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**NOTE: Below is example specification language for the Mechanical Engineer to issue on a project with cast iron plumbing under a slab-on-voidwork foundation. There is an accompanying example specification for the Structural Engineer to issue. Both sections and typical details are suggested for each project on a case-by-case basis at no cost to the Design Professionals by VoidForm’s Detailer: McFarlin Construction Services (Phone 915-276-5416 and jacktylermcfarlin@gmail.com)**

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**SECTION 22 05 31**

**PROTECTION OF UNDER-SLAB PLUMBING UNDER SLAB-ON-VOIDFORM FOUNDATIONS**

**PART 1 – GENERAL**

* 1. DESCRIPTION OF WORK
1. In general, the work to be included in this section is as follows:
2. Isolating all new under-slab plumbing, hangers and supports from the subgrade under new slab-on-voidform areas.
3. Installing flexible expansion joints in all new under-slab plumbing where the plumbing transitions between isolated conditions under new slab-on-voidform areas to soil-supported conditions at the perimeter of slab-on-voidform areas (isolated slabs).
4. This section shall apply to all sanitary sewer plumbing under slab-on-voidform areas and shall only apply if the Mudskipper System is used. This section does not apply to plumbing under crawlspace areas which will be accessible by occupants after completion of the construction, where the Owner can access the crawlspace and perform maintenance as needed if plumbing is damaged by expansive soil movement.
5. If there is a conflict between other specification sections and this section, or between any construction drawings and this section, this section shall govern with regard to the protection of under-slab plumbing.
6. The Contractor shall be permitted to, at the Contractor’s option, either install the plumbing before the slab is poured by using the PATENT-PENDING MudskipperTM System or install the plumbing after the slab is poured by accessing the under-slab space, removing all voidforms and excavating as required so as to epoxy anchor threaded hanger rods to the under-side of the slab and create the voidspace required. The Basis of Design is the MudskipperTM System. PlumbingVoid as manufactured by VoidForm shall not be permitted. PipeVoid or Utility Protection System as manufactured by SuperVoid shall not be permitted.
	1. QUALITY ASSURANCE
7. Manufacturers/Distributors: Firms who manufacture/distribute components specified in other sections shall meet any requirements of those specifications. If the PATENT-PENDING MudskipperTM System is to be installed on the project, firms who manufacture/distribute components of that system shall have obtained a license from the Inventor to make, use and sell components of that system.
8. Installer: Installers shall be qualified with at least 5 years of successful installation experience on projects using the techniques allowed by this section that will be implemented. It is not required for installers of components of the PATENT-PENDING MudskipperTM System to have 5 years of successful installation experience on projects with that system if the on-site Plumbing Foreman has attended an online training session ([www.mudskippersystem.com](http://www.mudskippersystem.com)) hosted by a Manufacturer/Distributor that is licensed to make, use and sell components of that system by the Inventor.
9. Pre-construction Meeting: If the PATENT-PENDING MudskipperTM System is to be installed on the project under slab-on-voidform areas, before any MudskipperTM Walls or plumbing trenches are excavated, the Contractor shall host an online pre-construction meeting, requiring attendance by the onsite Plumbing Foreman and onsite Concrete Foreman, inviting but not requiring attendance by the Building Official, Owner, Architect, Contractor, Geotechnical Engineer, Mechanical Engineer, Structural Engineer, Special Inspections and Testing Agency, Commissioning Agent, General Contractor, Concrete Subcontractor, and a representative of VoidForm Products, Inc., to:
10. Review the purpose of isolating the plumbing;
11. Review installation details and the sequence of events for installation;
12. Review the responsibilities of the Plumbing Subcontractor versus the Concrete Subcontractor related to protection of plumbing and installing voidforms/formwork;
13. Coordinate the schedule of material/product shipments, installations, inspections, and concrete pours; and,
14. Review the requirements for pre-pour and post-pour quality assurance videos of sanitary sewer systems.
