TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

February 12, 1981

Director of Nuclear Reactor Regulation
Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Schwencer:

In the Matter of the Application of) Docket Nos. 50-390
Tennessee Valley Authority) 50-391

Enclosed are five (5) copies of the information on Category I masonry walls at Watts Bar Nuclear Plant requested by S. A. Varga's letter dated April 21, 1980. We are continuing to evaluate the use of nonreinforced concrete masonry walls in Category I structures at Watts Bar and expect to supply you with additional information by June 1, 1981.

If you have any questions, please get in touch with D. L. Lambert at FTS 857-2581.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills, Manager
Nuclear Regulation and Safety

Sworn to and subscribed before me
this 12th day of Feb. 1981

Bryant M. Lowery
Notary Public
My Commission Expires 4/4/82

Enclosure (5)

NEED 2 R.id's
LETTER + Encl.
B001
s
1/1
DRAWINGS
B028
s
1/6
Aperture D.st.

8102200520

A

ENCLOSURE

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
RESPONSE TO INFORMATION REQUEST
CATEGORY I MASONRY WALLS EMPLOYED
BY PLANTS UNDER CONSTRUCTION PERMIT
AND OPERATING LICENSE REVIEW

Question

1. Are there any concrete masonry walls being used in any of the category I structures of your plant?

Response

There are reinforced concrete masonry walls in the category I structures at WBN and they are located as identified below:

Control building - At floor slab elevations 692 and 755

Auxiliary Building - At floor slab elevations 737 and 782

Diesel-generator building - At floor slab elevations 742 and 760.5

Question

2. Indicate the loads and load combinations to which the walls were designed to resist. If load factors other than 1 have been employed, please indicate their magnitudes.

Response

The reinforced concrete masonry walls were designed to resist the loads and load combinations as defined by "Design Criteria for Reinforced Concrete Block Walls," WB-DC-20-23 (shown in appendix A). As indicated by this criteria, no load factors other than 1 have been utilized.

Question

3. In addition to complying with the applicable requirements of the Standard Review Plan (SRP) sections 3.5, 3.7, and 3.8, is there any other code, such as the "Uniform Building Code" or the "Building Code Requirements for Concrete Masonry Structures" (proposed by the American Concrete Institute) which was or is being used to guide the design of these walls? Please identify and discuss any exceptions or deviations from the SRP requirements or the aforementioned codes.

Response

The structural design of the walls was completed in accordance with the previously referenced design criteria (WB-DC-20-23). This criteria utilizes a working stress design method with specified allowable stresses for flexure and shear in the concrete block, concrete, and reinforcing for each of the load combinations. No other code was utilized in the design of these walls and no exceptions or deviations were taken from the applicable requirements of sections 3.5, 3.7, and 3.8 of the SRP.

Question

4. Indicate the method that you used to calculate the dynamic forces in masonry walls due to earthquake; i.e., whether it is a code's method such as Uniform Building Code or a dynamic analysis. Identify the code and its effective date if the code's method has been used. Indicate the input motion if a dynamic analysis has been performed.

Response

The dynamic forces acting on the reinforced concrete block walls were determined by classical dynamic analysis techniques as discussed in Introduction to Structural Dynamics by J. M. Biggs. Initially, two boundary condition types and two block sizes were identified as being common to block walls at WBN. Using this data and the live and dead loads of these walls, a family of curves indicating the height versus period relationship were calculated and are shown in figure A of "Design Criteria for Reinforced Concrete Block Walls," WB-DC-20-23. Each building containing block walls was seismically analyzed according to section 3.7 of the WBN Final Safety Analysis Report (FSAR), and a report containing acceleration response spectra for the various floor elevations was written for each building. For each wall considered, the period of the wall from figure A and the appropriate response spectra yielded a uniform acceleration that was used to calculate earthquake loads. The calculated dynamic loads were evaluted using the criteria contained in the aforementioned design criteria.

Question

5. How were the masonry walls and the piping/equipment supports attached to them designed? Provide enough numerical examples including details of reinforcement and attachments to illustrate the methods and procedures used to analyze and design the walls and the anchors needed for supporting piping/equipment (as applicable).

Response

The masonry walls were designed for dead load, live load, one-half safe shutdown earthquake, and safe shutdown earthquake loads as outlined in Design Criteria WB-DC-20-23. A calculation illustrating the design of a typical reinforced concrete masonry wall is shown in appendix A. The details of the walls to include concrete placement in the block cells, reinforcement of the block cells, and mortared joints and attachment of the masonry walls to concrete slabs and walls are illustrated in the drawings listed below.

The attachments to the reinforced concrete masonry walls were designed to resist the loads and load combinations as defined in "Design Criteria for Seismically Qualifying Conduit Supports," SQN-DC-V-13.10 and "Design Criteria for Seismically Qualifying Conduit Supports," WB-DC-40-31.10. Each of these criteria provides tabulated results of a computer generated seismic analysis for a range of conduit sizes and lateral support spacings. The results from these seismic analyses were combined and two tables (shown in appendix A) were constructed to reflect the maximum vertical, lateral, and axial reactions and the maximum span distances for both steel and aluminum conduits.

Details of various attachments to the reinforced concrete masonry walls along with a calculation illustrating the capacity of a typical support are shown in appendix A.

An investigation of the inplace attachments to the walls was conducted by Sequoyah and Watts Bar Design Projects (SWP) and compliance with Design Criteria WB-DC-20-23 has been verified.

Question

6. Provide plan and elevation views of the plant structures showing the location of all masonry walls for your facility.

Response

Locations of all reinforced concrete masonry walls in the category I structures at Watts Bar Nuclear Plant are shown on the following drawings shown in Appendix B:

46W401-5 R3	46W405-2 R4
46W401-6 R6	46W405-3 R7
46W401-8 R2	46W405-4 R4
46W402-1 R7	16W418-2 R6
46W402-2 R12	16W419-1 R0
46W405-1 R3	16W419-2 R2

APPENDIX A

TENNESSEE VALLEY AUTHORITY

Division of Engineering Design

PLANT: WATTS BAR NUCLEAR PLANT

Design Criteria
For

REINFORCED CONCRETE BLOCK WALLS

Design Criteria No: WB-DC-20-23

Issue Date: December 22, 1972

	Revision RO	R1	R2	R3	R4	R5
	Date	6/27/80				
Prepared	B.W. Whittier *					
Supervised	—					
Reviewed						
Submitted						
Approved						
Reviewed NTSS Vendor	N/A					

TVA 10566 (6-72)

TVA 10167 (DED-6-71)

Thermal Power Engineering Branches						Thermal Power Design Project						Architectural, Hydro, & Special Projects Engineering & Design Branches							
MEB		FEB		CEB		Project Manager				R	A	AD		ME&D		CE&D		EE&D	
R	A	R	A	R	A	MD		ED		CD		R	A	R	A	R	A	R	A
						R	A	R	A	R	A								
NEB																			
R	A																		

COORDINATION LOG

Plant: [illegible]

Design Criteria No: [illegible]-DC-20-73

Design Criteria For: [illegible]

Revision: 1

R – Denotes review

A – Denotes approval

TVA

Title: WATTS BAR NUCLEAR PLANT DESIGN CRITERIA FOR REINFORCED CONCRETE BLOCK WALLS

REVISION LOG

WB-DC-20-23

Revision No.	DESCRIPTION OF REVISION	Date Approved
1	1. Paragraph 2.0 revised: a. To require concrete-filled cores in security walls b. To provide for grouted-in dowels 2. Paragraph 3.1 revised: a. Change concrete block to Grade N, Type I b. Add requirements for horizontal reinforcement 3. Paragraph 3.2 revised: a. Add weights of core-filled walls b. Change flexure stress basis from gross area to net area 4. Paragraph 4.0 revised to update assignments of design responsibility.	

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this design criteria document is to establish a guide for the designer and checker to assure design uniformity and to assure that a safe and complete design of reinforced concrete block walls is achieved.

2.0 GENERAL DESCRIPTION

These criteria are provided for use in the design of reinforced concrete block walls for all seismic Class I structures of this project. In addition, they may be used for Class II and III structures.

Standard concrete blocks with closed ends and two cores will be used to permit the placement of one or two layers of vertical reinforcement at 8 inches on cener or 16 inches on center. Only the cores that have reinforcement in them will be filld with concrete unless the wall is required for security or shielding. In these cases all cores will be filled with concrete. The wall will be designed to withstand horizontal and vertical forces due to earthquake and equipment loads. R1

All openings in the walls at floor level will have to be sized so dowels in the structural slabs can be designed and located before the structural slabs are constructed. After structural slabs are constructed, grouted-in dowels will be required to seismically qualify the concrete block walls. Other openings in the walls, including spare openings and sleeves by the mechanical and electrical design groups, will have to be sized, located, and designed before the block walls are installed. The spare openings and sleeves are to be filled in with concrete by the field if they are not required. R1

The lintels shall be designed for load distribution by TVA standards for short loose lintels. Only the portion of the lintel that is cast-in-place concrete will be used for design. For wall spans in the vertical direction only the net area of block and the cores filled with concrete will be used for design.

Concrete block wire reinforcement shall be used in the bed joints of alternate courses of all concrete block walls. Corner and tee partition lock fittings shall be used at all wall intersections. Walls that extend to the slab above will either be doweled into the slab or restrained by continuous angles anchored to the slab on both sides of the wall.

