Fermilab

Particle Physics Division

Mechanical Department Engineering Note

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Project: FLARE

Project Internal Reference:

Title: Flange Stand

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Key Words: FLARE, Flange Stand, Aluminum

Abstract/Summary:

This is an evaluation of an existing tripod type aluminum stand that was designed to support a large pipe flange. The original design calculations are not available.

Figure 1 shows the layout and dimensions of this stand. The legs are fabricated from 3 inch by 1.75 inch Aluminum Association Standard Channels with aluminum bearing plates welded top and bottom. A pipe flange with a 29.5 inch diameter bolt circle weighing 1000 pounds will be supported by this stand. A 50 pound horizontal load was applied to the top of one leg to check the stability during installation of the flange.

The calculations show that the stand will withstand the applied vertical and horizontal loads if bolted to the floor with a ½ inch diameter "Hilti Drop-in" anchor at the bottom of each leg.

Applicable Codes:

Aluminum Design Manual, The Aluminum Association, Sixth Edition 1994.

Hilti North America Product Technical Guide, Hilti U. S. ,2001 Edition.

Engineering Manual, Fermilab, 07/09 Edition.

CHECK ALUMINUM STAND FOR GIVEN LOADS:

VERT. LOAD = 334#/LEG

HORIZONTAL STABILITY LOAD = 100#

FROM FIGURE 1 PAGE 3:

ECCENTRICITY DUE TO 10° SLOPE

75" x TAN 10 = 0.58" L = 75/cos 10 = 76.2"

FROM ℄ HOLE TO END OF FLANGE ≈ 2.75"
"X" ON CHANNEL = .62"
2.13

0.58 + 2.13 = 2.71"
SAY 3"

COMPRESSION:
CHECK F_c: L/r OF SECTION:

L = 76.2" r = 0.55

L/r = 76.2/0.55
= 139 > 65 ∴ F_c = 51,000/(L/r)²
= 2.6 KSI
= 2,600 PSI

AXIAL LOAD = 334/cos 10
= 339#

f_c = 339/1.308
= 259 PSI

BENDING:
HORIZONTAL LOAD = 334(TAN 10)
= 59#
ADD'L 50# LOAD FOR SAFETY
TOTAL = 109#

M_H = 75(109) = 8175 #-IN F_b = 12.0 KSI
f_b = 8175/.37(2) = 11,047 PSI

COMBINED AXIAL & BENDING:

239/2,600 + 11047/12,000 = 1.01 ≈ 1.0
(WITHIN 10%) OK

SIZE FLOOR ANCHOR FOR LEGS:

CASE 1 – FLANGE LOAD
TENSION ON BOLT = 59#(75")/2.5"
= 1770# UPWARD

CASE 2 – 50# APPLIED LOAD FOR SAFETY
TENSION ON BOLT = 50#(75")/2.5"
= 1500#

CASE 1 & CASE 2 ARE INDEPENDENT SINCE 2 OTHER LEGS WILL BE ATTACHED WHEN FLANGE IS ATTACHED SHARING 50# HORIZONTAL SAFETY LOAD

1/2" ϕ "HILTI" DROP-IN W/ 4000 PSI CONCRETE
ALLOWABLE TENSION = 1785# > 1770#
OK

COMBINED TENSION & SHEAR:

$1770/1785 + \frac{50/3}{2V25} = 0.999 < 1.0$ OK

USE 1/2" ϕ HILTI DROP-IN ANCHOR.

