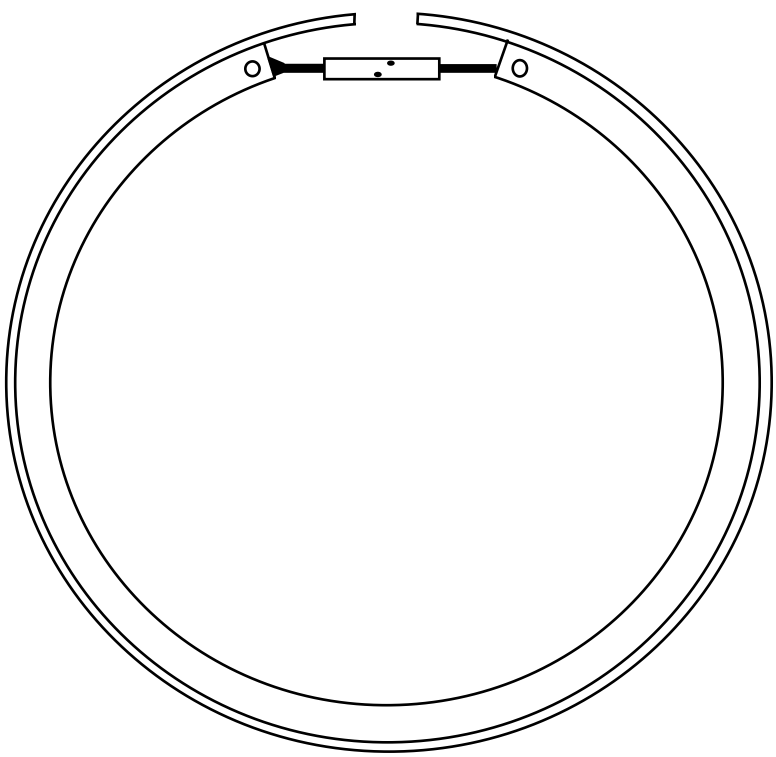
Manhole Riser Specifications

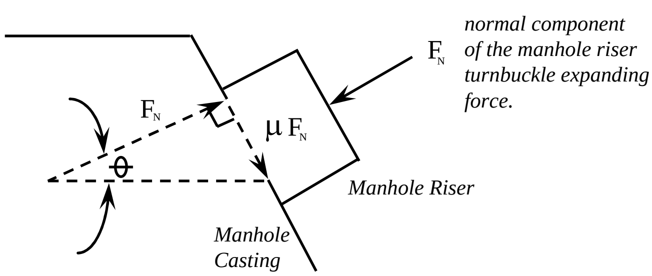


To provide a reliable manhole riser installation you must obtain full circumferential engagement. To achieve this, a pivoted expanding device is necessary. Engineering principals that show why this method of expansion must be used are enclosed.

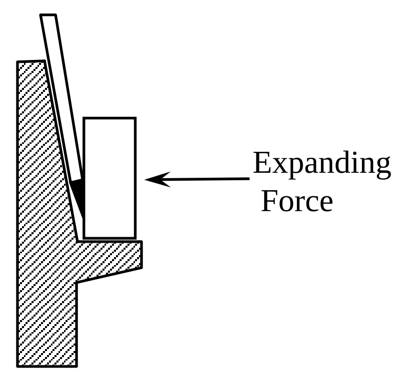
<u>**Manhole riser limits with expanding feature**</u>

<u>*Free Body Diagram*</u>

Showing the reaction forces of the manhole casting and the manhole riser at one point.



<u>*Cross Section of Manhole Riser in Manhole Casting*</u>



Coefficient of friction of steel against steel is .2

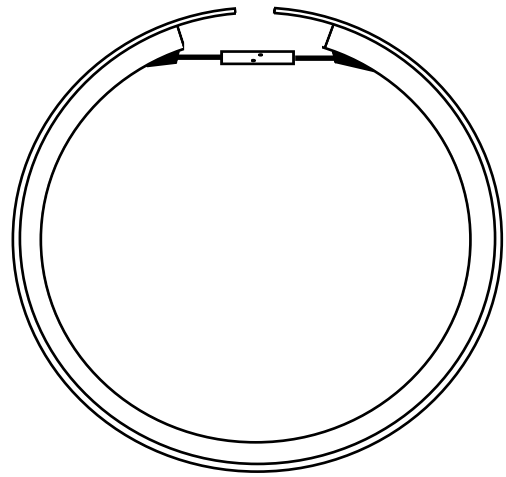
$$\tan\theta = \mu F_N / F_N$$

$$\tan\theta = .2$$

$$\theta = 11.3^{\circ}$$

Theoretical Maximum slope to accommodate expanding riser is 11.3 degrees, with a 8 degree maximum slope which is 1/8 inch, per 1 inch slope. Theoretically, anything above 11 degrees would allow riser to slide up the slope as it is expanded. Thus, an unreliable installation.