Concrete in the cores shall be placed in lift intervals or layers not to exceed 24 inches. Each layer shall be thoroughly consolidated and tied into the layer below by either rodding or internal vibration.

3.0 DESIGN CONSIDERATIONS

3.1 Materials

Materials	Specifications	
Concrete block	Full length lightweight two core closed end. ASTM Designation C90, Grade N, Type I. Compressive strength = 1000 psi on gross area.	R1
Sand	ASTM Designation C144	
Portland cement	ASTM Specification C150, Type I or II	
Coarse aggregate	ASTM Specification C33, maximum size aggregate 3/4 inch; slag is not acceptable	
Concrete	One part cement, 2-1/2 part sand, 2-3/4 part coarse aggregate, by weight, 6 gallons of water per bag of cement for lintels (maximum), 7 gallons of water per bag of cement for core fill (maximum)	
Reinforcement (Vertical)	ASTM Specification A615, Grade 60. Additional testing shall be carried out in accordance with Construction Specification G-2.	R1
(Horizontal)	Block wire reinforcement shall be standard grade with No. 9 side rods and No. 9 crossties and shall comply with ASTM A82.	

3.2 Load Combination and Allowable Stresses

Loads:

D = Dead Load.

Weight of wall with every other core filled with concrete. 8-inch wall = 62#/sq ft
12-inch wall = 94#/sq ft

Weight of wall with every core filled with concrete. 8-inch wall = 86#/sq ft
12-inch wall = 133#/sq ft R1

L = Live Load. (Vertical) — 20#/sq ft on one side of wall or 10#/sq ft on each side of wall. Spacing of equipment and piping supports, restraints, and anchors shall be controlled so that these live loads are not exceeded.

*E = 1/2 safe shutdown earthquake (1/2 SSE)
*E' = Safe shutdown earthquake (SSE)

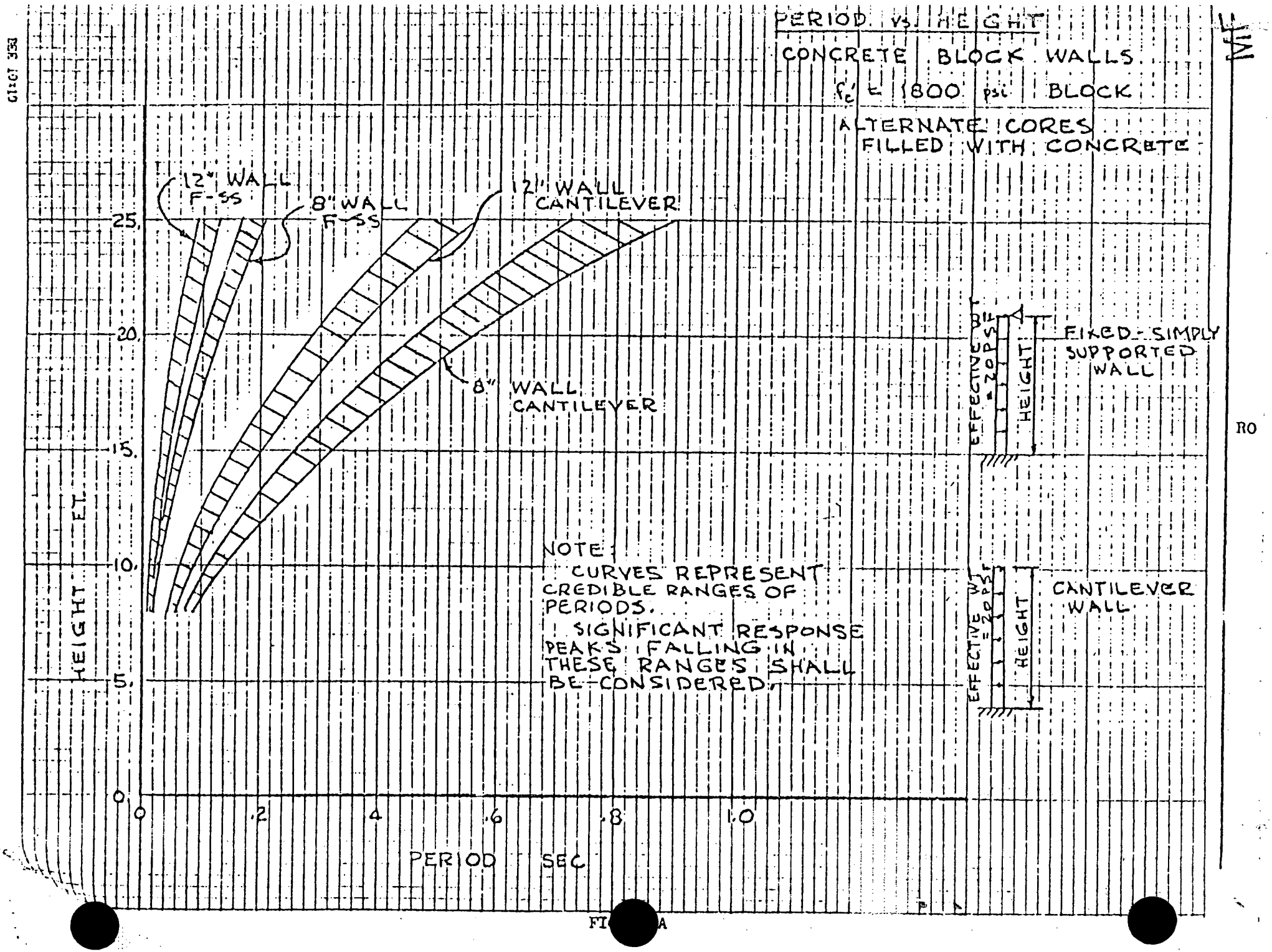
Load Combinations	Allowable WSD Stresses	Shear
Case I = D+L	Block with alternate cores filled--810 psi on net area	47 psi
	Block with every core filled--900 psi	55 psi
	Concrete--1350 psi (lintel)	60 psi
	Reinforcing steel--24,000 psi	-
Case II = D+L+E	Same as above except, reinforcing steel = 30,000 psi	
Case III = D+L+E'	Block with alternate cores filled--1350 psi on net area	78 psi
	Block with every core filled--1500 psi	92 psi
	Concrete--2250 psi (lintel)	100 psi
	Reinforcng steel--54,000 psi	-

*The natural period of vibration for concrete block walls will be considered. Periods to be used in conjunction with appropriate floor response spectra area given in Figure A. (These periods are based upon one-way action, more refined analysis is acceptable.)

4.0 RESPONSIBILITY

The civil group of the design project is assigned responsibility for the design of the reinforced concrete block walls in the auxiliary control, reactor, and diesel generator buildings. This group is also responsible for the design of the structural steel restraints where needed to support the top of the walls.

Detailed construction drawings will be made by the Architectural Design Branch. The Architectural Design Branch drawings will show each section of these walls in full elevations.


PERIOD VS. HEIGHT
CONCRETE BLOCK WALLS
f'c = 1800 psi BLOCK
ALTERNATE CORES FILLED WITH CONCRETE
12" WALL F-SS
8" WALL F-SS
12" WALL CANTILEVER
8" WALL CANTILEVER
FIXED - SIMPLY SUPPORTED WALL
EFFECTIVE HEIGHT
W = 20 PSF
CANTILEVER WALL
NOTE:
CURVES REPRESENT CREDIBLE RANGES OF PERIODS.
SIGNIFICANT RESPONSE PEAKS FALLING IN THESE RANGES SHALL BE CONSIDERED.
HEIGHT FT.
PERIOD SEC
0
5
10
15
20
25
.2
.4
.6
.8
1.0

CONTROL BLDG. - PSO ENGINEER SHOP — WBNP

NEW CONC. CEILING. FIRE PROTECTION

EI 755

COMPUTED DHS DATE 5-27-

CHECKED MGM DATE 6-E-7

SCOPE OF PROBLEM

PROVIDE A 7" THICK ROOF SLAB OVER P.S.O. ENGINEER SHOP IN CONTROL BLDG. ROOF TO SPAN 9'-5" FROM SIDE OF 10" CONCRETE WALL TO TOP OF 8" BLOCK (UNREINFORCED) WALL

We are requiring to be reinforced MGM

- USE 3" TYPE NCY 18GA. METAL DECK.
- HOLD BOTTOM OF BLOCK WALL WITH ANGLES AND REINFORCE VERTICALLY AS NEEDED, TYING THE REINF. INTO THE ROOF SLAB.
- USE LEDGE ANGLE AT CONC. WALL TO SUPPORT ROOF SLAB.
- DESIGN SLAB TO CARRY ITSELF + 50 psf LL.
- ENTIRE SYSTEM MUST QUALIFY SEISMICALLY

LOADING CRITERIA SEE WB-DC-20-23

WALL - 8"x8"x16" CONC. BLK W/ ALT. CELLS FILLED

D.L. = 62 psf pg. 3.

L.L. = 20 psf (ONE SIDE) pg. 3

ROOF - 7" CONC. SLAB ON 18 GA. METAL DECK

D.L = 75 psf

L.L. = 50 psf PER MGM.

