

## BIO-DATA

1. **Name:** Dr. Devesh Tiwari
2. **Date of Birth:** 31<sup>st</sup> July, 1962
3. **Current Position and Address:**

**Senior Principal Scientist and Ex. Group Coordinator** (Road Asset Management Group)  
Pavement Evaluation Division (PED), CSIR-Central Road Research Institute (CRRI), Mathura Road, New Delhi -110025, India  
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**Permanent Address**  
P1/8, Lane No. 15, Ravindrapuri Colony, District: Varanasi – 5, State: Uttar Pradesh, India

4. **Educational Qualification:**

Examination Passed	University / Board	Div./ Year	Subjects
Ph.D.	University of Roorkee (now, IIT Roorkee, India), Roorkee, Uttarakhand, India	2001	Transportation Engineering (Topic-Modelling of Integrated Bus Routes with Rapid Transit System)
Master in Engineering (ME)	University of Roorkee (now, IIT Roorkee, India) Roorkee, Uttarakhand, India	First/ 1991	Traffic and Transportation Engineering.
Bachelor in Engineering (BE)	Regional Engineering College (REC) Srinagar, Kashmir University (J & K), India	First/ 1984	Civil Engineering.

5. **Area of Specialization:**

- Pavement design
- Pavement construction and quality control
- Development of pavement maintenance management system
- Pavement data management and modelling
- Pavement evaluation, maintenance and rehabilitation needs
- Pavement technical audits
- Pavement failure investigations
- Pavement material testing and characterization
- Traffic engineering

6. **Academic/Research Experience/Employment**

(1) Employment

Post	Grade	From	To	Institute
Senior Principal Scientist (Scientist F)	Group –IV (5), PB-IV, Pay Scale 37,400-67,000 Grade pay 8900/--	14.12.2013	To date*	CSIR-CRRI, New Delhi, India

Principal Scientist (Scientist E II)	Group –IV (4), PB-IV, Pay Scale 37,400-67,000 Grade pay 8700/--	14.12.2007	13.12.2013	CSIR-CRRI, New Delhi, India
Senior Scientist (Scientist E I)	Group –IV (3), Pay Scale 12,000-375-16,500	14.12.2002	13.12.2007	CSIR-CRRI, New Delhi, India
Scientist C	Group –IV (2), Pay Scale 10,000-325-15,200	14.12.1997	13.12.2002	CSIR-CRRI, New Delhi, India
Scientist B	Group –IV (1), Pay Scale 8000-275-13,500	10.09.1992	13.12.1997	CSIR-CRRI, New Delhi, India

(2) Research Experience: Attached as **Enclosure - 1**

(3) Administrative Responsibilities / Academic Experience

➤ **Administrative Responsibilities**

- Responsibility taken as Group Coordinator (GC), Road Asset Management Group (RAMG) formulated and implement in the month of January, 2014 to January, 2016 by removing existing system of Head of Division (HOD) designation from entire Pavement Engineering Area.
- Provided additional responsibility taken as Group Coordinator, Pavement Materials and Construction Technology Group (PMCTG) from 2<sup>nd</sup> December to 31<sup>st</sup> December, 2014 apart of GC(RAMG).
- Presently working under various research projects as project leader and team member.

Activities

- Streamlined project implementation, execution, and distribution within group in an acceptable manner creating satisfaction among all group members.
- Generating research projects within the Group and Institute
- Guiding Scientist, Technical Officers, as well as students of AcSIR for Ph.D. and M.Tech.
- Completion of various assigned field tasks successfully with the coordination of team members.
- Implementing knowhow and knowledge usages of latest state of art equipments relevant to pavement area amongst Scientist within group and at Institute level.
- Maintaining and making operational all procured equipments viz. Asphalt Mix Performance Tester, Universal Testing Machine (UTM) used in testing Indirect Tensile Strength, Fatigue Characteristics, Roller Compacter, Automatic Mixer, Oven, pneumatic compressor, etc.
- Successfully delivery of time bound projects in time to the client from the Group / Institute.

➤ **Academic Involvement within Institute under AcSIR**

- Regular faculty for post-graduate students of “Pavement and Bridge Management Systems”, provided within Council of Scientific and Industrial Research – Central Road Research

Institute (CSIR – CRRI) under Academy of Scientific and Innovative Research (AcSIR), since it was regularized, till date.

- Developed Post Graduate (Master's) course content for Pavement Management System under AcSIR at CRRI. Created assignments which are delivered during semester.
- Evaluated seminars presentations of students under AcSIR as Examiner which is a part of semester course.
- Prepared assignments, midterm test questions and evaluated the answer sheets for PGRPE students at CSIR-CRRI.
- As thesis supervisor was involved in Evaluation of Term Paper of M. Tech. students and performance of Ph.D. students.

#### ➤ **Academic Involvement Outside Institute as Visiting Faculty**

- Regular visiting faculty for 2<sup>nd</sup> semester post graduate degree programme on '**Highway Panning and Design**' course, at Department of Transport Planning, **School of Planning and Architecture (SPA)**, New Delhi, India. The semester course duration is from January to May (2<sup>nd</sup> Semester) and teaching since the year 2008 to 2014.
- Regular Visiting Faculty at Indian Academy of Highway Engineers (IAHE, old name as NITHE) on Road engineering related topics, viz. Maintenance Management System for Roads, Pavement Maintenance and Rehabilitation, Highway Development and Management Software (HDM-4), Road Information System, etc. since 2005 to till date, depending on the course content.
- Provided expert Lectures on topics at Department of Civil Engineering, National Institute of Technology Karnataka (NITK), Surathkal, Mangalore related to 'Pavement Management System' to students of Master Course, Research Scholars and interacted with the faculty from 1<sup>st</sup> to 3<sup>rd</sup> April, 2014.

#### **7. Honors / Awards received/International Visits:**

- Received **KHOSLA RESEARCH AWARD** of University of Roorkee (Now IIT Roorkee), India for a research paper published in "Indian Highways", dated May, 1987.
- Received **COMMENDATION CERTIFICATE** of **COMMENDATION CERTIFICATE**, This research paper is on the Capacity Analysis and Level-of-service of At-grade Unsignalised Intersections under mixed traffic flow. The complete methodology has been incorporated in the IRC code, titled "**Guidelines for the Design of At-Grade Intersections In Rural & Urban Areas**", **Special Publication 41, Indian Roads Congress, 1994.**
- Qualified **Senior Research Fellowship (SRF)** of **CSIR** and joined **Ph.D.** as a full time research scholar from 1<sup>st</sup> Jan. 1992 to 9<sup>th</sup> Sept. 1992.
- Received **COMMENDATION CERTIFICATE** of Indian Roads Congress for a research paper entitled, 'A Simplified Approach for Location of Bus Stops on Urban Roads', published in HRB, Number 54, 1996, in 58<sup>th</sup> Annual IRC Session held at Bhopal, 5-8 January, 1998.
- **Ph.D.** was awarded in the Annual Convocation day of Indian Institute of Technology (IIT), Roorkee, India in the year 2001. The title of the Ph.D. thesis is, 'Modelling of Integrated Bus Routes with Rapid Transit System'.
- Was Nominated continuously for three years for '**IRC- PT. JAWAHARLAL NEHRU BIRTH CENTENARY AWARD**' for the year **2004-2006**. One of the most prestigious National Award for Highway Engineers in the country.

#### **International Visits**

- Presented paper entitled, “Effect of Higher axle load on the flexible pavement performance in India using Heavy Vehicle Simulator” at 9<sup>th</sup> International Conference on Road and Airfield Pavement Technology (9<sup>th</sup> ICPT, 2015), held at **Dalian, Liaoning, China**, 9<sup>th</sup> August to 13<sup>th</sup> August, 2015.
- Deputed as delegate for workshop and discussions on **Pavement Management Techniques at Eurfurt, Germany and Buzancais, France** and presented the status of different developed Pavement Management systems of India from 26<sup>th</sup> October to 31<sup>st</sup> October, 2014.
- Project Coordinator and instructor/lecturer for providing training on '**Highway Development and Management (HDM-4)**' software tool to the road Engineers of Northern Provincial Road Development Department, **Jaffna, Sri Lanka** at Anuradhapura, Sri Lanka from 7<sup>th</sup> October to 10<sup>th</sup> October, 2013.
- Presented paper entitled, “Deterioration Modelling of Flexible Pavements with Modified Bitumen” at Third International Conference on Construction In Developing Countries (ICCIDC–III), “Advancing and Integrating Construction Education, Research & Practice” held at Millennium Hilton, **Bangkok, Thailand**, (4-6 July, 2012).
- Presented paper entitled, “Impact Assessment of Rehabilitation Works on Road Roughness for State Highways – A Case Study”, at **Adelaide Convention Centre, Adelaide, Australia** (30<sup>th</sup> August to 1<sup>st</sup> September, 2008).
- Visited Transportation Research Laboratory (TRL), **Berkshire, U.K. on 17<sup>th</sup> September 2007 on invitation from TRL** and attended advance training course on HDM-4 (Version 2) at **University of Birmingham, U.K. from 10<sup>th</sup> September to 14<sup>th</sup> September 2007**.
- Provided onsite training to operate and evaluate **Highway Development and Management (HDM-4)** software tool, as an hands on instructor and delivered Lectures on HDM-4 software to **engineers of Roads Department, Royal government of Nepal, at Kathmandu** under a project entitled “Implementation of SKD-6: Road Construction/Management Planning Using HDM-4”.

## 8. Professional Affiliations:

### ▪ Membership of Professional Societies / Institutions:

- |   |                         |
|---|-------------------------|
| ◆ Institution of Engineer –                               | Fellow Institute Member |
| ◆ Indian Roads Congress –                                 | Life Member             |
| ◆ Indian Society of Construction Materials & Structures – | Life member             |
| ◆ Institute of Urban Transport –                          | Life Member             |

### ➤ Member of IRC, BIS and MORTH committees:

- Member in Mechanization Committee (G-4) for a period of three years (from January 2012 to December 2014).
  - Involved in producing IRC:SP:97-2013 entitled 'Guidelines on Compaction Equipment for Road Works'.

- Member of Sub-group constituted by H-6 Committee for Pavement preservation and Periodic Maintenance
  - Member of H-8 (Urban Roads, Streets & Transport) Committee (2015-17 and continued further for 2017-19)
    - Involved in the sub-committee for producing Urban Road Manual as well as Information Technology for Urban Roads
  - Member, Bureau of Indian Standards (BIS) committee on Aggregates from other than Natural Sources, CED 2/P3', since March, 2014.
  - Member of the Standing Committee constituted by MORTH on 'Introduction of new technology/alternative design in the projects on EPC/BOT basis'. The standing committee has been constituted to resolve several issues pertaining to adoption of new technology / alternative design for projects taken under EPC/BOT mode.
  - Member, HUDCO's research and training arm, Centre for Project Management and Development, Human Settlement Management Institute (HSMI), HUDCO Bhawan, Lodhi Road, New Delhi, ongoing since year 2015: Finalized and approved research proposal entitled ' Investigation on Mechanical and Durability Properties of Self Compacted Concrete Prepared with Recycle Coarse Aggregate from C & D Waste' and 'Construction of Low Volume Roads on Soft Subgrade Soil Improved by Locally Available Marginal Materials'.
  - Invitee Member for TIFAC which has been assigned by MOEF&CC to carry out a study 'Technology Needs Assessment (TNA)' on transport sector.
- **Member of various External Committees:**
- ◆ **Member:** Independent Performance Evaluation Committee for review of reports of State Quality Monitors (PMGSY), Uttaranchal Rural Roads Development Agency, Dehradun, Uttaranchal, since May, 2013.
  - ◆ **Member, Technical Scrutiny Committee:** The World Bank Aided Projects sponsored to Uttar Pradesh Public Works Department (U.P.P.W.D.), Uttar Pradesh State, India, since 2006 to till date.
  - ◆ **Member, Technical Committee:** Constituted by U.P.P.W.D. for providing Guidance in the development of Road Maintenance Management System for roads falling under P.W.D. since May, 2010.
  - ◆ **Member, Board of Studies:** Provided guidance / solution / discussion as Institute representative and committee member of Board of Studies (BOS) for Department of Civil Engineering Dr B R Ambedkar National Institute of Technology (NITJ) Jalandhar - 144 011, Punjab, India since year 2012-2015.
  - ◆ **Member:** Expert member of the committee constituted by "Hemwati Nandan Bahuguna Garhwal University, Srinagar Garhwal (Uttarakhand) regarding "Finalization of Road Alignment for Chauras Campus connecting under construction motorable bridge at Srinagar Garhwal", since 2<sup>nd</sup> July, 2011.
  - ◆ **Chairman of Technical Committee:** Constituted for checking the construction quality of various forest road works executed by Engineering Project India Limited (EPIL). The committee was formed by the Additional Principal Chief Conservator of Forest, Planning and Financial Management, Department of Forest, Dehradun, Uttarakhand. Involved in planning, organizing and testing of number of samples collected from 41 forest roads of Uttarakhand state. Submitted final test report/ results in the month of January, 2010.

- ◆ **Member, Technical Scrutiny:** The World Bank Aided Projects to Uttar Pradesh State Highway Authority (U.P.S.H.A.), Uttar Pradesh State, India, from year 2004 to year 2007.
  
