilitate the roads by using the environmental sustainable techniques so as to develop it for future generations. The rehabilitation techniques can be developed by studying the types of distresses, material conditions and environment conditions.

The Recycling of existing bituminous mixes are the only alternatives, through the reuse of aggregates and bitumen. Pavement rehabilitation is a logical and practical way to conserve our diminishing supply of construction materials and to help reduce the cost of preserving our existing pavement network.

Developing a rehabilitation design generally requires extensive investigation into the condition of the existing pavement structure, performance history, and laboratory testing of materials to establish suitability of existing and proposed materials for use in the rehabilitation design. Assessment of residual strength of existing pavement layers including sub-grade in its existing state plays a key role in evolving an economical solution for rehabilitation of old pavements. We have considered use of dismantled pavement materials like Recycling Asphalt Pavements (RAP) materials in the project.

1.1.1 Importance of Study

As a part of National Highway Development Programme (NHDP) undertaken by National Highway Authority of India (NHAI), many State Highways (SH) / Major District Roads (MDR) are being upgraded to National Highways (NH) based on traffic demand. Initially, most of these roads were designed as single lane carriageways as per available guidelines from that time. The quality of construction was also not up to the mark due to lack of supervision. As per traffic needs, these roads were strengthened time to time by providing asphalt overlay and widened to intermediate/two lane carriageways in the later period. Thus, with the periodical strengthening, the upper asphalt layers have become thicker, leaving the underlying unbounded layers structurally/functionally inadequate to sustain the increasing traffic loads. So, the usage of the RAP in the granular layers to enhance the strength of the lower layers becomes important. Reclaimed Asphalt Pavement (R.A.P) is the most and abundant Industrial waste available due to expansion and up gradation of the existing asphalt roads like Major District roads (M.D.R), State Highways (S.H) and National Highways (N.H). Millions of tonnes of asphalt have being wasted in the country, when these could be properly treated and recycled for rehabilitation of road projects and new pavements. Recycling of asphalt pavements is a major activity, which saves natural resources. It is a green technology and saves energy. So, a lot of positive effects are there in the use of RAP, but in India, people are cautious on accepting new technologies. The market for asphalt pavement recycling is at nascent stage. Recycling of existing asphalt pavement materials to produce new pavement materials results in considerable savings of material, money, and energy. The specific benefits of recycling can be summarised as follows:

- Substantial savings over the use of new materials,
- Saving of considerable amount of energy compared to conventional construction techniques,
- Performance equal or even better than new materials,
- Pavement geometrics is maintained and Conservation of natural resources.

2. REVIEW OF LITERATURE

2.1 Introduction

The chapter involves the discussion of various research papers reviewed for achieving the aim of the project. The research is in progress in the area of use of RAP material in the pavement courses. The papers described the RAP usage and its properties in the pavements. They involved the usage of various techniques in this concept. The utilization of RAP material varied in the research i.e as a base material or blending of RAP with virgin bitumen and virgin aggregate.

The literature papers collected on the subject are classified into various groups depending on the area of subject they discussed. The classification is as follows.

- RAP Application as Bituminous Layer
- RAP Application as subgrade layer

Raju Kumar Pandit et al, The thickness of sub grade is depending on the strength of the soil and it will also affect cost of construction of pavement. The bearing capacity of a soil (CBR value) present in sub-grade is found low as per the requirement to increase the bearing capacity of soil by stabilization process. For stabilization of soil, in some percentage reclaimed asphalt pavement material is replaced with soil. According to IRC code 37:2012, the CBR value of soil in sub-grade is minimum 8% for having traffic of 450 commercial vehicle / day or higher for Expressway, National highway, State highway and district road. The outcome of study 25% of reclaimed asphalt pavement material in place with soil, the CBR value is increase up to 10.29%, which is higher than recommended by IRC 37:2012.

Mohammad Niyaz Ali et al, laboratory test work on pure mixture and 0% to 50% RAP mixture, it is found that adding RAP can improve all the performance of asphalt mixture. This shows that under similar conditions, a mixture with a RAP of 0% to 40% performs better than a pure mixture. But 50% of RAP is not executed correctly. Likewise, the 50% strength of the RAP mixture is reduced.

3. OBJECTIVE AND METHODOLOGY

3.1 Objective

- To determine the traffic capacity by using CVPD method for initial traffic calculations.
- The determine the CBR for whole stretch of pavement design.
- To design of the flexible pavement with and without using RAP.
- To Analysis of the flexible pavement with and without using RAP.

3.2 Methodology

The methodology involved in the achievement of this objective is:

1. The first step involves the identification of the pavement for construction. The project corridor selected is located at Sri Sri Circle, Khammam Bypass road, Rotary Nagar (NH 365BB) to Dhanavaigudem Railway Bridge, Railway Over Bridge, Raparthi Nagar, Khammam in the state of Telangana, India. The chainage length of the road is for a length of 5.4 km.
2. The second step is to collect the soil samples for every 1km of stretch and finout the laboratory based CBR test.
3. The third step is to findout the average daily traffic with cctv recordings for 1 week of time.
4. To design the flexible pavement without and with RAP utilization and compare the layer thickness.

