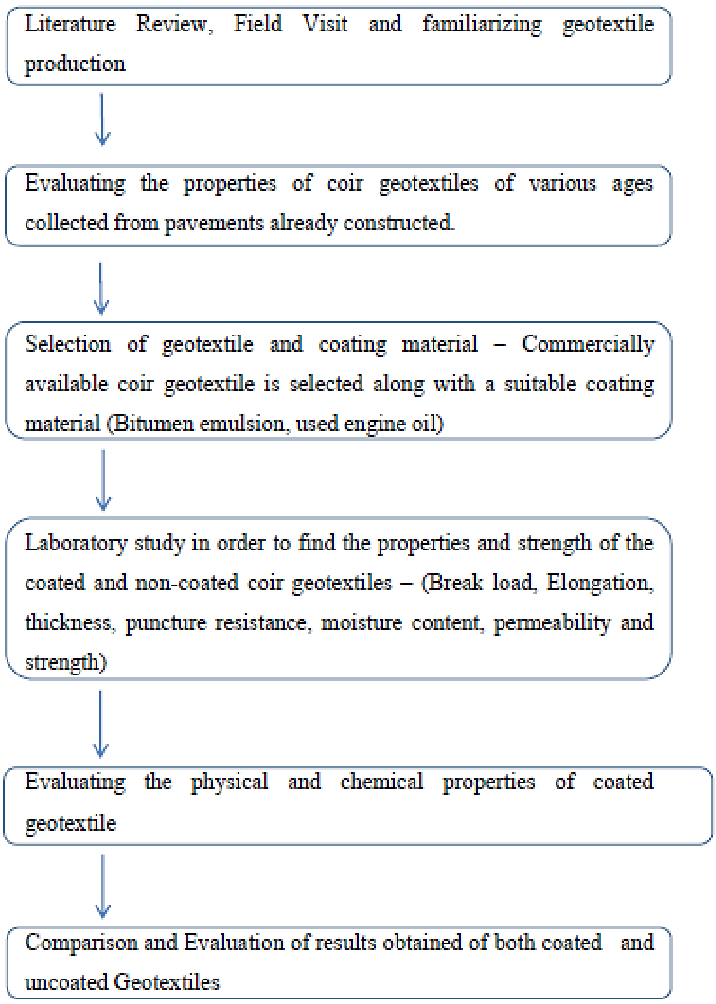
1. TRC23CET-RP1- Evaluation of Coated Coir Geotextile Reinforced Flexible Pavement

Geotextiles are thin & robust membrane material that is used to enhance soil & pavement properties. Geotextiles can be used as liners, for filtrations, drainage, reinforcement, sealing and protection. Natural geotextile, particularly coir geotextile, is being recognized as an ideal material that is capable of offering an environment friendly and ecologically sustainable solution. Coir geotextiles are ideally suited for low cost applications because coir is available in abundance at very low price compared to other synthetic geotextiles. Geo-synthetics are widely used in the construction of road all over the world, whereas use of coir geotextiles is very limited in such construction. Commercially available woven coir geotextiles are used for the study. Its performance can be improved by providing a proper coating. The coir geotextile is evaluated after giving a coating and its properties are studied.

Methodology



Work Done

Site Visits

The manufacturing of Visited the New Model coir society in Alappuzha in order to study and understand the manufacturing process of coir geotextile and the steps involved in it. The manufacturing process of coir geotextiles of various GSM was observed. The manufacturing process for coir geotextiles involves extracting the core fibre from the coconut husk, cleaning and sorting the fibre, spinning the fibre into yarn, weaving or knitting the yarn into geotextiles.

Fig 1. Manufacturing of Coir Geotextile

In order to study and understand the laying procedure of coir geotextiles in flexible pavement various construction sites of coir geotextile reinforced flexible pavement was visited. These include AC canal to Mankuzhy road construction in Alappuzha and Manathukad - Puthuveed road construction in Alappuzha

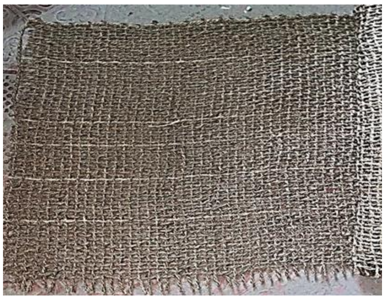
Fig. 2 AC canal to Mankuzhy road and Manathukad - Puthuveed road

Material Collection

Materials required for the study such as commercially available coir geotextile (GSM 400, GSM 700 and GSM 900) and coating materials such bitumen emulsion, used engine oil was purchased for the study. Various other materials such as drum, chemicals like caustic soda, copper sulphate, etc. which are required for the study were purchased.

