SOUTH RD BRIDGE #14

JPC # 23446-014

STATE OF VERMONT
ERNEST J. BROD
No. 3814
REGISTERED
PROFESSIONAL ENGINEER

LIFTING INSERT DESIGN CALCS
(WORK W/CARRARA SHOP DWGS)

PRECAST APPROACH SLAB

$$\text{WT OF SLAB} = 16.0^{T}$$

THERE ARE (4) LIFT POINTS AND ASSUME A 60° SLING ANGLE W/THE HORIZONTAL.

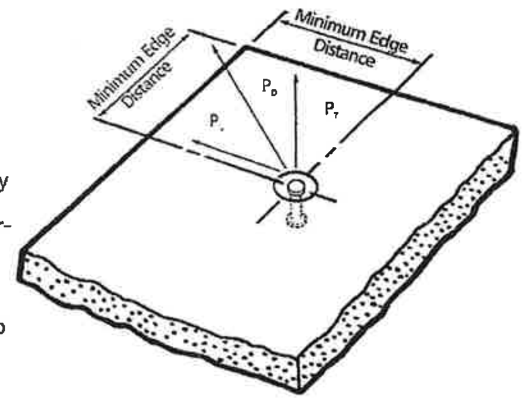
$$\text{DESIGN LOAD/INSERT} = \frac{16.0 \times 2}{4 \times 0.866} = 9.2^{k}$$

FROM ATTACHED PRODUCT LITERATURE

USE $8^{T} \times 6\frac{3}{4}''$ S.L. SWL = $11.2^{k} > 9.2^{k}$, O.K.
4:1 S.F.

P-52 Swift Lift® Anchor Tensile and Shear Capacity

When anchors are used in the face of thin concrete elements



The following table lists the P-52 Swift Lift Anchors that are currently manufactured. Other sizes and lengths are available on special order. However, the sizes and lengths of anchors shown will handle the majority of flat precast concrete elements.

When the P-52 Swift Lift Anchor is properly embedded in normal weight concrete, the tabulated working loads are applicable for any direction of load. This applies even if the direction of load is parallel to the axis of the anchor, perpendicular to it or at any other angle.

Minimum distance between anchors is twice the minimum edge distance.

It is critical to remember that in order to obtain the safe working loads listed in the table below, the normal weight concrete must have obtained the minimum concrete strength shown, prior to initial load application.

Swift Lift Anchor Ton x Length	Safe Working Load	Minimum Concrete Strength	Minimum Edge Distance
1 ton x 2-5/8"	1,700 lbs.	3,500 psi	8"
1 ton x 3-3/8"	2,000 lbs.	2,200 psi	10"
1 ton x 4-3/8"	2,000 lbs.	1,600 psi	10"
1 ton x 8"	2,000 lbs.	1,600 psi	10"
1 ton x 9-1/2"	2,000 lbs.	1,600 psi	10"
2 ton x 2-3/4"	2,100 lbs.	3,500 psi	8"
2 ton x 3-3/8"	2,900 lbs.	3,500 psi	10"
2 ton x 5-1/2"	4,000 lbs.	1,600 psi	13"
2 ton x 6"	4,000 lbs.	1,600 psi	13"
2 ton x 6-3/4"	4,000 lbs.	1,600 psi	13"
2 ton x 11"	4,000 lbs.	1,600 psi	14"
4 ton x 3-3/4"	4,000 lbs.	3,500 psi	12"
4 ton x 4-1/4"	4,900 lbs.	3,500 psi	13"
4 ton x 4-3/4"	5,800 lbs.	3,500 psi	14"
4 ton x 5-1/2"	7,400 lbs.	3,500 psi	17"
4 ton x 5-3/4"	7,900 lbs.	3,500 psi	17"
4 ton x 7-1/8"	8,000 lbs.	1,800 psi	20"
4 ton x 9-1/2"	8,000 lbs.	1,600 psi	17"
4 ton x 14"	8,000 lbs.	1,600 psi	18"
4 ton x 19"	8,000 lbs.	1,600 psi	20"
8 ton x 4-3/4"	6,400 lbs.	3,500 psi	16"
8 ton x 6-3/4"	11,200 lbs.	3,500 psi	21"
8 ton x 10"	16,000 lbs.	3,500 psi	19"
8 ton x 13-3/8"	16,000 lbs.	1,600 psi	23"
8 ton x 26-3/4"	16,000 lbs.	1,600 psi	27"
20 ton x 10"	25,000 lbs.	3,500 psi	24"
20 ton x 19-3/4"	40,000 lbs.	3,500 psi	31"

Safe Working Loads provide a factor of safety of approximately 4 to1 in normal weight concrete. Safe Working Load is based on anchor setback from face of concrete "X" dimension, as shown on page 26.

