

SECTION 02669 – THRUST RESTRAINTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section provides for the required restraining devices to prevent the movement of pipe and fittings.
- B. This section includes Restrained Joints and Concrete Blocking (backing blocks and straddle blocks).
- C. The specifications for concrete and appurtenances provided in this section only pertain to thrust restraint of water mains.

1.02 SPECIFICATION MODIFICATIONS

- A. It is understood that throughout this section these Specifications may be modified by appropriate items in Section 01015 – Specific Project Requirements, or as otherwise indicated on the Contract Drawings.

1.03 RELATED SECTIONS

- A. Section 01000 – General Project Requirements.
- B. Section 01015 – Specific Project Requirements.
- C. Section 01300 – Submittals.
- D. Section 01566 – Cleanup Operations.
- E. Section 02618 – Ductile Iron Pipe Water Mains.
- F. Section 02619 – Pre-stressed Concrete Cylinder Pipe Water Mains.

1.04 CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - ASTM A616 Standard Specification for Rail-Steel Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- C. City of Kansas City, Missouri Department of Public Works Construction and Material Specifications (<http://kcmo.gov/publicworks/design-construction-standards/>):
 - KCMO PW 2208 Subsection Section 2208, Portland Cement Concrete Pavement.

1.05 INFORMATION PROVIDED BY THE CITY

- A. As provided in the Contract Documents.

1.06 SUBMITTALS

- A. Submit as specified in Section 01300 – Submittals.
- B. Shop Drawings:
 - 1. Submit shop drawings and descriptive details showing the size, length, and location of each fitting and adjacent pipe, and the details of all anchorage and harnessing proposed.

C. Other:

1. Concrete Mix Design. See paragraph 2.04, part A.

1.07 QUALITY ASSURANCE

- A. The manufacturer shall be a company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Follow the provisions for the delivery, storage, protection and handling products to and on site as provided in Section 01000 – General Project Requirements.
- B. Concrete Mix Design: In accordance with KCMO PW 2208, a mix design, for all concrete mixes to be used, shall be submitted to the City in accordance with paragraph SUBMITTALS. As a minimum the following information must be in the Quality Management file for the plant or included with the mix design:
 1. Mix design designation required by project.
 2. Project name, location, project number and date.
 3. Name and location of ready mix plant or plants.
 4. List the source and type of all materials from each plant supplying mix.
 5. CA and FA Sieve Analysis and quality checks from each plant supplying mix.
CA-Ledge, quarry or mine name and location. FA- Sand plant name, location and source (MO or Kaw River) (less than 6 months old).
 6. ASR test results (less than 2 years old).
 7. Durability Factor test results for CA (less than 2 years old).
 8. Cement chemical analysis.
 9. Specific gravity of all materials.
 10. The mix design shall be based on one cubic yard of concrete or one cubic meter if required.
 11. The mix design shall contain the weight and volume of each mix component (S.S.D.).
 12. The results of 28-day compressive strengths shall be submitted when requested by the City.

PART 2 - PRODUCTS

2.01 RESTRAINED PUSH-ON JOINTS FOR DUCTILE IRON PIPE

- A. Flex-Ring® as manufactured by American Ductile Iron Pipe.
- B. Fast-Grip® as manufactured by American Ductile Iron Pipe.
- C. Super-Lock® as manufactured by McWane.
- D. TR Flex® as manufactured by McWane.
- E. Field Lok® as manufactured by McWane.
- F. Sure Stop 350® as manufactured by McWane.
- G. Snap-Lok® as manufactured by Griffin Pipe Products.

2.02 RESTRAINED MECHANICAL JOINTS FOR DUCTILE IRON PIPE

- A. MEGALUG® as manufactured by EBAA Iron, Inc. MEGALUG.
- B. Uni-Flange® as manufactured by The Ford Meter Box Company, Inc.
- C. Restrained joint fittings: One Bolt.
- D. Restrained mechanical joints shall not be used on plain end fittings.

2.03 RESTRAINED JOINTS FOR PCCP

- A. As specified in Section 02619 – Pre-Stressed Concrete Cylinder Pipe Water Main.

2.04 CONCRETE BLOCKING

A. Concrete:

1. Concrete shall conform to KCMO PW 2208 except as follows:
 - (a) Limestone may be used as coarse aggregate.
 - (b) Design strength of concrete shall be 4,500 psi or greater.
 - (c) Slump shall be 4 inches.
 - (d) Coarse Aggregate: 1-inch maximum.
 - (e) Air entrainment admixture is required.
 - (f) Water reducing admixture is required.
2. Ready mix concrete shall be supplied by a plant approved by the KCMO Public Works Department according to the Ready Mix Concrete Quality Management Plan. Submit ready mix concrete plant information in accordance with paragraph SUBMITTALS.
3. Submit concrete mix design in accordance with KCMO PW 2208.C and in accordance with the paragraph SUBMITTALS.

B. Water for mixing and curing concrete shall be potable.

C. Reinforcing Steel:

1. Reinforcing steel bars shall conform to the requirements of the following Standards and Grades:
 - (a) ASTM A615: Grade 40 or 60.
 - (b) ASTM A616: Grade 50 or 60.

D. Forms:

1. Suitable and substantial forms shall be provided. All forms shall be constructed and maintained plumb and true to line, securely braced, tied, clamped and shored, and tight enough to prevent leakage of concrete.
2. Where applicable, undisturbed earth may be used in lieu of forms.
3. The deflection of the forms due to the weight of plastic concrete, placing equipment, and workmen shall be accurately figured and taken into account in the design of the forms so that finished concrete members will have surfaces, lines, planes, and elevations required within tolerances in accordance with ACI 117.
4. Forms for walls and thrust restraints shall be designed structurally for the rate of placement of concrete.
5. All forms shall be removed prior to backfill unless the following conditions are met:
 - (a) As directed by the City.
 - (b) When constructed of unbrace plywood have a thickness of ½-inch or less, removal shall be optional unless otherwise directed by the City.
6. Forms shall be constructed so that they can be removed without damage to the concrete.

E. Formwork Accessories:

1. Forms shall be securely braced and tied with approved form ties that do not leave any parts within ¾ inch of the surface of the concrete. Wire ties and wood spreaders will not be permitted.

PART 3 - EXECUTION

3.01 REACTION ANCHORAGE AND BLOCKING

- A. Piping and fittings with push-on or mechanical joints, or similar joints subject to internal pressure shall be blocked, anchored, or harnessed to preclude separation of joints.
- B. All push-on and mechanical joint bends deflecting 11-1/4 degrees or more shall be provided with suitable blocking, anchors, joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure.
- C. Concrete backing blocks shall extend from the fitting to solid undisturbed earth and shall be installed so that all joints and bolts are accessible for repair.
- D. Standard Dimensions and Details: The City's standard details for backing blocks are provided for three (3) ranges of soil resistance. The dimensions of backing blocks shall be as indicated on the following details:
 - 1. 2,000 PSF Soil Resistance: Unless otherwise indicated on the Drawings or in Section 01015 – Specific Project Requirements, backing blocks shall be constructed in accordance with the following details:
 - (a) Detail 02669-1 – Typical Backing Blocks for Tees and Plugs (2,000 PSF Soil Resistance).
 - (b) Detail 02669-2 – Typical Backing Blocks for Horizontal Bends (2,000 PSF Soil Resistance).
 - (c) Detail 02669-3 – Typical Straddle Block for 6 and 8-inch Pipe (2,000 PSF Soil Resistance).
 - (d) Detail 02669-4 – Typical Straddle Block for 12 and 16-inch Pipe (2,000 PSF Soil Resistance).
 - (e) Detail 02669-5 – Typical Straddle Block for 20, 24 and 30-inch Pipe (2,000 PSF Soil Resistance).
 - 2. 2,500 PSF Soil Resistance: When the Design Professional can justify through geotechnical investigation, laboratory testing and analysis that the soil conditions within the project area meet or exceed a 2,500 pounds per square foot soil resistance, the backing blocks may be constructed in accordance with the following details. These details may only be used if noted on the Drawings or in Section 01015 – Specific Project Requirements:
 - (a) Detail 02669-6 – Alternate Backing Blocks for Tees and Plugs (2,500 PSF Soil Resistance).
 - (b) Detail 02669-7 – Alternate Backing Blocks for Horizontal Bends (2,500 PSF Soil Resistance).
 - (c) Detail 02669-8 – Alternate Straddle Block for 6 and 8-inch Pipe (2,500 PSF Soil Resistance).
 - (d) Detail 02669-9 – Alternate Straddle Block for 12 and 16-inch Pipe (2,500 PSF Soil Resistance).
 - (e) Detail 02669-10 – Alternate Straddle Block for 20, 24 and 30-inch Pipe (2,500 PSF Soil Resistance).
 - 3. 3,000 PSF Soil Resistance: When the Design Professional can justify through geotechnical investigation, laboratory testing and analysis that the soil conditions within the project area meet or exceed a 3,000 pounds per square foot soil resistance, the backing blocks may be constructed in accordance with the following details. These details may only be used only if noted on the Drawings or in Section 01015 – Specific Project Requirements:

- (a) Detail 02669-11 – Alternate Backing Blocks for Tees and Plugs (3,000 PSF Soil Resistance).
- (b) Detail 02669-12 – Alternate Backing Blocks for Horizontal Bends (3,000 PSF Soil Resistance).
- (c) Detail 02669-13 – Alternate Straddle Block for 6 and 8-inch Pipe (3,000 PSF Soil Resistance).
- (d) Detail 02669-14 – Alternate Straddle Block for 12 and 16-inch Pipe (3,000 PSF Soil Resistance).
- (e) Detail 02669-15 – Alternate Straddle Block for 20, 24 and 30-inch Pipe (3,000 PSF Soil Resistance).

