SECTION 4

PROCESS INFORMATION

Attachment 4-2
Foundation Calculations

MIXED WASTE FACILITY
RCRA/TSCA PERMIT APPLICATION

PERMA-FIX NORTHWEST RICHLAND, INC.

RICHLAND, WASHINGTON

ATG INC.

CALCULATION COVER SHEET

CALC. NO. D-26-002
No. of Sheets: 10

PROJECT ATG - MIXED WASTE FACILITY

PURPOSE
BUILDING FOOTING DESIGN FOR STABILIZATION (ANNEX) BUILDING (STB) AND GASVIT BUILDING (GVB)

SOURCES OF DATA
STRUCTURAL CALCULATIONS AND ITS ADDENDUM PROVIDED BY DIVERSIFIED DEVELOPMENT SERVICES COMPANY (ALL WEST INC.)

SOURCES OF FORMULAE & REFERENCES

—

ATTACHMENT

—

CONCLUSION
FOOTING SIZE AND ARRANGEMENT INCORPORATED IN STRUCTURAL DWG 31001-S-002 SHTS 203, 204 REV. 0

PRELIMINARY CALC. ☐ **FINAL CALC.** ☒ **SUPERSEDES CALC. NO.** _____

REV. NO.	REVISION	BY:	DATE	CHECKED	DATE	APPROVED	DATE
0	ORIGINAL FINAL ISSUE	ALL WEST INC.	1996	[illegible]	2/10/98	[illegible]	2/10/98

13-21-002 1/10 ~~+ ATTACHMENT 1 (2 SHTS)~~

STRUCTURAL CALCULATIONS
RIGID FRAME FOOTING/FOUNDATION SYSTEM
(Building Equipment Foundation for the Annex Building)

FOR
ALLIED TECHNOLOGIES GROUP -ALL WEST CONSTRUCTION INCORPORATED
PROJECT LOCATION - RICHLAND, WASHINGTON

DESIGN CRITERIA:

WIND REGION 70 MPH. EXPOSURE C
SEISMIC ZONE 2B. I = 1.0
CONCRETE - $f'c$ = 2500 PSI
REINFORCING STEEL - 20,000/40,000 PSI
SOIL BEARING PRESSURE 1,000 PSF (ASSUMED)

WILLIAM F. BOEHM
STATE OF WASHINGTON
28971
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 05/09/97

Job #9473_02 / Annex Building
Prepared by Diversified Development Services Company
1625A West Bruneau Place
Kennewick, Washington 99336
(509) 735-1475 Fax (509) 783-4245

DIVERSIFIED DEVELOPMENT SERVICES COMPANY
2625 A WEST BRUNEAU PL. KENNEWICK WA 99336
PHONE. (509) 735-4478 FAX: (509) 783-4245
Land Planning Civil Engineering Financial Packaging Construction Mgmt

PROJECT NAME ATG - ANNEX BUILDING
PROJECT NO 9673-02 SHEET NO 1 OF MULT.
CALCULATED BY R. JACKSON DATE 1996/AUG/1
CHECKED BY W.F.B. DATE 1996/AUG/1
SCALE N/A

FOOTING (F1) @ GRIDLINES (3) & (I) & (7) & (I)

NOTE: COMBINED UPLIFT FORCE @ GRIDLINE CO-ORDINATES (3) & (I) = 1.2K TOTAL
" " " " " (7) & (I) = 7.9K TOTAL

◆ FOOTINGS ARE DESIGNED AT THESE LOCATIONS BASED UPON MOST RESTRICTNE = 7.9K UP
TOTAL AXIAL ↓ DN. = 8.1K

$\frac{8.1K}{1.0K}\sqrt{8.1 FT^2} = 2.85 FT.$ ← 20.31 CU/FT (@ 30" DEPTH)

CHECK UPLIFT (FTG. ONLY - NEGATE WALL, EARTH @ SLAB) NET ↑ = 7.9K ~ D/LD FTG. = (150)(20.31) = 3.0K N.G.

ADJUST FTG. ~ 4.66 FT² = (150)(54.28) = 8.14K > 7.9K OK
USE FOOTING 4'-8" x 4'-8" x 2'-6" W/ (8) #5 EA. WAY BOTTOM, W/ (4) #5 L (CORNERS), (1) #5 L INTERMEDIATE ~ (3) #3 □ TIES TOP 5' @ -1" FROM T.O. FTG., BALANCE @ 8" O.C. VERT. ←

FOOTING (F2) @ GRIDLINES (3.9) & (I) & (5.9) & (I)
NET UPLIFT FORCE = 14.1K UP
TOTAL AXIAL ↓ DN. = 23.6K

$\frac{23.6K}{1.0K}\sqrt{23.6 FT^2} = 4.85 FT$ ← 59.0 CU/FT IS INSUFFICIENT FOR UPLIFT.

ADJUST FTG ~ 6.5 FT² = (150)(105.6) = 15.8K > 14.1K OK
USE FOOTING - 6'-6" x 6'-6" x 2'-6" W/ (12) #5 EA. WAY BOTTOM, W/ (4) #5 L (CORNERS), (3) #5 L INTERMEDIATE ~ (3) #3 □ TIES TOP 5' @ -1" FROM T.O. FTG., BALANCE @ 8" O.C. VERTICAL ←

FOOTING (F3) @ GRIDLINES (3) & (J), (K) & (L) & GRIDLINES (7) & (J), (K) & (L)

NET UPLIFT FORCE = 31.1K UP
TOTAL AXIAL ↓ DN. = 44.3K

$\frac{44.3K}{1.0K}\sqrt{44.3 FT^2} = 6.65 FT$ ← 110.75 CU/FT IS INSUFFICIENT FOR UPLIFT

ADJUST FTG. ~ 9.5 FT² = (150)(225.6) = 33.8K > 31.1K OK
USE FOOTING 9'-6" x 9'-6" x 2'-6" W/ (12) #5 EA. WAY BOTTOM, W/ (4) #5 L (CORNERS), (4) #5 L INTERMEDIATE ~ (3) #3 □ TIES TOP 5' @ -1" FROM T.O. FTG., BALANCE @ 8" O.C. VERTICAL. ←

END PG. 1

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Land Planning · Civil Engineering · Financial Packaging · Construction Mgmt

PROJECT NO. — SHEET NO. 2 OF MULT
CALCULATED BY — DATE —
CHECKED BY — DATE —
SCALE —

FOOTING (F4) @ GRIDLINE 4 (3) & (9) @ GRIDLINE (M)
NET UPLIFT FORCE = .9K UP
TOTAL AXIAL + DN. = 6.5K

$\frac{6.5K}{1.0K}\sqrt{6.5FT^2} = 2.6FT$ ← 16.25 LB/FT (@ 30" DEPTH)

CHECK UPLIFT = (150)(16.25) = 2.44K > .9K OK NET + = .9K ~ D/L D. FTG. = 2.44K
2.44K > .9K ← OK

USE FOOTING 6'-6" x 6'-6" x 2'-6" ~ SAME AS FOOTING AS (F2)
USE FOOTING (F2) @ (F4) LOCATIONS ←

FOOTING (F5) @ GRIDLINES (M) & (4.1) & (5.1)
COMBINED UPLIFT FORCE @ ALL LOCATIONS = 8.0K TOTAL
TOTAL AXIAL + DN. = 15.1K

$\frac{15.1K}{1.0K}\sqrt{15.1FT^2} = 3.9FT$ ← 37.75 LB/FT (@ 30" DEPTH)
(INSUFFICIENT FOR UPLIFT)

CHECK UPLIFT (FTG. ONLY - NEGATE, WALL, EARTH & SLAB) NET + = 15.1K ~ D/L FOOTING
= (150)(38.0) = 5.7K N.G.

