Shear behaviour of carbon fibre reinforced glulam beam

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Thesis advisor: Prof. Dr. Martin Lehmann

In recent time, the construction industry has witnessed widespread utilization of carbon fiber reinforced polymers (CFRPs) owing to their beneficial mechanical properties. The thesis will focus on the investigation of the shear behaviour of carbon fibre reinforced glulam beams. The aim is to gain knowledge on the circumstance when shear failure instead of bending failure would occur.

Yin Hang Henry Chung
Complex Timber Structures

Introduction

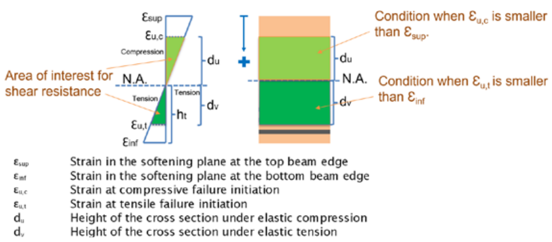
In this thesis, the calculation method of Lukas Blank is adopted for bending capacity.
It is adopted because the calculation method is strongly proved experimentally.
The characteristic bending capacity can be derived from the calculation, even though the calculation parameters are either characteristic strength or mean values.
Secondly, the mechanical model that Lukas Blank provides can quantify the strength increase of softwood timber due to presence of a reinforcement. Up until now, there are not many mechanical models that can be employed for composite carbon fiber reinforced timber beam.

Theoretical procedure

In this thesis, the shear reinforcement would be neglected for calculation as the impact to the maximum bending moment is minimal, as stated by Lukas Blank. Also, Blank and Alberti have indicated that a shear crack would have to be initiated in order to utilize the shear reinforcement.
Based on the experiments of Lucas Blank, the maximum bending capacity can be determined. To determine the shear capacity of the cross section, an assumption is made: Elastic zone of the cross section has shear capacity same as what has been stated in Eurocode, whereas plastic zone has no shear strength. The aim of the calculation is to know whether moment capacity is determining to the capacity of the overall beam, or shear capacity is.
An excel table has been created for the calculations of shear and bending moment capacity. The principle of the calculation is that the moment capacity, which is know, is utilized. With each span length, a four point bending test loading, uniform distributed load, or a three point bending load would be implemented increasingly. The capacity at critical point(s) in beam where there exists high bending moment and shear stress at the same time is checked. Shear at support is checked also, in case maximum shear and bending moment do not occur at the same location.

Result and Conclusion

In this thesis, single span beams and double span beams shear calculations have been studied.
Based on previous researches, utilizing the theoretical and experimental findings of Lukas Blank, a calculation method to determine whether shear or bending moment is determinant has been developed successfully. The theoretical results are in line with the experimental ones. It can be seen that for single span beams of the experiment, the shear is not a determining factor at the mid-span of uniformly distributed load beam. For four point bending test, maximum bending capacity can be attained before reaching maximum shear capacity for all the experimental setups conducted previously.
The volume effect plays also a role in the four point bending test as the maximum bending moment location is larger than the location with high shear.
For two span beams, the question now is whether the maximum bending capacity at the two midspan of the two-span beam could be attained.
To study into this further, an understanding of how the shear cracks are present outside and inside the timber beam is needed. Moreover, a method to calculate the resistance force required from the screws or glued in rod to prevent the propagation of longitudinal shear would be beneficial.



For a beam under bending, the shear strength of a cross section is derived only in elastic zone.