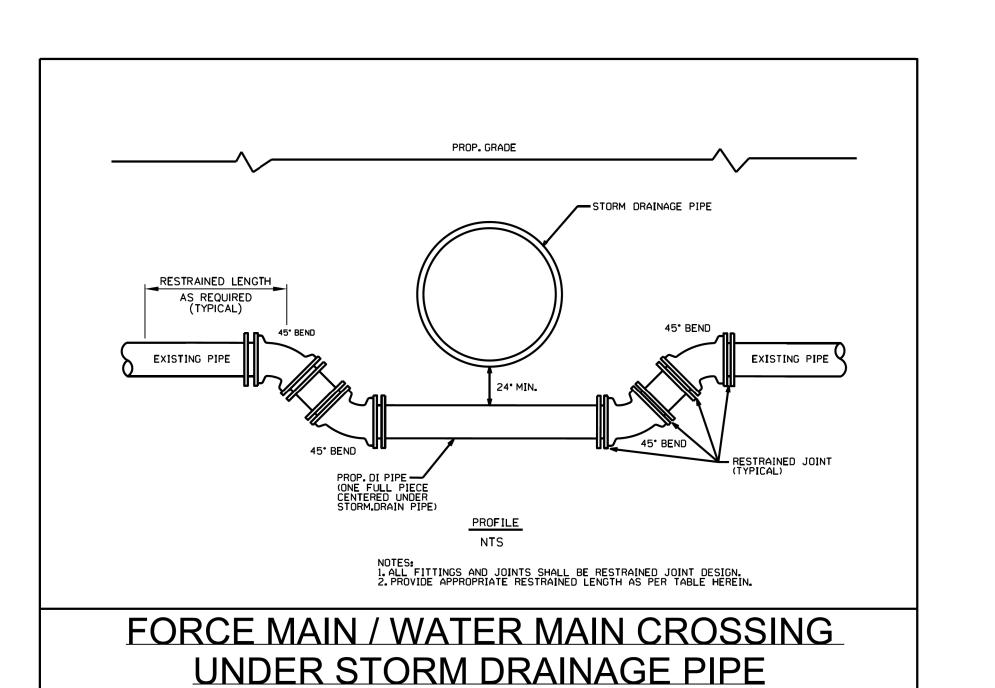
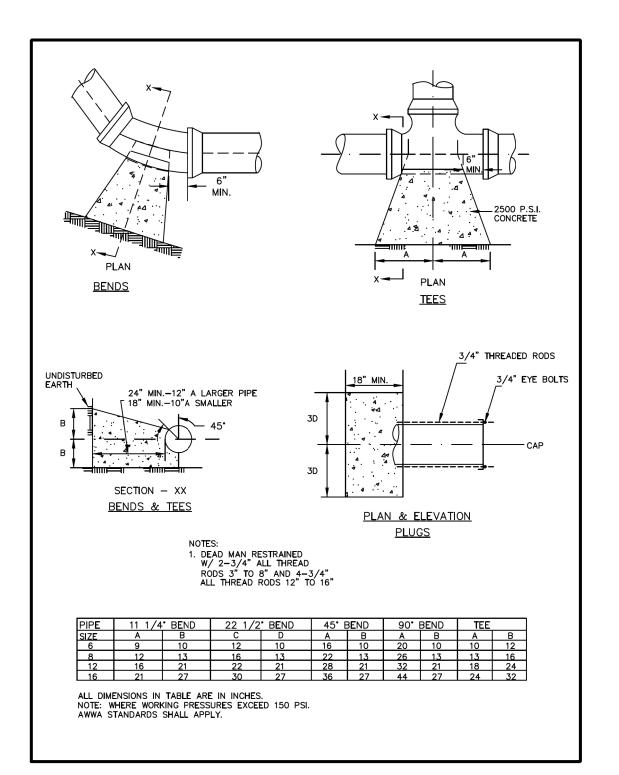
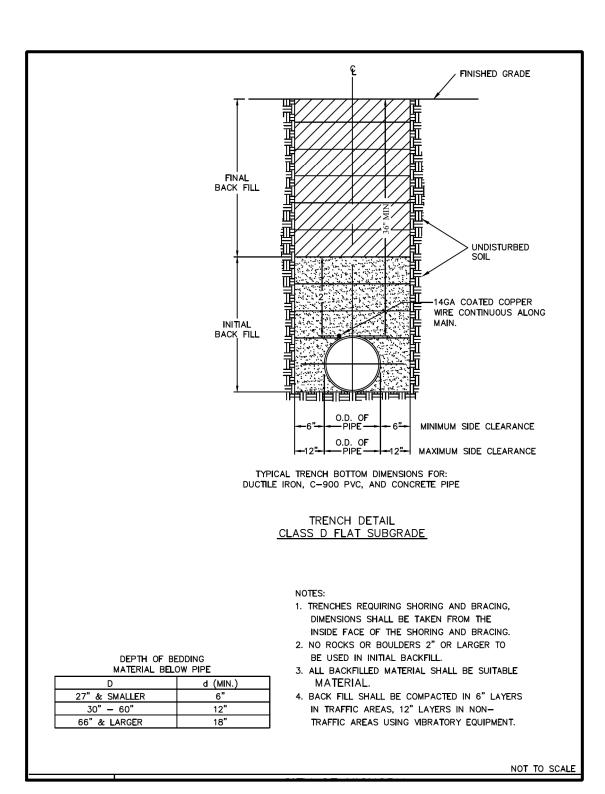
PROJECT TYPICAL DETAILS

