Use of Cell Concrete and EPS Blocks for Roadway Embankments at I-680 Marina Vista Interchange and Repair of Roadway Undulation

Hooshmand Nikoui, P.E.
Branch Chief, Geotech Design West Caltrans
I-680 Northern Undulation
Three Projects Involved:

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Description</th>
<th>Cell Concrete (m³)</th>
<th>EPS Block (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I-680 Southern Undulation Repair</td>
<td>17,000</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>I-680 Marina Vista Interchange</td>
<td>48,000</td>
<td>11,650</td>
</tr>
<tr>
<td>3</td>
<td>I-680 Northern Undulation Repair</td>
<td>34,300</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Cell Concrete Data:

A. Unit Weight:
(1) 6.3 – 6.6 kN/m³ (40 – 42 pcf) for top 1m (3.28 ft) layer below pavement subgrade
(2) 3.9 – 4.7 kN/m³ (25 – 30 pcf) for the lower layers.

B. 28 days Compressive Strength (ASTM C495):
(1) 550 kPa (80 psi) for 6.3 – 6.6 kN/m³ cell concrete
(2) 276 kPa (40 psi) for 3.9 – 4.7 kN/m³ cell concrete

C. Mix design:
Foaming agent – ASTM C 796
H₂O – Portable
Portland Cement – ASTM C150, Type I, II, or III, Pozzolans and other cementitious such as fly ash material may be used approved by foaming agent manufacturer.
Cell Concrete other info:
• A single cast density test shall present the lesser of 230 cubic meters or one day’s production.

• Specimens shall be moist cure in the molds for 7 days prior to 28-day compressive strength test. No oven dry.

• 0.6 m (2 feet) maximum lift. 12 hrs curing prior to the next lift. Minimum thickness 125 mm (5 inches).

• No cell concrete placement on frozen ground. If ambient temperatures are anticipated to be below 4.5 C within 24 hrs after placement, the mixing water should be heated approved by manufacturer of the foaming agent or not placed at all.

• Cost: ~ $60/cu yd
Cellular Concrete Production Process

1 Part Concentrate + 40 Parts Water → Foam

Cement (per "Standard Mix Design") + fly ash or sand (if desired) + Water → Mixer

→ Pump → Placement of ELASTIZELL Concrete
Green Machine – 350 CY/ Hour
Southern Undulation
PRELIMINARY PLANS SUBJECT TO REVISION

BEGIN CONSTRUCTION

STA "H" 87+80 KP 37.8
PM 23.5

END CONSTRUCTION

STA "H" 100+02 KP 39.0
PM 24.2
CELLULAR CONCRETE ELEVATION DETAIL

SCALE: Horiz 1:500
Vert 1:50

Note: For Lightweight Fill (cellular concrete) elevation under the retaining walls, see Typical Section, X-2 and Retaining Walls Detail, R-2.

All dimensions are in meters unless otherwise shown.

CONSTRUCTION DETAILS
SCALE: AS SHOWN
PROFILE
"H" LINE

SCALE: Horiz 1:1000
Vert 1:100

Note: *See Construction Detail Sheet C-2 for conform
Pavement elevations, "H" Line, 96+30 to 96+80 Lt,
97+40 to 97+55 Rt, 98+10 to 98+40 Lt, 99+20 to 99+50 Rt
**See Construction Detail Sheet C-3 for conform pavement
elevations, "N" Line, 96-00 to 96+40, 95-30 to 93-50
TYPICAL SECTION-STAGE 2
NO SCALE
From Sta. 90+00 to 93+50 "N" Line

TYPICAL SECTION-STAGE 3
NO SCALE
From Sta. 90+00 to 93+50 "HL3" Line

TYPICAL SECTION-STAGE 4
NO SCALE
From Sta. 90+00 to 93+65 "HR4" Line

ALL DIMENSIONS ARE IN
METERS UNLESS OTHERWISE SHOWN

EXHIBIT F
TYPICAL CROSS SECTIONS
FOR STAGE CONSTRUCTION

SCALE: AS SHOWN
4-CC-680 PM 38.0/39.0
4253-254501 APRIL 1998
ROUTE 680

"N" 9+90,000 TO 92+20,000 LT
"N" 9+75,000 TO 92+30,000 RT

SHELF DETAIL WITH SHEET PILE

300 mm Selected Material
Embankment

Light Weight
(Cellular Concrete)
Perm. Mit.,
(Blanket and Geomembrane)

Steel Sheet Pile

SHOULDER DETAIL
Southern Undulation - Stage 1 shoring and excavation
Stage 3 – Driving sheet piles (cutoff wall)
Stage 3 – Headwall for 5 - 36” X-Culverts Looking North
Northern undulation temporary fixed with AC-Overlay including the undulated off-ramp
New I-680 Northbound & New Marina Vista On- and Off-Ramps
PROJECT PLANS FOR CONSTRUCTION ON
STATE HIGHWAY
IN CONTRA COSTA COUNTY
IN AND NEAR MARTINEZ
FROM 0.5 km SOUTH OF MOCOCO OVERHEAD
TO BENICIA-MARTINEZ BRIDGE AND OVERHEAD

The standard plans list applicable to this
contract is included in the notice to
contractors and special provisions book.

