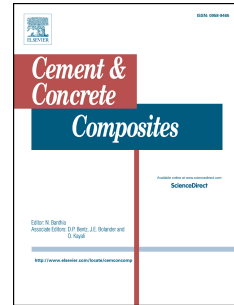


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Characterization of steel-concrete interface bonding conditions using attenuation characteristics of guided waves

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1 Characterization of steel-concrete interface bonding conditions using attenuation 2 characteristics of guided waves

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10 11 Abstract

12 This paper presents an air-coupled ultrasonic nondestructive evaluation
13 approach based on the attenuation characteristics of guided waves to characterize
14 interface bonding conditions of steel-clad concrete structures. Analytical guided wave
15 modal solutions for various interface bonding conditions are obtained using the global
16 matrix technique. The analytical results indicate that attenuation behavior of the
17 fundamental symmetric (S0) guided wave mode is sensitive to interface bonding
18 condition. A signal processing scheme is proposed to extract a dimensionless damage
19 index, the normalized S0 mode magnitude, which reflects the attenuation behavior of
20 the S0 mode. A series of numerical simulations are performed to verify the utility of the
21 parameter to characterize interface bond condition. The feasibility of the testing
22 approach is then established by experiments on steel-clad concrete specimens with
23 different interface bonding conditions. The numerical simulation and experimental
24 results demonstrate that interface bonding conditions of steel-clad concrete structures
25 can be quantitatively evaluated using the proposed approach.

26
27 **Keywords:** Global matrix technique, Lamb wave, attenuation, air-coupled sensing,
28 nondestructive testing, ultrasonic scanning, frequency-wavenumber ($f-k$) domain signal
29 analysis

30 31 1. Introduction

32 Steel-concrete composite (steel-clad concrete) structures are increasingly being
33 incorporated into the civil infrastructure because of favorable structural performance
34 and construction efficiency. Common examples of steel-concrete composite structures
35 are concrete-filled steel tubular (CFST) columns, where an inner concrete core is
36 confined within a steel tubular structure, and steel-concrete-steel (SCS) sandwich beams,
37 where a concrete bulk is sandwiched by two steel plates that serve as top and bottom

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