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4. EXPERIMENTAL WORK

4.1 Identification of Project Location

The construction of the pavement is the main idea behind the project. The pavement from Sri Sri Circle to Dhanavaigudem Railway Bridge in Khammam. The road at Sri Sri Circle, Khammam Bypass Road, Rotary Nagar (NH 365BB). National Highway 365BB is a national highway in India. It is a secondary route of National Highway 65. NH-365BB traverses the states of Telangana and Andhra Pradesh in India. It starts at Suryapet and ends at Kovvur. Major cities on this route are Suryapet, Khammam and Rajamahendravaram. The stretch selected covers a distance of 5.4 km.

4.2 California Bearing Ratio Test

The California bearing ratio test is penetration test meant for the evaluation of subgrade strength of roads and pavements. The results obtained by these tests are used with the empirical curves to determine the thickness of pavement and its component layers. This is the most widely used method for the design of flexible pavement. It is also defined as the ratio of force per unit area required to penetrate a soil mass with standard circular piston at the rate of 1.25 mm/min. to that required for the corresponding penetration of a standard material.

Table. 1: CBR results.

LOAD PENETRATION TEST DATA					
GENERAL INFORMATION	**Penetration (mm)**	**Proving ring reading**	**Corrected load (Kg)**	**Proving ring reading**	**Corrected load (Kg)**
Type of compaction used: Dynamic	0.0	0	0.0	0	0.0
Period of soaking: 04 days	0.5	10	60.0	12	72.0
Wt.of surcharge used (kg): 5 Kgs	1.0	15	90.0	16	96.0
Proving ring capacity: 50 KN	1.5	19	113.9	20	119.9
Least count of proving dial guage: 5.997	2.0	22	131.9	24	143.9
	2.5	28	167.9	28	167.9
	3.0	34	203.9	33	197.9
	4.0	42	251.9	42	251.9
	5.0	50	299.9	51	305.8
	6.0	60	359.8	63	377.8
	7.5	79	473.8	81	485.8
	10.0	92	551.7	96	575.7
	12.5	110	659.7	112	671.7
Corrected unit load from graph(kg)		170		165	

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for 2.5mm		
Corrected unit load from graph(kg) for 5.0mm	250	300
CBR at 2.5mm (%)	12.4	12.5
CBR at 5.0mm (%)	12.2	12.0
CBR Reported (%)	**12.4**	**12.5**

4.2.1 CBR calculations

Table. 2: CBR test results.

Location (Chainage) (km)	4 days soaked CBR (%)
0	12.5
1	12.2
2	8.5
3	10.2
4	11.3

Table. 3: Compute 90th percentile existing CBR value.

Chainage (km)	4 days soaked CBR	Count	Decending order CBR	Percentile
0	12.5	10	8.5	100
1	12.2	9	10.2	80
2	8.5	8	11.3	60
3	10.2	7	12.2	40
4	11.3	6	12.5	20

For 90% CBR: ((8.5+10.2)/2) = 9.35%
As per (Raju Kumar Pandit et al 2019) 25% of reclaimed asphalt pavement material in place with soil, the CBR value is increase up to 10.29%.
The 10.29% increment of CBR value = (9.35 + 0.96) = 10.31%

4.3 Traffic volume

4.3.1 Commercial Vehicle Per Day

Based on traffic volume count survey carried out on project corridor as per IRC SP 19-2001 for 7days 24 hour. Average of 7days traffic consider as average daily traffic (ADT). Only commericial vehicles (having the laden weight of 3 Tonnes or more) count to be considered.

Table. 4: Commercial vehicle per day.

DAY	CVPD (Two ways)
Monday	655
Tuesday	670
Wednesday	580

Thursday	700
Friday	643
Saturday	591
Sunday	690
Average	647 ≈ 650

Result: Initial CVPD based on traffic volume survey = 650 (Two ways)

5. DESIG OF THE FLEXIBLE PAVEMENT

5.1 Introduction

The pavement design basically aims at determining the total thickness of the pavement structure as well as thickness of individual structural components. Pavement is the most significant component of a road and therefore its design strengths must be assured to support the projected traffic loading throughout the design period.

The pavement design is carried out for flexible by using IRC and IIT PAVE methods. The overall thickness has been worked out, the results were compared, and the optimized solution based on characteristics of existing materials, best engineering judgment and environmental conditions has been adopted. In this chapter discussion about the design of flexible pavement by using the IRC 37: 2012, IIT PAVE software with usasge of RAP and the pavement stretch selected covers a distance of 5.0 km. In this design the pavement is divided into four layers i.e Bituminous course, DBM layer, Granular layer and Subgrade. In this layers except granular layer all other layer we used rap mix. So i need to analyse the properties of all these layers with the help of IIT Pave software with and without RAP.

