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	D24	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	243.2 562.8	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 $\lceil An=(\pi/4)\times(d_2+d_3)/2)^2\rfloor$ (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 $\lceil iAn=A-An\rfloor$ (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)
   $$q_a = \phi_{s2}(0.7\times_s\sigma_y\times_{sc}a_2) \cdots\cdots (3)$$
   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)
   $$q_{au} = 0.7\times_s\sigma_y\times_{sc}a_2 \cdots\cdots (3u)$$
   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
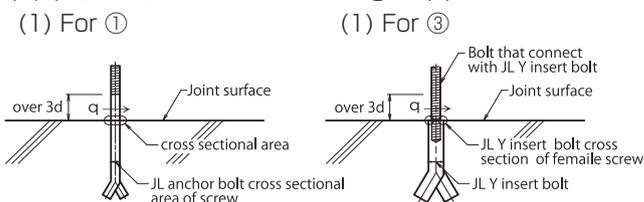
(d: Diameter of JL anchor bolt or JLY insert bolt. The area surrounded by ◯ shows respective cross section.)
Figure(b) Cross section of the bolt which is the object of $_{sc}a_2$

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

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

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 "NAc1"
   (ii) Calculation of allowable shear force and shear stress.
   a. Allowable shear force will be lower figure of that