CONTROL BLDG - P.S.O. ENGINEER SHOP — WSNP

NEW CONC. CEILING - FIRE PROTECTION

COMPUTED DHS DATE 5-27-

CHECKED [illegible] DATE 6-2-7

ALLOWABLE STRESSES

CASE I D+L — Block f_c = 810 psi
Reinf. steel f_s = 24000 psi

CASE II D+L+½ SSE — Block f_c = 810 psi
steel f_s = 30000 psi

CASE III D+L+SSE — Block f_c = 1350 psi
steel f_c = 54,000 psi

FROM CHART IN FIG A. WB-DC-20-23
FOR 8" BLOCK WALL 8'-8" HIGH.

PERIOD = .02 SEC.

FROM SPECTRAL RESPONSE CURVE:

HORIZ. ACCEL. = .4 FOR ½ SSE 2% DAMPING

VERT. ACCEL = .12 " "

HORIZ ACCEL. = .8 FOR SSE 5% DAMPING

VERT ACCEL. = .24 " "

CONTROL BLDG. - P.S.O. ENGINEER SHOP WBNP.

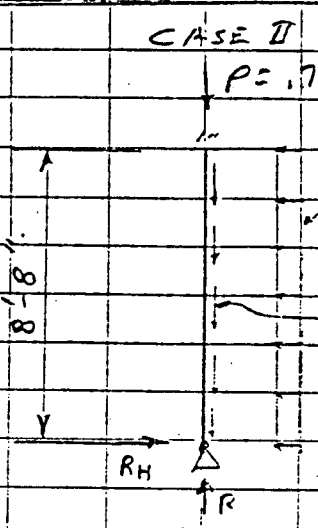
NEW CONC. CEILING. - FIRE PROTECTION.

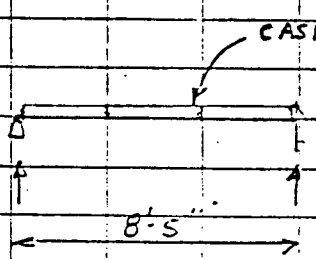
COMPUTED DHS DATE 5-27-

CHECKED MGH DATE 6-5-

DESIGN OF WALL (1'STAIR) ROOF

CASE II





$R_L = \frac{3}{8} wl = \frac{3(.125)(8.42)}{8} = .395$ k

$R_R = \frac{5}{8} wl = .658$ k

$P = R_R(1+A_V) = .658(1.12) = .737$ k.

$W = (D+L)(A_H) = .082(.4) = .0328$ k/f

$W_V = D_L(1+A_V) + L_L = .062(1.12) + .02 = .0894$

$R = .737 + .0894(8.67) = 1.51$ k.

FOR ROOF $M_R = \frac{wL^2}{8} = \frac{.125(8.42)^2}{8} = 1.11$ ft-k

FOR WALL $M_{TOP} = \frac{wL^2}{8} = \frac{.0328(8.67)^2}{8} = .308$ ft-k

$M_{MID} = \frac{9}{128} wl^2 = \frac{9(.0328(8.67)^2}{128} = .173$ ft-k.

$R_H = \frac{3}{8} wl = \frac{3}{8}(.0328)(8.67) = .107$ k.

$R_{TOP} = \frac{5}{8} wl = .178$ k

TVA-469 (REV-9-47)

SHEET 5 OF

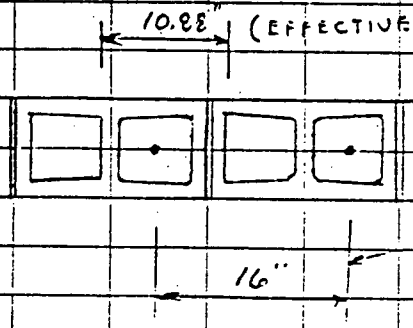
CONTROL BLDG. P.S.O. ENGINEER SHOP WBNP

NEW CONC. CEILING. - FIRE PROTECTION

COMPUTED DHS DATE 5-31

CHECKED [illegible] DATE [illegible]

INVESTIGATE BLOCK SECTION



LOADS FOR 16" M = .308 X 1.33 = .41 I-K

V = .178 X 1.33 = .237 K

f'_m = 1800 psi $E_c = 1000 f'_m = 1.8 \times 10^6$

FROM ACI SP3 p. 23 Ex. 9

$n = \frac{29}{1.8} = 16.1$

b = 10.88

d = 3.81

A_s = .31

$m = q = \frac{nA_s}{bd} = \frac{16.1(.31)}{10.88(3.81)} = .12$

FROM TABLE 11 K = .384

FROM TABLE 13, Z = .35 J = .873

$f_s = \frac{12000 M}{Jd A_s} = \frac{12000(.41)}{.873(3.81)(.31)} = .4771 f_s'$

$f_c = \frac{f_s}{n} \times \frac{k}{1-k} = \frac{4771}{16.1}\left(\frac{.384}{1-.384}\right) = 185$ psi

AXIAL STRESS $\frac{1.5 \text{ k}(1.33)}{10.88(7.62)} = .0242$ ksi. OR 24 psi

TVA 489 (REV. 9-47)

SHEET 6 OF

CONTROL BLDG. DSO ENGINEER SHOP — WBNP

NEW CONC. CEILING - FIRE PROTECTION

COMPUTED DHS DATE 5-31-

CHECKED LRG DATE 6-15-7

SUMMARY FOR WALL

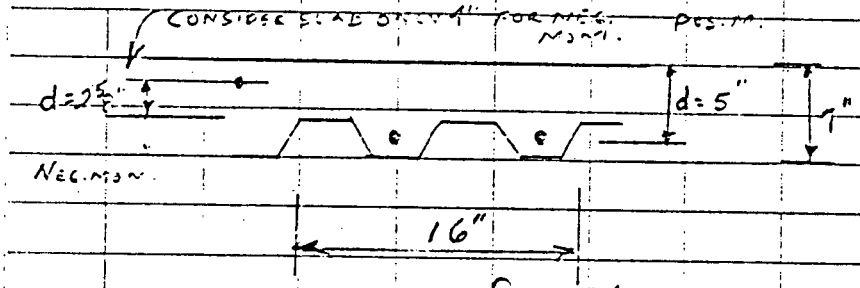
FOR I & SSE. $f_{s_{all}} = 30000 > 9480$ OK.

$f_{c_{all}} = 810 > 185$ OK.

FOR SSE $f_s = 2(9480) = 9000 < 54000$ OK.

$f_c = 2(185) = 390 < 1350$ OK.

ROOF SLAB



$f_s = 24000$

FOR $f'_c = 3000$ $f_c = 60000$ $q = 1.76$ SP3 p 81

NEG. MOM. CASE I D+L

$A_s = \frac{M}{qd} = \frac{1.11}{1.76(2.4)} = .24$ #6@16" $A_s = .337.24$

USE #4@8" BOT. (1 BAR IN EACH TROUGH) $A_s = .2$

USE #6@16" TOP @ CORNER EXTEND BARS 4/5 (SPLICE W/ VERT BARS)

OK $\frac{8.4}{3} = 2.8'$ SAY 3'-0"

FOR CASE II D+L+½SSE $f_s = 30,000$

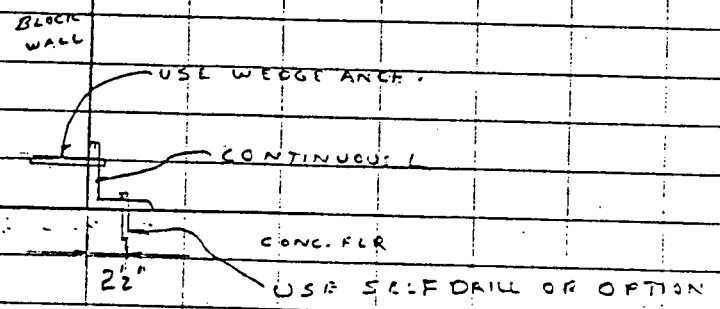
$w = .125 \times 1.12 = .14$ K/Ft

$M = 1.11 \times 1.12 = 1.24$ in-K

$A_s = \frac{1.24(12)}{30(7/8)(2.4)} = .22 / \text{in}^2 < .33$ OK

CONNECTION TO FLOOR

REF CIVIL DESIGN STD DS-C6.1



ANGLE @ FLOOR FOR WALL.

LOAD = .107K/FT = R_H

ASSUME ANCHORS @ 32" LOAD = .107 × 32/12 = .285K.

BENDING IN ANGLE: $M = \frac{wl^2}{8} = \frac{.107(2.67)^2}{8} = .095^{1-1K}$.

$S_{req} = \frac{M}{\sigma} = \frac{.095(12)}{22} = .052\ in^3$

L 4 × 4 × ¼ S = 1,65 7,05 OK.