5.2 Design of Flexible pavement

5.2.1 Poisons ratio

The compress values mentioned in below table

Table. 5: Poisson ratio.

LAYER	POISON RATION
BITUMINOUS LAYER	0.35
WMM	0.35
CTB	0.25
GSB	0.35
CTSB	0.25
AGGREGATE INTER LAYER	0.35
RAP BASE	0.35
SUB-GRADE	0.35

5.2.2 Elastic Modulus

Subgrade: The relation between modulus and the effective CBR in IRC is given as (Annexure 1)

$$E\ (MPa) = 10 * CBR \text{ for } CBR <= 5$$
$$= 17.6 * (CBR)^{0.64} \text{ for } CBR > 5$$

E= modulus of subgrade soil.

CBR value uptained is 9.35% for without RAP and 10.31% for with RAP used in subgrade layer.

Existed soil M_{RS} (Mpa) = 17.6 * $(9.35)^{0.64}$ = 73.59 Mpa

Existed soil with RAP M_{RS} (Mpa) = 17.6 * $(10.31)^{0.64}$ = 78.34 Mpa

Granular layers:

Sub-base materials comprise natural sand, gravel, laterite, brick metal, crushed stone or combinations there of meeting the prescribed grading and physical requirements. The sub-base material should have a minimum CBR of 20 % and 30 % for traffic upto 2 msa and traffic exceeding 2 msa respectively. Sub-base usually consist of granular or WBM and the thickness should not be less than 150 mm for design traffic less than 10 msa and 200 mm for design traffic of 1.0 msa and above. The modulus is found out by

$$E_{subbase} = E_{subgrade} * 0.2 * h^{0.45}$$

h = Thickness of the granular layer

$$E_{subbase\ (without\ RAP)} = 73.59 * 0.2 * (200+250)^{0.45} = 230\ Mpa$$
$$E_{subbase\ (without\ RAP)} = 78.34 * 0.2 * (200+250)^{0.45} = 245\ Mpa$$

Bituminous Layer:

The modulus for the bituminous material are obtained from the Table 9.2 in IRC 37: 2018.

For RAP treated bitumen layer : 800 Mpa at 35^0C.

For DBM and BC with VG40 : 3000Mpa at 35^0C.

5.2.3 Design traffic

Data:

- Two lane two way
- Initial CVPD based on traffic volume survey = 650 CVPD (two ways) = P
- Traffic growth rate = 5%
- Vehicle damage factor = 5 (same for both direction)
- Construction period = 1 year
- Design period = 20years

Derive Initial traffic in year of construction:

A = $P(1+r)^x$ = 650 $(1+0.05)^1$ = 682.5CVPD (two ways) = 682 CVPD = 341(assume 50 % in each side)

Derive MSA:

N_{DES} = [(365 ($(1+r)^n$ – 1) / r)) x A X D X F]

= [(365 $(1+0.05)^{20}$ – 1) / 0.05) x 341 X 0.4 X 5] = 8231107.95 = Say **9MSA**

5.2.4 Permissible Strains

Fatigue Criteria:

Calculations:

$N_F = 0.561 \times C \times 10^{-4} \times [1/\varepsilon_t]^{3.89} \times [1/M_{RM}]^{0.854}$

$C = 10^M$ & $M = 4.84 [(V_{be} / (V_{be} + V_a)) - 0.69]$

Use, $V_{be} = 11.5$ (Actual V_{be} : 11 to 13) & $V_a = 3.5$ (Actual V_a : not less than 3%)

M = 0.37 , C = 2.35

M_{RM} = 1600 Mpa (modified bitumen)

$\varepsilon_t = 0.0003246753$

Rutting Criteria :

$N_R = 1.41 \times 10^{-8} [1/\varepsilon_v]^{4.5337}$

$9 \times 10^6 = 1.41 \times 10^{-8} \times [1/\varepsilon_v]^{4.5337}$

$\varepsilon_v = 0.00056078$

5.2.5 Actual strains

IITPAVE software is used to calculate the Actual Horizontal Tensile Strain in Bituminous layer and Actual Vertical Compressive Strain on sub-grade.

The actual strains are computed using various trial pavement thickness combinations. The tyre pressure used in the analysis is 0.56 MPa. Standard axle used is dual type and single tyre load of 20,000 N. The Poisson's ratio of bituminous layer is taken as 0.35. The E values and Poisson's ratio obtained from above are given as inputs to the software and strains are calculated.

- **Launching the software**

Fig. 1: IIT PAVE.

i.) From the Home screen user can manually give input through input window by clicking on 'Design New Pavement Section'. User can also give input through properly formatted input file by clicking on 'Edit Existing File' option then browsing and opening the input file.

ii.) Next an input window will come. All the inputs required have to be given through that input window.

