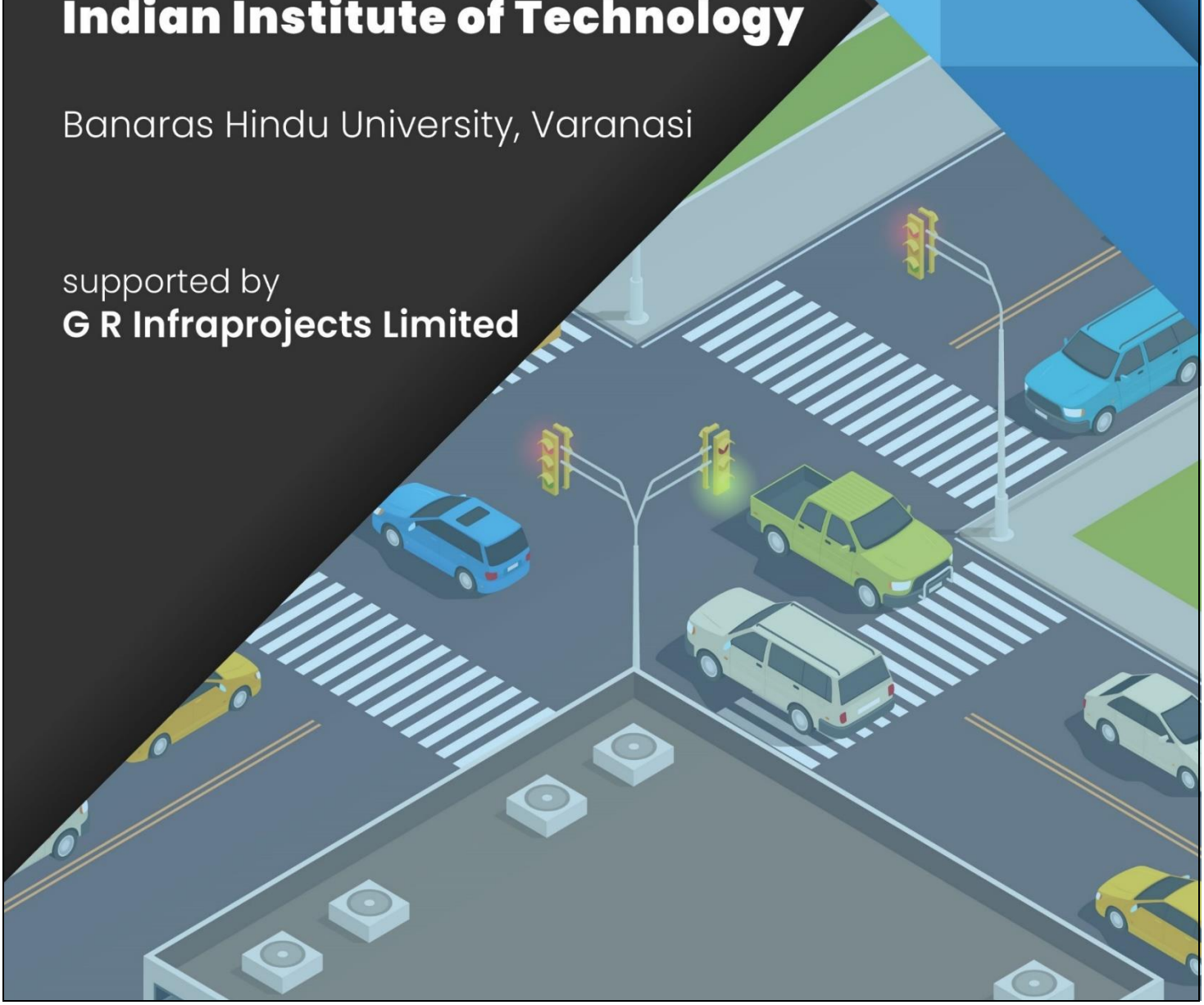
Impact Assessment Report

Road Research Laboratory established at Indian Institute of Technology

Banaras Hindu University, Varanasi

supported by

G R Infraprojects Limited



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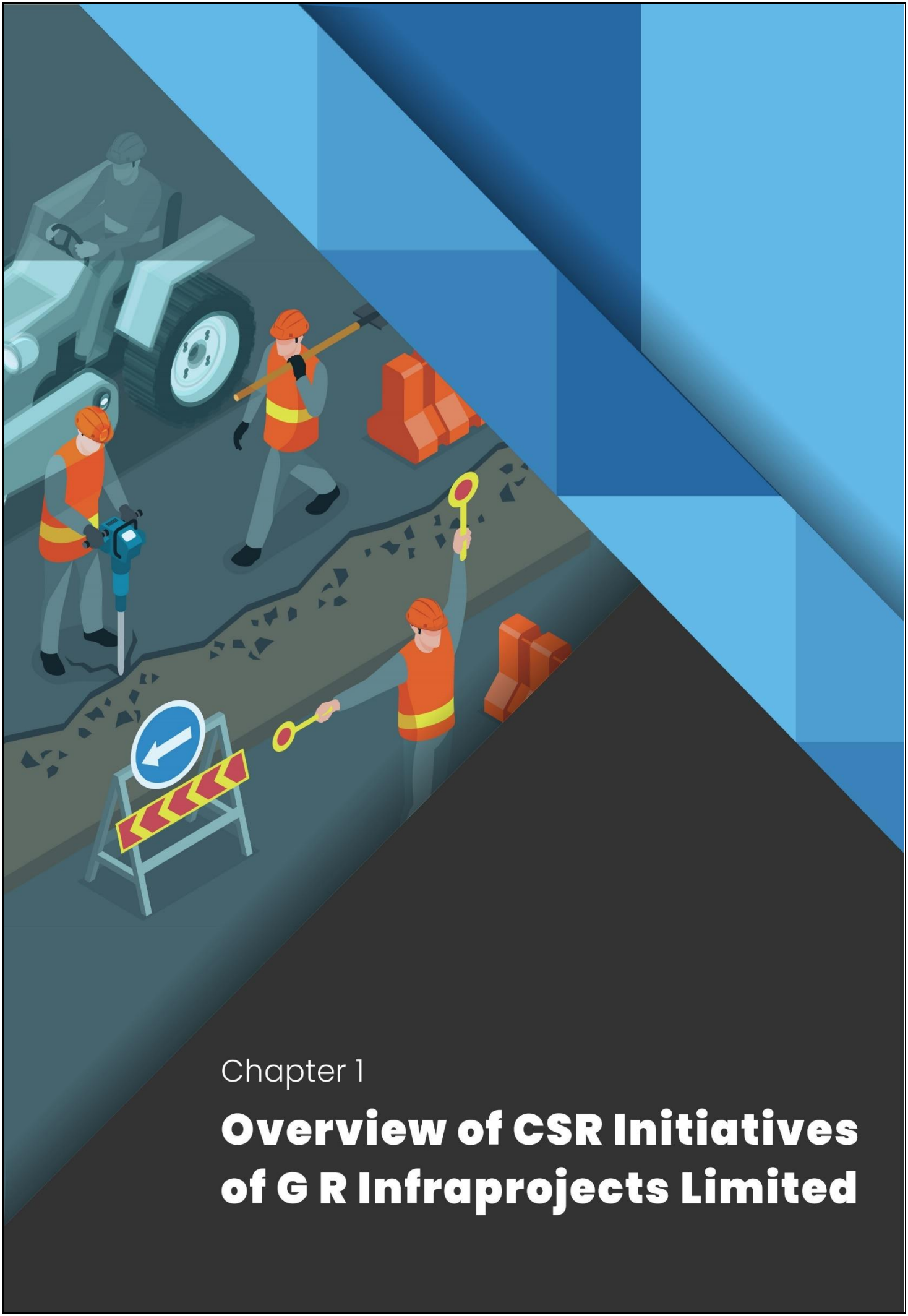


