MICHIGAN

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**WATER MAINS MATERIALS AND CONSTRUCTION**

GND:KAP 1 of 11 APPR:CJD:RPB:12-02-24

**a. Description.** This work consists of installing the following materials as part of the city of Grand Rapids’ water system. Unless otherwise noted below, ensure all work, materials, construction requirements, and methods of measurement and payment are in accordance with the standard specifications.

**b. Materials.** Furnish the listed materials below in accordance with current *AWWA* standards and the standard specifications. The specific items listed below conform to city of Grand Rapids water system requirements and no substitutions are permitted.

1. General. Valves and hydrants are to be tagged or stamped by the Manufacturer stating that they conform to the standard specifications and this special provision. Permanently attach a tag or stamp to the valves and the barrel of hydrants.

A. Submittals. Submit PDF product data consisting of shop drawings and manufacturer’s literature to the Engineer and the city of Grand Rapids for approval at least 10 work days prior to construction.

2. Bedding. Granular material Class II per section 902 of the Standard Specifications for Construction except that 100 percent of the material must pass a 3/8-inch sieve.

3. Pipe. Furnish DI pipe in accordance with *ANSI/AWWA C151/A21.51* and as specified herein. Ensure pipe is centrifugally cast and lined with cement mortar on the inside in accordance with *ANSI/AWWA C104/A21.4.*

A. Ensure pipe joints are push-on type coupled in accordance with *ANSI/AWWA C111/A21.11.*

B. Ensure pipe is Class 53, unless otherwise specified on the plans.

C. Coat DI pipe with a layer of arc-sprayed zinc per *ISO 8179*. Ensure the mass of the zinc applied is 200 g/m2 of pipe surface area. Apply a finishing layer topcoat to the zinc. Ensure the mean DFT of the finishing layer is not less than 3 mils with a local minimum not less than 2 mils. The coating system must conform in every respect to *ISO 8179-1 Ductile iron pipes - External zinc-based coating - Part 1: Metallic zinc with finishing layer.*

D. Use specialty rubber gaskets as shown on the plans. Specialty gaskets include but are not limited to Nitrile (NBR) gaskets, Viton Fluorel (FKM) gaskets or Engineer approved equal. Furnish gaskets supplied by the pipe manufacturer.

E. Ensure DI restrained joint pipe is as manufactured, supplied, or recommended by the manufacturer of the restrained joint pipe system installed.

4. Fittings. Furnish DI fittings in accordance with *ANSI/AWWA C153/A21.53* and with a minimum pressure rating of 350 psi.

Ensure nominal thickness of DI fittings is equal to Class 53 DI pipe thickness, cement lined in accordance with *AWWA/ANSI C104/A21.4* and with mechanical joints in accordance with *ANSI/AWWA C111/A21.11.*

5. Mechanical Joint Anchoring Fittings for Hydrants. Furnish Foster Adaptor by Infact Corp, or Engineer approved equal joint restraining glands. Mechanical joint anchoring fittings may be furnished as an alternate to restrained joint glands as noted in this special provision.

6. Joint Restraining Glands. Furnish joint restraining glands for mechanical joint pipe, fittings and valves. Megalug Series 1100 EBAA Iron, Inc., Uni-Flange Wedge Action MC retainer gland by Ford, or Engineer approved equal.

7. Joint Restraining Gaskets. Furnish joint restraining gaskets supplied by the pipe manufacturer. Use joint restraining gaskets only on push-on joint pipe up to 16‑inches. Do not use restraining gaskets on fittings.

8. Clamps, Nuts, Eye-Bolts and Appurtenances. Ensure clamps and other appurtenances which are not DI, cast iron or stainless steel, are coated as specified herein.

9. Gate Valves and Tapping Valves. Furnish cast or DI body, bronze mounted valves, for use in the water distribution system in sizes from 4-inches through 12-inches nominal diameter and designed for direct bury.

A. Ensure valves are in accordance with *ANSI/AWWA C515* and the following supplementary specifications:

(1) Double disc gate valves with non-rising stems. Mechanical or restrained joint ends in accordance with *ANSI/AWWA C515*. Valves with mechanical joint ends will be furnished with accessories, including glands, gaskets, and corten steel or stainless-steel tee-head bolts and nuts. Stems made of Grade D or E bronze in accordance with *ANSI/AWWA C515*. Ensure stuffing box is O-ring type as listed in *ANSI/AWWA C515.* Ensure gland bolts are of Class B, C, D, or E bronze, corten steel, or stainless steel as listed in *ANSI/AWWA C515*. Ensure bonnet bolts are rust-proofed by cadmium or zinc coating.

