WATER | ENERGY | LIFE

CITY OF RIVERSIDE PUBLIC UTILITIES

GENERAL SPECIFICATIONS FOR PRECAST REINFORCED CONCRETE STRUCTURES

UGS

REVISION: Updated Format & General Specifications; Added DCI & Macro SyntheticFiber Admixtures to Specifications.

CHECKED BY (ENGINEERING): SJ

CHECKED BY (FIELD): DM

DATE: 02/12/15

PREPARED BY: SJR

APPROVED BY: *Efren Mejia*

These General Specifications are intended as a guide to minimum requirements for precast reinforced concrete substructures used by the City of Riverside. Applicable city and state ordinances must also be complied with. All structures must meet or exceed these specifications and have received written approval from the Department before being acceptable for use on the City of Riverside system.

GENERAL

1. Identification

   All structures shall be identified with the manufacturer's name embedded, or otherwise permanently attached, to an interior wall. The nominal size or identifying number of the structure shall also be included as a portion of the identification.

2. Finish

   Concrete shall be free of rock pockets and "honeycomb" areas. Interior walls, ceilings and exterior surfaces exposed to view shall be smooth. Exterior surfaces below grade shall be dense and uniform, but a slight roughness is not objectionable. Floors shall have a 1/8" per foot slope to a sump with a float or broom finish to provide a uniform but slightly rough surface.

3. Water Tightness

   Structures shall be designed to provide a dry, watertight installation. Installation instructions and recommendations should be forwarded to the installing contractor if the manufacturer does not erect the structure.

4. Components

   Structure components shall be so designed to be interchangeable with units of the same design. Structure, sizes, openings, recesses, inserts, and other accessories, shall conform to UGS-005 (for vaults and manholes). △

5. Admixtures

   All concrete mixes for the utility boxes shall contain:

   (1) 4.0 gallons of calcium nitrate corrosion inhibitor (DCI). DCI corrosion inhibitor is a calcium nitrite-based solution which modifies the surface chemistry of the steel in order to slow of stop the corrosion process. Benefits of DCI also include being used as a concrete set accelerator.

   (2) 2.0 lbs. minimum macro-synthetic reinforcing fibers per cubic yard of concrete.

   No additives containing calcium chloride or any other material that will produce corrosive ions will be used in the concrete. All additives will be submitted to RPU for approval prior to use.

DESIGN CRITERIA

1. Loads

   Design loads shall consist of dead load, live load, impact, and in addition, loads due to water table, and any other loads, which may be imposed upon the structure.

   Live loads shall be for H-20 and/or H-20-S16 per AASHO Standard Specifications for Highway Bridges and late tentative revisions. Design wheel load shall be 16 kips. The live load shall be that loading which produces the maximum shears and bending moment in the structure.

2. Impact

   Impact factor shall be calculated by the equation $I = \frac{50}{L+125}100$. Where "I" is the percentage increase of the live load due to and "L" is the design span length of the roadway floor. Except that 30 percent shall be the maximum increase in live load due to impact.

   For shear due to truckloads, use the length of the loaded portion of the span from the point under consideration to the far reaction, except for cantilever arms, then use 30 percent.

   For Vaults With Cover 0' to I' -0" Inc., I=30%

   For Vaults With Cover 1'-1" to 2'-0" Inc., I=20%

   For Vaults With Cover 2 ' -1" to 2' -11" Inc., I=I0%

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3. Distribution of Wheel Loads

A minimum one-foot of earth cover shall be presumed in the dead load calculations for all vault covers. When the depth of fill is two feet or more, concentrated loads shall be considered as uniformly distributed over a square, the sides of which are equal to 1-3/4 times the depth of fill. When such areas from several concentrations overlap, the total load shall be considered as uniformly distributed over the area defined by the outside limits of the individual areas: but the total width of distribution shall not exceed the total width of the supporting slab.

For single spans the effect of live load may be neglected when the depth of cover is more than eight feet and exceeds the span length; for multiple spans it may be neglected when the depth of cover exceeds the distance between faces of end supports or abutments. When the depth of cover is less than two feet the wheel load shall be distributed as in slabs with concentrated loads.

4. Bending Moment

A. For main reinforcement perpendicular to traffic:

For simple spans, the live load moment shall be calculated by $M = \frac{S+2}{32} P$. For cantilever spans,

$M = \frac{PR}{E} X$ and $E = 0.8X + 3.75$ where:

M= live load moment foot-pounds per foot width of slab (impact not included)
S = effective span length, in. feet
P= 16, 000 pounds
PR= load on one rear wheel of truck
X = distance in feet from load to point of support
E= width of slab in feet over which a wheel is distributed

B. For main reinforcement parallel to traffic:

For simple spans, the live load moment shall be calculated by M = 900S and E = 4 + .06S, maximum 7.0 feet. For cantilever spans, $M = \frac{P}{E} X$ and E = .35X + 3.2, maximum 7.0 feet.

C. If traffic can approach the vault from any direction, then the maximum bending moment obtained by either method shall govern in the steel design.