WELDS:
FROM TABLE 7.1.3.2 P. 63 "SPECIFICATIONS FOR ALUMINUM STRUCTURES" FIFTH EDITION 1986

ALLOWABLE SHEAR STRESS FOR 6061 W/ 4043 FILLER MATERIAL = 5 KSI

FOR 3/16" WELD: 3/16 (.707)(5) = .662 K/IN

LENGTH OF WELD = 2(1.75) = 2.317 K
= 2317#

2317# > 1770# OK

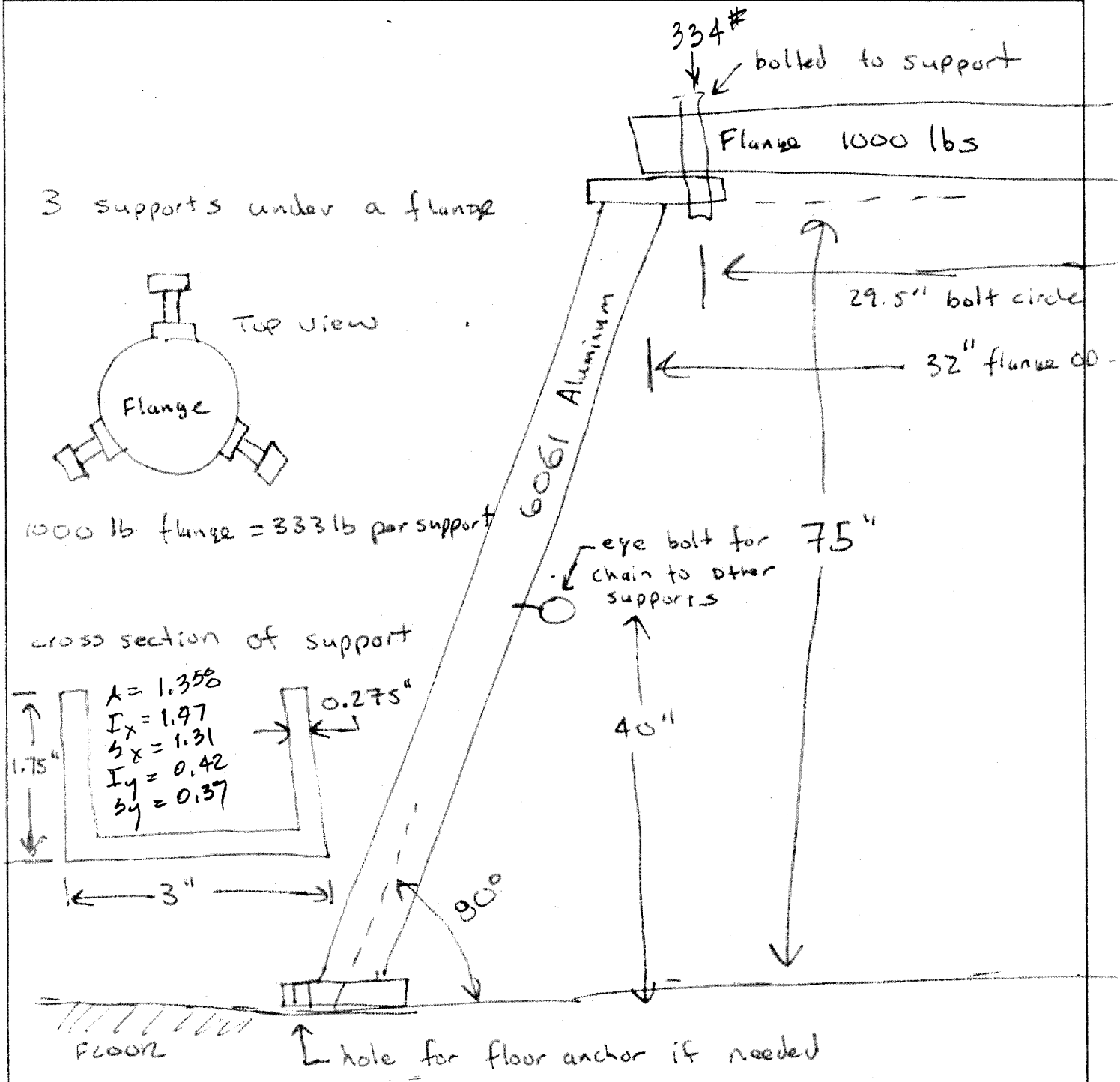
334#
bolted to support
Flange 1000 lbs
3 supports under a flange
Top view
Flange
29.5" bolt circle
32" flange OD
6061 Aluminum
1000 lb flange = 333 lb per support
eye bolt for chain to other supports
75"
cross section of support
A = 1.35□"
Ix = 1.97
Sx = 1.31
Iy = 0.42
Sy = 0.37
0.275"
1.75"
3"
40"
80°
Floor
hole for floor anchor if needed

