Quality Policy

The CSIR – Central Road Research Institute (CRRI) endeavors towards Continual Professional Excellence in the area of Roads and Road Transport including Bridges and Structures. The Institute is committed to accomplish Industrial as well as Societal Research and Development Programmes, Consultancy Services and HRD Programmes meeting diverse technical needs of the profession globally.

Prof. Satish Chandra
Director
CSIR-CRRI
The scientific & technical objectives of CSIR-CRRI are:

- To develop specifications and manuals for construction of low cost roads for different regions of country.
- To carry out applied research for investigation, construction and maintenance of different type of roads and runway including studies on related materials such as aggregates, bitumen, cement, etc. with a view to effecting economy and achieving greater serviceability.
- To develop appropriate tools, machinery, equipment and instruments for adapting technologies as related to highway engineering and relevant to the country for indigenous use.
- To carry out research and development activities in all aspects of roads under varying climatic and traffic conditions.
- To carry out research and development in all aspects of road traffic and transportation engineering, including study of accidents, development of road safety measure, psychology of road users and transportation economics in relation to different forms of transport.
- To render technical advice and consultancy services to various organisation in roads and related fields to avoid import of foreign expertise.
- To train engineers through refresher courses, workshops and training programmes for wider application of indigenously developed technologies.
- To create and establish all the needed infrastructure, both equipment and expertise, in the various facets of highway and transportation engineering for investigation, planning, design, construction and maintenance as well as to achieve judicious solutions for special problems.
- To collaborate with other institution for R&D studies concerning roads, road transportation and related practices particularly on regional problems.
- Publication of scientific and technical findings in journals, symposia, conferences, etc. devoted to research and development in related areas of highway engineering.
- Generation of intellectual property and its commercialization through technology transfer.
CSIR-CRRI ORGANISATIONAL CHART

- **Research Council**
- **Prof.(Dr.) Satish Chandra Director**
- **Management Council**
- **R&D Management Area**
- **R&D Areas**

**Geotechnical Engineering**
- Shri U.K. Guruvittal

**Flexible Pavements**
- Shri Manoj Kumar Shukla

**Rigid Pavements**
- Shri Binod Kumar

**Pavement Evaluation**
- Shri Sunil Jain

**Traffic Engineering & Safety**
- Dr. Neelima Chakrabarty

**Transportation Planning**
- Dr. E. Madhu

**Environmental Science**
- Shri P. V. Pradeep Kumar

**Bridge Engineering and Structure**
- Dr. S. S. Gaharwar

**HRD and Project Management**
- Shri T.K. Amla, Head, Information, Liaison and Training
- Dr. B. K. Dural, Head, Planning, Monitoring & Evaluation

**Estate Service**
- Dr. Niraj Sharma, Head, Civil
- Shri B. M. Sharma, Coordinating Officer, MBSQ & Horticulture
- Shri A. K. Tripathi, Head, MBSQ Maintenance

**R & D Support Service**
- Shri R. S. Bharadwaj, Head, Technical Support Division
- Dr. R. N. Dutta, Head, Computer Centre & Networking

**Knowledge Resource Centre**
- Mrs. Pavan Chhabra, Documentation & Library Services

**Quality Management**
- Shri R. S. Bharadwaj

**Rajbhasha**
- Shri Sanjay Choudhary

**Administration**
- Shri O. Oman Panicker, Sr. Controller of Administration
- Shri Padam Singh, Sr. Controller of Finance & Account
- Shri Tariq Bador, Controller of Store & Purchase
- Shri Kaushal Kishor, Store & Purchase Officer
- Shri Avanish Kumar, Finance & Account Officer
- Shri Md. F. A. Siddiqui, Manager, Guest House
- Shri Brahman Prakash, Manager, Canteen
- Shri Dharam Singh, Caretaker
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It gives me an immense pleasure to present before you the Annual Report of CSIR-Central Road Research Institute, New Delhi for the year 2016-17. This report highlights the R&D endeavors as well as achievements of the Institute in terms of design, construction and maintenance of roads and runways, traffic and transportation planning of Indian cities, management of roads in different terrains, improvement of marginal materials, utilization of industrial waste in road construction, landslide control, ground improvements, environmental pollution, road traffic safety, fatigue and corrosion studies of bridges, service life assessment and rehabilitation of highway and railway bridges. The institute provides technical and consultancy services to various user organizations in India and abroad for capacity building of human resources in the area of highway engineering to undertake and execute roads and runway projects.

In its endeavor for effective technology transfer and building a close linkage with user organizations, the Institute handled a large number of consultancy assignments and earned sizeable cash resource. Moreover, this year is marked with successful completion of 12th Five year plan projects. Under the theme area on ‘Housing, Road, Construction, Structures and Safety’, three projects were executed by CSIR-CRRI. These are (i) Development and Application of Technologies for Sustainable Transportation (SUSTRANS); (ii) Indo-Highway capacity manual and (iii) Modelling of fuel loss and emissions at signalized intersections. These projects were classified as network and supra institutional projects. The network projects were executed with other CSIR laboratories and academic institutions such as IITs, NIT and other technological Institutes. The outcome of these projects were aimed at developing industrial and societal oriented technologies, engineering design improvements, use of alternative and improved materials for better planning and management of infrastructural facilities in India. In addition to development of technologies, methodologies and guidelines, the study outcomes also contributed to develop various standards, codes and specifications for Indian Roads Congress (IRC), and Bureau of Indian Standards. The projects also generated knowledge base, skill development and produced many research papers and Ph. D. scholars.

It is gratifying that our Scientists have strove hard to push the frontiers of CSIR-CRRI. We made significant contributions to knowledge generation as evidenced from research papers and patents. This year our scientists filed nine patents. One patent on "New design for box insertion through highly unstable Cohesion less Soil by Stabilisation of Vertical cut slopes". Was granted this year. The licensing agreements were signed with many Industries for transfer of technologies. For example, New process for preparation of harder grade bitumen (VG40 and VG50) for formation of asphalt surfacing for roads and airfields was licensed to four industries namely M/S A R Thermosets Pvt Ltd., Kanpur; M/S Juno Bitumix Pvt. Ltd., Noida; M/S Jalnidi Bitumen Specialties Private Ltd., Kolkata and M/S Tikki Tar Industries Pvt Ltd., Vadodara. Similarly, "Car driving simulator with Driver Diagnostic and Training
Method" developed under 12th Five Year Plan Project was patented with M/S Faros Simulation System Pvt. Ltd. The license for manufacturing the "PATCHFILL-The Pothole Repairing Machine" was given to M/S Pioneer Industries, Solan; M/S Pioneer Industries, Solan (H.P) and to M/S Jalnidhi Bitumen Specialties Private Limited, Kolkata. Various agreements and MoU were signed with government and private agencies during the year for executing the various projects of national importance.

A large number of distinguished Scientists both from India and abroad visited our Institute, delivered lectures, and held discussions with Scientists of the Institute during the year.

Many of our Scientists received National and international recognition, served as expert members on important committees and contributed in the preparation of Standards/ Codes of Practices/ Manuals/ Guidelines/Specialization (IRC/BIS/MoRTH).

During the period under report, CSIR-CRRI hosted a bouquet of events. We proudly hosted the National Dissemination Workshops on Development and Application of Technologies for Sustainable Transportation (SUSTRANS); Indian Highway Capacity Manual (Indo-HCM); Establishing a Research Network on Vehicular Emission Reduction (EARNOVER-2017) and Estimation of Fuel Consumption during Idling of Vehicles at Bhikaji Cama Intersection and Savings after Employing Suitable Mitigation Measures.

On the societal front, CSIR-CRRI conducted numerous training programs in the areas of road and road transport. In addition, an International Training course on Dissemination of Highway Development and Management software (HDM-IV) was also organized. It was attended by participants from within the country and from other developing countries. Short term tailor made training programs were also organised for the Engineers of Government of Afghanistan; Engineers of Departments of Roads, Nepal; Urban Administration and Development Department Chhattisgarh; Madhya Pradesh Rural Road Development Authority, Rural Works Department, Government of Bihar; Rural Engineering Department, Uttar Pradesh; Transport Department, Government of Rajasthan; Officers of Air Head Quarter, New Delhi and Public Works Department, New Delhi.

Nurturing young talent by generating highly skilled Ph. D. graduates is one of the key components of National Human Resource Development activities in the Institute. During the period under report, seventeen students have registered for doctoral degree and Thirty five students have completed M. Tech/B. Tech theses. Ten new scientists have joined the institute during this year.

Team CSIR-CRRI acknowledges with immense gratitude the enduring support extended by Dr. Girish Sahni, Director General & Secretary DSIR, in the growth of the Institute by giving us his able guidance and advice. I also express my gratitude towards The Ministry of Science and Technology, CSIR Headquarter and our Research & Management Councils for the wholehearted support received from them. I am indeed thankful to our external experts also who guided in our pursuit for excellence.

I wish to acknowledge with gratitude the unstinted contribution of my fellow CSIR-CRRI staff members who helped the Institute achieve success during the year.

Prof. (Dr.) Satish Chandra
Director
Human Resource: 2016-17

- 30% Scientist (Group-IV)
- 27% Technical (Group-III)
- 23% Technical (Group I-II)
- 20% Administrative Staff

Paper Published: 2016-17

- Indian Journal: 60
- Foreign Journal: 24
- Indian Proceedings: 36
- Foreign Proceedings: 31
Vulnerability Assessment and Development of Adaptation Strategies for Climate Change Impact with Special Reference to Coasts and Island Ecosystems of India (VACCIN)

Global warming phenomena is the key issue in the present scenario and it is directly/indirectly related to the human activities. Fast depletion of forest cover to accommodate the increasing demand of growing population is contributing significantly to the temperature rise globally. Temperature rise may change in rainfall patterns and increased extreme events are further leading the frequent occurrences of hazards such as floods, cyclone and especially landslide. Increasing rainfall intensities and frequencies, coupled with population growth can drastically increase landslide-associated casualties.

The 12th five year plan project VACCIN under "Study of Changing Trends of Landslide Hazards considering Geoenvironmental Conditions in the parts of Peninsular India" has been sponsored by Planning Commission.

The main objective of the project was to study the change of pattern of landslide hazards considering the climate change in the parts of the peninsular India. In order to achieve this objective, temporal data of six years (1980, 1997, 2000, 2005, 2007 and 2014) has been used for the study area Munnar (approximately 550 sq. km), Kerala State (Fig1). Initially, area has been divided into (458) number of small parts called facet. Facet is a part of a slope having uniform inclination (±20) as well as direction (±20). Facet is a smallest unit in which study is limited. Facet of the study area (Fig.2) has been prepared and used as base map for preparing causative factor maps. All factorial maps and other maps has been prepared using existing maps, geospatial data and field data of different years. Land Use and Land Cover (LULC) is an important causative factor and mostly changed by the anthropological activities. It was found that there is distinct change in the land use and land cover pattern in the study area from all six year (Table-1) (1980, 1997, 2000, 2005, 2007 and 2014), 1980 to 2014 (Fig. 4 & 5). Change in land use and land cover is shown in π-diagram (Figs 3) and in table 1. Results (Table 1) shows that there is distinct change in all sub categories of LULC. Forest land reduced a little but thickly forested area increased significantly. Tea & other plantation, area of water bodies reduced. On the other hand, area of the Barren Land/Open Land/Rocky increased significantly. Similar way maps of other causative factors are made.

Finally, on the basis of causative factors, Landslide Hazard Zonation (LHZ) Maps of the area for the 1980, 1997, 2000, 2005, 2007 and 2014 years were prepared to know the change in the relative stability of the slopes in the area of study with time. Sub categories of landslide hazard is illustrated in LHZ map (Fig. 6 – 2 D Map and Fig. 7 – 3 D Map) of the Munnar study area of 2014 year. LHZ Map demonstrate that only four categories of hazard mainly Very Low Hazard (VLH), Low Hazard (LH), Moderate Hazard (MH) and High Hazard (HH) are
present in the study area. MH and LH slopes are dominating the area, whereas HH slopes are falling in the Northern part of the study area. Moderate hazard zones are considered to be safe but may contain pockets of unstable slopes. Low Hazard and Very Low hazard are commonly considered safe. Therefore, during planning of development schemes in future HH Zones should be avoided. Proper care of causative factors should be taken in case of MH Zones.

### Table 1  Land use / Land cover Change Details Since 1980 to 2014, Munnar Tehsil Idukki District, Kerala

<table>
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<th>Classified land use / land cover Classes</th>
<th>1980 Area (Ha)</th>
<th>1997 Area (Ha)</th>
<th>2000 Area (Ha)</th>
<th>2005 Area (Ha)</th>
<th>2007 Area (Ha)</th>
<th>2014 Area (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tea and Other Plantation</td>
<td>14,587</td>
<td>9,965</td>
<td>9,889</td>
<td>10,096</td>
<td>10,144</td>
<td>10,411</td>
</tr>
<tr>
<td>Agricultural land/Populated Flat</td>
<td>976</td>
<td>461</td>
<td>487</td>
<td>498</td>
<td>477</td>
<td>401</td>
</tr>
<tr>
<td>Thickly vegetated forest area</td>
<td>12,930</td>
<td>16,033</td>
<td>18,116</td>
<td>24,198</td>
<td>23,360</td>
<td>19,986</td>
</tr>
<tr>
<td>Moderately vegetated forest area</td>
<td>8,244</td>
<td>2,453</td>
<td>2,903</td>
<td>3,106</td>
<td>2,212</td>
<td>3,399</td>
</tr>
<tr>
<td>Sparsely vegetated area</td>
<td>3,668</td>
<td>11,956</td>
<td>9,096</td>
<td>6,045</td>
<td>5,884</td>
<td>3,848</td>
</tr>
<tr>
<td>Barren Land/Open Land/Rocky Waste</td>
<td>13,334</td>
<td>12,994</td>
<td>13,457</td>
<td>9,910</td>
<td>11,796</td>
<td>15,807</td>
</tr>
<tr>
<td>Water Body</td>
<td>5,563</td>
<td>10,426</td>
<td>10,376</td>
<td>10,594</td>
<td>10,621</td>
<td>10,812</td>
</tr>
</tbody>
</table>
Development and Evaluation of ‘Soil Nailing Technique’ for stabilisation of vertical slopes with surcharge

As a result of special impetus being paid to infrastructure development in cities, coupled with lack of availability of land, many underground structures are now being built. These underground structures are generally built by cut and cover methods, which involve extra soil excavation, as well as caving in due to deep excavation affecting the neighbouring properties. Underpass construction for providing road connectivity is being taken up at many locations in Indian metro cities. The excavations for underpasses are strengthened either by adopting ground improvement measures like; chemical stabilisation, cement/lime slurry grouting, etc. Other technique is to adopt soil Nailing and precast box pushing. The underpass construction project becomes challenging when construction has to be taken up below live rail/road traffic without disturbing the vehicular/rail movement. CRRI in the recent years has designed and supervised many projects in which RCC box pushing was facilitated by adopting soil nailing technique for stabilising the soil face into which box pushing was being done.

This R&D project was taken up to develop a simple design methodology which can address many possible variables during box pushing. The main objective of the project was (a) Develop design
methodology for stabilising the vertical cut for the construction of underpass by using box pushing below the live loads (b) To develop threshold value of overburden height according to live loads. (c) To develop a methodology for minimizing up heaving during box pushing.

Soil arching phenomenon within the overburden soil was studied by reinforcing the overburden soil through nails. The nails were provided in the overburden thickness of tunnel up to the influence zone. Though influence zone is assumed to be 1.5 B, nails were provided close to the influence zone. The equivalent zone was calculated for a width of footing (B), 8 mm diameter nails (d1), made of Tor steel bar were used. The horizontal spacing of Nail was kept as 10 times the diameter of nail and nails were provided in the influence zone only. The length of the nails (Y1) was kept constant (200 mm), which was almost equivalent to width of load dispersion (2H:1V) for lower nail and the criterion of adopting the length of nail is explained in Fig. 8. Fig. 9 and Fig 10. Schematic view of Test Setup and results have shown in Fig. 11 & 12 respectively.

The above study is under progress and till date the above results reveal the following.

- The tunnel excavation is not possible in dry sand.
- The stabilisation of sand with nail is not fruitful in 'Dry Sand' because of missing of apparent cohesion.
- The increase in the moisture content increase the strength with respect to overburden height. The arching effect is also increasing with the overburden height.
Development and evaluation of “Soil Nailing Technique” for stabilisation of soil slope for the construction of underpass intersection below Road traffic

This project has been taken up to evolve design methodology for constructing multiple underpasses at different depths below live traffic condition. This project has been taken up as ‘Fast Track Translational (FTT)’ project of CSIR. Design and fabrication of experimental test tank is underway. Model test tank for creating prototype of multiple underpass and proposed model test setup are shown in Fig 13 and 14 respectively.

Shielding of Structure Against Vibration due to Earthquake

A study on shielding of structures against earthquake vibrations due to earthquake and isolation of the ground using trench barriers is presently under progress. The site for investigation was chosen in CRRI campus and field test was done to evaluate the efficiency of the trench barrier and In-fill materials. A pulse was created inside the ground by giving impact at a point away from the trench and its effect was recorded at various locations before and after the trench. Two sensors were put just near the trench opposite to each other to study the effect on the wave after crossing the trench. The amplitudes (in terms of acceleration) were recorded at different points with the help of sensors to have an idea of dissipation of energy. SPT test was performed at four locations of the ground to estimate the Shear wave and Rayleigh wave velocity. The soil samples taken from different depths were also analysed in terms of their geotechnical properties. Variation of Shear modulus (G) and Young’s modulus (E) was studied with respect to depth. The values of Shear modulus (G), calculated from static and dynamic methods were compared to each other. Based on the value of Shear wave velocity (Vs), the trench was designed for the field experiment. Based on the experimental observations, the variation of Shear modulus (G) with respect to depth have been plotted.

Technologies for Utilisation of Waste and Marginal Materials in Road Construction - 12th FYP project under SUSTRANS

Under this project, database of different waste materials namely, Cinder, Coal ashes (pond ash, bottom ash and fly ash) from some of the power plants, Copper slag, Kimberlite, Jarofix, Steel slag, Jarofix, Jarosite, Zinc slag were compiled on the GIS platform (Using Mapinfo software). The data mainly included typical Physical, Chemical and Geotechnical characteristics. Typical design cross-sections of their utilization in embankment and pavement have also been compiled, which would
give an idea about their application in the field. The data would increase the confidence and awareness of the user agency like MORTH, MORD, NHAI, Local PWD's, Municipal Corporations etc. some of the wastes materials on which not much R&D have been carried out (Foundry sand, Red mud, Soft aggregates) were also collected and investigated for their feasibility in Road construction.

Apart from utilization of different waste materials in embankment and pavement layers, different waste materials viz. Copper slag, Pond ash, Foundry and Yamuna sand were investigated for their utilization as a backfill material in the mechanically stabilized retaining wall. The results of the study clearly showed that these waste materials have a significant potential for use as structural fill materials in place of conventional materials for mechanically stabilised earth wall and Reinforced slope applications.

To further evaluate feasibility of waste material usage in flexible and rigid pavements, different mechanistic parameters viz. Unconfined compressive Strength, Indirect tensile strength and fatigue characteristics of cement stabilized copper slag and fly ash waste materials were evaluated. The mechanistic characteristics of the cement stabilised fly ash determined in the laboratory were used to arrive at typical design pavement cross sections with its utility in sub base and base layers. It was found that cement stabilized copper slag-fly ash mixes can be effectively tried in base and sub base layers of road pavement. Two types of waste materials viz. Foundry sand, Jarosite and a marginal soft aggregate were investigated for their feasibility for use in Pavement Quality Concrete (PQC) and Dry Lean Concrete (DLC) mixes in rigid pavement construction. It was concluded that, only about 20 to 30 per cent foundry sand can be used as a replacement of fine aggregates in concrete mixes. Jarosite can be used in cement concrete, only in small amount of 10 per cent by weight of cement in PQC mixes. Also, as the compressive strength achieved with soft aggregates, was only about 40 per cent as compared to strength achieved with conventional aggregates, it was concluded that such aggregates cannot be used for rigid pavement construction.

**CSIR Network Project “Engineering of Disaster Mitigation and Health Monitoring for Safe & Smart Built Environment” (EDMISSIBLE)**

Under this project CRRI carried out the task entitled Landslide hazard information system and design of cost effective measures for landslide control at Maithana landslide. The selected Maithana landslide, located at km 423.5 on National Highway-58, 4 km ahead from Nandprayag covers 150 hectare of approximate area. The topographic base map which was produced, in appropriate scale (1:500), by survey with the help of high precision total station. The same topographic base map was used to develop a Digital Elevation Model (DEM) (Fig.-15) of the area which has given a 3D representation of the terrain. The DEM was further used for generation of derivatives maps such as slope map and aspects map. The drainage map (Fig.-16) was prepared by locating the local drainage of landslide area on topographic map. From Digital Terrain Model, the detectable changes on morphology such as slope and aspect information, water path direction and water concentration condition on slopes were analyzed. Drainage map (Fig.-16) depicts that most of the flow lines converged towards the landslide body and near to landslide boundary thereby creating favourable environment for sliding.

Landslide occurs as a result of slope instability associated mass movement of hill slopes. In order to predict the landslide occurrence, a quantitative assessment of slope stability is necessary. Selection of suitable remedial measures follows the estimation of stability. The GEO-5 stability analysis software available in CSIR-CRRI was used and slope stability was determined as per Bishop’s Method. The stability analysis clearly shows that both uphill side and downhill side of the slope are stable in dry condition, but the slope is unstable under saturation condition. Fig.-17 depicts geological cross section of slide area.
Alaknanda River is meandering at the toe of the Maithana slide and it is severely eroding the toe portion of the debris/soil. Due to toe erosion the downhill slope becomes steeper and further destabilising the slope. The natural stream at the crown of the slide has been left untreated and the water is seeping inside the soil results in saturating both uphill and downhill slope. From the stability analysis it was observed that the slope is stable in dry condition. Upon saturation the slope becomes unstable. To prevent toe erosion RCC retaining wall designed and suggested at the toe of the slope. The designed remedial measure for Maithana landslide are shown in Fig.-18.
**Design, Supervision and Pavement Performance Evaluation of Road Constructed By Using Phosphogypsum.**

Phosphogypsum is a waste material generated as a by-product during manufacturing of phosphoric acid. This project was taken up to study application of phosphogypsum waste material for road construction. Earlier feasibility study on Phosphogypsum had showed its potential for road construction application in the form of embankment fill, subgrade material and for sub-base course construction, but in the absence of proper standard and technical specifications, the material remains unutilized and is being dumped haphazardly within the plant area occupying costly land and affecting the environment. The study was sponsored to carry out design, supervision and performance monitoring of phosphogypsum road for utilization in the road construction by M/s. Paradeep Phosphate Limited, Odisha on experimental basis. Accordingly, material was collected from the plant area and its geotechnical engineering characteristics were investigated to assess its feasibility for use in embankment, sub grade and sub base layers of road construction.

The survey data indicated maximum height of embankment as 2m at the proposed site for the construction. As the phosphogypsum waste material is non-plastic in nature, embankment was designed as a composite structure with phosphogypsum in the core and with a cover of good soil on either side. It was recommended to provide 1m thick cover soil having PI value < 10.
Five different sections of embankments have been proposed for experimental test track construction. The top width of embankment proposed is 6.75 m (Single lane carriageway of 3.75 m along with side shoulder of 1.5 m width on either side). Details of different test sections are given below. Test track is presently under construction.

Section 1: Both embankment and pavement layers are to be constructed with conventional materials as per MORTH/IRC specifications.

Section 2: Embankment is proposed to be constructed with phosphogypsum without soil cover and pavement layers similar to conventional section -1 using conventional materials.

Section 3: As there is a possibility of erosion of embankment side slope constructed using phosphogypsum, 1 m cover soil is proposed to be provided over phosphogypsum embankment (Fig. 19). All the other pavement layers are similar to conventional section 1 using conventional materials.

Section 4: To investigate the feasibility of phosphogypsum as a sub grade material, 500 mm thick subgrade layer of phosphogypsum is proposed above the conventional soil embankment.

Section 5: Phosphogypsum is also proposed in the construction of sub base layer of thickness 150 mm replacing the conventional granular sub base.

Utilization of Ghazipur Landfill Municipal Solid Waste (MSW) for Embankment Construction

A detailed study was carried out by CSIR- Central Road Research Institute to investigate the possibility of utilizing the Municipal Solid Waste (MSW) collected from Ghazipur Landfill, East Delhi as an embankment material. The MSW is proposed to be utilized in the widening of NH-24 (Delhi-Meerut Expressway) from the existing 4 lane to 14 lane. The construction would be carried out by National Highway Authority of India (NHAI) under the supervision of CSIR- Central Road Research Institute.

About 200 tons of Municipal Solid Waste was collected from three different locations on the landfill site (Fig. 20), based on its age. These materials were dried and then segregated into different sizes in the existing compost plant shown in Fig.21. The different fractions were studied for their suitability for use in embankment construction. A segregation methodology was proposed in the study to arrive at suitable material to be used in the embankment. This Municipal Solid Waste (MSW) was also studied for the presence of heavy metals by carrying out leachate studies. The segregated MSW (Fig. 22) was then characterised to study its geotechnical...
properties. Stability and settlement analysis was also carried out to investigate its feasibility for embankment construction. It was concluded that:

1. About 65-75 per cent of segregated Municipal Solid wastes can be used for embankment construction.

2. Leachate studies indicate that MSW is a non hazardous material as concentration of heavy metals is within the permissible limit.

3. Typical design cross sections (Fig.23) with MSW embankment have been arrived for experimental test track construction along the Delhi-Meerut expressway. The MSW embankment would be instrumented and monitored over a period of 2 years before recommending the material for large scale field applications.
Ground improvement measures over soft organic soil in the Northern Campus of NIT Manipur, Langol, Imphal

This project was sponsored by CPWD. The objective of the project was geotechnical characterisation of existing sub-soil, proposed construction materials and design of ground improvement measures for construction of road and embankment over sub-soil having large proportion of organic materials. A total length of 2.5 km, including the main and service roads were proposed to be constructed in the NIT campus, Imphal. The existing sub-soil in the road alignment was found to be soft organic soil. Hence road construction above that would have resulted in excessive settlement and failures if it was constructed without any ground improvement measures. CRRI team visited the site and soil samples were collected for the detailed laboratory investigations. Based on the analysis and interpretation of data, suitable ground improvement measures have been proposed for the construction of road embankment on soft soil. A suitable pavement design (Fig. 24) has also been proposed in the report. Some of the conclusions from the study have been summarized below.

1. The subsoil is highly plastic with liquid limit 67 per cent and plasticity index of 23. According to BIS classification, the soil is classified as Organic clay with high plasticity (OH). The soil has low specific gravity of 2.2, High organic content of 24 per cent and free swell index value of 25 per cent.

2. The shear strength of the subsoil within a depth of 9m varies from 1 kPa to 6.6kPa, depending on the water content and in-situ bulk density.

3. Permeability of the soil at insitu density and water content is 3.2x10-7 m/sec which indicates moderately poor permeability.

4. The results of consolidation test indicated the value of Compression index, Cc as 0.26 and average value of coefficient of consolidation, Cv as 2.26m2/year.

5. The embankment soil is highly compressible inorganic clay with a liquid limit value of 50.6 per cent and plasticity Index of 22.3 and with a low specific gravity of 2.6.

6. The Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) of the embankment soil are 17.6 kN/m3 and 16.5 per cent respectively.

7. The CBR value of the embankment soil at 97 per cent of Maximum Dry Density, soaked in water for 96 hours, was 4 per cent.

8. The soil as such is not recommended for the construction of embankment due to its high compressibility. It can be mixed with 10 per cent fine sand for embankment construction and 20 per cent sand for Subgrade construction.

9. Different ground improvement measures have been recommended before the construction of road over soft subsoil namely a) Large size granular columns in combination with PVDs, b) Bored Piles with basal mattress, and c) Vacuum Consolidation with basal mattress. Slope stability analysis was done with and without ground improvement techniques, both for static as well as seismic case. The practical and economical feasibility at the site were recommended for consideration before finalising the ground improvement method.
Characterisation of Locally Available Road Construction Materials Near Manali-Sarchu Road, (H.P.)

This project was sponsored by Border Roads Organisation (BRO) to Characterise Locally Available Road Construction Materials near Manali-Sarchu Road, Himachal Pradesh. The objective of the project was to determine properties of locally available materials near Manali-Sarchu Road (NH-21) and to evolve a methodology for using such materials in road works. Different locally available materials like tunnel excavation muck (Fig. 25), sand, etc were identified by the CRRI team and subjected to extensive laboratory investigations to determine physical and engineering properties. From gradation test results it was observed that tunnel muck (Fig. 25) from both North Portal and South Portal are coarse grained gravelly materials. The tunnel muck from North Portal was found to be having less fines in comparison to tunnel muck from South Portal. Locally available Chenab river sand was found to be predominantly composed of sand size particles. When compared with a gradation of material specified for cement stabilisation (both MORD and MORTH Specifications), tunnel muck was found to be coarser in some of the sieves. After crushing and mixing with Chenab river sand, a mixture of tunnel muck + Chenab sand was found to be meeting the grading requirement of cement stabilised material. The most suitable gradation for cement stabilisation could be achieved by mixing crushed tunnel muck and sand in the proportion of 50:50. Tunnel muck partially meets the gradation requirement for using it in Crushed stone base (CSB which is similar to Crusher run macadam) or Non frost susceptible sub-base (NFSSB) layers. CSB and NFSSB are presently being adopted by BRO in their road works. Tunnel excavation muck can be used for NFSSB and CSB layer construction by suitably crushing, sieving and mixing with local sand.

Stabilisation techniques are adopted to improve the strength properties of pavement materials for incorporating them in the base/sub-base layers of the road pavement. The hard stone aggregates from North Portal muck was manually crushed and were mixed with different percentages of Chenab river sand (mechanical stabilisation) and were subjected various engineering strength tests. Samples
of tunnel excavation muck and mechanically stabilised mixture of tunnel excavation muck mixed with Chenab sand were stabilised by using different percentages of cement. Ordinary Portland cement Grade 43 was used for stabilisation. Unconfined compressive strength (UCS) tests at different time periods of curing and durability test were conducted on these cement stabilised samples. Curing of these samples was carried out under humid conditions in an enclosed chamber before determining the compressive strength of the specimens.

From the results of compression test on cement stabilised tunnel muck, it was observed that tunnel muck from North Portal develops adequate strength to be used in base/sub-base layers in cement stabilised form. When tunnel muck is mixed with sand (mechanical stabilisation) and then stabilised using cement, it developed, even more strength. MORD Specifications/IRC SP:72, which are used for low traffic volume rural roads, stipulates a 7 days unconfined compressive strength of 1.7 MPa for subbase and 3.0 MPa for base course. IRC SP:89 stipulates UCS strength of 7 MPa for cement stabilised base course. Hence by mixing about 7 to 8 percent cement, tunnel muck can be used for stabilised (bound) base course construction in highways also. The durability test results also indicate that cement stabilised tunnel muck is durable in presence of water also.

**Utilisation of Dredged Sand as a Construction Material for Road Construction in New Capital, Amaravati, Andhra Pradesh**

Government of Andhra Pradesh is developing a new capital city of Andhra Pradesh named as Amaravati, which is located on the southern banks of river Krishna. The new capital city is having an area of approximately 217 sq. km and proposed road network length in the capital is 81 km. As the new capital is located on the banks of river Krishna, dredged sand is available in abundance. Government of Andhra Pradesh has declared sand as a cost free material for utilising in civil construction works. Capital City Development and Management Corporation (CCDMC), Amaravati requested CSIR-Central Road Research Institute, New Delhi to provide technical feasibility of utilization of dredged sand as a construction material in road construction and feasible solution for the construction of proposed road network falls under black cotton soil.

CSIR-CRRI carried out filed investigations i.e. excavation of pits up to 1 m depth, collected BC soil samples and measured the field density (Fig.26). The locations of pits have been distributed in such a way so as to cover the entire capital proposed road network.
CRRI team also collected dredged sand samples from Lingayapalem, Amaravati, Andhra Pradesh and these samples were tested at CRRI. Based on the geotechnical laboratory study it was recommended that the dredged sand is suitable as a fill material and also for subgrade construction in road works. Since subgrade CBR of dredged sand is significantly high (more than 19 per cent), the pavement thickness (DBM layer thickness) can be reduced as per IRC: 37.

The black cotton soils in the new capital region was found to be having high liquid limit, high plasticity index its free swell index was also more. These soils can be classified as CH as per IS (Indian standard) classification system. The CBR values of black cotton soils are very low (About 1 per cent). The swelling pressure of black cotton soils in the new capital region varied from 60 kPa to 300 kPa. It indicates that black cotton soils are basically expansive soils and exert high free swell index and swelling pressure.

In light of the foresaid facts, two options for the construction of roads on black cotton soils were recommended. First option is the construction of road embankment with geomembrane as an impermeable layer and sand as a fill as well as subgrade material. Second option would be construction of road embankment with cohesive non-swelling soil (CNS) layer of 300 mm compacted thickness as an impermeable layer with geomembrane at end portion and sand as a fill as well as subgrade material. Both the options aim to prevent the ingress of water in the underlying expansive soil layer and counteracts the swelling of the soil. If underlying expansive soil heaves due to rise of ground water table, both the options provide uniform upheaval and are thus more effective.
Flexible Pavement
Design & Performance Evaluation of Cement Grouted Bituminous Mix (CGBM) for Urban Roads

Urban Roads are subjected to higher level of abrasion due to frequent acceleration and deceleration of vehicles and application of brakes. The conventional type of surfacing on these roads is bituminous concrete (BC), which is a binder rich mix and do not have desired resistance to abrasion. Mastic Asphalt which was in use for some time requires cooking of bituminous and filler at very high temperature and has since been banned by law in National Capital Region (NCR) of Delhi due to environmental concerns.

The objective of the research is to develop and demonstrate composite surfacing/wearing course for pavements using grouted high void bituminous mix with no permeability; resistance to deformation; resistance to abrasion and to provide adequate skid resistance for urban roads. This research will yield the design specifications for CGBM and these specifications will be forwarded to Indian Road Congress (IRC) to formulate a code of practice/guidelines for its implementation in field.

The user agencies like municipal corporations, PWDs and NHAI will be brought on board after getting the results of laboratory investigations and/or field Performance on some trial sections to be laid using CGBM.

Development of specifications of WMA for Indian conditions.

Department of Science and Technology entrusted CSIR-CRRI & IIT Roorkee a research project to develop specifications of warm mix asphalt (WMA) for Indian conditions. The broad objectives of this project are

- To characterize bituminous binders like VG 30, CRMB 55 and PMB 70 with different types of warm mix additives and thereby to evaluate the effect of these additives on rheological properties of the binders.
- To study and compare the strength and performance characteristics of WMA with hot mix asphalt (HMA) in terms of indirect tensile strength (ITS), tensile strength ratio (TSR), creep, rutting and fatigue properties.

Rheological properties of the warm mix asphalt binders are studied at different temperatures like high temperature (150 – 120°C NC), mid range temperature (50 - 70°C) and low temperature (sub zero). Viscosity – temperature relations have been developed using Brookfield viscometer and these relations and equi-volumetric principle were used to determine the mixing and compaction temperatures for different types of warm mix additives. Dynamic shear rheometer was used to determine the creep and shear modulus of neat, short term aged and long term aged binders to study their behavior under low and high temperatures. Bending beam rheometer (BBR) tests were also conducted on aged binders to study their low temperature performance. Three types of mixes were included in this investigation. Dense Bituminous Macadam (DBM) and Bituminous Concrete (BC) are extensively used as base course and surface course layers on all National and State Highways in the country. Stone Matrix Asphalt (SMA) is an open grade course designed for high rut resistance. The following tests were conducted on these three mixes.

- Design of mixes by Marshall Method and as per IRC/MoRTH Specifications
- Indirect tensile strength (ITS) tests on mixes with and without warm mix additives to see their effect on ITS and tensile strength ratio (TSR)
- Effect of dose and type of warm mix additive on retained stability
- Static and dynamic creep behavior of mixes with and without warm mix additives.
- Fatigue life of mixes and its variation with different types of warm mix additives.
- Rutting tests on mixes to evaluate effect of warm mix additive on rut depth.

Development of Technology For Use of Fly Ash As An Alternate Material In Pavement Construction Through Accelerated Pavement Testing

This Project, sponsored by Department of Science
MoST (Govt. of India) envisages that pavements serving traffic for the Indian rural road and low volume roads are the best bet for exploring a technology of maximised utilization of fly ash waste, with the following objectives:

- Experimental design of test pavement using selected fly ash waste in sub-base/base and construction of test strips within CRRI.
- Semi-field performance evaluation of pavement constructed using these materials using APTF.
- Development of design guidelines on their optimal usage.

Outcome of the projects are optimised usage of fly ash waste in different layers of pavement and Design Specifications with due deliberations with the experts. Six different (one conventional and five alternate) design specifications were proposed in the final design matrix to be studied and accordingly test strips have been constructed (Fig. 27).

**Feasibility Study on Utilization of Ferro Chrome Slag in Road Making**

M/S TATA Steel Limited entrusted CSIR CRRI to study the feasibility on utilization of Ferro Chrome slag in road making. The objective of this assignment is to explore feasibility of using both air cooled and water granulated ferro chrome slag in place of conventional road building materials in laboratory.

The representative sample of Air Cooled (AC) and water granulated (WC) Ferro Chrome Slag were used in this study. AC and WG slags were obtained from dumping site and supplied to CSIR-CRRI by Ferro Alloy Plant, Brahminipal and Raw Mat plant, Cuttak, respectively. View of supplied 40mm and 20mm air cooled slag and 10mm water granulated slag is given in Fig. 28. Performance of bituminous mix prepared with Ferro Chrome slag with 100% replacement of natural aggregate was studied. Result also shows that properties of slag also meet the specified requirements for granular bases and sub bases.
Validation of Executed Pavement Work vis-a-vis Pavement Design of Four Roads under Municipal Corporation of Greater Mumbai

M/S Relcon Infra Projects Limited, Andheri West, Mumbai entrusted CSIR-CRRI to validate the executed pavement work with the following objectives.