- **Member of various Internal Committees/CSIR:**
  - Member of Assessment Committee for the assessment of technical officers (Gazetted) of Central Mechanical Engineering Research Institute (CMERI), Durgapur, 29<sup>th</sup> to 31<sup>st</sup> May, 2018.
  - Member of Assessment Committee for the assessment of technical officers of Central Mechanical Engineering Research Institute (CMERI), Durgapur, from 2<sup>nd</sup> to 3<sup>rd</sup> November, 2018.
  - **Vice President** of Recreation club of the Institute (from 1<sup>st</sup> January, 2018 to till date).
  - As Advisory members of International Conference on Pavement and Computational Approaches (ICOPAC) 2018 organization committee.
  - ◆ **General Secretary** of Recreation club of the Institute (from Oct. 2005 to January 2011).
  - ◆ **Management Council (MC):** Member, MC of the Institute from year 2002 to 2005, which is the second highest committee of the Institute after Research Council (RC). RC is for guidance on R&D and other policy related issues and MC for decisions on administrative and other general matters.
  - ◆ **Purchase committee member** of the Institute (from Oct. 2005 to January 2010).
  - ◆ **Chairman Welfare Committee** of the Institute since 2014 till date.
  
- **Course Coordinator:**
  - ◆ **Course coordinator and Trainer / Instructor of HDM-4:** Course Coordinator since year 2012 to till date and faculty as well as hands on trainer (since 2005 till date) for annual regular training course held at CRRRI of two weeks duration. The Institute is known as one of the Asia Pacific training and dissemination centre of Highway Development and Management (**HDM-4**) software tool by The World Bank, Asian Development Bank, Transport Research Laboratory UK and Australian Road Research Board. Till date, about 300 officers from almost all leading private consultancy and Government organizations in India (viz. CES, SPAN, ICT, LEA, SWK, FEEDBACK, TCS, MMRDA, L&T, PWDs etc.) and about 70 officers from different countries including **Afghanistan, Bangladesh, Bhutan, Brazil, Iran, Nepal, Tanzania, Sri-Lanka**, etc have received training on HDM-4 operation from the Institute. Some of the details are given below:
    - 1) International Course on Dissemination of HDM-4
      - i. Country: Albania, Afghanistan, Chile, Bangladesh, Uganda and India
      - ii. Number of Participants : 16
      - iii. Duration : September, 2010 to October, 2010
    - 2) International Course on Dissemination of HDM-4
      - i. Tailor made for Country : Tanzania
      - ii. Number of Participants : 23 from Tanzania. Location: CSIR-CRRRI
      - iii. Duration : December 20, 2010 to January 18, 2011
    - 3) International Course on Dissemination of HDM-4
      - i. Country (regular training) : Afghanistan and India
      - ii. Number of Participants : 23, Location: CSIR-CRRRI
      - iii. Duration : October 10, 2011 to October 21, 2011
    - 4) International Course on Dissemination of HDM-4

- i. Tailor made for Bihar state : For Road Construction Division (RCD) Bihar
- ii. Number of Participants : 38, Location: Patna, Bihar
- iii. Duration :December 19, 2011 to December 24, 2011
- 5) International Course on Dissemination of HDM-4
  - i. Country (regular training) : Afghanistan, Nepal and India
  - ii. Number of Participants : 15, Location: CSIR-CRRI
  - iii. Duration :October 08, 2012 to October 19, 2012
- 6) International Course on Dissemination of HDM-4
  - i. Country (regular training) : Tanzania and India
  - ii. Number of Participants : 51, Location: CSIR-CRRI
  - iii. Duration :September 16, 2013 to September 27, 2013
- 7) International Course on Dissemination of HDM-4
  - i. Tailor made for Country : For Northern Province Engineers of Sri Lanka
  - ii. Number of Participants : 64, Location: Anuradhapura, Sri Lanka
  - iii. Duration :October 07, 2013 to October 10, 2013
- 8) International Course on Dissemination of HDM-4
  - i. Country (regular training) : Tanzania and India
  - ii. Number of Participants : 8, Location: CSIR-CRRI
  - iii. Duration : September 15, 2014 to September 26, 2014
- 9) International Course on Dissemination of HDM-4
  - i. Tailor made for Country : IRAQ
  - ii. Number of Participants : 13, Location: CSIR-CRRI
  - iii. Duration : June 16, 2014 to June 27, 2014

- ◆ **Coordinator and Instructor:** Organized Training Program for Senior Engineers of Road Development Authority, Sri Lanka on “Assistance in procurement of road data collection equipments”, from 1<sup>st</sup> to 6<sup>th</sup> February, 2007.
- ◆ **Course Coordinator** and instructor/lecturer for providing training on '**Highway Development and Management (HDM-4)**' software tool to the road Engineers of Northern Provincial Road Development Department, **Jaffna, Sri Lanka** from 7<sup>th</sup> October to 10<sup>th</sup> October, 2013, at **Anuradhapura, Sri Lanka**.
- ◆ **Coordinator, Instructor and Faculty:** Customized Training Programme on Highway Development and Management (**HDM-4**) for the **engineers of Road Construction Department (RCD)**, from 19<sup>th</sup> to 24<sup>th</sup> December, 2011 at Patna, Bihar.
- ◆ **Coordinator, Instructor and Faculty:** Customized Training Programme to disseminate knowledge on road maintenance management planning and budgeting using The World Bank's Highway Development and Management (HDM-4) software to the officials of Highway Research Station (HRS) Chennai under MoU from 6<sup>th</sup> to 10<sup>th</sup> Sep, 2016.

▪ **Course Faculty for Training:**

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- Short term course on 'Innovative Technologies in Transportation Engineering', Department of Civil Engineering, IIT Guwahati, Guwahati, 23-27 February, 2015.
- Customized Training Programme on 'Design, Construction and Maintenance of Flexible Pavement and Rigid Pavements" for Engineers of Road Construction Department (RCD), Patna, Bihar, 9-12 February, 2015.
- Customized Training Programme on capacity building of local engineers and contractors entitled, “Capacity Building for Contractors” for the Contractors and

Engineers of Public Works Department (PWD), Government of Meghalaya at Shillong for two days in the month of 13-14 October, 2014.

- Training Programme on 'Pavement Evaluation Techniques & Their Applications for Maintenance & Rehabilitation' at CRR , 16-20 December, 2013.
- Faculty for workshop on Sustainable Road Technologies for PMC at Pune. Provided lectures on Data Modelling and Management, 23- 25 October, 2013.
- Customized Training Programme on Rural Roads under PMGSY Scheme for third batch of AE to SE of RED, UP at CSIR-CRRI, 12-17 August, 2013.
- Customized Training Programme on "Project Preparation, SBD, Quality Assurance and Maintenance of Rural Roads" for field engineers involved in PMGSY at CSIR-CRRI, 08-12 July, 2013.
- Customized Training Programme on 'Design, Construction and Maintenance of Flexible Pavement and Rigid Pavements" for Engineers of Road Construction Department (RCD), Patna, Bihar, 21-24 January, 2013.
- Regular training programme on 'Pavement Evaluation Techniques & Their Applications for Maintenance & Rehabilitation' from 19<sup>th</sup> to 23<sup>rd</sup> November, 2012 at CRRI, New Delhi.
- Customized Training Programme on "Contract Management and Quality Control Aspects" for the Contractors and Young Engineers of Public Works Department (PWD), Government of Meghalaya at Tura and Shillong from 28<sup>th</sup> to 30<sup>th</sup> May, 2012 (at Tura) and 31<sup>st</sup> to 2<sup>nd</sup> June, 2012 (at Shillong).
- Faculty for Workshop on 'Sustainable Road Technologies for Tripura in North-East, 4-5 February, 2012.
- Training Programme on 'Highway Development and Management (HDM-4)', RCD Patna from 19-24 December, 2011.
- Customized Training Programme on "Pavement Evaluation Techniques and their Applications for Maintenance and Rehabilitation" for the engineers of Road Construction Department (RCD), Patna, Bihar from 30<sup>th</sup> June to 2<sup>nd</sup> July 2011.

### **Speaker/Expert Talks**

- Guest speaker to the students of Civil engineering, Dept. of Civil Engineering K.R. Mangalam University, Gurgaon on 28<sup>th</sup> February, 2019
- Chaired sessions on Pavement Management Systems and Advances in Pavement Engineering on the behalf of Indian Roads Congress - Young (IRC-Y) held at Department of Civil Engineering, VNIT, Nagpur, Maharashtra from 27<sup>th</sup> to 28<sup>th</sup> October, 2018.
- Key note speaker for Employee Training Workshop on Economic Analysis and demonstration of HDM IV software, Feedback Infra Pvt. Ltd, 15th Floor, Tower 9B, DLF Cyber City, Phase - III, Gurgaon 122 002, 21<sup>st</sup> July 2018
- Main Indian Speaker for Special Session of World Road Association (PIARC) entitled 'The Importance of Asset Management' held on 17<sup>th</sup> Nov. 2017 in 18<sup>th</sup> Cross Roads World Road Meeting (2017), 14-17 Nov. 2017 at India Expo. Ltd. Grater Noida.
- Expert talk on "Highway Maintenance Management" in the workshop held as a part of ADB funded project 'Multi-Sector Project for Infrastructure Rehabilitation in Jammu and Kashmir' for J&K PWD Engineers at Srinagar (Kashmir), 12<sup>th</sup> September 2013.



- Delivered Lecture for Advanced Technology In Construction of Warehousing Infrastructure for Engineers of Central Warehousing Corporation (CWC) sponsored by Department of Civil Engineering, Jamia Millia University New Delhi on 18<sup>th</sup> December 2012.
- Keynote speaker for Faculty Development Programme on "Emerging Trends in Civil Engineering" at Thapar University, Thapar Technology Campus, Patiala, Punjab (August 23, 2013).
- External Examiner for Transportation Engineering Lab for B. Tech. VI th semester at Department of Civil Engineering, Jamia Millia University, New Delhi (18<sup>th</sup> May 2013).
- External Examiner for Transportation Engineering Lab for B. Tech. VI th semester at Department of Civil Engineering, Jamia Millia University, New Delhi (2011).

### **Received Training**

- Participated in the training programme entitled 'Design of Experiments (DOEWS-2014)' from 10 to 14 November, 2014, at Indian Statistical Institute, Kolkata.
- Participated in the training programme entitled 'Statistical Modelling for Data Analysis (SMDA 2012)' from 10 to 15 December, 2012, at IIT Kharagpur.
- Participated in advance training course on HDM-4 (Version 2) at University of Birmingham, U.K. from 10<sup>th</sup> September to 14<sup>th</sup> September 2007.

**9. Number of Research Publications:** Journals: 28, International and National Conferences: 58  
Details are given in **Enclosure - 2**

**10. Number of Books Authored/Edited:** Nil

➤ **Journal Reviewer**

Journal of Civil Engineering and Architecture, published by David Publishing Company, 9460 Telstar Ave Suite 5, EL Monte, CA91731, USA, Tel:1-323-984-7526;Fax:1-323-984-7374

Email: [order@davidpublishing.org](mailto:order@davidpublishing.org), [www.davidpublishing.org](http://www.davidpublishing.org)

**11. Number of Patents granted / applied for:** One and the details are given below.

Patent Number: 0176NF2013 (Process has been patented)

Title: A Process for Road Construction using Thermocol (Expanded Polystyrene) Waste in Hot Bituminous Mixes

Thermocol also known as Expanded Polystyrene (THERMOCOL) is one form of polystyrene plastic which is made by blowing pentane gas (C<sub>5</sub>H<sub>12</sub>) through polystyrene and are non-biodegradable. It is abundantly used for various purposes like packaging, food storage, insulation, use & throws cups and plates etc. due to its low weight, high strength, and durability, ease of manufacturing and low cost. Disposal of Thermocol waste is a major problem since it chokes the drains, do harm to plants and animals, as well as degrade the water quality and aquatic life. Finer particles of Thermocol can even be more dangerous to health, if inhaled. Even burning of Thermocol produces excess heat and carbon dioxide (soot) which pollute the air completely. Disposal of Thermocol waste into the landfill pollutes soil and make it infertile over a period of time.

Commonly used plastic is made of polyethylene popularly known as polybags or polythene bags. Such plastic waste has already been found to be useful in Hot Asphaltic Mixes (HMA) for road construction in high temperature areas. Since, use of SBS to modify bitumen has been

found acceptable therefore it is expected Thermocol will improve the properties of bituminous mixes. The use of Styrene co-polymers for modifying bitumen to achieve high strength in bituminous mixes has paved the way for utilizing Thermocol waste which is Styrene blown with Pentane gas for HMA. The Objectives of the Invention is to provides a process for road construction using Thermocol (expanded polystyrene ) waste in hot bituminous mixes and another object of the present invention is to enhance the properties of bituminous mixes by using the Thermocol waste.

## 12. Dissertations supervised:

### (a) Ph.D.

#### Completed (3)

- 1) Shri Yogesh U. Shah: Supervisor for Ph.D. thesis entitled, '**Prioritization of Maintenance Management Decisions for Urban Transport Network**', registered at Centre of Transportation System (CTRANS), Department of Civil Engineering, Indian Institute of Technology (IIT), Roorkee, Uttarakhand, India, awarded on 20<sup>th</sup> September 2014.
- 2) Ms. Siksha Swaroopa Kar - Ph.D. thesis entitled '**Effect of Viscosity and Rheological Properties of Binders on Foamed Binder Characteristics and Mixes**' registered under Academy of Scientific and Innovative Research at CSIR- Central Road Research Institute (CRRI), New Delhi, December 2017.
- 3) Shri Sanjay Deori - Ph.D. thesis entitled '**Pavement Deterioration Modeling of Flexible Pavements having Mixes with Modified Binders**' registered at Indian Institute of Technology (IIT) Guwahati, Assam and working at CSIR – North East Institute of Science & Technology (NEIST), Jorhat as Principal Scientist and Group Leader, Assam, February 2018.