15. Manufacturer/Distributor Installation Reviews: If the PATENT-PENDING MudskipperTM System is to be installed to support sanitary sewer piping under slab-on-voidform areas, the Contractor shall video conference from the site with a representative of VoidForm Products, Inc. at the following times. Where a project has multiple concrete pours, this shall only be required for the first concrete pour of a slab-on-voidform area where the system is used. The Contractor shall make any corrections necessary if a representative of VoidForm Products, Inc. identifies any conditions which do not comply with the construction documents or the Initial MudskipperTM Plan.
16. When the Contractor believes conditions are ready for voidform placement before the first voidform is installed under the proposed slab.
17. When the Contractor believes conditions are ready for removal of MudskipperTM Rods before the first MudskipperTM Rod is removed from under the proposed slab.
18. If the PATENT-PENDING MudskipperTM System is installed to support sanitary sewer piping under slab-on-voidform areas, the following video inspection of sanitary sewer piping shall be performed by the Plumber before and after each concrete pour at slab-on-voidform areas, with the Plumber providing the General Contractor a copy of the final video each time:
19. Before-Pour Inspection: After all formwork, vapor barrier components, slab reinforcing bars and general reinforcing bar supports have been installed, after the Plumber has installed tie wire to anchor MudskipperTM Framing to slab reinforcing bars, after the Plumber has installed supports (e.g. rebar chairs) under reinforcing bars and/or MudskipperTM Framing to stabilize MudskipperTM Framing, after the Plumber has removed all temporary threaded rods, and after the Plumber has made any final adjustments to the flow lines of the plumbing (e.g. by turning nuts at the tops of hangers between slab reinforcing bars), but before the concrete slab is poured, the Plumber shall prove the system has sufficient slope to drain by:
	1. Temporarily plugging the lines and filling the plumbing with water,
	2. Removing temporary plugs and draining the water,
	3. Waiting a minimum of 30 minutes, and then
	4. Inserting a plumbing camera snake through all new sanitary sewer plumbing lines, while recording the video, to prove that wastewater will evacuate the system;
	5. If the test water does not evacuate, the Plumber shall adjust the flow line elevations and perform the inspection again until the system functions properly.
20. After-Pour Inspection: After the concrete slab is poured, the Plumber shall prove the system has sufficient slope to drain by:
	1. Temporarily plugging the lines and filling the plumbing with water,
	2. Removing temporary plugs and draining the water,
	3. Waiting a minimum of 30 minutes, and then
	4. Inserting a plumbing camera snake through all new sanitary sewer plumbing lines, while recording the video, to prove that wastewater will evacuate the system;
	5. If the test water does not evacuate, the Plumber shall excavate under the slab as required to access the under-slab plumbing, adjust the flow line elevations (e.g. by turning nuts in adjustable clevis hangers under the slab), and perform the inspection again until the system functions properly.
	6. SUBMITTALS
21. If components of the PATENT-PENDING MudskipperTM System are to be installed, the Contractor shall submit drawings to the Architect providing the Initial MudskipperTM Plan (obtained by the Concrete Subcontractor from the Distributor) for review by the Geotechnical Engineer, Mechanical Engineer, Structural Engineer and Civil Engineer. Contractor shall identify any proposed changes to the plumbing design or plumbing details by clouding such changes on the submittal. The Initial MudskipperTM Plan submittal shall include the following:
22. Proposed locations of under-slab plumbing;
23. Proposed plumbing trench depths and widths, including any benching of the subgrade, for applicable ranges of flow line elevations;
24. MudskipperTM Wall locations as required by the Structural Engineer showing cross-sectional geometries and expansion joint locations;
25. If applicable, proposed formwork in addition to specified formwork.
26. Proposed plan locations, elevations and details for MudskipperTM Stakes, MudskipperTM Rods and MudskipperTM Framing;
27. Proposed MudskipperTM Vault locations, dimensions and details, including but not limited to ingress flow lines, egress flow lines, flexible expansion joint model numbers, MudskipperTM Clamps, MudskipperTM Tails, slidable retainer boards, bentonite backfill and manholes.
	1. RELATED SECTIONS
28. Division 01 – General Requirements: Substitution procedures, submittal procedures, project meetings, progress schedules and documentation, reports and coordination.
29. Division 03 – Concrete: Void forms, vapor barrier, and concrete mix designs, including but not limited to Section 03 1114.
30. Division 22 – Plumbing: Plumbing piping, flexible expansion joints, plumbing supports and anchors.
31. Division 31 – Earthwork: Shoring and underpinning for excavation.

