

F.8.1 Porous surface plan standards

1. Verify that the plans include an appropriate sequence of construction that is specific to the construction of the porous surface. Refer to Section 4.2.5 for guidance. [Section 2.3.1]
2. To avoid soil disturbance and compaction during construction, verify that the infiltration area is proposed to be clearly marked before any site work begins. [Section 4.2.5, 1]
3. Verify that the plans include an appropriate cross-sectional detail for the porous surface. [Section 2.3.1]

F.8.2 Porous surface design standards

1. Verify the drainage area directed to any proposed porous surface. The porous surface cannot receive any runoff in addition to the direct (1:1) rainfall onto it. For porous surface over a structural SMP, the additional runoff must be conveyed directly to the underlying SMP. The porous surface over the structural SMP footprint must be considered, and modeled as, DCIA. The SMP beneath the porous surface requires infiltration testing. [Section 4.2.1]
2. For porous surface over a structural SMP, if infiltration is feasible, verify that the porous surface design meets all Design Guidance Checklist design standards noted in Appendix F.10, Subsurface Infiltration. [Section 4.2.3, 2]
3. For porous surface over a structural SMP, if infiltration is infeasible, verify that the porous surface design meets all Design Guidance Checklist design standards noted in Appendix F.14, Subsurface Detention. [Section 4.2.3, 3]
4. For porous surface DIC systems:
 - a. Verify that the porous surface DIC is installed on-site such that it does not create any areas of concentrated infiltration or discharge. [Section 4.2.3, 1a]
 - b. Verify that the surface slope in any direction across porous surface does not exceed 5%. [Section 4.2.3, 1b]
 - c. Verify that the choker course depth is a minimum of two inches. [Section 4.2.3, 1c]
 - d. If an underdrain is proposed, verify that the first 1.5 inches of runoff are stored below the lowest invert of the underdrain. [Section 4.2.3, 1d]
 - e. Verify that an appropriate porous surface curve number value is used when performing Flood Control calculations. [Section 4.2.3, 1e]
 - f. Verify that the stone storage bed depth is a minimum of eight inches, except when located beneath walkways or play surfaces, for which a depth of four inches is allowable. [Section 4.2.3, 6a]
 - g. Verify that stone is separated from soil media by a separation barrier, such as a geotextile or a pea gravel filter, to prevent sand, silt, and sediment from entering the system. [Section 4.2.3, 6b]
 - h. Verify that the stone storage system has a level bottom. Terraced systems may be used to maintain a level infiltration interface with native soil while accommodating significant grade changes. [Section 4.2.3, 6c]

5. Verify that pretreatment is provided for all runoff entering the porous surface, including pretreatment of runoff from all inlets. At a minimum, this can be achieved through the use of sumps and traps for inlets and sump boxes with traps downstream of trench drains. [Section 4.2.3, 4]
6. Verify that, when SMPs are used in series, the storage areas for all SMPs provide cumulative static storage for the WQv. [Section 4.2.3, 9]
7. Verify that any impervious liner, if necessary, lines a minimal portion of the total porous area. If a significant area needs to be lined, porous surface may not be an appropriate management strategy. [Section 4.2.3, 10]
8. Verify that underdrains, if proposed for porous surface DIC systems, meet the following requirements:
 - a. Underdrains must be surrounded by a sand or stone layer to filter sediment and facilitate drainage. [Section 4.2.3, 11a]
 - b. The minimum allowable thickness of a sand or stone filter layer is six inches both above and beneath the underdrain. [Section 4.2.3, 11b]
 - c. To prevent clogging, underdrain pipes must be surrounded by a geotextile fabric if a sand layer is used. [Section 4.2.3, 11c]
9. Verify that inlets or area drains are provided for all porous surface areas in excess of 5,000 square feet, in order to provide positive overflow. [Section 4.2.3, 12]
10. Verify that an adequate number of appropriately placed cleanouts, manholes, access panels and other access features are provided to allow unobstructed and safe access to the structural SMPs beneath porous surface for routine maintenance and inspection of inflow, outflow, underdrains, and storage systems. [Section 4.2.3, 14]
11. Verify that observation wells are provided for SMPs that include stone storage and that they meet the following requirements:
 - a. The observation well must be placed at the invert of the stone bed. [Section 4.2.3, 15a]
 - b. The observation well must be located near the center of the stone bed system to monitor the level and duration of water stored within the SMP (drain down time). A minimum of six inches of clearance must be provided between the edge of the observation well's concrete ring or frame and any nearby site features (curbing, tree pits, sidewalk edge, etc.). Plan view dimensioning for the proposed location of the observation well, relative to the boundaries of the SMP it lies within, must be provided on the plans. [Section 4.2.3, 15b]
 - c. Adequate inspection and maintenance access to the observation well must be provided. [Section 4.2.3, 15c]
 - d. An observation well located in a paved area must be outfitted with a cover and frame. The cover plate must be installed flush with the surrounding surface at finished grade, and grading should drain away from the observation well wherever possible. The solid section of the observation well must extend into the cover frame enough such that a bentonite/cement seal can be placed around the well within the frame, and a solid slip-on cap can be fitted onto the pipe end. [Section 4.2.3, 15d]
 - e. An observation well located in an unpaved area must have a concrete ring or frame poured for support, with three lengths of rebar evenly spaced around the ring and three inches from its outer edge. The observation well should be located outside of the ponding area of any surface SMPs. If, due to space limitations, an observation well must be placed in the ponding area of a surface SMP, the concrete ring and well cover must extend three inches above the SMP's maximum ponding depth. [Section 4.2.3, 15e]