GSM 400

GSM 700



GSM 900

Fig. 3 Coir Geotextile Samples

Cationic Bitumen emulsion of slow setting nature (SS 1) grade was selected for the study. For the study purpose, a spray gun with an air compressor was also purchased for uniformly spraying the coating material to the samples.

Laboratory Studies

Properties of coir geotextiles such as specific gravity, thickness, tensile strength, puncture resistance were found out. Specific gravity were determined using pycnometer test according to IS 15868- 1 to 6 (2008). Nominal thickness were determined using thickness gauge apparatus according to IS 13162-3(1992). Coir geotextiles sample tensile strength were determined using according to IS 13162-5 (1992). Puncture Resistance strength was found as per IS code 13162 – 4 (1992) and the samples were send for testing in NCRMI.

Table 1. Properties of samples purchased

Property	GSM 400	GSM 700	GSM 900
Specific Gravity	1.2	1.43	1.61
Nominal Thickness	8.11mm	9.5mm	10.8mm
Tensile Strength	6.88kN/m	9.62kN/m	11.72kN/m
Puncture Resistance	34.2mm	28.4mm	23.2mm

Sample Preparation

The sample preparation for the coating is done. Coir Geotextile was pretreated in alkaline solution inorder to remove the natural coating on its surface. Sodium Hydroxide was used to prepare the alkaline solution. Alkaline solution of PH 7.5 was prepared. The coir was immersed in the solution was then rinsed in water and dried. The sample is to be coated with the coating material by three modes such as brushing, dipping and spraying.

Work to be Done

The work to be proceeded in the upcoming year includes:

- To complete the field sample collection and its investigation
- Coating of Samples by different modes
- Laboratory Tests on samples
- Soil Burial Test
- Physical analysis of samples
- Chemical analysis of samples
- Comparison of the results

2. TRC23CET-RP2: Development of mix design methodology for Full Depth Reclamation projects with cement and emulsion as stabilizers

Objectives

- Determine the suitability of cement and emulsion as stabilizers over silty/sandy soil with granular material
- Develop an optimum dosage of cement for cement stabilized FDR
- To develop a mix design method for Asphalt Emulsified Full Depth Reclaimed material (AEFDR)
- To characterize the mechanical performance of AEFDR by evaluating Resilient modulus

Scope

The aim to analyse the versatility of cement and emulsified asphalt over different soil type and how the curing effect affects the property of material. Limits of strength properties of FDR bases and modulus parameters for different layers corresponding to the strength for these unconventional materials are not properly observed. When comes to structural part of FDR bases, layer properties should be analysed such as modulus of elasticity (E), M_r etc. The design parameters specified by IRC 37, 2018 are only established for conventional materials and not for FDR materials. Hence the effect of modulus over strength parameter under different curing period and dosages for cement and emulsion stabilizers are need to be established.