ADJUST FOOTING ~ 4.0' = (150)(4.0) = 6.0K > 5.7K OK
USE FOOTING 4'-0" x 4'-0" x 12" W/(7) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS), (1) #5 L INTERMEDIATE ~ (3) #3 □ TIES TOP 5" @ -1" FROM T.O. FTG., BALANCE @ 8" O.C. VERTICAL ←

FOOTING (F6) @ GRIDLINE (4.9) & (M)
NET UPLIFT FORCE = 6.3K UP
TOTAL AXIAL + DN. = 4.1K

$\frac{4.1K}{1.0K}\sqrt{4.1FT^2} = 2.0FT$ ← 10.25 LB/FT (@ 30" DEPTH)
(INSUFFICIENT FOR UPLIFT)

ADJUST FOOTING ~ 4.25' = (150)(45.15) = 6.7K > 6.3K OK

USE FOOTING 4'-3" x 4'-3" x 12" W/(7) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS), (2) #5 L INTERMEDIATE ~ (3) #3 □ TIES TOP 5" @ -1" FROM T.O. FTG., BALANCE @ 8" O.C. VERTICAL ←

END PG. 2

DIVERSIFIED DEVELOPMENT SERVICES COMPANY
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Land Planning Civil Engineering Financial Packaging Construction Mgmt

PROJECT NAME ____
PROJECT NO. — SHEET NO. 3 OF MULT
CALCULATED BY — DATE —
CHECKED BY — DATE —
SCALE —

FOOTING (FGA) @ GRIDLINES (2) & (3) & (4) @ GRIDLINE (F)
COMBINED NET UPLIFT FORCE (WORST CASE) = 10.5K UP
TOTAL AXIAL + DN. = 17.0K

$\frac{17.0K}{1.0K}\sqrt{17.0FT^2} = 4.1FT$ ← 42.5 CU/FT (@ 30" DEPTH)
(INSUFFICIENT FOR UPLIFT)

ADJUST FOOTING ~ 5.5' ~ (150)(75.42) = 11.34K > 10.5K OK
USE FOOTING 5'-6" x 5'-6" x 2'-6" W/ (10) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS), (2) #5 L INTERMEDIATE ~ (3) #3 ⊓ TIES TOP 5" @ ~1" FROM T.O. FTG. ~ BALANCE @ 9" O.C. VERTICAL ←

FOOTING (FH) @ GRIDLINE (5) & (F)
NET UPLIFT = 4.9K
TOTAL AXIAL + DN. = 19.9K

$\frac{19.9K}{1.0K}\sqrt{19.9FT^2} = 4.5FT$ ← 50.62 CU/FT (@ 30" DEPTH)

CHECK UPLIFT ~ (150)(50.62) = 7.6K > 4.9K OK
USE FOOTING 4'-6" x 4'-6" x 2'-6" W/ (9) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS), (1) #5 L INTERMEDIATE, (3) #3 ⊓ TIES TOP 5" @ ~1" FROM TOP FTG., BALANCE @ 9" O.C. VERTICAL ←

FOOTING (FB) @ GRIDLINE (6) & (F)
NET UPLIFT FORCE + = 10.5K UP
TOTAL AXIAL + DN = 9.9K

DUE TO UPLIFT REQUIREMENT, USE FOOTING AS (F6)

USE FOOTING (F6) @ (FB) LOCATION ← ⬢

FOOTING (FH) @ GRIDLINE (7) & (F)
NET UPLIFT FORCE + = 9.4K
TOTAL AXIAL + DN. = 5.0K

DUE TO UPLIFT REQUIREMENT, USE FOOTING AS (F6)

USE FOOTING (F6) @ (FH) LOCATION ← ⬢

END PG. 3

DIVERSIFIED DEVELOPMENT SERVICES COMPANY
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FOOTING (F10) @ GRIDLINES (1) & (G)

NET UPLIFT FORCE = 14.4K UP
TOTAL AXIAL DN = 10.7K

$\frac{10.7K}{1.0K}\sqrt{10.1FT^2} = 3.1 FT = 25.25 CU/FT$
(INSUFFICIENT FOR UPLIFT

TRY FTG. 6.66' = (150)(110.889) = 16.66K > 14.4K OK
USE FOOTING 5'-0" x 8'-10" x 2'-6" W/ (4) #5 LONG. / (11) #5 TRANSV. BOTTOM, (4) #5 (CORNER) / #5 L @ 24" O.C. LONGIT. SIDES / (2) #5 L ENDS INTERMEDIATE, (3) #3 ⊓ TIES TOP 5" @ -1" FROM T.O. FTG. ←

FOOTING (F11) @ GRIDLINES (7) & (G) & (6) @ (H)

NET UPLIFT FORCE = 13.6K UP
TOTAL AXIAL DN. = 18.4K

$\frac{18.4K}{1.0K}\sqrt{18.4FT^2} = 4.2FT = 46.0 CU/FT$
(INSUFFICIENT FOR UPLIFT

USE FOOTING (F10) @ (F11) LOCATIONS (DUE TO UPLIFT REQUIREMENTS) ← (F3)

NOTE! @ GRIDLINE (6) @ (H) FOOTING MAY BE 6'-8" x 6'-8" x 2'-6" W/ (8) #5 EA. WAY BOTTOM; W/ BALANCE OF REINFORCING AS THAT OF FOOTING (F3)

FOOTING (F12) @ (5) & (H)

NET UPLIFT FORCE = 5.3K UP
TOTAL AXIAL DN. = 43.3K

$\frac{43.3K}{1.0K}\sqrt{43.3FT^2} = 6.5FT = 108.25 CU/FT$

CHECK UPLIFT - (150)(108.25) = 16.23K > 5.3K ~ REDUCE DEPTH TO 12" =
~ (150)(42.25) = 6.3K > 5.3K OK
USE FOOTING - 6'-6" x 6'-6" x 12" W/ (12) #5 EA. WAY BOTTOM, (4) #5 L (CORNER) (4) #5 L INTERMEDIATE ~ (3) #3 ⊓ TIES TOP 5" @ -1" FROM T.O. SLAB @ (1) #3 ⊓ @ +3" BOTTOM OF FTG. ←

FOOTING (F13) @ GRIDLINE (3) @ (H)

NET UPLIFT FORCE = 19.8K
TOTAL AXIAL DN. = 36.3K

$\frac{36.3K}{1.0K}\sqrt{36.3FT^2} = 6.5' = 49.5 CU/FT$ (INSUFFICIENT FOR UPLIFT) (@ 30" DEPTH

TRY FOOTING 7.33' = (150)(134.3) = 20.14K > 19.8K OK
USE FOOTING 7'-4" x 7'-4" x 2'-6" W/ (9) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS), (4) #5 L INTERMEDIATE, (5) #5 ⊓ TOP 5" @ -1" FROM T.O. FTG., BALANCE @ 6" O.C. VERTICAL. ←

END PG. 4

DIVERSIFIED DEVELOPMENT SERVICES COMPANY
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FOOTING (F14) @ GRIDLINES (2) @ (H)

NET UPLIFT FORCE = 13.9K UP
TOTAL AXIAL + DN. = 17.3K

DUE TO UPLIFT FORCES USE FOOTING (F12)

USE FOOTING (F12) @ (F14) LOCATION ←

FOOTING (F15) @ GRIDLINE (7) @ (H)

NET UPLIFT FORCE = 9.2K UP
TOTAL AXIAL + DN. = 10.1K

DUE TO UPLIFT REQUIREMENTS USE FOOTING (F6A)

USE FOOTING (F6A) @ (F15) LOCATION ←

FOOTING (F16) @ GRIDLINE (1) (H)