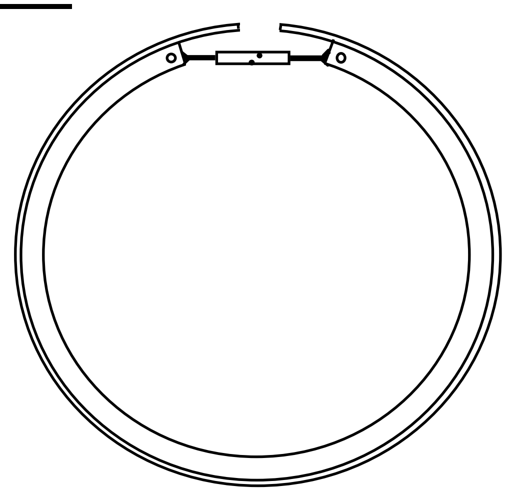
Welded Expanding Mechanisms:



Welded Expanding Mechanisms produce built in moments at each end. With the expanding mechanism welded to the bar to be expanded, three events or their combinations can occur.

1. Expanding device bends.
2. Welded ends of expanding device break.
3. Bar bends inward away from manhole casting at welded joint taking away the full circumferential engagement.

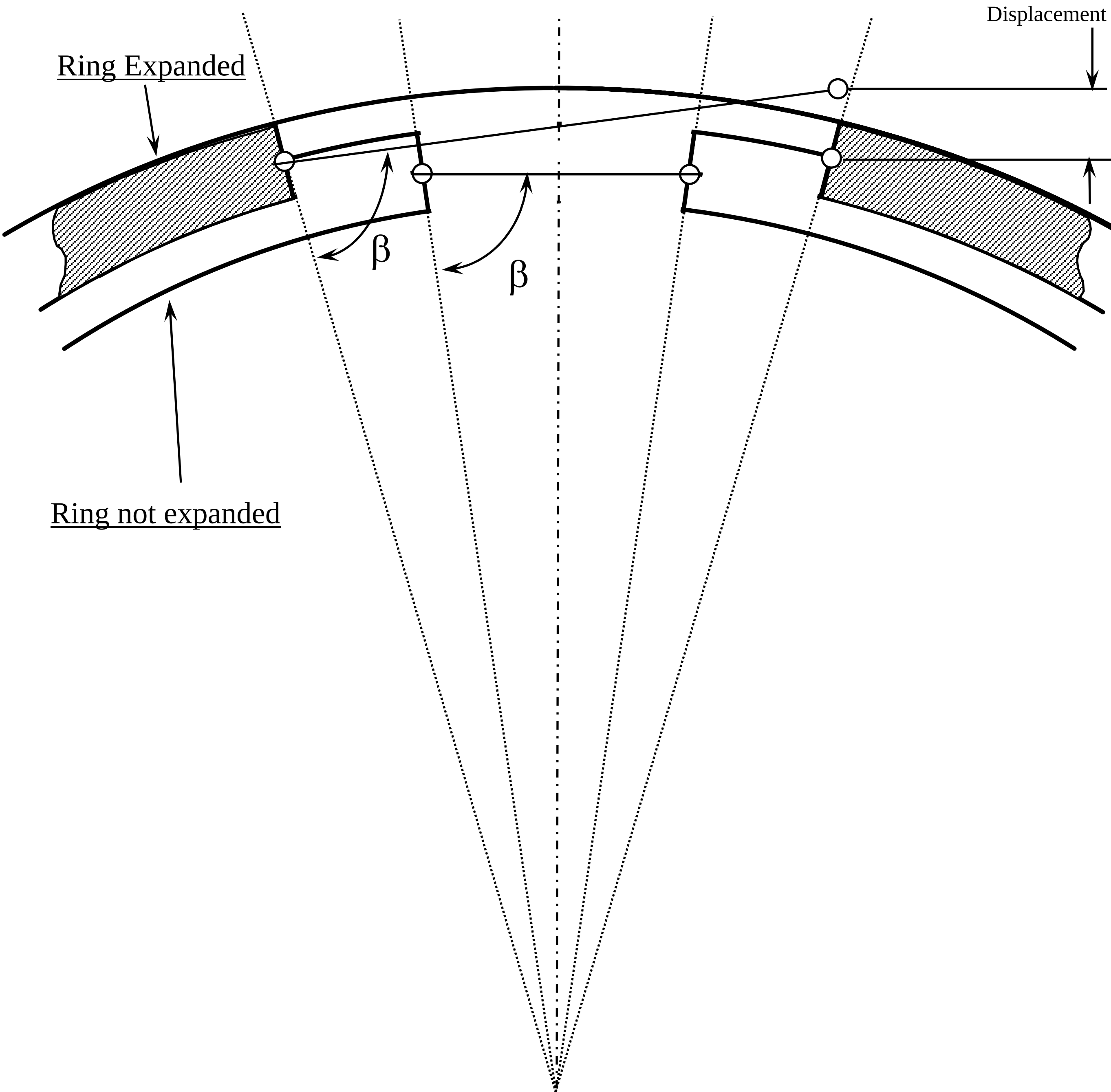
Pivoted Expanding Mechanisms:



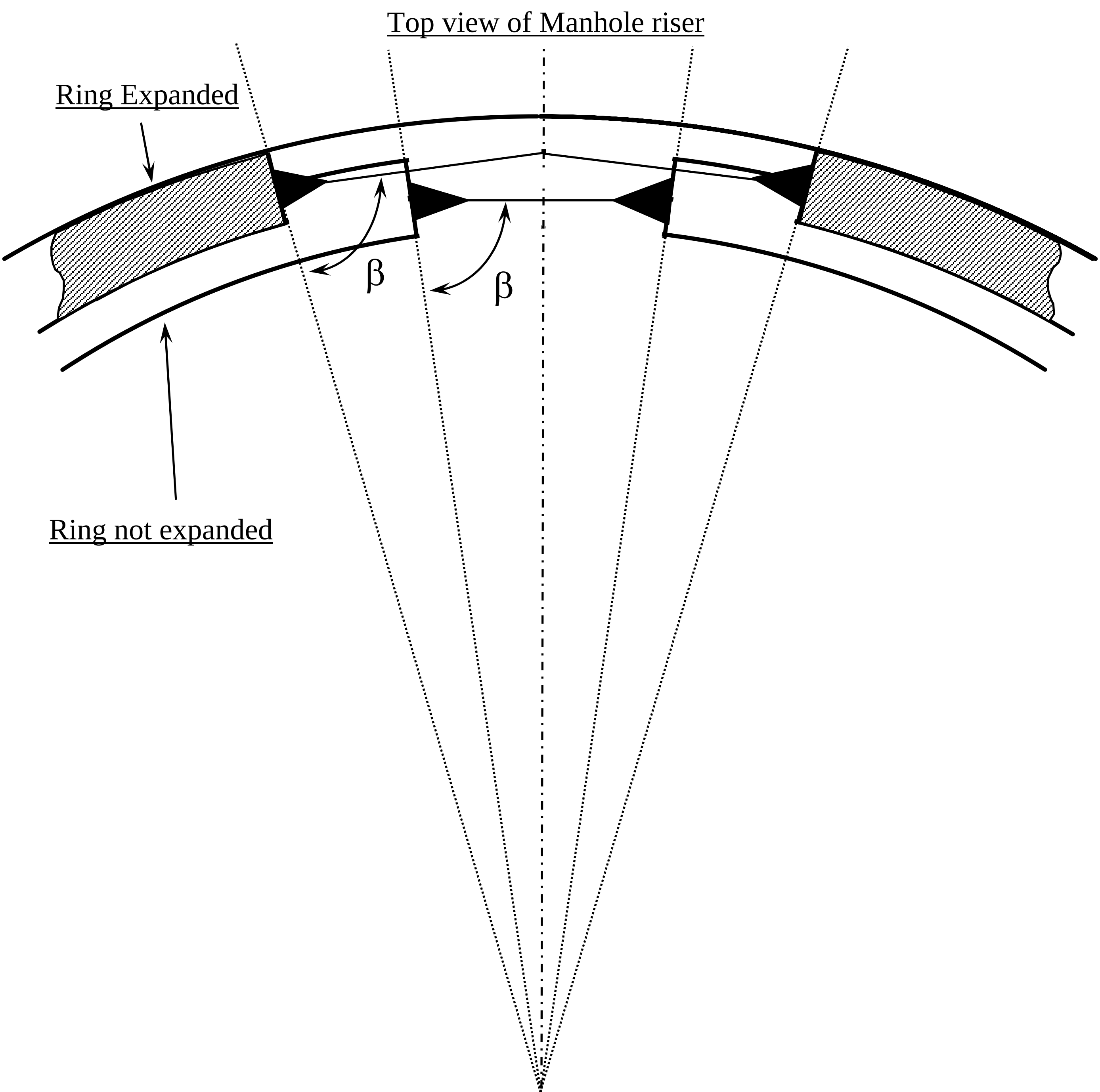
To provide a *reliable* manhole riser installation you *must* obtain full circumferential engagement. To achieve this, a pivoted expanding device is necessary. Engineering principals that show why this method of expansion must be used follows.