- f. The observation well must include a slotted section within the storage layer of the SMP. The top of the slotted well section must extend to a minimum of six inches below the top of the SMP storage layer, and the slotted section must extend down the entire depth of the SMP. [Section 4.2.3, 15f]
- 12. Verify that access features are provided for all underground storage systems that are not stone storage beds. [Section 4.2.3, 16a]
- 13. Verify that a sufficient number of access points in the system are provided to efficiently inspect and maintain the infiltration area. [Section 4.2.3, 16b]
- 14. For cast-in-place vault systems, verify that access features consist of manholes or grated access panels or doors. Grated access panels are preferred to maintain airflow. [Section 4.2.3, 16c]
- 15. For grid storage or other manufactured systems, verify that the manufacturer's recommendations are followed. [Section 4.2.3, 16d]
- 16. Verify that ladder access is proposed for vaults greater than four feet in height. [Section 4.2.3, 16e]
- 17. Verify that header pipes, at minimum 36-inch diameter, connected to manholes at each corner of the subsurface system are provided. Alternatively, smaller header pipes may be used if cleanouts are provided on the manifold/header pipe junction for each distribution pipe. The cleanouts must be on alternating sides of the SMP. [Section 4.2.3, 16f]

F.8.3 Porous surface material standards

- 1. Verify that permeable paver and grid systems, if proposed, are specified on the plans as meeting the following specifications: [Section 4.2.4, 2]
 - a. Permeable paver and grid systems must conform to manufacturer specifications.
 - b. The systems must have a minimum flow through rate of five inches per hour and a void percentage of no less than 10%.
 - c. Gravel used in interlocking concrete pavers or plastic grid systems must be well-graded and washed to ensure permeability.
- 2. Verify that stone designed for stormwater storage, if proposed, is specified on the plans as being uniformly graded, crushed, clean-washed stone and that it is noted that PWD defines "clean-washed" as having less than 0.5% wash loss, by mass, when tested per the AASHTO T-11 wash loss test. AASHTO No. 3 and No. 57 stone can meet this specification. [Section 4.2.4, 4a]
- 3. Verify that all aggregates used within a porous surface system meets the following requirements: [Section 4.2.4, 4b]
 - a. Maximum wash loss: 0.5% per AASHTO T-11
 - b. Minimum durability index: 35 per ASTM D3744
 - c. Maximum abrasion: 10% for 100 revolutions and 50% for 500 revolutions per ASTM C131
- 4. Verify that all choker course aggregate meets the specifications of AASHTO No. 57 and meets the gradation listed in Table 4.2-3 of the Manual. [Section 4.2.4, 4c]
- 5. Verify that sand, if proposed, is specified on the plans to be AASHTO M-6 or ASTM C-33 sand and to have a grain size of 0.02 inches to 0.04 inches. [Section 4.2.4, 5]

6. Verify that storage chambers for porous surface over a structural SMP, if proposed, are specified on the plans as meeting the following specifications: [Section 4.2.4, 6]
 - a. Pipe used within a subsurface infiltration SMP must be continuously perforated and have a smooth interior with a minimum inner diameter of four inches.
 - b. High-density polyethylene (HDPE) pipe, if proposed, must meet the specifications of AASHTO M252, Type S or AASHTO M294, Type S.
 - c. Any pipe materials outside the SMP are to meet City Plumbing Code Standards.
7. Verify that geotextile, if proposed, is specified on the plans to consist of polypropylene fibers and to meet the following specifications (AASHTO Class 1 or Class 2 geotextile is recommended): [Section 4.2.4, 7]
 - a. Grab Tensile Strength (ASTM-D4632): ≥ 205 lbs
 - b. CBR Puncture Strength (ASTM-D6241): ≥ 500 lbs
 - c. Flow Rate (ASTM-D4491): ≥ 95 gal/min/ft²
 - d. UV Resistance after 500 hrs (ASTM-D4355): $\geq 70\%$
 - e. Tear Resistance (ASTM-D4533): ≥ 80 lbs
 - f. Heat-set or heat-calendared fabrics are not permitted
8. Verify that underdrains, if proposed, are made of continuously perforated HDPE plastic piping with a smooth interior and a minimum inner diameter of four inches. HDPE pipe must be specified on the plans to meet the specifications of AASHTO M252, Type S or AASHTO M294, Type S. [Section 4.2.4, 8]
9. Verify that the observation well is specified on the plans as meeting the following specifications:
 - a. The observation well must consist of slotted plastic pipe with a minimum inner diameter of four inches and a solid cap at the surface. The slotted section of the well must consist of PVC slotted well screen with 0.01-inch slot size and an attached perforated PVC cap at the bottom. [Section 4.2.4, 10a]
 - b. The observation well's cover must be ductile iron in a gray iron frame. [Section 4.2.4, 10b]
 - c. For an observation well located in an unpaved area, the well's concrete ring must be a minimum of six inches wider in any dimension than the cover frame, of equal depth as the cover frame itself, and poured atop a minimum of six inches of AASHTO #57 stone bedding. A frame conforming to these minimum dimensions may be circular or square. [Section 4.2.4, 10c]
10. Verify that cleanouts are made of material with a smooth interior having an inner diameter that is no less than six inches. If the connecting pipe is eight inches in diameter or larger, verify that the cleanout is eight inches in diameter. [Section 4.2.4, 11]