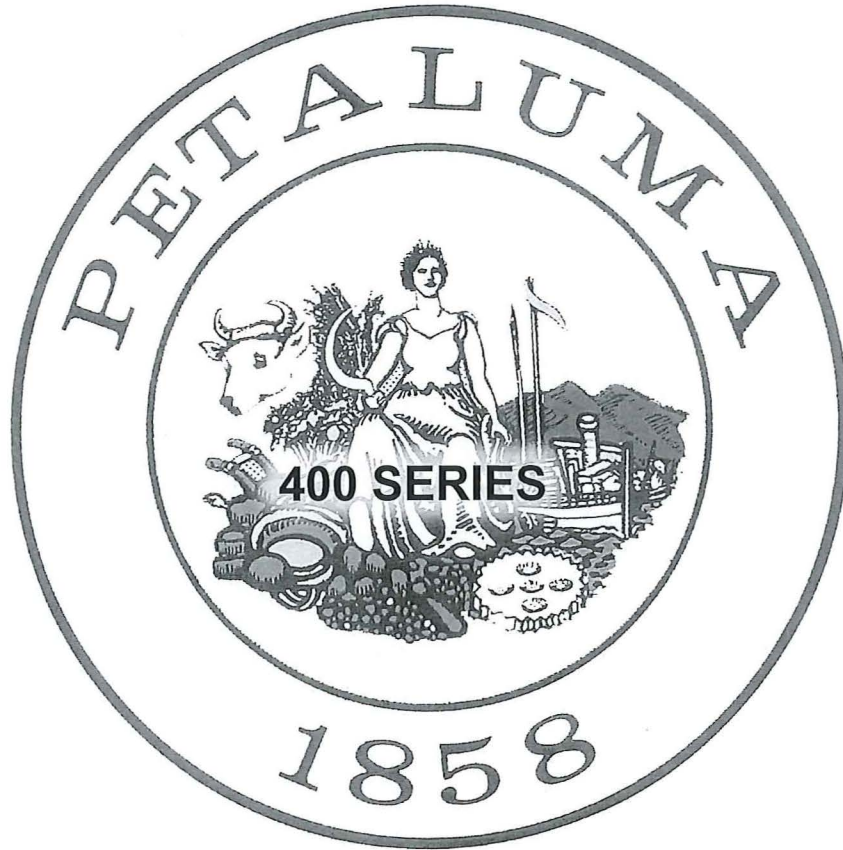


# Storm Drain System

- Design and Construction Standards
- Storm Drain Installation Detail Specifications No. 31



City of Petaluma - Sonoma County - California  
Public Works & Utilities  
202 North McDowell Boulevard  
Petaluma, CA 94954

APPROVED BY:

Kent R. Carothers, P.E., Operations Manager

1/8/19

Date

# Storm Drain System Construction Standards

## Standards List

<u>Std. No.</u>	<u>Title</u>	<u>Date Approved</u>
400	Standard Precast Concrete Manhole .....	April 1999
401-A	Standard Type "A" Catch Basin .....	December 1998
401-B	Standard Type "E" Catch Basin .....	December 1998
401-C	Standard Type "E" Catch Basin Grate Detail .....	August 1999
401-D	Catch Basin and Drop Inlet Notes .....	December 1998
401-E	Standard Modification of Existing Catch Basin to Accommodate Curb Ramps .....	August 1999
402	Standard Temporary Redwood Drain Box.....	February 1998
403	Standard Precast Catch Basin Cover.....	February 1998
404	Standard Sidewalk Underdrain .....	February 1998
405	Standard Precast Concrete Manhole Reducer Slab .....	February 1998
406	Standard Catch Basin Gallery .....	February 1998
407	Standard Drop Inlet.....	February 1998
408	Standard Trench Details .....	January 2019
409	Standard Type "A" Catch Basin over Cast-in-Place Pipe.....	February 1998
410	Standard Manhole over Cast-in-Place 1' to 2.5' of Cover .....	February 1998
411	Standard Manhole over Cast-in-Place 2.5' to 4.5' of Cover .....	February 1998
412	Standard Manhole over Cast-in-Place 4.5' or Greater Cover.....	February 1998
	Detail Specification No. 31 .....	April 1992

**NOTE NO. 1**

When manholes are installed in unimproved areas, the top of the cover shall be a minimum of 1 foot above adjacent grade.

**FOR MANHOLE COVER AND FRAME**  
(See Sewer Standards)

**NOTE NO. 2**

Minimum of one 3" and 6" grade adjustment rings. Maximum height of grade adjustment ring 20". Alternately, contractor may cast grade rings in place.

**NOTE NO. 3**

Gasket Sealer. "Ram-nek" or equal, may be used in joints, eliminating necessity for outside plastering of joints. Typical joint uses one 3 4"x2-1 2" "Ram-nek" seal or two seals in high water table areas.

**NOTE NO. 4**

Cone Section may be either concentric or eccentric unless otherwise specified by the Engineer.

**NOTE NO. 5**

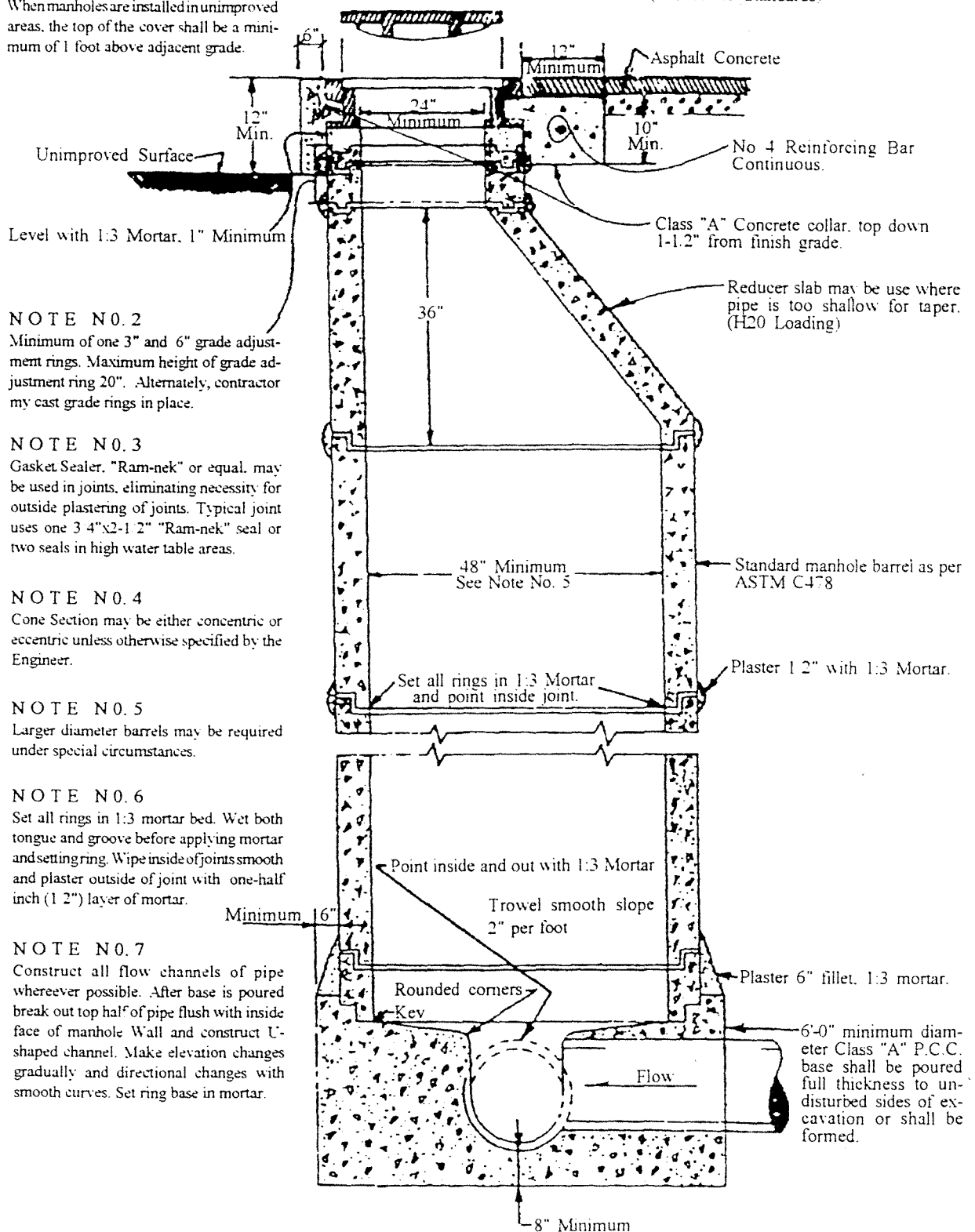
Larger diameter barrels may be required under special circumstances.

**NOTE NO. 6**

Set all rings in 1:3 mortar bed. Wet both tongue and groove before applying mortar and setting ring. Wipe inside of joints smooth and plaster outside of joint with one-half inch (1 2") layer of mortar.

**NOTE NO. 7**


Construct all flow channels of pipe wherever possible. After base is poured break out top half of pipe flush with inside face of manhole wall and construct U-shaped channel. Make elevation changes gradually and directional changes with smooth curves. Set ring base in mortar.

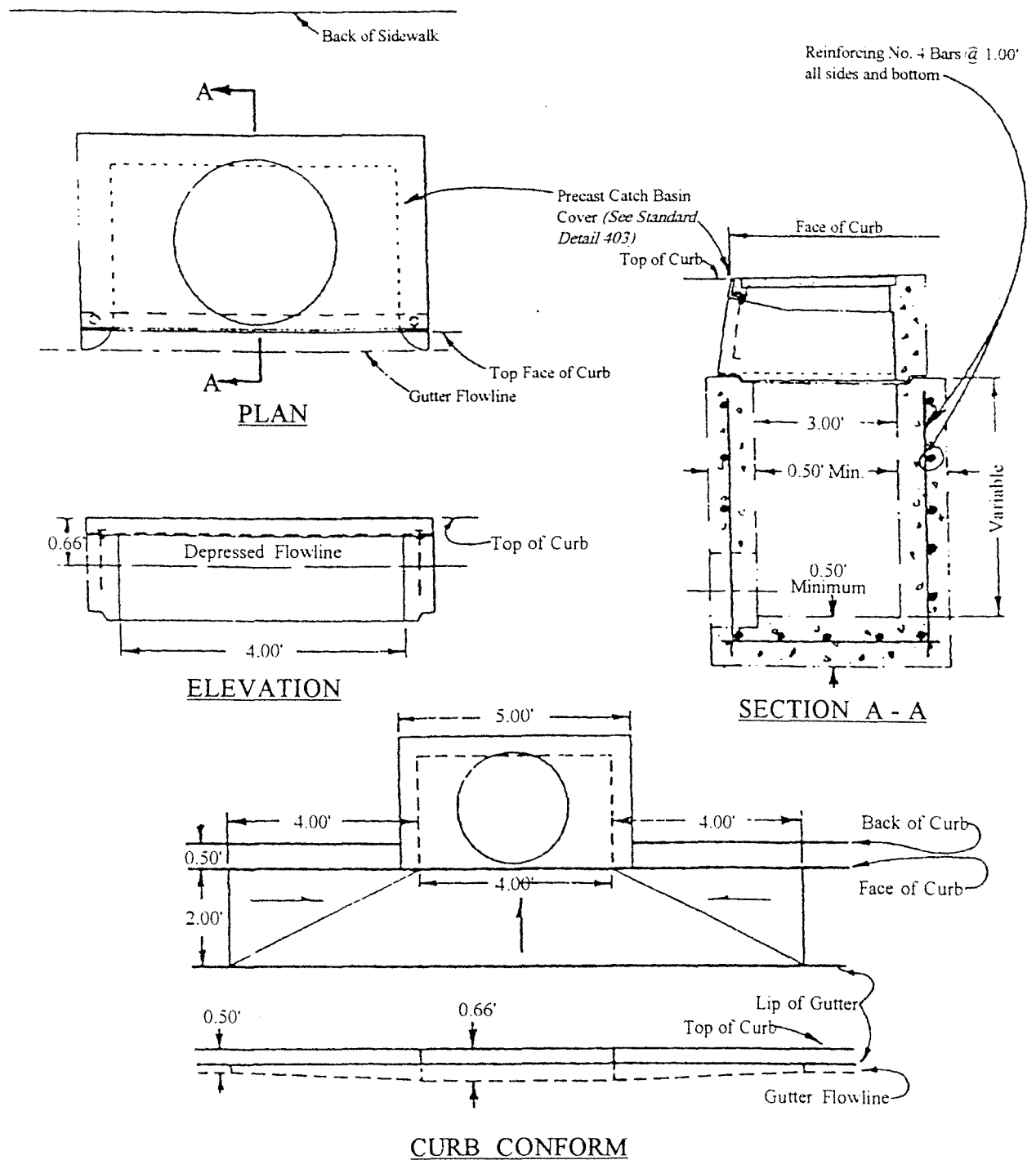


**CITY OF PETALUMA**  
Department of Engineering  
22 Bassett Street - Petaluma California 94952  
707-738-4304 - Fax 707-738-4437  
Approved By  
*Thomas S. Hargis*  
Thomas S. Hargis - R.C.E. 222566

Standard Precast  
**CONCRETE**  
**MANHOLE**  
Storm Drain

Drawn By  
Butch Smith  
Scale  
N. T. S.  
Date  
April 14th 1999 (Rev.)  
File Number  
Std. Det. SDS0000.400