D. When the slab is continuous over three or more supports, 80 percent of the simple span bending moment may be used.

E. In case of slabs supported on four edges and reinforced in both directions, the proportion of the load carried by the short span of the slab shall be assumed as given by the following equations:

For load uniformly distributed - $P = \frac{B^2}{A^2 + B^2}$

For load concentrated at center - $P = \frac{B^3}{A^3 + B^3}$

Where "P" is proportion of load carried by short span:

"A" is length of short span of slab
"B" is length of long span of slab

Where the length of slab exceeds 1-1/2 times its width, the entire load shall be assumed to be carried by the transverse reinforcement.

The distribution width "E" for the load taken by either span shall be determined as provided for other slabs. Moment obtained shall be used in designing the center half of the short and long slabs. The reinforcement steel in the outer quarters of both short and long spans may then be reduced 50 percent. In the design of the supporting beams, consideration shall be given to the fact that the loads delivered to the beams are not uniformly distributed.

5. Side Wall Design and Lateral Pressures

Structures that retain fills shall be proportioned to withstand pressures as given by Rankine's Formula. However, no structure shall be designed for less than an equivalent fluid pressure of 30 pounds per cubic foot without water table and no less than 75 pounds per cubic foot with water, in the saturated condition.

When highway traffic can come within a horizontal distance from the top of the structure equal to one-half of its height, the lateral pressure shall add to it a live load surcharge equal to not less than two feet of earth.

For rigid frames, a maximum of one-half of the moment caused by earth (lateral) pressure may be used to reduce the positive moment in the beams, in the top slab or in the top and bottom slab, as the case may be.

6. Bottom Slabs

The bottom slabs and beams must be proportioned to carry the full dead load of the vault together with super-imposed live loads. No allowances shall be made for positioning of equipment loads on the floor of the vault. The pressures on the underside of the vault shall be assumed to be uniform.

7. Design Stress

A. Concrete:

f'c = 2,500-2,900 psi n=12
f'c = 3,000-3,900 psi n=10
f'c = 4,000-4,900 psi n=8
f'c = 5,000 or more psi n=6
Extreme fiber in Compression f'c = 0.40f'c .

B. Shear:

Beams without Web Reinforcement:

Longitudinal bars not anchored	0.02f'c (75 psi max.)
Longitudinal bars anchored	0.03f'c (90 psi max.)
Beam with Web Reinforcement	V= 0. 075f'c bjd

C. Reinforcing Steel:

Tension inflexural members and web reinforcement f's = 20,000 psi
Bond - deformed bars
Straight or hooked ends, exclusive of top bars
(1) In beams, slabs and one-way footings 0.10f'c (350 psi max.)
(2) In two-way footings 0.08f'c (280 psi max.)
Top bars - bars near top of beams and girders having more than 12 inches of concrete under bars 0.06f'c (210 psi max.)
(3) Structural Steel 18,000 psi

8. Reinforcement

The minimum clear distance between parallel bars shall be not less than 1-1/2 times the nominal maximum size of the aggregate.

The tensile reinforcement shall not be spliced at points of maximum stress. When reinforcement is spliced, the spliced bars shall lap sufficiently to develop the full strength in bond.

The minimum covering, measured from the surface of the concrete to the face of any reinforcing bar, shall not be less than the following:

Concrete surfaces in contact with earth	1-1/2 inches
Beams and girders	
Main reinforcing steel	1-1/2 inches
Stirrups and ties	1 inch
Interior walls and top slabs	1 inch
Interior bottom slabs	1-1/2 inches

Where chairs or other steel supports are used to maintain specified concrete cover and are within 1/2 inch of a surface, such supports shall be hot-dip galvanized.

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Macro-Synthetic Reinforcing Fibers:

(1) Macro-synthetic fibers shall meet the requirements of ASTM C 116 Type III 4.1.3
(2) Fiber tensile strength shall be >60,000 psi measured by ASTM D-2256
(3) Elongation shall be <12% measured by ASTM D-2256

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APPROVALS

The acceptance criteria included herein shall govern all precast concrete pads, handholes, pull boxes, slab boxes, manholes, vaults & custom design or where field conditions are known.

For standard approval, all precast concrete structures shall be designed for the following conditions (unless otherwise specified in writing). Materials and/or workmanship failing to meet the requirements of the specification or installed without prior notice to RPU inspector will be subject to rejection. If required by inspector supplier shall remove rejected materials or workmanship and shall install new ones at his expense.

Standard approval shall mean approval of a design for general use on the City of Riverside system.

- Service Loads
  - Traffic — H-20-S16
  - Pedestrian — 300 pounds per square foot
- Impact — I = 30%
- Cover — One foot of earth.
- Traffic — Traffic can approach the structure from any direction
- Water table — The ground water table to be three feet below the finished surface. (75# per cubic foot).
- Concrete — f's = 3,000# (minimum).

No structure shall be accepted unless it is true to size & dimensions. Tolerances shall not exceed the following (unless unless otherwise specified in writing).

- Length ±1/8 per 10ft., ±3/8 maximum
- Cross sectional dimensions: Less than 24" ±1/4"; 24" to 36" ±3/8"; over 36" ±1/2".
- Thickness: ±1/4"
- Position of anchor and inserts: ±1/2" of centerline location shown on drawing.
- End squareness: 3/8" maximum; 1/8" per 6' measured on the diagonal.
- Knockout: ±1/2" off center line location shown on drawing.
- Equipment mounting / fixtures mounting (unistrut / rackback): ±1/8"