Description of Built in moment

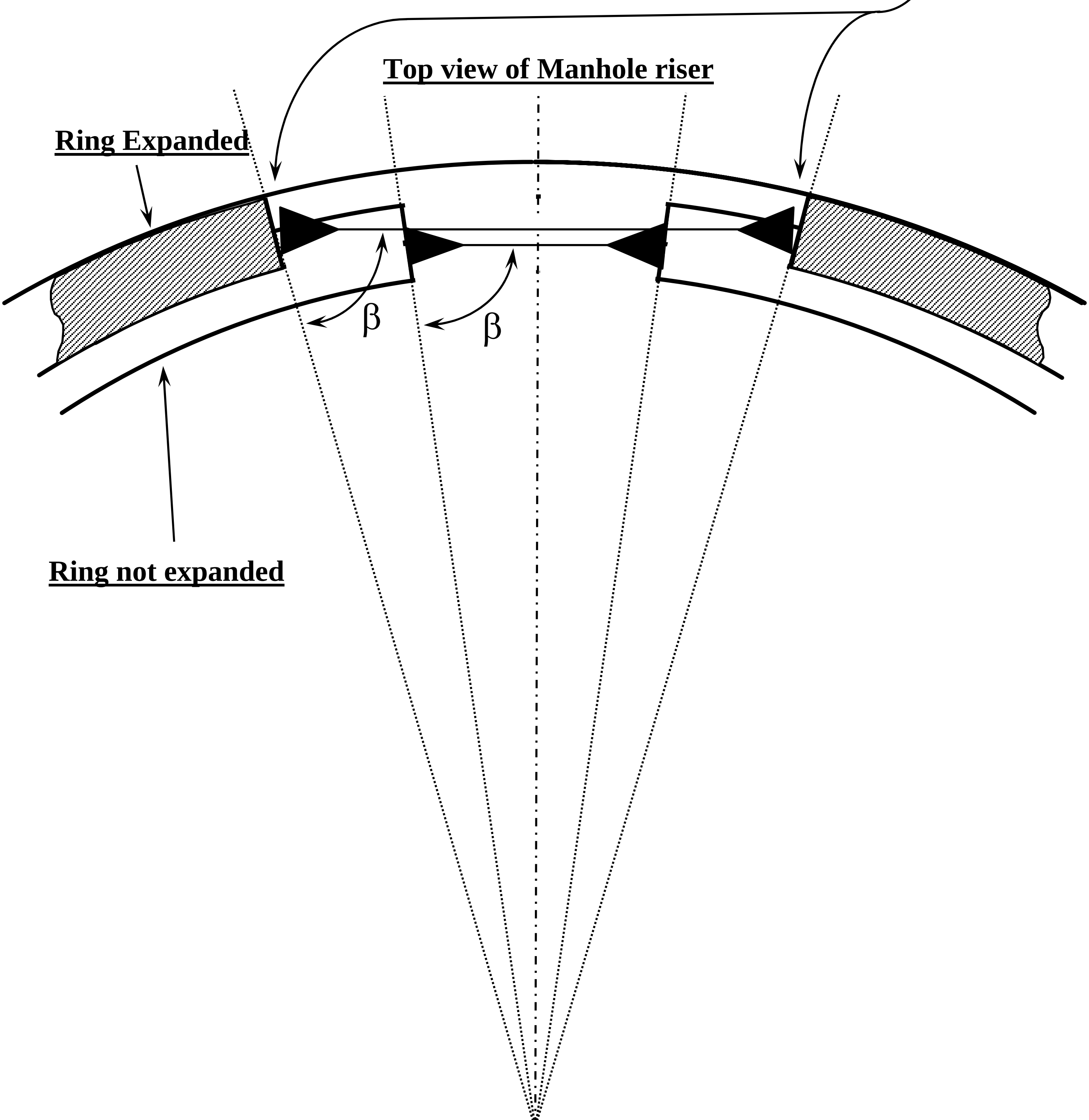
The angle “ β“ between the end of the riser bar and linkage cannot change if welded. Thus the displacement shown must be accommodated somehow.



