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16. Abstract

This report evaluates the drainage on some 25 viaduct type structures. The maintenance problems are discussed and methods of reducing the plugging of the drains are suggested.

Recommendations are made for design specifications to significantly reduce future maintenance costs from drain plugging.

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BRIDGE DECK DRAINS

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BRIDGE DECK DRAINS

INTRODUCTION

The maintenance of bridge deck drainage systems is an always difficult, sometimes dangerous, and usually expensive problem. Old drainage systems pose a particularly difficult maintenance problem because they usually have undersized pipe with angle bends and small catch basins. Dry roadway debris collects in catch basins and spills into drainpipes where it often causes a plug with the first shower. However, there are no known instances in California of deck drainage systems being hydraulically inadequate if they are clear of debris.

The drainage problem is especially common on long, flat viaducts. To prevent water from impinging on the traveled way it must be collected at many intermediate points and drained off. Viaducts in metropolitan areas pose an additional drainage problem in that collected water is usually directed to an underground drainage system through a complex plumbing network which often cannot be accessed from the bottom.

Deck drains will usually fill with debris during the dry summer months. Maintenance crews typically conduct an annual cleanout operation just prior to the rainy season to minimize the plugged drain problem.

NCHRP Synthesis of Highway Practice 67 states that on a section of Chicago Expressway some drains pass 6 tons of debris per year. Even if this large amount of debris would pass through the bridge drainage system without plugging, it would pose a significant removal problem in catch basins and sewer systems. The continued regular and consistent power sweeping of California viaduct decks is certainly the better method of getting large amounts of debris off the deck.

The seriousness of the bridge deck drain problem has been recognized in California for many years and there have been many changes in drainage system concepts in attempts to eliminate the plugging of deck drainage systems.

The changes have included revised catch basin shapes, flushing systems, baffles over drainpipe inlets and elimination of angular bends in drain pipes.

OBJECTIVE

The objectives of this research are:

1. To evaluate, on a statewide basis, the seriousness of the plugged drain problem.

2. To evaluate the effectiveness of existing types of bridge deck catch basins.

3. To evaluate the effectiveness of existing catch basin flushing systems.

4. To design and field test a new type bridge deck catch basin.

5. To modify and field test existing flushing systems.

6. To establish guidelines for designing bridge deck drainage systems.

RESEARCH PROCEDURE

1. Correspondence with other States.

Letters were written to other State Highway Departments to determine what problems they were experiencing with deck drainage systems. The letters requested information on their designs, such as standard and special details and flushing systems. Information concerning the seriousness of the plugging problem, cleaning procedures, and costs of maintenance were also requested.

All of the States contacted reported experiencing difficulty with keeping deck drains operational, especially those with complicated plumbing systems. Those drains with "through deck" designs were the most trouble free and were generally used whenever possible. Also the effort necessary to clear the drains with plumbing systems was considerably greater than with the "through deck" type. The information received confirmed that maintaining bridge deck drains is a universally difficult and costly problem. The costs of maintaining bridge deck drains however are unfortunately usually combined with maintaining highway drainage and are therefore difficult to determine.

2. Interviews with Maintenance Personnel

Interviews were conducted with Highway Maintenance superintendents and their personnel to try to determine and isolate the main problems with maintaining bridge deck drains. These interviews were held in Sacramento, San Francisco, Oakland, Stockton, Bakersfield, Los Angeles, and San Diego.

In Sacramento, which is typical for all maintenance areas, the street sweeper is usually the culprit as far as filling the catch basins with debris. As it sweeps along the shoulder it pushes the debris ahead of the broom and into each catch basin. The cleaning schedule for deck drains is generally twice a year, once in September-October and again in January. A vacumn device called a ECOLOTEC is often used to clear catch basins. It is basically a very large and powerful vacuum cleaner mounted on a large truck.

It works fairly well for cleaning debris out of catch basins; however, it does jam easily. The cost of cleaning a bridge deck drain catch basin in Sacramento was $11.86 per drain in 1977.

San Francisco has the same catch basin loading problem and in addition, due to the older type of drainage systems, the drain pipes plug more often. The older type plumbing has welded mitered joints which plug more easily. The intermittent light rains which occur during the summer wash some debris into the drain pipes where it sometimes dries and forms a plug. Maintenance personnel clean drains by using a water truck and a hose to wash out the catch basin and jet clean the pipe itself. Hoses in the past have locked in the drainage pipe while jetting and had to be abandoned. This results from debris packing around the hose during the cleaning operation. Some plugged drains have also been abandoned because the drains could not be cleaned from the top and the outlet was inaccessible as it emptied into a storm drain. Sweepers cause the same problems as in other locations.

The older type catch basin with the vertical outlet pipe plugs much more easily than the newer side outlet type. Plastic bags, styrofoam packing materials and cups are some of the worst offenders for plugging San Francisco deck drains.

Oakland has basically the same problems as San Francisco, considering the occasional summer rains and the commercial traffic hauling grains, lumber products, etc. The long viaducts with their complicated plumbing systems, some of which are of older design, are very troublesome.

Bakersfield has a less critical situation as few viaducts are located there. These structures are still plagued with plugging, resulting mostly from the commercial hauling of cottonseed and sand, in addition to the regular road debris.

In Los Angeles the problems are similar to other areas but of greater magnitude due to the size of the metropolitan area. There are a great number of viaducts that continually present plugged drain problems. One of the most constant source of problems is the Santa Monica viaduct. This is due to its flat grade, extremely heavy volume of traffic, (one of the heaviest in the country) and length (over 4 miles).

San Diego's problems with plugged drains are minimal as it has newer structures and a minimum of long viaducts. The Mission Valley Viaduct has some problems due to its sag vertical curve profile. The design of the catch basins makes them difficult to clean. Problems with plugged deck drains in San Diego have generally been negligible.

The standard size crew for a deck drain cleaning operation is 4 to 5 men, a tanker truck, a "shadow" truck (truck used to shield maintenance workers from oncoming traffic) and a dump truck for debris. The size of the crew is governed by the location of the work, that is whether it is in a high or low traffic density area.

3. Installation of Catch Basin Modifications

During discussions concerning concepts for a better catch basin design, a common field suggestion was to use a baffle plate to shield the outlet of the catch basin. This baffle plate would help keep the catch basin outlet pipe free of dry debris. During a rain the water would flow over the baffle plate, into the catch basin, eroding away debris and flushing it into the pipe which had been kept clear of dry debris by the baffle plate.

In order to test this concept, a viaduct in the Sacramento area that was not open to traffic was selected as a preliminary test site. Four deck drains, adjacent to each other along the same rail, were prepared. Two of the drains were fitted with baffle plates. (Fig. 1-3). All four catch basins were filled with debris collected from other structures in the area. The debris was dropped through the grating, dampened and lightly tamped. The two drains with the baffle plate had a void around the outlet. This operation of artificially placing debris in the catch basin is not equivalent to natural placement, however, it gave us an indication of the merit of using baffle plates. Later inspections during and after storms clearly showed that the drains with baffle plates attached to their grates stayed open through more storms and were significantly more self cleaning. The debris which entered these drains, however, was all windblown. This structure carries no traffic and is not swept with a power broom.

Twelve other deck drains on structures in the Sacramento area were prepared for an additional test. These drains were on structures that were open to traffic. Seven of these drains were fitted with baffle plates. The other five were used as control drains. Later inspections during and after storms clearly showed that the drains with baffle plates attached to their grates stayed open at least 3 times as long as the drains without baffles.

4. Problems with Deck Drain Systems

During this research project, inspections of the different types of deck drain systems were conducted. This inspection was concerned mostly with the plugging problem and not the system's hydraulic characteristics. The types of deck drainage systems on California highway structures vary considerably. The older ones reflect the ideas of the designer when purely hydraulic capabilities were considered. Over the years thoughts were directed to the system's ability to be more maintenance free from clogging with debris. The older systems had vertical pipe inlets, flat slopes, mitered bends, welded joints, and other characteristics that increased their chances of becoming plugged. The newer

Fig. 1

Grand Ave OH (Br 24-288R/L)
Test Drain - hand packed from top with damp debris.

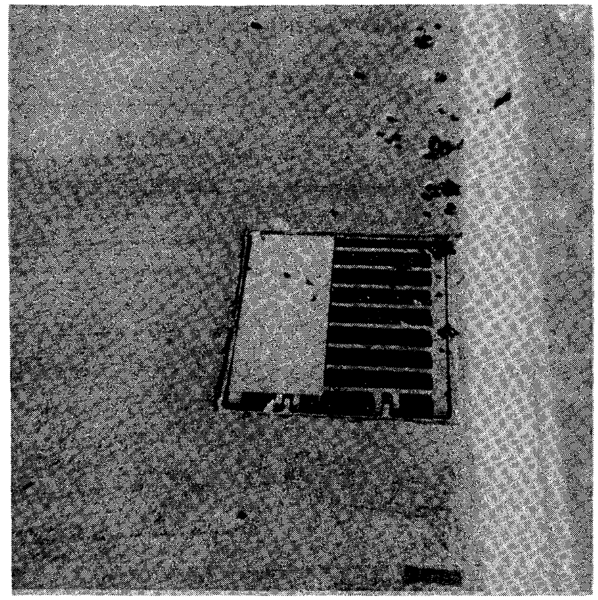

Fig. 2

Grand Ave OH (Br 24-288R/L)
Test Drain - After first rain. drain ran freely, no plugging.

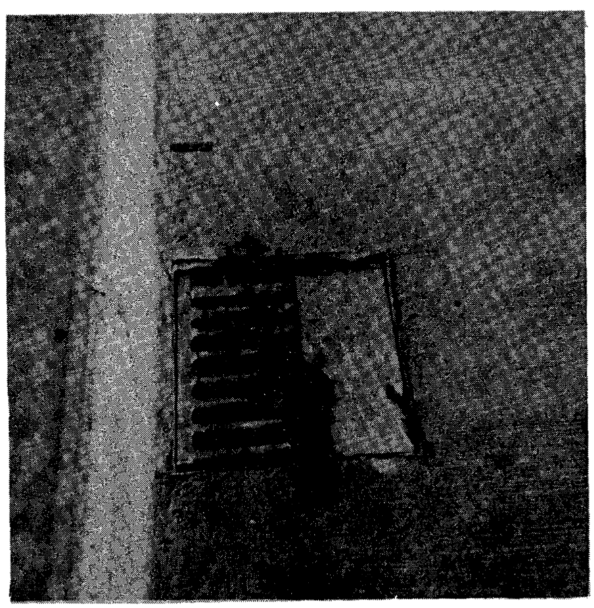

Fig. 3

Grand Ave OH (Br 24-288R/L)
Test Drain - later in same winter season. Drain still flowing.

systems are constructed with larger piping, adequate grades, large radius bends, and smooth joints, all of which reduce the chances of plugging.

The inspections includes structures in the areas where the interview of maintenance personnel were conducted. They included some of the oldest viaducts in the California Highway System and also some of the newest.

Older deck drain systems are sometimes topped by a grate which is cast into the deck concrete. This feature makes access to the outlet for cleaning purposes impossible. In old systems the drain pipe generally drops straight down before making a right angle mitered bend to pass beneath a girder. Debris fills this vertical pipe during the dry months practically guaranteeing a plug with the first rain and rendering the system useless. The only way this piping could be cleaned would be from the outlet and sometimes the deck drain system connects into an inaccessible city storm drain system. A maintenance man faced with this problem will often write that drain off. When the outlet is accessible, working a plumbers snake through all of the sharp (45°) mitered bends is next to impossible.

Later deck drains then incorporated the use of a removable grate. This was a big step forward for the maintenance of drains. The grate could be removed and the catch basin easily cleaned. But the vertical outlet pipe from the catch basin would still plug with debris. The common type mitered bends were notorious for catching sticks, paper cups, etc., which were followed by smaller debris that would plug the pipe. Some older, and a few newer drains have a reducer from a larger pipe to a smaller one (Colorado River Br at Yuma). This is an open invitation to a debris plug. Some older deck drain systems incorporate a longitudinal collector pipe which receives water from a number of deck drains. These generally are on a flat slope (therefore plug easily), and are difficult to clear because of poor access and a lack of cleanouts. At times there is a minimum amount of water and a maximum amount of debris and with a flat slope a plug is often the result.

Newer type deck drains systems have a number of innovations that reduce the amount of maintenance needed. One of these is the side outlet from the catch basin. This is done primarily to place the catch basin in the wide overhangs so common with the newer type structures. Its secondary effect is to shield the outlet pipe at the catch basin against debris that falls in the catch basin during the dry periods. The discharge pipe usually consists of smooth joints, large radius smooth bends, and the absence of flat slopes. One novel deck drainage system in Hawaii uses scuppers through the barrier rail and an overhang trough to catch the water and send it to large exterior mounted downspouts.

5. Deck Drain Flushing Systems

There are a number of deck drain flushing systems on structures in California's Highway System. Some of these are Fort Sutter Viaduct (Route 80) in Sacramento, Shattuck Avenue and College Avenue (Route 24) in Oakland and China Basin Viaduct (Route 280) in San Francisco. These flushing systems operate with varying degrees of success.

1. Fort Sutter Viaduct (Br. 24-188). The flushing system does not function well at all. The spray bar goes across the end of the catch basin over the outlet pipe and is shielded by a baffle plate. See Pages C-1 and C-2 in the appendix. Subsequently the flushing action is just in the vicinity of the outlet pipe and not the rest of the basin. The flushing system mains are only 1 inch plastic pipe. Each valve operates the spray bars in three catch basins. According to maintenance, the system has always suffered from a lack of pressure and volume. Maintenance forces do not use it.

2. Shattuck Avenue UC (Br. 33-411 R/L). The flushing system works somewhat better than at Fort Sutter Viaduct, but still suffers from a lack of water pressure and volume. One control valve controls spray bars in three catch basins from a 1-1/4 inch main. The spray bars run the length of the catch basin, which appears to be a better design. See Pages FS-1 and FS-2 in the appendix. As the location of the outlets is not known most of the debris is removed before any flushing is attempted. The catch basins are the standard "Type A". The outlets for the deck drain systems go directly into storm drains which deters the maintenance personnel from using the flushing system due to potential difficulties in clearing the pipe if a plug develops. Large debris is always removed before the flushing system is turned on.

3. Route 92/101 Separation (Br. 35-252 R/L). The flushing mains are 3 inch and 4 inch pipes which still do not provide adequate volume and pressure. Maintenance forces found that they could only flush one drain at a time. They also advised that when the drain is full of material the water will sometimes spray up and out toward traffic and cause a traffic hazard. They advise that it takes two days to check the drainage using the flushing system and only one day with a tank truck. This system is not used by maintenance forces because lane control is required in order to operate the valves which are located in the five foot shoulder close to the traffic lane and require difficult removal of a brass plug before they can be reached through a handhole. See Pages FS-3 to FS-10.

4. Huntington Avenue OH (Br. 35-253 R/L). The flushing mains are 4 inch pipe. The system is not used because the drains have serious operational problems and because they can be cleared and flushed safely and quickly using a

water truck and lane control. Some of the problems with the flushing system are:

1. The covers to the gate valve are located in the traffic lane and require a lane closure for access.

2. The covers have been "pounded" by traffic and cannot be removed without great diffculty.

3. The last time the system was operated it appeared that the backflow valves were frozen.

4. Some 25 man-weeks have been used in trying to get the system operable without success.

See Pages FS-11 to FS-13.

5. China Basin Viaduct (Br. 34-100). The water supply problems experienced with most other drain flushing systems does not exist here. The main supply is a 4 inch pipe and the supply to each control valve is a minimum of 2 inches for two catch basins and 3 inches for three catch basins. This total system has adequate volume and pressure, and does a more than adequate job of cleaning the catch basins. The flushing system is operated every 2 to 3 weeks to prevent a serious buildup of material in the drains. It takes two men about one hour. The majority of the catch basins are "Type A" with the spray bar extending the length of the box. There are several Type B inlets with the spray bar running across the end of the catch basin, which are also functioning satisfactorily.

6. Development of a Deck Drain Clearing Device

Plugged bridge deck drains have continuously plagued maintenance crews, especially when the obstruction is located in the outlet pipe. Drainage systems enclosed in the structure itself compound the problem and have made the job of clearing the plug difficult, if not impossible. Conventional methods of using water hoses, drain augers, and rodding oftentimes fail, especially in the complicated drainage systems of viaducts.

The Applied Research Section of the Office of Special Projects has developed a device which has effectively cleared many plugged deck drains which could not be cleared by conventional methods. It uses the technique of backflushing the plugged drain pipe from the outlet with air (or occasionally water), while a head of water is applied to the debris plug from the inlet. The combined effect of cycled air bubbling up and the water working down through the loosened debris plug breaks it up and washes it out.

This procedure is unique in that it is often possible to clear a plugged deck drain from the outlet during a rain with little or no exposure of maintenance personnel to traffic.

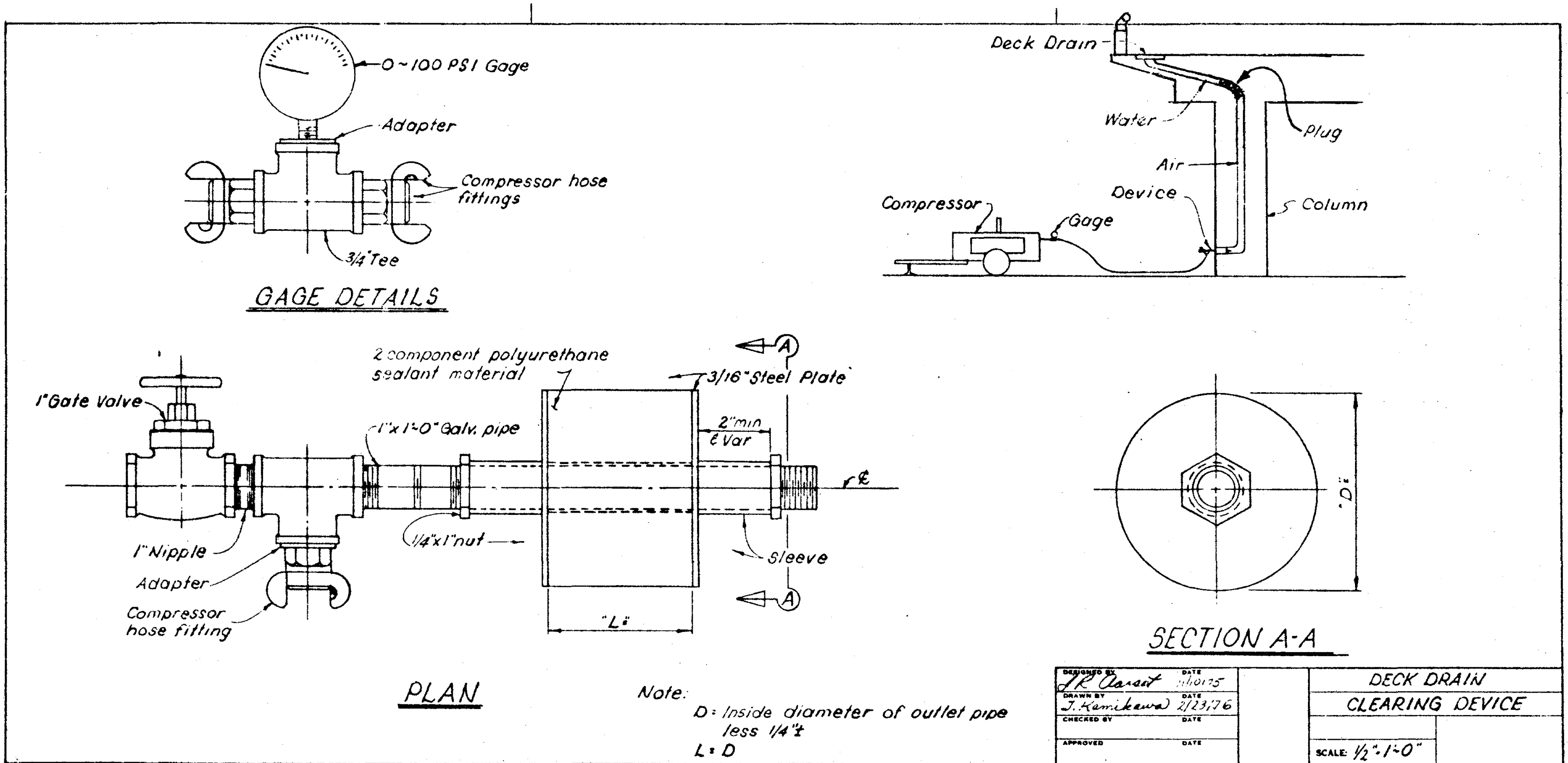

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FIGURE 4

The device consists of a mechanically expandable urethane seal, through which air (or water) is passed via a 1 inch threaded pipe. Figure 4 is a diagram of the device designed for a 6 inch ± drain pipe. A diagram for a device used on larger or smaller drain pipes would be similar except for the elimination or addition of the spacer sleeves. The air gauge is a very important part of the system in that it indicates how the debris plug is reacting to the air pressure. The gate valve is used to bleed off air or water pressure as needed.

The drain clearing procedure is as follows: The device is placed in the drain outlet using the largest steel plate that will fit the drain. The compression nut is tightened, expanding the urethane seal and locking the device in the pipe. (If the unexpanded device fits loosely in the outlet, the device will blow out). For safety reasons it is desirable to secure the device in place by either ropes or a timber "kicker". The guage is then connected to the compressor outlet and an air hose is connected from the gauge to the device. Water is then poured into the deck drain inlet until it backs up into the catch basin. The gate valve is checked to make sure it is closed. The compressor is started and air is carefully bled into the deck drain pipe, using the compressor control valve, while the operator observes the gauge. (40 psi is a good working maximum even though 70 psi has been reached without blowout.) The pressure is built up which forces air bubbles up through the debris plug. The air is then shut off, and the water works down through the passages created by the air bubbles. This combined air-water eroding action is cycled until the debris plug is broken up and the water and debris fall through to the device. The bleeder (gate) valve should be used to drain off the head of water in the pipe. If the device plugs, a stick, rod or wire can be run through the 1" pipe to clear it and to make sure all the water has drained out. The device should then be removed and additional flushing water poured into the drain at the deck.

At times a strong burst of air is required to clear stubborn plugs. This always creates a spectacular eruption at the inlet, and personnel on the deck should be warned.

This device and procedure was used on a total of 20 drains in Districts 03 (Sacramento), 04 (San Francisco and Oakland), 06 (Bakersfield), and 07 (Los Angeles) by research personnel, and 19 drains were cleared. The one not cleared had a hole in the pipe and pressure could not be built up. District 07 Maintenance personnel reported that they cleared 9 out of the 10 drains with this device. A number of collector systems (multiple inlets to one drain pipe) have been cleared using this method. This is done by temporarily sealing all open inlets except the one to be cleared. A heavy rubber mat is placed on the inlet grate with a 3/4" sheet of plywood on top of the mat. The wheel of a truck is then parked on the plywood. This produces a very effective seal with little air leakage.

Extreme caution should always be exercised due to the high air and water pressures involved with this system. At 40 psi there is over 1/2 ton outward thrust on the 6" device and over 1 ton on the 8" unit. The device must always be watched during the air-on cycles. An excessive movement (1/4") is a good indication of an impending blowout. Some drain pipes may not be capable of withstanding the internal pressures generated by this system, so they should be identified before using it. Eruptions of water and debris, as discussed before, have been experienced at the inlet so precautionary measures must be taken when this is expected. This can best be done by either placing a deflector or vehicle over the inlet.

This device is constructed from readily available standard materials, except for the steel plates and the two component polyurethane sealant material.

It has proven to be a very useful and dependable tool for clearing bridge deck drains. Some drains that were continuously plugged for more than 5 years in spite of the best efforts of maintenance personnel to clear them, using snakes and jetting, were cleared in a matter of minutes with this device.

In 1976, the bridge deck drain clearing device was demonstrated for the Highway Department of the State of Hawaii, and the FHWA representatives in Hawaii. This demonstration was done by Irvin R. Aarset and sponsored by the FHWA. The discussion of the demonstration follows:

> The Maintenance Engineer, Oahu District and his Bridge Maintenance Foreman advised that the current method of clearing drains was with a plumbers snake with a garden hose wired to it, with the nozzle just behind the head of the snake.
>
> A plugged 4" drain at Pearl City Viaduct that actually protruded 18" from the side of the column was selected to test the device. When the device was inserted and tightened and the inlet was filled with water, the compressor was turned on and a strong bubbling action was seen in the inlet. On opening the bleeder valve, water, silt, and small rocks immediately started flowing. Subsequent air on-air off cycling flushed large amounts of debris from the pipe. However, it was obvious that the main obstruction was still lodged in the pipe as evidenced by the restricted water (now clear) flow. Air pressures up to 35 psi were reached during the cycling. It was then decided to give a series of full quick blasts of air to try to dislodge the obstruction. The crew on the deck was warned to stand clear. The compressor valve was quickly turned wide open causing a terrific eruption in the inlet 4 or 5 feet high. This was done a number of times. The device was then removed and a torrent of water, two beer cans (one had been holed and bent by the snake), a short piece of board, and other miscellaneous articles gushed out of the pipe. The drain pipe was then flushed by the

tanker truck and it was clear that there were no more obstructions. The maintenance crew had previously tried to clear this drain with the snakewater hose method for 12 hours without success.

The maintenance people were enthusiastic at the success of the demonstration. This drain is located in a section of the Pearl City Viaduct where considerable problems with flooding and subsequent injury accidents had occurred.

7. Installation of Modifications at Alemany Interchange

In July 1976, the Alemany Interchange (Bridge No. 34-70) in San Francisco was investigated as a possible site for the installation of a series of catch basin modifications. The location was along the west rail of the structure where the "WU" line connects to the main line. This structure was selected due to the large size of the catch basins (25" x 24" x 12" deep, Figure 5). Notice that all dry debris would be funneled down into the pipe unless blocked off by a baffle plate.

As part of the design and construction of the structure, metal plates were made to fit under the grate to keep debris from entering the catch basin during the dry months. These plates are to be removed before the rainy season. This is not always practical as the first rain can occur during a weekend, at night when maintenance forces are otherwise busy, or maybe the plates were simply forgotten. In order to alleviate the situation, maintenance has cut and bent down one corner of the plate next to the rail. This creates a 6" square opening to allow water into the catch basin while keeping out the majority of the dry weather debris. This does not utilize the full amount of the grate area but it does the job and maintenance has had no problems with flooding of the deck in this area.

The three modifications selected for testing are shown in Figures 6, 7 and 8. These all use a baffle plate placed below the grate to keep the area around the outlet clear of debris. Figure 6 simply uses a straight pipe to raise the catch basin outlet so that the baffle plate keeps debris at a 1:1 angle of repose from its edges to the lip of the pipe. The elbow modification as shown in Figure 7 uses the concept of a side outlet catch basin with the outlet also protected by the baffle plate. The third modification is the most interesting. This uses the concept of a siphon as shown in Figure 8. The idea behind it is that no debris will enter the drainage pipe unless accompanied by a large amount of water. The concern is that if debris is not accompanied by an adequate "wash" of water it will settle in the outfall line where it may build up until it causes a plug. There is the added problem of the debris drying out between rains. The siphon effect guarantees a full "flush" of water or no water (and hopefully, no debris) at all. Drain water will flow into the catch basis until it reaches the flow line of the siphon. Water will start to spill over the siphon while the catch basin fills. When the head above

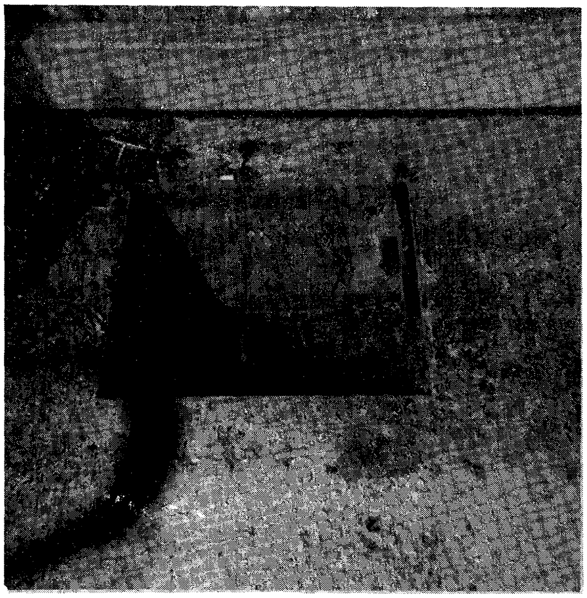


Fig. 5

Alemany Interchange (Br 34-70)
Typical deck drain - note center pipe and sloping sides.

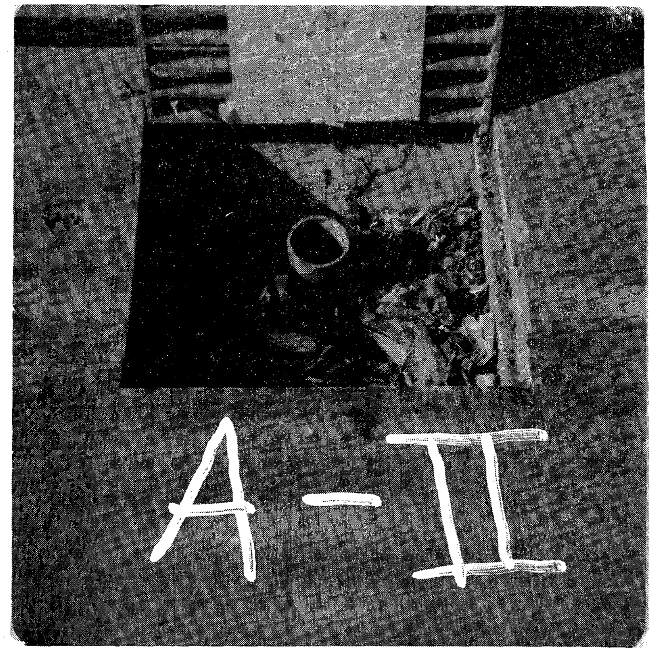


Fig. 6

Alemany Interchange (Br 34-70)
Vertical pipe extention.

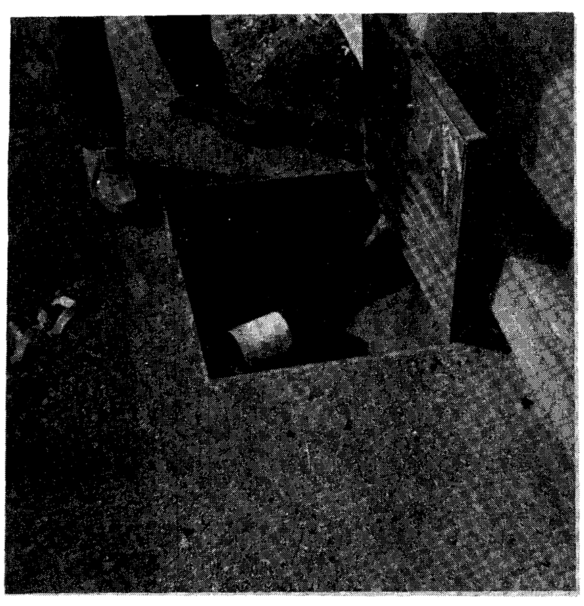


Fig. 7

Alemany Interchange (Br 34-70)
Side inlet pipe extention.

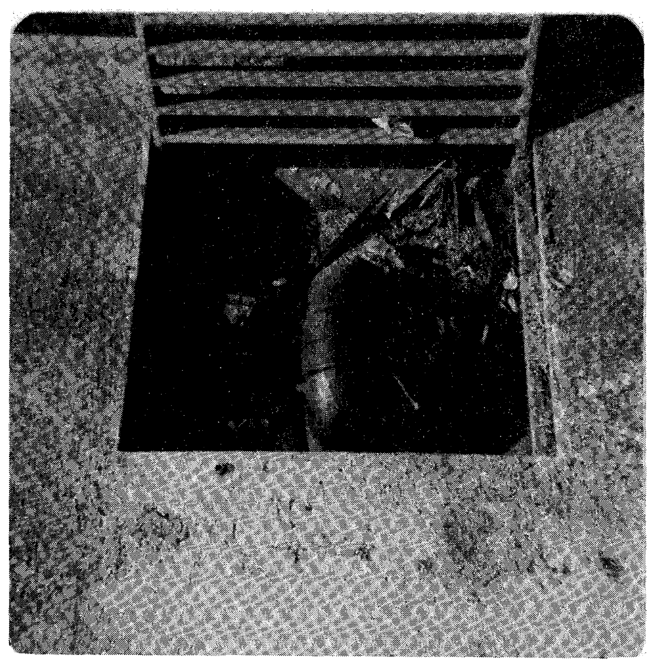


Fig. 8

Alemany Interchange (Br 34-70)
Inverted "U" pipe extention. Note length of sticks which got through grate.

the flow line of the siphon reaches the proper height the siphon starts to function. This siphon action creates an increased "drawdown" action on the inlet quickly removing the water and, hopefully, large amounts of debris.

There were two each of the three modifications placed at Alemany Interchange with a control drain placed in between each test drain. The control drain consisted of maintenance's bent down cover modification. The material for the pipes was 4" ABS plastic and the baffles were galvanized sheet metal. The baffles were clamped to the grates using a simple bolt and flat plate. The 4" plastic pipe fitted loosely into the 6" deck drain pipe and was wedged tight using plastic shims. This loose fit allowed the catch basin to drain completely. The pipe modifications were easily removable in order to clean either the catch basin or the drain pipe.

Later inspections after storms led to the conclusion that some moderate improvement in keeping the drains clear was afforded by each of the pipes. The main advantage seemed to be that the dry debris could no longer fall directly into the inlet pipe.

The vertical pipe extention worked best but on one occasion did plug from floating debris.

The horizontal pipe extension worked well and the maintenance foreman has advised that this modified drain is usually open during rainstorms even when adjacent ones have plugged.

The inverted "U" (siphon) extension was the least successful, possibly because of leaks at the connection with the existing pipe reduced the siphon action and the inlet to this extension was more often buried in debris.

DEBRIS

During this project a large sample of debris from a drain on a viaduct type structure that had never carried vehicular traffic, was taken during a rainstorm and analysed. The material had apparently been carried onto the bridge by wind and washed into the drain by wind or rainwater. It is interesting that this material had settled in the box even though it generally was fine and light. The dry weight consisted of 41% of the saturated wet weight with the following sizes:

Screen Retained On	% Retained	Description
3/8	3.5	chipwood, rock, piece of plastic
8	5.4	wood chips and splinters
16	10.4	wood fibers and grass fibers

Screen Retained On	% Retained	Description
20	15.5	wood fibers and sand
30	23.6	wood fibers and sand
50	51.3	60% wood fibers and 40% sand
100	80.1	50% wood fibers and 50% sand
200	91.4	20% wood fibers and 80% sand
Passing 200	100.0	fine silt

SACRAMENTO AREA DECK DRAINS

The maintenance supervisor and foremen made the following comments about drains in the Sacramento Area:

1. The annual cost of cleaning some 1728 drains in the Sacramento Area in 1975 was $8.08 each.

2. The "fixed" baffle plates on Fort Sutter Viaduct cause more plugs than they cure (See Detail on Page B-1). The sticks which often cause plugs at the pipe inlet cannot be reached by hand. The four drains where the baffle plates were cut out can be cleared easily and do not plug much more often than those with the plates.

3. Maintenance forces are blocked off from cleaning the dissipator boxes by locked fences and have to notify tennants of right of way under the viaducts before cleaning can be done.

4. Tennants under the viaducts have not handled the existing drainage well when they build and this causes problems when maintenance forces clean the deck drains or dissipator boxes. When ground under a viaduct is leased, the tennants should conform to a drainage standard. The State should spend whatever it takes to cure drainage problems before leasing the space.

5. Maintenance would rather deal with one large grate rather than three small ones (See Page A2, G1, Etc.) but there should be a 50 lb maximum grate weight. Hinged grates with the grates easily disconnectable would be the best type to work with.

6. Chapter VIII (Safety Code) is causing a very real time delay problem in clearing drains in a storm as California Highway Patrol assistance is required for lane closure.

7. Drain pipes should be larger, say 8" min and 10" if possible.

8. The rails on the Sacramento area viaducts have no scuppers. Scuppers should have been placed at the sag areas to prevent deck flooding.

