

Design Method of Lifting anchor

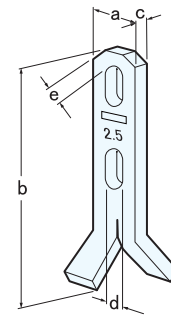
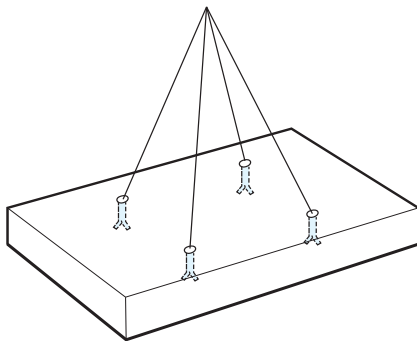
§ 1. Design overview

1-1) Use material and allowable stress

- (1) Design criteria strength of concrete
 $\sigma_{CK} = 30 \text{ (N/mm}^2\text{)}$
- (2) Allowable stress of Lifting anchor (SM490A)
 Allowable unit tensile stress for temporary loading
 $r_{ft} = 330.0 \text{ (N/mm}^2\text{)}$
 Allowable unit shear stress for temporary loading
 $r_{fs} = 190.5 \text{ (N/mm}^2\text{)}$
- (3) Impact load (for construction load)
 $z = 1.6$

1-2) Product diagram

- (1) Product name (symbol) PC-2



- (1) Calculation of head part of lifting anchor cross section area

A part cross sectional area :

$$\begin{aligned} a_{AN} &= (a-d) \times c \\ &= (30 - 14) \times 10 \\ &= 160.0 \text{ mm}^2 \end{aligned}$$

B part cross sectional area :

$$\begin{aligned} b_{AN} &= e \times c \times 2 \\ &= 9 \times 10 \times 2 \\ &= 180.0 \text{ mm}^2 \end{aligned}$$

- (2) A part of allowable tensile unit stress

$$\begin{aligned} P_{a(1)} &= a_{AN} \times r_{ft} \\ &= 160.0 \times 330.0 \\ &= 52.800 \text{ kN} > P1 = 18.560 \text{ kN} \\ &\quad (\alpha = 0.35) \text{ OK} \end{aligned}$$

- (3) B part of allowable shear unit stress

$$\begin{aligned} Q_{a(1)} &= b_{AN} \times r_{fs} \\ &= 180.0 \times 190.5 \\ &= 34.290 \text{ kN} > P1 = 18.560 \text{ kN} \\ &\quad (\alpha = 0.54) \text{ OK} \end{aligned}$$

§ 2. Consideration

2-1) Condition of considering assumption

- | | |
|---------------------------------|------------------|
| (1) Product name (symbol) | PC-2 |
| (2) Load/Product weight | W=40.000kN |
| (3) Ironware embedding surface | Horizontal plane |
| (4) Number of ironware embedded | ST = 4 parts |
| Lifting condition | Equivalent |
| Premium coefficient | SJ = 1.00 |
| Angle of wire rope (horizontal) | 89-60degree |
| Premium coefficient | SK1 = 1.16 |

2-2) Weight applied to single ironware

$$\begin{aligned} \text{〔荷重(引張力)〕 } P1 &= (W/ST) \times SJ \times SK1 \times z \\ &= (40.000/4) \times 1.00 \times 1.16 \times 1.6 \\ &= 18.560 \text{ kN} \end{aligned}$$

2-3) Consideration of head part of Lifting anchor (temporary loading)

- | | |
|-------------------------------|------------------------------------------|
| Use Lifting anchor | 2.5 series
FY 2.50ton x 200 |
| Allowable unit tensile stress | $r_{ft} = 330.0 \text{ (N/mm}^2\text{)}$ |
| Allowable unit shear stress | $r_{ft} = 190.5 \text{ (N/mm}^2\text{)}$ |
| Width of anchor | $a = 30 \text{ mm}$ |
| Length of anchor | $b = 200 \text{ mm}$ |
| Thickness of anchor | $c = 10 \text{ mm}$ |
| Width of anchor hole | $d = 14 \text{ mm}$ |
| Width of shear part of anchor | $e = 9 \text{ mm}$ |

2-4) Consideration of concrete (temporary loading)

Design criteria strength of concrete
 $\sigma_{CK} = 30 \text{ N/mm}^2$

Embedded length of lifting anchor

$$L_e = 200.0 \text{ mm}$$

Ironware embedded surface (horizontal surface)

Ironware embedded surface (left end)

$$X1 = 250.0 \text{ mm}$$

Ironware embedded surface (right end)

$$X2 = 500.0 \text{ mm}$$

Effective projected area of cone-like destruction of the concrete

$$\begin{aligned} A_{c1} &= \int [\sqrt{(L_e^2 - X^2)}] \quad \{ \text{Range } X2 \sim X1 \} \\ &= 144,513.2 \text{ mm}^2 \end{aligned}$$

$$\begin{aligned} P_{a(3)} &= 0.6 \times A_{c1} \times \sqrt{\sigma_{CK}} \times 0.313209 \\ &= 0.6 \times 144,513.2 \times \sqrt{30} \times 0.313209 \\ &= 148.748 \text{ kN} > P1 = 18.560 \text{ kN} \\ &\quad (\alpha = 0.13) \text{ OK} \end{aligned}$$