Chapter 1

Overview of CSR Initiatives of G R Infraprojects Limited

Chapter 1: Overview of CSR Initiatives of G R Infraprojects Limited

Today's world revolves around transport. The ability of transportation to facilitate the growth, coordination, and communication of all economic sectors makes it essential to modern society. It strengthens the state's foundation, permits resource mobility, and speeds up the resolution of crises and health-related problems. In the fiscal year 2020, road transport passengers amounted to around 25.2 trillion passengers per kilometre (km) across India. The road network across the South Asian country was the second largest in the world. India's automotive market was dominated by two-wheelers and passenger vehicles[1]. India has the second largest road network in the world, spanning about 66.71 lakh km, which includes national highways, state highways, district roads, and rural roads. This extensive network ensures connectivity across various regions of the country[2]. Even though the roads are the major mode of transport, which account for 87%[3], they mostly are under repair or are absent due to continuous wear and tear.

Mission

- To be fully accountable for the company's actions, to adequately assess impact; not adversely affecting the environment, community, economy or culture

Vision

- To make significant contribution for the upliftment of society so that the social community can be amplified.
- To promote education & empower women.
- To uphold the values of good citizenship, through our own behaviour, and by influencing other organisations to behave in a similar way.
- To promote good CSR and citizenship practices among our members, officers, associates and partner organisations; providing training and education where appropriate.
- To oppose unethical business practices and exert pressure to ensure accountability of businesses, for their behaviours.
- Build active and long-term partnerships with the communities in which we operate to significantly improve social condition of the needy people.

1.1 CSR Initiatives of G R Infraprojects Limited

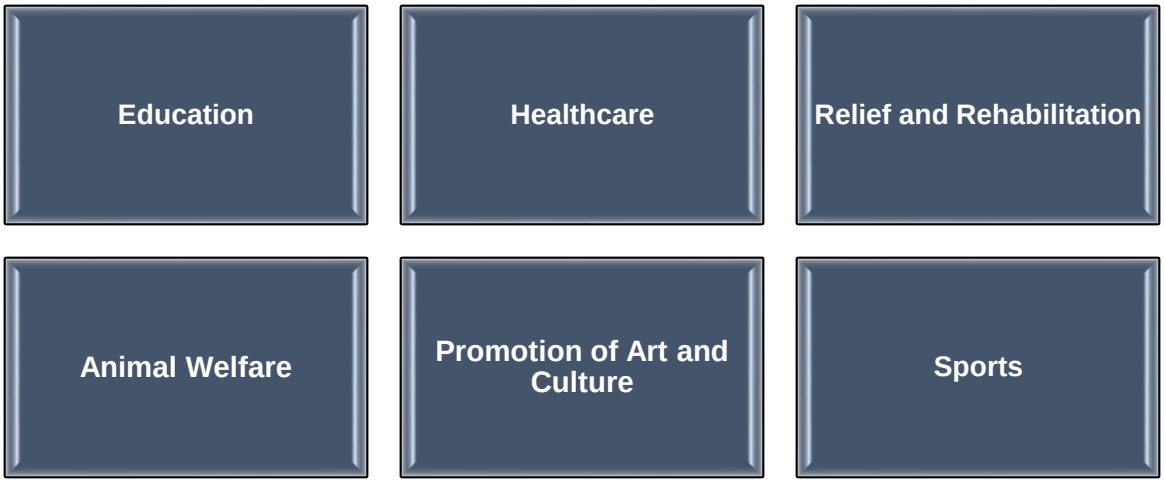
G R Infraprojects Limited was established in 1995 as a public limited company. As an infrastructure company, G R Infraprojects Limited (hereafter referred to as "the Company") is aware of how its actions affect society as a whole. The Company carries out specific programmes for social improvement and community advancement responsibly and with attention to corporate principles. The Company is committed to conducting business in a

[1] https://www.statista.com/statistics/667456/road-transport-passengers-india/
[2] https://www.investindia.gov.in/sector/roads-highways
[3] https://morth.nic.in/road-transport

responsible way that has a long-lasting good impact on all of its stakeholders, including the government, investors, shareholders, partners, community, environment, employees, and their families.

In the spirit of the development of intellectual academia-industry research, G R Infraprojects Limited (GRIL), Ahmedabad, Gujarat, as part of their Corporate Social Responsibility, had established a 5-year collaborative programme with the Indian Institute of Technology Banaras Hindu University, Varanasi (IIT-BHU), relating to research and development works in pavement engineering that may emerge over time. The purpose of the programme is to promote research for new knowledge and enhance high-quality research acumen. The major thrust of the research is pavement engineering and materials. The CSR team of G R Infraprojects Limited (GRIL) has commissioned an impact assessment study to gauge the impact of the road research laboratory established with the support of G R Infraprojects Limited CSR Funding at the Indian Institute of Technology Banaras Hindu University, Varanasi (IIT-BHU).

G R Infraprojects Limited - Focus Areas of CSR



1.2 Road Research Laboratory Project

The Memorandum of Understanding (MoU) was signed between G R Infraprojects Limited and the Indian Institute of Technology Banaras Hindu University, Varanasi in the year 2021. The MoU has been signed for 5 years. It particularly mentions the intended topics of research areas to be covered. They are: -

a. Recycling of bituminous mixes
b. Development of performance-based mixed design specifications for bituminous mixes.
c. Use of modified binders in bituminous mixes
d. Development of mechanistic pavement design procedures for Indian Roads
e. Use of waste materials for the construction of pavements.

The MoU also mentions that the funds provided by G R Infraprojects Limited can be utilised for the purchase of equipment, which will be useful in conducting the research. It also specifies

that the equipment will be the sole property of IIT-BHU during and post the completion of the MoU period. Funds allotted for this project are given in the table below: -

Support Type	Support Amount (INR)	In Words (INR)
Equipment (one time)	3,00,00,000	Three crores only
Consumables (per year)	5,00,000	Five lakhs only
Contingencies (per year)	5,00,000	Five lakhs only
Miscellaneous (per year)	5,00,000	Five lakhs only

1.3 Alignment with Schedule VII of the Companies Act, 2013

The Road Research Laboratory is aligned with Schedule VII of the Companies Act, 2013. It particularly has been aligned with clause (ii) which mentions: -

Subsection of Schedule VII	Activities
Section 135(ii)	**Promoting education**, including employment enhancing vocation skills, especially among, women, and the differently-abled, and livelihood enhancement projects;

1.4 Alignment with United Nations Sustainable Development Goals

The Sustainable Development Goals (SDGs) have been formulated by the United Nations to transform our world. They serve as a "blueprint to achieve a better and more sustainable future for all" and are integral to the United Nations 2030 Agenda for Sustainable Development. These goals were unanimously agreed upon by 193 countries in September 2015. The Road Research Laboratory's goals are aligned with the UN SDGs in the following manner: -

Sustainable Development Goals	Specific Targets	Alignment – Complete/Partial with the reason
	***9.1*** ***Develop sustainable, resilient and inclusive infrastructures*** Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. ***9.2*** ***Promote inclusive and sustainable industrialisation***	Complete alignment, as through the Road Research Laboratory, innovation in pavement engineering is the main goal.

