SPANCRETE MANUFACTURERS ASSOCIATION

RESEARCH NOTES

SPAN LIMITATIONS

Floor Vibrations - Heel Drop Response

As the use of longer spans and larger open areas has become more prevalent in office construction, awareness of floor vibrations has increased. The effect that one person walking on a floor has on others sitting at desks has been studied primarily in the steel construction industry. While few problems have been reported in the precast concrete industry, methods of analysis are available for evaluating Spancrete® hollowcore. For this type of floor vibration, the minimum required damping can be determined for specific conditions and compared to a probable expected damping.

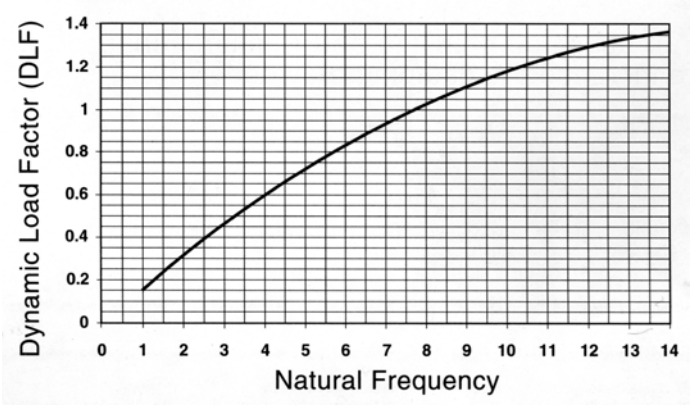
Expectations of actual damping are generally a funciton of non-structural items such as ceilings and partitions. While bare Spancrete has approximately 3% damping, a suspended ceiling could add 1 to 3% damping and partitions could add 5 to 10% damping. The design procedure follows.

Calculate the required minimum damping.

$$D_{min} = 35\,A_o f_o + 2.5 \quad \text{where} \quad A_o = DLF\left(\frac{0.6l^3}{48\,EI}\right) \text{and} \quad f_o = \frac{0.74}{L^2}\sqrt{\frac{EI}{wb}}$$

f_o = system natural frequency, Hz E = modulus of elasticity, ksi l = span, in.
DLF = dynamic load factor I = moment of inertia, $in.^4$ L = span, ft.
w = slab weight, psf b = slab width, ft.

(For A_o, the moment of inertia to be used should be that available in a design strip such as 0.55L.)
(For f_o, the moment of inertia to be used is that of the plank.)



When the required damping is less than about 3%, a bare floor will normally be found acceptable. When the required damping is in excess of 4.5%, particular care should be taken in identifying sources of damping.

Note: The support system can have a significant influence on performance, and may require a separate analysis. This presentation assumes a rigid support, such as a wall bearing structure. See RESEARCH NOTE “Floor Vibrations - Spancrete on Flexible Supports” for additional information.

A design example is given on the reverse side.

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DESIGN EXAMPLE

SPAN LIMITATIONS

Floor Vibrations - Heel Drop Response

PROBLEM:

Check the minimum damping required for 8" Spancrete® hollowcore with a unit weight of 60 psf on a 28 ft. span in an office floor application.

GIVEN:

The help drop dynamic load factor can be determined from the figure on the other side.

SOLUTION:

The plank natural frequency is: $f_o = \frac{0.74}{28^2}\sqrt{\frac{4300000(1730)}{60(4)}} = 5.25$ Hz

From the figure on the other side, heel drop DLF = 0.75

Using a 0.55L distribution width, the total moment of inertia is:

$I = 0.55(28)(1730/4 \text{ ft.}) = 6660.5 \text{ in.}^4$, and $Ao = 0.75\left(\frac{0.6(28x12)^3}{48(4300)(6660.5)}\right) = 0.012$ in.

Minimum damping $D_{min} = 35(0.012)5.25 + 2.5 = 4.7\%$

Conclusion: In this example, a suspended ceiling and regularly spaced partitions would be recommended to increase the damping provided.

Note: Sample calculations are intended to illustrate the concept presented and do not represent all considerations necessary for the complete design.