  
Page  
400




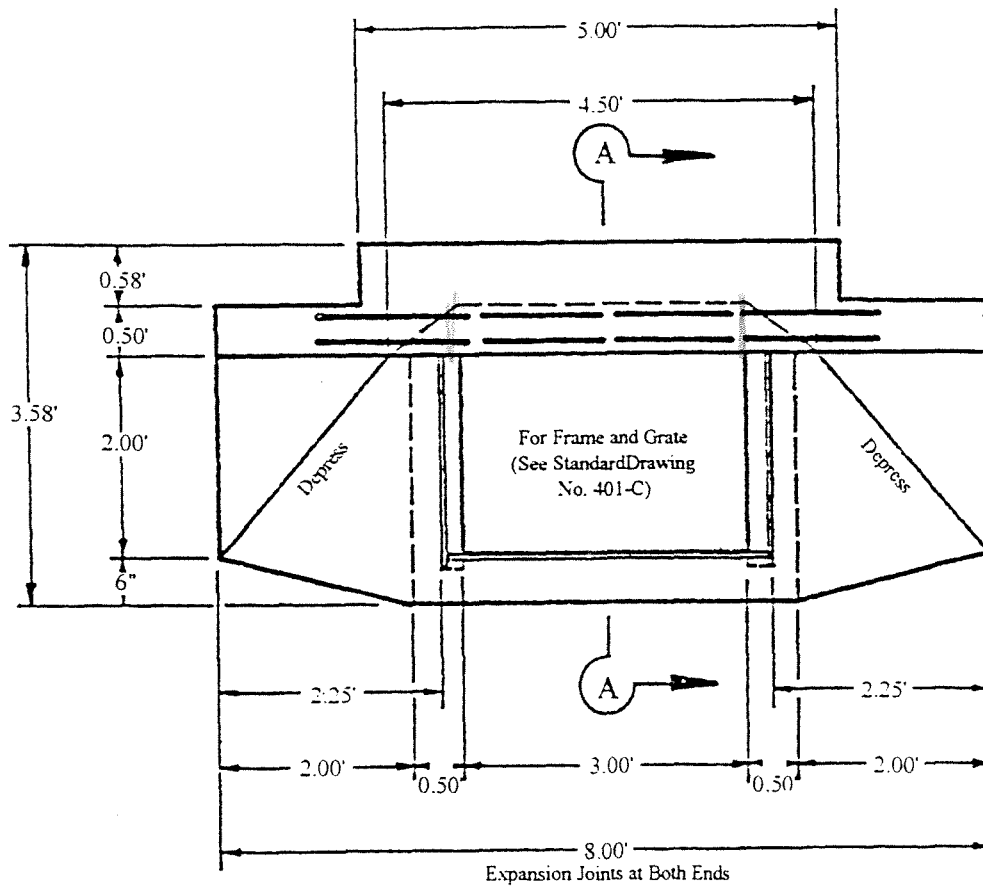
CITY OF PETALUMA  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 Phone "0" 8 4304 - Fax "0" 8 443"

Approved By:  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22366

Standard Type "A"  
**CATCH  
 BASIN**  
 Storm Drain

Drawn By:  
 Butch Smith  
 Scale:  
 N. T. S.  
 Date:  
 December 2nd 1998 (Rev.)  
 File Number:  
 Std.Det. SDS0000.401-A

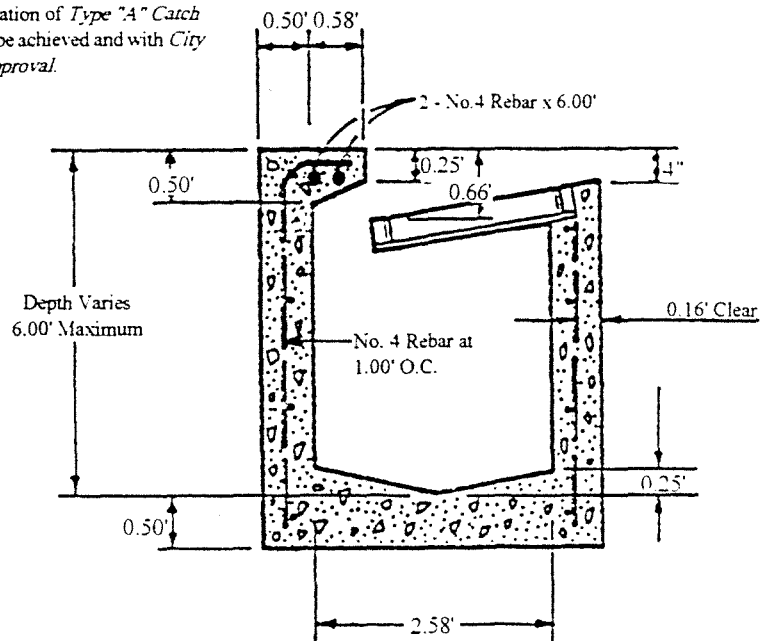
  
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 401-A



Expansion Joints at Both Ends

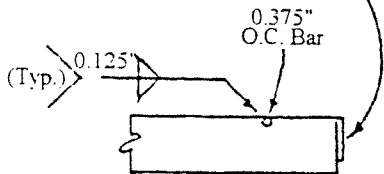
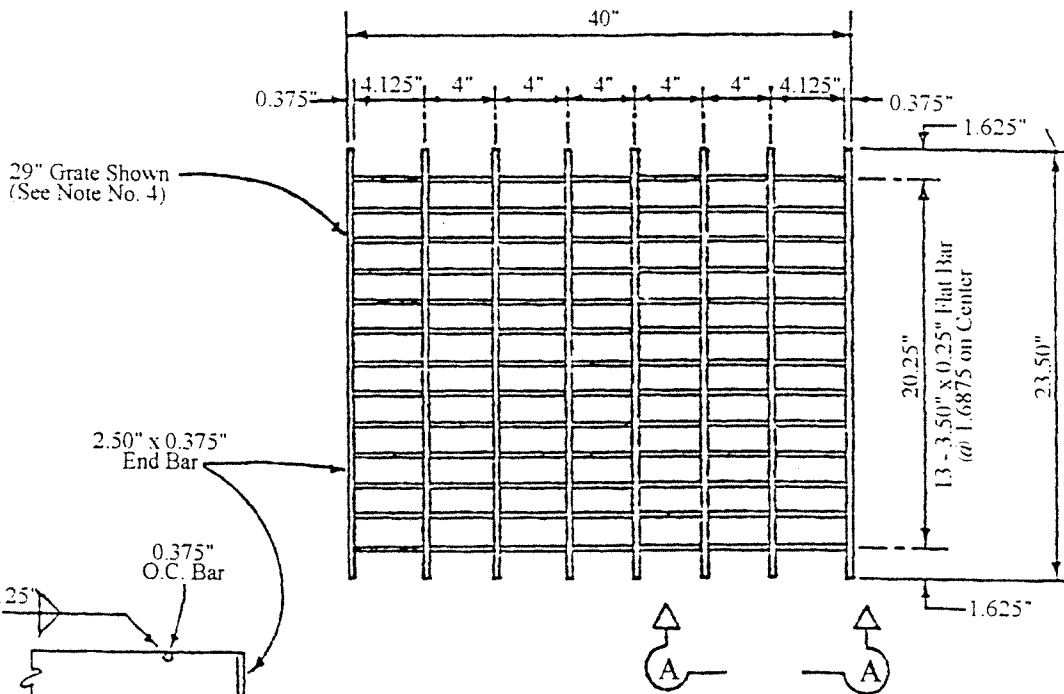
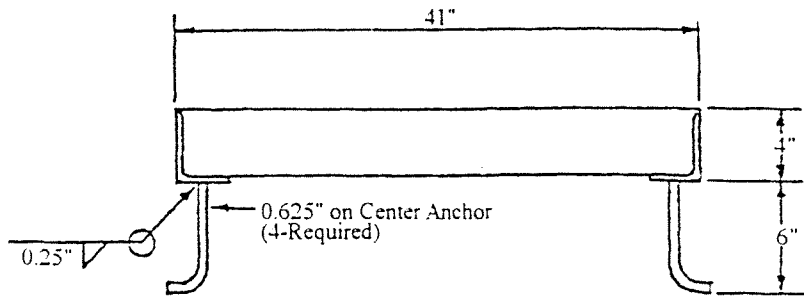
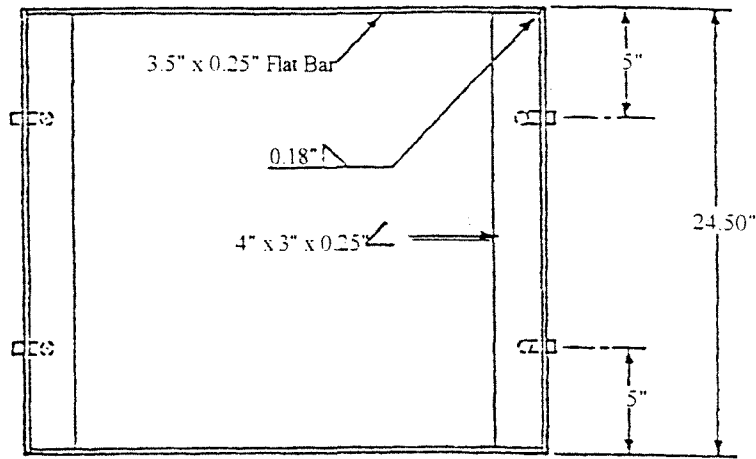
- NOTE:
1. See *Standard Drawing No. 401-D* for General Notes.
  2. *Type "E" Catch Basin* will be installed only if installation of *Type "A" Catch Basin* can not be achieved and with *City Engineer's Approval*.

PLAN



SECTION A-A

<p>CITY OF PETALUMA Department of Engineering 22 Bassett Street - Petaluma California 94952 707.778.4304 - Fax 707.778.4437</p>	<p>Standard Type "E" <b>CATCH BASIN</b> Storm Drain</p>	<p>Drawn by: Butch Smith Scale: N. T. S. Date: February 3rd 1999 File Number: Std. Det. SDS0000.401-B</p>	 <p>Page: 401-B</p>
<p>Approved By: <i>Thomas S. Hargis</i> Thomas S. Hargis - R.C.E. 22366</p>			



**SECTION A-A**

- NOTE:
1. All steel shall be structural grade.
  2. All steel shall be "Hot Dipped Galvanized" after fabrication.
  3. Top and Bottom surfaces of grate shall be ground flush after welding.
  4. For 40" Grate use *CALTRANS Standard Grate 24-12X or 24-10S*.