	Promote inclusive and sustainable industrialisation and, by 2030, significantly raise the industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries. ***9.5*** ***Enhance research and upgrade industrial technologies*** Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.	Complete alignment, as through the Road Research Laboratory, innovation in pavement engineering is the main goal. Complete alignment, as through the Road Research Laboratory, research is being conducted on bitumen and other elements, which are required for building roads.
	***11.2*** ***Affordable and sustainable transport systems*** By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.	Complete alignment, as through the Road Research Laboratory, research is being conducted on sustainable roads, which can withstand more vehicular traffic.

1.5 Alignment with Environmental, Social and Governance (ESG) Principles

Particularly, for the **Business Responsibility & Sustainability Reporting Format (BRSR)** shared by the Securities & Exchange Board of India (SEBI), the Road Research Laboratory can be covered under the following principles –

Principle 2	Principle 4	Principle 7	Principle 8
Business should provide goods and services that are safe and contribute to sustainability throughout their life cycle	**Business should respect and be responsive to the interests of its stakeholders**	**Businesses, when engaging in influencing public and regulatory policy, should do so in a manner that is responsible and transparent**	**Businesses should promote inclusive growth and equitable development**

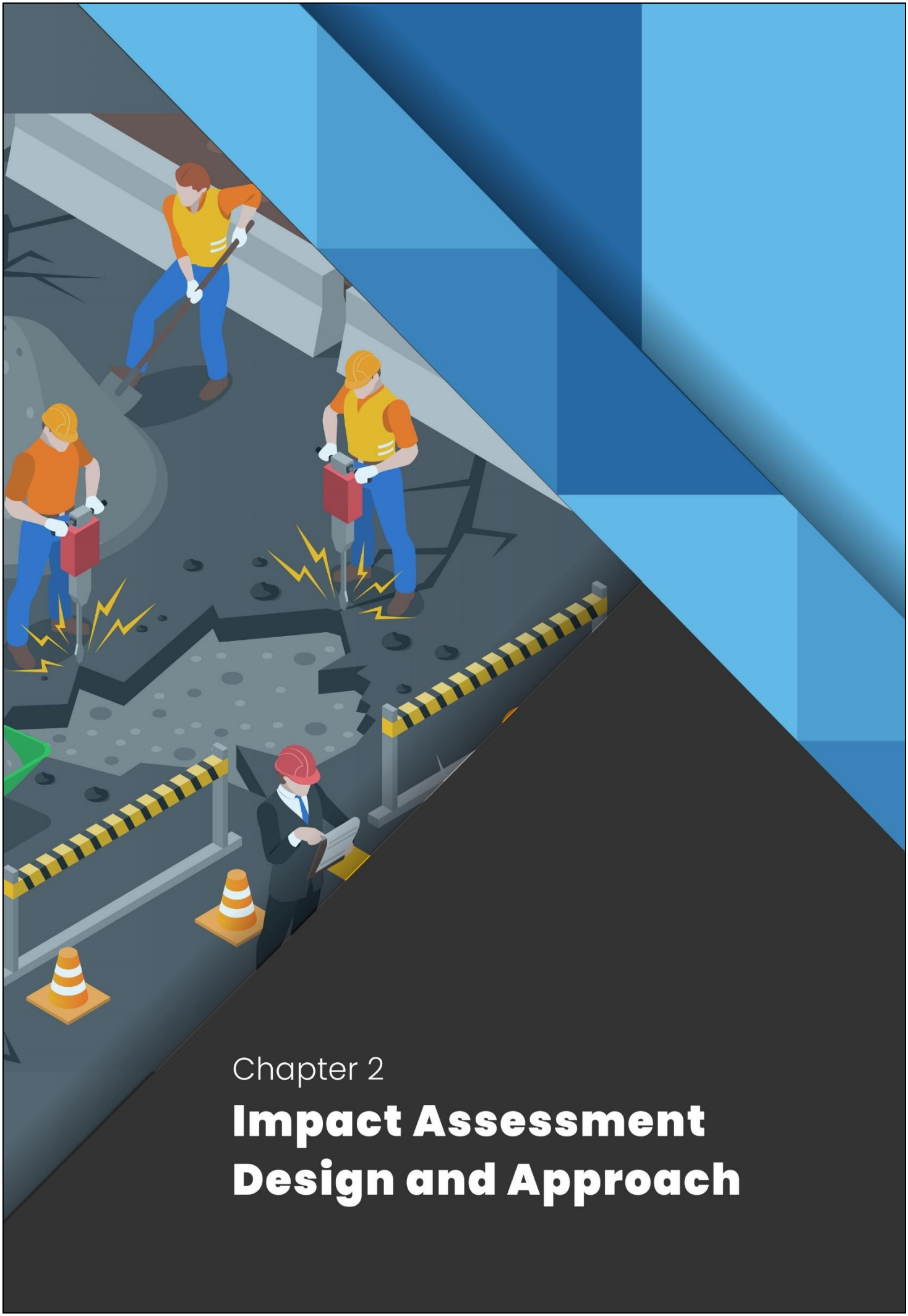
1.6 Alignment with National Priorities

The Road Research Laboratory is also aligned with the National Priorities[4] through the following programme: -

Bharatmala Pariyojana

- Bharatmala Pariyojana, launched by the Govt. of India in 2018 is a programme for the highways sector that focuses on optimizing efficiency of freight and passenger movement across the country by bridging critical infrastructure gaps through effective interventions like development of Economic Corridors, Inter Corridors and Feeder Routes, National Corridor Efficiency Improvement, Border and International connectivity roads, Coastal and Port connectivity roads and Green-field expressways.

[4] https://www.india.gov.in/spotlight/bharatmala-pariyojana-stepping-stone-towards-new-india