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- **Inputs to the Software**

i.) First, number of layers to be selected from drop down menu to fix up input boxes for different layer.
ii.) Next, Elastic modulus (E) values of the various layers in MPa, Poisson's ratio and thickness of the layers in mm excluding the subgrade thickness are to be provided.
iii.) Single wheel load and the tyre pressure are to be provided (tyre pressure of 0.56 MPa has been used for calibration of the fatigue equation and the same pressure can be used for stress analysis. Change of pressure even up to 0.80 MPa has a small effect upon stress values in lower layers.)
iv.) Then the number of points for stress computations is to be given through the drop down menu for Analysis points.
v.) Then corresponding to different points, the values of depth Z in mm and the corresponding value of radial distances from wheel centre (r) in mm are to be provided.
vi.) Provide whether analysis is for single wheel load or double wheel load by clicking 1 0r 2. 2 will be the most common case.

Table. 6: List of input values.

Property	Without RAP	With RAP
Elastic Modulus for surface layer (Mpa)	3000	800
Elastic Modulus for granular layer (Mpa)	230	245
Elastic Modulus for subgrade (Mpa)	73.59	78.34
Poisson ratio	0.35	0.35
Wheel load (Newtons)	20000	20000
Tier pressure (Mpa)	0.56	0.56
Wheel set	2	2
Analysis points	4	4

5.3 Design of flexible pavement with RAP

Strain Comparision:

1. Actual horizontal strain < = Permissible horizontal strain
2. Actual vertical strain < = Permissible vertical strain

The minimum thicknesses suggested by the IRC and MORTH guidelines mentioned in below table:

Table. 7: Min layer thickness as per IRC 37.

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LAYERS		MIN. THICKNESS AS PER IRC 37 & MoRTH
BITUMINOUS	BC/SDBC/GGRB	30 MM
	SMA AS WEARING COURSE	40 MM
	SMA AS BASE COURSE	45 MM
	DBM/BM	50 MM
GRANULAR	WMM/WBM/CRM/RC/GSB	150 MM
	CTB	100 MM
	CTSB	200 MM
	SUB-GRADE	500 MM

Trail – 1:

SURFACE COURSE = 30mm
BASE BINDER COURSE = 60mm
WMM = 250mm
GSB = 200mm
SUBGRADE = 500mm

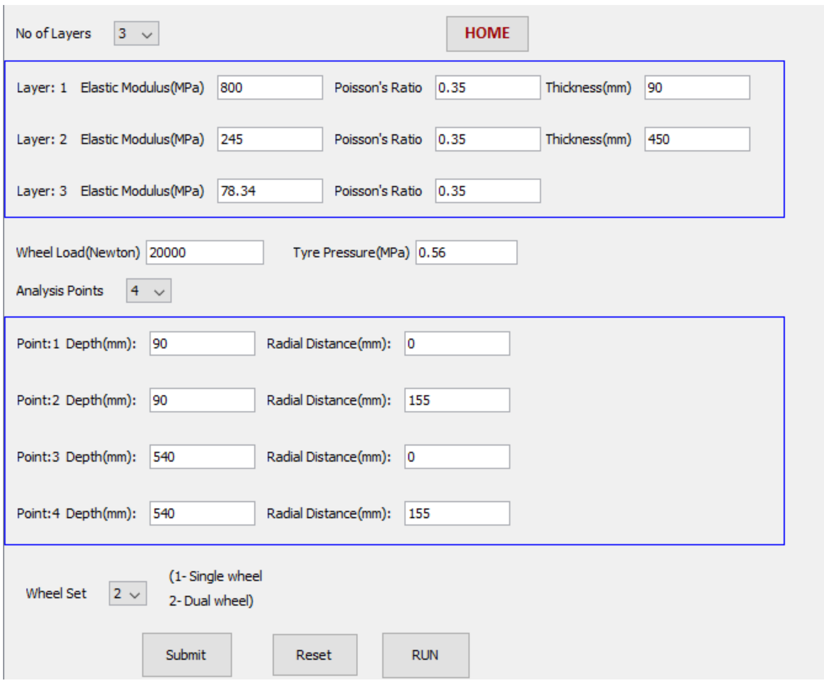

Fig. 2: Trail 1 input.

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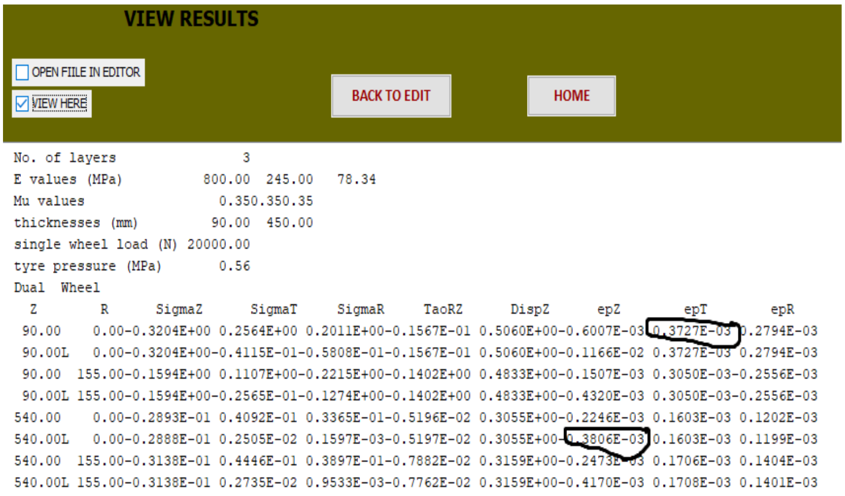