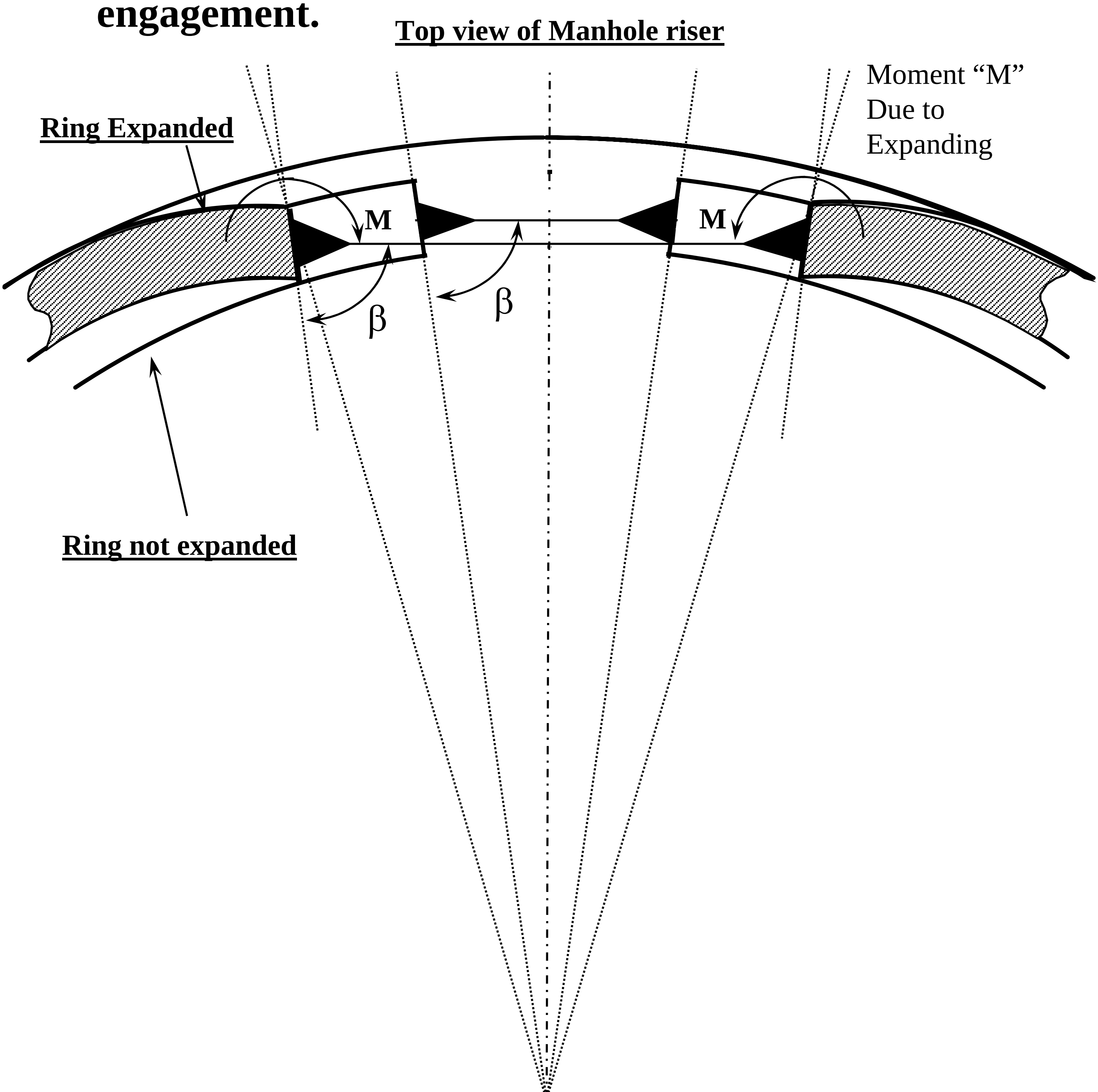
1. **Expanded device bends when expanded if weld does not break to accommodate displacement shown on previous page.**



2. Welded ends of expanding device break, i.e. moment must be less then the strength of weld or it <u>breaks</u> to accommodate displacement shown on *page 4*.