#### Ongoing (4)

- 1) Ongoing - Supervisor for Ph.D. thesis of Shri Gagandeep Singh entitled '**Investigation of Fatigue Endurance Limit in Bituminous Mixes Containing Modified Bitumen**' registered under Academy of Scientific and Innovative Research at CSIR- Central Road Research Institute (CRRI), New Delhi, Year 2013.
- 2) Shri Shahbaz Khan - Ph.D. thesis entitled '**Performance Evaluation of Inverted Pavement with Cement Fly Ash Base Layer**' registered under Academy of Scientific and Innovative Research at CSIR- Central Road Research Institute (CRRI), New Delhi, Registered Year 2014.
- 3) Fadamoro, Oluwafemi Festus - Joined under TWAS-CSIR fellowship programme (November, 2016) entitled '**Performance Evaluation of Foam Bitumen Stabilization Using Warm RAP Material and Aggregates**' registered under Academy of Scientific and Innovative Research at CSIR- Central Road Research Institute (CRRI), New Delhi, November, 2016.
- 4) Shri Bhavesh Jain - As Co-Supervisor of the Ph.D. thesis entitled '**Development of Asset Management System for the Road Network of a Smart City**', registered at Centre of Transportation System (CTRANS), Department of Civil Engineering, Indian Institute of Technology (IIT), Roorkee, Uttarakhand, India, April 2018.

### (b) Post-Graduation

- 1) Ms. Anamika Yadav - **M. Tech.** thesis entitled 'Impact of Dielectric constant on layer thickness using GPR', Transportation Engineering, Department of Civil Engineering, Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, ongoing since July 2019.
- 2) Mr. Ramasubramanya M.S. - **M. Tech. thesis** in Highway Technology entitled, ' ', Department of Construction Technology Management and Highway Technology, Dayananda Sagar College of Engineering, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore, Karnataka, India, July 2018.
- 3) Ms. Gauri R. Mahajan - **M. Tech.** thesis entitled 'Optimization of Mix Design Using Induction Technology in Self Healing of Flexible Pavements', Transportation Engineering, Department of Civil Engineering, Samrat Ashok Technological Institute, Vidisha (M.P.), June 2017.
- 4) Ms. Anik Gupta - **M. Tech.** thesis entitled 'Impact of One Time Damage from Single Heavy Axle with respect to ESAL's', registered under Academy of Scientific and Innovative Research at CSIR- Central Road Research Institute (CRRI), New Delhi, June, 2017.
- 5) Naveen Kumar - **M. Tech.** thesis entitled 'Effect of Road Roughness and Vehicular Speed on Emissions using HDM-4', Transportation Engineering, Department of Civil Engineering, National Institute of Technology (NIT), Kurukshetra, Haryana, India.
- 6) Naveen Kulkarni - **M. Tech.** thesis entitled 'Quality Certification of Road Infrastructure', Centre of Excellence for Transportation Systems(CTRANS), Indian Institute of Technology (IIT), Roorkee, Uttarakhand, India.
- 7) Mayur R. Chopde - **M. Tech.** thesis entitled 'Sensitivity Analysis of Vehicular Loading and Traffic Pattern on Total Transportation Cost for a High Speed Road Corridor', Transportation Engineering, Department of Civil Engineering, National Institute of Technology (NIT), Patna, Bihar, India.
- 8) Sanchit Anand – **Master's Thesis** entitled 'Endurance Limit of Hot Mix Asphalt Using Polymer Modified Bitumen', Department of Civil Engineering, MNIT Jaipur, Rajasthan, India, July 2015.
- 9) Lt Col Rahul Rajput – **Master's Thesis** entitled 'Road Safety Analysis of an Arterial Corridor– A Case Study of Mathura Road in Delhi', Department of Transport Planning, School of Planning and Architecture (SPA), New Delhi, India, Expected to finish by August 15.
- 10) Nithin Raj - **M. Tech.** thesis entitled 'GIS Based Road Life Cycle Management System', Infrastructures Systems, Centre for Transportation Systems, Indian Institute of Technology, Roorkee, Uttarakhand, May 2015.
- 11) Miss Annu - **M.E.** Thesis entitled 'Sensitivity Analysis of HDM-4 Tool Using a Case Study', Civil Engineering Department, Thapar University, Patiala, Punjab, July 2014.
- 12) Prabin Kumar Ashish - **M. Tech.** Thesis in Transportation Engineering entitled 'Mechanistic Characterization of Cement Stabilized Fly Ash Mixes for Design of Flexible Pavement', Academy of Scientific and Innovative Research, CSIR- Central Road Research Institute (CRRI), New Delhi, June 2014.
- 13) Deepak John Peter – **M. Tech.** Thesis in Transportation Systems Engineering entitled 'Laboratory Analysis of SMA and Dense Bituminous (BC) Mixes Using Asphalt Mixture Performance Tester', Department of Civil Engineering, National Institute of Technology Karnataka (NITK) Surathkal, Mangalore, October 2012 - March 2013.
- 14) Shahbaz Khan - **M. Tech.** Thesis in Engineering of Infrastructure and Disaster Mitigation (Building / Roads) entitled 'Synthesis of Permanent Deformation in Flexible Pavement Using APTF', Academy of Scientific and Innovative Research, CSIR- Central Road Research Institute (CRRI), New Delhi, June 2013.
- 15) Shri Satish Pandey – **M. Tech.** Thesis on 'Use of Geosynthetics in Pavements', Civil Engineering Department, Indian Institute of Technology (IIT) Delhi, New Delhi, March September 2011.
- 16) Shri Akash C. Prakasan – **M. Tech.** (Transportation Engineering) thesis on 'Development of Urban Road Management System using Analytical Hierarchy Process', Indian Institute of Technology (IIT) Roorkee, Uttarakhand, June 2011.

- 17) Shri Jignesh K. Patel – **M.E.** Thesis in Highway and Transportation entitled 'Pavement Evaluation of a State Highway- A Case Study', Technology & Engineering Institute, The Maharaja Sayajirao University of Baroda, Kalabhavan, Vadodra, Gujrat State, India, July 2008.
- 18) Shri Mukesh Kumar – **M. Tech.** Thesis on 'Life-Cycle Performance of Pavements', Indian Institute of Technology (IIT) Delhi, New Delhi, India, June 2007.
- 19) Ms. Radhika Bamzai – **Master's Thesis** in transportation Planning entitled 'Sensitivity Analysis of Calibration Parameters of Pavement Deterioration Model in HDM-4 and Effect of Cracking Calibration Factors on IRR and VOC', School of Planning and Architecture (SPA), New Delhi, India, August 2006.
- 20) Shri Mohit Verma – Thesis report 'Performance Based Maintenance Strategy for Rural Roads in Uttaranchal' in partial fulfillment of **Masters of Technology** in Civil Engineering, Department of Civil Engineering, IIT Roorkee, Uttaranchal, India, June 2006.
- 21) Shri Vikrant Goel – Project report on 'Development of PMMS for Urban Roads', in partial fulfillment of **Master in Computer Applications** at Jiwaji University, Gwalior (MP), May 2004.
- 22) Ms. U. Jaya Lakshmi – Project report on 'Calibration of HDM-4 for Indian Conditions' in partial fulfillment of **M. Tech. dissertation** at I.I.T. Bombay, India, 3d March 2004.
- 23) Shri Anurag Agarwal – Thesis report 'Development of Operational Pavement Maintenance Management System for Urban Roads' in partial fulfillment of **Master in Computer Applications**, at Bundelkhand University, Jhansi, India, February to July 2003.
- 24) Shri Mohammad Ashraf – An industrial training report on 'Analysis of Scientific Time Series Database for Deterioration Models of Modified Bitumen Road Surface' in partial fulfillment of the Degree of **Master in Computer Science and Applications**, from Aligarh Muslim University, Aligarh, India, July 2003.
- 25) Ms. Shafali Khattar- Project report on 'Evaluation of Pavement Strength and Traffic Effects for Maintenance of Roads' in partial fulfillment of **Master of Information Technology (MIT)**, at Department of Electronics, Kurukshetra University, India, October 2002.

**(c) Under Graduation Training (B.E./B.Tech.)**

- 1) Mr. Aditya Singh, training report entitled 'Effect of Ageing and Temperature on the Resilient Modulus of the Laboratory Compacted Asphalt Samples', six months project semester for the award of degree of B.E. (Civil Engineering), Thapar Institute of Engineering and Technology, Patiala, Punjab during June to Dec 2018.
- 2) Mr. Simranpreet Singh, from PEC, University of Technology, Chandigarh and worked on pavement evaluation aspect from January 2015 to May 2015, 5 months.
- 3) Karan Vir Singh Pundir, B. Tech. 6 months Summer Training entitled "Use of Waste Plastic in Bituminous Mixes", from PEC University of Technology Chandigarh, July 2013.
- 4) Mr. Shivam Pratap Singh - B.E. (Honours) Civil, 6 months Summer Training entitled "State of art Testing on Bituminous Mixes having Waste Plastics", from Birla Institute of Technology and Sciences (BITS) Pilani, Hyderabad, Rangareddy District, Telangana, December 2013.
- 5) Mr. Paras Deshpande - B.E. Civil & M.Sc. Honours, 6 months Summer Training entitled "Use of AMPT for Dynamic Modulus Test on Different Bituminous Mixes", from Birla Institute of Technology and Sciences (BITS) Pilani, Hyderabad, Rangareddy District, Telangana, December 2013.
- 6) Mr. Ashish Singh - B. Tech. 6 months Industrial Summer Training entitled "Evaluation of Flexible Pavement Through Material Testing", from Civil Engineering Department, Thapar University, Patiala, Punjab, June 2013.
- 7) Ms. Annu - B. Tech. 6 months Industrial Summer Training entitled "Study on Various Pavement Evaluation Techniques and HDM-4", Civil Engineering Department, Thapar University, Patiala, Punjab, June 2013.

- 8) Harshil Pawar - B. Tech. 6 weeks Summer Training entitled "Testing of Road Materials using Conventional and State of Art Equipments", from IIT, Bhubaneswar, Odisha, May to June, 2012.
- 9) Mr. Sovil Kumar - B. Tech. (Civil) Industrial training work of 6 weeks from JSS Academy of Technical Education, Noida, U.P. June 2012.
- 10) Mr. Amit Singh Rana - B. Tech. (Civil) Industrial training work of 6 weeks from Vivekanand College of Techn. & Management, Aligarh, U.P. June 2012.
- 11) Ms. Neha- B. Tech. (Civil) Industrial training work of 6 weeks from Institute of Applied Medicine and Research, Ghaziabad, U.P. June 2012.
- 12) Mr. Kanhaiya Kumar - B. Tech. (Civil) Industrial training work of 6 weeks from Sharda University, Gr. Noida, U.P. June 2012.
- 13) Mr. Manmeet Singh - B. Tech. (Civil) Industrial training work of 12 weeks from NIT Jalandhar, Punjab, June 2012
- 14) Mr. Anoop Joshi - B. Tech. (Civil) Industrial training work of 12 weeks from NIT Jalandhar, Punjab, June 2012.
- 15) Md. Manjar Hussain- B. Tech. (Civil) Industrial training work of 6 weeks from Sharda University, Gr. Noida, U.P. June 2012.
- 16) Mr. Saurbh Chaudhry - B. Tech. (Civil) Industrial training work of 6 weeks from Inderprastha Engg. College, Sahibabad, U.P. June 2012
- 17) Shri Virendra Chavda - B. Tech. (Civil-Construction) thesis work (final year, one semester) entitled "A Pavement Type Selection Procedure" from School of Building Science and Technology, CEPT University, Ahmedabad, Gujrat, India, January 2010.
- 18) Mohd. Farooq Khan – B. Tech. Industrial training work entitled 'Pavement Evaluation Techniques' from Civil Engineering Department, GZS College of Engineering & Technology, Bhatinda, Punjab, December 2009.
- 19) Shri Mohit Singla - B.E. industrial training work entitled 'Study on Use of Coal Fly Ash in Bituminous Layers' from Civil Engineering Department from Giani Zail Singh College of Engineering and Technology, Bathinda, Punjab, July 2009 to December 2009.
- 20) Shri Sachin B. Kumbhar - M.E. summer training work entitled 'Application of Integrated Testing Facility for Performance Parameters of Bituminous Mixes in HDM-4' from Department of Civil Engineering, IIT Chennai, Chennai, July 2009.
- 21) Shri R. Sivakkumar - M.E. summer training work entitled 'Testing Techniques for Performance Parameters of Bituminous Mixes' from Transportation Engineering, Department of Civil Engineering, Anna University, Chennai, June 2009.
- 22) Kunal Soni, Rahul Singh, Ankur Babbar and Bharat Singh – Guided B. Tech students from Delhi College of Engineering (DCE), Bawana Road, Delhi under their training programme from January to April 2009, entitled "Development of Computer Programme for IRC-37:2001 (Design of Flexible Pavement)".
- 23) Ms. Shrutika Barwal - Vocational training project entitled 'Alignment Fixation of Flexible Pavements using HEADS', B. Tech. Civil Engineering Department, National Institute of Technology, Durgapur, January 2009.
- 24) Shri Amit Jindal – B.E. Summer training project entitled 'A study on Axle Loading of Commercial Vehicles' from Civil Engineering Department, Punjab Engineering College (PEC), Chandigarh, India, July 2006.
- 25) Shri Ajit Kumar Yadav – Project report on 'Organizational Urban Pavement Management System' in partial fulfillment of Bachelor of Information Technology, at Department of Computer Science, University of Delhi, New Delhi, India, May 2004.
- 26) Shri Karandeep Singh Arora – Project report on 'Application of HDM-4 for Maintenance of Rigid Pavements' in partial fulfillment of B. Tech. thesis work from School of Building Science & Technology, Ahmedabad, India, May 2004.