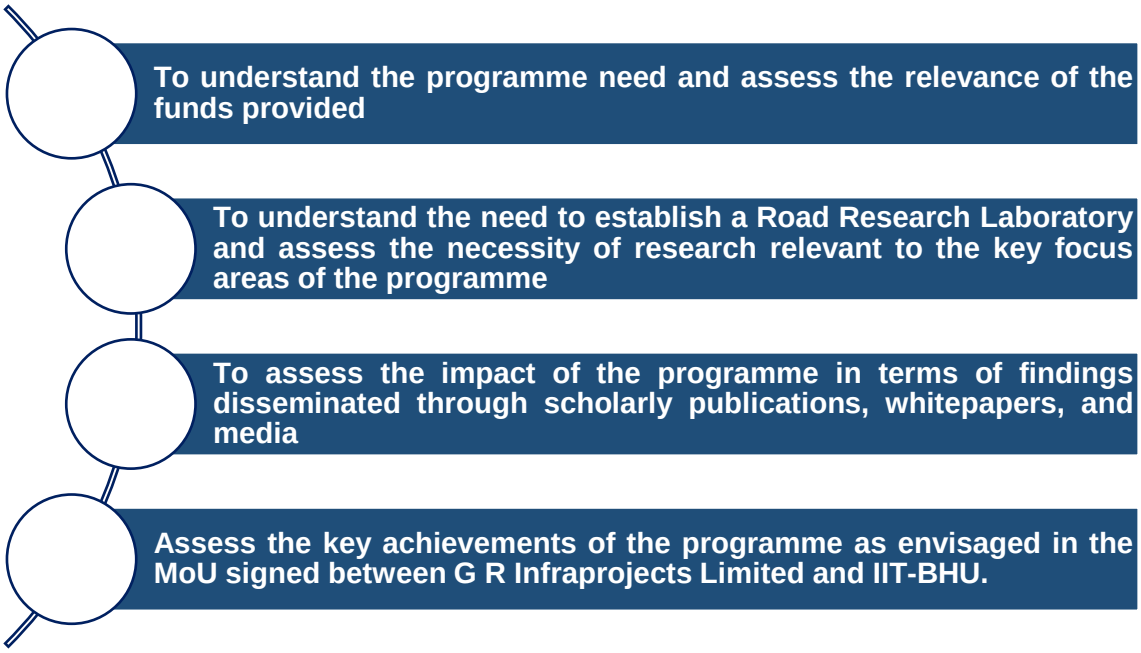
Chapter 2

Impact Assessment Design and Approach

Chapter 2: Impact Assessment Design and Approach

2.1 Impact Assessment Study Objectives

The objectives of the Impact Assessment study are as follows: -

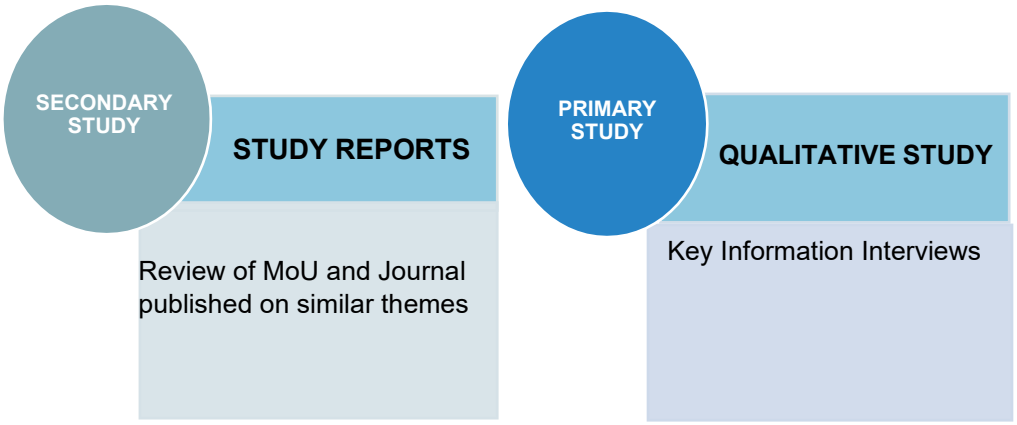


2.2 Methodology

Team CSRBOX adopted a two-pronged approach to data collection and review which included secondary data sources and literature and primary data obtained from and qualitative data collection methods.

Primary Sources of Data: **Primary Data** comprised of qualitative approaches to data collection and analysis. The qualitative aspects involved Key Information Interviews (KIIs) with the key stakeholders like Researchers, Faculty members, BHU Admin, and the CSR Team.

Secondary Sources of Data: The **secondary study** involved a review of MoU, progress report, other studies, and research by renowned organisations available in the public domain to draw insights into the situation of the area.



Theory of Change

Key Activities	Output Indicators	Outcome Indicators	Impact Indicators
Identification of Equipment to be purchased for the Road Research Laboratory Provision of research grant for procuring equipment	Purchase of equipment for the road research laboratory as per the need of the hour Students accessing the lab and using the equipment to increase their knowledge and try different tests to increase the efficiency of tests for bituminous mixes/road construction materials	Increased usage of equipment for research purposes Improved quality of research due to the availability of state-of-the-art equipment Increased collaboration due to the availability of state-of-the-art equipment Time saved during experiments due to the availability of state-of-the-art equipment	Enhance high-quality research acumen The Road Research Lab to publish articles which will create a revolution in pavement engineering. Creating a more knowledgeable workforce
	Students write articles to showcase the findings from different tests and submissions to reputed journals.	Dissemination of findings through scholarly publications, whitepapers, and in the media. Papers being accepted and acknowledgement of G R Infraprojects Limited for papers published Papers published by the students are being cited by other research scholars.	

2.3 Sampling Approach

Qualitative data was collected from stakeholders based on their availability.

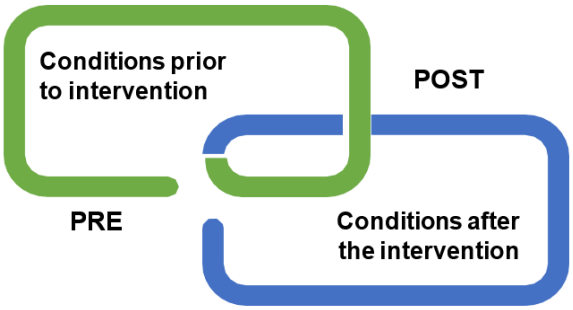
Stakeholder Mapping

Stakeholders	Mode of Data Collection
Research Scholars	Virtual KII
Faculty Members	Virtual KII
BHU Admin	Virtual KII
G R Infraprojects Limited CSR team	Virtual KII

Data was collected through virtual mode. The above stakeholder list was finalised based on information received from IIT-BHU.

2.4 Assessment Approach and Evaluation Framework

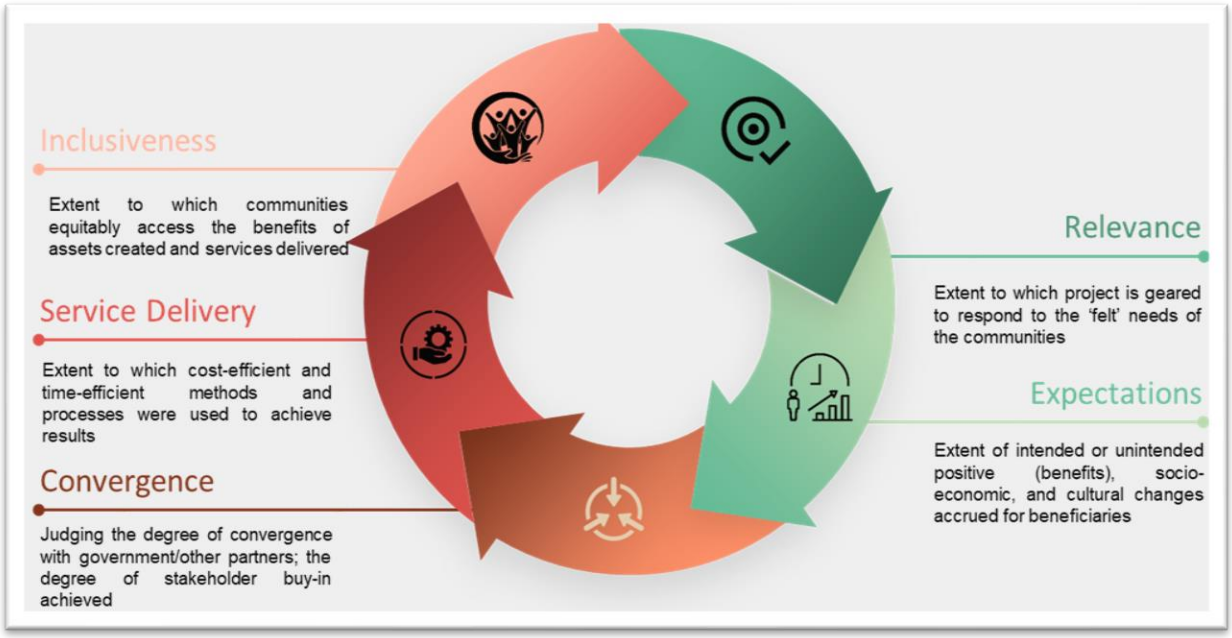
To measure the impact, a **pre-post programme evaluation approach** was adopted for the study.



