2.2 Precaution of usage for Bevel gear

① To obtain ideal engagement of the Bevel gears, the correct shaft angle and proper backlash is necessary when assembling.

② For Bevel gear, it is important to note method of installation. Bearing for the shaft for Bevel gear is mainly on one side. Therefore shaft becomes defective due to deflection when load is applied. Single contact occurs and results in overhung condition.
The design of gear axes and bearings should be firm and provide bearing as close as possible to Bevel gear.
During assembly, shift the non-fixed Bevel gear up and down in axis direction to obtain proper tooth bearing. It is recommended to put shim at area of base surface for adjustment of tooth bearing.

③ We recommend that Machined straight bevel gears are suitable for circumferential speed (pitch diameter) less than 328m/min and Machined spiral bevel gears are suitable for circumferential speed (pitch diameter) more than 328m/min. The above-mentioned statement does not apply to Injection molded type of Bevel gears.
The Gleason Company in USA recommend that Machined spiral bevel gears are suitable for circumferential speed (pitch diameter) more than 5.5 m/s and above 1,000 revolution per minute and Ground spiral bevel gear are suitable for circumferential speed (pitch diameter) more than 40 m/s.

④ Spiral bevel gears are able to run smoothly in high speed environment providing a quiet operation due to fewer Number of teeth contacting with mated gear and wide Number of teeth on Pitch cone as compared to Straight bevel gear.
Spiral bevel gear has overlapping engagement on Pitch cone surface element between tooth to tooth and the load does not concentrate on one (1) Tooth tip. The advantages are extremely steady and compact design for usage at high speed.
The only disadvantage is axial thrust load, which is generated due to Spiral tooth trace. Therefore proper design of the bearing location with firm support is needed to be as close to the Spiral bevel gear as possible in order to minimize this Axial thrust load. (Refer to Fig. 3)

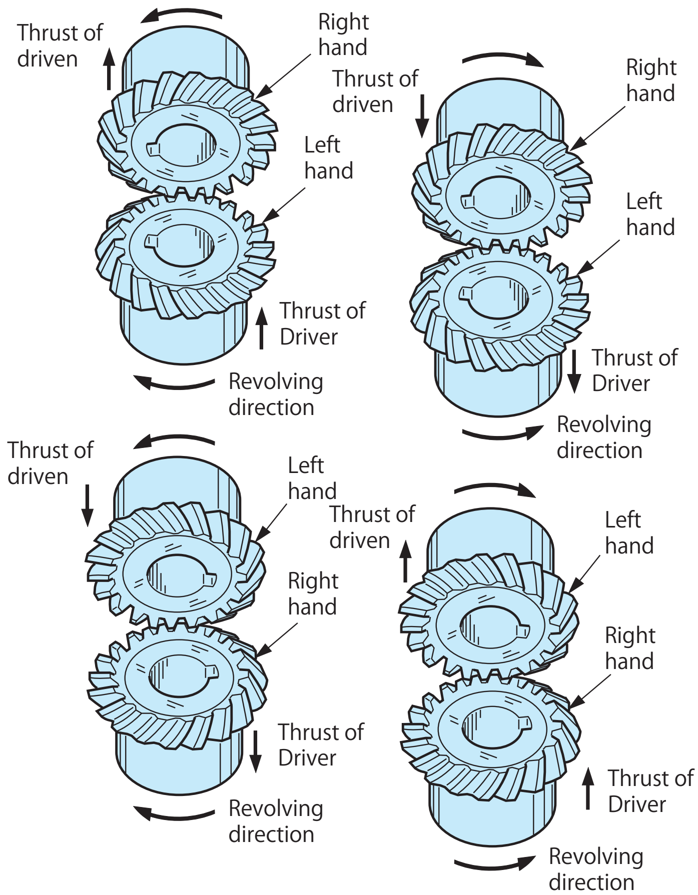

Fig. 3 Thrust load on Spiral bevel gear

⑤ The load applied to Straight bevel gear (Refer to Fig. 4)

(a) Tangential load

$$F = \frac{1.432H \times 10^6}{d_m n} \text{ (kgf)}$$

Hereby

H : Transfer power (PS)

n : Revolution per minute (rpm)

d_m : Mean pitch diameter (mm)