### 13. Other Relevant Information

- **Report on Heavy Weight Instrument Transportation:** Submitted comments/report with analysis to MoSRTTH, as requested regarding “Grant of Relaxation in Respect of per Axle Load, Gross Vehicle Weight and the Dimension of Hydraulic Trailer” for a case of Maharashtra Government on damage to normal flexible pavement by multiple tyres (12 separate axles and 48 tyres, gross trailer weight of 204000 kgs) in the month of June 2009.
- **Establishment of Bituminous Laboratory related to Performance Testing of Hot Bituminous Mixes (costing of about 1.23 Crore, year 2013)**
  - Asphalt Mixture Performance Tester (AMPT) which is fully integrated computerized testing equipment specifically designed to perform tests for determining the dynamic modulus (stress / strain behavior), flow number and flow time for hot mix asphalt. These performance parameters of hot bituminous mixes are presently being used in Superpave mix design which is a state-of-the-art method to design Hot-Mix Asphalt (HMA). The pavement design guide named as ‘Mechanistic Empirical Pavement Design Guide (MPEDG)’ has also been developed with using the concept of Dynamic Modulus.
  - The 14 kN Pneumatic - Universal Testing Machine which is a versatile environmentally controlled Universal Testing Machines. It has pneumatic control valves with digital control technology. It can be used for wide range of testing of bituminous paving materials using different Jigs having different range of transducers and fixtures. Software available for different International standards viz. ASTM, EN, etc. or user programmable tests can be used directly using UTM. Jigs for 4 point bending test and indirect tensile test (ITS) can be used directly for testing of fatigue life of asphalt beams subjected to repeated flexural bending until failure and stiffness modulus of asphalt mix, respectively.
  - Roller Compacter equipment which is designed for the preparation of sample of hot bituminous mix beam of size - 320 x 260 mm, height 40 to 120 mm. It is put into the mould and compacted by roller segment where mould and roller segment are electronically controlled. The compaction sequence is controlled by PC and removal of sample by electro – hydraulic extruder. Mould and roller segment are equipped with electronically controlled heating devices.
  - Automatic Bituminous Mixer: It has a mixing capacity of 20 L, and temperature of the oil bath ranges from 0 to 200 °C. Rotation speed is of 75 RPM with electro - controlled digital device.
  - Oven and Pneumatic Compressor.
  - Fully Automated Asphalt Saw for slicing of Asphalt core, Asphalt prism and proper finishing of extracted field Asphalt cores.
- **Working Knowledge in the Operation of Various Specialized Equipments and Interpretation of Outputs:**
  - **Accelerated Pavement Testing Facility (APTF):** APT facilitates is to simulate controlled application of a prototype wheel loading, at or above the appropriate legal load limit to a prototype or actual, layered, structural pavement system to determine pavement response and performance under a controlled, accelerated accumulation of damage in a compressed time period.

- **Dynamic Shear Rheometer (DSR):** To characterize the viscous and elastic behavior of asphalt binders at medium to high temperatures at different frequencies. This characterization is used in the Superpave PG asphalt binder specification.
- **Network Survey Vehicle (NSV):** Hawkeye 2000 series, a fully featured road survey data acquisition system at higher speeds (upto 120 kmph). Capable in capturing all road geometrics data, pavement condition data, pavement roughness data, skid value and road side asset data with their locational reference (using DGPS).
- **Asphalt Mix Performance Testing (AMPT):** To obtain Absolute value of Complex Modulus (dividing peak to peak stress by peak to peak strain subjected to sinusoidal loading), Flow Number and Flow Time.
- **14 Kn Pneumatic Universal Testing Machine with Pneumatic Control Valves and Digital Control Technology:** It consist of controlled environmental chamber and can work for wide range of paving materials. Various testing can be done viz. stiffness modulus, beam fatigue, creep test whether confined or unconfined.
- **Wheel Tracking System:** To simulate the rutting (permanent deformation) phenomenon of field in lab.
- **Heavy Falling Weight Deflectometer (HFWD):** To analyze deflection bowls, Modulus and other various design parameters of an existing pavement/run way through non destructive test.
- **Weigh-In Motion (WIM):** To find out the vehicle damage factor (VDF) for design of pavements. It also provides information on vehicle speed, load, etc.
- **Static Weighing Pads:** To record the axle weight of commercial vehicles in static position. Used in Axle Load Survey
- **Benkelman Beam:** To find out the deflection value of flexible pavement for structural evaluation.
- **Dipstick:** To find out the true profile of a pavement in terms of International Road Index (IRI) and for calibration of 5<sup>th</sup> Wheel Bump Integrator.
- **Bump Integrator (BI):** Response type fifth wheel bump Integrator for finding out the roughness value of pavement surface after calibrating/ Car mounted also.

Well versed with various International and National standards/specifications applicable to road materials, road construction, road maintenance, management and strengthening, pavement design and evaluation etc.

➤ **Working knowledge in operating various software language and system tools:**

Sl. No.	Description
1.	FORTRON-77
2.	Pavement Deterioration Modelling (PDM)
3.	CHEVRON
4.	NISA Finite Element Analysis Software
5.	Highway Design and Maintenance Standards Model (HDM-III)
6.	Highway Development and Management System (HDM-4)
7.	Maharashtra Economic Analysis (MEA)
8.	Highway Engineering and Design System (HEADS), Release 12.0

9.	IIT Pave (Pavement Design Software)
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## Enclosure - 1

(i) Past Experience before joining CRRI:

- **Indian Military Academy**, Dehradun (U.P.), India (Joined on 13<sup>th</sup> Jan., 1985) **2<sup>nd</sup> Lieutenant as trainee**. Left because of personal reasons.
- **Junior Research Fellow (JRF)**, on 4<sup>th</sup> Sept. 1986, under **University Grants Commission (UGC)** sponsored project entitled, "Urban Bus Transport Route Analysis and Design", in Transportation Engineering Section, Department of Civil Engineering, University of Roorkee, Roorkee, India.
- In continuity worked as **Research Associate (R.A.)** from 17<sup>th</sup> June, 1987 under **Ministry of Road Transport & Highways (MORTH)** sponsored project entitled, "Study of Road Intersection under Mixed Traffic Conditions", in Transportation Engineering Section, Department of Civil Engineering, University of Roorkee, Roorkee, India.
- In continuity worked as **Research Associate (R.A.) – 'C'** from 27<sup>th</sup> Sept. 1990, under **University Grants Commission (UGC)** sponsored project, entitled 'Urban Bus Transport Route Analysis and Design – Phase II (UBTRA – II)'.

### Research Experience

- Supervised team for Origin & destination (OD) survey, Volume count survey, Speed and delay measurements and Deflection of pavements using Benkelman Beam method on National Highways in North Zone of India under **World Bank** aided project sponsored by **Ministry of Road Transport & Highways (MORTH)** entitled 'Value for Money (VFM) / Road User Charges (RUC)' study, dated Oct. 1987 to June 1988.  
Assisted and supervised Origin & Destination (O & D) survey, Volume count survey, Intersection survey and Parking survey in Agra city which was a part of **Agra Heritage Project** sponsored by **U.S. National Park Services** and **Agra Planning and Development Authority** during Sept. 1990 to March 1991, under Transportation Engineering Section, Department of Civil Engineering, University of Roorkee, Roorkee,
- Worked as **Assistant Executive Engineer (AEE)** in General Reserve Engineering Force (**GREF**), Border Roads Organization (**BRO**) from 31-07-1996 to 29-10-1996, posted at 79 RCC, 31 BRTF, **Poonch, Jammu & Kashmir (J&K), India**. Joined back Central Road Research Institute (CRRI), New Delhi, India.

(ii) Brief details of various research projects actively involved:

### Five Year Planned Project

S. No.	Title of Project	Role in the Team/ Sponsor / Date of Completion	Contributions
1.	Development and Application of Technologies for Sustainable Transportation	Team Member 12th Five year Plan (2012 - 1217), CSIR-CRRI (Rs. 222.2 Million)	The objective of the research study has been divided into two parts viz. transportation module and road modules. There are seven work packages under road module and

			involved in Development of Technology Superior PERforming Bituminous PAVEments (SUPERPAVE) As Team Member deliberated, presented in the preparation of project proposal which was finally submitted in September, 2012. Involved in day to day testing and reporting.
2.	Evaluation of Economic Loss Due to Idling of Vehicles at Signalised Intersection and Mitigation Measures (ELSIM)	<b>Co-Champion</b> Supra Institutional Network Project (SINP) under 12th Five year Plan (2012 - 1217), CSIR-CRRI (Rs. 36.93 Million) Ongoing	The objectives of the study are quantification of fuel loss due to idling of motorized vehicles at signalized intersections covering metropolitan cities, to propose the mitigation measures and estimate the benefits over a period of time and estimation of emission and energy due to fuel loss during idling for various categories of vehicles and development of models between fuel loss and emission for Indian urban traffic conditions. The details and role are given below:  One of the ways to conserve fuels is to minimize its wastage. It is necessary to understand the amount of fuel loss and emissions generated at signalized intersections in country. By applying various engineering / management measures the fuel wastage and associated emissions can be reduced. Presently there is no model that can give the amount of fuel loss and emissions in relation to the type of vehicle and delays. The models developed under the study will be useful in life cycle economic analysis for project evaluation pertaining to improvement of signalized intersections.  Prepared, deliberated and presented at CSIR (final presentation in the month of July 2012 in the presence of DG CSIR), replied various technical and financial queries of CSIR, justified financial allotments of different heads to CSIR audit part and finally submitted the project proposal in the month of September, 2012. Involved in various surveys related to traffic, fuel station at various identified cities. Responsible for the development of models between fuel loss and emissions. Report compilation and chapter written on model development with conclusions.
3.	Development of a Management System for Maintenance Planning and Budgeting of High Speed Road Corridors	Team Leader (SIP-030) 11th Five Year Plan of CSIR recomm-ended for implement-tation by the Steering Committee of Planning Commission Ongoing (Started in April 2007 and now completed) Rs. 160.00 Million	The project objectives deals with the development of a pavement maintenance management system involving network of high speed road corridors towards making logical decisions about the budget requirements and allocation of funds thereof for pavement and bridge maintenance based on optimal life cycle costs. The responsibility and details of the project are given below:

	<p>The output of the system enables engineers and decision/policy makers to pre-conceive funds requirements for maintenance of road network in order to bring them to a desired level of serviceability. The system developed assist in minimizing wasteful losses occurring every year on account of poorly maintained roads. It also provides as a powerful tool to the road authorities in allocating maintenance funds judiciously and in prioritizing the maintenance treatments in view of limited resources. For logical decision on maintenance funds disbursement, Highway Development and Management (HDM-4) software has been used where pavement distress deterioration models have been calibrated and applied for zone wise road network depending on the environment and climatic conditions. It also includes in addition to above (i) road user cost models for high speed corridors (ii) accident prone locations and engineering solutions related to road parameters and (iii) Mitigation measures and appropriate solution(s) for correcting landslides along the corridors. Flexible as well as Rigid Pavements and Bridges involving network of high speed road corridors are also included within the scope of this study.</p> <p>Under the research project, was responsible for development of the methodology for zone wise identification of road network falling under different environmental and climatic areas covering entire country. After identification of road network, a matrix was developed separately for flexible and rigid pavements covering all sensitive parameters needed for the development of proposed system. Then, selection of one km test sections in length within the network covering entire climatic zones with details of pavement crust (cross section) and traffic scenario based on the desk study. Also responsible for deciding field teams to be sent into various part of the country to extract maximum existing road and traffic related data available from secondary sources. After having the data and based on the developed matrix about 59 sections were finalized which were fit for field surveys and also for regular six monthly monitoring for three continuous years on the aspects of pavement performance of test sections. Also responsible for dealing with HDM-4 software to find out logical decisions for disbursement of maintenance funds for the road network. Lead also as team leader for all test sections falling under Gujrat state from start to end of the project.</p>
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### Sponsored Research Projects

S. No.	Title of Project	Role in the Team/ Sponsor / Date of Completion	Contributions
1	Development of Road Maintenance Management System (RMMS) for Public Works Department, Government of Kerala (SSP-4631)	<b>Project Leader,</b> sponsored by Kerala PWD (status - ongoing, started in the month of August, 2019)	The project relates to the development of RMMS for State Highways, Kerala covering about 4000 km. As an initial startup, it may extend in future to further more categories of road network. Agreement has been made between CSIR-CRRI and Kerala, PWD with ToR consisting of development of RMMS, integration of HDM-4 and giving prioritized budget solutions
	The work consist of (1) Training to Kerala PWD officials on RMMS concept (2) One time road inventory data collection by CSIR-CRRI for 4000 km (3) One time pavement deflection data		

	collection using FWD (2 points per km) by CSIR-CRRI for 4000 km (4) Pavement crust data, traffic data and axle load data collection by PWD (5) Pavement history data related to construction details by PWD (6) Procurement of web based RMMS software with the technical assistance of CSIR-CRRI (7) Data input preparation of HDM-4 for further analysis of 4000 km jointly by PWD and CSIR-CRRI (8) Analysis of HDM-4 for identified road network by CSIR-CRRI (9) Training to identified PWD officials on HDM-4 analysis and RMMS operation.		
2	Investigation for Feasibility of Reducing the Existing Level of Carriageway and Needed Remedial Measures for Strengthening and Up-gradation of Rajpath under Jurisdiction of Central Public Works Department	<b>Project Leader and also as ex. Group Coordinator</b> , sponsored by CPWD, Vigyan Bhawan Mandal, New Delhi, April 2016	Involved in field surveys, data collection and interpretation, and preparation of final report. The details are given below:
	Due to number of bituminous overlaying/resurfacing executed till date as an addition, the Rajpath level has increased manifolds creating obstruction to the clear visibility of plinth level of Amar Jawan Jyoti structure. Further the raised level of road also affected the drainage system built on the sides of Rajpath and also reduced the level of some aesthetic structures built for panoramic view of the road side area. The matter was referred to the institute for the purpose of assessing the roadway condition to provide appropriate remedial measures related to reduction of the top bituminous road layers. As per the objectives and scope of the study the possibility of lowering down the existing level of carriageway of Rajpath by milling process and suitability of re-use of reclaimed bituminous material obtained from existing bituminous pavement to achieve the structural strength at the requisite elevation level were provided in the report. The latest state of art equipments were used under the project viz. GPR, Automatic Survey Vehicles, FWD, etc. The project cost was Rs. 1.824 million.		
3	Decay in Modulus of Stabilized Layers in Flexible Pavements	Team Member sponsored by UP Public Works Department (PWD), Lucknow (ongoing)	Team member Involved in discussions, planning and execution of field work wherein 1 <sup>st</sup> series of observations were made at different test sections. Amount Rs. 100 Lakh
	The research project is to monitor the decay in modulus of stabilized layers (base / sub-base layers with cement or emulsion treated) in flexible pavement with time. Seven test sections in total were identified from the five roads for long term performance observations through field investigations viz. test pit investigations, extraction of cores upto sub-base layers, commercial traffic volume survey, axle load survey, FWD survey. The project is at present ongoing.		
4	Evaluation of Existing Roads in Transport Nagar Under Jurisdiction of Bulandshahr Development Authority	Team member Sponsored by Bulandshahr Development Authority (BDA), Uttar Pradesh	Involved in the initiation of the project, preliminary site visit, execution of field work at site and report writing. Amount Rs. 11.80 Lakh
5	Performance Study on Use of Fly Ash in	<b>Project Leader</b> Sponsored by National	The project deals with the evaluation and performance of

