

Part 1 General

1.1 SCOPE

- .1 The work outlined in this section includes all operations related to placing the stone required for breakwater repairs.

1.2 RELATED SECTIONS

- .1 Section 01 29 00 – PAYMENT
- .2 Section 01 33 00 – DOCUMENTS AND SAMPLES TO SUBMIT
- .3 Section 01 35 43 – ENVIRONMENTAL PROTECTION
- .4 Section 01 41 00 – REGULATORY REQUIREMENTS
- .5 Section 02 41 19 – EXCAVATION OF STONE AND DOLOSSE
- .6 Section 31 32 19.16 – SOIL STABILIZATION WITH GEOTEXTILES
- .7 Section 35 31 24 – STONE PRODUCTION

1.3 DOCUMENTS AND SAMPLES TO SUBMIT

- .1 The following information must be submitted to the Departmental Representative in compliance with the requirements in section 01 33 00 – Documents and samples to submit.
 - .1 Construction procedures and equipment
At least ten (10) working days before stone placement begins, the Contractor must submit their construction procedures, which must include:
 - .1 a list of all equipment and machinery they intend to use;
 - .2 a detailed explanation of stone placement methods for each category, as well as the placement sequence; and
 - .3 a sample of the daily stone placement report.
 - .2 Inspection techniques and survey methods
At least ten (10) working days before stone placement begins, the Contractor must submit the following information to the Departmental Representative for examination:
 - .1 inspection techniques and evaluation criteria for stone placement; and
 - .2 an explanation of the surveying methods used to ensure precise placement of stones, including alignment, levelling, and cross-section control during construction.

After examination by the Departmental Representative, the submitted information must be incorporated into the Contractor's stone control plan.

- .3 Scale installation and certification
The Contractor must make arrangements to install and certify an electronic scale at the stone production site before transportation, in compliance with sub-subparagraph 1.4.1.1. The cost of installation and certification is to be borne by the Contractor.
At least five (5) working days before loading, the Contractor must submit details about the location and type of scale installed for the project. They must also submit a copy of the certification of the scale's accuracy in compliance with the requirements of the *Weights and Measures Act* (R.S.C., 1985, c. W-6).
- .4 Scale operators
The Contractor must employ scale operators and pay all associated costs.
- .5 Other weighing devices
Submit information about equipment, including gauges and all other devices, to be used for weighing individual stones. These devices are at the Contractor's expense.
- .6 Certified weight tickets
A copy of each weight ticket, including certification of the exact weight, the time of weighing and the time of delivery, must be submitted to the Departmental Representative within one day of weighing.
- .7 Survey data for existing conditions and work verification
A copy of each verification survey report, including existing conditions, must be submitted to the Departmental Representative on the business day following the survey day. A paper copy and a digital copy must be submitted.
- .8 Stone placement reports
The Contractor must submit daily reports regarding stone placement. These reports must include at least the following information: an estimate of the total weight of placed stones in tonnes; chaining measurements along the baseline (BL) between which the stones are placed; and the total time spent placing stones. The Contractor must also maintain progress tracking plans that indicate the dates and locations of stone placement and verification for each layer of stone for examination by the Departmental Representative at all times.

1.4 MEASUREMENT

- .1 All stones will be measured for payment by tonne of accepted material for placement. All measurement will be based on weight tickets issued by the certified scale, as described below:
 - .1 The scale must be a weight-recording scale. It must be large and long enough and have the capacity to weight the stone and its transportation method. The scale must be able to hold the all of the wheels of the transportation method used by the Contractor or subcontractors.

- .2 The Contractor must provide the Departmental Representative with copies of the weight tickets of all the stones delivered to the site, separated by category, every day.
- .3 The calculation of stone placed above tolerance limits that the Departmental Representative agrees to leave in place must be based on verification surveys made during construction. The volume of the stone will be determined based on the average cross-sectional area. It will be converted into tonnes at a rate of 1.9 tonnes/m³. The resulting tonnage will be deducted from the payment total. Lost material, material used by the Contractor for any other purpose and material that was not placed in compliance with the requirements and plans will also be deducted from the payment total.

1.5 TERMINOLOGY

- .1 Survey baselines (BL) and reference lines must be referred to in the stonework description. The following definitions cover these terms.
 - .1 Survey baselines (BL) - Lines indicated in the contract plans that serve as a reference for all surveying activities.
 - .2 Reference lines – Solid lines in the contract plans that show the limits of various types of stone. Tolerances for stone placement described in this section are perpendicular to these reference lines.
 - .3 "Tonne" (t) refers to a metric tonne (1 t = 1,000 kg).

Part 2 PRODUCTS

2.1 MATERIALS

- .1 All stone used for this project must meet the requirements laid out in section 35 31 24 – Stone production.

2.2 QUARRY-RUN STONE

- .1 Quarry-run stone will be produced from crushed quarry stone.
- .2 Quarry-run stone must have a stone size of between 2.5 kg and 100 kg.
- .3 Stone less than 2.5 kg must not exceed 5% of the total weight.

