TENDER DOCUMENTS

SUBSECTION 6.21
DEMOLITION AND REMOVAL

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SUBSECTION 6.21 DEMOLITION AND REMOVAL

6.21.1 GENERAL

6.21.1.1 This subsection describes the requirements applicable to the demolition and removal work prescribed in the Contract. That work includes selective or complete demolition of concrete, removal of bituminous pavement, removal of deteriorated or obsolete structural elements or components, and removal of equipment (permanently or temporarily) so that the structures can be repaired in accordance with the requirements of the Contract.

6.21.1.2 The demolition zones or elements, components and equipment to be removed identified in the *Special Technical Conditions* or shown on the drawings are approximate. The exact scope of the demolition and removal work to be carried out by the **Contractor** is determined on site by the Engineer.

6.21.1.3 Debris shall be removed and disposed of in accordance with the requirements of subsection 6.13, *Environmental Protection*.

6.21.1.4 The **Contractor** shall repair at its expense any structure or part of a structure that is damaged during the work.

6.21.1.5 The **Contractor** shall repair at its expense any part of a structure demolished beyond the limits prescribed by the *Special Technical Conditions* and shown on the drawings or prescribed by the Engineer.

6.21.1.6 At least fourteen (14) days prior to the start of demolition work, the **Contractor** shall submit to the Engineer for review drawings and diagrams describing clearly and in detail the order in which the demolition and removal work is to be carried out and temporary access facilities, including design notes, in accordance with the requirements of subsection 6.15, *Scaffolding, Platforms and Other Temporary Devices*.

6.21.1.7 The **Contractor** shall take such measures as are necessary to enclose the work area and protect the public, workers, road traffic (vehicles, pedestrians and cyclists), marine traffic and the various elements of the structures to be preserved or recovered. The **Contractor** shall use protective screens, if necessary, to eliminate dust and flying debris while demolition is being carried out.

6.21.1.8 The **Contractor** shall at all times protect existing structures that must remain in place (drains, electrical equipment, etc.) and materials that must be preserved or recovered, in particular reinforcing steel, sheaths and pre-stressing cables.

6.21.1.9 If any structures or materials are damaged, the **Contractor** shall, upon receiving notice from the **Owner**, replace or repair them promptly to the satisfaction of the Engineer and at no additional cost to the **Owner** or shall cover the cost of replacement or repairs carried out by the competent authority concerned.

6.21.1.10 While concrete demolition work or work on reinforcing steel is being carried out, the structural integrity of all components of the bridge or structure shall be maintained at all times by shoring or other appropriate means authorized by the Engineer.

6.21.2 LABOUR, EQUIPMENT AND TOOLS

6.21.2.1 The **Contractor** shall carry out the demolition and removal work using workers with at least five (5) years of experience in this type of work and appropriate equipment and tools. The equipment used shall not damage the parts of the structure to be preserved.

6.21.2.2 The **Contractor** shall provide a list of the specialized equipment it plans to use. The equipment must permit safe demolition of concrete, including underwater concrete and concrete in tidal areas. The equipment shall be accepted by the Engineer.

6.21.2.3 The **Contractor** shall not use explosives to demolish concrete.

6.21.2.4 The use of rock hammers or jackhammers of any size or excavators with a narrow-tooth bucket, a blade bucket or a wide-mouth bucket is not permitted unless otherwise indicated in the *Special Technical Conditions* or authorized by the Engineer.

6.21.2.5 The use of jackhammers is subject to the following restrictions:

6.21.2.5.1 the **Contractor** shall not use handheld jackhammers heavier than 6.8 kg (15 pounds) to carry out selective demolition of concrete or mortar near reinforcing bars, pre-stressing steel, sheaths or other embedded elements that are to be preserved;

6.21.2.5.2 13.8 kg (30 pound) handheld jackhammers may be used to carry out the initial demolition of concrete or mortar and to carry out coarse demolition of concrete; areas near and around reinforcing steel, pre-stressing cables, sheaths and other embedded elements that are to be preserved shall be finished with a 6.8 kg (15 pound) handheld jackhammer;

6.21.2.5.3 if the final profile once hydrodemolition is complete does not comply with the lines and dimensions shown on the drawings, the **Contractor** shall complete the demolition using a handheld jackhammer until the results required by the Engineer are achieved;

6.21.2.5.4 the tip used on jackhammers shall be pointed or flat;

6.21.2.5.5 demolition is prohibited within 5 m of any recently concreted area where the strength of the concrete is less than 70% of the specified strength at twenty-eight (28) days.

