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52

ASSESSMENT OF LOCATIONS ALONG THE PROPOSED HS2 ROUTES THAT ARE LIKELY TO EXPERIENCE GROUND VIBRATION BOOM FROM HIGH-SPEED TRAINS

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1 INTRODUCTION

The demand for high speed rail transportation has significantly increased over the last decade. This way of transportation is convenient and environmentally friendly. However, high train speeds bring into consideration some new environmental problems that were unknown for conventional trains. One of the most important is a dramatic increase in the level of railway-generated ground vibrations that can occur when the train speed exceeds the velocity of Rayleigh surface waves in the supporting ground. This phenomenon is known as 'ground vibration boom' (GVB), and it was first predicted theoretically in the papers[1-3]. Soon after that, it was observed experimentally on the new high-speed railway line in Sweden[4]. Further theoretical investigations of GVB have been carried out in the papers[5-8]. Note that the phenomenon of ground vibration boom from high-speed trains is similar to the well-known phenomenon of 'sonic boom' from supersonic aircraft that occurs when the speed of aircraft exceeds the velocity of sound in air. The essential difference though is in the fact that, whereas sound velocity in air is roughly the same in all locations above earth surface, the Rayleigh wave velocity is different in different locations, depending on geological properties of the ground. In some locations, where the ground is soft and marshy, the Rayleigh wave velocity can be very low. Such 'sensitive' locations are most likely to experience ground vibration boom from operating high-speed trains.

In the majority of geographical areas ground vibration boom is not a problem within high speed rail networks as, although the technological development of high speed trains now has them reaching service speeds surpassing 320km/h, Rayleigh waves usually travel at much higher velocities than this. However, in softer ground the propagation velocity of Rayleigh waves can be severely reduced, resulting in a higher number of occurrences of ground vibration boom along the route.

The present paper describes the results of the preliminary assessment of the proposed HS2 route from the point of view of possible occurrence of the phenomenon of ground vibration boom. The analysis is based on the available geological information about the soil composition along the proposed HS2 route and on the available information about the expected train speeds along the route, including areas of train acceleration and deceleration after departure from or before approach to railway terminals. Rayleigh wave velocities have been calculated for all distinctive sites along the route using the geological data and compared with the expected train speeds at the relevant locations. Using this method, several sensitive locations have been identified where ground vibration boom is likely to occure if no mitigation is applied. The expected levels of ground vibration boom have been estimated using the earlier developed theory[6, 7]. Some vibration reduction techniques are suggested to reduce effects of ground vibration boom on local residents and busineses.

2 INFLUENCE OF GEOPHYSICAL PROPERTIESS OF SOILS

As was mentioned above, ground vibration boom occurs when the speed of a train exceeds the velocity of Rayleigh waves. Therefore, it is necessary to study the effects of geophysical properties