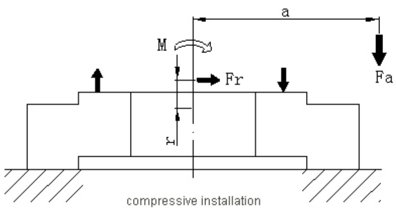
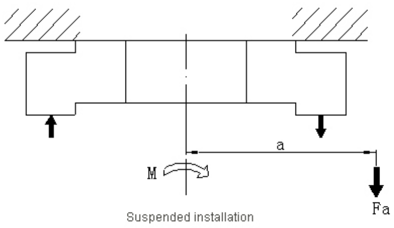
Selection Calculation

Ⅰ. Supporting Load of Slewing Ring

During the use of slewing ring, it is usually endure axial force, radial force and overturning moment together. For different application situation, due to the vary of working manner and structure form, the fuction combined condition also different of the above three loads. Sometimes may be the combination of two loads, sometimes may be only one load. Generally speaking, installation of slewing ring have two kinds of mode: compressive installation and suspended installation. The load of the bearing of this two kinds of installation see as follows:



compressive installation



Suspended installation

If the slewing ring is compressive installation, the customer could select and calculate as follows; if the slewing ring is suspended installation, please contact our Engineering Department for assistance.

1. Selection of Structure

Common structure of slewing ring have four kinds: single row ball slewing ring, cross-roller slewing ring, double-row different diameter ball slewing ring, three-row roller slewing ring.

Based our experience and calculation, we have follow conclution:

·Do ≤2000, single row ball slewing ring first; Do＞2000,three-row roller slewing ring first.

·For the slewing ring have the same figure size, the load capacity of single row ball slewing ring is more than the cross roller and double-row different diameter slewing ring.

·Single row ball slewing ring of Q-series have higher compact structure, less weight and more economically. They are the first chose of single row ball slewing ring.

2. Select Product Type by Calculation

(1) Calculation of single-row ball slewing ring

① Calculation of rated static capacity

Co = 0.6×Do×do0.5

Co —— kN Rated static capacity

Do —— mm Diameter of track center

Do —— mm Diameter of ball

② Equivalent load calculation according outside compound load

Cp = Fa + 4370M/Do + 3.44Fr

Cp—— kN Equivalent axial load

M —— kN·m Overturning moment

Fa —— kN Axial force

Fr —— kN Radial force

③ Safety factor

fs = Co / Cp≥fo

fo See the following table

(2) Calculation of 3-row roller slewing ring

① Calculation of rated static capacity

Co= 0.534×Do×do0.75

Co—— kN Rated static capacity

Do—— mm Diameter of track center

Do —— mm Upper row roller diameter

② Equivalent load calculation according outside compound load

Cp = Fa + 4500M/Do

Cp—— kN Equivalent axial load

M —— kN•m Overturning moment

Fa —— kN Axial force

③ Safety factor

fs = Co / Cp≥fo

fo See the following table

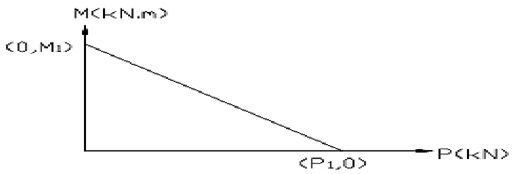
Safety Factor of Slewing Ring fo

Working condition	Characteristic	Example	f_0
Light duty	Not often full load, smooth slewing, small impact	Stacker, truck cranes, non-port wheeled cranes	1.00~1.15
Middle duty	Not often full load,slewing quickly, impact	Tower cranes, marine cranes,crawler cranes	1.15~1.30
Heavy duty	Often full load,heavy impact	Clamshell grabbing cranes,harbour cranes,single bucket excavator,container cranes	1.30~1.45
Extermely heavy duty	Full load,heavy impact or working condition badly	Bucker wheel excavators,tunnelling machines, metallurgical cranes,offshore work platform cranes	1.45~1.70

3. Select Product Type Use Static Load Curve

① Static load curve show the maximum load of slewing ring when in the static state. Each type of the slewing ring in this specimen has a corresponding load capacity curve. Load capacity curve can help customer to

make an elementary chose of slewing ring. Draw the static load curve. Customer draw the static load curve based on the type which wanted to be selected. See as follows:



P1=Co

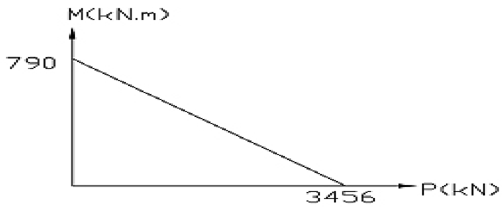
M1=Co*Do/4370 (　M1=Co*Do/4500)

②The point which total axial force Fa and total overturning moment M multiply the safety factor respectively should located below the static load curve.