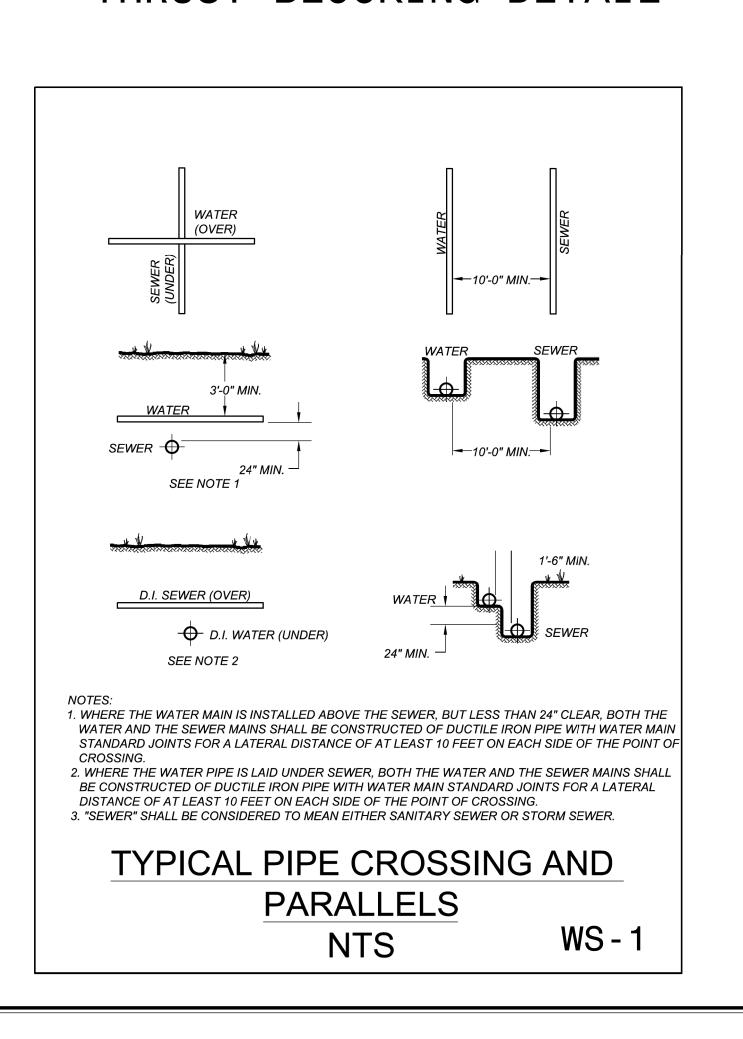




THRUST BLOCKING DETAIL



TRENCH DETAIL



PROJECT REFERENCE NO. A-0009CA DESIGNED BY: BCH DRAWN BY: CHECKED BY: APPROVED BY: REVISED: NORTH CAROLINA DEPARTMENT OF TRANSPORTATION UTILITIES ENGINEERING SEC.
PHONE: (919)707-6690
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4/8/2022
UTILITY CONSTRUCTION
PLANS ONLY

