SECTION 13222 - STRAINER NOZZLE AIR SCOURING FILTER UNDERDRAINS

City of San Diego, CWP Guidelines

$# _____

NTS: This Section assumes that gravel filter beds would be eliminated as permitted by the Design Guidelines for this type of underdrain system. If the project design differs from this assumption, appropriate modifications should be made to these Specifications.

_____ #$

PART 1 - GENERAL

1.1 CONTRACTOR'S OPTION FOR THE TYPE OF SYSTEM

A. An alternative system for the strainer nozzle air scouring filter underdrains indicated in this Section, is the plastic air scouring filter underdrains indicated in Section 13221. The CONTRACTOR has the option to select either type of system.

1.2 WORK OF THIS SECTION

A. The WORK of this Section includes providing the filter underdrain system as indicated, including all items and materials within the filter cell for collecting filtered water, for uniformly distributing backwash air and water, for retaining filter media, and for retaining, supporting, and sealing the filter underdrain system as required for a complete and operable filter underdrain system.

B. The WORK also requires that a single manufacturer accept responsibility for design of and furnishing the filter underdrain system as indicated but without altering or modifying the CONTRACTOR'S responsibilities under the Contract Documents.

1.3 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 03300 Cast-in-Place Structural Concrete
2. Section 03315 Grout
3. Section 05500 Miscellaneous Metalwork
4. Section 13226 Anthracite Media

1.4 CODES

A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. Uniform Building Code

1.5 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1. ANSI/ACI 318 Concrete Construction

1.6 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Documentation that the manufacturer meets the qualification criteria.

2. Manufacturer's catalog of the proposed filter underdrain system identifying all components of the system intended to be used.

3. Complete and explicit details of the design, construction, and operating characteristics of the proposed filter underdrain system. Submittal data shall include applicable structural design calculations, materials of construction, complete head loss data for air, water, and combined air/water flows, installation details and leveling requirements, the maximum percentage of flow maldistribution within a filter cell, certification of compatibility of the underdrain system with the filter media furnished, and all other data necessary to demonstrate conformance with requirements of the Contract Documents.

4. Complete test reports and design calculations showing conformity with all flow design requirements. Submittal data shall include the full range of flow conditions indicated and pertinent physical relationships between air and water metering orifices; cross-sectional flow areas for water and air during transport to the flow metering elements; relative magnitudes of entrance, transport, metering, and discharge losses; and such other data necessary to demonstrate conformance of the system with the requirements of the Contract Documents.

5. Complete design calculations referred to above shall be stamped and signed by a California registered structural engineer (for structural calculations) and by a California registered civil engineer (for hydraulic calculations).

6. Detailed concrete specifications for the concrete false floor slab recommended by the underdrain system manufacturer.

1.7 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:

1. Manufacturer's instructions for installation of all system components.

2. Manufacturer's maintenance procedures.

3. Manufacturer's certificate of compliance with Contract Documents.

4. Complete test reports for all field tests, describing the units tested, the type of test, test setups, procedures, and instrumentation, and test flow rates, pressures, levels, and all other data and test results as required to demonstrate that all items tested meet the requirements of the Contract Documents.

1.8 SERVICES OF MANUFACTURER

A. Installation

The CONTRACTOR shall provide the services of the manufacturer's technical representative for not less than 3 working days, prior to the concrete false floor casting, to inspect and supervise the installation of the filter underdrain system.

B. Field Testing

The CONTRACTOR shall also provide the services of the manufacturer's technical representative for not less than one working day to inspect and supervise the field testing of the system.

1.9 QUALIFICATIONS

A. **Manufacturer:** Company specializing in design and manufacture of filter underdrain systems, with a minimum of one successfully performing installation of comparable size and complexity constructed in the recent past.

PART 2 -- PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. General

1. The underdrain system shall be a cast-in-place, monolithic, reinforced concrete false floor forming a filtered water collection and wash water/air distribution plenum above the filter base slab and incorporating an array of water/air metering elements of the false floor. A false floor constructed of precast concrete panels will not be accepted.

2. The filter underdrain system shall be arranged for: (1) end entry/exit of water into a distribution chamber at one end of the filter cell; the chamber shall

provide primary air and water distribution to the filter underdrain plenum during backwash operations which, in turn, distributes the water to the water/air metering elements below the filter false floor, and (2) backwash air entrance to the chamber, above and on the same end as the water entrance/exit portal with entry into the filter underdrain plenum from the distribution chamber through horizontally oriented primary metering orifices in the chamber roof, as indicated.

