How to Quantify the Jacking or Boring of Storm or Side Drain Pipes – GDOT Specifications and Pay Items

What is jacking or boring to install a pipe?

Jacking or boring a pipe is a trenchless method for installing a pipe under a facility like a roadway or railroad such that the installation does not impede the function of the facility above. Basic explanations for the boring or jacking process to install a storm or side drain pipe when a steel casing is used is provided below. In this explanation and to coincide with GDOT Standard Specification Section 615 the steel casing is the "pipe". The storm or side drain pipe installed inside the steel casing is considered the "carrier pipe" and is governed by Specification Section 550 including measurement and payment separate from the Jack or Bore Pay Item.

1. Boring a pipe involves using a boring augur, attached ahead of or within the pipe to be installed, to tunnel under a roadway facility. The excavated material is removed through the pipe being installed and is accessible from pits on either side of the roadway. Once the pipe is installed, the carrier pipe is placed inside of it.
2. Jacking a pipe uses a hydraulic jack to push the pipe under the roadway while removing the excavated material through the pipe that is accessible from pits on either side of the roadway. Once the pipe is installed, a carrier pipe is placed inside of it.

The use of a steel casing pipe is not always needed to jack or bore to install a carrier pipe, but for the purpose of GDOT let project quantities, the designer should be conservative and assume that the contractor will need to use a steel casing pipe and account for the pay item and costs therein in their cost estimate. Designers are encouraged to also select the carrier pipe pay item based on the height of fill that it would support regardless of the loading that the casing pipe will handle.

The following pictures illustrate a typical jack or bore process.

1. This photo shows the inlet pit with tracks that will be used to hold the auguring machine as well as room for personnel to weld the sections of the casing pipe.

2. This photo shows the sections of casing pipe, with the augurs already inside of them. They will be lowered into the pit using a backhoe and then welded to the previous section of the casing pipe that has already been installed.

3. This photo shows construction personnel welding the sections of casing pipe prior to being augured into the fill.

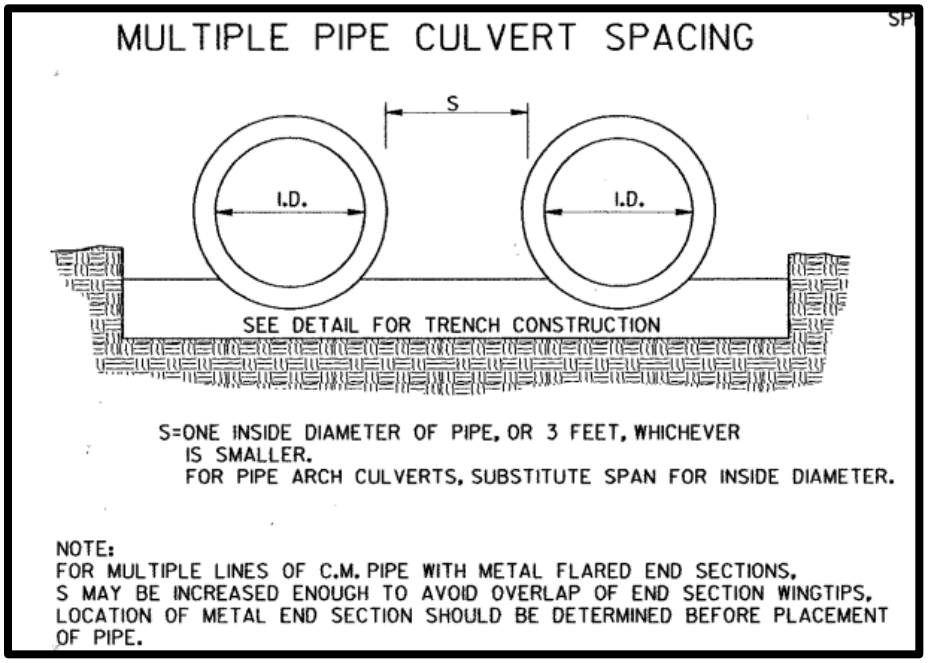
4. This photo shows an auguring machine that is tunneling the void that the casing pipe will fill. Keep in mind that the augurs are removed once the casing pipe has been fully installed.

5. This photo shows the entire pit for installing a jack or bore for a casing pipe.

When should I consider jacking or boring of a pipe?