3.02 CONCRETE AND REINFORCING STEEL

A. Placing of Reinforcing Steel:

- 1. Before being installed in the final position, all metal reinforcements shall be free of mud, clay, ice, grease, oil, loose rust and scale, and other coatings that would reduce or destroy the bond.
- 2. Metal reinforcements shall be accurately formed and positioned to the required dimensions.
- 3. Steel reinforcements shall be accurately positioned as required and shall be secured against displacement by using annealed wire ties or suitable clips at all intersections.
- 4. The steel reinforcements shall be supported by metal supports, spacers, or hangers.
- 5. The legs on the metal chair supports shall be plastic coated.

B. Forms:

- 1. Verify lines, levels and centers before proceeding with formwork.
- 2. A coat of non-staining oil, lacquer, or other approved material shall be applied to protect form surface and to facilitate stripping. Coating shall be applied in strict accordance with the directions of the manufacturer.
- 3. Forms shall be removed in such manner as to assure the complete safety of the structure. In no case shall supporting forms or shoring be removed until the concrete has acquired sufficient strength.

C. Placing of Concrete:

- 1. Only those methods and arrangements of equipment shall be used which will reduce to a minimum any segregation of coarse aggregate from the concrete.
- 2. Every consideration shall be given to the proper placement of all concrete and the proper care of all concrete after placement.
- 3. Concrete shall be deposited into the forms or on the grade as nearly as practicable in its final position and in such manner that the concrete will completely fill the forms.
- 4. Vibration shall not be used to move concrete in a horizontal direction after initial placement.
- 5. Concrete that has partially hardened or has been contaminated by foreign material shall not be deposited in the Work and shall be removed from the Site at no additional cost to the City.
- 6. When inclined chutes beyond the mixer are permitted by the City, a baffle shall be provided at the bottom end so that concrete will drop vertically without segregation.

7. No water shall be added to the concrete for any reason at the job site that will result in exceeding the specified water-cement ratio.
 8. Care shall be taken to assure proper concrete coverage of reinforcing steel as designed.
 9. Placement operations shall be performed in such a manner as to prevent loose earth falling into the excavation during placement of concrete.
 10. Concrete that might contact forms or reinforcing steel during placement shall be placed by the use of trunks or pipes whenever the drop exceeds six (6) feet for unexposed work, or three (3) feet for exposed work.
 11. When trunks or pipe are used, they shall be located at horizontal spacing of not to exceed ten (10) feet.
 12. Concrete for thrust restraints shall be placed in horizontal layers not exceeding two (2) feet in depth.
 13. Placing of concrete in thrust restraints shall be done in such manner as to prevent "cold joints," both horizontally and vertically.
- D. Vibrating:
1. Mechanical internal vibrators shall be used whenever possible in all formed concrete work.
 2. Vibrators shall be inserted at uniform spacing of twelve (12) inches to twenty (20) inches to assure thorough consolidation of all concrete.
 3. Vibrators shall be inserted and withdrawn vertically to a depth, which will assure penetration into the previous lift with vibration periods of from five (5) to fifteen (15) seconds.
 4. Form vibration and/or hand spading will be required at points inaccessible for thorough internal vibration.
 5. During placement of concrete, stand-by vibrators shall be immediately available in the event of mechanical failure in the vibrators being used.
- E. Cleanup:
1. Cleanup shall conform to Section 01566 – Cleanup Operations, paragraph CONCRETE WORK.

3.03 RESTRAINED JOINTS

- A. Use of restrained joints shall be as indicated on the Drawings.
- B. Length of restrained joints shall be as indicated on the Drawings.
- C. Differing subsurface or physical conditions: If the Contractor or City's Representative discovers during performance of the Work that support for a backing block against undisturbed soil cannot be obtained, then use of restrained joint pipe may be necessary. Refer to Section 00700 – General Conditions, Article 4:
 1. The Contractor shall notify the City that a restrained joint may be required.
 2. The Design Professional or the City shall provide the Contractor with the required length of restrained joints.
 3. Calculations for the required length of restrained pipe shall be subject to approval by the City.

3.04 BACKFILL

- A. To aid in the curing of concrete, a maximum of eight (8) inches of uncompacted backfill material may be placed over the concrete backing block.
- B. No compaction shall occur or additional backfill placed over the backing block until the concrete has been in place for at least one (1) day.

3.05 SUPPORT FOR FITTINGS

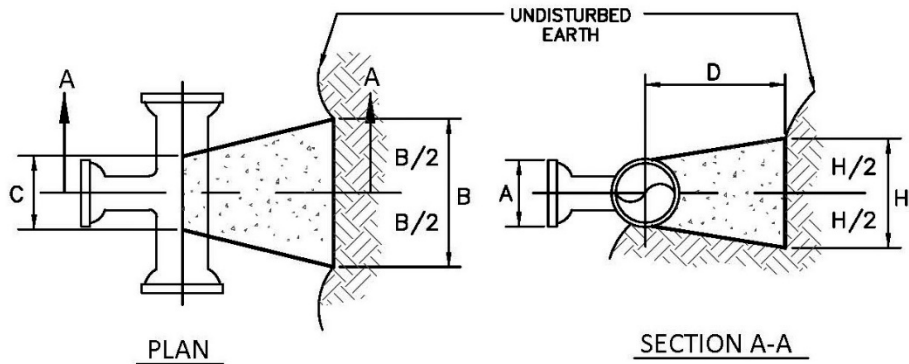
- A. Backing blocks, anchorages, or other supports for fittings installed in fills or other unstable ground, above grade, or exposed within structures, shall be provided as shown on the Drawings, required by the Construction Detail Drawings and as directed by the City.

3.06 EXTERIOR COATINGS

- A. All clamps, rods, bolts, and other metal accessories used in reaction anchorages, or joint harness subject to submergence or contact with earth or other fill material and not encased in concrete shall be protected from corrosion by two coats of approved coal tar epoxy applied in the field to clean, dry metal surfaces. The first coat shall be dry and hard before the second coat is applied.
- B. Metal surfaces exposed above grade or within vaults shall be painted with one prime coat and two finish coats of a paint acceptable to the City.