**CITY OF PETALUMA**  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 707-784304 - Fax 707-784437

Approved By:  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22366


Standard  
**Type "E"**  
**CATCH BASIN**  
**GRATE**  
**DETAIL**

Drawn by:  
**Butch Smith**

Scale:  
**N. T. S.**

Date:  
**December 2nd 1998**

File Number:  
**Std. Det. SDS0000.401-C**

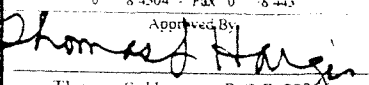



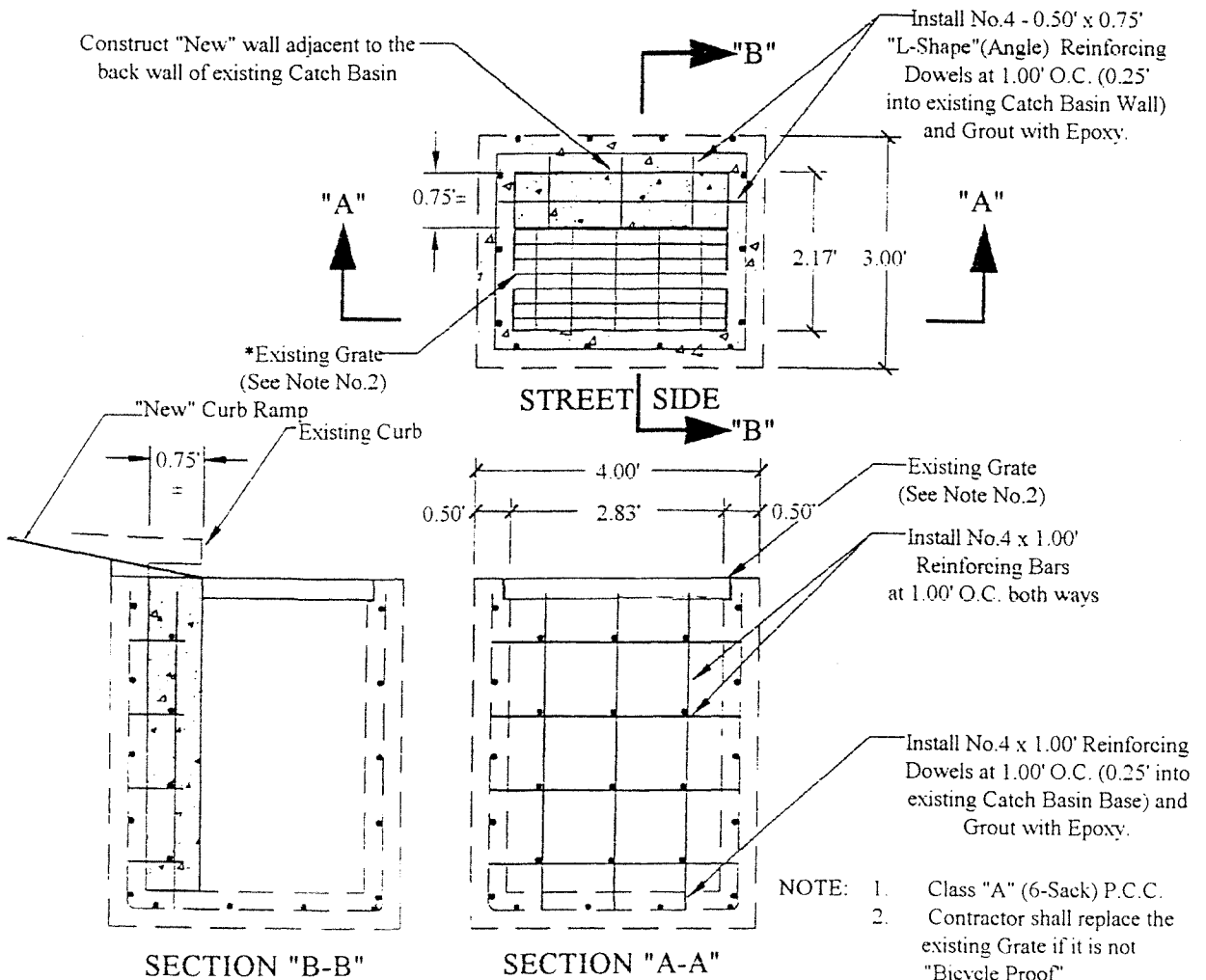
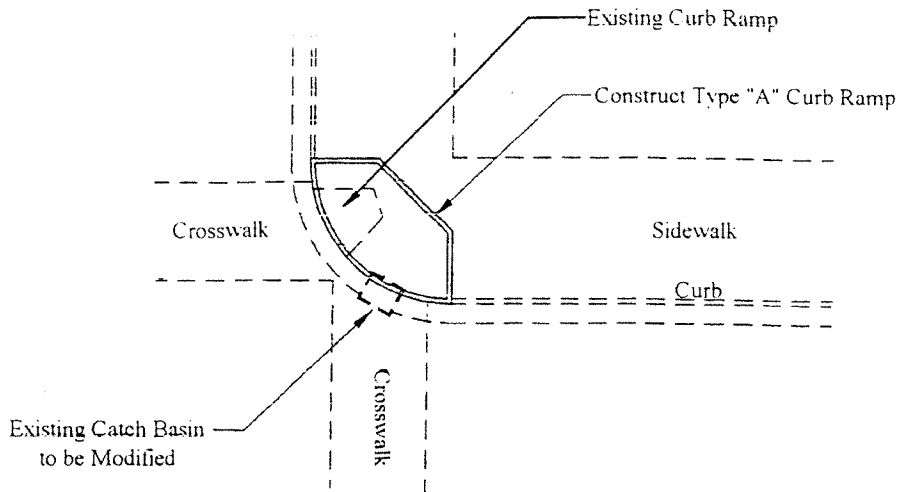
Page  
**401-C**

# CATCH BASIN AND DROP INLET NOTES

1. All concrete shall be *Class "A"* (6-sack mix) unless otherwise noted.
2. Base shall be placed against undisturbed earth. Sides may be formed or place against undisturbed earth.
3. Where conduits are encountered larger in diameter than the width of the wall through which they pass, the inside dimension of the walls normal to the direction of the pipe shall be increased to the outside diameter of the pipe.
4. Expansion joints shall be placed thru curb and sidewalk at both sides of catch basins and shall be limit of payment for curb and gutter. Unit prices for drainage structures shall include curb, gutter and sidewalk poured with drainage structure.
5. No concrete shall be placed prior to form and steel approval by the City Engineer.
6. See Standard Drawing Number 401-C for *Type "E" Catch Basin Grate Detail*.
7. Wall thickness and reinforcing shall be determined from the table below.
8. Place 0.75" weep holes as required by the *City Engineer*.
9. Equivalent precast structures may be substituted as approved by the *City Engineer*.

DEPTH	WALL THICKNESS	WALL REINFORCEMENT
Less than or equal to 8.00'	0.50'	No. 4 Rebar at 1.00' both ways
Over 8.0'	0.66'	No. 4 Rebar at 1.00' both ways

<p><b>CITY OF PETALUMA</b>          Department of Engineering          22 Bassett Street - Petaluma California 94952          Tel "707" 435-4304 - Fax "707" 435-4437</p> <p>Approved By            Thomas S. Hargis - R.C.E. 22568</p>	<p><b>CATCH BASIN AND DROP INLET NOTES</b></p>	<p>Drawn by Butch Smith          Scale N. T. S.          Date August 13th 1999 (Rev.)          File Number Std. Det. SDS0000.401-D</p>
		 <p>Page 401-D</p>



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 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 \*07 778 4304 - Fax \*07 778 4437

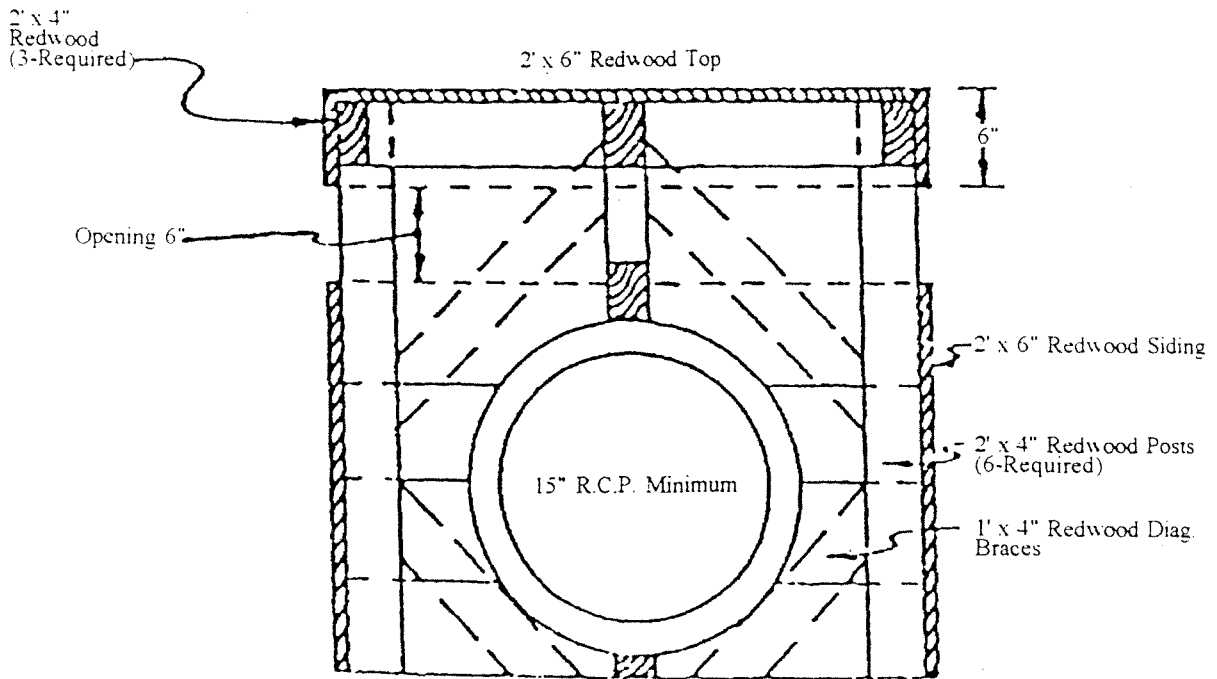
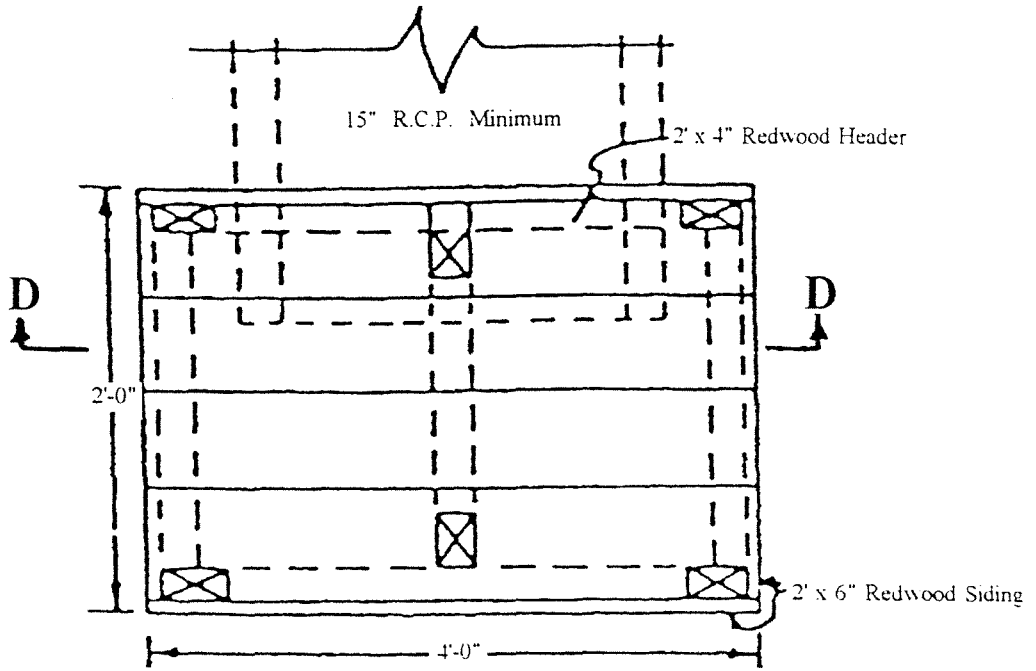
Approved By  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22266

Standard  
 Modification of Existing  
**Catch Basin**  
 to Accomodate the Installation  
 of "New" Curb Ramp

Drawn by  
**Butch Smith**  
 Scale  
 N. T. S.  
 Date  
**August 2nd 1999**  
 File Number  
 Std. Det. SDS0000.401-E

Page  
 401-E





**NOTE:**

Redwood Material shall be construction grade or better.


**SECTION D-D**

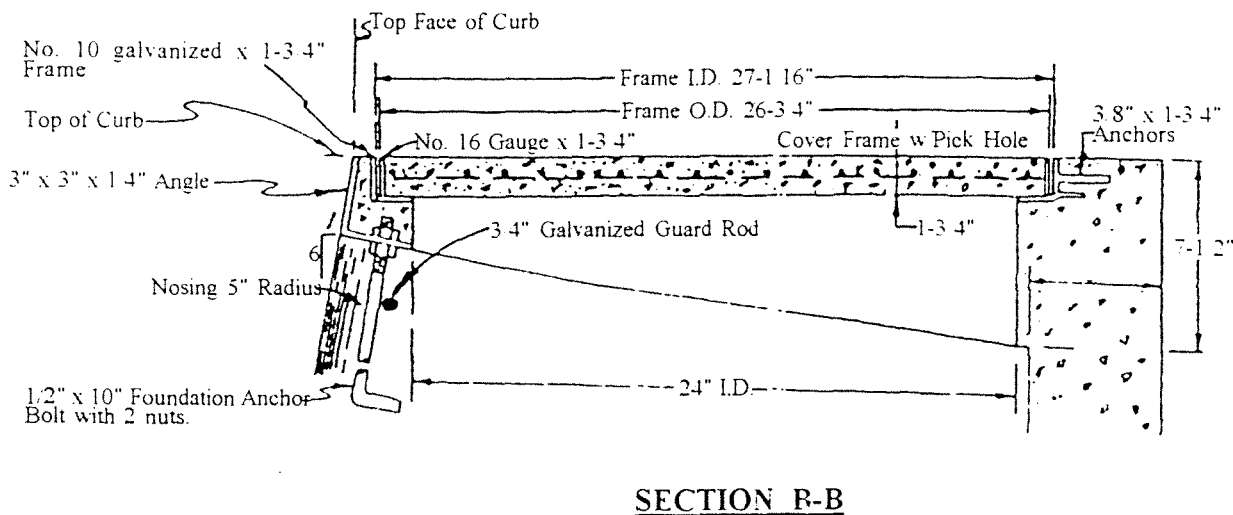
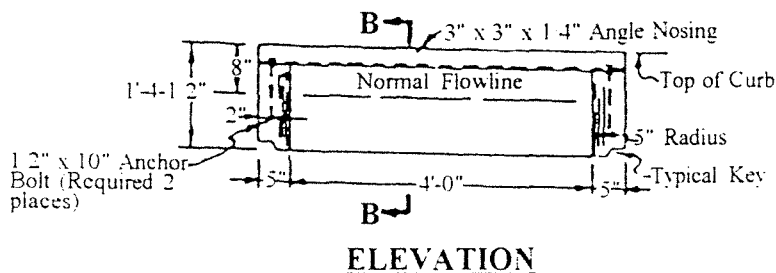
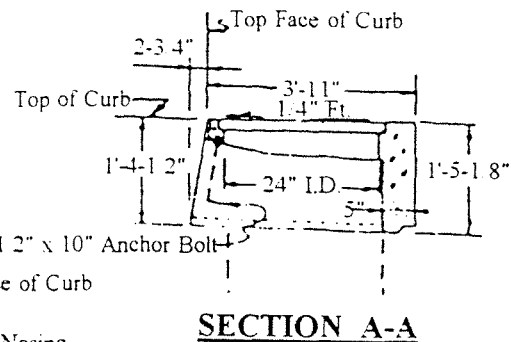
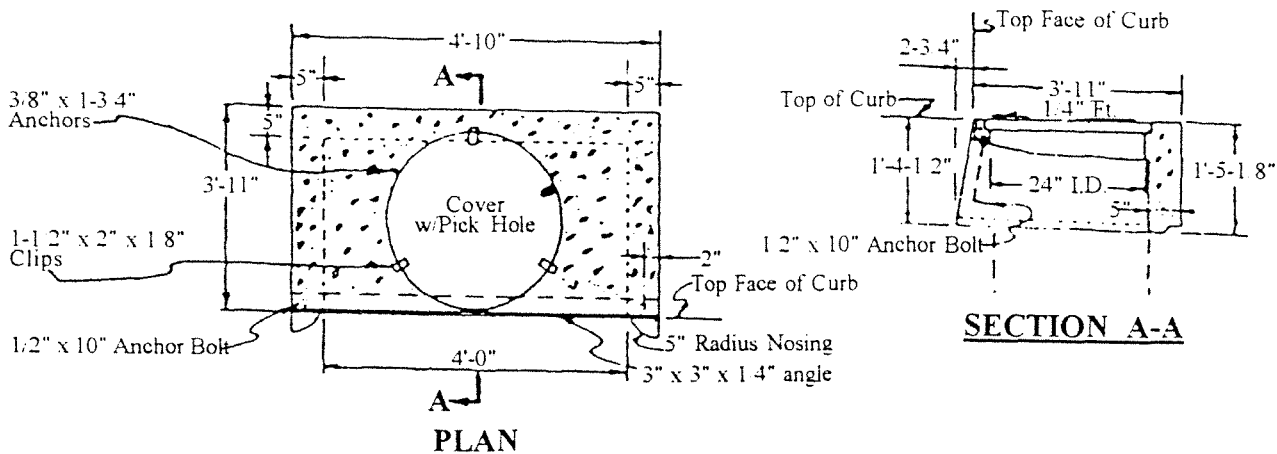
**CITY OF PETALUMA**  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 707 778 4304 - Fax 707 778 4437