USE ½" PHILLIPS WEDGE ANCHORS IN WALL @ 32" OC ALLOW LD: 2.1K. > .29 OK

USE ½" PHILLIPS SELF DRILL ANCHORS IN FLOOR OR GIVE OPTION ALLOW LD = 1.45K < 2.2 OK

REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPD

DSGN T.E. LANTZ
DRWN T.E. LANTZ
CHKD A.J. TUDBURY
SUPV
INSP
ENGINEER

COND. SIZE	STAT. LOAD			SEISMIC LOADS (STEEL)									PHYS. MAX. NO. COND.	FINAL MAX. NO. COND.
	STL. COND. PER MAX. SPAN			VERTICAL			LATERAL			AXIAL (MAX.)				
	MAX. LOAD	SPAN LOAD	MAX. NO. COND	MAX. LOAD	SPAN LOAD	MAX. NO. COND.	MAX. LOAD	SPAN LOAD	MAX. NO. COND.	MAX LOAD	SPAN LOAD	MAX. NO. COND.		
1/2"		4.73			8.0			8.0			6.9			
3/4"		6.55			11.0			10.0			9.6			
1" SEQ.		20.4			25.0			71.0			29.9			
1" W.B.		10.2			17.0			14.0			14.95			
1 1/2"		33.6			55.0			137.0			49.1			
2"		48.0			79.0			77.0			70.1			
2 1/2"		83.9			138.0			150.0			122.5			
3"		120.9			199.0			205.0			176.5			
4"		155.1			255.0			229.0			226.45			
5"		218.0			358.0			304.0			318.3			

MAX SPAN								
1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	5"
5'	5'	5'□	10'*	10'*	10'	10'	10'	10'

*9' SPAN DIESEL GEN. BLDG. W.B.
□ 10' SPAN SEQ.

CONDUIT TABLE (STEEL)

DESIGN INFORMATION

SEQ. & W.B. NUCLEAR PLANTS
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

KNOXVILLE

SUBMITTED

RECOMMENDED

APPROVED

RECORD COPY AS CONSTRUCTED

COND SIZE	STAT. LOAD			SEISMIC LOADS (ALUM.)									PHYS MAX. NO. COND	FINAL MAX. NO. COND.
	ALUM. CABLE PER MAX SPAN			VERTICAL			LATERAL			AXIAL				
	MAX. LOAD	SPAN LOAD	MAX. NO. COND.	MAX. LOAD	SPAN LOAD	MAX. NO. COND.	MAX LOAD	SPAN LOAD	MAX. NO. COND.	MAX. LOAD	SPAN LOAD	MAX NO COND.		
1/2"		2.27			4			4			3.3			
3/4"		3.29			5			5			4.7			
1" SEQ.		11.06			14			55			16.15			
1" W.B.		5.53			9			8			8.1			
1 1/2"		16.46			27			67			24.0			
2"		27.48			45			133			40.1			
2 1/2"		51.67			85			150			75.4			
3"		78.7			129			129			114.9			
4"		95.11			156			162			138.9			
5"		135.8			223			206			198.2			

MAX. SPAN								
1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	5"
5'	5'	5' □	9' *	10' ‡	10' ‡	10' ‡	10'	10'

* 8' SPAN IN DEISEL GEN. BLDG. W.B., 10' SPAN SEQ.
‡ 9' SPAN IN DEISEL GEN. BLDG. W.B.
□ 10' SPAN SEQ.

DESIGN INFORMATION

CONDUIT TABLE (ALUMINUM)

SEQ & W.B. NUCLEAR PLANTS
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

DSGN T.E. LANTZ
DRWN T.E. LANTZ
CHKD A.J. TUDLEY
SUPV

REV NO | ECN NO | DATE | DSGN | DRWN | CHKD | SUPV | ENGR | INSP | SUBM | RECM | APPD

INSP
ENGINEER

KNOXVILLE | SUBMITTED | RECOMMENDED | APPROVED

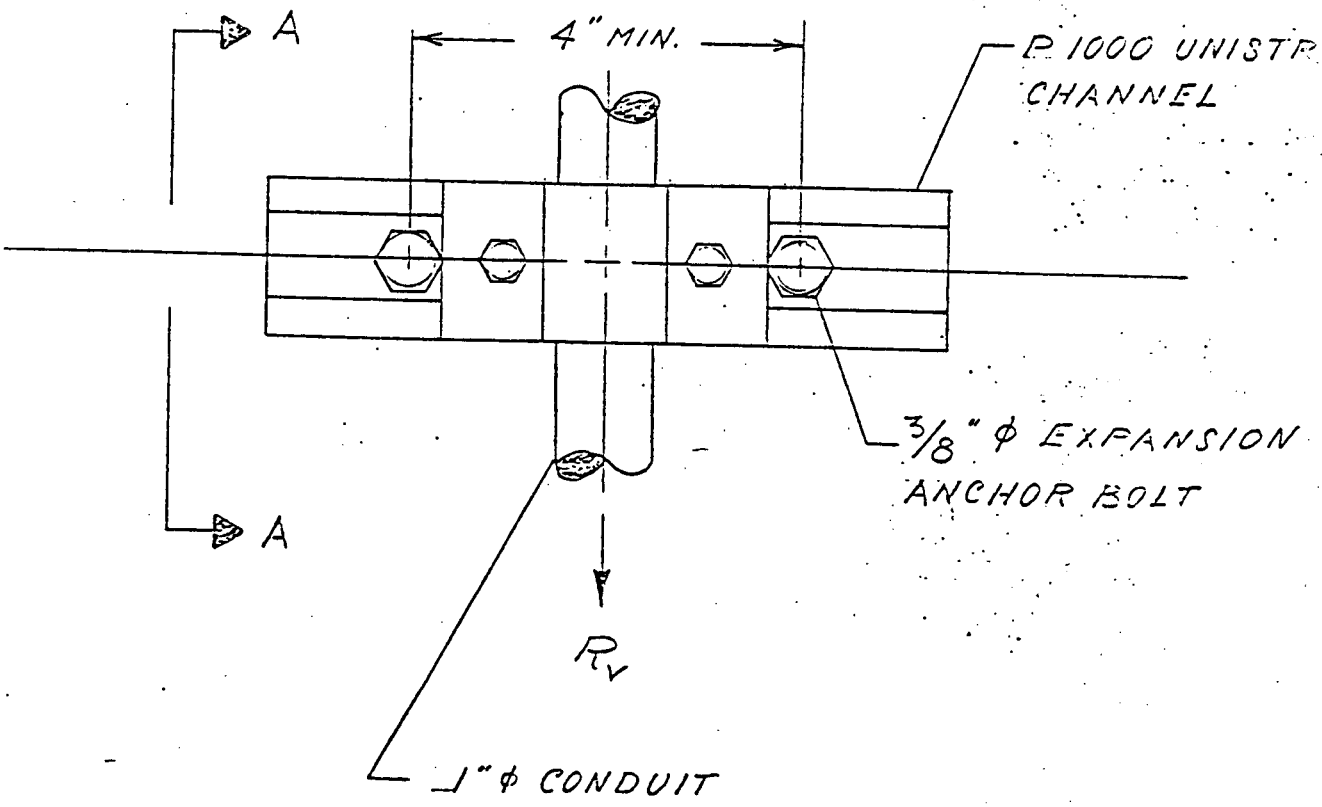
CONDUIT SUPPORT ATTACHMENTS IN SEISMICALLY QUALIFIED CONCRETE BLOCK WALLS

SHEET 1 OF 4

COMPUTED LW DATE 10-1

CHECKED WJG DATE 1+ OCT 8

BASED ON THE FOLLOWING "WORSE CASE" LOADING CONDITION



FACTORED DESIGN LOAD IN TENSION FOR 3/8 INCH SELF DRILLING EXPANSION ANCHOR =
1500 X 0.66 X 1.2 = 1200 LB.
(REF. CIVIL DESIGN STANDARD DS-C6.1, TABLE II)