- Review of Pavement Design for four roads as indicated in letter
- Design validation through available parameters and traffic data as per existing records

Validation of Executed Pavement Work vis-a-vis Pavement Design of Four Roads under Municipal Corporation of Greater Mumbai has been completed.

Investigations to Study the Causes of Distress/Rutting on Varanasi-Shaktinagar Road (SH-5A) Length – 113.440 Km. in the State of Uttar Pradesh

M/S Uttar Pradesh State Highways Authority (UPSHA), Lucknow has sponsored the project with the following objectives.

- Visual Distress Assessment/Rutting measurements
- Traffic Volume Study

Investigations to Study the Causes of Distress/Rutting on Varanasi-Shaktinagar Road (SH-5A) Length – 113.440 Km. in the State of Uttar Pradesh has been completed.

Development of specification and guidelines for use of sulphur modified asphalt in bituminous base & binder course construction

M/S Reliance Industries entrusted CSIR-CRRI to develop specification and guidelines for use of sulphur modified asphalt in bituminous base & binder course construction with the following objectives.

i. To find the optimum dose of sulphur to modify VG30 bitumen
ii. Evaluation of physical properties of sulphur modified bitumen
iii. Laboratory evaluation of performance of sulphur modified asphalt mixes

30% Sulphur pellets (Relbit) has been selected as optimum dose to prepare bituminous mixes. Marshall Properties, Tensile strength ratio, Dynamic creep and Resilient modulus of modified bituminous mixes have been found and compared with conventional VG 30 asphalt mix.

Design and Compliance Verification’ of the heavy vehicle dynamic test track at VRDE (DRDO), Ahmednagar

The institute had undertaken the assignment of ‘Design and Compliance Verification’ of the heavy vehicle dynamic test track at VRDE (DRDO), Ahmednagar, sometime back. The approved design was executed in 2014 to the highest standards and the institute was also involved during the execution phase for required verifications and guidance. As a result, the track was established and is being utilised for vehicle dynamics testing purpose.

After more than two years of service of the test track, a letter of appreciation commending the institute’s inputs has been received.
Investigations and design of Cement concrete pavement for Ramnagar Sites – I and II, Varanasi

M/S U.P. State Industrial Development Corporation Ltd., Allahabad entrusted CSIR CRRI for this project with the objective to provide recommendations for design of concrete pavement. Recommendations for concrete pavement were given.
Rigid Pavement
Development of Technology for Compensating Strength Loss in Paving Concrete due to Use of Aggregate from C&D Debris

The objectives of the project are:

- To optimize the substitution level of RCA for virgin aggregate to be used in the construction of rigid pavements.
- Development of Technology for compensating strength loss in paving concrete due to use of aggregate from C&D debris.

Coarse aggregate makes up 45%-55% of total aggregates in a concrete. Therefore, the characteristics of the coarse aggregate have immense impact on the properties of fresh as well as hardened concrete. Among all the alternate sources for aggregates, the recycling of construction and demolition waste/debris has an upper hand as it is widely available. But the presence of different components results in making the recycled coarse aggregate (RCA) derived from C&D waste, inhomogeneous unlike natural aggregate. The properties of RCA are very dynamic in nature which needs its thorough evaluation before using in any project. The study comparatively evaluated RCA collected from a commercially recycling plant and the influences of the replacement of natural coarse aggregate of different size ranges namely; 4.75-10 mm and 10-25 mm and all coarse aggregate by RCA on compressive strength, flexural strength, splitting tensile strength, abrasion resistance, carbonation depth, and water absorption of concrete mixes of M30 and M40. The physical properties and chemical durability of RCA were inferior to NCA. The study on mechanical properties of concrete concluded that 50% replacement of natural aggregate in size range 10-20 mm with RCA had insignificant influence on compressive and flexural strength of concrete. However, the abrasion resistance durability of such concrete was inferior to the control concrete yet adequate for the road construction for pneumatic tyred traffic. Further, it was seen that 100% coarse aggregate may be replaced by RCA but in such case 10% ASTM Class F fly ash by mass of cement as a mineral admixture had to be added for the manufacturing of pavement quality concrete without affecting strength significantly. Such concrete could be used in the construction of plain and dowelled bar cement concrete roads besides manufacturing of concrete paver blocks and other similar products. Further, in light of higher shrinkage value of concrete, the joint spacing for initiating control cracks should be closer in roads constructed with RCA than that of NCA. RCA before and after soundness tests are shown in Fig.29.
Design and Evaluation of 3FIVE6 Cement Optimizer for Rigid Pavement

M/S Quick Pay Private Limited entrusted CSIR CRRI to design and evaluate cement optimizer for rigid pavement with following objectives.

- The main objective of the study is to design and evaluate the pavement quality concrete mixes using cement optimizer 3 FIVE 6 as partial replacement of cement through laboratory testing.
- To study the strength and durability aspect of concrete incorporating 3FIVE6

A laboratory study was conducted to evaluate the effect of using 3FIVE6 cement optimizer as cement replacement in pavement quality concrete (PQC) mixes. The properties of concrete containing 20% of 3FIVE6 were compared with those of control mix having no cement optimizer. A view of the 3FIVE6 Cement optimizer is shown in Fig.30. The properties evaluated in laboratory are workability, Strength Activity index of mortar, compressive strength, flexural strength, drying shrinkage, abrasion resistance and rapid chloride ion penetration test (RCPT).

The major conclusion drawn from the laboratory evaluation are as follows:

1. The strength activity index of 3FIVE6 at a replacement level of 20% is more than 100% at both the ages of 7 and 28 days which indicate that it is a highly pozzolanic material.

2. The workability of the concrete mixes decrease slightly with the replacement of cement with cement
optimizer 3FIVE6. However, this can be managed by use of suitable dose of superplasticizer during construction.

3. Use of 3FIVE6 as 20% replacement of cement in PQC mixes increases its compressive strength. The average increase in compressive strength of concrete mixes was observed to be 31.9%, 17.9% and 8.3% at 7, 28, and 56 days respectively.

4. Use of 3FIVE6 as 20% replacement of cement in PQC mixes also increases its flexural strength. The average increase in flexural strength of concrete mixes was observed to be 32.4%, 27.9% and 15.5% at 7, 28, and 56 days respectively.

5. The use of 3FIVE6 in PQC mixes slightly increases its drying shrinkage.

6. The abrasion resistance of the concrete containing 3Five6 was observed to be better than the concrete without it.

7. The rapid chloride ion permeability test (RCPT) values of concrete containing 3FIVE6 are very low indicating high durability.

Based on the laboratory study results, it can be concluded that 3FIVE6 cement optimizer has the potential to be used as a replacement of the cement in pavement Quality concrete mixes. However, final conclusion regarding the feasibility in pavement construction can be arrived at only after field trials and evaluating its performance under actual traffic and environmental conditions.

**Repair and Rehabilitation of Container Parking Yard at N. S. Dock, Kolkata**

The container Parking Yard at N. S. Dock, Kolkata was constructed around the year 1990. The yard consists of five bays having a total area of approximately 25000 m2. Each bay has two crane tracks 23.47 m apart for the operation of Rubber Tyre Gantry (RTG) Cranes. The area between the crane tracks is used for storing the containers. The crane tracks consist of RCC of M30 Grade whereas the area between tracks was laid with 1:2:4 (M15) concrete. The storage yards were designed for storage of containers using RTG cranes. However, for some years now, the container stacking operation is being done using Reach Stackers (RST), which are mobile cranes running on large sized tyres (Fig. 31). The dynamic load of the RST is more than the static load of containers. Also, a considerable amount of frictional and tractive forces are generated during the operation of the RSTs. Due to this the surface of the concrete paved in the yard area had been damaged and require rehabilitation (Fig. 32). Important recommendations for the rehabilitation were:

- Existing layers of 140 mm thick concrete (1:2:4) and 150 mm thick lean concrete (1:3:6) shall be removed. The existing layers of 250 mm WBM (in two layers of stone and Jhama) and 250 mm sand shall be retained.

- Fresh 290 mm (140 mm + 150 mm) thick layer of M40 Grade plain concrete shall be laid over the compacted/repaired WBM in place of removed layers of concrete. To enhance the abrasion resistance of the concrete surface, a metallic surface/floor hardener shall be used at the time of placement of concrete.

- Deformed steel tie bars, 640 mm long, 12 mm dia shall be provided at all longitudinal joints at a spacing of 750 mm.

- Plain mild steel dowel bars of 32 mm dia, 500 mm length shall be provided at a spacing of 300 mm c/c at transverse construction joints only. A construction joint is formed either at the end of the day’s work or at the location where work of laying of concrete has to be stopped because of any reason. Dowel bars shall not be provided on other saw cut transverse contraction joints.

- 40 / 50 mm thick Mastic Asphalt may be provided over the RTG crane tracks to avoid the further abrasion as well as to take care of the small depressions on their surfaces. However, the life of Mastic Asphalt should not be expected to be more than 4-5 years after which it has to be relaid.

- Partial depth patch repair with M40 concrete or epoxy-sand mortar should be undertaken for the repair of damaged corners of the tracks as was observed at few places during inspection.
Institute to explore the reasons for the cracking and suggest suitable repair methodology. During the field visits distress survey of both the sections of concrete pavement was carried out. The information regarding the type and width of the old and newly constructed road, methodology of laying Pavement Quality Concrete (PQC), specifications relating to structural design and concrete material were also collected. Few cores were also taken over the saw cuts to see the formation of joint and cracks.

Full depth repair, cross stitching of narrow and stapling of wide longitudinal cracks was suggested as repair methodology. Field investigations indicated that non-uniform support conditions under existing and widened road area along with excessive curling of wide concrete slabs laid in one single operation resulted in the longitudinal cracking. Suggestions, on the basis of field investigations, were also given to avoid such cracking in future construction of concrete highways.

**Inspection and suggestion for rectification of cracks on cement concrete road near Raipur and Bilaspur on NH-200**

Public Works Department (PWD) of Chhattisgarh State constructed cement concrete pavement near Raipur end and Bilaspur end of the Raipur – Bilaspur section of National Highway No. 200. The concrete pavement near Raipur end is a six lane divided carriageway of length 7.50 km and the pavement near Bilaspur end is a four lane divided carriageway of length 9.0 km. The concrete pavement section near Raipur was constructed in the year 2014 and the section near Bilaspur was constructed in the year 2012-13. Within a period of two to two and a half years, both the concrete pavement sections have developed longitudinal cracking (Fig. 33). Chief Engineer, National Highway Zone, PWD Raipur, requested the CSIR-Central Road Research Institute to explore the reasons for the cracking and suggest suitable repair methodology.
Design and Evaluation of Pavement Quality Concrete mixes Using Ground Granulated Blast Furnace Slag as Partial Replacement of Cement

Ground Granulated Blast Furnace Slag (GGBFS) is a fine material obtained by grinding granulated Blast furnace slag into powder form (Fig. 34). Glassy granulated slag is produced by rapid cooling or quenching in water of molten slag generated in the Blast furnace during metallurgical process of iron and steel. Granulated slag is then dried and ground into a fine powder called as GGBFS. The glass content of slag suitable for blending with Ordinary Portland Cement (OPC) generally varies between 90 and 100% and depend on the cooling method and the temperature at which cooling is performed. Higher the glass content higher is the reactivity of slag.

A laboratory study was performed for the utilization of ground granulated blast furnace slag as partial replacement of ordinary Portland cement in pavement quality concrete mixes so that it can be used for the construction of concrete roads. The lime reactivity of GGBFS was determined as 15.3 MPa (Fig. 35). A control mix was designed for M40 Grade concrete with 400 kg/m³ cement and 0.4 water-cement ratio. Mixes containing different amount of grounded slag were then proportioned replacing cement from 10 to 60 %. Samples were prepared and tested for compressive strength, flexural strength, drying shrinkage, and abrasion resistance.

Analysis of test data led to the following conclusions:

- Workability of concrete mixes do not change with the use of any amount of GGBFS. Use of suitable plasticizer can take care of the workability of the mix without changing the water requirement.
- Both short term (7 & 28 days) and long term (90 days) compressive as well as flexural strength of concrete is increased when cement is partially replaced by GGBFS up to a level of 40%. When 50 % cement is replaced by GGBFS, the strength of the concrete remains almost same.
- Abrasion resistance of M40 Grade PQC containing different amount of GGBFS was observed to be adequate enough for its use in concrete pavement construction.
- Drying shrinkage of concrete reduces with the increase in GGBFS content. Thus, concrete containing GGBFS is comparatively more suitable than conventional concrete for road construction.

The study recommended that GGBFS can be used as partial replacement of OPC up to 50 % without compromising the requirement of short term and long term strength.
Utilization of Reclaimed Asphalt Pavement Material in Dry Lean Concrete Base under Pavement Quality Concrete

With greater emphasis on the construction of long lasting durable concrete pavements, many existing asphalt pavement highways are being widened and converted into cement concrete pavements under National Highway Development Programme (NHDP) in the country. It involves the complete removal of existing bituminous layers of the pavement and thus generating huge quantity of RAP which is being thrown on road sides or in the fields on both sides in an unacceptable manner.

One such project is being executed by G R Infraprojects Ltd (GRIL) on EPC mode in the state of Punjab under NHDP-IV. The project consists of widening and strengthening of existing two lane flexible pavement to four lane rigid pavement on Harike-Zira-Faridkote Section (Km 166.925 to Km 221.380) and Faridkote-Kotapura-Bathinda Section (Km 221.380 to Km 287.615) of NH-15. The project involves extensive milling of the existing bituminous layers. A study was conducted for the utilization of the milled RAP material (Fig. 36 & 37) of the project in Dry Lean Concrete (DLC) base layer under Pavement Quality Concrete (PQC).

The following conclusions were drawn from the study:

i. The milled RAP used in the study did not fulfill the grading requirement of DLC mix. It was deficient mainly of the material passing 4.75 mm sieve, i.e. fine aggregate.

ii. Blending of 80 percent milled RAP with 20 percent fine aggregate was done to achieve the specified grading for DLC.

iii. The average bitumen content of the milled RAP material was 4.18 percent

iv. DLC mixes with milled RAP can be designed with maximum aggregate-cement ratio of 12:1 to achieve the specified strength of 7MPa at 7 days.
Self-Healing Technology of Bituminous Pavements with Induction Energy

The main objective is to develop a self-healing technology for flexible pavements where bituminous materials enable a system to self-heal after initiation of cracks by using induction heating technology.

The bituminous material is a self-healing material. When it is subjected to a rest period, bituminous material has the potential to restore its stiffness and strength by closing the micro cracks that occur when the pavement is subjected to traffic loads. It requires adequate amount of rest time to undergo the complete process which is insufficient. To enhance the property of self-healing of the flexible pavements, a number of approaches for self-healing techniques are under research stage. Inductive heating is the most progressive self-healing technology for bitumen pavements reported, till date.

The induction process operates by sending an alternating current (AC) through the coil and generating an alternating electromagnetic field. When the conductive bitumen specimen is placed under the coil, the electromagnetic field induces currents flowing along the conductive loops formed by the steel fibers. It generates heat and bitumen viscous property reduces and micro cracks are refilled with binder making once again a homogeneous material.

The present stage of research is at stage of mix design i.e. preparation of steel fiber modified bituminous mixes. The mix design procedure adopted for this is Marshall Mix design as shown in Fig. 38 to 43.
Physical properties of aggregate and bitumen were determined by conducting the required tests. The bitumen content for each percentage of steel fiber is optimized by using Marshall Mix design. The dosage of steel fibers will be optimized using the induction machine in the next step, further study is in progress.

**Water Harvesting using Porous Flexible Pavements**

The objectives of this research project are

- Developing porous bituminous mix for flexible pavements and pavement design methodology for porous flexible pavement according to Indian conditions
- Design of complete mechanism and guidelines for rainwater harvesting recharging of groundwater table

The overall work plan adopted for the study has been divided into two modules based on the in house capability.

- Module one consists of methodology for developing the optimum porous bituminous mix and guidelines as final pavement design for porous flexible pavements as per the Indian conditions.
- Module two consists of developing a complete mechanism for rainwater harvesting system using porous flexible pavements, construction of test track using developed mix, analysis of results and benefit cost analysis for the developed pavements.

Physical properties of aggregate and bitumen were determined by conducting the required tests. By studying four internationally followed gradations for porous pavements, a porous bituminous mix for Indian standards will be developed. A detailed research will be conducted to understand porous system’s critical design and construction considerations, potential challenges and limited applications.

**Guidelines for the Use of Geo-Cells in Flexible Pavements**

Department of Science and Technology entrusted CSIR- CRRI to prepare the guidelines for the use of Geo cells in flexible pavements with following objectives

1. Assessment of Pavement Surface Condition (types, extent and severity of distress, pavement surface roughness and rut depth)
2. Deflection studies using Falling Weight Deflectometer (FWD) and Benkelman Beam Deflection Method
3. Traffic volume and axle load surveys
4. Characterisation of materials / mixes used for construction of the study section

The study on “Guidelines for the Use of Geo-Cells in Flexible Pavements” has been undertaken by CRRI as a collaborative project with Indian Institute of Science, Bangalore and Karnataka Rural Road Development Authority (KRRDA), Bangalore. The project is sanctioned by Department of Science and Technology. The primary objective of the CRRI element of the study is Periodic Performance Monitoring of Experimental Sections laid with
different specifications, using geo-cells, roadmesh, geogrid and bamboo as reinforcement. The project road is a single lane road from Gudumadanahalli to T-02 Road in Chamundeshwari Constituency, Mysore with the length of 4.285 km. KRRDA completed the construction of the experimental road sections during June-July 2014 shown in following Fig. 44 to 47.

A Report entitled “Guidelines for the Use of Geo-Cells in Flexible Pavements Performance Observation on Experimental Sections was submitted to IISc, Bangalore in June 2016.

**PCN Evaluation of Various Runway Pavements at Hindon Air Force Station, Hindon**

This project was awarded to the Institute by Central Public Works Department, Hindon Project Division, Hindon Air force Station, Ghaziabad. Airport pavements at airfield station, Hindon consist of one main runway, two taxi tracks, several dispersal areas and taxi links.

The broad objective of the project was to determine the safe load carrying capacity of different sections of the existing runway in terms of Pavement Classification Number (PCN) for their suitability for the safety of anticipated / proposed aircraft during the landing and take-off operations.

The structural evaluation of the study area was undertaken using Heavy Weight Deflectometer (HWD) shown in Fig.48 and the data was analysed for the determination of PCN values for different airfield pavements.
A Report entitled “PCN Evaluation of Various Runway Pavements at Hindon Air Force Station, Hindon” was submitted to CPWD in July 2016.

**Design of 60 M Wide Peripheral Roads along Sector Ecotech- 10, Greater Noida**

M/S Greater Noida Industrial Development Authority entrusted CSIR CRRI to design peripheral roads in Greater Noida.

The objective of the study is to suggest the design of crust thickness for construction of 60m wide peripheral flexible pavement roads along Sector Ecotech -10, Greater Noida. (Fig. 49)

To assess the properties of soil available along the alignment of project roads soil samples were collected from the existing ground upto a depth of 0.5m. Apart from this traffic volume and axle load surveys were also conducted at nearby road sites to assess the design traffic.

Pavement design for project roads has been done for both VG-40 and VG-30 bitumen using IIT PAVE Software as per IRC:37-2012 guidelines.
Investigation for Feasibility of Reducing the Existing Road Level of Rajpath with Suggested Improvements

Central public works department has given this project to investigate feasibility of reducing the existing road level of Rajpath. The broad objectives of the project was to determine the possibility of lowering down the existing level of carriageway of Rajpath by milling process and a suitable possible adoption to re-use of reclaimed bituminous material obtained from existing bituminous pavement of Rajpath study stretch which could be an alternative rehabilitation to achieve the structural strength at the requisite elevation level.

Assessment of existing project roads were done for its structural and functional soundness using state of art equipment viz. Automated Road Survey System, Falling Weight Deflectometer and Ground Penetrating Radar (Fig. 50). Based on the analysis of data, the recommendations for reduction in level of Rajpath through milling and needed rehabilitation measures have been suggested and the report was submitted to CPWD in Aug 2016.
Improvement/Widening to two laning with paved shoulder of Udaipur- Sabroom Section from Km 55.00 to Km 128.712 of NH-44, Tripura under SARDP-NE Phase 'A' - Cementitious Sub-base and Base-course

National Highways and Infrastructure Development Corporation Limited (NHIDCL) has entrusted CSIR CRRI this project with following objectives.

- Review of the pavement design proposed for sub-base, base layers (with foam bitumen) and BC layer in light of IRC - 37-2012, IRC-SP: 89-2010, Ministries specification for Road & Bridge works and any other codal provisions with opinion towards adoption and implementation of new technology for base layer (RAP treated).
- Examination and recommendation for the use of crushed brick / brick bats in cementitious sub-base as per code of practices.

The field observations and recommendations based on the field investigations as well as laboratory investigations carried out at site (Fig.51) as well as at CRRI laboratory concluded that the brick aggregates produced at site from Jhama bricks meet the requirements as stipulated in IRC codes and are suitable for use in sub-base layer. The composition of brick as proposed i.e., 56.5 % aggregate; 40% sand and 3.5 % cement meets the minimum specified requirements as per IRC;37-2012.

The laboratory testing work related to emulsion/form bitumen bound sub base course is in progress and the final report is under preparation.
Intelligent Remote Health Monitoring (IRHM) for Bridge System

Department of Science and Technology has sponsored this project.

The performance criteria / levels of the bridges and assessment of damage states helps in assessing parameters for damage detection towards structural health assessment of bridges. Also, by studying the changes in measured structural vibration, the unknown changes of structural properties can be identified. The potential benefits of Structural Health Monitoring (SHM) as part of bridge management approach are timely maintenance, improved durability, extended service life and improved accuracy of deterioration models for better prediction of future conditions.

Toward this aim, the first study aims to investigate the effect of liquefaction during earthquake on bridges founded in the soft alluvium has been carried out. A two span box girder bridge has been analysed located in Yamuna river planes. The bridge foundation soil strata have layers of fine sand to sandy silt deposits. The capacity and vulnerability of the bridge under normal soil and liquefied conditions have been studied. Fragility curves have been developed to assess the seismic performance of the bridge. The bridge pier along with piles as part of the typical urban bridge for PGA of 0.24 g as studied is shown in Fig.52.

As the soil liquefies, pile loses its soil confinement thus the slenderness of the pile increases. The soil liquefaction may results in settlement and if the site is on a sloppy ground, soil may also spread. The spreading soil may exert a lateral thrust on the piles and may induce buckling thus making the piles unstable. The demand capacity curves for the two soil conditions have been assessed. From the demand capacity curves it is observed that as the soil liquefies the capacity shows a decreasing trend while the demand shows an increasing trend. The hinge formation location in a pier-pile system under different soil conditions have been shown in Fig. 53. The hinges are formed at the bottom of the pier and at the top of the pile when the soil confinement is full.

![Fig. 52: Pier in elevation](image)

![Fig. 53: Hinge formation patterns under (a) Non-liquefied condition (b) Lateral soil spread condition](image)
From the fragility curves, discrete vulnerability curves for PGA of 0.24 g have been derived and changes in discrete probabilities of four damage states have been shown in Fig.54. From these curves it is observed that at same levels of spectral displacement the structure may undergo higher damage when liquefaction occurs. From these fragility curves we observe that under design earthquake of 0.24 PGA, the mono-pier is safe but when soil liquefies especially in case of soil spread, the deflection is excessive and has 32% probability of occurrence of slight damage that it may experience spalling of cover to reinforcement, some cracking on the surface. Liquefaction has also increased the probability of severe damage up to 4% i.e. the bridge may be rendered failed as the bridge structure experiences substantial loss of strength.

In the present study, the assessment of effect of liquefaction on a mono-pier with a group of piles has been successfully achieved. This study will help to ensure the performance criteria / levels of the bridges and assessment of damage states / parameters for damage detection towards structural health assessment of bridges.

Further, in the second study, structural health monitoring technique has been adopted to develop a correlation between damaged and undamaged beams by determining frequency of vibration and mode shapes using modal analysis. In this study, a steel beam specimen was excited to measure the vibration responses so as to achieve the resonant frequencies and mode shapes of that structure. The test specimen was induced with five damaged cases and compared it with undamaged cases in order to assess the changes in vibration parameters leading to health assessment of the structure and damage detection.

A steel I beam is considered as a test specimen with the overall dimension of 125 mm x 60mm x 4mm as shown in Fig.55. The specimen is simply supported with a 2 m span. The self-weight of specimen is 63.765 N/m.

Fig. 55 : Details of beam

Fig. 54 : Change in Damage states due to liquefaction under PGA of 0.24 g
In this study, the modal analysis is carried out by using enhanced frequency domain decomposition in frequency domain algorithm. The Enhanced Frequency Domain Decomposition (EFDD) technique is an extension to the Frequency Domain Decomposition (FDD) technique. The experiment was conducted on simply supported beam and modal parameters were obtained from observed time histories of the acceleration records and analysis were carried out using Fast Fourier Transform (FFT) and Artemis software.

To study the influence of damage on modal response, the following damage cases in the beam were introduced.

1. **Case 1** - A slit at one by third of the span (L/3) from support A with a depth of one by third of the beam depth (D/3).
2. **Case 2** – An additional slit on the beam at one by third of the span (L/3) from support B with the same slit depth as in case 1.
3. **Case 3** - Increasing the slit depths in case 2 to half of the beam depth (D/2).
4. **Case 4** - An additional slit on the beam, mentioned in case 3, at the mid-span with a slit depth of one by third of the beam depth (D/3).
5. **Case 5** - Increasing the mid-span slit depth in case 4 to half of the beam depth.

The occurrence of damage in structural members causes changes in the vibration parameters of the structure. The intensity of damage is evaluated by chi-square test using distribution techniques on modal parameters recorded in the test of the listed undamaged and damaged cases. A chi-squared test, also referred to as $x^2$ test, is any statistical hypothesis test in which the sampling distribution of the test statistic is a chi-square distribution when the null hypothesis is true. Chi-squared tests are often constructed from a sum of squared errors, or through the sample variance. The Fig.56 shows the intensities of the damage level when the Chi-squared value exceeds the threshold shown as a yellow horizontal line. In Fig. 5, the green bars (R1 to R5) are five reference samples of undamaged cases and the red bars (C1 to C5) are the five damaged cases induced in the specimen. The yellow (lower) and red (upper) lines parallel to the x axis are the significance levels obtained by the chi-square test iteration. The damage can be expected when the red or upper threshold line is crossed.
From the Fig. 46, it is clear that the five damage states have been successfully inferred based on the modal parameters. It may be noted that the influence of the damage (location and depth of the crack) is directly proportional to the intensity of the damage and the same has been observed in results for damage cases. The intensity or severity of the fifth damage case (C5) can be seen here which is seven times larger than the first damage case (C1) showing successful detection of damage sensitivity in the presented study. From the above findings, it can be concluded that the structural health monitoring by adopting modal analysis is the reliable method to evaluate the real behavior of structures and damage detection.

Security Audit regarding the Structural Stability of Existing Flyovers and Bridges in New Town, Kolkata

Preliminary visual inspection of the five existing flyovers and bridges namely; 1) Kestopur Canal Bridge / NBCC Flyover, 2) CBD / Axis Mall Flyover, 3) DLF Flyover / Bogjola Canal Bridge, 4) Haldiram Flyover, and 5) Jatra Gachi Flyover, was carried out in New Town, Kolkata. General views of the above flyovers / Bridges are shown in Fig.57. These Flyovers/Bridges fall under the jurisdiction of West Bengal Housing Infrastructure Development Corporation Limited (WB HIDCO Ltd), New Town, Kolkata. Out of the five structures, four are relatively new as compared the Kestopur Canal Bridge / NBCC Flyover, which is about 15 years old. The three structures namely; Kestopur Canal Bridge/ NBCC Flyover, CBD/Axis Mall Flyover, and DLF Flyover / Bogjola Canal Bridge have 3-Lane Dual Carriageways. Settlement of Approach Slab and bulging of extreme faces of RE walls have been the main concerns as shown in Fig.58, other than the deterioration in the form of cracks in the Kestopur Canal Bridge / NBCC Flyover.

Fig. 57 : General view of Flyovers and Bridges
On the basis of the Preliminary Visual inspection, it was decided to carry out detailed field studies for the four flyovers and bridges except the Jatra Gachi Flyover. Detailed field studies were under taken to find out the causes of settlement of Approach Slab, bulging of RE walls and occurrence of cracks in the structure using Non-destructive Testing including Static Load Test as per the IRC Standards. Static Load Test was carried out to assess the structural behavior of the superstructure under the superimposed Live Loads. Based on the findings of the field studies, appropriate scheme(s) for rehabilitation are being suggested.

Detailed investigations of the above four existing flyovers and bridges were carried out in two phases. In the first phase of investigations, following activities were involved i) Visual Inspection, ii) Non-Destructive Testing of the structures using Rebound Hammer, Ultrasonic Pulse Velocity and Cover meter techniques to estimate in-situ compressive strength, homogeneity and cover of concrete, iii) Subsoil investigations to know the probable causes for settlement. In the Phase-2 of investigations, Static Load Test on one Carriageway of the 3-Lane Dual Carriageways of above three Flyovers and Bridges except the Haldiram Flyover was carried out. Typical view of NDT and Static Load Test are shown in Fig. 59 and Fig. 60 respectively. Prospective View Axis Mall Flyover in RM Bridge V10 and Axis Mall Flyover Theoretical Deflection of the Span Under Design Loads in RM Bridge V10 are shown in Fig. 61 and Fig. 62 respectively.
(a) Marking of Measurements Points for NDT on the Soffit Slab of CBD/Axis Mall Flyover

(b) Rebound Hammer Measurements

(c) UPV Measurements

Fig. 59 : NDT under Progress

(a) Instrumentation for Deflection Measurement

(b) IRC Class A -3 Lane Equivalent Vehicular Load Placed on the Span Under Consideration

Fig. 60 : Static Load Test under Progress
Fig. 61: Prospective View Axis Mall Flyover in RM Bridge V10

Fig. 62: Axis Mall Flyover Theoretical Deflection of the Span Under Design Loads in RM Bridge V10
Collection and Analysis of Bridge Condition & Inventory Data by MBIU for the Purpose of the Major/Minor Bridges on all NHs in Jharkhand State

Ministry of Road Transport and Highways (MoRTH) had entrusted the work of inventory and Condition Survey of Bridges on National Highways in India to various Bridge Engineering consultants. The entire country has been divided into 18 zones and Consultants have been appointed for each zone for the subject work through Open Tendering for a period of three years. Out of which, Zone No. 8 for Jharkhand State was awarded to the Joint Venture consortium of M/S Intercontinental Consultants and Technocrats (P) Ltd., New Delhi, and CSIR-Central Road Research Institute, New Delhi. Field inspection and Inventorization has been continuing since 11th December, 2015. During the year 2016-17, inventorization of all the major and minor bridges as well as taking of two sets of condition survey measurements of all the bridges on NH in Jharkhand State have been carried out during “pre-monsoon” and “post-monsoon” periods utilizing Mobile Bridge Inspection Unit (MBIU).

There are a total of 597 nos. of existing bridges on National Highways in the State of Jharkhand. Out of which, 25 nos. are Extra-long bridges, 58 nos. are major bridges, 487 nos. are minor bridges and 27 nos. are ROBs. Besides, there are 27 nos. of level crossings wherein at 7 level crossing sites; construction of ROBs is under progress. It is also observed that there are 3249 Nos. of existing culverts on National Highways in the State of Jharkhand. Out of which, 2280 Nos. are slab culverts, 296 Nos. are box culverts, 653 Nos. are Hume pipe culverts and 20 Nos. are arch culverts. During Condition Survey, the bridges found in distressed condition were reported to the MORTH for taking remedial measures for adopting appropriate rehabilitation schemes. Some of the bridges located on NH in the state of Jharkhand, whose Condition Survey has been carried out are shown in Fig. 63-67.

![Fig. 63: Inspection of PSC Girder Bridge using MBIU on NH in Jharkhand State](image1)

![Fig. 65: Inspection of Arch Bridge using MBIU on NH in Jharkhand State](image2)

![Fig. 64: Inspection of bridge using MBIU on NH in Jharkhand State](image3)
Project Monitoring And Quality Assurance of Construction of Three Lane Grade Separator (With Approach Road) on NH-58 Located at Meerut Tiraha, Ghaziabad

The project has been sponsored by Ghaziabad Development Authority. Meerut Tiraha Grade Separator is located on NH-58. The Grade Separator starts near the Mayamaya Stadium located towards the Ghaziabad End and ends near the Hindon River Bridge located towards the Delhi End. The Nomenclature for Abutment / Pier Arrangement is given accordingly. It has a total length of 400,000 m, out of which the viaduct portion is of 259,000 m length and the Approach Roads having the Reinforced Earth (R.E.) and Retaining Wall portion towards Delhi End has a length of 130 m whereas on Ghaziabad End, the length of Reinforced Earth (R.E.) and Retaining Wall portion 106 m. The Span (c/c of Expansion Joint) arrangement is as follows.

A1 (Mahamaya Stadium End located towards the Ghaziabad) – P1 – P2 – P3 – P4 – P5 – P6 – P7 – A2 (Hindon River Bridge located towards the Delhi End)

Span A1 – P1: 31.250 m, P1 - P2: 31.300 m, P2 – P3: 31.300 m; P3 – P4: 31.300 m, P4 – P5: 40.000 m, P5 – P6: 31.300 m, P6 – P7: 31.300 m, P7 – A2: 31.250 m

Superstructure of the Span P4 – P5 is of Cast In-Situ Single Cell Box Girder Configuration whereas Superstructures of the other Spans is of Pre-Cast PSC Girders and Cast In-Situ Deck Slab Type Configuration. All the spans are simply supported spans having POT cum PTFE Type Bearings.

Scope of Work:
- Project Monitoring of 3 Lane Grade Separator during its construction
- Checking of Quality of various ingredients of construction materials such as concrete, approaches to the bridge etc. and conducting necessary tests on these materials at CRRI Laboratory / site.
- Checking of Steel Reinforcement Detailing before Concreting both in Substructure as well as Superstructure.
- Verifying the Concrete Mix Design provided by GDA
- Assessing the Workability of Green Concrete
- Assessing the in-situ compressive strength of concrete
- Assessing the quality and uniformity of concrete
- Assessing the quality of construction for durability of the structure.
- Supervision of the construction activities
- Assisting the contractor to set up laboratory at site for testing of construction materials
- Submission of Monthly Progress Reports

During the year, the entire structure portion and the approach road portion towards the Mahamaya Stadium including crash barriers and road got constructed (Fig. 68). Construction of the approach road portion towards the Delhi end could not be started due to pending environment and tree cutting permission.
Fig. 68: View of Construction Site
Traffic Engineering and Safety
Development of Indian Highway Capacity Manual (INDO - HCM)

The main hypothesis behind conceiving the above titled project is that Indian traffic characteristics are fundamentally different from those witnessed in the developed countries coupled with the drivers behaviour which is vastly different from even the developing economies like China and Indonesia. Consequently, the project on development of Indian Highway Capacity Manual (Indo-HCM) had been undertaken on priority in the form of a mission mode project by considering the various categories of Indian roads like Expressways, National Highways (NHs), State Highways (SHs), Major District Roads (MDRs), Other District Roads (ODRs) and Urban Roads (UR) separately. The principal goal of this research envisages to study the nationwide characteristics of road traffic and to develop a manual for determining the capacity and Level of Service (LoS) for varying types of inter-urban roads and urban roads separately by including controlled intersections i.e. signals and roundabouts and uncontrolled intersections coupled with addressing the capacity of various forms of pedestrian facilities existing on the relevant type of roads. To accomplish the stated goal, the study aims at analyzing the characteristics of the heterogeneous traffic, flow as shown in Photo given below, to identify appropriate distributions of various variables influencing the traffic stream characteristics by examining the traffic flow characteristics through extensive field data collection and analysis.

The study was undertaken by CSIR - CRRI at the National level under sponsorship from CSIR, to develop the Indian Highway Capacity Manual (henceforth referred to as ‘Indo-HCM’). Indo-HCM is being executed by CSIR - CRRI in coordination with some of the reputed academic institutions in the country which include, Indian Institute of Technology (Roorkee), Indian Institute of Technology (Bombay); Indian Institute of Technology (Guwahati); School of Planning and Architecture (Delhi); Sardar Vallabhai Patel National Institute of Technology. (Surat); Indian Institute of Engineering & Science University (IIEST), Shibpur- (Howrah); and Anna University (Chennai). The research endeavour elaborates on study methodology for capacity estimation, Level of Service (LoS) and the associated study deliverables of varying types of Indian road facility.

The manual Covers uninterrupted flows on Single, intermediate and two lane roads interrupted flows on urban roads, signalized intersections, roundabouts and unsignalized intersections as specific areas: pedestrian facility, and reliability of road network. The manual developed will serve as a practical tool for the practicing engineers and planners to mitigate the traffic and infrastructure problems. This is a maiden attempt made in India for the first time which is very much useful to the practicing engineers and decision makers and would serve as a basic guide towards capacity augmentation of various facilities in India.

It is pertinent to mention that capacity values recommended by Indian Roads Congress (IRC) have become obsolete. Reflecting the Indian realities, Indian Capacity Highway Manual lays down the guidelines for when and how to expand or manage all types of roads. The analysis and methods given in the manual can be used for better road planning covering a gamut of roads from single-lane, two-lane, multi-lane roads to inter-urban highways, expressways. The manual also sets norms for managing intersections and roundabouts with corresponding impact on pedestrian facilities.

Typical Heterogeneous Traffic Flow Conditions on Indian Roads

Devising Novel Method in Driver Testing and Certification

The objectives of the project are

- Screening of driving related Sensorimotor/ psycho-physical traits among all categories of drivers for enhancing road safety in India.
Development of comprehensive testing framework for driver testing and licensing.

162 drivers serving in the Special Protection Group (SPG) of the Government of India have been administered battery of Porto clinic Visual Tests which included host of tests namely, Visual Acuity, Night Vision, Glare Tolerance Capacity, Colour Vision, Depth Perception, Phoria and Horizontal Field Test shown in Fig. 69. These tests have been done for left, right eyes separately as well as both eyes together. Those subjects, who could not pass even one of the above-mentioned tests, were subjected to a retest after they undergone medical tests with their respective medical practitioners and wearing appropriate spectacles. The successful subjects who passed all the above tests were further administered Reaction Time and Decision Time (RTDT) test through Vienna Test System followed by testing of their driving skills in the Car Driving Simulator which is basically under controlled environs. The above data has been compiled, analysis work is on progress. The endeavor of the team is to incorporate the findings emerging from the above tests for the testing, licensing and evaluation of driving licensing process in India.