	Construction of Bituminous Road Surfacing	Thermal Power Corporation (NTPC) (Started on July 2009), Ongoing (Rs. 1.1 Million)	flexible pavements constructed with different types of bituminous surfacings by using fly ash as mineral filler vis-a-vis bituminous surfacings constructed with conventional material (by using lime or stone dust as the mineral filler). The responsibility and details of the project are given below:
	<p>The primary objective of the research study is to evaluate performance of road sections constructed with different types of bituminous surfacings by using fly ash as mineral filler vis-a-vis bituminous surfacings constructed in a conventional way (by using lime as mineral filler). The scope of work is divided into three parts viz. (1) Pavement condition survey before construction, materials and construction specifications, preparation of BOQs, job mix designs, and limited construction quality checking / supervision of road sections, (2) Association during laying of demonstration stretches for use of fly ash in Bituminous Concrete (BC), Stone Matrix Asphalt (SMA) and Slurry Seal / Micro-Surfacing and (3) To develop periodic pavement performance data (such as deflection, roughness, surface distress, traffic volume etc.) at six months interval for a period of 3 years.</p> <p>As Project Leader developed matrix which included different bituminous surfacing and use of fly ash in replacement of lime as filler in mix design. Organized field surveys and submission of reports based on field surveys, worked as third party quality control during construction. Identification of test sections based on matrix to have conventional and non-conventional (addition of fly ash) bituminous surfacing. The matrix involves different combinations of bituminous surfacing having fly ash and without fly ash during road construction works at Dadri and Badarpur NTPC plants. The project is under Phase-II where all road construction activities at Dari has been completed and at Badarpur plant is ongoing.</p>		
6	Development of GIS Based National Highway Management System	<b>Team Leader and Module 4 Project Leader</b> Ministry of Shipping, and Road Transport and Highways (MOSRTH) Ongoing (Starting April 2007)	The project deals with development of a GIS based National Highway Management System which involves Life Cycle Analysis of Pavements using HDM-4 as Module 4. There are four modules and involved in all modules right from procuring of National Survey Vehicle (NSV) procured from ARRB, Running and installation of Onlooker Live (software for capturing geometrics and images) and processing tool (for analysis).
7	Evaluation of RECRON 3S Polyester Fiber for use in Bituminous Mixes	<b>Project Leader</b> Reliance Industries Ltd. (RIL), Bombay	Objective is to optimize the use of polyester (RECRON 3 S) of dimensions 3 mm, 6 mm and 12 mm in bituminous mixes, through various laboratory tests. The details are given below:
	The work consist of optimization of physical, chemical and mechanical requirements of		

	polyester fiber and Development of cost effective, high performance mixes using polyester fiber for bituminous roads in heavy traffic conditions. Detailed laboratory evaluation of fiber modified bituminous mix (FMBM), crumb rubber-modified bitumen (CRMB) mix and conventional mix were carried out and compared with each other with respect to laboratory results.		
8	Study on Optimum Axle Load of Commercial Vehicles for Indian Roads	<b>Team Leader</b> Asian Institute for Transport (AITD) and supported by The World Bank June 2004	The project deals with the overloading of commercial vehicles and unplanned maintenance of roads by different agencies. The role and details of the project have been given below:  Due to rampant overloading, the road users are paying unnecessary the price of overloading in terms of higher vehicle operating cost (VOC) and also because of bad roads. Responsible for running/using HDM-4 software for a real case of National Highway and State Highway in capping the normally overloaded trucks to the chosen maximum limits alternately at 10, 11, 12 and 13 tonnes. The total transportation cost (TTC) variable has been used for different possible legal limits which indicated a definite pattern for locating the optimum TTC for Indian conditions and had come between 10 tonnes to 11 tonnes. The analysis revealed the economics of operating the trucks with most optimum legal axle loads at minimum TTC. Responsible for entire HDM-4 analysis, final report preparation and submission.
9	Impact assessment of Rehabilitation works on Overloading, Travel Time and Roughness for State Highways in Uttar Pradesh	<b>Project Leader</b> Uttar Pradesh Public Works Department, Lucknow, February 2006 (Rs. 2.6 Million)	The study involved roughness measurements along both the wheel path for all 12 corridors (in terms of IRI), speed assessment through travel time and delays surveys by using floating test car method in traffic stream for all the 12 corridors, axle load surveys, using static weigh pads at all the 12 corridors and classified traffic volume surveys round the clock on same locations where axle load surveys were done.  As project leader was involved in the planning and field studies, data management and analysis with suggestions and recommendations and finally submission of report. Was also involved in the analysis with the previous available data obtained from the past project and the present data. The impact was found based on the roughness survey with respect to past poor road and after rehabilitation of the road in the present project. The VOC was found for all the individual commercial vehicle in terms of monetary value and benefits were estimated after rehabilitation of the road. Under the project also responsible for producing publications and presenting abroad.
10	Maintenance Management Study for Rural Roads in Three Districts of Maharashtra State	<b>Co-Project Leader</b> Maharashtra PWD Work started in the year 1998 and completed in the year 2000 (Rs. 2.0 Million)	The objective of the project is to develop Maintenance Management System for Rural roads in the three districts viz. Pune, Yavatmal and Raigarh of Maharashtra State. The details of the project has been given below:

	Responsible for the development and demonstration of roughness based pavement maintenance management system for three Districts of Maharashtra State. The system developed was named as Maharashtra Economic Analysis (MEA). Responsible for providing training to PWD engineers and installing of the system software at each district PWD head quarter. Also responsible for coordinating and execution of field studies, development of scientific data bank, development of system software which consist Visual Basic Application and Micro Soft Excel software, report preparation and submission.		
11	Pavement Performance Study-Study on New Pavement Sections (Phase-I)	Team Member MoRT&H March, 2001 (Rs. 15.0 Million)	<ul style="list-style-type: none"> <li>▪ Under the project was responsible for, development of simple models and inferences.</li> <li>▪ Data management and statistical analysis using different statistical approach</li> <li>▪ Development of different time series deterioration models</li> <li>▪ writing analysis chapter</li> </ul>
12	Pavement Performance Study: (R-19): Study On Existing Pavement Sections	Team Member Ministry of Surface Transport, Govt. of India, September 1993 (Rs. 10.00 Million)	<ul style="list-style-type: none"> <li>▪ Under the project was responsible for field surveys and time series data collection.</li> </ul>

### In-house Research Project

S. No.	Title of Project	Role in the Team/ Sponsor / Date of Completion	Contributions
1.	Self Healing Technology for Bituminous Pavements through Induction Energy	<b>Team member</b> In-house Project, CSIR-CRRI	Conceived the idea and generated the project, involved in work execution, procurements, etc. Project cost - Rs. 20/-- Lakh
2.	Water Harvesting using Porous Flexible Pavements	<b>Team member</b> In-house Project, CSIR-CR, Ongoing	Conceived the idea and generated the project, involved in work execution, procurements, etc. Project cost - Rs. 1.7/-- Crore
3.	Bicycle based Road Asset Management system (BRAM)	<b>Team member</b> In-house Project, CSIR-CRRI, May 2016 to December 2017	Involved in design concept, work execution, procurements, etc.
4.	Impact of road condition on fuel consumption of vehicle (GAP-4564)	<b>Team member</b> In-house Project, CSIR-CRRI, March 2017 to April 2018	Involved in design concept, work execution, procurements, etc. Project cost - Rs. 25/-- Lakh
5.	Development of Master Curves for Hot Bituminous Mixes Used in India	<b>Project Leader</b> In-house research project, CSIR-CRRI (Rs. 10.04 Million)	Prepared the In-house research proposal, presented, and got approved. Laboratory work regarding testing of different bituminous mixes with respect

		August 2015	to Dynamic modulus, Beam Fatigue, Stiffness Modulus, Creep etc. are ongoing.
	<p>The Complex modulus testing for hot bituminous mixtures describes visco-elastic test performed on bituminous mixtures when a sinusoidal stress is applied to a cylindrical specimen at a given frequency and measures a response in sinusoidal strain at the same frequency. These tests are conducted under controlled temperature conditions at varying load amplitudes and frequencies. The Mechanistic Empirical Pavement Design Guide (MEPDG) developed in USA under the NCHRP 1-37A 2004 addresses the use of dynamic modulus test of bituminous mixes for flexible pavement design.</p> <p>As project leader formulated the entire research proposal, testing procedures, matrix of different tests with number of samples and testing frequencies, etc. The project is under progress.</p>		
6.	Feasibility Study for Use of Thermocole Waste Materials in Bituminous Mixes	<b>Team Member</b> In-house research project, CSIR-CRRI (Rs. 0.425 Million) August 2015	Main objective of the project is to provide a process for use of Thermocol (expanded polystyrene) waste in hot bituminous mixes for road construction. It also includes the enhancement in the properties of bituminous mixes by using the Thermocol waste. The role and responsibility have been described below:
	<p>Wet method was adopted having proportioned aggregates and Bitumen. Addition of Thermocole waste was optimized and added to hot bitumen as per design requirements. Initially, the Thermocole waste was completely dissolved in hot bitumen to form a blend. Later on, it was observed that in adding lower percentage of Thermocole waste, the blend was quite homogenous whereas lump formation was found when a higher percentage of Thermocole was used. Later on design methodology was formulated and accepted for patent.</p> <p>Responsible for preparing entire project proposal, estimate and design of experiments with respect to number of samples. Involved in testing and data interpretation for the results. The process has been patented.</p>		
7.	Study on Noise Reflection and Absorption for Flexible and Rigid Pavement Surfaces	<b>Team Member</b> In-house research project, CSIR-CRRI (Rs. 1.2 Million Rs.) August 2015	Prepared In-house research proposal having scope of work and role have been detailed below:
	<ul style="list-style-type: none"> <li>• Finding of reflection and absorption of noise in different types of pavement surfaces i.e. rigid pavement surface and flexible pavement surface (BC with modified bitumen, BC with conventional bitumen, Micro-surfacing and Stone Matrix Asphalt) where the objective is to monitor the noise reflection and absorption in-situ test of existing road. For conducting the test, micro flow surface impedance meter PU probe (based on sound pressure and particle velocity movement) has been used.</li> <li>• Role and responsibility was to create test section matrix, identify the test sections with knowledge of surface layer bituminous mix design at various locations. Arrangement of field studies and data interpretation.</li> <li>• The benefit is the construction of more noise absorptive surface which will help to control the noise pollution at source. It will not only be useful to road user agencies MoRTH, NHAI, PWDs, DST but will also be useful to the community/ society as a whole.</li> </ul>		



## Consultancy Projects

S. No.	Title of Project	Role in the Team/ Sponsor / Date of Completion	Contributions
1.	Detailed investigation for feasibility of reducing the existing road level of Rajpath starting from Vijay Chowk to North and South Block, upto President House including peripheral roads	<b>Project Leader</b> Central Secretariat Division, CPWD, South Block, New Delhi May 2019 (ongoing)	Conceived, Coordinated and completed the project. Project cost - Rs. 51,92,000/--
As PL accomplished the main objective of identifying the reduced road level thickness from the existing road level for milling using ground GPR, cable locator and Total station keeping in view that no damage may take place to any utilities, cables (live / dead), sensors buried below the road surface with drainage. The area starts from the front of President house gate, North-South Block to Vijay chowk and Raja Sabha Marg to Motilal Nehru Marg. Report with drawings submitted.			
2.	Investigation of Dimapur - Kohima Road to Ascertain Causes of Cracks in Newly Laid Dense Bituminous Macadam Layer	<b>Project Leader</b> National Highways & Infrastructure Development Corporation Limited (NHIDCL) Dimapur, Nagaland	Coordinated, investigated and submitted final report consisting of reasons with remedial measures for all field investigations viz. identification of cracked DBM layer locations in both the packages, structural assessment of pavement through test pit observations and material characterization, extraction of bituminous cores, observation with comments on the method of execution of DBM works. Project cost - Rs. 37,76,000/--
3.	Investigation of Gulabpura - Uniara Section of NH-148D to ascertain the causes of defects and needed remedial measures in the state of Rajasthan	<b>Project Leader</b> National Highways Authority of India Project Implementation Unit Bundi, Rajasthan	The investigation project was completed in two phases, separately. Project cost - Rs. 64,90,000/--
As PL coordinated, investigated and submitted final report consisting of reasons with remedial measures for all field investigations viz. identification of cracked DBM layer locations in both the packages, structural assessment of pavement through test pit observations and material characterization, extraction of bituminous cores, observation with comments on the method of execution of DBM works.			
4.	Consultancy services for	<b>Project Leader</b>	Coordinated field surveys, site visits