VIEW RESULTS

OPEN FIILE IN EDITOR

VIEW HERE

BACK TO EDIT

HOME

No. of layers 3
E values (MPa) 800.00 245.00 78.34
Mu values 0.350.350.35
thicknesses (mm) 90.00 450.00
single wheel load (N) 20000.00
tyre pressure (MPa) 0.56
Dual Wheel

Z	R	SigmaZ	SigmaT	SigmaR	TaoRZ	DispZ	epZ	epT	epR
90.00	0.00	-0.3204E+00	0.2564E+00	0.2011E+00	-0.1567E-01	0.5060E+00	-0.6007E-03	0.3727E-03	0.2794E-03
90.00L	0.00	-0.3204E+00	-0.4115E-01	-0.5808E-01	-0.1567E-01	0.5060E+00	-0.1166E-02	0.3727E-03	0.2794E-03
90.00	155.00	-0.1594E+00	0.1107E+00	-0.2215E+00	-0.1402E+00	0.4833E+00	-0.1507E-03	0.3050E-03	-0.2556E-03
90.00L	155.00	-0.1594E+00	-0.2565E-01	-0.1274E+00	-0.1402E+00	0.4833E+00	-0.4320E-03	0.3050E-03	-0.2556E-03
540.00	0.00	-0.2893E-01	0.4092E-01	0.3365E-01	-0.5196E-02	0.3055E+00	-0.2246E-03	0.1603E-03	0.1202E-03
540.00L	0.00	-0.2888E-01	0.2505E-02	0.1597E-03	-0.5197E-02	0.3055E+00	-0.3806E-03	0.1603E-03	0.1199E-03
540.00	155.00	-0.3138E-01	0.4446E-01	0.3897E-01	-0.7882E-02	0.3159E+00	-0.2473E-03	0.1706E-03	0.1404E-03
540.00L	155.00	-0.3138E-01	0.2735E-02	0.9533E-03	-0.7762E-02	0.3159E+00	-0.4170E-03	0.1708E-03	0.1401E-03

Fig. 3: Trail 1 output.

(ε_t = 0.0003246753) < (epT = 0.0003727)

(ε_v = 0.00056078) > (epZ = 0.0003806)

Permissible strains < actual strain ……….. Un-safe

Trail – 2:

SURFACE COURSE = 30mm

BASE BINDER COURSE = 100mm

WMM = 200mm

GSB = 200mm

SUBGRADE = 500mm

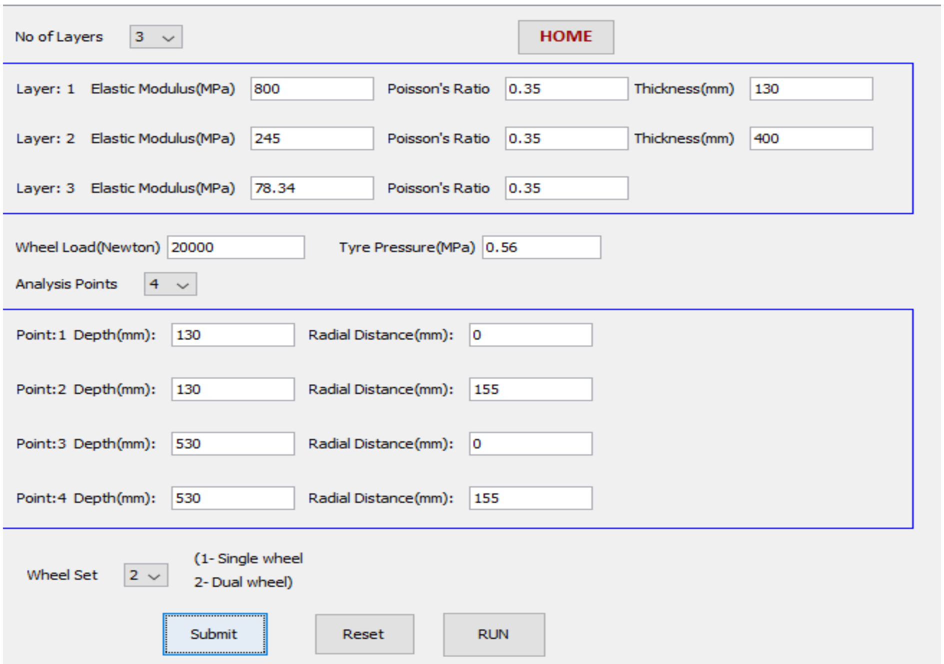

Fig. 4: Trail 2 input.

