DISKTRON BEARING CALCULATIONS

FOR

WALSH CONSTRUCTION

PIER 6 MASONRY PLATE MODIFICATIONS

MAIN SPAN – UNIT 2

INNERBELT BRIDGE
I-90WB, BRIDGE NO. CUY-90-1566
CLEVELAND, OHIO
CUY-90-14.90
PID NO. 77332/85531

2687A

STATE OF OHIO
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REGISTERED
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RJ Watson, Inc - LRFD Masonry Plate Calculations - Model DB2650F *Pier 6 G2-4*

$tbp := 2.50in$ — *new* masonry plate thickness

$MPL := 59in$ — *new* masonry plate length (longit)

$MPW := 68in$ — *new* masonry plate width (trans)

$LBP = 42.00\ in$ — lower bearing plate diameter

$off := 6.50in$ — maximum lower bearing plate *offset* on masonry plate (trans)

$$Mmin := \min\left[\frac{MPL}{2}, \left(\frac{MPW}{2} - off\right)\right]$$

minimum distance from centerline of lower bearing plate to edge of masonry plate

$Mmin = 27.5\ in$

--> design masonry plate as a cantilever beam bending about the edge of lower bearing plate

$A1 := \pi \cdot (Mmin)^2$	$A1 = 2376\ in^2$	effective loaded area - assuming circular pressure distribution limited by closest edge of masonry plate
$Ap := \frac{\pi}{4} \cdot LBP^2$	$Ap = 1385\ in^2$	bearing area of lower bearing plate
$Force := \frac{Pu}{A1} \cdot (A1 - Ap)$	$Force = 1584\ kips$	effective bending force
$Arm := \frac{Mmin - \frac{LBP}{2}}{2}$	$Arm = 3.25\ in$	moment arm
$Mu := Force \cdot Arm$	$Mu = 5148\ kips \cdot in$	factored bending moment
$Z := \pi \cdot LBP \cdot \frac{tbp^2}{4}$	$Z = 206.2\ in^3$	plastic section modulus

$\phi f := 1.00$ — resistance factor for flexure at **strength** limit state (AASHTO LRFD 6.5.4.2)

$Fy := 50ksi$ — yield strength of plate (ASTM A709 Gr. 50)

$Mn := Z \cdot Fy$	$Mn = 10308\ kips \cdot in$	nominal flexural resistance
$Mr := \phi f \cdot Mn$	$Mr = 10308\ kips \cdot in$	factored flexural resistance

$Mr = 10308\ kips \cdot in$ $\geq$ $Mu = 5148\ kips \cdot in$ — check flexural capacity of plate ..... OK

RJ Watson, Inc - LRFD Masonry Plate Calculations - Model DB2650F Pier 6 G2-4

Concrete Bearing Pressure ....

$A1 := \frac{\pi \cdot LBP^2}{4}$ $A1 = 1385\,in^2$ conservatively assume effective loaded area = lower bearing plate area

$w := 78in$ conservatively assume effective concrete supporting area is limited by minimum pedestal width

$A2 := \frac{\pi \cdot w^2}{4}$ $A2 = 4778\,in^2$ area as defined by AASHTO LRFD 5.7.5

$m := \min\left(\sqrt{\frac{A2}{A1}}, 2.0\right)$ $m = 1.86$ modification factor

$fc := 4.00ksi$ concrete compressive strength

$Pn := 0.85 \cdot fc \cdot A1 \cdot m$ $Pn = 8748\,kips$ nominal concrete bearing resistance (AASHTO LRFD 5.7.5-2)

$\phi := 0.70$ resistance factor for bearing on concrete (AASHTO LRFD 5.5.4.2.1)

$Pr := \phi \cdot Pn$ factored concrete bearing strength (AASHTO LRFD 5.7.5-1)

$Pr = 6124\,kips \geq Pu = 3800\,kips$ check bearing capacity of concrete ..... OK

RJ Watson, Inc - LRFD Masonry Plate Calculations - Model DB2650F *Piers 6 & 7*

$tm := 2.50in$	as designed thickness of masonry plate
$tbp := 2.20in$	***minimum masonry plate thickness required***
$MPL := 59in$	masonry plate length (longit)
$MPW := 60in$	masonry plate width (trans)
$LBP = 42.00\ in$	lower bearing plate diameter

--> design masonry plate as a cantilever beam bending about the edge of lower bearing plate

$A1 := \frac{\pi \cdot (\min(MPL, MPW))^2}{4}$	$A1 = 2734\ in^2$	effective loaded area - assuming circular pressure distribution limited by smallest width of masonry plate
$Ap := \frac{\pi}{4} \cdot LBP^2$	$Ap = 1385\ in^2$	bearing area of lower bearing plate
$Force := \frac{Pu}{A1} \cdot (A1 - Ap)$	$Force = 1874\ kips$	effective bending force
$Arm := \frac{\min(MPL, MPW) - LBP}{4}$	$Arm = 4.25\ in$	moment arm
$Mu := Force \cdot Arm$	$Mu = 7966\ kips \cdot in$	factored bending moment
$Z := \pi \cdot LBP \cdot \frac{tbp^2}{4}$	$Z = 159.7\ in^3$	plastic section modulus

$\phi f := 1.00$ resistance factor for flexure at **strength** limit state (AASHTO LRFD 6.5.4.2)

$Fy := 50ksi$ yield strength of plate (ASTM A709 Gr. 50)

$Mn := Z \cdot Fy$	$Mn = 7983\ kips \cdot in$	nominal flexural resistance
$Mr := \phi f \cdot Mn$	$Mr = 7983\ kips \cdot in$	factored flexural resistance
$Mr = 7983\ kips \cdot in \quad \geq$	$Mu = 7966\ kips \cdot in$	check flexural capacity of plate ..... OK