1.0 **GENERAL**

1.1 **REFERENCE STANDARDS**

.1 Concrete Work shall conform to the requirements current edition of the following standards unless otherwise required by this specification.

- BC Building Code
- CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- CSA-A23.2, Methods of Test for Concrete.

1.2 **SCOPE OF WORK**

.1 Provide all labour materials services and equipment necessary and incidental for new concrete for exterior curbs, sidewalks, toppings, exterior concrete repairs and miscellaneous concrete Work in areas shown on the Drawings and as directed by the Consultant.

1.3 **PROTECTION**

.1 Provide and maintain all legal and necessary guards, railings and warning signs during the execution of the Work to fully protect all persons and Owner from loss, damage, death or injury through the neglect or carelessness of the Contractor or the condition or handling of equipment. Ensure that employees have WHMIS training for materials being handled on site and that material safety data sheets for all materials being used are available for use and inspection on site.

1.4 **MEASUREMENT FOR PAYMENT**

.1 Removal and replacement of all concrete curbs, sidewalks, medians or topping shall be paid on a Unit Rate or Lump Sum basis, as detailed in the Bid Form, for areas authorized by the Consultant.

.2 Include all costs necessary and incidental for Concrete Work including demolition, labour, materials, equipment, temporary protection, and cleanup in the Unit Rates and/or Lump Sum Price.

1.5 **INSPECTION BY THE CONSULTANT**

.1 Provide adequate notice to the Consultant to ensure that he has the opportunity of inspecting all prepared areas prior to placement of concrete.

.2 Contractor to pay all costs incurred for uncovering and making good any Work covered before required inspection is completed and approved by the Consultant.

.3 Payment for inspection and specified testing to be provided by the Owner except for the following and as noted above:

   a) Testing required by laws, ordinances, rules, regulations or orders of the public authorities.
   b) Inspection and testing performed exclusively for the Contractor's convenience.

.4 Where tests or inspections by the Consultant reveal Work not in accordance with Contract requirements, the Contractor shall pay costs for additional tests or inspections that the Consultant may require to verify acceptability of the corrected Work.
2.0 PRODUCTS

2.1 CONCRETE REPAIR MATERIALS - GENERAL

.1 Type GU Portland cement in accordance with CAN/CSA-A5.

.2 Supplementary cementing materials in accordance with CAN/CSA-A23.1/A23.5, Type F, Type CI/CH or Type SF.

.3 Concrete Aggregates in accordance with CAN/CSA-A23.1.

.4 Water to be potable in accordance with CAN/CSA-A23.1.

.5 Air entraining admixtures in accordance with CAN3-A266.1.

.6 Water reducing admixtures in accordance with CAN3-A266.2.

.7 Superplasticizing admixtures in accordance with CAN3-A266.6.

.8 Chlorides either as a raw material or as a constituent in admixtures shall not be used.

.9 Liquid membrane curing compounds shall not be permitted.

2.2 PRE-PACKAGED CONCRETE REPAIR PRODUCTS - GENERAL

.1 For pre-bagged products, each bag of product delivered to the site is to be clearly identified with the supplier and product name and date of manufacture. Technical literature detailing mixing, placing and curing requirements to be supplied to the site with the repair material.

.2 Submit specified Concrete Repair Systems to the Consultant for review 7 days prior to concrete placement.

.3 Consultant's written approval of Concrete Repair Systems is required before initiation of repairs.

.4 All pre-bagged repair materials shall meet ASTM C-666 Test Method for Resistance of Concrete to Rapid Freezing and Thawing - minimum durability factor of 90%.

.5 All pre-bagged repair materials shall have a minimum 28 day compressive strength of 40 MPa.

.6 Pre-bagged materials shall not be used later than 6 months from the date of manufacture.

2.3 BONDING SLURRY

.1 Bonding slurry for concrete repairs shall be in accordance with CSA A23.1 and shall consist of:
   a) Type GU Portland cement: 1 part by volume
   b) Clean sharp, masonry sand: 1 part by volume
   c) Water to give a thick creamy consistency.

