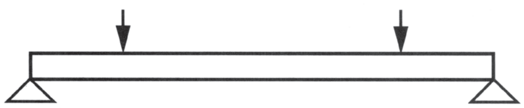
SPANCRETE MANUFACTURERS ASSOCIATION

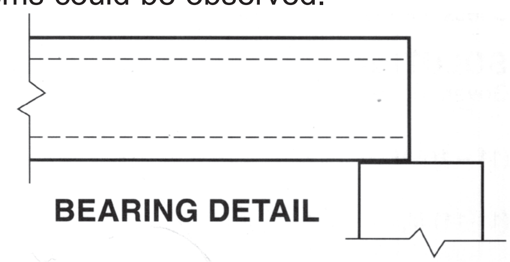
RESEARCH NOTES

SHEAR STRENGTH

Tests were conducted to investigate the applicability of the ACI equations for shear in prestressed members to Spancrete® hollowcore plank. By varying the shear span, both web shear and inclined shear failure mechanisms could be observed.



TEST ASSEMBLY



BEARING DETAIL

CONCLUSIONS:

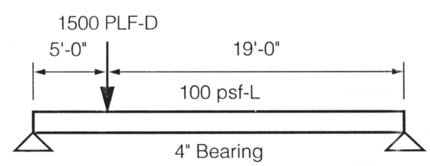
1. The ACI equations for shear in prestressed members apply to Spancrete.
2. Satisfactory performance was observed for $V_u = \varnothing V_c$ without shear reinforcing.

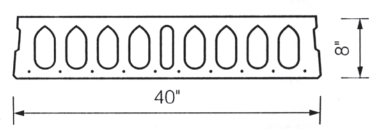
DESIGN EXAMPLE

SHEAR STRENGTH

GIVEN:

8" Spancrete reinforced with (12) 3/8" dia., 250 ksi strands; superimposed loads as shown.





bw = 17" d = 7.06" I = 1515 in^4
Y_b = 3.98" W = 64 psf f'_c = 4000 psi
(Approach similar for any other plank width)

PROBLEM:

Check the member for adequacy in shear.

SOLUTION:

Governing equations (from ACI 318-02)

(11 - 10) $V_{ci} = 0.6\sqrt{f'_c}\, b_w d + V_d + \frac{V_i M_{cr}}{M_{max}}$

(11 - 11) $M_{cr} = \frac{I}{y_b}(6\sqrt{f'_c} + f_{pe} - f_d)$

(11 - 12) $V_{cw} = (3.5\sqrt{f'_c} + 0.3 f_{pc})\, b_w d + V_p$

Investigate left 5' of span

$V_d = \frac{24}{2}(3.33)(.064) - 3.33(.064)X = 2.56 - .213X$ $\qquad M_d = 2.56X - \frac{.213X^2}{2}$

$V_i = \frac{24}{2}(3.33)\,1.6(.1) + \frac{19}{24}(3.33)\,1.2(1.5) - 1.6(3.33)(.1)X = 11.15 - .533X$ $\qquad M_{max} = 11.15X - \frac{.533X^2}{2}$

$V_u = 1.2(2.56) + 11.15 - [1.2(.213) + .533]X = 14.22 - .789X$

M_{cr} is a function of the strand transfer length $l_t = 50 d_b = 18.75"$

This design example continues on the other side.

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continued from reverse side

$A_{ps} f_{se}$ = 12(.08) 250 (.65) .8 = 124.8^K (Tensioning to 65% and assuming 20% losses.)

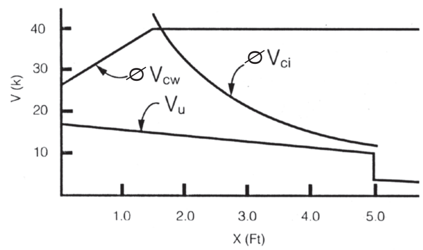
$$M_{cr} = \frac{1515}{3.98}\left[\frac{6\sqrt{4000}}{1000} + 124.8\left(\frac{1}{218} + \frac{3.04 \times 3.98}{1515}\right)\left(\frac{12X+4}{18.75}\right) - \frac{M_d\,(12)\,3.98}{1515}\right]\frac{1}{12}$$

$$= 12.04 + 49.78\left(\frac{12X+4}{18.75}\right) - M_d \text{ where } \left(\frac{12X+4}{18.75}\right) \leqq 1.0$$

$$f_{pc} = \frac{A_{ps}f_{se}}{A} = \frac{124.8}{218}\left(\frac{12X+4}{18.75}\right) \text{ where } \left(\frac{12X+4}{18.75}\right) \leqq 1.0$$

From 0 to 5', the following table can be developed by varying x and evaluating the equations.

x (ft)	V_u (k)	V_d (k)	V_i (k)	M_{max} (ft-k)	M_{cr} (ft-k)	$\varnothing V_{ci}$ (k)	$\varnothing V_{cw}$ (k)
0.33	13.96	2.49	10.97	3.68	32.34	78.2	26.5
1.00	13.43	2.35	10.62	10.88	52.06	43.3	33.1
2.00	12.64	2.13	10.08	21.23	57.13	25.4	35.4
3.00	11.85	1.92	9.55	31.05	55.10	17.6	35.4
4.00	11.06	1.71	9.02	40.34	53.28	13.6	35.4
5.00	10.28	1.50	8.49	49.09	51.68	11.2	35.4



Beyond 5', $\varnothing V_{ci}$ is the minimum per code while V_u drops drastically and therefore need not be checked for this case.

(V_{ci} min = $1.7\sqrt{f'_c}\, b_w d$)

Since $V_u < \varnothing V_c$, the section selected is adequate.

Note: Sample calculations are intended to illustrate the concept presented and do not represent all considerations necessary for the complete design. This research was done using 40" wide, 8" thick Standard Spancrete® hollowcore. However, this concept applies to all Spancrete cross sections.

MIDWEST
Hanson Structural Precast Midwest, Inc.
Maple Grove, Minnesota

Spancrete, Inc.
Green Bay, Wisconsin

Spancrete Industries, Inc.
Waukesha, Wisconsin

Spancrete of Illinois, Inc.
Arlington Heights, Illinois

Wells Concrete
Wells, Minnesota

WEST
Hanson Structural Precast Pacific, Inc.
Irwindale, California

KIE-CON
Division of Kiewit Pacific Co.
Anitoch, California

Owell Precast
Sandy, Utah

SOUTHWEST
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Schertz, Texas

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Cement Industries, Inc.
Fort Myers, Florida

Florida Precast Industries, Inc.
Sebring, Florida

EAST
Mid-Atlantic Precast, LLC.
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Mexico City, Mexico

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Preconco Limited
Barbados, West Indies

TURKEY
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Hi-Tech Concrete Products LLC
Abu Dhabi, UAE

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Armenia *Ireland*
China *Japan*
Denmark *Russia*
Guatemala *South Korea*
Hungary *Switzerland*

Spancrete® hollowcore is a registered trademark

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