	Pavement Investigations, Ground Improvement, and Design of Approach Road to Railway Goods Platform at Verna Yard, Goa	Konkan Railway Corporation Limited (KRCL), Navi Mumbai - 400614 February 2018	and discussions with KRCL officials. Project cost- Rs. 20,52,173/--
5.	Improvement and Widening to Two- Laning with Paved Shoulder of Udaipur - Sabroom Section from km 55.000 to km 128.712 of NH- 44 in the State of Tripura under SARDP - NE Phase A- Cementitious Sub- Base and Subgarde	<b>Project Leader</b> National Highways and Infrastructure Development Corporation (NHIDCL), New Delhi, April 2018	Involved in field surveys, data collection and interpretation, and preparation of Phase 1, Phase 2 and final reports. Project cost - Rs. 28,62,000/--
6.	Quality Supervision of Construction of Inner Ring Road (2 <sup>nd</sup> Phase) from Fatehabad road to Deori road, Agra-202001 (U.P.)	<b>Project Coordinator and Project Leader</b> (Pavements aspects) Agra Development Authority (ADA), UP Ongoing	It is the extension of the Phase-1 project (at serial no. 10). Coordinating the entire Phase-II project. Formulated estimate after negotiation, supervised teams for site visits and till date work is ongoing. Total Project cost is Rs. 2.5 crore wherein received Rs. 1.0 crore. Divisional share received amount is - Rs.55.45 Lakh
7.	Detailed Investigation about the Quality of Construction and reasons for development of Defects at various locations and Premature Pavement Failure between Pali- Pindwara section of NH-14 (length 131.12 km)	<b>Team Member and Group Coordinator</b> (GC) National Highways Authority of India (NHAI), New Delhi February 2017	Discussed and convinced the client to bring the project as Group Coordinator. Completed the assignment and submitted the report within the time frame. The objective of premature failure was obtained through all field studies consisting of structural and functional assessment of the roads. <b>Project cost - Rs. 38,52,500/--</b>
8.	Design of Flexible Pavement for 60 m wide road between Sector 36-31 and 37-32, Rohini, Delhi	<b>Project Leader</b> Delhi Development Authority (DDA), New Delhi, May 2017	Executed the project timely Received an amount of Rs. 5.75 Lakh
9.	Investigation of Bihta - Sarmera Section of SH-78 in Bihar for Needed Remedial Measures for already Constructed Pavement Layers and Improvement Measures	<b>Team Member and Group Coordinator</b> , Bihar State Road Development Corporation Limited (BSRDCL), Patna, Bihar	Involved in field surveys, data collection and interpretation and preparation of Phase 1, Phase 2 and Final report. Project cost - Rs. 40,00,000/--

	for the On- going Construction in the project Section		
10.	Quality Supervision of Construction of Inner Ring Road (1 <sup>st</sup> Phase) from Kuberpur to Fatehabad Agra	<b>Project Coordinator and Project Leader</b> (Pavements aspects) Agra Development Authority (ADA, UP), May 2017.	This project deals with the green field development connecting Expressway with Tajmahal in Agra. It consist construction of two major bridges with flexible and rigid pavements. The role and responsibility has been detailed below:
Coordinating all construction activities of the Project which includes bridges, pavement layers, traffic and safety. It also includes guidance for laboratory setup and clients in-house capacity enhancement, time to time. The project includes limited frequency quality control checks during construction starting from site clearance, dismantling, earthwork, construction of all pavement layers, CD structures with protection and drainage works and conformance of traffic sign markings, other appurtenances as per specifications (BoQ). The project was completed successfully in the month of April, 2017 and received the full consultancy amount of Rs. 30.6 Million.			
11.	Evaluation of Pavement Condition, Strengthening Requirements and Development of Database Management System for Delhi PWD Roads (Ring Road and Outer Ring Road	Team Member Public Works Department (PWD) New Delhi (Rs. 7.13 Million)	Involved as team leader for test pit investigations covering entire outer and inner ring road in different study sections. The test pit investigations include identification of different layer thickness with subgrade field density.
12.	Consulting Services for Quality Audit of Lucknow – Muzaffarpur National Highways Projects (LMNHP), 8 Contracts	<b>Key Professional</b> National Highways Auhtority of India (NHAI), New Delhi, June 2012 to January 2013 (Rs. 12.21 Million)	The Govt. of India received a loan from International Bank for Reconstruction and Development (World Bank) towards the cost of widening and strengthening of existing two lane stretches of about 483 kms length on National Highway-28 (NH-28) (Lucknow-Muzaffarpur) consisting 12 packages. The details of project and responsibility is given below:
The project consist of post quality audit of 8 EPC projects starting from Lucknow to Bihar border. As key professional for pavements, coordinated all activities related to pavements under the purview of Technical Audit for all the 8 Contracts. The responsibility completed are detailed below:			
<ul style="list-style-type: none"> <li>• Received LOI and RFP from NHAI</li> <li>• Submitted final Technical and Financial Proposal</li> <li>• Filed data collection and documents verifications</li> <li>• Submitted Inception report in May 2012</li> <li>• Pre and Post Technical quality audit</li> <li>• Preparation of final report till December 2012 which includes gaps observed between field</li> </ul>			

	construction procedures and documented procedures. Project completed in 2013.		
13.	Examination of Provisions of Wearing Course and Suggest Appropriate Designs of Bituminous and Concrete Wearing Courses for the Sarita Vihar Flyover Underpass at New Delhi	<b>Project Leader</b> Delhi Development Authority (DDA), New Delhi, September 2011 (Rs. 0.35 Million)	Responsible for rigid pavement crust design and other related activities are detailed below: <ul style="list-style-type: none"> <li>• Planning of field studies</li> <li>• final report preparation and report submission</li> </ul>
14.	Design of Rigid Pavement for 60 M Row Roads Between Sectors 29-30, 29-34, 34-35 and 30-35, 45 M Row Road along Western Yamuna Canal and 30 M Row Roads In Sectors 29-30, Rohini Phase-IV & V	<b>Project Leader</b> Delhi Development Authority (DDA), New Delhi, September 2011 (Rs. 0.6618 Million)	Responsible for rigid pavement crust design and other activities are detailed below: <ul style="list-style-type: none"> <li>• Planning of field studies</li> <li>• final report preparation and submission</li> </ul>
15.	Consultancy Services for Conducting Road Safety Audit for PPP Projects on DBFO Basis	<b>Key Professional</b> National Highways Authority of India (NHAI), New Delhi 2011 (Rs. 76.2 Million.)	The project is related to safety audits of 12 National Highway projects scattered all over India. Responsible for coordinating all the activities related to pavements viz. pavement surface condition, roughness measurement, texture depth, etc. under road safety.
16.	Design of Flexible Pavement for 30 M Right of Way Roads In Sector 29 & 30 (Part) At Rohini	<b>Project Leader</b> Delhi Development Authority (DDA), New Delhi May 2011 (Rs. 0.375 Million)	<ul style="list-style-type: none"> <li>• Field work planning with execution of quality checks during construction of bituminous layers with advice on quality control techniques as per guidelines.</li> <li>• Data management and analysis</li> <li>• Report writing</li> </ul>
17.	Third Party Quality Checking for the Road Work of 60m ROW MP I (for proposed heliport) between Sec. 31-32 & 36-36 phase IV & V Rohini	<b>Project Leader</b> Delhi Development Authority (DDA), New Delhi, May 2010 (Rs. 2.01 Million)	<ul style="list-style-type: none"> <li>• Field work planning with execution of quality checks during construction of bituminous layers with advice on quality control techniques as per guidelines.</li> <li>• Data management and analysis</li> <li>• Report writing</li> </ul>
18.	Third Party Validation of Design of Indore Test Tracks	Team Member Sponsored by National Automotive Test Tracks (NATRip), New Delhi July to December 2009	<b>The project deals with the</b> Third Party technical vetting of various pavement design <b>and Geo-technical aspects to be constructed at Indore test tracks.</b> As a Team Member responsible for validation of

		(Rs. 0.198 Million)	test tracks designed provided by NATRIP through consultant IDIADA, Spain.
19.	Project Appraisal of DPRs for National Capital Region Planning Board (NCRPB)	<b>Project Leader</b> Ministries of Urban Development, Delhi, India (Completed projects between December 2007 to December 2012) still ongoing	Responsible as Project coordinator for checking of all technical aspects in DPR related to traffic planning and studies, CD structures, road materials, road construction and environment aspects. Also as team member responsible for checking of the technical aspects related to flexible pavement activities of DPR. The details of projects handled are given below:
<ul style="list-style-type: none"> <li>• Appraisal of DPR for Construction of Slip Road from Northern Bypass Rohtak to NH-17A in Rohtak District in NCR of Haryana</li> <li>• Appraisal of DPR for Construction of Bypass at Kharkhoda in Sonapat District</li> <li>• Appraisal of DPR for Improvement of Gurgaon-Farrukhnagar-Jhajjar Road (SH-15A)</li> <li>• Appraisal of DPR for Improvement of Rohtak-Kharkhoda-Delhi Border Road (SH-18)</li> <li>• Appraisal of DPR of Four Laning of Jhajjar-Dhaur-Beri Road, located at NCR of Haryana State.</li> <li>• Appraisal of DPR for upgrading of Existing Road Dighal-Beri-Jhazgarh Road located at NCR of Haryana State.</li> <li>• Appraisal of DPR for Improvement of Roads from BKP Road Upto GA Road located at NCR of Haryana State.</li> <li>• Appraisal of DPR for Package No. 4: Improvement of Road No.1 – Gurgaon – Pataudi Road; Road No. 2 – Dj Road (Rampur) – Kota Khandewla Via Naurangpur Road; Road No. 3 – Urban Estate – Kherki Majra upto Dhankot Road; Road No 4. – Manesar – Kasan upto Puran Bhagat Mandir Road; Road No. 5 – Hayatpur Dhana – Bhangraula Road</li> <li>• Appraisal of DPR for Package No. 5: Improvement of Road No.1 (Pataudi to Khandewal via Rampura Jataula Road) and Road No. 2 (Wazirpur to Farrukh Nagar Road)</li> <li>• Appraisal of DPR for Package No. 6: Improvement of Gurgaon – Nuh – Rajasthan Border (SH-13) Road: Provision of Service Roads &amp; Miscellaneous Improvements</li> <li>• Appraisal of DPR for Package No. 7: Improvement and Widening of Five Roads in Sonapat District of Haryana (Road No. 1- Gohana – Sisana Road; Road No. 2 - Sonapat – Farmana Road; Road No. 3 – Sonapat – Bidhlan Road; Road No. 4 – Jagsi – Gangana Road; Road No. 5 – Kharkhauda – Assaudha Road)</li> <li>• Appraisal of DPRs for Four By-pass Schemes – <ul style="list-style-type: none"> <li>- Construction of Bye-Pass at Beri (Length: 5.850 kms)</li> <li>- Construction of Bye-Pass at Chhara (Length: 5.350 kms)</li> <li>- Construction of Bye-Pass at Subana (Length: 3.050 kms)</li> <li>- Construction of Bye-Pass at Kosli (Length: 3.400 kms)</li> </ul> </li> <li>• Appraisal of DPR for Construction and Upgradation of Gurgaon – Chandu – Badli -</li> </ul>			

	Bahadurgarh Road		
20.	Appraisal of DPRs for Jawaharlal Nehru National Urban Renewal Mission (JNNURM)	<b>Project Leader</b> Ministries of Urban Development, Delhi, India (Started April 2007 till 2010)	Also as one of the evaluator in the team, responsible for flexible pavement related activities of DPR: <ul style="list-style-type: none"> <li>• Appraisal of DPR for Ahmedabad</li> <li>• Appraisal of DPR for Indore</li> <li>• Appraisal of DPR for Pune</li> <li>• Appraisal of DPR for Chandigarh</li> <li>• Appraisal of DPR for improvement of road network in Faridabad</li> </ul>
21.	Pavement Performance of Test Sections on NH-2, Dankuni to Panagarh	Team member GAMUDA WCT (INDIA) PVT. LTD., <b>Ongoing</b>	<ul style="list-style-type: none"> <li>• Field work planning, execution and management</li> <li>• Field data collection, compilation and management</li> <li>• Interim report writing</li> </ul>
22.	Economic Benefits of Toll Roads in India (Asset Management Study)	<b>Team Leader</b> Infrastructure Transportation Network Limited (ITNL), Mumbai (Completed 2012) (Rs.1.65 Million)	The project deals with the Economic Assessment of involving BOT Toll Road projects of India. Analysis has been done by <b>using HDM-4</b> . Details of involvement are given below: <ul style="list-style-type: none"> <li>• Planning and field studies</li> <li>• Data Management, analysis and presentation of the final conclusions in the form of schedule of pavement maintenance using HDM-4 and compared with the maintenance schedule developed by the client for one of a BOT project entitled, 'Asset Management Study for Ahmeabad-Mehsana Toll Road'.</li> </ul>
23.	Design of Flexible Pavement for 100 M RoW Urban Extension Road No. II (UER-II) from Western Yamuna Canal to Kanjhawala Road near Village Karala Majari	<b>Project Leader</b> Delhi Development Authority (DDA), New Delhi September 2009 (Rs. 0.292 Million)	Responsible for pavement crust design on an existing green field area and all other related activities such as, <ul style="list-style-type: none"> <li>• Planning of field studies</li> <li>• Laboratory investigation of soil</li> <li>• Traffic volume surveys</li> <li>• Final report preparation and submission</li> </ul>
24.	Design of Flexible Pavement for M.P. Road Between Sector 31-32 and Sector 36-37 (Proposed Heliport) at Rohini	<b>Project Leader</b> Delhi Development Authority (DDA), New Delhi May 2009 (Rs. 0.25 Million)	The project is related to 2010 Commonwealth Games under which Flexible Pavement was designed linking the proposed heliport. The existing planned route was a green field area. Responsible for activities such as, <ul style="list-style-type: none"> <li>• Planning of field studies</li> <li>• Laboratory investigation of soil</li> </ul>