FIGURE 1

FIGURE 2 - ONE LEG

FIGURE 3 - TOP PLATE - SIDE VIEW

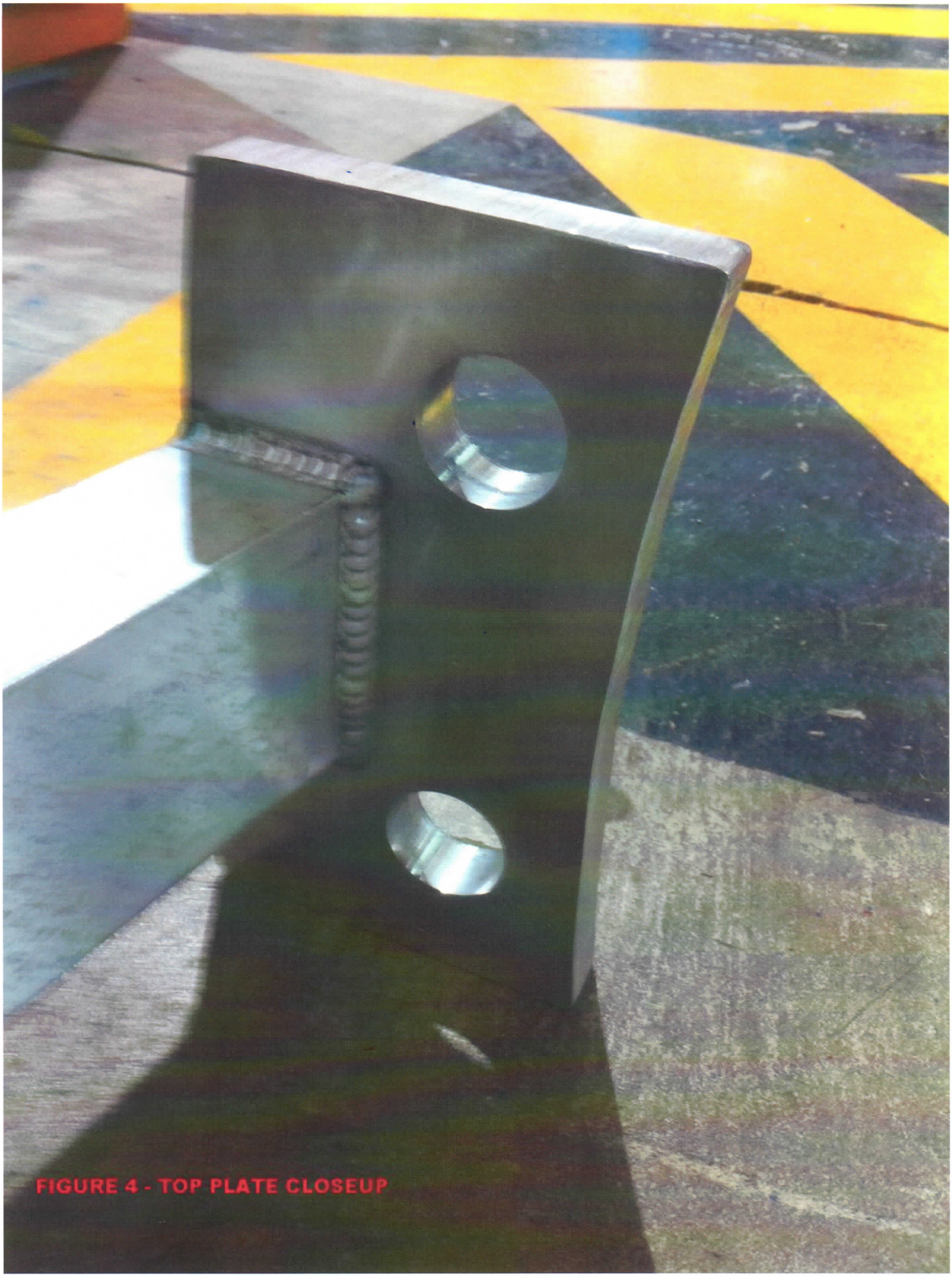

