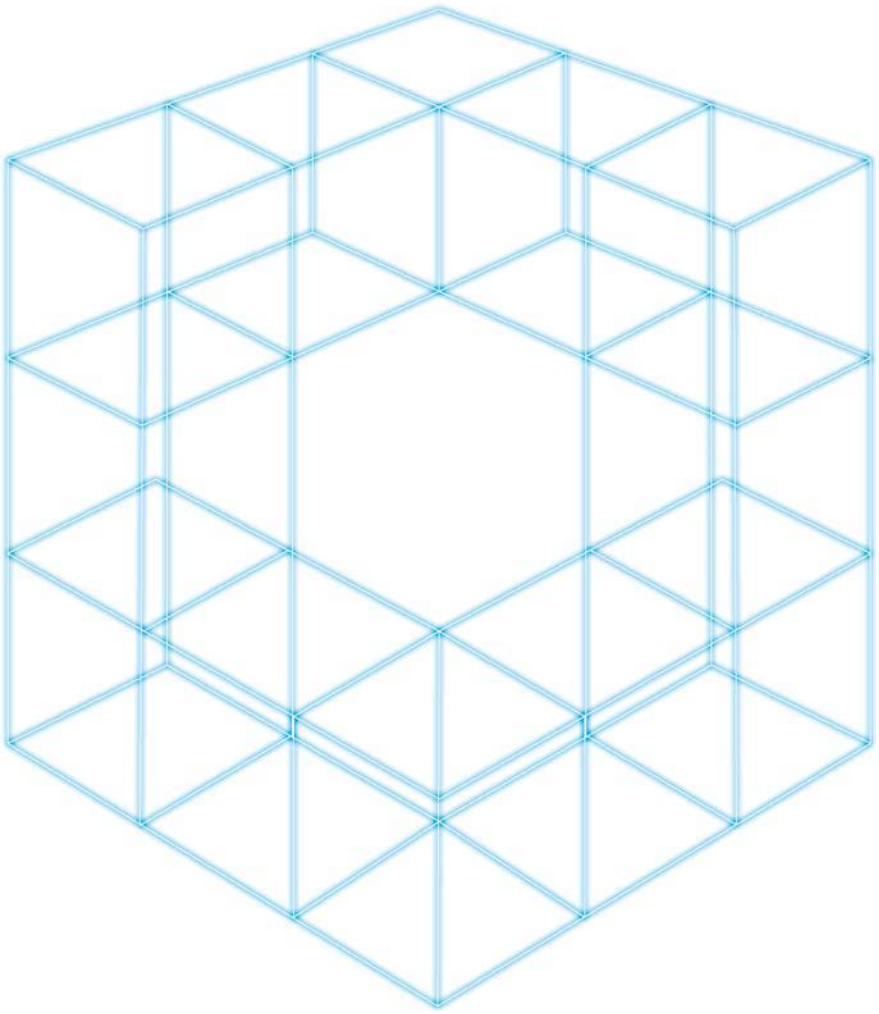
Nice Communication Nice Tomorrow

Technical Data



Japan Life Co., Ltd.
ジャパンライフ株式会社

Designing of JL bolt application

Only receiving tensile force

1. Designing of allowable stress

The allowable tensile strength of JL bolt (hereafter JL anchor bolt and JL Y inserts bolts collectivelly called "JL bolt")that fixed with concrete building frame is supposed to be calculated by (1) or (2), and either the lower result will be used.

$$p_{a1} = \phi_1 \times \sqrt{Fc} \times Ac \times 0.313209 \quad \cdots\cdots (1)$$

$$p_{a2} = \phi_2 \times {}_s\sigma_y \times {}_{sc}a_1 \quad \cdots\cdots (2)$$

p_{a1} : The allowable tensile strength(N) of JL bolt that decided by the corn shaped destruction.

p_{a2} : Allowable tensile strength (N) of JL bolt that decided by the yield point of the bolt used with JL anchor bolt or JL Y insert bolt.

$\phi_1 \cdot \phi_2$: Reduction coefficient of allowable tensile strength. Use with table 1 showing in below.

Table 1: Reduction coefficient of allowable tensile strength

	ϕ_1	ϕ_2
For long term load	0.4	2/3
For short term load	0.6	1.0

Fc : Strength of standard design for concrete(N/mm²)

Ac : This is the effective area of hirizontally projected as of the corn shaped destruction of concrete, which is calculated by showing by figure 1.
But if plural number of JL bolt that contiguitlly locate with, the effective area of horizontally projected is shown on figure 2. (mm²)
Embeded length(le) of JL bolt will be calculated as showing on figure 3.

