

Determining strength limits for standing tree stems from bending tests

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Non-destructive tests are essential in urban tree risk assessment. One of the commonly used methods, the pulling test method, relies on wood properties derived from testing small clear samples of green wood. In the past, such data had been suspected to overestimate the strength of intact tree trunks. Here we propose and test a novel method to measure the limit of proportionality directly in large standing trees. Material properties determined in tests on small specimen were not correlated with tree strength derived by testing entire tree stems. Exceeding the proportional in bending tests on entire stems caused local fibre buckling on the compression side. Thus, it is important to test strength thresholds on entire tree stems using the new field method described here in order to improve the credibility of the pulling test method. Furthermore, we show that stiffness measured during non-destructive pulling tests is a good indicator for yield strength in bending for both intact and damaged tree stems. This confirms that pulling tests actually measure data that are relevant for strength assessments.

Keywords: proportional limit, pulling test method, bending test, fibre buckling, *Acer pseudoplatanus*, *Fraxinus excelsior*, *Picea abies*, *Platanus acerifolia*, *Quercus palustris*

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