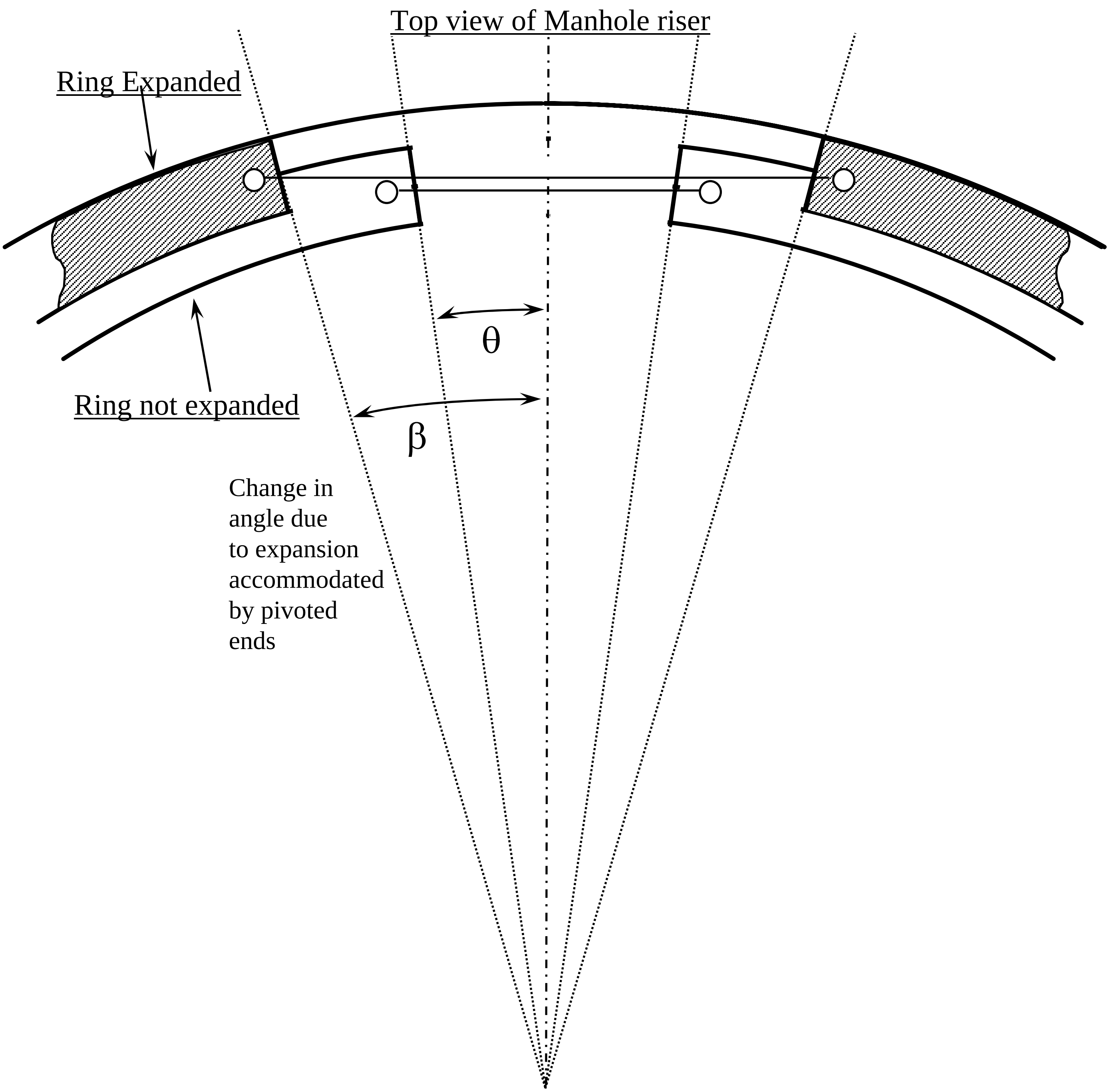


3. When expanding the mechanism, the built in moment at the welds deflects riser bar away from casting. Bar bends inward away from manhole casting at welded joint taking away the full circumferential engagement.



These problems are eliminated with pivoted ends

Pivoted ends eliminate the built in moment when expanding. Thus all the force applied to the expanding device will bend the heavy steel riser ring to take the shape of the manhole casting. Therefore, full circumferential engagement is achieved and the end result is like a pressed in bearing. This is a very reliable installation.



Skirt Strength

Material is made of A.I.S.I. 1020 Steel (A-36)

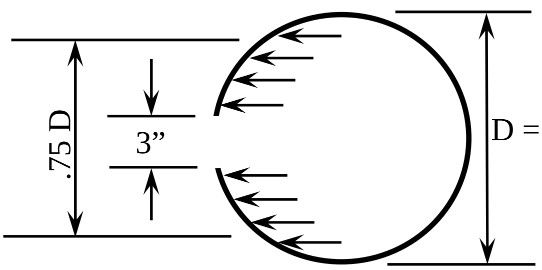
$S_{y\ shear}$ = 21,000 P.S.I.

$S_{ult\ shear}$ = 45,000 P.S.I.

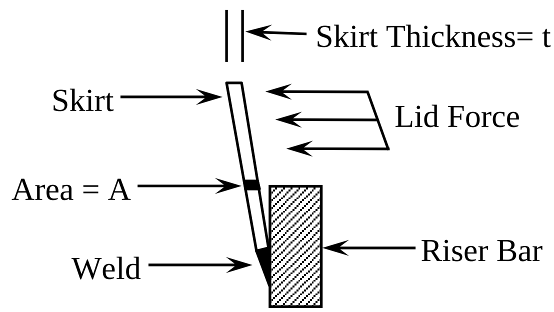
Horizontal force supported by 12 GA. Skirt over 75% of projected area. Assume a 3 inch skirt gap to be positioned for lowest support.