Phase 1 test plan

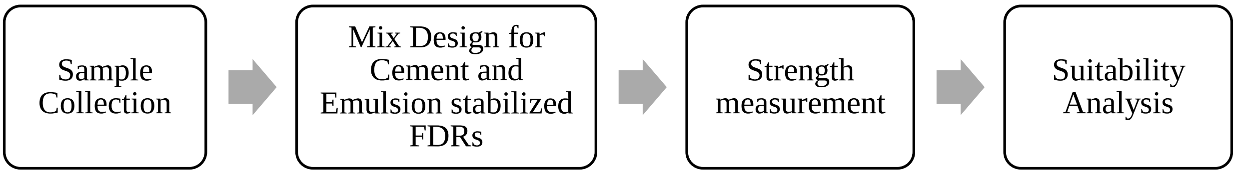


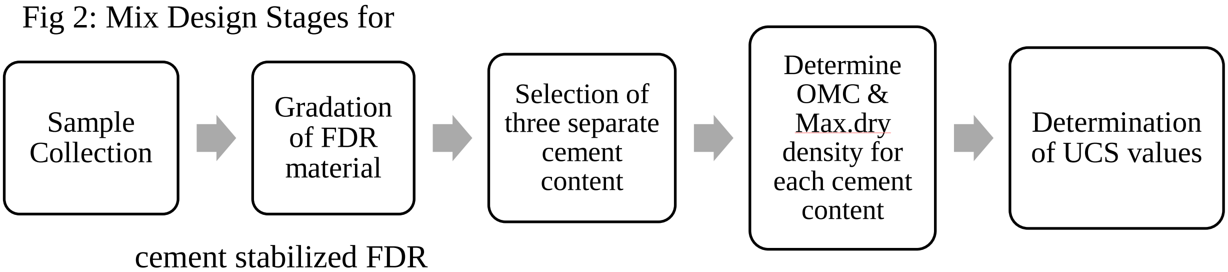
Fig 4. Methodology

The first stage of the work is to obtain a field sample. Separate mix design procedures were proposed for both cement stabilized FDR and Asphalt Emulsified FDR work. The cement content was increased by 2%, and three mixtures were prepared as shown in experimental matrix table 2. The strength of an FDR mix will depend on the cement content curing, and density of the mix. In the case of AEFDR, emulsion content varies with a 1% increment, and three different mixes with varying RAP content are shown in Table 3. The optimal emulsion dosage was determined based on the indirect tensile strength ratio for wet and dry tests, and resilient modulus is determined for modulus parameter measurement. Hence, the rate at which strength achieved is analysed and the suitability of these two types of stabilizers are to be observed.

Table 2: Experimental Matrix for cement stabilized FDR

Mix	Percentage of Cement (%)	Curing Period
M1	2	3, 7, 28 Days
M2	4	
M3	6	

Fig 2: Mix Design Stages for



cement stabilized FDR

Table 3: Experimental Matrix for AEFDR

Mix	**Aggregate Blend**	**Percentage of Emulsion**	**Curing (Days)**	**Percentage of filler**	**Base Binder for emulsion**
M1	20% RAP & 80% FDR	8%	Mass loss reaches asymptotic to 0.05% change	1%	VG10, VG 30
		9%			
		10%			
M2	10% RAP & 90% FDR	8%	Mass loss reaches asymptotic to 0.05% change	1%	VG10, VG 30
		9%			
		10%			
M3	20% Fresh Aggregate & 80% FDR	8%	Mass loss reaches asymptotic to 0.05% change	1%	VG10, VG 30
		9%			
		10%			

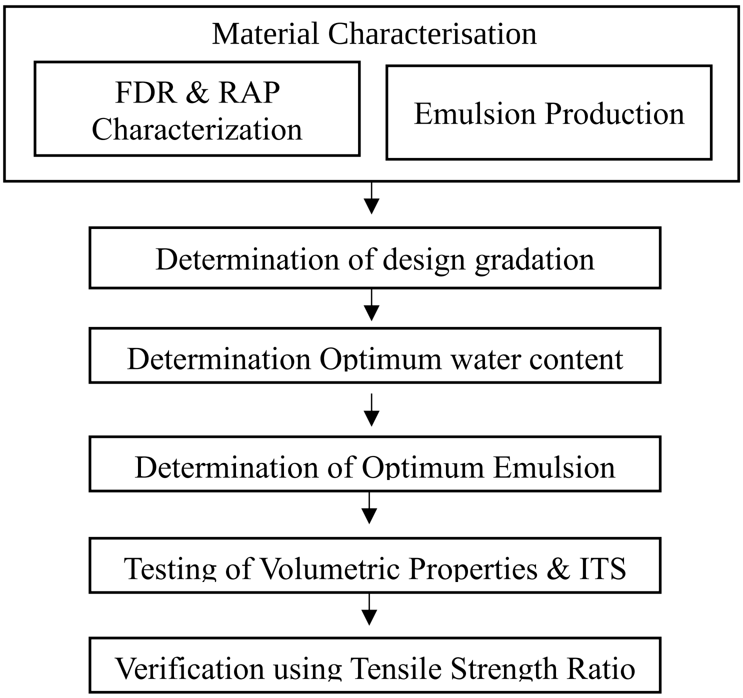


Fig 5: Steps included in the mix design of AEFDR

(A) Sample collection

FDR Sample collected from location 1

FDR sample was collected from Pathanapuram-Punnala road in Kollam district which is a low volume road. Rehabilitation work of 14.5km road with cement stabilised FDR construction under KRFB funded by KIIFB. The selected site is coming under village road category having 20mm chipping carpet road with 150mm of base layer and 50mm of sub-base layer. Total depth of FDR work is about 200mm. Fig 6 shows the milled samples collected from the location.