6.21.2.6 For hydrodemolition work, the **Contractor** shall meet the following requirements:

6.21.2.6.1 the **Contractor** shall submit a detailed work plan to the Engineer; the work plan must be accepted by the Engineer, failing which the **Contractor** may not proceed with the hydrodemolition work.

6.21.2.6.2 The detailed work plan shall include:

6.21.2.6.2.1 a complete description of the proposed equipment, including the water supply system and the high-pressure pumping system indicating the maximum operating pressure;

6.21.2.6.2.2 a description of the control method that will be used to ensure the precision and uniformity of the work;

6.21.2.6.2.3 proof of the competence of the hydrodemolition equipment operator;

6.21.2.6.2.4 a list of the replacement equipment that will be available on site;

6.21.2.6.2.5 the equipment that will be used to control and recover water and residue.

6.21.2.6.3 The **Contractor** shall install a system for filtering any water discharged into the river such that suspended solids do not exceed 25 mg/l. The **Contractor** shall obtain all the necessary permits and authorizations and shall comply with all applicable legislation.

6.21.2.6.4 Before the work covered by this section begins, calibration tests shall be conducted with the Engineer present in order to ensure that the equipment, personnel and work methods proposed by the **Contractor** can produce the required results to the Engineer's satisfaction. The tests shall be conducted in accordance with the following criteria:

6.21.2.6.4.1 the tests shall be conducted on two areas approximately three square metres (3 m^2) each; one area shall be in sound concrete and one in deteriorated concrete, as determined by the Engineer;

6.21.2.6.4.2 the hydrodemolition equipment shall first be calibrated in the test area with sound concrete to remove a minimum thickness of 10 mm of concrete and a maximum thickness equal to half the diameter of the coarsest aggregate in the existing concrete;

6.21.2.6.4.3 the hydrodemolition equipment shall then be used in the deteriorated concrete test area using the parameters established for the sound concrete area; if all of the deteriorated concrete is removed to the Engineer's satisfaction, the equipment will be considered calibrated and the same parameters will be used for the demolition work; the **Contractor** shall repeat the calibration until the results are deemed satisfactory by the Engineer;

6.21.2.6.4.4 the **Contractor** shall assume the cost of these tests and shall record the test results and parameters and provide a copy to the Engineer;

6.21.2.6.4.5 the Engineer reserves the right to refuse to permit hydrodemolition if the test results do not meet the **Owner**'s requirements.

6.21.3 DEMOLITION SEQUENCES

6.21.3.1 The demolition sequences indicated in the *Special Technical Conditions* or shown on the drawings are the minimum requirement. On-site conditions and the results of the demolition methods used by the **Contractor** may require modification of these sequences in order to guarantee the structural integrity of the roadway infrastructure.

6.21.3.2 The Engineer reserves the right to change the demolition sequences at any time during the work if, in his opinion, the structural integrity or stability of the elements concerned is in jeopardy either because of the condition of the existing elements or because of the demolition and reconstruction methods used by the **Contractor**.

6.21.3.3 Any changes to demolition sequences resulting from the **Contractor**'s methods shall be made without additional cost to the **Owner**.

6.21.3.4 If the **Contractor** wishes to change the demolition sequences required by the Engineer, it must provide evidence, supported by design notes, that the structural integrity and stability of the roadway infrastructure components will be maintained at all times. The Engineer may, however, refuse to reduce the demolition sequences indicated in the *Special Technical Conditions* or shown on the drawings.

6.21.4 CONCRETE DEMOLITION

6.21.4.1 PLANNING

6.21.4.1.1 At least fourteen (14) days prior to the start of demolition, the **Contractor** shall submit a work plan that includes, but is not limited to, the following:

6.21.4.1.1.1 the demolition sequences and limits that must be respected at all times;

6.21.4.1.1.2 a complete description of the proposed equipment;

6.21.4.1.1.3 an appropriate method of containing demolition debris or collecting it regularly while the work is being done.

6.21.4.1.2 The **Contractor** shall provide the access needed to allow the Engineer to mark the areas to be demolished at least forty-eight (48) hours prior to the start of demolition.

6.21.4.2 MARKING OF AREAS TO BE DEMOLISHED

6.21.4.2.1 The main areas where the **Contractor** is required to remove concrete are indicated approximately on the drawings. The Engineer may also instruct the **Contractor** to demolish areas not indicated on the drawings.

6.21.4.2.2 Once the concrete surfaces have been sufficiently cleared to the Engineer's satisfaction of any substance that might impede their inspection, the Engineer will locate the areas to be demolished using hammer sounding or any other auscultation method chosen by the Engineer and mark them with paint. The **Contractor** shall ensure that the Engineer has the access and time needed to complete this survey.