DETAILS 02669-1 THROUGH 02669-15
ARE ON THE FOLLOWING 15 PAGES

DETAIL 02669-1



NOTES:

1. BACKING BLOCKS FOR PIPING SIZES UP THROUGH 12-INCH ARE BASED ON WORKING PRESSURE OF 175 P.S.I. PLUS 50% SURGE.
2. BACKING BLOCKS FOR PIPING SIZES 16-INCH THROUGH 24-INCH ARE BASED ON A WORKING PRESSURE OF 150 P.S.I. PLUS 50% SURGE.
3. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR THE DESIGN OF THRUST BLOCKS. THE BLOCK SIZES SPECIFIED HEREIN ARE MINIMUM SIZES, BASED ON SOIL RESISTANCE OF 2,000 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

BRANCH OR PLUG SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	46	6	20	24	7.4	0.24
8"	60	8	26	32	13.2	0.55
12"	114	12	51	38	29.7	2.45
16"	126	16	55	52	45.2	4.00
20"	140	20	60	72	70.7	6.74
24"	184	24	80	80	101.8	13.00
30"	230	30	100	100	159.0	25.61

TYPICAL BACKING BLOCKS FOR TEES AND PLUGS 2,000 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

DRAWING NO. 02669-1

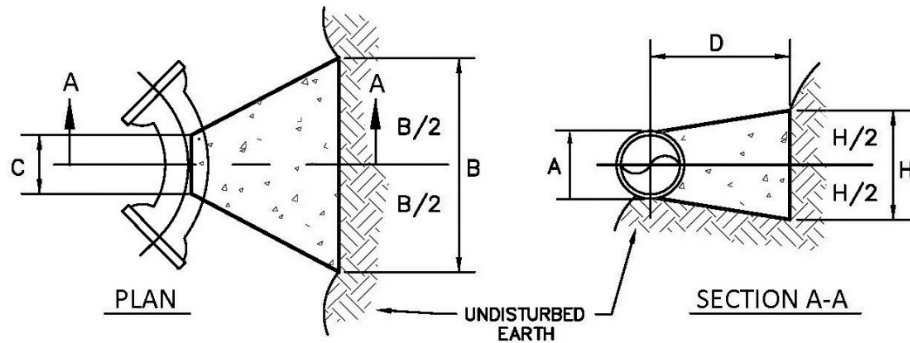
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TECHNICAL ADVISORY COMMITTEE

APPROVED BY: _____

DATE: 1/13/2021

1 OF 1

DETAIL 02669-2



NOTES:

1. BACKING BLOCKS FOR PIPING SIZES UP THROUGH 12-INCH ARE BASED ON WORKING PRESSURE OF 175 P.S.I. PLUS 50% SURGE.
2. BACKING BLOCKS FOR PIPING SIZES 16-INCH THROUGH 24-INCH ARE BASED ON A WORKING PRESSURE OF 150 P.S.I. PLUS 50% SURGE.
3. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR THE DESIGN OF THRUST BLOCKS. THE BLOCK SIZES SPECIFIED HEREIN ARE MINIMUM SIZES, BASED ON SOIL RESISTANCE OF 2,000 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

11° DEGREE BENDS

PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	18	6	12	12	1.5	0.03
8"	28	8	12	14	2.6	0.06
12"	38	12	13	22	5.8	0.14
16"	50	16	17	26	8.9	0.28
20"	64	20	22	32	13.9	0.58
24"	76	24	26	38	20.0	0.97
30"	95	30	33	48	31.2	1.90

22° DEGREE BENDS

PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	28	6	12	16	2.9	0.06
8"	34	8	13	22	5.1	0.11
12"	56	12	22	30	11.6	0.43
16"	72	16	28	36	17.7	0.85
20"	86	20	33	46	27.6	1.54
24"	106	24	41	54	39.7	2.77
30"	136	30	53	66	62.1	5.60

45° DEGREE BENDS

PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	38	6	16	22	5.7	0.15
8"	54	8	23	28	10.1	0.39
12"	82	12	35	40	22.7	1.28
16"	100	16	42	50	34.6	2.37
20"	130	20	55	60	54.1	4.83
24"	152	24	64	74	77.9	8.10
30"	196	30	83	90	121.7	16.49

90° DEGREE BENDS

PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	60	6	27	26	10.5	0.46
8"	84	8	38	32	18.7	1.12
12"	126	12	57	44	42.0	3.47
16"	160	16	72	58	64.0	7.36
20"	200	20	90	72	100.0	14.27
24"	242	24	109	86	143.9	24.98
30"	324	30	147	100	224.9	52.46

TYP. BACKING BLOCKS FOR HORIZONTAL BENDS

2,000 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

DRAWING NO. 02669-2

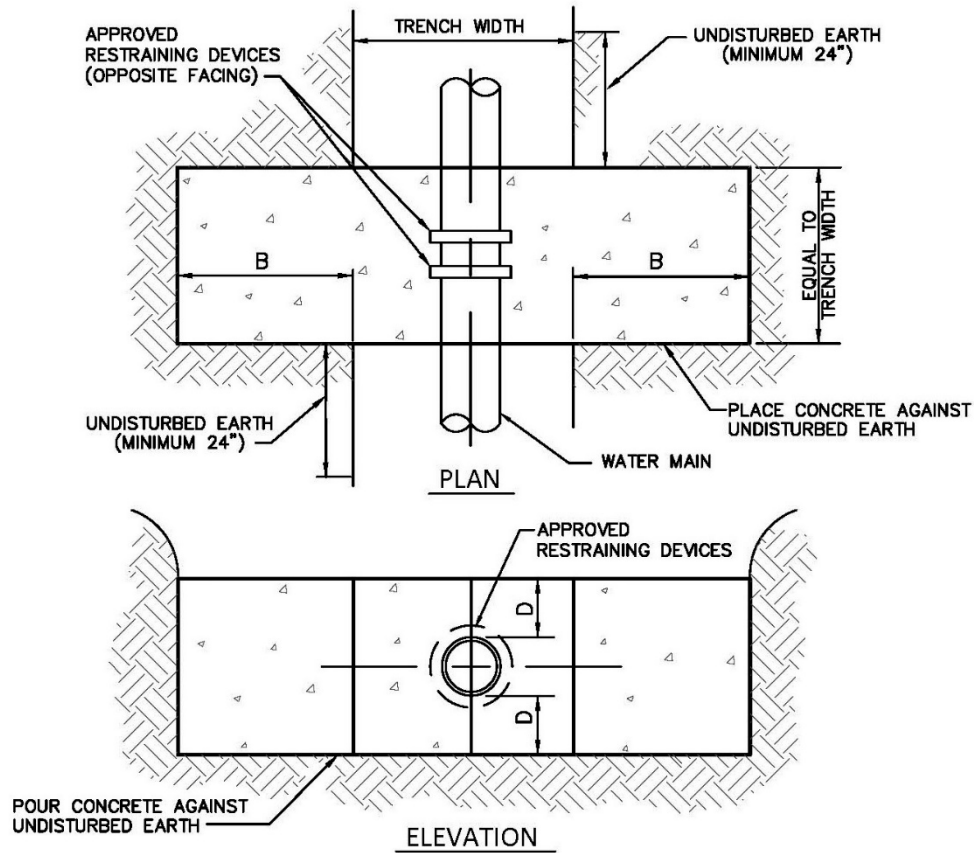
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TECHNICAL ADVISORY COMMITTEE

APPROVED BY:

DATE: 1/13/2021

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DETAIL 02669-3



NOTES:

1. STRADDLE BLOCKS ARE SIZED FOR 175 P.S.I. LINE PRESSURE 50% SURGE.
2. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR DESIGN OF STRADDLE BLOCKS. THE SIZES SPECIFIED HEREIN ARE MINIMUM SIZES BASED ON SOIL RESISTANCE OF 2,000 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

PIPE SIZE	TRENCH WIDTH (in.)	B (in.)	D (in.)	REQUIRED BEARING AREA (SQ. FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	30	24	9	7.4	0.9
8"	32	30	12	13.2	1.5

TYPICAL STRADDLE BLOCK FOR 6 AND 8 INCH PIPE 2,000 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES

CITY OF KANSAS CITY, MISSOURI

DRAWING NO.