**PART 2 – PRODUCTS**

2.01 PATENT-PENDING MudskipperTM System products to be installed by the Plumber. If the Contractor chooses to install MudskipperTM System products, the Concrete Subcontractor shall purchase the following with voidforms and include the cost of this purchase in the Concrete Subcontractor’s Bid (not to be included in the Plumbing Subcontractor’s Bid). If the Plumbing Subcontractor wants to order extra items provided by Voidform (i.e. extra Mudskipper rods or stakes), the Plumbing Subcontractor shall reach out to voidform directly and the cost of these added items shall be included in the Plumbing Subcontractors bid. During construction, the Plumber shall obtain the following products from the Concrete Subcontractor on-site and the Plumber shall install them:

1. MudskipperTM Stakes to Remain in the Subgrade Permanently: 3/4” diameter smooth rods, 18” long, with a chiseled end to facilitate penetrating the subgrade, and a 1/2” diameter x 2.5” long, smooth hole at the other end to receive MudskipperTM Rods; A36 Domestic Steel; no galvanized finish; no primer or paint finish; as distributed by:
2. VoidForm® Products, Inc.; [www.voidform.com](http://www.voidform.com); phone: 888-704-8643
3. Other manufacturers are permitted only if licensed by Mudskipper, LLC; [www.mudskippersystem.com](http://www.mudskippersystem.com); email: info@mudskippersystem.com
4. Substitutions that the Contractor believes to be equal or better must be submitted and approved before proposals are submitted. However, substitutions which would constitute infringement on the intellectual property rights of the inventor of the MudskipperTM System will not be permitted.
5. Re-Usable MudskipperTM Rods and Rod Accessories: 1/2" diameter threaded rods; minimum length required, minimum 6 inches greater than the difference in elevation between the finish floor elevation of the slab-on-voidform and the subgrade elevation below at each location of a MudskipperTM Stake; accessories, 1/2" diameter support nut to support MudskipperTM Framing and double 1/2” diameter top nut assembly for removal of MudskipperTM Rods after MudskipperTM Framing is supported by voidforms; galvanized finish, including nuts; permitted to be re-used as MudskipperTM Rods on this project only; it shall not be permitted to re-use MudskipperTM Rods or accessories from another project; as distributed by:
6. VoidForm® Products, Inc.; [www.voidform.com](http://www.voidform.com); phone: 888-704-8643
7. Other manufacturers are permitted only if licensed by Mudskipper, LLC; [www.mudskippersystem.com](http://www.mudskippersystem.com); email: info@mudskippersystem.com
8. Substitutions that the Contractor believes to be equal or better must be submitted and approved before proposals are submitted. However, substitutions which would constitute infringement on the intellectual property rights of the inventor of the MudskipperTM System will not be permitted.
9. MudskipperTM Framing to be Field-Cut and Wire Welded Together by Plumber On-Site and Cast Permanently into the Concrete Slab, and Framing Accessories: 12 gage 1.625” x 1.625” strut channels with slotted holes in the webs and saddle washers for pipe hangers; oriented with the open side at the top; material and finishes permitted: ungalvanized and unpainted steel, galvanized steel, or painted steel; as distributed by:
10. VoidForm® Products, Inc.; [www.voidform.com](http://www.voidform.com); phone: 888-704-8643
11. Other manufacturers are permitted only if licensed by Mudskipper, LLC; [www.mudskippersystem.com](http://www.mudskippersystem.com); email: info@mudskippersystem.com
12. Substitutions that the Contractor believes to be equal or better must be submitted and approved before proposals are submitted. However, substitutions which would constitute infringement on the intellectual property rights of the inventor of the MudskipperTM System will not be permitted.