Approved By  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22276

Standard Temporary  
**REDWOOD**  
**DRAIN BOX**  
 Storm Drain

Drawn By  
 Butch Smith  
 Scale  
 N. T. S.  
 Date  
 February 9th 1998 (Rev.)  
 File Number  
 Std Det. SDS0000 402

  
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**NOTE:**

1. The Contractor, at his option, may use a fiberglass liner and cast the catch basin top in place.
2. A cast iron frame ring may be substituted for the galvanized frame for the cover opening provided that the frame I.D. remains as shown.

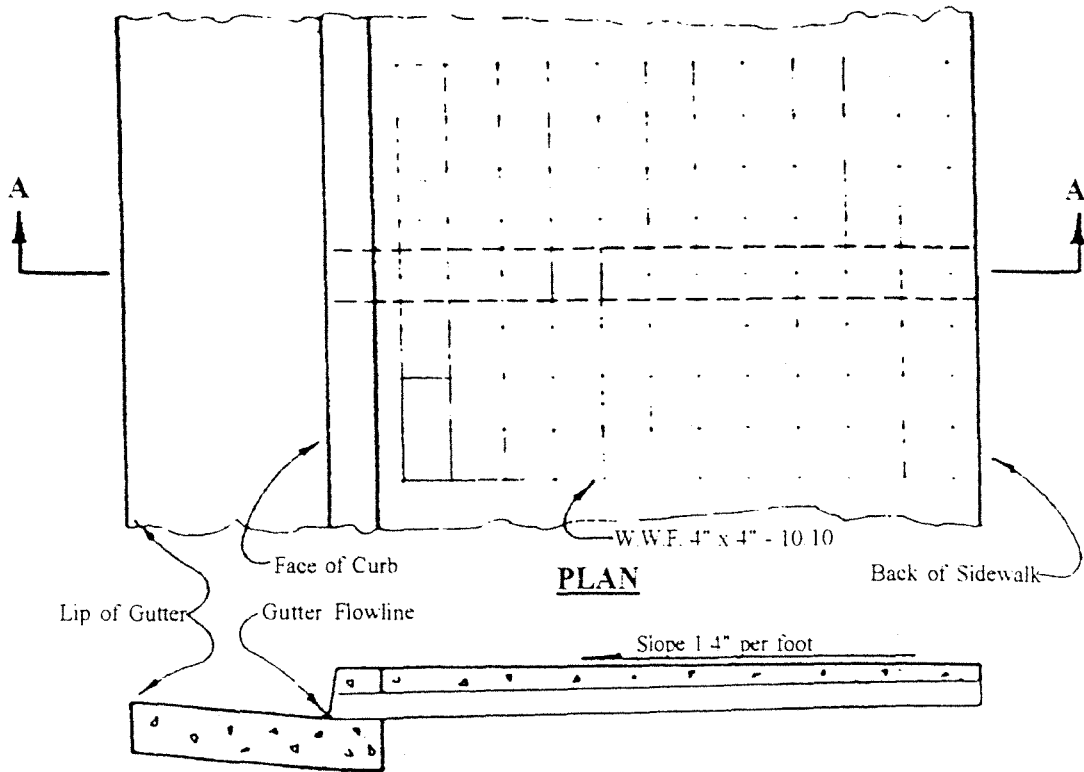
**CITY OF PETALUMA**  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 707 784304 - Fax 707 784437

Approved By  
*Thomas S. Hargin*  
 Thomas S. Hargin - R.C.E. 22366

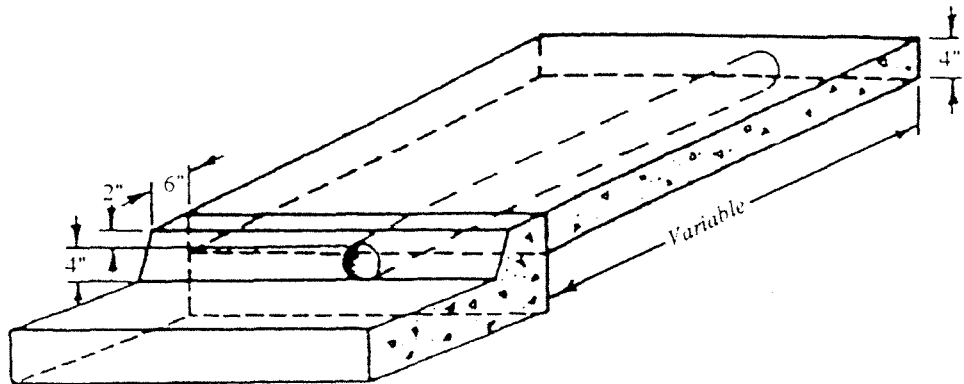
Standard Precast  
**CATCH BASIN**  
**COVER**  
 Storm Drain

Drawn By  
**Butch Smith**  
 Scale  
 N. T. S.  
 Date  
 February 9th 1998 (Rev.)  
 File Number  
 Std Det. SDS0000.403





**SECTION A-A**



**CURB OPENING DETAIL**

**NOTE:**

1. Wire mesh shall be 4'-0" wide (minimum). Length shall equal sidewalk with minus 4".
2. On site drainage and location of curb outlets shall be by owner to the satisfaction of the City Engineer.
3. Drain pipe shall be installed so that top of pipe is 3" minimum below finish grade at back of sidewalk.
4. Sidewalk drain to be 3" schedule 40 heavy wall rigid polyvinyl chloride pipe or approved equal.

**CITY OF PETALUMA**  
 Department of Engineering  
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Approved By:  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22566


Standard  
**SIDEWALK  
 UNDERDRAIN**  
 Storm Drain

Drawn by  
 Butch Smith

Scale  
 N. T. S.

Date  
 February 9th 1998 (Rev )

File Number  
 Std. Det. SDS0000.404

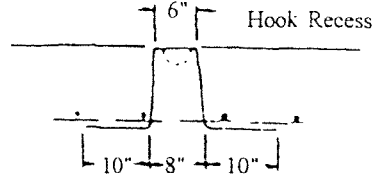
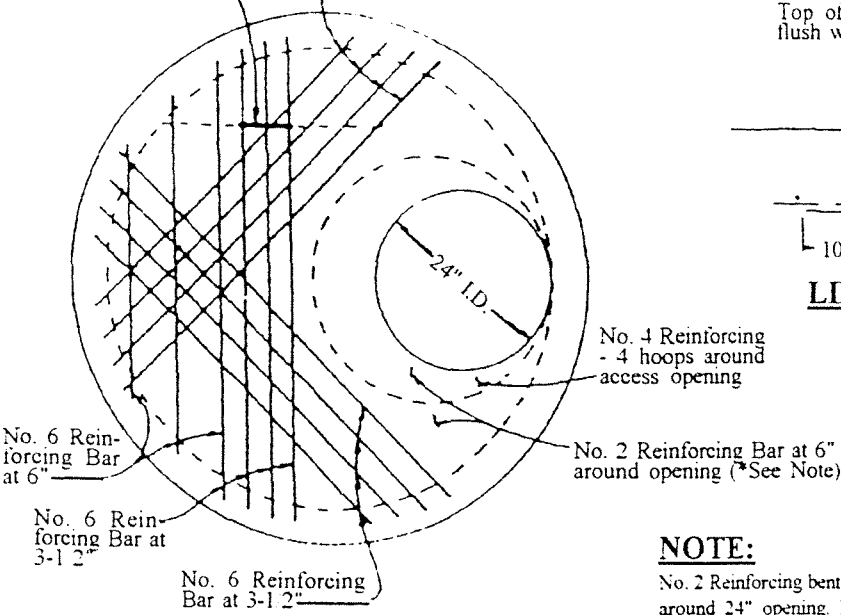


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 404

Lifting eyes at balance point, two places

No. 6 Reinforcing Bar at 3-1 2"

Top of lifting eye to be flush with top of slab



**LIFTING EYE  
DETAIL**

No. 4 Reinforcing - 4 hoops around access opening

No. 2 Reinforcing Bar at 6" around opening (\*See Note)

No. 6 Reinforcing Bar at 6"

No. 6 Reinforcing Bar at 3-1 2"

No. 6 Reinforcing Bar at 3-1 2"

**SLAB PLAN**

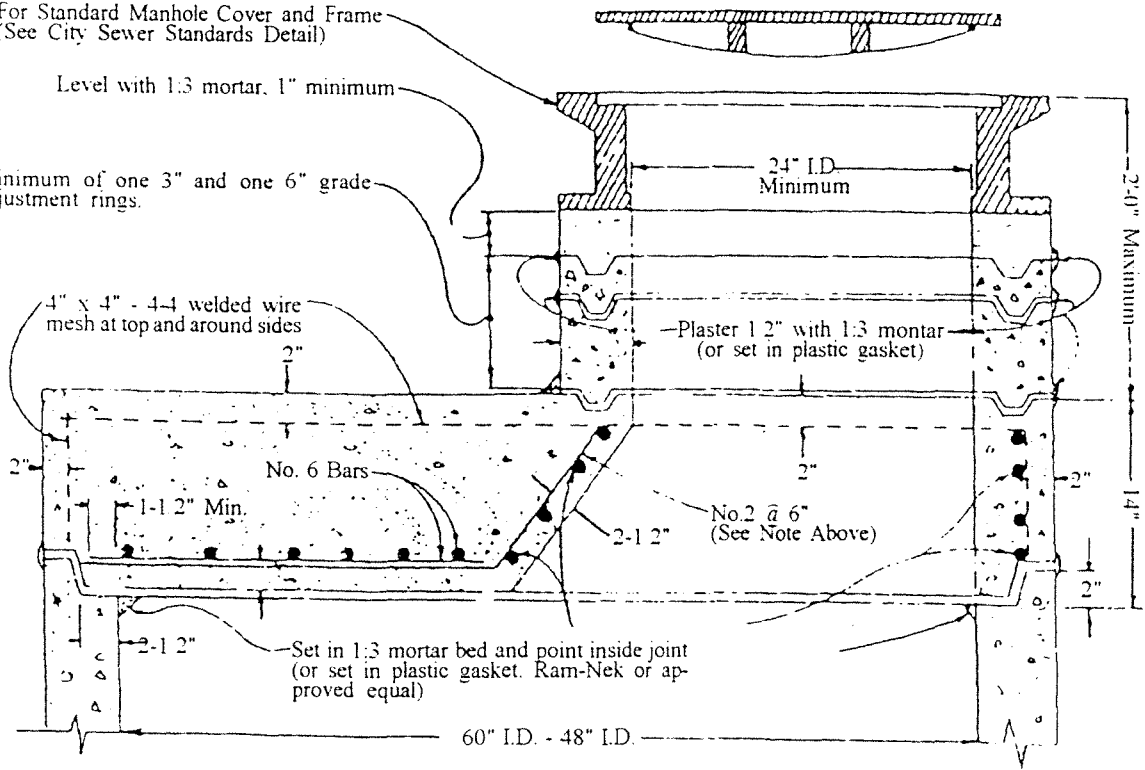
**NOTE:**

No. 2 Reinforcing bent up and spaced 6" on center around 24" opening. Horizontal legs to fan out equally spaced, to 2-1 2" clear at edge of slab.

For Standard Manhole Cover and Frame (See City Sewer Standards Detail)

Level with 1:3 mortar, 1" minimum

Minimum of one 3" and one 6" grade adjustment rings.