UTILITY CONSTRUCTION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

RESTRAINED JOINT DESIGN TABLE FOR DUCTILE IRON PIPE

FITTING HORIZONTAL BENDS	REQUIRED RESTRAINED LENGTH (FT) OF BARE D.I. PIPE BY DEPTH OF COVER							
	3 FT	4 FT	5 FT	6 FT	7 FT	8 FT	9 FT	10 FT
6 INCH DIA - 11.25 DEG	3	2	2	2	2	1	1	1
6 INCH DIA - 22.5 DEG	5	4	4	3	3	3	3	2
6 INCH DIA - 45 DEG	11	9	8	7	7	6	5	5
6 INCH DIA - 90 DEG	26	22	19	17	16	14	13	12
8 INCH DIA - 11.25 DEG	3	3	2	2	2	2	2	2
8 INCH DIA - 22.5 DEG	7	6	5	5	4	4	3	3
8 INCH DIA - 45 DEG	14	12	10	9	8	8	7	7
8 INCH DIA - 45 DEG 8 INCH DIA - 90 DEG						19	17	_
	33	29	25	23	20			16
12 INCH DIA - 11.25 DEG	5	4	4	3	3	3	2	2
12 INCH DIA - 22.5 DEG	9	8	7	6	6	5	5	5
12 INCH DIA - 45 DEG	20	17	15	13	12	11	10	10
12 INCH DIA - 90 DEG	47	41	36	33	29	27	25	23
16 INCH DIA - 11.25 DEG	6	5	5	4	4	3	3	3
16 INCH DIA - 22.5 DEG	12	11	9	8	8	7	6	6
16 INCH DIA - 45 DEG	25	22	19	17	16	14	13	12
20 INCH DIA - 11.25 DEG	7	6	6	5	5	4	4	4
20 INCH DIA -22.5 DEG	15	13	11	10	9	9	8	7
20 INCH DIA - 45 DEG	31	27	24	21	19	18	16	15
20 INCH DIA - 90 DEG	74	65	57	52	47	43	40	37
VERTICAL RENDS DOMN	2.55	4.55		6.5	7.5	0.53	0.55	100
VERTICAL BENDS - DOWN 6 INCH DIA - 11.25 DEG	3 FT 7	4 FT 6	5 FT 6	6 FT 5	7 FT 4	8 FT 4	9 FT	10 FT
								+
6 INCH DIA - 22.5 DEG	15 31	13 27	23	10 21	9 19	8 17	8 16	7
6 INCH DIA - 45 DEG	_							15
8 INCH DIA - 11.25 DEG	10	8	7	6	6	5	5	5
8 INCH DIA - 22.5 DEG	19	17	15	13	12	11	10	9
8 INCH DIA - 45 DEG	40	35	30	27	25	22	21	19
12 INCH DIA - 11.25 DEG	14	12	10	9	8	8	7	7
12 INCH DIA - 22.5 DEG	28	24	21	19	17	16	14	13
12 INCH DIA - 45 DEG	57	50	44	39	35	32	30	28
16 INCH DIA - 11.25 DEG	18	15	14	12	11	10	9	9
16 INCH DIA - 22.5 DEG	36	31	27	25	22	20	19	17
16 INCH DIA - 45 DEG	74	65	57	51	46	42	39	36
20 INCH DIA - 11.25 DEG	22	19	17	15	14	12	11	11
20 INCH DIA -22.5 DEG	44	38	34	30	27	25	23	21
20 INCH DIA - 45 DEG	91	79	70	63	57	52	48	44
VERTICAL BENDS - UP	2 ==	4 5		6 5	7 ==	O ET	9 FT	10 0
6 INCH DIA - 11.25 DEG	3 FT	4 FT 2	5 FT 2	6 FT 2	7 FT 2	8 FT 1	1	10 FT
6 INCH DIA - 22.5 DEG	5	4	4	3	3	3	3	2
6 INCH DIA - 45 DEG	11	9	8	7	7	6	5	5
8 INCH DIA - 43 DEG	3	3	2	2	2	2	2	2
	7	6	5			4		
8 INCH DIA - 22.5 DEG				5	4		3	3
8 INCH DIA - 45 DEG	14	12	10	9	8	8	7	7
12 INCH DIA - 11.25 DEG	5	4	4	3	3	3	2	2
12 INCH DIA - 22.5 DEG	9	8	7	6	6	5	5	5