(2) All valves must rotate clockwise to open, wrench nut to be painted red, and be 115/16 inches square at the top, 2 inches square at the base and 1¾ inches high. Ensure the nut or cap screw for the wrench nut is bronze or stainless steel per *ASTM F593* and *ASTM F594*.

(3) Ensure the minimum number of turns to operate the valve from fully open to fully closed is in accordance with *ANSI/AWWA C515* using stems with single lead threads.

B. Valve Boxes. Furnish four-piece valve boxes (base, bottom, top and cover marked water) produced with Class 35 cast iron in accordance with and meeting all applicable terms and provisions of *ASTM A48/A48M*.

10. Compression Type Fire Hydrants.

A. Furnish a 5¼-inch, EJ Model 5BR250 in accordance with the *ANSI/AWWA C502* and the following specifications:

(1) Ensure main valve is bronze to bronze mounted. Dry type bonnet design (free draining) and contains no oil. Ensure the inlet at the hydrant butt is mechanical joint *ANSI A21.11* standard 6-inch. The delivery or head of the hydrant must have two 2½-inch and one 4-inch National Standard hose coupling male screw thread outlets with caps. Have a bury length of 6 feet from the invert of the connecting pipe to the ground line. The distance from the center line of the connecting pipe to the center line of the outlet nozzles must not be less than 7 feet 6 inches. Supply each nozzle with a suitable rubber or synthetic rubber gasket and chains with S hooks attached to the barrel. Ensure the hydrant is opened by turning the operating nut clockwise. Ensure a clearly visible arrow and the word OPEN is cast in relief on the top of the hydrant to designate the direction of opening. Painted with a zinc chromate primer and finish coat of paint above grade and with two coats of asphalt varnish below grade. Ensure painting is in strict accordance with *ANSI/AWWA C502*. Shop painted in accordance with *NSF/ANSI Standard 61*. Operating nut and nozzle caps must have a 1¾-inch square portion 1-inch high. Install O ring seals in the hydrant top. Stuffing box seals are prohibited. Capable of withstanding a minimum of 200-foot pounds of torque in both the opening and closing directions without causing permanent deformation of metal parts. Ensure barrel and stem extensions are made at or above the ground line and without digging. Ensure outlet nozzles are threaded into the barrel and pinned. Supplied with a tapped drain. Plug the drain.

(2) The main valve stem operating and supporting mechanism must not restrict the flow of water through the nozzles. Loss of head due to friction, within the hydrant, corrected for inlet and outlet velocity head, must not exceed the maximum permissible head loss as given in the following table:

**Table 1: Compression Type Fire Hydrants**

|  |  |  |  |
| --- | --- | --- | --- |
| Number of  Outlet  (nozzles) | Nominal Diam. of  Outlet Nozzles  (inches) | Total Flow from Outlet Nozzles  (gallons per minute) | Max. Permissible  Head Loss  (psi) |
| 1 | 2½ | 250 | 1.0 |
| 2 | 2½ | 500(a) | 2.0 |
| 1 | 4 | 1000 | 5.0 |
| a. 250 gallons per minute approximately, from each outlet nozzle. | | | |

B. Furnish EJ Model 5BR250 hydrant extensions as required for hydrant setting requirements section c.7 of this special provision.

11. Water Service Pipe, 2-inch and smaller. Furnish type K annealed seamless soft copper tubing in accordance with *ASTM Specifications*.

12. Copper to Copper Connections. Furnish connections in accordance with *ANSI/AWWA C800* and certified to *NSF 61*.

13. Tapping Saddles. Furnish saddles with threads in accordance with *ANSI/AWWA C800* (Standard Mueller Thread). 1½-inch and 2-inch taps require saddles on 4-inch through 16-inch water mains. Direct taps are allowed in non-buried applications such as valve chambers.

14. Corporation Stops. Furnish corporation stops with threads in accordance with *ANSI/AWWA C800* (Standard Mueller Thread).