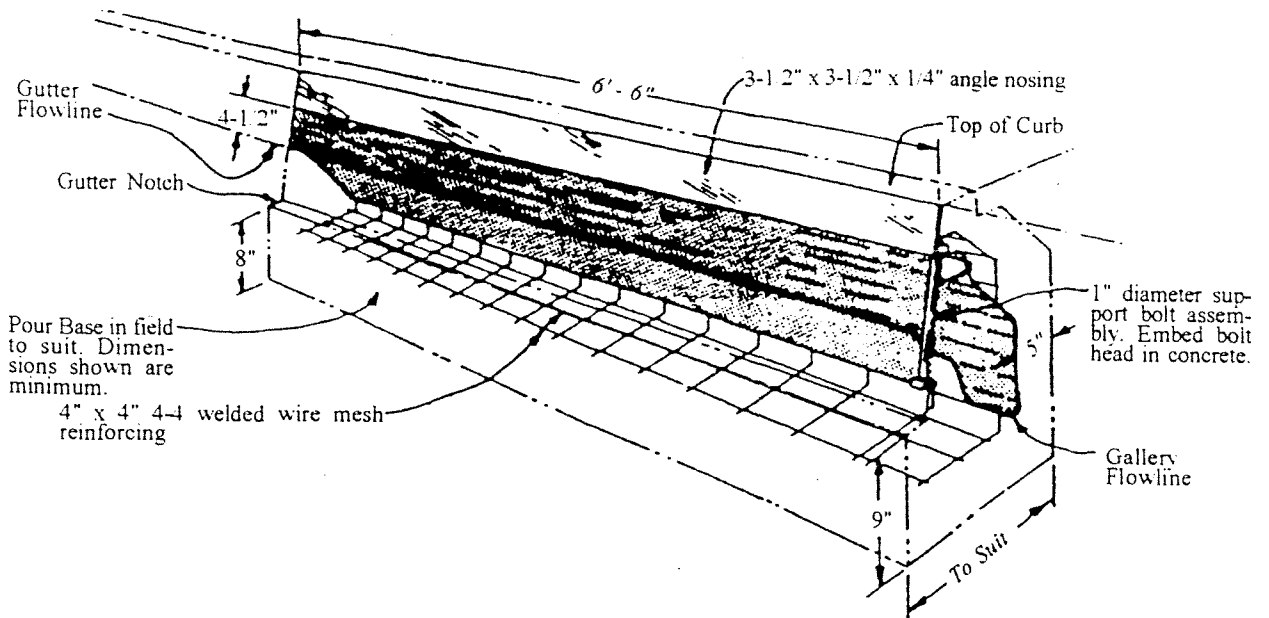
**CITY OF PETALUMA**  
Department of Engineering  
22 Bassett Street - Petaluma California 94952  
707 78 4304 - Fax 707 78 443

Approved By:  
*Thomas S. Hargis*  
Thomas S. Hargis - R.C.E. 22366

Standard Precast Concrete  
**MANHOLE  
REDUCER SLAB**  
Storm Drain

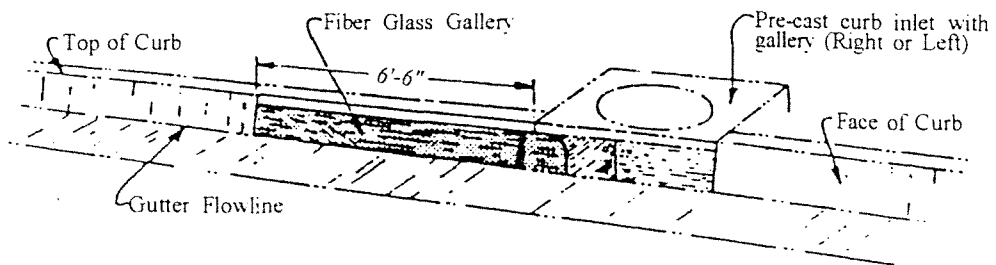
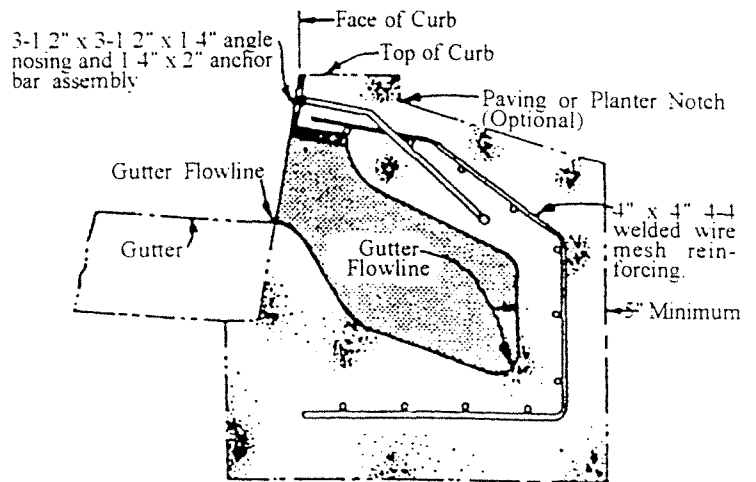
Drawn By:  
**Butch Smith**  
Scale:  
N. T. S.  
Date:  
February 9th 1998 (Rev.)  
File Number:  
Std. Det. SDS0000.405





**NOTE:**

1. Concrete shall be 3000 p.s.i. at 28-days.
2. Nosing assembly (angle and welded anchor bars) shall be hot dipped galvanized after fabrication per ASTM Spec. A123-59
3. Either cast-in-place or precast units are acceptable.



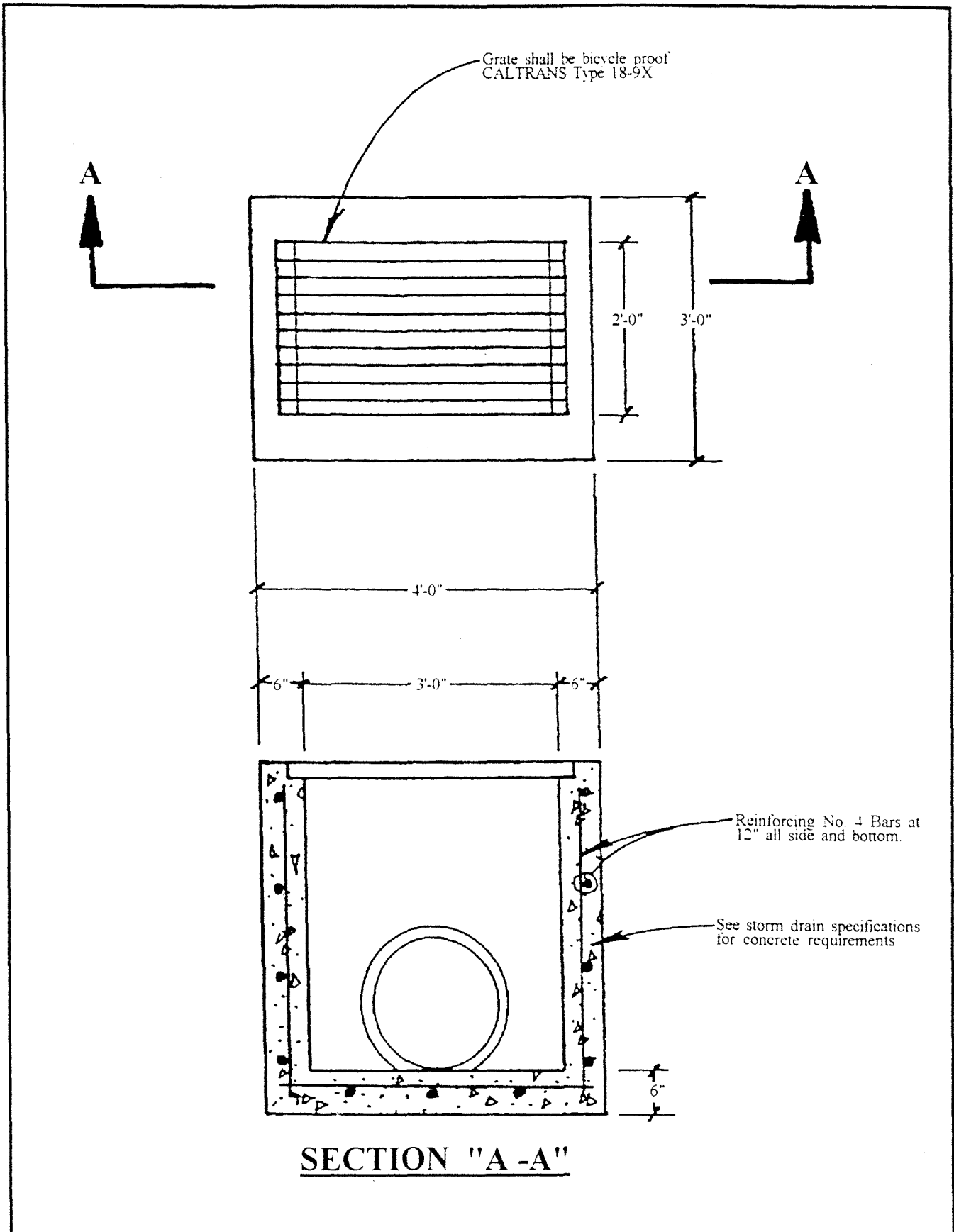
**CITY OF PETALUMA**  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 707 778 4304 - Fax 707 778 4437

Approved By:  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22706

Standard  
**CATCH BASIN**  
**GALLERY**  
 Storm Drain

Drawn By:  
**Butch Smith**  
 Scale:  
 N. T. S.  
 Date:  
 February 9th 1998 (Rev.)  
 File Number:  
 Std. Det. SDS0000.406





**CITY OF PETALUMA**  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
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Approved By:  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22706

Standard  
**DROP  
 INLET**  
 Storm Drain

Drawn by:  
 Butch Smith  
 Scale:  
 N. T. S.  
 Date:  
 February 9th 1998 (Rev.)  
 File Number:  
 Std Det. SDS0000 407

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 407

PLEASE REFER TO CITY STANDARDS  
219.1 - 219.3



**CITY OF PETALUMA**

**PUBLIC WORKS & UTILITIES**  
UTILITIES DIVISION

202 N. McDOWELL BLVD. TEL. 707-778-4546  
PETALUMA, CALIFORNIA 94954 FAX. 707-778-4508

**STANDARD TRENCH  
DETAILS**

DATE: JAN 7, 2019

SCALE: N.T.S.

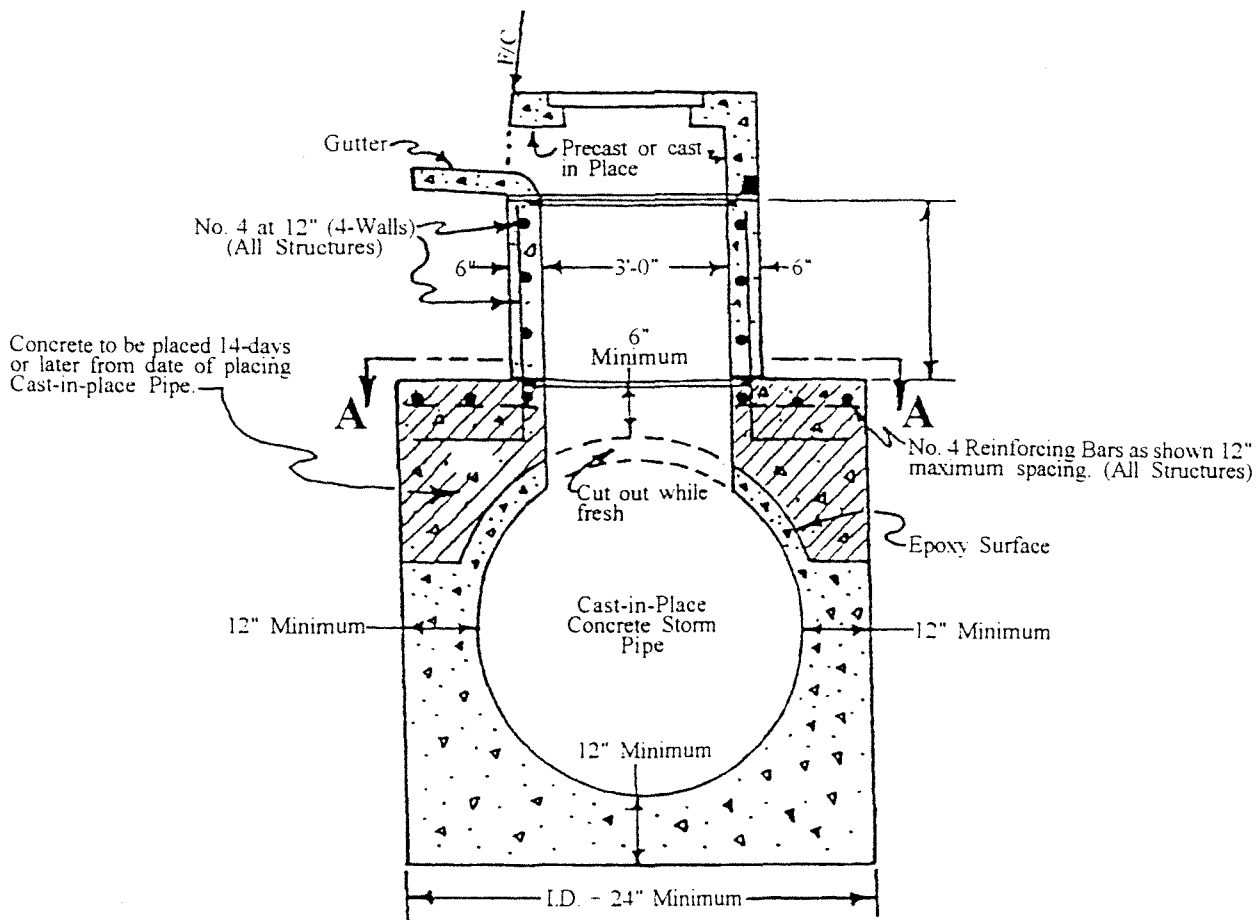
APPROVED BY:

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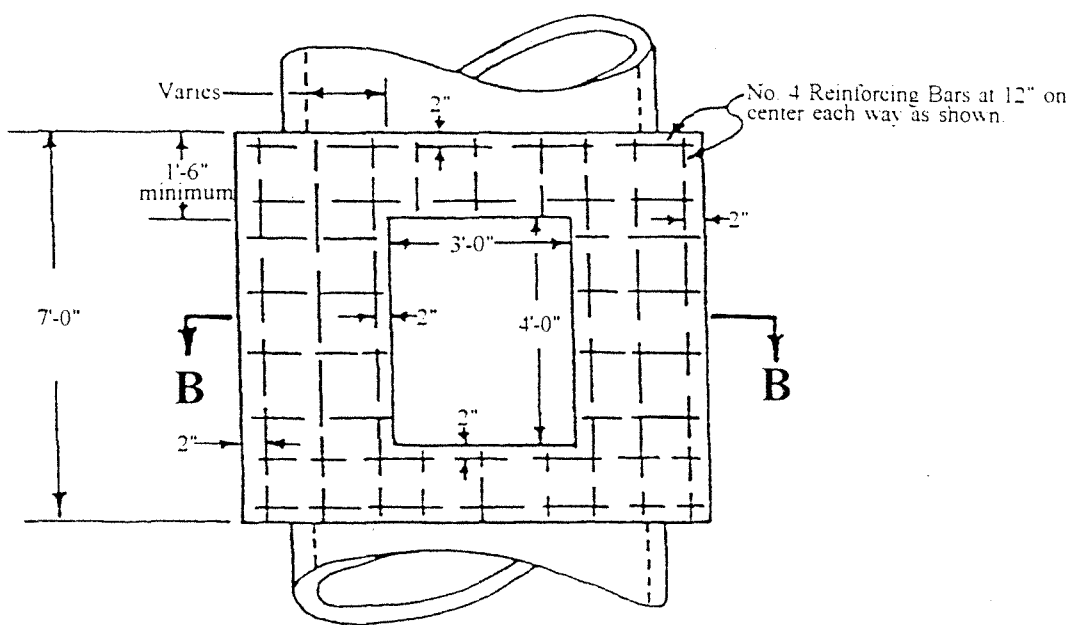
Kent R. Carothers, P.E. Operations Manager C60671

DRAWN BY: TKM

NO. 408



**SECTION "B-B"**



**SECTION "A-A"**

**CITY OF PETALUMA**  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 707 778-4304 - Fax 707 778-4457

Approved By  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22366

Standard "Type A"  
**CATCH BASIN**  
 Over Cast-in-Place Pipe  
 Storm Drain

Drawn by  
**Butch Smith**

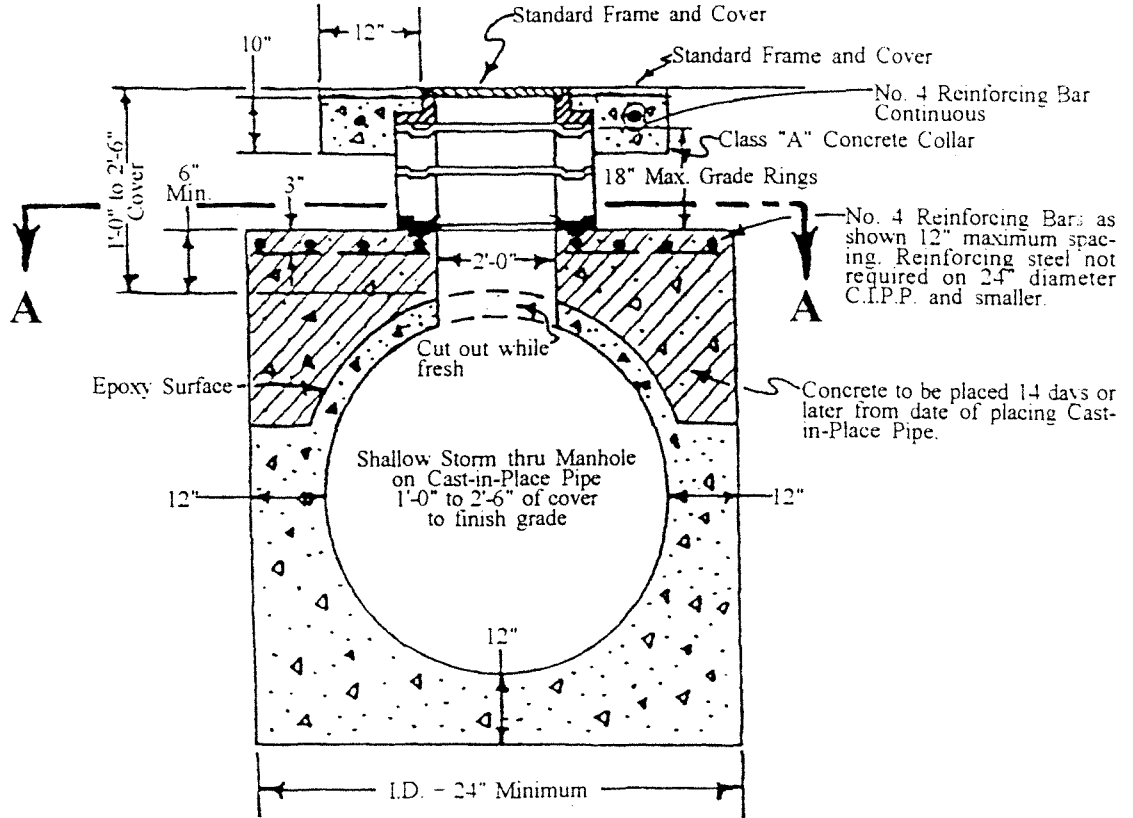
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**N. T. S.**

Date  
**February 9th 1998 (Rev.)**

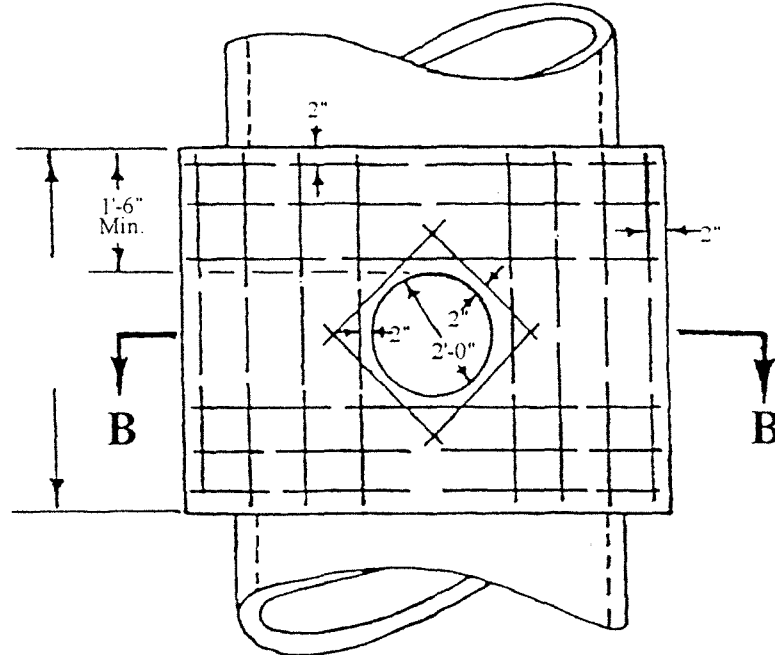
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**SECTION "B-B"**



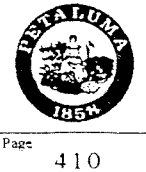
**SECTION "A-A"**

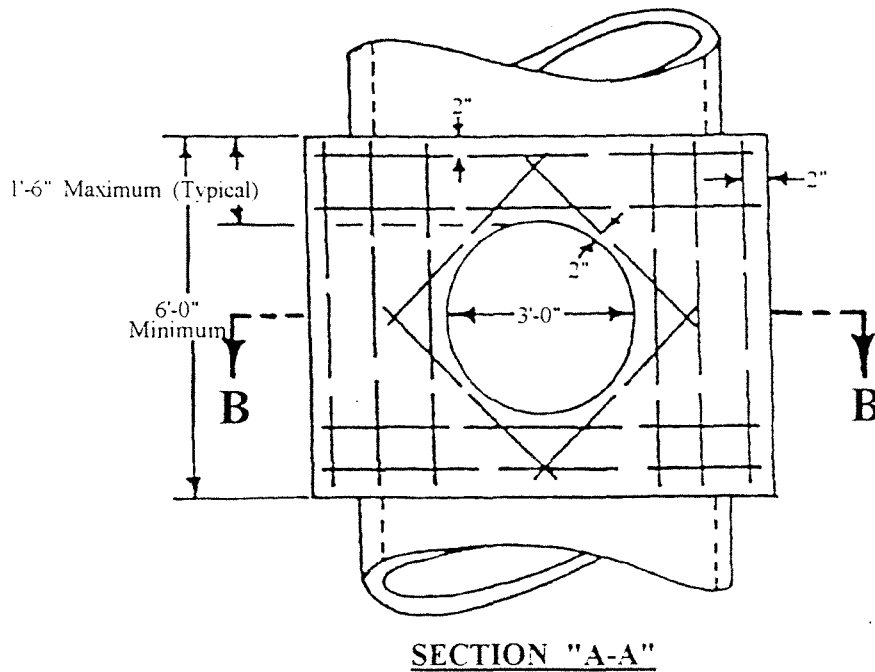
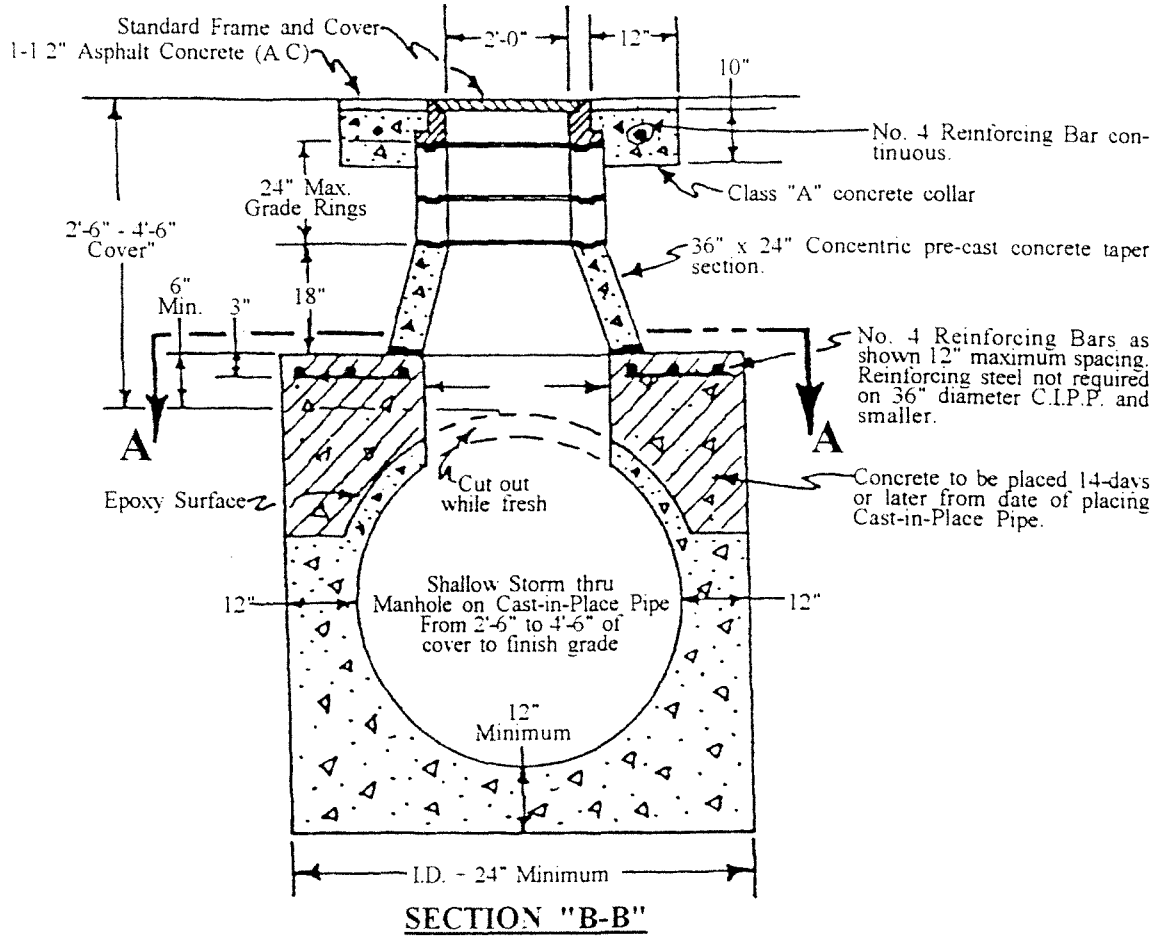
**CITY OF PETALUMA**  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 707-784304 - Fax 707-784445