9. Maintenance sweeps Fort Sutter Viaduct about once a week.

10. The vacumn sweeper (ECOLOTEC) doesn't work well because it plugs up with sticks and cans.

11. Maintenance foremen are very opposed to "Y" connections because it makes clearing drain lines far more difficult. They would like a separate line from each drain to the ground.

12. In Sacramento plugging is often caused by rice hulls and wood chips which are mixed with dirt and sand. Grain truck spills which result in wheat growing out of a box with extensive matted roots are not uncommon.

13. If new flushing systems are installed the valves should be on the deck so the "flushing" action can be observed and the situation of a spray rebounding into traffic can be avoided.

14. There was unanimous agreement that all welded in baffle plates should be removed as they interfere too much with drain cleaning.

The deck drains consist of 1'-4" by 4'-0" steel boxes which extend from the face of rail 4'-0" into the shoulder. The drain boxes are 5" to 9" deep with the 9" deep end directly over the outside steel girders. A 6" steel pipe extends horizontally from the box and curves 90° (1'-6" Min CL R) down into the cap, and then column, of a concrete pier. Three inches of the upper drain pipe fits into a 8" pipe reducer at the top of the pier cap. This detail permits the upper section of the drain to move 1" with superstructure movement.

There are 3 @ 1'-4" by 1'-4" grates in each box and each grate is held down with 2 "L" hooks with tension maintained on only one hook with a spring. The grates are "unlocked" with a 3/8" socket pressed down to release the spring-loaded "L" hook and then rotated 90°. See details on pages A1 and A2. The "slots" in the grates are 1-1/2" wide and parallel to the roadway.

When the ramp structures at the east end of the bridge were built a few years later, the same drainage details were used except that the grates were rotated 90° to place the slots transverse to traffic, and they were attached with 2 each spring-loaded "L" hooks.

The expansion joint drains on this structure had a unique problem. The expansion fingertype joint provided for 6-3/4 inches of total movement and to capture the runoff into the joint a horizontal piece of neoprene was loosely attached to both sides across the opening. The "sag" in the neoprene collected then dropped the runoff into a 18" x 24" x 1'-6" deep catch basin located just inside the exterior girder and the runoff was carried horizontally in a 6" Ø pipe to a vertical elbow with a cleanout where the pipe dropped vertically into the cap then column, of a concrete pier. Three inches of the upper drain pipe fit into a 8" reducer at the top of the pier cap. See details on Pages A-3 and A-4.

This entire detail has been unsuccessful in controlling runoff into the joint. Some of of the problems are:

1. Almost immediately the 1/16" neoprene sheet would flex upward under some vehicles with an audible popping. This was apparently due to air turbulence behind large vehicles.

2. At least one sheet had a construction hole in it and leaked immediately.

3. The neoprene sheet was attached between the finger unit castings and the cast in angles where it apparently acted as a compressible rubber washer which caused the attachment high strength bolts to loosen under traffic time and time again. It also may have lead to significant stress

variations in the high strength bolts which eventually caused fracturing of some bolts.

4. The high strength bolts were not suitable for the stress flexing situation caused by the neoprene "washer" and some finger section bolts broke under traffic. In one case, all 9 HS bolts broke within the first year and the deck had to be chipped out to remove the broken bolt ends.

5. The neoprene "washers" also permitted the finger sections to settle up to 1/4".

6. The "joint" soon became jammed with dirt and foreign material, including rice hulls from nearby mills, near the gutterlines.

7. The continued flexing of the neoprene under truck traffic caused wear where the neoprene flapped against the concrete edges of the joint and this soon made holes in the material.

8. Within one year, removal of the neoprene between the finger sections and toe cast-in angles was called for. The neoprene was to be reattached to the bottom portion of the angles. Due to the projected high cost of this work it was later decided to leave the original detail alone in the vicinity of the gutterline (which would still collect 80 percent of the drainage, and remove but not reattach the rest of the neoprene in the joint.

9. Within two years, the 5-foot lengths of neoprene left at the gutterlines cracked and split and became ineffective. The 11-foot to 14-foot sections at the gutterlines were repaired by replacing the split 1/16" neoprene with new 1/8" neoprene.

10. The steel catch basins under each of the finger joints packed full of foreign material.

The maintenance history of the regular drainage boxes indicates regular plugging with rice hulls from mills in the area being a major contributor. One report identifies broken hold-down bolt units at four locations which indicates that this detail should be strengthened.

The bridge maintenance engineer for this structure had the following comments on the drains:

1. The three grates in the long drains are each much easier to remove than if one large grate was used.

2. Approximately 50 of the "L" hook assemblies have broken or come loose in the life of the bridge.

3. The grates, however, apparently never "kick" out, probably because with a 10-foot shoulder, vehicle wheels seldom cross them.

4. The "joint" in the drain pipe where the 6" superstructure pipe fits loosely into a 8" reducer in the pier seems okay. We sometimes get a dirty pier when "backup" water spills out of the joint but the deck will drain.

5. The outfall drainage box works okay though it might provide a breeding place for mosquitoes and it does make use of the backflushing device difficult and dirty.

6. He feels a 18" Min CL R (instead of 12") would make clearing with a "snake" easier.

7. His experience is that parallel slots in the grates are better and he suggests cross bars at locations where bicyclists might cross.

COMMENTS ON EXISTING INSTALLATION

1. The 1'-4" by 4'-0" steel deck drain boxes are of adequate size and can be cleaned easily with a flat shovel and as they extend 4' into the shoulder they do a good job of intercepting gutter flow.

2. A 8" drainpipe exiting from the box would eliminate many inlet pipe plugging situations. The pipe should be 8" full length.

3. The use of a short horizontal run of the pipe from the box before it turns down is a very good detail as dry debris collecting in the box can spill into the horizontal pipe but cannot reach the vertical pipe where it could keep spilling until it caused a plug.

4. The minimum pipe radius should be increased to 3'-0" which with larger pipe should largly eliminate blockages due to sticks hanging up at bends.

5. The sleeve connections on the pipe should have been continuously welded so air pressure from backflushing could be built up in the pipe.

6. The superstructure drain pipe fits loosely into the top of the pier drain pipe to permit it to move with the superstructure. A 5' section at the bottom of the superstructure pipe should be easily removeable to permit rodding and flushing in both directions. The loose fit in the pipeline at the top of the pier has the big advantage of permitting the deck to drain when a plug is in the substructure portion of the drainline. This suggests that on exposed piping designs, designers should plan for

draining the deck when the pipe is plugged by providing an "overflow" in the pipe which will only pass water when the pipe is plugged below it. The presumption being that the safety "spill" causes less of a problem than flooding the deck.

7. The grates are generally satisfactory but the spring mounted "L" hook detail does not work well. The springs are too light for the job and often the hooks come loose or are not refastened when the grates are replaced. Having only one spring mounted "L" hook per grate is a better detail.

8. Grates with slots both parallel and transverse to gutter flow were used on this project. Reports suggest that parallel slots are the better design but grate hydraulic efficiency becomes minor in light of the plugging problem.

9. The drainage design at the expansion finger joints was completely unsuccessful and the radical revision of this type placed at Stockton Channel #29-176 R/L was only partially successful and will be discussed in the report on that bridge. The fingers should have provided flushing access from the top as the neoprene "gutter" was difficult to reach from below. In particular there should have been an access hole through the fingers so located that the vertical pipe from the drain box could have been rodded and flushed from the deck to keep it clear.

The deck drains consist of 3'-4" by 1'-9" steel boxes which extend from the rail 3'-4" into the shoulder. The boxes are 6-1/2" to 1'-2" deep. The drains are all located in the caps of bents and a 6" steel pipe extends at a -15° slope from the box and curves down (1'-6" Min CL R) at the CL of the column then empties into an outlet box. This pipe is continuous and entirely encased in cap and column concrete. The grates are very unusual in that 10 @ longitudinal #18 bars cross over each drain in the grate area. Each pair of rebar are encased in a 4x4 bar of concrete and reduces the drainage openings to 2 each 2" wide slots between rebar bars and 2 @ 8" widths each equipped with a grate. The slots in the grates are each 1-1/2" wide and are parallel to the roadway. These grates have two bolts welded to them to permit tying down to similar bolts on the frame with a loop of #9 galvanized wire. The drain is equipped with a permanent baffle welded to the frame which prevents any debris or water falling closer than 7-1/4" to the inlet of the pipe and is intended to keep the inlet of the pipe from being clogged by debris "broomed" or washed into the grates. The deck drain details are shown on Sheets B1 and B2.

The baffle is not removable and prevents cleaning from one of the grates. It would probably have been better to have attached the baffle to the grate so that when the grate was removed good access was provided for cleaning. About four years after construction these baffles were cut from four of the drains and the maintenance foreman reported easier cleaning of the box and the box doing a better job of self-cleaning without the baffle. There was no indication that removal of these baffles permitted the inlet of the pipe to become plugged any easier.

The maintenance history of this bridge indicates that this type drain box plugs with debris easily.

The bridge maintenance engineer for this structure made the following comments:

1. These drains plug fairly easily.

2. Cleaning is difficult because shovels will not fit into the drain box.

3. The grates remove easily and the wire tie is usually gone.

4. The wire ties are poor. They are often not replaced. The grates do not pop out because there is a wide shoulder and vehicles seldom cross them.

5. He does not feel hinged grates would be better to work with.

6. The outlet box is okay as it stands but the cover should be fastened down in areas where vandals can get to it.

Comments on Existing Installations

1. The drain boxes are a good size but are very difficult to clean out because of the small individual grates (2), the concrete bars crossing over the box which prevent clearing the box normally with a shovel, and the welded in baffle plate which prevents probing the inlet with a bar through the grates and makes it very difficult to clear debris from the pipe inlet by hand.

   The maintenance crews agree that the baffle plates cause more plugging problems than they solve and should be removed.

2. The grates are solid enough but the tie down detail is usually ignored and the grates are replaced untied. The original #9(.148") galvanized wires ties are largely gone and are replaced with more common ungalvanized wire or none at all when they are replaced.

3. The drain pipe should be 8" min dia. and have 3' minimum CL R bends.

4. The outlet should be a tee outlet with the cleanout above final grade.

5. The outlet box appears satisfactory but the cover plate should have been fastened down in areas where vandals can get to it.

FORT SUTTER VIADUCT (Unit 1)   #24-188   03-Sac-80

The deck drains on this structure are the same as on Unit 2 except that each drain box is equipped with a water line which, on demand, sprays two 1/4" jets of water into the box near the inlet of the drain pipe. See details on Pages C1 and C2. The water sprays in three adjacent boxes are controlled by each water valve.

The maintenance foreman stated that this particular design of spray flushing would not completely clear the drain box and the debris left was more difficult to clean because it was now wet. He also stated that the inlet often contained large materials such as sticks, smashed cans, and paper that the flushing system could not remove and which potentially could clog the drain pipe itself.

The bridge maintenance engineer for this structure made the same comments as for Unit 2 and in addition felt that the flushing system was ineffective because of an insufficient flow of water.

The maintenance history of this bridge indicates that this type drain plugs with debris easily.

Comments on Existing Installation

The comments made for Fort Sutter Viaduct (Unit 2) apply to Unit 1 (this). The following comments are in addition to those.

The flushing system on this structure is inadequate and not only doesn't clear the drain but by wetting the debris causes it to pack tighter. This system has not been used in the past 5 years.

The problem is probably that the 1" plastic line (est. .75" inside dia) doesn't feed the 2 @ 1/4" holes at each box enough water to provide an effective flushing action.

We recommend that the following change be made to one unit of 3 drains to see if this would make the flushing action effective.

1. Cut out the baffle plate
2. Tap and plug the 2 @ 1/4" holes
3. Drill and tap for a single spray (horizontal) at middle of pipe, angled 30° down.

We recommend that any future flushing system designs be patterned after the very successful one at China Basin Viaduct (#34-100) which is discussed later in this report.

CAMELLIA CITY VIADUCT #24-248 R/L 03-Sac-80

The deck drain details on this structure are the same as described for Fort Sutter Viaduct (Unit 2) whose plan details are shown on Page B1 and B2.

Local maintenance people have stated that these drains are difficult to clean properly due to the 8" x 14" size of the access opening which will not admit a normal square-nose shovel. They advise that it is difficult to reach and remove the material from under the covered portions of the drain pan even with a modified shovel, and the baffle which blocks debris from falling into the pipe also makes cleaning very difficult.

The bridge maintenance engineer made the same comments as for Fort Sutter Viaduct (Unit 2) #24-188.

The comments on this drainage installation are the same as for Fort Sutter Viaduct (Unit 2).

SOUTHSIDE PARK VIADUCT #24-243 R/L 03-Sac-80

The deck drain details on this structure are the same as described for Fort Sutter Viaduct (Unit 2) whose plan details are shown on Sheets B1 and B2.

Local maintenance people have stated that these drains are difficult to clean properly due to the 8" x 14" size of the access opening which will not admit a normal square-nose shovel. They advise that it is difficult to maneuver a modified shovel back under the solid sections between the movable grates. The baffle which blocks debris from falling into the drain also makes cleaning very difficult.

The bridge maintenance engineer made the same comments as for Fort Sutter Viaduct (Unit 2) #24-188.

The comments on this drainage installation are the same as for Fort Sutter Viaduct (Unit 2).

"W" STREET OFF RAMP UC   #24-224   03-Sac-80

The deck drain details on this structure are the same as described for Fort Sutter Viaduct (Unit 2) whose plan details are shown on Pages B1 and B2.

Local maintenance people have stated that these drains are difficult to clean properly due to the 8" x 14" size of the access opening which will not admit a normal square-nose shovel. They advise that it is difficult to reach and remove the material from under the covered portions of the drain pan even with a modified shovel and the baffle which blocks debris from falling into the drain also makes cleaning very difficult.

The bridge maintenance engineer makes the same comments as for Fort Sutter Viaduct (Unit 2) #24-188.

The comments on this drainage installation are the same as for Fort Sutter Viaduct (Unit 2).

"X" STREET ON RAMP UC   #24-225   03-Sac-80

The deck drain details on this structure are the same as described for Fort Sutter Viaduct (Unit 2) whose plan details are shown on Pages B1 and B2.

Local maintenance people have stated that these drains are difficult to clean properly due to the 8" x 14" size of the access opening which will not admit a normal square-nose shovel. They advise that it is difficult to reach and remove the material from under the covered portions of the drain pan even with a modified shovel and the baffle which blocks debris from falling into the drain also makes cleaning very difficult.

The bridge maintenance engineer makes the same comments as for Fort Sutter Viaduct (Unit 2) #24-188.

The comments for this drainage installation are the same as for Fort Sutter Viaduct (Unit 2).

ROUTE 99/50 SEPARATION (East) (Unit 1)   #24-222   03-Sac-99

The deck drain details on this structure are the same as described for Fort Sutter Viaduct (Unit 2) whose plan details are shown on Pages B1 and B2.

Local maintenance people has stated that these drains are difficult to clean properly due to the 8" x 14" size of the access opening which will not admit a normal square-nose shovel. They advise that it is difficult to reach and remove the material from under the covered portions of the drain pan even with a modified shovel.

The comments for this drainage installation are the same as for Fort Sutter Viaduct (Unit 2).

ROUTE 99/50 SEPARATION (East)(Unit 2) #24-222 03-Sac-99

This structure was designed and built three years after Unit 1 and the drains are a modification of those used on Unit 1. The deck drains consist of 2'-0" by 1'-8" boxes which are located between 1 foot and 3 feet from the rail and are entirely in the 8'-0" shoulder. A 2" high concrete dike is placed to divert flow from the rail to the box. The boxes are 6-1/2" to 1'-2" deep. The drains (3) are all located in the caps of bents and a 6" steel pipe extends at a -20° slope from the box and curves down (1'-6" CL R) at the centerline into an outlet box. This pipe is continuous and entirely encased in cap and column concrete. The grates are unusual in that a longitudinal #18 bar crosses over the drain in the center of the grate area. The bar is encased in a 4x4 bar of concrete and reduces the drain openings to two 10" widths each equipped with a grate. The slots in the grates are each 1-1/2" wide and are parallel to the roadway. These grates each have two bolts welded to them to permit tying down to similar bolts on the frame with a loop of #9 galvanized wire. Another unusual feature is that the bottom of the drainpan slopes 20° toward the drain pipe inlet. The deck drain details are shown on Pages D1 and D2.

This particular design not only does not have a baffle to keep debris from falling near the drain pipe but has a significant slope which encourages the debris to move toward the pipe.

The maintenance history of the deck drains on this bridge indicates regular plugging (4 weeks from clean to full).

The bridge maintenance engineer for this structure made the same comments as for Fort Sutter Viaduct (Unit 2) #24-188.

The comments for this drainage installation; are the same as for Fort Sutter Viaduct (Unit #2).

ELMHURST VIADUCT #24-228 R/L 03-Sac-50

The deck drains consist of 1'-2" by 2'-0" steel boxes which extend from 1'-0" from face of rail to 3'-0" from face of rail into the shoulder. The boxes are 6" to 14" deep. Most drains are located in the caps of bents and a 6" pipe extends at a -15° slope from the box and curves down (1'-6" Min CL R) at the CL of the column then empties into a outlet box. This pipe is continuous (no cleanouts) and entirely encased in cap and column concrete. The grates are unusual in that a main reinforcement bar encased in a 2" square bar of concrete crosses over each drain in the grate area and reduces the drainage openings to two 10" widths each equipped with a grate. The slots in the grates are each 1-1/2" wide and are parallel to the roadway. These grates each have two bolts welded to them to permit tying down to similar bolts on the frame with a loop of #9 galvanized wire. New wire must be used each time the grate is removed.

Another unique detail of this drain is a 2" high concrete dike angled 45° upstream to intersect the drainage in the one-foot between rail and drain. The deck drain details are shown on Pages E-1 and E-2.

The maintenance history of the deck drains on this bridge indicates regular and usual drain plugging.

The bridge maintenance engineer makes the same comments as for Fort Sutter Viaduct (Unit 2) #24-188.

GRAND AVENUE OVERHEAD #24-276 R/L 03-Sac-80

This structure was built in 1970.

The 14 deck drains on this structure are the standard D-2 deck drains. They are 1'-6" by 1'-5" and are located against the face of the rail. The boxes are a shallow 5-1/2" to 7-1/2" deep and a 6" pipe, flattened to 2-1/2" at the drain box, exits normal to the box and turns down (1'-6" Min. CL R) into the center of a concrete column where it exits at 90° to just above the ground line.

Comments on Existing Installation

The D-2 drains, because of their flattened 2-1/2" vertical opening, plug easily at the inlet and are difficult to clean.

This type drain was used as it was desired to hide the drainage from view. Details are shown on Pages F-1 and F-2.

The grates have 1-1/2" slots transverse to drainage flow and are hinged on the oncoming traffic end. They fasten with the usual spring-loaded "L" hook.

A discussion of the debris found in one of the drains will be found listed under "DEBRIS".

This structure does not have a drainage maintenance record as it has never carried traffic (the route it is on was abandoned).

The 22 deck drains (Modified Type C) consist of 1'-4" by 4'-0" steel drain boxes which extend from face of rail 4'-0" into the shoulder. The boxes are 5" to 9" deep with the 9" deep end on the inside end. A 6" steel pipe flattened to 2-1/2" at the drain end, connects horizontally to the drain and after crossing over the outside girder it slopes at 45° to the top of a pier where it is loosely inset into a 8" pipe reducer at the top of the pier. This permits the superstructure to move 1" relative to the pier.

There are 3 @ 1'-4" by 1'-4" grates in each box and each grate is held down with 2 spring-loaded "L" hooks. The grates are unlocked with a shallow 3/8" socket pressed down to release the "L" hooks and then rotated 90°. The slots in the grates are 1-1/2" wide and transverse to the roadway. Deck drain details are shown on Page G1.

The expansion joint drains on this structure were a redesign of the ones on Sacramento Viaduct, Br. 24-04, which had many problems and were discussed earlier. The expansion finger type joint provided for 6" or so of total movement and to capture the runoff into the joint a horizontal piece of neoprene was loosely attached to both sides across the opening. The "sag" in the neoprene dropped the runoff into a 18" by 30" catch basin located just inside the exterior girder and the runoff was carried vertically in a 6" pipe to a point below the girder bottom flange where it exhausted into the air. Expansion joint drain details are shown on Pages G2 and G3.

This expansion joint detail has also been unsuccessful in controlling runoff into the joint. Some of the problems are:

1. Within two years of construction the neoprene had worn and torn and replacement was called for.

2. Due to the high cost of replacing the neoprene and the fact that the leakage is into the river, the repair work has not yet been done.

The maintenance history of the deck drains on this bridge indicate the regular and usual drain plugging.

The bridge maintenance engineer for this structure had the following comments on the drains:

1. Three grates in the long drains are each easier to remove than if one large grate was used.

2. The grates never "kick" out, probably because with a 10-foot shoulder vehicle wheels seldom cross them.

WEST END VIADUCT #24-69R/L 03-Sac-5

This structure drainwise is divided into three portions: Concrete mainline, steel mainline and steel ramps.

A. Concrete Mainline - This portion has 5 D-3 drains, 5 D-2 drains and I D-4 drains. The D-3 drains are all in the right structure and are 1'-5" by 1'-4" with a shallow 4 1/2" deep box. A short 6" steel pipe extends down vertically from the curb side of the box. The bottom 1 1/2" of the pipe is lapped with a 8" elbow (permits movement) and 8" pipe which curves 90° (1'-0" min CL R) to a shallow slope then crosses through the air to the left structure (generally out of view) through the cap to where it has a "Y" joint (1'-0" min & R) with a type D-2 drain from the left structure then goes down a column and drains into a discharge box there is a single grate in each drain box hinged at the traffic end fastened with a spring loaded "L" hook. The slots in the grates are 1 1/2" wide and parallel to the roadway.

   The D-2 drains are all in the left structure and have identical grates but a shallow drain box (5 1/2" to 7 1/2") with a 6" pipe (flattened to 2 1/2" at the box) extending at a shallow slope into the gap and down a concrete column where it drains into a discharge box. This type is used where it is desired to hide the drainage pipes from view.

   The D-4 drain is in the left structure and has an identical grate but a deep 1'-2" box. This drain is between girder stems so was dropped below the top slab enough so the 8" pipe which exits near horizontally does not interfere with the slab reinforcement. It extends to a column where it drops vertically then turns 90° into a outlet box.

   Details are shown on Pages H1 to H4.

B. Steel Mainline - This portion has a unique drainage system. The standard C-2, C-3, and C-4 drains all feed into open steel flumes which are runs of half-pipe sections (14" to 24" diam) which slope between -0.6% and -1.6%.

   The single C-2 and 7 C-3 drains are unique in that 2 feet or more of the 7' by 1'-4" drain box is covered over at the inside end where a 8" vertical pipe along the inside of the girder runs down to a flume. The grates are the same as on the concrete mainline drains.

   The 8 C-4 drains are 4'-0" by 1'-4" and 8" deep. The vertical 6" drain pipe drops on the outside of the girder, so this type drain is only used at locations hidden from public view. The vertical drain runs to the flume which also runs on the outside of the girder where it is also hidden from public view.

   Details are shown on Pages H5 to H10.

C. Steel Ramps - This portion has 12 D-2 drains, 8 C-1 drains and one C-4 and one C-2 drain.

The D-2 drains are the same as those on the concrete mainline except it is not joined by drainage from the other side in a "Y" connection.

The C-1 drains are 4'-0" by 1'-4" with a 5'-9" deep drain box. A 6" drain pipe extends at a -10% slope to the inside where it drains down into a flume. The grates are the same as on the concrete mainline drains.

The C-4 drain is 4'-0" by 1'-4" with an 8" deep drain box. A 6" pipe extends vertically down on the outside of the girder and drains to a flume. The grate are the same as on the concrete mainline drains.

The C-2 drain is unique in design in that 3'-4" of the inside end of drain box is covered over by deck leaving a deck opening of 4'-0" by 1'-4". A 8" vertical pipe at the inside of the girder runs down to a flume. The grates are the same as the concrete mainline drains.

Details are similar to those on sheets H5 to H10.

Comments on Existing Installations.

1. The D-3 drains work well. The vertical 6" pipe from the box passes the flow directly into a 8" or 12" collector pipe and this larger pipe does not plug. At two locations the 12" collector pipe is reduced to 8" pipe but these constrictions have not caused blockages.

2. The D-2 drains, because of their flattened 2 1/2" vertical opening, plug easily at the inlet and are difficult to clean. The hinged grates work well though some hinges are on the side away from approaching traffic. It would be better if the hinged end faced traffic and if the grate could be removed in the up position.

3. The D-4 drains work well primarily because of the deep (1'-3") box. They are located only where the box can be hidden. The full diameter pipe mininizes plugs at the inlet but placing the inlet pipe low in the box lets inches of debris pack above the pipe. It would be better to place the top of the pipe at the very top of the box (blocked off by a removable grate) so that the entire pipe could not fill with debris and the first water into the pipe could wash out the debris in the pipe.

4. The flumes in the steel mainline portion work very well and there are no known drainage or plugging problems involving them.

STOCKTON AREA DECK DRAINS

The maintenance foremen made the following comments about the drains in Stockton.

1. They prefer one heavy grate to three smaller grates as vandals have removed the smaller grates and thrown them over the side. They have welded the three grates together which has stopped the vandalism.

2. The standard grate lock is fairly easy to work, although some springs have broken and had to be replaced.

3. They see no advantage to hinging grates even if they are removable in the up position.

4. They think placing two grates in channels with only one locked grate would unnecessarily complicate grate removal.

5. They think 6" pipe would be ok if drains were well maintained but need 8" or larger if maintenance is irregular.

6. The 6" pipe drains they deal with need more cleanouts.

7. A minimum radius of only 1'-6" causes plugs. They recommend substantially larger minimum radius.

8. They do not use "snakes" to clean drains. They use a 1" pressure water hose.

9. The flat drainpipe grades (up to 7%) cause plugs. The area has minimal rain so dry seeds can fall into the drainpipes and sprout with the roots tying together a solid plug.

10. The drainpiping on Stockton Channel has too many bends and shallow slopes, and plugs occur easily and are difficult to clear.

11. They use a 4000 gallon tanker and a 1" stiff pressure hose to clear the drains from the top.

STOCKTON CHANNEL VIADUCT #29-176 R/L 10-SJ-5

The deck drains are 4'-0" by 1'-4" steel boxes which are located 2" from the rail. The box is 5" to 9" deep and a 6" pipe flattened to 2-1/2" carries the runoff from the deep end at a -(4-1/2)% slope over the girder then turns down 90° (1'-6" ℄ R) to a 6" collector pipe which turns down and drains into a pipe in the pier. The 6" superstructure pipe fits into a 8" pipe reducer to permit 1" of horizontal movement of the superstructure drain into the pier drain pipe. There are 3 @ 1'-4" by 1'-3" grates in each box and each grate is held down with two spring-loaded "L" hooks. The slots in the grates are 1-1/2" wide and transverse to the roadway. A baffle plate to prevent debris from falling near the pipe inlet is welded to the grate nearest the pipe inlet. See details on Page I-1.

The maintenance history of these drains indicate the regular and usual drain plugging.

The ramp expansion joints were provided with sheet neoprene seals which were intended to sag down into the joint. See details on Page I-2. Due to the heavy skew of these joints, deck movements caused the neoprene to ripple and buckle up and form hills and valleys. This got so bad in rainy weather that it became a traffic hazard from ponded water and it became necessary to punch holes in the neoprene seal.

The finger expansion joint drains on this structure had a unique design to avoid the neoprene seal failures at Sacramento River Viaduct and at Sacramento River (Bryte Bend). Instead of a sheet of neoprene connecting the two halves of the joint this design has a 6" wide 12 gauge galvanized gutter running the full length of the joint and carrying the runoff to a 6" vertical pipe at the center of the bridge. The other half of the joint has a water deflector plate which deflects runoff from that side of the joint into the gutter. Because the deflector plate overhangs the side of the gutter, even at maximum opening, all runoff through the joint is collected into the gutter, down a 6" pipe (-4% min. slope) and into a 8" pipe reducer at the top of the drain pipe in the pier. See details on Page I-3.

The bridge maintenance engineer for this structure advises the following:

1. The metal troughs under the steel finger joints fill with debris. The drains plug and water ponds against the barrier rails and into the traveled way. The troughs are very hard to clean.

2. One grate instead of three on the long drains would be harder for kids to remove and throw over the side. This type of vandalism has occurred at similar bridges. There should also be more positive grate lockdowns to discourage vandalism.

3. Hinged grates (not removable) would be desirable in areas where vandals might otherwise remove grates.

4. A minimum 8" drain line would possibly minimize the common plugging of 6" pipe with bark and other debris.

5. 12" radius on pipelines does not seem to cause plugging.

ROUTE 5/4 CONNECTOR #29-233 10-SJ-5,4

The deck drains are 1'-4" by 1'-5" steel boxes (Type D-2 Drains) which are located 2' from the curb. The box is 5-1/2" to 8" deep. A 6" pipe, flattened to 2-1/2" at the drain box exits normal to the box at a good slope then turns to go through a girder web and into the cap and down a column where it exits at right angles just above ground line. The box has a single grate, with 1-1/2" slots parallel to the roadway, which is fastened down with two spring-loaded "L" hooks. See details on Pages J-1 and J-2.

The maintenance history of these drains indicate they plug frequently and the plugging debris is usually sand and debris.

ROUTE 5/4 SEPARATION #29-232 R/L 10-SJ-5,4

The deck drains are 1'-4" by 1'-5" steel boxes (Type D-2 Drains) which are located 1'-0" clear from the curb. The box is 5-1/2" to 8" deep. The 1'-0" clear from rail dimension is caused by the wide and thin overhang which does not leave room for pipe if the drain is placed 1" from rail. At each drain an area of 3'-5" diameter is dished out (1" deep) around the drain. A 6" pipe, flattened to 2-1/2" at the drain box exits normal to the box then turns down into a column where it exits at right angles just above ground line. The box has a single grate, with 1-1/2" slots parallel to the roadway which is hinged at the traffic end and fastened with one spring-loaded "L" hook.

The maintenance history of these drains indicates they plug easily and frequently and the plugging debris is usually sand and debris.

CROSSTOWN FREEWAY VIADUCT #29-269 10-SJ-4

The deck drains are 1'-4" by 1'-5" steel boxes (Type D-2 Drains) which are located 2' from the curb. The box is 5-1/2" to 8" deep. A 6" pipe, flattened to 2-1/2" at the drain box exits normal to the box at a good slope then turns to go through a girder web and into the cap and down a column where it exits at right angles just above ground line. The box has a single grate, which 1-1/2" slots parallel to the roadway, which is fastened down with two spring-loaded "L" hooks. See detals for Route 5/4 Connector which is similar on Pages J-1 and J-2.

The maintenance history of these drains indicate they plug frequently and the plugging debris is usually leaves and debris.

SAN FRANCISCO AREA DECK DRAINS

The maintenance supervisor and foreman made the following comments about drains in the San Francisco area.

1. The drains are cleared during September-October. It takes a crew of 5 about 60 working days to clear all the drains before winter.

2. Most of the emergency drain cleaning occurs at night in bad weather when the hazard to traffic and workers is the greatest.

3. Most of the drain boxes are too small. They pack with debris, bags, plastic, and orange peels.

4. The vertical outlet pipe from the box plugs easily and the side outlet is the key to minimizing drain plugging.

5. Future designs must get rid of 90° bends and plumbing joints. Pipes should have a smooth inside to prevent hangups. Two 45° bends will not cause plugging where a 90° bend will.

6. Do not use anything but steel pipe. Some runs of transite pipe have broken and are hidden in bays so cannot be repaired. The deck drains had to be sealed off.

7. Effective deck drain design would need larger diameter (8") pipe, larger grates and larger boxes.

8. Debris packs much more solidly when it is dampened or wetted and the San Francisco area with all its fog is especially vulnerable this way.

9. Deck vibrations seem to tighten the debris pack and makes plugging easier and cleaning more difficult.

10. A lot of winter debris comes from the bottom of cars.

11. Routine deck clearing equipment consists of a 3400 gallon tank truck and a 400-500 psi pressure pump.

EMBARCADERO VIADUCT #34-55 04-SF-480

This structure was built in 1959.

The deck drains in the 1959 portion consist of 11" by 23" steel boxes which are located in the gutterline. The box is 7" deep and its sides taper to a 6" vertical pipe at the center of a box. Anything that enters the box falls into the vertical drain pipe. This pipe angles at 45° miter bends to a column leg then makes two 45° miter bends below ground to connect to a storm drain system. There is a cleanout for this bottom section located just above ground.

The drain box has a single grate with 1-1/4" slots parallel to the roadway. There are no hold down devices. Details are shown on Pages K-1 and K-2.

The deck drains in the 1965 portion consist of 1'-2" by 1'-6" steel boxes which are 1'-2" deep. A 6" pipe exits at -1% minimum slope and is joined into a 8" pipe which makes 90° bends (1'-10" CL R) and discharges into an underground drainage system.

This drain box has a single grate with 1'-1/2" slots parallel to the roadway. The grate is held down with two 1/2" welded J hooks, each with a nut which has to be removed in order to remove the grate. See details on Pages K-3 and K-4.

The maintenance history for this structure indicates the drains plug easily and frequently.

The bridge maintenance engineer for this structure comments as follows:

1. The drains are typical of those constructed during this period.

2. The grates in the 1965 portion remove quite easily as they are not fastened down. An occasional vehicle (emergency parking) will cross over and kick out a grate.

3. He recommends tying down all grates on all structures. The standard spring-mounted "L" hook is okay. Even though they sometimes break, they are easily repaired and maintenance likes them because they are easy to unlock.

4. Sections with 8" pipe occasionally jam but far less than sections with 6" pipe.

5. The cleanout plugs work alright except they are often not easily accessible.

6. He feels that the line with low slope (say <10%) plug but that drainage lines with slopes over 10% do not plug in the line.

7. He feels that a removable grate is better than hinged as it is out of the way while cleaning. A hinged grate that can be easily removed when necessary would be a good design.

8. If the structure is on a truck route the drains can plug with dirt or gravel from dump trucks. If there is a gravel plant nearby the drains will plug far more often.

CHINA BASIN VIADUCT #34-100 04-SF-280

This bridge was built in 1971.

Some deck drains are 1'-4" by 1'-5" steel boxes which are located 6" from the curb. The box is 1'-2" deep and a 6" pipe exits at -1% minimum and makes 90°bends (1'-6" CL R). The box has a single grate, with 1-1/2" slots parallel to the roadway, which is hinged on the traffic side and hooks with the standard spring-mounted "L" hook. The details are shown on Page L-1.

Some deck drains are 4'-0" by 1'-5" steel boxes which are located 6" from the rail. The box is 3-1/2" to 6" deep and a 8" pipe drops vertically at the deep (traffic) end. The box has three grates with 1-1/2" slots parallel to the roadway. The grate on the traffic side is hinged on the traffic side. The one away from traffic is hinged on the rail side. They are "locked" with spring-mounted "L" hooks as is the center unhinged grate. This pipe is extended into a 12" collector pipe with a min. slope of -1.0%. All piping is connected using neoprene sleeves and hose clamps. The details are shown Pages L-2 and L-3.

Each drain box is equipped with a flushing pipe with 6 (3 in small box) 3/16" spray holes. The valve to operate the flushing pipes are located in the shoulder area just below a 3" hole in the deck. A 3" brass plug must be removed and a wrench used to operate the valve. Details are shown on Pages L-4 and L-5.

The bridge maintenance engineer for this bridge advised the following:

1. The drains in this structure seldom plug because they are flushed regularly with the flushing system. The flushing system is activated once a month and two men can flush all the drains in one hour.

2. The flushing system on this structure is excellent and performs well. In particular, there is very adequate water and pressure.

3. This structure has wide shoulders so access to the water valves is good without endangering traffic.

4. The 8" minimum drainage lines on much of the system appears to contribute to the lack of plugging. 8" minimum drain lines are recommended all over. In addition, the collector lines are a generous 12" minimum diameter.

5. The flushing system at Route 92/101 Sep (#35-252 R/L) has inadequate water, long runs of too small water pipe, inaccessible valves and requires lane closures for anything. In addition, the spray has gone into the traffic lanes. Maintenance has discontinued use of this spray system.