Some of the situations where a designer should consider if jacking or boring a pipe is applicable for their project include but are not limited to the following:

1. Existing roadways that are elevated under considerable fill where trench cutting a pipe could not be accomplished in a time sensitive manner or without considerable reconstruction of the roadway facility.
2. Roadways that have considerable volumes of traffic, both day and night, where lane closures or lane reductions are not allowed or are discouraged.
3. A roadway's stormwater analysis indicates that an existing pipe will require additional, adjacent pipes to convey the volume of stormwater. In this instance, jacking or boring a parallel pipe may be necessary if an open cut cannot be achieved. The spacing of the new pipe(s) is still governed by Georgia Standard 1030D even though the spacing is shown for trench construction (see excerpt below). Keep in mind that the spacing "S" would be from the outside diameter of the existing pipe to the outside diameter of the proposed casing pipe and should provide adequate separation for the jack or bore operation. It is also worth noting that that the inside diameter (I.D.) for the casing pipe would be whatever size steel pipe can hold the necessary carrier pipe.



4. During survey or investigation of the existing pipes, it is found that an existing pipe is damaged and cannot be replaced in kind or removed and must be filled with flowable fill. However, the carrying capacity of that pipe is needed and an equally sized pipe is placed parallel to the original pipe.
5. If the drainage design of a roadway facility affects the drainage patterns of an adjacent rail line whereby a carrier pipe is needed beneath the rail line. Keep in mind that coordination with the railroad in question should occur before proposing a pipe be jack or bored on or under railroad property. Railroads typically mandate a thicker wall on the casing pipe to accommodate the loading from the railroad and to

combat corrosion of the steel casing over time. In some cases, the railroad may allow the casing pipe acting alone for this conveyance of stormwater. However, it is encouraged that designers use a casing pipe and an appropriate carrier pipe pay item based on the height of fill as a safety measure should a structure failure occur.

How much space is needed to jack or bore a pipe?

The ideal time to identify pipes that will require jacking or boring is during the development of the PFPR plan set and prior to right of way acquisition to ensure adequate space is provided.

Jacking or boring a steel casing pipe for a carrier pipe requires a pit capable of holding the hydraulic jack or auguring machine, room for welding the casing sleeve and assembling the carrier pipe, as well as for removing the excavated material. The jack or bore pits, located on each side of the roadway, require that the designer allots adequate required right of way or temporary easement for the construction of the pits. Generally, the area needed for a jack or bore pit would be set up as temporary easement unless there will be permanent structures left within that space. In that case, the designer should set up the area as required right of way which will allow for the maintenance of the permanent feature in the future. The image below depicts a pit used to both assemble the carrier sleeve and house the auger used to excavate the tunnel under the roadway. You can also see that temporary shoring is being used adjacent to the roadway fill to help facilitate the boring pit. This image illustrates the considerable amount or space that the jack or bore process may need.

The process for jacking or boring of a pipe involves an entrance and exit pit. The entrance pit carries the equipment to bore the pipe and assemble the casing pipe. The exiting pit is generally considerably smaller than the entrance pit. The exiting pit is very similar to an open cut operation where the contractor simply extends the pipe to the required outlet elevation once it has reached a certain point beneath whatever facility is above it. Designers should keep in mind that jack or bore operations are generally done in an uphill direction.

Consultation with district construction personnel about where the entrance and exit pits should be located is encouraged for the purpose of setting up needed easement or right of way.

Jack or bore pits may be discouraged where utility conflicts exist or if the pit would impact an environmental resource. Designers are encouraged to confer with district construction personnel about whether jack or bore seems applicable and how much right of way or easement will be needed to accomplish the pipe placement. There are cases where additional pits may be needed along the pipe alignment to allow for staged construction or additional access points for very long installations. The designer is encouraged to discuss the amount of space needed for the pits with district construction so that ample right of way or temporary easement can be obtained.

The following table provides general guidance on the amount of space that a jack or bore pit will necessitate.

Casing Pipe Size (Single Line of Pipe)	Length	Width
≤ 60-IN	40-FT	16-FT
> 60-IN	40-FT	Inquire with district construction personnel about the width needed for your casing pipe.