NET UPLIFT FORCE = .4K UP
TOTAL AXIAL + DN. = 4.0K

$\frac{4.0K}{1.0K}\sqrt{4.0FT^2} = 2.0FT = 10.0CU/FT$

CHECK UPLIFT = (150)(10.0) = 1.5K > .4K OK
USE FOOTING - 21.0" x 21.0" x 21.6" W/ (3) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS) (1) #5 L INTERMEDIATE - (3) #3 □ TIES TOP 5" @ -1" FROM T.O. FTG., BALANCE @ 9" O.C. VERTICAL ←

FOOTING (F17) @ GRIDLINE (6) @ (G)

NET UPLIFT FORCE = 1.4K UP
TOTAL AXIAL + DN. = 4.1K

$\frac{4.1K}{1.0K}\sqrt{4.1FT^2} = 3.0FT = 11.97 CU/FT$ (@ 16" DEPTH)

CHECK UPLIFT = (150)(11.97) = 1.79K > 1.4K OK
USE FOOTING 31.0" x 31.0" x 21.6" W/ (4) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS), (1) #5 L INTERMEDIATE, (3) #3 □ TIES TOP 5" @ -1" FROM T.O. SLAB / (1) #3 □ @ +3" FROM BOTTOM OF FOOTING ←

FOOTING (F18) @ GRIDLINE (1) + (P)

NET UPLIFT FORCE = 7.5K UP / TOTAL AXIAL + DN. = 3.7K $\frac{3.7K}{1.0K}\sqrt{3.7FT^2} = 2.0FT = 10.0 CU/FT$ (@ 30" DEPTH)
CHECK UPLIFT = (150)(10.0) = 1.5K < 7.5K N.G.

ADJUST FTG - 4.5' = (150)(50.62) = 7.6K > 7.5K OK
USE FTG 41.6" x 41.6" x 21.6" W/ (8) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS), (2) #5 L INTERMEDIATE, (5) #3 □ TIES TOP 5" @ -1" FROM T.O. FTG., BALANCE @ 9" O.C. VERTICAL ←

END PG. 5

DIVERSIFIED DEVELOPMENT SERVICES COMPANY
2625A W. BRUNEAU PLACE KENNEWICK, WA 99336 (509) 735-4373
Land Planning Civil Engineering Financial Packaging Construction Mgmt

PROJECT NO — SHEET NO 6 OF MULT
CALCULATED BY — DATE —
CHECKED BY — DATE —
SCALE —

FOOTING (F19) @ GRIDLINE (4.9) & (I)

NET UPLIFT FORCE = 11.7K
TOTAL AXIAL ⊥ DN. = 14.9K

$\frac{14.9K}{1.0K}\sqrt{14.9 Ft^2 - 3.8' = 37.25 CU/FT}$ (INSUFFICIENT FOR UPLIFT)

TRY FTG - 6.0' = (150)(90.0) = 13.5K > 11.7K OK

USE FOOTING 6'-0" x 6'-0" x 2'-6" W/ (7) #5 EA. WAY BOTTOM, (4) #5 L (CORNERS), (3) #5 L INTERMEDIATE, (3) #3 □ TIES TOP 5" @ -1" FROM TOSLAB, BALANCE @ 8" O.C. VERTICAL ←

END PG. 6 - END FOOTINGS

PROJECT NAME [illegible]
PROJECT NO 9673.0241 SHEET NO 1 OF
CALCULATED BY R.J. [illegible] DATE 1996/AUG
CHECKED BY WEB DATE 1996/AUG
SCALE

DIVERSIFIED DEVELOPMENT SERVICES COMPANY
[illegible]

DESIGN CRITERIA

$f'_c = 2{,}500$ PSI $f_c = 1{,}125$ PSI $n = 10$
$f_s = 20{,}000$ [DESIGN] V_c = LIMIT 60 PSI / PERIPHERAL SHEAR = 110 PSI
$p = .0102$ $k = .362$
$j = .879$ $R = 179$ U - LIMIT #4 = 340 / #5 = 272

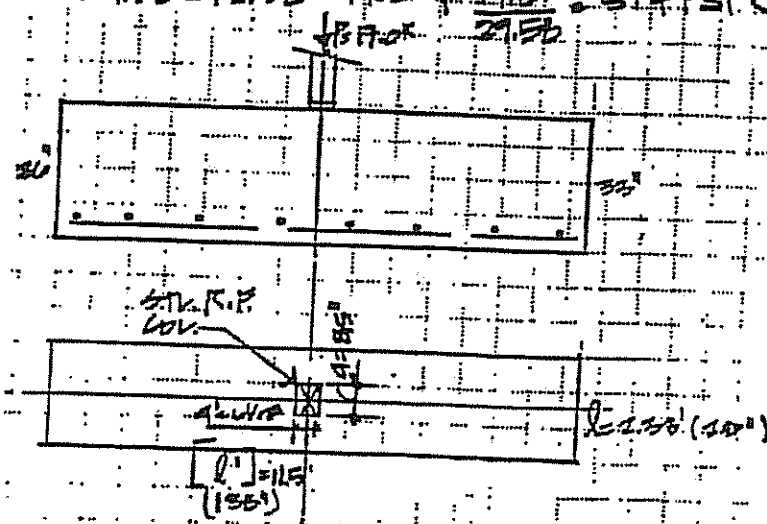
WILLIAM E. BOEHM, STATE OF WASHINGTON, 28971, REGISTERED PROFESSIONAL ENGINEER
EXPIRES 05/09/97

F20 [F21 APPLYS THOUGH VERTICAL LOAD IS 19.0K]

FTG WT = 12.58K (12,500 LB) ⌉ TOTAL LD TO FNDN. BED = 29.58K
TOTAL AXIAL ↓ DN. = 17.0K ⌋ TOTAL = 29.58K ↓

$\frac{29.58^K}{1.00^K}\sqrt{29.58\ FT^2} = 29.58\ FT^2$ NET ↑ ON FOUNDATION BED (DUE TO BENDING)

$= 29.58^K - 12.58^K = 17.0^K$, $\frac{17.0^K}{29.58} = 574$ PSF < 1000 OK ←



$c = \frac{l-a}{2} = \frac{2.33' - .7083'}{2} = .819'$

$M = (6)(574)(2.33)(.819^2) = 5{,}382.5$ IN/LBS
$M = 5{,}382.5$ IN/LBS MAX. BENDING MOMENT

EFFECTIVE DEPTH:

$d = \sqrt{\frac{5382.5}{(179)(28)}} = 1.03$ IN ←

- REVERSE DIRECTION OF MOMENT -

$c = \frac{l'-a'}{2} = \frac{11.5' - .547'}{2} = 5.5'$

$M = (6)(574)(11.5)(5.5^2) = 1{,}198{,}900.0$ IN/LBS
$M = 1{,}198{,}900.0$ IN/LBS MAX. BENDING MOMENT

EFFECTIVE DEPTH:

$d = \sqrt{\frac{1{,}198{,}900.0}{(179)(138)}} = 6.9667$ IN ←

INVESTIGATE SHEAR

$c = 5.45'$ $c - d = 5.45' - 2.73' = 2.73'(2.33)$
$= 6.33\ FT^2$ $V = (6.33)(574) = 3634$ LB

$V = \frac{3634}{(138)(36)} = .73$ PSI < 60 PSI OK

$A_s = \frac{1{,}198{,}900}{(20{,}000)(.879)(36)} = A_s = 1.89$ IN/SQ.
= (6) #5 (@ .31 IN²/EAR) ~ (5) #5 PROVIDED
ADDITIONAL REINF. WAS ADDED @ #5 = 8 1/2"
O.C. TRANSVERSE ~ OK ←

SUMMARY:
FOOTING F20 & F21 CONTAIN SUFFICIENT REINFORCING AS DENOTED IN THE FOOTING SCHEDULE UNDER APDENDUM NO 1 - NO FURTHER INVESTIGATION IS WARRANTED.
[NOTE: ACTUAL f_s = 60,000]

