

## Dynamic Response of Deepwater Bridge Pier Pile Group Foundation Under Wave-Current Coupling (Postprint)

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### Abstract

To investigate the dynamic response characteristics of deep water bridge pier group pile foundations under wave-current coupled action, the Huizhan spectrum was employed to simulate nonlinear wave effects, MATLAB programming was utilized to solve for wave-current force time-history curves, and a three-dimensional finite element model of Pier #3 of the Taihe Gan River Bridge was established using ANSYS numerical analysis software to simulate the response patterns of deep water bridge pier group pile foundations under wave-current coupled action and to conduct transient dynamic analysis. The results demonstrate that: displacements at the pier top exhibit a cumulative trend; displacements, stresses, and strains in the pier body, bottom, and top display nonlinear fluctuation characteristics; transverse deformations reach their maximum at the pier top, gradually decreasing downward with minimum values occurring at the pile top; the maximum stress and strain in the pier body are located at the still water level and at the junction between the pier bottom and pile cap, respectively, while minimum values occur at the pier top and pile top. These research findings can provide theoretical guidance for the design, operation, and maintenance of deep water bridge pier foundations.

### Full Text

## Numerical Study on the Dynamic Response of Pile Foundation of Deepwater Bridge Piers Under Coupled Wave-Current Load

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### Abstract

To investigate the dynamic response characteristics of pile group foundations for deepwater bridge piers under coupled wave-current action, this study adopts the JONSWAP spectrum to simulate nonlinear wave effects and employs MATLAB programming to compute time-history curves of wave-current forces. A three-dimensional finite element model of Pier 3# of the Taihe-Ganjiang Bridge was constructed using ANSYS numerical analysis software to simulate the response behavior of deepwater bridge pier pile group foundations under wave-current coupling, and transient dynamic analyses were performed. The results demonstrate that displacement at the pier top shows a cumulative trend, while displacements, stresses, and strains at the pier body, bottom, and top exhibit nonlinear fluctuation characteristics. Transverse deformation reaches its maximum at the pier top and gradually decreases downward, with the minimum occurring at the pile top. The maximum stress in the pier body occurs at the still water level, whereas the maximum strain occurs at the intersection between the pier bottom and the cap; minimum values of both stress and strain occur at the pier top and pile top. These research findings provide theoretical guidance for the design and operational maintenance of deepwater bridge pier foundations.

**Keywords:** deepwater bridge pier; pile group foundation; dynamic response; wave-current coupling; numerical calculation; three-dimensional finite element model

*Note: Figure translations are in progress. See original paper for figures.*

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