The 2025 World Congress on
Advances in Structural Engineering and Mechanics (ASEM25)
BEXCO, Busan, Korea, August 11-14, 2025

Numerical Method for Predicting Fatigue Life of Wind Turbine Blade reinforced with Graphene Platelets

Hyeong Jin Kim[1)] and *Jin-Rae Cho[2)]

[1)] *Department of Mechanical Engineering, University College London, London WC1E 7JE, United Kingdom*
[2)] *Department of Naval Architecture and Ocean Engineering, Hongik University, Sejong 30016, Republic of Korea*
[2)] *jrcho@hongik.ac.kr*

ABSTRACT

This study numerically investigates the fatigue life of wind turbine blades reinforced with GPLs, comparing their performance against conventional fiberglass blades. The traditional fiberglass blade was modeled based on the SNL 5MW wind turbine model of Sandia National Laboratories, while the GPL-reinforced composite (GPLRC) blade was designed by reinforcing with GPLRCs. Wind speed data were randomly sampled following the probability distribution observed at European wind farms, and corresponding aerodynamic loads were computed using blade element momentum theory (BEMT). Finite element analyses were performed to derive stress time-histories, and fatigue life was predicted using the S-N curve approach, incorporating the Goodman diagram and the Palmgren-Miner rule. The numerical experiments were performed to verify the developed numerical method and to investigate the fatigue life characteristics.

ACKNOWLEDGEMENT

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (RS-2023-00240618).

REFERENCES

Kim, H.J. and Cho, J.R. (2024) “Exploratory study in the application of graphene platelet-reinforced composite to wind turbine blade”, *Polymer, **16***, 2002.
Cho, J.R. (2015), “Fatigue life assessment of fabric braid composite rubber hose in complicated large deformation cyclic motion”, *Finite Elem. Anal. Des.*, **100**, 65-76.

[1)] Graduate Student
[2)] Professor

The 2025 World Congress on
Advances in Structural Engineering and Mechanics (ASEM25)
BEXCO, Busan, Korea, August 11-14, 2025