

CVG2141 - Quiz 7

1. Describe the advantages and disadvantages of wood.

Wood is advantageous because of its high availability, high strength, light weight (which is beneficial for construction), cost efficiency, renewable nature, and aesthetic properties. However, due to the fact that it is a natural resource, it may have flaws and variations and will deteriorate over time. As well, the properties will differ depending on the direction of the force (longitudinal, radial, or tangential). Also, it may shrink due to humidity changes, has low fire resistance, and is susceptible to creep.

2. Explain the strength of wood depending on its moisture content and density.

The strength of wood varies depending on the specific gravity since the specific gravity depends on the moisture content. The relationship can be described as the following:

$$\downarrow \text{MC} \rightarrow \uparrow \text{SG} \rightarrow \uparrow \text{Strength (and vice versa)}$$

This is because when the moisture content is lower, the chemical bonds are closer and the wood is denser (the cavities are tighter together) resulting in a stronger structure.

3. Explain the orthotropic properties of wood (i.e. presence of fibers) in terms of its tensile and compressive strength.

The orthotropic properties of wood describes how wood responds differently depending on if the axis is longitudinal (tree axis), radial (radius through annual rings), or tangential (tangential to annual rings). As well, the main components of wood (cellulose, lignin, and hemicellulose) play a role in the tensile and compressive strength results. When a tensile or compressive force is applied parallel, the cellulose holds the wood together and since cellulose is mainly responsible for the strength in wood, the strength is high. However, when a tensile or compressive force is applied perpendicularly, the lignin and hemicellulose hold the wood together. However, these components work as a binder for cellulose and have much less strength resulting in a low overall strength.

4. What are the likely durability problems of wood members? Cite the possible types of treatment to be done in order to improve the performance of long-term timber.

Wood can encounter durability problems with regard to fire, fungal attacks, and bug attacks. Fire is a very flammable material and some methods to help mitigate this issue include adding gypsum boards to cover the wood members or using chemicals (pressure impregnation or paintings). In addition, there are 3 main types of fungal attacks (brown, white, and dry rot) which are caused by four conditions including humidity, air, temperature, and food (wood). The performance can be improved by reducing the moisture (by keeping wood dry or using chemicals) and/or oven drying the wood to try and kill the fungi. Moreover, the risk of insect attacks can be reduced by applying wood sealing treatment, treatment by autoclave process, or controlled wood drying process.

5. Calculate the MOR (MPa) and the shear stress (τ max; MPa) of the following wood/timber beam:

$$M = \frac{PL}{4} = 700Nm$$

$$I = \frac{bh^3}{12} = \frac{(0.2)(0.4)^3}{12} = 0.001067$$

$$MOR = \frac{Mc}{I} = \frac{(700)(0.2)}{0.001067} = 131250 Pa = 0.131 MPa$$

$$\tau(max) = \frac{3V}{2A} = \frac{3(200)}{2(0.2)(0.4)} = 3750 Pa = 0.00375 MPa$$