This approach is dependent on the recall capacity of the respondents. Under this approach, the beneficiaries are enquired about conditions before the programme intervention and after the programme intervention. The difference helps in understanding the contribution of the programme in improving the intended condition of the beneficiary. This approach, at best, can comment on the contribution of the programme in improving the research standards, though may not be able to attribute the entire changes to the programme. Other external factors may also play a role in bringing positive changes along with the programme. Hence, the contribution will be assessed, but attribution may not be entirely assigned to the programme.

To determine the inclusiveness, relevance, appropriateness, coherence, effectiveness, impact potential, and efficiency of the programme, the evaluation will use the **IRECS Framework**. The IRECS Network has defined six evaluation criteria – relevance, coherence, effectiveness, efficiency, impact, and sustainability. These criteria provide a normative framework used to determine the merit or worth of an intervention (policy, strategy, programme, project, or activity).

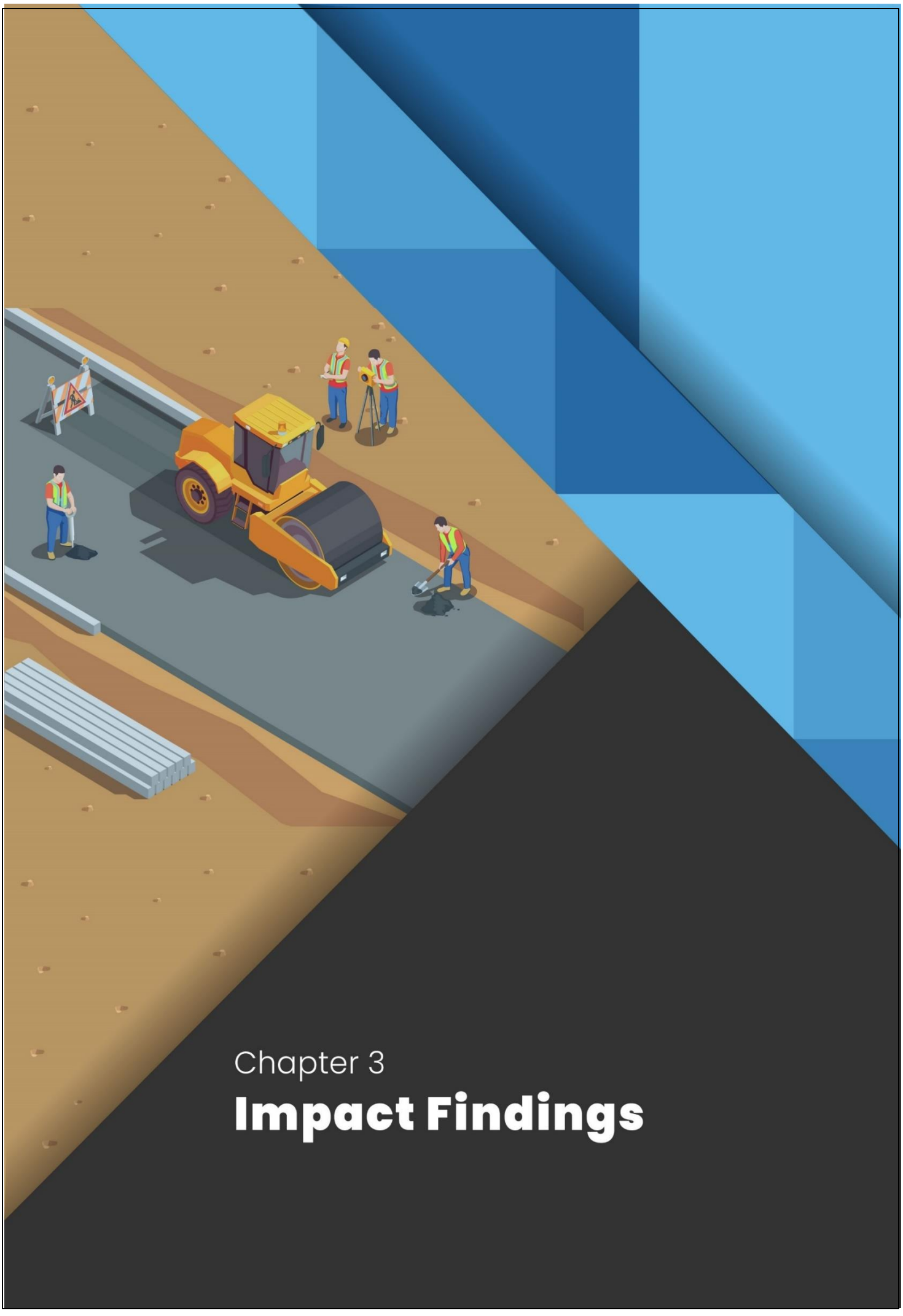
They serve as the basis upon which evaluative judgments are made. Using the logic model and the criteria of the IRECS framework, the evaluation will be able to assess the G R Infraprojects Limited (GRIL) Team's contribution to the results while keeping in mind the multiplicity of factors that may be affecting the overall outcome.



The **evaluation matrix** below maps the evaluation questions with the key information areas, the source of data collection, and the methods used for data collection. These framework pillars are the key information areas that will play an instrumental role in the development of data collection tools and data analysis.

Framework Pillars	Information Indicators	Source of Data
Inclusiveness	• Extent of participation among all strata of the community	• Secondary research – including reviewing project documents, Journals • Virtual KIIs with Research scholars BHU Admin, Faculty members and CSR team members
Relevance	• The extent to which the objectives of the programme are aligned with the beneficiaries' requirements. • Extent of usage of lab equipment for performing research.	
Expectations	• Change in research methodology and adoption of modern equipment for performing research. • Research papers published with the support of the Road Research Lab, and sharing of whitepapers.	
Convergence	• The extent to which support from external stakeholders has improved the research process • The extent of sustainability of the road research laboratory	

Framework Pillars	Information Indicators	Source of Data
Service Delivery	• The extent to which programme design is initiating cost-efficient interventions outputs and outcomes that will pave the way for a new understanding of road infrastructure. • Cascading effect of the intervention on families of the students	



Chapter 3

Impact Findings

Chapter 3: Impact Findings

This chapter documents the findings of the Impact Assessment study - specifically highlighting the role of the Road Research Laboratory in meeting its objectives. The information provided in the following sections is based on the responses provided during the virtual interactions with different stakeholders. The broad tangible outcomes created by the project are presented through the impact canvas below:

3.1 General Impact Findings of the Road Research Laboratory

Establishment of a Road Research Laboratory

Indian Institute of Technology Banaras Hindu University (IIT-BHU), Varanasi has procured certain equipment under the Road Research Laboratory funding by G R Infraprojects Limited under its CSR initiative. The procured equipment has been installed at the existing Civil Engineering Lab.