02669-3

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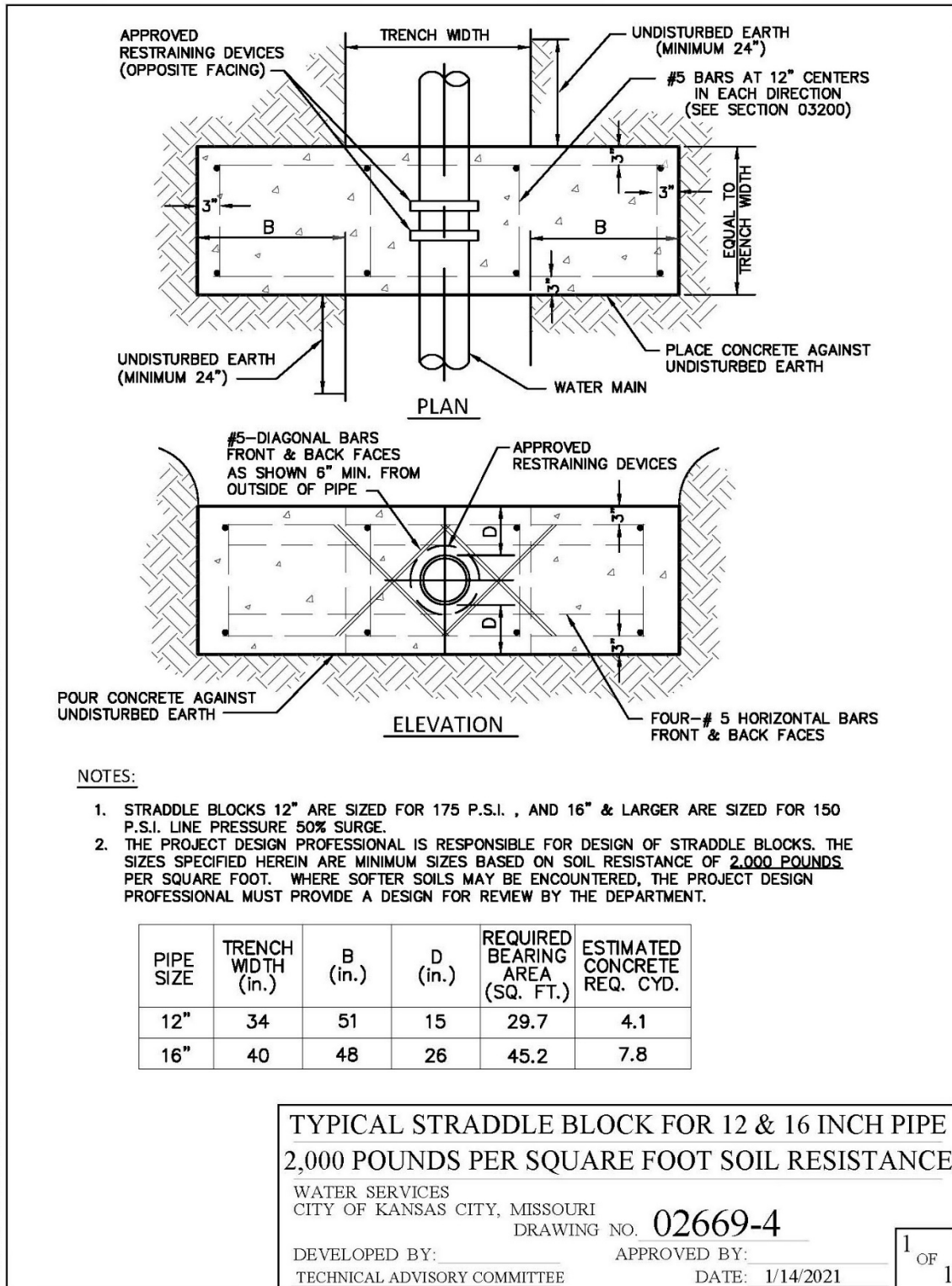
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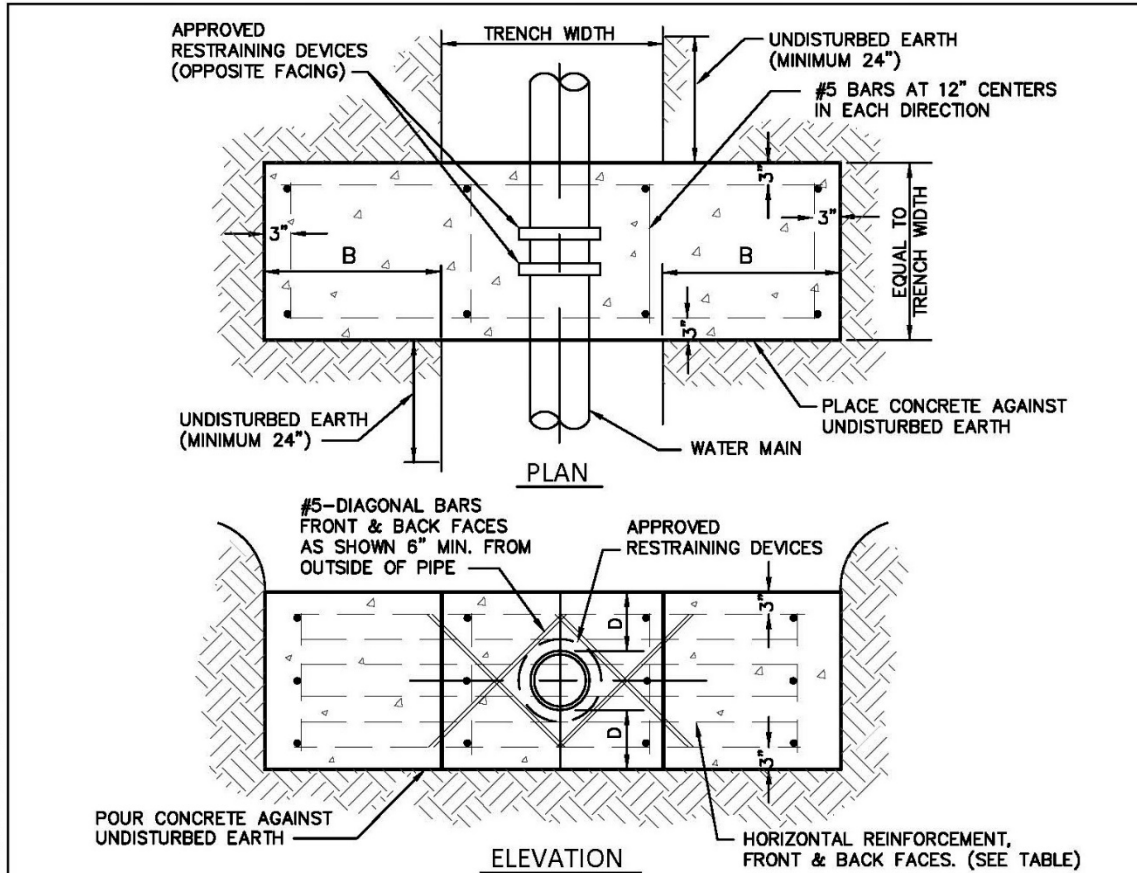
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DETAIL 02669-4



DETAIL 02669-5



NOTES:

1. STRADDLE BLOCKS ARE SIZED FOR 150 P.S.I. LINE PRESSURE 50% SURGE.
2. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR DESIGN OF STRADDLE BLOCKS. THE SIZES SPECIFIED HEREIN ARE MINIMUM SIZES BASED ON SOIL RESISTANCE OF 2,000 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

PIPE SIZE	BAR SIZE	NO. OF BARS (each face)	TRENCH WIDTH (in.)	B (in.)	D (in.)	REQUIRED BEARING AREA (SQ. FT.)	ESTIMATED CONCRETE REQ. CYD.
20"	#5	5	44	71	26	70.7	12.3
24"	#6	6	48	92	28	101.8	18.6
30"	#7	6	60	115	35	159.0	36.4

TYP. STRADDLE BLOCK FOR 20, 24, & 30 INCH PIPE 2,000 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

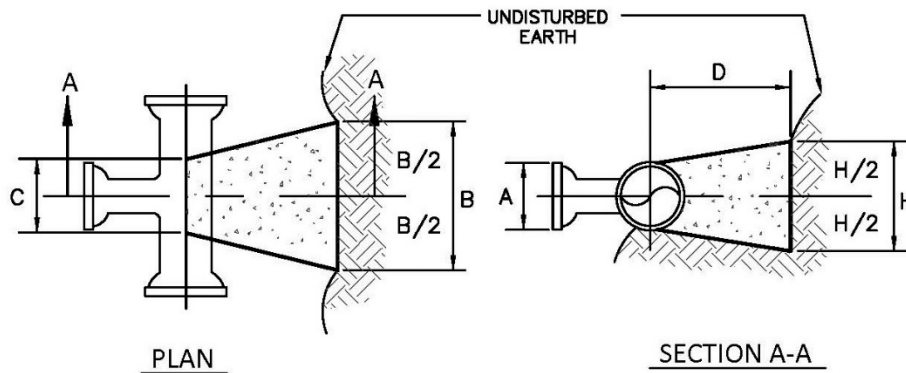
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TECHNICAL ADVISORY COMMITTEE

APPROVED BY: _____
DATE: 1/14/2021

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DETAIL 02669-6



NOTES:

1. BACKING BLOCKS FOR PIPING SIZES UP THROUGH 12-INCH ARE BASED ON WORKING PRESSURE OF 175 P.S.I. PLUS 50% SURGE.
2. BACKING BLOCKS FOR PIPING SIZES 16-INCH THROUGH 24-INCH ARE BASED ON A WORKING PRESSURE OF 150 P.S.I. PLUS 50% SURGE.
3. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR THE DESIGN OF THRUST BLOCKS. THE BLOCK SIZES SPECIFIED HEREIN ARE MINIMUM SIZES, BASED ON SOIL RESISTANCE OF 2,500 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