D-2i-002

Pg ~~8 of 8~~ 8/10

SHT. 9/10

Land Planning
Civil & Site Engineering
Structural Engineering
Financial Pro formas
Architectural Renderings
Comp. Development Design
Total Development Mgm't

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1996/August/20

Mr. Lawrence Chiu
Allied Technologies Group
47375 Fremont Blvd.
Fremont, California 94538

Addendum No. 1: Revised End Wall Column Footings for the Annex Building (Reference Drawing No. Exhibit D-1B - Figure 9 and D-1B Figure 10)

Dear Lawrence,

Pursuant to our conversation on the evening of 1996/August/20 regarding possible conflict between Footings at the existing Building No. 13 and the proposed new Annex Building along Gridline 'F', between Gridline's No. 2 through Gridlines No. 6 we are revising the Footing configuration for the new building at the above referenced co-ordinates as follows:

On Drawing Exhibit D-1B, Figure 9;

*a.) Revise Footing F6A and F8 (@ Gridline 'F' and Gridline's 2, 3, 4 and 6) from 5'-6" x 5'- 6" x 2'-6" to 11'-6" x 2'-4" x 3'-0" (Depth increased to 3'-0"). **This Footing will now bear the new Mk. No. of F20 on the revised drawings and calculations forthcoming.***

*b.) Revise Footing F7 (@ Gridline 'F' and Gridline 5) from 4'-6" x 4'-6" x 2'-6" to- 7'-6" x 2'- 3" x 3'-0" (Depth increased to 3'-0"). **This Footing will now bear the new Mk. No. of F21 on the revised drawings and calculations forthcoming.***

On Drawing Exhibit D-1B, Figure 10;

c.) Revise Detail No. 5, dimension indicated from 'Grid' to Face of Concrete on the new Annex Building Monolithic Footing from "1'-0"" to "2'-11-1/2"". This revision will be effected in the revised drawings forthcoming.

d.) Revise Detail No. 2, dimension indicated from Top of Footing to Bottom of Footing from "2'-6"" to "Varies from 2'-6" to 3'-0" at some locations".

DIVERSIFIED DEVELOPMENT SERVICES COMPANY
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D-2i-002 SHT. 10/10

Since all the Footing revisions noted above result in new rectangular Footings with a beam configuration, reinforcing will need to be recalculated to satisfy flexural forces. Due to time constraints, these calculations will have to follow. You may anticipate receiving them by Fax no later than Friday, the 23th of August. Drawings reflecting these revisions will be sent to you by Federal Express on Friday as well.

Very Truly yours,

FREDERICK C. JACKSON

Frederick C. Jackson

ATG INC.

CALCULATION COVER SHEET

CALC. NO. D-26-003
No. of Sheets: 3

PROJECT ATG - MIXED WASTE FACILITY

PURPOSE
BUILDING FOOTING DESIGN FOR THE STORAGE BUILDING (WSFB)

SOURCES OF DATA
STRUCTURAL CALCULATIONS PROVIDED BY DIVERSIFIED DEVELOPMENT SERVICES COMPANY (ALL WEST INC.).

SOURCES OF FORMULAE & REFERENCES
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ATTACHMENT
—

CONCLUSION
FOOTING SIZE AND ARRANGEMENT INCORPORATED IN STRUCTURAL DWG 31001-S-002 SHTS S206, S207 REV. 0

PRELIMINARY CALC. ☐ **FINAL CALC.** ☒ **SUPERSEDES CALC. NO.** _____

REV. NO.	REVISION	BY:	DATE	CHECKED	DATE	APPROVED	DATE
0	ORIGINAL FINAL ISSUE	ALL WEST INC.	1996	S. Chin	2/10/98	[illegible]	3/14/98

D-27-003

STRUCTURAL CALCULATIONS
RIGID FRAME FOOTING/FOUNDATION SYSTEM
(Building Equipment Foundation Plan for the Storage Building)

FOR
ALLIED TECHNOLOGIES GROUP - ALL WEST CONSTRUCTION INCORPORATED
PROJECT LOCATION - RICHLAND, WASHINGTON

DESIGN CRITERIA:

WIND REGION 70 MPH, EXPOSURE C
SEISMIC ZONE 2B, I = 1.0
CONCRETE - f_c = 2500 PSI
REINFORCING STEEL - 30,000/40,000 PSI
SOIL BEARING PRESSURE 1,000 PSF (ASSUMED)

WILLIAM E. BOERGER
STATE OF WASHINGTON
20971
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 05/09/97

Job #9473_01 / Storage Building
Prepared by Diversified Development Services Company
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Land Planning Civil Engineering Financial Packaging Construction Mgmt

PROJECT NAME ATG STORAGE BLDG
PROJECT NO 9673-01 SHEET NO 1 OF MULT.
CALCULATED BY R. JACKSON DATE 1996/AUG/11
CHECKED BY WPB DATE 1996/AUG/
SCALE N/A

FOOTING (F4) @ GRIDLINES (1) & (A), (7) & (A) & GRIDLINES (1) & (E) & (7) & (E)
NOTE: COMBINED UPLIFT FORCE @ GRIDLINE COORDINATES (1) & (A) & (7) & (E) = 4.1K ←
" " " " " (1) & (E) & (7) & (A) = .9K ←

◆ FOOTING IS DESIGNED @ ALL (4) LOCATIONS BASED UPON MOST RESTRICTIVE = 4.1K UP
TOTAL AXIAL ↓ DN. = 5.1K

$\frac{5.1^K}{1.0^K}\sqrt{5.1\ FT^2} = 2.3\ FT$ ← = 13.22 CU/FT (@ 30" DEPTH)

CHECK UPLIFT (FTG. ONLY - NEGATE WALL/EARTH/SLAB) = NET ↑ = 4.1K ~ D/LD. FTG = (150)(13.22) = 1.98K N.G.
ADJUST FTG. ~ 3.5 FT² = (150)(30.62) = 4.5K > 4.1K OK
USE FTG. 3'-6" x 3'-6" x 2'-6" DEEP W/(6)#5 EA. WAY BOTTOM, (4)#5 L (CORNERS), (4) #5 L INTERMEDIATE ~ (3)#3 □ TIES TOP 5" @ -1" FROM T.O. FTG., BALANCE @ 8" O.C. VERT. ←

FOOTING (F2) @ GRIDLINES (1) & (B) & (7) (D) & GRIDLINES (1) & (D) & (7) & (B)
NOTE: COMBINED UPLIFT FORCE @ GRIDLINE CO-ORDINATES (1) & (B) & (7) & (D) = 5.7K ←
" " " " " (1) & (D) @ (7) (B) = 1.8K ←

◆ FOOTING IS DESIGNED @ 5.7K UP (SEE ◆)
TOTAL AXIAL ↓ DN. = 9.5K

$\frac{9.5^K}{1.0^K}\sqrt{9.5\ FT^2} = 3.0\ FT$ ← 22.5 CU/FT (@ 30" DEPTH) IS INSUFFICIENT FOR UPLIFT

CHECK UPLIFT W/TRIAL FTG. = 4.0 FT² = (150)(40.0) = 6.0K D/LD. FOOTING
NET ↑ = 5.7K ~ D/LD FTG. = 6.0K ~ 6.0K > 5.7K

USE FOOTING - 4'-0" x 4'-0" x 2'-6" DEEP W/(7)#5 EA. WAY BOTTOM, (4)#5 L VERT. (CORNERS), (4) #5 L INTERMEDIATE ~ (3)#3 □ TIES TOP 5" @ -1" FROM T.O. FTG., BALANCE @ 8" O.C. VERTICAL ←

FOOTING (F3) @ GRIDLINES (1) & (C) & GRIDLINES (7) & (C)