6. At Route 380/101 (#35-255 R/L) the flushing system works fair and there is good access on adequate shoulders. The water supply is adequate but the system does not function anywhere near as well as at China Basin.

SOUTHERN FREEWAY VIADUCT #34-46 04-SF-280

The deck drains are 14" by 13-1/2" steel boxes that are 14" deep in the box girders or caps and 8" deep in the medians. The box is drained by a 6" pipe which exits at -2% and then turns down 90° (12" CL R) into a bent leg then turns 90° to exit at ground, curb, or into a storm drain system. The box has a single grate with 1-1/2" slots parallel to the roadway. The grates are each fastened with two studs, and the nuts must be removed to remove the grate. Details on Page M-1.

The maintenance history of this structure indicates that these drains plug often particularly due to the street sweeper cleaning of the shoulders.

The longitudinal joint in the deck is often on the high side of the CL median rail. This ponds water over a working joint and leads to leakage through the joint. Also the drain must be placed away from the low spot. See Page M-1. It would have been much better to have placed the CL joint on the low side of the median rail.

The bridge maintenance engineer advised the following:

1. The 2% drain pipe grades appear too flat and may be the cause of some plugging.

2. On occasion the entire pipe from outlet to deck drain has plugged solid with material swept into the grate.

3. This structure has drain problems similar to Embarcadero Viaduct and Central Viaduct.

The deck drains are 1'-4" by 1'-5" steel boxes (Type D-2) drains which are located 1" clear from the curb. The box is 5-1/2" to 8" deep. A 6" pipe, flattened to 2-1/2" at the drain box exits normal to the box then turns down into a column. The box has a single grate with 1-1/2" slots parallel to the roadway and is anchored with one spring-loaded "L" hook.

The maintenance history for this bridge indicates that the drains on this structure suffer from the usual problem of D-2 drains. The drains plug relatively easily due to the shallow 2 1/2" pipe opening. The structure is on generous grade however and the good drainage off the bridge keeps the structure from having ponded areas.

Comments on Existing Installations

1. The D-2 drains, because of their flattened 2 1/2" vertical opening, plug easily at the inlet and are difficult to clean. The hinged grates work well though some hinges are on the side away from approaching traffic. It would be safer for traffic if the hinge end always faced approaching traffic and it would be easier for maintenance if the grates were removable in the up position.

SAN PEDRO-TERMINAL ISLAND BRIDGE #54-1790 07-LA-167

The deck drains on this structure are located on the approach spans only. The drainage on the suspension span spills into the air. The deck drains are 1'-2" by 2'-0" steel boxes which fit against the curbs. A 10" wide by 4" high horizontal steel tube carries the drainage from the drain box to the inside of the plate girder where it drops into a short 5" pipe which is loosely inset into a 6" near vertical pipe (2 @ 30° angular bends). At the top of the piers the 6" pipe fits loosely into a 8" vertical pipe which permits substantial movement of the superstructure without binding the pipe. In solid pier legs the 8" vertical pipe has a "T" intersection with a horizontal 8" pipe which drains on one side and has a cleanout at the other end. On cellular piers the 8" pipe uniquely exhausts into the cell which is drained by a 6" hole in the cell wall at groundline.

Maintenance forces advise that the deck drains plug easily with most of the plugs caused by sand, silt, chunks of coke which are crushed under traffic, twigs and leaves. If there is dirt hauling over the bridge the drains will plug in 2 days. They dig out the debris usually every three months and the drains must be cleaned "after" every rain.

The cleaning technique consists of removing the grate, removing the debris with a shovel and clearing the debris from the tube using a small hoe then flushing the box and pipe clear.

The brass cleanout plugs in the deck are almost impossible to remove, apparently because the pounding of traffic has jammed the threads. Two holes were drilled in some covers to attempt removal with a special tool but this was not very successful. The holes through the cover however permit a 3' rod to be used to clear any plugs which occur at the top of the pipe.

The grates are usually held down with only one or two nuts but they never come out under traffic. Occasionally traffic will loosen a nut or strip a bolt thread but maintenance is satisfied with the 4 bolt holddown detail.

The drain details for this stucture are on Pages N-1 and N-2. This drain has a few details which encourage plugging and make clearing under ponded conditions difficult. As debris fills the box it spills into the outlet "tube" where it can plug easily because of the shallow 4 1/2" vertical dimension. This dimension should be at least 6". A plug in the tube can only be cleared by removing the grate and rodding from the drain box. Another detail which can cause problems is that there is a "lip" entirely around the 5" pipe which exits vertically from the "tube". This lip permits sticks to bridge over the pipe and start a plug. A better detail would have been for the tube to shape to the back of the pipe so as to eliminate the back lip. In addition the 5" dia. section of outlet pipe is too small. The length of 6" dia pipe which carries the flow from the box to the top of the pier has two

30° mitered bends. Apparently this has not caused any plugs but pipe with bends over 30° should be curved to minimize the chances of sticks jamming. If this entire length of pipe were 8" dia. there probably would never by any plugging at the pipe inlet or in the pipe.

A good detail is the use of a cleanout plate in the deck over the pipe inlet. Although most cleanout plates are jammed so they are not removable, those with holes through the plate permit easy cleaning (with a rod) of plugs which occur at the top of the pipe.

It might be possible to reduce the plugging problem by welding a 4" by 10" steel baffle plate to the bottom of the grate adjacent to the tube inlet to reduce movement of dry debris into the tube. A 2" hole drilled through all cleanout cover plates in the deck would permit probing with a hooked rod to clear plugs at the top of the pipe and would permit water which is ponding to drain directly into the pipe.

SANTA MONICA VIADUCT #53-1301 07-LA-10

The structure was built in 1962.

Most of the deck drains in the RC box girder spans are 1'-4" by 1'-5" steel boxes which are located 2" clear of the rail. The bottom of the box (3-1/2" deep min.) slopes 30° to the 6" outlet pipe which continues at the same slope. It appears that most of the debris which falls through the grate would wind up in the pipe. The box has a single grate with 1-1/2" slots which run parallel to the roadway. The drain is set 1/2" to 1-1/2" below the deck level with the transition starting 20" upgrade from the drain and ending 5' downgrade. The 6" outlet pipe from the drain is inset into an 8" drain pipe which slopes sharply and runs down a column. The bends in the pipe are angular. See Page O-1 for details.

Most of the deck drains in the steel girder spans are 4'-2" by 1'-2" steel boxes which are located right up against the rail and extends 4' into the shoulder. The long length of the drain permits a vertical 6" diameter pipe to exit from the box on the inside of the plate girder (out of sight). Each box is 4" to 8" deep and slopes slightly to the pipe. The box has a single grate which is bolted down to 6 studs in the frame. The vertical pipe outlet can be probed with any tool which will fit through the grate opening or, with the grates removed, a derooter type tool could be used to clear the drain. The 6" drain has two angular bends then drops into a column. At the top of the column, a cleanout is provided. Bends in the pipe are provided by a 2' radius curve or angular segments (30° max. per segment). The outflow at the bottom of the pipe is provided with a cleanout. See Page O-2 for details.

The Bridge Maintenance Engineer commented as follows:

1. The plugging problem is so severe and extensive that only the critical drains can be regularly cleaned.

2. The drain pipe have too small a bend radius and mitered angular bends, both of which lead to plugs. He recommends smooth bends only in future pipes, with a minimum CL radius of 3 or 4 feet.

3. The relatively flat grade is the cause of much of the ponding. At another large bridge in the area, all the drains are usually plugged but the bridge has good grade and the water drains off the ends.

The local maintenance forces comment as follows:

1. The design of the pipes is "bad". The small pipe with angled mitered bends lets sticks hang up and cause plugging.

2. Plugging debris consists of pieces of styrofoam cups, sticks, rags, and crushed cans with a lot of the debris blowing out of trash trucks on their way to the dumps.

3. The maintenance men never pull the small grates because they were bolted securely down when a traffic lane was relocated over them. They use a flexible probe rod pushed through the grate to clear the inlet pipe.

4. There are now 30 plugged drains which maintenance cannot clean with the equipment provided to them.

5. Flat grades cause the ponding problem. At Elysian Viaduct the significant longitudinal grade prevents ponding from plugged drains by draining the water off the ends of the bridge.

6. There has been as much as 1'-6" (?) of water in the traffic way due to the scuppers being too high (?).

7. The scuppers in the median New Jersey rail are too few and too high and they pond water as high as 4" above deck as well as concentrating excessive flow on the traveled way on the low side of the median.

Comments on Existing Installation

1. The biggest problem at this bridge is that traffic lanes have been placed in the original shoulder area and vehicles run over many of the original drains. This drops more debris into the drains, packs it down tighter, loosens grates not designed for traffic and worst of all does not provide a safe shoulder area for drain cleaning work. Extensive modification of the drainage system, beyond the scope of this report, has been performed to correct many of the most serious problems, but drainage on this structure in winter is still a nightmare.

2. This structure has had by far the severest drain plugging record in the state. Currently (6/81) there are about 30 drains so severely plugged that they cannot be cleaned by normal maintenance procedures and they will have to be cleaned by contract with a power auger company.

3. The drains generally plug easily and because of the large number in this 3 mile long structure, require continual cleaning in the winter season. The problem gets so bad that only the most critical drains that could cause accidents due to ponding, are cleaned.

4. A lot of the ponding problems are directly due to the very flat grades on the structure which do not provide for adequate runoff when some drains are plugged during a rainstorm.

5. There are too few scuppers in the New Jersey rail and they are too high which both cause ponding on the upstream side and concentrated flow across traffic on the down stream side.

6. One of the original construction contracts called for scuppers through the rail at each drain to prevent water from ponding more than 2" before spilling through the rail. Apparently many of these as not functioning. They should be investigated and reestablished at ponding areas.

7. The design at each drain and pipe was such that plugging occurs easily because-

   A. Most drain pipe is too small at 6" dia.

   B. The slope of 30° from the drain box permits the dry debris to "flow" well into the pipe.

   C. The mitered (angular) bends at small radius (1'-6" CL) permits sticks to "hangup".

   D. Although some drains are provided with cleanouts in the deck, cleanouts are seldom used because of the difficulty of removing the cleanout plate. As a test, some of these plates should have 1" holes drilled through them to permit rodding or flushing without removing the plate.

ELYSIAN VIADUCT #53-1424 07-LA-4

The structure was built in 1962.

Most of the deck drains in the RC box girder spans are 1'-4" by 1'-5" steel boxes which are located tight against the rail. The bottom of the box (4-1/2" deep min.) slopes 30° to the 6" outlet pipe which exits at a 30° or more slope. It appears that most of the debris which falls through the grate would fall into and down the pipe. The box has a single grate with 1-1/2" slots which run parallel to the roadway. The 6" outlet pipe is tapered to an 8" outlet pipe which is carried at a good slope to a column where it outflows horizontally with a cleanout onto ground or into a storm drain. Bends are angled segments (30° max. per segment) or 2' radius curves. See details on Page P-1.

Most of the deck drains in the steel girder spans are 4'-2" by 1'-2" steel boxes which are located right up against the rail and extends 4' into the shoulder. The long length of the drainbox permits a vertical 6" diameter pipe to exit from the box on the inside of the plate girder (out of sight). Each box is 5" to 9" deep and slopes slightly to the pipe. The box has a single grate which is bolted down to 6 studs in the frame. The vertical pipe outlet can be probed with any tool or rod which will fit through the grate openings. The 6" drain angles directly to the top of and down the nearest column. The outflow at the bottom of the pipe is provided with a cleanout. The drains over the Arroyo Seco carry the drain pipe to just below the bottom flange where it freefalls into the channel. See details on Page P-2.

Comments on Existing Installation

1. In 1962 experimental covers were placed under the grates to prevent debris from falling into the drain pipes. Although it was later decided that these covers prevented debris from falling directly into the pipe this made cleaning the drains with a high pressure hose very difficult and they were therefore permanently removed after a test.

2. The drains in the RC box girder section plug fairly easily probably largely due to the steep slope of the outlet pipe from the drain box which permits dry debris to buildup in the pipe.

3. The drains in the plate girder section also plug easily due to dry debris falling into the vertical outlet pipe. If this pipe were covered with a 9 1/2" by 12" heavy gage plate welded to the bottom of the grate over the pipe it should reduce plugging significantly. If a 1" hole was drilled into this plate directly over the outlet pipe and between grate bars, it would permit rodding or washing plugs without removing the grate.

4. One of the most important things concerning the drains on this structure is that even when many are plugged in rainy weather there is no traffic hazard because the grade is sufficient to carry the water adequately off the bridge.

5. Overflow scuppers are shown on the drain detail sheets. This is a good idea because it reduces the risk that they would be overlooked when shown on the rail sheet only.

MISSION VALLEY VIADUCT #57-720 R/L 11-SD-805,8

This structure was built in 1968.

The deck drains are 3'-4" by 2'-1" steel boxes which are located with the 3'-4" side against the rail. The box is 8" to 11" deep. The entire 3'-4" traffic side is open and in about 3' funnels down to 1' wide where a 8" steel pipe drops near vertically then turns to a -5° minimum slope and carries the runoff to a bent where it exits into the storm drainage system. The box has a single grate with 1-3/8" slots parallel to the roadway and the standard detail for this grate clearly points out that it is to be used only where pedestrians and bicycles are excluded. This grate weighs 374 lbs and is not fastened down to the frame.

The drain details for this structure are on Pages Q-1 and Q-2. At first glance this design seems to promise plugging problems. In particular, the outlet "funnel" area decreases 70° in less than 3 feet so it appears plugs might easily occur here. In addition, the only access to such a plug is from the drain box which means the 374 lb grate must be lifted out to rod out the opening.

Another detail which could cause problems is that there is a "lip" entirely around the pipe where it exits vertically from the drain. This permits sticks to bridge over the pipe and start a plug. A better detail would be for the funnel to shape to the back of the pipe so as to eliminate the backlip.

Some good features of this design are the use of 8" pipe throughout, the use of 2' minimum radius bends and a 5° minimum slope. Another good detail is having the drain pan flush with the soffit. See details on Pages Q-1 and Q-2.

The local maintenance foreman advises that the drains on this structure do plug easily and often and advises that the usual cause is sticks which bridge the pipe. He advised that the drains at the sag area have ponded water as much as 1 foot deep, and that the overflow scuppers (located at the sag drain only) probably plugged. He said the dry debris collects quickly in the deck drain boxes (2 weeks?) and the deck power brooming contributes seriously to this. The main debris items which form plugs are sticks which bridge the pipe inlet or jam in the pipe, and soft drink container lids.

He advised that the grates are very heavy and are usually moved with a crew of 3 using "T" type lifting handles. It is a difficult operation when the water is ponded.

Maintenance uses a truck mounted "VACTOR" when available, to suck up the ponded water then to jet out the plug.

The foreman urged that on future designs that the drains at sag points have far more capacity because they have to carry the water from many plugged uphill drains. He agreed that if a 1" hole were drilled from the deck through the drain "funnel" above the "plug" area that most plugs could be quickly cleared from the deck with a section of hooked rod.

Comments on Existing Installation

1. 3" (v) x 1'-0" scuppers are placed in the rails at the drains at the sag point of the structures. They were a good attempt to prevent serious ponding at the sag area. They often plug however, when they are most needed because the 3" vertical opening is too small. Scuppers should be 6" (vert) by 15".

2. A cleanout in the deck as a extension of the near vertical pipe would have made clearing these drains easier especially if the cleanout plate had a 1" hole in it to permit rodding the pipe without removing either the grate or the cleanout plate.

SAN DIEGO RIVER BRIDGE #57-566 R/L 11-SD-5,8,109,209

This structure was built in 1969.

The drains are all Type D-1 which are designed to be used in RC box girders with a small deck overhang where the 1'-3" deep drain box can be hidden in a box girder cell. The drains are all 1'-4" by 1'-5" steel boxes which are located about 2' from the rail in a 3/4" depression in the deck. A 6" pipe exits normal to the box and turns down (1'-6" min. R) to just below the box girder bottom slab where it outlets into the San Diego River Channel. This box has a single grate with 1 1/2" slots, transverse to the roadway, which is hinged at the traffic end and which is fastened with a single spring-loaded "L" hook.

These drains have a history of good operation with very few plugs. The short outlet line with only one bend substantially reduces the section where plugs could form.

It does appear that an 8" or larger pipe running from the deck to below the soffit of the box girder in a straight fall would have permitted any dry debris to fall immediately into the channel and would have eliminated any chance for plugging. The drain box could have been left out and a simple grate welded to the top of the pipe.

ROUTE 209/5 SEPARATION #57-551R 11-SD-5,8,109,209

This structure was built in 1969.

The drains are all Type D-2 which are designed to be used in deck overhangs. The drains are all 1'-4" by 1'-5" steel boxes which are located tight against the rail. A 6" pipe, flattened to 2-1/2" at the drain box, exits normal to the box and turns down (1'-6" Min. CL R) into the center of a concrete column where it exits at 90° to just above the ground line.

Comments on Existing Installation

The D-2 drains, because of their flattened 2 1/2" vertical opening, plug easily at the inlet and are difficult to clean. The hinged grates work well though some hinges are on the side away from traffic. It would be safer for traffic if the hinged end faced traffic. It would be better for maintenance if the grate could be removed in the up position.

As the bridge is entirely on curve and therefore has significant cross-slope, and as the structure is on a humped vertical curve, rainwater does not pond even with some drains plugged but runs off the bridge or down the ramp.

EAST CONNECTOR VIADUCT #57-735R 11-SD-5,15

The structure was built in 1977.

The deck drains are 1'-4" by 1'-5" steel boxes (Type D-2 Drains) which are located 1" from the rail. The box is 5-1/2" to 8" deep. A 6" pipe, flattened to 2-1/2" at the drain box exits normal to the box at a -2% minimum slope then turns down through the center of a concrete column. The box has a single grate, with 1-1/2" slots parallel to the roadway, which is fastened down with 2 spring-loaded "L" hooks.

Comments on Existing Installations

The D-2 drains because of their flattened 2 1/2" vertical opening, plug easily at the inlet and are difficult to clean.

As the bridge is largely on curve and therefore has significant cross-slope, and as the structure is on a significant humped grade, rainwater does not pond even with some drains plugged but runs off the bridge or down the ramp.

WABASH VIADUCT #57-732 11-SD-5,15

This structure was built in 1977 and has the same drain details as East Connector Viaduct #57-736.

Comments on Existing Installations

The D-2 drains because of their flattened 2 1/2" vertical opening, plug easily at the inlet and are difficult to clean.

This 1503' long bridge is largely on a curve and therefore has significant cross-slope and as the structure is on a significant humped grade to the north, most of the bridge does not pond even with some drains plugged. Near the southerly end of the bridge however, there is a sag in the profile grade and a reversing cross-slope has diverted water to the other side of the deck with only one drain and it was necessary to drill two 4" holes through the rail as scuppers to prevent ponding in this area.

This problem indicates that there should be an extra drain just upstream of each drainage crossover area and that there should be a minimum of two drains in any sag area with the higher drain set no more than 2" higher than the lowest drain.

COMMENTS

1. Maintenance people generally feel the usual standard 6"Ø pipe is the root cause of plugging and a 8" minimum diameter pipe would minimize plugging problems and some feel a 10" minimum might well eliminate all plugging. There is much to be said for this opinion. The size of debris that enters the drain box is limited by the grate openings and amounts which could cause a wedging plug in the 6" could well wash right through the 8" pipe. Plus some plug starters in the 6" pipe such as long sticks (12"-15") or smashed beer cans would probably pass right through an 8" pipe.

   The change from a 6" to 8" encased drain pipe would increase the cost of the pipe about $1.40/lf ($1.50/lb) and save about $1.20 of concrete ($216/CY) in encased portions.

   Larger pipe would pose a bigger problem in interference with reinforcement especially at the outlet at the bottom of a column. This should be considered by designers and placement of rebar around the pipe should be detailed. Designers should show the placement of rebar around the outlet of even the current 6" pipe.

2. Hinged Grates - Maintenance personnel generally comment on grates as follows:

   A. Hinged grates are easier and quicker to open because they require only one hold down device.

   B. Hinged grates are easier and safer to open because personnel do not have to lift the entire weight of the grate.

   C. Hinged grates avoid the problems of mixing up grates on mulitple grate boxes and avoid reversing or rotating single grates.

   D. Debris can easily be flushed from the grates as they rest in a near vertical position.

   E. The opened hinged grates are somewhat in the way during cleaning operations and make drain flushing with hoses or, flushing equipment, a little more difficult.

   F. In most cases it would be desirable to remove the grates once they are in the open position. This can be done by having 2 hinge pins on the grate slip into holes in tabs welded to the grate, so dimensioned that the grate must be opened to slip the pins out.

3. Flushing Systems - Early drain flushing systems were relatively ineffective so those generally are not used.

The most recent installation at China Basin Viaduct (1971) however has been very successful and is highly regarded by local maintenance people.

The problem in a unsuccessful system is as follows:

> The Rte 92/101 interchange has low water pressure. The water line is too small and only one drain can be flushed at a time. Local maintenance forces have abandoned the flushing system and rely on high pressure hose on a tank truck. Basically the system had neither the pressure or volume necessary to dislodge the large amounts of debris collected.

4. D-2 Drains

This drain is built of a separate bottom pan and a separate upper frame so that it can be fitted to the space available. At some drains where space was limited the upper frame has been pushed too far down over the bottom pan before they were welded together and about 1" of the 2- 1/2" drain pipe height was closed off which causes frequent plugging. Maintenance should call for cutting out that portion of the upper section that blocks off part of the pipe inlet.

Due to the cross-slope of the deck the hinged grates move toward the rail when they are opened and one could be opened only 4" before it jammed against the rail. The design detail should call for 3" minimum from the rail and more as necessary for high cross-slopes.

The design of the type D-2 drain should be modified so that the inlet pipe section is "flattened" as little as possible and it appears that the pipe generally could be kept to 5" vertical min. instead of the 2 1/2" detailed.

RECOMMENDATIONS

"SPECIAL"- Many problems will disappear if the designer will recognize that drains do not have problems with water but with "GLOP" which includes silt, sand, plastic bags, cups and covers, crushed beer cans, sticks, and general garbage.

1. Drain pipes should be a minimum of 8" diameter if at all possible.

2. Minimum radius of pipe bends should be
   2'-0" for bends up to 45°
   3'-0" for bends over 45°

3. No mitered (angular) bends in the pipe should be permitted.

4. 90° bends should be avoided. The smaller the angular change the less possibility of plugging.

5. There should be no fixed baffle plates in drain boxes. Baffle plates attached to the grates and which block debris from entering the pipe inlet are desirable.

6. The D-2 drain detail should be modified so the pipe is flattened as little as possible where it enters the drain box. The bottom of the box should be at the plane of the deck soffit.

7. Grates should be hinged if possible. The hinge should be at the end facing traffic. The drain box must be located far enough away from the rail that the hinged grate will clear the rail even on severe cross-slope. The hinged grate should be removable in the open position (pin in eye type), but make sure the grate slips off moving away from the rail.

8. There should be a minimum grade of 2% on structures over 250' long in order to prevent ponding, even if this requires up then down vertical curves.

9. Shoulder cross-slopes should be a minimum 3% on viaducts where the longitudinal grade is less than 2%.

10. All structures with drains should have shoulders a minimum of 8' wide to minimize the hazard to maintenance personnel clearing drains in a storm.

11. Single grates rather than 2 or 3 grates per drain should be used until the weight reaches 50#.

12. If cleanout plugs are put in the deck the plug should have a 1" hole in it to permit probing with a rod without removing the plug.

13. Do not use threaded brass cleanout covers (Alhambra A-386) in the deck where traffic may run over them. In time the threads jam apparently due to traffic impact. Use (Alhambra A-386-B or equal) which is a boltdown cover. Drill a 1" hole through the plate at center so a hooked rod can be used to clear plugs at top of pipe.

14. The control of crossover deck flow when deck slopes reverse, is often poor and a resulting sheet of water running across the deck can be a hazard to traffic. We recommend that one extra drain be placed within 50' upstream of the drain at the crossover point which at some locations does not collect all the water. (The longitudinal slope equals cross slope just before a drainage crossover point which makes collection difficult).

15. The tiedown detail of grate bolt studs wired down with #9 galvanized wire should be discarded forever.

16. The use of rebar crossing over drain inlets should not be permitted.

17. The grates should be designed to permit some probing of the inlet pipe with a rod through the grate. This can be accomplished by placing the grate slots in line with the outlet pipe. Slots transverse to traffic is another way of stating it.

18. A spare grate or more (say 5% min.) of each grate size should be provided under the contract and given to local maintenance to later replace lost or broken grates.

19. Overflow scupper openings should be 6" deep at all sag area drains, to eliminate plugging.

20. Some installations of the D-2 drains which feature a horizontal 6" outlet pipe flattened to 2 1/2" vertical, have the upper frame improperly located so as to block off a portion of the already small 2 1/2" opening. All D-2 drains should be checked and any interfering frame portions should be cut out. It is recommended that the detail be changed so the bottom of the drain is always placed flush with the soffit. This would also permit less flattening of the pipe at the inlet.

21. All drains which might cause ponding should have their location marked on the rail or curb adjacent to the drain. We suggest a 4" wide white line painted vertically from gutter line up 2' or so. This will permit maintenance to quickly find the drain in a ponded situation. This should make hazardous work a little safer.

22. It is time to take a hard look at the policy of "hiding" drainpipe within the structural section. Wide and thin over-

hangs and wide spacing on bent columns all contribute to the severe reductions in pipe size (and flattenings), small radius 90° bends, shallow slopes and interference with column reinforcing steel which result.

Because of the many locations where plugged drains have caused ponding which has endangered public traffic and maintenance personnel, it is not difficult to find adherents who would recommend the most effective drainage design first and "looks" of the drainage last at critical locations.

The problem is, clearly, that an effective 8" pipe from the deck drain to groundline or a catch basin which could eliminate most of the pipe line plugs is potentially very "ugly".

One solution might be to eliminate the pipe and carry water from a generous "hole" in the deck to the ground with an anchored heavy chain. It would seem unlikely that a chain would plug. This might be acceptable architecturally if the chain length is minimal and if the area below is landscaped.

Another more acceptable solution might be to design the drain pipe to come down inside a column leg, but to have the pipe take a straight "shot" from the deck drain to the top of column, and to have the pipe "angle" in the column so as to reduce the angular bends at top and bottom of the column. As a portion of this drain pipe and possibly the drain box would then protrude below the overhead soffit it would be desirable to box them in with concrete in a pleasing manner.

A "bad" drain with its consequent hazard to public traffic and maintenance forces is too high a price to pay for getting all the drainage appurtences out of sight.

23. The contract acceptance of a bridge drainage system should be conditioned on a solid ball of a diameter 2" less than the pipe diameter, passing through all the drainage pipe. The common problem is that concrete grout leaks through pipe joints and then solidifies in the pipe. The constricted opening will pass water easily but will quickly plug with debris due to necking down.

24. The following recommendations are made for deck flushing systems.

    A. Provide drain flushing systems on all viaduct structures.

    B. Locate the valves so that the operator is in a safe location, has minimum interference with traffic, and can see each drain being flushed.

C. Use regular valve handles in lieu of "keys".

D. Specify removable caps at ends of water supply lines so rust and debris can be drained out.

E. 1/4" holes drilled in the pipe seem as good as nozzles.

F. The sections of flushing pipe in the drain boxes should be removable and should be rotatable so maintenance could change the spray heads or spray angle. Standard unions are one solution.

25. Grates with spring loaded "L" hooks should never be used where traffic might someday pass over them.

26. Do not use neoprene sheet seal across finger expansion joints on skew as due to relative movement, the neoprene buckles and ripples. See discussion for Stockton Channel Viaduct on page 37.

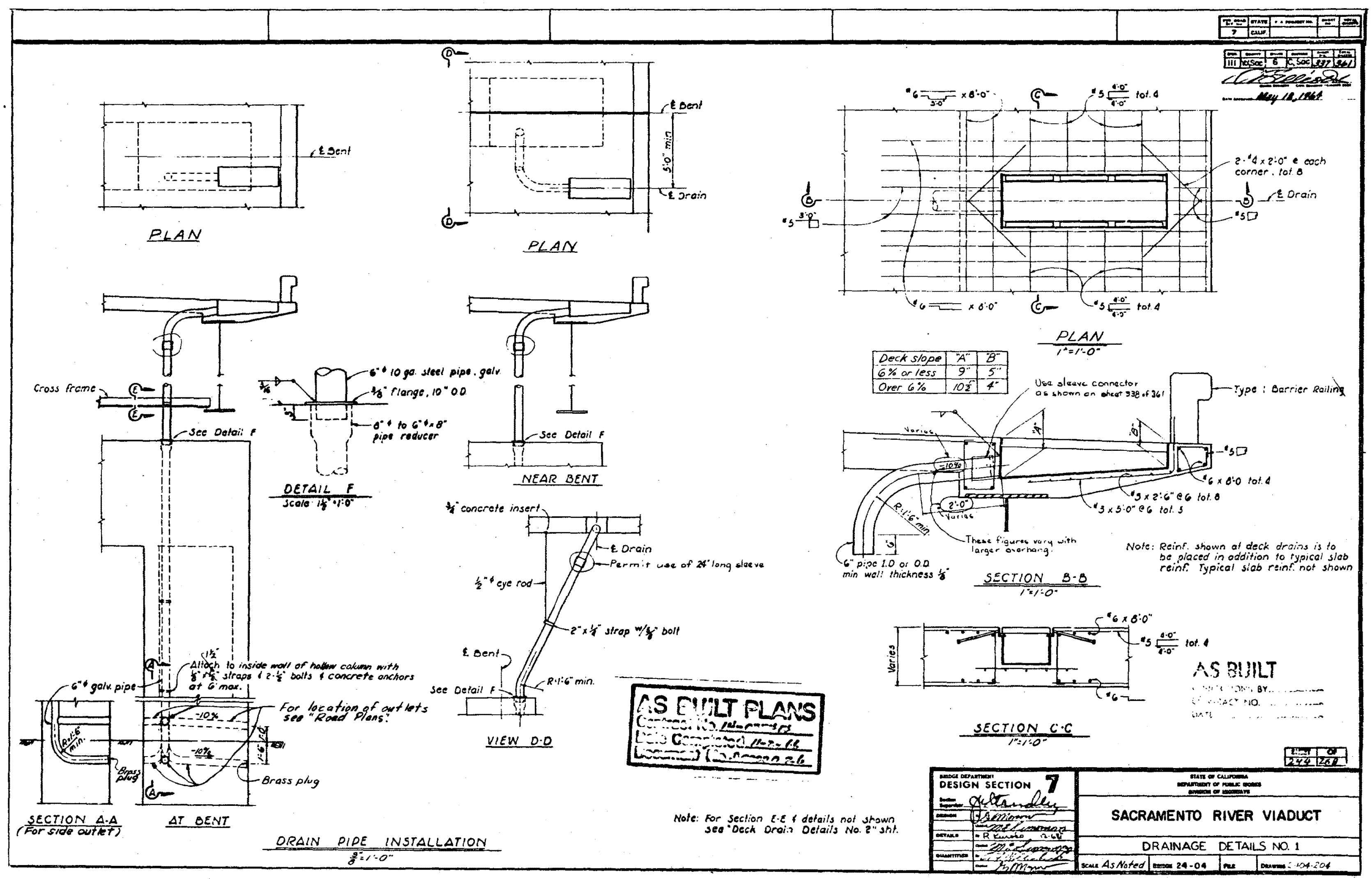
IMPLEMENTATION

Copies of this report will be distributed to the Office of Project Design of the California Department of Transportation. A review of the recommendations will be made and those design type recommendations approved by the design supervisors will become part of "Memos to Designers" where they will become part of future designs.

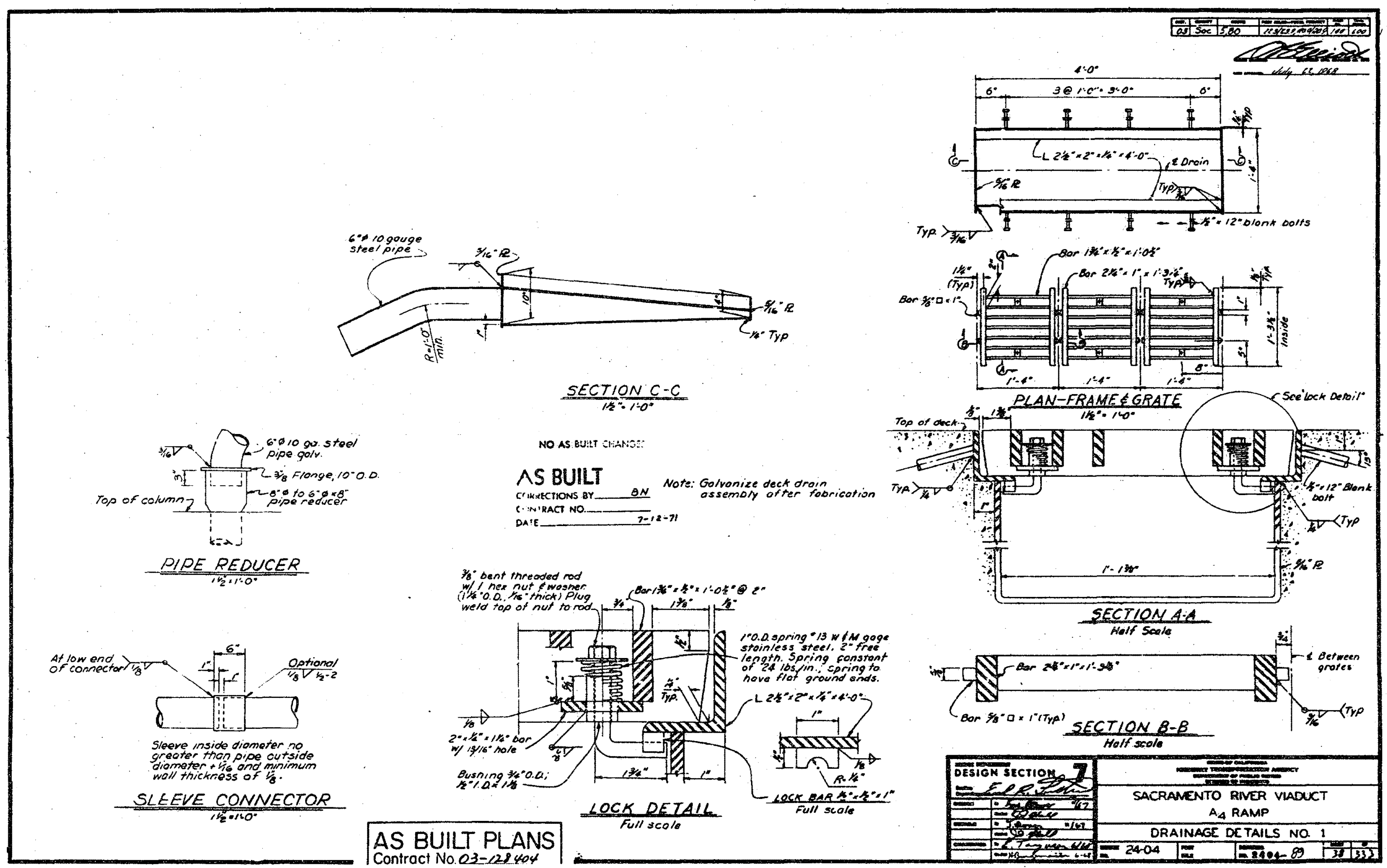
Additional copies of this report will be distributed to Structures Maintenance Bridge Engineers and it is expected that those maintenance problems and solutions discussed in the report will be considered by the Bridge Maintenance Engineers and where applicable will be put into operation by Bridge Maintenance Reports.