Skirt to yield

Top View



Cross Section



$F_{y\ horz\ skirt}$ = $S_{y\ shear}$ x A (75% of projected area)

= $S_{y\ shear}$ x Effective Shear Length x Skirt Thickness

= 21,000 x [(.75 (π D/2))-3] x (.104)

= 52,626 lb.

Maximum single axle loading is 22,500 lb. One set of dual tires could exert 22,500/2 = 11,250 lb. Horizontal force assuming a coefficient of friction of 1.00 would be 11,250 lb.

Safety Factor = Max. Shear Load/ Max Truck Tire Loading =52,626/11,250

= **4.7**

Horizontal Shear Force on weld

50% circ. weld on skirt

$S_{ult\ tensile}$ = 72,000 P.S.I.

S_y = 60,000 P.S.I. weld wire

$S_{ult\ shear}$ = 54,000 P.S.I.

$F_{horz\ shear\ force\ on\ weld}$ = A $S_{ult\ shear}$

= t l $S_{ult\ shear}$

= [.104 (((.75πD/2) - 3) / 2)] $S_{ult\ shear}$

= 67,662 lb.

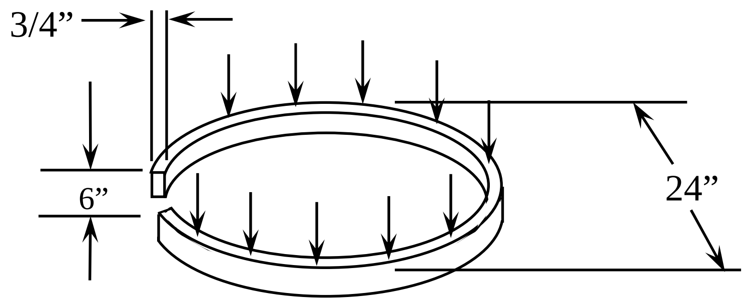
Safety Factor to Failing = 67,662 lb./ 11,250 lb. = **6**

Riser Bar Yield on Vertical Loading

Material is made of A.I.S.I. 1020 Steel (A-36)

$S_{yield\ ten}$ = 33,000 P.S.I. $S_{ult\ ten}$ = 60,000 P.S.I

Vertical force supported by 3/4" wide bar having a 24" O.D. with a 6 inch gap in riser bar.



$F_{max\ vertical\ load}$ = $S_{y\ tensile}$ x A (area of riser bar supporting lid)
= 33,000 x .75 [(23.25) π - 6]
= 1,659,290 lb.

Safety Factor = Max. Vertical Load/ Max Truck Tire Loading
= 1,659,290 lb. / 11,250 lb.
= **147**

*** NOTE : The max tire loading of 11,250 lb. per dual tire is equal or less for every States D.O.T. H20/HS20 Maximum Traffic Loading in the U.S.*

Pivoted Turnbuckle Expanding Linkage Forces

$T = \mu d F$

$F = T / \mu d$

$F = Q L / \mu d$

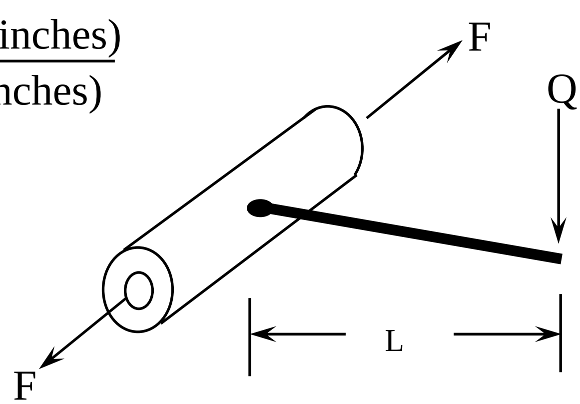
μ = coefficient of friction Q = force applied