Driver Decision Modelling for safety Evaluation at the onset of Yellow light Transition

The broad objectives of the project are

- Defining Dilemma zone, its various conflict points and Modelling Driver decision making
- Reshaping Dilemma zone as a Cost-Benefit problem

In the first stage of work, work done by the various researchers in the first five decades will be studied thoroughly in the context of dilemma zone (DZ) conflicts at signalized intersection. Six tasks will be conducted to fulfill the study objectives:

1. Literature review: study of influencing parameter in Indian context at signalized intersection
2. Experimental design frame work: Flow chart of working methodology
3. Onsite data collection through video graphic survey
4. Data analysis and study of human learning technique
5. Surrogate measure to minimize the conflicts
6. Cost - Benefit analysis of conflicts and delay caused due to indecisiveness of the drivers

Five signalized intersections are chosen in the city of Delhi based on different traffic and intersection characteristics as shown in Fig.70.
The present study will use traffic conflict technique for assessing the safety benefits of potential conflicts and estimates the cost of clearing a vehicle through its dilemma hazard zone by calculating the amount of delay incurred by the queue formed on the stopped phases. After calculating the benefits obtained for clearing vehicles trapped in dilemma zone and cost of delay for opposing movements, the break-even point can be determined. The technique evaluates the trade-offs between safety and efficiency for efficient and safe operation at high-speed intersections. As the driver as well as NMT users are potentially vulnerable and subjected to hazards while entering the DZ, this study will be helpful to identify the dilemma zone and help drivers to take required steps to avoid conflicts. Another benefit of using an economic perspective is the transparency available to field practitioners in trading-off the costs and benefits. Moreover, this study is expected to be a useful surrogate measure for dilemma zone protection systems as well as for the determination of optimal clearance time at the signalized intersections.

**Design Stage Road Safety Audit of Sambalpur - Rourkela Section of State Highway - 10 (SH-10) from Km 4/900 to Km 167/900**

Odisha Works Department entrusted CSIR CRRI for Road Safety Audit. To review the design drawings for any deficiencies in the entire stretch and to suggest the best possible corrective measures based on the feasibility of implementation on the ground in discussion with stakeholders.

The main aim of the road infrastructure development is to provide seamless travel with safety. At the same time, it is very much necessary to ensure sure that the developed facilities are safe in operation. The Odisha Public Works Department (OWD), Government of Odisha, has subjected one of their State Highways (SHs) namely, SH-10 connecting Sambalpur with Rourkela to the process of Road Safety Audit (RSA). The project corridor taken up for the Road Safety Audit starts at Km. 4/900 at the outskirts of Sambalpur and ends at the urban fringes at Rourkela at Km. 167/900 spanning 163 Km. The existing SH-10 is a two-lane bi-directional carriageway with 2.5 m wide earthen shoulders on either side which was selected for widening to four lane divided carriageway with 1.5 m paved shoulders by adopting the principle of Design - Build - Finance - Operate (DBFO) model by the OWD. Considering the present and future demand on this state highway, OWD is developing this road by providing bypasses at selected locations to bypass some major townships coupled with effecting improvements to road geometrics and intersections throughout the section. For project execution under the above model, OWD had appointed M/S Larsen and Toubro Sambalpur Rourkela Tollway Limited (L & T - SRDL) as the Concessionaire and M/S Aarvee Associates, Hyderabad was subsequently appointed as the Independent Engineer (IE).
Thereafter, CSIR-Central Road Research Institute (CRRI), New Delhi was nominated as the Safety Consultant for the conduct of Road Safety Audit (RSA) on the project corridor by OWD which encompasses the conduct of RSA at the Design / Development Stage coupled with the RSA visit at periodic intervals during the construction phase of the project till the conduct of Pre-Opening RSA. The objective was to ensure that the project corridor is developed by the concessionaire conforming to the safety standards prescribed in the Indian Roads Congress document IRC: SP-88 (2010) titled, “Manual on Road Safety Audit” and other International practices, wherever required. The scope of the current project encompasses the chainage-wise findings of the Design Stage Road Safety Audit conducted by CSIR - CRRI covering RSA of the plan and profile drawings of the mid block sections as well as major intersections including cross sectional drawings of the above and analysis of super elevation data supplied by the concessionaire to check for its adequacy based on the Design Speed. (Fig.-71)
Road Safety Audit of 23.55 Km Stretch of Ten Lane Divided Eastern Express Highway, Mumbai

PWD Maharashtra entrusted CSIR CRRI for Road Safety audit at Eastern Express Highway.

The broad objectives are

- To conduct the Road Safety Audit of the 23.55 km stretch of Eastern Express Highway starting at Sion i.e. Km 584/750 and ending at Thane i.e. 561/200 which is a 10 lane divided Urban Carriageway.
- To propose appropriate improvement measures on Project Corridor and its adjoining Service Roads aimed at enhancing road safety.

Maharashtra Public Works Department sponsored the study to CSIR-CRRI to conduct the Road Safety Audit (RSA) aimed at mitigating the rising road crashes on the expressway as well as for suggesting appropriate improvement to the expressway. CSIR-CRRI study team visited the site in the month of September 2015 and March 2016 and subsequently conducted the traffic studies and Road Safety Audit on Eastern Expressway. Through exhaustive traffic surveys and collection of road crash data from various police stations, the existing deficiencies on the study stretch were identified and supplemented the RSA findings. Based on them, necessary improvements to the road corridor have been suggested.

Evaluation of Special Protection Groups of Drivers

Special Protection Group, Cabinet Secretariat has given this project for Drivers’ testing. The objective was to evaluate SPG drivers for Psycho-physical traits for selection and safety.

Seventy-three drivers from Special Protection Group were administered different psychomotor ability test i.e. Car driving simulation test, action judgment test, and simple and complex reaction time test, depth perception test (judgment of height, distance and width), night vision and glare test, visual acuity test, driver behavior rating scale (field testing) as shown in Fig. 72. Three drivers were tested every day.

Following Test Data were analyzed

i. Driving Simulation test: In this test 56.16% drivers performed as “Very Good”, 41.10 % driver performed “Good”, and 2.74 % are “Reasonably Good”.

ii. Reactive capacity (complex reaction time) Test: In this test 19.8% drivers performed as “Very Good”, 48.40% as “Good” and 32.42% as “Reasonably Good” none of the driver performed excellent or outstanding which shows that the present sample was having “Good” safety related performance.
Sensorimotor Coordination Test: This test measures psychomotor functions: precision of motion control, coordination of several limbs, movement orientation time, speed of arm movements speed control, dexterity of the hands and figures, postures consistency of arm and hands etc. The data reveal that only 5.15% drivers were performed “very good” followed by 88.04 % “Good” and 6.81 % “Reasonably Good.

iii. Driver Behavior Rating Scale: This test has been developed by CSIR-CRRI for measuring driver’s attitude on the road side infrastructure, pedestrian, road signs and signals, lane discipline and road marking. In the present sample 56.20 % drivers performed “Very good”, 41.06 % drivers performed “Good”, 2.74 % drivers performed “reasonably Good”.

iv. Hand Grip test: This test measures hand grip strength of drivers, this test is important because it helps to predict the driver grip strength on the steering maneuvering movements. The date reveals that majority of the drivers 42.37 % have performed “Very Good”, 26.03 performed “Good”.

Compulsory tests are as follows.

i. Glare Recovery test: This test measures how quickly the drivers comes out of the glare effect caused by the head lights of oncoming vehicles. In the present sample 48.31% “Outstanding”, 15.07% “Excellent” and 36.62 “Good”.

ii. Night vision test: This test measures driver’s ability to see accurately in darkness. In the present test 4.11% drivers performed “outstanding”, 26.02% “Excellent”, 68.50% “Very Good” and 1.37% “Good”.

iii. Road sign test: In this test 15.40 % performed “Outstanding”, 51.50% performed “Excellent”, and 33.10% performed “Very Good”), which shows that drivers must improve in the awareness regarding road signs and road rules.

iv. Visual Acuity Test: In this test, all drivers had normal eyes sight (6/6).
Transportation Planning
Development and Application of Technologies for Sustainable Transportation (SUSTRANS)

12th Five Year Plan project SUSTRANS has been funded by Planning Commission.

The objectives of the study are formulated under two modules:

Transportation Module

- Design Guidelines to develop Sustainable Integrated Public Transportation System and Sustainable NMT System
- Design and Development of Indigenous Car Driving Simulator

Road Module

- Design Guidelines to develop Sustainable Roads through innovative technologies for utilization of waste and marginal materials, improved design methods and materials / mixes, designs to reduce pavement thickness and long lasting pavements

WP-1: Quality Enhancement of Public Transport System

The work carried out in this work package includes:

- Identification of quality parameters of for different PT systems (Table 2)
- Designing a process to enhance the quality of PT systems in terms of frequency, comfort, safety, restructuring routes, time scheduling using optimization techniques etc.
- Development of quality management plan aiming for sustainable PT system

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<tr>
<td>II</td>
<td>Cleanliness Of buses, Functionality of Electrical Equipment's (Fan/Light), Bus Fare, Facilities for disabled People, Periodicity of Ticket Inspection, Bus Helpline Information, Behaviour of Bus Conductor, Seat Priority For Senior Citizen and Handicapped People, Bus Stopping at exact Bus Stop Location</td>
<td>Availability of Seats at Station, Information Dissemination at Station, Timely Information Announcement and display at Station, Periodicity of Ticket Inspection</td>
</tr>
<tr>
<td>III</td>
<td>Cleanliness of Bus stop, Complete Stopping at every bus Stop, Metro Feeder Services</td>
<td>Functionality of Electrical Equipment's (Fan/Light), Railway Fare, Luggage Facilities On Board</td>
</tr>
<tr>
<td>IV</td>
<td>Personal Safety On Board, Personal Safety at Bus Stop, Bus stop Maintenance, Comfort During Travel, Regularity of buses, Parking Facilities, Information dissemination at bus stop, Information dissemination On Board, Availability of Schedule/Map at Bus Stop, Complaint Registration Facilities,</td>
<td>Cleanliness of Toilet Facilities on Train/Station, Crowding On Board, Comfort On Board, Frequency of Train, Regularity of Train, Parking Facilities, Facilities for Disabled Persons, Complaint Registration Facilities</td>
</tr>
</tbody>
</table>

Note: *Quadrant-1 (High expectation and low performance), Quadrant II Maintenance achievement (High expectation and high performance), Quadrant III, Excessive (High performance low expectation), and Quadrant IV Low priority (Low expectation and low performance);
WP-2: Feeder Transport System and Parking Facilities at Public Transport Terminals

The work carried out in this work package are:

- Design of feeder routes using optimization techniques which improves ridership of PT system (Table 3)
- Evaluation of various possibilities of different modes as feeder systems for PT
- Design of advanced parking facilities for different vehicles including NMT at PT terminals encouraging PT trips

It was observed from the study that access and egress trip for covering 20% distance of total journey, commuters have to spend 42% of their journey time and 52% of total cost. The average time spent and cost incurred in the first and last mile reflect the quality and availability of feeder services. The steps to design optimal feeder network which improves ridership of PT system:

<table>
<thead>
<tr>
<th>Journey Sections</th>
<th>Journey Distance (in km)</th>
<th>Journey Time (in min)</th>
<th>Journey Cost (in Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin to metro</td>
<td>1.8</td>
<td>10.3</td>
<td>9.60</td>
</tr>
<tr>
<td>In metro</td>
<td>12.5</td>
<td>27.4</td>
<td>16.40</td>
</tr>
<tr>
<td>Metro to destination</td>
<td>1.4</td>
<td>9.5</td>
<td>8.30</td>
</tr>
<tr>
<td>Total Journey</td>
<td>15.7</td>
<td>47.2</td>
<td>34.30</td>
</tr>
</tbody>
</table>

- Locate the feeder network to the metro station covering the attraction point situated in the area, where large assessment of the commuters are available.
- Consider the plan of the existing roads to adjudge the movement of the feeder bus to attract large numbers of commuters to use the system.
- Estimate the number of feeder service (Minibus or Share Auto) required for each route taking in to consideration the frequency of the Mass rapid transit per hour and the loading to be catered by the system.
- Appraise the necessity of Integrated Transport System with regard to the willingness of commuters in the area.
- Calculate the Travel time of Feeder Bus, evaluate the occupancy of Public Transport Trip.
- Study the requirement of separate Feeder bus with par to Public Transport service currently operating.

WP-3: Advanced Public Transport Information Systems using ITS Technologies

The following work has been carried out in this work package:

- Design of advanced public transport information systems (APTIS) using ITS technologies
- Development of Intelligent Integrated Dynamic Information System for PT
- Development of policy guidelines for implementation of APTIS

Experts were asked to rank potential technologies for solving or mitigating an issue on the parameters of overall effectiveness of solution and practical
difficulties to implement in India. Study was made to provide guidance for transit agencies and their partners for selecting feasible ITS technology. Analysis results of technologies for various issues are shown in Table 4. Based on expert opinion survey, the assessment of technologies use for reducing fuel consumption and environment cost is that the Transit Signal Priority may give better result in reducing fuel consumption and environment cost on the background of overall efficiency and overall practical efficiency for Indian conditions while fleet management and monitoring can be most practically feasible solution for Indian condition.

### Table 4: Effective solution and practical feasibility for different objectives of Transportation

<table>
<thead>
<tr>
<th>Effective Solution</th>
<th>Practical Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of ITS solution/ Objective</td>
<td>Mobility</td>
</tr>
<tr>
<td>Real Time Passenger Information</td>
<td>19</td>
</tr>
<tr>
<td>Advance Traffic Management System (ATMS)</td>
<td>18</td>
</tr>
<tr>
<td>Advance Traveler Information System (ATIS)</td>
<td>19</td>
</tr>
<tr>
<td>Transit Signal Priority</td>
<td>10</td>
</tr>
<tr>
<td>Incident Management</td>
<td>9</td>
</tr>
<tr>
<td>Automated Enforcement</td>
<td>9</td>
</tr>
<tr>
<td>Fleet Management/ Monitoring</td>
<td>10</td>
</tr>
<tr>
<td>Precision Docking at station/ Bus stop</td>
<td>9</td>
</tr>
<tr>
<td>Electronic Fare Collection</td>
<td>10</td>
</tr>
<tr>
<td>Surveillance /CCTV (Closed Circuit Television)/ Security system</td>
<td>9</td>
</tr>
<tr>
<td>Automated Vehicle Location (AVL)</td>
<td>10</td>
</tr>
</tbody>
</table>

**WP-4: Design and Development of Advanced Car Driving Simulator**

The car driving simulator which can train, test and evaluate driving abilities to increase safe behaviour has been developed as shown in Fig.73. The driving test track which was also incorporated in the simulator which would be useful in testing drivers for the purpose of issuing driving license is given in Fig.74. The views of the software implemented in the simulator has been presented in Fig.75.
WP-5: Development of Sustainable Non-Motorised Transport System

The work carried out in this work package is given below:

- estimation of demand of Non Motorised Trips in Delhi
- methodology for identifying missing links in NMT network
- compare different road crossing infrastructures (at-grade crossing facilities, foot over bridges [FOB] and subways)
- Preparation of Guidelines for road space share for NMT enhancing accessibility

In order to assess the missing links in NMT network and the prevailing condition of NMT infrastructure, the methodologies for estimation of following indices / scores have been developed:

- Footpath Score based on Types of Obstructions (FoSTO)
- Pedestrian Serviceability Measurement (PSM)
- Bicycle Level of Service (BLOS) at Mid-Block
- Access to Public Transport Stop/ Stations (PT Access)

The guidelines are proposed to identify the most common parameters being considered for making a decision regarding identification of most suitable infrastructure for road crossing by NMT as given in Table 5.

Table 5: Selection Criteria for the Infrastructure for Road Crossing by NMT

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Pedestrian Flow (pedestrians per hour - PPH)</th>
<th>Commuter Flow</th>
<th>Proportion of NMT&amp;PT commuters in total commuters at mid-block</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low (less than 30%)</td>
</tr>
<tr>
<td>1</td>
<td>High (more than 800 PPH)</td>
<td>Low: less than 17500</td>
<td>At grade signalised</td>
</tr>
</tbody>
</table>
WP-6: Policy Level Sustainable Strategies to Restrict/Control Usage of Private Vehicles

The work carried out is as follows:

- Evolve Travel Demand Management Measures and policy level strategies (Congestion pricing and Parking charges)
- Review of the possibilities to introduce innovative/new PT modes

From the Expert Opinion Surveys considering relevance and feasibility, adopting the Vehicles Quota System and Increase in taxes on Car will be the most suitable policy options for restricting car ownership in Delhi. Based on the above three policy analysis, merits and demerits of each policy has given in Table 6.

Table 6: Merits and Demerits of Different Vehicle Usage Restriction Policy

<table>
<thead>
<tr>
<th>Policy Measures</th>
<th>Congestion Pricing</th>
<th>Parking Charging</th>
<th>Odd/Even Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Reduction in Travel Demand</td>
<td>20% Reduction in Car Users (Rs.69/entry)</td>
<td>26% Reduction in Car Users (@Rs39/hr)</td>
<td>15 to 30% Reduction in Car Users</td>
</tr>
<tr>
<td>Equity among Road Users</td>
<td>LIG have dis-benefits compared to HIG</td>
<td>All users are better off</td>
<td>All users are better off Except Car users</td>
</tr>
<tr>
<td>Implementable</td>
<td>Filed implementation is difficult (*)</td>
<td>Implementable (***), Long run reduction in cars may reduce</td>
<td></td>
</tr>
<tr>
<td>Sustainability</td>
<td>Sustainable (*)</td>
<td>More Sustainable (***)</td>
<td>Somewhat Sustainable (**)</td>
</tr>
</tbody>
</table>
WP-7: Integration of Mass Transportation System thorough Travel Demand Modelling Using Soft Computing Techniques

The following work has been carried out:

- Four stage travel demand modelling by using macroscopic-simulation techniques and develop transport model for Delhi.
- Develop integration of mass transport systems considering Feeder Transport and Park and Ride systems for metro stations.
- Study the impact of developed integrated transport system under different scenarios.

The travel decisions are formulated through sequential four steps - Trip Generation, Trip Distribution, Mode Choice and Trip assignment and implemented four stage travel demand model for the city of Delhi in this study through statistical techniques and macroscopic simulation model namely VISUM software. The Integrated Transportation System namely Integration of metro with feeder modes (Case 1) and Park and Ride as an additional mode (Case 2) with Park and Ride with parking charges at Rs.5/hr and Rs.10/hr are considered. A general quantitative comparison between the these alternatives as shown in Fig.76 indicates that the Case 2 with park and ride facility at Rs.5/hr incurs maximum benefits at the network of integration. Metro with feeder mode integration incurs second highest ridership in metro. The limitation with park and ride facilities is the establishment of Park and Ride Sites at all metro zones. This makes - Integration of metro with feeder mode as most feasible option.

WP-8: Evaluation of Sustainable Transportation System (Economic, Social and Environment)

The work carried out in this work package are:

- Selection of relevant indicators (social, economic and environmental)
- Develop a sustainability index
- Evaluate the changes in the sustainability index before and after the implementation of a sustainable transport system

Table-7 shows the brief about selected parameters, measurement and their unit in which measurements are to be performed. In order to evaluate sustainability of the proposed transport system, mainly three broad components have been identified: Socio impacts, Economic impacts and Environmental Impacts. Ideally it should have been assigned 33.33% weight to all above mention components. The impact or parameter has been evaluated from 4 major sources: (a) Data extraction from expert evaluation (b) Data extraction from public opinion (c) Data extraction through various model and available formula of literature (d) Data extraction by directly measuring the impact in field before and after implementation of any policy scenario for public transportation system. The flow diagram shown in figure shows the research frame work for data collection.
### Table 7: Selected Relevant Sustainability Indicators and their description

<table>
<thead>
<tr>
<th>Group</th>
<th>S. No</th>
<th>Parameter of Sustainability</th>
<th>Description / measurement</th>
</tr>
</thead>
</table>
|       | 1     | Energy use and consumption  | 1. Energy consumption per private motorised passenger kilometre  
|       |       |                             | 2. Energy consumption per road based public transport passenger kilometre (at vehicle)  
|       |       |                             | 3. Energy consumption per rail based public transport passenger kilometre (at vehicle)  |
|       | 2     | Environmental Quality       | Number of days particulate matter concentrations (PM10) exceeds 50 μg/m³ in Urban Audit cities—days per year  
|       |       |                             | Number of days ozone concentration exceeds 120 μg/m³ in Urban Audit cities-days per year  |
|       | 3     | Noise pollution             | 75-80 dbA as per Environment (Protection) Amendment Rules, 2005  |
|       | 4     | Usage of renewable Energy Sources (Solar, Bio, wind, Hydro, Geothermal, CNG) | Percentage fleet of solar/electric/biodiesel and CNG  |
|       | 5     | GHG Emissions (CO2, CH4, N2O, HFC, Total) due to public transportation system | Fuel Use = Distance x Fuel Economy Factor  
|       |       |                             | CO2 Emissions = Distance Travelled x Emission factor  |
|       | 6     | Other Air Pollutants (Ozone, PM, NO, CO, HC) due to public transportation system | Check ambient air quality standards  |
|       | 7     | Accessibility (<0.4 Km) to Public Transportation System | 04km, 0.5km >0.5 km  |
|       | 8     | Satisfaction to public transportation system | Frequency, travel, seat availability  |
|       | 9     | Safety & Security in public transportation system | Safety from crime, Accident, People perception on Safety measures  |
|       | 10    | Fatalities and Injuries due to public transportation system | 12-20% involvement in fatality  |
|       | 11    | Employment due to public transportation system |  |
|       | 12    | Affordability of ticket (Rs) of public transportation system | Minimum fare 5-7-10 Rs for 3km  |
|       | 13    | Household Exp. Allocation to transport | 7-8-10%  |
|       | 14    | Transport Emission Cost Damage Cost and Mitigation cost |  |
|       | 15    | Transport Demand and Intensity |  |
|       | 16    | Accident Cost due to public transportation system |  |
|       | 17    | Transport Cost and prices |  |
Evaluation of Economic Loss Due to Idling of Vehicles at Signalised Intersection (ELSIM)

CSIR 12th Fear Year Plan ELSIM has been funded by Planning Commission.

The objectives of this project are

a) Quantification of Fuel loss due to idling of motorized vehicles at Signalised Intersections and benefits of Mitigation Measures and estimate the benefits over a period of time

b) Estimation of Emission and Energy due to fuel loss during Idling and Development of model between fuel loss and emission.

In this study, classified traffic volume count surveys are conducted at identified signalised inter sections in Delhi, Chandigarh, Kolkata, Chennai, Bhopal and Vadodara to study the traffic flows characteristics. Speed and Idling delay characteristics of vehicles plying on the road network were also collected. Further, measurement of idling fuel consumption was conducted on vehicles using state of the art on-time fuel flow detector covering different cities. The measurement was carried out on 346 Petrol and Diesel powered vehicles covering Two wheeler motorcycles, Three wheeler, Four wheeler as well as Trucks and Buses. The summary of measured idling fuel consumption for petrol and diesel at controlled conditions of the entire vehicles for each of the test runs at hot stabilized condition are estimated. The mean value of observed fuel consumption at idling is predominantly dependent on engine capacity and vehicle technology and varies from 144 ml/hr to 900 ml/hr. The fuel consumption was summarized in terms of model year into four different categories based on categories for Indian emission regulation monitoring such as pre BS-I, BS-II, BS-III and BS-IV. Fuel consumption in term mL/10 min. is given in Fig. 77.

![Idling fuel consumption for different vehicles in different model years](image)

Subsequently, the framework and knowledge generation in the form of methodology for estimating idling fuel consumed, energy consumed and estimation of emission due to motorised vehicles idling for at-grade signalised intersections were developed. Estimated emissions interims of CO2, CO, NO, NOx and NMVOC due to idling of vehicles at signalized intersections based on the IPCC emission factors. It was observed from study intersections in Delhi (11 Intersections) that monetary loss due to idling is about 8 lakhs/day which can be saved/reduced. The developed guidelines will provide an assessment of Fuel loss at idling stage through motorised vehicles at at-grade signalized intersection for which models have been developed under this project. The proposed mitigation measures can be taken by implementing in the form of alternative infrastructure changes to save fuel and environment. It will also reflect the monetary savings by the alternative
changes. During Fuel station survey, it was observed that the drivers agreed for switching off the engines, which ranges from 20% - 40%.

**Design of Noise Barrier based on Different Frequencies**

This project has been taken up under FTT - Fast Track Transitional funded by CSIR.

The objectives of the study are to develop design of noise barrier based on different frequencies as given below:

a. Low frequency based Noise Barrier(<200Hz),

b. Middle frequency based Noise Barrier (200-1k Hz) and

c. High frequency based Noise Barrier (1k-20k Hz)

At global level, Noise Barriers are not designed based on their disturbing frequency. In this study, it would be done based on disturbing frequency of noise pollution and there will be three types of noise barrier: Low frequency (<200Hz), Middle frequency (200-1k Hz) and High frequency (1k-20k Hz). This technology is in line with the Innovate in India missions of Government of India, Environmental sound technologies for noise reduction by various road and transport infrastructure and thereby creating smart cities for better standard of life.

The present invention reveals about designing of noise barrier (to be erected on the road side or expressways or flyover) based on the disturbing frequency of noise pollution. CSIR-CRRI has developed three types of noise barrier:

- Low frequency based Noise Barrier(<200Hz),
- Middle frequency based Noise Barrier (200-1k Hz) and
- High frequency based Noise Barrier (1k-20k Hz)

The Socio-Economic Impact is given as below:

*Industry Impact:* Problem based solution for noise barrier manufacturers

*Improvement in Quality of Life:* Drastic reduction of noise level after installation of this noise barrier which will improve quality of life in surrounding area.

**Environment Conservation:** This noise barrier will be very much useful for human as well as animals in protection where train passes through forest areas.

**Low Cost Road Asset Management System**

Inhouse project has been taken up on Low cost Road Asset management system funded by CSIR-CRRI with the objective to develop low cost prototype road asset management system and Calibration and Validation of the system.

A test bicycle has been designed to instrument with screen, battery, GPS and other wire sensors and Fig.78 shows typical view of developed instrumented bicycle for road asset management. The developed equipped bicycle was tested in CRRI campus and collected the information related to road asset. This low cost asset management system was able to collect data on chainage of each asset along and across the road along with their longitude and latitude with camera view angle. Asset in the sides need to be calibrated with distance and their location utilising longitude and latitude data. Speedometer installed in the screen to show the current speed of the bicycle on the road. The installed camera will capture road view along with pavement condition. With this setup, even the joints on concrete roads are also clearly visible along with their chainage, longitude and latitude. Whereas side camera shows the side asset such as trees, lamp posts etc. within the range of view of camera. This system also logged several parameter such speed, distance, time of run and event location. Typical view of video recording showing asset of roads is shown in Fig.79.
In wake of above mentioned precarious situation in Indian transport sector we need to resort to multimodal integrated travel demand modelling with incorporation of sustainability as a yardstick for planning and development. Also, in times of diminishing economic and natural resources, using sustainable approaches in transportation will allow us to continue to enhance quality of life and serve the transportation needs of the present without compromising the ability of future generations to meet their needs.

The present study / project will aim to develop a multimodal integrated travel demand modeling method, that will incorporate novel methods of Stochastic User Equilibrium and Dynamic User Equilibrium to bring about true integration in demand and supply side of transport system. An elaborate framework for evaluation of sustainability of the developed travel demand model along using statistical methods will also be carried out. Different transport policies and their impact assessment on the transport network will be done.

**Estimation of Fuel Consumption during Idling of Vehicles at Bhikaji Cama Intersection and Savings after Employing Suitable Mitigation Measures**

Petroleum Conservation Research Association (PCRA), New Delhi entrusted CSIR-CRRI this project with the objective to compare fuel loss and emission change ‘before and after’ employing mitigating measures (Switching off of engines of vehicles) at Bhikaji Cama Intersection.

The study was divided into three phases, One ‘BEFORE’ scenario, where the existing situation without any intervention was assessed. Then a One week rigorous Awareness Campaign was undertaken. A Switching Off behavior assessment survey was conducted ‘DURING’ the ongoing campaign and ‘AFTER’ 7 days campaign was over. Various types of primary & secondary data have been collected including Classified Traffic Volume Counts (CTVC), Delay studies, switching-off behavior observations, fuel consumption and emission levels. Number
of switched off vehicles were observed during all three scenarios manually. About 20% vehicles were observed switching off BEFORE campaign which increased to 62% DURING campaign and about 53% are switching off AFTER campaign. Apart from this, it was also found that about 7% increase in switching-off behavior due to corrected positions of Countdown timers. Estimated fuel savings in monitory terms is Rs. 5499, Rs. 17368 and Rs. 13518 for "Before", "During" and "After" scenarios respectively. The CO2 loads reduction in Before scenario were 280.23 Kg per day due to switching off of vehicles during Red phase. With increase in incidence of switching off the reduction in pollutant loads was estimated to be 893.38 Kg per day and 689.03 Kg per day. During and After campaign respectively. In other pollutants like NOx and CO similar trends were observed.

**Route Choice and Frequency optimization under countdown information for bus passengers with strict capacity constraints**

In-house project funded by CSIR-CRRI has the following objectives.

- To assess the route choice of passengers in presence of countdown information at transit stops with strict capacity constraints of transit services
- To optimize the frequency of the lines for the obtained flow along various links of the network

A pilot survey was carried out to assess the rate of passenger arrivals as well as the rate of transit service arrivals within the study area. A constrained model has been developed. The inter-arrival distribution of transit services was assessed and it was found to be exponentially distributed. A chi square goodness of fit was done to assess the fitness to exponential distribution. The database of the bus routes was modified based on the observed data. A conference paper has been submitted.

**Estimation of Fuel Consumption during Idling of Vehicles at Bhikaji Cama Intersection and Savings after Employing Suitable Mitigation Measures**

With increasing traffic at intersections it becomes essential to install traffic control devices to regulate the movements through the intersection. Automatic traffic signals are the most commonly used traffic control devices installed at the road intersections. When the vehicles are waiting for their turn to clear the intersection, the drivers normally do not keep the engines off and this results extra fuel consumption due to idling. A vehicle engine consumes fuel even when it’s running while idling. The idling during Red phase at signalized intersections contribute significantly in total Fuel Loss, Small amount of fuel aggregated over number of cycles per day, number of days per month and number of signalized intersections becomes a huge quantity.

The endeavor of Petroleum Conservation Research Association (PCRA), New Delhi is to explore and implement ways and means to conserve the fast depleting fuel reserves. PCRA New Delhi initiated the installation of Countdown timers at signalized intersections to encourage vehicle drivers to switch off their vehicles if the Red phase is more than 15 seconds With a view to assess the wastage of fossil fuels during idling of vehicles and to evaluate the effect of Countdown Timers and an Awareness Campaign to sensitize about the benefits of turning off engines of the vehicle and encourage to do so, on ‘switching off’ behavior of vehicle drivers during Red phase at signalized intersection. . PCRA entrusted CSIR- Central Road Research Institute, New Delhi with a research project entitled” Estimation of Fuel Consumption during Idling of vehicles at Bhikaji Cama Intersection and savings after employing suitable mitigation measures. With this background the objectives of the study are as follows;

- Quantification of fuel loss during idling of vehicles at selected intersection.
- To know the effect of awareness program on switching-off behaviour.
- To estimate the saving potentials of engine switching-off behaviour at selected intersection.
To compare fuel loss and emission change 'before and after' employing mitigating measures (Switching off of engines of vehicles)

This study is limited to only one location i.e. Bhikaji Cama Intersection.

The study was divided into three phases, One 'BEFORE scenario, where the existing situation without any intervention was assessed. Then a One week rigorous Awareness Campaign was undertaken. A Switching Off behavior assessment survey was conducted 'DURING' the ongoing campaign and 'AFTER' 7 days campaign was over. Various types of primary & secondary data have been collected including Classified Traffic Volume Counts (CTVC), Delay studies, switching-off behavior observations, fuel consumption and emission levels.

At-grade traffic observed at intersection was 1.03 lakh; out of this 62161 (62% of total traffic) is potential traffic that can switch off during idling. A rigorous on-site campaign was undertaken employing the above measures to draw the attention of the vehicle drivers during the campaign and spread the message of Switching off their vehicles during Red Phase. More than 50,000/- bilingual Pamphlet were distributed to the drivers directly during idling and with the help of newspaper distributors. Advertisements were published in English and Hindi newspaper as well. On-site banners, stationary boards, enumerators holding placards, etc. were at site for 7 days.

Number of switched off vehicles were observed during all three scenarios manually. 19.96% vehicles were observed switching off before campaign which increased to 62.33% during campaign and reduced to 52.88% after campaign. Apart from this, 7.15% increase in switching-off behavior has been observed due to corrected positions of Countdown timers.

Estimated fuel savings in monitory terms is 5499, 17368 and 13518 for "Before", "During" and "After" scenarios respectively.

The CO2 loads reduction in Before scenario were 280.23 Kg per day due to switching off of vehicles during Red phase. With increase in incidence of switching off the reduction in pollutant loads was estimated to be 893.38 Kg per day and 689.03 Kg per day During and After campaign respectively. In other pollutants like NOx and CO similar trends were observed.

**Development of Research Network on Vehicular Emission Reduction (EARNOVER)**

Shakti Sustainable Energy Foundation, New Delhi entrusted CSIR CRRI to develop research Network on Vehicular Emission reduction envisaged to organize training and workshop for development of research network on vehicular emission and formulation of research vision on vehicular emission

Auto Fuel Policy-2003 based on the recommendation of Mashelkar Committee had identified the need to bridge the research gaps and align the work of different organizations working on vehicular emission reduction. The committee recommended the creation of a research network to bring together all organizations working on vehicular emission reduction mandate for mutual collaboration and alignment. However, till date no such collaboration has been established and considerable research gaps that hinder policy formulation continue to exist.

CSIR-Central Road Research Institute (CRRI), New Delhi with support from Shakti Sustainable Energy Foundation (SSEF) has proposed to organise two workshops on 30th November 2016 and 23rd January 2017 to take forward the recommendations of the Mashelkar Committee (2003) and create a network of research organizations, institutions, academicians and individual researchers working on vehicular emission reduction issues. The glimpses of these workshops are shown in Fig.80. The purpose of this network will be to initiate a dialogue among its members to establish a common research agenda that would be aligned with the national level policy requirements. This network will also provide a platform for collaborations amongst the members through joint research, knowledge, expertise and experience sharing and peer learning.
Consultancy Services on Developing Thematic GIS Database for Integrated Road Management System for RCD

Road Construction Department (RCD), Govt. of Bihar has sponsored this project to develop GIS database for thematic mapping of Bihar for integrating road asset management system.

GIS based Database were introduced and installed for 38 district of Bihar state. For each district, field engineer provided their comments and feedback on the database and accordingly correction on the database were incorporated by CRRI considering view point of field engineers and staff at RCD headquarter. NIC with help of database developed by CRRI started developing web environment for people friendly dissemination of massage related to road, bridge, condition and inventory as shown in Fig.81. GIS Database has been also used to find the roughness condition and their pattern in different districts of Bihar. Such information is useful for repair and maintenance planning of roads. The Fig.82 shows typical roughness and side drain conditions of Siwan district of Bihar.
Transportation and Traffic Study at Naval Base, Karwar

Indian Navy, Ministry of Defense, Government of India has entrusted CSIR CRRI for Transportation and Traffic study at Naval Base, Karwar. The major objectives are

- To estimate traffic demand on study road network resulting from projected and incremental increase in military and civilian populations for the base and horizon year by considering macroscopic traffic simulation model.
- To develop short term and long term improvement plans and suggest measures to minimize traffic related problems. Also to develop microscopic traffic simulation model to validate the workability of the suggested improvement measures.

In the year 1999, Ministry of Defense had approved Project Seabird to develop a new naval base at Karwar in Goa. The Naval Base, Karwar, region includes existing and proposed Naval bases. Under the Project Seabird, Phase-IIA, the Navy will expand its presence and operations at sites in next 10 Years by assigning and home porting additional naval ships, submarines, aircrafts and personnel at these sites. As the navy presence and supporting population (both active duty military and civilian personnel and their families) grows incrementally over the next 10 Years to approximately 30,000 (currently at approximately 3,000), the impact on the existing roadway and highway network within, and between, the existing and proposed Navy bases will be significant. As much as the Navy has invested much time and resources into developing state-of-the-art master plan and design of infrastructure within the boundaries of 5 Naval Base sites to be built and/or expanded within the region, it is equally important that the entry/access points and road network within the naval bases themselves, also be designed and built, using modern technology, to support the naval base for futuristic needs as well. Fig.83 shows the location map of Karwar region.

Concerned with the present and future problems related to traffic in the road network in the Naval Base area ie. Karwar, Head Quarter (HQ) Seabird approached CSIR-Central Road Research Institute (CRRI) to conduct transportation and traffic study at Naval base, Karwar on the existing road network and suggest improvement measures to reduce traffic delays at Karwar road network.
Road Safety Audit of Outer Ring Road, Hyderabad

HMDA, Hyderabad, Govt. of Telangana entrusted CSIR-CRRI for Road safety audit. The objective of this project is to assess the safety situation by conducting the Road Safety Audit (RSA) at Operational Stage. The main aim of the road infrastructure development is to provide seamless travel with safety. At the same time, it is very much necessary to make sure that the developed facilities are safe in operation. In this direction, Hyderabad Growth Corridor Limited (HGCL), Hyderabad Metro Development Authority (HMDA), Government of Telangana recently developed Outer Ring Road (ORR) Expressway in Hyderabad and given due consideration to assess the safety situation to conduct the Road Safety Audit (RSA) at Operational Stage. Some of the issues related to road safety has been shown in Fig.84.