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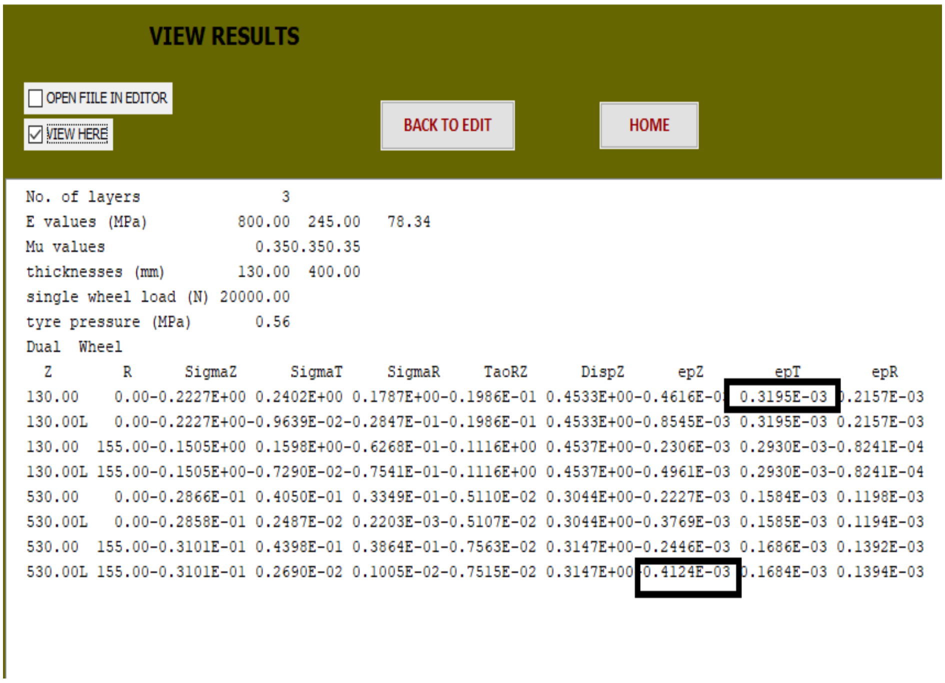

```
VIEW RESULTS
OPEN FIILE IN EDITOR
VIEW HERE
BACK TO EDIT    HOME

No. of layers              3
E values (MPa)          800.00  245.00   78.34
Mu values                 0.350.350.35
thicknesses (mm)        130.00  400.00
single wheel load (N) 20000.00
tyre pressure (MPa)       0.56
Dual  Wheel
  Z        R       SigmaZ      SigmaT      SigmaR      TaoRZ       DispZ       epZ         epT         epR
130.00    0.00-0.2227E+00 0.2402E+00 0.1787E+00-0.1986E-01 0.4533E+00-0.4616E-0  0.3195E-03 .2157E-03
130.00L   0.00-0.2227E+00-0.9639E-02-0.2847E-01-0.1986E-01 0.4533E+00-0.8545E-03 0.3195E-03 0.2157E-03
130.00  155.00-0.1505E+00 0.1598E+00-0.6268E-01-0.1116E+00 0.4537E+00-0.2306E-03 0.2930E-03-0.8241E-04
130.00L 155.00-0.1505E+00-0.7290E-02-0.7541E-01-0.1116E+00 0.4537E+00-0.4961E-03 0.2930E-03-0.8241E-04
530.00    0.00-0.2866E-01 0.4050E-01 0.3349E-01-0.5110E-02 0.3044E+00-0.2227E-03 0.1584E-03 0.1198E-03
530.00L   0.00-0.2858E-01 0.2487E-02 0.2203E-03-0.5107E-02 0.3044E+00-0.3769E-03 0.1585E-03 0.1194E-03
530.00  155.00-0.3101E-01 0.4398E-01 0.3864E-01-0.7563E-02 0.3147E+00-0.2446E-03 0.1686E-03 0.1392E-03
530.00L 155.00-0.3101E-01 0.2690E-02 0.1005E-02-0.7515E-02 0.3147E+00 0.4124E-03 .1684E-03 0.1394E-03
```

Fig. 5: Trail 3 output.

(ε_t = 0.0003246753) > (epT = 0.0003195)
(ε_v = 0.00056078) < (epZ = 0.0004124)
Permissible strains > actual strain ……….. safe

Table. 8: Layer thickness (with RAP).

