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Seismic response of deep tunnels: Comparison of different existing methods

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The task at the present study was the verification of the current methods used in a conventional manner so as to estimate the behavior of a tunnel against ground motion but also the investigation and suggestion of additional methods. To accomplish this objective, the study analyzes a real project that had been designed by the engineering team of Geodata. Moreover there is a review of what has already been applied to the case (pseudo-static methods) and in parallel there is a consideration of various other existent procedures: analytical, dynamic time-history and a different numerical model again in pseudo-static condition. The time-history method is highlighted in particular as it is a rigorous scheme that needs prudent consideration. In the end, the comparison brought out both advantages and drawbacks but as well as the contrasts of the distinct proceedings and made the associated proposal for future performance issues. Creating a model for a pseudo-static approach has a simplicity that makes it advisable as the primary way to characterize the situation. On the other hand, it is the only way among all those that were described at the study and can exist on its own. The model itself is capable of enclosing sufficient results provided that the configuration guarantees a reliable representation of the surrounding mass conditions (in the present case, the project adopted pure material homogeneity and a detailed grid around the tunnel). Shear deformation is the dominant value that plays the role to define the level of the response and therefore the dynamic analysis was also a tool to detect the relative strain levels. Even so, a thorough search among past ground motion scenarios brings the suitable records (the key parameter here is the PGA of the region) that can more or less set the stress-strain framework to strengthen the reliability of the numerical model. The use of time-history (dynamic) analysis requires a suitable record selection (three or more) and a number of accompanying checks. The record time-histories must be compatible to the site response spectrum and were scaled to the relevant PGA. Further checks have to do with the frequency propagation ability offered by the model but also with the energy content of the input. Even the damping issue is considered in more than one ways. Consequently, this method turns out to be a useful, representative and exceptional tool as it is the only one that inserts dynamic loading. The basic topic is the interaction and the coexistence of the dynamic analysis with any simplified numerical approach. Such a combination is to be further examined at a large group of deep elements. This study demonstrates that, the two methods, if put together, can set the analyses to the same strain levels and consequently the correlation between them will be considered much more valid so as to evaluate the seismic response of the structure.

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External pre-stressing: Construction technique or rehabilitation method

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External pre-stressing is an efficient method for constructing new structures such as bridges or for strengthening existing structures. However, each application needs different requirements. This paper discusses the components, types, advantages and disadvantages of external pre-stressing system relative to ordinary internal pre-stressing system and also the requirements for using external pre-stressing in both applications.

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