COASTAL VEGETATION IMPACT ON STRUCTURAL INTEGRITY UNDER INUNDATION EVENTS

Aikaterini Kyprioti, University of Notre Dame, akypriot@nd.edu
Alexandros Taflanidis, University of Notre Dame, ataflani@nd.edu
Andrew Kennedy, University of Notre Dame, akenned4@nd.edu

MOTIVATION

Flooding events caused by hurricanes or tsunamis pose a substantial risk for the integrity of coastal infrastructures. The impact of such inundation events (IEs) greatly depends on the natural and anthropogenic disturbances, such as existing vegetation or neighboring structures. Figure 1 shows an example from hurricane Matthew (2016) from Kijewski-Correa et al. [2018].

Figure 1 – Protection offered by vegetation during hurricane Matthew for nursing school buildings on a beach at Côteaux (Haiti).

APPROACH

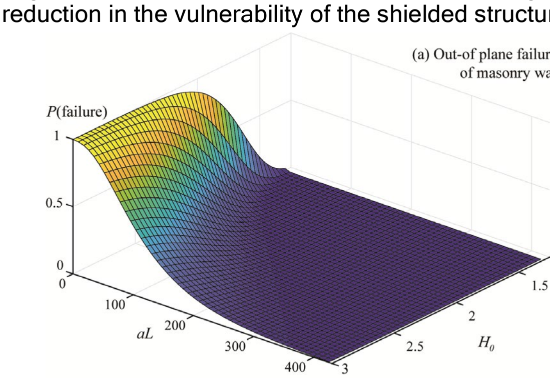
For the estimation of structural loads due to wave loading behind semi separable vegetation, numerical results from Alagan Chella et al. [2019] are utilized. This study provides information for (i) intensity measures (IMs) commonly used to describe fragility against IEs, such as momentum flux or inundation depth, as well as for (ii) forces directly applied on the structure itself, by considering different characteristics for the semipermeable obstacle (damping, length of vegetation) and for the generated wave (breaking wave height). Demonstrating the use of both wave outputs for the quantification of the structural vulnerability, two approaches were followed: the first one used results from (i) and readily available fragility curves, and the second one, based on (ii), damages were analytically estimated by comparing the capacity of the structure against the demand.

APPLICATION

Since the provided quantities of interest (i)-(ii) correspond to peak values, a regression in logarithmic scale was performed to average out any potential numerical or turbulence instabilities. The regression was performed with respect to the breaking offshore wave height and the vegetation damping. For the fragility quantification, two examples were investigated: the out-of-plane failure of an unreinforced masonry (URM) infill wall, where the forces generated by the waves are compared to its capacity, and the global failure of a reinforced concrete frame structure. For the latter, readily available global failure fragility curves connecting the momentum flux to the probability of damage for different damage states were used Alam et al. [2017]. Results are presented in Figure 2.

COMMENTS

Results demonstrate that the protection offered by vegetation is substantial and can lead to a significant reduction in the vulnerability of the shielded structure.



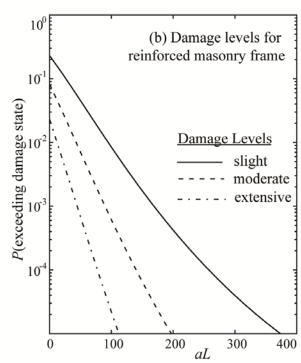


Figure 2 – (a) Probability of out -of - plane failure of masonry infill wall, as function of breaking wave height (H_o) in *m* and dimensionless vegetation dissipation parameter aL. (b) Probability of exceeding different damage states for the reinforced concrete frame as function of aL.

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