Notes:

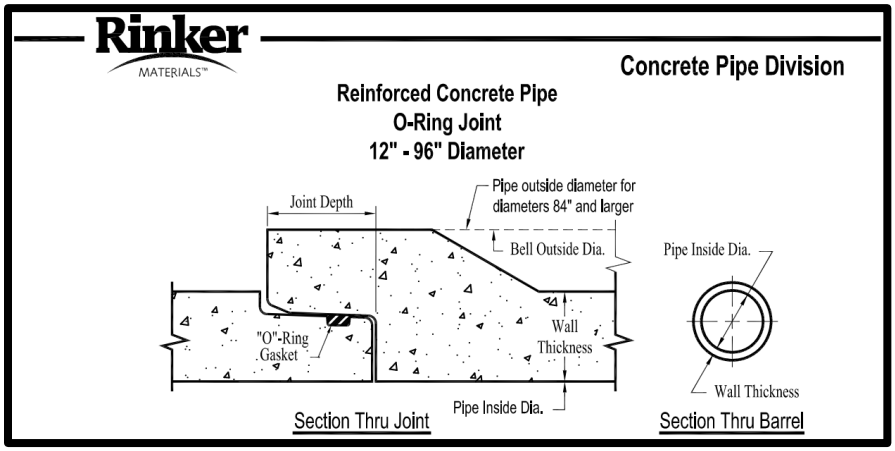
1. Designers can assume the entering and exiting pits are the same size unless their specific case indicates the jacking or boring operation must be one direction. In that instance the designer should consult with District Construction about possibly shortening the length of the exiting pit, if needed to minimize impacts.
2. Double lines of pipe will require double the width for the bore pit.
3. Shoring for the bore pit is required for deep roadway fills and common for most jack or bore installations.

How do I determine the size of the casing pipe?

The inside diameter of the steel casing pipe must be large enough to allow the carrier pipe (aka storm/side drain pipe) to be inserted through it. Manufacturers steel casing diameter is the outside diameter. The image below depicts a section of a steel casing that will eventually house a carrier pipe inside of it.

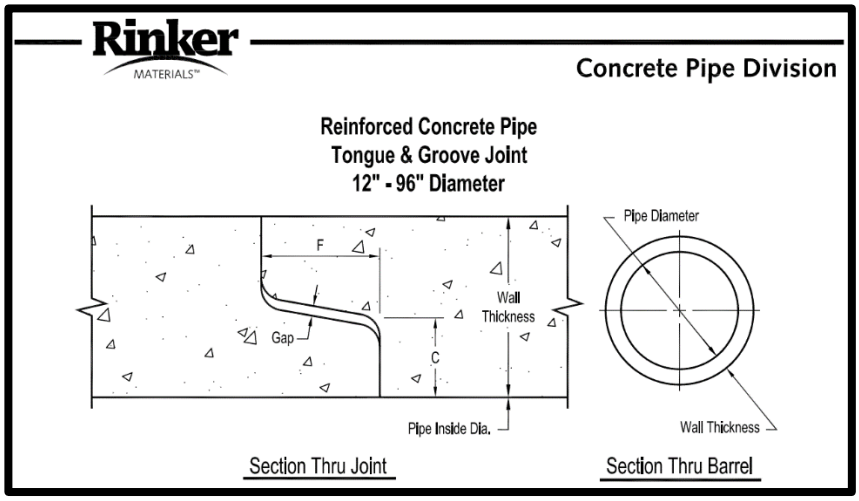
Remember that the diameter, specified in the plans, for the storm/side drainpipe is the inside diameter thus we need to estimate the maximum outside diameter to determine an appropriate casing inside diameter that can accommodate the storm/side drain pipe.

We typically think of drain pipe that uses an O-Ring joint with a bell shape on one end of the pipe (see the image below) thus the bell outside diameter becomes the maximum outside diameter. It's safe to use this style of pipe which will be conservative when estimating the maximum outside diameter. Of course, there are many manufacturers with varying dimensions for the pipe and bell thickness.



Another common reinforced concrete pipe is a tongue and groove design where there is no bell (see the pictures below). For this pipe style the inside diameter plus the thickness of the wall twice becomes the maximum outside diameter. However, designers are encouraged to use the O-ring / Bell

style pipe to estimate the size of the casing pipe as that should produce a maximum sized casing pipe and will not force the contractor to use a tongue and groove style pipe.



How do I pay for jacking or boring a pipe?

Section 615 of the GDOT Standard Specifications covers Jacking or Boring Pipes. The excerpt from the Standard Specifications explains how jack or bore pipe is to be paid for.

615.5 Payment

Work performed and materials furnished as prescribed by this item and measured as provided above will be paid for at the Contract Price per linear foot (meter) for jacking and boring of the pipe type, size, and class specified. Payment is full compensation for furnishing the pipe and the incidentals to complete the Item.