Considering the above, HGCL, Hyderabad, Government of Telangana assigned the task of conducting the Road Safety Audit to CSIR-CRRI. Accordingly the CSIR-CRRI study team critically studied the ORR Expressway by carrying out the RSA along with traffic operating conditions, accident analysis and identified the existing deficiencies in the stretch. This report presents an account of the traffic studies and the findings of the Road Safety Audit at operational stage along with the suggested measures to be implemented to prevent the accident proneness on ORR Expressway.

The appropriate corrective measures for improving the safety are suggested to mitigate the deficiencies. The study team critically reviewed the existing inadequacies in design especially alignment, cross sections, median treatments, safety measures at curves and straight sections, road markings, road signs, Object Hazard Makers (OHM) on Bridges, Cross Drainage works, exit and entry locations including toll plazas, ramps, interchanges, service roads, fixed object markings coupled with an assessment of the possible safety measures such as replacement, installation of new sign boards and markings, chevron markers, delineators, retro-reflective markers for improving the night driving and speed arresters, optical speed bars and transverse bar markings to reduce the speeds, object markers and metal beam crash barriers to avoid/ reduce the impact of accidents etc. are suggested for the enhancement of safety of road users considering the operating speeds of the traffic on the study stretch. It is highly recommended that the suggested measures shall be implemented as per the recommendations which are expected to help in mitigating the road crashes and enhance the safety on the Expressway. The motto ‘Prevention is better than Cure’ should always be kept in mind while deciding the priorities for expenditure and costs and benefits of a treatment and its impact on risk to the road users. The recommendations are intended to show application of principles of road safety audit and advice on good practice. These may be used with discretion and judgment and to be complemented by experience of site engineer.
Site Impact Study due to the Proposed DMRC Commercial Complex at Jantar Mantar Area, New Delhi

Delhi Metro Rail Corporation, DMRC has sponsored this project with following objectives.

- To estimate the passenger/vehicular traffic generated by the proposed DMRC Commercial and assess the impact of traffic on the adjoining road network.
- Enumeration of the existing traffic flows on the major road links in the vicinity of the proposed development and appreciate the present and future traffic scenarios in the adjoining road network.

Keeping the view of traffic management problems arising due to the commercial office building proposed by DMRC; DMRC had approached CSIR - CRRI to study the traffic pattern that would arise in event of the construction of an commercial complex at 8, Jantar Mantar Road, Delhi (Patel Chowk Metro Station).

Impact of road condition on fuel consumption of vehicle

Petroleum Conservation Research Association (PCRA), New Delhi sponsored this project with the objective to establish the co-relation between road condition (roughness) and fuel consumption and developing the fuel consumption models for different road surfaces (Flexible/Rigid) and road conditions.

Identification of road test stretches with different road unevenness/roughness conditions and types of vehicles to be used in around Delhi The bench marking of roughness will be conducted to have feel of minimum roughness and then three different vehicles (Small car SUV and Truck) to measures the duel consumption on flexible and rigid pavement,. The fuel saving will be investigated to understand eco-friendly road investment decision plan.
Evaluation of fuel consumption for a given driving pattern

In-house project sponsored by CSIR CRRI with following objectives.

- To capture driving data and corresponding fuel consumption from In-use Vehicles for different operating modes
- To estimate fuel consumption from a given driving pattern.

Procured Maruti Wagon R as well as OBD II data logger as envisaged: The Installation of fuel flow data acquisition system along with engine RPM meter has been completed. Capturing fuel consumption at Wagon R at various steady speeds and at idling with Air conditioner switched ON and OFF conditions for speeds ranging up to 80 km/hr has been completed. Capturing fuel consumption for various levels of acceleration/deceleration for Wagon R, with Air conditioner switched ON and OFF is in progress.

The steady speed fuel consumption at idling has been observed to be more than 10% with Air conditioner switched On than with Air conditioner switched OFF for all the steady speed tests on petrol powered Wagon R. Fig.85 below shows the observed values for steady speed tests ranging from 5 km/hr to 70 km/hr.

It was observed from idling test that it takes about 5 minutes for the engine to hot stabilize (engine coolant temperature to reach steady value of around 900 C). Fig.86 below shows the observed values of coolant temperature with Air conditioner switched ON and OFF.

Pilot Study on in-Vehicle Exposure of Volatile Organic Compounds (VOC), Carbon Monoxide (CO) and Black Carbon (BC) and its Health Impact on Commuters

In-house project sponsored by CSIR CRRI with the objective to evaluate the exposure to particulate matter, VOCs and CO under varying vehicle operating conditions.

Little data exist on pollution levels within interior cabins of vehicles. Vehicle cabin represents a confined space where passengers are exposed to pollutants for variable periods of time. Exposure to pollutant inside vehicles is often 3-5 times higher than ambient pollution levels. According to WHO, people spend 1-1.5 h/day in daily commuting in many countries. This study focuses on the exposure of commuters to particulates, VOCs, CO and BC while commuting through different modes of transport in Delhi. Although, the average time spent during commuting is less, but the short term, high-level exposure to different pollutants is related to negative health impacts. This study also assesses the health impacts of air pollution on commuters through a questionnaire–based survey. Measurement were made in four major modes of transport, namely bus, car, three wheelers and two wheelers during commuting. Commuter's exposure to particulate was measured using GRIMM environmental dust Monitor, Personal CO monitor and Microaethelometer. The Active sampling methodology was adopted for VOCs and the analysis was carried out using GC-FID instrument. Table-8 depicts commuter perception related to
health problems caused due to vehicular fumes. The majority of the commuters face health problems like headache (96%), fatigue/drowsiness (91.2%), nasal congestion (89.6%), eye irritation (86.4%) nose irritation (77.6%), sneezing (74.4%). Other health problems that are quite often faced by commuters are: skin irritation (67.2%), respiratory problems (64.8%) and throat irritation (53.6%). The following are the major health problems which are sometimes faced by the commuters due to traffic fumes: vomiting (46.4%), throat irritation (41.6%) and respiratory problems (35.2%). The following are the major health problems which are never faced by the commuters due to traffic fumes: hearing loss (61.6%), visibility reduction (60.4%).

Table 8: Distribution of the data with respect to the health problems caused due to the vehicle

<table>
<thead>
<tr>
<th>Health problems</th>
<th>Quite often</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye irritation/Watery eyes</td>
<td>86.4%</td>
<td>13.6%</td>
<td>0%</td>
</tr>
<tr>
<td>Nose irritation</td>
<td>77.6%</td>
<td>21.6%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Throat irritation</td>
<td>53.6%</td>
<td>41.6%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Nasal congestion</td>
<td>89.6%</td>
<td>10.4%</td>
<td>0%</td>
</tr>
<tr>
<td>Vomiting/Nausea</td>
<td>32%</td>
<td>46.4%</td>
<td>21.6%</td>
</tr>
<tr>
<td>Cough/Sore throat</td>
<td>68%</td>
<td>27.2%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Hearing loss</td>
<td>15.2%</td>
<td>23.2%</td>
<td>61.6%</td>
</tr>
<tr>
<td>Respiratory problems</td>
<td>64.8%</td>
<td>35.2%</td>
<td>0%</td>
</tr>
<tr>
<td>Skin irritation</td>
<td>67.2%</td>
<td>23.2%</td>
<td>9.6%</td>
</tr>
<tr>
<td>Sneezing</td>
<td>74.4%</td>
<td>25.6%</td>
<td>0%</td>
</tr>
<tr>
<td>Headache</td>
<td>96%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Visibility reduction</td>
<td>12%</td>
<td>27.6%</td>
<td>60.4%</td>
</tr>
<tr>
<td>Fatigue/drowsiness</td>
<td>91.2%</td>
<td>8.8%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Higher concentration was observed inside cars followed by two and three wheelers as shown in Fig. 87 and 88.
The results indicated that the private vehicle commuters are exposed to higher pollutants as compared to public transport commuters depending on the ventilation conditions.

Pilot Study for the Development of Surface Enhanced Raman Scattering (SERS) based Sensors for the Detection of Environmental Pollutants (Air/Water/Soil)

In-house project sponsored by CSIR CRRI with the objective to develop inexpensive, sensitive, selective, paper based SERS sensors for the detection and quantification of ground-level air pollutants / environmental pollutants.

Theoretical calculation for electric field enhancement factor around various metallic nanostructures has been carried out using Matlab software. Calculation and optimization of various parameters (size, shape, distance) for electric field enhancement factor is in progress.

Clean Water: Sustainable Options, Assessment of pollution loads in road runoff

Network project funded by CSIR to Analyze, Evaluate and Assess the Pollution Load of Roads Runoff.

Environmental pollution has become a major problem in India especially metro cities like Delhi, Mumbai, Chennai and Kolkata. Rapid population growth, urbanization and large-scale development are potential factors in the pollution of road runoffs from urban and highways roads. The protection of the water resource is getting more complicated, due to the recognition of polluted runoff, as a major problem. This diffuse form of pollution which is fast becoming one of the nation's leading threats to water quality is derived from contaminants washed off the surface of roads by rain water, and carried either directly or indirectly into waterways or groundwater. The increasing number of over-aged vehicles in conjunction with heavy traffic has also contributed to the pollution of the environment with heavy metals and has become a major concern because of their toxicity and threat to human life and the environment. Once off the road these runoffs are moving into surrounding water bodies which serve as a direct source of drinking water for some communities within or outside the localities.
The variability from one location to another is caused by differences in land-use, seasonal influences, atmospheric deposition, maintenance, road drainage designs, and vehicles as well as other automobiles sources. It is therefore important and necessary to assess road runoffs to be able to gather information regarding their contribution to the pollution of surface water. Till now, very few studies have been conducted to assess the contribution of road runoffs, which is fast gaining grounds as one of the most important sources of surface water pollution.

Runoff samples were collected for various categories of roads like Urban Roads (UR), Industrial Roads (IR), Highway Roads (HR), Expressway Roads (ER), Low Traffic (LT) and High Traffic (HT) Roads, roads on the basis of pavement types (Bituminous and Concrete roads) and Bus Depo Roads. The sampling sites for all above categories include CRRI Main Gate, Ashram Chowk, Maharani Bagh, Okhla Industrial Phase II, Noida Expressway, Jaipur Molarband Road, Dhaula Kuan Ring Road, Trilokpuri NH 24, CRRI near APTF, Saraikalekhan, ISBT. Accessibility for runoff sampling was also considered during site selection. Road runoff samples were collected from the edge of the road/highway within the first 10 to 20 minutes of downfall when runoff has just begun, depending on the intensity of the rain. A variety of water quality parameters such as, pH, turbidity, electrical conductivity (EC), total suspended solids (TSS), total dissolved solids (TDS), aqueous concentrations of Chloride (Cl-), phosphate, nitrate, sulphate ions as well as the total concentrations of heavy metals iron(Fe), copper (Cu), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg), Nickel (Ni) and total Chromium (Cr) were analyzed. The highest increase in pollutant loadings was associated with the heavy metals and some physico-chemical parameters such as EC and turbidity. For some of the locations the heavy metals limits was above the permissible level (Fig.89). The concentration of trace metals were in the order: Zn > Mn > Cu > Pb > Cr > Ni > Co > Cd. Strong positive correlation between Cu-Pb, Zn-Pb, Zn-Cu, Co-Cr suggests common source of pollution: automobile emissions, auto exhaust, moving engine parts, asphalt and concrete pavements. Study proves that highway, traffic and bus terminal roads contribute significant amount of heavy metals.
HRD & Project Management

- Planning, Monitoring & Evaluation
- Information, Liaison & Training
Planning, Monitoring & Evaluation
R&D management is the main activity of this Division which inter-alia covers Planning, Monitoring & Evaluation of R&D projects, issues concerning Intellectual Property and Business Development, attending to technical queries and technical/performance audits and assistance to Director, Management Council (MC) and Research Council (RC) on the project related matters.

Major activities that PME Division carried out during 2016–17 are as follows:

**PLANNING ACTIVITIES**

Project Planning [Mission Mode/Fast Track Translational/other R&D Projects]

Organized brainstorming sessions to identify the thrust areas for delivering in mission/faster track mode and the projects of translational in nature. A comprehensive mission mode project titled ‘Green and Climate Resilient Road and Transportation Infrastructure’ prepared and submitted to CSIR. In addition to this, PME interacts with scientists for submission of R&D proposals to various funding agencies including International collaborations. During the year, 29 In-House R&D project proposals, and three FTT projects submitted by the scientists are processed & approved.

**CRRI BUDGET**

The budgetary requirement under various heads of expenditure was prepared based on the estimates of various R&D projects and demand for R&D equipments and other activities of the institute.

**SCRUTINY & REGISTRATION OF PROJECT PROPOSALS**

Scrutiny and Registration of all externally funded projects and allotment of specific identity in terms of a Project Number. is effected at PME, soon after the money for the project is received along with In-Principle approval. Registration and Technical scrutiny of in-house R&D projects is also carried out by the Division.

**DEVELOPMENT AND REGULAR MAINTENANCE OF PROJECT DATABASE**

PME has developed Project Database which is regularly updated incorporating addition of new projects, and modifications during their implementation stage and finally during their completion. The database includes project title, classification and technical and financial details which help in tracking the technical and financial progress of the projects. PME also maintains the cash inflow of all the projects. The database is highly useful for monitoring and evaluation of the projects.

Scientists Meet: Organized a scientists’ meet during Oct’16 where in every Division has come up with various plans and programmes to achieve the Government of India polices, CSIR-CRRI vision and to reach out common men.

**MONITORING ACTIVITIES**

Reporting on performance and the status of various projects was carried out through preparation of Quarterly Performance Reports contains information about the performance of the Institute on various parameters such as projects handled; technologies developed etc. on quarterly basis in line with Dehradun declaration and GoI policies. These reports are sent to CSIR for their perusal on quarterly basis. These reports also help the Institute in reviewing its own performance as a monitoring tool.

PME Division also calls for progress report of all the on-going projects in the Institute. This exercise is meant to monitor and ascertain the status of each of the projects with respect to adherence to time schedule and other milestones. Any deviation is intimated to the respective project leader and remedial measures are taken to put the project on course. Completed projects, as reported by the respective Project Leaders are processed for closure.
PROJECTS MONITORING

EXTERNALLY FUNDED PROJECTS
Externally funded projects were regularly monitored particularly for their adherence to time schedule, amount dues, if any, documentation, closure etc. through divisional/project review meetings.

IN-HOUSE PROJECTS
Project Identification and Monitoring Committee monitors the progress of the In-house projects. The committee also reviews the progress of the In-house projects periodically. The new projects are taken up if approved by the Committee after the presentation made by the Project Leader. Similarly at the time of completion of a project, a presentation is made by the Project Leader to incorporate suggestions if any made by the committee members.

EXTERNAL CASH FLOW (ECF)
The Institute undertakes projects sponsored by various external agencies such as Ministry of Road Transport & Highways (MORT&H), National Highway Authority of India (NHAI), Department of Science and Technology (DST), National Rural Roads Development Agency, PWD, Industries, Consultants, etc. The details of External Cash Flow i.e., money received from these agencies to carry out specified task was regularly recorded and monitored vis-à-vis target established by the Institute.

EXPENDITURE MONITORING
Efforts were made to keep track on the expenditure vis-à-vis budgeting allocations/requirements on the monthly basis so that performance/working of the Institute could be made more effective.

EVALUATION ACTIVITIES
Research Council (RC) is the apex advisory/monitoring body in CSIR-CRRI through which the major R&D activities are monitored and evaluated. Also it gives direction/guidance for future R&D programmes of the institute. During the Year, PME Division has provided various information/data for Agenda, progress reports of R&D projects, Information for Action taken Report, Information for Director’s Presentation and other related logistics for conducting of meeting.

PME is responsible for preparing the up to date projects summary and providing the information on projects that are to be ratified by the Management Councils. In addition, as per ISO, Customer Feedback on all completed project was carried out. The result showed that the clients are highly satisfied with the Institute.

MISCELLANEOUS ACTIVITIES
CSIR Platinum Jubilee Celebrations: Compilation of information for theme based document on the 75 years of CSIR. Preparation of Brochures/Charts/Posters for display in Pavilions during CSIR Techno Fest at IITF 2016. Coordinated the activities such as VIP protocol and business development activities/signing of MoUs. Further actively coordinated/participated in India International Science Festival (IISF) organized at NPL, New Delhi

Performance Appraisal Board: Compiled the information related to Performance appraisal reports of CRRI for the appraisal period 2012-17. Assisted the Director in preparation of presentations/documents from time to time.

MANAGEMENT OF VARIOUS PROJECT PROFORMAE
PME designs, maintains, manages and modifies the proformae pertaining to various project-related activities as per the need arises from time to time in line with ISO requirements.

TECHNICAL QUERIES FROM WITHIN/OR OUTSIDE CRRI AND CSIR
PME handles technical queries pertaining to various projects being handled by the various R&D Divisions of the Institute from CSIR, DST, MoRTH & CAG Audit etc. These queries are related to CSIR guidelines, technical progress of projects etc. PME is also required to interact with various Directorates of CSIR particularly RPPBD, Mission and DGTC
regarding the preparation of Plans/Budget, Management of Plan Projects, Audit, ECF queries etc. Also interacts with the project clients related to amount dues, schedule, taking satisfaction feedback etc. Prepared report for Performance Appraisal Board constituted by CSIR.

**PARLIAMENT QUESTIONS**

PME also handles parliament questions which are technical in nature. During the year, replies to Parliament questions were prepared after collecting, compiling and collating information from various divisions of the institute.

**CENTRAL PUBLIC GRIEVANCE REDRESS AND MONITORING SYSTEM (CPGRAMS)**

PME is the nodal division in CRRI to handle Public Grievances received through pgpportal.gov.in. It examines the cases appropriately and disposes-off them in time through online as well as intimating to the concerned person.

**SERVICE TAX ACTIVITY**

On receipts of amounts under externally funded projects, Service Tax is paid to the Government. PME Division regularly prepares the statement on the receipts and ensures for the payment by accounts section of Service Tax on monthly basis. PME also prepares and files the half yearly returns of Service Tax. Efforts are being made to migrate GST regime.

**DEVELOPMENT & MAINTENANCE OF PME SYSTEM**

Designed & Developed web based “Project Management System” by PME division to manage the projects in the Institute effectively with less manpower. Time to time enhancement in the system is also taking place by adding new features. This also increased the transparency in the system.

e-PPS (e-Project Proposal System) This is initiated by PME division. In this, the scanned copies of all the Project Proposals after approval are uploaded on to PME Intranet and also a copy is sent to Concerned PL & F&A Section through email. This has reduced a lot of manpower time, saving of paper and printing / xeroxing in turn saving of environment.

**ERP (PROJECTS, R & D MODULE)**

The Division has uploaded the details of all ongoing projects in the CSIR ERP site, also entry of Projects amount receipts in the Central Value Register of ERP site. Addition/Deletion of projects members and map their credentials according to the requirement of ERP System. In addition PME staff also assisted to implement the HR module under ERP system in CRRI.

**TECHNOLOGY TRANSFER**

- Technology Transfer for "New process for preparation of harder grade bitumen (VG40 and VG50) for formation of asphalt surfacing for roads and airfields" for ARThermosets pvt Ltd., Kanpur on 16 Nov 2016.
- Technology Transfer for "New process for preparation of harder grade bitumen (VG40 and VG50) for formation of asphalt surfacing for roads and airfields" for Tiki Tar Industries Pvt Ltd., Vadodara on 16 Nov 2016.
- Technology Transfer for NEW PROCESS FOR PREPARATION OF HARDER GRADE BITUMEN (VG40 AND VG50) FOR FORMATION OF ASPHALT SURFACING FOR ROADS AND AIRFIELDS for Jalnidhi Bitumen Specialties Private Ltd, Kolkata on...
06 Mar, 2017

- Technology has been transferred to 4 industrial partners:
  - M/s Tikki Tar Industries India Limited, Mumbai
  - M/s Juno Bitumix Pvt. Ltd., Noida
  - M/s A. R. Thermosets Pvt. Ltd., Kanpur
  - M/s Jalnidhi Bitumen Specialities Pvt. Ltd., Kolkata

- Software Development of Transportation Sustainability Indicator (TSI) By Dr Ravindra Kumar, Dr E Madhu, Dr Ch Ravisekhar

**AGREEMENT SIGNED**

- With Reliance Industries Limited, Mumbai on 26 Sep, 2016


- With IHQ-MoD(NAVY), New Delhi on 10 Nov, 2016

- With World Bank on 22 Feb 2017

**MoU SIGNED**

- A MoU signed with NRDC, New Delhi on 21 Jun, 2016

- A Memorandum of Understanding (MoU) was signed on 16th November, 2016 by CSIR-CRRI with the three industrial partners for the Transfer of Technology related to “Hard Grade Bitumen for the Formation of Bituminous Surfacing for Roads and Airfield Pavements and the Process thereof” during the CSIR Platinum Jubilee Technofest, 2016 held at Pragati Maidan. The three industrial partners are M/s. Juno Bitumix Pvt. Ltd., Noida; M/s. AR Thermosets Pvt. Ltd., Kanpur; and M/s. Tikki Tar Industries, Vadodara.

- During the IITF Technofest, an MOU was also signed between CSIR-CRRI and M/s Faros Simulations on Technology Transfer for the Design and Development of Car Driving Simulator. Various news papers published the article also on Car Driving Simulator.

- CSIR-CRRI Flexible Pavement Division signed an Agreement, with Reliance Industries New Delhi for undertaking study which includes field and laboratory evaluations of RelBit additive for modification of bitumen and its use in road construction. The study will be carried out in 3 phases by CRRI.

- CSIR-Central Road Research Institute, New Delhi signed Agreement on 04-01-2017 with PIONEER Industries, Tehsil Baddi, Solan (H.P) for Transfer of Technology “PATCHFILL-The Pothole Repairing Machine”

- CSIR-Central Road Research Institute, New Delhi signed Agreement on 07-03-2017 with JALNIDHI Bitumen Specialities Private Limited, Kolkata for Transfer of Knowhow on “Process Technology For VG-40 and VG-50 Grade Bitumen”

- CRRI signed an agreement with Ministry of Defense (Navy) on 5/12/2016 for a project "Traffic and Transportation Study at Naval Base" Karwar.

- CSIR-Central Road Research Institute, New Delhi signed Agreement on 26-9-2016 with Reliance Industries Ltd., Mumbai

- CSIR-Central Road Research Institute, New Delhi signed Agreement on 05-10-2016 with National Research Development Corporation (NRDC).

- CSIR-Central Road Research Institute, New Delhi signed Agreement on 10-11-2016 with IHQ-MoD (NAVY), New Delhi

- CSIR-Central Road Research Institute, New Delhi signed Agreement on 22-02-2017 with World Bank.
INTELLECTUAL PROPERTY MANAGEMENT

IP/Patent Filed

- New Process for preparation of Harder Grade Bitumen (VG40 and VG50) for formation of Asphalt Surfacing for Roads and Airfields [Complete filing date 9-Sep-16]
- Car Driving Simulator with Driver Diagnostic and Training Method [30-Nov-16]
- Process for Laying Roads Using Cold-Mix Technology [17-Nov-16]
- Carbon Based Mixture for Improved Performance of Flexible Pavements as one of Bitumen Additives or Fillers and Methods of Preparation thereof
- Patent No. 0234NF2016 entitled “Car Driving Simulator with Driver Diagnostic and Training Method” filled by Dr. Neelima Chakrabarty, Dr. E. Madhu, Dr. Ch. Ravi Sekhar, Dr. S. Velmurugan, Ms. Kamini Gupta on 28th November 2016.
- A patent on “Hard Grade Bitumen for construction of asphalt surfacing for roads and airfield pavements and the process thereof”, has been filed by its Inventors namely Dr. P. K. Jain, Abhishek Mittal, Gajendra Kumar and Smt. Khushboo Arora on 9th Sept., 2016.
- New Process for preparation of Harder Grade Bitumen (VG40 and VG50) for formation of Asphalt Surfacing for Roads and Airfields [Complete filing date 9-Sep-16]
- Process for Laying Roads Using Cold-Mix Technology [17-Nov-16]
- Carbon Based Mixture for Improved Performance of Flexible Pavements as one of Bitumen Additives or Fillers and Methods of Preparation thereof
Granted

New design for box insertion through highly unstable Cohesion less Soil by Stabilisation of Vertical cut slopes [granted Singapore and USA in May & July 2016 respectively]
Regular Training Programme

Imparting training to the engineers of the user agencies is an integral part of the research programme of the Institute. During the year, following refresher courses/training programmes for in-service engineers of the user organizations related to roads and road transportation in the Govt. Public & Private Sectors were organized. Through these programmes, the Institute imparted training to the junior, middle and senior level engineers of the user organizations and acquainted them with the latest research based information on various aspects of road and road transportation.

<table>
<thead>
<tr>
<th>TITLE OF THE COURSE</th>
<th>DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. PAVEMENT ENGINEERING &amp; MATERIALS</strong></td>
<td></td>
</tr>
<tr>
<td>• Design, Construction and Maintenance of Flexible Pavements</td>
<td>08-12 Aug., 2016</td>
</tr>
<tr>
<td>• Pavement Evaluation Techniques and their applications for Maintenance and Rehabilitation</td>
<td>19-23 Dec., 2016</td>
</tr>
<tr>
<td><strong>B. ROAD DEVELOPMENT PLANNING &amp; MANAGEMENT</strong></td>
<td></td>
</tr>
<tr>
<td>• International Course on Dissemination of HDM-4</td>
<td>19-30 Sep., 2016</td>
</tr>
<tr>
<td>• Geo-Spatial Technology (GIS, GPS, RS etc) for Road and Transportation</td>
<td>06-09 Feb., 2017</td>
</tr>
<tr>
<td><strong>C. GEOTECHNICAL ENGINEERING</strong></td>
<td></td>
</tr>
<tr>
<td>• Geotechnical and Landslide Investigations for Highway Projects</td>
<td>29 Aug-2 Sep., 2016</td>
</tr>
<tr>
<td><strong>D. BRIDGES &amp; STRUCTURES</strong></td>
<td></td>
</tr>
<tr>
<td>• Bridge Diagnostics, Performance Evaluation and Rehabilitation</td>
<td>20-24 June, 2016</td>
</tr>
<tr>
<td>• Bridge Design and Construction</td>
<td>07-11 Nov., 2016</td>
</tr>
<tr>
<td><strong>E. TRAFFIC &amp; TRANSPORTATION PLANNING</strong></td>
<td></td>
</tr>
<tr>
<td>• Traffic Engineering &amp; Road Safety Audit</td>
<td>25-29 July, 2016</td>
</tr>
<tr>
<td>• Air and Noise Pollution Measurement and Analysis</td>
<td>21-23 Nov., 2016</td>
</tr>
</tbody>
</table>

Glimpses of Regular Training Program at CSIR-CRRI

Economics & Financial Evaluation of Highway & Transportation Projects (July 11-15, 2016)
Traffic Engineering & Road Safety Audit (July 25-29, 2016)

Design, Construction and Maintenance of Flexible Pavements (August 08-12, 2016)

Geotechnical and Landslide Investigation for Highway Projects (August 29-02 Sept., 2016)
Training Programme on “Design, Construction & Quality Control Aspects” at CSIR-CRRI (17-21 October 2016)

Training Programme on “Bridge Design and Construction” at CSIR-CRRI (07-11 November 2016)
Besides the regular training programmes, the Institute conducted customer oriented programmes to meet the specific training requirements of the user agencies. During the year, the Institute conducted the following customer oriented training programmes:

**Customised Training Programme**

Besides the regular training programmes, the Institute conducted customer oriented programmes to meet the specific training requirements of the user agencies. During the year, the Institute conducted the following customer oriented training programmes:
International Course on Dissemination of HDM-4

A special Training Programme on Highway Development and Management (HDM-4) was organised from September 19-30, 2016. During the programme hands on Experience on HDM Software was given to the participants for arriving decision making strategies for implementation of Highway Project.

Concrete Road & B T Roads for the Engineers of Urban Administration & Development, Raipur

On request of UADD, Raipur, a customized training programme on “Concrete Road & B T Roads for the Engineers of Urban Administration & Development, Raipur was organized from April 4-6, 2016 at Raipur.

Planning, Design, Construction and Maintenance Management of Bituminous and Rigid Pavements

On request of Department of Roads, Govt. of Nepal, a customized training programme on “Planning, Design, Construction and Maintenance Management of Bituminous and Rigid Pavements” for the Engineers of Department of Roads, Nepal was organized from April 21 to May 02, 2016 at CSIR-CRRI, New Delhi.

Road Safety Issues & Audit for the Engineers of RCD, Bihar

On request of RCD, Bihar, a customized training programme on “Road Safety Issues & Audit” by CSIR-CRRI, New Delhi for the Engineers of RCD, Bihar was organized in two batches from June 13-16 & October 05-08, 2016 at Patna.

HDM-4 at Highway Research Station, Chennai

On request of HRS, Chennai, a special Training Programme on Highway Development and Management (HDM-4) was organised from September 06-10, 2016 for the officers of HRS at Chennai. During the programme hands on Experience on HDM Software was given to the participants for arriving decision making strategies for implementation of Highway Project.

Design, Construction & Maintenance of Flexible Pavement including Micro-Surfacing/Resurfacing Work

On request of Public Works Department, Govt. of NCT of Delhi, a customized training programme on “Design, Construction & Maintenance of Flexible Pavement including Micro-Surfacing/ Resurfacing Work” for the field staff of Public Works Department, Govt. of NCT of Delhi was organized in three batches from October 24-28, 2016, November 07-10, 2016 and January 30 to February 3, 2017 at CSIR-CRRI, New Delhi.

Road Safety Audit and other Road Safety Aspects/Certification Course for Road Safety Auditors

On request of PWD, Bihar, a customized training programme on “Road Safety Audit and other Road Safety Aspects/Certification Course for Road Safety Auditors” by CSIR-CRRI, New Delhi for the Engineers of PWD, Bihar was organized from Nov. 28 - Dec. 01, 2016 at Patna.

Design, Construction of Flexible Pavement and Rigid Pavement

On request of Chhattisgarh PWD, Raipur, a customized training programme on “Design, Construction of Flexible Pavement and Rigid Pavement” for the engineers of Chhattisgarh PWD was organized from December 05-07, 2016 at Raipur.

Pavement Evaluation Techniques and Applications for Maintenance and Rehabilitation

On request of Air Headquarters, Indian Air Force, New Delhi, a customized training programme on “Pavement Evaluation Techniques and Applications for Maintenance and Rehabilitation” for the officers of Indian Air Force in two batches was organized in three batches from February 13-18, 2017 and March 20-25, 2017 at CSIR-CRRI, New Delhi.

Road Safety and Road Safety Audit

On request of Transport Department, Government of Rajasthan, a customized training programme on “Road Safety and Road Safety Audit” by CSIR-CRRI, New Delhi for the officers of Transport Department, Government of Rajasthan was organized from February 27 – March 03, 2017 at CSIR-CRRI, New Delhi.
Glimpses of Customised Training Programs

Customized Training Programme on “Concrete Roads and BT Roads” for the Engineers of UADD, Raipur at Raipur (April 4-6, 2016)

Customized Training Programme on “Planning, Design, Construction and Maintenance Management of Bituminous and Rigid Pavements” for the engineers of Department of Roads, Nepal at CRRI (April 20 - May 2, 2016)

Customized Training Programme on “Roads Safety Issue & Audit” for the Engineers of RCD, Bihar at Patna (June 13-16, 2016)
Information, Liaison & Training

HRD & Project Management

Customized Training Programme on HDM-IV for the Engineers of Highways Department at HRS, Guindy, Chennai organised by Director General and the Chairman, ICE & RS Cell, Highways Research Station Highways Department at Chennai (Sept.06-10, 2016)

International Course on Dissemination of HDM-4 (Sept.19-30, 2016)
**Customised Training Programme on “Road Safety Audit and Road Engineering Related Aspects” for Senior Engineers of PWD, Police officers and Officers from Transportation Department, Arunachal Pradesh at Itanagar (26th to 30th September, 2016)**

**Customised Training Programme on “Road Safety Issues & Audit” was organised for Engineers of RCD -Bihar at Patna (5-8 October, 2016)**

**Customised Training Programme on Design, Construction & Maintenance of Flexible Pavement including Micro-surfacing /Resurfacing Work for PWD, Delhi (24-28 October 2016) (1st Batch)**

**Customised Training Programme on Design, Construction & Maintenance of Flexible Pavement including Micro-surfacing /Resurfacing Work for PWD, Delhi (07-11 November 2016) (2nd Batch)**
Customised Training Programme on “Design and Construction of Flexible Pavement and Rigid Pavement” for the Engineers of Chhattisgarh PWD, Raipur at Raipur (December 05-07, 2016)

Customised Training Programme on “Design and Construction of Flexible Pavement and Rigid Pavement” for the Engineers of Chhattisgarh PWD, Raipur at Raipur (December 05-07, 2016)

Customised Training Programme on “Design, Construction and Maintenance of Flexible Pavement including Micro-Surfacing/ Re-surfacing Work” for the field staff of Public Works Department, Delhi at CSIR-CRRI (January 30 - February 03, 2017)
Customised Training Programme on “Pavement Evaluation Techniques and their Applications for Maintenance & Rehabilitation” for the officers of the Indian Air Force at CSIR-CRRI (13-18 February 2017)

Customised Training Programme on “Road Safety and Road Safety Audit” for the officers of Transport Department, Govt. of Rajasthan at CSIR-CRRI (February 27 – March 03, 2017)

Customised Training Programme on “Pavement Evaluation Techniques and their Applications for Maintenance & Rehabilitation” for the officers of the Indian Air Force at CSIR-CRRI (20-25 March 2017)
**Human Resource Development Programme**

Human resource development is a philosophy of management and is purported to upgrade the capabilities and professional skills of the personnel working in an organization to match the changing work demands. To enhance the professional capabilities of scientists and scientific staff for undertaking the R&D work in frontline areas of highway engineering and with the urge to develop technologies which have competitive edge and marketable strength, CRRI has been devoted in human resources development. Realizing the need for skill development and capacity building of the human resources, training programmes were selected. Staff members received specialized training in the areas of their expertise to cope up with the challenging assignments.

**Publications**

**CRRI Annual Report for the Year 2015-2016**

The report is the profile of achievements of the Institute during the year 2015-2016. It also serves as a medium to acquaint the user agencies, clients and the other related organizations in the roads and road transportation research with R&D and other concomitant activities of the Institute. Progress reports of the R&D work and other related activities during the year from the various divisions/sections of the Institute was collected, compiled, edited and brought out as Institute’s Annual Report for the year 2015-16.

**CRRI Newsletter**

During the year, three issues of CRRI Newsletter were brought out. The Newsletter contains information related to R&D activities and other general information related to the Institute.

**Other Activities**

**Mailing of Publications**

The Institute’s R&D publications such as CRRI Annual Report and CRRI Newsletter were sent to highway professionals, engineering & academic organizations in the country and abroad. The publications are meant to disseminate R&D based information to the highway engineering profession.

**Technical Queries**

Technical queries concerning the R&D activities and technical know-how of the Institute were attended. Information on various technologies developed by the Institute was sent to a number of organizations dealing with databases, technology transfer and consultancy assignments pertaining to roads and road transportation.

**Press Publicity**

Various local presses approached CRRI for information on research & developments and studies carried out by the Institute on roads, flyovers, bridges etc. The needed information was provided to the press for the purpose of publicity.

Press clipping pertaining to road and road transport in particular and Science and Technology in general were culled out from various National dailies and were brought to the notice of the Director and circulated to staff members for information, if needed. These were also compiled in the form of document.

**Publicity through CRRI Advertisement**

To popularise the Institute past R&D achievements and present R&D programmes, capabilities, facilities and expertise, the Institute issued various advertisements at various forums. One such forum was the scientific documents brought out by various organizations on different occasions. The Institute got published its various advertisements in the documents brought out by the various organizations on the different occasions.

**Publication of Research Outputs**

Research outputs i.e. Research Papers emanating from the R&D work were processed for publication in various National & International Journals/Conferences through internal review system. Cases pertaining to deputation of CRRI Scientists to attend various Conference/Symposia were processed and attended.

**ISTAG Activities**

The scientists of the Institute were deputed abroad under various collaborative, exchange and bilateral programme of CSIR to participate in various conferences/symposia/seminar/study programmes and to attend advanced equipment training.

**Exhibitions**

The Institute participated in the following exhibitions and depicted its expertise, capabilities and R&D achievements.
Visitors
Visits of distinguished professionals and delegates from various organizations related to road transportation from India and abroad to CRRI were organized during the year.

Glimpses of Visitors at CSIR-CRRI

Linkages with Professional Bodies
The Institute is represented as the Institutional Member on the various technical, executive and administrative committees and groups of various National and Foreign Organizations. These organizations maintain their databases including R&D activities, Organizational Heads, etc. of the Member Institutions and regularly seek the updated information. The updated information on CRRI was provided to various organizations and the annual subscriptions were paid to continue the membership. The Institutional membership of the Institute is given on page 182.
Estate Services

- Civil
- Electrical
- MBSQ
Civil
Civil Engineering Support

Civil infrastructure works executed during 2016-17 are as follows:

- Development of Noise/Vibration laboratory for TP division at CRRI (Amount in lakhs: 5.60)
- Construction of toilets in PED division & Ramps for disable persons in the Institute (Amount in lakhs 11.23)
- Renovation of Account and E-II Section at IInd Floor of Administrative block of the Institute (Amount in lakhs 22.54)
Renovation of Raj Bhasha, E-I, Purchase & Photo Section at 1st floor of Administrative block of the Institute (Amount in lakhs 34.48)

Renovation / Repair of 72 Bigha area Boundary wall & Miscellaneous civil work at CRRI (Amount in lakhs 3.95)

Providing and Laying New Test Track for APTF Machine at CRRI (Amount in lakhs 13.16)

Renovation of laboratory of FP division and Soil Nailing laboratory of GTE division at CRRI (Amount in lakhs 9.49)
R & D Support Services

- Technical Support Division
- Computer Centre & Networking
**Technical Support Division**

Technical Services Division is responsible for the following:

The division is involved in Design & Development of Electronic and Mechanical Equipment, Repair of R&D equipment, Maintenance and installation of Electrical equipment, Repair and maintenance of Airconditioners, operation and maintenance of Air conditioning Plants and other temperature controlled equipment. Maintenance of Water Purifiers, Supervision of AMC for Telephone Exchange, Calibration of R&D equipment etc., besides handling the transport facility for smooth functioning of the Institute.