12 INCH DIA - 45 DEG	20	17	15	13	12	11	10	10
16 INCH DIA - 11.25 DEG	6	5	5	4	4	3	3	3
16 INCH DIA - 22.5 DEG	12	11	9	8	8	7	6	6
	25	22	1 10	17		14	13	12
			19		16			+
20 INCH DIA - 11.25 DEG	7	6	6	5	5	4	4	4
20 INCH DIA - 11.25 DEG						4 9	8	4 7
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG	7	6	6	5	5			
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG	7 15	6 13	6	5 10	5 9	9	8	7 15
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES	7 15 31	6 13 27	6 11 24	5 10 21	5 9 19	9 18	8 16	7
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA	7 15 31 3 FT	6 13 27 4 FT	6 11 24 5 FT	5 10 21 6 FT	5 9 19 7 FT	9 18 8 FT	8 16 9 FT	7 15 10 FT
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA	7 15 31 3 FT 50	6 13 27 4 FT 45	6 11 24 5 FT 41	5 10 21 6 FT 38	5 9 19 7 FT 35	9 18 8 FT 33	8 16 9 FT 31	7 15 10 FT 29
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA	7 15 31 3 FT 50 65	6 13 27 4 FT 45 59	6 11 24 5 FT 41 54	5 10 21 6 FT 38 50	5 9 19 7 FT 35 46	9 18 8 FT 33 43	8 16 9 FT 31 40	7 15 10 FT 29 38
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA 12 INCH DIA	7 15 31 3 FT 50 65 80 94	6 13 27 4 FT 45 59 72	6 11 24 5 FT 41 54 66	5 10 21 6 FT 38 50 61	5 9 19 7 FT 35 46 56 66	9 18 8 FT 33 43 52 62	8 16 9 FT 31 40 49 58	7 15 10 FT 29 38 46
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA 12 INCH DIA 16 INCH DIA	7 15 31 3 FT 50 65 80	6 13 27 4 FT 45 59 72 85	6 11 24 5 FT 41 54 66 78	5 10 21 6 FT 38 50 61 72	5 9 19 7 FT 35 46 56	9 18 8 FT 33 43 52	8 16 9 FT 31 40 49	7 15 10 F1 29 38 46 54
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA 12 INCH DIA 16 INCH DIA 20 INCH DIA	7 15 31 3 FT 50 65 80 94 123 151	6 13 27 4 FT 45 59 72 85 111 137	6 11 24 5 FT 41 54 66 78 102 125	5 10 21 6 FT 38 50 61 72 94 115	5 9 19 7 FT 35 46 56 66 87 107	9 18 8 FT 33 43 52 62 81 100	8 16 9 FT 31 40 49 58 76 93	7 15 10 FT 29 38 46 54 71 88
16 INCH DIA - 45 DEG 20 INCH DIA - 11.25 DEG 20 INCH DIA - 22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA 12 INCH DIA 16 INCH DIA 20 INCH DIA REDUCERS 12 INCH X 8 INCH	7 15 31 3 FT 50 65 80 94 123	6 13 27 4 FT 45 59 72 85 111	6 11 24 5 FT 41 54 66 78 102	5 10 21 6 FT 38 50 61 72 94	5 9 19 7 FT 35 46 56 66 87	9 18 8 FT 33 43 52 62 81	8 16 9 FT 31 40 49 58 76	7 15 10 FT 29 38 46 54 71