Excavation will not be paid for separately but will conform to Section 205 and Section 208.

Payment will be made under:

Item No. 615	Jack or bore pipe (type), (class), (size)	Per linear foot (meter)

What information should I provide in the supplemental description?

A common error when a steel casing is specified for a separate carrier pipe is that the supplemental information for the jack or bore pay item is just the size of the carrier pipe being installed in the casing. That is not the case. The applicable Section 550 pay items should be used to pay for the carrier pipe (aka storm/side drain pipe) and should not be referenced in the supplemental description for jacking or boring for that pipe. The 615-1000 pay item is intended to quantify and pay for the steel casing and its installation. The information that the designer will need to provide gives the contractor the outside diameter of the casing (size), material of the casing (type which should be steel), and the wall thickness of the casing (class).

The image above illustrates the inside diameter of a steel casing pipe.

The image above illustrates the wall thickness of the steel casing pipe.

Pay Item	Pay Item Description	Units	Supplemental Description for Steel Casing
615-1000	JACK OR BORE PIPE -	LF	Casing material type, wall thickness & size

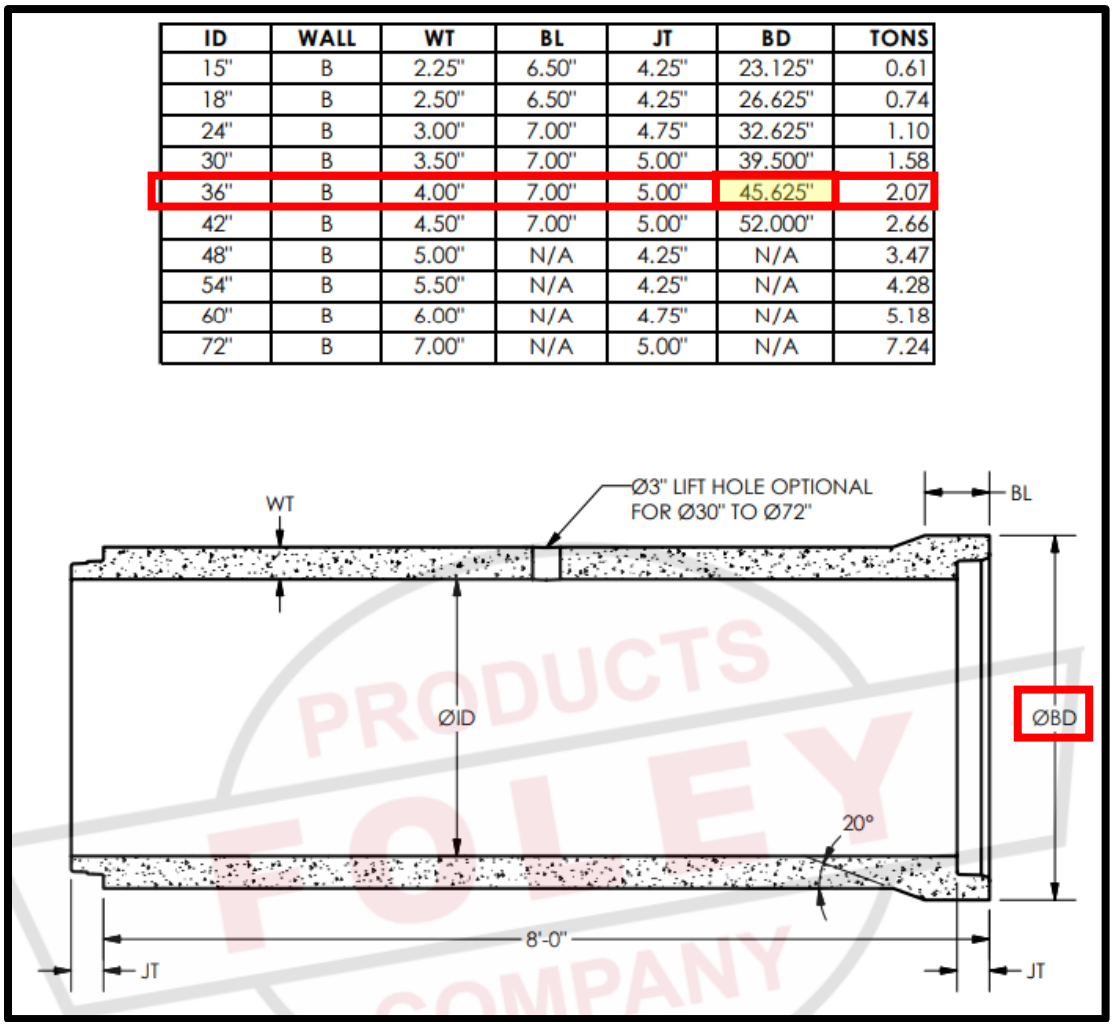
An example for determining the size, material type and the wall thickness of a casing pipe

To illustrate how a Jack or Bore steel casing pipe is determined we will use the following example.