(b) Thrust in Axial direction

$$F_\alpha = F \tan\alpha \sin\delta \text{ (kgf)}$$

Hereby

α : Pressure angle

δ : Pitch angle

(c) Calculation for load to displace the axis

$$F_s = F \tan\alpha \cos\delta \text{ (kgf)}$$

(d)Normal load

$$F_n = \frac{F}{\cos\alpha} \text{ (kgf)}$$

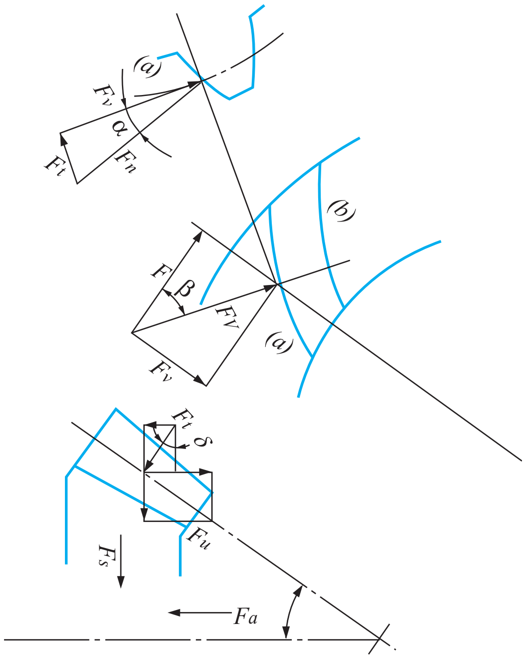

Fig. 5

⑥ The load applied to Spiral bevel gear. (Refer to Fig. 5)

(a)Tangential load

$$F = \frac{1.432H \times 10^6}{d_m n}$$

Hereby

H : Transfer power (PS)

n : Revolution per minute (rpm)

d_m : Mean pitch diameter (mm)

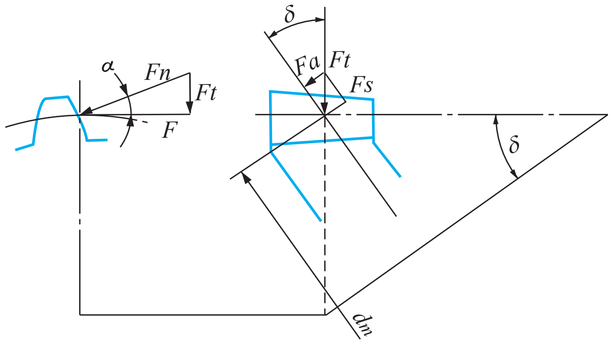

Fig. 4

(b) When convex side is driver

(b.1) Thrust in axial direction

Driving gear

$$F_a = F\left\{\tan\alpha\left(\frac{\sin\delta}{\cos\beta}\right) - \tan\beta\cos\delta\right\} \cdot 9.80665\,[\text{N}]$$

Driven gear

$$F_a = F\left\{\tan\alpha\left(\frac{\sin\delta}{\cos\beta}\right) + \tan\beta\cos\delta\right\} \cdot 9.80665\,[\text{N}]$$

Hereby

α :Pressure angle

δ :Pitch angle

β : Spiral angle

Refer to Fig. 5, when the condition is $F_a>0$, axial thrust direction is away from the top. The condition is $F_a<0$, axis thrust direction is towards the top.

Generally, pinion has smaller pitch angle δ due to $F_a<0$. Stable design to convex side is necessary.

(b.2) Calculation for load to displace the axis

$$F_s = F\left\{\tan\alpha\left(\frac{\cos\delta}{\cos\beta}\right) + \tan\beta\sin\delta\right\} \text{ (kgf)} \cdot 9.80665\,[\text{N}]$$

(b.3) Normal load

$$F_n = \frac{F}{\cos\beta\cos\alpha}$$

(c) When concave side is driver.

When the load is applied to flank, F_u direction is opposite from drawing,

(c.1) Thrust to axial direction (direction away from the top)

Driving gear

$$F_a = F\left\{\tan\alpha\left(\frac{\sin\delta}{\cos\beta}\right) + \tan\beta\cos\delta\right\} \cdot 9.80665\,[\text{N}]$$

Driven gear

$$F_a = F\left\{\tan\alpha\left(\frac{\sin\delta}{\cos\beta}\right) - \tan\beta\cos\delta\right\} \cdot 9.80665\,[\text{N}]$$

(c.2) Calculation for load to displace the axis

$$F_s = F\left\{\tan\alpha\left(\frac{\cos\delta}{\cos\beta}\right) - \tan\beta\sin\delta\right\} \cdot 9.80665\,[\text{N}]$$