BRANCH OR PLUG SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	48	6	21	18	5.9	0.20
8"	60	8	26	26	10.6	0.45
12"	96	12	42	36	23.8	1.62
16"	110	16	47	48	36.2	2.79
20"	140	20	60	60	56.5	5.76
24"	180	24	78	66	81.4	10.41
30"	220	30	95	84	127.2	19.73

ALT. BACKING BLOCKS FOR TEES AND PLUGS 2,500 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

DRAWING NO. 02669-6

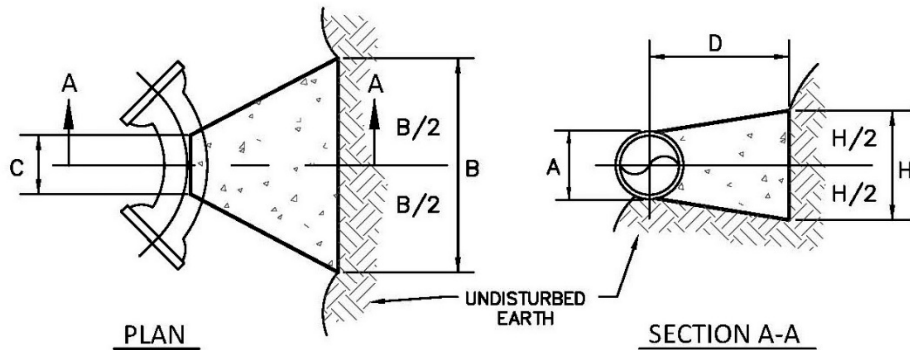
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DETAIL 02669-7



NOTES:

1. BACKING BLOCKS FOR PIPING SIZES UP THROUGH 12-INCH ARE BASED ON WORKING PRESSURE OF 175 P.S.I. PLUS 50% SURGE.
2. BACKING BLOCKS FOR PIPING SIZES 16-INCH THROUGH 24-INCH ARE BASED ON A WORKING PRESSURE OF 150 P.S.I. PLUS 50% SURGE.
3. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR THE DESIGN OF THRUST BLOCKS. THE BLOCK SIZES SPECIFIED HEREIN ARE MINIMUM SIZES, BASED ON SOIL RESISTANCE OF 2,500 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

11° DEGREE BENDS						
PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	18	6	12	12	1.5	0.032
8"	28	8	12	14	2.6	0.059
12"	36	12	12	20	5.8	0.100
16"	40	16	12	26	8.9	0.167
20"	56	20	18	30	13.9	0.401
24"	64	24	20	36	20.0	0.617
30"	90	30	30	40	31.2	1.447

22° DEGREE BENDS						
PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	24	6	12	16	2.3	0.050
8"	28	8	12	20	4.1	0.091
12"	46	12	19	28	9.3	0.341
16"	78	16	24	32	14.1	0.593
20"	86	20	35	36	22.1	1.365
24"	96	24	36	48	31.8	2.000
30"	142	30	52	54	49.6	4.534

45° DEGREE BENDS						
PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	34	6	14	20	4.5	0.11
8"	46	8	19	26	8.1	0.26
12"	80	12	34	34	18.2	1.00
16"	100	16	42	40	27.7	1.90
20"	116	20	48	54	43.3	3.40
24"	150	24	63	60	62.3	6.50
30"	168	30	69	84	97.4	11.10

90° DEGREE BENDS						
PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	52	6	23	24	8.4	0.32
8"	78	8	35	28	14.9	0.84
12"	122	12	55	40	33.6	3.00
16"	144	16	64	52	51.2	5.30
20"	180	20	80	64	80.0	10.20
24"	208	24	92	80	115.2	17.00
30"	288	30	129	90	179.9	37.10

ALT. BACKING BLOCKS FOR HORIZONTAL BENDS 2,500 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

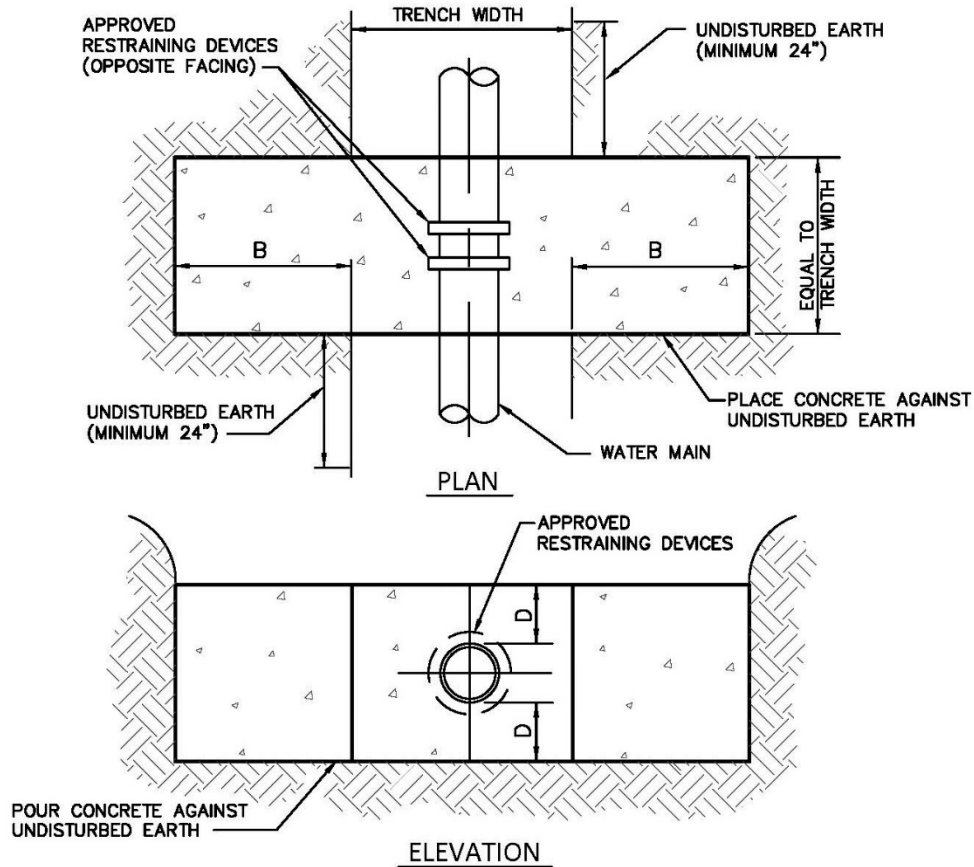
DRAWING NO. 02669-7

DEVELOPED BY:
TECHNICAL ADVISORY COMMITTEE

APPROVED BY:
DATE: 1/13/2021

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OF
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DETAIL 02669-8



NOTES:

1. STRADDLE BLOCKS ARE SIZED FOR 175 P.S.I. LINE PRESSURE 50% SURGE.
2. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR DESIGN OF STRADDLE BLOCKS. THE SIZES SPECIFIED HEREIN ARE MINIMUM SIZES BASED ON SOIL RESISTANCE OF 2,500 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