APPENDIX

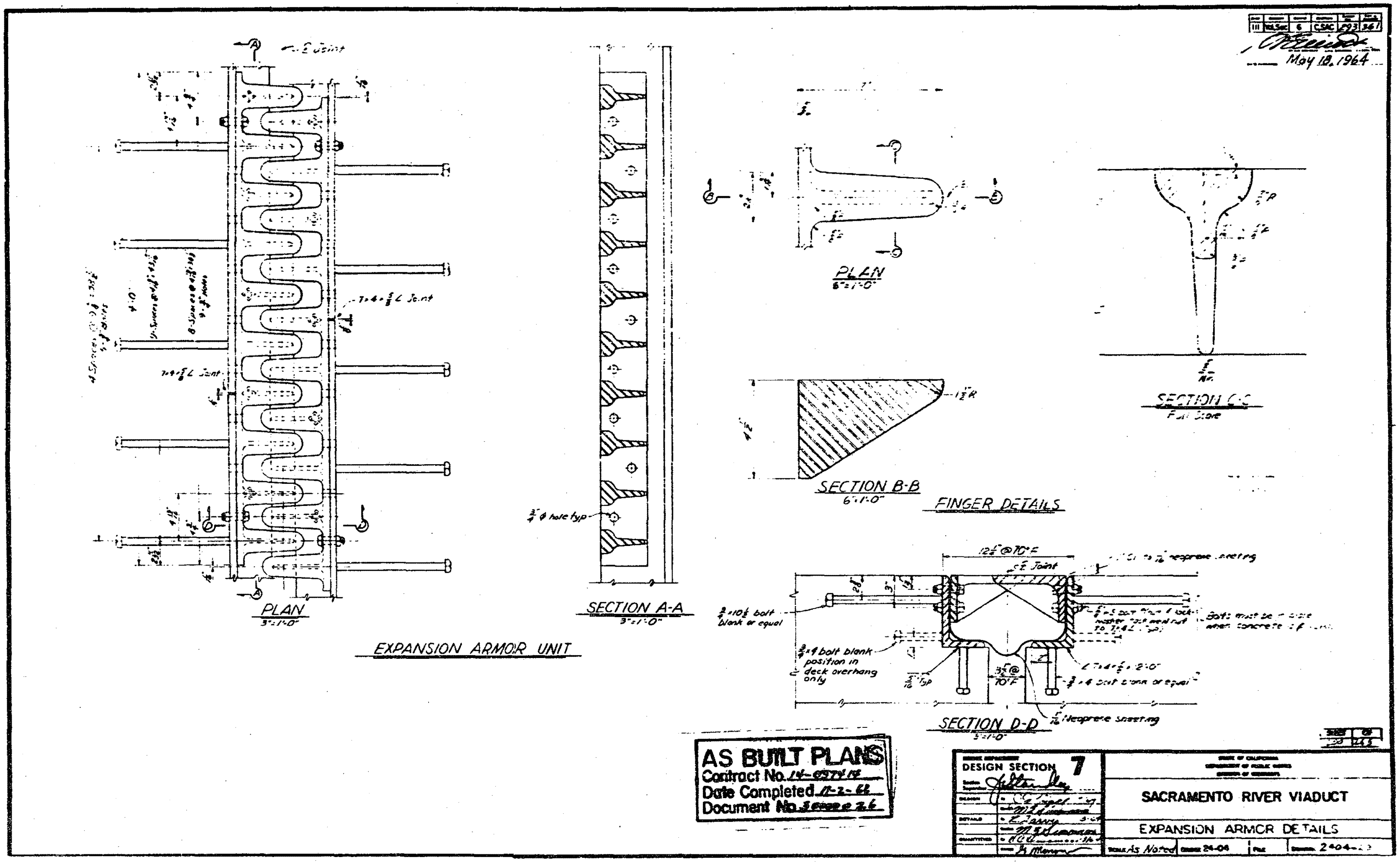
A-1

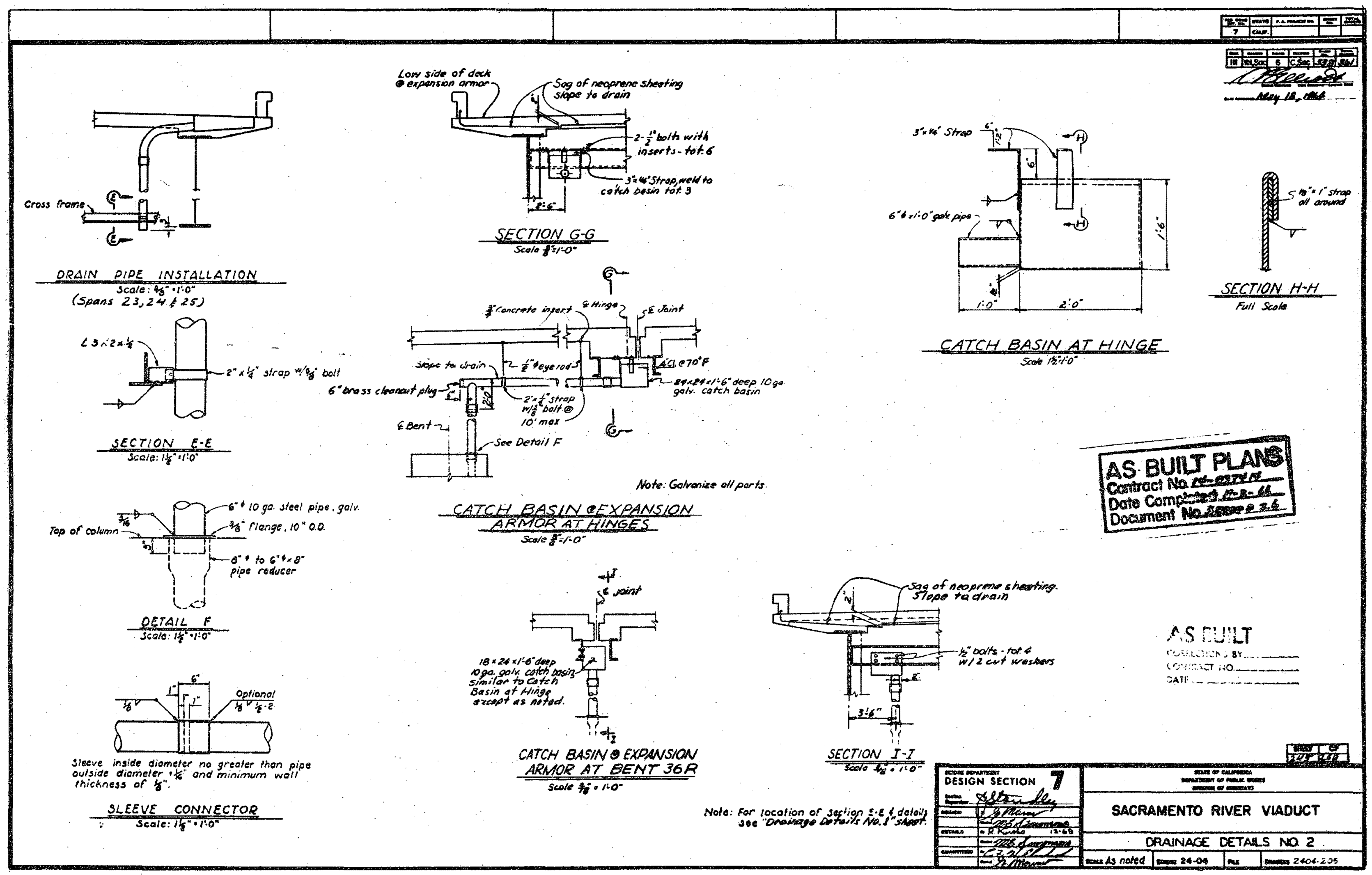

PLAN
℄ Bent
PLAN
℄ Bent
5'-0" min.
℄ Drain
#6 x 8'-0"
#5 tot. 4
2-#4 x 2'-0" @ each corner, tot. 8
℄ Drain
PLAN
1"=1'-0"
May 18, 1964
Cross frame
See Detail F
6" ɸ 10 ga. steel pipe, galv
3/8" flange, 10" OD
8" ɸ to 6" ɸ x 8" pipe reducer
DETAIL F
Scale 1½"=1'-0"
See Detail F
NEAR BENT
Deck slope | "A" | "B"
6% or less | 9" | 5"
Over 6% | 10½" | 4"
Use sleeve connector as shown on sheet 338 of 361
Type: Barrier Railing
#6 x 8'-0 tot. 4
#3 x 2'-6" @6 tot. 8
#3 x 5'-0" @6 tot. 3
These figures vary with larger overhang.
6" pipe I.D. or O.D. min wall thickness ⅛"
SECTION B-B
1"=1'-0"
Note: Reinf. shown at deck drains is to be placed in addition to typical slab reinf. Typical slab reinf. not shown
¾" concrete insert
℄ Drain
Permit use of 24" long sleeve
½" ɸ eye rod
2" x ¼" strap w/⅜" bolt
℄ Bent
See Detail F
R=1'-6" min.
VIEW D-D
Attach to inside wall of hollow column with ⅛" x 1½" straps & 2-½" bolts & concrete anchors at 6' max.
6" ɸ galv. pipe
For location of outlets see "Road Plans".
Brass plug
Brass plug
SECTION A-A
(For side outlet)
AT BENT
DRAIN PIPE INSTALLATION
⅜"=1'-0"
#6 x 8'-0"
#5 tot. 4
Varies
SECTION C-C
1"=1'-0"
AS BUILT
AS BUILT PLANS
Note: For Section E-E & details not shown see "Deck Drain Details No. 2" sht.
BRIDGE DEPARTMENT
DESIGN SECTION 7
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
SACRAMENTO RIVER VIADUCT
DRAINAGE DETAILS NO. 1
SCALE As Noted
BRIDGE 24-04
244 OF 268

A-2



AS BUILT PLANS
Contract No. 03-128404

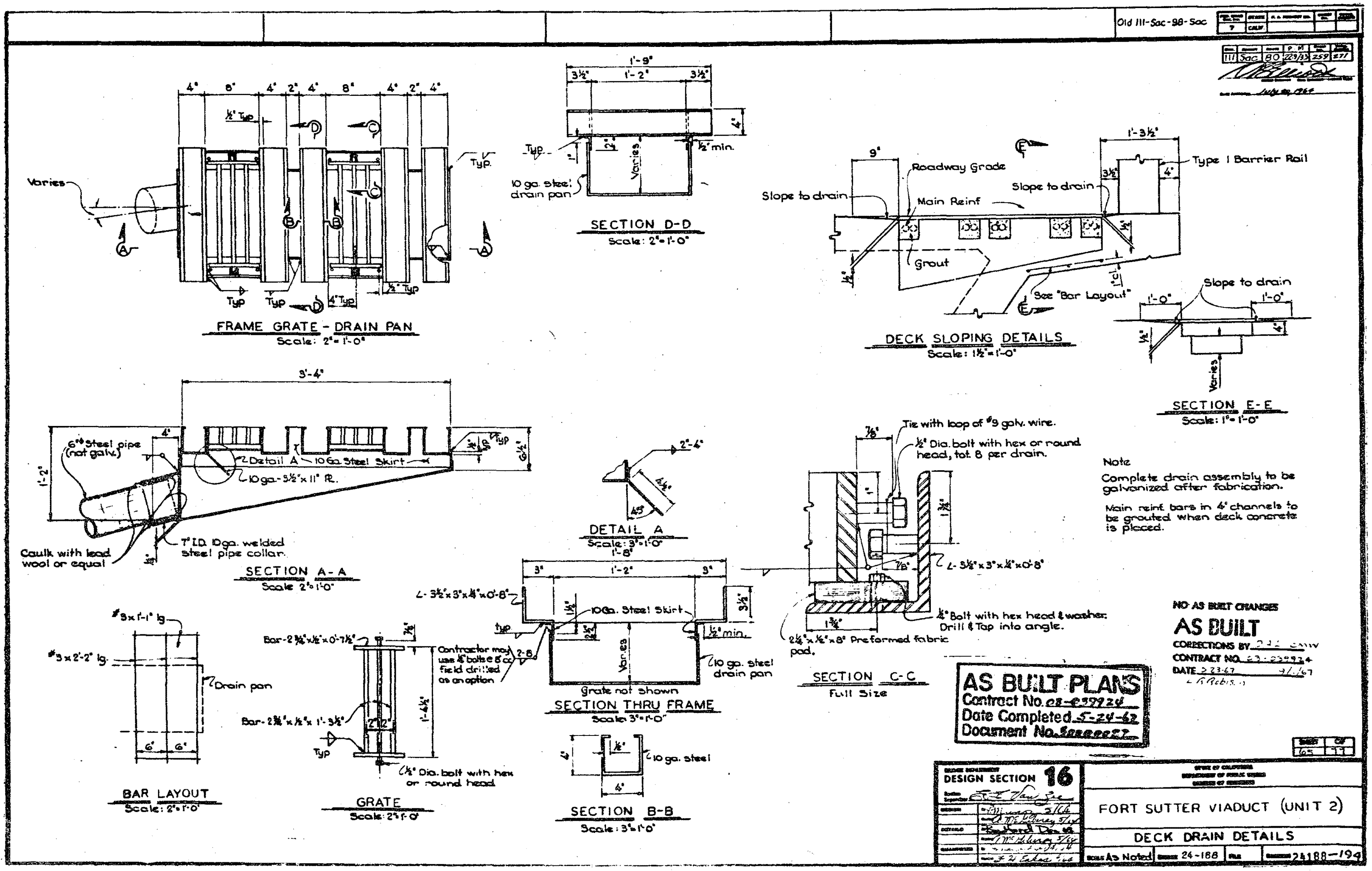

May 18, 1964
PLAN
3"=1'-0"
EXPANSION ARMOR UNIT
SECTION A-A
3"=1'-0"
¾"ϕ hole typ
PLAN
6"=1'-0"
SECTION B-B
6"=1'-0"
FINGER DETAILS
SECTION C-C
Full Scale
SECTION D-D
3"=1'-0"
℄ Joint
⁵⁄₁₆" Neoprene sheeting
Bolts must be in place when concrete is placed
AS BUILT PLANS
Contract No. 14-057414
Date Completed 11-2-66
Document No.
DESIGN SECTION 7
SACRAMENTO RIVER VIADUCT
EXPANSION ARMOR DETAILS
SCALE As Noted
24-04



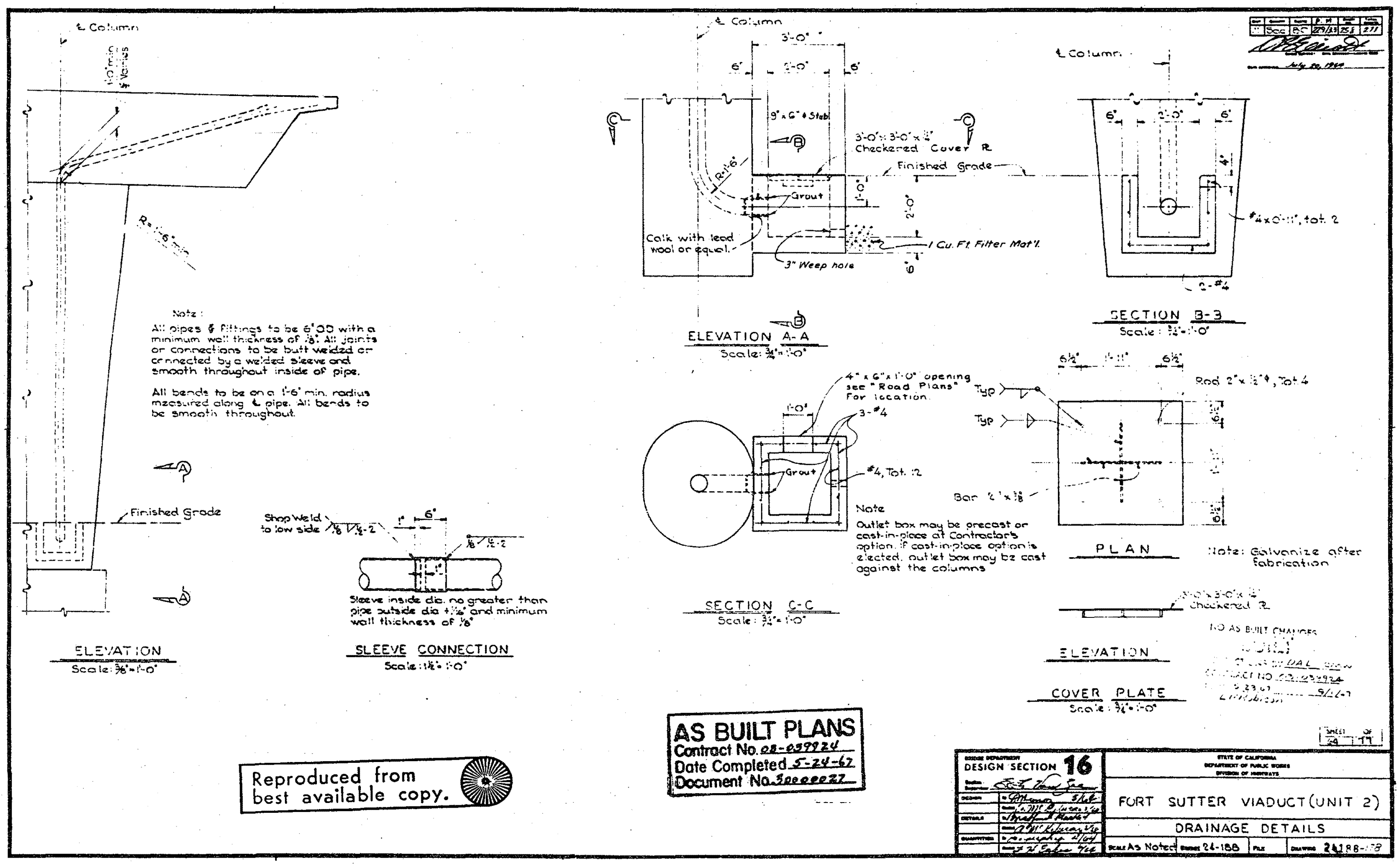
DRAIN PIPE INSTALLATION
Scale: 3/8" = 1'-0"
(Spans 23, 24 & 25)
Cross frame
Low side of deck @ expansion armor
Sag of neoprene sheeting slope to drain
2-1/2" bolts with inserts - tot. 6
3"x1/4" Strap, weld to catch basin tot. 3
SECTION G-G
Scale 3/8"=1'-0"
3"x1/4" Strap
6"φ x1'-0" galv. pipe
CATCH BASIN AT HINGE
Scale 1 1/2"=1'-0"
1/8" x 1" strap all around
SECTION H-H
Full Scale
L 3x2x1/4
2" x 1/4" strap w/3/8" bolt
SECTION E-E
Scale: 1 1/2" = 1'-0"
3/4" Concrete insert
℄ Hinge
℄ Joint
Slope to drain
1/2" φ eye rod
6" brass cleanout plug
2"x1/4" strap w/3/8" bolt @ 10' max
24x24x1'-6" deep 10 ga. galv. catch basin
℄ Bent
See Detail F
Note: Galvanize all parts.
CATCH BASIN @ EXPANSION ARMOR AT HINGES
Scale 3/8"=1'-0"
AS BUILT PLANS
Contract No.
Date Completed
Document No.
6"φ 10 ga. steel pipe, galv.
3/8" flange, 10" O.D.
Top of column
8"φ to 6"φ x 8" pipe reducer
DETAIL F
Scale: 1 1/2" = 1'-0"
℄ joint
18x24x1'-6" deep 10 ga. galv. catch basin similar to Catch Basin at Hinge except as noted.
CATCH BASIN @ EXPANSION ARMOR AT BENT 36R
Scale 3/8" = 1'-0"
Sag of neoprene sheeting. Slope to drain
1/2" bolts - tot. 4 w/2 cut washers
SECTION I-I
Scale 3/8" = 1'-0"
AS BUILT
CORRECTIONS BY
CONTRACT NO.
DATE
Optional
Sleeve inside diameter no greater than pipe outside diameter + 1/8" and minimum wall thickness of 1/8".
SLEEVE CONNECTOR
Scale: 1 1/2" = 1'-0"
Note: For location of Section E-E & details see "Drainage Details No. 1" sheet.
DESIGN SECTION 7
SACRAMENTO RIVER VIADUCT
DRAINAGE DETAILS NO. 2
Scale As noted
24-04
2404-205

A-4

B-1



Old III-Sac-98-Sac
FRAME GRATE - DRAIN PAN
Scale: 2" = 1'-0"
Varies
Typ.
SECTION D-D
Scale: 2" = 1'-0"
10 ga. steel drain pan
½" min.
Roadway Grade
Slope to drain
Main Reinf
Type 1 Barrier Rail
Grout
See "Bar Layout"
DECK SLOPING DETAILS
Scale: 1½" = 1'-0"
SECTION E-E
Scale: 1" = 1'-0"
6" Steel pipe (not galv.)
Detail A
10 Ga. Steel Skirt
10 ga.-3½" x 11" Pl.
Caulk with lead wool or equal
7" I.D. 10 ga. welded steel pipe collar.
SECTION A-A
Scale 2" = 1'-0"
DETAIL A
Scale: 3" = 1'-0"
Tie with loop of #9 galv. wire.
½" Dia. bolt with hex or round head, tot. 8 per drain.
L-3½" x 3" x ¼" x 0'-8"
¼" Bolt with hex head & washer. Drill & Tap into angle.
2¼" x ½" x 8" Preformed fabric pad.
SECTION C-C
Full Size
Note
Complete drain assembly to be galvanized after fabrication.
Main reinf. bars in 4" channels to be grouted when deck concrete is placed.
#5 x 1'-1" lg.
#5 x 2'-2" lg.
Drain pan
BAR LAYOUT
Scale: 2" = 1'-0"
Contractor may use ⅜" bolts & 8 cc field drilled as an option
GRATE
Scale: 2" = 1'-0"
10 Ga. Steel Skirt
10 ga. steel drain pan
Grate not shown
SECTION THRU FRAME
Scale 3" = 1'-0"
10 ga. steel
SECTION B-B
Scale: 3" = 1'-0"
NO AS BUILT CHANGES
AS BUILT
AS BUILT PLANS
DESIGN SECTION 16
FORT SUTTER VIADUCT (UNIT 2)
DECK DRAIN DETAILS
As Noted
24-188
24188-194



℄ Column
Note:
All pipes & fittings to be 6" OD with a minimum wall thickness of 1/8". All joints or connections to be butt welded or connected by a welded sleeve and smooth throughout inside of pipe.
All bends to be on a 1'-6" min. radius measured along ℄ pipe. All bends to be smooth throughout.
Finished Grade
ELEVATION
Scale: 3/8"=1'-0"
Shop Weld to low side
Sleeve inside dia. no greater than pipe outside dia +1/16" and minimum wall thickness of 1/8"
SLEEVE CONNECTION
Scale: 1½"=1'-0"
3'-0"
2'-0"
9"x6"♦Stub
3'-0"x3'-0"x ¼" Checkered Cover ℞
Finished Grade
Grout
Calk with lead wool or equal.
1 Cu. Ft. Filter Mat'l.
3" Weep hole
ELEVATION A-A
Scale: ¾"=1'-0"
4"x6"x1'-0" opening see "Road Plans" for location.
3-#4
#4, Tot. 12
Grout
Note
Outlet box may be precast or cast-in-place at Contractor's option. If cast-in-place option is elected, outlet box may be cast against the columns
SECTION C-C
Scale: ¾"=1'-0"
#4x0'-11", tot. 2
2-#4
SECTION B-B
Scale: ¾"=1'-0"
Rod 2"x½"♦, Tot 4
Typ
Bar 2"x⅜
PLAN
Note: Galvanize after fabrication
3'-0"x3'-0"x ¼" Checkered ℞
ELEVATION
COVER PLATE
Scale: ¾"=1'-0"
NO AS BUILT CHANGES
AS BUILT PLANS
Contract No. 03-039924
Date Completed 5-24-67
Document No. 50000027
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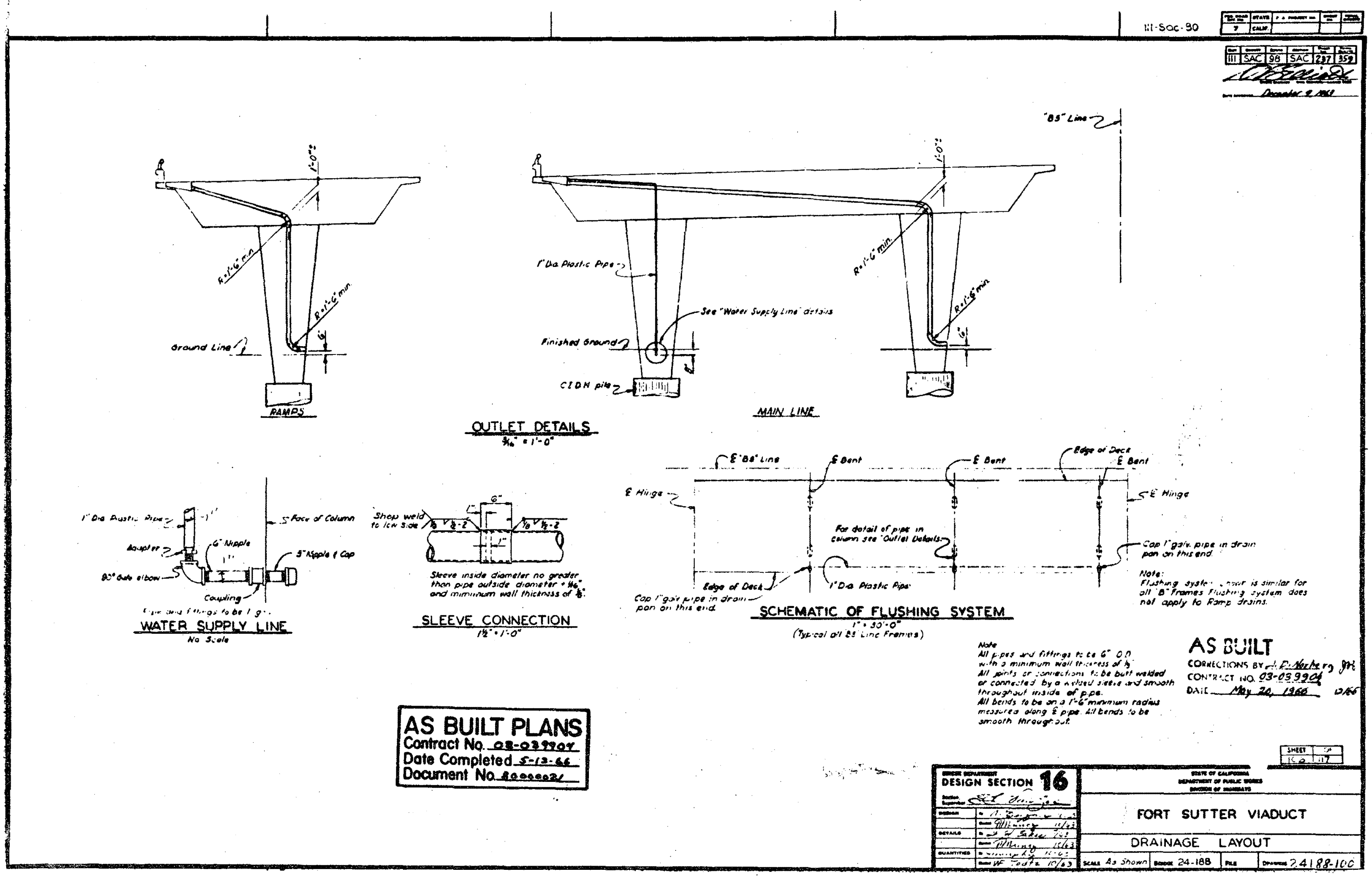
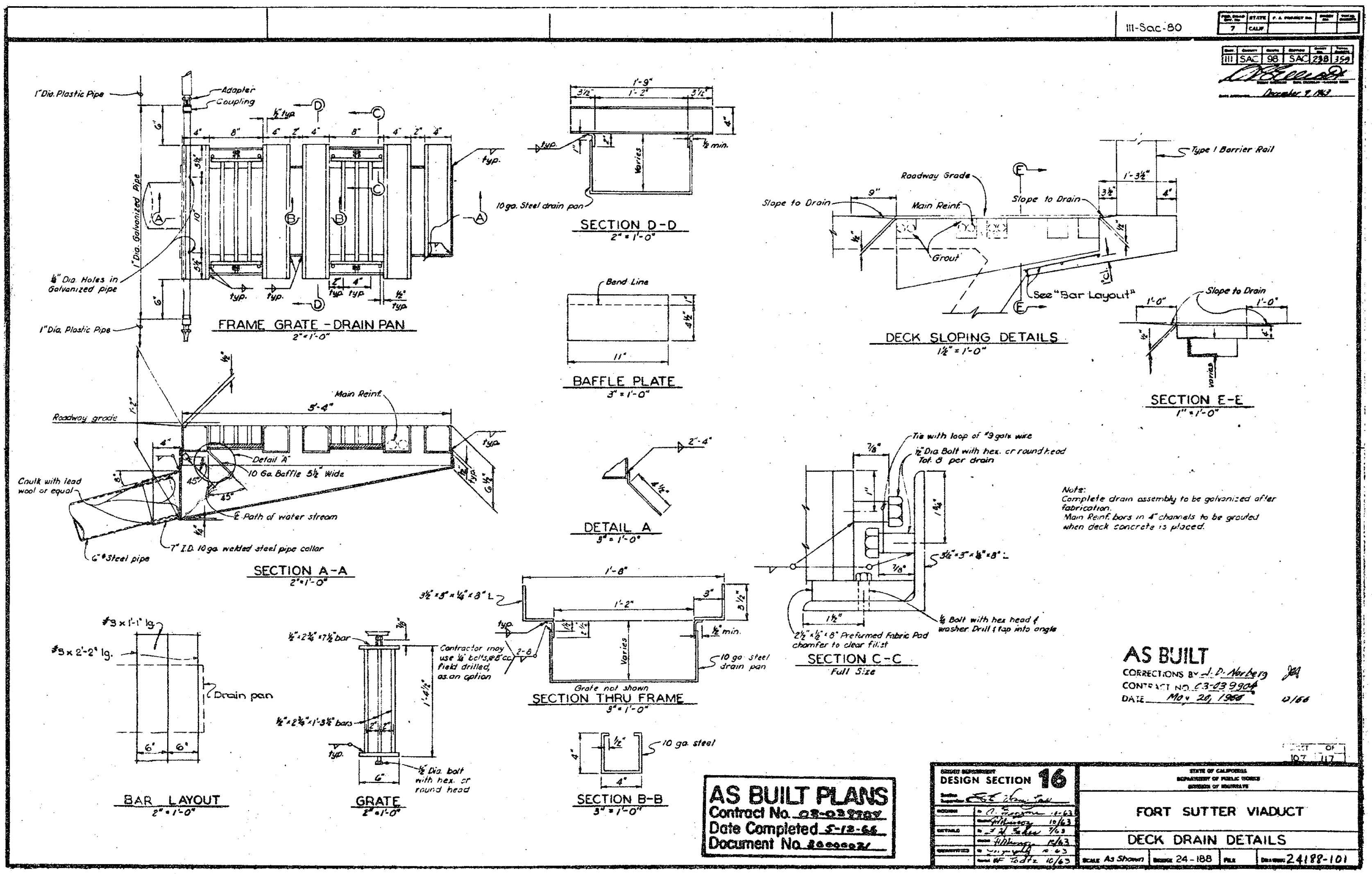
DESIGN SECTION 16
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
FORT SUTTER VIADUCT (UNIT 2)
DRAINAGE DETAILS
SCALE As Noted
24-188
24188-178

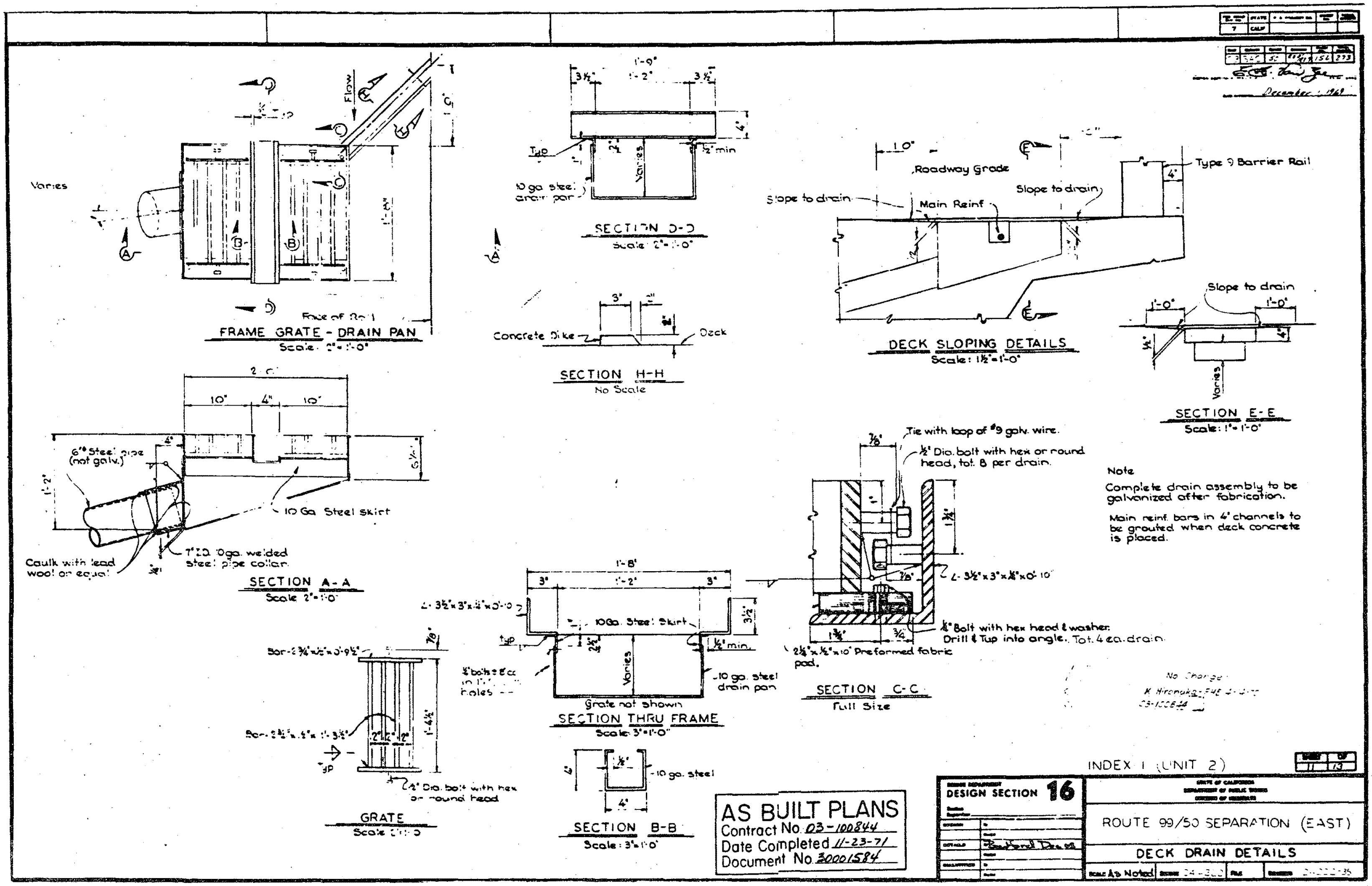
C-1

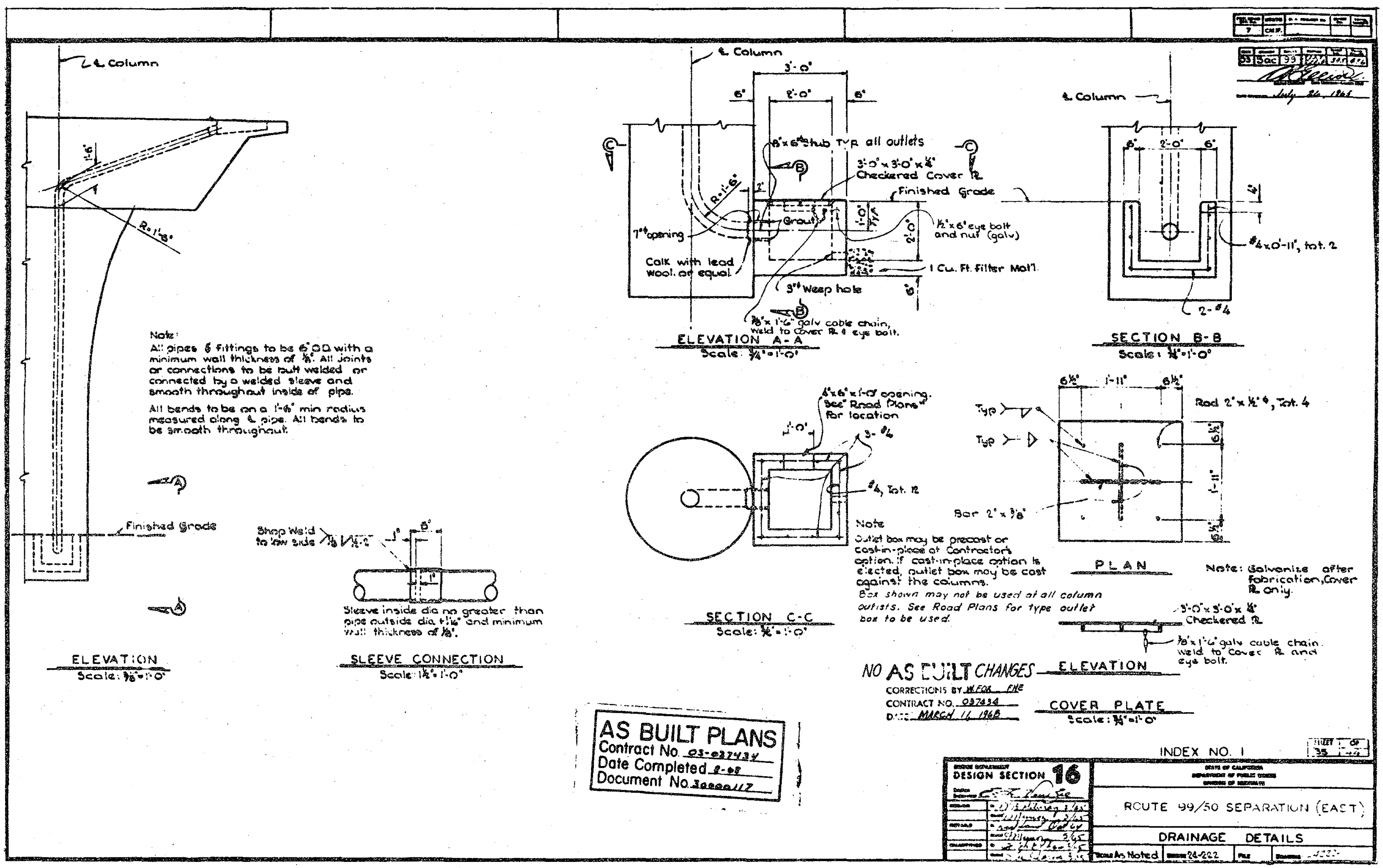


III-Sac-80
III SAC 98 SAC 237 359
December 9, 1963
"B5" Line
1'-0"
R=1'-6" min.
Ground Line
RAMPS
1" Dia. Plastic Pipe
See "Water Supply Line" details
Finished Ground
CIDH pile
MAIN LINE
OUTLET DETAILS
3/16" = 1'-0"
1" Dia. Plastic Pipe
Face of Column
Coupler
6" Nipple
5" Nipple & Cap
90° Gate elbow
Coupling
WATER SUPPLY LINE
No Scale
Shop weld to low side
Sleeve inside diameter no greater than pipe outside diameter + 1/16" and minimum wall thickness of 1/8".
SLEEVE CONNECTION
1½" = 1'-0"
℄ "B8" Line
℄ Bent
Edge of Deck
℄ Hinge
For detail of pipe in column see "Outlet Details"
Cap 1" galv. pipe in drain pan on this end.
Edge of Deck
1" Dia. Plastic Pipe
Note:
Flushing system shown is similar for all "B" Frames Flushing system does not apply to Ramp drains.
SCHEMATIC OF FLUSHING SYSTEM
1" = 30'-0"
(Typical all B5 Line Frames)
Note
All pipes and fittings to be 6" O.D. with a minimum wall thickness of 1/8"
All joints or connections to be butt welded or connected by a welded sleeve and smooth throughout inside of pipe.
All bends to be on a 1'-6" minimum radius measured along ℄ pipe. All bends to be smooth throughout.
AS BUILT
CORRECTIONS BY J. D. Norberg JR
CONTRACT NO. 03-039904
DATE May 20, 1966
AS BUILT PLANS
Contract No. 03-039904
Date Completed 5-13-66
Document No. 80000021
SHEET 106 OF 117
DESIGN SECTION 16
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
FORT SUTTER VIADUCT
DRAINAGE LAYOUT
SCALE As Shown
BRIDGE 24-188
DRAWING 24188-100