6.21.4.2.3 To enhance the durability of the repairs, the Engineer may require that some areas be combined, at no additional cost, in order to eliminate sharp angles, establish rectilinear outlines and simple shapes, or ensure continuity.

6.21.4.2.4 Demolition may include demolition of sound concrete in order to follow the markings authorized by the Engineer. The scope of demolition can therefore range from large regular areas covering almost an entire element to small irregular repair patches here and there.

6.21.4.2.5 The minimum demolition depths indicated on the drawings and in the specifications may also require the removal of sound concrete in areas that are congested with reinforcing steel and pre-stressing cables that make concrete demolition more difficult.

6.21.4.2.6 The repair depths are determined by the Engineer based on the types of repairs prescribed in the drawings and *Special Technical Conditions* and identified on site.

6.21.4.3 DEMOLITION WORK

6.21.4.3.1 No work shall be done before the Engineer gives authorization to proceed.

6.21.4.3.2 The **Contractor** shall make a saw cut 20 mm deep around the areas to be demolished identified by the Engineer. The **Contractor** shall check the depth of the cuts to make sure the demolition will be to the required depth.

6.21.4.3.3 The saw cuts shall be made straight so as to ensure that the finished work is aesthetically pleasing. The cuts shall not extend beyond the corners of the area being repaired. Chipping shall be used to define the corners.

6.21.4.3.4 If, as the saw cuts are being made, the **Contractor** encounters any surface reinforcing steel or other elements (in particular conduit and pipes) that may be embedded in the concrete or has reason to believe that such elements are present, it shall stop work immediately and notify the Engineer.

6.21.4.3.5 The **Contractor** shall take the necessary precautions to ensure that no damage is done to reinforcing steel, conduit, sheaths or pre-stressing cables.

6.21.4.3.6 If the work is impeded by any existing elements, such as electrical conduit, light fixtures or drain pipes, the **Contractor** shall obtain authorization from the Engineer before dismantling them. The **Contractor** shall re-install any dismantled elements once the work is complete. The **Contractor** shall assume the cost of removing and re-installing such elements and providing a temporary power supply, if necessary.

6.21.4.3.7 The **Contractor** shall remove the concrete by chipping once the saw cuts are made, as directed by the Engineer and in accordance with the drawings and the *Special Technical Conditions*. The **Contractor** shall also bevel slightly inward (maximum angle 45°) the perimeter of all areas where concrete has been removed.

6.21.4.3.8 For vertical repairs, the upper face of the demolished surface shall be inclined inward at least 30° from horizontal so as to eliminate high points that might trap air during concreting.

6.21.4.3.9 Once the deteriorated concrete has been removed from the final third of the depth, the jackhammer shall be operated at an angle between 45° and 60° relative to the surface of the demolition area.

6.21.4.3.10 The **Contractor** shall break up the surface of areas of non-demolished concrete that are to be concreted in order to produce a uniformly rough surface.

6.21.4.3.11 The **Contractor** shall profile the demolition area in order to facilitate concreting.

6.21.4.3.12 If the **Contractor** encounters any deteriorated, disintegrated, crumbled or porous concrete beyond the demolition limits, it shall notify the Engineer.

6.21.4.3.12.1 No demolition beyond the demolition lines indicated on the drawings and in the specifications shall be carried out without the authorization of the **Owner**'s engineer/designer.

6.21.4.3.12.2 Following a minimum twenty-four (24) hours notice, the **Owner**'s engineer/designer will inspect the condition of the structures, decide whether demolition should continue beyond the demolition lines indicated on the drawings and in the specifications, and issue instructions to that effect, as appropriate.

6.21.4.3.12.3 When demolition beyond the demolition lines is carried out on instructions from the **Owner**'s engineer/designer, the engineer/designer will inspect the demolished areas again within twenty-four (24) hours after being notified by the **Contractor**.

6.21.4.3.13 The Engineer will inspect the demolished areas for approval once the **Contractor** gives notice that the demolition work is complete.

6.21.4.3.14 Demolished areas beyond the demolition limits indicated on the drawings or beyond the limits authorized by the Engineer or the **Owner**'s engineer/designer, as the case may be, will not be measured for payment and shall be repaired by the **Contractor** using the same materials used for the concrete repair in accordance with the Engineer's instructions, at no additional cost to the **Owner**.

6.21.4.3.15 The **Contractor** shall take appropriate precautions so as not to move or damage reinforcing steel or reduce its bond with sound concrete during concrete demolition work.

6.21.4.3.16 When any reinforcing steel that is exposed is corroded to the point where its cross-section is reduced, the **Contractor** shall immediately notify the Engineer, who will provide instructions.