Part 3 EXECUTION

3.1 QUALITY CONTROL OF STONE PLACEMENT

- .1 General
 - .1 The Contractor is responsible for quality control and must establish and maintain a quality control program according to the requirements in section 35 21 24.
 - .2 The Contractor must maintain logs of all quality control tests, surveys, inspections and corrective measures. Copies of these logs must be submitted to the Departmental Representative.

- .2 Quality control benchmarks
 - .1 The Contractor must provide ranging rods, marker buoys, templates, batter boards and/or any other methods of guidance or tracking required for placing the stone layers within the required tolerances.
 - .2 The Contractor must provide and maintain markers every 15 metres along the crest of the structure and along every work zone. These ranging rods must be visible in both directions along the chaining.
 - .3 Provide, install and maintain tide gauges with stilling tubes as needed so the Contractor and Departmental Representative can read the water level at any time during the project. Graduate the tide gauge every metre and every 25 cm and place graduation marks every 2.5 cm. Install the tide gauge so that the water level can be read directly against the datum level (CD or chart datum). The type of tide gauge and its placement must be approved by the Departmental Representative.
- .3 Underwater construction benchmarks
 - .1 **All underwater stone placement must be done with the support of a computer system that is capable of displaying the construction template and the position of the backhoe bucket or crane bucket used, in real time, on a computer monitor.**
 - .2 **The Contractor must use a dual-frequency GPS equipped with Real Time Kinematic (RTK) technology.**
- .4 Verification surveys
 - .1 Object
 - .1 The Contractor must perform verification surveys as work progresses to ensure that the layer thicknesses, lines and levels are within prescribed tolerances.
 - .2 Verification surveys must be used by the Departmental Representative to estimate the volume of stone beyond the tolerance limits, if the Departmental Representative has authorized that stone to remain in place. The volume will be converted to tonnage, as described in sub-subparagraph 1.4.1.1.3, and will be deduced from the payment total.
 - .2 Scope
 - .1 Verification surveys for the existing structure must be completed before placing stone from any category. Each verification survey must include cross-sections of the structure every 10 m along the survey baseline (BL). These cross-sections are to be made by the Contractor.
 - .2 Take elevation measurements every 1.5 m over a distance of at least 3 m beyond the end of the verified stone layer. Take additional elevation measurements if instructed by the Departmental Representative.
 - .3 Different spacing between cross-sections may be used if the Departmental Representative decides it to be appropriate.

.3 Equipment

- .1 Verification surveys must be carried out with a DGPS device, a total station and a prism with sight. A transit level, ranging rod, surveyor's chain, guide lines, survey bucket or any other method that meets the requirements laid out in this section may also be used, subject to the Departmental Representative's approval. If a range pole surveying device is used, it must be equipped with a solid base at least 30 cm wide.
- .2 Depth measurements may be taken only through physical contact with the stone, for example with a range pole surveying device or with leaded lines. Sonar or electronic measurements are not acceptable for measuring depth. Measurements must be accurate to within 6 cm.
- .3 Other measurement methods, such as sonar or electronic measuring devices, may be taken into consideration pending approval by the Departmental Representative. The Contractor must prove the accuracy of any unauthorized method through detailed comparisons with measurements made by physical contact with the stone for all stone layers.
- .4 The Contractor must provide boats, personnel and any equipment required to safely and accurately perform the verification surveys.

.4 Execution

- .1 Surveying above the water must be done with traditional land surveying methods. For underwater surveying, the Contractor must go to the desired spot for each reading with a boat or a platform, depending on what is required to survey the entire structure, including the tide range zone.
- .2 All verification surveys must be done based on the survey baseline (BL) and the datum level (CD).
- .3 Verification surveys must be carried out in the presence of the Departmental Representative unless they waive this requirement.
- .4 For each verification survey performed, the Contractor must submit a verification survey log to the Departmental Representative. This log must include:
 - Location of the verification survey (station on the BL)
 - Stone category studied
 - Date and time of survey
 - Weather conditions
 - Tide gauge measurement at time of survey
 - Name(s) of participant(s)
 - Field notes
 - Drawing on graph paper, showing the BL, contour lines and individual height markers
- .5 The exact format of the verification survey log must be approved by the Departmental Representative and the Contractor.
- .6 The Contractor's verification surveys of the underlying material (i.e. the existing structure or previously placed stone layers) must be verified by the Departmental Representative before the next layer of stone can be placed.