3. Prefabricated reinforced formwork panels with preformed holes to receive the flow elements, flow metering elements, and any specialties required for installation such as special anchorage, concrete retaining strips, and temporary sealing caps, shall be the products of a single manufacturer.

B. Performance Criteria

1. **Flow Rates:** The filter underdrain systems shall perform as indicated when operated under the following flow conditions:

a. Downflow of filtered water at [ ] to [ ] gpm/ft^2

b. Upflow of backwash air at [ ] to [ ] $scfm/ft^2$

c. Upflow of backwash air at [ ] to [ ] $scfm/ft^2$ together with backwash water at [ ] gpm/ft^2

d. Upflow of backwash water at [ ] to [ ] gpm/ft^2

2. Air Temperature: During backwash with air, the air temperature at the backwash air trough will be a maximum of 200 degrees F.

2.2 DESIGN REQUIREMENTS

A. The filter underdrain system shall be designed to insure long-term stability in its operating characteristics. It shall be resistant to changes in head loss and flow uniformity; corrosion, and any other effects which would in time cause loss of efficiency or effectiveness of its operation.

B. **Flow Distribution:** The filter underdrain system shall be designed to produce near-uniform air and water flows throughout the filter cell. Flow uniformity per square foot of filter area shall be as indicated to permit efficient and effective filter operation and backwashing, and there shall be no localized areas with flow rates which would cause mounding, lateral displacement, or other deleterious disturbances in the filter medium.

The filter underdrain system, as installed, shall satisfy at least one of the following 2 criteria for acceptable flow uniformity. Maldistribution of air and water flows during backwash, for all indicated flow conditions, shall not exceed:

1. Water: Plus or minus 5 percent of average gpm/square foot of filter.

2. Air: Plus or minus 10 percent of average cfm/square foot of filter.

C. STRUCTURAL

1. **General:** The filter underdrain system, including anchorage, supports, etc., shall be designed to safely withstand loadings as indicated. Reinforced concrete design shall be as per ANSI/ACI 318. Steel shall be designed in accordance with the AISC steel manual.

2. **Internal Loading:** The filter underdrain system, when installed, shall be designed for a net internal loading during backwash of the greater of either 600 psf or 200 percent of maximum pressure at maximum backwash rates. No credit shall be taken for the weight of filter media in the design calculations.

3. **Downward Load:** The filter underdrain system shall also be designed to withstand a net downward loading of not less than 1,400 psf, plus its own dead weight.

4. **Safety Factor:** A factor of safety of at least 2 shall be included in the design to account for dynamic loadings which may occur during the initiation and termination of backwash.

5. **Handling Loads:** The design shall adequately provide for all loads incurred during shipment, handling, and installation.

2.3 COMPONENTS

A. **Support System:** The false floor shall be made up of reinforced concrete, cast in place, over the prefabricated reinforced formwork panels which form the underside of the floor slab and provide preformed holes for locating and supporting the cast-in-place flow element inserts. The prefabricated formwork panels shall be supported by separate reinforced concrete piers and ledges. The support system shall adequately provide for both longitudinal and transverse flow under the false floor to insure uniformity of flow distribution.

Concrete and reinforcement shall conform to the applicable requirements of Section 03300, except that coarse aggregate shall be not larger than 3/8-inch maximum diameter in slabs of 3-inch depth or less and shall not be larger than 1/2-inch maximum diameter in slabs with depths greater than 3 inches. Grout shall be a mixture of one part of portland cement and two parts of sand, with nonshrink admixture in accordance with the written recommendations of the underdrain manufacturer/supplier.

B. **Formwork Panels:** The preformed, prefabricated formwork panels shall be constructed of permanent food grade styrene and designed with reinforcing ribs to support the placement of concrete with a maximum deflection of 1/8-inch.

C. **Flow Nozzles and Inserts:** The false floor shall contain an array of plastic flow element inserts cast in the concrete, uniformly spaced at not more than 8-inch

centers both ways, and designed to receive separate, plastic, self-locking nozzle stems and domes. The flow metering nozzle stems and domes shall be designed to uniformly meter air and water flows throughout the filter cells. They shall be installed after placement of the reinforced concrete in accordance with the manufacturer's written instructions and as indicated. They shall be designed and installed to remain in position during use, but shall have the ability to be adjusted vertically, from above, over a distance of up to 2 inches at time of installation or subsequently, after the filter floor has been cast. The nozzle stems shall be removable from the underside of the floor (underdrain plenum) to permit future maintenance or replacement.

The flow metering elements shall be of identical multipart construction of a suitable high strength plastic material, with a discharge dome situated above the false floor and a nozzle stem extending into the plenum space below. The flow metering elements shall contain no metal screws or other metallic parts.