NET UPLIFT FORCE = 1.8K UP
TOTAL AXIAL ↓ DN. = 10.1K

$\frac{10.1^K}{1.0^K}\sqrt{10.1\ FT^2} = 3.2\ FT$ ← 25.6 CU/FT (@ 30" DEPTH)

CHECK UPLIFT = (150)(25.6) = 3.8K ~ NET ↑ = 1.8K ~ D/LD. FTG. = 3.8K ~ 3.8K > 1.8K OK ←
USE FOOTING 3'-3" x 3'-3" x 2'-6" W/(6)#5 EA. WAY BOTTOM, (4)#5 L VERT. (CORNERS), (4) #5 L VERT. INTERMEDIATE ~ (3)#3 □ TIES TOP 5" @ -1" FROM T.O. FTG., BALANCE @ 8" O.C. VERTICAL ←

2625 A WEST BRUNEAU PL. KENNEWICK, WA 99336
PHONE: (509) 735-4478 FAX: (509) 783-4245
Land Planning Civil Engineering Financial Packaging Construction Mgmt

PROJECT NAME ____
PROJECT NO. — SHEET NO. 2 OF MULT
CALCULATED BY — DATE —
CHECKED BY — DATE —
SCALE —

FOOTING (F1) @ GRIDLINES (2) THRU (6) ON GRIDLINE (A) & (B) GRIDLINES (2) THRU (6) ON GRIDLINE (E)

NET UPLIFT FORCE = 17.6K UP

TOTAL AXIAL + DN. = 37.3K ↑ 38.0K ←

$\frac{38.0K}{1.0K}\sqrt{38.0\ FT^2} = 6.2\ FT$ ← 95.0LB/FT. (@ 30" DEPTH)

CHECK UPLIFT = (150)(95.0) = 14.25K < 17.6K N.G.

ADJUST FTG. ~ 7.0 FT² = (150)(122.5) = 18.37K > 17.6K ←

NET ↑ UP = 17.6K ~ DWLD FTG. = 18.37K ~ 18.37K > 17.6K OK

USE FOOTING 7'-0" x 7'-0" x 2'-6" W/ (13) #5 EA. WAY BOTTOM, (4) #5 L VERT. (CORNERS), (2) #5 L VERT. EA. SIDE INTERMEDIATE [TOTAL (12) #5 L] ~ (3) #3 □ TIES TOP 5" @ ~1" FROM T.O. FTG., BALANCE @ 5" O.C. VERTICAL ←

WILLIAM F. BOEHM
STATE OF WASHINGTON
26971
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 05/09/97

ATG INC.

CALCULATION COVER SHEET

CALC. NO. D-26-004
No. of Sheets: 3

PROJECT ATG - MIXED WASTE FACILITY.

PURPOSE

BUILDING FOOTING DESIGN FOR THE STABILIZATION BUILDING (STB) (EXISTING BUILDING 13).

SOURCES OF DATA

STRUCTURAL CALCULATIONS PROVIDED BY ALL WEST CONSTRUCTION COMPANY

SOURCES OF FORMULAE & REFERENCES

—

ATTACHMENT

—

CONCLUSION

FOOTING SIZE AND ARRANGEMENT INCORPORATED IN STRUCTURAL DWG 31001-S-002 SHT. 202 REV. 0

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	BY:	DATE	CHECKED	DATE	APPROVED	DATE
0	ORIGINAL FINAL ISSUE	ALLWEST	1994	[illegible]	2/10/98	[illegible]	2/14/98

D-2i-004

STRUCTURAL FOOTING / FOUNDATION CALCULATIONS FOR A RIGID FRAME STEEL BUILDING

FOR
ATG / RICHLAND, WASHINGTON
CONTRACTOR: ALL WEST CONSTRUCTION COMPANY
7520 SKIPLEY ROAD
EVERETT, WASHINGTON 98205

BUILDING SIZE: 100'-0" X 150'-0"
SINGLE STORY - NON-HEATED SPACE
(BUILDING 13 - ~~NON THERMAL TREATMENT~~)
STABILIZATION BUILDING (STB)

CONTRACT CODE CONSULTANT SERVICES
P.O. BOX 1668
RICHLAND, WASHINGTON 99352
(509) 946-4876 (509) 967-3617

FOOTING / FOUNDATION CALCULATIONS
ALL WEST CONSTRUCTION COMPANY / ATG - RICHLAND

TABULATED SERVICE LOADS ARE PER STEEL BUILDING VENDORS REACTIONS

COLUMN LINES ARE AS FOLLOWS A-E & 1-7
FOOTING DESIGN 1 @ F1, 2 @ F2, 3 @ F3, 4 @ F4.

LINE A & (*)

ASSUMED SOIL BEARING PRESSURE @ 1,500 PSF WITHOUT SOILS REPORT (1.5 KIPS)

1. A & (1,7), AXIAL = 5.6 KIPS
(AXIAL = VERTICAL DOWN)

5.6/1.5= 3.7333[SQ.ROOT]
IS 1.93

FOOTING SIZE

2'-0" X 2'-0" X 2'-0" W/ (3) #5
E.W. BOTTOM, 3" CLEAR BOTTOM

2. E & (1,7) 5.6 KIPS
(AXIAL = VERTICAL DOWN)

SAME AS #1.

3. A & (2,3,4,5) = 18.3 KIPS
(AXIAL = VERTICAL DOWN)

18.3/1.5= 12.20[SQ.ROOT]
IS 3.5

FOOTING SIZE

3'-6" X 3'-6" X 2'-0" W/(6) #5
E.W. BOTTOM

4. E &(2,3,4,5) = 18.3 KIPS
(AXIAL = VERTICAL DOWN)

SAME AS #3.

5. A &(6) = 43 KIPS
(AXIAL = VERTICAL DOWN)

43/1.5= 28.6667[SQ.ROOT]
IS 5.5

FOOTING SIZE

5'-8" X 5'-8" X 2'-0" W/(8) # 5
E.W. BOTTOM

6. C &(2,3,4,5) = 47.2 KIPS

47.2/1.5= 31.47[SQ.ROOT]
IS 5.695 8"

FOOTING SIZE SAME AS # 5

7. D &(1,7) = 10.5 KIPS
(AXIAL = VERTICAL DOWN)

10.5/1.5=7.0[SQ.ROOT]
IS 2.65

FOOTING SIZE

2'-10" X 2'-10" X 2'-0" W/(5) #4
E.W. BOTTOM

8. B &(1,7) = 10.7 KIPS
(AXIAL = VERTICAL DOWN)

10.7/1.5=7.13[SQ ROOT]
IS 2.7

FOOTING SIZE

2'-10" X 2'-10" X 2'-0" W/(5) #4
E.W. BOTTOM

9. C &(1,7) 10.7 KIPS
(AXIAL = VERTICAL DOWN)

SAME AS # 8

FOOTING SCHEDULE

FOOTING MK#	FOOTING SIZE	REINFORCING
F1	5'-8" X 5'-8" X 2'-0"	(8) #5 BAR E.W. BOTTOM
F2	2'-10" X 2'-10" X 2'-0"	(5) #4 BAR E.W. BOTTOM
F3	3'-6" X 3'-6" X 2'-0"	(6) #5 BAR E.W. BOTTOM
F4	2'-0" X 2'-0" X 2'-0"	(3) #5 BAR E.W. BOTTOM

NOTE: SEE DRAWINGS FOR SEISMIC CAGE AT ANCHOR BOLT LOCATIONS, TYPICAL (4) #4 VERTICAL ON 12" CENTERS (6" MINIMUM 90 DEGREE LEG), (3) #3 TIES - TOP 5", BALANCE #3 TIES @ 8" O.C. MAXIMUM - TYPICAL ALL COLUMN / POST FOOTINGS) ALL FOOTINGS HAVE BEEN CHECKED FOR OVERTURNING MOMENT DUE TO UPLIFT FORCES PER THE STEEL BUILDING VENDORS REACTIONS, AND ARE FOUND TO BE WITHIN THE ALLOWABLE RANGE FOR SUCH FORCES.

