FactSheet Nov2013

Meyer TIMBER

LOADINGS AND DEFLECTIONS

The basis of all structural design, including timber design, revolves around strength and serviceability calculations. The serviceability, or deflection, depends on what loads are applied, and the strength depends on how these loads are applied.

When designing with timber for residential jobs, there are two main standards that apply:

- AS1720.1-2010 *Timber structures: Design methods*
- AS1684.1-1999 *Residential timber-framed construction: Design criteria*

STRENGTH

Timber, being a natural material, has an interesting property in that it can withstand higher stresses for short periods of time than it can withstand permanently. This means when you apply the loads to check the strength you need to know if they are long term Dead loads (G), medium term Live loads (Q) or short term (Wind loads, etc). The design methods of AS1720.1 for timber strength are based on a load duration of 5 minutes. All other combinations are assigned a load duration factor (k_1<1) depending on how long the load will be applied. The worst case is pure dead load, where k_1=0.57. This means if a beam can take a 100kg load put in the centre of it for 5 minutes, if you were applying the load permanently you could only put on 57kg. A lesser load for a longer period of time may therefore be the critical design case. In addition to this, the loads are factored to account for the possibility of overloading. Distributed Live loads on floors (1.5kPa) are factored up by 50% in strength calculations. The table below shows for a floor joist the main load cases, what the k_1 factors are, and how much load is applied using G=40kg/m2, Q_1=0.5kPa, Q_2=1.5kPa & Q_5=1.8kN:

LOAD CASE	COMBINATION	STRENGTH LOADING AT 450CRS FOR 4M SPAN	K_1	LOAD CASE CAPACITY (200X35 hySPAN)
Dead (G) +Permanent Live (Q_1)	$1.35(G+Q_1)$	0.61kN/m	0.57	20%
Dead (G) + Distributed Live (Q_2)	$1.2G+1.5Q_2$	1.28kN/m	0.8	31%
Dead (G) + Point Live (Q_5)	$1.2G+1.5Q_5$	0.27kN/m + 2.7kN (central)	0.94	33%

*Table values indicative only – not to be used for specification.

STIFFNESS

Deflection calculations are much less severe (the beam will not cause structural failure but just bend a bit more) and as such the loads applied are not factored. Limits are given in AS1684.1 based on experience and reasonable in-service conditions (no tile cracking etc). Dead load (long term) deflections are doubled as when long term loads are applied the timber fibres tend to re-align over the first year or so. Be wary of absolute deflection limits (max floor joist deflection = 8mm for example). The astute specifier looks at the use of the member and makes a decision from there. I would not specify a 2.4m span floor joist with 8mm deflection (within code) if it had 600x600 porcelain tiles sitting on top of it. In contrast I would be happy to specify a 5m span joist in a carpeted bedroom over a garage which had close to the limit of 15mm deflection in it.

Note that the deflections are based on theoretical calculations with theoretical loadings. Live load has 150kg/m2 applied (270kg furniture etc spread on a 4m span joist at 450crs). The measured deflection will in almost every case be different as the loads are different and not normally uniformly applied along the entire joist length.

SUMMARY

When considering initial designs the important factor is to understand as much as possible about the member. Based on the intended use you can then make some judgement decisions on what loading to apply, how conservative the loading should be, and how much stiffer than code (if at all) is reasonable.

Some questions for a floor joist design could be:

- Is the joist critical, say under parallel loadbearing wall (be conservative on strength)?
- Are people going to get access to sight lines, going up stairs etc (consider reducing deflection)?
- What is going on top of the joist (carpet, tiles, floating floor, etc)?
- What is underneath (subfloor, garage, home theatre)?
- Are there any non-loadbearing walls over the top of the joist to stiffen the joist up, or is it a big open area?
- Does it look like a lot of furniture will go in the room above (to dampen joist response)?
- How many joists are there in the run (One longer span joist in a run is not as critical as the load is shared with adjacent joists)?

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