			<ul style="list-style-type: none"> <li>• Traffic volume surveys</li> <li>• Data Management and analysis and final report submission</li> </ul>
25.	Pilot study on Effect of Overloading on Road Infrastructure	<b>Key Professional (Flexible Pavement)</b> MORTH April 2009 (Rs. 1.234 Million)	Responsible for finding the effect of overloading by considering an existing case study data. Responsible for completing entire analysis of overloading using HDM-4 tool and writing of Chapter 3 of the report as a part of HDM-4 analysis.
26.	Review of Pavement Designs and Material Specifications for Construction of Three Border Roads in North Sikkim	Team member Central Public Works Department (CPWD) Indo-Bangla Border Zone (IBBZ), Siliguri, India August 2008 (Rs. 0.393 Million)	The project deals with the physical review of proposed DPR at project site (altitude 18000 ft. and above) for border roads (China border) located at Sikkim state. The works executed were: <ul style="list-style-type: none"> <li>• Site visits</li> <li>• Data analysis, suggestions and Recommendations</li> <li>• Report Writing and submission</li> </ul>
27.	Improvement and Strengthening of Road No. 3 from Rithala turning to Rajiv Marg	<b>Project Leader</b> Municipality Corporation of Delhi (MCD), Delhi May 2008 (Rs. 0.283 Million)	<ul style="list-style-type: none"> <li>• Field surveys</li> <li>• Data Management and analysis</li> <li>• Road material testing and final report submission</li> </ul>
28.	Quality Surveillance of Strengthening of Road with BM and BC (MP-3 Road Crossing 61, 59 and 66, 71) in Noida	<b>Project Leader</b> Noida Authority, Distt. Gautam Budh Nagar (U.P.) May 2008 (Rs. 0.65 Million)	<ul style="list-style-type: none"> <li>• Field surveys</li> <li>• Data Management and analysis</li> <li>• Road material testing and final report submission</li> </ul>
29.	Pavement Evaluation of Road No.6 from Flex Industries to NH-24 in Noida	<b>Project Leader</b> Noida Authority, Distt. Gautam Budh Nagar (U.P.) January 2008 (Rs. 0.359 Million)	Pavement evaluation with overlay recommendation and distress remedial measures for arterial road. <ul style="list-style-type: none"> <li>• Planning and conducting required field surveys related to functional and structural analysis and laboratory tests</li> <li>• Data management, analysis, final report preparation and submission</li> </ul>
30.	DPR Audit of Selected Public Private Partnership (PPP) Projects	<b>Team Leader</b> Controller of Auditor General (CAG) of India sponsored project August 2007	The project consists of technically auditing of BOT projects and physically scrutinizing with reference to DPR and their Deviations, at site. Involved in

			<ul style="list-style-type: none"> <li>• Planning of field surveys, site visits</li> <li>• Data Management and analysis</li> <li>• Road material testing and at site and laboratory</li> <li>• Final report submission</li> </ul>
31.	Third Party Quality Surveillance of D.B.M. and BC works on Express Highway from Sector – 14 A to Amity Crossing	<b>Project Leader</b> Noida Authority, Distt. Gautam Budh Nagar (U.P.) July 2007	<ul style="list-style-type: none"> <li>• Planning and field studies</li> <li>• Data Management and analysis</li> <li>• Suggestions and Recommendations</li> <li>• Report Writing</li> </ul>
32.	Third Party Acceptance and Testing of Road Information System (RIS) Software	Team member NHAI, Delhi, July 2006	The objective of the project is Third Party Acceptance and Testing of Road Information System (RIS) Software developed by NHAI. The responsibility as team member is given below:
	Responsible in identifying the loose strings in the software and making it more logical with respect to Road Information System. The decision software HDM-4 was integrated with RIS for which necessary guidance was provided. Was also involved in the development of different modules of road information compatible to HDM-4 inputs. Overall activity was to find error and its rectification in development of RIS, which was based on GIS platform.		
33.	Technical Inspection of PMGSY Roads	<b>Team Leader</b> for Kurnool, AP and Kendripada, Orissa, October 2005	<ul style="list-style-type: none"> <li>• Field work planning, execution and management</li> <li>• Data compilation and management</li> <li>Part of report writing</li> </ul>
34.	Assessment of Pavement Surface Condition of Golden Quadrilateral (Delhi-Mumbai-Chennai-Kolkata-Delhi) of National Highway Development Programme	<b>Team Leader</b> (Delhi-Kolkata-Chennai) National Highway Authority of India (NHAI), MSRTH, Delhi, May 2005	Responsible for complete road roughness data collection (up and down directions from Delhi to Chennai via Kolkata), management and analysis of roughness data for GQ connecting four metropolises. <ul style="list-style-type: none"> <li>• Identification of construction problems at field</li> <li>• Report writing</li> </ul>
35.	Technical Inspection of NHDP Projects	Team Member Comptroller of Audit General (CAG), New Delhi, August 2004	Responsible for atsite technical Inspection of Surat-Manor Construction Package I, II and III under PIU, Vadodara (NHDP Packages) <ul style="list-style-type: none"> <li>• Data management &amp; analysis</li> <li>• Report writing</li> </ul>
36.	Evaluation of Pavement for Core Road Network of Mizoram State Roads	<b>Project Leader</b> PWD, Government of Mizoram April 2004 (Rs. 2.0 Million)	The objective of the project is to develop road data bank viz. road inventory, pavement surface condition, roughness data and basic inventory of bridges and drains for



			about 1100 kms (core road network) of SH, MDRs and ODRs in HDM-4 format as required by the World Bank. The responsibility has been detailed below:
	<p>The entire road data bank collected for 1100 kms (sample length covering entire state road network excluding National Highways in all directions) consisting inventory of route , pavement surface condition, roughness data and basic inventory of bridges and drains were produced in HDM-4 format so that it can become direct input to the software. During the data collection, training to PWD engineers were provided on data collection techniques at field with demonstration of equipment.</p> <p>Organized a work shop at Aizwal on the methodology of field data collection, about HDM-4 and resultant outputs before the start of the project. Involved in preparation of final report and submission.</p>		
37.	Third Party Quality Assurance for WMM, GSB and Soil with Concrete Core Evaluation	<b>Project Leader</b> , PWD, Dhaula Kuan, New Delhi, March 2004	<ul style="list-style-type: none"> <li>• Field work planning with execution of quality checks during construction with advice on quality control techniques as per guidelines.</li> <li>• Data management and analysis</li> <li>• Report writing</li> </ul>
38.	Implementation of SKD-6: Road Construction / Management Planning Using HDM-4	Team Member <b>International Course sponsored by the Roads Department Royal Govt. of Nepal at Kathmandu from 28.12.03 to 03.01.04</b>	Responsible for providing HDM-4 software training by delivering lectures and also at site hands on training. Side by side deliberated on various problems related to running and understanding of software to the engineers of Roads Department, Royal government of Nepal
39.	Evaluation of Pavement on Two Stretches of Agra-Jaipur Highway (NH-11) for Needed Remedial Measures	Team Member PWD, Government of Rajasthan, May 2003 to July 2003 (Rs. 1.0 Million)	<ul style="list-style-type: none"> <li>• Data collection and management</li> <li>• Data analysis</li> <li>• Report writing</li> </ul>
40.	Evaluation of Delhi Road for Maintenance and Rehabilitation Strategies	Team Member PWD, Government of Delhi Sept. 2002 to Dec. 2003 (Rs. 4.8 Million)	The project is related to rehabilitation and maintenance of Delhi roads which included NDMC, PWD and DDA roads. Entire functional and structural data were collected for entire road. Remedial measures in terms of overlays were provided to the PWD. Responsible for entire axle load surveys at all strategic locations, analysis and inferences.

41.	Post Construction Quality Audit of Roads at DSIDC Bawana (Delhi)	Team Member Delhi State Industrial Development Corporation (DSIDC) August 2002	<ul style="list-style-type: none"> <li>• Planning of field visits</li> <li>• Data collection and data management</li> <li>• Data analysis</li> </ul>
42.	Evaluation of Bitumen Emulsions	<b>Project Leader</b> PWD, HP Work started in the month of November 2001	<ul style="list-style-type: none"> <li>• Lab testing</li> <li>• Analysis of results</li> <li>• Report writing</li> </ul>
43.	Structural and Functional Evaluation of Andaman Trunk Road and Needed Improvement Measures	Team Member Andaman PWD August 2001	The project consist of Structural and Functional Evaluation of Andaman Truck Road starting from Port Blair (Km. 0.00) to Diglipur (Km. 300.00, North of Andaman). The entire road was segmented into homogenous sections which were surveyed accordingly. The role and responsibility are detailed below:
	Involved in planning of field visits, segmenting entire road into homogeneous sections, presented lecture in the workshop organized for engineers, at site training to the engineers for pavement related data collection and interpretation, data management and recommendations on remedial measures. Also published a paper in Indian Highways, IRC about developing a pavement management system for Andaman Truck Road.		
44.	Development of High Performance Bituminous Binders	Team Member BPCL, Mumbai July 2001	<ul style="list-style-type: none"> <li>• Laboratory visit</li> <li>• Literature review on Multi Grade Bitumen and its performance</li> <li>• Inception report writing</li> </ul>
45.	Pradhan Mantri Gramin Sadak Yojana (PMGSY)	Team Member Ministry of Rural Roads Development March 2001	<ul style="list-style-type: none"> <li>• Total engineering scrutiny</li> <li>• In the finalization of Bituminous Construction and Quality Control Chapters</li> <li>• Partly report editing/writing</li> </ul>
46.	Appropriate Cold Mix Technologies for Different Types of Roads in North Eastern Sector	<b>Project Leader</b> CSIR February 2001	<ul style="list-style-type: none"> <li>• Field Visit</li> <li>• Literature Review</li> <li>• Inception report writing</li> </ul>
47.	Evaluation of Materials and Pavements for Implementation of Cold Mix Technology for Delhi Roads	Team Member Delhi, PWD December, 2000	<ul style="list-style-type: none"> <li>• Planning of axle load survey and traffic survey</li> <li>• Data management and analysis</li> <li>• General recommendations</li> <li>• Report writing</li> </ul>
48.	BETA Test Report (HDM-4, version 1.3)	Team Member World Bank & CSIR Oct. 1999	Responsible for BETA test of HDM-4 software and provided existing errors in running of software in the form of

			report. The error reporting also included all the bugs while giving inputs and reporting outputs.
49.	Roughness Measurements and Travel Time Studies on Indore Dewas Section of NH-3 (Km. 590.600 to Km. 573.000)	<b>Project Leader</b> RITES, New Delhi, August 1999	<ul style="list-style-type: none"> <li>• Planning and field studies</li> <li>• Data Management and analysis</li> <li>• Suggestions and Recommendations</li> <li>• Report Writing</li> </ul>
50.	Axle Load studies on State Highways in Gujarat State	Team Member LEA Associates South Asia Pvt. Ltd, New Delhi May 1997	<ul style="list-style-type: none"> <li>• Data management</li> <li>• Data analysis</li> </ul>
51.	Rural Road Maintenance Planning Study in the State of Gujrat	Team Member RITES, New Delhi February 1993	<ul style="list-style-type: none"> <li>• Data management</li> <li>• Data analysis</li> </ul>

## Enclosure-2

### PUBLICATIONS

#### Journals

- 1) Sanjay Deori, Rajan Choudhary, **Devesh Tiwari** & Abhinay Kumar, 'HDM-4 Deterioration Modelling: Validation and Adoption for Flexible Pavements with Modified Bituminous Road Surfacing', published in "**The Baltic Journal of Road and Bridge Engineering**", ISSN:1822-427X/eISSN1822-4288, <https://doi.org/10.7250/bjrbe.2019-14.440>, Volume 14, Issue -2:208-226, 2019 pp. 208-226.
- 2) Sanjay Deori, Rajan Choudhary, **Devesh Tiwari** & S. Gangopadhyay, 'Calibration of HDM-4 Pavement Performance Models for Indian National Highways', published in "**The International Journal of Pavement Engineering and Asphalt Technology (PEAT)**", ISSN:1464-8164, [www.degruyter.com/view/j/ijpeat](http://www.degruyter.com/view/j/ijpeat), Volume: 19, Issue: 1, May 2018, doi:10.1515/ijpeat-2016-0018, pp. 23-35
- 3) Siksha Swaroopa Kar, Aravind Krishna Swamy, **Devesh Tiwari** & Promod Kumar Jain, 'Impact of Recycled Asphalt Pavement on Properties of Foamed Bituminous Mixtures', published in '**The Baltic Journal of Road and Bridge Engineering**', ISSN 1822-427X/eISSN 1822-4288, <https://doi.org/10.3846/bjrbe.2018.383>, Volume 13 Issue 1, year March, 2018, pp. 14–22.
- 4) Siksha Swaroopa Kar, Aravind Krishna Swamy, **Devesh Tiwari**, and P. K. Jain 'A Critical Review on Foam and Emulsion Based Cold Recycled Asphalt Mixes', **Indian Highways**, Volume 45 Issue 8, August 2017.
- 5) Siksha Swaroopa Kar, A K Swamy, **Devesh Tiwari** and P K Jain, 'Impact of Asphalt Binder on Foamed Bituminous Mixtures Properties', Proceedings of the **Institution of Civil**