③ Example:Draw the static load curve of QUA1000.32　　　P1=Co=0.108*1000*32=3456kN

M1=Co * Do/4370=3456*1000/4370=790 kN•m

Static load curve see as following:



4、Technical Parameter of Slewing Ring Selection After making an elementary chose of slewing ring, customer could confirm the selecting result together with our Engineering Department or provide some informations about slewing ring to our company. When the selection is made by our company, please filling Technical References Concerned for Selection of Slewing Ring in detail, so as to provide you economical and suitable selection of the slewing ring as soon as we can.

<table>
<tr><td colspan="4">Technical References Concerned for Selection of Slewing Ring</td></tr>
<tr><td colspan="2">Name of company：
Contact person：
Telephone：</td><td colspan="2">Address：
Department：
Fax：</td></tr>
<tr><td>Using condition (Model of Main Machine)</td><td colspan="3">Installing type (Compression or suspension)</td></tr>
<tr><td>Requirement of gear shape:
(inner teeth,outer teeth,no teeth or no restrict)</td><td colspan="2">Application character
Only positioning
Intermittent rotation
Continuous rotation</td><td>Revolution per minute
Normal
Maximum</td></tr>
<tr><td colspan="4">Value of Load</td></tr>
<tr><td>Type of Load</td><td>Maximum Working Load</td><td>Maximum Testing Load</td><td>Destroy Load</td></tr>
<tr><td>Axial Load (kN)</td><td></td><td></td><td></td></tr>
</table>

Radial Load (kN)			
Overturning Moment(kNm)			

Load driving torque:Normal ______Maximum______No. of Drive Pinion:

Special requirement:special situation,temperature,fit size,figure size limit etc.

Deatailed load condition	Axial load (kN)	Radial load (kN)	Overturning moment (kNm)	Revolution per minute (rpm)	Working time (%)
1)					
2)					
3)					
4)					
。。。					
					100%

Continue working condition
Life:Under the mean speed of __rpm,work at least _hours

Intermittent working condition
Required life:Under angular of +/- ___degree,work at least___hours

Please fill this table thoroughly so as to provide you economical and suitable selection of the slewing ring as soon as we can.
Signature : Date :

Appendix:Confirmation of the Load Outside the Slewing Ring When selecting the slewing ring, customer first to confirm the outside load of the slewing ring. The outside load of single row ball slewing ring is the total load after combination which include:

a.overturning moment M, N•mm

b.total axial force Fa, N

c.total radial force Fr of the fuctional surface of total overturning moment M When the outside mechanical force composing the outside load, customer should put working condition factor K into consideration which based on the working type of the machine. The following are examples of crane and excavator which explain the confirmation of outside load.(The listed calculational position not always represent the abominable condition of working condition, customer should calculate according to the maximum working condition.

1. Crane(see figure 1)

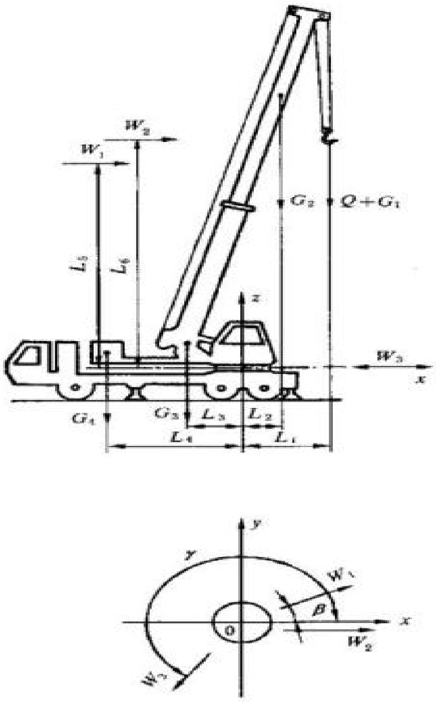


Figure 1：Crane Calculation

$$Fa = [K \cdot (Q + G_1) + G_2 + G_3 + G_4] \cdot g$$

$$M = [K \cdot (Q + G_1) \cdot L_1 + G_2 \cdot L_2 - G_3 \cdot L_3 - G_4 \cdot L_4] \cdot g + W_1 \cdot L_5 \cdot \cos\beta + W_2 L_6$$

$$Fr = W_1 \cdot \cos\beta + W_2 + W_3 \cdot \cos\gamma$$

Q — Maximum rated lifting weight under this working condition, kg;

G1—Weight of hoist tool

G2— Weight of amplitude part

G3— Weight of turntable

G4— Balance weight

W1— Horizontal force of inertia, N；

W2— Wind force, N；

W3 — Meshing force of gear, N；

L1— Working amplitude, mm；

L2— Horizontal distance from gravity of amplitude part G2 to slewing center, mm；

L3— Horizontal distance from gravity of turntable G3 to slewing center, mm；

L4 — Horizontal distance from gravity center of balance weight to slewing center, mm；

L5 — Vertical distance from point of horizontal force of inertia W1 to slewing ring, mm;

L6— Vertical distance from point of wind force W2 to slewing ring, mm；

g — Gravity accleration, g≈9.8m/s2；

β — Angle between horizontal force of inertia W1 and M surface,（°）

γ — Angle between meshing force of gear W3 and M surface, （°）

K — Working condition factor, decide by table 1.