15. Curb Stops. Furnish curb stops with connections in accordance with *ANSI/AWWA C800* and certified to *NSF 61*.

16. Curb Boxes. Furnish curb boxes with connections in accordance with *ANSI/AWWA C800* and certified to *NSF 61*. Curb Box Lock. Vadle Curb Box Locks by JRC Supplies.

17. Rust Preventive Coating. Ensure fittings, clamps, bolts, nuts, appurtenances, etc., which are not DI, cast iron, stainless steel or corten steel, and are buried in the ground are coated with a modified polyamine epoxy in accordance with *ANSI/AWWA C210*. Ensure application of the material is in accordance with the specifications and instructions of the manufacturer.

**c. Construction.** Ensure construction is in accordance with the current *AWWA* standards, the standard specifications, city of Grand Rapids specifications and as detailed on the plans. Keep existing fire hydrants and valves clear for use, unless otherwise approved by the Engineer. Notify the Grand Rapids Water Department of any hydrants or valves to be taken out of service.

1. Excavation.

A. Width of Trench. The maximum bottom width of trench must be 36 inches for pipe, 8-inch to 12- inch inclusive in diameter. For larger sizes of pipe, the maximum width of trench must be not more than 2 feet greater than the inside diameter of the pipe, except as otherwise specified or directed. The above limiting restrictions on trench width apply from the outside bottom of pipe to 12 inches above the outside top of pipe.

B. Depth. Ensure the depth of the water main is 5 feet 9 inches from grade to center line of pipe or have a minimum 5 feet of cover to the top of the pipe, unless otherwise shown on the plans. Adjustment may be required to avoid conflicts with existing or proposed utilities.

C. Alignment. Ensure alignment of the trench is as shown on the plans.

2. Horizontal and Vertical Changes. The data shown on the plans is indicative of adjacent and/or interfering structures and features. Small adjustments can be made by deflecting joints as per manufacturer’s recommendation and not exceeding *AWWA C600*.

A. Complete work in the locations shown on the plans, with minor adjustments as approved by the Engineer. Make deflections in pipes and fittings with sufficient number of joints being deflected to allow for clearance of underground structures. The maximum deflection permissible is limited to that allowed in *AWWA C600*. For Engineer approved vertical changes only, the depth from centerline of main to grade must not exceed 8-feet and the minimum distance from top of pipe to ground line is 4 feet provided said vertical change can be accomplished within 40 linear feet each side of the conflicting utility.

B. Expose all underground utilities at potential points of conflict before laying water main to determine whether to go over or under the existing utilities. Forty-five-degree bends to accomplish elevation changes of the water main will only be used when required or approved by the Engineer.

3. Interruption of Water Service. In case of an emergency interruption of water service immediately notify the Fire Department, Grand Rapids Water System and consumers affected regarding the time and probable duration of each shut-off.

For scheduled interruptions of water service notify the Fire Department, Grand Rapids Water System personnel and consumers affected at least 1 day in advance of the shut-off. The Grand Rapids Water System personnel will then open and close valves on mains in service where necessary, in conjunction with the Contractor's work, subject to such limitation as to time and place as requirements of the Grand Rapids Water System will impose.

4. Continuity of Service for Reconstructing an Existing Water Main. Schedule work in such a manner to ensure that the time period during which water service is shut down is kept to a minimum. Construct the new water main while the existing water main remains in service. Employ the following general procedure to ensure minimum service interruptions:

A. Lay the entire new main.

B. Test and chlorinate new main.

C. After the testing and chlorination has been approved, connect one end of the new water main to the water system and plug the open end of the existing water main that is to be abandoned.

D. While proceeding with the reconnection of existing water services, ensure both the old and the new water mains are in service with each water main being connected to the water system at one end only.

E. Upon completion of the water service reconnections, remove the temporary plug from the "dead end" of the new water main and connect that end of the main to the water system to complete the loop and permanently disconnect the old main from the water system.

F. Ensure all work necessary to maintain service as described above is coordinated with the Engineer and the Grand Rapids Water System and is included in other items of the contract.

5. Pipe Installation.

A. Bell Ends to Face Direction of Laying. Unless otherwise approved, ensure pipe is laid with bell ends facing the direction of laying; and for lines on an appreciable slope, bells must face up-grade, at the direction of the Engineer.

