SPANCRETE MANUFACTURERS ASSOCIATION

RESEARCH NOTES

SPAN LIMITATIONS

Floor Vibrations - Flexible Supports

Calculation of floor vibration characteristics for Spancrete® hollowcore plank on rigid supports was addressed in RESEARCH NOTES 1021 and 1022. When Spancrete is supported on flexible supports, those supporting members will reduce the natural frequency of the system as compared to the Spancrete alone. Therefore, it is appropriate to include the effects of flexible support members when the system is to be evaluated for vibration criteria.

For floor plank combined with suport beams, the natural frequency of the system can be approximated by:

$$\frac{1}{f^2_n} = \frac{1}{f^2_p} + \frac{1}{f^2_b}$$

where f_n = system natural frequency, Hz
f_p = Spancrete plank natural frequency, Hz
f_b = support beam natural frequency, Hz

Where a bay of plank is being investigated and the supporting beams at each end are different, the beam with the lower natural frequency should be used to determine the system natural frequency.

The individual natural frequencies are calculated as:

$$f_p = \frac{0.74}{L^2}\sqrt{\frac{EI}{wb}}$$ for the plank, and $$f_b = \frac{0.74}{L^2_b}\sqrt{\frac{E_b I_b}{w_b}}$$ for the beam

where

L, L_b = respective span, ft
b = plank width, ft
w_b = uniform beam load, plf
E, E_b = respective modulus of elasticity, psi
I, I_b = respective moment of inertia, in^4
w = uniform plank weight, psf

The system natural frequency can then be used instead of the slab natural frequency for the evaluation procedures presented in RESEARCH NOTES 1021 and 1022.

A design example is given on the reverse side.

SPANCRETE MANUFACTURERS ASSOCIATION

DESIGN EXAMPLE

SPAN LIMITATIONS

Floor Vibrations - Flexible Supports

GIVEN:

Two bays of 22' long 8" Spancrete® hollowcore weighing 60 psf supported by a beam with spans 20'.

PROBLEM:

Determine the natural frequency of the system when the support beam is:
(1) a steel beam, w18 x 50 (2) a precast concrete beam, IT 30 x 20

SOLUTION:

(1) For plank $f_p = \frac{0.74}{L^2}\sqrt{\frac{EI}{wb}} = \frac{0.74}{(22^2)}\sqrt{\frac{4{,}300{,}000\ (1730)}{60(4)}} = 8.51$ Hz

For steel beam $f_b = \frac{0.74}{L_b^2}\sqrt{\frac{E_b I_b}{w_b}} = \frac{0.74}{(20^2)}\sqrt{\frac{29{,}000{,}000\ (800)}{22\ (60) + 50}} = 7.61$ Hz

For system $\frac{1}{f_n^2} = \frac{1}{f_p^2} + \frac{1}{f_b^2} = \frac{1}{8.51^2} + \frac{1}{7.61^2} = 0.0311$ and $f_n = \sqrt{\frac{1}{0.0311}} = 5.67$ Hz

(2) For precast beam $f_b = \frac{0.74}{(20^2)}\sqrt{\frac{4{,}700{,}000\ (1650)}{20\ (60) + 542}} = 11.84$ Hz

For system $\frac{1}{f_n^2} = \frac{1}{8.51^2} + \frac{1}{11.84^2} = .0209$ and $f_n = 6.91$ Hz

Conclusion: Use results for the total system frequencies in place of simple plank frequencies in the evaluation techniques in RESEARCH NOTES 1021 and 1022.

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