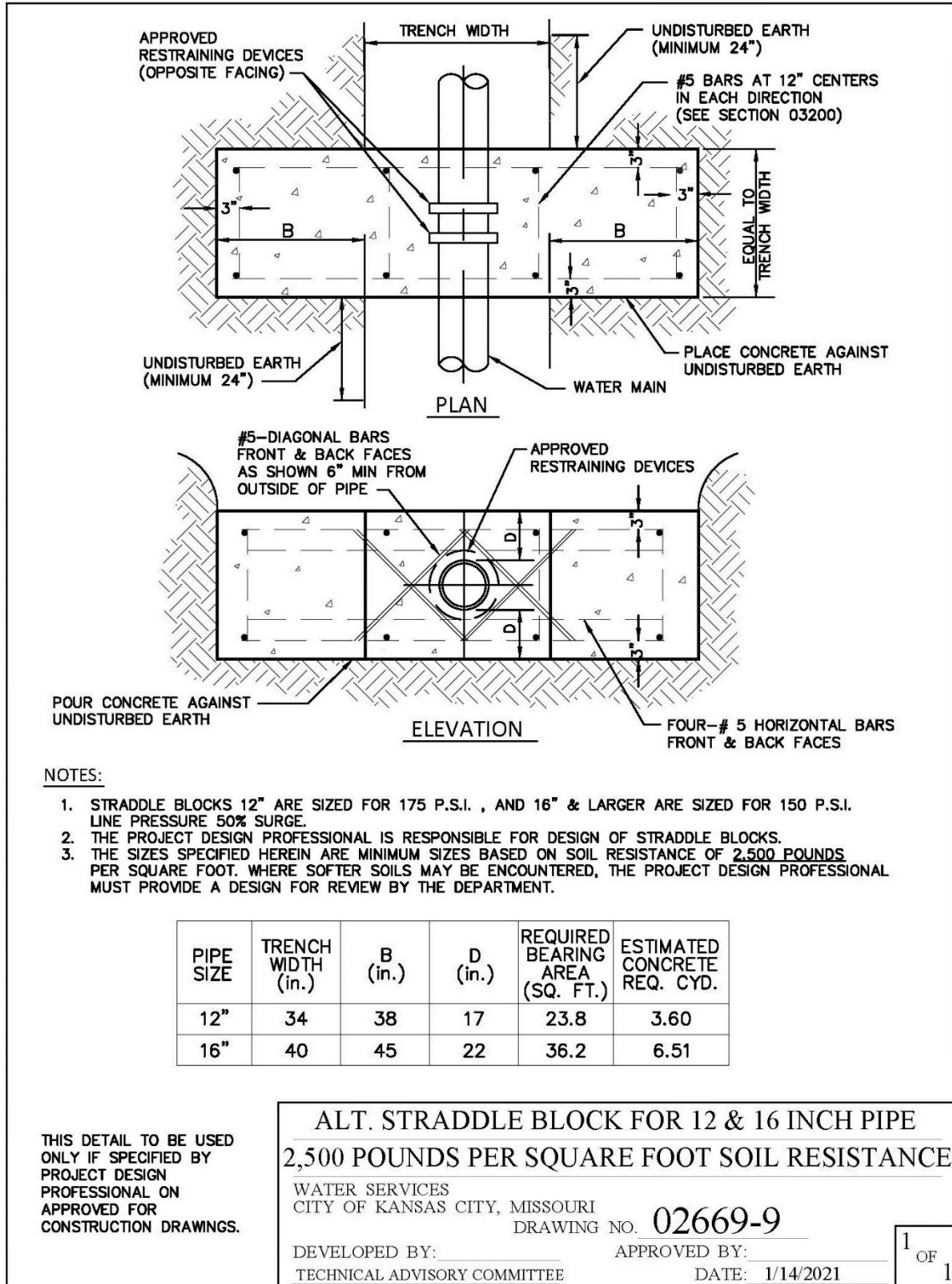
PIPE SIZE	TRENCH WIDTH (in.)	B (in.)	D (in.)	REQUIRED BEARING AREA (SQ. FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	30	24	6	5.9	0.71
8"	32	32	8	10.6	1.16

THIS DETAIL TO BE USED ONLY IF SPECIFIED BY PROJECT DESIGN PROFESSIONAL ON APPROVED FOR CONSTRUCTION DRAWINGS.

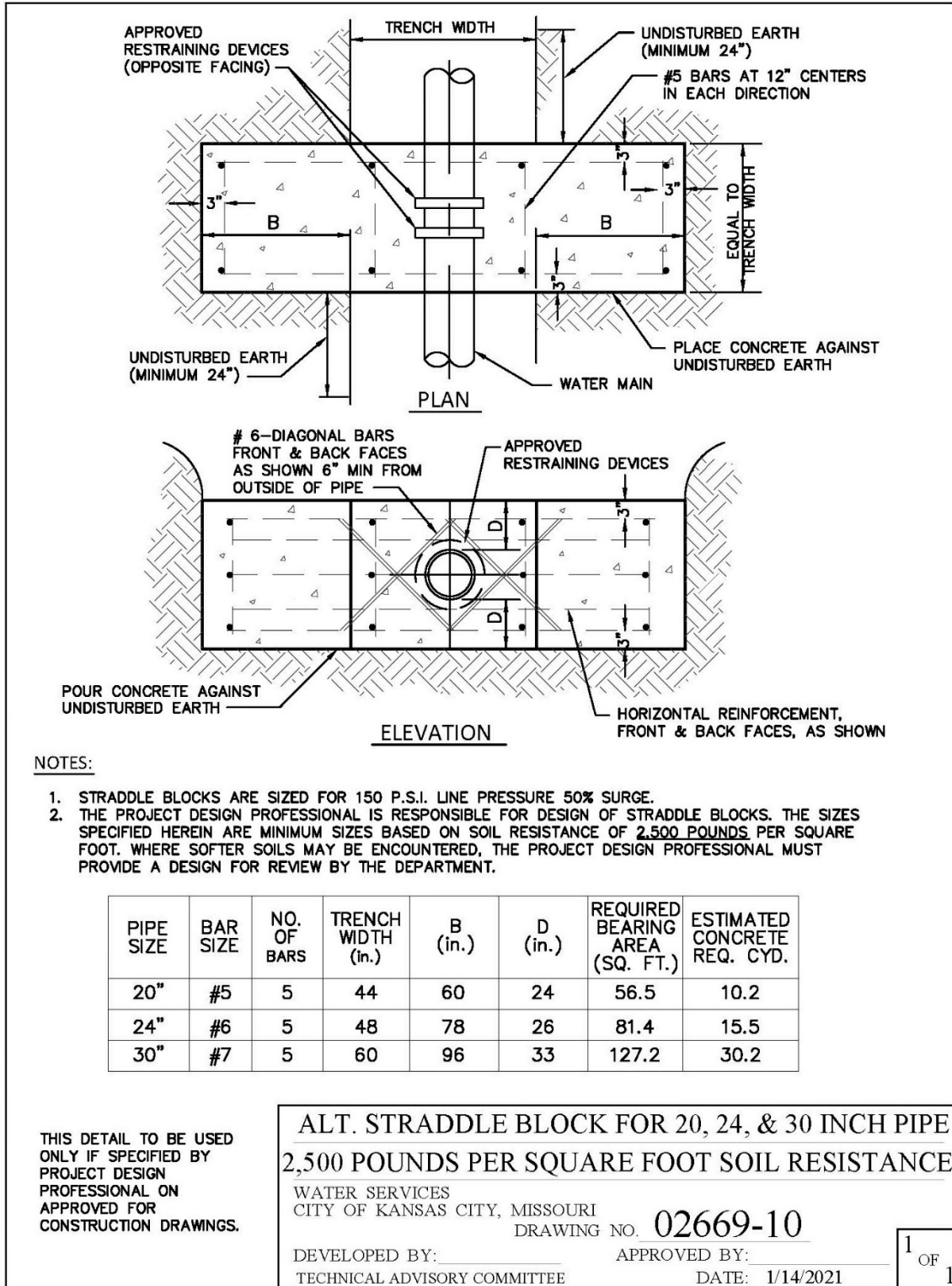
ALT. STRADDLE BLOCK FOR 12 & 16 INCH PIPE
2,500 POUNDS PER SQUARE FOOT SOIL RESISTANCE
WATER SERVICES
CITY OF KANSAS CITY, MISSOURI
DRAWING NO. 02669-8
DEVELOPED BY: TECHNICAL ADVISORY COMMITTEE
APPROVED BY: _____
DATE: 1/14/2021

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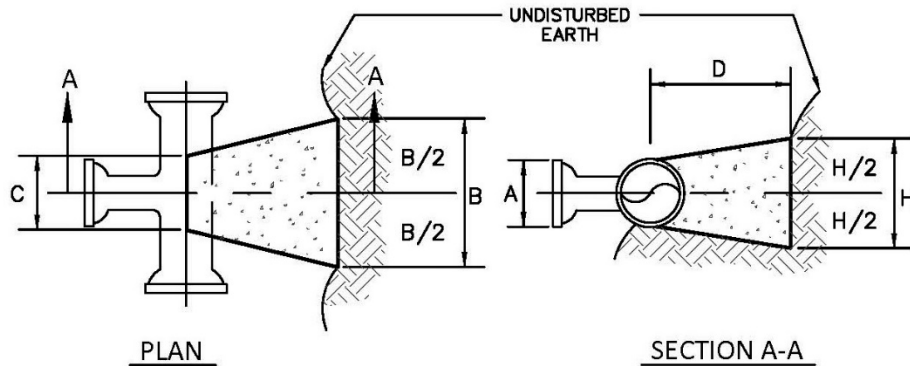
DETAIL 02669-9



DETAIL 02669-10



DETAIL 02669-11



NOTES:

1. BACKING BLOCKS FOR PIPING SIZES UP THROUGH 12-INCH ARE BASED ON WORKING PRESSURE OF 175 P.S.I. PLUS 50% SURGE.
2. BACKING BLOCKS FOR PIPING SIZES 16-INCH THROUGH 24-INCH ARE BASED ON A WORKING PRESSURE OF 150 P.S.I. PLUS 50% SURGE.
3. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR THE DESIGN OF THRUST BLOCKS. THE BLOCK SIZES SPECIFIED HEREIN ARE MINIMUM SIZES, BASED ON SOIL RESISTANCE OF 3,000 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