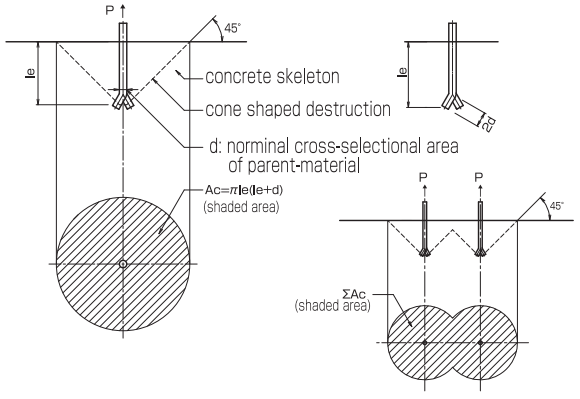
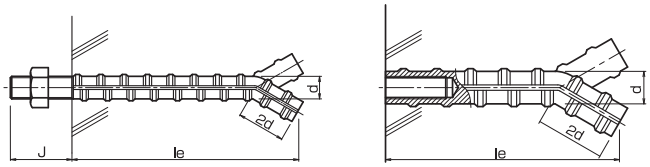


Figure1. Effective area of horizontally projected as for the corn shaped destruction.

Figure2. When the JL bolt at located by contiguitlly in Figure 1.



JL anchor bolt　　JL Y insert bolt

J : Length of projection le : Embeded length of JL bolt d : nominal diameter of parent material

Figure 3. How to calculate the length (le) of embeded JL bolt

${}_s\sigma_y$: Yield strength of steel material used for JL anchor bolt or JL Y insert bolt (Same with short-term allowable tensile stress) (N/mm²)

${}_{sc}a_1$: Effective cross sectional area of the bolt used at JL anchor bolt or JL Y insert bolt.

2. Calculation of horizontal proof stress

The tensile strength of fixed JL bolt into concrete skeleton will be the lower result of calculation either (1u) or (2u). But in case of requiring fracture toughness, it will be decided with (2u)

$$p_{u1} = \sqrt{Fc} \times Ac \times 0.313209 \quad \cdots\cdots (1u)$$

$$p_{u2} = {}_s\sigma_y \times {}_{sc}a_1 \quad \cdots\cdots (2u)$$

p_{u1} : The tensile strength(N) of JL bolt that decide by the corn shaped destruction of fixed concrete skeleton

p_{u2} : The tensile strength(N) of JL bolt that decided by the yield point of the bolt used at JL anchor bolt or JL Y insert bolt.

Fc : Please refer to (1)

Ac : Please refer to (1)

${}_s\sigma_y$: Please refer to (2)

${}_{sc}a_1$: Please refer to (2)

Commentary

1. The destructive mode that decide the allowable tensile strength of JL bolt is as shown in figure(a), there are two types. As for formula(1), ①is the factor to decide, for formula(2), ②is the factor to decide the allowable tensile strength.

Figure(a) Destructive mode

As for the calculated result of "effective cross sectional area of thread" for main JL bolts will be shown at figure 2.

2. (1) As for the formula (1u) and (2u), these are the based on formula (1) and (2) by putting "1.0" to both ϕ1 and ϕ2.
But for formula(1u), the allowable tensile strenth decided by factor of ①, for (2u), they decided by factor of ②.

(2) In order to apply the calcuration result of (2u) formula for sure, the pulling force that calculated by (1u) needed to be higher than the result of (2u) but the The embeded length of JL bolt will be decided in order to make above happen.

(3) When JL bolt installed at nallow area such as continuous footing, and if we expect fracture toughness, we will add reinforcement bars in order to do the stress transmission of JL bolt.
But the reinforcement of the axial direction of the material can be used as the flexural reinforcement of at anchorage zone of the concrete as well.

Designing of JL bolt application

Figure2 : Effective sectional area of JL anchor bolt and JL Y insert bolt.