A 120-foot length of 36-inch diameter storm drain pipe needs to be installed under an arterial roadway. Traditional trench cut installation of the pipe cannot occur as the roadway's traffic cannot be diverted and traffic volumes will not allow for lane closures. You have conferred with district construction personnel and have determined that a jack or bore installation of the pipe is needed. The following steps illustrate how you can determine the casing needed for your 36-inch (storm drain) carrier pipe.

1. Determine the maximum outside diameter for the carrier pipe. We will assume an O-Ring style pipe with a bell, as this would yield the largest outside diameter that the casing pipe would need to accommodate. To determine common dimensions for this style pipe, we can use the GDOT's Office of Materials and Testing's Qualified Product List to find a concrete pipe supplier (QPL-4). Foley Products Company is one of the sources used by GDOT for concrete pipes and their pipe properties table for O-Ring style pipe is shown below.

ID	WALL	WT	BL	JT	BD	TONS
15"	B	2.25"	6.50"	4.25"	23.125"	0.61
18"	B	2.50"	6.50"	4.25"	26.625"	0.74
24"	B	3.00"	7.00"	4.75"	32.625"	1.10
30"	B	3.50"	7.00"	5.00"	39.500"	1.58
36"	B	4.00"	7.00"	5.00"	45.625"	2.07
42"	B	4.50"	7.00"	5.00"	52.000"	2.66
48"	B	5.00"	N/A	4.25"	N/A	3.47
54"	B	5.50"	N/A	4.25"	N/A	4.28
60"	B	6.00"	N/A	4.75"	N/A	5.18
72"	B	7.00"	N/A	5.00"	N/A	7.24



2. We can determine that a 36-IN Storm Drain Pipe, or carrier pipe, will have an outside bell diameter (BD) of 45.625-inches from the pipe properties chart,
3. The steel casing that will encapsulate the selected carrier pipe needs to have an inside diameter capable of holding the carrier pipe's outside bell diameter as well as any shims or spacers needed to move the carrier pipe into the casing. We will consider a 54-inch steel casing for our carrier pipe using the information provided in the steel pipe chart below.

Pipe Weights lbs/ft *(kg/m)*

Outside Diameter (OD) in *(mm)*	WALL THICKNESS (t) in *(mm)*									
	0.188 *4.78*	0.203 *5.16*	0.219 *5.56*	0.250 *6.35*	0.312 *7.92*	0.375 *9.53*	0.500 *12.70*	0.625 *15.88*	0.750 *19.05*	1.000 *25.40*
12.75 *323.9*	25.25 *37.57*	27.23 *40.52*	29.34 *43.66*	33.41 *49.71*	41.48 *61.74*	49.61 *73.83*	65.48 *97.43*			
14 *355.6*	27.76 *41.31*	29.94 *44.56*	32.26 *48.01*	36.75 *54.69*	45.65 *67.94*	54.62 *81.28*	72.16 *107.38*			
16 *406.4*	31.78 *47.29*	34.28 *51.02*	36.95 *54.98*	42.09 *62.64*	52.32 *77.87*	62.64 *93.21*	82.85 *123.29*			
18 *457.2*	35.80 *53.27*	38.62 *57.47*	41.63 *61.95*	47.44 *70.59*	58.99 *87.79*	70.65 *105.15*	93.54 *139.20*			
20 *508.0*	39.82 *59.25*	42.96 *63.93*	46.31 *68.92*	52.78 *78.55*	65.66 *97.72*	78.67 *117.08*	104.23 *155.11*	129.45 *192.64*		
24 *609.6*	47.86 *71.22*	51.64 *76.85*	55.67 *82.85*	63.47 *94.46*	79.01 *117.57*	94.71 *140.94*	125.61 *186.92*	156.17 *232.41*	186.41 *277.40*	
30 *762.0*				79.51 *118.32*	99.02 *147.36*	118.76 *176.73*	157.68 *234.65*	196.26 *292.07*	234.51 *348.99*	310.01 *461.35*
36 *914.4*				95.54 *142.18*	119.03 *177.14*	142.81 *212.53*	189.75 *282.38*	236.35 *351.73*	282.62 *420.58*	374.15 *556.80*
42 *1067*				111.58 *116.05*	139.04 *206.92*	166.86 *248.32*	221.82 *330.10*	276.44 *411.38*	330.72 *792.17*	438.29 *652.25*
48 *1219*				127.61 *189.91*	159.05 *236.70*	190.92 *284.12*	253.89 *377.83*	316.52 *471.04*	378.83 *563.76*	502.43 *747.70*
54 *1372*						214.97 *319.91*	285.96 *425.55*	356.61 *530.70*	426.93 *635.35*	566.57 *843.15*
60 *1524*						239.02 *355.70*	318.03 *473.28*	396.70 *590.35*	475.04 *706.93*	630.71 *938.60*
72 *1829*						287.13 *427.29*	382.17 *568.73*	476.87 *709.67*	571.25 *850.11*	758.99 *1129.50*
84 *2134*						335.23 *498.88*	446.31 *664.18*	557.05 *828.98*	667.46 *993.29*	887.27 *1320.41*
96 *2438*							510.45 *759.63*	637.22 *948.30*	763.67 *1136.46*	1015.55 *1511.31*
108 *2743*							574.59 *855.08*	717.40 *1067.61*	859.88 *1279.64*	1143.83 *1702.21*
120 *3048*							638.73 *950.53*	797.57 *1186.92*	958.09 *1422.82*	1272.11 *1893.11*

