

PART 1 - GENERAL

1.1 RELATED  
REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 MEASUREMENT AND  
PAYMENT

- .1 Measure supply and installation of precast ultra reef ball modules by the unit installed.

1.3 REFERENCES

- .1 ACI-211.191-Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
  - .2 ASTM C 260 - Standard Specifications for Air-Entraining Admixtures for Concrete.
  - .3 ASTM-C 1115 Type III - Standard Specifications for Fiber Reinforced Concrete or Shotcrete.
  - .4 ACI - 305R-91 - Hot Weather Concreting.
  - .5 ACI - 306R-88 - Cold Weather Concreting.
  - .6 ACI - 308 - Standard Practice for Curing Concrete.
  - .7 ASTM C 618 - Fly Ash for Use as a Mineral Admixture in Portland Cement Concrete.
  - .8 ASTM C 494-92 - Standard Specifications for Chemical Admixtures for Concrete.
  - .9 ASTM C 1202-91 - Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.
  - .10 ASTM C 33 - Concrete Aggregates.
  - .11 ASTM C 94 - Ready Mix Concrete.
  - .12 ASTM C 150 - Portland Cement.
  - .13 ACI 304 - Recommended Practice for Measuring, Mixing Transporting and Placing Concrete.
  - .14 ASTM C 39 - Standard Specifications for Compressive Testing.
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1.3 REFERENCES  
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- .15 ASTM C-1240-93 - Standard Specifications for Silica Fume Concrete.
- .16 CSA Group
  - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CSA A23.4, Precast Concrete-Materials and Construction.
  - .3 CSA A3000, Cementitious Materials Compendium.
- .17 Compressive Strength shall be tested in accordance with ASTM C39.

1.4 ACTION AND  
INFORMATIONAL  
SUBMITTALS

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- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for ultra reef ball module and include product characteristics, performance criteria, physical size, mix design, finish and limitations.
- .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
- .4 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.
- .5 Trial Mix: Contractor to provide minimum (3 m<sup>3</sup>) trial mix containing proposed concrete design mix placed at a site in location acceptable to Departmental Representative.

1.5 DELIVERY,  
STORAGE AND  
HANDLING

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- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
  - .1 Store materials on site in protected location in accordance with Departmental Representative's recommendations.
  - .2 Store and protect reef balls from damage.

1.5 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)

- .2 (Cont'd)
- .3 Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products being used.
- .4 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Portland cement: Shall be Type II and conform to ASTM C-150.
- .2 Fly Ash, when permitted, may be used as a substitution for cement up to a maximum replacement of 15%. Shall meet requirements of ASTM C-618, Type F, and must be proven to be non-toxic.
- .3 Water: Shall be potable and free from deleterious substances and shall not contain more than 1000 parts per million of chlorides or sulfates and shall not contain more than 5 parts per million of lead, copper or zinc salts and shall not contain more than 10 parts per million of phosphates.
- .4 Fine Aggregate: Shall be in compliance with ASTM C-33.
- .5 Coarse Aggregate: Shall be in compliance with ASTM C-33 9 mm (pea gravel). (Up to 25 mm aggregate can be substituted with permission from the mold user.) Limestone aggregate is preferred if the finished modules are to be used in tropical waters.
- .6 Chemical admixtures: Shall be in compliance with ASTM C 494.
- .7 Required Additives: The following additives shall be used in all concrete mix designs:
  - .1 High Range Water Reducer: Shall be ADVA flow 120 or 140.
  - .2 Silica Fume: Shall be force 10,000 densified in concrete ready bags. (ASTM C-1240-93) or any of the permitted equivalent silica fume brands as defined in the training manual.
  - .3 Air-Entrainment: Only if ADVA is not used: Shall be Darex II (ASTM C-260).

2.1 MATERIALS  
(Cont'd)

- .8 Optional Additives: The following additives may be used in concrete mix designs when producing Reef Balls.
  - .1 Fibers: Shall be either microfibers or Fibermesh Fibers (38 mm or longer). Any non-calcium chloride or Daracell may be used. (ASTM C-494 Type C or E).
  - .2 Retarders: Shall be in compliance with ASTM-C-494-Type D as in Daratard 17.
- .9 Prohibited Admixtures: All other admixtures are prohibited. Other admixtures can be submitted for approval by Departmental Representative.