- Engineers (ICE)- Construction Materials**, 170(4), [https:// doi.org/10.1680/ jcoma.16.00037](https://doi.org/10.1680/jcoma.16.00037), August 2017, pp. 194–204.
- 6) Siksha Swaroopa Kar, Dr. P. K. Jain, Dr. A. K. Swamy & **Dr. Devesh Tiwari**, 'Study on Effect of Viscosity of Foaming Characteristics and Stabilized Mix Properties', published in the **International Journal of Pavement Engineering & Asphalt Technology**, Volume 18 (1) May 2017, pp. 11-30.
  - 7) Sanjay Deori, Rajan Choudhary, **Devesh Tiwari** & S. Gangopadhyay, 'Calibration of HDM-4 models for Indian conditions of flexible pavement having modified bitumen in wearing course', published in '**International Journal of Pavement Engineering**', **Taylor & Francis**, DOI: 10.1080/10298436.2016.1208196, ISSN: 1029-8436, July 2016.
  - 8) Siksha Swaroopa Kar, **Devesh Tiwari**, AK Swamy and P.K. Jain, 'Significance of RAP Content and Foamed Binder Content on Mechanistic Characteristics of Recycled Foamed Bituminous Mixes', published in open access '**Journal of Civil & Environmental Engineering**', Volume 6, Issue 2, 1000220 <http://dx.doi.org/10.4172/2165-784X.1000220>, Eng, April, 2016.
  - 9) Akash C. Prakashan, **Devesh Tiwari**, Yogesh U. Shah and Manoranjan Parida, 'Pavement Maintenance Prioritization of Urban Roads Using Analytical Hierarchy Process', published in the **International Journal of Pavement Research and Technology (IJPRT)**, Chinese Society of Pavement Engineering, ISSN 1997 - 1400, Volume 8 NO. 2, March 2015, pp. 112 – 122.
  - 10) Yogesh U. Shah, S.S. Jain, M.K. Jain and **Devesh Tiwari** , 'A Critical Appraisal of Urban Drainage Systems - Research and Design Issues', published in **Highway Research Journal**, Highway Research Board, Indian Roads Congress (IRC), Delhi, India, Volume 7 No. 2, July - December 2014, pages 1 to 16.
  - 11) Ashish Prabin Kumar, Havanagi Vasant G. and **Tiwari Devesh**, 'Shrinkage and Cracking Behavior of Cement Stabilized Material in Flexible Pavement - A Critical Review', published in the **Indian Highways**, Journal of Indian Roads Congress (IRC), New Delhi in the month of October 2014, Vol. 42, pages 13 to 17.
  - 12) Shukla Manoj, **Tiwari Devesh** and Sitaramanjaneyulu K. 'Performance Characteristics of Fiber Modified Asphalt Concrete Mixes', published in the **International Journal of Pavement Engineering and Asphalt Technology (PEAT)**, **U.K.**, ISSN 1464-8164, Volume 15, Issue 1, May 2014, pp. 38-50.
  - 13) Shukla Manoj, **Tiwari Devesh** and Sitaramanjaneyulu K, 'Performance Characteristics of Asphalt Concrete Mix Modified with Glass Fibres', published in the Proceedings of **International Journal of Pavements Conference (IJPC)**, São Paulo, Brazil, 9 – 10 December, 2013.
  - 14) Yogesh U. Shah, Dr. S.S. Jain, Dr. M.K. Jain and **Dr. Devesh Tiwari**, 'Evaluation of Urban Pavement Drainage Quality Effects on Pavement Performance', **International Journal of Pavements**, Published by São Paulo, Brazil, Vol. 12, Number 1-2-3, January-May-September, 2013, pp. 103-109.
  - 15) Khan Shahbaz, **Tiwari Devesh**, Nagabhushana M.N. and Jain P.K., 'Modeling of Permanent Deformation on Flexible Pavement Using Accelerated Pavement Testing', published in the **Journal of Mechanical and Civil Engineering (JMCE)**, publisher International Organization of Scientific Research (IOSR), e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 6, Issue 3 (May. - Jun. 2013), PP 37-41.
  - 16) Kumar Ravindra, Parida Purnima, **Tiwari Devesh** and Gangopadhyay S., 'Idling Emission at Intersection and Exploring Suitable Mitigation Measures', **Journal of Traffic and**

**Logistics Engineering, USA** (DOI: 10.12720/ ISSN: 2301-3680), Volume 1, No.2, June, 2013, p.p. 184-190.

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- 18) Yogesh U. Shah, Jain S.S., **Tiwari Devesh** and Jain M.K., 'Studying the Effect of Maintaining the Urban Roads at Different Serviceability Levels and Applying Deferred Maintenance', **i-managers Journal on Civil Engineering**, Volume 2(3), June - August 2012, pp. 1-6.
- 19) S.S., Jain, Yogesh U. Shah, **Tiwari Devesh** and Jain M.K., "Evaluation and Modelling the Performance of Pavement Drainage Systems", published in **New Building Materials & Construction World (NBM & CW) Magazine** (ISSN 0973-0591), Volume 17 (9), March 2012, pp. 150-156.
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- 21) Gupta Rajesh, Goyal J.K., Das Shankh and **Tiwari Devesh**, "Low Cement Concrete Technology for Sustainable Construction", published in '**The Indian Concrete Journal**' in the month of November 2010, Vol. 84, No. 11, pages 32 to 40.
- 22) Deori Sanjay, Jain P.K., Jain Sunil and **Tiwari Devesh**, "Full Scale Performance Study on Crumb Rubber Modified Bitumen and Conventional Bitumen in Bituminous Concrete", published in the **Indian Highways**, Journal of Indian Roads Congress (IRC), New Delhi in the month of October 2010, Vol. 38, pages 45 to 54.
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- 25) Sood V. K., Kanchan P.K., **Tiwari Devesh**, "Suggested Vehicle Damage Factor For National Highways", **Indian Highways**, New Delhi, August 2000.
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- 1) Fadamoro Oluwafemi, Siskha Swaroopa Kar & **Devesh Tiwari**, 'Eco friendly Foam Bitumen Technology in Road Construction – A Case Study', Poster presentation at International Conference On SMART CITIES: Opportunities and Challenges, 2019, from 14<sup>th</sup> – 16<sup>th</sup> March, 2019 at New Delhi.

- 2) Shahbaz Khan, M N Nagabhushana, Guru Vittal and **Devesh Tiwari**, 'Use of Fly Ash in Cemented Base Layer, published in the 'International Conference on Pavements and Computational Approaches (ICOPAC-2018)', CSIR-CRRI, 16 to 17 November, 2018, New Delhi.
- 3) Fadamoro Oluwafemi, Siskha Swaroopa Kar, **Devesh Tiwari** & Ajapal Singh, 'Strength Characteristics of Stabilized Soil Using Cow Dung Ash and Rice Husk Ash, poster presentation at 'International Conference on Pavements and Computational Approaches (ICOPAC-2018)', CSIR-CRRI, 16 to 17 November, 2018, New Delhi.
- 4) Anik Gupta, **Devesh Tiwari**, A.K. Sagar, 'Evaluation by Ddamage Caused by Overloaded Vehicle on Flexible Pavement', published in the 'International Conference on Pavements and Computational Approaches (ICOPAC-2018)', CSIR-CRRI, 16 to 17 November, 2018, New Delhi.
- 5) Siksha Swaroopa Kar, **Devesh Tiwari** , A K Swamy & P.K.Jain, 'Laboratory Analysis of Foamed Bituminous Mixes with Different Binder Grade', 4th Conference of the Transportation Research Group of India (CTRG-2017) 17 to 20 December, 2017, Mumbai, India (Paper Accepted for publication in TiDE Journal).
- 6) Siksha Swaroopa Kar, Devesh Tiwari, A K Swamy & P.K.Jain, 'Potential Use of Foamed Bituminous Mixes with respect to Energy Consumption and Emissions', IRF's World Road Meeting on "Safe Roads and Smart Mobility: the Engines of Economic Growth" 14-17 Nov. 2017, New Delhi.
- 7) Sampath Kumar Pasupunuri, Dr. Devesh Tiwari, Sunil Jain and Pradeep Kumar, ' Self-Healing Pavements: A Revolution in Pavement Materials', published in the proceedings of IRF's World Road Meeting on "Safe Roads and Smart Mobility: the Engines of Economic Growth" 14-17 Nov. 2017, New Delhi.
- 8) Shahbaz Khan, M N Nagabhushana, Guru Vittal and **Devesh Tiwari**, 'Use of Fly Ash in Low Volume Road ', published in the proceedings of IRF's World Road Meeting on "Safe Roads and Smart Mobility: the Engines of Economic Growth" 14-17 Nov. 2017, New Delhi.
- 9) Siksha Swaroopa Kar, Devesh Tiwari , A K Swamy & P.K.Jain, 'Development of Response Surface Model for Mechanical Properties of Foamed Bitumen Mixtures', published in proceeding of International Conference in Advances in Construction Materials and system, 3-8 Sept, 2017, Chennai, Vol 3, pp 234-242.
- 10) M. N. Nagabhushana, Shahbaz Khan, Abhishek Mittal and **Devesh Tiwari**, 'Potential Benefits of APTF for Evaluation of Flexible Pavement for Its Permanent Deformation Behaviour', the online conference paper published in the book entitled 'The Roles of Accelerated Pavement Testing in Pavement Sustainability', publisher Springer Link where this compendium gathers exclusively the latest advances in the area of Accelerated Pavement Testing (APT), September, 2016, pp. 227-239.
- 11) Siksha Swaroopa Kar, **Dr Devesh Tiwari**, Dr Aravind Krishna Swamy & Dr P. K. Jain, 'Impact on Strength Characteristics Using Recycled Foamed Bituminous Mixes', published in the conference proceedings on 'Sustainable Asphalt Pavement for Developing Countries' held at CSIR-Central Road Research Institute (CRRI), New Delhi, 11 - 12 March 2016.
- 12) Mayur Chopde, Prof. Sanjeev Sinha, Dr Devesh Tiwari and Pradeep Kumar, 'Impact of Optimal Budget Utilization for Maintenance of Flexible Pavements', published in the conference proceedings on 'Sustainable Asphalt Pavement for Developing Countries' held at CSIR-Central Road Research Institute (CRRI), New Delhi, 11 - 12 March 2016.

- 13) Kumar N., P. Aggarwal, S. Jain & **D. Tiwari**, 'A Critical Review On HDM-4 Vehicular Emission Models', published in the proceedings of National Conference on Recent Advances in Civil Engineering (RACE2016) held at S.V. National Institute of Tecnology (SVNIT), Surat, India, 5 - 6 March, 2016, Page no. 962-969.
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- 15) **Devesh Tiwari**, Shahbaz Khan & Deepak John Peter, 'Laboratory Analysis of Bituminous Concrete (BC) Mix Using Asphalt Mixture Performance Tester (AMPT)', published in the proceedings of 3<sup>rd</sup> Conference of Transportation Research Group (CTRG), held at The Lalit Great Eastern, Kolkata, India, 17- 20 December, 2015.
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- 18) Sanjay Deori, Dr. Rajan Choudhary, **Dr. Devesh Tiwari** and Dr. S. Gangopadhyay, 'Evaluation of Flexible Pavement Performance Using Laser Based Multifunction Automated Road Survey System', published in the proceedings of 14th Annual International Conference on Asphalt, Pavement Engineering and Infrastructure at Liverpool John Moores University School of the Built Environment Built Environment and Sustainable Technologies (BEST) Research Institute, Centre for Materials Technology, Liverpool, UK, 11 - 12 February, 2015.
- 19) Shahbaz Khan, M.N. Nagabhushana, **Dr. Devesh Tiwari** and Dr. P.K. Jain, 'Comparison of Uni and Bi-directional Rutting in Flexible Pavement with Accelerated Pavement Testing Facility', published in the Proceedings of International Conference on Transportation Planning and Implementation Methodologies for Developing Countries (11th TPMDC) organized by Transportation Systems Engineering, Department of Civil Engineering, Indian Institute of Technology (IIT) Bombay, Powai, Mumbai, December 10-12, 2014.
- 20) Gagandeep Singh, **Devesh Tiwari**, P.K. Jain and A.K. Swami, 'A Critical Review of Endurance Limits of Bituminous Mixes for Developing Countries', published in the Proceedings of 11<sup>th</sup> Transportation Planning and Implementation Methodologies for Developing Countries, TPMDC 2014, organized by Transportation Systems Engineering, Department of Civil Engineering, Indian Institute of Technology (IIT) Bombay, Powai, December 10-12, 2014, Mumbai, India.
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- 22) Yogesh U. Shah, Dr. S.S. Jain and **Dr. Devesh Tiwari**, 'Adaptation of HDM-4 Tool for Strategic Analysis of Urban Roads Networks', published in the Proceedings of International Conference on Transportation Planning and Implementation Methodologies for Developing Countries (11th TPMDC) organized by Transportation Systems Engineering, Department of Civil Engineering, Indian Institute of Technology (IIT) Bombay, Powai, Mumbai, December 10-12, 2014.
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  - 24) Kamraj C., **Tiwari Devesh**, 'Characterization of Thermal, Rheological and Microscopic Properties of Crumb Rubber Modified Binders', published in the proceeding of National Conference on Innovations and Advances in Civil Engineering towards Green and Sustainable Systems held at Coimbatore Institute of Technology, Coimbatore , India, April 28-30, 2014.
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