D. **Discharge Domes:** The discharge domes shall be of the vertical, narrow-slot type, wherein the slots are capable of retaining the filter media during normal operation and during backwash, and discharge horizontally into the filter medium. The slots in the discharge domes shall have a tapered width to prevent the lodging of small particles in the slot. The design of the domes and slots shall be compatible with the anthracite filter medium indicated in Section 13226.

E. **Nozzle Stems:** The nozzle stems shall provide for the flow of air and water between the discharge domes and the plenum space below the false floor. They shall be arranged for water flow through the open end, and shall have air orifices properly sized and located for air entry through the side walls. All flow passages shall be free of burrs or other obstructions which would adversely affect flow characteristics. The nozzle stems shall be of self-locking adjustable length to provide for in-place leveling of the stem bottoms to prevent bottom entry of air under any indicated flow condition.

F. **FASTENERS:** All anchor bolts, fasteners, washers, spring clips shall be Type 304 or 316 stainless steel.

2.4 MANUFACTURER

A. The underdrain system shall be as manufactured by Paterson-Candy International LTD., of London, England; or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General**: The CONTRACTOR shall install the filter underdrain system in strict accordance with the manufacturer's installation drawings and printed recommendations, and as indicated. The CONTRACTOR shall obtain from the underdrain manufacturer such written installation details and recommendations as are necessary to acceptably interface the filter underdrain system with all surrounding structures, including requirements for grouting keys and pockets, dowels, support ledges and piers, anchorage, etc. The CONTRACTOR is cautioned that such installation details are not indicated on the Contract Drawings, as they will vary according to the individual manufacturer requirements.

B. **Placement and Cleaning:** The CONTRACTOR shall take all necessary precautions recommended by the underdrain manufacturer in writing and as indicated to insure that the underdrain system and piping connected thereto is completely clean and free of any debris, dirt, or other foreign materials which could clog the underdrain system or interfere with flow. Backwash air and water piping shall be thoroughly flushed clean. Air piping shall be flushed with air only. All loose debris and dirt within the filter cell and flume shall be removed by brooming down and vacuuming. Care shall be taken to prevent grout from extruding into any flow passages or ports, and any extruded grout shall be removed. As installation progresses, underdrain sections partially completed shall be protected with heavy building paper, masking tape, or other acceptable means to maintain cleanliness. Cleanliness shall be maintained until final placement of filter media. The filter media shall be placed after the preliminary distribution test indicated under "Field Testing."

C. **Underdrain Installation:** The reinforced concrete false floor underdrain system shall be finished to a true and level plane within the tolerance indicated by the manufacturer of the filter underdrain. The false floor support ledges and piers shall be prepared as necessary to enable installation within the required level tolerance. Reinforcing steel shall be placed to accurately fit in place without bending of the reinforcing bars in the field. The CONTRACTOR shall flood the underdrain with water to ascertain compliance with the level tolerance.

D. **Grouting:** Grouting shall conform to the requirements of Section 03600. Reinforcing dowels shall be placed to accurately fit without bending of the dowel bars in the field.

3.2 FIELD TESTING

A. **General:** The CONTRACTOR shall conduct all indicated testing and shall furnish all material, instrumentation, suitable portable blower if necessary, personnel, etc., for the tests indicated. All costs for such testing, as well as the costs for all work and materials to correct deficiencies revealed during testing and retesting, shall be borne by the CONTRACTOR. The CONTRACTOR shall give the CONSTRUCTION MANAGER sufficient advance notice of the testing to enable witnessing of the tests.

B. **Data Accuracy**: All test setups, procedures, and instrumentation shall be capable of providing data accuracy of plus or minus 2 percent.

C. **Underdrain Flow Distribution Test:** The filter underdrain system in each filter cell shall be given a visual water flow distribution test to verify that orifices are not clogged with debris and flow distribution is uniform. This test shall be performed before filter media is placed. The filter underdrain system shall be partially filled with clean water to approximately half the height of the underdrain system at the beginning of the test. The test flow rate shall be at the normal design backwash rate of [ ] gpm/ft^2 and the flow rate shall be sustained for approximately 2 minutes while visual observations are made. The test shall be repeated 3 times.

D. **Visual Flow Test:** During each test, flow from each orifice as well as any sign of dead spots or boils shall be visually observed. The CONTRACTOR shall take such measures as are necessary to correct any deficiencies revealed by these tests, and shall repeat the indicated tests until such deficiencies are corrected.

** END OF SECTION **