B. Spacers in Sleeves. When connecting DI to cast iron pipe with a sleeve, if the space between the adjoining DI and cast-iron pipes does not exceed 1 inch, no spacer is required. Where the space between adjoining DI and cast iron pipe exceeds 1 inch, a spacer is required to fill the space. Ensure the spacer is DI pipe of the same diameter and class as the adjoining pipes and cut straight and uniform and be free of defects and damage.

C. Water mains 6-inch in diameter and less called to be abandoned on the plans do not require filling, but all open ends are to be capped and plugged with concrete. Abandonment is not paid for separately and is to be considered included in items for laying new water main. Flowable fill for abandonment of water mains larger than 6-inch will be paid for separately.

6. Setting Valves and Valve Boxes. Restrain all valves in accordance with this special provision.

7. Setting Hydrants.

A. Location. All hydrants set within the street right-of-way must have their grade line mark located 6 inches above the proposed centerline grade. Set hydrants a minimum of 36 inches from face of curb to face of hydrant and a minimum of 24 inches from sidewalk to face of hydrant.

Furnish and place all necessary hydrant extensions. Paint all extensions as specified in this special provision.

B. Position of Nozzles. Ensure hydrants stand plumb and have their hose or 2.5-inch nozzles parallel with the curb, with the pumper nozzle pointing normal to the curb. Ensure the 4-inch nozzle is a minimum of 18 inches above the ground.

C. Anchorage for Hydrants, Hydrant Valves, and Hydrant Laterals. Ensure each hydrant is restrained to the hydrant lateral valve and the valve is restrained to the water main or tee with restrained joint pipe with mechanical joint anchoring fittings as specified in this special provision. Thrust blocks are prohibited for restraint on hydrants or hydrant laterals. Ensure the entire hydrant lateral is restrained as provided for herein.

D. Pumping Hydrant. Pump fire hydrants completely dry when the water main is placed in service.

8. Laying Water Services. Lay water services perpendicular to the water main unless otherwise approved by the Engineer. The curb stop will normally be 1 foot from the sidewalk, toward the street.

The locations of the existing water services shown are approximate and actual locations may vary. Furnish a minimum of 6 inches clearance between existing services or utilities and the proposed water service. Place proposed water services under existing water main or as approved by the Engineer. Locations of proposed water taps and connections to existing water services will be as approved by the Engineer and/or the Water Department. Water service taps are to be a minimum of 3 feet apart.

A. Vadle™ Curb Box Lock and Brick Supports. Install Vadle curb box locks on all 1-inch water services installed with the curb box. Stabilize installations in sidewalk or driveway locations by placing a brick immediately under the base of the curb box lock. Install curb box locks per manufacture’s installation instructions, including the following additional installation instructions. Install the curb box locks and curb stop on an Engineer approved block or brick support so that the valve can be operated normally after backfilling.

B. Seal the service shut by using a copper-to-copper connection or cast iron or DI plug.

C. Ensure water services replacements are a minimum of 1-inch copper for residential properties and 1½-inch copper for commercial properties.

D. Maintain a minimum of 7 foot clearance between trees and proposed water services.

E. Final determination for replacement or reconnection of all water services including the size will be as approved by the Engineer and/or the Water Department.

F. Remove and replace curb and gutter when laying water services under it. Tunneling under the curb and gutter to lay water services is prohibited except where the water service is directionally bored.

9. Tapping for Water Services. No taps will be made until a permit has been issued by the city of Grand Rapids Water Department, the water main has passed hydrostatic and bacteriological testing and approval has been granted by the Engineer. The Contractor must apply for and obtain tap permits. Install the corporation stop using a tapping machine approved by the Engineer and along the horizontal axis of the pipe. Ensure the flow arrow points away from the main.

10. Anchorage of Bends, Valves, Tees and Plugs. Securely anchor all bends, tees, plugs, reducers and other fittings. Anchorage can be accomplished by the following methods: joint restraint, thrust blocks and encasements. However, thrust blocks and encasements will only be permitted where shown on the plans, or as approved by the Engineer.

A. Joint Restraint. Includes mechanical devices such as restrained joint pipe, joint restraining glands, joint restraining gaskets or mechanical joint anchoring fittings.