13. MudskipperTM Clamp: Each MudskipperTM Clamp consisting of four identical components, with each component consisting of a half of a steel standard pipe clamp, sized for a C900 PVC pipe of the applicable egress piping diameter, welded to a 12 gage steel strut channel with slotted holes; minimum length of each strut: 20”; all stainless steel; combining each pair of components tougher with stainless steel bolts and nuts to clamp onto piping; each pair to straddle the sides of the receiving concrete support beam; stainless steel threaded rods to be epoxied into concrete support beam through strut channels after mounting; as manufactured/distributed by:
14. VoidForm® Products, Inc.; [www.voidform.com](http://www.voidform.com); phone: 888-704-8643
15. Other manufacturers are permitted only if licensed by Mudskipper, LLC; [www.mudskippersystem.com](http://www.mudskippersystem.com); email: info@mudskippersystem.com
16. Substitutions that the Contractor believes to be equal or better must be submitted and approved before proposals are submitted. However, substitutions which would constitute infringement on the intellectual property rights of the inventor of the MudskipperTM System will not be permitted.
17. MudskipperTM Tails: Inner piping comprised of C900 piping with the specified diameter at flexible expansion joints for egress piping; construction felt wrapped around inner piping; outer piping comprised of PVC with a minimum diameter being 8” greater than the egress piping diameter; concrete fill between outer piping and construction felt to have a minimum compressive strength of 3,000 psi at 28 days; length of inner piping to extend minimum 24” past each end of outer piping when shipped to the site, to be field cut as necessary for project conditions; length of outer piping to be sufficient to provide 1.5 factor of safety against overturning with an assumed 2,000 psf bearing capacity of the subgrade and the full weight of the specified flexible expansion joint bearing at the end of the specified pipe that cantilevers from the MudskipperTM Tail into the MudskipperTM Vault at each location; as manufactured/distributed by:
18. VoidForm® Products, Inc.; [www.voidform.com](http://www.voidform.com); phone: 888-704-8643
19. Other manufacturers are permitted only if licensed by Mudskipper, LLC; [www.mudskippersystem.com](http://www.mudskippersystem.com); email: info@mudskippersystem.com
20. Substitutions that the Contractor believes to be equal or better must be submitted and approved before proposals are submitted. However, substitutions which would constitute infringement on the intellectual property rights of the inventor of the MudskipperTM System will not be permitted.
21. MudskipperTM Retainer Boards: Three 3/4” thick white plastic retainer board around each MudskipperTM Tail; as manufactured/distributed by:
22. VoidForm® Products, Inc.; [www.voidform.com](http://www.voidform.com); phone: 888-704-8643
23. Other manufacturers are permitted only if licensed by Mudskipper, LLC; [www.mudskippersystem.com](http://www.mudskippersystem.com); email: info@mudskippersystem.com
24. Substitutions that the Contractor believes to be equal or better must be submitted and approved before proposals are submitted.
25. MudskipperTM Plug Material: Sodium Bentonite to be installed by Plumber around MudskipperTM Tails and extending past MudskipperTM Retainer Boards: natural sodium bentonite clay material; as manufactured/distributed by:
26. VoidForm® Products, Inc.; [www.voidform.com](http://www.voidform.com); phone: 888-704-8643
27. Other manufacturers are permitted only if licensed by Mudskipper, LLC; [www.mudskippersystem.com](http://www.mudskippersystem.com); email: info@mudskippersystem.com
28. Substitutions that the Contractor believes to be equal or better must be submitted and approved before proposals are submitted.
29. MudskipperTM Walls: Refer to Structural Specification Sections for the earth-formed, gravity retaining walls to retain soil for plumbing trenches to be installed on-site by Contractor with unreinforced, flowable concrete fill.