Layer	Thickness (mm)
Subgrade	500
Sub-base	200
Base	200
Base binder course	100
Surface course	30
Total thickness	**1030 mm**

5.4 Design of flexible pavement without RAP

Trail – 1:

SURFACE COURSE = 30mm
BASE BINDER COURSE = 50mm
WMM = 200mm
GSB = 150mm
SUBGRADE = 500mm

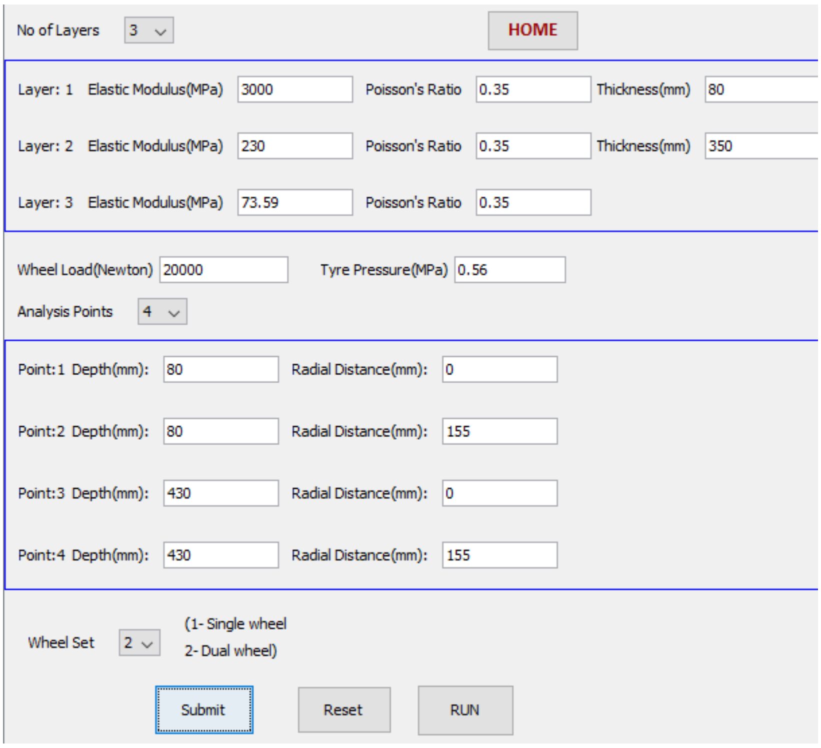

Fig. 6: Trail 1 input.

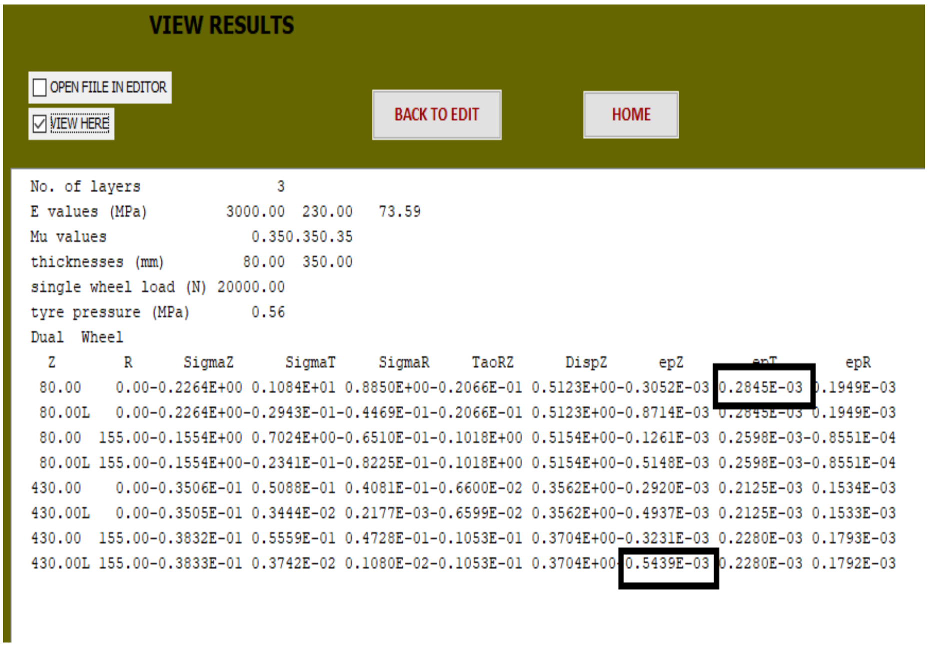

Fig. 7: Trail 1 output.

$(\varepsilon_t = 0.0003246753) > (epT = 0.0002845)$

$(\varepsilon_v = 0.00056078) > (epZ = 0.0005439)$

Permissible strains > actual strain ……….. safe

Trail – 2:

SURFACE COURSE = 30mm

BASE BINDER COURSE = 50mm

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WMM = 150mm
GSB = 150mm
SUBGRADE = 500mm

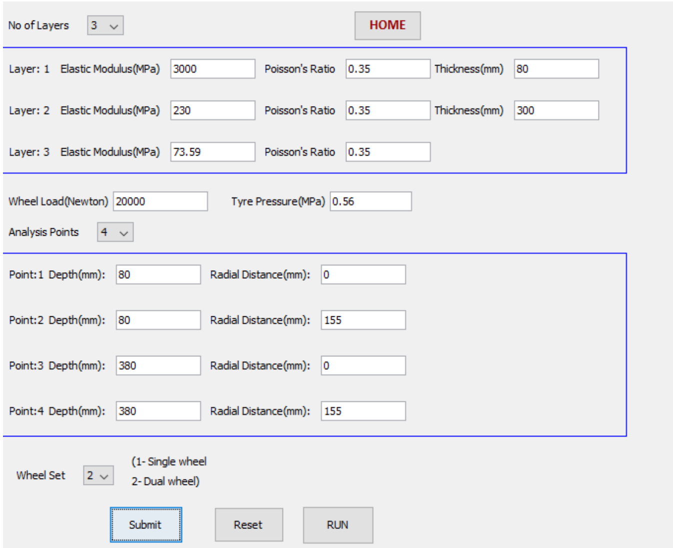

Fig. 8: Trail 2 input.