ZAN MIN
STATE OF WASHINGTON
#28213
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 10/20/

17/97

CONTRACT CODE CONSULTING SERVICES
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RICHLAND, WASHINGTON
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ATG INC.

CALCULATION COVER SHEET

CALC. NO. D-2i-040

No. of Sheets: 6

PROJECT ATG - MIXED WASTE FACILITY.

PURPOSE

DESIGN OF CONCRETE SLAB ON COMPACTED SUBGRADE FOR STB, GVB, WSB, ACB

SOURCES OF DATA

SOURCES OF FORMULAE & REFERENCES

ATTACHMENT

CONCLUSION

ALL SLAB REINFORCEMENT HAVE BEEN INCORPORATED IN DWGS.

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	BY:	DATE	CHECKED	DATE	APPROVED	DATE
0	ORIGINAL ISSUE	K. LIU	2/13/98	C. CHI	2/13/98	[illegible]	2/14/98

D-2i-040

ATG CALCULATION SHEET

SHEET NO 1 OF 6

alg5.wk4

PROJECT NO :

SUBJECT : Concrete Slab on Grade
5" slab on exist slab - STB

MADE BY : K. Liu

CHECKED BY :

DATE : 02/13/98

New 5" Concrete Slab on Existing 6" Slab:

Data : Concrete fc' = 3000 psi @ 28 days Ec = 3122 ksi
fc' = 3300 psi @ 90 days Ec = 3274 ksi
μ = 0.15
Reinforcement fy = 60000 psi
Subgrade : 90 % compaction Ks = 400 pci = 0.400 kci
Slab thickness h = 5 inch
Fork Lift Wheel Load P = 14.5 kips per wheel DL + LL + I

Design :

Concrete rupture Stress fr = 7.5 (fc') ^ 0.5 = 431 psi
Wheel contact Area A = 53 sq. inch
Equivalent radius a = 4.1 inch
Slab Radius of Relative Stiffness r = ((Ec h ^3) / (12(1 - u ^2)Ks))^0.25
r = 17.19 inch 409250 4.6920

Concrete fiber stress fc = 974 psi > fr 1.9488
Required Reinforcement 0.239
Excess Stress = fc - 0.8 x fr = 630 psi 0.9776
M = Excess stress x b x h^2 / 6 = 31475 inch Lb 0.4889
= 2.623 kip ft/ ft
Mu = 1.7 M = 4.459 kip ft/ ft
d = 2.75 inch
Mu / (phi x fc' x b x d^2)= 0.198525
q = 0.2296
Req'd Reinf = q x fc' / fy = 0.012628 0.0168
As (req'd) = 0.417 sq inch/ ft
Provide # 5 @ 9" O. C. = 0.413 sq. inch / ft EW in one layers

4" MIN. SLAB AT A SMALL FLAT LOW POINT AREA -
GENERAL SLAB THICKNESS ≥ 5".

Allied Technology Group; 47375 Fremont Blvd. Fremont, CA 94538
Tel: 510-490-3008 Fax: 510-490-1032

D-2i-040

ATG CALCULATION SHEET

SHEET NO 2 OF 6

alg2.wk4

PROJECT NO :

SUBJECT : Concrete Slab on Grade
8" slab on grade — WSB

MADE BY : K. Liu

CHECKED BY :

DATE : 02/13/98

New 8" Concrete Slab on compacted subgrade:

Data : Concrete fc' = 3000 psi @ 28 days Ec = 3122 ksi

fc' = 3300 psi @ 90 days Ec = 3274 ksi

u = 0.15

Reinforcement fy = 60000 psi

Subgrade : 90 % compaction Ks = 250 pci = 0.250 kci

Slab thickness h = 8 inch

Fork Lift Wheel Load P = 14.5 kips per wheel DL + LL + I

Design :

Concrete rupture Stress fr = 7.5 (fc') ^ 0.5 = 431 psi

Wheel contact Area A = 53 sq. inch

Equivalent radius a = 4.1 inch

Slab Radius of Relative Stiffness r = ((Ec h ^3) / (12(1 - u ^2)Ks))^0.25

r = 27.50 inch 1676288 2.9325

Concrete fiber stress fc = 454 psi > fr 0.7613

Required Reinforcement 0.1494

Excess Stress = fc - 0.8 x fr = 109 psi 0.9579

M = Excess stress x b x h^2 / 6 = 14003 inch Lb 0.3865

= 1.167 kip ft/ ft

Mu = 1.7 M = 1.984 kip ft/ ft

d = 4.68 inch

Mu / (phi x fc' x b x d^2)= 0.030497

q = 0.03107

Req'd Reinf = q x fc' / fy = 0.00170885 0.0023

As (req'd) = 0.128 sq inch/ ft

Provide # 4 @ 12" O. C. = 0.20 sq. inch / ft EW in two layers

Allied Technology Group: 47375 Fremont Blvd. Fremont, CA 94538

Tel: 510-490-3008 Fax: 510-490-1032

D-21-040

ATG CALCULATION SHEET

SHEET NO 3 OF 6

alg3.wk4

PROJECT NO :

SUBJECT : Concrete Slab on Grade
6" slab on grade – GVB, STB (ANNEX)
– SLAB ON GRADE

MADE BY : K. Liu

CHECKED BY :

DATE : 02/13/98

New 6" Concrete Slab on compacted subgrade:

Data : Concrete fc' = 3000 psi @ 28 days Ec = 3122 ksi

fc' = 3300 psi @ 90 days Ec = 3274 ksi

u = 0.15

Reinforcement fy = 60000 psi

Subgrade : 90 % compaction Ks = 250 pci = 0.250 kci

Slab thickness h = 6 inch

Fork Lift Wheel Load P = 14.5 kips per wheel DL + LL + I

Design :

Concrete rupture Stress fr = 7.5 (fc') ^ 0.5 = 431 psi

Wheel contact Area A = 53 sq. inch

Equivalent radius a = 4.1 inch

Slab Radius of Relative Stiffness r = ((Ec h ^3) / (12(1 - u ^2)Ks))^0.25

r = 22.16 inch 707184 2.9325

Concrete fiber stress fc = 750 psi > fr 1.3533

Required Reinforcement 0.1854

Excess Stress = fc - 0.8 x fr = 405 psi 0.9658

M = Excess stress x b x h^2 / 6 = 29185 inch Lb 0.4305

= 2.432 kip ft/ ft

Mu = 1.7 M = 4.135 kip ft/ ft

d = 2.687 inch

Mu / (phi x fc' x b x d^2)= 0.192813

q = 0.22185

Req'd Reinf = q x fc' / fy = 0.01220175 0.0163

As (req'd) = 0.393 sq inch/ ft

Provide # 5 @ 9" O. C. = 0.41 sq. inch / ft EW in one layers

Allied Technology Group; 47375 Fremont Blvd. Fremont, CA 94538

Tel: 510-490-3008 Fax: 510-490-1032

D-2i-070

ATG CALCULATION SHEET

SHEET NO 4 OF 6

atg4.wk4

PROJECT NO :

SUBJECT : Concrete Slab on Grade
5" slab on grade — ACB

MADE BY : K. Liu

CHECKED BY : G. Chin

DATE : 02/13/98

New 5" Concrete Slab on compacted subgrade:

Data : Concrete fc' = 3000 psi @ 28 days Ec = 3122 ksi

fc' = 3300 psi @ 90 days Ec = 3274 ksi

u = 0.15

Reinforcement fy = 60000 psi

Subgrade : 90 % compaction Ks = 250 pci = 0.250 kci

Slab thickness h = 5 inch

Fork Lift Wheel Load P = 6 kips per wheel DL + LL + I

No wheel loads

Design :

