Rammed Earth Specifications

Part 1 General

1.1 SECTION INCLUDES

- .1 Rammed earth walls including insulation, reinforcing, control joints, blockouts and all accessories.
- .2 Associated formwork.

1.2 REFERENCES

- .1 ASTM C51106 Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes.
- .2 ASTM C61798(2003) Standard Practice for Capping Cylindrical Concrete Specimens.
- .3 ASTM D163300(2007) Standard Test Methods for Compressive Strengths of Molded Soil Cement Cylinders
- .4 CAN/CSAA300003 Cementitious Materials Compendium.
- .5 CSAA23.104/A23.204 Concrete Materials and Methods of Concrete Construction Methods of Test and Standard Practices for Concrete.

1.3 SUBMITTALS FOR REVIEW

- .1 Submission procedures as per Prime Consultant's direction.
- .2 Samples: Submit up to 12 rammed earth samples indicating colour range possible.
- .3 Shop Drawings: Indicate expected minimum performance, reinforcing, list of materials, hydroscopic and high cement content locations, reinforcing, waterproofing details, affected related Work and expansion and contraction joint location and details. Shop drawings to be signed and sealed by an Engineer licensed to practice in the local jurisdiction.
- .4 Submit formwork shop drawings:
- .5 Sustainable Design (if applicable):
 - .1 LEED documentation procedures as per Prime Consultant's direction.
 - .2 Provide required LEED/LBC Data Form for rammed earth, reinforcing steel, formwork and insulation.
- .6 Material Safety Data Sheets on colouring agents, cement type(s), admixtures and insulation.

1.4 SUBMITTALS FOR INFORMATION

.1 Submission procedures as per Prime Consultant's direction.

.2 Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent Work.

1.5 QUALITY ASSURANCE

- .1 Perform Work in accordance with applicable sections of CSAA23.1/A23.2.
- .2 Acquire cement and soil from the same source for all work.
- .3 Test samples to be cured in a steam room or lime bath, as per ASTM C51106 and then capped as per ASTM C61798(2003). Create samples such that the height of the sample is twice that of the diameter. Compressive Strength to be determined at an approved geotechnical testing facility using ASTM D1633 00(2007).
- .4 Installer Qualifications: Company specializing in performing the work of this section must be supported by one professional with minimum 10 years insulated rammed earth experience.
- .5 Completed rammed earth is non-uniform in colour and texture. Non-structural shrinkage cracks, non-structural "character flaws", and efflorescence may occur.

Part 2 Products

- .1 All earth and concrete materials to be manufactured and extracted from within a 500km radius of the building site (if applicable).
- .2 No products in this section to be on the LBC Red List.

2.2 RAMMED EARTH MATERIALS

- .1 Portland Cement: CAN/CSAA3001, Grey colour.
- .2 Proprietary mix of amended soil and admixtures.
- .3 Water: CSAA23.1, clean and not detrimental to rammed earth.
- .4 Colour as per Prime Consultant selection.

2.3 ADMIXTURES

.1 Chemical Admixtures: as recommended by rammed earth installer

2.4 INSULATION

- .1 Polyisocyanurate Insulation (Faced): CAN/ULCS704 Type 1, ASTM C1289 Type I, closed cell insulation conforming to the following:
- .2 Compressive Strength: 172 kPa
- .3 Thermal Resistance: Aged RSI of 1.145/25mm (R 6.5/inch)
- .4 Facing: Factory applied facing of aluminum/poly/kraft on both faces.
- .5 Board Size: 1220x2440 mm
- .6 Board Edges: square.

- .7 Flame/Smoke Properties: accordance with CAN/ULCS102. ASTM E84.
 - .1 Isocast R Dow Chemical Company.

2.5 ACCESSORIES

- .1 Provide crystalline waterproofing slurry as recommended by rammed earth subcontractor.
- .2 Plastic lumber structural grade.
- .3 Acceptable Product: Bedford Technology FiberForce® plastic lumber

2.6 FORMWORK

- .1 No tie holes to be permitted.
- .2 Provide formwork surface sufficient to provide a visual 300-1200 micron finish.
- .3 Insulation to be extended beyond the end of the walls where window and door openings are specified.
- .4 (Optional) Vertical and horizontal formwork joints should not be visible on finished surface.

2.7 RAMMED EARTH MIX

- .1 Mix and deliver rammed earth in accordance with applicable sections of CSAA23.1, and to meet the following criteria:
 - .1 Mix capable of producing a durable and solid rammed earth wall which does not require a sealed finish.
 - .2 Cement Type: Ordinary Portland Cement (OPC)
 - .3 Compressive Strength (100 day): minimum 10 MPa
 - .4 Nominal size of soil/sand: Is determined by the Fuller parabola A = 100 d/D where A is the weight of all grains with meters less then d, expressed as a proportion of the total mass which has the largest grain of diameter D. This is then modified to include angularity, parent rock, as well as fineness modulus.
 - .5 Slump at time and point of discharge: determined by qualified contractor
- .2 Puddled earth: Compressive Strength (100 day): minimum 15 MPa.
- .3 Provide hydrophobic admixture as recommended by rammed earth subcontractor.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify all dimensions and locations required on drawings.

- .3 Verify requirements for rammed earth cover over reinforcement.
- .4 Verify that anchors, seats, plates, reinforcement and other items to be cast into rammed earth are accurately placed, positioned securely, and will not impede rammed earth placement.
- .5 Verify locations of all openings and embedments required for other structural, architectural and electrical work.

3.2 PREPARATION

- .1 Prepare previously placed concrete according to rammed earth installer's instructions. Provide crystalline waterproofing slurry at top of foundation wall.
- .2 Coordinate the placement of joint devices with erection of rammed earth formwork and placement of form accessories.

3.3 PLACING RAMMED EARTH

- .1 Place rammed earth in accordance with rammed earth contractor's recommendations.
- .2 Install reinforcing and interwythe connectors according to shop drawings.
- .3 Install individual lift for full length of wall in forms indicated on drawings approximately 100mm-200mm lifts.
- .4 Compress with pneumatic tampers along full length of wall.
- .5 Install puddled earth at the top of walls and window sills.
- .6 Install embedded plastic lumber as detailed.
- .7 Provide hydrotropic admixture at bottom of wall and at parapet locations recommended by the rammed earth installer.
- .8 Notify Consultant minimum 24 hours prior to commencement of operations.
- .9 Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during rammed earth placement.

3.4 CURING AND PROTECTION

- .1 Immediately after placement, protect rammed earth from rain and flowing water, premature drying, excessively hot or cold temperatures, and mechanical damage.
- .2 Maintain rammed earth with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of rammed earth.

3.5 FIELD QUALITY CONTROL

- .1 Field inspection and testing as per Prime Consultant's direction.
- .2 Provide free access to Work and cooperate with appointed firm.
- .3 Three test cylinders will be taken and tested for every 75 cu m of

rammed earth placed.

.1 Minimum one test per day.

3.6 PATCHING

- .1 Allow Consultant to inspect rammed earth surfaces immediately upon removal of forms.
- .2 Patch imperfections as directed.

3.7 DEFECTIVE RAMMED EARTH

- .1 Defective Rammed earth: Rammed earth not conforming to required lines, details, dimensions, tolerances or specified requirements.
- .2 Repair or replacement of defective rammed earth will be determined by the Consultant.
- .3 Do not patch, fill, touchup, repair, or replace exposed rammed earth except upon express direction of Consultant for each individual area.

END OF SECTION