6.21.4.3.17 At the request of the Engineer or where required by the specific repair method, the **Contractor** shall continue demolishing concrete until there is a clearance of at least 25 mm around the exposed reinforcing steel bar. The corroded bar shall be further exposed an additional 600 mm measured lengthwise on both sides of the corroded area. After the reinforcing steel is cleaned by abrasive blasting, the Engineer will examine the extent of the corrosion of the reinforcing bars and determine whether they need to be replaced.

6.21.4.3.18 The **Contractor** shall use concrete anchors and fasteners as required to support any exposed steel that is likely to sag because of its length, especially during concreting.

6.21.4.3.19 If, owing to a lack of precaution, the reinforcing steel to be preserved is damaged and cannot be reused, the **Contractor** shall replace it to the Engineer's satisfaction at no additional cost to the **Owner**.

6.21.4.3.20 The **Contractor** shall, using abrasive blasting followed by brushing, water blasting or any other appropriate method authorized by the Engineer, clean the surfaces to be concreted so as to remove any crumbled concrete, debris, loose particles or contaminants, such as oil, grease and laitance, that may hinder adhesion between the new and old concrete.

6.21.4.3.21 Wet abrasive blasting shall be used to remove all traces of corrosion or loose pieces of concrete from corroded reinforcing steel exposed during the course of concrete demolition other than exposed pre-stressing sheaths, cables, strands and wires, which are not to be abrasive blasted, but simply air or water blasted. Reinforcing steel that still has a layer of delaminated rust after it is cleaned shall be cleaned using scrapers or steel brushes.

6.21.4.3.22 Water blasting shall be carried out as follows:

6.21.4.3.22.1 pressure: 15 MPa (2,175 psi);

6.21.4.3.22.2 flow: 20 litres of water per minute using a concentrated circular jet nozzle;

6.21.4.3.22.3 nozzle-concrete distance: 150 mm to 200 mm.

6.21.4.4 INSPECTION OF WORK

6.21.4.4.1 The **Contractor** shall not put in place any reinforcing steel, formwork, concrete or metal wire mesh before the Engineer has approved the demolished surfaces.

6.21.4.4.2 Unless otherwise indicated on the drawings or in the *Special Technical Conditions*, the accepted tolerance on demolition work is ±25 mm over the length and width of the defined areas. The tolerance for depth discrepancies is a maximum of 10 mm beyond the demolition limits indicated on the drawings or prescribed by the Engineer.

6.21.4.4.3 Any area demolished beyond the prescribed tolerance will not be measured for payment.

6.21.5 UNDERWATER CONCRETE DEMOLITION

6.21.5.1 MARKING OF UNDERWATER DEMOLITION AREAS

6.21.5.1.1 The **Contractor** shall completely clean the underwater surfaces and surfaces in tidal areas. The surfaces shall be cleared of marine growth, vegetation, mussels, limestone buildup and buildup of any other material so that the **Contractor**'s employees can confirm the damage indicated on the drawings and identify any other damage that might not have been found in previous inspections. This cleaning shall be done using water blasting or any other method that will ensure a degree of cleaning equivalent to abrasive blasting.

6.21.5.1.2 The **Contractor** shall thoroughly examine the surfaces to be repaired in order to identify any deterioration of the concrete (cracks, delamination, etc.).

6.21.5.1.3 The **Contractor** shall conduct a meticulous survey and report on the drawings any deterioration it finds. The following information must be recorded on the drawings: dimensions (length, width and depth), orientation and exact location of the deterioration. Any areas of scouring or ravelling shall also be indicated.

6.21.5.1.4 The **Contractor** shall also produce a video recording of the deterioration survey.

6.21.5.1.5 The **Contractor** shall submit the surveys in the form of drawings and the video recording to the Engineer prior to the start of demolition work. The Engineer will use the drawings and video recording to validate the equipment, repair methods and materials to be used. The Engineer may accept preliminary drawings at this stage; final drawings shall, however, be submitted when the work is finished.

6.21.5.2 UNDERWATER DEMOLITION WORK

6.21.5.2.1 The perimeter of the areas to be repaired shall be outlined with a saw cut or by hydrodemolition so that the concrete can be profiled perpendicular to the surface. Bevelled edges (ending in a null thickness) are not acceptable.

6.21.5.2.2 The validated areas shall be demolished using jackhammers or high-pressure water blasting. The demolition method must be capable of allowing demolition of concrete up to 25 mm behind the reinforcing steel.

6.21.5.3 INSPECTION OF UNDERWATER WORK

6.21.5.3.1 The **Contractor** may not proceed with subsequent works until the Engineer has approved the demolished areas.