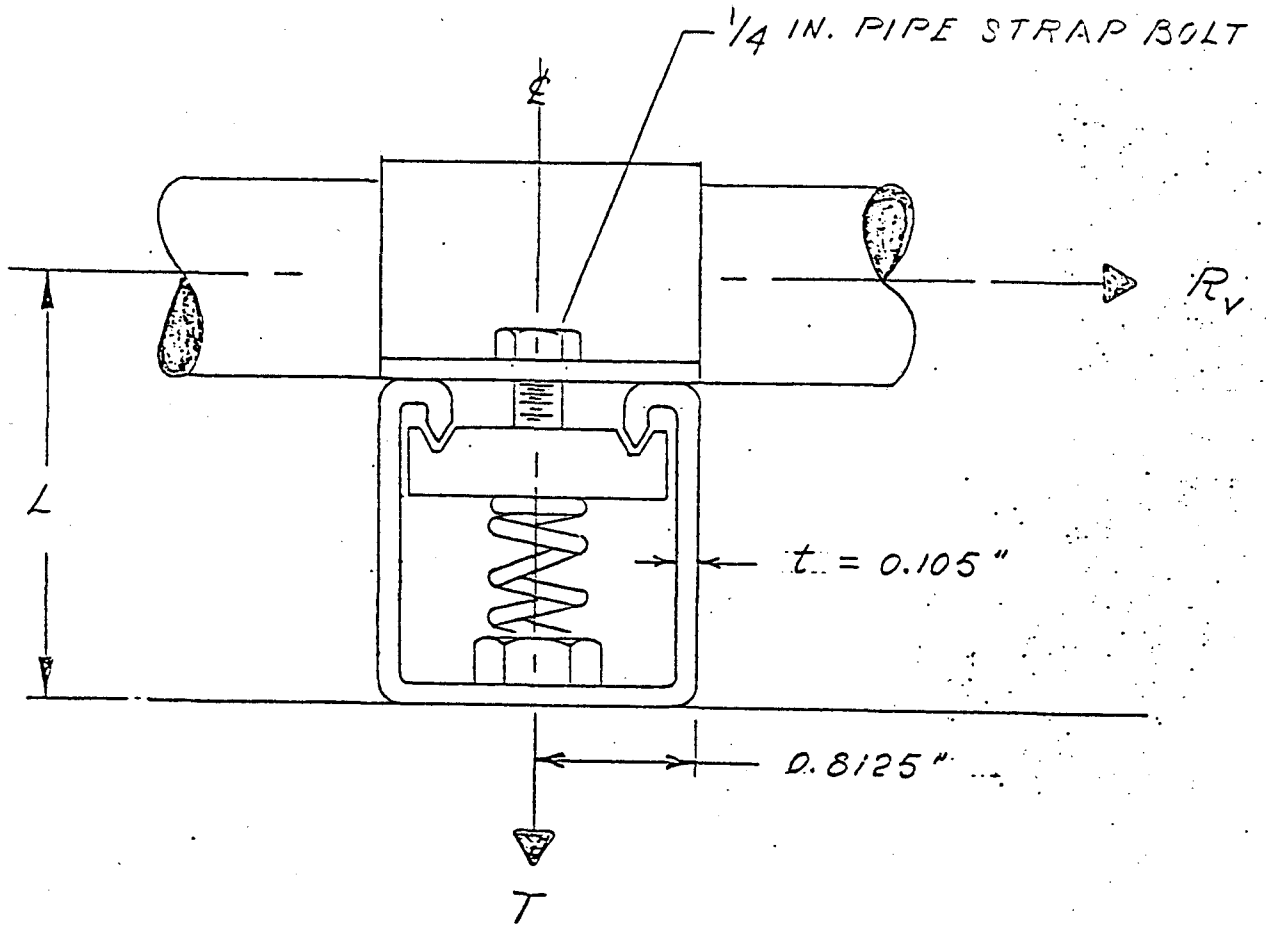
COMMENTS BY CHECKER

1.0 THE SUPPORT ASSEMBLY IS ADEQUATE FOR THE GIVEN LOADS.

2.0 REFER TO REPORT CEB-77-15 FOR CONDUIT WEIGHTS AND SUPPORT SPACINGS.

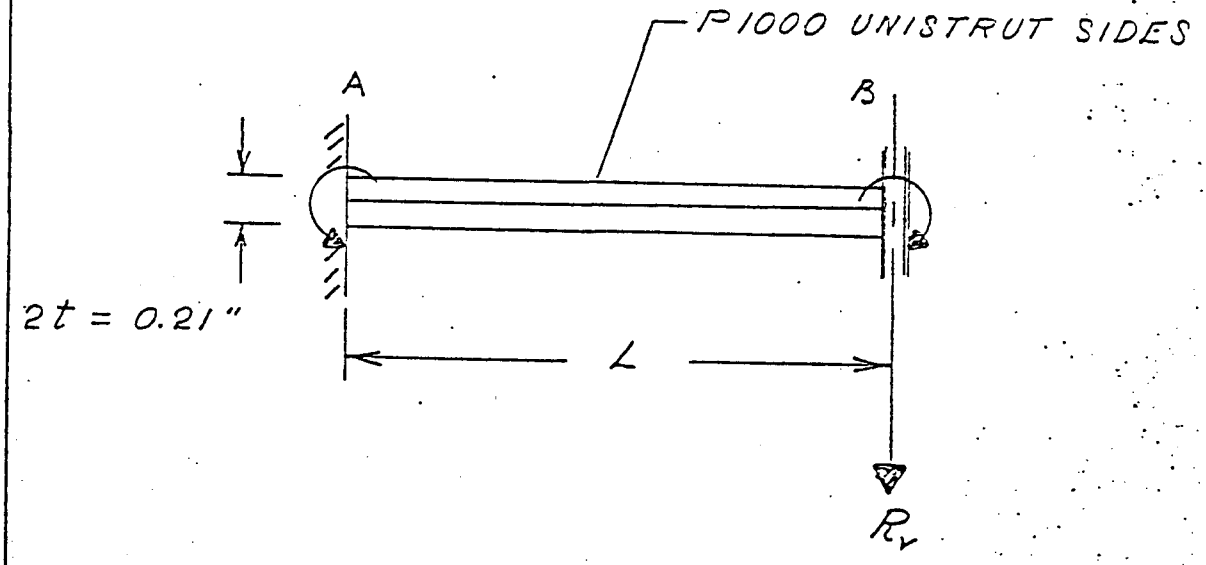
3.0 IT IS ASSUMED THE SUPPORTS, FOR ESSENTIAL CONDUIT, WILL BE INVESTIGATED IF SUBJECTED TO JOT IMPINGEMENT.

A 11030 (WM-7-75)



VIEW A-A

BEAM ANALOGY



MAXIMUM BENDING MOMENT :

ASSUME $L \leq 6$ IN. (SEE VIEW A-A)

$$M_A = M_B = R_V \frac{L}{2} = 3 R_V$$

MOMENT-OF-INERTIA OF CHANNEL SIDES :

$$I = \frac{b (2t)^3}{12} = 0.0031 \text{ IN.}^4$$

WHERE: b = MINIMUM SPACING BETWEEN ANCHORS (4 IN.)
t = CHANNEL MATERIAL THICKNESS (0.105 IN.)

ATTACHMENTS (CONT.)

COMPUTED LW DATE 10-10

CHECKED WNG DATE 14 OCT 8

R_V BASED ON MAXIMUM ALLOWABLE BENDING STRESS IN THE CHANNEL SIDES :

$$R_V = \frac{I f_b}{3t} = \underline{\underline{338.7}} \text{ LB.}$$

WHERE: f_b FOR FACTORED LOAD CONDITIONS
$= 0.96 \times 36 = 34.56$ KSI

R_V BASED ON ANCHOR TENSILE LOAD OF 1200 LB. :

$$R_V = \frac{2T(0.8125)}{L/2} = \underline{\underline{650}} \text{ LB.}$$

R_V BASED ON SHEAR CAPACITY OF 1/4 INCH PIPE STRAP BOLTS :

USE A307 BOLTS WITH PROOF LOAD AT 33 KSI

$\therefore f_s = 0.52 \times 33{,}000 = 17{,}160$ PSI

SHEAR STRESS AREA OF $1/4 \times 20 = 0.0269$ IN.^{2}

$R_V = 2 \times 0.0269 \times 17{,}160 = \underline{\underline{923}}$ LB.

NOTES:

MATERIAL AND WELDING REQUIREMENTS

1. All structural shapes shall be ASTM-A36 unless otherwise noted.
2. A certificate of compliance by manufacturer is required for all materials.
3. Lugs that are to be welded to stainless steel piping systems are to be made from ASTM-A240, Type 304 or Type 316.
4. Lugs welded to carbon steel pipe requiring only certification of compliance are to be made from ASTM-A36 or A283, Grade C. (Lugs welded to traceable carbon steel pipe are to be made from ASTM-A516, Grade 70 or from ASTM-A36 with full traceability.)
5. All bolts shall be ASTM-A307, Grade B, or equal.
6. Installation of bolt anchors shall be in accordance with General Construction Specification No. G-32.
7. A bolt anchor assembly shall consist of a Phillips Red Head bolt anchor or equal, ASTM-A307 bolt, and a standard flat circular washer.
8. Quality assurance required for miscellaneous steel supports is quality level II in accordance with DEC-QCP-2.3, 2.7.
9. All welding shall be in accordance with General Construction Specification No. G-29. Inspection of welds to piping components shall follow the requirements of the related piping system. R3
10. Carbon steel supports shall have a field coat of zinc chromate primer <u>except</u> where contact between stainless steel, copper, or aluminum exists. For these cases use Carbo-Weld 11 primer with a minimum thickness of 1.7 mils. Supports inside containment vessel shall be primed with Carbo-Weld 11.
11. For material see 47BM050-1 & 2.
12. Existing embedded plates or building steel may be utilized in lieu of anchor plates.
13. FOR ADDITIONAL GENERAL NOTES SEE 47A050 SERIES TYPICAL DRAWINGS

REV NO	ECN NO	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR
3	ECN 1597	[illegible]									
ADDED NOTE 13											
2	S-1	[illegible]									
REVISED PER FCR-M-741											
1	S-1	11-6-[illegible]									
REVISED PER FCR-M-142											

DSGN: Q KESTNER
DRWN: Q KESTNER
CHKD: A TUCKER
SUPV: J.S. ARRINGTON
INSP: J.S. ARRINGTON
ENGINEER: [signature]