.2 Addition of polymer bonding agent in the bonding slurry or direct application of polymer bonding agent is not required for readi-mix or pre-bagged concrete repairs.

.3 Do not use Portland cement bonding slurry for pre-packaged rapid setting concrete or mortar. Strictly follow the manufacturers' instructions for rapid set concrete or mortar installation.
2.4 READI-MIX CONCRETE FOR GRADE SLABS, CURBS, SIDEWALKS, CONCRETE TOPPINGS OR STRUCTURAL CONCRETE:

.1 Readi-mix concrete shall be supplied in accordance with CSA-A23.1, Alternative 1. It shall be ready-mix supplied Portland cement concrete meeting all the requirements of CSA-A23.1 with the following properties and constraints:

- Maximum water/cementing materials ratio of 0.40
- Minimum 28 day compressive strength of 40 MPa
- Maximum coarse aggregate size of 20 mm
- Slump of 80 ± 20 mm (prior to superplasticizer addition)
- Air Content of 6 ± 1 %

Note: The use of 10 mm maximum size coarse aggregate is also permitted. The air content shall be 7 ± 1 % for 10 mm maximum coarse aggregate.

Alternatively, pre-bagged dry-mix concrete may be used. Target 6000 psi Concrete Mix is a pre-approved product.

.2 Cementitious content may include up to 20% Type F or Type C fly ash by mass of cement. The use of silica fume in the concrete mixture is not considered necessary.

.3 Submit proposed concrete mix design proportions to the Consultant for review and written approval seven (7) days prior supplying to the Project.

.4 Superplasticizer may be used to increase the workability of readi-mix concrete. Use superplasticizers that do not significantly alter the air content after addition.

.5 All superplasticizer shall be added on site, not at the batch plant unless otherwise approved by the Consultant. The fresh concrete shall be adjusted to 80 ± 20 mm on site prior to superplasticizer addition. The slump after superplasticizer addition shall be 110 mm ± 30 mm.

.6 Tests for slump and air content shall be conducted on every truck load of concrete. Concrete slump and air content shall be measured before and after superplasticizer addition. Tests for slump and air content shall be conducted before any concrete is placed. Cast specimens for compressive strength testing at 7 and 28 days (1 specimen tested at 7 days and the average of 2 specimens at 28 days) shall be taken in accordance with CSA-A23.2. Cast two field cure specimens to confirm field compressive strength prior to shoring removal.

.7 Concrete testing shall be arranged for by the Consultant and paid for by the Owner.

2.5 RAPID HARDENING PRE-PACKAGED CONCRETE FOR GRADE SLAB, CURBS, SIDEWALKS, CONCRETE TOPPING OR STRUCTURAL DECK SURFACE REPAIRS:

.1 Pre-bagged rapid hardening concrete for slab surface repairs shall be weight batched, air entrained, freeze/thaw resistant, low shrinkage concrete with 3/8" (10 mm) maximum aggregate size. Pre-approved products include:

- Target Traffic Patch Fine (neat or extended up to 30% by weight with 3/8" (10 mm) coarse aggregate).
- Rapid Set DOT Repair Mix (neat or extended up to 30% by weight with 3/8" (10 mm) coarse aggregate).
2.6 **MORTAR OR CONCRETE FOR DECK SLAB SURFACE/SOFFIT, WALL OR COLUMN REPAIRS:**

.1 Mortar for minor concrete deck surface/soffit, wall or column repairs less than 2" (50 mm) in thickness shall be pre-bagged weight batched, air entrained, freeze-thaw resistant, low shrinkage mortar. Pre-approved products include:

- Planitop XS by Mapei
- Target VO Patching Mortar
- Thoro Thorite 100

.2 Concrete for exterior concrete repairs greater than 2" (50 mm) in thickness shall be pre-bagged weight batched, air entrained, freeze-thaw resistant, flowable, low shrinkage concrete with 3/8" (10 mm) maximum aggregate size. Pre-approved products include:

- Target 6000 psi concrete.
- Target Flowcrete.