6.21.5.3.2 Unless otherwise indicated on the drawings or in the *Special Technical Conditions*, the accepted tolerance on underwater demolition work is ±40 mm over the length and width of the defined areas. The tolerance for depth discrepancies is a maximum of 15 mm beyond the demolition limits indicated on the drawings or prescribed by the Engineer.

6.21.5.3.3 Any area demolished beyond the prescribed tolerance will not be measured for payment.

6.21.5.3.4 Demolished areas beyond the limits indicated on the drawings or authorized by the Engineer shall be repaired by the **Contractor** using the same materials used for the concrete repair in accordance with the Engineer's instructions, at no additional cost to the **Owner**.

6.21.6 REMOVAL OF ASPHALT PAVEMENT

6.21.6.1 MARKING AREAS FOR REMOVAL

6.21.6.1.1 The Engineer marks the areas where existing asphalt pavement is to be removed by the **Contractor**.

6.21.6.1.2 No asphalt pavement shall be removed until the Engineer has inspected the removal areas and granted authorization to proceed.

6.21.6.1.3 The **Contractor** shall begin by checking the thickness of the asphalt pavement using a drill and concrete bits at points up to 5 metres apart around the perimeter of the surface and up to 10 metres apart longitudinally and at least in each lane. The Engineer may require that the thickness be checked at closer spacings.

6.21.6.2 REMOVAL WORK

6.21.6.2.1 The **Contractor** shall make a saw cut along all of the demolition limits in accordance with the drawings and shall not damage the deck of the bridge, the viaduct or of any other structure. The saw cuts shall be made straight so as to ensure that the finished work is aesthetically pleasing.

6.21.6.2.2 The equipment used to remove the asphalt pavement shall not reduce the reinforcing steel cover and shall not damage the slab or other elements of the structure; it shall be authorized by the Engineer.

6.21.6.2.3 If milling is permitted in the *Special Technical Conditions*, milling of bituminous concrete near joints shall be done using equipment that :

6.21.6.2.3.1 produces an even milled surface with no deformation, a uniform texture and grooves with a relative depth less than 8 mm;

6.21.6.2.3.2 has an automatic profile control device (allowable error ±3 mm); the equipment shall not damage the slab, the top of the pre-stressed beams, the edges of the waterproof membrane along and under the barriers, or other elements of the structure;

6.21.6.2.3.3 has a maximum mass of 25 t, not including the water, but does not exceed the capacity of the bridge, viaduct or roadway infrastructure concerned;

6.21.6.2.3.4 has a cutter drum not wider than 1,000 mm;

6.21.6.2.3.5 has a rear conveyor that can be removed to mill where the expansion joints meet the curb.

6.21.6.2.4 Hand tools shall be used to remove asphalt pavement in areas that mechanical equipment cannot reach, such as the concrete shoulders of deck joints, drains, sumps and manholes, or in areas where elements on the surface of the slab could be damaged.

6.21.6.2.5 After removing the asphalt pavement and repairing the deteriorated surfaces, the **Contractor** shall thoroughly clean the surface of the slab using air blasting in order to remove any traces of waterproof membrane, asphalt pavement, crumbled concrete and other debris.

6.21.6.3 INSPECTION OF WORK

6.21.6.3.1 The Engineer inspects the prepared areas in order to evaluate their compliance with the specifications once the **Contractor** gives notice that the removal work is complete. The Engineer may ask the **Contractor** to remove any residue that in his or her opinion hinders the inspection or is undesirable for subsequent work.

6.21.6.3.2 The accepted tolerance is ±25 mm over the length and width of the defined areas. Any area removed beyond the prescribed tolerance will not be measured for payment and shall be repaired by the **Contractor** at its expense according to the Engineer's instructions.

6.21.7 REMOVAL OF EQUIPMENT AND STRUCTURAL ELEMENTS

6.21.7.1 Equipment and structural elements that are to be removed permanently will be identified before the work begins. Unless otherwise indicated in the *Special Technical Conditions* or on the drawings, such equipment and elements shall, once they are removed, become the property of the **Contractor** and shall be disposed of at authorized sites.

6.21.7.2 Equipment and elements that are to be removed temporarily and re-installed are the responsibility of the **Contractor** during construction but remain the property of the **Owner**. Unless otherwise indicated, they shall be properly stored on site while the work is being done.

6.21.7.3 The removal of any electrical or lighting equipment shall be carried out in accordance with the **Owner**'s lock-out procedure as identified in paragraph 6.12.2.4.6 of subsection 6.12 *Health and Safety*.

END OF SUBSECTION