JL anchor bolt				JLY insert bolt			
nominal name	raw material	sectional area of material A(mm²)	effective sectional area of screw An(mm²)	nominal name	raw material	sectional area of material A(mm²)	effective sectional area of screw An(mm²)
M10	D10	71.3	58.0	M10	D16	120.1	58.0
M12	D13	126.7	84.3	M12	D19	202.2	84.3
M16	D16	198.6	157.0	M16	D22 D25	230.1 349.7	157.0
M20	D19	286.5	245.0	M20	D29 D32	397.4 549.2	245.0
M22	D22	387.1	303.0	M22	D35	653.6	303.0
M24	D25	506.7	353.0	M24	D38	787.0	353.0
M27	D29	642.4	459.0	M27	D41	881.0	459.0
M30	D32	794.2	561.0	M30	D51	1466.0	561.0
W3/8	D10	71.3	49.0	W3/8	D16	149.6	49.0
W1/2	D13	126.7	87.4	W1/2	D19	199.1	87.4
W5/8	D16	198.6	143.9	W5/8	D22 D25	243.2 362.8	143.9
W3/4	D19	286.5	213.3	W3/4	D29 D32	429.1 580.9	213.3
W7/8	D22	387.1	294.7	W1	D38	753.0	387.0
W1	D25	506.7	387.0	W1 1/8	D41	852.0	487.9
W1 1/8	D29	642.4	487.9				

nominal name : Simbol of screw that showing diameter, style and pitch of the screw. (mainly the standard outer diamer of male thread will be used)

sectional area of material (A) : Using the sectional dimention(S) of steel bars for concrete inforcement specified by JIS G 3112.

effective sectional area(An) : As for sectional area of of male screw, the effective sectional area will be calculated by 「$An=(\pi/4)\times(d_2+d_3)/2)^2$」
(d_2=effective diameter), (d_3=diameter of a valley)

Effective sectional area of inserts : The area of effective section for insert will be calculated by 「iAn=A-An」
(D=diameter of valley for female thread, A=sectional area of material)

Only receiving shear

1. Design of allowable stress

Allowable stress that fixed with concrete skeleton will be calculated by (3)

$$q_a = \phi_{s2}(0.7\times {}_s\sigma_y \times {}_{sc}a_2) \quad \cdots\cdots (3)$$

q_a : Allowable shear (N) of JL bolt

ϕ_{s2} : Reduction coefficient of allowable shear 2/3 to long-term load, 1.0 to short-term load.

${}_s\sigma_y$: Please refer to (2)

${}_{sc}a_2$: Effective sectional area(mm²) at joint surface of 1. JL anchor bolt, 2. JL Y insert bolt female screw, 3. Bolt used at JL Y insert bolt

2. Calculation of horizontal proof stress

Shear strength of JL bolt that fixed to concrete skeleton will be calculated by (3u)

$$q_{au} = 0.7\times {}_s\sigma_y \times {}_{sc}a_2 \quad \cdots\cdots (3u)$$

q_{au} : Shear strength(N) of JL bolt

${}_s\sigma_y$: Please refer to (2)

${}_{sc}a_2$: Please refer to (3)

Commentary

(1) Sectional surface of bolt subject to ${}_{sc}a_2$ is as below.

(I) JL anchor bolt (*) d is diameter of material part of JL anchor bolt

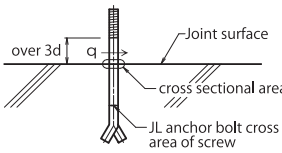
	Embeded status of JL anchor bolt	Sectional surface of bolt that subject to ${}_{sc}a_2$
①	In case of the material part of JL anchor bolt go out of joint surface for more than 3d(*)	Sectional surface of the material of JL anchor bolt
②	Other	Sectional surface of the screw part of JL anchor bolt

(II) JL Y insert bolt (*) d is diameter of material part of JL Y insert bolt

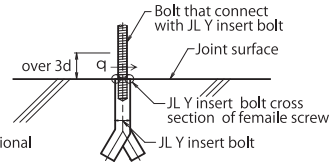
	Embeded status of JL Y insert bolt	Sectional surface of bolt that subject to ${}_{sc}a_2$
③	In case of the material part of JL Y insert bolt go out of joint surface for more than 3d(*)	Sectional surface of the material of JL Y insert bolt
④	Other	Sectional surface of the screw part of JL Y insert bolt

(2) (1) ①and②will be shown at figure(b)

(1) For ①



(1) For ③



(d: Diameter of JL anchor bolt or JLY insert bolt.
The area surrounded by ⬭ shows respective cross section.)

Figure(b) Cross section of the bolt which is the object of ${}_{sc}a_2$

When receiveing tensile force and shear at a same time

When the JL bolt fixed with concrete structure will receive tensile force and shear at a same time, allowable stress design need to satifies below (4) formula

$$\left(\frac{p}{p_a}\right)^2+\left(\frac{q}{q_a}\right)^2 \leqq 1 \quad \cdots\cdots (4)$$

p : Pulling force (N)

q : Shear force (N)

p_a : Allowable pulling force(kg) decide by article 4.

q_a : Please refer to (3)

Commentary

(1) When calculate the held holizontal strength that receiving pulling force and shear force at a same time, will be consider the stress state of JL bolt that fixed to concrete structure.