Fig 1. Premises of the Laboratory

Timings of the Laboratory

Post discussion with the users, it was noticed that there were no specific timings to access the laboratory, and one set of keys was always available with the research scholars, so that they could use it at their convenience.

"I conduct my research as per the availability of the equipment. We have an internal WhatsApp group through which we coordinate with each other for the keys. There is practically no restriction on timings to use the equipment"

- *Ms. Sadiya Sheikh, Research Scholar*

Identification of Equipment purchased under the Road Research Laboratory Funds

According to the invoices shared by IIT-BHU, the following equipment has been purchased under the allocated funds: -

S. No	Name of the Equipment
a.	Rolling Thin Film Oven
b.	Dynamic Shear Rheometer
c.	Pressurized Aging Vessel
d.	Asphalt Mixer
e.	Zigs for UTM for Asphalt Mix Testing
f.	Fourier Transform Infrared Spectroscopy (FTIR)

"Quality of Research has improved post the acquisition of the equipment"

- *Mr. Aakash Singh, Research Scholar*

Other equipment available at IIT-BHU Laboratory are as follows: -

- Wheel Rut Tester – Purchased from other grants available exclusively for this equipment
- Superpave Gyratory Compactor – This has been approved but not yet finalised
- Moisture-Induced Stress Tester – This has been kept on hold as the alternate equipment available was working well after maintenance
- Light Weight Deflectometer – This has not been purchased as this is a field equipment and currently not required by any scholar
- Rice Specific Gravity Apparatus – This has been purchased from two different grants
- Automatic Marshall Frame – This has not been purchased
- Automatic Marshall Compactor – This has been purchased
- Falling Weight Deflectometer – This has not been purchased as this is a field equipment and the proposed field research was not finalised

Based on our interactions, we were able to confirm that other equipment quoted in the progress letter shared with G R Infraprojects Limited have not been purchased under these funds, as other funding is also available to them for these equipment. During our discussion with Dr Ankit Gupta (*Faculty and Mentor to PhD scholars at IIT-BHU)*, he mentioned that the department was thinking of purchasing a Dynamic Testing System (DTS) frame subject to admission in June/July 2024 for PhD. He added that they had flexibility in utilisation of G R Infraprojects Limited CSR funding, as unlike other grants which were specified for only purchase of certain equipment. This fund allowed them to procure any equipment which aids in the road research which are aligned to the identified research topics. He also added that due to this funding, the institute has the confidence to procure any equipment for the lab as and when required, and they do not have to seek any additional funds.

"Before purchasing any equipment, there is a discussion which takes place between the faculty members and the research scholars, and only if there is a need for the equipment, then an order is placed by Dr Ankit Gupta"

- Mr. Abhinav Kumar, Research Scholar

3.2 Inclusiveness

Extent of participation among all strata of the community

The Laboratory had participation from different users such as:

a. **Research Scholars**
   Research scholars/PhD students were the major users of the lab, as they accessed equipment for their research from time to time.
b. **Students**
   PG civil engineering students, students of Integrated civil engineering degree and students from other departments are also allowed to use the lab in the presence of the research scholars.
c. **Faculty members**
   Faculty members also use the lab for writing their research papers and for teaching the students.
d. **Interns**
   Students from other institutions like IITs, and NITs also use this lab as part of their summer/winter internships.
e. **Companies that provide their materials for testing purposes**
   Some companies also conduct material testing here in the laboratory.

3.3 Relevance

The extent to which the objectives of the programme are aligned with the beneficiaries' requirements

Some of the research scholars who are currently pursuing their PhD from IIT-BHU have their research studies aligned with the topics mentioned in the Memorandum of Understanding. These research scholars have been working on one of the areas of research and have also published their papers in reputed journals, which will have an impact on the future of road research engineering.

Usage of Equipment

In interaction with all of the research scholars, they did mention that they have used/are using the equipment provided by G R Infraprojects Limited to conduct various tests as part of their research process. They also mentioned that all the equipment available in the lab have a validity period of fifteen to twenty years depending on the usage and its maintenance.

"We have immensely benefitted from the usage of the equipment especially the Asphalt Mixer, as previously we used to make moulds with hands for conducting the experiments. This used to be a time-consuming process as we used to do it manually using a bucket. Now we can conduct our experiments with ease, as we have machines to make them"

- *Ms.Sadiya Sheikh, Research Scholar and Dr. Mayank Sukhija, Post-Doc at Oregon State University, USA*

Fig 2. Asphalt Mixer

"*The high-end equipment available at the lab has helped in instilling confidence amongst the research scholars, as they can conduct experiments which will give higher quality research work.*

- *Dr. Agnivesh Pani, Faculty and Mentor to PhD scholars at IIT-BHU and Mr. Aakash Singh, Research Scholar*