BRANCH OR PLUG SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	40	6	17	18	4.9	0.14
8"	54	8	23	24	8.8	0.34
12"	72	12	30	40	19.8	0.97
16"	88	16	36	50	30.2	1.80
20"	114	20	47	60	47.1	3.65
24"	136	24	56	72	67.9	6.22
30"	154	30	62	100	106.0	10.83

THIS DETAIL TO BE USED
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ALT. BACKING BLOCKS FOR TEES AND PLUGS 3,000 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

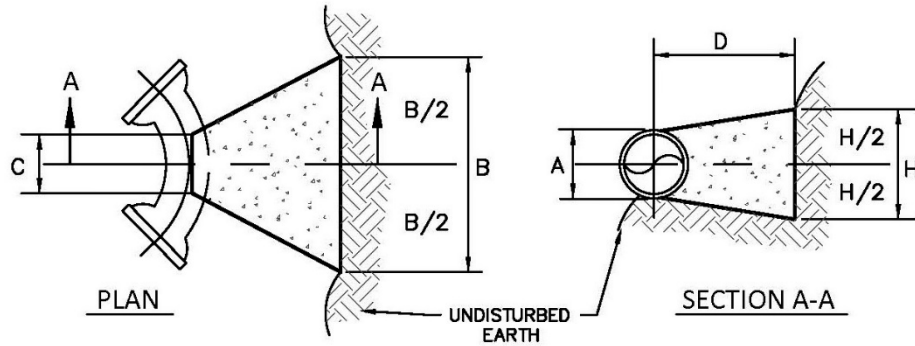
DRAWING NO. 02669-11

DEVELOPED BY:
TECHNICAL ADVISORY COMMITTEE

APPROVED BY:
DATE: 1/13/2021

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OF
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DETAIL 02669-12



NOTES:

1. BACKING BLOCKS FOR PIPING SIZES UP THROUGH 12-INCH ARE BASED ON WORKING PRESSURE OF 175 P.S.I. PLUS 50% SURGE.
2. BACKING BLOCKS FOR PIPING SIZES 16-INCH THROUGH 24-INCH ARE BASED ON A WORKING PRESSURE OF 150 P.S.I. PLUS 50% SURGE.
3. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR THE DESIGN OF THRUST BLOCKS. THE BLOCK SIZES SPECIFIED HEREIN ARE MINIMUM SIZES, BASED ON SOIL RESISTANCE OF 3,000 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

11° DEGREE BENDS						
PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	18	6	12	12	1.0	0.032
8"	20	8	12	14	1.7	0.044
12"	32	12	12	20	3.9	0.101
16"	36	16	12	24	5.9	0.144
20"	40	20	12	34	9.2	0.226
24"	52	24	14	38	13.3	0.380
30"	76	30	23	40	20.8	0.971

22° DEGREE BENDS						
PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	24	6	12	14	1.9	0.048
8"	28	8	12	18	3.4	0.073
12"	46	12	17	24	7.7	0.227
16"	62	16	23	28	11.8	0.491
20"	78	20	29	34	18.4	0.949
24"	96	24	36	40	26.5	1.704
30"	142	30	56	42	41.4	4.100

45° DEGREE BENDS						
PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	30	6	12	18	3.8	0.074
8"	40	8	16	24	6.7	0.176
12"	74	12	31	30	15.1	0.785
16"	94	16	39	36	23.1	1.521
20"	120	20	50	44	36.1	3.044
24"	140	24	58	54	51.9	5.057
30"	164	30	67	72	81.2	9.125

90° DEGREE BENDS						
PIPE SIZE A	B (in.)	C (in.)	D (in.)	H (in.)	REQUIRED BEARING AREA (SQ.FT.)	ESTIMATED CONCRETE REQ. CYD.
6"	52	6	23	20	7.0	0.265
8"	72	8	32	26	12.4	0.664
12"	112	12	50	36	28.0	2.238
16"	128	16	56	48	42.7	3.841
20"	166	20	73	58	66.6	7.845
24"	188	24	82	74	96.0	12.732
30"	270	30	120	80	149.9	28.935

THIS DETAIL TO BE USED
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CONSTRUCTION DRAWINGS.

ALT. BACKING BLOCKS FOR HORIZONTAL BENDS 3,000 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

DRAWING NO. 02669-12

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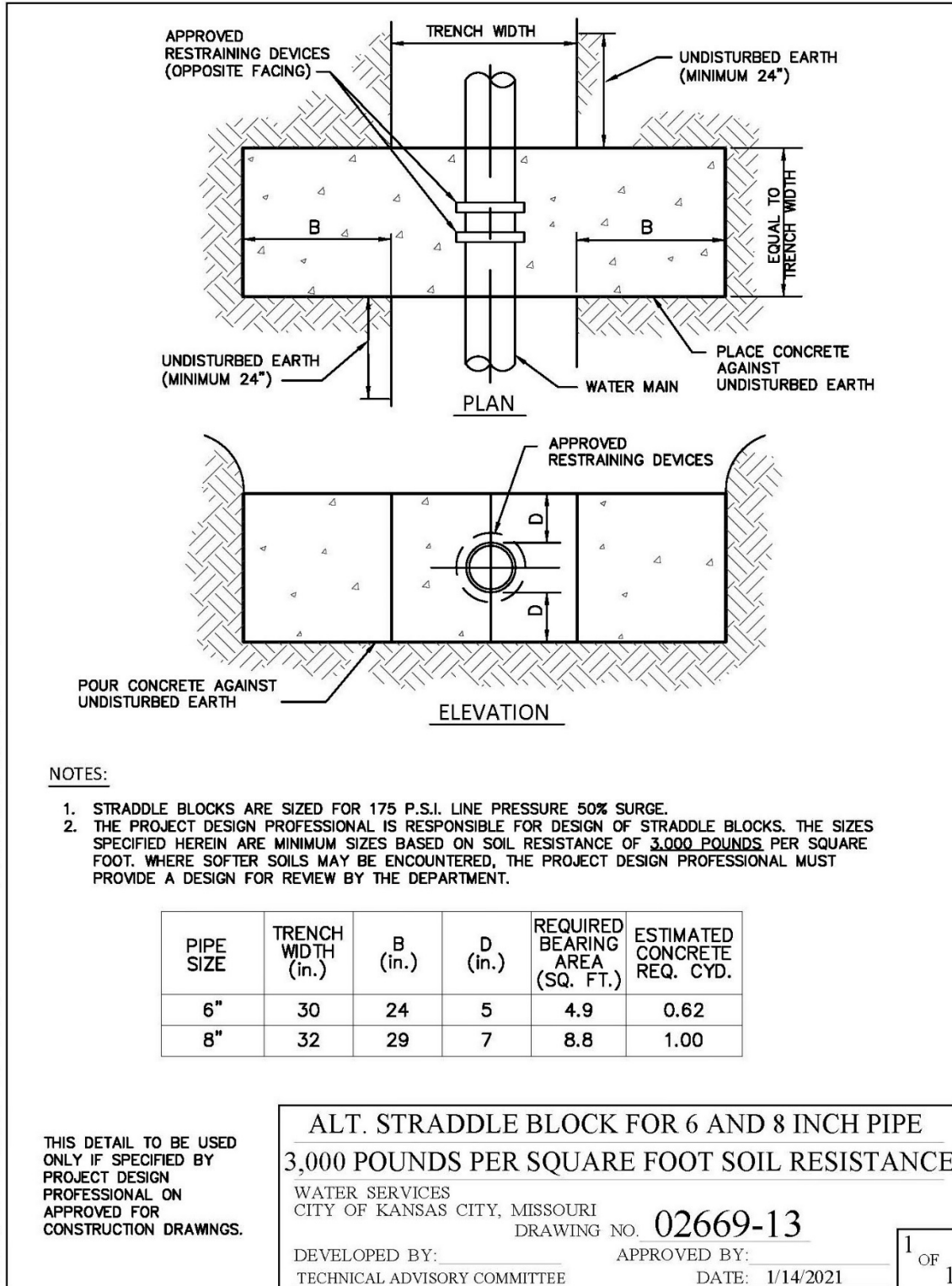
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TECHNICAL ADVISORY COMMITTEE