d = diameter of screw L = length of moment arm

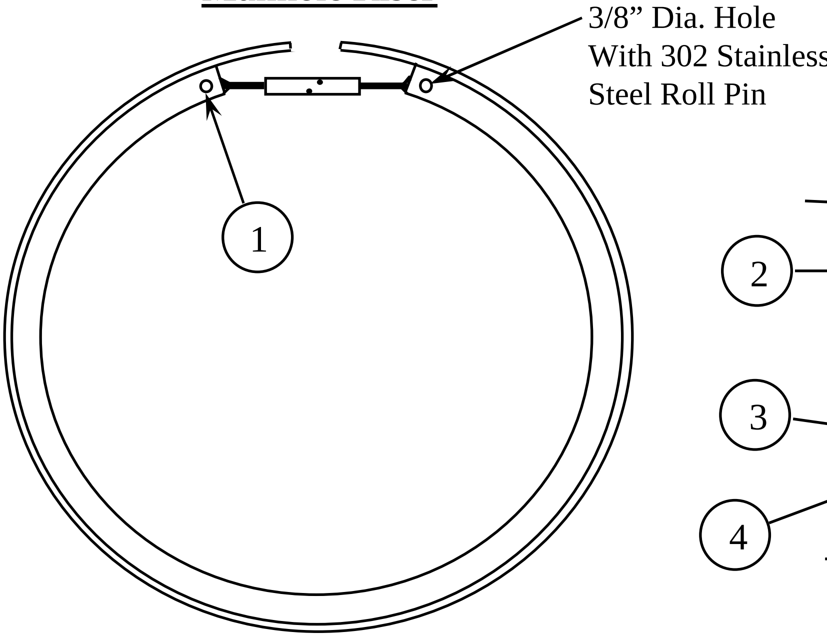
F = expanding force T = Torque

$$F = \frac{(60 \text{ lbs}) (7 \text{ inches})}{(.2) (.375 \text{ inches})}$$

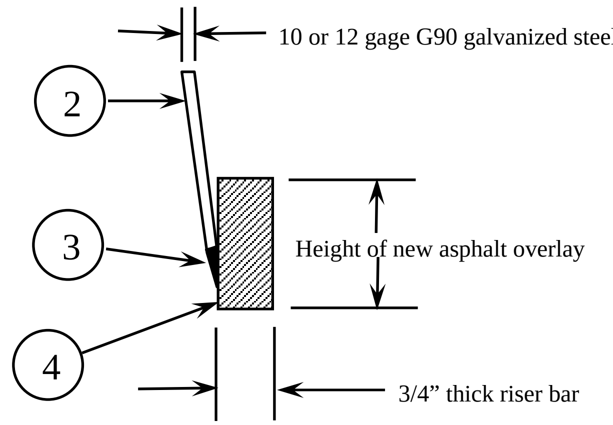
F = 5,600 lbs



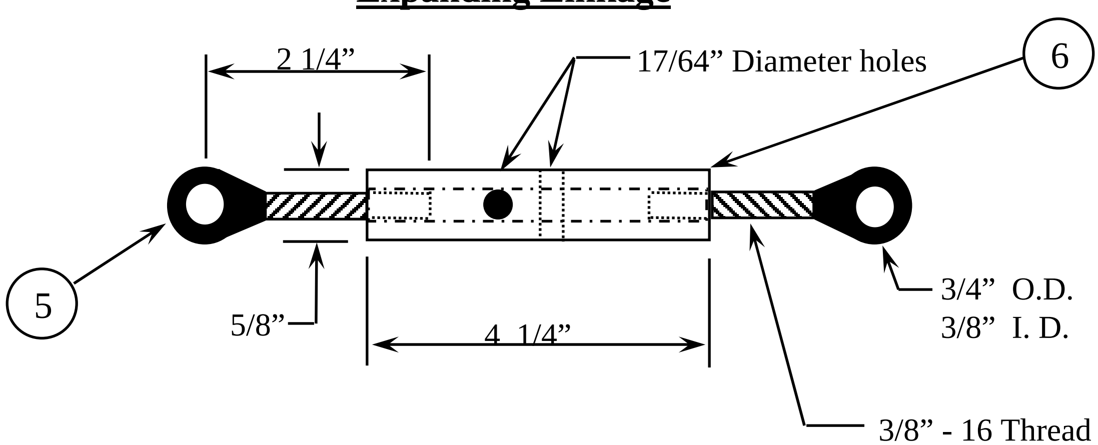
Manhole Riser



Cross Section view



Expanding Linkage



Item Number	Item Description	Material Description	Tensile Yield	Tensile Ultimate
1	3/8“ Roll Pins	302 Stainless Steel (14,000 LB Double Sheer Strength)		
2	Steel Skirt	12 or 10 gage A.I.S.I. 1020 Steel (A-36) G-90 Galvanized	33,000 P.S.I.	60,000 P.S.I.
3	Weld	65%-70% circumference welded	75,000 P.S.I.	85,000 P.S.I.
4	3/4” wide Riser Bar	Hot Rolled Steel A.I.S.I. 1020 (A-36)	33,000 P.S.I.	60,000 P.S.I.
5	Rod Ends	Forging A.I.S.I. C-1030 Steel Heat Treated BHN 240 Zinc Plated with Dichromate Finish	70,000 P.S.I.	92,000 P.S.I.
6	Turnbuckle	A.I.S.I. 1020 BHN 149 Zinc Plated dipped in Linebacker rust inhibitor	70,000 P.S.I.	80,000 P.S.I.