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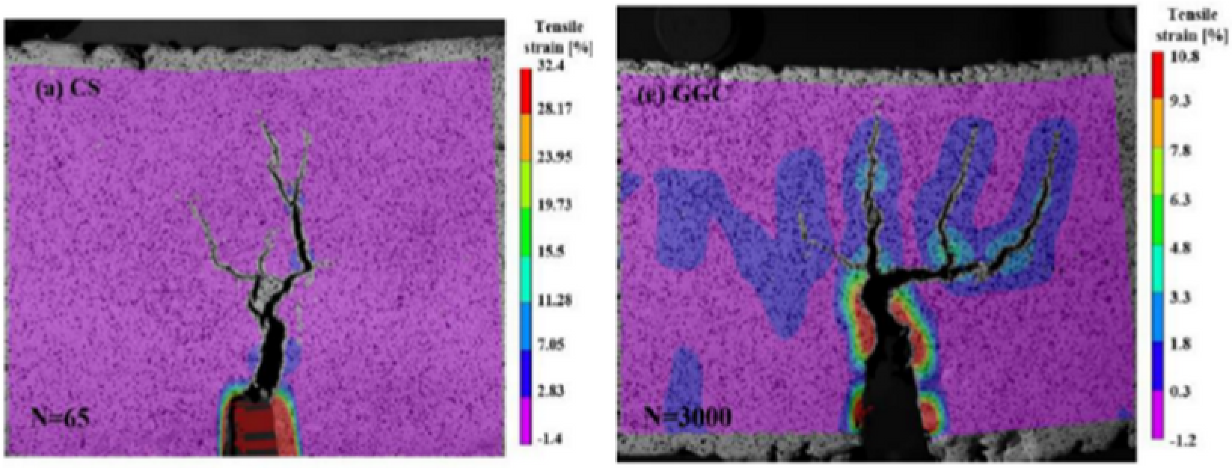

Figure-2: Reflection cracks in unreinforced (CS) and reinforced section (GGC) using the DIC technique

A digital imaging technique would certainly help understand the pattern of cracks, the energy required, tensile strains, etc., to understand the crack propagation mechanisms better, **as shown in Figure 2**. Currently, the National Highways Authority of India (NHAI) and the National Technical Textiles Mission (NTTM) are heavily supporting research on these aspects.The research group at IITH collaborating with leading industry partners to improve these products for better future national highways.

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Sustainable surface courses for pavements: Performance evaluation of CGBM containing RAP material

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A growing number of organizations, institutions, industries, companies, agencies, and governing bodies are keenly focusing on the principle of sustainability to manage their activities and achieve their goals. A sustainable approach emphasizes considering the key environmental, economic, and social factors in the decision-making process. A sustainable pavement is a solution that fulfils its specific engineering objectives such as, (1) satisfies structural and functional characteristics, (2) efficiently utilises resources, and (3) protects/restores surrounding ecosystems. Six key pavement life-cycle phases are considered for sustainability best practices, as illustrated in **Figure 1**. One such efficient sustainable pavement technologies is semi-flexible pavement containing cement grouted bituminous mixtures as a surface layer.

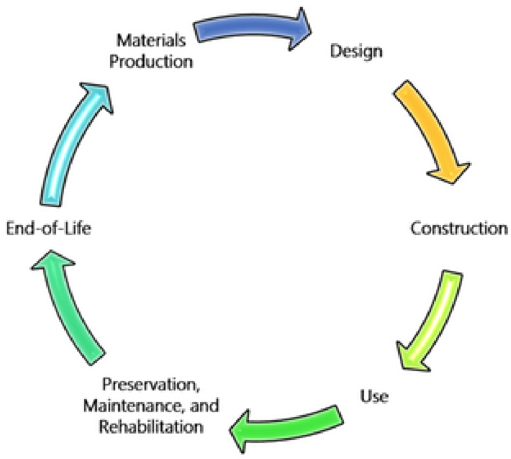

Figure-1: Pavement life-cycle phases (FHWA-HIF-14-012, 2014)

Cement grouted bituminous mix (CGBM): CGBM is an innovative type of composite pavement material consisting of a porous asphalt mixture injected with cementitious grouting material. Initially, open-graded asphalt mixtures are prepared with 20-35% air voids **(refer to Figure 2a),** and cementitious grouting material is injected into the air voids of the porous asphalt mixture **(refer to Figure 2b)**. Over the past few decades, CGBM has gained attention due to its numerous advantages over conventional flexible and rigid pavements.