COMPANION DWG: 47A058-1A

SEISMIC CATEGORY I STRUCTURES

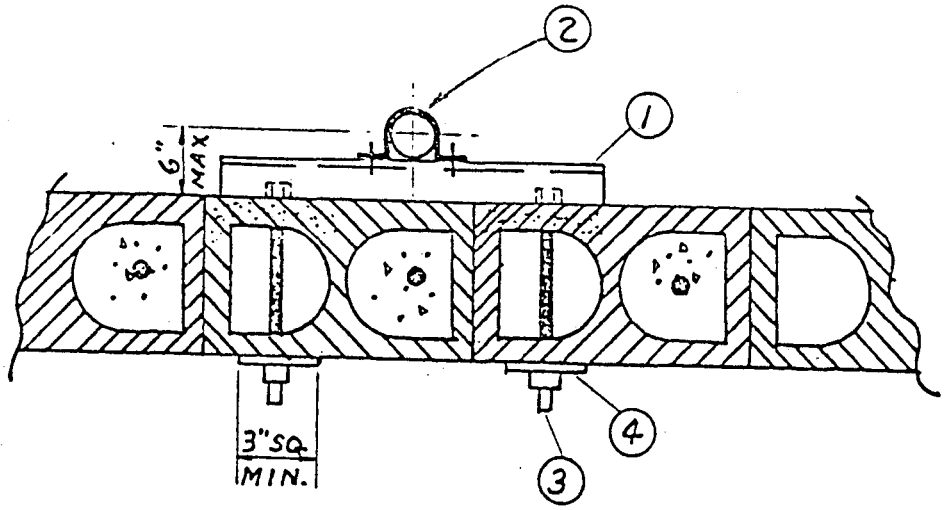
MECHANICAL
DEADLOAD SUPPORTS FOR
PROCESS PIPE 2" DIA. AND LESS

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

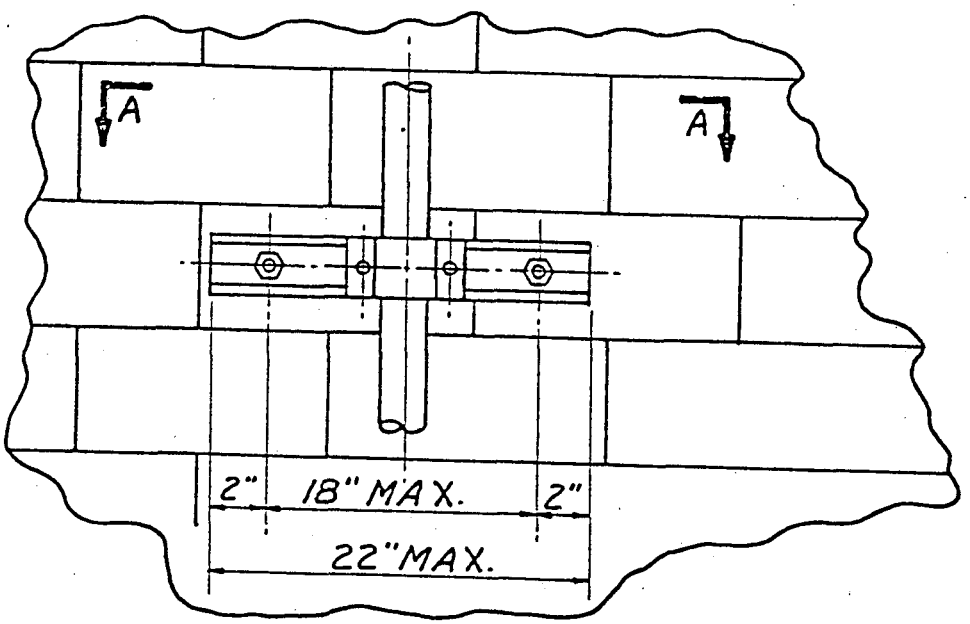
SUBMITTED: [signature] RECOMMENDED: [signature] APPROVED: R.M. [signature]

KNOXVILLE 5-1-75 85 M 47A058-1 R3

RECORD DRAWING AS CONSTRUCTED



SECTION A-A



ELEVATION

COMPANION DWG. 47A058-40A

NOT TO SCALE

ITEM	QTY	MATERIAL DESCRIPTION FOR ONE SUPPORT
4	2	R 1/2" W/ 7/16" ϕ HOLES
3	2	3/8" ϕ BOLT W/ NUTS & LOCKWASHERS (SEE NOTE 3)
2	1	P 2558-5, 7, 10, 12, 15 OR 20
1	1	P 1000 UNISTRUT

REV NO	ECN NO	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPD

DSGN - T. D. ROACH
DRWN - L. KOWALSKI
CHKD - J. ELLANI
SUPV - L. M. CHILSON

INSP ----------
ENGINEER ----------

SEISMIC CATEGORY I STRUCTURES

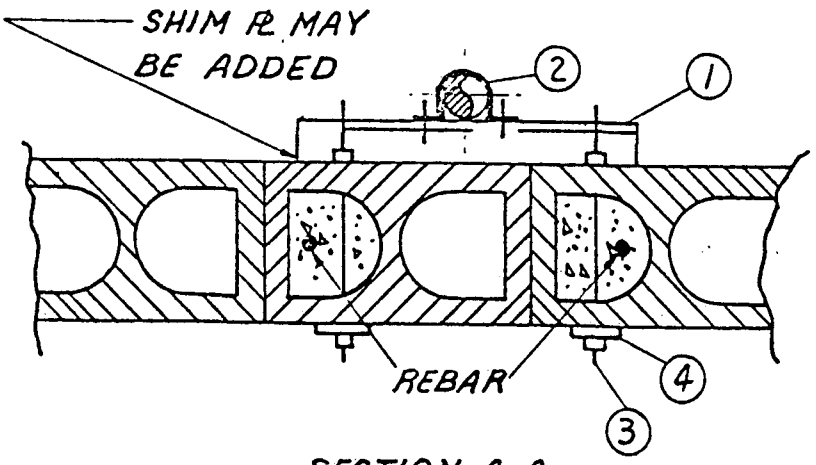
MECHANICAL
CATEGORY I SUPPORT
PROCESS PIPE 2" ϕ & LESS

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

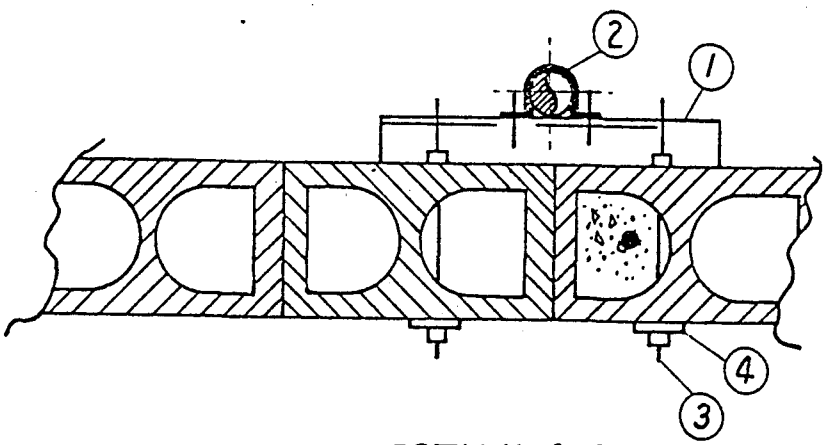
SUBMITTED	RECOMMENDED	APPROVED

KNOXVILLE | 85 M | 47A058-40

RECORD DRAWING AS CONSTRUCTED



SECTION A-A
ALTERNATE A



SECTION A-A
ALTERNATE B

NOTES:

1. FOR GENERAL NOTES SEE 47A058-1.
2. THE MAXIMUM ALLOWABLE LOADING ON ONE SUPPORT SPAN IS 110# IN THE VERTICAL DIRECTION AND 110# IN THE HORIZONTAL DIRECTION.
3. THREADED RODS, FLAT WASHERS AND LOCKWASHERS ARE OPTIONAL.

FOR DIM. SEE
COMPANION DWG. 47A058-40

NOT TO SCALE

SEISMIC CATEGORY I STRUCTURES

MECHANICAL
CATEGORY IL SUPPORT
PROCESS PIPE 2"ϕ & LESS

REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPD

DSGN T. D. ROACH
DRWN L. KOWALSKI
CHKD T. E. LANE
SUPV A. M. CRISCO

INSP
ENGINEER J. J. Rumbley

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED

KNOXVILLE | 85 | M | 47A058-40A

NOTES:

1. All conduit in Seismic Category I buildings shall be supported using the typical conduit supports in this drawing series. These supports have been designed in accordance with WB-DC-40-31.10, Design Criteria for Seismically Qualifying Conduit Supports.

2. Conduit shall be routed as close to ceilings and/or walls as practicable and installed per Construction Specification No. G-40 (except where specific instructions for support distances are given for all types of conduit commonly used). When a pull box is installed in an exposed conduit run, a support shall be placed as close as possible to each side of the box.

3. All welds shall be per Construction Specification No. G-29 using E70 series electrodes. Visual inspection is required.

4. All material shall be ASTM A 36 unless otherwise noted.

5. Certification of compliance by manufacturer is required for all materials.

6. Installation of bolt anchors shall be per Construction Specification No. G-29 unless otherwise noted. A bolt anchor assembly consists of a Phillips Red Head self-drilling bolt anchor, or equal, an ASTM A 307 bolt, and a standard flat circular carbon steel washer.

7. Straight runs of conduit require an axial support at least every 30 feet. No axial restraint is required on nondivisional conduit.

8. A support is required in all vertical runs not mounted directly to walls or ceiling, that does not terminate in or exit from concrete, or that exceeds the vertical support spacings as shown on conduit support drawings. The termination point at control cabinets is considered a support if there is an axial support at the bend where the conduit changes direction to enter the cabinet.