Concrete rupture Stress fr = 7.5 (fc') ^ 0.5 = 431 psi

Wheel contact Area A = 53 sq. inch

Equivalent radius a = 4.1 inch

Slab Radius of Relative Stiffness r = ((Ec h ^3) / (12(1 - u ^2)Ks))^0.25

r = 19.33 inch 409250 2.9325

Concrete fiber stress fc = 424 psi > fr 0.8064

Required Reinforcement 0.2125

Excess Stress = fc - 0.8 x fr = 79 psi 0.9718

M = Excess stress x b x h^2 / 6 = 3958 inch Lb 0.461

= 0.330 kip ft/ ft

Mu = 1.7 M = 0.561 kip ft/ ft

d = 1.75 inch

Mu / (phi x fc' x b x d^2)= 0.06165

q = 0.06407

Req'd Reinf = q x fc' / fy = 0.00352385 0.0047

As (req'd) = 0.074 sq inch/ ft

Provide # 4 @ 12" O. C. = 0.20 sq. inch / ft EW in one layers

Allied Technology Group; 47375 Fremont Blvd. Fremont, CA 94538

Tel: 510-490-3008 Fax: 510-490-1032

CALCULATION SHEET

SUBJECT: Slab on Existing 6" slab

JOB NO.:

MADE BY: K. LIU

DATE: 3/13/13

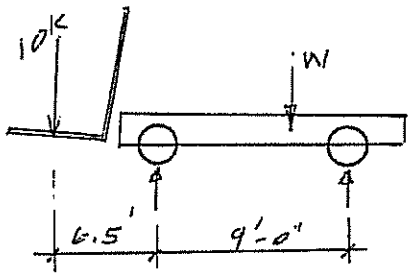
New 5" Concrete on (E) 6" slab:

$f_c' = 3000$ psi, $f_c' = 3300$ psi @ 90 days $\rightarrow E_c = 3274^{ksi}$

$\mu = 0.15$ for conc poison's ratio

Spring constant of subgrade, normally 150 pci for non-compacted soil. Since the base is a 6" (E) slab, assume $k_s = 400$ pci

Wheel load: <u>Fork Lift (10-kip capacity)</u>



unloaded 14.4^K

Loaded 24.4^K

with Impact $24.4(1+30\%) = 31.72^K$

85% on Drive wheel $= 27^{kip}$ (2 wheels)

$R_{max} = \frac{27}{2} = 13.5^K$

LL	17.2	-7.2
LL+I	22.4	-9.4
DL	7.2	7.2
	29.6^K	-9.4 ←

LL+I	22.4	-9.4
DL	5.0	+9.4
	27.4^K	0

Wheel Load: H-20 Loads → Single Axle Load

$= 24^K(1+30\%) = 31.2^{kip}$

$R_{max} = \frac{31.2}{2} = 15.6^{kip}$/wheel ← Governs

<u>Design for Fork Lift wheel load only</u>

$R_{max} = 13.5^{kip}$ use $P = 14.5^{kip}$ for desi

CALCULATION SHEET

D-21-040
SHEET NO 6 OF 6

SUBJECT: Slab on Existing 6" Slab

JOB NO.:

MADE BY: K. LIU

DATE: 2/13/98

Concrete Rupture Stress $f_r = 7.5\sqrt{f_c'} = 431$ psi

Wheel contact Area $= 53\ in^2$

Equivalent radius $a = \left(\frac{53}{\pi}\right)^{1/2} = 4.1^{in}$

Slab Radius of Relative Stiffness $r = \left(\frac{E_c h^3}{12(1-\mu^2)k_s}\right)^{1/4}$

Slab thickness $h = 5''$

$$r = \left[\frac{3274000 \times 5^3}{12(1-0.15^2) \times 400}\right]^{1/4} = 17.19^{in} \longrightarrow a/r = 0.23851$$

Concrete fiber stress f_c due to wheel load P.

$$f_c = \frac{3.36P}{h^2}\left[1 - \frac{(a/r)^{1/2}}{0.925 + 0.22\cdot\left(\frac{a}{r}\right)}\right] = \frac{3.36 \times 14.5}{5^2}\left[1 - \frac{(0.23851)^{1/2}}{0.925 + 0.22(0.23851)}\right]$$

$$= 0.975^{ksi} = 975 \text{ psi}$$

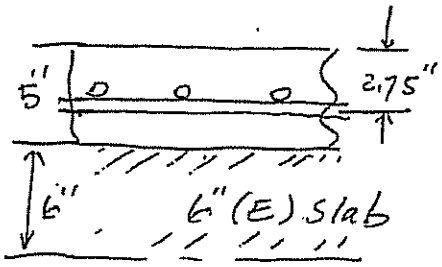
Excess fiber stress

$$\Delta f_c = 975 - 0.8 \times f_r = 630 \text{ psi}$$

Excess Moment $= \Delta f_c \times \frac{bh^2}{6} = 630 \times \frac{12 \times 5^2}{6} = 31500^{in\text{-}lb}$

$$M = 2.625^{1K/Ft}$$

$$M_u = 1.7M = 4463^{1\#/Ft}$$



$$\frac{M_u}{\phi f_c' b d^2} = 0.1986 \rightarrow \omega = 0.2298$$

$$\rho_m = \omega \times \frac{f_c'}{f_y} = 0.01264$$

$A_s(\text{req'd}) = \rho b d = 0.417^{in^2/Ft}$ use #5 @ 9" o.c $= 0.413^{in^2}$

ATG INC.

CALCULATION COVER SHEET

CALC. NO. D-2i-041

No. of Sheets: 5

PROJECT ATG - MIXED WASTE FACILITY

PURPOSE

FOUNDATION DESIGN - ACB
- GVB (UTILITY ROOM)
- WSB (COVERED STORAGE PAD)

SOURCES OF DATA

SOURCES OF FORMULAE & REFERENCES

ATTACHMENT

CONCLUSION

FOOTING SIZE INCORPORATED IN DWG S1001-S-002
SITE S205, S207, S214

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	BY:	DATE	CHECKED	DATE	APPROVED	DATE
0	ORIGINAL ISSUE	K. LIU	2/8/98	[illegible]	2/10/98	[illegible]	2/14/98

PB CALCULATION SHEET

W-2L-041

SHEET NO 1 of 5

SUBJECT : Access Control Bldg Foundations

JOB NO. :

CHKD BY : [illegible]

MADE BY : K. Liu

DATE : Feb-98

Footing @ (JJ) & (15)

Tributary Area $= \frac{19+29}{2} \times \frac{60}{2} = 720$ SQ Ft

Loads from Roof:

DL $= 15$ psf $\times 720 = 10\,800$ #

LL $= 20$ psf $\times 720 = 14\,400$ } $= 25{,}200$ #

Loads from walls

DL $= 10$ psf $\times 20 \times 1.4 = 2\,800$

Loads from Slab & FTG

DL $= 150 \times 4' \times 4' \times 2.5 = 6\,000$

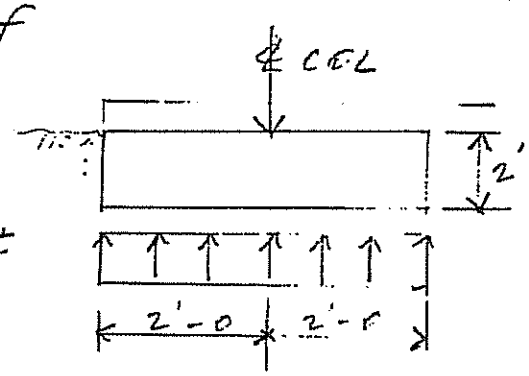
$\Sigma W = 34\,000$ #

Soil Pressure $q = \frac{\Sigma W}{A} = \frac{34\,000}{4' \times 4'} = 2125$ psf $< q_a$ OK