Approved By  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22266

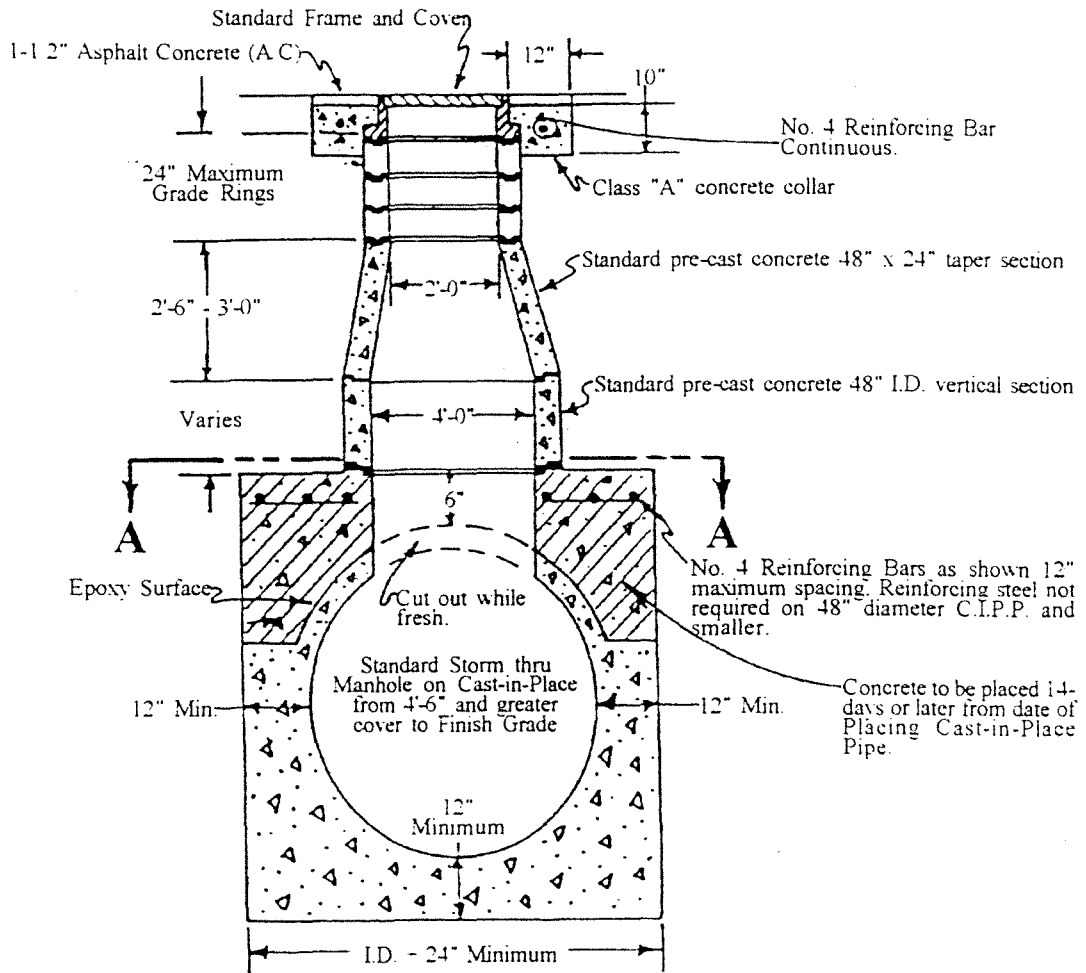
Standard  
**STORM DRAIN  
 MANHOLE**  
 Over Cast-in-Place Pipe  
 1.0' to 2.5' of Cover

Drawn By  
**Butch Smith**  
 Scale:  
 N. T. S.  
 Date  
 February 9th 1998 (Rev.)  
 File Number  
 Std. Det. SDS0000 410

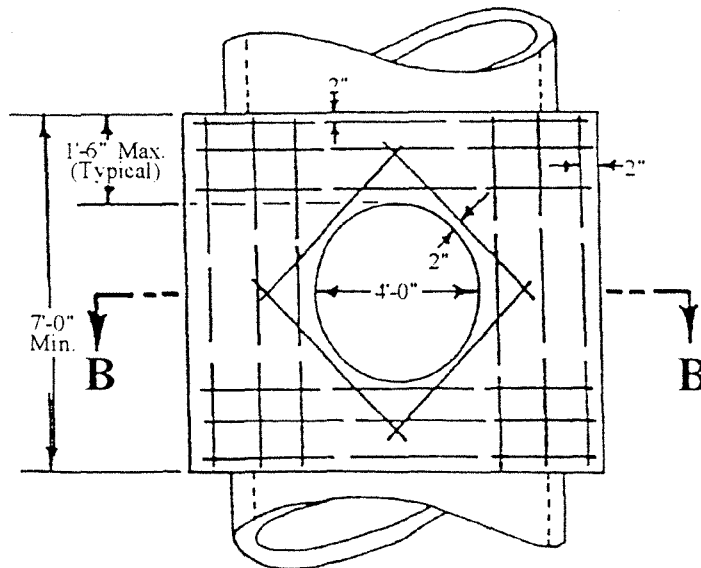




<p><b>CITY OF PETALUMA</b> Department of Engineering 22 Bassett Street - Petaluma California 94952 07-78 4304 - Fax 07-78 4437</p>	<p>Standard <b>STORM DRAIN MANHOLE</b> Over Cast-in-Place Pipe 2.5' to 4.6' of Cover</p>	<p>Drawn By Butch Smith Scale N T S Date February 9th 1998 (Rev.) File Number Std. Det SDS0000.411</p>	 <p>Page 411</p>
<p>Approved By <i>Thomas S. Hargis</i> Thomas S. Hargis - R.C.E. 22866</p>			



**SECTION "B-B"**



**SECTION "A-A"**

**CITY OF PETALUMA**  
 Department of Engineering  
 22 Bassett Street - Petaluma California 94952  
 707 778 4304 - Fax 707 778 4437

Approved By:  
*Thomas S. Hargis*  
 Thomas S. Hargis - R.C.E. 22566

Standard  
**STORM DRAIN**  
**MANHOLE**  
 Over Cast-in-Place  
 4.5' and Greater Cover

Drawn by:  
 Butch Smith  
 Scale:  
 N. T. S.  
 Date:  
 February 9th 1998 (Rev.)  
 File Number:  
 Std. Det. SDS0000 412



City of Petaluma  
Petaluma, California

STORM DRAIN INSTALLATION  
DETAIL SPECIFICATIONS NO. 31

Description

- 3101.1 Description. The work shall include the furnishing of all material, labor, tools, implements, and equipment necessary to construct the storm drains, drop inlets, and manholes, complete and ready to operate; all construction to be in accordance with the details shown on the plans and with these specifications.

Materials

- 3102.1 Portland Cement Concrete. Portland Cement Concrete shall conform to the requirements of Section 90 of the Standard Specifications and as herein specified. The concrete shall be Class "A" containing size (6) sacks of Portland Cement per cubic yard of concrete. The grading of the combined aggregate shall conform with the requirements for one and one-half (1-1/2) maximum. The consistency of the fresh concrete shall be such that the slump does not exceed four (4") inches as determined by Test Method No. California 519A.
- 3102.2 Portland Cement. Portland Cement shall conform to ASTM Designation C150.67, Type II, and shall be delivered in the original package with the brand name of the manufacturer plainly marked thereon.
- 3102.3 Reinforcing Steel. Reinforcing Steel shall be intermediate grade steel of the sizes and spacings called for on the plans. Steel shall meet the requirements of the ASTM Designation A-15-65.
- 3102.4A Reinforced Concrete Culvert Pipe. The storm sewer shall be constructed in accordance with Section 65-102A of the State Specifications or where called for on the plans shall be centrifugally spun reinforced concrete pipe with self-centering type joints as manufactured by the American Pipe & Construction Company or approved equal. The pipe shall be manufactured in accordance with the design requirements for Class III (unless otherwise indicated on the plans) reinforced concrete pipe, ASTM Designation C76-66T. The wall design shall be at the option of the manufacturer.
- 3102.4B Cast in Place Concrete Pipe. Cast in place concrete pipe shall conform with Section 63 of the Standard Specifications. After the pipeline has been completed and protected for at least forty-eighty (48) hours and/or the concrete strength reaches one thousand (1000) psi, the subsequent backfill may be installed in accordance with Section 3103.8B of this specifications.

In all cases, the contractor shall be responsible for correcting any damage to cast-in-place concrete pipe caused by premature or excessive loading.

At the option of the contractor, Class III reinforced concrete pipe, conforming to Section 3102.4, may be substituted for cast-in-place concrete pipe. Pipe and installation shall conform to Section 65, "Reinforced Concrete Pipe", of the Standard Specifications, except that backfill shall conform to the provisions under Section 3103.8, "Backfilling", of these specifications. Regardless of which optional material the contractor selects, pipe laid at the locations shown on the plans for cast-in-place concrete pipe will be paid for at the contract price per linear foot for cast-in-place concrete pipe, which includes payment for excavation and backfill, as provided under Section 3103.13A, "Payment", of these provisions.

3102.4C Abestos Cement Pipe. The storm sewer shall be constructed with asbestos cement pipe culvert conforming to Section 64-1.02 and 64-1.03 of the January 1973 Standard Specifications of the Department of Public Works Division of Highways, State of California. The asbestos cement pipe shall be Class III, unless shown otherwise on the plans or specified in the Special Provisions and designated in the contract item. Section 3103.7 of these specifications shall not apply when asbestos cement pipe is used in a storm drain culvert.

3102.4D Corrugated Aluminum Pipe. The storm sewer shall be constructed with corrugated aluminum pipe conforming to Section 66-2 of the January, 1973, Standard Specifications of the Department of Public Works, Division of Highways, State of California. The pipe shall be either riveted or spirally corrugated.

The gauges shall be in accordance with the U.S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, 1970 revision, titled, "Corrugated Metal Pipe-Structure Design Criteria & Recommended Installation Practice". Fill Height Table 8 for circular pipe and Fill Height Table 14 for arch pipe.

3102.4E Corrugated Polyethylene Pipe. The storm sewer pipe shall be constructed of high density polyethylene (HDPE) in conformance with AASHTO Specifications M-294 latest addition, nominal diameters 15" through 36".

Minimum pipe stiffness at 5% deflection per ASTM D-2412 shall be as follows:

<u>Diameter</u>	<u>Stiffness</u>
15"	42
18"	40
24"	34
30"	28
36"	22

The HDPE storm pipe shall have outer corrugation with smooth inner liner. The Mannings "n" factor for the interior of the pipe shall be a minimum of 0.012.

Minimum allowable cover shall be 24" to finish grade. Maximum cover shall be in accordance with the HDPE pipe manufacturer's recommendations. Pipe shall be N-12 as manufactured by Advanced Drainage Systems, Inc., Hancor, Inc., or equal.

Joints

Pipe shall be joined with the bell-and spigot joint and shall provide a minimum pull-apart strength of 400 lbs. The bell shall be an integral part of the pipe.

The joint shall use a gasket for form a silt-tight connection. Gaskets shall be installed in the bell by the pipe manufacturer. Joints shall remain silt-tight when subjected to a 1.5° axial misalignment.

3102.5 Reinforced Concrete Manhole Sections. These sections shall conform to size, shape and details shown on the plans. Pipe sections shall conform to ASTM Specification C76-66T, Class II. A minimum of one cage of reinforcing is required, the cross-sectional area of which is equal to that specified for the inner cage of the above ASTM Specification.

3102.6 Castings. Castings for manhole rings, cover and other purposes, shall conform accurately to the form and dimensions shown on the detailed drawings. Castings must be of workmanlike finish, free from blow and sandholes or defects of any kind, and shall be made from a superior quality of tough even-grained gray iron, and shall possess a tensile strength of not less than twenty thousand (20,000) pounds per square inch.

Before leaving the foundry, they shall be thoroughly cleaned and coated by dipping in asphalt applied at a temperature of three hundred (300) degrees Fahrenheit in such a manner as to provide a firm, durable, tenacious coating.

3102.7 Mortar. All mortar used in the construction of pipe joints and manholes shall consist of one (1) part by volume of Portland Cement and two (2) parts by volume of clean sand, and shall otherwise conform to Section 65-1.06A of the Standard Specifications.

3102.8 Select Backfill Material. Select backfill shall be granular material of the quality herein specified. Select backfill material shall have a size and gradation falling within the following limits:

<u>Sieve Size</u>	<u>% Passing Sieve</u>
1"	100
3/4"	90 to 100
No. 4	35 to 55
No. 30	10 to 30
No. 200	2 to 9

The material shall compact to a relative compaction of ninety (90) percent. The relative compaction is that determined by Test Method No. California 216 Materials and Research Department, California Division of Highways. The material shall have a minimum sand equivalent value of twenty-five (25) as

determined by the test method currently in use by the California Division of Highways.

The in-place density and moisture of solid and aggregates may be determined by the use of nuclear methods and the area concept as per Test Method No. California 231 with the following conditions. The test maximum density shall be determined as specified in Part II of Test Method No. California 216. A minimum of one in-place density test using the sand volume method as prescribed in Part I of Test Method No. California 216 shall be taken to standardize the nuclear gauge for each type of soil or aggregate. After correlation is assured and the equipment standardized then the nuclear gauge may be used as directed by the Engineer.