3.2 STONE PLACEMENT

.1 General

- .1 Stone placement must not deviate from the reference lines in the plans beyond the tolerances indicated in this section.
- .2 Approval of stone placement and/or verification surveys for a stone layer or portion thereof does not constitute final acceptance. Stonework will be considered final when the Departmental Representative has approved the stone placement and the verification surveys for all layers in all repair zones.
- .3 Before final acceptance, any damage to the existing structure or the partially constructed or approved layers of rock caused by wind, waves, tides, ice or the Contractor's or subcontractors' operations must be repaired by the Contractor at their own expense.
- .4 At the end of every work day that involves stone placement, the Contractor must provide a written summary of the stone placement work to the Departmental Representative. The exact format of the stone placement summary must be determined and accepted by the Departmental Representative and the Contractor before stone placement work begins. The summary must include at least the following: an estimate of total tonnage placed and the chainings between which the stones were placed.
- .5 Stones must be placed carefully to avoid damaging existing structures. All costs for repair and/or replacement of structures damaged as a result of failure to take the necessary precautions will be borne by the Contractor.
- .6 Placement using a method likely to cause segregation in a given stone category is prohibited. Placement must begin at the bottom of the slope and move towards the top of the slope. Stones must not be thrown or moved by sliding or pushing them towards the bottom. The final slope and height must be made once the stone is placed.

.2 Armour stone

- .1 Stones must be placed individually between the reference lines and according to the slope indicated on the contract plans, and within the tolerances described in this section.
- .2 Stones of the same category should be distributed evenly by size across the enrockment to avoid creating areas where all stones are the same size.
- .3 The equipment used to place the stones must be able to set each stone down without releasing it more than 0.3 m above its final position. It must also be able to move and reposition the stone as needed.
- .4 Place the stones so that each rests securely on those underneath it and is touching the stones around it. It may be necessary to shift the adjacent stones, including those in the existing structure, to do so.
- .5 Stones must be placed irregularly and orientated randomly so that the edges between neighbouring stones are not aligned.
- .6 Outward slopes shall be finished as the same time the armour stone is placed. The finished surface must be uniform and have no empty spaces.

- .3 Filter and quarry-run stone
 - .1 Dumping and spreading of filter and quarry-run stone directly on the structure is prohibited. These stones must be placed with a clamshell bucket, dragline bucket, backhoe or other similar equipment to ensure that material is uniformly distributed on the existing base, on the existing/excavated structure or on material that has already been placed. Stones must not be released more than 0.6 m above their final position.
 - .2 All material must be placed uniformly according to the lines and slopes indicated in the contract plans and within the tolerances described in this section.
 - .3 Materials must be handled and placed to minimize segregation, create a well-distributed mass in terms of stone size and to ensure the desired stone sizes are in place.
 - .4 Placement and finishing according to the required tolerances, as well as the required verification surveys, must be carried out before placing the next stone layer.
- .4 Stone degradation caused by the Contractor's operations
 - .1 The finished structure must not contain material that is too small. The Contractor is responsible for removing and replacing any stones that have been damaged or degraded during work to the point that they no longer meet the requirements in this document.

3.3 DEFORMATION

- .1 If any part of the newly placed rock deforms during construction or following work completion but before acceptance, the Contractor must remove the displaced materials and rebuild that portion of the structure with new materials or with the materials moved for reconstruction, if appropriate.
- .2 Stone placement without installation of external protection is at the Contractor's own risk.

3.4 TOLERANCES

- .1 The finished surface must not deviate from the indicated lines and slopes in the contract plans beyond the tolerances indicated below, whether that difference is more or less than indicated measurements. Tolerances are measured perpendicularly to reference lines.
- .2 Extreme limits of the tolerances listed below must not be continuous in any direction more than five (5) times the average size of the stone and/or over more than 10 m² of the surface of the structure.
- .3 Any section of a stone layer built based on the upper tolerance limits must not be immediately next to a section built based on the lower tolerance limits and vice versa. In other words, transitions between the tolerance extremes must be gradual.

Stone categories	Above reference lines	Below reference lines
Quarry-run stone 100 to 300 kg 200 to 400 kg 300 to 500 kg 500 to 800 kg 600 to 1,000 kg 800 to 1,200 kg	300 mm	200 mm
1 to 3 t 2 to 4 t 3 to 5 t 5 to 8 t	450 mm	300 mm
6 to 10 t 8 to 12 t	600 mm	300 mm

- .4 In addition to the aforementioned tolerances perpendicular to the slope, the horizontal position of each slope change for finished stone layers must be within 60 cm of indications in the contract plans. This change must not be systematic in any way. The lines, arches, and curves must be uniform and continuous without visible deflections, bends or deviations.
- .5 The tolerances listed above are intended to ensure that the structure is built according to the required levels, slopes and thicknesses. Any placed material that does not meet these requirements must be removed and/or reworked according to the Departmental Representative's instructions.

3.5 DEBRIS

- .1 All wood, unsatisfactory material and debris found in the construction zone must be removed unless otherwise instructed by the Departmental Representative. This material becomes the property of the Contractor. All material must be correctly disposed of in compliance with the requirements in sections 01 35 43 and 01 41 00.

3.6 CONTROLLING TURBIDITY

- .1 The Contractor must ensure that stone is placed in a way that minimizes turbidity. The Contractor's operations must be in compliance with the requirements outlined in sections 01 35 43 and 01 41 00 of the specifications.

END OF SECTION 35 31 25