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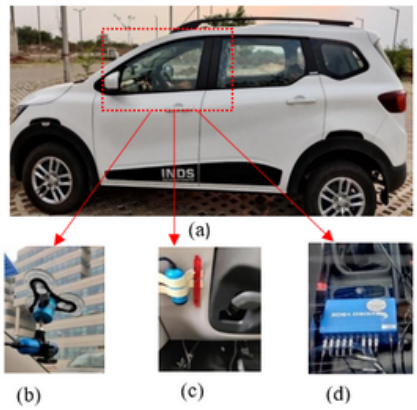

Figure-2: (a) Indian Naturalistic Driving Study (INDS) vehicle (b) Front camera (c) Camera facing towards driver brake movements (d) GPS data logger.

Conclusion:
The findings of the research suggest that drivers with activated ICWS had a lower mean speed, shorter response time and longer speed reduction time compared to those without ICWS condition (i.e., signboard not activated). It indicates that when ICWS is activated, drivers are able to apply brakes earlier and reduce their speed prior.

Thus evade collision at the intersection, since they have been provided with a piece of information in advance about the presence of vehicle on the adjacent side of the intersection.

Further, the questionnaire results exhibit a positive response from the participants, describing that the conflict warning system was found to be helpful in crossing and reducing collisions at the intersection.

The insights from the research would be helpful for transportation engineers and highway safety authorities to design and deploy the intersection conflict warning system at several unsignalized intersections for developing world traffic. This research acts as a key initiative towards designing and evaluating the ICWS for Indian driving conditions.

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Something to do with wrinkles and cracks on the pavement surface?

KID: 20230313

The wrinkles and cracks seen on the pavement surface are certainly not the artistic work of a Civil Engineer. Ever wonder why these cracks and wrinkles are seen on roads? The roads are generally designed to resist traffic loads for a certain number of years, referred to as the design life of a pavement. Due to heavy usage or temperature variation (of course one can blame it on climate change effects) and seasonal moisture fluctuations due to summer and monsoon periods, these pavements undergo huge internal stresses. Needless to say, any stress would cause strain in a body…these excessive strains (tensile) would eventually crack the bituminous layers to show fatigue cracking on the surface, as seen in **Figure 1**.

As discussed, there are various reasons for them to develop further and deteriorate the pavement. So the next question is 'Do we have a face pack to cover it up?' Yes, we do have several options, the simplest being asphalt overlay, a thin asphalt layer (20 – 30 mm) covering all these cracks to improve the ride quality, and of course the user perception! You know, we spent about INR 1,400 Cr during 2021-22 just to repair such cracks. So, more sustainable ways are always explored for controlling these cracks. **One such solution is to introduce polyester or glass fiber grids as interlayers in the bituminous layers. A small study demonstrates that the cracks have moved laterally instead of vertical direction because of the presence of interlayers.**

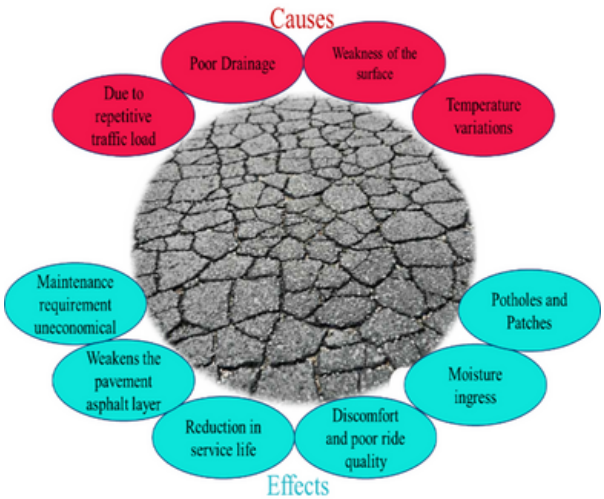

Figure-1: Causes and effects of fatigue surface cracks on asphalt pavements

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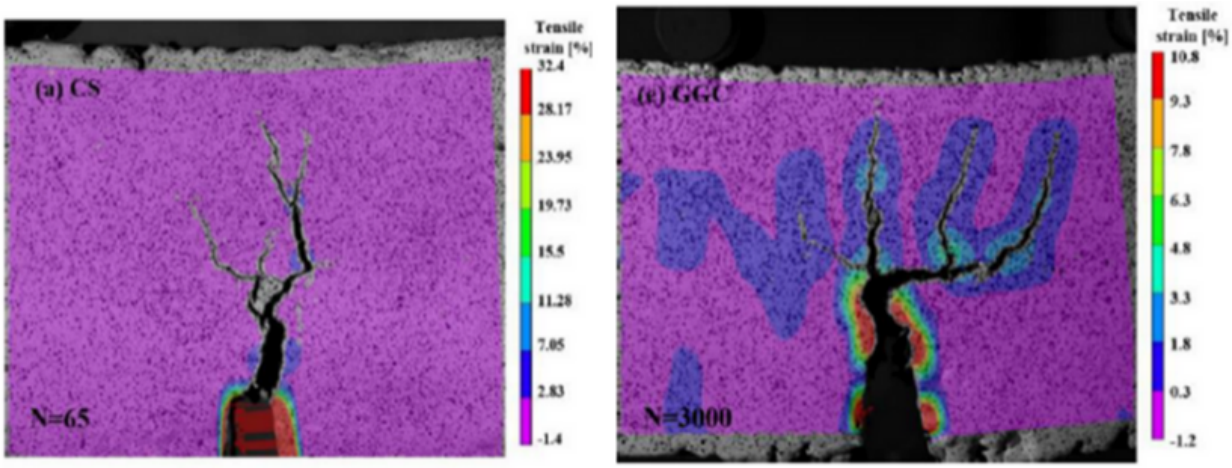

Figure-2: Reflection cracks in unreinforced (CS) and reinforced section (GGC) using the DIC technique

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.

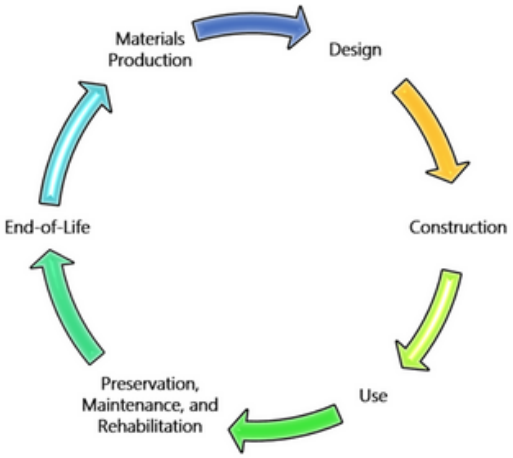

Figure-1: Pavement life-cycle phases (FHWA-HIF-14-012, 2014)

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.