BEGIN CONSTRUCTION
STA N 92+40 KP 38.5
PM 23.9

End Work
STA N 90+00

Limit of Work
(Waterfront Rd)
STA MW 6+14-
STA MW 8+23

Limit of Work
(Mococo Rd)
STA MO 14+20-
STA MO 15+40

End Work
STA H 110+27
KP 40.1
PM 24.9

The contractor shall possess the class (or classes) of license
as specified in the "Notice to Contractors".

Contract No. 04-006054

April 8, 2002

Fees Appointed Date
SOIL PROFILE
Along the East edge of New Freeway & Marina Vista Off-Ramp
"CCNB" Line Sta. 94+802 to 95+602
& "48" Line Sta. 54+002 to 74+002

SOIL PROFILE
Along the East edge of New I-680 Freeway
"CCNB" Line Sta. 94+802 to 98+002

SOIL PROFILES
SCALE AS SHOWN

All Dimensions are in Meters unless otherwise shown
### Physical Properties of EPS Blocks

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM Designation</th>
<th>Acceptance Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>C 303</td>
<td>24 kg/m³ Minimum 32 kg/m³ Maximum (1.5 to 2.0 pcf)</td>
</tr>
<tr>
<td>Compressive Strength (at 5% deformation)</td>
<td>D 1621</td>
<td>100 kPa Minimum (14.5 psi)</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>C 203</td>
<td>300 kPa Minimum (43.5 psi)</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>D 1623</td>
<td>130 kPa Minimum (18.9 psi)</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>C 272</td>
<td>2.0% Maximum by Volume</td>
</tr>
</tbody>
</table>
Expanded Polystyrene (EPS) Blocks Info:

- Prefabricated Size: 3’ x 4’ x 12’
- Minimum thickness of EPS block: 6”
- Timber fastener or gluing used to connect EPS blocks
- Glue joints capable of developing a minimum of 12.5 psi shear strength (ASTM D 732) was used.
- Cost: ~ $60/cu yd
ROUTE 680
CONB 97+40.000 to CONC 98+21.530

SHOULDER DETAIL
(Cellulor Concrete)

CONB 96+80.000 ft to CONB 97+40 ft
WR 8+90.044 Lt to WR 7+41.708 Lt

FIGURE 7
04-CC-680
KP 38.5/40.1
04225-006051 DECEMBER 2000
TYPICAL CROSS SECTIONS

Engineering Service Center
Division of Structural Foundations
Office of Roadway Geotechnical
Engineering (North) Branch 3

All Dimensions are in Meters unless otherwise shown.
NO SCALE
TIMBER FASTENER DETAIL-A

- Typical timber fastener: Size 104.8 mm x 104.8 mm x 25.4 mm deep
  Bolt hole size to 25.4 mm

ELEVATION

- Standard EPS Blocks
- Custom Manufactured EPS Blocks
- Geomembrane (Type A, Gasoline Resistant)
- Embankment

PLAN VIEW

- EPS Block Wall Construction
- EPS = Expanded Polystyrene (Lightweight Subgrade Material)

TYPICAL CROSS SECTION

- Notes:
  1. For partial EPS block placement, min. width of 0.61 m is required. If 0.61 m width is not achievable cut portion of the adjacent block to allow 0.61 m min. width. It may be necessary to use custom manufactured block, cut to fit widths more than standard EPS block.
  2. Pre-gluing partial blocks to achieve custom manufactured block size will be acceptable.
  3. If "H" is greater than 1 m, shoring is required.

CELLULAR CONCRETE SUBGRADE PROFILE (PARTIAL)

- Structural section and PCC slab over Geotextile
- Geomembrane (Type A, Gasoline Resistant)
- Structural section and PCC slab over Geotextile cushion
- Geocomposite drain (See Structure Plans)

DETAILS

- DETAIL B
- DETAIL C
- DETAIL D

CONSTRUCTION DETAILS

- LIGHTWEIGHT EMB. MT (EPS BLOCK)
- NO SCALE
New Marina Vista/I-680 Off-Ramp
New Marina Vista/I-680 NB On-Ramp Approach Embankment
Abutment Wall for Marina Vista/ I-680 NB On-Ramp
Dewatering
Excavation Filled with Cell Concrete
Marina Vista/ I-680 NB On-Ramp Bridge
Excavation for Main I-680 NB Freeway at Marina Vista OH Abutment
Excavation for New I-680 NB Freeway
Excavation against Cell Concrete Placed for NB Off-Ramp
Placing Cell Concrete for I-680 NB Freeway
Diagonal Cracks Developed on Exist.
SB/NB I-680
Bracing with Pipe Piles Looking South
EPS Blocks
Northern Undulation
Thank You!

Questions?