2.02 Related PATENT-PENDING MudskipperTM System products to be purchased, fabricated and/or installed by the Concrete Subcontractor, not the Plumber. If the Contractor chooses to install MudskipperTM System products, the Concrete Subcontractor shall install the following items as specified in other sections:

1. MudskipperTM Walls: Refer to Structural Specification Sections for the earth-formed, gravity retaining walls to retain soil for plumbing trenches to be installed on-site by Contractor with unreinforced, flowable concrete fill.
2. Degradable MudskipperTM Decking: Refer to Structural Specification Sections for plywood to be located between and around plumbing hangers and MudskipperTM Rods, to support voidforms and/or concrete.
3. MudskipperTM Decking Supports: Refer to Structural Specification Sections for strut channel supports to bear on MudskipperTM Walls and provide support for MudskipperTM Decking where plumbing lines interrupt MudskipperTM Walls.
4. MudskipperTM Vaults: Refer to the Structural Drawings for concrete cast-in-place vaults outside of the building footprint that provide a space for a flexible expansion joint transition.

2.03 Pipe Hangers: Stainless Steel threaded rods and stainless steel clevis hangers, to be purchased by the Plumber and installed by the Plumber.

2.04 Flexible Expansion Joints for Sanitary Sewer Plumbing: PVC DWV Flex-Tend as manufactured by EBAA Iron Works (Contact is Nathan Kidd: 254-629-6534) or equal, installed by the Plumber as recommended by the manufacturer. Important Note: A different product by EBAA Iron Works will be required at the vertical plumbing expansion joint inside the building for the courtyard roof drain above slab, where an epoxy coated ductile iron Force-Balanced EX-TEND will be required with C 900 pipe at each end and accessories recommended by the manufacturer.

2.05 Other Products: Other projects not mentioned herein are specified elsewhere in the construction documents.

**PART 3 – EXECUTION**

3.01 Inspection: Before Concrete Subcontractor performs work each day, the Plumber shall inspect conditions on-site and verify that all required elements to be installed by others have been installed and that the subgrade is at the proper elevation, as well as existing utilities and other project conditions. If the Plumber identifies any conditions that do not meet the project requirements or are not addressed by the construction documents, the Plumber shall notify the Architect and work collaboratively to resolve any issues while trying to maintain the project schedule.

* 1. Isolation of Under-Slab Plumbing from the Subgrade under Slab-On-Voidform Areas.
1. For the purposes of this specification section, a slab-on-voidform is a slab with an under-floor space that has no designed access for occupants (i.e. is not a crawlspace). Where new under-slab plumbing is installed under new slab-on-voidform areas, the plumbing shall be suspended so that plumbing, hangers and supports are isolated, by a voidspace, from the effects of expansive soil swelling and shrinking with a minimum clearance vertically of 6”.  To protect the voidspace, soil shall be sloped, benched or retained in accordance with an approved design methodology. To accomplish this requirement, the Contractor shall utilize one of the following approaches at all new under-slab plumbing installed under new slab-on-voidform areas, with the Contractor selecting whichever option is preferred by the Contractor considering cost and schedule:

1. Pre-Slab Installation: For this approach, the Contractor shall be required to install the plumbing before the slab is poured by using the PATENT-PENDING MudskipperTM System, or approved equal that does not infringe on intellectual property rights. If utilized, the use of the MudskipperTM System shall include use of MudskipperTM Stakes, MudskipperTM Rods, MudskipperTM Framing, MudskipperTM Walls, and MudskipperTM Decking as recommended by MudskipperTM LLC (www.mudskippersystem.com).