.3 Polymer additive to be used with pre-bagged mortar or concrete as mixing liquid and in bonding slurry only if required by the manufacturer in accordance with the manufacturer's instructions.

2.7 **CONCRETE REINFORCEMENT:**

.1 Reinforcing bars where required shall be billet steel, grade 400, deformed bars to CSA G30.12 unless indicated otherwise.

.2 Welded wire mesh where required shall conform to CSA G30.5, “Welded Steel Wire Fabric for Concrete Reinforcement”.

.3 Chairs, bolsters, bar supports, spacers adequate for strength and support of reinforcing construction conditions.

.4 Reinforcing steel accessories shall be non-corrosive and commercially manufactured.

.5 Fabricate reinforcing to above reference standards.

.6 Fabrication tolerances for reinforcing steel ACI Standard 315.

.7 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.

2.8 **SEALANTS:**

.1 Primers: Primer shall be used and shall be type recommended by sealant manufacturer.

.2 Backer Rod: Closed cellular foam backer rod, Sika Backer Rod or approved equal.

.3 Bond Breaker: pressure sensitive plastic tape, which will not bond to sealants.

.4 Sealants for joints shall be single component polyurethane non-hardening sealant suitable for exterior use and shall be compatible with and adhere to the substrate to which it is applied. Select appropriate grade of sealant for application on sloped and horizontal surfaces. Sealants shall conform to the current edition of the following standard:


Pre-approved sealants are as follows:

- Sikaflex 1a Traffic Grade
- Tremco Dymonic FC
  Color to be concrete grey.
  .5 Joint Cleaner: xylol, methylethylketone or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

2.9 JOINT FILLER
  .1 Sidewalk curb and slab/wall isolation joint filler to be ½” thick asphalt impregnated fibreboard.

3.0 EQUIPMENT:
3.1 SAND BLAST CLEANING EQUIPMENT
  .1 Sandblasting equipment to be minimum 50 kg capacity pot, fitted with appropriate oil separators to ensure that only oil-free air is mixed with sand. Wet sand blasting equipment may also be used to minimize dust.

3.2 CONCRETE MIXING EQUIPMENT
  .1 Concrete shall be delivered to site in transit mix trucks from a commercial batch plant which conforms to the requirements of CSA-A23.1.
  .2 Pre-bagged concrete or mortar shall be mixed in suitable mechanical mixers. Hand mixing of pre-bagged concrete or mortar is not permitted.

3.3 CONCRETE PLACING AND FINISHING EQUIPMENT
  .1 Concrete placing and finishing shall be in accordance with CSA-A23.1.

3.4 CONCRETE CURING EQUIPMENT
  .1 Sufficient clean burlap and water sprinklers are to be provided to ensure that concrete can be moist cured as specified.
  .2 Moist curing shall be in accordance with CSA-A23.1.
  .3 Concrete curing compounds are not allowed on surfaces that require a membrane.

3.5 EQUIPMENT APPROVAL AND SUBSTITUTIONS
  .1 Consultant may require the replacement of any unsatisfactory equipment during the Work to ensure that the project specification is met.

4.0 EXECUTION
4.1 DEMOLITION
4.1.1 EXTERIOR CONCRETE GRADE SLABS, CURBS, SIDEWALKS
  .1 Where required, remove and dispose off site all concrete grade slabs, curb, sidewalks and asphalt in designated areas shown on the Drawings.
  .2 Provide a minimum 2” deep saw cut at the transition between asphalt or concrete to be removed and disposed off site and concrete to be left in place. Saw cut the existing curb full depth at each end of the repair area to provide a clean joint for the new curb.
  .3 Cut back and dispose off site existing vegetation where required. Remove and dispose of existing top soil to provide room to install concrete forms.
4.1.2 **CONCRETE REPAIRS**

.1 Provide a saw cut around the perimeter of the repair area a minimum of 1" deep (2" deep saw cut for grade slabs and concrete toppings). Avoid cutting reinforcing steel.

