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***Abstract*—- Rigid Pavement which is principally a slab made of reinforced concrete is predominant in recent years for its long-lasting structural lifecycle. Comparable to the other RC structures, permanent deformation in the form of cracks are generated because of external loads. Such cracks are harmful from the serviceability point of the pavements. The literature available in this field suggests that acoustic emission (AE) is an efficient technique in the domain of structural health monitoring (SHM) to find the damage in real time. Additionally, the works done by the previous researchers show that investigation through the AE waveforms in the time-frequency domain using wavelet transform is also being used in the past for detecting the damage in concrete structures. However, as per the knowledge of the authors, the appropriateness of group velocity in detecting the damage, which has proved to be very effective in different types of materials, its application in RC slabs is rare as per the literature. In this study, the authors have attempted for damage detection in a sample RC slab with the use of the higher symmetric & anti-symmetric modes and group velocity of AE waves. The results found for localization are promising.**

Keywords— Reinforced Concrete Slab, Acoustic Emission, Structural Health Monitoring, Wavelet Transform

I. INTRODUCTION

Rigid pavements are primarily concrete slabs with steel reinforcement prepared over the base course. Loads coming from vehicles are distributed to the soil subgrade through the different layers of the pavement. Due to vehicular load repetition on road, cracks are developed internally in the slab which in turn, leads to perpetual damage. The matter of early detection, location and assessment of the structural damage of engineering structures is one of the key aspects because it is closely associated with the safety and durability of the facility. Structural health monitoring (SHM) is the process of understanding the state of construction with time using the collected data through different experimental techniques. SHM is carried out either by periodic examination followed by non-destructive testing (NDT) or by continual sensor-based checking. One of the finest SHM techniques is the Acoustic Emission (AE) technique. Acoustic Emission has commonly been used over several decades for the evaluation of damage [1-2]. The collected data using the AE technique, regarded as the AE response are analyzed to locate the crack. There are different approaches as per the earlier studies, which are used for the analysis of these response signals in concrete. A tool used for signal analysis is wavelet transform (WT), which is very popular in AE data analysis. It allows non-stationary signals to be effectively analyzed [3-5]. Wavelet Transform (WT) basically investigates the AE data in the time-frequency domain [6-7]. Earlier studies indicate that the WT technique is suitable for the investigation of frequency components for the AE data obtained experimentally as a time function and in separating valid or actual signals and noises [8]. On bridge beams, a study has been conducted where the dynamic behavior of the beam, after getting cracked was studied using mode superposition [9]. Another study introduced a new wavelet-based method for finding the damage in a structure similar to the beam with the combination of both discrete and continuous wavelet transforms [10]. Another researcher introduced a new method for localization of damage on the basis of symbolic dynamics of time series data for the detection and localization of the deterioration in the system, which is gradually developing [10].

From the above discussion, it is quite evident that existing research work associated with the localization of AE sources using WT-based approaches has been carried out on different types of concrete structures. However, another technique of damage detection is there which depends on the group velocity of the group of waves. The group of waves has a central frequency traveling with a characteristic velocity, called group velocity. The group velocity is material-property and, its value will be different at different frequencies [11-13]. Using the group velocity approach, the localization technique has been used successfully over the years on different types of materials with the fundamental modes of group velocity; however, such type of study has not been conducted on concrete structures. Hence, in the

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