In the present study, a total of five three-dimensional finite element models are implemented for the tested bridge. Four ... as the deck model with different girder models (girder models G1, G2, G3, and G4) as discussed in the previous section.

Compatible finite element methods for three-dimensional finite element stress analysis are usually limited in terms of computational cost and accuracy. To enhance the computational efficiency and accuracy, a novel three-dimensional compatible finite element method has been developed. The method consists of 18 nodes and is compatible with 27 node isoparametric hexahedral elements available in the ABAQUS ® software [25].

The method is based on the principle that the element should be able to represent the stress and strain fields accurately. The element is designed to be compatible with the displacement field of the solid, ensuring that the strain field is continuous across element boundaries. The element also satisfies the compatibility conditions at the nodes.

The three-dimensional compatible finite element method is compared with the classical finite element method, and the results show that the proposed method provides a more accurate solution, especially in areas with high stress gradients. The method is particularly useful for analyzing complex structures with non-linear material behavior.

In conclusion, the three-dimensional compatible finite element method is a promising tool for the analysis of large deflections in structures. Its ability to accurately represent the stress and strain fields makes it a valuable addition to the engineer's toolkit.