9. In cases where anchor plates are specified, these may be omitted if embedded plates can be used, or if attaching to building steel heavier than W14 x 43.

10. Single or groups of conduits carrying Train A, Train B, Channel I, II, III, or IV cable may share a common support except in missile areas as noted on conduit drawings.

11. For material see 47BM050-1, -2, and -3.

R1
12

KEY NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR
2	[illegible]	12-5-77	WEL	WEL	EES	[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]
1	[illegible]	9-16-77	WEL	WEL	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]

ADDED NOTE 10

ADDED NOTE 9

DSGN W. G. MONROE
DRWN E. BARRINGER
CHKD W. E. SCHORE
SUPV J. E. BURLINGTON

INSP
ENGINEER

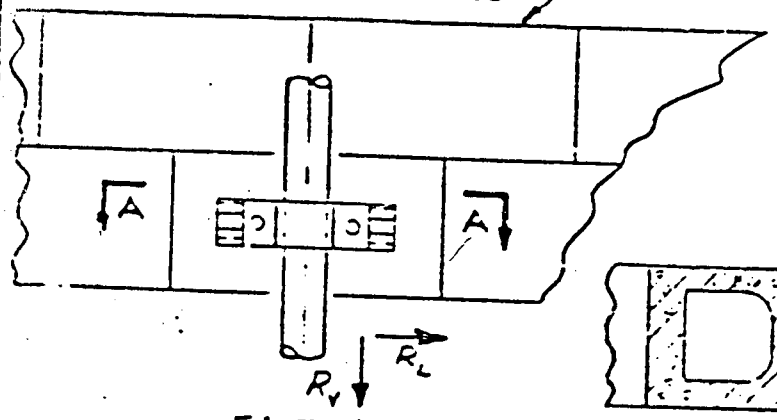
SEISMIC CATEGORY I STRUCTURES

MECHANICAL
CATEGORY I & IL
CONDUIT SUPPORTS

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
[signature]	[signature]	[signature]
KNOXVILLE	12-2-77	[illegible]

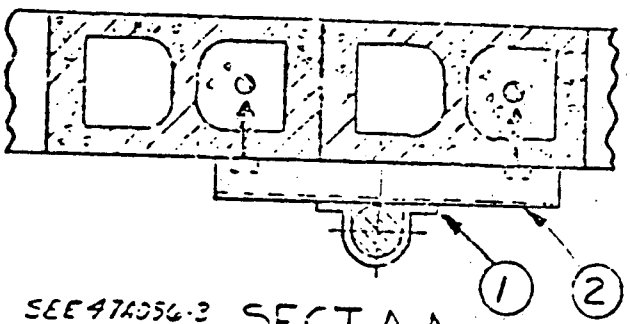
R2



ELEV.

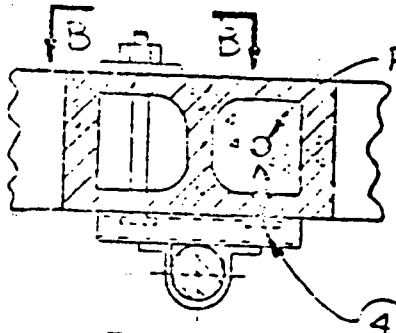
BASED ON 10' S.I.R SPACING

SIZE	R_V	R_L
5"	312 #	304 #
3"	176.5 #	205 #
1"	22 #	71 #

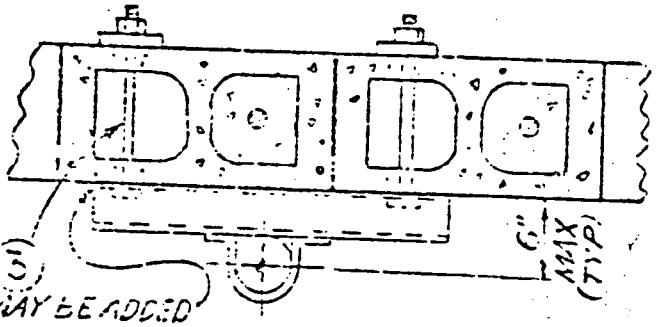


SEE 47A056-3 FOR ADD DETS.

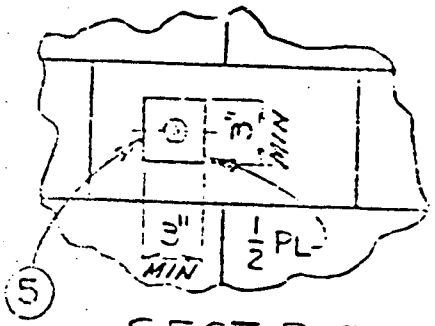
SECT A-A (ALTERNATE A)



SECT. A-A



SECT A-A (ALTERNATE B)



SECT. B-B

ITEM NO	NO REQ'D	MATERIAL DESCRIPTION
1	AS REQ'D	UNISTRUT (P-2568) CLAMP W/NUTS & BOLTS
2	AS REQ'D	P-1000 A UNISTRUT OR P1001A SERIES
3	AS REQ'D	3/8" Ø BOLT W/NUTS & FLAT WASHERS
4	AS REQ'D	3/8" Ø BOLT ANCHOR ASS'Y
5	AS REQ'D	1/2" PL W/ 7/16" Ø HOLE, PL SIZE VARIES

NOTES:
1. FOR GEN NOTES SEE 47A056-1
2. THE CONCRETE ANCHORS ARE COUNTERSUNK INTO THE CONCRETE IN SUCH A WAY THAT THE EXPANDING PART OF THE ANCHOR IS IN SOLID CONCRETE AND NOT IN THE CONCRETE BLOCK.

NOT TO SCALE

SEISMIC CATEGORY I STRUCTURES

MECHANICAL
CATEGORY I
CONDUIT SUPPORT

WATTS BAR NUCLEAR PLANT

DES R. TIMKO
DR T.E. LAMB
CHK W.G. MCBURCE
APP S. ARRINGTON

1931-X85 M 4 47A056-38 RO

NOTES:

1. ALL STRUCTURAL SHAPES SHALL BE ASTM A 36 UNLESS OTHERWISE NOTED. CERTIFICATION OF COMPLIANCE BY MANUFACTURER IS REQUIRED.
2. LUGS THAT ARE TO BE WELDED TO STAINLESS STEEL PIPING SYSTEMS ARE TO BE MADE FROM ASTM A 240, TYPE 304 OR 316, WITH FULL TRACEABILITY WHERE REQUIRED.
3. LUGS WELDED TO TRACEABLE CARBON-STEEL PIPE ARE TO BE MADE FROM ASTM A 515, GR 65, OR FROM ASTM A 36 WITH FULL TRACEABILITY. LUGS WELDED TO CARBON STEEL PIPE REQUIRING ONLY CERTIFICATION OF COMPLIANCE ARE TO BE MADE FROM ASTM A 36 (A 283, GR C).
4. ALL BOLTING SHALL BE ASTM A 307, GR 3, OR EQUAL, UNLESS OTHERWISE NOTED.
5. INSTALLATION OF BOLT ANCHORS SHALL BE PER CONSTRUCTION SPECIFICATION NO. G-32.
6. ALL WELDING SHALL BE PER CONSTRUCTION SPECIFICATION NO. G-29.
   A. INSPECTION OF WELDS TO STRUCTURAL COMPONENTS REQUIRE VISUAL INSPECTION ONLY.
   B. INSPECTION OF WELDS TO PIPING COMPONENTS SHALL FOLLOW THE REQUIREMENTS OF THE RELATED PIPING SYSTEM AND CODES.
7. WHERE 1/16" CLEARANCE BETWEEN PIPE AND SUPPORT IS CALLED FOR ON DRAWINGS, REFER TO PARAGRAPH 5.4 OF GENERAL CONSTRUCTION SPECIFICATION NO. G-43, SUPPORT AND INSTALLATION OF CATEGORY I AND I(L) PIPING SYSTEMS (REQUIREMENTS TO VALIDATE ANALYSES).
8. A BOLT ANCHOR ASSEMBLY SHALL CONSIST OF A PHILLIPS RED HEAD BOLT ANCHOR, OR EQUAL, ASTM A 307 BOLT, AND A STANDARD FLAT CIRCULAR WASHER.
9. QUALITY ASSURANCE IS REQUIRED FOR MISCELLANEOUS STEEL SUPPORTS. REFER TO WBNP-QCP 4.8 AND 1.3.
10. SUPPORTS SHALL HAVE A FIELD COAT OF CARBO-WELD 11 PRIMER WITH A MINIMUM THICKNESS OF 1.7 MILS.
11. FOR FIELD FABRICATION TOLERANCES SEE 47A054-1B.
12. FABRICATION AND INSTALLATION OF ALL CATEGORY I AND I(L) SUPPORTS SHALL BE IN ACCORDANCE WITH GENERAL CONSTRUCTION SPECIFICATION NO. G-43, SUPPORT AND INSTALLATION OF CATEGORY I AND I(L) PIPING SYSTEMS (REQUIREMENTS TO VALIDATE ANALYSES).
13. THE SEISMIC SUPPORTS SHOWN WITHIN THIS DRAWING SEPIES WERE DESIGNED USING THE FOLLOWING WATTS BAR CRITERIA: WB-DC-40-31.9, -31.7, -31.3; CEB-76-5, CEB-75-9, CEB-75-17, & CIVIL DESIGN STANDARD DS-C6.1.