FAIRFIELD BRIDGES
JPC # 23446-014

STATE OF VERMONT ERNEST J. BROD No. 0814 PROFESSIONAL ENGINEER

LIFTING LOOP DESIGN CALCULATION

SOUTH ROAD BRIDGE

WT OF SLAB 16.76^{T}

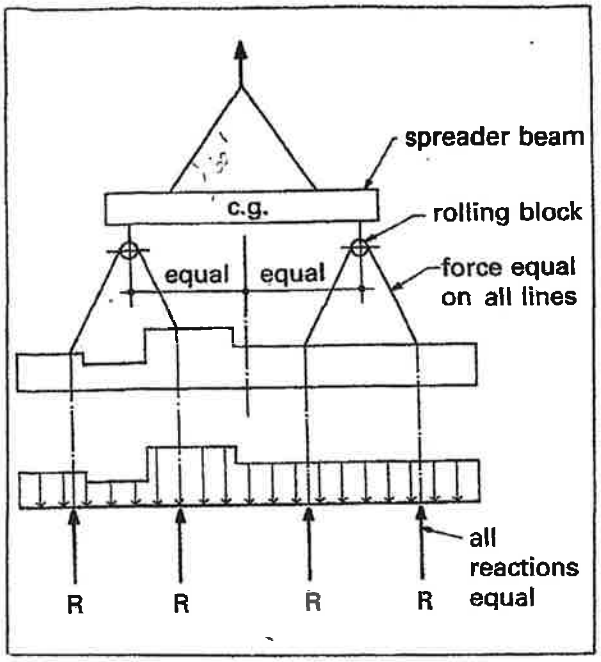
THERE ARE 4 LIFT POINT AND ASSUMING
A 60° SLING ANGLE W/ THE HORIZONTAL,
DESIGN LOAD @ EACH LIFT POINT

$$= \frac{16.76 \times 2}{4 \times 0.866} = 9.7^{K}$$

FROM ATTACHED PCI LITERATURE (BY INTERPOLATION)

USE DOUBLE ½"φ x270 KSI STRAND LIFTING LOOP,
MIN EMBEDMENT 14" W/ 12" HOOKS
SWL ≅ 16^{K} > 9.7^{K} (4:1 S.F.), O.K.

Fig. 5.2.10 Arrangement for equalizing lifting loads



lines equal. The member can then be analyzed as a beam with varying load supported by equal reactions.

The force in inclined lift lines can be determined from Fig. 5.2.7.

5.2.8 Handling devices

The most common lifting devices are prestressing strand or cable loops projecting from the concrete, threaded inserts, or special proprietary devices.

Since lifting devices are subject to dynamic loads, ductility of the material is part of the design requirement. Deformed reinforcing bars should not be used since the deformations result in stress concentrations from the shackle pin. Also, reinforcing bars are often hard-grade or re-rolled rail steel with little ductility and low impact strength at cold temperatures. Smooth bars of a known steel grade may be used if adequate embedment or mechanical anchorage is provided. The diameter must be such that localized failure will not occur by bearing on the shackle pin.

Prestressing strand is often used for lifting loops. The variables involved make it almost impossible to calculate a capacity which can be used for all situations. Generally, producers will establish standard criteria for use in handling the standard products manufactured by that plant. Table 5.2.3 is an example which has been used successfully.

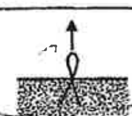
Reduced capacities for shorter embedment lengths may be suitable. In shallow products, providing a 90° bend can reduce the required embedment length significantly. Lightly rusted strand has better bond than bright strand.

The diameter of the bend of the loop should be at least 4 in. For smaller diameters, the loop capacities in Table 5.2.3 should be reduced to:

1 in. dia. — 70 %
2 in. dia. — 85 %
3 in. dia. — 90 %

The angle of incline of lifting has little effect on the strand lifting loop capacity if the angle from the horizontal is more than about 20°. Typical handling methods are usually such that this angle is no less than 60°.

Table 5.2.3 Capacity of ½ in. diameter, 270 ksi strands used as lifting loops

Lifting angle	Embedment length (in.)	Single loop (kips)	Double loop (kips)	Triple loop (kips)
45 degrees 	16	5	8.5	11.5
	22	8	13	17.5
	28	10	18	23
	34	11	23	29
Vertical 	16	7.5	12.5	16.5
	22	11.5	19	24.5
	28	15.5	25.5	33
	34	16	32.5	41

1. These values are limited by slippage rather than strand strength, with a factor of safety of 4. For other strand diameters, multiply table values by 0.75 for ⅜ in. diameter, 0.85 for 7/16 in. diameter, and 1.1 for 0.6 in.diameter.
2. Minimum f'_c = 3000 psi.
3. Multiple strand loops must be fabricated to ensure equal force on each strand.