2. Excavator(see figure 2)

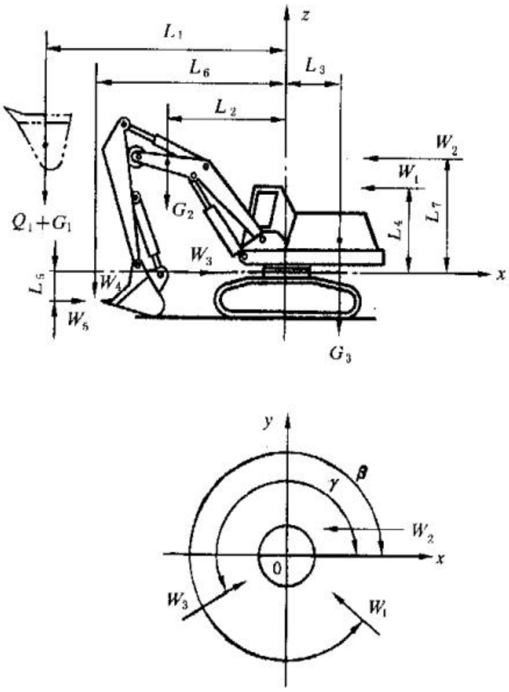


Figure 2：Excavator Calculation

2.1 Full Bucket Revolution Condition

$$Fa=[K\cdot(Q+G_1)+G_2+G_3]\cdot g$$

$$M=[K\cdot(Q+G_1)\cdot L_1+G_2\cdot L_2-G_3\cdot L_3]\cdot g+W_1\cdot L_4\cos\beta+W_2\cdot L_7$$

$$Fr=W_1\cdot\cos\beta+W_2+W_3\cdot\cos\gamma$$

2.2 Excavate Condition

$$Fa=K\cdot W_4+[K\cdot(Q+G_1)+G_2+G_3]\cdot g$$

$$M=K\cdot W_4\cdot L_6+[K\cdot(Q+G_1)\cdot L_1+G_2\cdot L_2-G_3\cdot L_3]\cdot g+K\cdot W_5\cdot L_5+W_2\cdot L_7$$

$$Fr=W_2+W_3\cdot\cos\gamma-W_5$$

2.1 Full Bucket Revolution Condition

$$Fa=[K\cdot(Q+G_1)+G_2+G_3]\cdot g$$

$$M=[K\cdot(Q+G_1)\cdot L_1+G_2\cdot L_2-G_3\cdot L_3]\cdot g+W_1\cdot L_4\cos\beta+W_2\cdot L_7$$

$$Fr=W_1\cdot\cos\beta+W_2+W_3\cdot\cos\gamma$$

2.2 Excavate Condition

$$Fa=K\cdot W_4+[K\cdot(Q+G_1)+G_2+G_3]\cdot g$$

$$M=K\cdot W_4\cdot L_6+[K\cdot(Q+G_1)\cdot L_1+G_2\cdot L_2-G_3\cdot L_3]\cdot g+K\cdot W_5\cdot L_5+W_2\cdot L_7$$

$$Fr=W_2+W_3\cdot\cos\gamma-W_5$$

Q - Material mass in full bucket condition, kg ;

G1 - Bucket weight, kg ;

G2 - Weight of amplitude part, kg ;

G3 —Weight of non-amplitude part of turntable, kg ;

W1—Horizontal force of inertia in revolution condition, N ;

W2—Wind force, N ;

W3—Meshing force of gear, N ;

W4— Vertical excavate force, N ;

W5—Horizontal excavate force, N ;

L1 — Horizontal distance from gravity of bucket and material to slewing center, mm ;

L2 — Horizontal distance from gravity of amplitude part G2 to slewing center, mm ;

L3 — Horizontal distance from gravity of non-amplitude part of turntable G3 slewing center, mm

L4 — Vertical distance from horizontal force of inertia in revolution W1 to slewing ring, mm ;

L5 — Vertical distance from horizontal excavate force W5 to slewing ring, mm ;

L6 — Horizontal distance from vertical excavate force W4 to slewing center, mm ;

L7 — Vertical distance from point of wind force W2 to slewing ring, mm ;

β — Angle between horizontal force of inertia W2 and M surface, (°)

γ — Angle between meshing force of gear W3 and M surface, (°)

K — Working condition factor, decide by table 1.

Table 1 working condition factor K

Working condition	Example	K
Light duty	Stocker,truck cranes,non-port wheeled cranes.	1.10~1.25
Middle duty	Tower cranes,marine crane,scrawler cranes.	1.20~1.35
Heavy duty	Clamshell grabbing cranes,harbour cranes,container cranes.	1.30~1.50
	Single bucket excavator,dredger,offshore work platform cranes.	1.40~1.70
Extermely heavy duty	Bucker wheel excavators,tunnelling machines,metallurgical cranes.	1.60~2.00