MF
CU

COMPANION DWG: 47A054-1A&B

REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPD

DSGN T.E.LANTZ
DRWN F.BARRINGER
CHKD T.D.ROACH
SUPV D.E.SICKINS
INSP
ENGINEER

SEISMIC CATEGORY I STRUCTURE

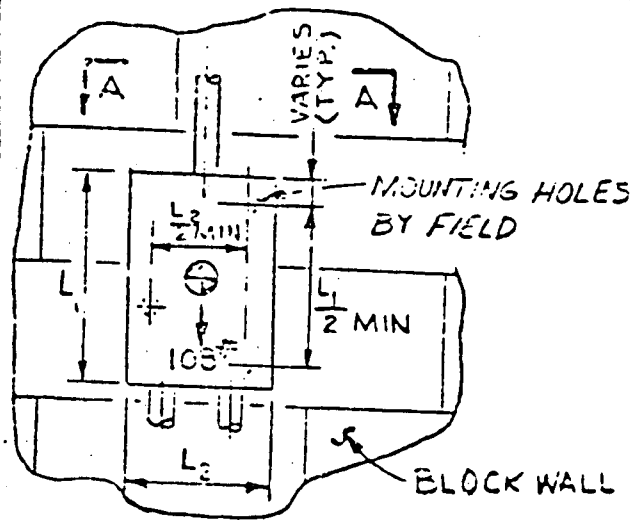
MECHANICAL
SEISMIC CATEGORY I SUPPORT
CONTROL AIR LINES

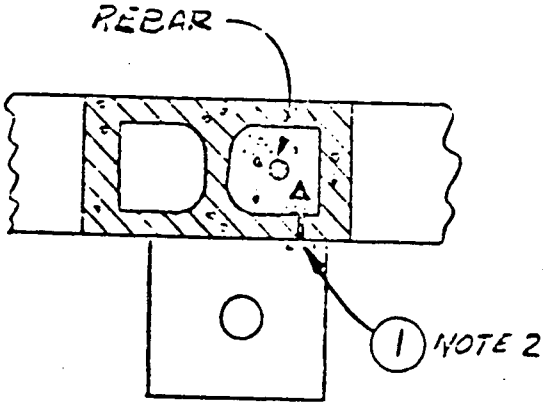
WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED

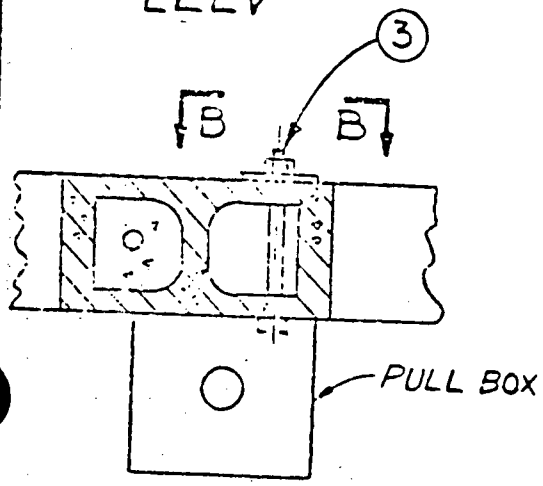
KNOXVILLE 11-27-85 M 47A054-1 R0

RECORD DRAWING AS CONSTRUCTED

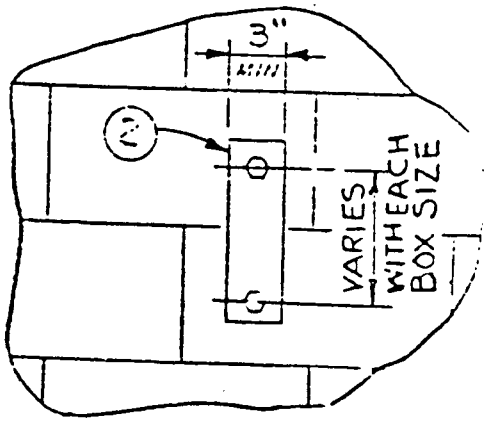




SECT A-A
(ALTERNATE)



SECT "A-A" (ONE ANCHOR SHOWN)



SECT B-B

A 3"x3" MIN ℄ MAY BE USED FOR EACH BOLT

NOTES:

1. FOR GEN. NOTES SEE 47A056-1
2. THE CONCRETE ANCHORS ARE COUNTERSUNK INTO THE CONCRETE IN SUCH A WAY THAT THE EXPANDING PART OF THE ANCHOR IS IN SOLID CONCRETE AND NOT IN THE CONCRETE BLOCK
3. CONDUIT PULL BOXES COME IN VARIOUS SIZES (I.E. 6"x8"x12", 12"x12"x12" AND 12"x12"x18") LARGER BOXES IN WEIGHT WILL REQ. MORE ANCHORS, THE SIZES LISTED WERE SUPPORTED WITH (2) - 3/8" ℄ ANCHORS

ITEM NO.	NO. REQ'D	MATERIAL DESCRIPTION
1	AS REQ'D	BOLT ANCHOR ASS'Y - 3/8" DIA.
2	AS REQ'D	PLATE - W/ 7/16" HOLE
3	AS REQ'D	3/8" BOLT W/NUTS & FLAT WASHER

NOT TO SCALE

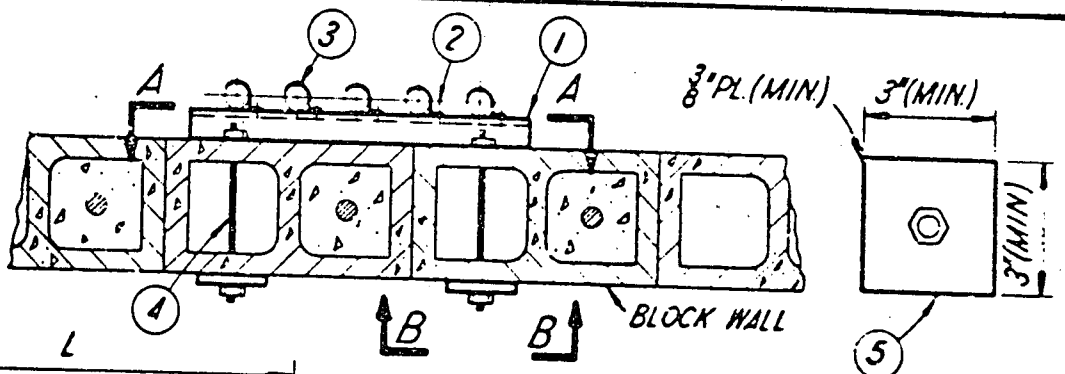
SEISMIC CATEGORY I STRUCTURES

MECHANICAL
CATEGORY I
CONDUIT SUPPORT
WATTS BAR NUCLEAR PLANT

R. TIMKO
TE LAND
W.G. MONROE
J.S. ARRINGTON

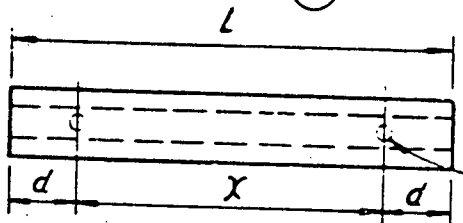
J. C. Key R. McBride

RS-3785 M 4 47A056-39 R0



PLAN VIEW

SECTION B-B



SECTION A-A

Nº OF LINES	L (MAX)	X (MAX)	BOLT ANCHOR DIA IN	d
1	7	4	1/2"	1 1/2"
2	10	7	1/2"	1 1/2"
3	12	9	1/2"	1 1/2"
4	16	12	1/2"	2"
5	16	12	1/2"	2"

NOTES:

1. SEE 47A054-1 FOR GENERAL NOTES & INSTALLATION REQUIREMENTS.
2. CLAMP TO BE GALV. OR CADMIUM PLATED

AIR LINE MATERIAL	SIZE	MAX SPAN
SS	1/4" O.D	3'-6"
	3/8" O.D	4'-4"
COPPER	1/4" O.D	2'-10"
	3/8" O.D	3'-6"

NOT TO SCALE

ITEM	QTY.	DESCRIPTION
5	2	C.S. PL SEE SECTION B-B ASTM A36
4	2	1/2" BOLT W/ NUTS & FLAT WASHERS & LOCK WASHERS (OPTIONAL)
3	AS REQD.	UNISTRUT CLAMP, 2008, 2009, OR 2010, SEE NOTE #2
2	AS REQD.	UNISTRUT NUT, Nº P1006-420 & BOLT
1	AS REQD.	UNISTRUT, P1000 W/ GREENAMEL FINISH

REV NO. | ECN NO. | DATE | DESGN | DRWN | CHKD | SUPV | ENGR | INSP | SUBMT ECN | APPD

DESIGN T.E. LANTZ RE
DRAWN E. BARRINGER
CHKD D. E. SMITH (M)
SUPV J. S. ARRINGTON
INSP
ENGINEER

SEISMIC CATEGORY I STRUCTURES

MECHANICAL
CATEGORY I SUPPORT
CONTROL AIR LINES

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

KNOXVILLE | 12/5-7/85 | M | 47A054-13 | R0