(1) Ensure joint restraining glands are as specified in this special provision and may be used as an alternative to restraint joint pipe on 24-inch diameter pipe and less. Approved joint restraining glands are permitted on pipe fittings, and valves, and for hydrants, hydrant laterals and hydrant valves. Restraining glands are prohibited for use on plain end fittings.

(2) Mechanical joint anchoring fittings as specified in this special provision are approved only for use for anchorage of hydrants, hydrant valves and hydrant laterals.

(3) When joints are to be restrained with mechanical devices as noted above, ensure all joints are restrained for a minimum distance from the fitting as required in the Pipe Restraint Length Required table shown on the plans.

(4) Ensure joints lying within the above minimum distances from the fitting are restrained as noted herein and as shown on the plans.

(a) Tees. Restrain tees in the branch direction as required in the Pipe Restraint Length Required table shown on the plans. In the straight through direction, ensure the minimum length of the first pipe on either side of the tee is 10 feet. Where a valve is placed at the tee, ensure the valve is restrained to the tee as noted below and ensure the next pipe is a minimum length of 10 feet.

(b) Plugs. Cap or plug all dead ends and restrain back from the plug or cap as required in the Pipe Restraint Length Required table shown on the plans.

(c) Bends. Restrain bends in both directions as required in the Pipe Restraint Length Required table shown on the plans.

(d) Valves. Restrain valves used in conjunction with restraint joint pipe in accordance with the recommendations of the manufacturer of the restrained joint pipe. Ensure all valves at crosses or tees are restrained to the tee by use of restrained joint pipe.

B. Thrust Blocks. Use thrust blocks only at the specific locations shown on the plans, or as specifically approved by the Engineer. Install an Engineer approved bond breaker between pipe and thrust block as shown on the plans.

C. The cost of furnishing anchorage is included in the price for the water main and will not be paid for separately.

11. Hydrostatic Testing, Chlorination and Bacteriological Testing. Ensure testing is completed in accordance with section 823 of the Standard Specifications of Construction, *AWWA C600*, *AWWA C651*, and as specified in this special provision.

A. General Requirements. Hydrostatically test all newly constructed water main. Coordinate with the city of Grand Rapids to chlorinate and bacteriologically test the new main.

B. Construction Coordination. Furnish a minimum of 72 hours advance notice to the Grand Rapids Water System to schedule the observation of hydrostatic testing and scheduling of chlorination and bacteriological testing. Ensure that all trenches are open, that riser pipes are easily accessible without use of ladders and that provisions have been made for the removal of ground water so that testing and chlorinating can begin immediately upon arrival of Grand Rapids Water System personnel.

Supply all the necessary plugs, caps and 2-inch galvanized riser pipes with 2-inch gate valves. The main plugs or caps placed at the end of the water main and/or the end of the stub services for future main extensions for testing, flushing, and chlorinating, must have an opening extension or connection of not less than 2 inches in diameter, so that filling, flushing and chlorinating can take place at a sufficient velocity to clean the main and reduce the time required for these operations. Furnish a clean city water supply to within 50 feet of the test site as shown on the plans.

Flush the water main to ensure the removal of all foreign material prior to testing. Furnish restraints adequate for the testing pressures. Flushing may include the use of a polyethylene swab or the injection of compressed air into the main as approved by the Engineer. Furnish a suitable and approved means for discharge of flushing, testing and chlorinating water. This includes disposing of heavily chlorinated water.

Witness and approve the chlorination of the water main and all bacteriological samples collected by the city of Grand Rapids Water System personnel.

C. Hydrostatic Tests. Ensure testing is witnessed by Grand Rapids Water System personnel using a water meter supplied by the Grand Rapids Water System. Existing valves used as necessary to flush and fill the main may be operated by the Contractor as approved by the Engineer and the Grand Rapids Water System personnel.

The length of water main to be tested will be as approved by the Engineer. Large test sections will not proportionally increase the leakage allowance but will be rounded off to the next higher 100 joint increment. Tests made against an existing valve are not allowed unless approved by the Engineer. Test the new main separate from existing water mains unless a connection is approved by the Engineer and the Grand Rapids Water System personnel.

Ensure the pipe is filled with water slowly, and all air pockets removed by bleeding off at hydrants or standpipes. Pressurize all valves, hydrants and the pipe, to the test pressure of 160 psi by a pressure pump.