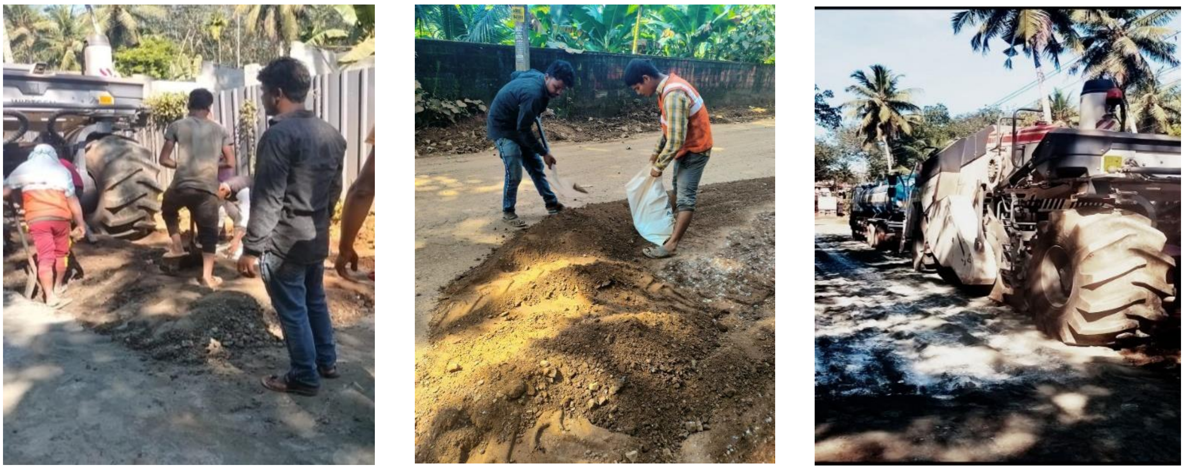


Fig 6: Soil Collection from site using WRITGEN WR 240 which is equipped with DURAFORCE milling and mixing rotor

FDR Sample collected from location 2

FDR sample was collected from Kattakada - Kottoor – Tachamcodu road in Thiruvananthapuram district which is a low volume road under PMGSY. Sample is collected as 50 x 50 cm square pit which is dug out from the selected distressed locations. Sampling of various layers separately is important as the segregated pavement fraction is later mixed in proportion to the existing layer thicknesses to form a representative mix prior to performing mix design. Fig 7 shows the detailed sampling procedure from three pits on the same road stretch. Frequency of the sampling is based on the total road stretch.

Fig 7: 50 x 50 cm test pits

Fig 8: Separately collect various pavement layers

Fig 9: Thickness of each layer is measured

3. TRC23CET-RP4 DRISHTI: An AI based Distraction Alert System for Indian Roads

The primary objective of the project is to develop an AI-based system tailored for Indian roads that can effectively detect and alert drivers when they are distracted. There are two components in this system: 1) a system to estimate the angle of curvature of the horizontal curves in the road and 2) a system to estimate the trajectory of the vehicle.

System for Estimating the Angle of Curvature: The data of roads in Trivandrum were captured and had successfully segmented the road in the videos. A sample is shown in Fig. 10. The process of estimating the curvature from these images are being experimented currently.

System for Estimating the Trajectory of the Vehicle: Development of the system for estimating the trajectory of the vehicle is completed. The device can also measure the linear and angular accelerations and also has a GPS module. The photo of the device is shown in Fig. 11. As an alternative, a steering mount device for measuring the angle of the steering is also under investigation.

Fig. 10 System for Estimating the Angle of Curvature

Fig. 11 System for Estimating the Trajectory of the Vehicle

Upcoming Work: The ML algorithm for segmenting roads should be implemented on an Edge AI device. This device will also monitor any non-congruence between the vehicle's path and the estimated alignment of the road and will alert the driver.

Deliverables:

The deliverables of the project are classified into three groups, viz. product, dataset and research article.

The Product is a stand-alone system with the following functionalities, which can be retrofitted to any vehicle:

- ✓ Ability to detect centre line, traffic lane and/or border line markings on the road in real-time from the video captured from the camera placed in the dashboard of a vehicle.
- ✓ Ability to detect the edge of the road in real-time from the video captured from the camera placed in the dashboard of a vehicle.
- ✓ Ability to estimate the alignment of the road including the radius and deflection of horizontal curves.
- ✓ Ability to estimate the angular velocity and linear acceleration of the vehicle and the congruence between the vehicle's path and the estimated alignment of the road.

Societal Relevance:

Drivers on Indian Roads: They will directly benefit from enhanced safety due to the system's ability to alert them in real-time about potential distraction-induced deviations.

Vehicle Manufacturers: Companies can integrate this system into their vehicles, especially those targeting the Indian market, to enhance safety features and appeal to safety-conscious consumers.

Transportation and Regulatory Authorities: They can utilize the insights from the system to frame better safety regulations and guidelines.

Research Community: With the provision of an open-access dataset and research articles, researchers focusing on driving safety and autonomous vehicles, especially in conditions specific to Indian roads, will find invaluable resources to further their work.

General Public: An overall reduction in road accidents due to distractions will ensure safer roads, indirectly benefiting all road users, not just drivers.