.2 Remove a minimum of 1" up to 2" concrete depth in the designated repair area. Concrete removal to be conducted using chipping hammers not exceeding 7 kg class.

.3 Where delaminated concrete or corroded reinforcing steel is encountered, remove delaminated concrete and expose corroded reinforcing. Contact the Consultant for review prior to continuing with repairs.

.4 Provide a minimum of 3/4" clearance around exposed reinforcing where more than 1/3 the diameter of the bar is exposed.

.5 Dispose all excavated concrete off site.

4.2 **SURFACE PREPARATION**

4.2.1 **EXTERIOR CONCRETE GRADE SLABS, CURBS AND SIDEWALKS**

.1 The Consultant shall review the sub-base condition prior to grading for new concrete slabs, curbs or sidewalks. Remove and replacement substandard sub-base materials as required by the Consultant.

.2 Compact sub-base to a Standard Proctor Density of 100% in accordance with Master Municipal Construction Document (MMCD) standards.

.3 Obtain Consultant’s approval of compacted sub-base before concrete placement.

4.2.2 **CONCRETE REPAIRS**

.1 Sandblast clean all prepared concrete surfaces to remove all loose and micro-fractured concrete particles, dust and contamination deleterious to bond.

.2 Sandblast clean the exposed existing reinforcing steel to remove loosely adhered concrete and residual corrosion products.

.3 Use air wands (dry, oil-free air) and/or vacuum cleaning equipment to remove blasting grit, slurry and debris from form work and concrete surfaces.

.4 Provide adequate protection and screens during demolition and blast cleaning operations to ensure the safety of pedestrian and vehicle traffic.

.5 When bonding fresh concrete to existing concrete, thoroughly saturate the existing concrete 16 to 24 hours before placing concrete. Use oil free compressed air to remove water from low areas and from exposed reinforcing steel.

4.2 **LINES AND GRADES**

.1 The Contractor is responsible for survey control of all Work. Periodic checks by the Consultant do not relieve the Contractor of any responsibility herein stated.

.2 Minimum concrete grade slab thickness for pedestrians shall be 4". Minimum concrete grade slab thickness for vehicle traffic shall be 6". Contractor shall confirm loading requirements and grade slab thickness with the Consultant prior to installing concrete forms.

.3 The Contractor shall provide a system such as screed rails or other approved methods to provide the specified concrete cover to reinforcing steel (where required) and to ensure strict adherence
to the drainage slopes. Concrete shall be sloped so no water ponds form on the finished concrete surface.

.4 Forming is not required for concrete repairs less than 2" thick. Concrete repairs greater than 2" thick must be formed and poured.

4.3 **REINFORCING STEEL**

.1 Install reinforcing steel or wire mesh as shown on the drawings.

.2 Where required, reinforcing steel of wire mesh to be installed at the midpoint of the slab depth using chairs or similar method.

.2 Minimum cover to reinforcing steel shall be 2" at all locations.

.3 At control joint locations, cut a 3" section from every second reinforcing bar or mesh wire for crack control.

4.4 **CONCRETE PLACEMENT FOR GRADE SLABS, CURBS, SIDEWALKS AND CONCRETE TOPPING REPAIRS**

.1 Inform Consultant at least 24 hours before placing concrete. No concrete to be placed until Consultant has inspected and approved in writing all preparation of concrete and reinforcing steel, and installation of forms. Adjustment of elevations at any unsatisfactory areas, and retesting, will be required before approval of preparation work by Consultant.

.2 When concreting starts, carry on as a continuous operation until the placing of the section is complete. When shown on Drawings, place concrete in the sections indicated and according to the sequence given.

.3 Place freshly mixed concrete in accordance with CSA-A23.1.

For concrete supplied by readi-mix transit trucks, all concrete must be placed and consolidated within 120 minutes of initial mix water addition. Site addition of water to maintain workability shall conform strictly to CSA-A23.1. No water shall be used to re-temper the concrete mix after the addition of superplasticizer.