III-Sac-80
FRAME GRATE - DRAIN PAN
2" = 1'-0"
SECTION D-D
2" = 1'-0"
BAFFLE PLATE
3" = 1'-0"
DECK SLOPING DETAILS
1½" = 1'-0"
SECTION E-E
1" = 1'-0"
SECTION A-A
2" = 1'-0"
DETAIL A
3" = 1'-0"
SECTION C-C
Full Size
Note:
Complete drain assembly to be galvanized after fabrication.
Main Reinf. bars in 4" channels to be grouted when deck concrete is placed.
BAR LAYOUT
2" = 1'-0"
GRATE
2" = 1'-0"
SECTION THRU FRAME
3" = 1'-0"
SECTION B-B
3" = 1'-0"
AS BUILT
AS BUILT PLANS
Contract No. 03-039904
Date Completed 5-12-66
DESIGN SECTION 16
FORT SUTTER VIADUCT
DECK DRAIN DETAILS
Scale As Shown
24-188
24188-101

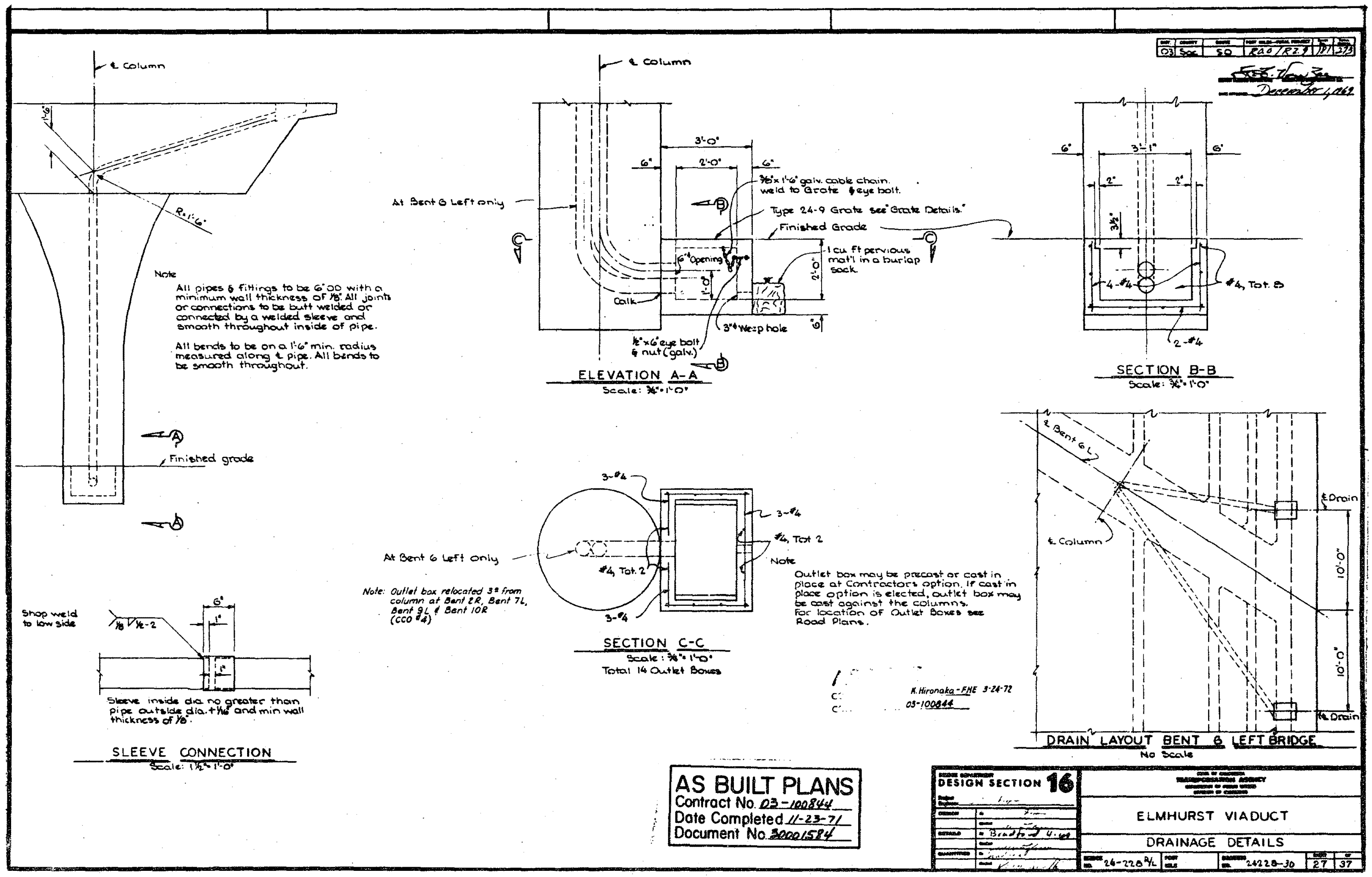

FRAME GRATE - DRAIN PAN
Scale: 2"=1'-0"
Face of Rail
Flow
Varies
SECTION D-D
Scale: 2"=1'-0"
10 ga steel drain pan
Typ
½" min
SECTION H-H
No Scale
Concrete Dike
Deck
DECK SLOPING DETAILS
Scale: 1½"=1'-0"
Roadway Grade
Slope to drain
Main Reinf
Type 9 Barrier Rail
SECTION E-E
Scale: 1"=1'-0"
SECTION A-A
Scale 2"=1'-0"
6"ø Steel pipe (not galv.)
10 Ga. Steel skirt
7" I.D. 10ga. welded steel pipe collar
Caulk with lead wool or equal
SECTION THRU FRAME
Scale: 3"=1'-0"
10Ga. Steel Skirt
10 ga. steel drain pan
Grate not shown
SECTION B-B
Scale: 3"=1'-0"
10 ga. steel
GRATE
½" Dia. bolt with hex or round head
SECTION C-C
Full Size
Tie with loop of #9 galv. wire.
½" Dia. bolt with hex or round head, tot. 8 per drain.
¼" Bolt with hex head & washer. Drill & Tap into angle. Tot. 4 ea. drain.
2¼"x½"x10" Preformed fabric pad.
Note
Complete drain assembly to be galvanized after fabrication.
Main reinf. bars in 4" channels to be grouted when deck concrete is placed.
AS BUILT PLANS
Contract No. 03-100844
Date Completed 11-23-71
Document No. 30001584
INDEX 1 (UNIT 2)
DESIGN SECTION 16
ROUTE 99/50 SEPARATION (EAST)
DECK DRAIN DETAILS
As Noted
December, 1969



℄ Column
Note:
All pipes & fittings to be 6" O.D. with a minimum wall thickness of ⅛". All joints or connections to be butt welded or connected by a welded sleeve and smooth throughout inside of pipe.
All bends to be on a 1'-6" min radius measured along ℄ pipe. All bends to be smooth throughout.
Finished Grade
ELEVATION
Scale: 3/16"=1'-0"
Shop Weld to low side
Sleeve inside dia no greater than pipe outside dia +1/16" and minimum wall thickness of ⅛".
SLEEVE CONNECTION
Scale: 1½"=1'-0"
3'-0"
2'-0"
6"x6" stub TYP all outlets
3'-0"x3'-0"x¼" Checkered Cover ℞
Finished Grade
7" opening
Grout
½"x6" eye bolt and nut (galv)
Calk with lead wool or equal
1 Cu. Ft. Filter Mat'l.
3" Weep hole
⅜"x 1'-6" galv cable chain, weld to Cover ℞ & eye bolt.
ELEVATION A-A
Scale: ¾"=1'-0"
SECTION B-B
Scale: ¾"=1'-0"
#4 x 0'-11", tot. 2
2-#4
6"x6" x 1'-0" opening. See Road Plans for location
3-#4
#4, Tot. 12
Note
Outlet box may be precast or cast-in-place at Contractor's option. If cast-in-place option is elected, outlet box may be cast against the columns.
Box shown may not be used at all column outlets. See Road Plans for type outlet box to be used.
SECTION C-C
Scale: ⅜"=1'-0"
Rod 2"x½"φ, Tot. 4
Bar 2"x⅜"
PLAN
Note: Galvanize after fabrication, Cover ℞ only.
3'-0"x3'-0"x¼" Checkered ℞
⅜"x1'-6" galv cable chain. Weld to Cover ℞ and eye bolt.
ELEVATION
COVER PLATE
Scale: ¾"=1'-0"
NO AS BUILT CHANGES
CORRECTIONS BY W.FOX FHE
CONTRACT NO. 037434
DATE MARCH 11, 1968
AS BUILT PLANS
Contract No. 03-037434
Date Completed 8-68
Document No. 30000117
INDEX NO. 1
DESIGN SECTION 16
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
ROUTE 99/50 SEPARATION (EAST)
DRAINAGE DETAILS
Scale As Noted
24-222

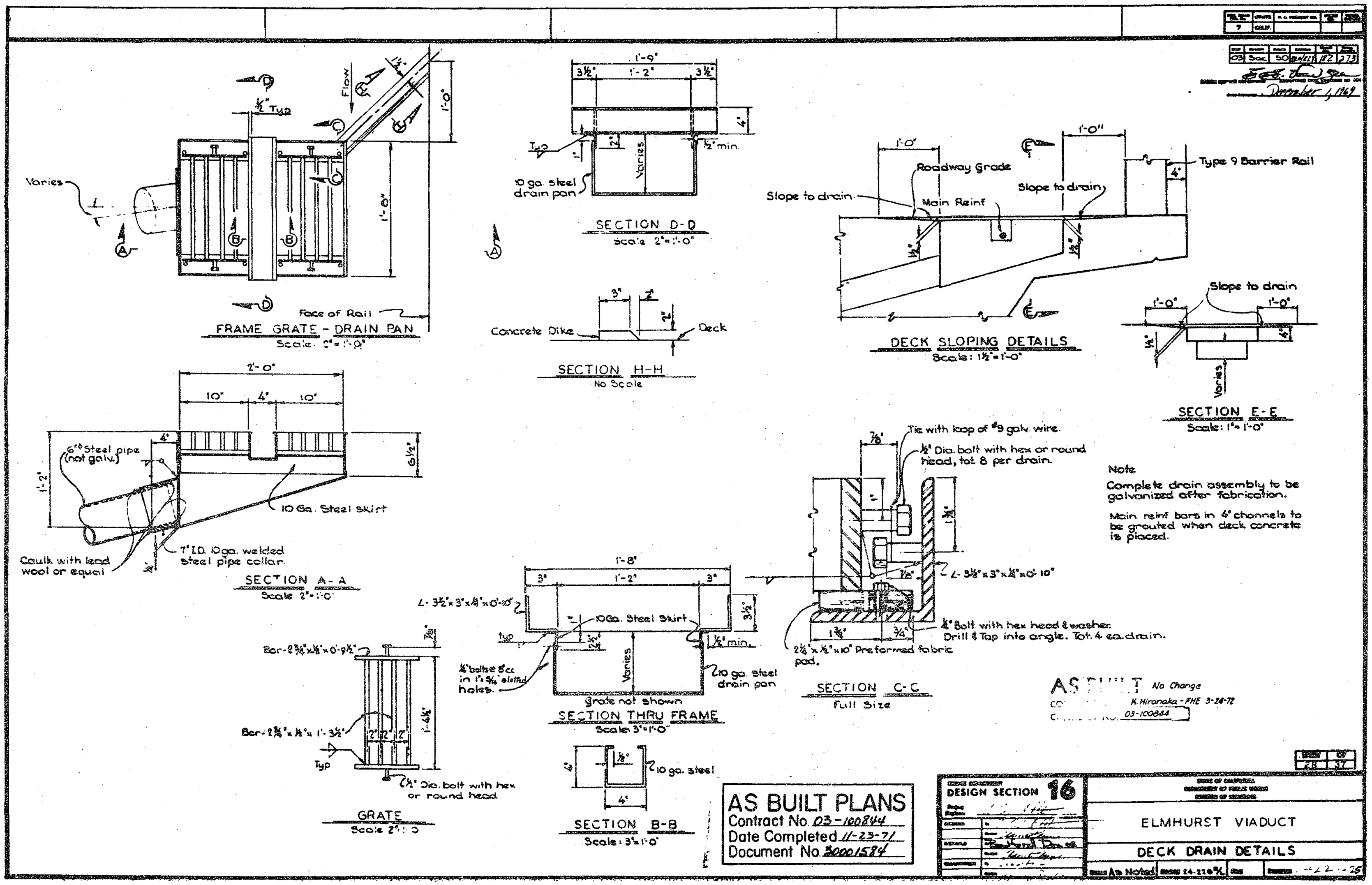
D-2

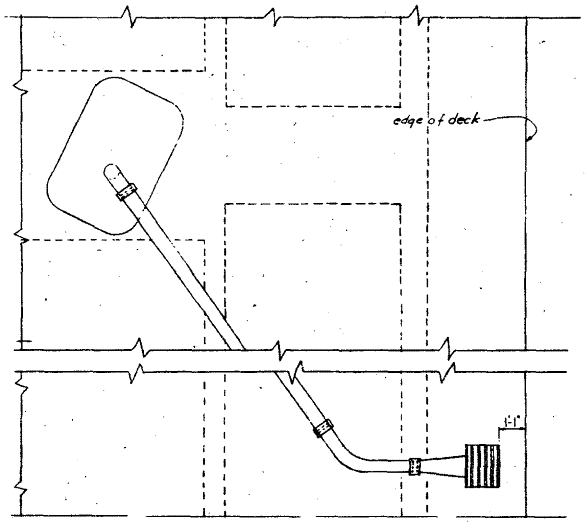
E-1



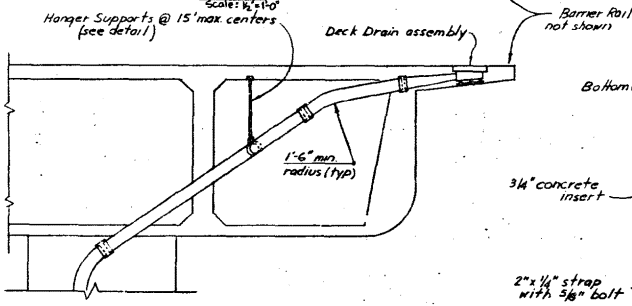
℄ Column
R=1'-6"
Note
All pipes & fittings to be 6" OD with a minimum wall thickness of 1/8". All joints or connections to be butt welded or connected by a welded sleeve and smooth throughout inside of pipe.
All bends to be on a 1'-6" min. radius measured along ℄ pipe. All bends to be smooth throughout.
Finished grade
At Bent 6 Left only
3'-0"
2'-0"
6"
3/16"x 1'-6" galv. cable chain. weld to Grate & eye bolt.
Type 24-9 Grate see "Grate Details."
Finished Grade
6" Opening
1 cu ft pervious mat'l in a burlap sack.
Calk
1/2"x 6" eye bolt & nut (galv.)
3" Weep hole
2'-0"
ELEVATION A-A
Scale: 3/4"=1'-0"
3'-1"
2"
4-#4
#4, Tot. 8
2-#4
SECTION B-B
Scale: 3/4"=1'-0"
3-#4
#4, Tot 2
Note
Outlet box may be precast or cast in place at Contractors option. If cast in place option is elected, outlet box may be cast against the columns. For location of Outlet Boxes see Road Plans.
Note: Outlet box relocated 3" from column at Bent 2R, Bent 7L, Bent 9L & Bent 10R (CCO #4)
SECTION C-C
Scale: 3/4"=1'-0"
Total 14 Outlet Boxes
Shop weld to low side
1"
Sleeve inside dia. no greater than pipe outside dia. + 1/16" and min wall thickness of 1/8".
SLEEVE CONNECTION
Scale: 1 1/2"=1'-0"
℄ Bent 6 L
℄ Drain
℄ Column
10'-0"
10'-0"
DRAIN LAYOUT BENT 6 LEFT BRIDGE
No Scale
K. Hironaka - FHE 3-24-72
03-100844
December 1, 1969
03 Sac 50
AS BUILT PLANS
Contract No. 03-100844
Date Completed 11-23-71
Document No. 30001584
DESIGN SECTION 16
ELMHURST VIADUCT
DRAINAGE DETAILS
24-228 R/L
24228-30
27 37

E-2

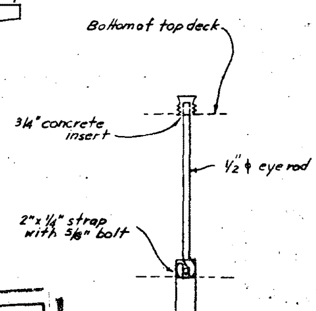

FRAME GRATE - DRAIN PAN
Scale: 2" = 1'-0"
Varies
Flow
Face of Rail
1/2" Typ
SECTION D-D
Scale 2" = 1'-0"
10 ga. steel drain pan
1/2" min.
SECTION H-H
No Scale
Concrete Dike
Deck
DECK SLOPING DETAILS
Scale: 1 1/2" = 1'-0"
Roadway Grade
Slope to drain
Main Reinf
Type 9 Barrier Rail
SECTION E-E
Scale: 1" = 1'-0"
SECTION A-A
Scale 2" = 1'-0"
6" ф Steel pipe (not galv.)
10 Ga. Steel skirt
7" I.D. 10 ga. welded steel pipe collar
Caulk with lead wool or equal
SECTION THRU FRAME
Scale 3" = 1'-0"
10 Ga. Steel Skirt
Grate not shown
10 ga. steel drain pan
SECTION C-C
Full Size
Tie with loop of #9 galv. wire.
1/2" Dia. bolt with hex or round head, tot. 8 per drain.
1/4" Bolt with hex head & washer. Drill & Tap into angle. Tot. 4 ea. drain.
2 1/2" x 1/2" x 10" Preformed fabric pad.
Note
Complete drain assembly to be galvanized after fabrication.
Main reinf bars in 4" channels to be grouted when deck concrete is placed.
GRATE
Scale 2" = 1'-0"
1/2" Dia. bolt with hex or round head
SECTION B-B
Scale: 3" = 1'-0"
10 ga. steel
AS BUILT No Change
K. Hironaka - FHE 3-24-72
03-100844
AS BUILT PLANS
Contract No. 03-100844
Date Completed 11-23-71
Document No. 30001584
DESIGN SECTION 16
ELMHURST VIADUCT
DECK DRAIN DETAILS
December 1, 1969



PLAN
Scale: ½"=1'-0"



ELEVATION
scale: ½"=1'-0"



HANGER SUPPORT
no scale

Lt. Br.	Drain No.	Station	Outlet Elevation
	1	273 + 10	51.5
	~~2~~	~~275 + 40~~	~~52.0~~
*	~~3~~	~~275 + 60~~	~~52.0~~
	4	280 + 00	54.5
	5	281 + 80	56.5
	6	284 + 30	56.0
	7	286 + 70	58.0
	8	288 + 70	55.5
	2	276 + 78	52.0
*	3	276 + 68	52.0

Rt. Br.	Drain No.	Station	Outlet Elevation
	1	271 + 30	52.5
	2	274 + 40	52.0
	3	277 + 50	53.5
	4	279 + 90	54.5
	5	282 + 25	55.0
	6	284 + 65	54.5

Note: Slope of pipe to be 4% minimum.
Pipe must pass under post tensioned tendons with minimum 6" clear.
All hangers and pipe not embedded in concrete to be galvanized.
For Details not shown, see Standard Plans "Drain and Details. Type D-2."

AS BUILT
CORRECTIONS BY C.W. Purkiss
CONTRACT NO. 03-082734
DATE 6-12-70

AS BUILT PLANS
Contract No. 03-082734
Date Completed 6-8-70
Document No. 30000942

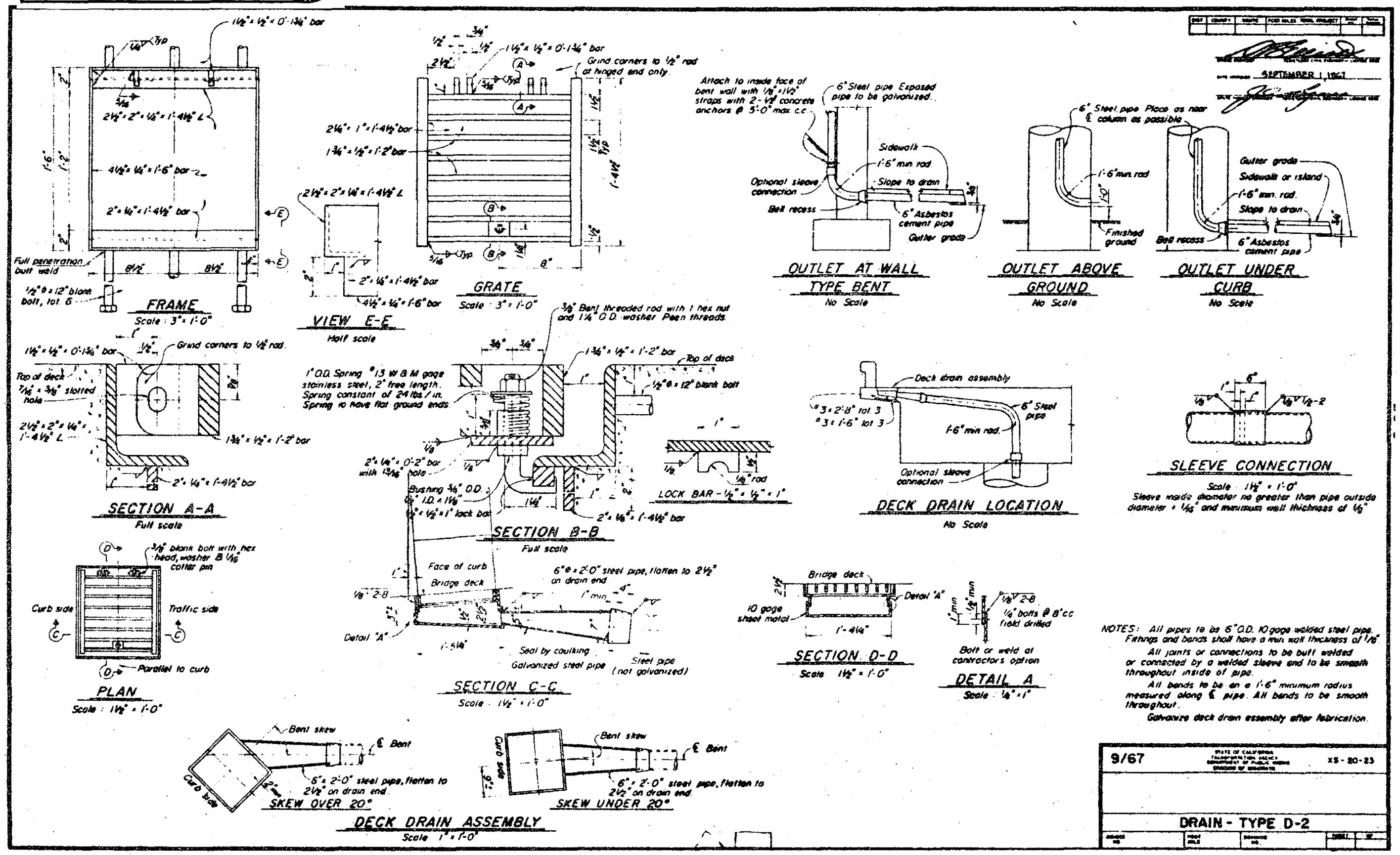
DESIGN SECTION 14

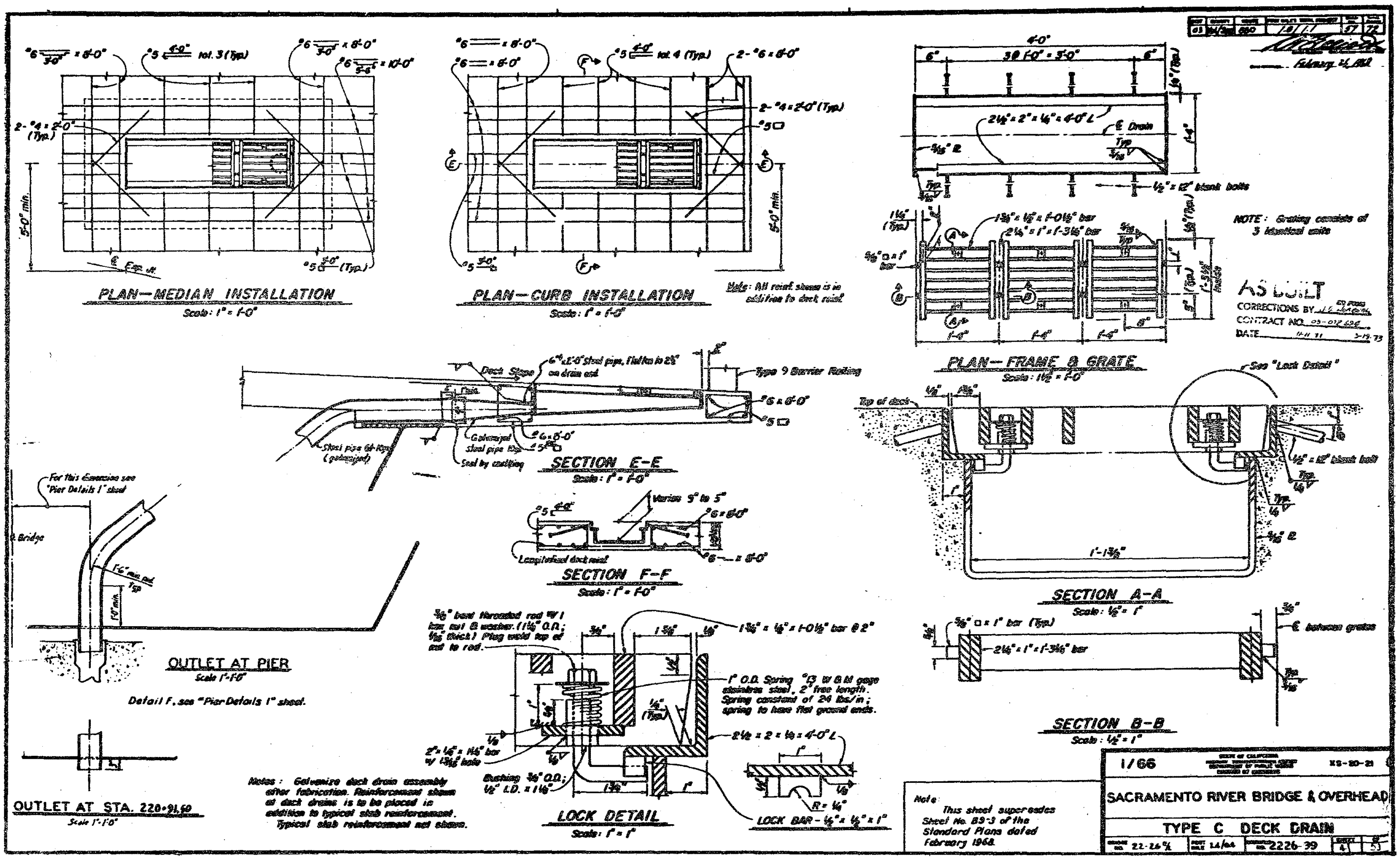
GRAND AVENUE OVERHEAD

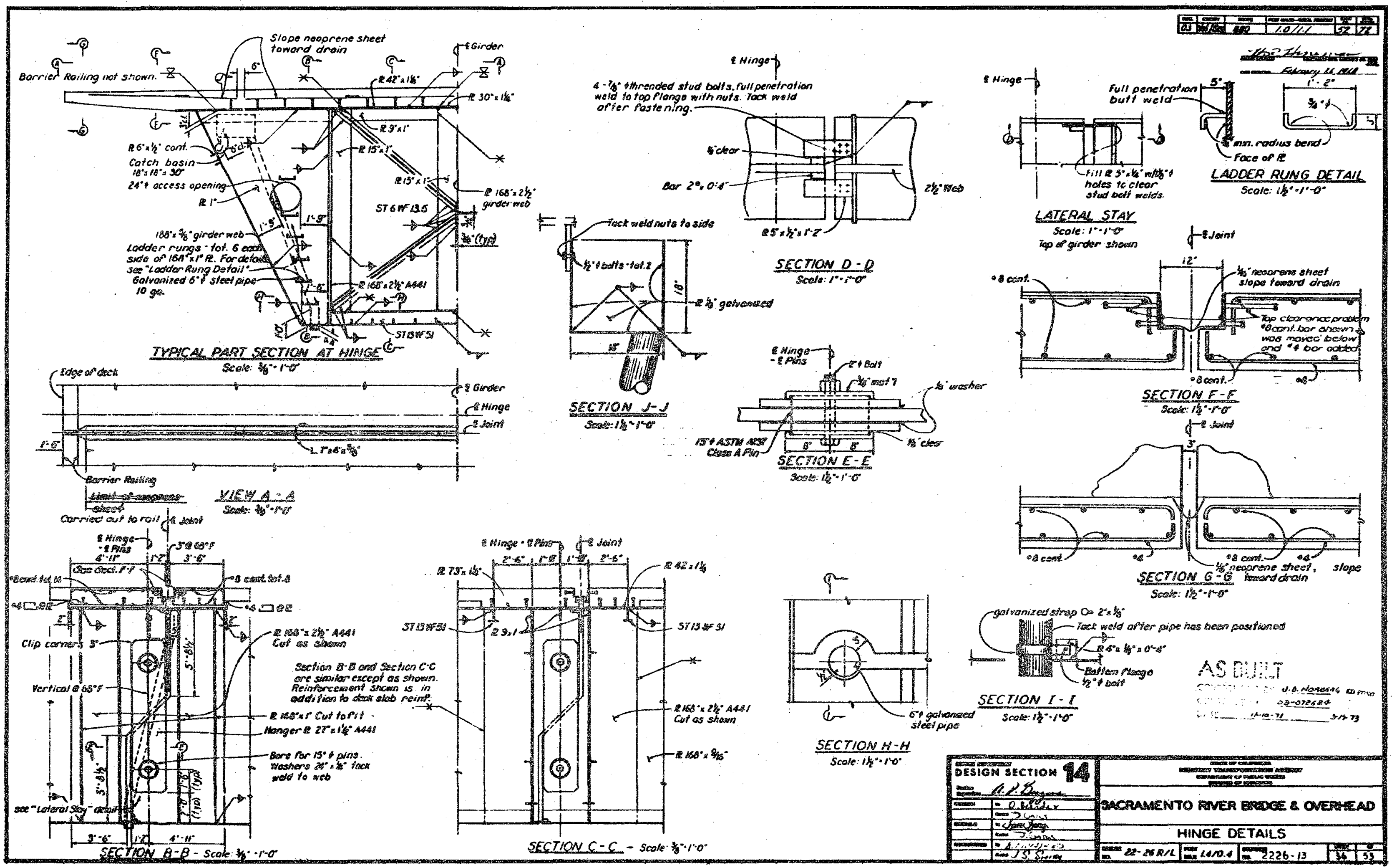
DECK DRAIN DETAILS

No. 24-276R/L | R 8.8 | No. 24276-6 | 95 | 43

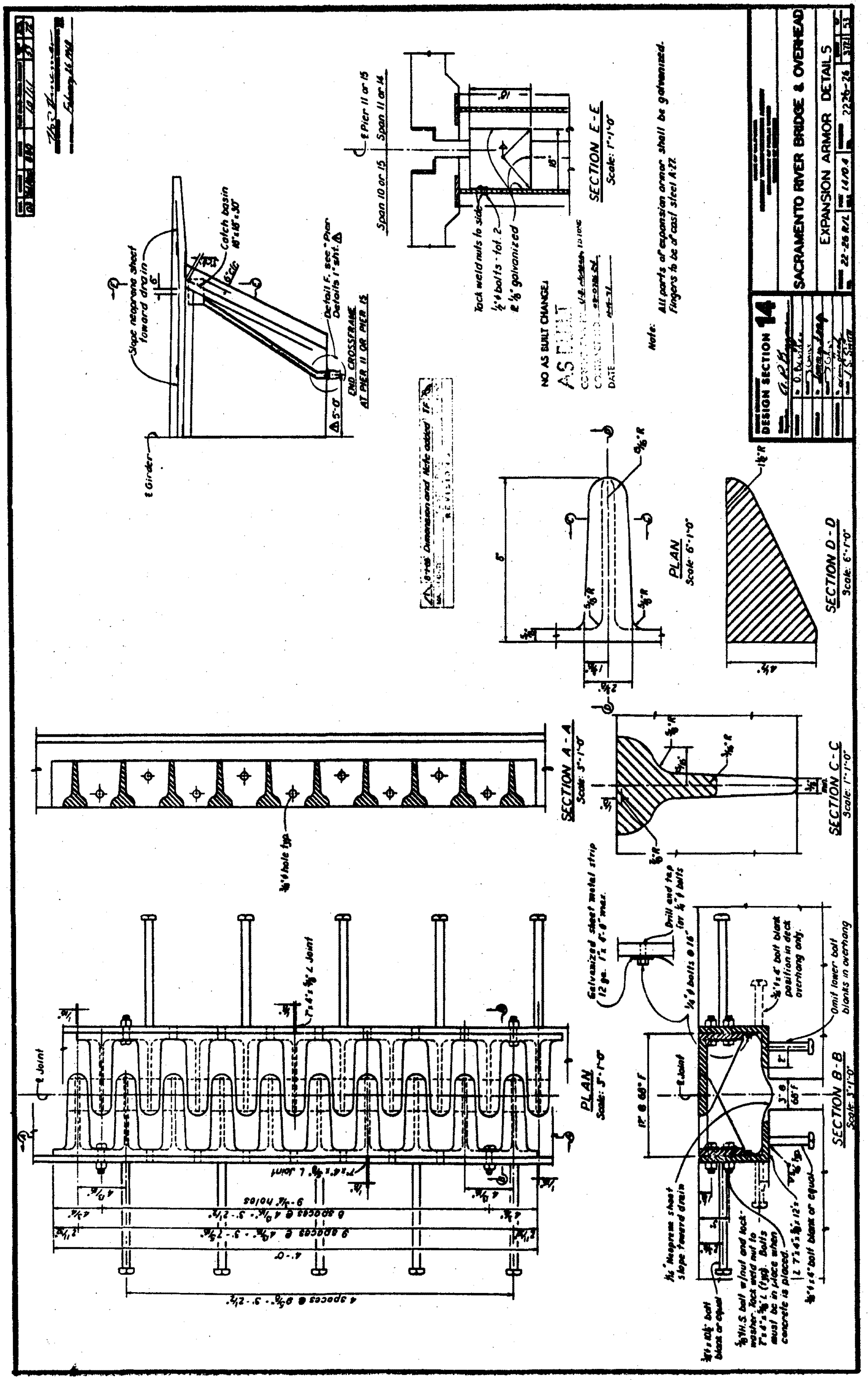
F-1


FRAME
Scale : 3" = 1'-0"
VIEW E-E
Half scale
GRATE
Scale : 3" = 1'-0"
OUTLET AT WALL
TYPE BENT
No Scale
OUTLET ABOVE
GROUND
No Scale
OUTLET UNDER
CURB
No Scale
SECTION A-A
Full scale
SECTION B-B
Full scale
LOCK BAR
DECK DRAIN LOCATION
No Scale
SLEEVE CONNECTION
Sleeve inside diameter no greater than pipe outside diameter + 1/16" and minimum wall thickness of 1/8"
PLAN
Curb side
Traffic side
Parallel to curb
SECTION C-C
SECTION D-D
DETAIL A
SKEW OVER 20°
SKEW UNDER 20°
DECK DRAIN ASSEMBLY
SEPTEMBER 1, 1967
NOTES: All pipes to be 6" O.D. 10 gage welded steel pipe. Fittings and bends shall have a min. wall thickness of 1/8".
All joints or connections to be butt welded or connected by a welded sleeve and to be smooth throughout inside of pipe.
All bends to be on a 1'-6" minimum radius measured along ℄ pipe. All bends to be smooth throughout.
Galvanize deck drain assembly after fabrication.
9/67
XS-20-23
DRAIN - TYPE D-2