Covering depth and embeded length

1. Embeded length of JL bolt (le)

JL anchor bolt le ≧ 5d

JL Y insert bolt le ≧ 50mm

2. Covering depth of JL bolt

Covering depth of JL bolt supposed to be more than 30mm. (At the area of the concrete surface touching with earth will be more than 40mm)

But, as for the designing of fixing area of JL bolt, it is required to consider the edge distance from the bolt.

Commentary

(1) When the edge distance of JL bolt is short, the designing of fixed area will be below.

(i) Calculation of allowable pulling force and allowable strength Calculate by replacing "Ac" of the Formula (1) or formula (1u) with "${}_N$Ac1"

(ii) Calculation of allowable shear force and shear stress.

a. Allowable shear force will be lower figure of that

calculation result of formula (1), but replacing "Ac" with "$_N$Ac2"(refer to figure (d)), and that the calculation result of formula (3).

b. Shear stress will be lower figure of that calculation result of formula (1u), but replacing "Ac" with "$_N$Ac2" (refer to figure (d)), and that the calculation result of formula (3u). When it require toughness, it supposed to be decided by (3u)

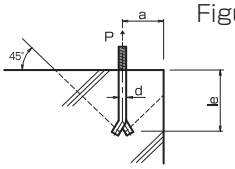


Figure (c): Effective horizontal projected area that influenced by edge stance. (When receiving tensile force)

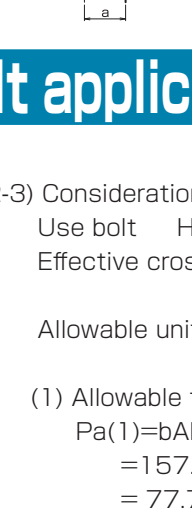


Figure (d): Effective horizontal projected area that influenced by edge distance. (When receiving shear force)

Calculation Method of JL bolt application

§ 1. Design overview

1-1) Use material and allowable stress

(1) Design criteria strength of concrete
σCK=30(N/mm²)

(2) Allowable stress of insert (SD295A)

Allowable unit tensile stress for temporary loading
ift = 295.0 (N/mm²)

Allowable unit shear stress for temporary loading
ifs = 170.3(N/mm²)

(3) Allowable stress of bolt (High tension bolt10.9)

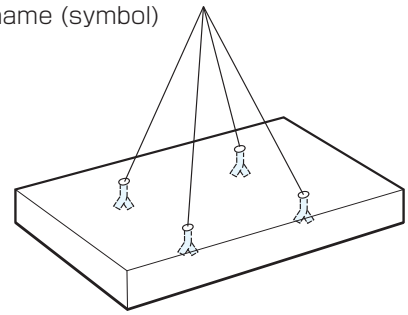
Allowable unit tensile stress for temporary loading
bft = 495.0(N/mm²)

Allowable unit shear stress for temporary loading
bfs = 240.5(N/mm²)

(4) Impact load (for construction load)
z = 1.6

1-2) Product diagram

(1) Product name (symbol) PC-1



§ 2. Consideration

2-1) Condition of considering assumption

(1) Product name (symbol)	PC-1
(2) Load/Product weight	W=20.000kN
(3) Ironware embedding surface	Horizontal plane
(4) Number of ironware embeded	ST = 4 parts
Lifting condition	Equivalent
Premium coefficient	SJ = 1.00
Angle of wire rope (horizontal)	89-60degree
Premium coefficient	SJ = 1.16

2-2) Weight applied to single ironware

〔Load(tensile strength)〕 P = (W/ST) x SJ x SK1 x z
=(20.000 / 4) x1.00 x1.16 x 1.6
=9.280kN

2-3) Consideration of mounting bolt (temporary loading)

Use bolt High tension bolt 10.9 M16

Effective cross section area of screw part
bAN=157.0/mm²

Allowable unit shear stress
bfs=240.5(N/mm²)

(1) Allowable tensile stress

Pa(1)=bAN x bft
=157.0 x 495.0
= 77.715kN > P=9.280kN (α =0.12) OK

(2) Allowable shear stress

Qa(1)=bAN x bft
=157.0 x 240.5
=37.758kN > Q=0.000kN

2-4) Consideration of insert (temporary loading)