**Thrust Areas**

- Non – Destructive testing (NDT) of Pavements
- Calibration of Automatic Road Unevenness Recorder (ARUR) and Axle Mounted Roughness Measuring Device (AMRMD)
- Repair & maintenance of electronic equipment
- Design and development of mechanical equipment required by R&D divisions
- Repair of mechanical equipment
- Repair of electrical equipment
- Repair of temperature controlled equipment
- Repair of air conditioners and operation and maintenance of airconditioning plants
- Management of transport facilities for R&D and Administrative purposes
- Management of Institute’s vehicles

**Design and Development**

Design & Development of Gym Facilities for CRRI recreation club and CRRI staff quarters, Maharani bagh

**Calibration of Automatic Road Unevenness Recorder (ARUR)**

Automatic Road Unevenness Recorder
R&D Support Services
Technical Support Division

Out-door Gym developed for CRRI staff Quarters, Maharani Bagh

Out-door Gym developed for CRRI staff Club
(ARUR) units, comprising both Car Axle Mounted Bump Integrator and Fifth Wheel Bump Integrators, received from different manufacturers and user agencies, were calibrated using Dipstick, Class I equipment. Roughness measurements, using Dipstick and the Response Type Roughness Measuring Device, were undertaken on a number of selected test sections having varying roughness levels (excellent to very poor). Calibration equation between the observed roughness and the standard roughness is developed to determine the corrected / calibrated Roughness. Calibration certificate is issued to these agencies.

**Repair of R&D and other equipment**

Management of Communication facilities:

- 500 line EPABX MATRIX Exchange
- DRRI Office Siemens Exchange
- Operation & Maintenance of Internal Telephone Lines
- Public Address Systems

**Repair & Maintenance**

- 80 Nos. of 500 VA Offline UPS for Computer like NGPBS, Uniline, Samtek, other R & D Equipments like Electronic balances, CVTs
- Dipstick
- Network Survey Vehicle
- Disposal of Nucleonic Devices is in progress.
R&D Support Services

- Benkelman beam
- Automatic Soil Compaction Machine
- Compression Machine
- Automatic Bitumen Compactors
- Core Cutting Machine
- CBR Moulds
- UTM

Around 440 job card (excluding A.C. repairs) related to repairs and fabrication was completed during the reported period.

**Air conditioner Repairs and maintenance**
- The division undertakes in-house repair and maintenance of approximately 350 air conditioners of the Institute
- The division is also supervising Operation and Maintenance of Air Conditioning Plant.

**Transport section**
- Repair, maintenance and insurance etc. of staff cars and other instrumented vehicles are being taken care off.
- 10 nos. CRRI vehicles have attained their age of usage as per NGT orders. They are being processed for condemnation. Papers related the same are being prepared.
- Hiring of vehicles from CRRI approved external agencies for movement of CRRI staff for official purposes and processing their bills for payment.
The main objective and function of CCN Division is to meet the ICT requirements in R&D related with Road & Transport area.

CRRI’s LAN Infrastructure has been secured by Unified Thread Management System (UTM) security appliance for a complete enterprise class security solution with centralized management, logging, reporting and restrict unauthorized network use. The optimal performance of LAN is maintained and made perimeter protection intact.

CCN operates the connectivity through a fully networked campus with state-of-the-art IT infrastructure, computing & communication resources, offers Scientists and Research Scholars the facility of 24x7 uninterrupted, super-fast, reliable and secure Wifi Access having 53 Access Points and LAN Connectivity with 1GBPS NKN to carryout the R&D works in a easier manner.

The present LAN/IT system is supported by Layer 3 Core Switches, Layer 2 Edge Switches, Routers, Firewall, Access Control Server, Net Manager and Wireless Controller for its functionalities and operations.

The centralized Corporate Antivirus Security Solutions is provided with End-Point protection, Web reputation, URL filtering, etc. to all the computing devices in the institutes.

The regular IT Support facilitates the following areas

- Procurement of IT hardware and Software items
- Hardware and Software supports of all the IT equipments in CRRI including Servers, PCs, Printers, Laptops and various computer peripherals.
- Conducting Training programmes for increasing IT literacy among Group 1 and 2 Staff
- IT support for Seminars, and Video conferencing and webinars
- CRRI Home page development, maintenance and regular updates with latest news, events, tenders, RTI information, training programmes and recruitment details etc.
- Provides E-Mail facility to all the Staff in the institute.
- Alignment of CRRI with RTI Online, Govt of India portal.
Knowledge Resource Centre

- Documentation & Library Services
Documentation and Library Services
Prof. S.R. Mehra library provides information services to the staff of the Institute in the field of traffic, transportation and highway engineering. The library has a collection of over 90,000 publications including books, reference books, periodicals, conference proceedings, technical reports standards specifications, microfilms, maps, CD-ROM databases, video cassettes etc.

**Bibliographic Service**

Literature searches were carried out and bibliographic service was provided on request to researchers of CRRI on topics related to highway engineering and transportation.

**Reference Service**

Specific information provided on more than one hundred reference queries.

**Collection Development**

Publications like books, periodicals, conference proceedings, technical reports, CD-ROM databases, standards, related to roads, transport and related areas etc, were acquired for updating the library collection.

**Technical Processing**

Publications added to the collection were classified, catalogued, indexed and well maintained for efficient retrieval.

**Access to E-Journals**

Access to full text E-Journals is being provided through Internet from various publishers like WOS, ASCE, ASTM Digital Library, Taylor & Francis, Wiley, ICE, etc.

**Computerisation of Documentation and Library Services**

Database is being developed for the publications received in the library.

**E-CART Bulletin- Current Awareness in Roads & Transport**

A monthly current awareness service containing scanned content page of the current journals received in the library is e-mailed to individual scientists to make them abreast of latest developments in the field of transportation and highway engineering.

**Library Statistics**

- Book added during the period (01.04.2016 -31.03.2017) 242
- Total No. of books as on 31.03.2017 90,000
- Maps 688
- Microforms 655
- Videocassettes 122
- Periodicals titles received regularly (Foreign+Indian) 50
Quality Management
Quality Management Division is responsible to ensure that IS/ISO 9001:2008 Quality Management System operates effectively and efficiently in the Institute. Besides, adopting higher level of quality standards in the working of the Institute is also the mandate of the division during the year, the division was engaged in conducting internal quality audits: discussing the findings of the audit in the management review committee meetings; ensuring the Institute’s readiness for the external audits to be conducted by certification agency i.e. Bureau of Indian Standards (BIS) for the surveillance audit for higher level of quality standards in the working of the Institute.

**Internal Quality Audits (IQA)**

The Internal Quality Audits are systematic and independent examination of the system to determine whether the planned arrangements are implemented effectively and are suitable to achieve the objectives. The audit was carried out by trained quality auditors of the Institute with the following objective:

- To determine the conformity or non-conformity of the quality system elements with specified requirements.
- To determine the effectiveness of the implemented quality system in meeting the specified quality objectives.
- To provide the auditee with an opportunity to improve the quality system.
- To meet regulatory requirements.

During the internal audit, two aspects namely the requirements of the quality management system as defined in the Quality Manual and the Quality System Procedures were focused. The non-conformity reports (NCR) and corrective action report (CAR) were communicated to the auditees for ensuring the corrective and preventive actions. The action taken by the auditees were verified during the subsequent audit. NC’s were closed.

Two Internal Quality Audit of the Institute were carried out during 06/05/2016 & 23/05/2016 to 25/05/2016 and 22/08/2016 to 29/08/2016 to check whether the IS/ISO 9001:2008 QMS is effectively and efficiently in place in the Institute. The audit findings were discussed in the Management Review Meeting.

**Management Review Meeting (MRM)**

After the internal quality audits, the findings of the audit and its reports were discussed in the detail in the Management Review Committee. Besides the finding of the audits, the gray areas related to the functioning of the Institute were also discussed and resolved to ensure that Institute’s work is carried out as per the planned arrangements. The Quality Policies and Quality Objectives were reviewed to make them in line with each other keeping in view the mandate of Institute. The Quality Objectives were reviewed to ensure that they are quantifiable and measurable to meet the QMS requirement.

**Renewal of license for the Quality Management System Certification;**

License for the Quality Management System Certification was renewed for the period 02/02/2017 to 14/09/2018. Renewal audit was conducted by BIS from 08/12/2016 & 09/12/2016 and recommended for renewal.
राजभाषा
हिंदी परखवाड़ा (पक्ष)
सीएसआईआर–केंद्रीय सड़क अनुसंधान संस्थान (सीएसआईआर–सीआईआईआई). नई दिल्ली में दिनांक 14 सितंबर 2016 को हिंदी दिवस का आयोजन किया गया। इस उपलब्धि में दिनांक 07 सितंबर 2016 को संस्थान में 21 सितंबर 2016 तक चलने वाले हिंदी परखवाड़ा का उद्घाटन किया गया। इस अवसर पर, रवि प्रकाश टेकचंदानी, निदेशक, केंद्रीय हिंदी निदेशालय ने अपने भाषासाधनों के हिंदी के महत्व पर बांटने वाले विश्वासदेव बनाने के लिए अन्य भारतीय भाषाओं में उपलब्धि विशाल शब्द संप्रेषण के उद्योग बढ़ाने की आवश्यकता बताई।
हिंदी प्रख्यातियों के दौरान संस्थान के कार्यालयों के लिए विभिन्न हिंदी प्रतियोगिताओं यथा निबंध लेखन, राजभाषा पोस्टर प्रतियोगिता, कविता हिंदी में भाषण प्रतियोगिता तथा हिंदी शब्द ज्ञान प्रतियोगिता का आयोजन किया गया। प्रख्यातियों के अंतर्गत संस्थान के अनुभाग/प्रभागों के हिंदी कार्य की समीक्षा की गई। संस्थान के अनुसंधान एवं विकास कार्यों में हिंदी के प्रयोग में वृद्धि के उद्देश्य से ‘हिंदी में तकनीकी लेखन’ विषय पर एक पॉयंट प्रस्तुतीकरण भी रखा गया। हिंदी प्रख्यातियों के दौरान संस्थान में कविताओं के वाचन का एक सत्र भी आयोजित किया गया। सत्र के दौरान श्री आर.पी. जोशी, सहायक महाप्रबंधक (रामा), एयर इंडिया लिमिटेड ने अपनी कई कविताएं पढ़ कर सुनाई। इस सत्र में संस्थान के कुछ कार्यालयों ने अपनी स्वयंसेवक कविताएं भी प्रस्तुत की।

प्रख्यातियों के दौरान संस्थान के कार्यालयों में हिंदी के कार्य के प्रति रुझान एवं उत्साह का संचार करने के लिए हिंदी
कार्यालय का आयोजन भी किया गया। हिंदी दिवस के अवसर पर 14 सितंबर 2016 को संस्थान में विशिष्ट हिंदी व्याख्यान का आयोजन किया गया। आमंत्रित अधिकारियों के रूप में श्री बलदेव माई शर्मा, अध्यक्ष, राष्ट्रीय पुस्तक न्यास ने समारोह की शामी बढ़ाई तथा अपने व्याख्यान में हिंदी दिवस तथा हिंदी की महत्ता को प्रतिपादित किया। हिंदी पखवाड़े का समापन एवं पुरस्कार वितरण समारोह दिनांक 21 सितंबर 2016 को आयोजित किया गया। संस्थान के कार्यालय को संबोधित करते हुए निदेशक प्रो. सतीश चंद्र ने कहा कि आम जनता तक वैज्ञानिक उपलब्धियों की जानकारी राजभाषा के माध्यम से पहुँचाया जाना नितांत आवश्यक है।
हिंदी पाक्वरा (प्रवक्तता)

CSIR-CRRI celebrated Hindi Day on September 14, 2016. On this account, Hindi Pakhwara was inaugurated on 7th Sept. 2016. Several Competitions such as Essay writing, Hindi Poster, Poem recitation, Debate and Hindi speech were organised. The pakhwara was marked by the presence of eminent dignitaries like Prof. Ravi Prakash Tekchandani, Director, Central Hindi Directorate and Professor, Delhi University; Sh. Baldev Bhai Sharma, Chairmen, National Book Trust, New Delhi and Shri R.P. Joshi, Asst. Director General (Rabha), Air India Ltd.

A review of the progress regarding Hindi work of different section and divisions of the institute was also made during the Hindi Pakhwara. So as to encourage the progressive use of Hindi in R&D works of the scientific divisions a power point presentation was organized on “Hindi mein takniki lekhan”. A special session of poem recitation was held for the staff members in which Shri R.P. Joshi, Air India Ltd. recited some of his beautiful poems.

The closing ceremony & Prize Distribution ceremony of Hindi Pakhwara was organized on 29th Sept. 2015. Dr. S. Gangopadhyay, Director, CSIR-CRRI presided over the closing ceremony. Sh. Harinder Kumar, Director Deptt of Official Language, Ministry of Home Affairs delivered the keynote lecture on this occasion. He dwelt upon the role of Hindi in official work and the need to ensure its progressive use in our day to day work.

All those staff who had done commendable work in Hindi during the last financial year were given awards. Winners of different Hindi competitions were given cash prizes and certificates for their performance. Staff members recognized for their remarkable noting & drafting in Hindi were honoured as per the Incentive prize scheme. The inauguration as well as the closing ceremony was conducted successfully by Shri Sanjay Choudhary, I/C Hindi Section.

हिंदी व्याख्यान

राजभाषा अनुभाग द्वारा हिंदी व्याख्यान का आयोजन किया गया। श्री आशुतोष अशुल ने “सड़क सुरक्षा लेखापरीक्षा – क्या और कैसे” एवं श्री आर के मांझी ने “सड़क सुरक्षा परीक्षण” पर दिनांक 10/03/2017 को प्रस्तुतीकरण दिया।
हिंदी टेबल कार्यशाला का आयोजन

संस्थान में अनुसंधान व विकास (R&D) प्रमाणों द्वारा किए जा रहे हिंदी कार्य की समीक्षा करने हेतु दिनांक 29/03/2017 को एक दिवसीय हिंदी टेबल कार्यशाला का आयोजन किया गया। इस दौरान प्रमाणों में जाकर हिंदी कार्य की प्रत्यक्ष जांच की गई। धारा 3(3) के पूर्णत: अनुपालन तथा संसदीय राजनीति समिति की दूसरी उपसमिति को दिए गए आश्वासनों को पूर्ण करने के लिए गणतंत्र से प्रयास करने पर बल दिया गया। सभी अधिकारियों एवं कार्मिकों ने हिंदी कार्य की मात्रा को बढ़ाने हेतु पूर्णत: सहयोग करने का आश्वासन दिया।

हिंदी में व्यक्तियों/तकनीकी प्रस्तुतीकरण
1. शहरी ढारा सड़कों का सीमेंट कंक्रीट परत से सुधारकरण – श्री बिनोद कुमार, प्रमुख, आरआरएस
2. ‘पैदल यात्री की सेवा के रंग को मापने के लिए एक पद्धति’ – डॉ. मुक्ति आडवाणी, वैज्ञानिक, टीपी
3. ‘सीआरआरएस में परिवहन प्रबंधन’ – श्री आर एस भारद्वाज, प्रभागीय प्रमुख, टीएसडी
4. ‘गुणवत्ता योजना’ – श्री आर एस भारद्वाज, प्रभागीय प्रमुख, टीएसडी
5. ‘हिंदी में तकनीकी लेखन’ – डॉ. नीरज शर्मा, वरिष्ठ प्रमाण वैज्ञानिक, इंजीनियर
6. ‘सरकारी नीतियों के कार्यान्वयन में हिंदी का महत्व’ – प्रो. रवि प्रकाश टेकचंद, निदेशक, केंद्रीय हिंदी निदेशालय व प्रोफेसर, दिल्ली विश्वविद्यालय,
7. ‘हिंदी एवं अन्य भारतीय भाषाएं’ – श्री बलदेव भाई शर्मा, अध्यक्ष, नेशनल बुक ट्रस्ट, नई दिल्ली।

Hindi Lecture/Technical Presentation in Hindi
1. Shehari Damar sarakon ka cement concrete parat se sudridhikan – Sh. Binod Kumar, HOD, RPD
2. Paidal yatri ki sewa ke satar ko maapne ke liye ek padhati – Dr. Mukti Advani, Sr. Scientist, TP
3. CRRI mein parivahan parbandhan – Sh. R.S. Bhardwaj, HOD, TSD
4. Gunvatta Yojana – Sh. R.S. Bhardwaj, HOD, TSD
5. Hindi mein Takniki Lekhan – Dr. Niraj Sharma, Sr. Principal Scientist, ES
6. Sarkari Nityon ke karyanvayan mein Hindi ka mahtva – Prof. Ravi Prakash Tekchandani, Director, Central Hindi Directorate and Professor, Delhi University.
Memorable Events
Memorable Events

National Technology Day

11th May is observed as National Technology Day each year all over India to commemorate the technological breakthrough made by India. The Institute celebrated National Technology Day on 11th May, 2016.

Shri T.K. Amla, Head (ILT), gave a brief background of National Technology Day Celebration. While Prof. (Dr.) Satish Chandra, Director, CSIR-CRRI introduced the Chief Guest and delivered the welcome address. Dr N.S. Raman, Deputy General Manager – Bitumen, Extraction & Distillation, IOC R&D Centre, Faridabad graced the occasion as the Chief Guest and delivered a lecture on “Technology: A Nation’s Priority for Prosperity”.

Celebration of International Yoga Day at CSIR-CRRI

21st June is observed as International Yoga Day each year all over the world. CSIR-CRRI celebrated International Yoga Day in its premises from 21-24 June 2016. During this period, Yoga exercise session for the Institute’s staff, for the duration of one hour in the morning, was conducted by Dr. Neelam J. Gupta, Principal Scientist, in the presence of Prof. (Dr.) Satish Chandra, Director, CSIR-CRRI. More than 100 staff member attended the Yoga session.
One day Workshop on Soil stabilization

A one day workshop on Soil stabilization at Patna in the month of July 2016 was organised by BSRDC Ltd., for the Engineers of BSRDC Ltd., Road Construction Department of Govt. of Bihar, NHAI Regional Office, Contractors and Academicians from IIT, Patna & NIT, Patna. Representatives of Construction Industry were also present.

Independence Day

On the occasion of 69th Independence Day, Prof. Satish Chandra, Director, CSIR-CRRI hoisted the National Flag on August 15, 2016. The function was attended by the staff members alongwith their family members. Devotional and patriotic songs were recited on this occasion by the wards of CRRI staff members.
Memorable Events

Hindi Pakhwada (Fortnight)

Hindi Pakhwada (fortnight) was organized during 07th September, 2016 to 21st September, 2016 at CSIR-CRRI, New Delhi. Several competitions related to Hindi Poster, Hindi Essay Writing, Hindi Terminology Knowledge and Hindi Speech, etc. were organized during the fortnight. About 100 employees of the institute participated in different competitions.

The inaugural function was organized on 07th September, 2016. On this occasion Prof. Satish Chandra, Director, CSIR-CRRI called on the employees to do most of their work in Hindi. The function was graced by Prof. Ravi Prakash Tekchandani, Director, Central Hindi Directorate. Prof. Tekchandani stressed upon the importance of Hindi in the implementation of official policies and called upon everyone present to utilize the vocabulary available in other Indian languages which will also ensure the progressive popularity of Hindi.

Hindi Pakhwada was marked by various programs and these were organized mainly to motivate the employees to work in Hindi. A power point presentation on the topic ‘Hindi mei takniki lekhan’ was made on 13th September 2016. A Hindi workshop was also organized on 16th September, in which Smt. Tanuja Sachdev, Assistant Director, Central Hindi Training Institute was invited as the expert faculty member. She delivered two lectures on ‘Sarkari kamkaj mein Hindi karye ki anivaarya’ and ‘Tippani evam praroop lekhan’ and also gave practice work to the participants.

Hindi Diwas was celebrated on 14th September 2016. Shri Baldeo Bhai Sharma, Chairman, National Book Trust was the chief guest. The Chief Guest also a delivered special lecture and asserted that Hindi is gaining popularity day by day which can be further increased by using simple and popular words. Simple language will help more participation of non-Hindi officers in increasing use of Hindi in official work. Shri B.M. Sharma, Chief Scientist, encouraged all the employees to regularly work in Hindi ensuring its increasing and for progressive use. Miss D.Vijayalakshmi, COA stated that CSIR-CRRI has been making good progress in Hindi work which should be continued in future also.

Closing ceremony and prize distribution function was organized on 21st September, 2016. On this occasion, prizes were given away to the winners of different competitions and also to the employees for their commendable work related to original noting and drafting done in Hindi. Speaking on this occasion, Director, CSIR-CRRI urged all CSIR-CRRI employees to do routine work in Hindi and also review the quantity of Hindi work being done by them on regular basis.
CSIR Foundation Day Celebration

CSIR Foundation Day was celebrated on September 27, 2016. On this occasion, Dr. M.P. Dhir, Ex-Director, CSIR-CRRI, New Delhi was the Guest of Honour while Dr. Rohit Baluja, President, Institute of Road Traffic Education, New Delhi & Director, College of Traffic Management, Faridabad was the Chief Guest. The function was attended by the Scientists, employees and ex-colleagues of CSIR-CRRI. Prof. Satish Chandra, Director, CSIR-CRRI addressed the gathering and highlighted the progress and journey made by CSIR-CRRI over the years. Various prizes were given away by Dr. Rohit Baluja, to the winners of various competitions organized by CSIR-CRRI for the children of CSIR-CRRI’s employees. CSIR-CRRI employees, who had completed 25 years of service in CSIR and all those who had retired during September 2015 to August 2016, were also honoured and mementoes were presented to them by the Director.
Memorable Events

Vigilance Awareness Week

Vigilance Awareness Week was observed at CSIR-CRRI from 31st October to 5th November 2016. On October 31, 2016, a pledge administered by the Director, CSIR-CRRI was taken by the staff members for maintaining integrity and continue to strive in bringing about transparency in all spheres of life. On these days signing on Integrity Pledge by each staff member of CSIR-CRRI, banners and posters were displayed at the prime location in the premise of this Institute. Slogan writing competition on “Public Participation in Promoting Integrity and Eradicating Corruption” was organized for the staff members. The winners of the competitions were also awarded on this occasion.

Science Fest, Open Day & Technical Exhibition

On the request of Ministry of Science & Technology and Ministry of Earth Sciences, Govt. of India and in association with Vijnana Bharti, a Public Outreach Programme, as a precursor event of IISF-2016, was organised at CSIR-CRRI on 11th November 2016.

The one day Public Outreach Programme was organised for School Students as well as for Civil Engineering students and general public which included their visit to the Institute on 11th November 2016 (F/N & A/N). Scientists of the Institute explained the students about the research activities being pursued in this Institute, through short films, popular science lectures and technical exhibitions etc. About 700 students from various schools/colleges visited CRRI and participated in the Outreach Programme. A Science Quiz was also organised in which 12th class students participated.
Memorable Events
Ekta Divas

On the eve of “Communal Harmony Campaign and Fund Raising Week”, a National Integrity Pledge was taken by all the staff of CSIR-CRRI on 18th November, 2016.

Pledge

The Govt. of India Celebrated 125th Birth Anniversary of Dr. B.R. Ambedkar as the Constitution Day on 26th November 2016. As part of celebration “The Preamble to the Constitution of India” was read out by Shri T.K.Amla, Chief Scientist in the presence of all the staff of CSIR-CRRI.
New Year Celebrations 2017

A get-together was organised on the occasion of New Year Day at CSIR-CRRI on 2nd January 2017. Prof. Satish Chandra, Director CSIR-CRRI, in his address highlighted the achievements of the Institute during the preceding year (2016) and expressed the hope the scientists and technologists will do more R&D work in the coming year and motivated the CRRI family to meet new challenges. Prof. Satish Chandra extended best wishes to all the staff members and their families.

Road Safety Week

Road Safety Week was observed to increase understanding of the dangers related to high speeding and other risk-taking practices, thereby saving lives on the roads. As a part of Road safety week, various activities were conducted by CSIR-CRRI team for Bicycle safety, two wheeler safety, bus safety and pedestrian safety awareness campaign from 9th January to 13th January 2017.

Following activities were carried out during this week. One of the main themes was pedestrians’ safety campaign in which approximately, 5000 pamphlets in bilingual languages and full length Road Safety banners were prepared for showing safety aspects for pedestrians and bicyclists safe movements and safety rules. From 8 a.m. morning till evening many Road Safety Banners showing safe activities and road safety rules for all categories of road users were fixed to the all over walls of institute promises so that all road users commuting on the NH-2 can see and learn from them. Posters and Pamphlets were distributed among pedestrians and vehicle users on Delhi-Mathura Road.
Another main theme was Road Safety Awareness Campaign for Safe & Smart Two Wheeler Riders, this activity was carried out on NH-2 near CSIR-CRRI Premises on 10th January 2017. As a part of this activity CSIR-CRRI team along with Trax S. Society distributed about 500 pamphlets showing safety for two wheeler riding behaviour and wearing helmet while riding. With the help of traffic police the riders who were not wearing helmets were given road safety pamphlets and also road safety tips. Community feedback is a vital part of creating safer roads for all; for this, every two wheeler rider was given one flower for inspiring to follow road safety rules and wearing proper and standard helmet. It was observed that some of those riders who were not wearing helmets instantly wore helmets after this campaign.
Memorable Events

Road Safety Awareness Campaign outside CSIR-CRRI Premises

During third day main theme was Road Safety Awareness Campaign for Safe Bicycle Riding Activities among School Children. As a part of this activity team has visited Sarvodaya Bal Vidyalaya, Mithapur for road safety awareness campaign for safe bicycle riding among School Children. Designed banners and distributed pamphlets on site and among children too. Interactive session and quiz conducted for school children on road safety. More than 150 Retro Reflective tapes have been fixed on bicycles of school children and on site bicycles and cycle rickshaws for easy spotting by drivers of other vehicles at night to prevent crashes.

Half Day Workshop on Road safety was jointly organised by CSIR-CRRI and Trax. S. Society with the target of creating awareness about road safety among school children. On fifth day the main theme was creating Road Safety Awareness Campaign among Bus Drivers, for this perspective various posters and placards were made and pamphlets were distributed near designated area adjoining road NH-2 near CSIR-CRRI Premises on 13th January 2017 to create awareness among bus drivers. Bus drivers were advised to follow bus bay and not to hinder the pedestrian movements. Traffic police officers helped during all these activities.
**Free Eye and Dental Check-Up Camp**

CSIR-CRRI Recreation Club organised a Free Eye and Dental Check-Up Camp on 15\textsuperscript{th} February 2017 and 18\textsuperscript{th} February 2017 for the benefit of CRRI staff and their families, staying at Maharani Bagh Staff Quarters and Scientist Apartments, Ashram Chowk respectively. More than 200 staff members got benefited through these camps.

**One day Workshop on Plaxis (2D&3D) Softwares**

M/S Ram Caddsys Pvt. Ltd., Chennai, organised a one day Workshop on Plaxis (2D&3D) Softwares for R&D applications on 10\textsuperscript{th} Feb., 2017 at CSIR-CRRI, New Delhi.

**National Science Day Celebration**

To commemorate the discovery of Raman Effects made by Sir C.V.Raman, the Institute celebrated National Science Day on February 28, 2017. Dr. Ajay Ranka, Managing Director, M/s Zydex Industries Pvt. Ltd., Vadodara graced the occasion as the Chief Guest and delivered National Science Day Lecture on “Future Technologies for Pavement 2040”. On this occasion, Prof Satish Chandra, Director, CSIR-CRRI, highlighted the background of celebrating National Science Day while Sh. T. K. Amla, Head, ILT Division proposed the Vote of Thanks and conveyed gratefulness to the Chief Guest for sparing his valuable time.
Memorable Events

National Dissemination Workshop on “Development and Application of Technologies for Sustainable Transportation (SUSTRANS)”

12th Five Year Plan Network Project (ESC-0106) March 17, 2017

Venue: CV Raman Hall, CSIR-CRRI, New Delhi – 110025

Organized by CSIR-Central Road Research Institute (CRRI), New Delhi

In association with CSIR-NAL, Bangalore, CSIR-CSIO, Chandigarh and CSIR-CLRI, Chennai

The National Dissemination Workshop on “Development and Application of Technologies for Sustainable Transportation (SUSTRANS)” was organised as a part of XII Five Year Plan Network Project sponsored by CSIR. The program started around 10:00 AM with Inauguration Session, in which Sh. Durga Shanker Mishra, IAS, Addl. Secretary, Ministry of Urban Development (GOI) as Chief Guest and Dr. Manoj Singh, Adviser, NITI Aayog (GOI) as Guest of Honour have graced the occasion. Dr. Errampalli Madhu, Principal Scientist, CSIR-CRRI, also Champion (SUSTRANS) gave a brief introduction on conceptualisation, objectives and execution of project SUSTRANS. Prof. Satish Chandra, Director CSIR-CRRI has emphasised the achievements from SUSTRANS namely Car Driving Simulator, Guidelines for sustainable public transport and Non-motorised transport and sustainable roads. Both Sh. Mishra and Dr. Singh highly appreciated the efforts carried out by CRRI namely patents, publications, technology leads that have emerged in the SUSTRANS project suggested to take these findings to implementing agencies, practicing engineers so that the actual benefits can be achieved by the nation. Shri. Binod Kumar, Principal Scientist, CSIR-CRRI, also Co-Champion (SUSTRANS) proposed the vote of thanks. Photos below show the inaugural session presentations.
Memorable Events

Technical sessions divided into transportation and roads areas. Transportation Session - I is on Sustainability through Strengthening of Existing Public Transport System covering the Development of quality enhancement of public transport system, Development of feeder transport system and parking facilities at public transport terminals, Development of policy level sustainable strategies to restrict/control usage of private vehicles and Design of advanced public transport information systems using ITS technologies. This session was chaired by Dr. S. Gangopadhyay and the Photo below shows the Transportation Sessions I presentations.

Transportation Session II theme is based on Sustainability through Modelling, Evaluation and Safety which covered on Sustainable integrated mass transportation system, Evaluation through Sustainability Index for public transport, Sustainable Non-Motorised Transport (NMT) System and Road Safety Enhancement through Car Driving Simulator. This session was chaired by Dr. T. S. Reddy and the Photo below shows the Transportation Sessions II presentations.

Roads Session I theme is based on Sustainable Roads utilizing Waste Materials focussing on Utilization of Industrial Waste Materials in Road Construction, Conversion of Chromium from Leather Industry Waste into Road Construction Material and Utilization of RAP materials in road construction. This session was chaired by Sh. D. P. Gupta and the Photo below shows the Roads Sessions I presentations.
Memorable Events

Roads Session II theme is based on Sustainable Roads through Innovative Designs and Mixes focussing on Improved designs, materials and mixes towards Sustainable Roads, Superior Performance Bitumeneous Pavements (SUPERBITPAVE), Low Cost and Energy Pavements through Emulsion based Warm Mix Design and Estimation of carbon footprints in the road construction process. This session was chaired by Prof. Animesh Das and the Photo below shows the Roads Sessions II presentations.

In the Concluding Session, Dr. Errampalli Madhu and Sh. Binod Kumar presented the observations from different session from Transportation and Roads respectively and the way forward. Prof. Satish Chandra Director CSIR-CRRI has chaired this session. The Work shop ended with the vote of thanks as shown in photo below.

Dissemination Workshop on Indian Highway Capacity Manual (Indo – HCM)

This article describes the Dissemination Workshop on Indian Highway Capacity Manual (Indo - hcm) study undertaken by the CSIR - CRRI at the national level to develop the Indian Highway Capacity Manual (henceforth referred to as 'Indo-HCM'). Indo-HCM is being executed by CSIR - CRRI in coordination with some of the reputed academic institutes in the country which includes, Indian Institute of Technology (Roorkee), Indian Institute of Technology (Mumbai), Indian Institute of Technology (Guwahati), School of Planning and Architecture (Delhi), Sardar Vallabhai Patel National Institute of Technology, (Surat), Indian Institute of Engineering & Science University (IIEST), Shibpur, (Howrah) and Anna University (Chennai). This article briefly describes the above research endeavour by elaborating on study methodology for capacity estimation, Level of Service (LoS) and the associated study deliverables of varying types of Indian road facility.

As an outcome of the 12th Five Year Plan research output, a Manual on "Indian Highway Capacity Manual has been Developed on the extensive field studies carried out covering the length and breadth of the country. The manual outlines the evolved capacity and Level of Service (LoS) of varying types of road way facilities and the procedure towards their estimation dealt under the following chapters:

Chapter 1: Basic Concepts
Chapter 2: Two Lane, Intermediate and Single Lane Carriageways
Chapter 3: Multilane Interurban Highways
Chapter 4: Interurban and Urban Expressways
Chapter 5: Urban Roads
Chapter 6: Signal Controlled Intersections
Chapter 7: Roundabouts
Chapter 8: Uncontrolled Intersections
Chapter 9: Pedestrian Facility
Chapter 10: Reliability as a Performance Measure for Interurban and Urban Arterials

The above study findings were discussed in the national dissemination workshop as part of the above project by CSIR-CRRI on 20th and 21st February, 2017. The above dissemination workshop was well attended by about 250 delegates comprises of Regional Coordinators and invitees as shown in Photo. Photo below shown the inaugural session, has been inaugurated by by Shri. R.K.Pandey, Member (Projects), NHAI, New Delhi, told in his inaugural speech that, this study is the one of landmark study in India, which is well executed by CSIR-CRRI along with seven Institutes in India. Professor Satish Chandra given Presidential Address, and explained how this study has been formulated and executed being one of Regional Coordinator and subsequently in charge to this study after taking charge of Director, CSIR-CRRI. Dr S Velmurugan, champion to this project given overview about the study and Dr Kayitha Ravinder proposed the vote of thanks. The study results were disseminated in the workshop under five sessions comprising of Basic concepts, Uninterrupted Flow (Single Lane, Intermediate Lane and Two lane Carriageways, Multi lane Highways and Expressways), Interrupted Flow (Urban Roads, Signal Controlled Intersections, Roundabouts and Unsignalized Intersections), Pedestrian Facility & Travel Time Reliability. The concluding session mainly concentrated on how to go publication of this manual either under the umbrella of IRC/MoRTH/CSIR-CRRI. Presently the study team planned to unveil this manual in the month of July 2017 for the formal release by the related union minister, government of India.
Memorable Events


Auto Fuel Policy-2003 formulated based on the recommendations of Mashelkar Committee, had identified the need to bridge the research gaps and align the work of different organizations working on vehicular emission reduction. The committee had also recommended the creation of a research network to bring together all organizations working on vehicular emission reduction and mandate - for mutual collaboration and alignment. However, no such collaboration could be established as on date and considerable research gaps that hinder policy formulation continue to exist even today.

CSIR- Central Road Research Institute, New Delhi with support from Shakti Sustainable Energy Foundation (SSEF) under agreement no. P16 SSEF dated 07-09-2016 organised a national workshop on 23rd January 2017 to take forward the recommendations of Mashelkar Committee and to create a network of research organizations, institutions, academicians and individual researchers working on vehicular emission reduction related issues. The purpose of this network will be to initiate a dialogue among its members to establish a common research agenda that would be aligned with the requirements of national level policy. This network will also provide a platform for collaborations amongst the members through joint research and sharing of knowledge, expertise and experience including peer learning.

Estimation of Fuel Consumption during Idling of Vehicles at Bhikaji Cama Intersection and Savings after Employing Suitable Mitigation Measures sponsored by PCRA, New Delhi

Workshop was organised on 24th March 2017 for the dissemination of the project. Various stack holders, transport planners and engineers have attended the workshop.
Memorable Events

Workshop on Soil Stabilization

हिंदी व्याख्यान
राजभाषा अनुसार हिंदी व्याख्यान का आयोजन किया गया। श्री आशुतोष अरुण ने “सड़क सुरक्षा लेखापरीक्षा – क्यों और कैसे” एवं श्री आर के मांझी ने “सड़क सुरक्षा परीक्षण” पर दिनांक 10/03/2017 को प्रस्तुतीकरण दिया।

हिंदी टेबल कार्यशाला का आयोजन
संस्थान में अनुसंधान व विकास (R&D) प्रारंभों द्वारा किए जा रहे हिंदी कार्य की समीक्षा करने हेतु दिनांक 29/03/2017 को एक दिवसीय हिंदी टेबल कार्यशाला का आयोजन किया गया। इस दौरान प्रमाणों में जाकर हिंदी कार्य की प्रत्यक्ष जांच की गई। धारा 3(3) के पूर्णत: अनुपालन तथा संसदीय राजनीति समूह की दूसरी उपसमिति को दिए गए आश्वासनों को पूर्ण करने के लिए गर्भितता से प्रयास करने पर बल दिया गया। सभी अधिकारियों एवं कार्यकर्ताओं ने हिंदी कार्य की मात्रा को बढ़ाने हेतु पूर्णत: सहयोग करने का आश्वासन दिया।
Memorable Events

Meetings

- 7th & 8th Task Force Committee Meetings of ELSIM Project (12th Five Year Plan) were held on 4th October, 2016 & 23rd December, 2016 respectively to discuss the progress of the project.
- Sectoral Monitoring Committee meeting was held on 17-18 February 2017.
- 48th Management Council Meeting held on 9th March 2017.
Honors & Awards
Honours & Awards

- Shri Anil Kumar Sinha was awarded his Ph.D. degree in Civil Engineering from NIT, Kurukshetra. The Title of his Ph.D thesis is “Strength and deformation behavior of Jarofix waste material for embankment construction”.

- Dr. Ambika Behl, Scientist, Flexible Pavement Division presented poster on “Use of waste PVC in road construction” under the theme “Waste to Wealth”, during IISF held on 7th -11th November 2016 at CSIR-NPL New Delhi. Dr. Ambika Behl won Best Poster Award, which was presented to her by Dr. Harshvardhan, Hon'ble Union Minister of Science and Technology, Govt. of India.

- Dr. Ambika Behl was the session chair, keynote speaker and mentor at researcher links workshop titled, "Urban Air Pollution in Indian and UK Cities: Characterization and Prediction of Chemically Reactive Air Pollutants", sponsored by RCUK and British Council, India at IIT- Delhi from 28th November to 1st December 2016.

