1.7.11. ACOUSTIC EMISSION SIGNAL PROPAGATION THROUGH WELDED STEEL BRIDGE JOINTS

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Abstract. Steel as well as concrete bridges require periodic inspections to ensure the structural safe service. Many inspections methods for assessment of steel bridges, especially non-destructive techniques, like penetrating radiation tests or ultrasound have been compared and criticized [1]. One of the non-destructive methods is the Acoustic Emission (AE) monitoring technique, which has applied on steel bridges to monitor crack initiation and propagation in welds [2, 3].

In this research, the main focus is on the assessment of steel bridges using AE monitoring technique. The safety of engineering structures is affected by numerous chemical and mechanical factors, like for example corrosion or external force impact, which can cause structural damage and deterioration. In case of steel bridges, mostly affected elements, i.e. the weak points of the structure, are bearings, expansion joints and connection braces. This research centres especially on steel connection braces, which are crucial elements of structural integrity. During laboratory test on a full scale bridge joint (see fig. 1), the signal propagation through the steel connection braces, was studied whether acoustic signals propagate through these structural elements, or whether acoustic signals are fully or partially reflected. The bridge joint was assembled of parallel steel St3S profiles (lower band 2 × C 160 × 2000, upper band 2 × C 100 × 2000, cross band 2 × C 160 × 530 and joint plate 640 × 400 × 8) connected by welded braces (flat rectangular shape steel plates 60 × 210 × 8 mm) and steel 18G2A pins 40 mm in diameter.

Fig. 1. Full scale steel St3S bridge joint

One of the crucial questions was choosing the type of sensors for the experiment. Because of the low signal damping in steel structures, acoustic signals can travel long distances without any disturbance and may be reflected several times by material discontinuities (damages). Registered AE signals and their sources [4, 5] can be located by the sensors placed at the monitored profiles (plane 1) or at the parallel profiles (plane 2) due

to signals propagating through the connection braces. Transmitted acoustic signals may lose some part of energy by reflection. Therefore, accuracy of signal acquisition and analysis should be high and appropriate sensors should be applied. The DECI SE55-R low frequency, high sensitivity at 55 kHz AE sensors were chosen for monitoring of steel bridge joints because of their low signal damping.

Performed experiments involved AE reference source analysis (pencil lead breaking) to discover AE signal propagation through the steel connection brackets. The analysis of the results shows that the AE signals transfer through the steel connection braces without any disturbance. Therefore, the overall condition evaluation should not be affected by exact placing of the sensors at the monitored bridge element. A next step could be to study AE signals propagation, when the steel connection braces are damaged.

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