Use insert JL Y insert
D25 x 125 (M16)

Effective cross section area of screw part
iAN=506.7-157.0

Allowable unit tensile stress
ift=295.0(N/mm²)

Allowable unit shear stress
ifs=170.3(N/mm²)

(1) Allowable tensile stress

Pa(2)=iAN x ift
=349.7 x 295.0
=77.715kN > P=9.280kN (α =0.12) OK

(2) Allowable shear stress

Qa(2)=iAN x ifs
=349.7 x 170.3
=59.553kN > Q=0.000kN

2-5) Consideration of concrete (temporary loading)

Design criteria strength of concrete σCK=30(N/mm²)
Embeded depth of insert Le = 125.0mm
Ironware embeded place (left end) X1 = 250.0mm
Ironware embeded place (right end) X2 = 500.0mm
Effective projected area of cone-like destruction of the concrete Ac

$Ac1 = \int [\sqrt{(Le^{-2} - X^{-2})}]$ { Range X2 ~ X1}
=58,904.8mm²

$Pa(3) = 0.6 \times AC(1) \times \sqrt{\sigma ck} \times 0.313209$
$= 0.6 \times 58{,}904.8 \times \sqrt{30} \times 0.313209$
=60.631kN > P=9.280kN
(α =0.15) OK

Design Method of Lifting anchor

§ 1. Design overview

1-1) Use material and allowable stress

(1) Design criteria strength of concrete

σ CK=30(N/mm²)

(2) Allowable stress of Lifting anchor (SM490A)

Allowable unit tensile stress for temporary loading

rft = 330.0 (N/mm²)

Allowable unit shear stress for temporary loading

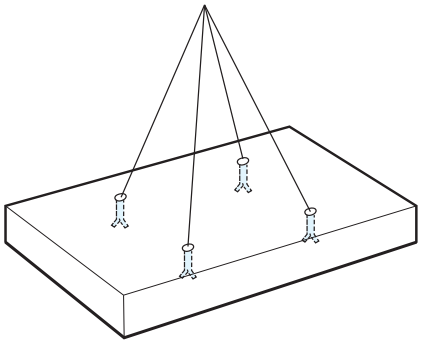
rfs = 190.5(N/mm²)

(3) Impact load (for construction load)

z = 1.6

1-2) Product diagram

(1) Product name (symbol) PC-2



§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 embeded	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

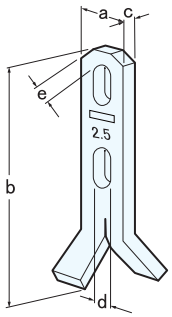
〔荷重(引張力)〕 P1=(W/ST)×SJ×SK1×z

=(40.000/4)×1.00×1.16×1.6

=18.560kN

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	rft=330.0 (N/mm²)
Allowable unit shear stress	rft=190.5 (N/mm²)
Width of anchor	a = 30mm
Length of anchor	b = 200mm
Thickness of anchor	c = 10mm
Width of anchor hole	d = 14mm
Width of shear part of anchor	e = 9mm



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

A part cross sectional area :

aAN = (a-d) x c

= (30 - 14) x 10

= 160.0mm²

B part cross sectional area :

bAN = e x c x 2

= 9 x 10 x 2

= 180.0mm²

(2) A part of allowable tensile unit stress

Pa(1) = aAN x rft

= 160.0 x 330.0

= 52.800kN >P1 = 18.560kN

(α =0.35) OK

(3) B part of allowable shear unit stress

Qa(1) = bAN x rfs

= 180.0 x 190.5

= 34.290kN > P1 =18.560kN

(α =0.54) OK

2-4) Consideration of concrete (temporary loading)

Design criteria strength of concrete

σCK=30N/mm²

Embeded length of lifting anchor

Le = 200.0mm

Ironware embeded surface(horizontal surface)

Ironware embeded surface(left end)

X1 = 250.0mm

Ironware embeded surface(right end)

X2 = 500.0mm

Effective projected area of cone-like destruction of the concrete Ac

$Ac1 = \int [\sqrt{(Le^2 - X^2)}]$ {Range X2 ~ X1}

=144,513.2mm²

$Pa(3) = 0.6 \times AC(1) \times \sqrt{\sigma ck} \times 0.313209$

$=0.6 \times 144{,}513.2 \times \sqrt{30} \times 0.313209$

=148.748kN > P1=18.560kN

(α =0.13) OK

Japan Life Co., Ltd.
ジャパンライフ株式会社
http://www.japanlife.co.jp