For pre-bagged concrete, add dry concrete to water with continuous power mixing to achieve the required consistency. Use the minimum amount of water to achieve the required slump. Water to be weighed or volume batched to maintain consistency between batches. Mix for a minimum period of 5 minutes. All concrete must be placed and consolidated within 20 minutes of initial mixing. Subsequent addition of water or superplasticizer to maintain workability shall not be permitted.

For rapid hardening pre-bagged concrete, the mixing equipment and shall have sufficient capacity to ensure continuous concrete batching without interruption. The Contractor shall provide a sufficiently large work force to maintain continuous rapid hardening concrete batching, placement and finishing and ensure the final concrete placement meets the requirements of the project specifications.

.4 Deposit concrete as close as practical to its final position. Provide delivery equipment which will not exceed the safe loading capacity of the structure.

.5 Vibrators shall be adequately powered and sufficiently intense to compact the concrete readily into place. Systematically apply vibrators at such intervals that the zones of influence of the vibrator overlap. Insert the vibrator vertically into the concrete long enough to ensure that the concrete is
properly compacted. Employ a sufficient number of vibrators so that the required rate of placement vibration throughout the entire volume of each layer of concrete compaction is secured. Keep one spare vibrator at site for emergency use.

.6 Finished concrete surface is to be within 1/4" (5 mm) of the design elevation, but not uniformly low.

.7 Finish concrete in accordance with CSA-A23.1. Provide a smooth steel trowel float finish to horizontal suspended slab surfaces. Grade slab perimeters to have a 1/4" rounded edge.

.8 As soon as the concrete surface has been finished and can bear weight without marking, carefully cover with burlap. Place burlap sections to overlap each other by 6 inches or more and to overlap concrete slab by 1 ft (300 mm) or more at each side.

Thoroughly wet the burlap with water before placing it on the concrete and keep saturated during curing period with a water spray sufficiently fine to avoid damaging the concrete surface.

Cover burlap with polyethylene sheeting to maintain saturation of concrete during curing periods. For readi-mix concrete, the Contractor shall ensure that the burlap is kept wet at all times for 7 days after placing concrete. For rapid setting cement concrete, the curing period is a minimum of 4 hours or until the heat generated by the repair concrete has fully dissipated (whichever is the greater time).

.9 Grind any fins or protrusions within the repair area, and patch minor voiding.

4.5 MORTAR OR CONCRETE FOR CONCRETE REPAIRS

.1 A Portland cement/masonry sand bonding slurry (Section 2.3) shall be used when bonding fresh concrete to existing concrete or as directed in the product manufacturer's literature, whichever is more stringent.

.2 Allow concrete to come to a saturated surface dry condition (SSD) before applying bonding slurry or concrete. Prepare a bonding slurry mixed with sufficient water to give a creamy consistency. Mix only enough slurry in each batch to ensure that the application of slurry is placed no longer than 20 minutes ahead of concrete placement. Discard any slurry that is not applied within 20 minutes of mixing.

.3 Apply bonding slurry by scrubbing on to the surface with a stiff bristle brush.

.4 For rapid set concrete and mortars, brush the mortar paste into the SSD concrete surface with a stiff bristle brush.

.5 Prepare mortar in accordance with the manufacturer's recommendations using the manufacturer's recommended latex as the mixing liquid. Add bagged product to latex with continuous power mixing to achieve the required consistency. Use the minimum amount of mixing liquid consistent with the placement method.

.6 Pre-soak concrete substrate and allow concrete to come to a saturated surface dry condition before applying bonding slurry or concrete. If required, use the manufacturer's recommended latex as the mixing liquid for the cement/sand slurry. Scrub bonding slurry onto the prepared surface with a stiff brush.

.7 Place and consolidate material as soon as practical after mixing and before bonding slurry has dried out.