- Shri Satish Pandey, Sr. Scientist, Flexible Pavement Division was elected as the Council Member at 77th Annual Session of Indian Roads Congress held at Hyderabad, Telangana.

- Siksha Swaroopa Kar was awarded Best Poster Award at Conference on Sustainable Asphalt Pavement for Developing Countries, CSIR-CRRI, Delhi, 11-12 March 2016.

- National Research Development Corporation of India (NRDC) has awarded Innovation Award-2014 to the technology “Design and Development of an Indigenous Mobile Bridge Inspection Unit (MBIU)” developed by CSIR laboratories namely CSIR-CRRI, New Delhi and CSIR-CMERI-CoEFM, Ludhiana) on 24th March 2017. This award carried Rs five lacs prize for the team. Dr. Rajeev Kumar Garg, Chief Scientist of CSIR-CRRI led the team (Principal Investigator) of this technology for which CSIR and Department of Science and Technology (DST), New Delhi provided the funds.

- Dr. Rajiv Kumar Garg, Senior Principal Scientist, BES Division and Dr. Ch. Ravi Sekhar, Senior Scientist, TP Division have received achievement award 2017 under Construction Industry Development Council (CIDC) Award in the category of Scientist on 7th March 2017.

- Highly Commended Paper Award Emerald Literati Awards for Excellence 2015-2016 for the paper entitled “Effect of type of lead vehicle on following headway behaviour in mixed traffic” in the journal “World Journal of Science, Technology and Sustainable Development”, date & Name 05-11-2015, to Dr. Ravinder Kumar.
The institute had undertaken the assignment of ‘Design and Compliance Verification’ of the heavy vehicle dynamic test track at VRDE (DRDO), Ahmednagar. The approved design was executed in 2014 to the highest standards and the institute was also involved during the execution phase for required verifications and guidance. As a result, the track was established and is being utilized for vehicle dynamics testing purpose.

After more than two years of service of the test track, a letter of appreciation has been received on 18th March, 2017 for exemplary work carried out by team of S/Sh. M. N. Nagbhushana, Principal Scientist, FP Division and Shankh Das, Senior Technical Officer, FP Division commending the Institute's inputs.
Lectures Delivered
<table>
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<tr>
<th>S.No.</th>
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<th>Title of Lecture/Speech</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>1</td>
<td>Dr. Ravindra Kumar</td>
<td>Driving cycle and application of GIS in Transportation Planning</td>
<td>Five Days Self Sponsored STTP On Road Planning, Design, Construction, Operation, Evaluation, And Rehabilitation, SVNIT, Surat</td>
<td>13.05.2016</td>
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<td>2</td>
<td>Dr. S.Velmurugan</td>
<td>Traffic Stream Parameters: Speed, Flow and Density</td>
<td>Invited Talk during the Certification Course titled, &quot;Road Safety Auditors&quot;, conducted by IAHE - ARRB - IRF and organised by IAHE, Noida.</td>
<td>25.05.2016</td>
</tr>
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<td>3</td>
<td>Dr. Ch. Ravi Sekhar</td>
<td>Basic Statistics for Traffic Engineering: Probability &amp; Statistics, Normal Distribution, Other Distributions, Hypothesis Testing.</td>
<td>Certification for Road Safety Engineers and Auditors, Organised by Indian Academy of Highway Engineers in association with ARRB and IRF, Noida</td>
<td>25.05.2016</td>
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<td>4</td>
<td>Dr. Mukti Advani</td>
<td>Sustainable Transport Planning : Non-motorised and Public Transport</td>
<td>Invited Presentation in the Special Session - 1 (SS-1) of the 14th World Conference on Transport Research (WCTR) held at Shanghai, China on the progress achieved in the above two XII FYP projects sponsored by CSIR</td>
<td>13.07.2016</td>
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<td>7</td>
<td>Shri Binod Kumar</td>
<td>“Rigid Pavements in India–Understanding Past and Moving Ahead”,</td>
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<td>8</td>
<td>Dr. S.Velmurugan</td>
<td>Road Safety Issues and Redressing Mechanism through Road Safety Audit</td>
<td>Invited Lecture for about 60 practicing engineers of Odisha Works Department (OWD) in the Workshop on Road Safety, Automated Data Collection and HDM Analysis held at Bhubaneswar.</td>
<td>19.08.2016</td>
</tr>
<tr>
<td>10</td>
<td>Dr. Kishor Kumar</td>
<td>Structural and Non-structural Measures for Landslides</td>
<td>SAARC Regional Training Programme on “Landslide Risk Mitigation and Management in South Asia”, held at NIDM, New Delhi.</td>
<td>31.08.2016</td>
</tr>
<tr>
<td>11</td>
<td>Dr. S.S. Gaharwar</td>
<td>Health Monitoring of Bridges</td>
<td>National Seminar on ‘Role of Engineers on Modern &amp; Fast Development of India”, organized by Delhi Development Authority, Vikas Sadan, New Delhi, ‘Engineers’ Day Celebrations.</td>
<td>15.09.2016</td>
</tr>
<tr>
<td>12</td>
<td>Dr. S.Velmurugan</td>
<td>Road Safety Condition of Indian Roads: An Important Indicator of Urban Development</td>
<td>Invited Lecture in Seminar on &quot;Role of Civil Engineers in Make in India” organised by Institution of Civil Engineers, New Delhi.</td>
<td>15.09.2016</td>
</tr>
<tr>
<td>14</td>
<td>Dr. Anuradha Shukla,</td>
<td>Heat, Transport and Air Pollution</td>
<td>Sectoral Expert Speaker at National Consultation on Roadmap for Heat wave Management in India. at Hotel Park in New Delhi</td>
<td>21.09.2016</td>
</tr>
<tr>
<td>S.No.</td>
<td>Name of the staff</td>
<td>Title of Lecture/Speech</td>
<td>Purpose</td>
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</tr>
<tr>
<td>16</td>
<td>Dr. S. Velmurugan</td>
<td>Road Safety Issues and Redressing Mechanism through Road Safety Audit</td>
<td>Invited Lecture for about 75 practicing engineers / planners of M/s Highway Concession Limited and their consortium</td>
<td>30.09.2016</td>
</tr>
<tr>
<td>17</td>
<td>Dr. (Prof.) Satish Chandra</td>
<td>Role of CSIR-CRRI in nation Building</td>
<td>National Workshop on Opportunities and Challenges for Regional Innovation System at CSIR-NISTAD, New Delhi</td>
<td>07.10.2016</td>
</tr>
<tr>
<td>18</td>
<td>Dr. (Prof.) Satish Chandra</td>
<td>Development of Indian Highway capacity manual – Issues and Challenges</td>
<td>Invited lecture at IIT Madras for students</td>
<td>19.10.2016</td>
</tr>
<tr>
<td>19</td>
<td>Dr. (Prof.) Satish Chandra</td>
<td>Role of Civil Engineers in nation Building</td>
<td>Invited Lecture at IIT BHU, Banaras for students</td>
<td>24.10.2016</td>
</tr>
<tr>
<td>20</td>
<td>Shri P. S. Prasad</td>
<td>Landslide investigations and design of remedial measures</td>
<td>National Workshop on Recent Advances in Civil Engineering (NWRACE 2016) Bankura Unnayani Institute of Engineering, Bankura, West Bengal.</td>
<td>24.10.2016</td>
</tr>
<tr>
<td>21</td>
<td>Dr. Ravindra Kumar</td>
<td>Evaluation of Sustainable Urban Public Transportation System using AHP and DS Theory-A Case Study of ODD Even Scheme in Delhi</td>
<td>Sustainable Urban Transportation for Patna; A Curtain Raiser” organised by National Institute of Technology, Patna.</td>
<td>27.10.2016 to 28.10.2016</td>
</tr>
<tr>
<td>22</td>
<td>Prof. Satish Chandra</td>
<td>Joy and Challenges of being a Civil Engineer</td>
<td>Invited lecture at Jamia Millia Islamia University for students</td>
<td>10.11.2016</td>
</tr>
<tr>
<td>23</td>
<td>Dr. Anuradha Shukla</td>
<td>Urban Air Pollution in Indian and UK cities: Characterization and Prediction of Chemically Reactive Air Pollutants</td>
<td>Session chair, keynote speaker and mentor at researcher links workshop sponsored by RCUK and British Council India at IIT Delhi.</td>
<td>28.11.2016 to 01.12.2016</td>
</tr>
<tr>
<td>S.No.</td>
<td>Name of the staff</td>
<td>Title of Lecture/Speech</td>
<td>Purpose</td>
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<tr>
<td>25</td>
<td>Dr. (Prof.)Satish Chandra</td>
<td>Measurement of density under mixed traffic conditions</td>
<td>Keynote during 12th International conference on Transportation Planning Implementation Methodology in Developing Countries (TPMDC 2016)</td>
<td>21.12.2016</td>
</tr>
<tr>
<td>26</td>
<td>Dr. Ravindra Kumar</td>
<td>Impact of driver behavior on fuel consumption</td>
<td>Training programme organized by IIP Dehradun</td>
<td>13.01.2017</td>
</tr>
<tr>
<td>27</td>
<td>Dr. S.S. Gaharwar</td>
<td>Design Features of Bridge Bearings &amp; Expansion Joints and Determination of Efficacy of Rehabilitation Schemes using NDT</td>
<td>Soil Investigations and Testing of Materials for Pavements, Buildings and Bridges’, Training Programme organized by Maulana Azad National Institute of Technology, Bhopal (M.P.), for the Field Engineers of MPRRDA, Bhopal (M.P),</td>
<td>16.01.2017</td>
</tr>
<tr>
<td>28</td>
<td>Dr. Devesh Tiwari</td>
<td>Design of Pavement overlays using FWD and BBT Evaluation</td>
<td>Under Road and Bridge Including Computer Aided Design Techniques for the Engineers of 12 African Countries, Sponsored under Ministry of External Affairs (MFA), at Indian Academy of Highway Engineers (IAHE) Noida.</td>
<td>18.01.2017</td>
</tr>
<tr>
<td>29</td>
<td>Dr. P. Lakshmy</td>
<td>“Condition Survey and Bridge Management System”</td>
<td>ING-IABSE Workshop on Inspection, Investigation, Repair &amp; Rehabilitation of Bridges &amp; Flyover, Bangalore,</td>
<td>20.01.2017</td>
</tr>
<tr>
<td>30</td>
<td>Dr. S.Velmurugan</td>
<td>Road Safety Issues and Case Studies on Road Safety Audit and their effectiveness</td>
<td>Invited Lecture for about 30 Post Graduate students of Transportation Engineering and Infrastructure Engineering Divisions of IIT, Kharagpur.</td>
<td>27.01.2017</td>
</tr>
<tr>
<td>31</td>
<td>Dr. Niraj Sharma</td>
<td>Ambient Monitoring &amp; Its Challenges,</td>
<td>Horiba, Pune (India)</td>
<td>08.02.2017</td>
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<tr>
<td>32</td>
<td>Shri Binod Kumar</td>
<td>Utilization of Ground Granulated Blast Furnace Slag in Pavement Quality Concrete</td>
<td>JSW GGBFS Conclave, Chennai</td>
<td>24.02.2017</td>
</tr>
<tr>
<td>S.No.</td>
<td>Name of the staff</td>
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<tr>
<td>33</td>
<td>Sh. Sanjay Choudhary, Dr. Nityanand Choudhary</td>
<td>सशक्त भारत के लिए 'मेक इन इंडिया' अभियान एवं सीएसआईआर प्रयोगशालाओं का योगदान</td>
<td>राष्ट्रीय विज्ञान संग्राम, सीएसआईआर–सीएसआईआरआई, दुर्गापुर, पश्चिम बंगला</td>
<td>26.02.2017(27.02.2017)</td>
</tr>
<tr>
<td>34</td>
<td>Dr. Kishor Kumar</td>
<td>Lead Speaker in Earth Sciences &quot;Himalayan Highways and landslides&quot;</td>
<td>11th Uttarakhand State Science and Technology Congress (USSTC), Uttarakhand State Council for Science &amp; Technology, Dehradun</td>
<td>02.03.2017 to 05.03.2017</td>
</tr>
<tr>
<td>35</td>
<td>Dr. Ravindra Kumar</td>
<td>Transportation Survey for Road Construction</td>
<td>MITS Gwalior</td>
<td>03.03.2017</td>
</tr>
<tr>
<td>36</td>
<td>Dr. Anuradha Shukla</td>
<td>Environmental Challenges due to Road Transportation in Developing Countries</td>
<td>Surrey-TERI University International Workshop on Emerging Socio-economic and Environmental Challenges in Developing Countries at TERI University, Delhi</td>
<td>10.03.2017</td>
</tr>
<tr>
<td>37</td>
<td>Shri K. Sitaramanjaneyulu</td>
<td>New Technologies for Construction and Maintenance of Pavements</td>
<td>Invited special Talk in &quot;Urban Transport Management&quot; Organised by Association of Bangalore University Highway Engineering Alumni, Bangalore</td>
<td>11.03.2017</td>
</tr>
<tr>
<td>38</td>
<td>Shri K. Sitaramanjaneyulu</td>
<td>Panel Discussion on How India speed up Building Infrastructure- Faster and Quicker</td>
<td>Roads and Ports Summit 2017</td>
<td>17.03.2017</td>
</tr>
</tbody>
</table>
Participation in Training Programs/Short Term Courses (Outside CRRI)
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the staff</th>
<th>Name of the Course</th>
<th>Venue</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shri Abhishek Mittal</td>
<td>Short term course on &quot;LaTeX: A Scientific Writing Tool&quot;</td>
<td>Jaipur</td>
<td>23-27 May 2016</td>
</tr>
<tr>
<td>2</td>
<td>Shri Dinesh Ganvir</td>
<td>Management development programme on Multivariate Data Analysis (MDA -2016)</td>
<td>IIT kharagpur</td>
<td>01-06 June 2016</td>
</tr>
<tr>
<td></td>
<td>Shri Pradeep Kumar</td>
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<tr>
<td></td>
<td>Ms. G.S. Parvathi</td>
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<tr>
<td>5</td>
<td>Dr. R.N. Dutta</td>
<td>Training programme on “Knowledge Management &amp; Knowledge Sharing in Organization”</td>
<td>Indian Institute of Public Administration (IIPA), New Delhi</td>
<td>29-Aug. 2016 to 02-Sep. 2016</td>
</tr>
<tr>
<td>7</td>
<td>Shri Vivek Dubey</td>
<td>Training programme on “9th Capacity Building Programme for Technical Personnel”</td>
<td>Indian Institute of Public Administration (IIPA), New Delhi</td>
<td>05-16 Sept. 2016</td>
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<td></td>
<td>Shri Anil Kumar</td>
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<tr>
<td>12</td>
<td>Shri Dinesh Kumar</td>
<td>Training Programme on Public Procurement</td>
<td>Alwar</td>
<td>05-06 Nov. 2016</td>
</tr>
<tr>
<td></td>
<td>Shri Sumer Singh</td>
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<tr>
<td>S.No.</td>
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<td>Venue</td>
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<tr>
<td>13</td>
<td>Shri S. Mariappan</td>
<td>Training workshop on RTI online for Nodal Officers</td>
<td>HRDC, Ghaziabad</td>
<td>10-Nov. 2016</td>
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<tr>
<td>14</td>
<td>Ms. Renu Chaddha</td>
<td>“Science and Technology for Rural Societies”</td>
<td>IIPA, New Delhi with the support from DST, New Delhi</td>
<td>07-11 Nov. 2016</td>
</tr>
<tr>
<td>15</td>
<td>Ms. Minal</td>
<td>Training Programme on &quot;Road Safety&quot; in Road Safety week</td>
<td>CSIR-CRRI</td>
<td>09-13 Jan. 2017</td>
</tr>
<tr>
<td>16</td>
<td>Shri Durga Prasad Shri Sumpath Kumar Shri Romil Sagwal Ms. Minal</td>
<td>Induction Training Programme for newly recruited Scientists,</td>
<td>CSIR-HRDC Ghaziabad</td>
<td>6-15 Feb. 2017</td>
</tr>
<tr>
<td>17</td>
<td>Shri Dinesh Ganvir</td>
<td>Short term course on &quot;F.E.M based design using ABAQCUS&quot;</td>
<td>Chandigarh</td>
<td>13-15 Feb. 2017</td>
</tr>
</tbody>
</table>
Deputation Abroad
Deputation Abroad

- Dr. S. Velmurugan, Scientist to attend and present his papers in the 14th World Conference on Transport Research, Shanghai, China from 10-15 July, 2016.
  
  
  
iii) Ashish Verma; Neelima Chakrabarty; S.Velmurugan; Prithvi Bhat; Dinesh Kumar H. “Sensation Seeking Behavior and Crash Involvement of Indian Bus Drivers”, A paper presented at the 14th WCTR and published in Transportation Research Procedia 25:4754-4766, December 2017 DOI: 10.1016/j.trpro.2017.05.487
  
  
v) Neelima Chakrabarty; Kamini Gupta; S. Velmurugan; Reetesh Rikku “Assessment of Driving Behaviour and Safe Driving Skills of Goods Vehicle Drivers in India”. Presented at 14th World Conference on Transport Research, WCTRS 2016, 10-15 July 2016, Shanghai, China.

- Dr. Neelam J Gupta, Principal Scientist was deputed to attend and present her 2 papers entitled “Development of Saturation Flow Model at Signalised Intersection for heterogeneous traffic” and “Estimation of Critical Gap of Roundabout Under Mixed Traffic Condition” in the World Conference on Transport Research, Shanghai, China from 10-15 July, 2016

- Dr. Purnima Parida, Sr Principal Scientist was deputed to attend and present her papers in the 14th World Conference on Transport Research, Shanghai, China from 10-15 July, 2016.
  
i) “Estimation of free speed of pedestrian flow on stairway at busy suburb rail transit station in India“ authored by Jaten Shah, G J Joshi and P Parida
  
ii) “Methodology for Evaluating walking facilities based types of obstructions observed on footpath of Indian Roads” authored by Mukti Advani, Purnima Parida and M Parida.
  
iii) “Idling delay estimation at signalized intersections using Inputs – Output flow” authored by Ravi Sekhar, K Ravinder and Purnima Parida

- Sh. Dinesh Ganvir, Scientist was deputed to attend and present his papers entitled” Evaluation of Pulverized Non Metallic Fraction of Printed Circuit Boards in Pavement Quality Concrete“ in the 8th International Conference on Maintenance and Rehabilitation of Pavements (MAIREPAV-8), Singapore from 27-29th July, 2016.

- Dr. Ambika Behl, Scientist was deputed to attend and present her paper entitled “Compaction Characteristics and Performance of Warm Mix Asphalt” in the 8th International Conference on Maintenance and Rehabilitation of Pavements (MAIREPAV-8), Singapore from 27-29th July, 2016.

- Dr. Rajiv Goel, Principal Scientist was deputed to attend and present his 2 papers entitled “Development of Bridge Maintenance Management System in GIS Environment in India” and “A case study of Strengthening of Distressed Prestressed Concrete Box Girder Bridge” in the 4th International Conference on Sustainable Construction Materials and Technologies, Las Vegas, USA from 7-11 August , 2016.
Supervision
## Ph.D. Research Supervision

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Student</th>
<th>Institute</th>
<th>Thesis Title</th>
<th>Supervisor (s)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Shri Lalit Kumar</td>
<td>AcSIR- CRRI, New Delhi</td>
<td>Geo-engineering approach to landslide and rockfall hazard and risk assessment on NH-58 (Maithana and Gulabkoti areas), Uttarakhand.</td>
<td>Dr. Kishor Kumar Geotechnical Engineering Division</td>
</tr>
<tr>
<td>2</td>
<td>Shri Sanjay Deori</td>
<td>Indian Institute of Technology (IIT) Guwahati, Assam</td>
<td>Pavement Deterioration Modeling of Flexible Pavements having Mixes with Modified Binders’</td>
<td>Dr. Rajan Choudhary, IIT, Guwahati Dr. Devesh Tiwari, CSIR-CRRI</td>
</tr>
<tr>
<td>3</td>
<td>Ms. Siksha Swaroopa Kar</td>
<td>AcSIR- CRRI, New Delhi</td>
<td>Effect of Viscosity and Rheological Properties of Binders on Foamed Binder Characteristics and Mixes’</td>
<td>Dr. Devesh Tiwari, CSIR-CRRI Dr. P. K. Jain, Ex-Chief Scientist, CSIR-CRRI, Prof. A. K. Swami, IIT, Delhi,</td>
</tr>
<tr>
<td>4</td>
<td>Shri Gagandeep Singh</td>
<td>AcSIR- CRRI, New Delhi</td>
<td>Investigation of Fatigue Endurance Limit in Bituminous Mixes Containing Modified Bitumen’</td>
<td>Dr. Devesh Tiwari Dr. P. K. Jain and Prof. A. K. Swami, IIT, Delhi</td>
</tr>
<tr>
<td>5</td>
<td>Shri Oluwafemi Festus Fadamoro (from Nigeria)</td>
<td>CSIR-CRRI, ACSR New Delhi CSIR- TWAS Post Graduate Fellowship,</td>
<td>Geotextile as a Subgrade Stabilization and base course Reinforcement for low volume Roads on Soft Soil</td>
<td>Dr. Devesh Tiwari, CSIR-CRRI</td>
</tr>
<tr>
<td>6</td>
<td>Shri Tushar Bagul</td>
<td>SVNIT Surat</td>
<td>Development of Three wheeler Autorickshaw Driving Cycle for Indian city</td>
<td>Dr. Rakesh Kumar, CSIR-CRRI</td>
</tr>
<tr>
<td>7</td>
<td>Shri Rashid Khan</td>
<td>AcSIR-CRRI, New Delhi</td>
<td>Gap acceptance Phenomena and Capacity estimation of U Turn on Multilane interurban highways</td>
<td>Dr. Ch. Ravisekhar Dr. S. Velmurugan CSIR-CRRI</td>
</tr>
<tr>
<td>8</td>
<td>Ms. Aashtha Mehta</td>
<td>Effect of RAP on Foam Bituminous Mixes</td>
<td>The Maharaja Sayajirao University of Baroda</td>
<td>Ms. Siksha Swaroopa Kar CSIR-CRRI</td>
</tr>
<tr>
<td>S.No.</td>
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<td>Supervisor (s)</td>
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<td>9</td>
<td>Ms. Rajni Dhyani</td>
<td>AcSIR-CRRI, New Delhi</td>
<td>Performance Evaluation and Sensitivity Analysis of Vehicular Pollution</td>
<td>Dr. Niraj Sharma CSIR-CRRI</td>
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<tr>
<td></td>
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<td>Dispersion Modeling Under Mixed Traffic Conditions</td>
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<tr>
<td>10</td>
<td>Ms. Manisha Gaur</td>
<td>AcSIR-CRRI, New Delhi</td>
<td>Characterization and source profiling of volatile organic compounds from road traffic in Delhi</td>
<td>Dr. Anuradha Shukla CSIR-CRRI</td>
</tr>
<tr>
<td>11</td>
<td>Shri Tushar Bagul</td>
<td>SVNIT Surat</td>
<td>Development of Three wheeler Auto rickshaw Driving Cycle for Indian city</td>
<td>Dr. Ravindra Kumar Dr. Rakesh Kumar, SVNIT</td>
</tr>
<tr>
<td>12</td>
<td>Shri Anish Kumar Bharti</td>
<td>IIT Roorkee</td>
<td>Operational Analysis of Bus Transit System</td>
<td>Dr. Ch. Ravi Sekhar, CSIR-CRRI Prof. (Dr.) Satish Chandra, Director, CSIR-CRRI</td>
</tr>
<tr>
<td>13</td>
<td>Shri Ankit Khaturia</td>
<td>IIT Roorkee</td>
<td>Travel Time Reliability for Performance Measurement of Urban Road Network</td>
<td>Dr. Ch. Ravi Sekhar CSIR-CRRI Prof. M. Parida, (IIT Roorkee)</td>
</tr>
<tr>
<td>14</td>
<td>Ms. Minal</td>
<td>AcSIR-CRRI, New Delhi</td>
<td>Integrated Travel Demand Modelling for Evaluation of Sustainable Transport System</td>
<td>Dr. Ch. Ravi Sekhar Dr. Errampalli Madhu, CSIR-CRRI</td>
</tr>
<tr>
<td>15</td>
<td>Shri Pervez Alam</td>
<td>Department of Civil Engg, JMI, New Delhi</td>
<td>Road Traffic Noise Mapping under Variable Road Conditions Cycle for Indian city</td>
<td>Dr. Kafeel Ahmad, Dr. Shakeel, Dr. Nasim Akhtar CSIR-CRRI</td>
</tr>
<tr>
<td>16</td>
<td>Shri Rakesh Manocha</td>
<td>Manav Rachna International University, Faridabad (Haryana)</td>
<td>Comparative Field Measurement of Tire-Pavement Noise &amp; Suggestive Measures for Reduction</td>
<td>Dr. Srijit Biswas, Dr. Nasim Akhtar CSIR-CRRI</td>
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</tbody>
</table>
## M. Tech Dissertations

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Title of Project/Thesis</th>
<th>Names of Student</th>
<th>Institute</th>
<th>Supervisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Effect of Road Roughness and Vehicular Speed on Emissions using HDM-4'</td>
<td>Naveen Kumar</td>
<td>National Institute of Technology (NIT), Kurukshetra, Haryana</td>
<td>Dr. Devesh Tiwari, Shri Sunil Jain</td>
</tr>
<tr>
<td>2</td>
<td>'Quality Certification of Road Infrastructure'</td>
<td>Naveen Kulkarni</td>
<td>IIT, Roorkee, Uttarakhand, India</td>
<td>Dr. Devesh Tiwari</td>
</tr>
<tr>
<td>3</td>
<td>Sensitivity Analysis of Vehicular Loading and Traffic Pattern on Total Transportation Cost for a High Speed Road Corridor</td>
<td>Mayur R. Chopde</td>
<td>NIT, Patna</td>
<td>Dr. Devesh Tiwari, Shri Pradeep Kumar</td>
</tr>
<tr>
<td>4</td>
<td>Impact of One Time Damage from Single Heavy axle with respect to ESALs</td>
<td>Anik Gupta</td>
<td>AcSIR, CSIR- Central Road Research Institute (CRRI), New Delhi</td>
<td>Dr. Devesh Tiwari</td>
</tr>
<tr>
<td>5</td>
<td>Identification of Induction Method for Self Healing Flexible Pavements</td>
<td>Gauri R. Mahajan</td>
<td>Samrat Ashok Technological Institute, Vidisha (M.P)</td>
<td>Dr. Devesh Tiwari, Shri Sunil Jain</td>
</tr>
<tr>
<td>6</td>
<td>Structural Evaluation of Flexible Pavements Using Falling Weight Deflectometer – A Case Study of a Stretch of Outer Ring Road, New Delhi</td>
<td>D Praveen Raju</td>
<td>Dayanand Sagar College of Engineering, Bengaluru</td>
<td>K. Sitaramanjaneyulu, Shri Pradeep Kumar</td>
</tr>
<tr>
<td>7</td>
<td>Performance Properties of Cement Stabilized Bases with Brick Ballast and Flyash</td>
<td>K. V. Srinivas</td>
<td>Jawaharlal Nehru Technological University, Hyderabad</td>
<td>Shri M. N. Nagabhushana, Shri K. Sitaramanjaneyulu</td>
</tr>
<tr>
<td>8</td>
<td>Sustainability index using damspster safer theory</td>
<td>Asif Hussain</td>
<td>Delhi Technical University, Delhi</td>
<td>Dr. Ravindra Kumar, Dr. Rajeev Mishra</td>
</tr>
<tr>
<td>S.No.</td>
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<td>Names of Student</td>
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<td>9</td>
<td>Obtaining LOS guidelines for Indian multilane interurban highways using supervised clustering</td>
<td>Sneha Sarkar</td>
<td>NIT Patna</td>
<td>Shri Ashutosh Arun&lt;br&gt;Dr. S. Velmurugan</td>
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<td>10</td>
<td>Crash hotspot identification (HSID) in urban roads in India using Fuzzy-c-means (FCM)</td>
<td>Piyush Anshuman Singh</td>
<td>NIT Patna</td>
<td>Shri Ashutosh Arun&lt;br&gt;Dr. S. Velmurugan</td>
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<td>11</td>
<td>Evaluation of Effectiveness of ITS technologies for Public Transportation</td>
<td>Akash Anand</td>
<td>Sri G.S. Institute of Technology and Science, Indore</td>
<td>Dr. J. Nataraju&lt;br&gt;Dr. E. Madhu</td>
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<td>12</td>
<td>Assessment of Influence of Music on Reaction Time and Sensorimotor Performance of Drivers</td>
<td>Ms. Haritha P.C.</td>
<td>National Institute of Technology Calicut</td>
<td>Dr. Neelima&lt;br&gt;Chakrabarty&lt;br&gt;Ms. Kamini Gupta</td>
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<tr>
<td>13</td>
<td>Binary and Ternary Blended Concrete mixes for Pavement Quality Concrete</td>
<td>Nikunj Sureja</td>
<td>M. S University, Vadodara</td>
<td>Shri Dinesh Ganvir&lt;br&gt;Shri Binod Kumar</td>
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<td>14</td>
<td>Performance Properties Of Cement Stabilized Bases With Over Burnt Brick Ballast And Fly Ash</td>
<td>Kannelli Venkata Srinivas</td>
<td>JNTUH College Of Engineering Hyderabad, (Telangana)</td>
<td>Shri M. N. Nagabhushana</td>
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<td>15</td>
<td>Study on Retardation of Reflection Cracks Using Glass Fibre in Bituminous Overlay Laid Over Cement Concrete Pavement</td>
<td>Sagar Kumar Verma</td>
<td>Sheri G.S. Institute of Technology &amp; Science, Indore</td>
<td>Shri Manoj Shukla</td>
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<td>16</td>
<td>Assessment of idling fuel consumption and Delay for a typical vehicle at various signalized intersection in Delhi”</td>
<td>Mr. Bhudhrani Ronak Singh,</td>
<td>Parul Institute of Engineering &amp; Technology Vadodra</td>
<td>Dr. Niraj Sharma&lt;br&gt;Shri P. V. Pradeep Kumar</td>
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<tr>
<td>17</td>
<td>Performance Evaluation of CALPUFF Model For An Urban Area”</td>
<td>Mr. Umesh Kumar</td>
<td>Deptt. of Civil Engg, IIT Delhi</td>
<td>Dr. Niraj Sharma</td>
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<tr>
<td>S.No.</td>
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<td>Development of Capacity Models for Inter-Urban Bidirectional Roads and Adjustment Factors</td>
<td>Balakrishna Kuniyal</td>
<td>AcSIR-CRRI, New Delhi</td>
<td>Dr. Ch. Ravi Sekhar Dr. S. Velmurugan</td>
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<td>19</td>
<td>Capacity Analysis of Hybrid BRTS Facility</td>
<td>Harprinderjot Singh</td>
<td>IIT Roorkee</td>
<td>Prof. M. Parida Dr. Ch. Ravi Sekhar</td>
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<td>20</td>
<td>Bus Lane Capacity Estimation and Frequency Optimisation</td>
<td>Vishwajeet Kishore Verma</td>
<td>NIT Suratkal</td>
<td>Dr. A.U Ravi Shankar Dr. Ch. Ravi Sekhar</td>
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<tr>
<td>21</td>
<td>Evaluation of Sustainability of Road Transportation due to ODD-EVEN Policy in Delhi NCR</td>
<td>Krishna Kumar Gajrani</td>
<td>S.G.S.I.T.S. Indore, M.P.</td>
<td>Dr. (Mrs) Vandana Tare Dr. Ch. Ravi Sekhar</td>
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<td>22</td>
<td>Pedestrian Accessibility Measurement Around Public Transport stations – A case study of Delhi metro</td>
<td>Kishan Savaliya</td>
<td>M.S. University, Vadodara</td>
<td>Dr. Mukti Advani Dr. Neelam J.Gupta</td>
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<td>23</td>
<td>Capacity Estimation of unsignalised intersection with and without speed breaker</td>
<td>Saurabh Kaushik</td>
<td>NIT Patna</td>
<td>Dr. Mukti Advani Dr. S.Velmurugan</td>
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<td>24</td>
<td>Route Searching based on travel time variability for bus network</td>
<td>Bincy Babu</td>
<td>Rajiv Gandhi Institute of Technology Kottayam</td>
<td>Dr. S. Padma Ms. Geeva George</td>
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<td>25</td>
<td>Optimal strategy based transit assignment including travel time variance</td>
<td>Riya Elizabeth Robin</td>
<td>Rajiv Gandhi Institute of Technology Kottayam</td>
<td>Dr. S. Padma Shri Jomy Thomas</td>
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<td>26</td>
<td>Shri Rashid Khan</td>
<td>AcSIR-CRRI, New Delhi</td>
<td>Modelling of the Gap Phenomena at U-turn Provisions on the Median Openings of Inter-Urban Highway Corridors</td>
<td>Dr. Ch. Ravi Sekhar Dr. S. Velmurugan CSIR-CRRI</td>
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## B. Tech Projects

<table>
<thead>
<tr>
<th>S.No.</th>
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<th>Names of Student</th>
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<tr>
<td>1</td>
<td>Smart journey planning using GIS</td>
<td>Abhinav Pokharva</td>
<td>BITS Pilani</td>
<td>Dr. Ravindra Kumar</td>
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<td>2</td>
<td>Sustainability indicator identification and scenario development</td>
<td>Dharamdeep</td>
<td>BITS Pilani</td>
<td>Dr. Ravindra Kumar</td>
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<td>3</td>
<td>Stopped delay and switching off behavior</td>
<td>Mayank Mishra</td>
<td>BITS Pilani</td>
<td>Dr. Ravindra Kumar</td>
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<td>4</td>
<td>Level of Service Analysis for Intermediate Intercity Highways under Mixed Traffic Condition</td>
<td>M. Mounica</td>
<td>MVGR Engineering College Vizianagaram (AP)</td>
<td>Dr. Ch. Ravi Sekhar</td>
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<td>5</td>
<td>Determining LOS criteria and Design Service Volume for Multilane Interurban Highways</td>
<td>Abhinav Yadav</td>
<td>BITS Pilani</td>
<td>Shri Ashutosh Arun</td>
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<td>Dr. S. Velmurugan</td>
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<td>6</td>
<td>Testing of Highway Materials &amp; concrete Mix Design for Concrete Pavement</td>
<td>Shadan Saifi &amp; Mohammad Adil</td>
<td>Jamia Millia Islamia University New Delhi</td>
<td>Shri Dinesh Ganvir</td>
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<td>7</td>
<td>Design and Evaluation of Effect of Bituminous Layer Thickness on The Level of Achievable Compaction</td>
<td>Bollisetty Venkat A Naga Sai</td>
<td>Vignan’s University Guntur</td>
<td>Shri Manoj Shukla</td>
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<td>Shri M.N. Nagabhushana</td>
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<td>8</td>
<td>Transient Seepage and Slope Stability Analysis of a Rainfall Induced Landslide in Maithana, Uttarakhand</td>
<td>Abhishek Sharma</td>
<td>Birla Institute of Technology &amp; Science, Pilani</td>
<td>Dr. P.S. Prasad, Ms. Parvathi G.S.</td>
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Visitors
<table>
<thead>
<tr>
<th>S.No.</th>
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<th>Visitor (name and affiliation)</th>
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<tbody>
<tr>
<td>1</td>
<td>Administration</td>
<td>Shri Mukesh Chaturvedi, Director, Deptt. of Personnel &amp; Training (GOI), Ministry of Personnel &amp; Public Grievances, New Delhi.</td>
<td>Awareness presentation of the “Sexual Harrassment of Women at Workplace (Prevention, Prohibition and Redressal) Act 2013”, under Rule 3(C) of CCS (Conduct) Rules and its related provision</td>
<td>19.07.2016</td>
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<td>2</td>
<td>Traffic Engineering and Safety Division (TES) and Transportation Planning Division (TPD)</td>
<td>Shri Rob McInerny, CEO, International Road Assessment Program (iRAP), Australia</td>
<td>Potential partnership between India and Australia on Road assessment and Road Safety and presentation/lecture on “The life saving potential of 3-star and better roads in India”.</td>
<td>17.08.2016</td>
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<td>3</td>
<td>Transportation Planning Division (TPD)</td>
<td>Prof. Yoshitsusu Hayashi, Nagoya University, Japan</td>
<td>Lecture on “Policy Making based on Quality of life Vs Infrastructure Cost Performance Better for everyone”</td>
<td>17.12.2016</td>
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<td>4</td>
<td>Bridge Engineering and Structures</td>
<td>Shri Kulbhushan, Chief Executive Officer, M/s SOM Projects Pvt. Ltd.</td>
<td>Technical Discussion</td>
<td>09.01.2017</td>
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<td>5</td>
<td>Bridge Engineering and Structures</td>
<td>Ms. Kamalika Kundu, Manager – Codes &amp; Approvals, M/s HILTI Pvt Ltd.</td>
<td>Technical Discussion</td>
<td>13.01.2017</td>
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<td>6</td>
<td>Transportation Planning Division (TPD)</td>
<td>Dr. Tim Dalman, ICCT USA</td>
<td>Workshop</td>
<td>23.01.2017</td>
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<td>7</td>
<td>Traffic Engineering and Safety Division (TES)</td>
<td>Shri Kamran Khan (Australian Government)</td>
<td>Visit to Driver Testing Lab and Interaction with Scientists on R&amp;D</td>
<td>28-01-2017</td>
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<tr>
<td>8</td>
<td>Traffic Engineering and Safety Division (TES)</td>
<td>Dr. Mark King (Coordinator Education and International Development) Australia</td>
<td>Visit to Driver Testing Lab and Interaction with Scientists on R&amp;D</td>
<td>02.02.2017</td>
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<td>9</td>
<td>Traffic Engineering and Safety Division (TES)</td>
<td>Shri Yogen Bhatnagar (URAP, Australia)</td>
<td>Visit to Driver Testing Lab and Interaction with Scientists on R&amp;D</td>
<td>02.02.2017</td>
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<td>Bridge Engineering and Structures</td>
<td>Shri Jitendra Rathore, VP, M/s Sanfield India Pvt. Ltd</td>
<td>Technical Discussion</td>
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<td>11</td>
<td>Bridge Engineering and Structures</td>
<td>Shri N.R.K. Raju, VP, Head Engg., M/s Tata Projects; and Shri Dambar Singh, Chief Project Manager, M/s Tata Projects</td>
<td>Technical Discussion</td>
<td>14.03.2017</td>
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<td>12</td>
<td>Transportation Planning Division (TPD)</td>
<td>Shri P.K. Prkayastha, Add Director, PCRA</td>
<td>Workshop</td>
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Membership of Staff on Various Technical Committees
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the scientist/staff</th>
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<th>Name of the committee</th>
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<tr>
<td><strong>Indian Roads Congress</strong></td>
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<tr>
<td>1</td>
<td>Sh. K. Sitaramanjaneyulu</td>
<td>Member Secretary</td>
<td>H-6 &quot;Road Maintenance and Asset Management Committee&quot;</td>
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<tr>
<td>2</td>
<td>Sh. K. Sitaramanjaneyulu</td>
<td>Member Secretary</td>
<td>H-2 &quot;Flexible Pavement Committee&quot;</td>
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<tr>
<td>3</td>
<td>Dr. Devesh Tiwari</td>
<td>Invitee Member</td>
<td>H-8 (Urban Roads, Streets &amp; Transport) Committee (2015-17), Committee for Accreditation of New/Alternate Materials/Technologies for the Year 2015-2017</td>
</tr>
<tr>
<td>4</td>
<td>Dr. Devesh Tiwari</td>
<td>Member</td>
<td>Subgroup under H-1 Committee</td>
</tr>
</tbody>
</table>
| 5     | Dr. S. Velmurugan         | Expert Member of the Sub Group in the revision or bringing out the following new/revised documents:  
- IRC: 35 titled, “Code of Practice for Road Markings” (Second Revision)  
- IRC: 108 titled, “Guidelines for Traffic Prediction on Highways” (First Revision)  
- IRC: 119 titled, "Guidelines for Traffic Safety Barriers" - New Document | Subgroup under H-1 Committee |
| 6     | Shri M.N. Nagabhushana    | Member          | H-6 and H-2 Committee |
| 7     | Dr. Anuradha Shukla       | Member          | Technical Committee on Reduction of Carbon Footprint in Road Construction and Environment (G-3) |
| 8     | Dr. Errampalli Madhu      | Member          | IRC H8 Committee |
| 9     | Dr. Ch. Ravi Sekher       | Member          | IRC H8 Committee |
| 10    | Dr. Mukti Advani          | Member          | IRC H1 Committee |
| 11    | Dr. P. Lakshmy            | Member          | HRB Identification, Monitoring & Research Application Committee of IRC |
| 12    | Dr. P. Lakshmy            | Co-Convenor (2015-2017) | IRC’s B-2 Committee: Loads and Stresses |
### Membership of Staff on Various Technical Committees