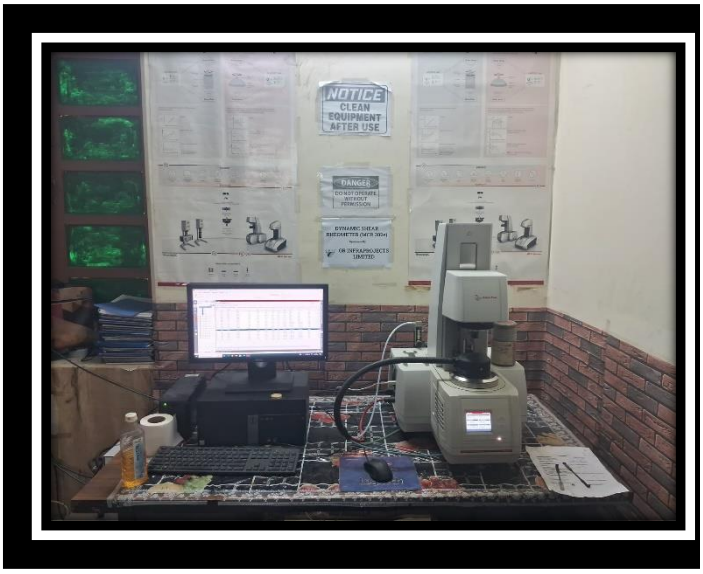


Fig 3. Dynamic Shear Rheometer

Fig 4. Fourier Transform Infrared Spectroscopy

Fig 5. Pressure Aging Vessel

Fig 6. Rolling Thin Film Oven

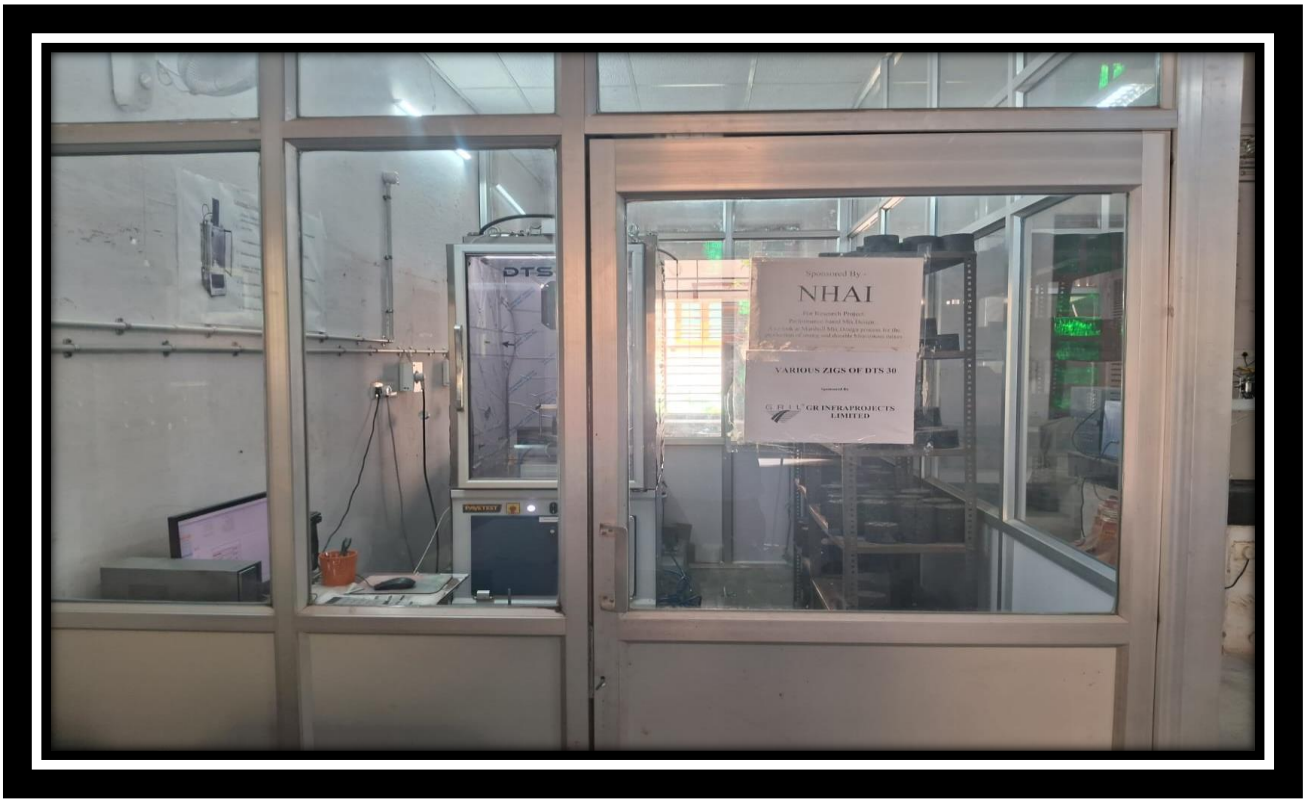


Fig 7. Various zigs of DTS-30

3.4 Expectations

Change in research methodology and adoption of modern equipment for performing research

During interaction with the research scholars, it was evident that the course of their research and the objectives had changed as they were able to use sophisticated and latest equipment to conduct their research efficiently.

It was also understood that Superpave mixed design is being used abroad, whereas, in India, very few institutes have this machine, so we stick to Marshall mixed design.

"We did not have a DSR 302, Compactors before the establishment of this lab in 2021. I can conduct experiments of higher quality due to the availability of equipment"

- *Mr. Vivek Wagh, Research Scholar*

"*I reduced the temperature by 30 degrees Celsius as compared to the conventional methods, and tried to achieve the same results using the equipment and zigs provided, to improve sustainability and reduce the ill-effects to the environment and the people involved in laying of roads***"**

- *Dr.Mayank Sukhija, Post-Doc at Oregon State University, USA*

Research papers published with the support of the Laboratory and the sharing of Whitepapers

A total of 22 papers (based on ***Google Scholar*** and the information received from IIT-BHU) have been published from 2021 to 2024 by research scholars in reputed and peer-reviewed Q1 and Q2 journals such as Construction and Building Materials, International Journal of Pavement Engineering, Innovative Infrastructure Solutions, Coatings, etc to mention a few. Out of these 22 papers, in 3 papers, G R Infraprojects Limited has been acknowledged by the authors.

A journal's impact factor is revised annually and may change from one year to the next[5]. Multiple subject areas can be linked to a single journal, and each of these subject areas is probably going to be affected by the journal to a different extent.

"Conducting experiments and writing the thesis itself takes a considerable amount of time from the research scholars. Post this, they submit the paper to a reputed journal. Based on our experience, publishing research papers in reputed journals takes a lot of time and effort from the research scholars. Sometimes it takes a few months, whereas sometimes the process takes up to 8-9 months depending on the journal."

- *Dr.Ankit Gupta, Faculty and Mentor to PhD scholars at IIT-BHU*

A journal title's impact index in any given year is a fixed index in JCR. There are four quartiles for each subject area of journals: Q1, Q2, Q3, and Q4.
Q1 - The top 25% of the journals on the list are found in Q1,
Q2 - Followed by journals in the 25 to 50% group in Q2,
Q3 - Journals in the 50 to 75% group in Q3, and
Q4 - Journals in the 75 to 100% category in Q4.

The most prestigious journals within a subject area are those which occupy the first quartile, Q1.

The exhaustive list of papers which have been shared by co-authors Dr Ankit Gupta and Dr Agnivesh Pani, faculty at Indian Institute of Technology Banaras Hindu University, Varanasi are given below: -

[5] https://www.mondragon.edu/en/web/biblioteka/publications-impact-indexes

Sl. No	Title of the Publication	Name of the Author/Co-author	Year of Publication	Name of the Journal	Number of Citations (where available)
1.	Influence of red mud filler on the fatigue behaviour of bituminous mastic	Mohit Chaudhary, Nikhil Saboo, Ankit Gupta, Miomir Miljković	2021	Green and Intelligent Technologies for Sustainable and Smart Asphalt Pavements	
2.	Introduction of a new parameter to quantify the fatigue damage in asphalt mastics and asphalt binder	Mohit Chaudhary, Nikhil Saboo, Ankit Gupta	2021	Coatings	6
3.	Influence of filler-binder ratio and temperature on the Linear Viscoelastic (LVE) characteristics of asphalt mastics	Mohit Chaudhary, Nikhil Saboo, Ankit Gupta, Michael Steineder, Bernhard Hofko	2021	Advances in Materials and Pavement Performance Prediction II	
4.	A comparative analysis of engineering and economical suitability of bituminous mastics containing waste fillers	Jayvant Choudhary, Mayank Sukhija, Ankit Gupta	2022	Case Studies in Construction Materials	5
5.	Tribology as emerging science for warm mix technology: A review	Vivek Pratap Wagh, Nikhil Saboo, Ankit Gupta	2022	Construction and Building Materials	8
6.	Comparing different fatigue test methods at asphalt mastic level	Michael Steineder, Martin Johannes Peyer, Bernhard Hofko, Mohit Chaudhary, Nikhil Saboo, Ankit Gupta	2022	Materials and Structures	9
7.	Contribution of mineral filler to the fatigue damage behaviour of	Mohit Chaudhary, Nikhil Saboo, Ankit Gupta, Miomir Miljković	2022	Construction and Building Materials	6

	bituminous mastic				
8.	Assessing the Suitability of Polyethylene Terephthalate (PET) in Bituminous Concrete Mixes	Mohit Chaudhary, Nikhil Saboo, Ankit Gupta	2022	Proceedings of the Fifth International Conference of Transportation Research Group of India: 5th CTRG Volume 1	1
9.	Economic and environmental aspects of warm mix asphalt mixtures: A comparative analysis	Mayank Sukhija, Nikhil Saboo, Agnivesh Pani	2022	Transportation Research Part D: Transport and Environment	20
10.	Study on Estimation of Optimum Dosage of Warm Mix Additives for Production of Asphalt Mixtures	Mayank Sukhija, Nikhil Saboo, Agnivesh Pani	2022	International Conference on Transportation Infrastructure Projects: Conception to Execution	
11.	Intermediate and high temperature damage of bitumen modified by HDPE from various sources	Aakash Singh, Ankit Gupta, Miomir Miljković	2023	Road Materials and Pavement Design	2
12.	Exploring the consequences of reduced aging on the performance of warm mix asphalt binders	Vivek Pratap Wagh, Mayank Sukhija, Ankit Gupta	2023	International Journal of Pavement Engineering	
13.	Investigation on bonding between aggregates and asphalt binder containing warm mix additives	Vivek Pratap Wagh, Mayank Sukhija, Ankit Gupta	2023	Construction and Building Materials	