FORMULA TO FIND WEIGHT PER FOOT OF STEEL PIPE = (OD INCHES — WALL THICKNESS) x 10.69 x WALL THICKNESS = WEIGHT PER FOOT

4. The chart indicates that a 54-inch casing pipe has a pipe wall thickness range from 0.375 inch up to 1.000 inch. We will use a mid-range wall thickness of 0.625 inches to determine the inside diameter of the casing pipe. Designers are encouraged to evaluate whether a thicker pipe wall thickness may be merited in instances of higher fills.

   Casing Pipe Outside Diameter – 2 x (Casing Pipe Wall Thickness) = Casing Pipe Inside Diameter
   54.0 inches – (2 x 0.625 inches) = 52.75 inches

5. The 52.75 inch inside diameter is large enough to handle the carrier pipe outside bell diameter 52.75 inches > 45.625 inches. We can then determine how much room will remain for shims to place the carrier pipe within the casing. Designers can use 3 inches a minimum spacing between the outside diameter of the carrier pipe and the inside diameter of the casing pipe.

   (Casing Pipe Inside Diameter – Carrier Pipe Outside Diameter) / 2 = Spacing for Shims
   (52.75 inches – 45.625 inches) / 2 = 3.563 inches

6. We now have the necessary information to quantify the casing pipe for this jack or bore example.

Pay Item	Pay Item Description	Units	Quantity	Supplemental Description
615-1000	JACK OR BORE PIPE -	LF	120	Steel, 0.625-IN, 54-IN

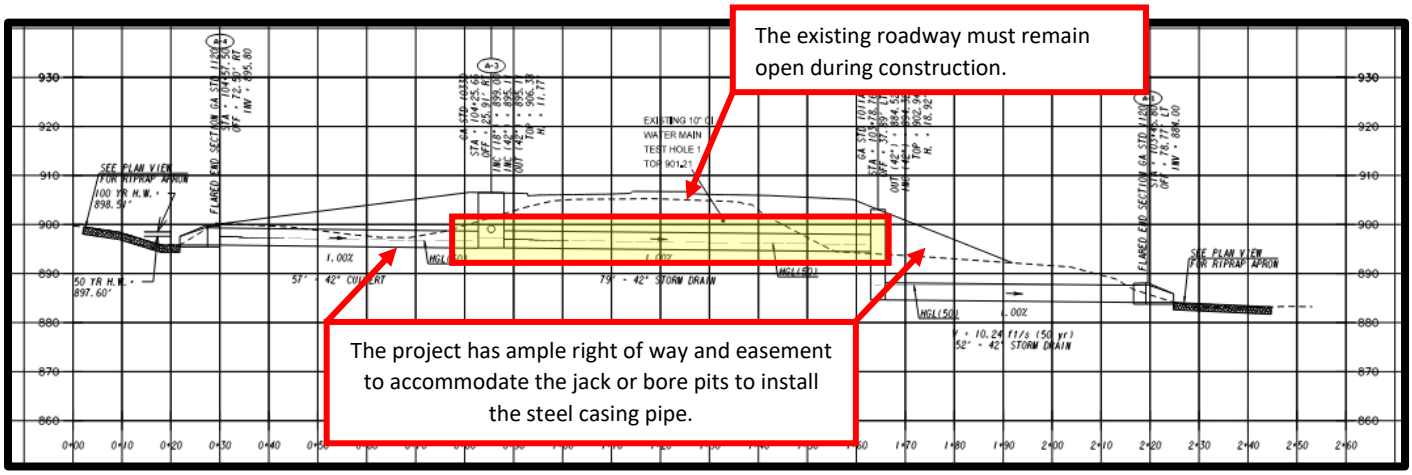
7. The quantity should be included in the Summary of Quantities as shown below:

DRAINAGE QUANTITIES							
				STORM DRAIN PIPE			JACK OR BORE PIPE
STRUCTURE NUMBER	ROADWAY	LOCATION	SIDE	CLASS 3	CLASS 3	CLASS 3	STEEL, 0.625-IN
				18 IN	24 IN	36 IN	54 IN
				LF	LF	LF	LF
C-1	SR 20	105+50.00	LT			120	120

A good example of real-world application of jack or bore as shown in a plan set.

The following excerpts are from the summary of quantities and drainage profiles sheets, respectively. They illustrate how 79 linear feet of 72-inch steel casing pipe should be shown in the plan set.

STR. NO	LOCATION	SIDE	CLASS III PIPES									INLETS AND MISC. DRAINAGE ITEMS																			
			STORM DRAIN PIPES	STORM DRAIN PIPES	STORM DRAIN PIPES	STORM DRAIN PIPES	STORM DRAIN PIPES	STORM DRAIN PIPES	UNDERDRAIN PIPE	SLOPE DRAIN	SLOPE DRAIN	DROP INLET GA. STD. 1019A	DROP INLET GA. STD. 9031S	DROP INLET GPI ADDL DEPTH	MANHOLE GA. STD. 1011A	MANHOLE GPI ADDL DEPTH	FLARED END SECT. 18 IN. STORM DRAIN GA. STD. 1120	FLARED END SECT. 24 IN. STORM DRAIN GA. STD. 1120	FLARED END SECT. 30 IN. STORM DRAIN GA. STD. 1120	FLARED END SECT. 36 IN. STORM DRAIN GA. STD. 1120	FLARED END SECT. 42 IN. STORM DRAIN GA. STD. 1120	CATCH BASIN, 24 IN. GA. STD. 1033D	CATCH BASIN, 30 IN. GA. STD. 1033D	CATCH BASIN, 42 IN. GA. STD. 1033D	CATCH BASIN GPI ADDL DEPTH	CATCH BASIN GPI ADDL DEPTH	CONC. SPILLWAY, TYPE 1	CONC. SPILLWAY, TYPE 3	CONC. SLOPE DRAIN	SPRING BOX	JACK OR BORE PIPE, STEEL, 0.500-IN. WALL, 46-IN	JACK OR BORE PIPE, STEEL, 0.500-IN. WALL, 54-IN	JACK OR BORE PIPE, STEEL, 0.500-IN. WALL, 72-IN
			LF 18"	LF 24"	LF 30"	LF 36"	LF 42"	LF 42"	LF 6"	LF 6"	LF 10"	EA	EA	LF	EA	LF	EA	EA	EA	EA	EA	EA	EA	EA	LF	LF	EA	EA	SY	EA	LF	LF	LF
A-1	S. R. 20, STA 103+46	LT																			1												
A-2	S. R. 20, STA 103+79	LT						52							1	13																	
A-3	S. R. 20, STA 104+25	LT					79																	1		6							79
A-4	S. R. 20, STA 104+58	LT					57														1												
A-5	S. R. 20, STA 105+30	LT	104									1																					
A-6	WEST HIGHTOWER, STA 208+43	LT	75									1																					
B-1	S. R. 20, STA 107+60	LT																1															
B-2	S. R. 20, STA 107+87	LT		43								1																					
B-2	S. R. 20, STA 107+91	LT		57																		1			1						57		
B-3	S. R. 20, STA 107+94	LT		26														1															
B-4	S. R. 20, STA 107+48	RT	44									1																					
B-5	S. R. 20, STA 106+87	RT	75									1																					
C-1	WEST HIGHTOWER, STA 200+77	RT																	1														
C-2	WEST HIGHTOWER, STA 201+00	LT			85								1	3																		50	
D-1	WEST HIGHTOWER, STA 206+01	RT															1																
D-2	WEST HIGHTOWER, STA 206+10	RT	31									1																					
D-3	WEST HIGHTOWER, STA 207+00	LT	99									1																					
E-1	WEST HIGHTOWER, STA 209+14	LT																			1												
E-2	WEST HIGHTOWER, STA 209+10	LT				104																	1		5							104	
E-3	WEST HIGHTOWER, STA 208+50	LT	54									2																					
E-4	WEST HIGHTOWER, STA 209+35	LT				32							1	1																			
F-1	S. R. 20, STA 104+25	RT									38																1						
G-1	S. R. 20, STA 104+80	RT									17																1						
H-1	WEST HIGHTOWER, STA 203+50	RT																										1	9				
I-1	WEST HIGHTOWER, STA 205+50	RT									17																1						
J-1	WEST HIGHTOWER, STA 207+04	RT							20																								
M-1	WEST HIGHTOWER, STA 201+34	LT								17																							
	AS REQUIRED																																
	TOTALS		482	126	85	136	136	52	20	17	72	9	2	4	1	13	1	2	1	1	2	1	1	1	6	6	3	1	9	1	57	154	79