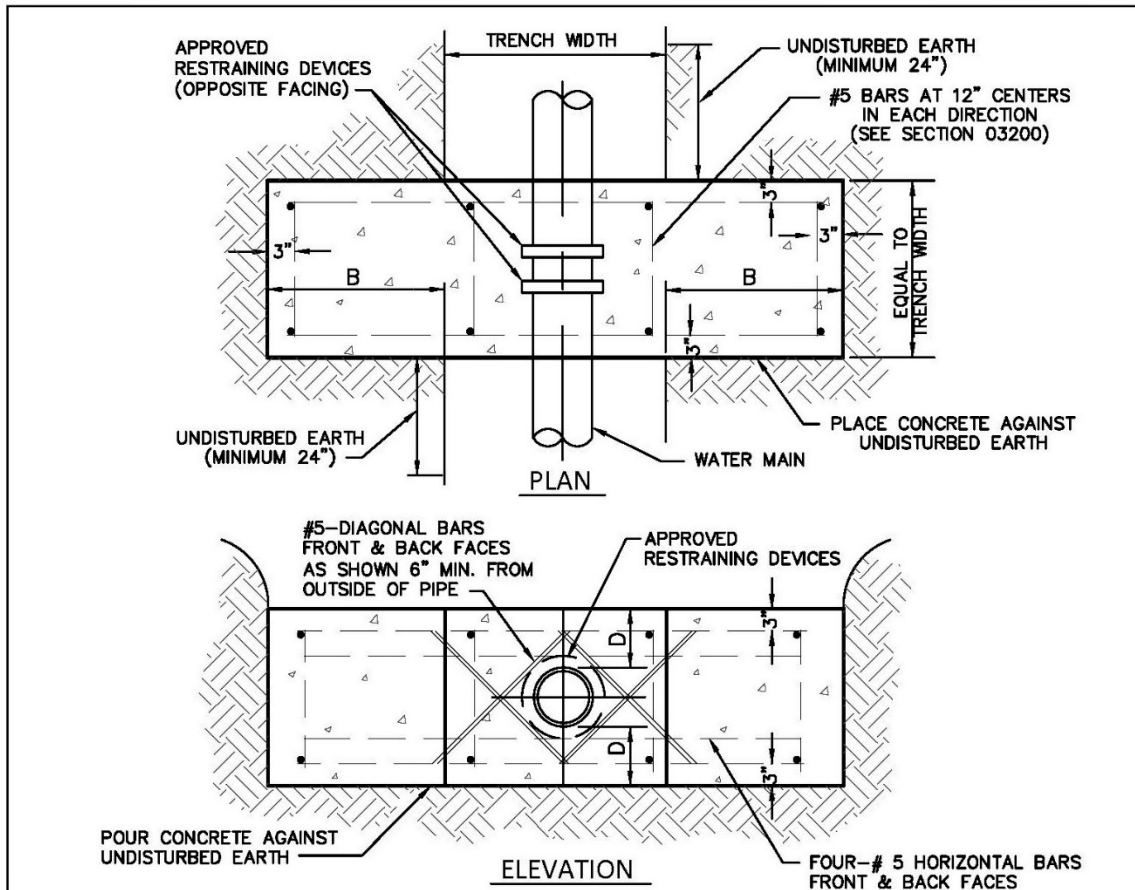
DATE: 1/13/2021

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DETAIL 02669-13



DETAIL 02669-14



NOTES:

1. STRADDLE BLOCKS 12" ARE SIZED FOR 175 P.S.I. , AND 16" & LARGER ARE SIZED FOR 150 P.S.I. LINE PRESSURE 50% SURGE.
2. THE PROJECT DESIGN PROFESSIONAL IS RESPONSIBLE FOR DESIGN OF STRADDLE BLOCKS. THE SIZES SPECIFIED HEREIN ARE MINIMUM SIZES BASED ON SOIL RESISTANCE OF 3,000 POUNDS PER SQUARE FOOT. WHERE SOFTER SOILS MAY BE ENCOUNTERED, THE PROJECT DESIGN PROFESSIONAL MUST PROVIDE A DESIGN FOR REVIEW BY THE DEPARTMENT.

PIPE SIZE	TRENCH WIDTH (in.)	B (in.)	D (in.)	REQUIRED BEARING AREA (SQ. FT.)	ESTIMATED CONCRETE REQ. CYD.
12"	34	34	15	19.8	3.0
16"	40	42	18	30.2	5.4

THIS DETAIL TO BE USED ONLY IF SPECIFIED BY PROJECT DESIGN PROFESSIONAL ON APPROVED FOR CONSTRUCTION DRAWINGS.

ALT. STRADDLE BLOCK FOR 12 & 16 INCH PIPE 3,000 POUNDS PER SQUARE FOOT SOIL RESISTANCE

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

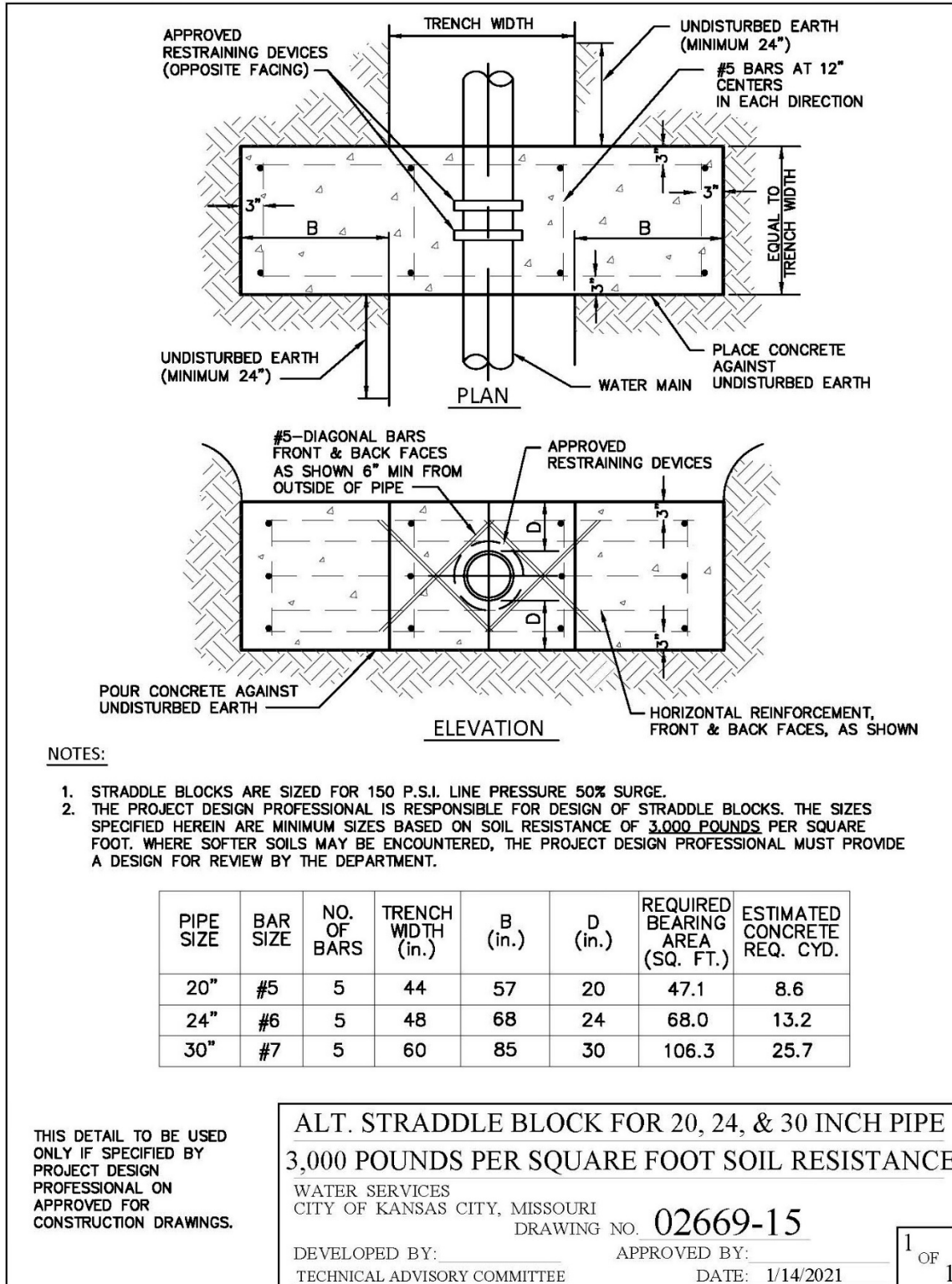
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