* 1. Where MudskipperTM Walls are specified by the Structural Engineer, the walls shall be located a minimum horizontal clearance of 6” from the plumbing, hangers and supports, to allow for lateral expansion of the subgrade. Provide a 1” expansion joint to separate MudskipperTM Walls from foundation elements (e.g. piers, pier caps and gradebeams). Refer to Section 03 1114.
	2. Where degradable voidforms are specified for the project under the slab, Contractor shall be permitted to bench the subgrade on a 1.5 to 1 horizontal to vertical ratio with the first vertical cut being a minimum of 30 inches from the edge of the clevis hanger supports for under-slab plumbing. Additionally, the Contractor shall be permitted to install MudskipperTM Walls with Degradable MudskipperTM Decking to support degradable voidforms for the slab. Refer to Section 03 1114.
	3. Where MudskipperTM Decking is installed, intermediate supports shall be permitted to consist of strut channels bearing on seats ground out of MudskipperTM Walls, or dry-stacked, unreinforced, ungrouted concrete masonry units having a maximum nominal height to width ratio of 2:1. MudskipperTM Decking shall not be attached to MudskipperTM Walls or foundation elements. Refer to Section 03 1114.
	4. Before pouring concrete, vapor barrier shall be repaired where threaded rods for permanent hangers penetrate the vapor barrier by using StegoTack Tape, or approved equal, pressing the material into the threads and sealing it to the vapor barrier material. Refer to Section 03 1114. Refer to Section 03 1114.
	5. Before MudskipperTM Rods are removed, the Plumber shall install tie wires to support MudskipperTM Framing to perpendicular slab reinforcing bars above and add supports as required under slab reinforcing bars to stabilize the MudskipperTM Framing. Refer to Section 03 1114.
	6. It shall not be permitted for the plumbing, hangers and supports below the slab or below the framing to be in contact with soil or any assemblage of materials that is in contact with soil within the active zone.
1. Post-Slab Installation: For this approach, the Contractor shall form the bottom of the slab with temporary shoring and then, after the slab is poured, remove temporary shoring so as to epoxy-anchor post-install hangers, supports and plumbing as under slab-on-crawlspace areas. The temporary shoring can consist of voidforms or traditional wood-framed temporary shoring systems. Where traditional wood-framed temporary shoring systems are used, all traditional wood-framed temporary shoring systems shall be removed before construction is complete.

* 1. Transitions of Under-Slab Plumbing from Isolated Conditions to Soil-Supported Conditions
1. Where under-slab pluming transitions from isolated conditions to soil-supported conditions beyond the perimeter of slab-on-voidform areas, the Contractor shall install flexible expansion joints in MudskipperTM Vaults, or equal that does not infringe on intellectual property rights, outside of the perimeter of the slab-on-voidform areas. Each vault shall have a 24” diameter minimum manhole, precast rings and a manhole cover rated for the loads associated with the conditions at the surface, to be either specified or approved by the Civil Engineer. The top of the vault cap shall be a minimum of 12” below the finished grade or pavement elevation. The vault cap shall be a reinforced concrete slab that is formed along the bottom surface of the cap, with temporary shoring being removed through the manhole after concrete has sufficiently cured. Openings for ingress piping through the gradebeams at the perimeter of isolated slab areas shall be caulked around ingress piping with sealant as specified elsewhere. Piping inside the vault shall transition to C900 piping and then be anchored to a concrete support beam with MudskipperTM Clamps, or equal that does not infringe on intellectual property rights, in a manner that cradles the pipe, clamps down on the pipe, prevents axial and transverse movement of the pipe from the tension and compression associated with raising and lowering of the flexible expansion joints, prevents rotation of the pipe about a transverse axis, and allows the egress piping to cantilever 6” from the concrete support beam inside the vault. Egress piping that transitions to soil-supported conditions shall be protected by MudskipperTM Tails, or an equal system that does not infringe on intellectual property rights, that allows egress piping to raise and lower a minimum of 6” within a vertically slotted hole, protects the egress piping from breaking at slidable soil retainers as soil swells and shrinks, has sufficient weight and length to resist overturning of a counterweight with a minimum of 1.5 factor of safety assuming a minimum allowable subgrade bearing capacity of 2,000 psf when the full weight of the flexible expansion joint is attached, and allows the egress piping to cantilever into the vault so as to connect to the egress-end of each flexible expansion joint. A minimum thickness of 6” of MudskipperTM Plug Material shall be installed against slidable MudskipperTM Retainer Board soil retainers that prevent soil from entering into the vault through the vertically slotted opening, with MudskipperTM Plug Material extending a minimum of 6” beyond the limits of the slidable soil retainers, vertically and horizontally.

**END OF SECTION**