FIGURE 4 - TOP PLATE CLOSEUP

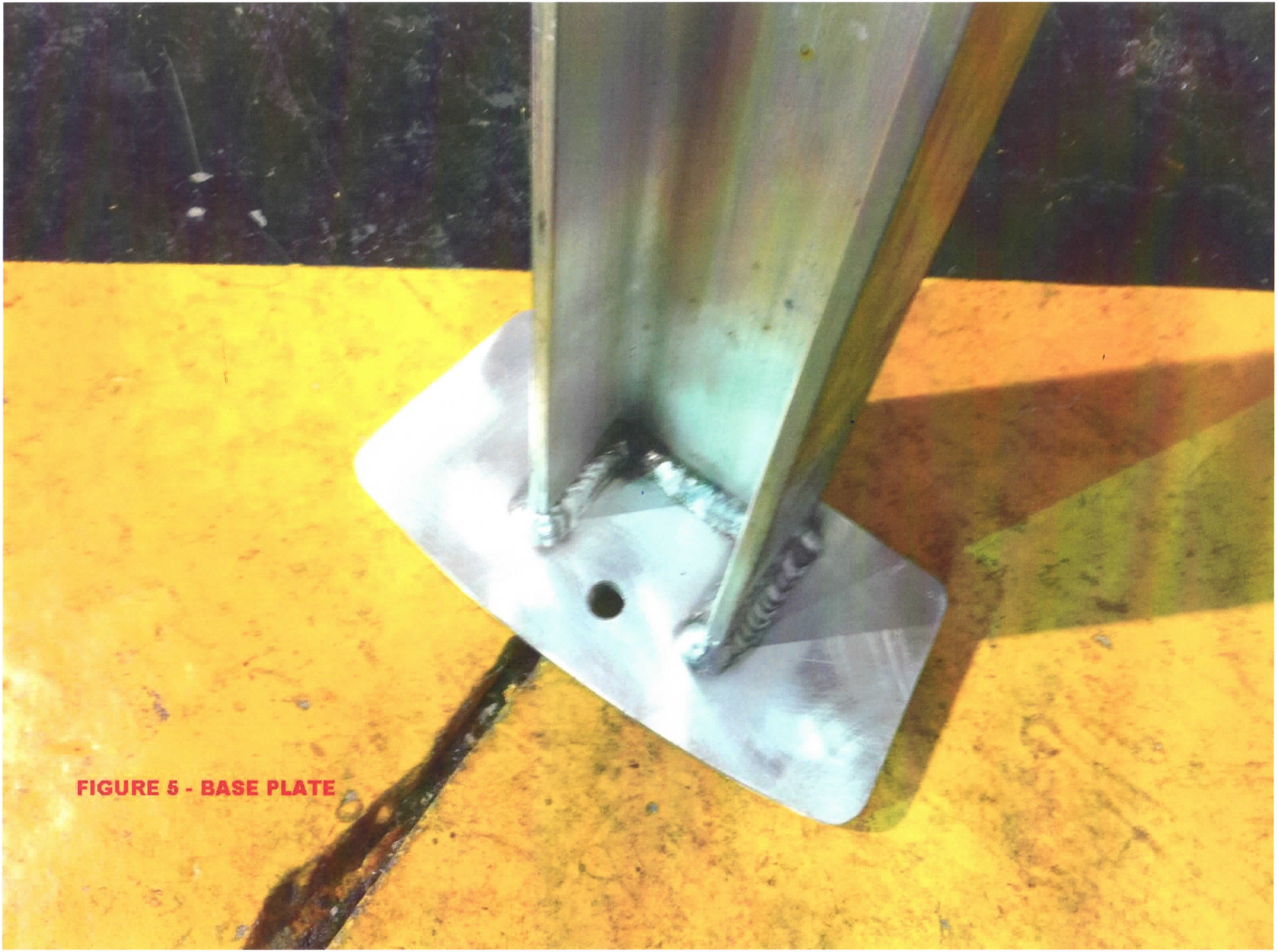

FIGURE 5 - BASE PLATE