### Construction Methods

- 3103.1 Trench Excavation. Trench excavation shall include the removal of all materials or obstructions of any nature, the installation and removal of all sheeting and bracing and the control of water, necessary to construct the work as shown. Unless otherwise indicated on the drawings or permitted by the Engineer, excavation for storm drains shall be by open cut. Trenching machines may be used, except where their use will result in damage to existing facilities. Trenches shall be excavated to the line and grade shown on the plans.
- 3103.2 Trench Width. The maximum allowable width of trench measured at the top of the pipe shall be the outside diameter of the pipe exclusive of bells and collars, plus twenty-four (24) inches, and such maximum width shall be inclusive of all trench timbers. Minimum width of trench shall be outside diameter, plus eighteen (18) inches. Whenever the maximum allowable trench width is exceeded for any reason, the contractor shall, at his expense, embed or cradle the pipe in concrete in a manner satisfactory to the Engineer.
- 3103.3 Bracing & Shoring. The contractor's attention is directed to Section 3(f), "Excavation and Trenching Safety", of the General Provisions. Excavation shall be supported as set forth in the rules, orders and regulations of the California Industrial Accident Commission. Failure to comply with any of these rules, orders and regulations shall be sufficient cause for the Engineer to immediately suspend all work. Compensation for losses incurred by the contractor by such an emergency suspension shall not be allowed. During backfilling the bottom of the shoring shall be kept above the level of the backfill at all times.
- 3103.4 Control of Water. The contractor shall furnish, install and operate all necessary machinery, pumps and equipment to keep excavations reasonably free from water during construction, and shall dispose of the water so as not to cause injury to public or private property, or to cause a nuisance or a menace to the public. He shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies and shall have available at all times competent mechanics for the operation of all pumping equipment. During pouring of concrete and until concrete has set hard, excavations shall be kept free of water.
- 3103.4A Trench Bottom Drainage & Stabilization. When additional gravel or crushed rock are required to stabilize a soft, wet or spongy foundation caused by the operations

of the contractor, such gravel or crushed rock shall be furnished at the contractor's expense.

The Engineer shall be the sole judge of the suitability of the trench bottom and as to the amount of gravel required to stabilize a soft foundation. The contractor shall remove any soft material and replace it with gravel or crushed rock when ordered to do so by the Engineer.

Gravel or crushed rock shall have a size and gradation falling within the following limits:

<u>Sieve Size</u>	<u>% Passing Sieve</u>
2"	100
1 1/2"	90 to 100
3/4"	5 to 30
3/8"	5 to 20
No. 200	0 to 4

Payment for trench bottom drainage and stabilization shall be made at the contract unit price bid per ton of gravel or crushed rock in place, complete including excavation and disposal of soft material and dewatering the trench.

3103.5 Disposal of Excess Excavated Material. Arrangements for disposing of excess excavated material shall be made by the contractor. Excavated material suitable for backfilling shall be stored temporarily in such a manner as will facilitate work under the contract and not cause undue inconveniences to property owners along the sewer route.

3103.6 Pipe Laying. No pipe shall be laid until the Engineer inspects and approves the condition of the bottom of the trench. Pipe laying shall proceed upgrade with the tongue ends of tongue and groove pipe pointing in the direction of flow. Each piece shall be laid true to line and grade and in such a manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line.

As the work progresses, the interior of the storm drain shall be cleared of all dirt and debris of every description. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At time when work is not in progress, open ends of pipe and fittings shall be closed.

Pipe shall be placed on prepared subgrade of imported material at least four (4) inches deep below the barrel of the pipe. The imported material shall meet the requirements specified herein for "initial backfill" and be thoroughly compacted to obtain a final density of at least ninety (90) percent of maximum at optimum moisture as determined by Test Method No. California 216. After compaction, the bottom of the trench shall be shaped so the pipe, when laid, will have a uniform bearing under the full length of the pipe.

3103.7 Pipe Jointing. Joints in pipes eighteen (18) inches in diameter and smaller shall be made prior to closure by buttering with mortar the joint space of the bell end of



the pipe section previously laid. After inserting the spigot, the excess mortar squeezed from the joint shall be removed by an inflated swab or squeegee. Joints in pipe twenty-one (21) inches in diameter and larger shall be made by partially filling the inside joint with mortar after the pipe has been laid and before the initial backfill has been placed. No mortar will be required in the outside joints of tongue and groove pipe. After the final backfill has been placed and completely compacted by jetting, joints in pipe twenty-one (21) inches in diameter and larger shall be finished by completely filling the inside joint with mortar. Before final acceptance, the joints shall be left smooth without any abrupt rise or drop in the flow line and without any cracks which will permit leakage.

The connecting bands for corrugated aluminum pipe shall conform to the requirements of AASHO M-106.

3103.8 Backfilling.

3103.8A Initial Backfill. "Select Backfill Material" as specified in Section 3102.8 of these specifications shall be used for initial backfill. After the pipe has been properly laid and inspected, select backfill material shall be placed on both sides and over the pipe to such a depth that after thorough compaction, the final depth shall be at least twelve (12) inches above the top of the pipe. The contractor shall be wholly responsible for damage to the pipe.

The initial backfill shall be compacted by hand tamping. The use of machine tampers will not be permitted. The initial backfill material shall be hand tamped in layers not exceeding four (4) inches in uncompacted depth. The final depth of compacted initial backfill shall be at least twelve (12) inches above the top of the pipe.

After handtamping, the relative compaction of the initial backfill material shall be not less than ninety (90) percent as determined by Test Method California No. 216.

3103.8B Subsequent Backfill. Above the level of the initial backfill, the trench shall be backfilled with structural backfill (excluding pea gravel) as specified in Paragraph 19-3.06 Structure Backfill of the State of California, Department of Transportation, Standard Specifications, dated January 1988. Unless otherwise specified in the special provisions or certified by an approved soil testing laboratory that the native trench excavated material meets the requirements of structural backfill as stated above - native excavated trench material shall not be used for backfill in any portion of the trench.

The contractor shall compact by tamping and/or rolling, the backfill material in layers not exceeding eight (8) inches in loose depth, each layer being thoroughly compacted by tamping and/or rolling before succeeding layers are placed. "Stomper" type equipment for compaction shall not be permitted. Vibrating equipment that does not damage the pipe or adjacent facilities may be used for compaction.

Subsequent backfill compacted by tamping and/or rollings shall be free from stones or lumps exceeding three (3) inches in greatest dimension, vegetable matter, or other unsatisfactory material, and shall be compacted to a relative compaction of not less than ninety (90) percent as determined by Test Method No. California 216, except that within two and one-half (2 1/2) feet of finished

permanent surfacing grade the relative compaction shall not be less than ninety-five (95) percent. The contractor will be charged for the cost of all compaction tests where the test results do not meet the above specifications.

3103.8C Re-excavation. If the compaction requirements as specified above are not met, the trench shall be re-excavated. Backfill material shall then be compacted by tamping and/or rolling as specified above until the compaction requirements are satisfied.

3103.8D Restoration of Existing Facilities. Whenever existing improvements, such as pavements, curbs, gutters, sidewalks, driveways, storm drains, sanitary sewers, laterals, utilities, utility services, etc., have been cut or damaged in order to construct storm drains and appurtenances, the backfill shall be thoroughly compacted and all improvements restored to their original conditions. The cost of restoring all original improvements shall be included in the unit bid price for storm sewer pipe, or appurtenances, and no additional allowance shall be made therefor.

3103.9 Subgrade Preparation. The finished subgrade immediately prior to placing base material thereon shall have a relative compaction of not less than ninety-five (95) percent, for a depth of two and one-half (2 1/2) feet below finished permanent surfacing grade, as determined by Test Method No. California 216. Mud or other soft or spongy material shall be removed and the space filled with select backfill material and rolled or tamped in layers not exceeding eight (8) inches in thickness until the above relative compaction requirement is satisfied. Subgrade preparation is not required in unimproved areas where trench surfacing is not required.

3103.10 Trench Surfacing.

3103.10A General. Where an unimproved surface is encountered the trench shall be restored to its original surface.

Where a gravel surface is encountered, it shall be replaced over the width of the trench with Class 2 Aggregate Base six (6) inches in depth as specified in Section 26 of the Standard Specifications. Where the existing surface is some type of asphalt concrete, it shall be restored with a temporary surface followed by a permanent surface as specified herein.

3103.10B Temporary Surfacing. The temporary surfacing shall be Class 2 Aggregate Base as specified in Section 26 of the Standard Specifications. The aggregate base shall be equal in depth to the existing pavement structural section, but in any case not less than fourteen (14) inches in depth.

The aggregate base shall be given a penetration treatment as specified in Section 36 of the Standard Specifications. Liquid asphalt used for the treatment shall be grade MC-70 or SC-70. The rate of application of the liquid asphalt shall be the maximum that will, under favorably weather conditions, be completely absorbed by the base material within twenty-four (24) hours from the time of application. A sufficient amount of liquid asphalt shall be applied to bind the aggregate base and prevent raveling. Care shall be taken that no liquid asphalt is applied to the adjoining pavement surface.

All temporary surfacing shall be laid within two (2) days after backfilling. Before the street is opened for traffic, all excess dirt, rock and debris shall be removed and the street surface shall be swept clean. Temporary surfacing shall be maintained constantly so that at no time will there be any mudholes nor shall the surface settle below one (1) inch nor be raised more than one (1) inch from the existing pavement. All temporary asphalt shall comply fully with the Bay Area Air Quality Management District's Regulation 8, Rule 15.

Section 302 of Rule 15 prohibits the use of "cut back" asphalt (including MC-70) during the months of April through October in paving material or in paving and maintenance operations. The contractor shall use only slow-cure (SC) liquid asphalts for temporary trench paving during April through October.

3103.10C Permanent Surfacing. Permanent surfacing shall not be constructed until the compaction requirements of Section 3103.8 of these specifications are satisfied. The wearing surface for permanent surfacing shall be replaced "in kind", but in no case shall the new surfacing be less than two (2) inches thick for asphalt concrete or less than six (6) inches thick for Portland Cement Concrete. A permanent surface shall be installed no later than ten (10) calendar days from completion of backfill.

3103.10C1 Asphalt Concrete. The existing pavement shall be neatly cut to a depth of two (2) inches and removed to at least five (5) inches outside each side line of the pipe trench to permit proper keying in the restored pavement. The existing pavement cut shall be straight, vertical and with no ragged edges.

The base course for permanent surfacing shall be Class 2 aggregate base as specified in Section 26 of the Standard Specifications. The aggregate base shall be equal in depth to the existing pavement structural section, but in any case not less than twelve (12) inches in depth.

The wearing surface for permanent surfacing shall be asphalt concrete two (2) inches minimum in depth. The asphalt concrete shall be "Type B Asphalt Concrete" with one-half (1/2) inch maximum, medium grading aggregate conforming to the requirements of Section 39 of the Standard Specifications.

3103.10C2 Portland Cement Concrete Paving. The existing pavement shall be neatly sawcut to a minimum depth of two (2) inches and at least five (5) inches outside each side line of the pipe trench to permit proper keying in the restored pavement. The contractor shall chip along the edge of the existing concrete pavement and remove all loose pieces prior to replacing the wearing surface for permanent surfacing.

The base course for permanent surfacing shall be Class 2 aggregate base as specified in Section 26 of the Standard Specifications. The aggregate base shall be equal in depth to the existing pavement structural section less six (6) inches, but in any case not less than six (6) inches in depth.

The wearing surface for permanent surfacing shall be Portland Cement Concrete in conformance with Section 90 of the Standard Specifications.

3103.11 Storm Sewer Manholes. Storm manholes shall be reinforced concrete, constructed at the locations shown on the plans and to the form and dimensions shown on the detailed plans.

In the construction of reinforced concrete manholes, joints shall be made in the same manner and sequence as heretofore specified for reinforced concrete pipe, tongue and groove jointed.

The storm sewer pipe shall be carried through the manhole structure and the concrete base of the manhole shall be constructed around the pipe. The top of the pipe shall be broken out flush with the inside of the manhole wall and top of platform. Pipe stubs for main and lateral sewers shall be built into the structure as shown on the plans.

- 3103.12 Drop Inlets. Drop inlets shall be constructed to the lines and grades shown on the plans and in accordance with the provisions of Sections 51 and 70 of the Standard Specifications as herein modified. Inlet boxes shall conform to "Type A Inlets" as detailed on the plans, or as otherwise specified.

The floor and the walls of the inlet box may be poured monolithically using Class "A" Concrete. "Ordinary Surface Finish" shall be applied to all the inside surfaces of the box. No concrete shall be poured when subgrade is excessively wet. The interior of the box shall be kept free of dirt, excess mortar and other foreign materials and shall be left clean at the completion of the inlet lateral.

Backfill around the completed drop inlet shall be thoroughly tamped into place by use of pneumatic tamper where possible, or other means approved by the Engineer. The relative compaction shall be ninety-five (95) percent.

- 3103.13 Payment.

- 3103.13A Storm Sewer Pipe. Quantities for payment shall be made by measuring horizontally along the centerline of the storm drain less the design distance between the ends of the pipe in manholes through which the pipe does not pass. Whenever split pipe is required through a manhole, such pipe shall be included in the measurement.

The contract unit price per linear foot for reinforced concrete pipe or cast-in-place concrete pipe shall include full compensation for all costs necessary and incidental to the complete installation of the concrete pipe storm sewer of the designated size and class, as specified herein and as designated on the plans.

- 3103.13B Storm Sewer Manholes. The contract unit price per each for "Storm Sewer Manholes" of the applicable diameter, four (4) feet or five (5) feet shall include full compensation for all costs necessary and incidental to furnishing and installing a storm sewer manhole complete including excavation, backfill, ring and cover, as herein specified and detailed on the plans. The cost of setting the manhole cover to grade after the asphalt concrete pavement is placed shall not be included in the contract unit price per each for storm sewer manhole, but paid for under asphalt concrete paving.

- 3103.13C Drop Inlets. The contract unit price for each "Drop Inlet" in place shall include full compensation for furnishing all labor, materials, tools, equipment and performing all work necessary to complete the drop inlet, including backfilling, and no additional allowance will be made.

3103.13D Cast In Place Payment. The contract unit price per linear foot measured along the centerline of the pipe shall include full compensation for the pipe in place including excavation, curing and backfill.

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