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA 12 INCH DIA 16 INCH DIA 20 INCH DIA REDUCERS 12 INCH X 8 INCH	7 15 31 3 FT 50 65 80 94 123 151 3 FT 50	6 13 27 4 FT 45 59 72 85 111 137 4 FT 45	6 11 24 5 FT 41 54 66 78 102 125 5 FT 41	5 10 21 6 FT 38 50 61 72 94 115	5 9 19 7 FT 35 46 56 66 87 107 7 FT 35	9 18 8 FT 33 43 52 62 81 100 8 FT 33	8 16 9 FT 31 40 49 58 76 93 9 FT 31	7 15 10 FT 29 38 46 54 71 88 10 FT 29
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA 12 INCH DIA 16 INCH DIA 20 INCH DIA REDUCERS 12 INCH X 8 INCH	7 15 31 3 FT 50 65 80 94 123 151 3 FT 50	6 13 27 4 FT 45 59 72 85 111 137 4 FT 45	6 11 24 5 FT 41 54 66 78 102 125 5 FT 41	5 10 21 6 FT 38 50 61 72 94 115 6 FT 38	5 9 19 7 FT 35 46 56 66 87 107 7 FT 35	9 18 8 FT 33 43 52 62 81 100 8 FT 33	8 16 9 FT 31 40 49 58 76 93 9 FT 31	7 15 10 FT 29 38 46 54 71 88 10 FT 29
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA 12 INCH DIA 16 INCH DIA 20 INCH DIA REDUCERS 12 INCH X 8 INCH TEES 8" RUN X 8" BRANCH : RL = 1 FT	7 15 31 3 FT 50 65 80 94 123 151 3 FT 50	6 13 27 4 FT 45 59 72 85 111 137 4 FT 45	6 11 24 5 FT 41 54 66 78 102 125 5 FT 41	5 10 21 6 FT 38 50 61 72 94 115 6 FT 38	5 9 19 7 FT 35 46 56 66 87 107 7 FT 35	9 18 8 FT 33 43 52 62 81 100 8 FT 33	8 16 9 FT 31 40 49 58 76 93 9 FT 31	7 15 10 F1 29 38 46 54 71 88 10 F1 29
20 INCH DIA - 11.25 DEG 20 INCH DIA -22.5 DEG 20 INCH DIA - 45 DEG DEAD ENDS / VALVES 6 INCH DIA 8 INCH DIA 10 INCH DIA 12 INCH DIA 16 INCH DIA 20 INCH DIA REDUCERS	7 15 31 3 FT 50 65 80 94 123 151 3 FT 50	6 13 27 4 FT 45 59 72 85 111 137 4 FT 45	6 11 24 5 FT 41 54 66 78 102 125 5 FT 41	5 10 21 6 FT 38 50 61 72 94 115 6 FT 38	5 9 19 7 FT 35 46 56 66 87 107 7 FT 35	9 18 8 FT 33 43 52 62 81 100 8 FT 33	8 16 9 FT 31 40 49 58 76 93 9 FT 31	7 15 10 FT 29 38 46 54 71 88 10 FT 29

ASSUMPTIONS

LAYING CONDITION = TYPE 4 SOIL DESIGNATION = COHESIVE-GRANULAR DESIGN PRESSURE = 200 PSI (TEST PRESSURE) SAFETY FACTOR = 1.5

1. RESTRAINED LENGTH IS MEASURED AS FOLLOWS:

A. HORIZONTAL/VERTICAL BENDS: ALONG EACH SIDE OF BEND.

B. HORIZONTAL/VERTICAL BENDS - OFFSET: ALONG THE OUTER SIDE OF EACH BEND.

ALL PIPE BETWEEN THE TWO BENDS SHALL BE RESTRAINED JOINT. 2. WHEN IT IS NOT POSSIBLE TO INSTALL THE RESTRAINED LENGTHS AS NOTED BY THIS TABLE, CONTRACTOR SHALL INSTALL THE APPROPRIATE CONCRETE THRUST RESTRAINTS AS PER THE DETAILS HEREIN.