Acceptance will be determined based on allowable leakage. If any test discloses a leakage greater than that specified in Table 2, locate and repair the defects until the leakage is within the specified allowance. Leakage is defined as the quantity of water to be supplied into the newly laid pipe necessary to maintain the specified leakage test pressure after the pipe has been filled with water and air expelled.

Allowable leakage per 100 joint increment of pipeline will be as follows and based on a test pressure of 160 psi:

**Table 2: Allowable Hydrostatic Test Losses**

|  |  |
| --- | --- |
| Pipe Diameter  (inches) | Allowable Loss  (gallons per 2 hours  per 100 joints) |
| 4 | 0.6 |
| 6 | 0.9 |
| 8 | 1.2 |
| 10 | 1.5 |
| 12 | 1.8 |
| 16 | 2.4 |
| 24 | 3.5 |

Repeat the test as necessary to maintain the test pressure for 1 hour. In all cases, restore the pressure to 160 psi at the end of the 1-hour period. The loss must not exceed the allowance in the table for the size of pipe and number of joints.

D. Chlorination. The city of Grand Rapids Water System personnel will perform the chlorination of the water main after the hydrostatic test has been satisfactorily completed.

E. Bacteriological Testing. The city of Grand Rapids Water System personnel will initiate sampling for bacteriological testing, with the assistance of the Contractor, once the hydrostatic testing and chlorination have been completed and the water main filled with city water. Ensure bacteriological testing is in accordance with *AWWA C651*. The length of section for testing must not exceed 1200 feet unless specifically approved by the city and the EGLE.

F. Responsibility for Testing Costs. All work performed by the Grand Rapids Water System in connection with two initial chlorination and bacteriological testing of the water main will be done at the expense of the city of Grand Rapids. Additional costs required beyond the two initial tests will be the responsibility of the Contractor.

The cost for all work performed by the Contractor and materials supplied by the Contractor in connection with testing and chlorinating the water main is included in the unit the price bid for other items and will not be paid for separately.

12. Abandon water mains in accordance with section 823 of the Standard Specifications for Construction.

**d. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price in accordance with subsection 823.04 of the Standard Specifications for Construction except as follows:

**Pay Item Pay Unit**

Water Main, DI, \_\_ inch, Grand Rapids Tr Det Foot

Water Service, \_\_ inch Foot

Curb Stop and Box on Water Service, \_\_ inch Each

Tap for Water Service, Including Corporation Stop, \_\_ inch Each

Valve and Box, \_\_ inch Each

Tee, \_\_ inch by \_\_ inch by \_\_ inch Each

Hydrant, 5 inch Each

Sleeve, \_\_ inch Each

Bend, \_\_ Degree, \_\_ inch Each

Thrust Block, Detail \_\_ Each

1. **Water Main, DI, \_\_ inch, Grand Rapids Tr Det** is to be measured per foot along the centerline of pipe. The price includes payment in full for furnishing all labor, equipment and materials required to install the water main.

2. **Water Service, \_\_ inch** includes copper water service pipe and connection to existing water services including furnishing and placing the pipe-to-pipe adapter needed to connect the service.

3.**Curb Stop and Box on Water Service, \_\_ inch** includes furnishing and installing curb stop locks for water services.

4. **Tap for Water Service, Including Corporation Stop, \_\_ inch** is paid for as Each and includes taps, corporation stops and tapping saddles.

5. **Valve and Box, \_\_ inch** of the types and sizes required include the cost of furnishing and installing the valve and valve box, complete and ready for use.

6. **Tee, \_\_ inch by \_\_ inch by \_\_ inch**; **Sleeve, \_\_ inch**; and **Bend, \_\_ Degree, \_\_ inch** are to be paid for as Each, as shown on the plans or as approved by the Engineer.

7. **Hydrant, 5 inch** includes the cost of furnishing and installing the hydrant, including restraint, anchorage, and pumping hydrant dry, at the locations shown on the plans in a ready-for-use condition. The Department will pay separately for auxiliary valves or other items included in the contract as separate pay items.

8. **Thrust Block, Detail \_\_** is paid for as Each and includes furnishing, forming, and placing concrete thrust blocks and bond breaker between the water main and thrust block in accordance with details as shown on the plans.