Jack or Bore for Utility Relocations Included in the Construction Plans/Contract – Drawing Section 44 Plans

Designers should be cognizant that utility relocations such as water mains or sanitary sewer lines can employ the same jacking or boring process for pipe (steel casing) inside of which carrier pipe (water mains or sanitary sewer lines) are installed. The same installation processes, consideration or the space needed for the pits, method to determine the steel casing size, and measurement and payment for the steel casing using the Section 615-1000 pay item previously presented for storm/side drain pipe may be valid for these applications.

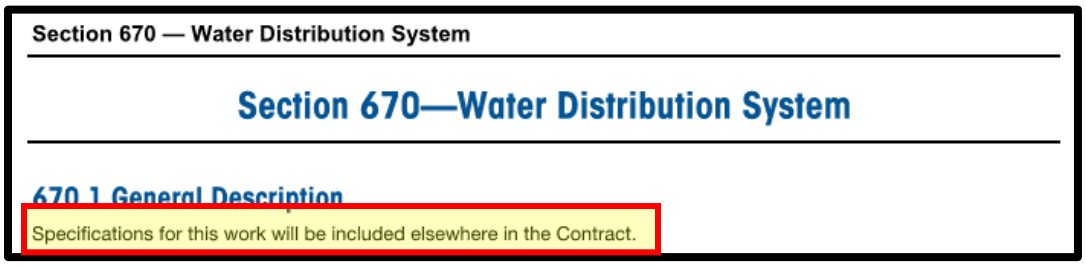
However, designers need to understand that utility relocation items such as water mains and sanitary sewer lines require Project Specific Special Provisions since the 2021 Standard Specifications has the following for Section 660 Sanitary Sewers and Section 670. Although not shown the same applies for Gas Distribution Systems.

Section 660 — Sanitary Sewers

Section 660—Sanitary Sewers

660.1 General Description

Specifications for this work will be included elsewhere in the Contract.



Section 670 — Water Distribution System

Section 670—Water Distribution System

670.1 General Description

Specifications for this work will be included elsewhere in the Contract.

The required Project Specific Special Provisions may specify a different measurement and payment method for the Jack or Bore. The excerpt below is taken from a Project Specific Special Provision Section 670 for a Water Distribution System and explains what would be included in the Section 670 pay item used for Steel Casing.

Q. Steel Casing

Steel casing pipe shall be paid for at the unit price per linear foot according to the diameter and thickness of the steel casing installed and shall cover the cost for all materials, transportation, labor, equipment, excavation, sheeting and shoring, protection of existing utilities, steel casing pipe, skid, steel straps, coatings, casing spacers, end seals, boring and jacking pits, backfilling, backfill materials, disposal of unsuitable backfill material, tamping, testing, densities, dewatering, trench stabilization, clean-up, restoration, and all work and materials necessary to install the steel casing except where such items are shown to be paid for under a separate Item. The carrier pipe shall be paid from another applicable Pay Item.

The plan sheet excerpt below illustrates a water main installation that employed a steel casing.