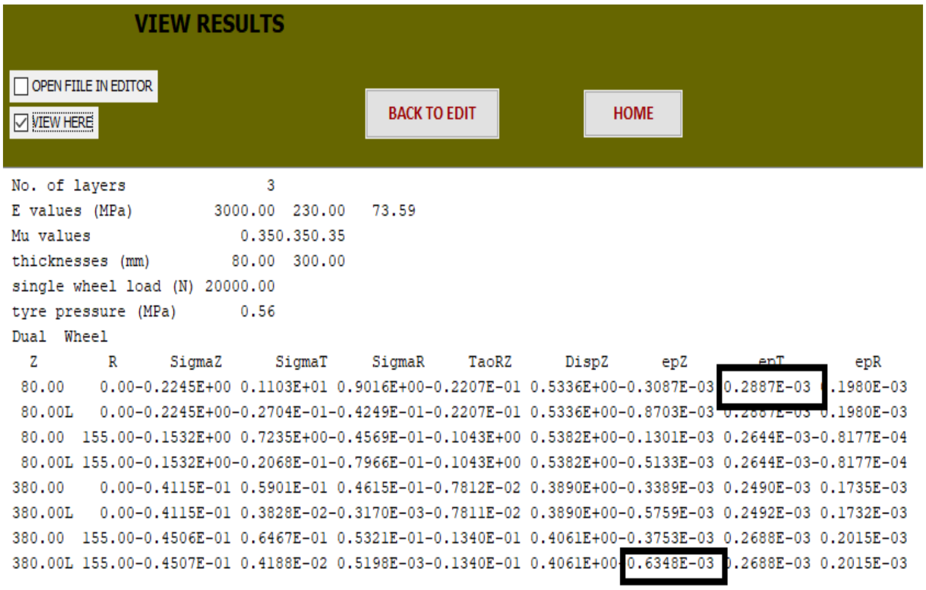

Fig. 9: Trail 2 output.

(ε_t = 0.0003246753) > (epT = 0.0002887)
(ε_v = 0.00056078) > (epZ = 0.0006348)
Permissible strains > actual strain ……….. un-safe

Table. 9: Layer thickness (without RAP).

Layer	Thickness (mm)
Subgrade	500
Sub-base	150
Base	200

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

Base binder course	50
Surface course	30
Total thickness	**930 mm**

6. CONCLUSIONS

- The RAP usage in the mix enhanced the strength at lower bitumen content thereby reducing the cost of the pavement.
- 40% replacement of the Bituminous mix with the RAP which is a non eco friendly product and its give good strength as compare to other mixes as per Mohammad Niyaz Ali[2] reaserach.
- 25% replacement of the subgrade soil with the RAP material(Raju Kumar Pandit[1]) which is a non eco friendly product. The disposal of the old bituminous mix in open atmosphere leads to evolution of harmful gases.
- By using IIT pave software the analysis and design performed with and without RAP, based on this analysis the layer thickness is lesser for conventional pavement construction but as per cost in view the subgrade around 25% stabilized by RAP and 40% RAP used for wearing courses. The difference between (with RAP and without RAP) layer thickness is uptained 100mm. The pavement construction is decresed by using RAP.
- It is a very low cost process as the RAP is freely available material which can be processed by the milling process. The virgin bitumen and aggregates usage in the new pavements can be decreased by this rehabilitation process.
- Pavement rehabilitation strategies like reconstruction using dismantled asphalt materials will not only be cost-effective solutions and an environment friendly option but will also ensure the intended performance level throughout the design life of the pavement at the defined cost.

REFERENCES

[1] Raju Kumar Pandit, Dr. S.S. Goliya, Dr. Rakesh Mehar “A STUDY ON RECLAIMED ASPHALT PAVEMENT (RAP)MATERIAL USING SUB-GRADE LAYER OF FLEXIBAL PAVEMENT IN VIDISHA CITY” (IRJET) volume: 06 Issue: 12 | Dec 2019

[2] Mohammad Niyaz Ali, B.Santhoshi Matha, “RECYCLED ASPHALT PAVEMENT MIXTURES FOR ROAD CONSTRUCTION”, (IRJET), Volume: 08 Issue: 02 | Feb 2021

[3] IRC: 37-2018, “Guidelines for the design of flexible pavements”, Indian Road Congress, New Delhi, 2012.

[4] Highway Engineering- S. K. Khanna & C. E. G Justo and A.Veeraragavan, Revised 10th Edition.