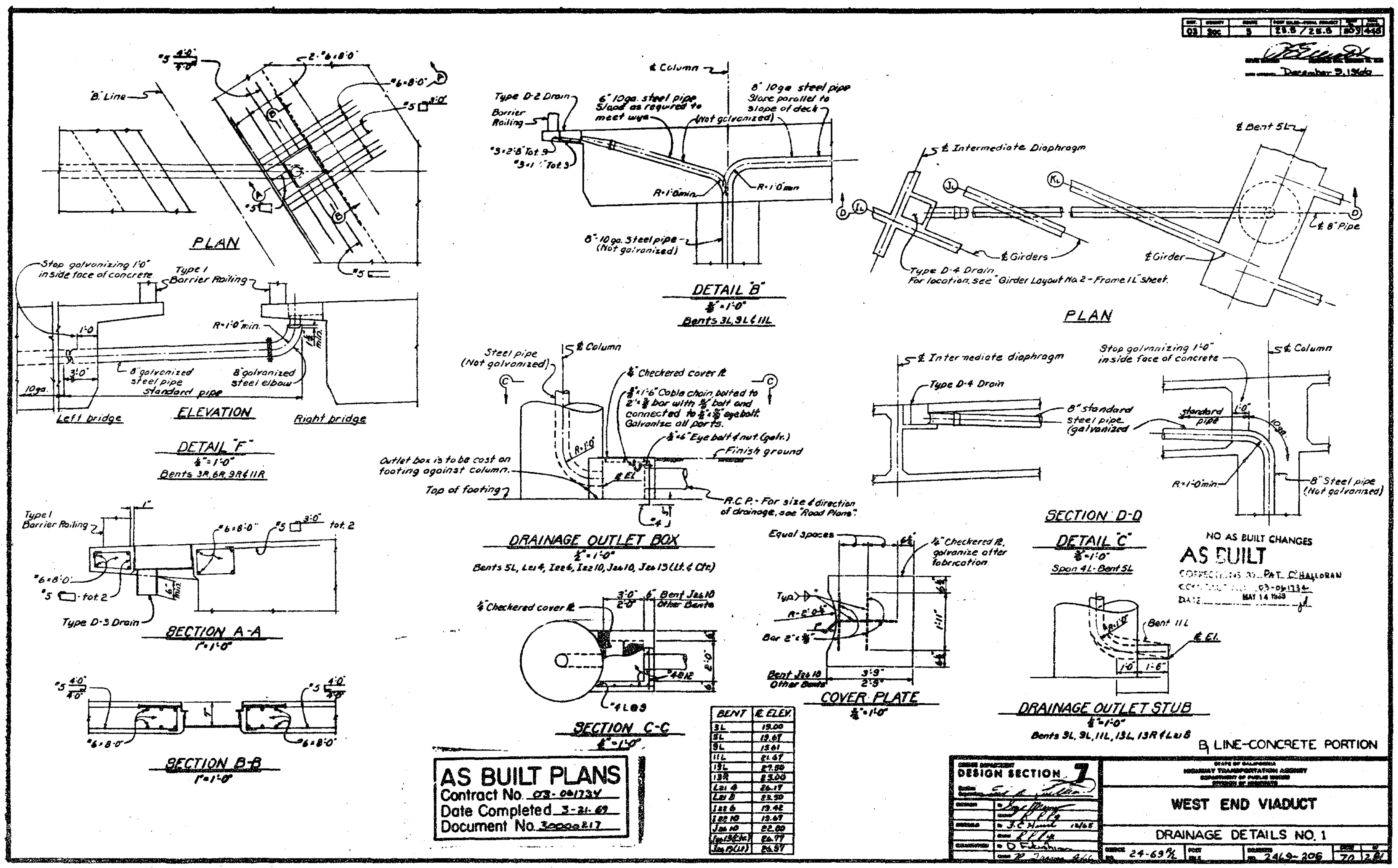

PLAN—MEDIAN INSTALLATION
Scale: 1" = 1'-0"
PLAN—CURB INSTALLATION
Scale: 1" = 1'-0"
Note: All reinf. shown is in addition to deck reinf.
PLAN—FRAME & GRATE
Scale: 1½" = 1'-0"
NOTE: Grating consists of 3 identical units
AS BUILT
CORRECTIONS BY
CONTRACT NO.
DATE
SECTION E-E
Scale: 1" = 1'-0"
Type 9 Barrier Railing
SECTION F-F
Scale: 1" = 1'-0"
Longitudinal deck reinf.
SECTION A-A
Scale: ½" = 1"
SECTION B-B
Scale: ½" = 1"
OUTLET AT PIER
Scale 1"-1'-0"
Detail F, see "Pier Details 1" sheet.
OUTLET AT STA. 220+91.60
Scale 1"-1'-0"
LOCK DETAIL
Scale: 1" = 1"
LOCK BAR - ½" x ½" x 1"
R = ¼"
1" O.D. Spring #13 W & M gage stainless steel, 2" free length. Spring constant of 24 lbs/in; spring to have flat ground ends.
Notes: Galvanize deck drain assembly after fabrication. Reinforcement shown at deck drains is to be placed in addition to typical slab reinforcement. Typical slab reinforcement not shown.
Note: This sheet supersedes Sheet No. B3-3 of the Standard Plans dated February 1968.
1/66
SACRAMENTO RIVER BRIDGE & OVERHEAD
TYPE C DECK DRAIN
22-26¾
2226-39



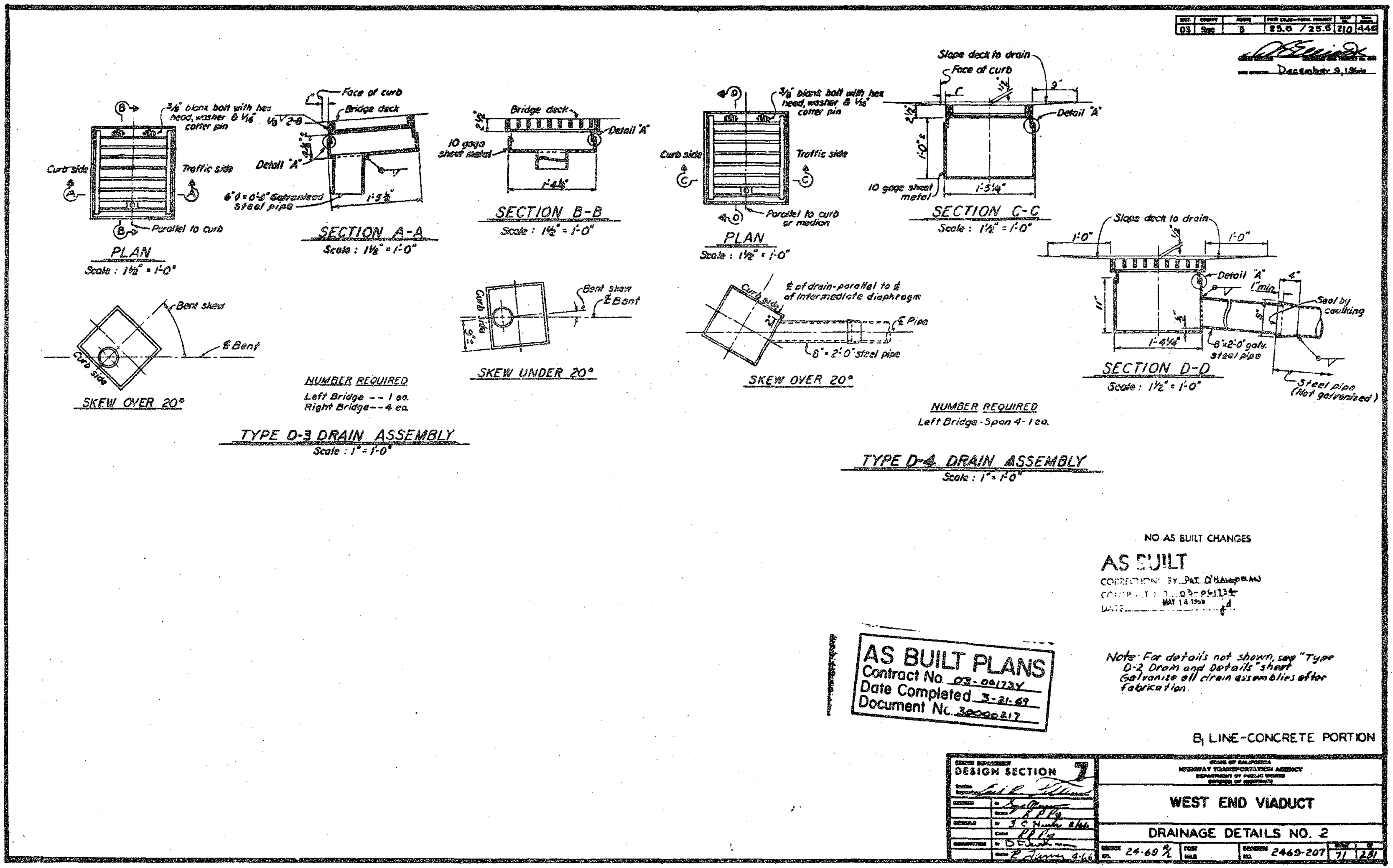
TYPICAL PART SECTION AT HINGE
Scale: 3/8" = 1'-0"
Slope neoprene sheet toward drain
Barrier Railing not shown.
Catch basin 18"x18"x30"
24"φ access opening
Galvanized 6"φ steel pipe 10 ga.
VIEW A - A
Scale: 3/8" = 1'-0"
Edge of deck
Barrier Railing
Carried out to rail
SECTION D - D
Scale: 1" = 1'-0"
4 - 7/8"φ threaded stud bolts, full penetration weld to top flange with nuts. Tack weld after fastening.
SECTION J - J
Scale: 1½" = 1'-0"
Tack weld nuts to side
SECTION E - E
Scale: 1½" = 1'-0"
15"φ ASTM A237 Class A Pin
LATERAL STAY
Scale: 1" = 1'-0"
Top of girder shown
Full penetration butt weld
LADDER RUNG DETAIL
Scale: 1½" = 1'-0"
Face of PL
SECTION F - F
Scale: 1½" = 1'-0"
1/8" neoprene sheet slope toward drain
SECTION G - G
Scale: 1½" = 1'-0"
SECTION B - B - Scale: 3/8" = 1'-0"
Clip corners 3"
Section B-B and Section C-C are similar except as shown. Reinforcement shown is in addition to deck slab reinf.
Bars for 15"φ pins. Washers 26" x ½" tack weld to web
SECTION C - C - Scale: 3/8" = 1'-0"
SECTION H - H
Scale: 1½" = 1'-0"
6"φ galvanized steel pipe
SECTION I - I
Scale: 1½" = 1'-0"
galvanized strap
Tack weld after pipe has been positioned
Bottom flange
AS BUILT
DESIGN SECTION 14
SACRAMENTO RIVER BRIDGE & OVERHEAD
HINGE DETAILS
22-26 R/L
2226-13



SACRAMENTO RIVER BRIDGE & OVERHEAD
EXPANSION ARMOR DETAILS
DESIGN SECTION 14
PLAN
SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
SECTION E-E
END CROSSFRAME AT PIER 11 OR PIER 15
Note: All parts of expansion armor shall be galvanized. Fingers to be of cast steel A27.

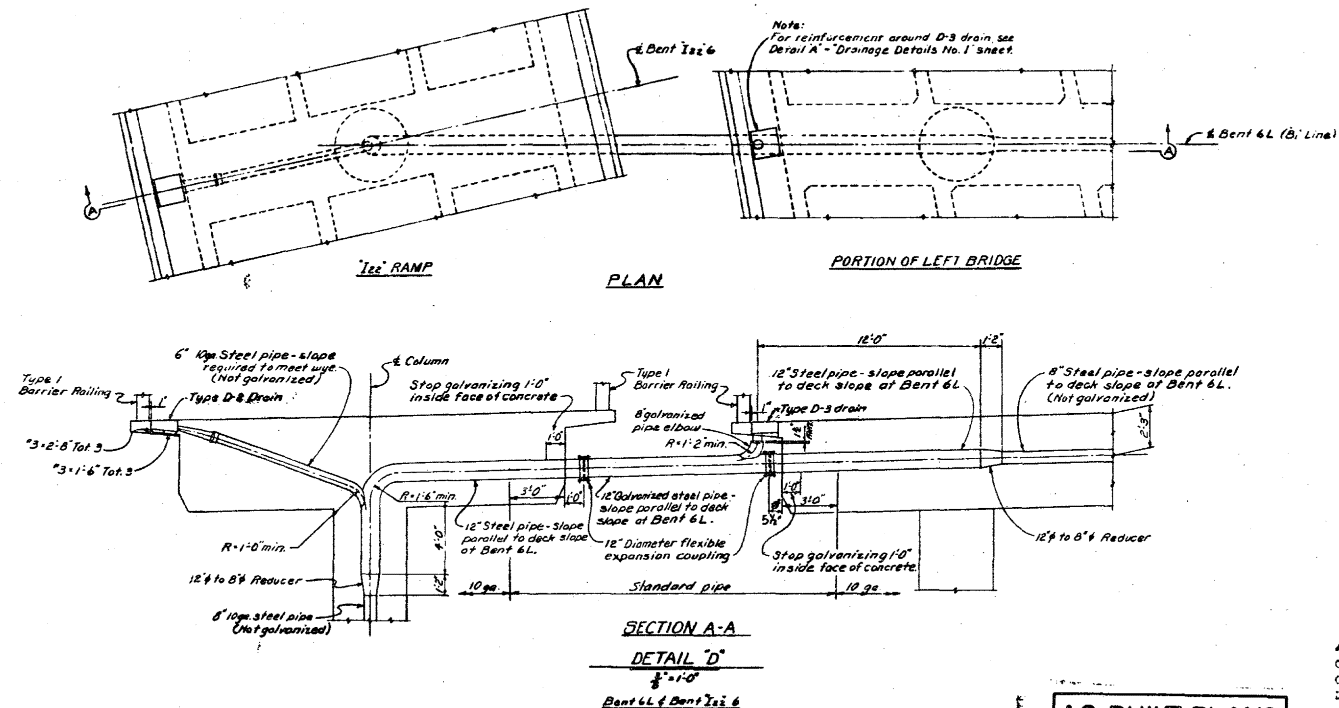


BENT	℄ ELEV.
3L	19.00
5L	19.67
9L	19.61
11L	21.67
13L	27.50
13R	23.00
Lu 4	26.17
Lu 8	23.50
Izz 6	19.42
Izz 10	19.67
Jzz 10	22.00
Jzz 13 (Ctr.)	26.77
Jzz 13 (Lt.)	26.57



TYPE D-3 DRAIN ASSEMBLY
Scale : 1" = 1'-0"
PLAN
Scale : 1½" = 1'-0"
SECTION A-A
Scale : 1½" = 1'-0"
SECTION B-B
Scale : 1½" = 1'-0"
SKEW OVER 20°
SKEW UNDER 20°
NUMBER REQUIRED
Left Bridge -- 1 ea.
Right Bridge -- 4 ea.
Curb side
Traffic side
Parallel to curb
Face of curb
Bridge deck
Detail "A"
10 gage sheet metal
Bent skew
℄ Bent
TYPE D-4 DRAIN ASSEMBLY
Scale : 1" = 1'-0"
PLAN
Scale : 1½" = 1'-0"
SECTION C-C
Scale : 1½" = 1'-0"
SECTION D-D
Scale : 1½" = 1'-0"
SKEW OVER 20°
NUMBER REQUIRED
Left Bridge - Span 4 - 1 ea.
Slope deck to drain
Parallel to curb or median
8" x 2'-0" steel pipe
Steel pipe (Not galvanized)
Seal by caulking
NO AS BUILT CHANGES
AS BUILT
AS BUILT PLANS
Contract No. 03-061734
Date Completed 3-21-69
Document No. 30000217
Note: For details not shown, see "Type D-2 Drain and Details" sheet. Galvanize all drain assemblies after fabrication.
B1 LINE-CONCRETE PORTION
DESIGN SECTION 7
WEST END VIADUCT
DRAINAGE DETAILS NO. 2
24-69 R/L
2469-207
December 9, 1966

H-2



December 9, 1966

AS BUILT
CORRECTIONS BY PAT. O'HALLORAN
CONTRACT NO. 03-061734
DATE 12-13-68
5-14-68

AS BUILT PLANS
Contract No. 03-061734
Date Completed 3-21-69
Document No. 30000217

B1 LINE-CONCRETE PORTION

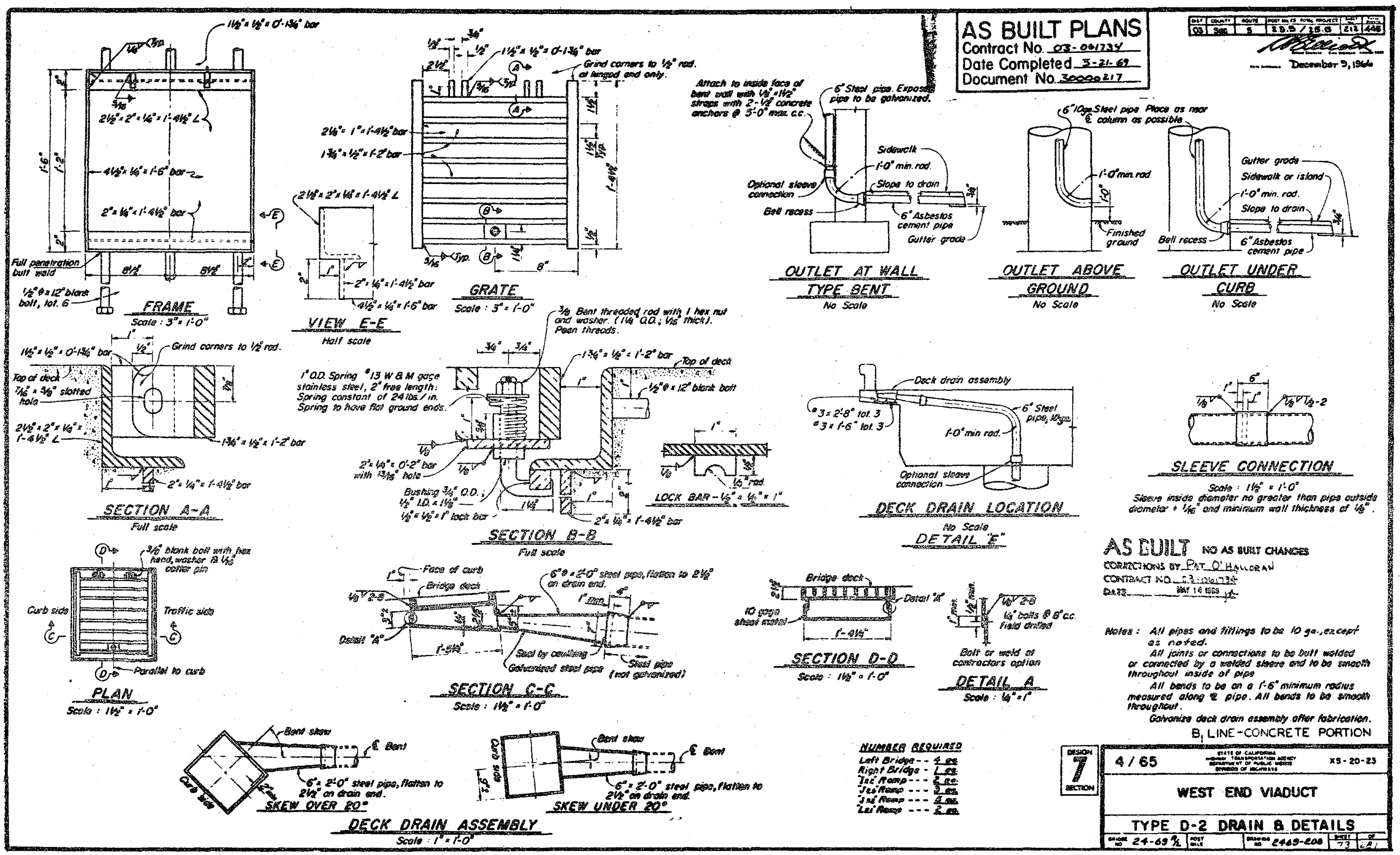
DESIGN SECTION 7

WEST END VIADUCT

DRAINAGE DETAILS NO. 3

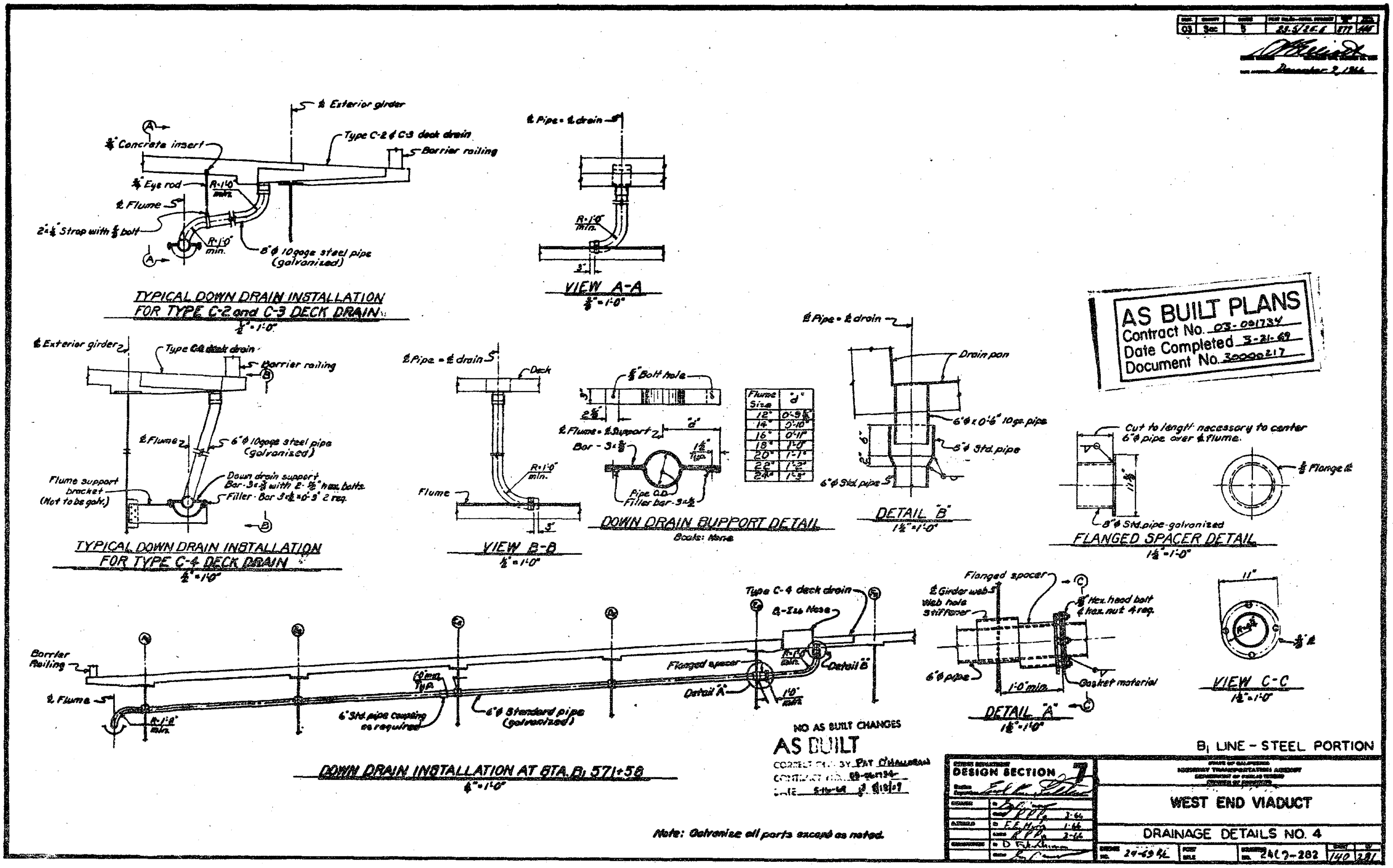
24-69 ⁶/₂			2469-242	72	281

H-3

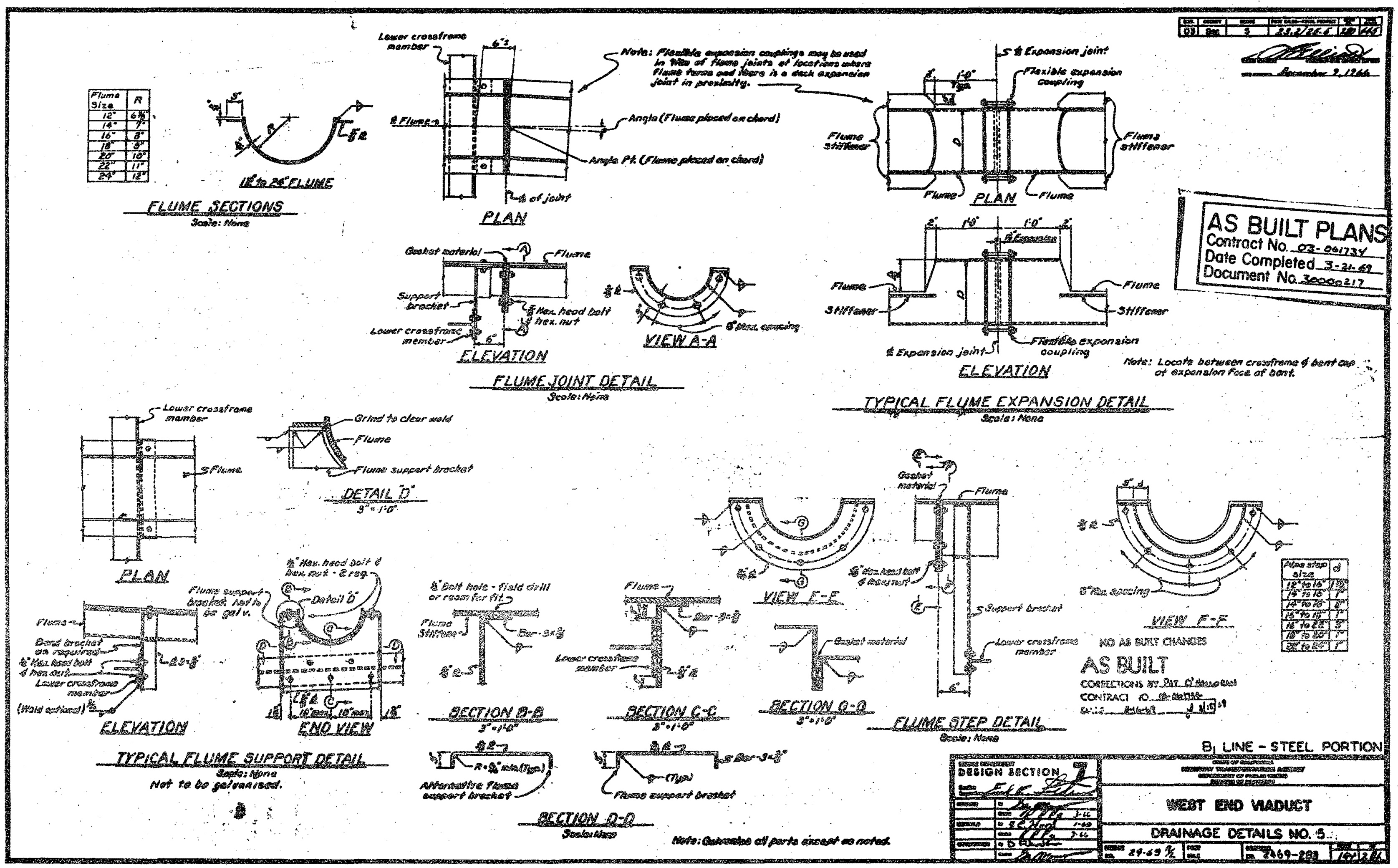


AS BUILT PLANS
Contract No. 03-061734
Date Completed 3-21-69
Document No. 30000217
December 9, 1966
FRAME
Scale: 3" = 1'-0"
VIEW E-E
Half scale
GRATE
Scale: 3" = 1'-0"
OUTLET AT WALL TYPE BENT
No Scale
OUTLET ABOVE GROUND
No Scale
OUTLET UNDER CURB
No Scale
SECTION A-A
Full scale
SECTION B-B
Full scale
LOCK BAR - 1/2" x 1/2" x 1"
DECK DRAIN LOCATION
No Scale
DETAIL "E"
SLEEVE CONNECTION
Scale: 1 1/2" = 1'-0"
Sleeve inside diameter no greater than pipe outside diameter + 1/16" and minimum wall thickness of 1/8".
PLAN
Scale: 1 1/2" = 1'-0"
SECTION C-C
Scale: 1 1/2" = 1'-0"
SECTION D-D
Scale: 1 1/2" = 1'-0"
DETAIL A
Scale: 1/4" = 1"
AS BUILT NO AS BUILT CHANGES
CORRECTIONS BY PAT O'HALLORAN
CONTRACT NO. 03-061734
DATE MAY 14 1969
Notes: All pipes and fittings to be 10 ga., except as noted.
All joints or connections to be butt welded or connected by a welded sleeve and to be smooth throughout inside of pipe.
All bends to be on a 1'-6" minimum radius measured along ℄ pipe. All bends to be smooth throughout.
Galvanize deck drain assembly after fabrication.
B1 LINE-CONCRETE PORTION
NUMBER REQUIRED
Left Bridge - - 4 ea.
Right Bridge - 1 ea.
SKEW OVER 20°
SKEW UNDER 20°
DECK DRAIN ASSEMBLY
Scale: 1" = 1'-0"
4 / 65
XS-20-23
WEST END VIADUCT
TYPE D-2 DRAIN & DETAILS
24-69 R/L
2469-208