.8 Provide a key by scribing the surface of the mortar when the repair is completed in several lifts.
4.6 JOINTS

.1 Concrete control joints and isolation joints must be installed as part of the Work. Refer to project drawings for joint location and spacing, or this specification, whichever is more stringent.

.2 Install joints in concrete repairs to match the existing joints. Joint width to match existing. Install sealant and backer rod or asphalt impregnated board to match existing.

.3 For new concrete grade slabs, provide 1/2" wide, full depth isolation joints around the slab perimeter to isolate the slab from adjacent concrete work. For concrete curbs, install a full depth ½" wide joint every 8 feet. Install asphalt impregnated board in ½" joints.

.4 Provide sawcut control joints in the concrete grade slabs unless otherwise specified. Concrete control joints must be sawcut after the concrete has sufficiently hardened. Saw cutting must be conducted as soon as the concrete can be cut without ravelling and in no case later than 18 hours after the start of the pour.

.5 Control joint sawcut spacing to be equal to the width of the grade slab or maximum 8 feet for 4" thick slabs and 12 feet for 6" thick slabs. Sawcut depth to be 1/3 of the slab thickness (1-3/8" deep saw cut for a 4" thick slab and 2" deep saw cut for a 6" thick slab).

.6 For street sidewalks, provided tooled joints located at spacing equal to the sidewalk width. Joints to be 1/3 the depth of the sidewalk slab. Provide a ½" wide joint every 16 feet. Install asphalt impregnated board in ½" joints.

4.7 FINAL FINISHING

.1 For architectural grade slabs and walkways, steel trowel finish grade slab surfaces to receive a light sandblast after the 7 day curing period. Sandblast finish to be CSP 1 to 2 without exposing coarse aggregate particles. Contractor to conduct a mockup section for review and approval by the Consultant and Owner prior to continuing with the work.

.2 For street sidewalks, provide a medium broom finish.

4.8 SEALANTS

.1 For joint sealant, where required, install joint sealant in strict accordance with the manufacturer’s instructions or as detailed in this specification, whichever is more stringent.

.2 Prepare joint faces by abrasive cleaning or grinding. Ensure that all substrate surfaces are smooth, dry and firm. Immediately prior to sealant application, remove all dust using oil free compressed air.

.3 Prime joint faces with manufacturer’s primer.

.4 install closed cell foam backer rod or bond breaker tape. Sealant profile ratio to be 1 wide by ½ to 1 deep. Install sealant to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.

.5 Install sealant to fill joints completely from the back, without voids or entrapped air, using proven techniques, proper nozzles and sufficient force that results in sealants directly contacting and fully wetting the primed joint surface. Superficial pointing with a skin bead is not acceptable.

.6 Protect adjacent surfaces from sealants and install sealants with a clean neat transition to the edges of the joint surface. Remove any sealant from adjacent surfaces immediately. Remove any masking tape after sealant installation.
4.9  DEFECTIVE CONCRETE AND PATCHING

.1  Concrete surfaces to be free from open texturing, voids, and projections.

.2  For repair of defective concrete Work:
   
a)  Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by Consultant.
   
b)  Grind off high surface variations where directed and re-texture surface to match adjoining concrete as closely as possible.

.3  Remove and replace defective concrete where directed. Removal and replacement procedures will be detailed by the Consultant.

.4  Repair of defective concrete Work and/or removal and replacement of defective concrete prior to final acceptance of the deck to be carried out at Contractor's expense.

.5  Immediately after the removal of forms, all bolts, ties, nails or other metal not specifically required for construction purposes shall be removed or cut back to a depth of 25 mm (1") from the surface of the concrete.

4.10  PROTECTION

.1  All freshly placed and consolidated concrete shall be suitably protected during the curing period against damage from adverse weather conditions. Protection of the concrete from adverse weather conditions is the sole responsibility of the Contractor and shall be conducted in strict accordance with CSA-A23.1.

4.11  TOLERANCES

.1  Tolerances shall conform to CSA-A23.1 (current edition) or the requirements of these specifications, whichever are more rigorous.

*** END OF SECTION***