2.2 CONCRETE MIXES

- .1 Proportion concrete in accordance with CSA A23.1/A23.2, Alternative 1, to following requirements:
  - .1 Type Portland cement.
  - .2 Minimum compressive strength at 28 days: 35 MPa.
  - .3 Minimum cement content: 356 kg/m<sup>3</sup>.
  - .4 Slump at time and point of discharge: 170 to 250 mm and to achieve 40 w/c ratio.
  - .5 Air content: 5 to 8%.
  - .6 Sand content: 688 kg/m<sup>3</sup>.
  - .7 Water content: 142 kg/m<sup>3</sup>.
  - .8 Force 10K: 30 kg/m<sup>3</sup>.
  - .9 Microfibre: .3 bag/m<sup>3</sup>.
  - .10 ADVA flow: 1/m<sup>3</sup>.
  - .11 Accelerator: As needed to achieve de-molding no sooner than 3-4 hours for heavy duty molds, 6-7 hours for standard molds.
- .2 When the Contractor wishes to purchase concrete from a ready mix concrete supplier, submit a letter from the supplier certifying the following:
  - .1 That plant and equipment is certified and all materials to be used in the concrete comply with the requirements of CAN/CSA-A23.1.
  - .2 That the mix proportions selected will produce concrete of the specified quality and yield. Indicate mix proportions and sources of all materials.
  - .3 That the strengths will comply with the strengths specified herein.

2.2 CONCRETE MIXES  
(Cont'd)

- .3 When the Contractor wishes to mix concrete on site, identify the source of aggregates and submit samples of fine and coarse aggregates to a testing laboratory for testing and trial mixes in order to determine a suitable mix design. The testing laboratory, at Contractor's cost, will test the trial mix for slump, air content, density and strength. The results of these tests will be submitted to the Departmental Representative to be reviewed for compliance with the specification. This review must be completed before permission to place concrete is given.

2.3 FABRICATION

- .1 Fabricate: to CSA A23.4, 1500 mm diameter x 1200 mm high as indicated on drawings.
- .2 Finish: Aggregate exposed outside surface texture.
- .3 Fabricate 21-26 holes per unit, as indicated.
- .4 Bottom to be wavy, produced by a sand bed under mold.

PART 3 - EXECUTION

3.1 TESTING

- .1 Departmental Representative will appoint a concrete testing company to test all work under this section of specification as per CAN/CSA-A23.1.
- .2 Cost of compressive strength tests shall be paid for by the Departmental Representative.
- .3 Testing company shall issue reports to Departmental Representative on quality of test cylinders.
- .4 Notify Departmental Representative at least 7 days prior to start of placing concrete. Provide for testing purposes an adequate quantity of approved test cylinders.
- .5 At least 1 set of 3 cylinders each shall be taken from 25 m<sup>3</sup> or fraction thereof of each day's pour, whichever is less. 1 cylinder shall be tested at 7 days and other 2 tested at 28 days.

3.1 TESTING  
(Cont'd)

- .6 Crate cylinders and deliver to the testing laboratory within 48 hours after casting in accordance with CAN/CSA-A23.1. Contractor will pay for crating and delivery of cylinders to the laboratory.
- .7 If strength tests of test cylinder for any portion of the work falls below the specified compressive strength at 28 days, the Departmental Representative reserves the right to determine the acceptability of the concrete by performing additional field testing as outlined in CAN/CSA-A23.1.
- .8 If concrete does not conform to drawings or specifications, take measures as directed to correct the deficiency. All costs of correctional measures will be at the expense of the Contractor.

3.2 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for precast concrete installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of approval to proceed from Departmental Representative.

3.3 PREPARATION

- .1 Prior to placement of the ultra reef balls, DFO-SCH will verify suitability of the harbour bottom in the area by conducting an underwater dive.
- .2 Once a location is selected for the suitability for the placement of the reef ball, it will be marked with a buoy.

3.4 INSTALLATION

- .1 Install ultra reef balls as directed by Departmental Representative.

3.4 INSTALLATION  
(Cont'd)

- .2 Construction of the reef balls will occur offsite and they will be shipped to site and set in place by divers.
- .3 Contractor will mobilize to site with the required equipment to install the reef balls.
- .4 Dive team will place marker buoys for each of the proposed reef ball placement locations and control sites and record the GPS coordinates.
- .5 Dive team will take underwater video of each of the marked locations.
- .6 DFO/SCH's environmental representative can modify the locations as required based on the dive survey results.
- .7 DFO-SCH will provide results of survey to DFO-FFHPP to verify suitability of selected sites.
- .8 A boom truck will be set up in the upland staging area.
- .9 At high tide, the boom truck will place the reef balls on a barge and transport out to area approved for placement, 8 m to 9 m water depth range and approximately 5 m apart from one another on the ocean floor.
- .10 Dive team will utilize air bags to float the individual reef balls from the barge to the predetermined positions and place them securely on the ocean floor.
- .11 When all reef balls have been placed in their permanent locations, dive team will photograph, video the ultra reef ball site and provide all as-built measurement information.
- .12 Replace damaged and defective reef balls as directed by Departmental Representative.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by precast concrete specialties installation.