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<tr>
<td>13</td>
<td>Dr. P. Lakshmy</td>
<td>Member (2015-2017)</td>
<td>IRC’s B-4 Committee: Concrete (Reinforced &amp; Prestressed ) Structures</td>
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<td>14</td>
<td>Dr. P. Lakshmy</td>
<td>Member (2015-2017)</td>
<td>IRC’s B-5 Committee: Steel and composite Structure</td>
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<tr>
<td>15</td>
<td>Dr. P. Lakshmy</td>
<td>Member (2015-2017)</td>
<td>IRC’s B-8 Committee: Maintenance and Rehabilitation</td>
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<td>16</td>
<td>Dr. P. Lakshmy</td>
<td>Member (2015-2017)</td>
<td>IRC’s B-9 Committee: Committee: Sealinks Including special structures</td>
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<td>Member (2015-2017)</td>
<td>IRC’s H-5 Committee: Rural Road</td>
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<td>18</td>
<td>Dr. Rajeev Goel</td>
<td>Member (2015-2017)</td>
<td>IRC’s B-1 Committee: General Design features (Bridges &amp; Grade Separator structures)</td>
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<td>19</td>
<td>Dr. S.S. Gaharwar</td>
<td>Member (2015-2017)</td>
<td>IRC’s B-3 Committee: Protective Works and Masonry Structures</td>
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<tr>
<td>20</td>
<td>Dr. S.S. Gaharwar, Dr. Suraj Prakash</td>
<td>Member-Secretary (2011-2017) Member (2007-2010) Member (2011-2014)</td>
<td>IRC’s B-6 Committee: Bearing, Joints &amp; Appurtenances</td>
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<tr>
<td>21</td>
<td>Shri G. K. Sahu</td>
<td>Member (2015-2017)</td>
<td>IRC’s B-7 Committee: Formwork and Temporary Structures</td>
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<td>22</td>
<td>Dr. V.V.L.K. Rao</td>
<td>Member (2015-2017)</td>
<td>IRC’s B-8 Committee: Maintenance and Rehabilitation</td>
</tr>
<tr>
<td>24</td>
<td>Shri U.K.Guru Vittal, Dr. Vasant G Havanagi</td>
<td>Member Member Secretary</td>
<td>Indian Roads Congress H 4 Committee on ‘Embankment, Ground Improvement &amp; Drainage’</td>
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<td>25</td>
<td>Shri U.K.Guru Vittal, Dr. Kishor Kumar</td>
<td>Member Member Secretary</td>
<td>Indian Roads Congress G6 Committee on Disaster Management</td>
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**Bureau of Indian Standards, New Delhi (BIS)**

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<tbody>
<tr>
<td>1</td>
<td>Dr. Anuradha Shukla</td>
<td>Chairperson</td>
<td>Solid Waste Management Sectional Committee CHD- 33</td>
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## Membership of Staff on Various Technical Committees

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<td>2</td>
<td>Prof. Satish Chandra</td>
<td>Chairman</td>
<td>PCD-6 Committee</td>
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<td>3</td>
<td>Shri K. Sitaramanjaneyulu</td>
<td>Member</td>
<td>CED-6 &quot;Stone Sectional Committee&quot;</td>
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<td>4</td>
<td>Dr. Pankaj Gupta</td>
<td>Member</td>
<td>CED:56 Hill Area Development Engineering Sectional Committee,</td>
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<tr>
<td>5</td>
<td>Dr. Devesh Tiwari</td>
<td>Member</td>
<td>Bureau of Indian Standards (BIS) committee on Aggregates from other than Natural Sources, CED 2/P3'</td>
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<td>6</td>
<td>Shri R.K. Panigrahi</td>
<td>Alternate Member</td>
<td>Rock Mechanics Sectional Committee, CED 48</td>
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<td>7</td>
<td>Dr. Rakesh Kumar</td>
<td>Member</td>
<td>BIS CED. ISO/TC 71 &amp; ISO/TC 74, CED 2/P1</td>
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<td>Dr. Jakkula Nataraju</td>
<td>Member</td>
<td>Intelligent Transport Systems Sectional Committee, TED</td>
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<td>9</td>
<td>Shri M.N. Nagabhushana</td>
<td>Member</td>
<td>PCD 6 BIS</td>
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<td>10</td>
<td>Dr. Ambika Behl</td>
<td>Member</td>
<td>PCD 6 BIS</td>
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<td>Dr. Rajeev Kumar Garg</td>
<td>Member (2012-2017)</td>
<td>BIS's CED: 38 Committee Special Structural Committee</td>
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<td>Dr. P. Lakshmy</td>
<td>Alternate Member (2012-2017)</td>
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<td>12</td>
<td>Dr. Rajeev Goel</td>
<td>Alternate Member</td>
<td>BIS's CED 46:P8 Plain Reinforced and Prestressed Concrete</td>
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<td>13</td>
<td>Dr. S.S. Gaharwar</td>
<td>Alternate Member (2016-2017)</td>
<td>BIS's CED:54 Committee Concrete Reinforcement Sectional Committee</td>
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### Formulation of National landslide risk management strategy

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<th>Committee Name</th>
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<tr>
<td>1</td>
<td>Dr. Kishor Kumar</td>
<td>Head of the Subgroup on &quot;capacity building and training of stakeholders&quot;</td>
<td>Taskforce Committee on &quot;Formulation of National landslide risk management strategy&quot;</td>
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<tr>
<td>2</td>
<td>Dr. Pankaj Gupta</td>
<td>Convener</td>
<td>Working group to revise IS 14680 landslide control guidelines</td>
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### GB Pant Institute of Himalayan Environment and Sustainable Development

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<td>1</td>
<td>Dr. Kishor Kumar</td>
<td>Expert member</td>
<td>PMC</td>
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### National Mission on Himalayan Studies(NMHS)

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<tr>
<td>1</td>
<td>Dr. Kishor Kumar</td>
<td>Expert member</td>
<td>Monitoring, Learning and Evaluation(MLE) committee</td>
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<td><strong>Bhagalpur College of Engineering, Bhagalpur</strong></td>
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<td>Shri K. Sitaramanjaneyulu</td>
<td>Member</td>
<td>Board of Governors</td>
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<td><strong>NIT, Tirucharappalli</strong></td>
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<td>1</td>
<td>Shri K. Sitaramanjaneyulu</td>
<td>Member</td>
<td>Research Advisory Board of Centre of Excellence in Transportation Engineering (CETransE)</td>
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<td><strong>MORTH, New Delhi</strong></td>
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<tr>
<td>1</td>
<td>Dr. Devesh Tiwari</td>
<td>Member</td>
<td>Standing Committee constituted by MORTH on 'Introduction of new technology/alternative design in the projects on EPC/BOT basis'</td>
</tr>
<tr>
<td>2</td>
<td>Dr. P. Lakshmy</td>
<td>Member</td>
<td>Committee for Empanelment of Bearing and Expansion Joint Manufacturers and Suppliers, MORTH, New Delhi</td>
</tr>
<tr>
<td></td>
<td><strong>World Bank</strong></td>
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</tr>
<tr>
<td>1</td>
<td>Dr. Devesh Tiwari</td>
<td>Member</td>
<td>Technical Scrutiny Committee on the World Bank Aided Projects sponsored to Uttar Pradesh Public Works Department</td>
</tr>
<tr>
<td></td>
<td><strong>NCCBM Ballabhgarh, Faridabad</strong></td>
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</tr>
<tr>
<td>1</td>
<td>Dr. Rakesh Kumar</td>
<td>Member</td>
<td>IDC, NCCBM Ballabhgarh, Faridabad</td>
</tr>
<tr>
<td></td>
<td><strong>IIT Indore</strong></td>
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</tr>
<tr>
<td>1</td>
<td>Dr. Rakesh Kumar</td>
<td>Member</td>
<td>Building &amp; Works Committee of IIT Indore</td>
</tr>
<tr>
<td></td>
<td><strong>Sustainable Smart Cities India</strong></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>Dr. Ravindra Kumar</td>
<td>Advisor</td>
<td>Sustainable Smart Cities India</td>
</tr>
<tr>
<td>2</td>
<td>Dr. Neelima Chakrabarty</td>
<td>Board Member &amp; Coordinator of Navchetna Club by Delhi Traffic Police.</td>
<td>Navchetna Club</td>
</tr>
</tbody>
</table>
### Membership of Staff on Various Technical Committees

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the scientist/Staff</th>
<th>Position held</th>
<th>Name of the committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Dr. S.Velmurugan</td>
<td>Expert Member of Delhi Traffic Police (DTP)</td>
<td>Expert Member of the Technical Evaluation Committee of Delhi Traffic Police for finalizing the technical specifications and functional requirements of the new Intelligent Transport System (ITS) installations being procured by DTP.</td>
</tr>
<tr>
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<tr>
<td><strong>Samarthyam (National Centre for Barrier Free Design)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Dr. Neelima Chakrabarty</td>
<td>Board of Director (Project Team) Samarthyam (National Centre for Barrier Free Design) for finalizing the technical reports and other major functional requirements</td>
<td>Samarthyam</td>
</tr>
<tr>
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<tr>
<td><strong>Transport Research Board (India) TRB</strong></td>
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<tr>
<td>1</td>
<td>Dr. Neelima Chakrabarty</td>
<td>Executive Member of Transport Research Board (India) for finalizing the technical and functional requirements</td>
<td>TRB</td>
</tr>
<tr>
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<tr>
<td><strong>International Road Federation (India Chapter DTS) IRF</strong></td>
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<tr>
<td>1</td>
<td>Dr. Neelima Chakrabarty</td>
<td>Member of International Road Federation (India Chapter DTS)</td>
<td>IRF</td>
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<tr>
<td><strong>Organization of International Women Engineers and Scientists (INWES)</strong></td>
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</tr>
<tr>
<td>1</td>
<td>Dr. Neelima Chakrabarty</td>
<td>Committee Member Organization of International Women Engineers and Scientists INWES for finalizing the technical and functional requirements</td>
<td>INWES</td>
</tr>
<tr>
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<tr>
<td><strong>Ministry of Environment, Forests and Climate Change, Government of India</strong></td>
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<tr>
<td>1</td>
<td>Dr Anuradha Shukla</td>
<td>Member</td>
<td>Expert Appraisal Committee (EAC) for Projects related to Infrastructure Development, Coastal Regulation Zone, Building/Construction and Miscellaneous projects. Ministry of Environment, Forests and Climate Change, Government of India</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the scientist/Staff</th>
<th>Position held</th>
<th>Name of the committee</th>
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<tbody>
<tr>
<td><strong>Materials Research Society, Singapore</strong></td>
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<tr>
<td>1</td>
<td>Dr Rina Singh</td>
<td>Member</td>
<td>MRS Singapore</td>
</tr>
<tr>
<td><strong>Institute of Steel Development and Growth, Kolkatta</strong></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>Dr. P. Lakshmy</td>
<td>Member</td>
<td>Project Review Committee (PRC) Institute of Steel Development and Growth, Kolkatta</td>
</tr>
<tr>
<td><strong>Indian Concrete institute, Western UP Center, Ghaziabad</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>Dr. Rajeev Goel</td>
<td>Vice President</td>
<td>Executive Committee of Indian Concrete institute, Western UP Center, Ghaziabad</td>
</tr>
<tr>
<td></td>
<td>Shri G. K. Sahu</td>
<td>Secretary</td>
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<tr>
<td><strong>ISWE</strong></td>
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<tr>
<td>1</td>
<td>Dr. P. Lakshmy</td>
<td>Member</td>
<td>Executive Committee (ISWE)</td>
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<tr>
<td><strong>Indian Association of Structural Engineers, New Delhi</strong></td>
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<tr>
<td>1</td>
<td>Dr. Rajeev Goel</td>
<td>Member</td>
<td>Executive Committee,</td>
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<tr>
<td><strong>National Rural Roads Development Authority (NRRDA)</strong></td>
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<tr>
<td>1</td>
<td>Dr. P. Lakshmy</td>
<td>Member (2016-2017)</td>
<td>Expert group for suggesting measures for cost reduction in Rural Roads (NRRDA)</td>
</tr>
<tr>
<td>2</td>
<td>Dr. S.S. Gaharwar</td>
<td>Member (2016-2017)</td>
<td>Appellate Committee to consider State’s Appeal in respect of PMGSY Works Notified as having Defects of Non-rectifiable Nature (NRRDA)</td>
</tr>
<tr>
<td><strong>International Journal of Construction Materials &amp; Structures(IJCMS)</strong></td>
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<tr>
<td>1</td>
<td>Dr. P. Lakshmy</td>
<td>Member</td>
<td>Editorial Board, International Journal of Construction Materials &amp; Structures(IJCMS), ISSN 2321-2231</td>
</tr>
<tr>
<td><strong>Pune Municipal Corporation (PMC)</strong></td>
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<tr>
<td>1</td>
<td>Dr. P. Lakshmy</td>
<td>Member</td>
<td>STAC Committee, Pune Municipal Corporation (Bridge Expert)</td>
</tr>
</tbody>
</table>
Membership of National and International Organisations
• Australian Road Research Board (ARRB)
• Bureau of Indian Standards, Manak Bhawan, 9. Bahadur Shah Zafar Marg, New Delhi
• Indian Institute of Bridge Engineers (IIIBS), New Delhi
• International Road Federation (IRF), Geneva
• Indian Association of Special Libraries and Information Centers, Kakugachi, Kolkata
• Indian National Group of International Society for Rock Mechanics, Central Board of Irrigation and Power, Malcha Marg, Chanakyapuri, New Delhi
• Indian Society of Desert Technology, College of Engineering, Jodhpur, Rajasthan
• Asian Information Centre for Geotechnical Engineering, Bangkok, Thailand
• Permanent International Association of Road Congress, 43, Avenue D4, President Wilson 75116, Paris, France
• Indian Scientific Translators Association, New Delhi
• Transportation Research Board of the National Academy of Science, National Research Council, 2101, Constitution Avenue, Washington DC, USA
• Indian Geotechnical Society, C/o Central Soil and Material Research Station, Olof Palme Marg, Hauz Khas, New Delhi
• Indian Road Congress, Jamnagar House, Shahjahan Road, New Delhi
• Government of Indian Librarians Association (GILA (Regd.)) C/o Planning Commission, Library, Yojna Bhawan, Sansad Marg, New Delhi
• Society for Information Science, NISCAIR Building, Hillside Road, New Delhi
• Indian Group of Geotextiles, Central Board of Irrigation & Power, Malcha Marg, Chanakyapuri, New Delhi
• Institutional Membership of Belgium Road Research Institute, Belgium
• Associate Membership of Current Science Association, Bangalore
• Asian Institute of Transport Development (AITD), New Delhi
• Institutional Membership of Consultancy Development Centre, New Delhi
• International Road Federation (IRF) India Chapter
Marketable Products and Services
Intellectual Property (Patents)

Intellectual Property (Patents filed in India)

- A Device Useful For Evaluation Of Road Conditions (Filing No.- 0325DEL2004)
- Utilisation Of Waste Plastic Bags For Modification Of Bitumen (Pat no. 246060)
- New Design For Box Insertion Through Highly Unstable Cohesion less Soil By Stabilisation Of Vertical Cut Slopes (Filing No.- 0136DEL2012)
- Vehicle Mounted Automatic Controlled Mobile Bridge Inspection Device (Filing No.- 2984 DEL 2012)
- Upgraded Device For Road Condition Evaluation (Filing No.- 201611003957)
- Use Of Thermocol(Expanded Polystyrene) Waste In Hot Bituminous Mixes For Road Construction (Filing No.- 1258 DEL2014)
- Utilisation Of Pvc Pipe Waste In Modifying Bitumen For Paving Applications (Filing No.-1368DEL2014)
- Design And Development Of Pothole Repair Machine (Filing No.- 0821 DEL 2014)
- Electro Mechanical Field Density Gauge (Filing No.- 1632DEL2014)
- New Process For Preparation Of Harder Grade Bitumen (Vg40 And Vg50) For Formation Of Asphalt Surfacing For Roads And Airfields (Filing No.- 2837DEL2015)
- Car Driving Simulator With Driver Diagnostic And Training Method (Filing No.-201611040851.00)
- Process For Laying Roads Using Cold-Mix Technology(FilingNo.- 201611039241A)
- Carbon Based Mixture For Improved Performance Of Flexible Pavements As One Of Bitumen Additives Or Fillers And Methods Of Preparation Thereof (Filing No.- 201611008235.00)

Intellectual Property (Patents filed Abroad)

- New Design For Box Insertion Through Highly Unstable Cohesion less Soil By Stabilisation Of Vertical Cut Slopes, (International Patent- In 4-Four Countries)
- US Patent no. - 14/415.553
- Singapore Patent No. - 11201500373T
- Sri Lanka Patent No.- 18089
- Great Britain Patent No. - 1502552.1

Process Ready for Exploitation

- Process Know How Of Polymer Modified Bitumen
- Axle Mounted System For Measuring Road Roughness
- Waste Plastic Modified Bitumen Technology
- Vehicle Mounted Automatic Controlled Mobile Bridge Inspection Device
- Design And Development Of Pothole Repair Machine
- New Process For Preparation Of Harder Grade Bitumen (Vg40 And Vg50) For Formation Of Asphalt Surfacing For Roads And Airfields
- Car Driving Simulator With Driver Diagnostic And Training Method
- New Design For Box Insertion Through Highly Unstable Cohesion less Soil By Stabilisation Of Vertical Cut Slopes
- Electro Mechanical Field Density Gauge
- Utilisation Of Pvc Pipe Waste In Modifying Bitumen For Paving Applications
- Use Of Thermocol(Expanded Polystyrene) Waste In Hot Bituminous Mixes For Road Construction
- Process Know How Of Polymer Modified Bitumen
- Upgraded Device For Road Condition Evaluation
- Indigenous Weight-in-Motion and Vehicle Classification System
- Automated Benkelman Beam
- Bitumen Emulsion

Marketable Software( Copyrighted)

- Design Of Trail Suspension Bridges (Tbsd.For)
- Prediction Of Strains Induced In Concrete Due To Effects Of Creep And Shrinkage
- No Mobile When Mobile
Marketable Products and Services

- Three-Dimensional Finite Element Analysis Of Prestressed Concrete Structures Considering Material Nonlinearities And Effects Of Creep And Shrinkage
- Design Of Visual Inspection Unit Including Structural Analysis And Mechanical Joints
- Cinematography On Understanding Of Real World Driving Cycle And Its Development

Services Offered

Contract Research

- Collaborative Projects

Consultancy Services

Testing & Calibration

Training Programs

For capacity building in human resources in the area of highway engineering to undertake and execute roads and runway projects, CSIR-CRRI organizes following regular training programme each year for the in-service highway, traffic and transportation engineers and planners. The details of the training programme organized are as follows:

<table>
<thead>
<tr>
<th>Title of the Course</th>
<th>Duration</th>
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<tbody>
<tr>
<td><strong>A. PAVEMENT ENGINEERING &amp; MATERIALS</strong></td>
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<tr>
<td>• Design, Construction and Maintenance of Flexible Pavements</td>
<td>(5 days)</td>
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<tr>
<td>• Rigid Pavements: Design, Construction &amp; Quality Control Aspects</td>
<td>(5 days)</td>
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<tr>
<td>• Pavement Evaluation Techniques and their applications for Maintenance and Rehabilitation</td>
<td>(5 days)</td>
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<tr>
<td><strong>B. ROAD DEVELOPMENT PLANNING &amp; MANAGEMENT</strong></td>
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<tr>
<td>• International Course on Dissemination of HDM-4</td>
<td>(2 Weeks)</td>
</tr>
<tr>
<td>• Geo-Spatial Technology (GIS, GPS, RS etc) for Road and Transportation</td>
<td>(4 days)</td>
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<tr>
<td><strong>C. GEOTECHNICAL ENGINEERING</strong></td>
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</tr>
<tr>
<td>• Geotechnical and Landslide Investigations for Highway Projects</td>
<td>(5 days)</td>
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<tr>
<td><strong>D. BRIDGES &amp; STRUCTURES</strong></td>
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</tr>
<tr>
<td>• Bridge Diagnostics, Performance Evaluation and Rehabilitation</td>
<td>(5 days)</td>
</tr>
<tr>
<td>• Bridge Design and Construction</td>
<td>(5 days)</td>
</tr>
<tr>
<td><strong>E. TRAFFIC &amp; TRANSPORTATION PLANNING</strong></td>
<td></td>
</tr>
<tr>
<td>• Economics &amp; Financial Analysis of Highway &amp; Transportation Projects</td>
<td>(5 days)</td>
</tr>
<tr>
<td>• Traffic Engineering &amp; Road Safety Audit</td>
<td>(5 days)</td>
</tr>
<tr>
<td>• Air and Noise Pollution Measurement and Analysis</td>
<td>(3 days)</td>
</tr>
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</table>

Customized Tailor Made Programmes

In addition to the above, CSIR-CRRI also organizes customized tailor made programmes as per the clients requirements.
Paper Publications in Journals
Paper Publications in Journals


• Anil Mann and Ravindra Kumar (2016) Exploring the natural combating powers of plant species against air pollution by assessing their APTI values, INTERNATIONAL JOURNAL OF ENVIRONMENTAL SCIENCES Volume 7, No 2, pp 212-219, DOI:10.6088/ijes.7019


• Tushar R Bagul, Ravindra Kumar, Rakesh Kumar, (2016) Analysis of urban ecological footprints using real world driving cycle, Material Science, Journal of Perspectives in Science (ISSN:2213-0209, (under publication)

• Shrinivas Arkatkar, S. Velmurugan, Ravikiran P., Balaji P. and Sukrit Narula, (2016) “Methodology for Simulating Heterogeneous Traffic on Expressways in Developing Countries: A Case Study in India”, Transportation Letters; England; Maney Online Publisher, DOI: http://dx.doi.org/10.1179/1942787515Y.0000000008


• Neelima Chakrabarty; Kamini Gupta; S. Velmurugan; Reetesh Rikku (2016) Personality traits and risk taking practices among heavy transport vehicle drivers in India. BVAAP, 24(2), 159-163, Dec 2016 (CSIR Journal)


• रजनी धामी, नीरज शर्मा, अर्धना वैश्य एवं मोन, (2016), “उत्तराखंड के नगरीय पहाड़ी क्षेत्रों में ईंधन के विकल्प और उससे महत्वपूर्ण क्षेत्रों के स्वास्थ्य पर होने वाले प्रभाव”, भारतीय वैज्ञानिक एवं आंदोलनिक अनुसंधान पत्रिका (सीएसआरआईआर–राष्ट्रीय विज्ञान संसार एवं सूची स्रोत संस्थान, 24(2) : 135-144

• रीना सिंह, मनोज गौर, अनुराधा शुक्ला (2016) दिल्ली की परिवेशी मात्रा में मौसम और BTEX की स्थानिक विभिन्नता, Sadak Darpan, Vol 13, Pp 22-30, September 2016


Paper Publications in Seminars/Conferences/Symposium


• Rakesh Kumar, (2016) “Wollastonite Mineral Fibre in Manufacturing of an Economical Pavement Concrete”, the Proceedings of 4th International Conference on Sustainable Construction Material and Technology, Las Vegas, USA.


• Rakesh Kumar, (2016) “Concrete Core Tests: Easy to Order but not Easy to Interpret”, the proceeding of Conference on Repair, Rehabilitation & Retrofitting of Concrete Structures, New Delhi.

• Ravindra Kumar, A.V.A. Bharat Kumar, Purnima Parida, E. Madhu (2016) Does connectivity index of transport network have impact on delay for driver? 14th World Conference on Transport Research, China 2016


• Amudapuram Mohan Rao, S. Velmurugan and Laxmi (2016). Evaluation of influence of roadside friction points on urban roadway capacity-a case study of Delhi. World Conference on Transport Research Society 2016, Shanghai, China
• Ashish Verma; Neelima Chakrabarty; S.Velmurugan; Prithvi Bhat; Dinesh Kumar H. (2016) “Sensation Seeking Behaviour and Crash Involvement of Indian Bus Drivers” Presented at 14th World Conference on Transport Research, WCTRS 2016, July 2016, Shanghai, China.


• Neelima Chakrabarty (2016) “Case Studies and Invention related to Road Safety in India” Presented at International Workshop on Trends and Recent Advances in Civil Engineering, August, 2016 Amity University Noida, U.P.


• Dinesh Ganvir, Pranshul Jain, Dr Sangita & Dr Vandane Tare, (2016), Evaluation of Pulverized Non metallic fraction of Printed Circuit Board in Pavement Quality Concrete” Proceeding of 8th International conference on Maintenance and Rehabilitation of Pavements(MAIREPAVE-8), Singapore. 154-161, ISBN: 978-981-11-0449-7Pg

• Ambika Behl and Satish Chandra, (2016) “Compaction Characteristics and Performance Properties of Warm Mix Asphalt”, 8th International Conference on Maintenance and Rehabilitation of Pavements (MAIREPAV8), Singapore


• Siksha Swaroopa Kar, (2016) Development of Indigenous Pothole Repair Machine, Published in Proceeding of India International Science Festival at NPL, New Delhi

• Siksha Swaroopa Kar and M N Nagabhushan, (2016) “Relative Environmental Assessment of Hot and Cold Bituminous Road Technologies., Published in Proceeding of India International Science Festival at NPL, New Delhi


• Kaushik, H., Kumar, N., Bhupendra, Kumar, P. V. Pradeep., and Nagabhushana, M.N.(2016) Operational and maintenance management of hydraulic and pneumatic system-A case study of heavy vehicle simulator (HVS). Conference on current trends in Research and Innovative Developments in the field of fluid power , June, IISc Bangalore, organized by Fluid Power society of India.


• Kumar, R., Parida, P., Errampalli, M., Bharat Kumar A. V. A. (2016). Does connectivity index of transport network have impact on delay for driver?, Proc. 14th World Conference on Transport Research (WCTR), Shanghai, China.


• Rajeev Goel, (2016). Maintenance and Monitoring Strategies for Concrete Bridges of Indian Highways’, 2nd International Innovative Advancements in Engineering and Technology (IAET – 2016) Jaipur National University, Jaipur in association with Myongji University, South Korea, April 1-2, 2016


• Inqualabi K. Q. & Garg, R. K (2016) Seismic Vulnerability Assessment of a Typical Bridge under Liquefaction 6th International Conference on Recent advances in Geotechnical Earthquake Engineering & Soil Dynamics, IIT Roorkee.


• Durgaprasad Golla, Azharuddin, Prashant Singh & Dr.S.S. Gaharwar (2016), Utilization of Construction and Demolition waste in Structural Applications India International festival-2016 Dec 07-11, CSIR-NPL, New Delhi

• Dr. S.S. Gaharwar (2016) Evaluation of Efficacy of Rehabilitation Scheme Using In-Situ NDT Measurements ICI conference on “Repair Rehabilitation of Retrofitting of Concrete Structures, India” Habitat Centre New Delhi, 9th-10th September 2016


Paper Publications in Seminars/Conferences/Symposium

- Tushar Bagul, Vilash Shingare, Parag Suryavanshi, Ravindra Kumar and Rakesh Kumar, (2017) Development of Three wheeler Autorickshaw Driving Cycle for Indian city , CTRG 2017
- संजय चौधरी व झानिलाल नन्द चौधरी (2017).सक्षम भारत के लिए “ मेक इन इंडिया” अभियान एवं सीएसआईआर प्रयोगशालाओं का योगदान “मेक इन इंडिया” विषय पर राष्ट्रीय विज्ञान संगोष्ठी, सीएसआईआर–सीएसआईआरआई, दुर्गापुर, पश्चिम बंगाल
- Sanjay Choudhary, Dr. Nityanand Choudhary (2017), Sakshat Bharat ke liye ‘Make in India’ Abhiyan evam CSIR prayogshalaon ka yogdan, National Science Seminar on ‘Make in India’, CSIR-CMERI, Durgapur,
Participation in Conferences/Seminars
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the staff</th>
<th>Details of conference/seminar</th>
<th>Venue</th>
<th>Dates</th>
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<tbody>
<tr>
<td>1</td>
<td>Shri U.K. Guru Vittal Dr. Pankaj Gupta Dr. Kishor Kumar Shri R.K. Panigrahi</td>
<td>National workshop on “Climate change and landslides”. Organised by CSIR-Central Road Research Institute, Newdelhi.</td>
<td>CSIR-CRRI, NEW DELHI</td>
<td>05-06 May, 2016</td>
</tr>
<tr>
<td>2</td>
<td>Dr. Kishor Kumar</td>
<td>2nd Global Geosynthetics Summit.</td>
<td>New Delhi</td>
<td>19-20 May, 2016</td>
</tr>
<tr>
<td>3</td>
<td>Shri H. Kaushik Shri N. Kumar Bhupendra Shri P.V. Pradeep Kumar Shri M.N. Nagabhushana</td>
<td>Conference on current trends in Research and Innovative Developments in the field of fluid power, organized by Fluid Power society of India.</td>
<td>IISc Bangalore</td>
<td>17-18 June, 2016</td>
</tr>
<tr>
<td>4</td>
<td>Dr. Neelam J Gupta Dr. S Velmurugan Dr. Neelima Chakrabarty</td>
<td>14th World Conference on Transport Research, Shanghai, China</td>
<td>14th World Conference on Transport Research, Shanghai, China</td>
<td>10-15 July, 2016</td>
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<tr>
<td>6</td>
<td>Shri Manoj Kumar Shukla Shri Satish Pandey</td>
<td>Conference on “Revitalising PPPs in Infrastructure”</td>
<td>New Delhi</td>
<td>26-27 July, 2016</td>
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<tr>
<td>8</td>
<td>Dr. Ambika Behl</td>
<td>Eighth International Conference on Maintenance and Rehabilitation of Pavements (Mairepav8)</td>
<td>Singapore</td>
<td>27-29 July, 2016</td>
</tr>
<tr>
<td>9</td>
<td>Prof. Satish Chandra Shri U.K. Guru Vittal</td>
<td>National Conference on Fifteen Years of PMGSY</td>
<td>Civil Eng. Deptt., IIT Roorkee</td>
<td>August 6-7, 2016</td>
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</table>
## Participation in Conferences/Seminars