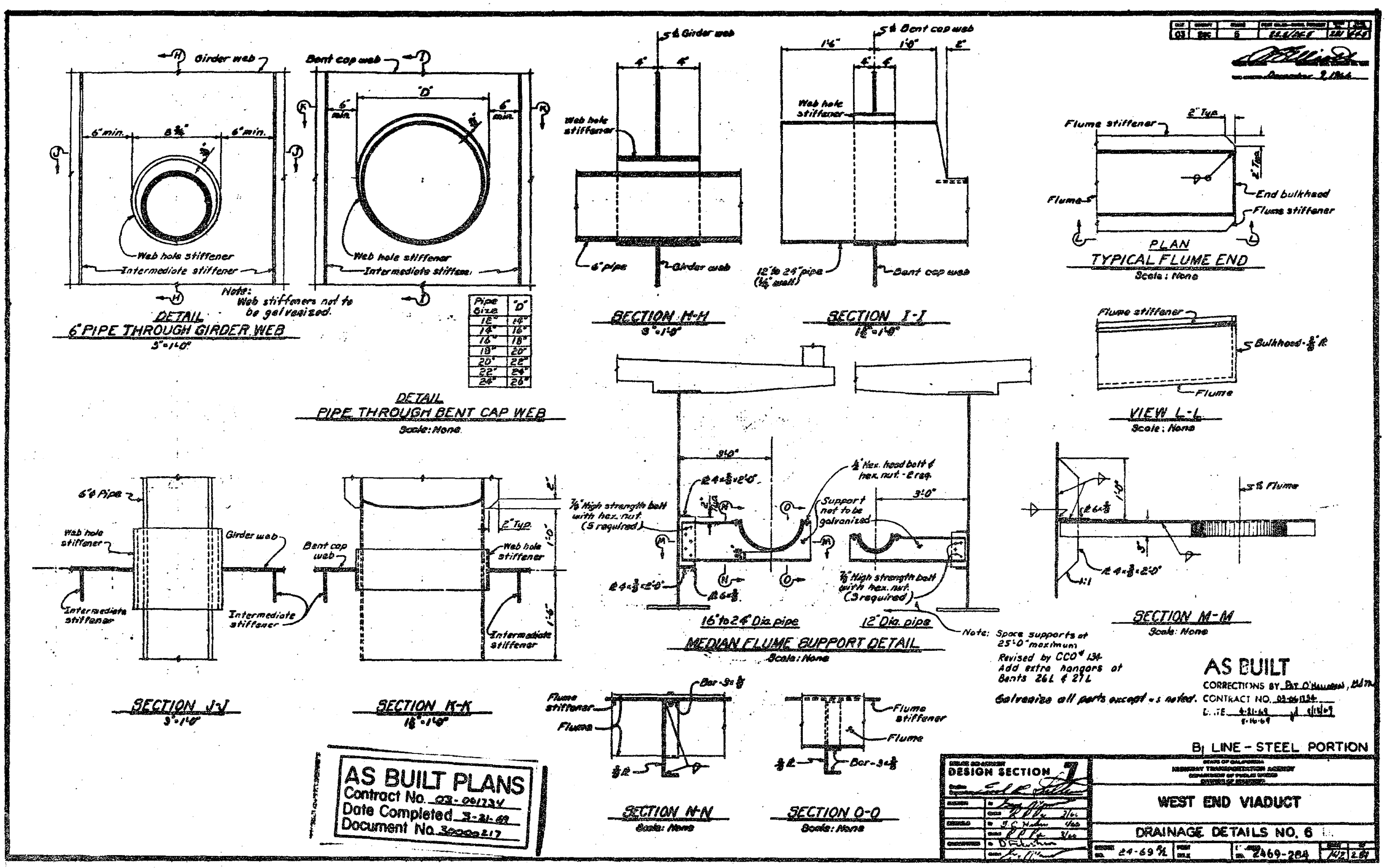
H-5



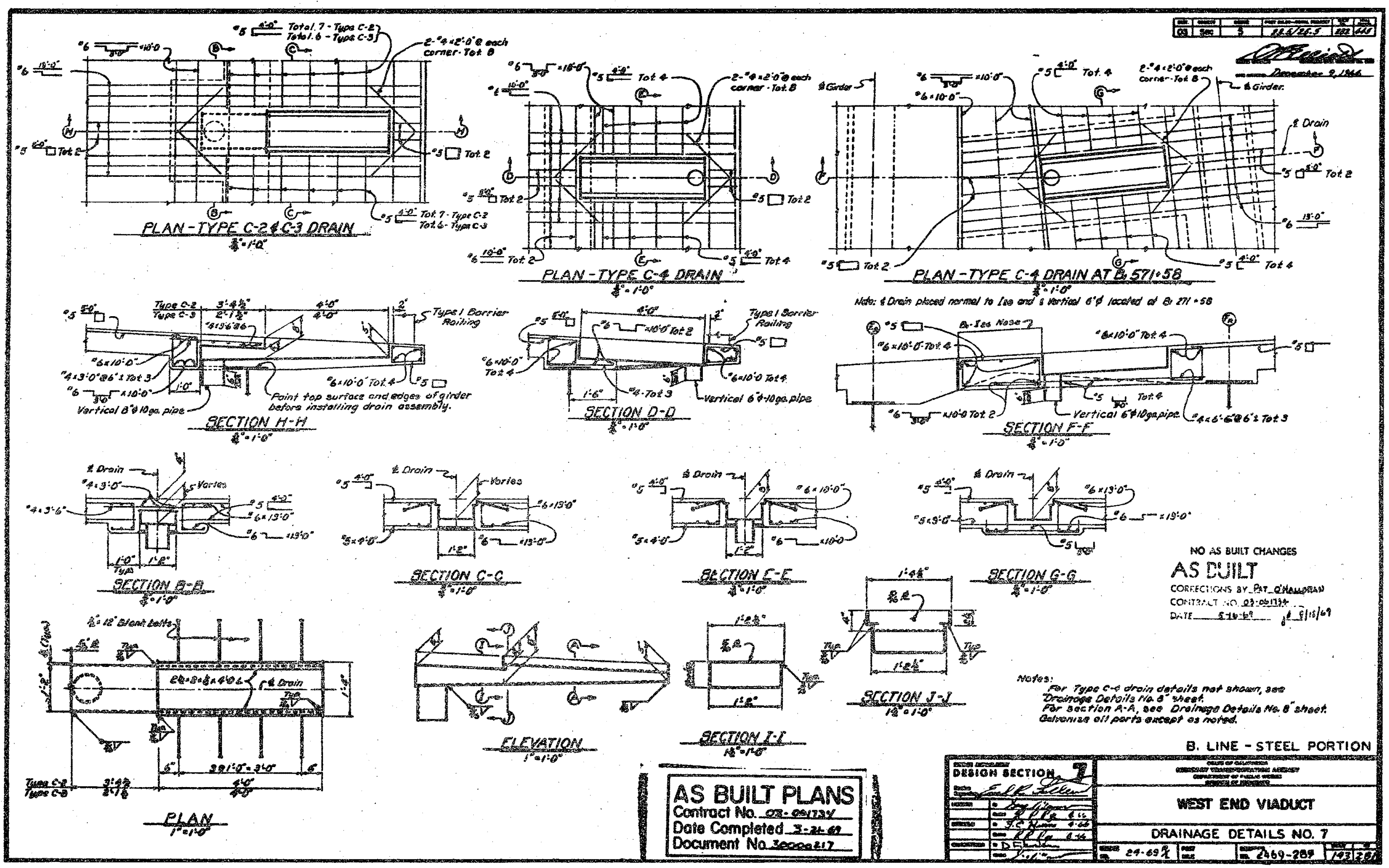
TYPICAL DOWN DRAIN INSTALLATION FOR TYPE C-2 and C-3 DECK DRAIN
VIEW A-A
TYPICAL DOWN DRAIN INSTALLATION FOR TYPE C-4 DECK DRAIN
VIEW B-B
DOWN DRAIN SUPPORT DETAIL
Scale: None
DETAIL "B"
FLANGED SPACER DETAIL
DOWN DRAIN INSTALLATION AT STA. B1 571+58
DETAIL "A"
VIEW C-C
Exterior girder
Type C-2 & C-3 deck drain
Barrier railing
Concrete insert
Eye rod
Flume
Strap with bolt
8"Ø 10 gage steel pipe (galvanized)
6"Ø 10 gage steel pipe (galvanized)
Flume support bracket (Not to be galv.)
Down drain support
Filler - Bar
Deck
Drain pan
6" Std. pipe
6" Std. pipe coupling as required
6"Ø Standard pipe (galvanized)
Flanged spacer
Girder web
Web hole stiffener
Hex. head bolt
Gasket material
Type C-4 deck drain
Flume Size | "d"
12" | 0'-9"
14" | 0'-10"
16" | 0'-11"
18" | 1'-0"
20" | 1'-1"
22" | 1'-2"
24" | 1'-3"
AS BUILT PLANS
Contract No. 03-001734
Date Completed 3-21-69
Document No. 30000217
NO AS BUILT CHANGES
AS BUILT
B1 LINE - STEEL PORTION
DESIGN SECTION 7
WEST END VIADUCT
DRAINAGE DETAILS NO. 4
Note: Galvanize all parts except as noted.


FLUME SECTIONS
Scale: None
12" to 24" FLUME
Flume Size | R
12" | 6½"
14" | 7"
16" | 8"
18" | 9"
20" | 10"
22" | 11"
24" | 12"
PLAN
Lower crossframe member
Note: Flexible expansion couplings may be used in lieu of flume joints at locations where flume turns and there is a deck expansion joint in proximity.
Angle (Flume placed on chord)
Angle Pl. (Flume placed on chord)
Gasket material
Support bracket
Hex. head bolt hex. nut
Lower crossframe member
ELEVATION
VIEW A-A
FLUME JOINT DETAIL
Scale: None
℄ Expansion joint
Flexible expansion coupling
Flume stiffener
PLAN
ELEVATION
Note: Locate between crossframe & bent cap at expansion face of bent.
TYPICAL FLUME EXPANSION DETAIL
Scale: None
AS BUILT PLANS
Contract No. 03-001734
Date Completed 3-21-69
Document No. 30000217
Grind to clear weld
Flume
Flume support bracket
DETAIL "D"
3" = 1'-0"
PLAN
ELEVATION
Lower crossframe member
Flume support bracket. Not to be galv.
Detail "D"
END VIEW
TYPICAL FLUME SUPPORT DETAIL
Scale: None
Not to be galvanized.
Flume stiffener
SECTION B-B
3" = 1'-0"
SECTION C-C
3" = 1'-0"
SECTION G-G
3" = 1'-0"
Alternative flume support bracket
Flume support bracket
SECTION D-D
Scale: None
Note: Galvanize all parts except as noted.
VIEW E-E
Gasket material
Support bracket
Lower crossframe member
FLUME STEP DETAIL
Scale: None
VIEW F-F
NO AS BUILT CHANGES
AS BUILT
B1 LINE - STEEL PORTION
DESIGN SECTION
WEST END VIADUCT
DRAINAGE DETAILS NO. 5

H-7

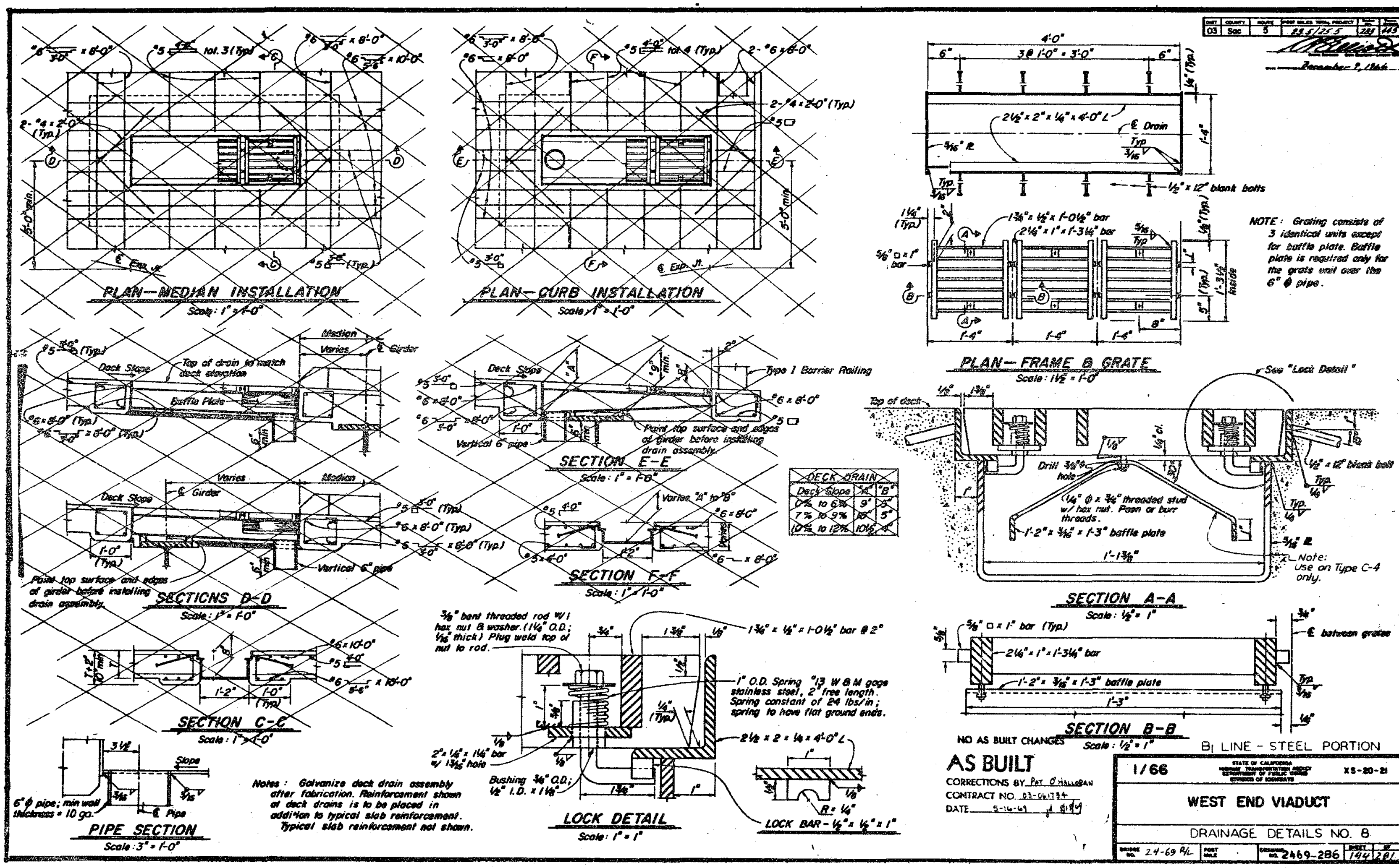


DETAIL
6" PIPE THROUGH GIRDER WEB
3" = 1'-0"
Note: Web stiffeners not to be galvanized.
DETAIL
PIPE THROUGH BENT CAP WEB
Scale: None
Pipe Size | "D"
12" | 14"
14" | 16"
16" | 18"
18" | 20"
20" | 22"
22" | 24"
24" | 26"
SECTION H-H
3" = 1'-0"
SECTION I-I
1½" = 1'-0"
Web hole stiffener
Intermediate stiffener
Girder web
Bent cap web
6" pipe
12" to 24" pipe
PLAN
TYPICAL FLUME END
Scale: None
Flume stiffener
End bulkhead
Flume
VIEW L-L
Scale: None
SECTION J-J
3" = 1'-0"
SECTION K-K
1½" = 1'-0"
16" to 24" Dia. pipe
12" Dia. pipe
MEDIAN FLUME SUPPORT DETAIL
Scale: None
Support not to be galvanized
SECTION M-M
Scale: None
Note: Space supports at 25'-0" maximum
Revised by CCO# 134. Add extra hangers at Bents 26L & 27L
Galvanize all parts except as noted.
SECTION N-N
Scale: None
SECTION O-O
Scale: None
AS BUILT
CORRECTIONS BY Pat O'Halloran
CONTRACT NO. 03-061134
AS BUILT PLANS
Contract No. 03-061134
Date Completed 3-21-69
B1 LINE - STEEL PORTION
DESIGN SECTION 7
WEST END VIADUCT
DRAINAGE DETAILS NO. 6
24-69
2469-284

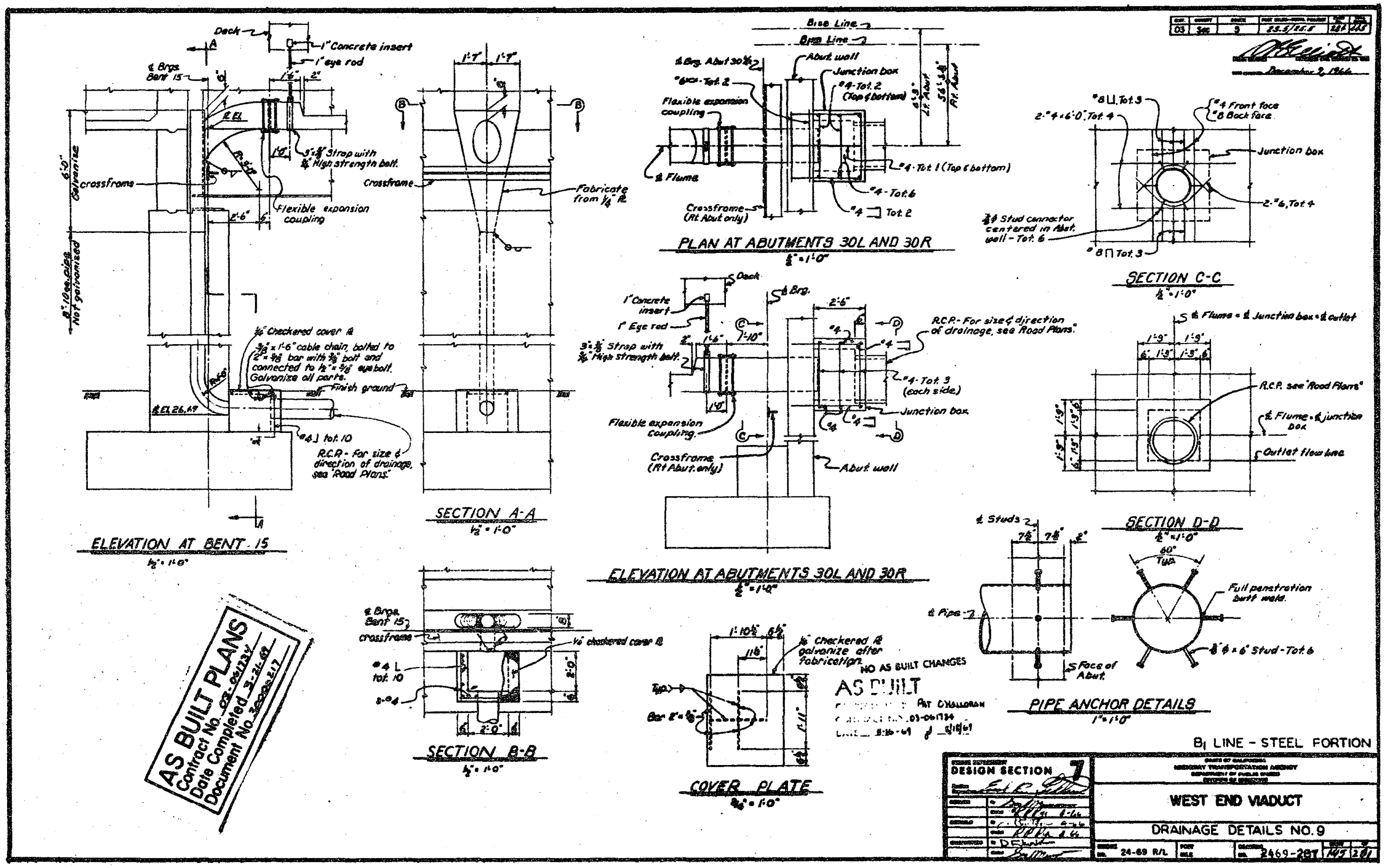

PLAN - TYPE C-2 & C-3 DRAIN
PLAN - TYPE C-4 DRAIN
PLAN - TYPE C-4 DRAIN AT B. 571+58
SECTION H-H
SECTION D-D
SECTION F-F
SECTION B-B
SECTION C-C
SECTION E-E
SECTION G-G
SECTION J-J
SECTION I-I
ELEVATION
PLAN
Paint top surface and edges of girder before installing drain assembly.
Type I Barrier Railing
Vertical 8"φ 10ga. pipe
Vertical 6"φ 10ga. pipe
Note: ℄ Drain placed normal to ℄ and ℄ Vertical 6"φ located at B. 571+58
NO AS BUILT CHANGES
AS BUILT
Notes:
For Type C-4 drain details not shown, see "Drainage Details No. 8" sheet.
For section A-A, see Drainage Details No. 8 sheet.
Galvanize all parts except as noted.
B. LINE - STEEL PORTION
AS BUILT PLANS
Contract No. 07-001734
Date Completed 3-21-69
Document No. 30000217
DESIGN SECTION 7
WEST END VIADUCT
DRAINAGE DETAILS NO. 7
2469-289

H-8

H-9

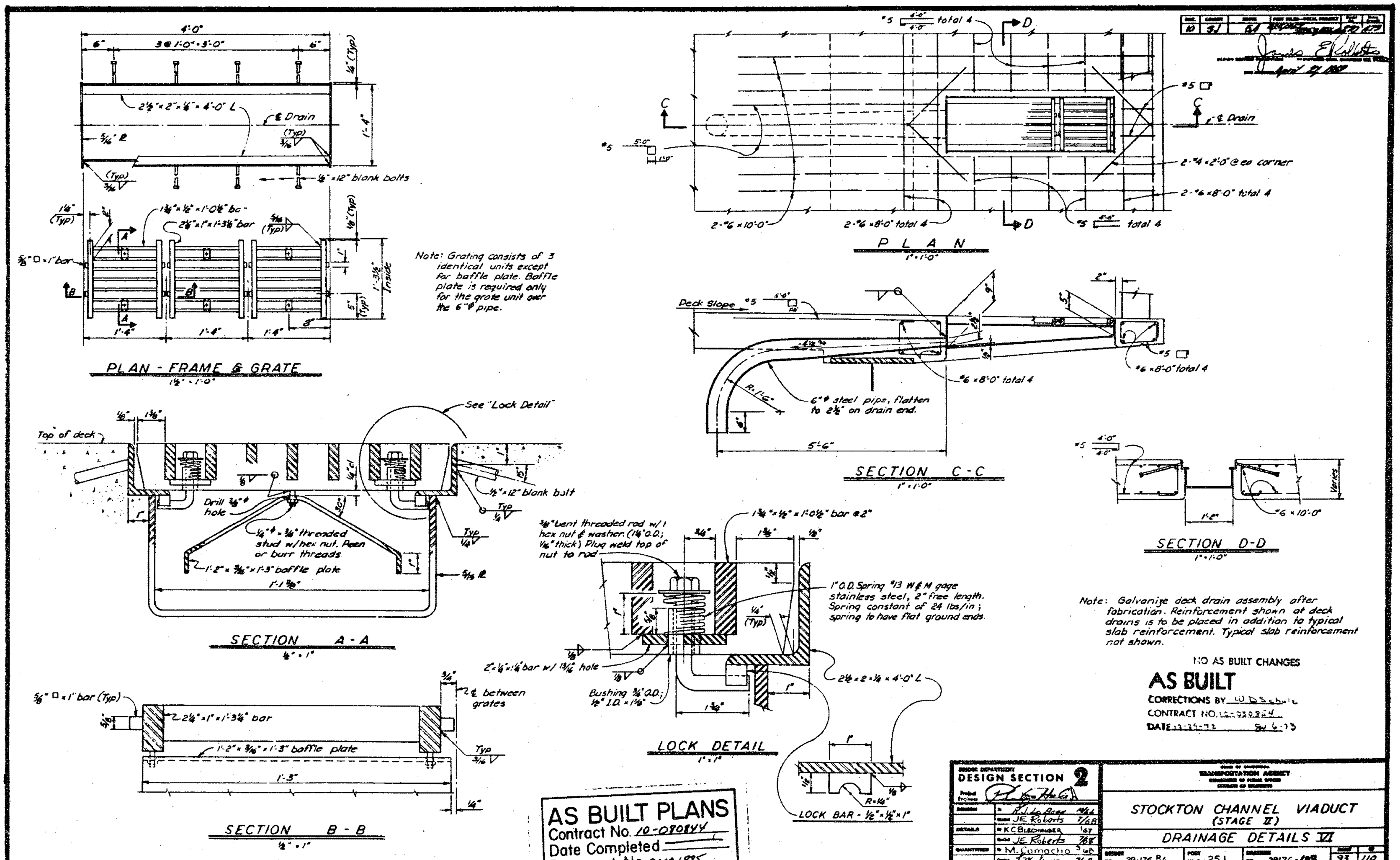


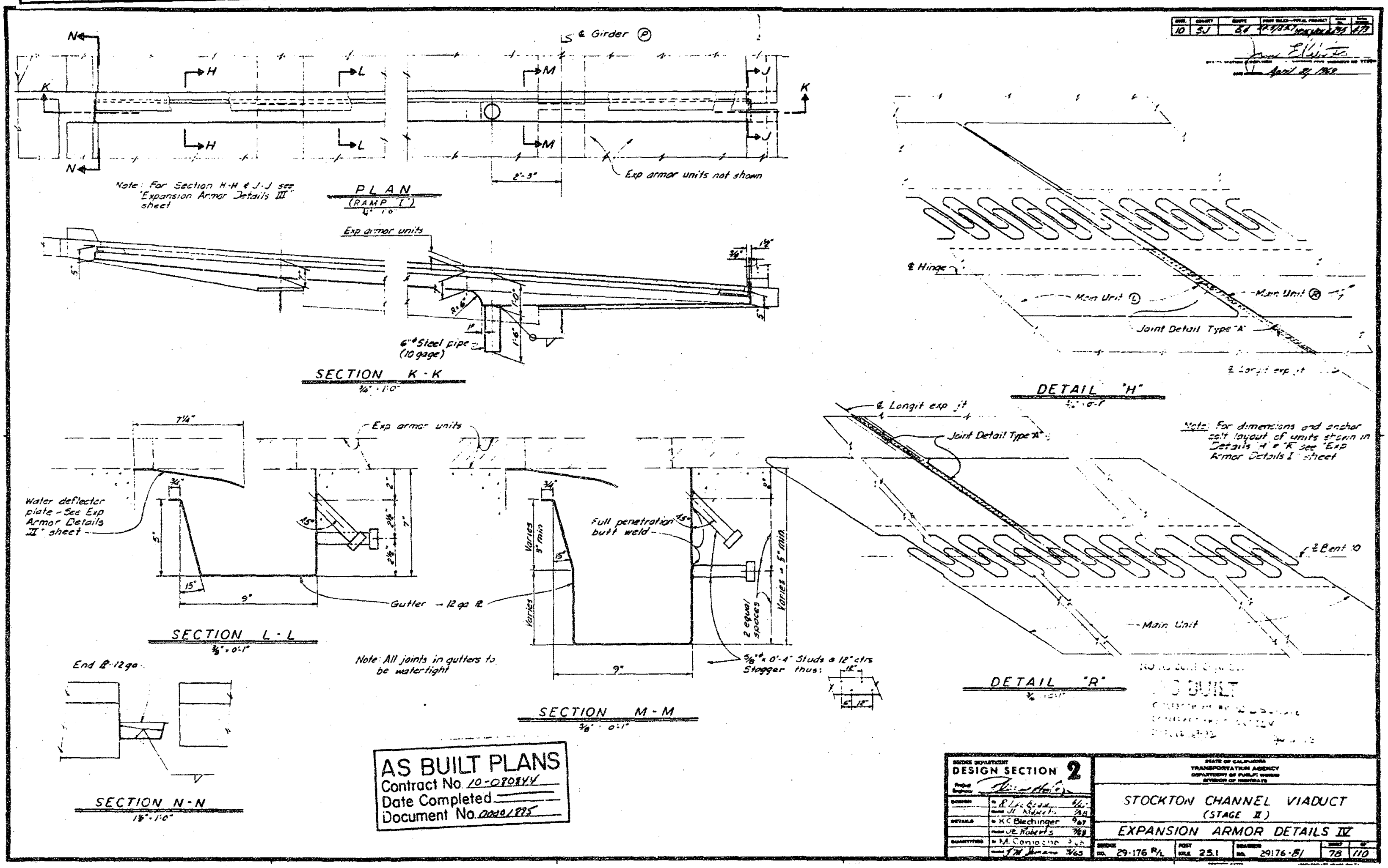
PLAN—MEDIAN INSTALLATION
Scale: 1" = 1'-0"
PLAN—CURB INSTALLATION
Scale: 1" = 1'-0"
PLAN—FRAME & GRATE
Scale: 1½" = 1'-0"
NOTE: Grating consists of 3 identical units except for baffle plate. Baffle plate is required only for the grate unit over the 6" ϕ pipe.
SECTIONS D-D
Scale: 1" = 1'-0"
SECTION E-E
Scale: 1" = 1'-0"
SECTION F-F
Scale: 1" = 1'-0"
SECTION A-A
Scale: ½" = 1"
SECTION C-C
Scale: 1" = 1'-0"
SECTION B-B
Scale: ½" = 1"
PIPE SECTION
Scale: 3" = 1'-0"
LOCK DETAIL
Scale: 1" = 1"
LOCK BAR - ½" x ½" x 1"
Type 1 Barrier Railing
Deck Slope
Top of drain to match deck elevation
Baffle Plate
Vertical 6" pipe
Paint top surface and edges of girder before installing drain assembly.
DECK DRAIN
Deck Slope | "A" | "B"
0% to 6% | 9" | 5"
7% to 9% | 10" | 5"
10% to 12% | 10½" | 4"
1" O.D. Spring #13 W & M gage stainless steel, 2" free length. Spring constant of 24 lbs/in; spring to have flat ground ends.
⅜" bent threaded rod w/1 hex nut & washer. (1¼" O.D.; 1/16" thick) Plug weld top of nut to rod.
Note: Use on Type C-4 only.
6" ϕ pipe; min wall thickness = 10 ga.
Notes: Galvanize deck drain assembly after fabrication. Reinforcement shown at deck drains is to be placed in addition to typical slab reinforcement. Typical slab reinforcement not shown.
NO AS BUILT CHANGES
AS BUILT
CORRECTIONS BY Pat O'Halloran
CONTRACT NO. 03-041794
DATE 5-16-69
BI LINE - STEEL PORTION
1/66
XS-20-21
WEST END VIADUCT
DRAINAGE DETAILS NO. 8
24-69 R/L
2469-286
03 | Sac | 5



ELEVATION AT BENT 15
½" = 1'-0"
SECTION A-A
½" = 1'-0"
PLAN AT ABUTMENTS 30L AND 30R
½" = 1'-0"
SECTION C-C
½" = 1'-0"
ELEVATION AT ABUTMENTS 30L AND 30R
½" = 1'-0"
SECTION D-D
½" = 1'-0"
SECTION B-B
½" = 1'-0"
COVER PLATE
PIPE ANCHOR DETAILS
1" = 1'-0"
Deck
1" Concrete insert
1" eye rod
Crossframe
Flexible expansion coupling
Fabricate from ¼" ℞
Junction box
Abut. wall
R.C.P. - For size & direction of drainage, see Road Plans.
Finish ground
Full penetration butt weld.
Face of Abut.
AS BUILT PLANS
NO AS BUILT CHANGES
AS BUILT
B1 LINE - STEEL PORTION
DESIGN SECTION 7
WEST END VIADUCT
DRAINAGE DETAILS NO. 9
24-69 R/L
2469-28T

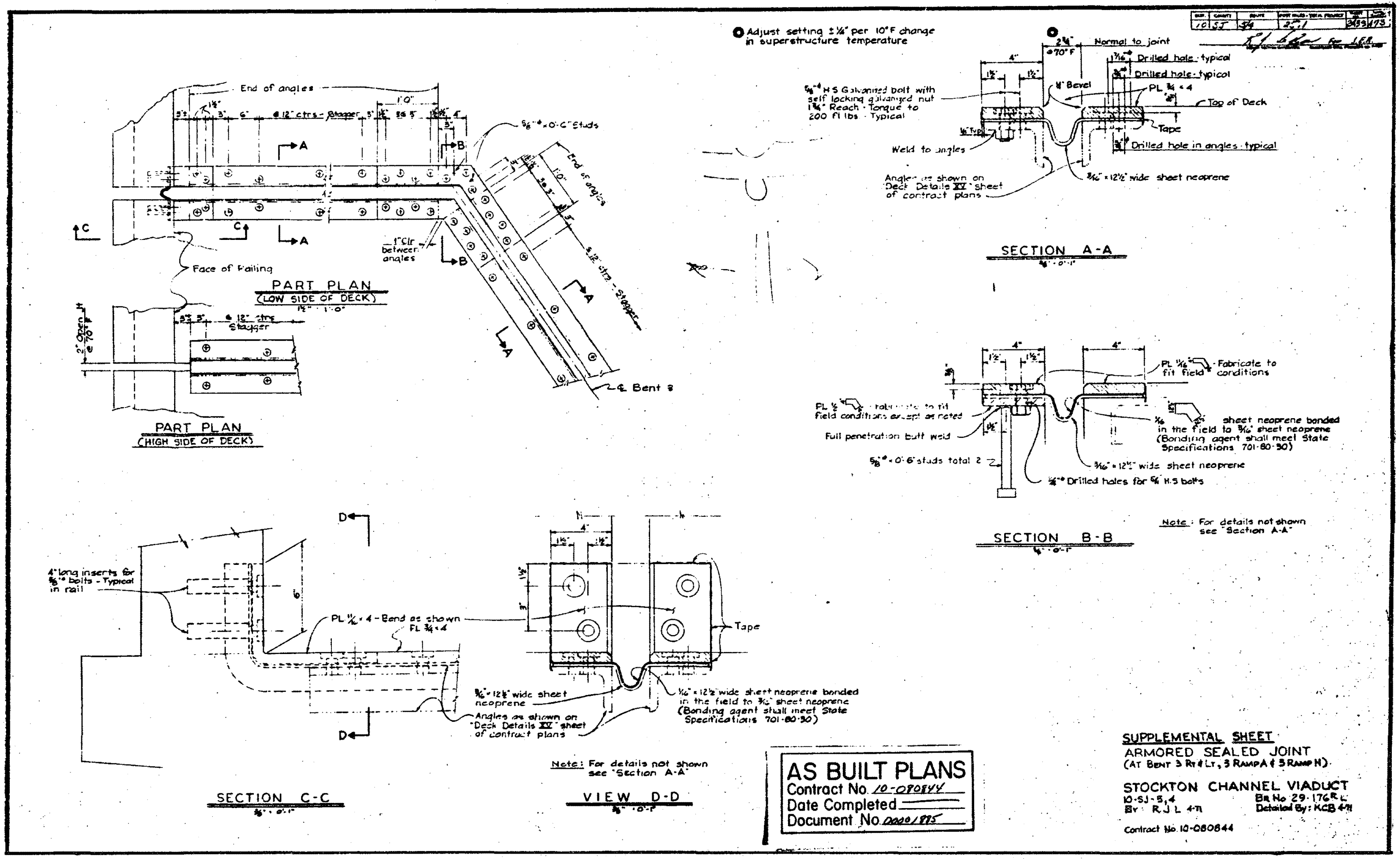
I-1


PLAN - FRAME & GRATE
1½" = 1'-0"
Note: Grating consists of 3 identical units except for baffle plate. Baffle plate is required only for the grate unit over the 6"⌀ pipe.
PLAN
1" = 1'-0"
2-#6 x 10'-0"
2-#6 x 8'-0" total 4
#5 total 4
2-#4 x 2'-0" @ ea corner
2-#6 x 8'-0" total 4
℄ Drain
See "Lock Detail"
Top of deck
Drill ⅜"⌀ hole
¼"⌀ x ¾" threaded stud w/ hex nut. Peen or burr threads.
1'-2" x 3/16" x 1'-3" baffle plate
½" x 12" blank bolt
SECTION A - A
¼" = 1"
6"⌀ steel pipe, flatten to 2½" on drain end.
#6 x 8'-0" total 4
SECTION C - C
1" = 1'-0"
SECTION D - D
1" = 1'-0"
⅜" bent threaded rod w/ 1 hex nut & washer (1¼" O.D.; 1/16" thick) Plug weld top of nut to rod
1" O.D. Spring #13 W & M gage stainless steel, 2" free length. Spring constant of 24 lbs/in; spring to have flat ground ends.
2-¼" x ¼" bar w/ 13/16" hole
Bushing ¾" O.D.; ½" I.D. x 1⅛"
2½ x 2 x ¼ x 4'-0" L
LOCK DETAIL
1" = 1"
LOCK BAR - ½" x ½" x 1"
⅝" □ x 1" bar (Typ)
2¼" x 1" x 1'-3¼" bar
1'-2" x 3/16" x 1'-3" baffle plate
℄ between grates
SECTION B - B
½" = 1"
Note: Galvanize deck drain assembly after fabrication. Reinforcement shown at deck drains is to be placed in addition to typical slab reinforcement. Typical slab reinforcement not shown.
NO AS BUILT CHANGES
AS BUILT
CORRECTIONS BY
CONTRACT NO.
DATE
AS BUILT PLANS
Contract No. 10-080844
Date Completed
DESIGN SECTION 2
STOCKTON CHANNEL VIADUCT
(STAGE II)
DRAINAGE DETAILS VI
29-176 R/L
25.1
93
110

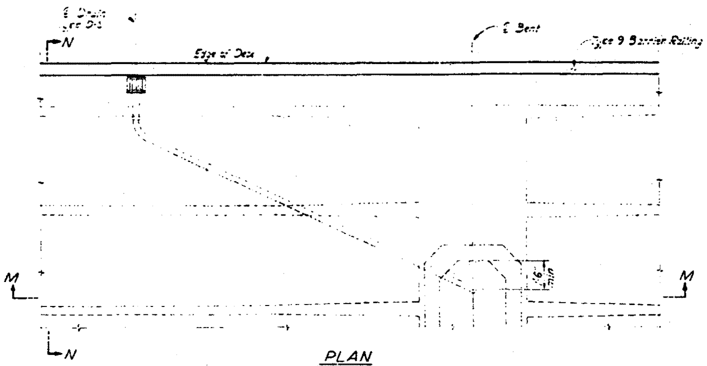


℄ Girder Ⓟ
Note: For Section H-H & J-J see "Expansion Armor Details III" sheet
PLAN
(RAMP "I")
Exp armor units not shown
Exp armor units
6"⌀ Steel pipe (10 gage)
SECTION K-K
DETAIL "H"
℄ Hinge
Main Unit Ⓛ
Main Unit Ⓡ
Joint Detail Type "A"
℄ Longit exp jt
Note: For dimensions and anchor bolt layout of units shown in Details "H" & "R" see "Exp Armor Details I" sheet
Water deflector plate - See Exp Armor Details "II" sheet
Full penetration butt weld
Gutter - 12 ga ℞
SECTION L-L
Note: All joints in gutters to be watertight
5/8"⌀ x 0'-4" Studs @ 12" ctrs Stagger thus:
SECTION M-M
End ℞ 12 ga
SECTION N-N
℄ Bent 10
Main Unit
DETAIL "R"
AS BUILT
AS BUILT PLANS
Contract No. 10-080844
Date Completed
Document No. 00001895
DESIGN SECTION 2
STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
STOCKTON CHANNEL VIADUCT
(STAGE II)
EXPANSION ARMOR DETAILS IV
29-176 R/L
25.1
29176-81
78
110