FAIRFIELD BRIDGES
JPC # 23496-014

LIFTING LOOP DESIGN CALCULATIONS
(WORK W/CARRARA SHOP DWNGS & ATTACHED SKETCHES)

SOUTH ROAD BRIDGE #14 ABUTMENT FA-AB1 & FA-AB2

$WT = 34.54^T$

THERE ARE (2) LIFTING LOOPS AND THE MINIMUM SLING ANGLE W/ THE HORIZONTAL IS 60°

DESIGN LOAD / LIFT LOOP = $\frac{34.54 \times 2}{2 \times 0.866} = 39.9^k$

FROM ATTACHED PCI LITERATURE, PTS, 28

USE (4) 0.600"φ x 270 KSI STRANDS/LIFT LOOPS, MIN EMBED 4'-9", SWL (4:1 S.F) = $1.1 \times \frac{(29+41)}{2}$

$= 38.5^k \cong 39.9^k$, O.K. (WILL ACCEPT)

CHECK USING ATTACHED PCI LITERATURE, FIG 6.15.7A

$\phi P_{c1} = \phi\, 2.67 \sqrt{f'c}\,(x_1)(y_1)$

$= \frac{0.85 \times 2.67 \sqrt{3500}\,(36)(72)}{1000}$; 6'-0" BETWEEN 2'-0" φ HOLES

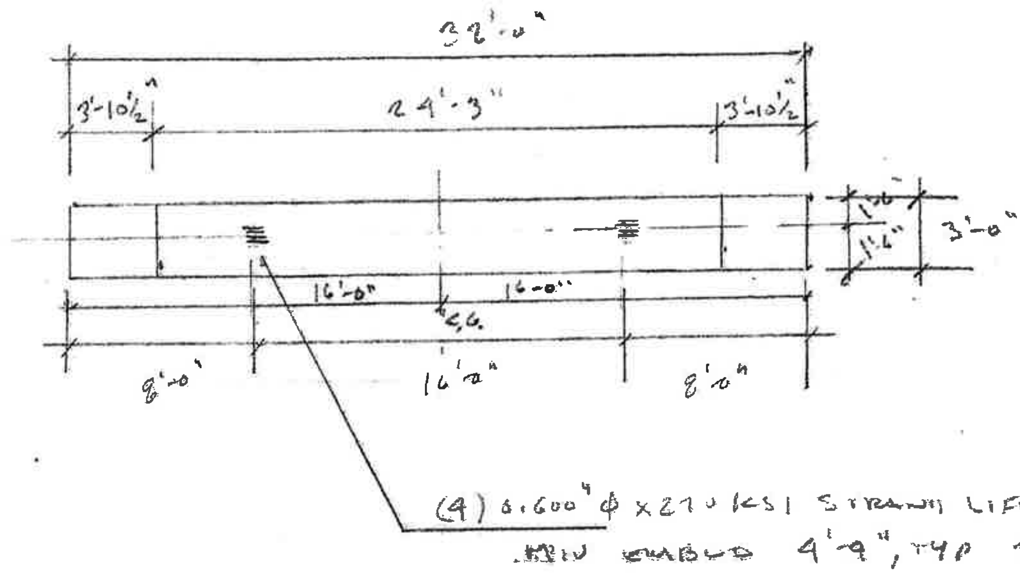
$= 348^k$

FOR 4:1 S.F.

$SWL = 348/4 = 87^k > 39.9^k$, O.K

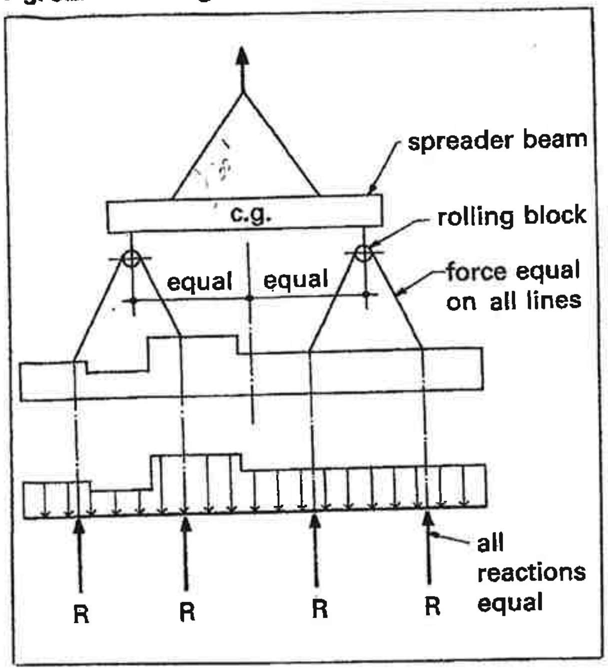
SEE SHT 6 FOR LIFT LOOP LOCATION

FA-AB1/-AB2 WT 39.54^T   PARTIAL PLAN VIEW



NOTE; LIFTING LOOP LOCATION MAY BE ADJUSTED SLIGHTLY TO FACILITATE FABRICATION

Fig. 5.2.10 Arrangement for equalizing lifting loads



lines equal. The member can then be analyzed as a beam with varying load supported by equal reactions.