14.	Effect of analysis procedure and sample geometry on the fatigue life results of asphalt mastics from linear amplitude sweep test	Mohit Chaudhary, Nikhil Saboo, Ankit Gupta, Michael Steineder, Bernhard Hofko	2023	Mechanics of Time-Dependent Materials	5
15.	Applicability of multiple stress creep and recovery test for the analysis of fatigue resistance of bituminous mastics	Jayvant Choudhary, Mohit Chaudhary, Ankit Gupta	2023	Petroleum Science and Technology	1
16.	Understanding the moisture sensitivity of warm-mix asphalt binders based on bond strength	Mayank Sukhija, Nikhil Saboo, Agnivesh Pani	2023	Proceedings of the Institution of Civil Engineers-Transport	5
17.	Effect of warm mix asphalt (WMA) technologies on the moisture resistance of asphalt mixtures	Mayank Sukhija, Nikhil Saboo, Agnivesh Pani	2023	Construction and Building Materials	23
18.	Suitability of warm mix asphalt (WMA) technologies based on performance and energy consumption	Mayank Sukhija, Nikhil Saboo, Agnivesh Pani	2023	Road Materials and Pavement Design	1
19.	Material and mix design aspects of hot recycled asphalt mixes: A review	A Nirmal Prasad, Nikhil Saboo, Agnivesh Pani	2023	Environmental Science and Pollution Research	1

20.	Using tribological approach to assess production temperatures of asphalt binders	Vivek Pratap Wagh, Nikhil Saboo, Ankit Gupta	2024	Construction and Building Materials	
21.	Finite element-based framework to study the response of bituminous concrete pavements under different conditions	Abhinav Kumar, Ankit Gupta, Kumar Anupam, Vivek Pratap Wagh	2024	Construction and Building Materials	
22.	Upcycling of plastic waste in bituminous mixes using dry process: Review of laboratory to field performance	Aakash Singh, Ankit Gupta	2024	Construction and Building Materials	

3.5 Convergence

The extent to which support from external stakeholders has improved the research process

As per our observations, support has been received by external stakeholders like the Ministry of Road Transport[6] in carrying out research on areas, which is in complete alignment with the MoU signed with G R Infraprojects Limited. Support from other external agencies has been limited to the usage of equipment purchased from other funds received. However, the equipment purchased under the G R Infraprojects Limited CSR funding is also used for performing other research as and when required.

The extent to which other stakeholders have benefitted from the usage of equipment

"The equipment has also helped in testing the nearby road infrastructure, and civil infrastructure development such as Varanasi Ring Road, Ayodhya city redevelopment, etc, along with supporting the local Public Works Department as well.
- Dr. Ankit Gupta, Faculty and Mentor of Research Scholars at IIT-BHU

Sustainability of the road research laboratory

If the Road Research Laboratory is fully operational, it will be a sustained research intervention that will spur innovation and new concepts/alternatives in the design of road pavement. This has been producing positive findings even in the absence of an exhaustive laboratory setting. Over time, results will be improved if sufficient money for human resource can be obtained. The project is also sustainable because all the equipment procured with CSR funding from G R Infraprojects Limited have a 15–20-year lifespan, as reported by the research scholars.

[6] https://morth.nic.in/sites/default/files/MoRTH%20Annual%20Report%20for%20the%20Year%202022-23%20in%20English.pdf

“Procurement of equipment is a time-consuming process. But once equipment is purchased, it is used by a lot of research scholars as part of their research. As each equipment can be used for a minimum of 15-20 years, it makes the procurement sustainable.”

- Dr. Ankit Gupta, Faculty and Mentor of Research Scholars at IIT-BHU

3.6 Service Delivery

The extent to which programme design is initiating cost-efficient interventions outputs and outcomes that will pave the way for a new understanding of road infrastructure

The research scholars have been identifying new alternatives to conventional road-building materials, which can withstand wear and tear and also sustain for a longer period. They have also been experimenting with materials such as bitumen, plastic, and other additives to understand the causal relationship. This programme has already started yielding results as the study done by the research scholars has also been presented at various conferences such as the Fifth International Conference of Transportation Research Group of India and, the Second International Conference on Transportation Infrastructure Projects: Conception to Execution.

“Our alumni who are in top positions have appreciated the efforts taken by our current research scholars in creating new avenues of research and understanding on pavement engineering”

- *Dr.Ankit Gupta, Faculty and Mentor of Research Scholars at IIT-BHU*

The cascading effect of the intervention on the families of the students

The Laboratory has had a cascading effect on the families of the students, as these research scholars will complete their PhD and work at good research institutes for their post-doc. It was also laudable that two of their alumni are currently working on their post-doc at Oregon State University, USA and Rowan University, USA and are happy with the base that their research work here has provided them with. Current research scholar, Mr.Vivek Wagh, is also going to pursue his Post-doc in Canada.

“I am happy that my research work at IIT-BHU with the support of the Infra provided by G R Infraprojects Limited has helped me in pursuing my postdoc at Oregon State University”

- *Dr Mayank Sukhija, Post-Doctoral Researcher at Oregon State University USA*

Chapter 4

Recommendations and Way Forward

Chapter 4: Recommendations and Way Forward

The Road Research Laboratory has been established by the Indian Institute of Technology Banaras Hindu University, Varanasi and supported by G R Infraprojects Limited. This section covers the recommendations and the way forward for the Road Research Laboratory:-

Acknowledgement of G R Infraprojects Limited

- **Acknowledgement to be provided to G R Infraprojects Limited in the papers published by the research scholars, along with sharing a copy of the same with the CSR Team.**

Meetings to be held between both parties

- **Regular meetings could be scheduled at periodic intervals to showcase the current status of research.**
- **Research scholars can be invited to meetings/conferences hosted by G R Infraprojects Limited so that findings can be presented.**
- **Addendum can be added- Annual Miscellaneous/Contingency funds to be allocated towards hiring of manpower/ research scholars / sponsoring of events organized at IIT BHU with topics related to pavement engineering.**

Reporting and Documentation

- **Database to be maintained on the research conducted in the laboratory using CSR funds.**
- **Quarterly/half-yearly reports could be submitted with information on published papers and name of the journal/details of ongoing research work.**

Purchase of Equipment

- **Superpave Gyratory Compactor equipment was suggested by many research scholars as an addition to the existing equipment**

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