A simplified model predicting the weight of the load carrying beam in a wind turbine blade

Based on a simplified beam model, the loads, stresses and deflections experienced by a wind turbine blade of a given length is estimated. Due to the simplicity of the model used, the model is well suited for work investigating scaling effects of wind turbine blades. Presently, the model is used to predict the weight of the load carrying beam when using glassfibre reinforced polymers, carbon fibre reinforced polymers or an aluminium alloy as the construction material. Thereby, it is found that the weight of a glass fibre wind turbine blade is increased from 0.5 to 33 tons when the blade length grows from 20 to 90 m. In addition, it can be seen that for a blade using glass fibre reinforced polymers, the design is controlled by the deflection and thereby the material stiffness in order to avoid the blade to hit the tower. On the other hand if using aluminium, the design will be controlled by the fatigue resistance in order to making the material survive the 100 to 500 million load cycles experience of the wind turbine blade throughout the lifetime. The aluminium blade is also found to be considerably heavier compared with the composite blades.