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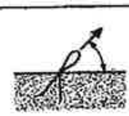
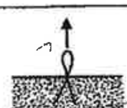
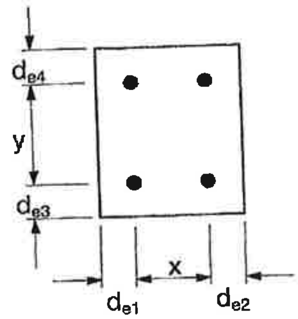
45 degrees 	16 22 28 34	5 8 10 11	8.5 13 18 23	11.5 17.5 23 29
Vertical 	16 22 28 34	7.5 11.5 15.5 16	12.5 19 25.5 32.5	16.5 24.5 33 41

1. These values are limited by slippage rather than strand strength, with a factor of safety of 4. For other strand diameters, multiply table values by 0.75 for ⅜ in. diameter, 0.85 for 7/16 in. diameter, and 1.1 for 0.6 in. diameter.
2. Minimum f'_c = 3000 psi.
3. Multiple strand loops must be fabricated to ensure equal force on each strand.

Figure 6.15.7A (continued) Design tensile strength for $h \geq h_{min}$, ϕP_{c1}—Case 6



x and y are the overall dimensions (width and length) of the stud group.

Case 6: Free edges on four adjacent sides

$\phi P_{c1} = \phi 2.67\lambda\sqrt{f'_c}\,(x_1)(y_1)$

$\phi = 0.85$

where: x_1 and y_1 are the dimensions of the flat bottom of the part of the truncated pyramid.

For Case 6: $x_1 = x + d_{e1} + d_{e2}$ $y_1 = y + d_{e3} + d_{e4}$

Note: Table values are based on $\lambda = 1.0$ and $f'_c = 5000$ psi;

for different material properties, multiply table values by $\lambda\sqrt{f'_c/5000}$

ℓ_e in.	y_1, in. \ x_1, in.	Design tensile strength, ϕP_{c1} (kips)													
		2	4	6	8	10	12	14	16	18	20	22	24	26	28
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	1	1	2	3	3	4	5	5	6	7	7	8	9	9
	4	1	3	4	5	7	8	9	10	11	13	14	15	17	18
	6	2	4	6	8	9	11	13	15	17	19	21	23	25	27
	8	3	5	8	10	13	15	18	21	23	25	29	31	33	36
	10	3	7	9	13	16	19	23	25	29	32	35	39	42	45
	12	4	8	11	15	19	23	27	31	35	39	42	46	50	54
	14	5	9	13	18	23	27	31	36	41	45	49	54	59	63
	16	5	10	15	21	25	31	36	41	46	51	35	61	67	72
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	1	1	2	3	3	4	5	5	6	7	7	8	9	9
	4	1	3	4	5	7	8	9	10	11	13	14	15	17	18
	6	2	4	6	8	9	11	13	15	17	19	21	23	25	27
	8	3	5	8	10	13	15	18	21	23	25	28	31	33	36
	10	3	7	9	13	16	19	23	25	29	32	35	39	42	45
	12	4	8	11	15	19	23	27	31	35	39	42	46	50	54
	14	5	9	13	18	23	27	31	36	41	45	49	54	59	63
	16	5	10	15	21	25	31	36	41	46	51	57	61	67	72
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	1	1	2	3	3	4	5	5	6	7	7	8	9	9
	4	1	3	4	5	7	8	9	10	11	13	14	15	17	18
	6	2	4	6	8	9	11	13	15	17	19	21	23	25	27
	8	3	5	8	10	13	15	18	21	23	25	28	31	33	36
	10	3	7	9	13	16	19	23	25	29	32	35	39	42	45
	12	4	8	11	15	19	23	27	31	35	39	42	46	50	54
	14	5	9	13	18	23	27	31	36	41	45	49	54	59	63
	16	5	10	15	21	25	31	36	41	46	51	57	61	67	72
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	1	1	2	3	3	4	5	5	6	7	7	8	9	9
	4	1	3	4	5	7	8	9	10	11	13	14	15	17	18
	6	2	4	6	8	9	11	13	15	17	19	21	23	25	27
	8	3	5	8	10	13	15	18	21	23	25	28	31	33	36
	10	3	7	9	13	16	19	23	25	29	32	35	39	42	45
	12	4	8	11	15	19	23	27	31	35	39	42	46	50	54
	14	5	9	13	18	23	27	31	36	41	45	49	54	59	63
	16	5	10	15	21	25	31	36	41	46	51	57	61	67	72