$q_a = 4000$ psf

Bott. Reinf:

Upward Bending M



$M = \frac{26\,000}{4 \times 4} \times \frac{2^2}{2} = 3500$ #/Ft

$M_u \cong 1.5M = 5250$ #/Ft

$\frac{M_u}{\phi f_c' b d^2} = 0.00421 \rightarrow \omega = 0.00422$ $\quad d = 24" - 3.5" = 20.5"$, $\phi = 0.9$, $f_c' = 3300$ psi

$\rho = \omega \times \frac{f_c'}{f_y} = 0.00423 \times 1.333 = 0.00031$

$A_s(\text{req'd}) = \rho b d = 0.08$ in²/Ft $\quad$ use #4 @ 12" $= 0.20$ in²/Ft

CHECK SHEAR $\quad V = \frac{31.375}{2} = 15\,688$ # $\rightarrow V_u = 1.5V$

$v_u = \frac{V_u}{0.85 \times 4 \times 12 \times 20.5} = 50$ psi $< v_c = 2\sqrt{f_c'} = 115$ psi

d

OK

SUBJECT : Access Control Bldg Foundations
MADE BY : K. Liu
JOB NO. :
CHKD BY : [illegible]
DATE : Feb-98

Footing @ (JJ) & (15) cont.

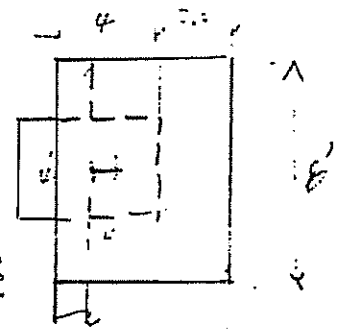
Top reinforcement (For uplift Reaction)

$$M = \frac{3375}{4 \times 4} \times \frac{2^2}{2} = 422\ ^{1\#}/_{ft} \longleftarrow \text{Negligible}$$

use #4 @ 12" c.c. E.W.

Check Max. uplift Reactions

The max upward reaction should be less than 80 % of the Dead Load of FTG + Slab.

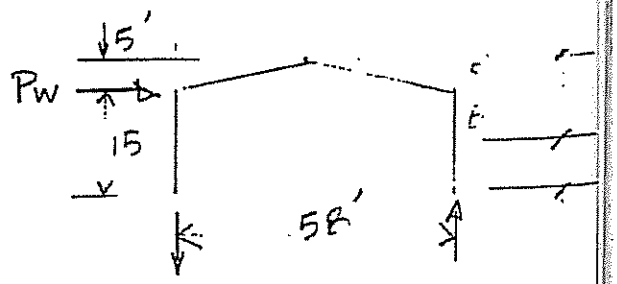


Footing wt = 3375#
Slab & ground = 150 × 2' × 6' × 0.5
2' × 4' × 0.5
2' × 4' × 0.5
$\Sigma W = 5775^{\#}$

∴ Max. Allow. uplift = 0.80(5775) = 4620

Possible uplift due to wind

$$R_w = 20psf \times \frac{48}{2} \times 13 \times \frac{15}{58} = 1614^{\#} < 4620^{\#} \text{ ok}$$



PB CALCULATION SHEET

SHEET NO 3 of 5

SUBJECT : Access Control Bldg Foundations

JOB NO. :

CHKD BY : C. Chi

MADE BY : K. Liu

DATE : Feb-98

Footing @ (KK) & (15)

Loads from Roof : $DL = 15psf \times \frac{30 \times 30}{4} = 3375^{\#}$

$LL = 20psf \times \quad '' \quad = 4,500^{\#}$

$= 12,075^{\#}$

Loads from wall $DL = .10psf \times (15+15) \times 14 = 4,200^{\#}$

DL from Slab & FTG $150 \times 3 \times 3 \times 2.5 = 3375$

$\Sigma W = 15450^{\#}$

Try 3' x 3' FTG

Soil Pressure $= \frac{\Sigma W}{3 \times 3} = 1717 psf < q_a = 4000 psf$ OK

Net. $p = \frac{12075}{3 \times 3} = 1342 psf$

$M = p \times \frac{1}{2} \times 1.5^2 = 1510'^{\#}/Ft \qquad M_u = 1.5M = 2264$

$\frac{M_u}{\phi f_c' b d^2} = 0.00181 \rightarrow \omega = 0.00182 \qquad D = 24''$

$\rho = \omega \times \frac{f_c'}{f_y} = 0.00010 \qquad d = 20.5''$

use #4 @ 12 $= 0.20 in^2/Ft$. Top & Bott EW

use F17 = 3' x 3' x 2'-6" OK

D-21-041

PB CALCULATION SHEET

SHEET NO 4 of 5

SUBJECT : Utility Bldg Foundations

MADE BY : K. Liu

JOB NO. :

CHKD BY : [illegible]

DATE : Feb-98

Footing @ (N) & (6.1) ; (P) & (6.1)

Loads from Roof : DL = 15psf × $\frac{40 \times 26}{4}$ = 3900 #
LL = 20psf × " = 5200 #
} = 11,900#

Loads from wall DL = 10psf × $\frac{40}{2}$ × 14 = 2800#

DL from Slab & FTG 150 × 3 × 3 × 2.5 = 3375

ΣW = 15275 #

Try 3' × 3' FTG

Soil Pressure = $\frac{\Sigma W}{3 \times 3}$ = 1697 psf < q_a = 4000 psf OK

Net p = $\frac{11900}{3 \times 3}$ = 1322 psf

M = p × $\frac{1}{2}$ × 1.5^2 = 1488 '#/Ft Mu = 1.5M = 2231

$\frac{M_u}{\phi f_c' b d^2}$ = 0.00188 → ω = 0.00182 D = 24"
d = 20.5"

ρ = ω × $\frac{f_c'}{f_y}$ = 0.00010

use #4 @ 12 = 0.20 in^2/Ft. Top & Bott EW

use F17 = 3' × 3' × 2'-6" OK

PB CALCULATION SHEET

D-21-041

SHEET NO 5 of 5

SUBJECT : Storage Building Foundation

MADE BY :

JOB NO. :

CHKD BY :

DATE : Feb-98

Footing @ Grid Lines (CC) & (11.5)

Roof Trib. Area $= \frac{42}{2} \times \frac{79}{2} = 830$ SQ FT

DL $= 15$ psf $\times 830 = 12,450$ #

LL $= 20$ psf $\times 830 = 16,600$ #

Loads from wall

DL $= 10$ psf $\times \frac{42}{2} \times 15 = 3150$

$= 33,050$ #

Wt of FTG $= 150 \times 4 \times 4 \times 2.5 = 6000$

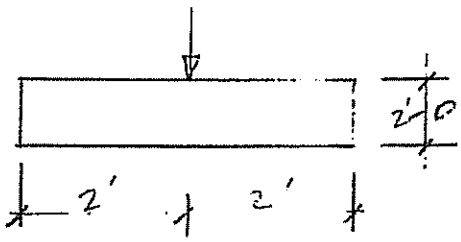
$\Sigma W = 39,050$ #

Bearing Pressure

$q = \frac{\Sigma W}{4 \times 4} = 2439$ psf $< q_a = 4000$ #/ft² rk

Footing Reinf

$M = \frac{33050}{4 \times 4} \times \frac{2^2}{2} = 4129$ '#/ft



$M_u = 1.5M = 6194$ '#/ft

$d = 24'' - 3.5 = 20.5''$

$\frac{M_u}{\phi f_c' b d^2} = 0.00496 \rightarrow \omega = 0.00496$

$\rho_{min} = \omega \times \frac{f_c'}{f_y} = 0.00027 \times 1.33 = 0.00036$

A_s(req'd) $= \rho b d = 0.09$ in²/ft use #4 @ 12 E.W T & B.