

## Accepted Manuscript

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PII: S0263-8223(18)31333-3

DOI: <https://doi.org/10.1016/j.compstruct.2018.07.127>

Reference: COST 10045

To appear in: *Composite Structures*



Please cite this article as: Dan, L., Yifeng, Z., Boshu, L., Bin, D., Static and dynamic analysis of composite box beam based on geometrically exact nonlinear model considering non-classical effects, *Composite Structures* (2018), doi: <https://doi.org/10.1016/j.compstruct.2018.07.127>

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Static and dynamic analysis of composite box beam  
based on geometrically exact nonlinear model  
considering non-classical effects <sup>☆</sup>

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**Abstract**

In order to accurately predict the static and dynamic behavior of composite box beam, the Geometrically Exact Nonlinear Model (GENM) of composite **box** beams with arbitrary material distribution and large deflection was performed based on the Hodges' generalized Timoshenko beam theory. The strain of any point in the deformed beam was calculated by the rotational tensor decomposition. Then, the asymptotic variational method was used to determine the arbitrary sectional warping. The generalized Timoshenko strain energy was derived from the second-order asymptotically exact strain energy using the equilibrium equation. The motion equations of GENM were established by using the Hamilton's generalized principle. Finally, the proposed model was applied to the static and dynamic analysis of the composite **box** beam and verified by comparison with the experimental data. The influence of non-classical effects of sectional warping and transverse shear deformation on the composite **box** beam were further investigated. The results show that the sectional warping has significant effects on the static deformation and natural frequencies of composite **box** beams, and the influence of transverse shear deformation on the static deformation and the natural frequencies are related to the aspect ratio of beam length to section dimension.

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