6. Determine minimum modulus of elasticity due to vibration

The span required is not greater than 15 feet and the $\ell/360$ deflection check uses a 40 psf floor live load. Therefore, the deflection check is assumed to provide adequate vibration control.

7. Determine minimum required unadjusted properties by using NDS tabulated lumber data

Bending

$$f_b \leq F_b'$$
$$F_b' = F_b C_r C_F C_D$$
$$F_{bmin} = \frac{f_b}{C_r C_F C_D} = \frac{1{,}408 \text{ psi}}{(1.15)(1.1)(1.0)} = 1{,}113 \text{ psi}$$

Horizontal shear

$$f_v \leq F_v'$$
$$F_v' = F_v C_H C_D$$
$$F_{vmin} = \frac{f_v}{C_H C_D} = \frac{77 \text{ psi}}{(2)(1.0)} = 39 \text{ psi}$$

Bearing

$$f_{c\perp} \leq F_{c\perp}' \quad \text{(assume minimum 2-in bearing)}$$
$$F_{c\perp} = F_{c\perp} C_b$$
$$F_{c\perp min} = \frac{f_{c\perp}}{(1.0)} = 236 \text{ psi}$$

Minimum unadjusted tabulated properties required

$F_b = 1{,}113$ psi $F_{c\perp} = 236$ psi
$F_v = 39$ psi $E = 1.55 \times 10^6$ psi

8. Select optimum lumber grade considering local availability and price by using NDS-S Table 4A or 4B data

Minimum No. 2 grade lumber is recommended for floor joists because of factors related to lumber quality such as potential warping and straightness that may affect constructability and create call-backs.

Considering 2x10 Douglas Fir-Larch, the grade below (No. 1 and Btr) was selected to meet the required properties.

F_b	=	1,200 psi	>	1,113 psi	OK
F_v	=	95 psi	>	39 psi	OK
$F_{c\perp}$	=	625 psi	>	236 psi	OK
E	=	1.8×10^6 psi	>	1.55×10^6 psi	OK

Conclusion

Many other species and grades should be considered depending on local availability and cost. Also, the No. 1 and higher grades are generally considered as “premium” lumber. A more economical design may be possible by using a closer joist spacing to allow for a lower grade (i.e, 19.2 inches on center or 16 inches on center). Also, a lower grade 2x12 should be considered or, perhaps, engineered wood I-joists.