Roller Compacted Concrete Placement at McAlpine Lock

By

Larry Dalton, P.E.
PURPOSE: Share results of the recent placement of Roller Compacted Concrete at the McAlpine Lock Replacement Project as well as Structural Lessons Learned.
RCC PLACEMENT PROCEDURE

1. FORM
   CONVENTIONAL CONCRETE
   2'-6"
   PREVIOUS LIFT
   2'-0"

   FOR EACH LIFT, CONVENTIONAL CONCRETE IS PLACED PRIOR TO ADJACENT RCC

2. CONVENTIONAL CONCRETE
   RCC
   PREVIOUS LIFT

   RCC IS SPREAD IN THIN LAYERS UNTIL FULL LIFT THICKNESS IS ACHIEVED.
RCC PLACEMENT PROCEDURE

3. Interface between RCC and conventional concrete is thoroughly vibrated.

4. Consolidate RCC with vibratory roller as close to conventional concrete as possible.
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Deposit RCC by conveyor. RCC is deposited, spread and consolidated within the specified neat line.</td>
</tr>
<tr>
<td>2</td>
<td>Spreading and compacting RCC. RCC is spread in 6&quot; thick layers until full lift thickness is achieved.</td>
</tr>
<tr>
<td>3</td>
<td>Deposit and spread backfill. Backfill is spread in layers matching the RCC lift.</td>
</tr>
<tr>
<td>4</td>
<td>Compaction of the backfill and RCC interface. Vibratory roller is used to compact the RCC and backfill at the interface.</td>
</tr>
</tbody>
</table>
TYPICAL FLOATING MOORING BITT & LINE HOOK PLAN
EXISTING STRUCTURE

SEE RCC WALLS ELEV. SHEET S-193 TO S-203
SEE S-202 FOR OVERLOOK RCC PIER FOUNDATION ON L-14

4" EXPANSION JOINT MATERIAL BETWEEN RCC AND EXISTING STRUCTURE SEE NOTE 1.

UTILITY TRENCH
UTILITY TRENCH DRAIN (TYPICAL)
MASS CONCRETE (TYPICAL)

2'-0" OF MASS FACING CONCRETE (TYPICAL)
INTERFACE LINE (TYPICAL)
RCC IN 2'-0" LIFTS (TYPICAL)

FOUNDING ELEVATION AS APPROVED BY CONTRACTING OFFICER

MONOLITH L-5 THRU L-15
SOUTH LOCK WALL
SCALE: 1/8"=1'-0"

EL. 428.0
EL. 425.0
EL. 443.0

50'-0"
MONOLITH SM-11 THRU SM-12 AT STA.26+72.5
NORTH LOCK WALL
SCALE: 1/4" = 1'-0"

EL. 443.0
UTILITY TRENCH DRAIN (TYPICAL)

EL. 425.0
M A S S C O N C R E T E (TYPICAL)

2'-0" OF MASS FACING CONCRETE (TYPICAL)

INTERFACE LINE (TYP.)

2'-0" OF MASS FACING CONCRETE (TYP.)

RCC IN 2'-0" LIFTS (TYPICAL)

EL. 384.0

FOUN DING ELEVATION AS APPROVED BY CONTRACTING OFFICER

TO P OF BACKFILL ELEVATION V A R I E S

UTILITY TRENCH

E'-0" MIN. FACING CONCRETE BELOW BACKFILL SURFACE

46'-0"

46'-0"

12'-0"

34'-0"
## ROLLER COMPACTED CONCRETE
### MATERIAL PROPERTIES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Assumed For Design</th>
<th>Actual QA Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Weight</td>
<td>150 pcf</td>
<td>154 pcf</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>2000 psi</td>
<td>3300 psi</td>
</tr>
<tr>
<td>Phi</td>
<td>45 degrees</td>
<td>??</td>
</tr>
<tr>
<td>Cohesion</td>
<td>25 psi</td>
<td>??</td>
</tr>
</tbody>
</table>
ROLLER COMPACTED CONCRETE
- DESIGN CRITERIA -

CRACKED PLANE (Full Uplift Assumed)

CHECKS
Location of Resultant for Overturning Stability
Factor of Safety Against Sliding
Compression Stresses Against Allowables

UNCRAKED PLANNE (Reduced and Zero Uplift Assumed)

CHECKS
Factor of Safety Against Sliding
Compression and Tension Stresses Against Allowables
Allowable Tension Stress 25% of Table 4-1
(Design Value = 59.5 psi vs. 332 psi w/ 100% & QA values)
Allowable Compressive Stress 100% of Table 4-1
(Design Value = 1800 psi vs. 2970 psi w/ Actual QA values)
Bond Strength

PORTUGUES DAM RCC
MIX 6D - TENSILE STRENGTH

TENSILE STRENGTH (PSI)

AGE (DAYS)

- MIX 6D CYLINDER SPLITTING TENSILE STRENGTH
- PANEL G DIRECT TENSION ON HORIZONTAL CORE
- PANEL G DIRECT TENSION ON VERTICAL CORE
- PANEL G SPLITTING TENSION ON HORIZONTAL CORE
- PANEL A DIRECT TENSION ON VERTICAL CORE
- PANEL A SPLITTING TENSION ON HORIZONTAL CORE
- PANEL B DIRECT TENSION ON VERTICAL CORE
- PANEL B SPLITTING TENSION ON HORIZONTAL CORE
- RAPID LOAD STRAIN CAPACITY BEAMS
## PRELIMINARY

### - MIX PROPORTIONS -

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>130</td>
<td></td>
<td></td>
<td></td>
<td>156</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fly Ash</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fly Ash for Fines</td>
<td>104</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limestone Fines</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>1317</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Sand</td>
<td>1252</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>63 to 19.0 mm</td>
<td>1463</td>
<td></td>
<td></td>
<td></td>
<td>1400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0 to 4.75 mm</td>
<td>979</td>
<td></td>
<td></td>
<td></td>
<td>934</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>168</td>
<td></td>
<td></td>
<td></td>
<td>221</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WRA</td>
<td>12.0 fl oz</td>
<td></td>
<td></td>
<td></td>
<td>14.4 fl oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vebe (average)</td>
<td>15 sec</td>
<td></td>
<td></td>
<td></td>
<td>16 sec</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CONTRACTION JOINT DETAIL