<table>
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<th>S.No.</th>
<th>Name of the staff</th>
<th>Details of conference/seminar</th>
<th>Venue</th>
<th>Dates</th>
</tr>
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<tr>
<td>10</td>
<td>Dr. Rajeev Goel</td>
<td>Fourth International Conference in Sustainable Construction Materials and Technologies’</td>
<td>Las Vegas, USA,</td>
<td>August 7-11, 2016</td>
</tr>
<tr>
<td>11</td>
<td>Dr. Rakesh Kumar</td>
<td>One day International Symposium on 3D Printing of Concrete</td>
<td>IIT Madras, Chennai</td>
<td>08 August, 2016</td>
</tr>
<tr>
<td>12</td>
<td>Dr. Neelima Chakrabarty</td>
<td>International Workshop on Trends and Recent Advances in Civil Engineering, Amity University Noida, U.P</td>
<td>Amity University, Noida, U.P</td>
<td>11-12 Aug., 2016</td>
</tr>
<tr>
<td></td>
<td>Dr. S. Velmurugan</td>
<td></td>
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<tr>
<td></td>
<td>Ms. Kamini Gupta</td>
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<tr>
<td>13</td>
<td>Dr. Anuradha Shukla</td>
<td>Conference on “Trends and Recent Advances in Civil Engineering”</td>
<td>Amity University, Noida,</td>
<td>11-12 Aug. 2016</td>
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<tr>
<td></td>
<td>Dr. Rina Singh</td>
<td></td>
<td></td>
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<tr>
<td>15</td>
<td>Dr. Rakesh Kumar</td>
<td>Conference on Repair, Rehabilitation &amp; Retrofitting of Concrete Structures</td>
<td>New Delhi</td>
<td>09-10 Sept. 2016</td>
</tr>
<tr>
<td>16</td>
<td>Dr. S.S. Gaharwar</td>
<td>ICI conference on “Repair Rehabilitation of Retrofitting of Concrete Structures</td>
<td>India” Habitat Centre New Delhi,</td>
<td>9-10 Sept. 2016</td>
</tr>
<tr>
<td></td>
<td>Ms Kamini Gupta</td>
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<tr>
<td>19</td>
<td>Shri Satish Pandey</td>
<td>6th Asian Regional conference on Geosynthetics</td>
<td>New Delhi</td>
<td>8-11 Nov, 2016</td>
</tr>
<tr>
<td>20</td>
<td>Shri Durgaprasad Golla</td>
<td>India International Science festival</td>
<td>CSIR-NPL, New Delhi</td>
<td>07-11 Dec, 2016</td>
</tr>
<tr>
<td>S.No.</td>
<td>Name of the staff</td>
<td>Details of conference/seminar</td>
<td>Venue</td>
<td>Dates</td>
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<tr>
<td>21</td>
<td>Shri Satish Pandey</td>
<td>77&lt;sup&gt;th&lt;/sup&gt; Annual IRC Session, Hyderabad</td>
<td>Hyderabad</td>
<td>17-19th Dec, 2016</td>
</tr>
<tr>
<td>22</td>
<td>Prof. Satish Chandra Dr. Ravisekhar, Ch. Shri P. V. Pradeep Kumar Dr. Ambika Behl Dr. Neelima Chakrabarty Dr. Velmurgan Dr. Neelam J Gupta Dr. Mukti Advani Shri Subhash Chand Ms. Kamini Gupta</td>
<td>International Conference on Transportation Planning and Implementation Methodologies for developing countries (TPMDC -2016)</td>
<td>IIT Bombay (India).</td>
<td>19-21 Dec., 2016.</td>
</tr>
<tr>
<td>23</td>
<td>Ms. Minal</td>
<td>International Road Federation-2017</td>
<td>India Islamic Culture Centre, New Delhi</td>
<td>Jan., 2017</td>
</tr>
<tr>
<td>24</td>
<td>Dr. Rina Singh</td>
<td>Asia-Pacific Congress on Catalysis (APCAT – 7) in Mumbai</td>
<td>Hotel Lalit, Mumbai</td>
<td>17-21 Jan., 2017</td>
</tr>
<tr>
<td>25</td>
<td>Dr. Kishor Kumar</td>
<td>ESRI India User Conference 2017</td>
<td>NEW Delhi,</td>
<td>19-20 Jan. 2017</td>
</tr>
<tr>
<td>26</td>
<td>Shri Binod Kumar</td>
<td>JSW GGBFS Conclave</td>
<td>Chennai.</td>
<td>24 Feb, 2017</td>
</tr>
<tr>
<td>27</td>
<td>श्री संजय चौधरी वरिष्ठ हिन्दी अनुवादक</td>
<td>सीईएसआईआर–सीईएमईआरआई हीरक जयलंक के उपलक्ष्य में 'मेक इन इंडिया' विषय पर राष्ट्रीय विज्ञान संगोष्ठी.</td>
<td>CSIR-CMERI, Durgapur, W. Bengal</td>
<td>26-27 Feb, 2017</td>
</tr>
<tr>
<td>28</td>
<td>Dr. Ambika Behl Dr. Siksha Swaroopa Kar</td>
<td>International conference on &quot; Nanomaterials and Nanotechnology”</td>
<td>VBRI, Allahabad</td>
<td>01- 03 Mar. 2017</td>
</tr>
<tr>
<td>29</td>
<td>Dr. Kishor Kumar</td>
<td>11&lt;sup&gt;th&lt;/sup&gt; Uttarakhand State Science and Technology Congress (USSTC),</td>
<td>Uttarakhand State Council for Science and Technology, Dehradun.</td>
<td>02-05 Mar. 2017</td>
</tr>
<tr>
<td>30</td>
<td>Shri U.K. Guru Vittal</td>
<td>Urban Transport Management (UTM) 2017</td>
<td>ABUHEA, Bangalore</td>
<td>11 March 2017</td>
</tr>
<tr>
<td>S.No.</td>
<td>Name of the staff</td>
<td>Details of conference/seminar</td>
<td>Venue</td>
<td>Dates</td>
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<tr>
<td>31</td>
<td>Dr. Pankaj Gupta</td>
<td>National Seminar on Importance of hill area development engineering &amp; rock mechanics</td>
<td>Civil Engineering Department, IIT Roorkee</td>
<td>20 Mar. 2017</td>
</tr>
<tr>
<td></td>
<td>Shri Dinesh Ganvir</td>
<td></td>
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<tr>
<td>34</td>
<td>Shri Dinesh Ganvir</td>
<td>5th National conference &amp; awards on Waste to Wealth: Solid Waste, Plastic waste, Industrial Waste organized by ASSOCHAM</td>
<td>Le –Meridan Hotel, New Delhi</td>
<td>30 Mar, 2017</td>
</tr>
</tbody>
</table>
Conferences Attended
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Conference</th>
<th>Attended by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>International Conclave on Air Pollution hosted by Centre for Science and Environment, 19-20 April, 2016, New Delhi</td>
<td>Shri P.V. Pradeep Kumar</td>
</tr>
<tr>
<td>2</td>
<td>Conference and exhibition on &quot;Concrete and structures&quot;, 18-20 May, 2016, New Delhi</td>
<td>Dr. Rajiv Goyal</td>
</tr>
<tr>
<td>3</td>
<td>2nd Global Geosynthetics Summit, 19-20 May, 2016, New Delhi</td>
<td>Dr. Kishor Kumar, Shri Kanwar Singh, Shri N.K. Goyal</td>
</tr>
<tr>
<td>4</td>
<td>28th meeting of BIS on &quot;Automotive Braking and steering system, vehicle testing and performance evaluation sectional committee (TED-4) hosted by National Automotive Test Tracks (NATRAX). 17th June, 2016, Indore</td>
<td>Shri P.V. Pradeep Kumar</td>
</tr>
<tr>
<td>5</td>
<td>Attended the meeting of consultant appointment committee conducted by Asst Director (Plg.), PWD Delhi. 22nd June, 2016, Delhi Secretariat</td>
<td>Shri P.V. Pradeep Kumar</td>
</tr>
<tr>
<td>6</td>
<td>14th World Conference on Transport Research, Shanghai, China from 10-15 July, 2016</td>
<td>Dr. Neelam J Gupta, Dr. S Velmurugan</td>
</tr>
<tr>
<td>7</td>
<td>NGV India Summit: Building Infrastructure &amp; fuelling Growth. 14-15th July, 2016, New Delhi</td>
<td>Shri P.V. Pradeep Kumar</td>
</tr>
<tr>
<td>8</td>
<td>Conference on &quot;Revitalising PPPs in Infrastructure&quot; 26-27 July, 2016, New Delhi</td>
<td>Shri Manoj Shukla, Shri Satish Pandey</td>
</tr>
<tr>
<td>9</td>
<td>International Conference on &quot;Recent Advances in Geotechnical Earthquake Engineering and soil dynamics, 1-6 August, 2016, Greater Noida IIT Roorkee Campus</td>
<td>Dr. R.K. Garg, Shri Q.I. Kashif</td>
</tr>
<tr>
<td>10</td>
<td>Conference on &quot;Fifteen Years of PMGSY&quot; 6-7 August, 2016, Roorkee</td>
<td>Dr. H Lokeshwor Singh</td>
</tr>
<tr>
<td>11</td>
<td>International Symposium on &quot;3-D Printing of Concrete&quot; 8th August, 2016, Chennai</td>
<td>Dr. Rakesh Kumar</td>
</tr>
<tr>
<td>12</td>
<td>Sustainable and Efficient Structures in Smart Cities, 17th September 2016, Greater Noida</td>
<td>Dr. S.S. Gaharwar, Shri G.K. Sahu, Dr. Rajeev Goel</td>
</tr>
<tr>
<td>13</td>
<td>National workshop on &quot;Advances in Repairs and Rehahilitation of Concrete Structures&quot; 22-23 September 2016, Roorkee</td>
<td>Shri V.K. Tyagi, Shri Vaibhav Varshney</td>
</tr>
<tr>
<td>14</td>
<td>National Workshop on &quot;Utilisation of Construction and Demolition Waste in construction of Dwelling Units and related Infrastructures, 23rd September 2016, New Delhi</td>
<td>Shri Sudhir Mathur</td>
</tr>
<tr>
<td>15</td>
<td>Symposium on Composite Cement on 30th September, 2016 at Ballabgarh</td>
<td>Ms. Lincy Varghese</td>
</tr>
<tr>
<td>16</td>
<td>First Biennial Conference on &quot;Indian Bridge management system (IBMS 2016) 4-5 October, 2016, New Delhi</td>
<td>Dr. Rajeev Goel, Shri G.K. Sahu, Dr. S.S. Gaharwar</td>
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<tr>
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<tr>
<td>17</td>
<td>National Seminar on “Towards Building Smart and Sustainable Infrastructure in Urban Development”, 7-8 October, 2016, New Delhi</td>
<td>Shri Pankaj Bhatt</td>
</tr>
<tr>
<td>18</td>
<td>6th Asian Regional conference on &quot; Geosyntheses, 8-11 November, 2016 New Delhi</td>
<td>Shri Satish Pandey</td>
</tr>
<tr>
<td>19</td>
<td>CRRI participated in CSIR Techno fest as part of platinum jubilee celebration at IITF, Pragathi Maidan organized by Indian Trade Promotion Organization, Theme Pavillion on Ecology and Environment coordinated by NEERI Nagpur was awarded the second prize among the entire CSIR theme pavilion. 14-27th Nov., 2016, New Delhi</td>
<td>Shri P.V. Pradeep Kumar</td>
</tr>
<tr>
<td>20</td>
<td>14th National conference on &quot; India's vision 2030 - What Engineers and Technologists can do&quot; 28th November, 2016, New Delhi</td>
<td>Dr. Rajiv Goel</td>
</tr>
<tr>
<td>21</td>
<td>India International science Festival 2016, 7-11 December, 2016, New Delhi</td>
<td>Shri Durgaprasad Golia</td>
</tr>
<tr>
<td>22</td>
<td>77th Annual IRC Session, 17-19th December, 2016, Hyderabad</td>
<td>Shri Satish Pandey</td>
</tr>
<tr>
<td>23</td>
<td>“12th Transportation Planning and Implementation Methodologies for Developing Countries ( TPMDC 2016)“, 19-21 December, 2016, Mumbai</td>
<td>Dr. S. Velmurgan, Dr. Ambika Behl, Dr. Neelima Chakraborty, Dr. S. Padma, Kamini Gupta</td>
</tr>
<tr>
<td>24</td>
<td>Conference on&quot; Structural Engineering Convention (SEC 2016), 21-23 December, 2016, Cheenai</td>
<td>Shri Kashif Q I, Dr. R.K. Garg</td>
</tr>
<tr>
<td>25</td>
<td>Structural Engineering Convention 2016, 21-23 December, 2016, Chennai</td>
<td>Ms. Lincy Varghese</td>
</tr>
<tr>
<td>26</td>
<td>Conference on &quot; Asia-Pacific congress on Catalysis (APCAT-7), 17-21 January, 2017, Mumbai</td>
<td>Dr. Rina Singh</td>
</tr>
<tr>
<td>27</td>
<td>Workshop on &quot;Design and Analysis of Experiments, 18-20 January, 2017, Ghaziabad</td>
<td>Shri Ramesh Kumar Majhi, Shri G. Bharat, Shri M. Vinth</td>
</tr>
<tr>
<td>28</td>
<td>Round Table on Reinventing In-Use Emissions Compliance Regime hosted by CSE.3rd Feb., 2017, New Delhi</td>
<td>Shri P.V. Pradeep Kumar</td>
</tr>
<tr>
<td>29</td>
<td>International Conference union of Leather Technologists and Chemists Societies ( IULTCS-2017), 5-7 Feb, 2017 at Cheenai</td>
<td>Shri C Kamraj</td>
</tr>
<tr>
<td>30</td>
<td>Workshop on &quot; Concrete Construction Technologies &quot; 18 February, 2017, Noida</td>
<td>Dr. Rajiv Goel, Shri G.K. Sahu, Dr. S.S. Gaharwar, Dr. V.V.L.K. Rao, Shri T.K. Amla, Shri Akash Verma, Shri Manish Kumar, Ms. Naveet Kaur</td>
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<tr>
<td>31</td>
<td>Conference on &quot; 3D Printing - The Game Changer, 22 Feb, 2017 New Delhi</td>
<td>Dr. R.K. Garg</td>
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<td>Dr. S.S. Gaharwar</td>
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<td>Shri G.K. Sahu</td>
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<td>Dr. Rajeev Goel</td>
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<td></td>
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<td>Shri S.K. Sharma</td>
</tr>
<tr>
<td>32</td>
<td>International conference on&quot; Nanomaterials and Nanotechnology, 1-3 March 2017, Allahabad</td>
<td>Dr. Ambika Bhel</td>
</tr>
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<td></td>
<td></td>
<td>Dr. Siksha Swaroopa Kar</td>
</tr>
<tr>
<td>33</td>
<td>National Workshop on “Disability, Assistive Technology and Independent Living :Issues and Challenges in Indian Context ” Organised by Society for Disability and Rehabilitation Studies-SDRS (New Delhi) in collaboration with Social Action and Research Foundation (New Delhi) 3rd &amp; 4th March 2017</td>
<td>Dr. Neelima Chakraborty; Kamini Gupta</td>
</tr>
</tbody>
</table>
Retirements, Joining & Promotions
Following staff members have retired from services of the Institute during the period. CRRI Welfare Committee organized function to bid all of them a grand farewell:

- **Shri N. Kr. Sakkarwal, Sr. Technician**
  
  - Date: 31-5-2016

- **Shri B. Singh Batra, Sr. Steno**
  
  - Date: 30-6-2016

- **Shri R. K. Swami, Sr. Pr Scientist**
  
  - Date: 29-7-2016

- **Shri Hari Ram, TSS**
  
  - Date: 29-7-2016

- **Shri Shahbuddin Khan, Sr. Technician**
  
  - Date: 29-7-2016

- **Shri Prem, Bhabadur Thapa, Tea Maker**
  
  - Date: 31-8-2016

- **Shri Attar Singh, Senior Technical Officer**
  
  - Date: 31-8-2016

- **Shri S. K. Rishi, Sr. Technician (2)**
  
  - Date: 31-10-2016

- **Shri Ajit Kumar, Work Assistant**
  
  - Date: 31-10-2016

- **Shri Ashok Kumar, Senior Technician**
  
  - Date: 30-11-2016

- **Shri Rishi Pal Saini, Senior Technical Officer**
  
  - Date: 31-12-2016

- **Sh. Sunil Chandra Saha, Senior Technician**
  
  - Date: 31-1-2017

- **Shri S.K. Gupta, Sr. Tech. Officer (3)**
  
  - Date: 28-2-2017

- **Sh. G. C. Lohani, Senior Steno**
  
  - Date: 28-2-2017

- **Sh. Ravinder Kumar, Senior Technical Officer**
  
  - Date: 31-3-2017
WELCOME ON JOINING CRRI

- Shri Durga Prasad Golla Joined as Scientist on 18/07/2016
- Shri Ramesh Chandra Manjhi Joined as Scientist on 25/07/2016
- Shri Romeil Sagwal Joined as Scientist on 12/08/2016
- Sampath Kumar Pasupunuri joined as Scientist on 15/06/2016
- Sh. S. Ravi Shankar joined as Scientist w.e.f. 22/02/2017
- Ms. Anupama Sharma, Jr. Hindi Translator, Joined on 22/12/2016
- Shri Tariq Badar Joined as Controller of S&P (transferred from NPL) on 25/07/2016
- Shri Binoth M, Scientist, Joined on 14-10-2016
- Shri Kaushal Kishor, SPO Joined on 16/11/2016 (transferred to CSIR-CRRI From NBRI, Lucknow)
- Shri O. Omman Panicker, Sr. COA Joined on 2/12/2016 (transferred to CSIR-CRRI From CSIR Complex)
- Shri Padam Singh, Sr. COFA Joined on 26/12/2016 (transferred to CSIR-CRRI From IIP, Dehradun)

CONGRATULATIONS ON PROMOTIONS

Shri J.K. Goyal, Principal Scientist      Sr. Principal Scientist
Sh. Y.C. Tiwari, Principal Scientist     Sr. Principal Scientist
Dr. Sunil Jain, Principal Scientist      Sr. Principal Scientist
Dr. Sippy Kalra Chauhan, Senior Scientist Principal Scientist
Sh. P.S. Prasad, Senior Scientist        Principal Scientist
Dr. Chalumuri Ravi Sekhar, Senior Scientist Principal Scientist
Sh. Manoj Kumar Shukla, Senior Scientist Principal Scientist
Sh. Alok Ranjan, Senior Scientist        Principal Scientist
Sh. Abhishek Mittal, Scientist           Senior Scientist
Sh. Dinesh V. Ganvir, Scientist          Senior Scientist
Ms. Ambika Behl, Scientist               Senior Scientist
Dr. S. Padma, Scientist                  Senior Scientist
Dr. Mukti Advani, Scientist              Senior Scientist
Ms. Renu Chadda, Sr. Technical Officer(3) Principal Technical Officer
Ms. Neera Agarwal, Sr. Technical Officer(3) Principal Technical Officer
Sh. Naresh Kumar Sharma, Sr. Tech. Officer(3) Principal Technical Officer
Sh. Ravinder Deekonda, Technical Officer  Sr. Technical Officer (1)
Ms. Nidhi Agarwal, Technical Officer      Sr. Technical Officer (1)
Sh. Rajesh Rana, Technical Officer        Sr. Technical Officer (1)
Sh. Muni Raj Meena, Technical Officer     Sr. Technical Officer (1)
Ms. Kamla Masih, Sr. Technical Officer(1) Sr. Technical Officer (2)
Joining & Promotions

Sh. S. Mariappan, Sr. Technical Officer(1) Sr. Technical Officer (2)
Sh. Vijay Kumar Kanaujia, Sr. Tech. Officer(1) Sr. Technical Officer (2)
Sh. Mukesh Kumar, Sr. Technical Officer(1) Sr. Technical Officer (2)
Late Sh. Beg Raj, Sr. Technical Officer(2) Sr. Technical Officer (3)
Sh. P.C. Meshram, Sr. Technical Officer(2) Sr. Technical Officer (3)
Sh. Ashok Kumar (Hort), Sr. Tech. Officer(2) Sr. Technical Officer (3)
Sh. A.K. Tripathi, Sr. Technical Officer(2) Sr. Technical Officer (3)
Sh. S. Kanan, Sr. Technical Officer(2) Sr. Technical Officer (3)
Sh. K.K. Gola, Technical Assistant Technical Officer
Sh. H. Lokeshor Singh, Technical Assistant Technical Officer
Sh. Manpreet Singh, Technical Assistant Technical Officer
Sh. Babu Lal Meena, Technician (2) Sr. Technician (1)
Sh. Sunil Dutt, Technician (2) Sr. Technician (1)
Sh. Harish Kumar, Sr. Technician (1) Sr. Technician (2)
Sh. Amin Ali Khan, Sr. Technician (1) Sr. Technician (2)
Sh. Sanjay Kumar, Sr. Technician (1) Sr. Technician (2)
Sh. Nihendra Singh, Sr. Technician (1) Sr. Technician (2)
Sh. Satyabir Singh, Sr. Technician (1) Sr. Technician (2)
Sh. Daya Ram, Sr. Technician (1) Sr. Technician (2)
Sh. Om Kumar, Sr. Technician (1) Sr. Technician (2)
Sh. Dinesh Prakash, Lab Attendant (2) Lab Assistant
Sh. Asif Hussain Choudhary, Lab Attendant (2) Lab Assistant
Ms. Sunita Saini, Lab Attendant (1) Lab Attendant (2)
Sh. Suresh Prasad Thakur, Lab Attendant (1) Lab Attendant (2)
Sh. Shiv Lal, Lab Attendant (1) Lab Attendant (2)
Sh. Prem Chand, Lab Attendant (1) Lab Attendant (2)
Sh. Sant Ram, Lab Attendant (1) Lab Attendant (2)
Sh. Raja Lal Manjhi, Lab Attendant (1) Lab Attendant (2)
Sh. Fasih Ahmed Siddiqui, Gr. III(4) Gr.III(5)
Sh. R.C Pardesi, Gr.II (3) (Retd) Gr.II(4)
With profound grief and sorrow, we inform the sad and sudden demise of our esteemed colleague Sh. R.C. Joon, Administrative Officer, who left us for his heavenly abode on July 07, 2016. We deeply mourn the death of Sh. R.C. Joon and convey our heartfelt condolences to the bereaved family. We pray to the Almighty that may his noble soul rest in peace and be blessed with the eternal peace.

With profound grief and sorrow, we inform the sad and sudden demise of our esteemed colleague Sh. Vinod Kumar, Work Assistant, who left us for his heavenly abode on December 19, 2016. We deeply mourn the death of Sh. Vinod Kumar and convey our heartfelt condolences to the bereaved family. We pray to the Almighty that may his noble soul rest in peace and be blessed with the eternal peace.

With profound grief and sorrow, we inform the sad and sudden demise of our former Director General & former Director, CSIR-IHBT Palampur, Dr. Paramveer Singh Ahuja, who left us for his heavenly abode on January 20, 2017. We deeply mourn the death of Dr. Paramveer Singh Ahuja and convey our heartfelt condolences to the bereaved family. We pray to the Almighty that may his noble soul rest in peace and be blessed with the eternal peace.
Human Resource

Director

Prof. Satish Chandra
B.E (Hons) Civil, M.E. (Transportation) Ph.d

Bridge Engineering & Structures (BES)

Head
Sh. S. S. Gaharwar, M.E. (Structure)

Scientists/Technical Officers
Dr. P. Lakshmy, M.E., Ph.D.
Dr. R. K. Garg, M.Tech, Ph. D.
Sh. D. C. Sharma, B.E. (Elect), M.Tech (Computers)
Sh. G. K. Sahu, M.E. (Structure)
Dr. Rajeev Goel, M.E.(Structural Engineering), Ph.D.
Dr. Suraj Prakash, M.E. (Earthquake Engineering), Ph.D. (On Deputation)
Dr. V.V.L. Kanta Rao, M.Sc., Ph.D.
Sh. J. K. Goyal, M.E.(Structures) (On Deputation)
Sh. U. S. Rao, M.Tech. (Structure)
Sh. A. K. Dhall, M.Tech
Dr. S. K. Sharma, M.E. (Structure) Ph.D
Sh. Sushil Kumar, B.Sc., Dip. in Civil Engg., AMIE
Sh. Narendra Kumar, M. Sc.
Sh. Yogender Kumar Singh, Dip. Electronics
Sh. Pradeep Kumar, M.E. (Structure Engineering)
Sh. Rajesh Rana, Diploma in Mechanical, AMIE
Sh. Kumar Shashi Bhushan, Diploma in Civil Engg. AMIE
Sh. Mahipal Singh Rana, ITI

Traffic Engineering & Road Safety (TES)

Head
Dr. Neelima Chakraborty, M.A., (Psycho.), P.G. Dip. (Environmental Psycho.), Ph.D

Scientists/Technical Officers
Dr. S.Velmurugan, M.E., Ph.D. (Transportation Engineering)
Sh. Subhash Chand, M.E. (Highways)
Dr. A. Mohan Rao, M.Tech. (Transportation Engineering)
Dr. J. Natraju, M.E.(Highways), Ph.d.
Sh. Ashutosh Arun, M.Tech
Sh. Ramesh Ch. Majhi, M.Tech
Sh. S. Kannan, Post Graduate (IT)
Ms. Kamini Gupta, M.Tech. (Transportation Planning)

S&T and Supporting Staff
Sh. Rajan Verma, Diploma in Civil Engg.
Sh. S.K. Biswas, Draftsman
Sh. Satyabir Singh, SSC, ITI (Printing)
Sh. Aniket Ranjan, ITI.
Smt. Krishna Verma,
Smt. Sushma Bhel, Intermediate
Sh.Narender Kumar, Matric
Sh. Jaglal Mehto, Non-Matric
Smt. Raj Bala, Non-Matric

Transportation Planning (TP)

Head
Dr. Errampalli Madhu M.Tech (Transportation Engineering), Ph. D.

Scientists/Technical Officers
Dr. Parida Purnima, M.A. (Economics), M.Tech.
Dr. Kirti Bhandari, M.Sc. (Environmental Engg.), Ph.D.

S&T and Supporting Staff
Sh. Surendra Kumar Verma, Diploma in Civil Engineering, BE (Civil)
Sh. Vijay Kumar, ITI , Diploma in Civil Engg
Sh. Rajveer Singh, Non-Matric
Ms. Indu Rani, B.A.
Sh. Sunil Dutt, Non Matric
Dr. Ravinder Kumar, ME (Transportation Engg.), Ph.D.
Dr. K. Ravinder, M. Tech. (Transportation Engg.) Ph.D.
Dr. Nasim Akhtar, M.Tech. (Dr.) (Environmental Engg.)
Dr. Ch. Ravi Sekhar, M.E. (Transportation Engineering), Ph.D.
Smt. Farhat Azad, M.Tech
Dr. S. Padma, M.Tech., Ph.D.
Dr. Mukti Advani, M.E. (Transportation Engineering), Ph.D.
Ms. Minal, M.Tech (Transportation Engineering)
Dr. H. Lokeshwar Singh, M.Sc. (Electronics) Ph.D. (Instrumentation)
Dr. Pritikana Das, Ph.D. (Transportation Engineering)

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Sh. Jagdish Singh, Intermediate
Mr. Sanjay Kumar, M.A. (Pub. Admn.), B.Lib.
Smt. Shakuntla Devi, Non-Matri

Environmental Science (ES)
Head
Dr. P.V. Pradeep Kumar, M.E. (Mech.), M.B.A.

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Dr. Anuradha Shukla, M.Sc., M.Tech. (Corrosion Science), P.G. Diploma in Ecology & Environment Science, Ph.D.
Dr. Niraj Sharma, M.Tech. (Environmental Engg.), Ph.D.
Dr. Sippy K. Chauhan, Ph.D. (Chemistry)
Dr. Rina Singh, M. Tech. (Material Science), Ph.D (Nanotechnology, Physics)

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Ms. Sethi Sarita, B.A. (Steno)
Sh. Daya Ram, B.A.
Ms. Neha Chaudhary, Diploma in PHE
Sh. Sunil Kumar, Graduate
Sh. Brij Mohan Singh, Matric

Flexible Pavement Division (FP)
Head
Sh. Manoj Kumar Shukla, M.Tech. (Highway Engg.)

Scientists/Technical Officers
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Dr. Ambika Behl, M.Tech, Ph.D.
Sh. Satish Pandey, B.E, M.Tech (Transport Engg.)
Ms. Siksha Swaroopa Kar, M.Tech
Sh Gagandeep singh, M.Tech
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Sh. Abhishek Mittal, M.Tech (Transportation Engg.)
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Sh. Shankh Dass, B.E. (Civil)
Sh. Madan Pal Singh, B.Sc.

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Sh. Amit Kumar, B.Tech (Civil)
Sh. J.P. Shukla, Matric
Sh. Nihendra Singh, B.A.
Sh. Raghusaran Balmiki, Non-Matric

Rigid Pavement (RP)
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Dr. Rakesh Kumar, M.Tech, Ph.D. (Civil Engg)
Ms. Lalita Jangpangi, B.Sc. (Engg.)
Sh. Dinesh V. Ganvir, M.E. (Highways & Transportation)
Sh. Romeil Sagwal, M.Tech
Sh. Ravi Shankar S, M.Tech
Sh. Pankaj Goel, M.Tech (Const. Engg. & Management)

S&T and Supporting Staff
Sh. Ashok Pant, Higher Secondary
Ms. Aashia, I.T.I.
Sh. Manoj Kumar Singh, B.E. (Civil)
Sh. Balvir Singh, Non Matric

Pavement Evaluation Division (PED)
Head
Sh. Sunil Jain, M.E. (Transportation Engg.)

Scientists/Technical Officers
Sh. K. Sitaram Anjaneyulu, M.E. (Highway Engg.)
Sh. Sudesh Kumar, M.Sc. (Chemistry)
Dr. Devesh Tiwari, M.E (Transportation Engg.), Ph.D
Sh. Pradeep Kumar, M.Sc. (Physics), M. Phil (Instrumentation)
Sh. A. K.Sagar, B.Sc. Engg. (Civil), MBA, M.Tech. (Environmental Engg.)
Sh. A. K.Jain, M.E. Hons. (Transportation Enggs.)
Sh. Sampath Kumar Pasupunuri , M.Tech.
Sh. Rampal, B.Sc.
Sh. Y.V. Rao, M.Sc. (Maths)
Sh. Attar Singh, Diploma in Civil Engineering (Retired)
Sh. A.P. Singh, B.E Civil Engg.

S&T and Supporting Staff
Sh. PR Singh, B.sc
Sh. Pratap Singh, Matric ,ITI
Sh. Subhash, Cert. In Draftsman
Ms. Neha Dhimani, ITI
Sh. Mahinder Prasad Singh, Non-Matric
Sh. Ram Lal, Non-Matric (Retired July 2017)

Geotechnical Engineering (GTE)
Head
Sh. U. K. Guru Vittal, M.E. (Highway)

Scientists/Technical Officer
Sh. Sudhir Mathur, M.Tech (SM & FE)
Dr. Kishore Kumar, Ph.D. (Geology Engineering)
Dr. Vasant.G. Havanagi, M.Tech, Ph.D. (Highway & Geotech Engg.)
Dr. Pankaj Gupta, M. Tech, Ph.D (Engg. Geology)
Sh. R. K. Panigrahi, M.Sc. (Applied Geology)
Sh. Ambrish Saurikhia, M.Sc. (Env. Engg.), PGDPM, AMIE
Sh. Kanwar Singh, M.Tech. (Geotechnical Engg.)
Dr. Prasad P.S., M.E. (Geotechnical Engg.), Ph.D.
Sh. Alok Ranjan, M.Tech. (Engineering Geology)
Sh. Anil Kumar Sinha, M.Tech. (Geotech. Engg.)
Sh. Vinoth M., ME (Soil Mechanics & Foundation Engg.)
Sh. V. K. Kanaujia, M.Tech. (Geotechnical Engg.)
Dr. P. Pramada Valli, M.Sc. (Applied Geology), Ph.D. (Applied Maths)
Sh. R.K. Swami, M.Sc. (Chemistry)
Retired on July,2016
Sh. Nitesh kumar Goel, M.Tech (Transportation)
(on deputation)
S&T and Supporting Staff
Smt. Prema Prasad, M.A.
Sh. V. Murugesan, SSLC
Ms. Rekha, I.T.I., B.A.
Sh. Jamdar Mehto, Non-Matric
Sh. Surender Kumar, Non-Matric
Sh. Hari Ram, Non-Matric (Retired)
Sh. Sunil Chander Saha, Matric (Retired)

HRD & Project Management (HRP)

PME
Head
Dr. Kanaga Durai, M.A. (Eco), M.R.P. (Regional Planning) Ph. D

Scientists/Technical Officers
Sh. Ravinder Deekonda, Diploma in Computer Engg., BCA, MCA
Smt. Nidhi Aggarwal, M.Sc. (Chemistry)
Sh. Anshul Saxena, M.Tech (IT)

S&T and Supporting Staff
Sh. Dinesh Prakash, Non-Matric
Smt. Santosh, Non-matric
Sh. Sri Lal, H.S.C. (Retired)

Information, Liaison & Training (ILT)

Head
Sh. T. K. Amla, M.Sc. (Chemistry), Associateship in Information Science, M. Phil. Science Communication & Journalism

Scientists/Technical Officers
Dr. Neelam J. Gupta, M.Sc. M.Phil (Computer Application), Ph.D. (Numerical Analysis)
Sh. M.K. Meena, M.Tech. (Civil)
Sh. R.C. Agarwal, B.E. (Mechanical Engg.), AMIE, PG-PDQM (TQM), C. Engr. (I), Certificate in Cyber Law

S&T and Supporting Staff
Smt. Kavita Jain, M.Com (Retired)
Smt. Sarita Rastogi, Diploma in Commercial Art
Sh. Vijay Kumar Kaushal, MCA, MBA, OCA
Sh. Ashok Kumar, Certificate Course in Colour Photography (Retired)

S&T and Supporting Staff
Sh. Amin Ali Khan, M.A. (Political Science)
Sh. Rajbir Singh, B.A.
Smt. Sumitra Bai, Non-Matric

Quality Management
Sh. R.S. Bharadwaj, M.Sc., Associateship in Information Science, M.Phil (Science Communication & Journalism)

Computer Centre & Networking (CCN)

Head
Dr. R. N. Dutta, M.Sc. (Operational Research), Ph.D.

Scientists/Technical Officer
Sh. S. Mariappan, M.C.A.
Smt. Reeta Kukreja, M.Sc. (IT), M.B.A.
Sh. Kamla Masih, M.C.A
Sh. Vivek Dubey, M.C.A., PGDBM (Finance & Marketing)
Sh. Manpreet Singh, M.E. (Electronics & Communication Engg.)
Smt. Preeti Sinha, B.C.A.

S&T and Supporting Staff
Sh. Anil Kumar, Diploma in Computer Hardware
Sh. Shiv Lal, Diploma in Computer Hardware

Technical Services Division

Head
Sh. R.S. Bharadwaj, M.Sc., Associateship in Information Science, M.Phil (Science Communication & Journalism)
**Human Resource**

**Scientists/Technical Officers**
- Sh. Y.C. Tiwari, M.Sc. (Physics)
- Sh. Subodh Kumar, M.S., M.B.A.
- Sh. N.K. Sharma, Diploma in Mechanical Engg., B.A. B.Tech. (Mechanical)
- Ms. Renu Chadda, M.Sc. (Botany)
- Sh. P.C. Meshram, M.Tech. (Digital Communication Engg.)
- Sh. Mohd. Irshad, Diploma in Draftsmanship (Mech.)
- Sh. Ashok Kumar Arora, M.A., Dip. in Auto Engg.
- Sh. Suresh Chandra, B.E. (Electrical Engg.), (In-Charge) (Retired)
- Sh. R.P Saini, B.Sc., Diploma (Electronic Engg.) (Retired)

**S&T and Supporting Staff**
- Sh. K.J.S.Kapoor, B.Com, I.T.I
- Sh. Devender Kumar
- Sh. Lakhbinder Singh, H.Sc., I.T.I. (Motor Mech.)
- Sh. Kishan Swroop, ITI (Electrical/Wireman Course)
- Sh. Om Prakash, I.T.I. (Fitting)
- Sh. S.K.Dhingra, Steno
- Sh. Sant Ram, B.A.

**Documentation & Library Services (DLS)**
- Head
  - Smt. Pavan Chhabra, M.Sc. (Physics), M.LI.Sc,

**Scientists/Technical Officers**
- Ms. Neera Aggarwal, M.A., B.LI. Sc., Associateship in Information Science
- Sh. Ravinder Kumar, M.A. (Pub.Adm.) Diploma in Offset Printing Technology (Retired)
- Smt. Mitali Mohapatra, DLISc., PDLSc., MLSc., PGDLAN

**S&T and Supporting Staff**
- Smt. Ching Lydia, B.Sc., MLISc.
- Sh. Om Kumar, B.A., I.T.I.
- Sh. Dev Dutt Sharma, Matric

**Post-Graduate Research Programme (PGRP)**
- Dr. Kanaga Durai, M.A. (Eco), M.R.P. (Regional Planning) Ph. D (Coordinator)

**Rajbhasha Unit**
- Smt. Santosh Khuttan, B.A.
- Ms. Anupama Sharma, MA, PG Dip. In Translation
- Sh. Tek Chand Thapa, B.A. (Retired)

**Estate Services (ESS)**
- Civil Section
  - Head
    - Sh. A. K. Jain, M.E. Hons. (Transportation Engg.)

**Scientists & Technical Officers**
- Sh. Pankaj Bhatt, Diploma in Civil Engineering
- Sh. A.K. Sabharwal, B.E.(Civil), M.B.A. (Marketing)
- Sh. V.K. Tyagi, Dip. in Civil Engg.
- Sh. Mukesh Kumar, M.Tech. (Construction Engg. & Management)

**S&T and Supporting Staff**
- Sh. Vaibhav Varshney, Diploma in Civil Engineering
- Sh. Harish Kumar, ITI (Plumbing)
- Sh. Asif Hussain Choudhary, B.Com.
- Sh. Bhanwar Singh, Non-Matric
- Sh. Kailash Kumar, Matric
- Sh. Gautam Pandaey, Non-Matric
- Sh. Mohan Lal, Non Matric
- Sh. Vinod Kumar, Non-Matric (Deceased)
Human Resource

Horticulture
In-charge
Sh. Ashok Kumar, M.Sc. (Hort.)

S&T and Supporting Staff
Sh. Raj Pal Singh Gautam

Maharani Bagh Staff Quarters (MBSQ)
Head
Dr. Rajeev Goel, M.E. (Structural Engineering), Ph.D.
Sh. A. K. Tripathi, Dip. in Civil Engg. (Head Maintenance)
Sh. B.M.Sharma, M.E. Transportation Engg., Area Advisor (Retired)

Scientists & Technical Officers
Sh. D.V. Singh, M.Sc.
Sh. Sunil Grover, B.E. (Civil)
Sh. Muni Raj Meena, B. Tech (Electrical)
Sh. Tara Chand, Dip. in Civil Engg.

S&T and Supporting Staff
Sh. Prem Chand, Non-Matric
Sh. Raja Lal Manjhi, Non-Matric
Sh. Shababuddin Khan, Non-Matric (Retired)

Directorate
Sh. Daleep Mutreja ,B.Com
Sh. Kartar Singh, Matric
Smt. Sunita Saini, HSc

Administration
Smt. D.Vijaya Lakshmi Controller of Administration
Transferred to CSIR Complex
Sh. O. Omman Panicker Sr Controller of Administration

Sh. Vijay Kumar, HSc
Sh. Yoginder Mehto, Non-Matric
Sh. Suresh Prasad Thakur, Matric
Sh. Karam Singh, Matric
Smt. Priti Sachdeva, B.A. (Hons.) & Diploma in Secretarial Practices
Sh. Ravi Kumar, Non-Matric
Sh. Dharam Singh
Sh. Om Prakash, Non-Matric
Sh. Ram Singh, Non-Matric

Establishment-I
Sh. Sudhanshu Kumar, (Section Officer)
Sh. Chander Kant,
Smt. Satinder Kaur, B.A.
Sh. Rajeev Chopra, Sr. Sec.
Sh. Manoj Kumar,
Sh. Sri Ram Mahto, Matric
Smt. Sumitra Devi, Non-Matric
Sh. R. C. Joon (Deceased)
Sh. Vinod Kumar, B.A. (Transfered)

Establishment-II
Sh. Sanjeev Shankar, (Section Officer)
Smt. K.B. Verghese, Senior Secondary
Sh. Anil Kumar, B.A.
Sh. V.K. Bhambota, Matric
Sh. Ramesh Badola,
Sh. Dinesh Kumar, Non-Matric
Sh. Desh Raj
Sh. Bhwesh Paswan
Sh. Rakesh Kumar, Intermediate
Sh. Sharma Ramesh Chand, H.Sc.
Sh. Singh Bhajan, B.A.

Personnel Cell
Smt. Vandana D. Singh, (Section Officer)
Sh. Rajan Tirkey, B.A. (Hons.)
Smt. Karuna Saini  
Sh. Dharam Pal, Non-Matric  
Sh. Murari Lal Meena, B.A.

**Vigilance Cell**  
Sh. Sudhanshu Kumar, (Section Officer)  
Sh. Sam Kurian, SSLC  
Sh. Meesam Zaidi  
Sh. Satish Kumar, B.A.

**Cash**  
Sh. V.K. Bhambota, Matric

**Finance & Account Section**  
Sh. Padam Singh Sr.CoFA  
Sh. Avanish Kumar, F&AO  
Sh. Phool Chandra, M.A.  
Sh. Bishan Dass Sharma, B.A.  
Sh. K.C. Paliwal, F & AO (Transferred)  
Sh. Dinesh Kumar F & AO (Transferred)  
Smt. Neelam Malik, Matric  
Sh. Vikas Negi  
Sh. Jagdish Singh Negi, Matric  
Sh. Shiv Narayan, Non-Matric  
Sh. Ajit Kumar Singh, B.A. (Retired)

**Purchase Section**  
Sh. Mukesh Khanna, Senior Store and Purchase Officer (Transferred)  
Sh. Tariq Badar, Sr.S&PO  
Sh. Kaushal Kishore, SPO  
Sh. Sumer Singh Chhachhia, SO  
Sh. K. Bairagi  
Sh. Virender Kumar Dussy  
Sh. Vijender Kumar, Matric  
Ms. Rachna Kumari,  
Sh. Sujit Kumar, (Resign)  
Ms. Veena Verma, M.A.

**Store Section**  
Sh. C.M. Kukreti, HSc  
Sh. Bijender Kumar  
Sh. Gore Lal Paswan, Matric

**Guest House (Wing I & II)**  
Sh. Fasih Ahmed Siddiqui (Manager)  
Sh. Rajbir Singh  
Sh. Keshav Ram Acharya  
Sh. Rajesh Bariya  
Sh. Chet Narayan  
Sh. Rajpat Singh  
Sh. Ramsai Balmiki

**Canteen**  
Sh. Brahm Prakash, (Manager)  
Sh. Hem Kumar (Retired)  
Smt. Kamlesh Kumari  
Sh. Balbir Singh  
Sh. Rajinder Singh  
Sh. Thapa Prem Bahadur (Retired)
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JNTU & Visiting Professor,
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Director
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Director, CSIR- Structural Engineering Research Centre, Taramani,
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Controller of Finance & Accounts/
Finance & Accounts Officer
CSIR-Central Road Research Institute,
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Sr Controller of Administration/
Controller of Administration/
Administrative Officer
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