Applications: The application of CGBM is wide and particularly effective in places of tunnels, heavy loading yards, airport pavements, locations where the pavement needs to take heavy stationary loads, and pavement with the possibility of exposure to petroleum and chemical attacks.

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Reclaimed asphalt pavement (RAP): RAP is a removed/processed pavement material taken from the existing pavement after the completion of service life **(refer to Figure 3)**. The proper use of RAP materials provides greater economic and environmental benefits by reusing valuable non-renewable resources (aggregate and asphalt) and reducing the disposal and dumping of waste materials. Literature studies infer that the consumption of RAP up to 30% in the bituminous mixes led to a saving in cost up to 30% and a reduction in energy consumption and CO2 emission was observed to be around 16%.

Currently, the literature on the utilization of RAP in CGBM mainly focuses on micromechanical analysis. The possibility for the utilization of RAP material in the CGB mixes needed to be studied to understand the design, mechanical, and performance characteristics of CGB mixes containing RAP material. The current research work focuses on the design of porous asphalt mixture and the selection of suitable cementitious grouting material that provides full-depth penetration into the porous asphalt mixtures containing RAP material, mechanical properties, rutting, fatigue, moisture damage resistance, fuel, and abrasive resistance of CGBM containing RAP material. The outcome of the current study provides a detailed understanding of the performance characteristics of CGBM containing RAP and helps the industries and government bodies in moving forward with the construction of CGBM containing RAP material with higher confidence levels, which ultimately results in greater economic and environmental benefits.

Figure 2 (a) Porous asphalt mixture containing 50% RAP material; (b) Cement grouted bituminous mixtures containing 50% RAP material

Figure-3: Milling of RAP material (Source: dykespaving.com)

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The Future of Transportation: Revolutionizing Mobility through Vehicle Autonomy

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In today's transportation, smooth traffic flow and safer roads are the needs and desires of every individual. According to the World Health Organization (WHO), road crashes kill nearly 1.3 million people each year, and the majority of these crashes (around 90%) occur due to human errors. With the rapid advancements in the area of research in sensor devices, robotics, and intelligent transport systems, we can foresee autonomous vehicles (AV) taking over conventional, manually driven cars. Since these AVs are equipped with technology that helps them sense the road infrastructure and detect other vehicles around them with the least input from the human driver, they greatly reduce the cognitive burden and physical exhaustion of driving. AVs not only reduce human error but also contribute with other positives, such as allowing for work on-the-go, better fuel efficiency, improved road capacity, and mobility to the elderly and disabled. AVs are charaterized by varying levels of autonomy; the Society of Automotive Engineers (SAE) classifies AVs into levels 0 to 5. The Level-0 AVs are majorly limited to warning systems, with no significant control taken over by the vehicle itself.

Level-1 AVs integrate driving assistance systems that occasionally support the driver in lateral or longitudinal driving tasks. Level-2 AVs automatically provide multi-dimensional assistance. Level-3 AVs are empowered to autonomously handle acceleration, deceleration, and steering within specific environments. At Level-4, AVs operate autonomously under defined constraints, relieving the driver from driving duties unless a critical software malfunction occurs. Lastly, Level-5 entails complete AV autonomy across all environmental conditions, negating the need for driver intervention.

The Incorporation of AVs into the existing traffic environment comes with the need to overcome some prominent challenges.

The technological risks involved and the mandatory infrastructural requirement of AVs are among the major challenges to overcome (refer **to Figure 1**).