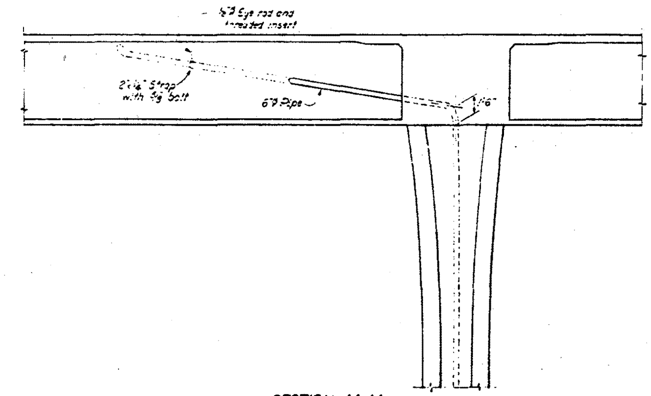
I-2


Adjust setting ±¼" per 10°F change in superstructure temperature
End of angles
5/8"ø×0'-6" Studs
PART PLAN
(LOW SIDE OF DECK)
1½" = 1'-0"
Face of Railing
1"Clr between angles
End of angles
12" ctrs - Stagger
℄ Bent 8
PART PLAN
(HIGH SIDE OF DECK)
Normal to joint
Drilled hole - typical
Drilled hole - typical
Bevel
PL ¾ × 4
Top of Deck
Tape
Drilled hole in angles - typical
5/8"ø H S Galvanized bolt with self locking galvanized nut 1¾" Reach - Torque to 200 Ft lbs - Typical
Weld to angles
Angles as shown on "Deck Details XV" sheet of contract plans
3/16" × 12½" wide sheet neoprene
SECTION A-A
PL 1/16" Fabricate to fit field conditions
PL ½" fabricate to fit field conditions except as noted
Full penetration butt weld
5/8"ø × 0'-6" studs total 2
1/16" sheet neoprene bonded in the field to 3/16" sheet neoprene (Bonding agent shall meet State Specifications 701-80-30)
3/16" × 12½" wide sheet neoprene
Drilled holes for 5/8" H.S bolts
SECTION B-B
Note: For details not shown see "Section A-A"
4" long inserts for 5/8"ø bolts - Typical in rail
PL 1/16 × 4 - Bend as shown
PL ¾ × 4
3/16" × 12½" wide sheet neoprene
Angles as shown on "Deck Details XV" sheet of contract plans
SECTION C-C
Tape
1/16" × 12½" wide sheet neoprene bonded in the field to 3/16" sheet neoprene (Bonding agent shall meet State Specifications 701-80-30)
Note: For details not shown see "Section A-A"
VIEW D-D
AS BUILT PLANS
Contract No. 10-080844
Date Completed
Document No. 0000/875
SUPPLEMENTAL SHEET
ARMORED SEALED JOINT
(AT BENT 3 RT & LT, 3 RAMP A & 3 RAMP H)
STOCKTON CHANNEL VIADUCT
10-SJ-5,4
Br No 29-176R L
By: RJL 4-71
Detailed By: KCB 4-71
Contract No. 10-080844

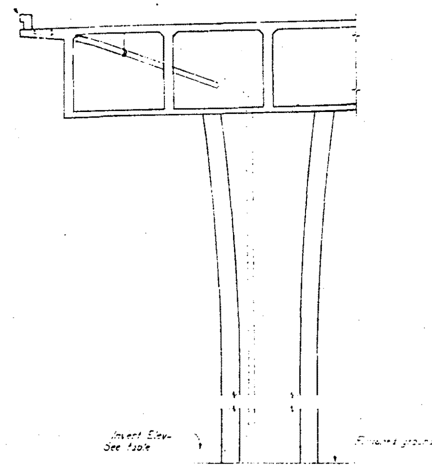
I-3



PLAN
1/4" = 1'-0"



SECTION M-M



SECTION N-N

BENT	DRAIN STATION	OUTLET FACE	INVERT ELEV
[illegible]	[illegible]	NE	[illegible]
3A	16+8.00	SW	12.00
4A	19+00.00	NE	12.50
5A	19+46.00	SW #	9.00
6A	21+36.00	N	8.5
8A	23+36.00	SW	11.00
10A	25+96.00	SE	12.00
12A	28+69.00	SE #	10.00
14A	32+57.00	SE #	8.50
16A	35+25.00	SW	16.00
[illegible]	[illegible]	N	13.00
[illegible]	[illegible]	NE #	9.00
3C	15+95.00	N	13.00
6C	19+00.00	NE	25.00
8C	22+55.00	NW #	4.50
10C	25+62.00	E #	[illegible]
12C	28+14.00	N	[illegible]

* Slope pipe to clear prestressing ducts

For location, see General Plan sheets
For deck drain assembly see
Drain Type [illegible] sheet

# Indicates [illegible] required

Δ Outlet face indicates direction of column outlet.

NO AS BUILT CHANGES
ND SCHULZ
DATE 12/27/72

December 19, 1969

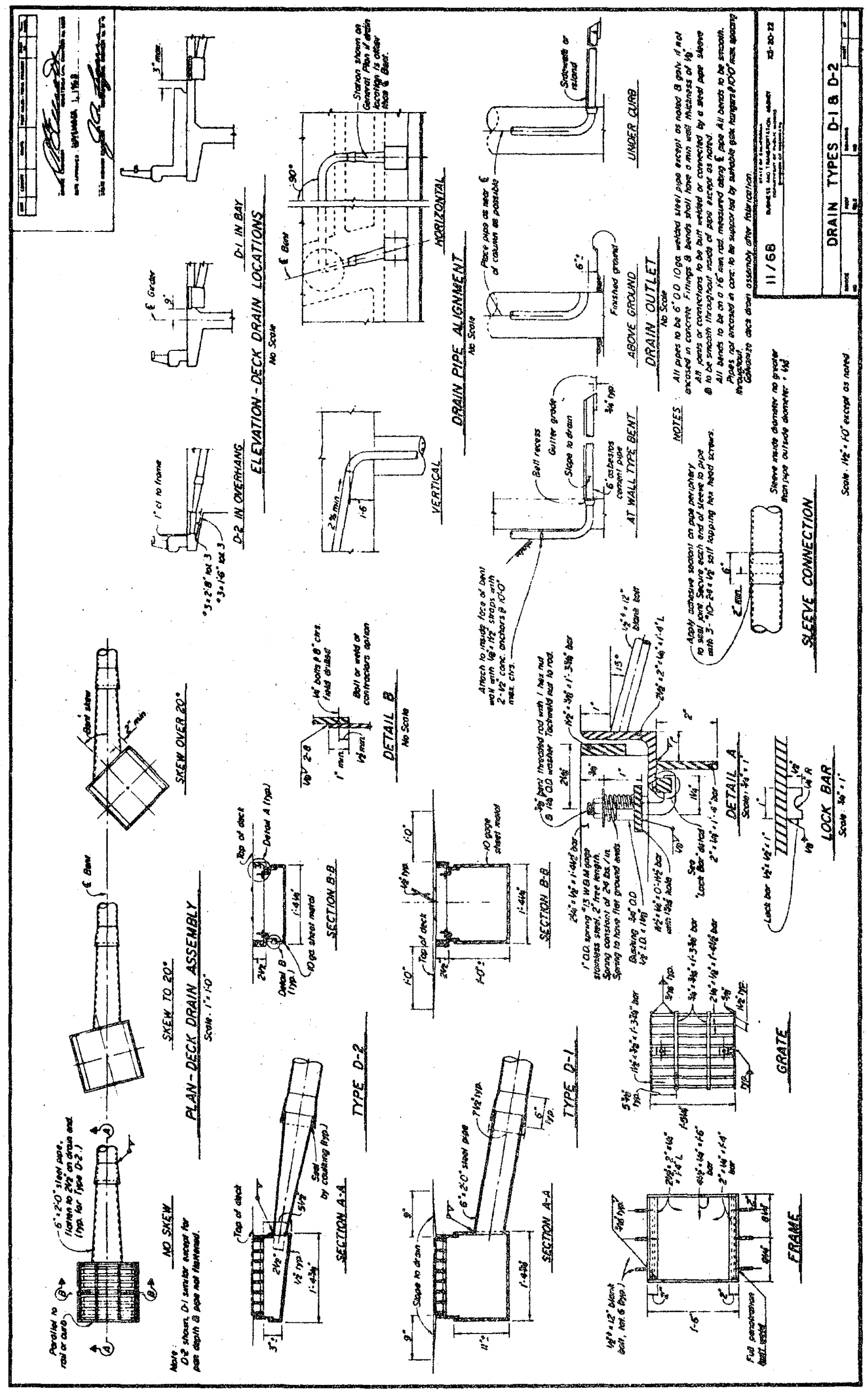
AS BUILT PLANS
Contract No. 10-080E5-4
Date Completed ______
Document No. 0000/886

DESIGN SECTION 2

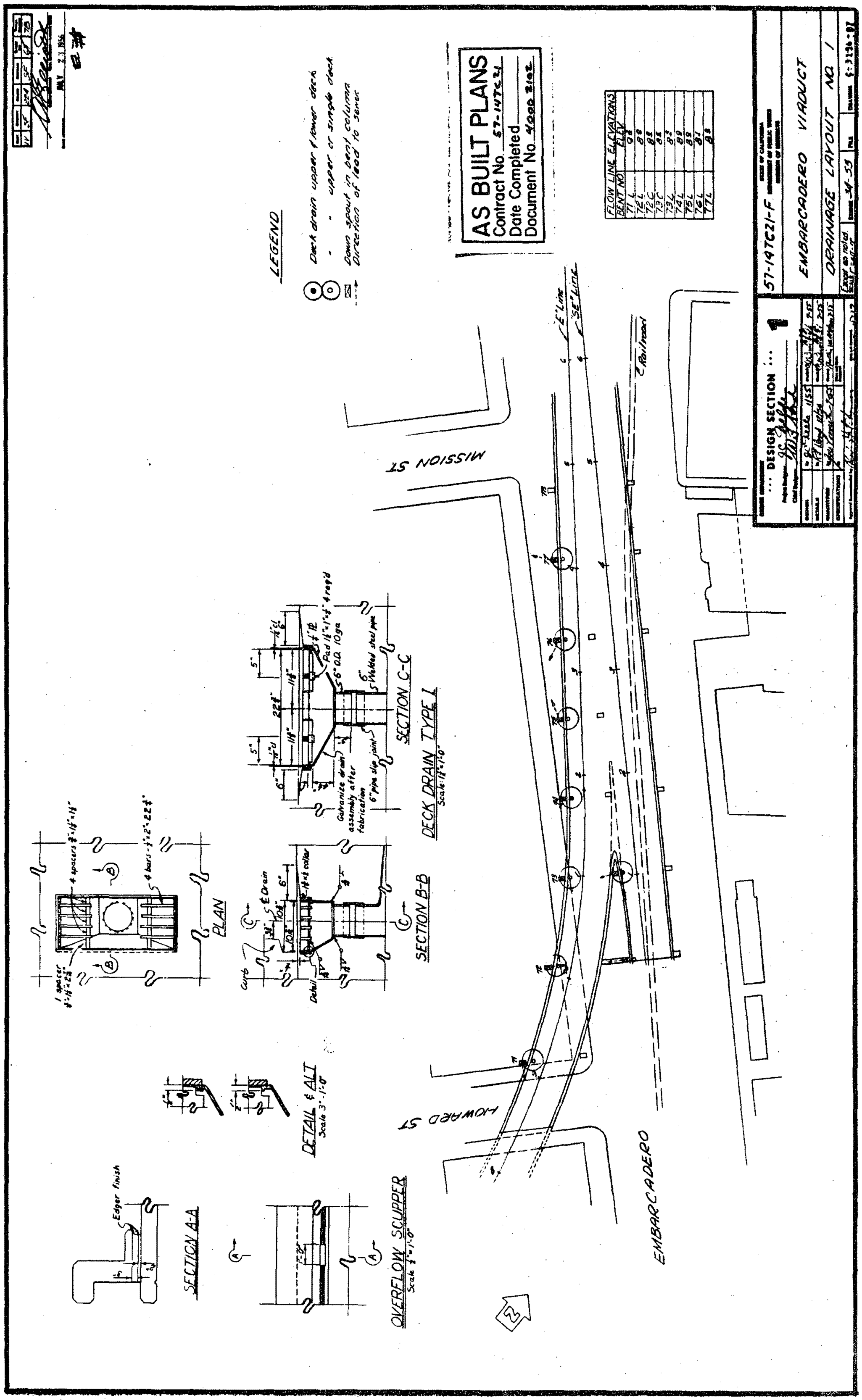
STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS

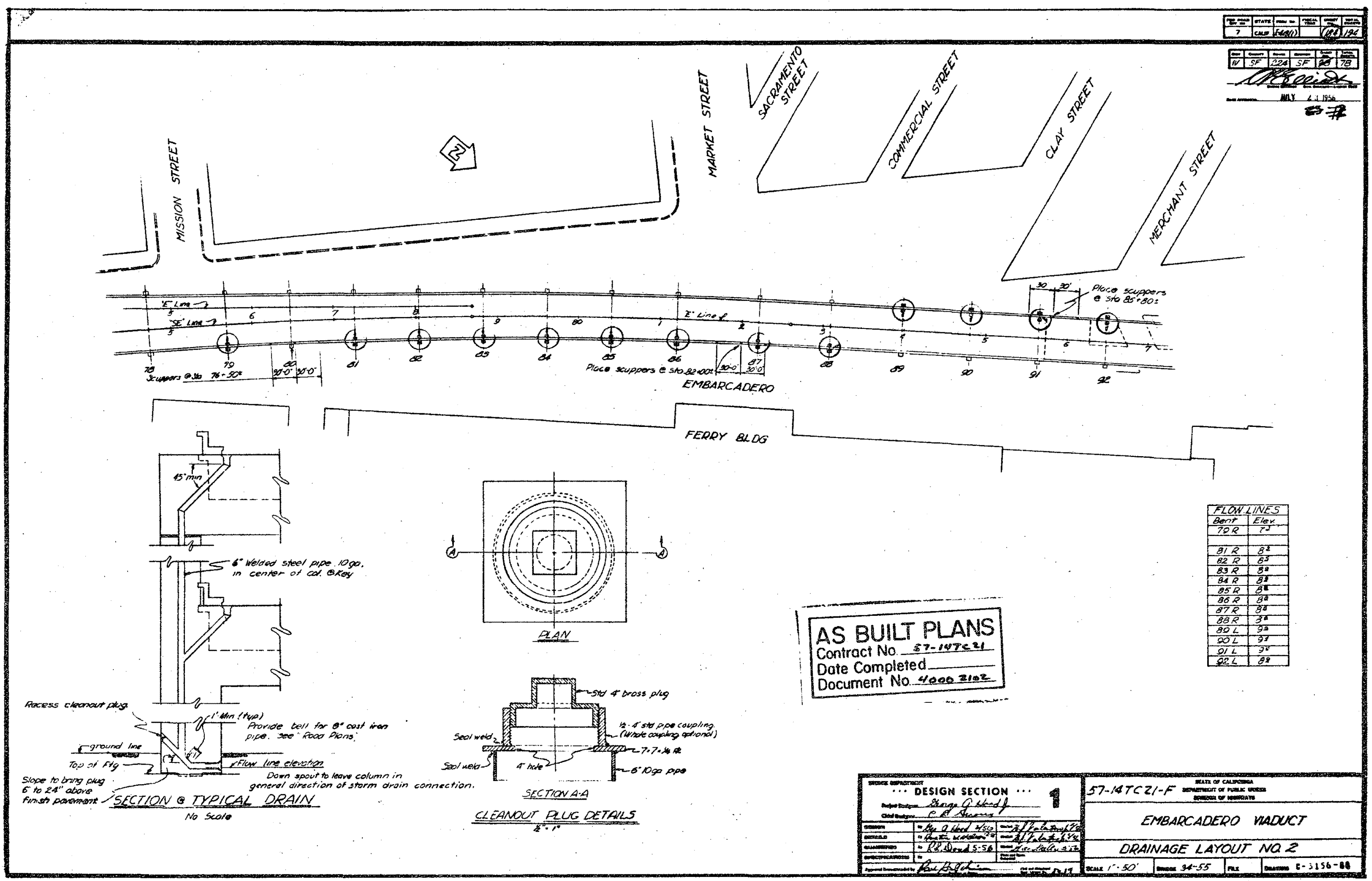
STAGE III
ROUTE 5/4 CONNECTOR VIADUCT

DECK DRAINAGE DETAILS



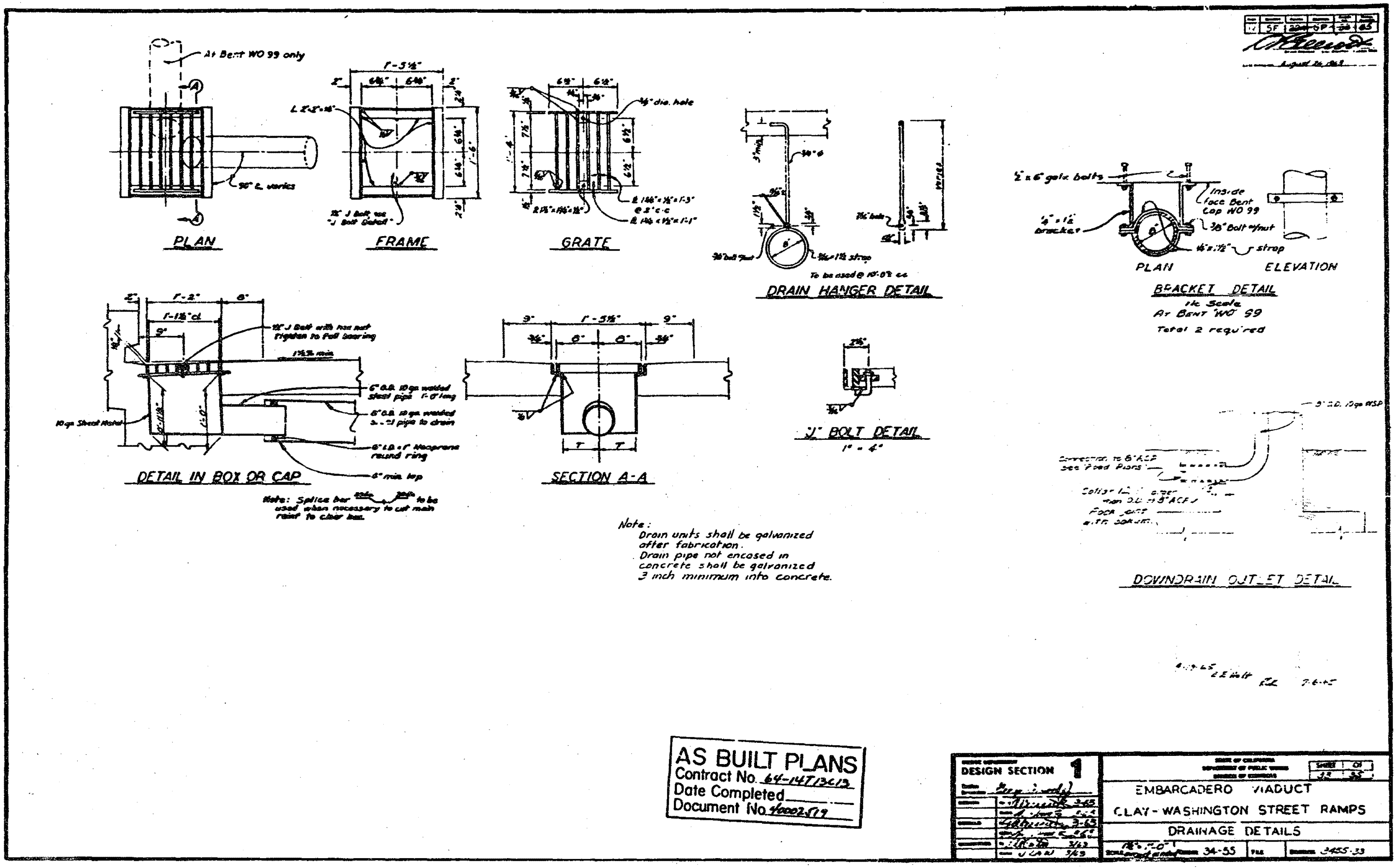
DRAIN TYPES D-1 & D-2
11/68
PLAN-DECK DRAIN ASSEMBLY
NO SKEW
SKEW TO 20°
SKEW OVER 20°
TYPE D-2
TYPE D-1
SECTION A-A
SECTION B-B
DETAIL B
DETAIL A
FRAME
GRATE
LOCK BAR
SLEEVE CONNECTION
ELEVATION-DECK DRAIN LOCATIONS
D-2 IN OVERHANG
D-1 IN BAY
VERTICAL
HORIZONTAL
DRAIN PIPE ALIGNMENT
AT WALL TYPE BENT
ABOVE GROUND
UNDER CURB
DRAIN OUTLET
NOTES


SECTION A-A
Edger finish
OVERFLOW SCUPPER
DETAIL & ALT
PLAN
SECTION B-B
SECTION C-C
DECK DRAIN TYPE I
Galvanize drain assembly after fabrication
6" pipe slip joint
Welded steel pipe
LEGEND
Deck drain upper & lower deck
Down spout in bent column
Direction of lead to sewer
HOWARD ST
MISSION ST
EMBARCADERO
"E" Line
"SE" Line
Railroad
AS BUILT PLANS
Contract No.
Date Completed
Document No.
FLOW LINE ELEVATIONS
BENT NO.
ELEV.
DESIGN SECTION 1
EMBARCADERO VIADUCT
DRAINAGE LAYOUT NO. 1

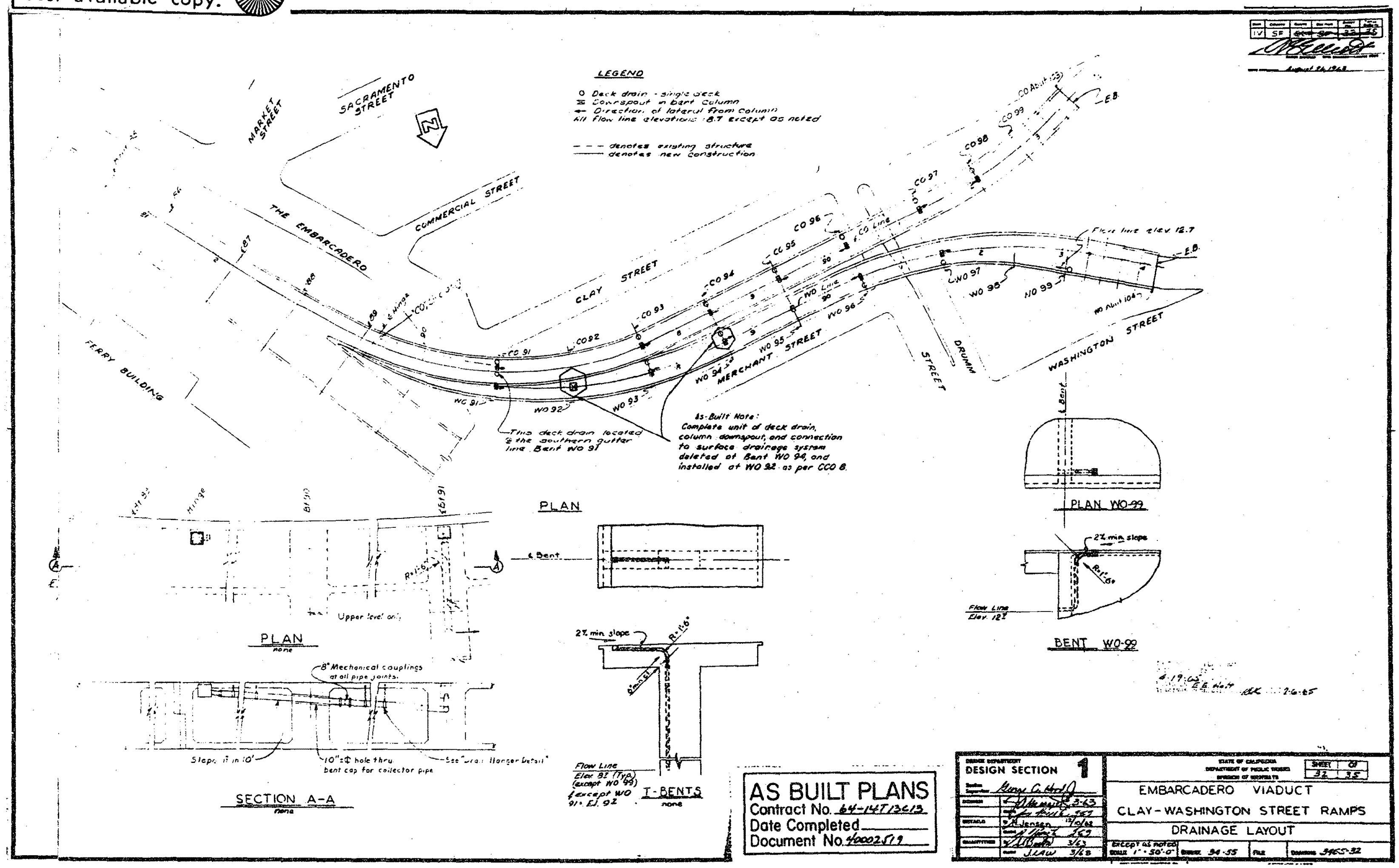


FLOW LINES	
Bent	Elev.
79 R	7^{2}
81 R	8^{2}
82 R	8^{5}
83 R	8^{8}
84 R	8^{8}
85 R	8^{8}
86 R	8^{8}
87 R	8^{8}
88 R	3^{6}
89 L	9^{2}
90 L	9^{3}
91 L	3^{6}
92 L	8^{8}

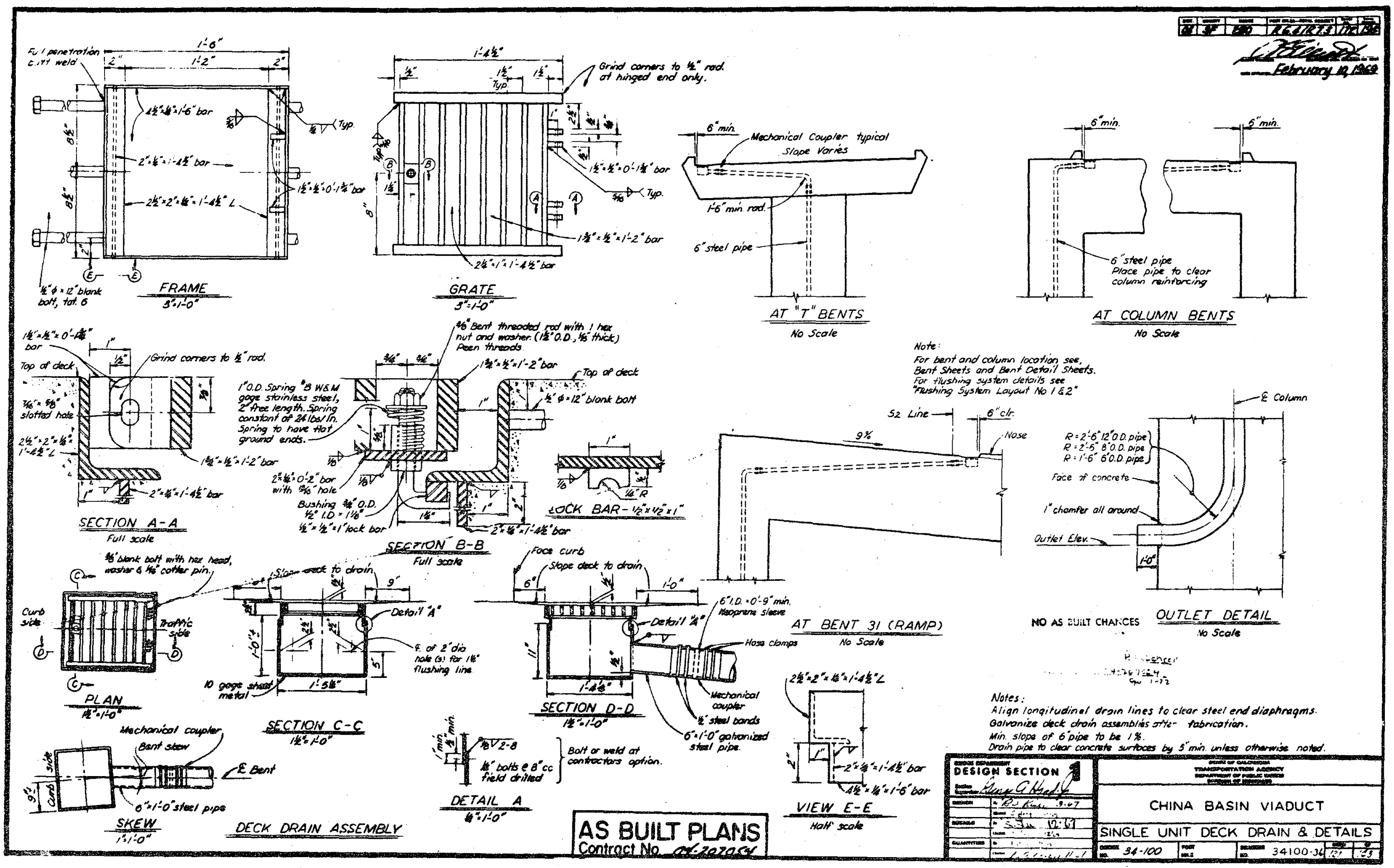
K-2



At Bent WO 99 only
PLAN
FRAME
GRATE
DRAIN HANGER DETAIL
To be used @ 10'-0" cc
BRACKET DETAIL
No Scale
At Bent "WO" 99
Total 2 required
PLAN
ELEVATION
Inside face Bent Cap WO 99
DETAIL IN BOX OR CAP
Note: Splice bar to be used when necessary to cut main reinf. to clear box.
SECTION A-A
"J" BOLT DETAIL
1" = 4"
DOWNDRAIN OUTLET DETAIL
Note:
Drain units shall be galvanized after fabrication.
Drain pipe not encased in concrete shall be galvanized 3 inch minimum into concrete.
AS BUILT PLANS
Contract No. 64-14T13C13
Date Completed
Document No. 40002519
DESIGN SECTION 1
EMBARCADERO VIADUCT
CLAY-WASHINGTON STREET RAMPS
DRAINAGE DETAILS
34-55
3455-33

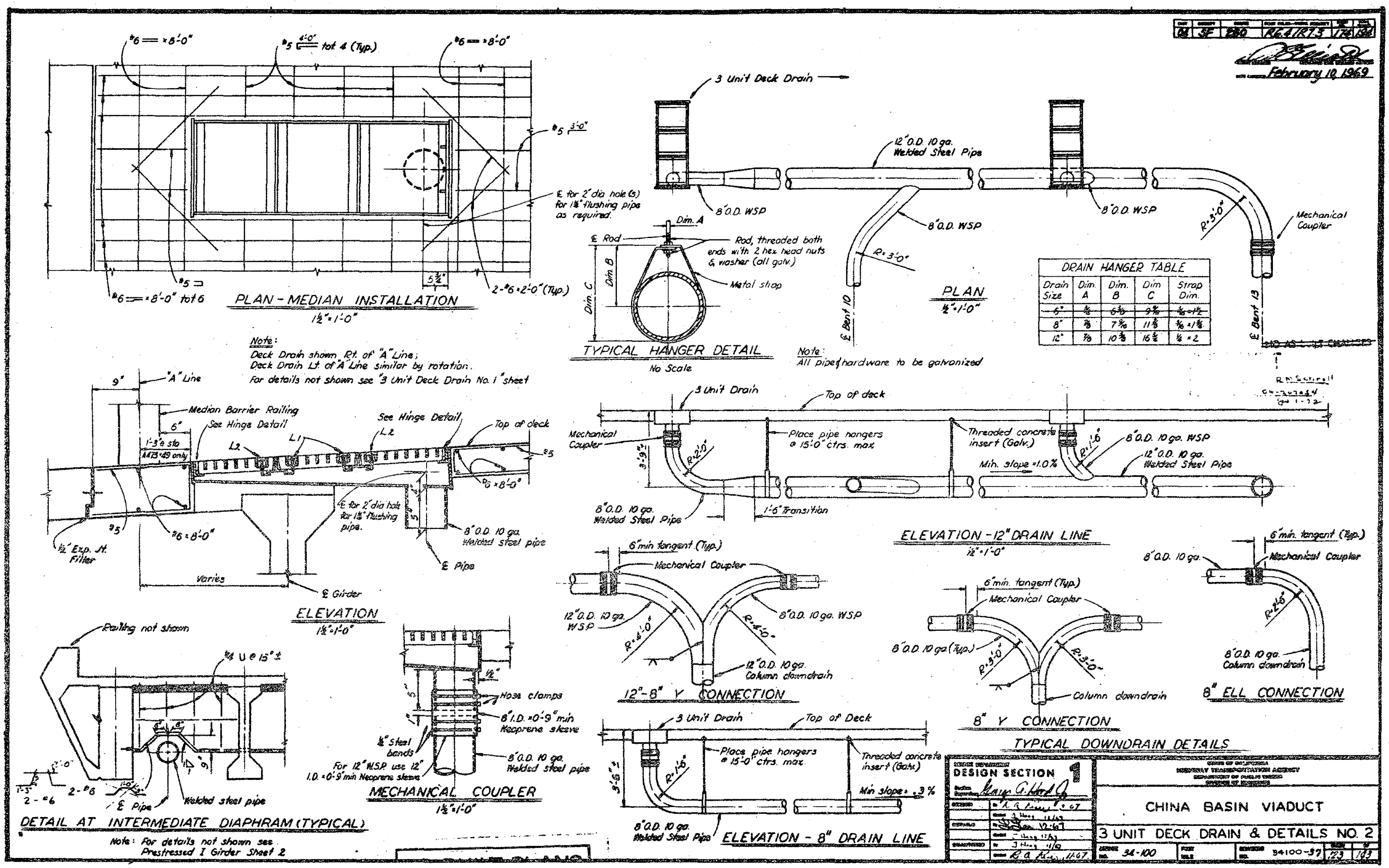

LEGEND
o Deck drain - single deck
Downspout in bent column
Direction of lateral from column
All flow line elevations 8.7 except as noted
- - - denotes existing structure
—— denotes new construction
SACRAMENTO STREET
MARKET STREET
THE EMBARCADERO
COMMERCIAL STREET
CLAY STREET
MERCHANT STREET
WASHINGTON STREET
DRUMM STREET
FERRY BUILDING
As-Built Note:
Complete unit of deck drain, column downspout, and connection to surface drainage system deleted at Bent WO 94, and installed at WO 92 as per CCO 8.
This deck drain located ℄ the southern gutter line Bent WO 91
Flow line elev 12.7
PLAN
SECTION A-A
8" Mechanical couplings at all pipe joints.
10"± ⊄ hole thru bent cap for collector pipe
Slope 1" in 10'
See "Drain Hanger Detail"
Upper level only
PLAN
T-BENTS
2% min slope
Flow Line Elev 9.1 (Typ) (except WO 99) (except WO 91 & El. 92)
PLAN WO-99
BENT WO-99
Flow Line Elev 12.7
AS BUILT PLANS
Contract No. 64-14T13C13
Date Completed
Document No. 40002519
DESIGN SECTION 1
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
SHEET 32 OF 35
EMBARCADERO VIADUCT
CLAY-WASHINGTON STREET RAMPS
DRAINAGE LAYOUT
EXCEPT AS NOTED
SCALE 1" = 50'-0"
34-55
3465-32

K-4



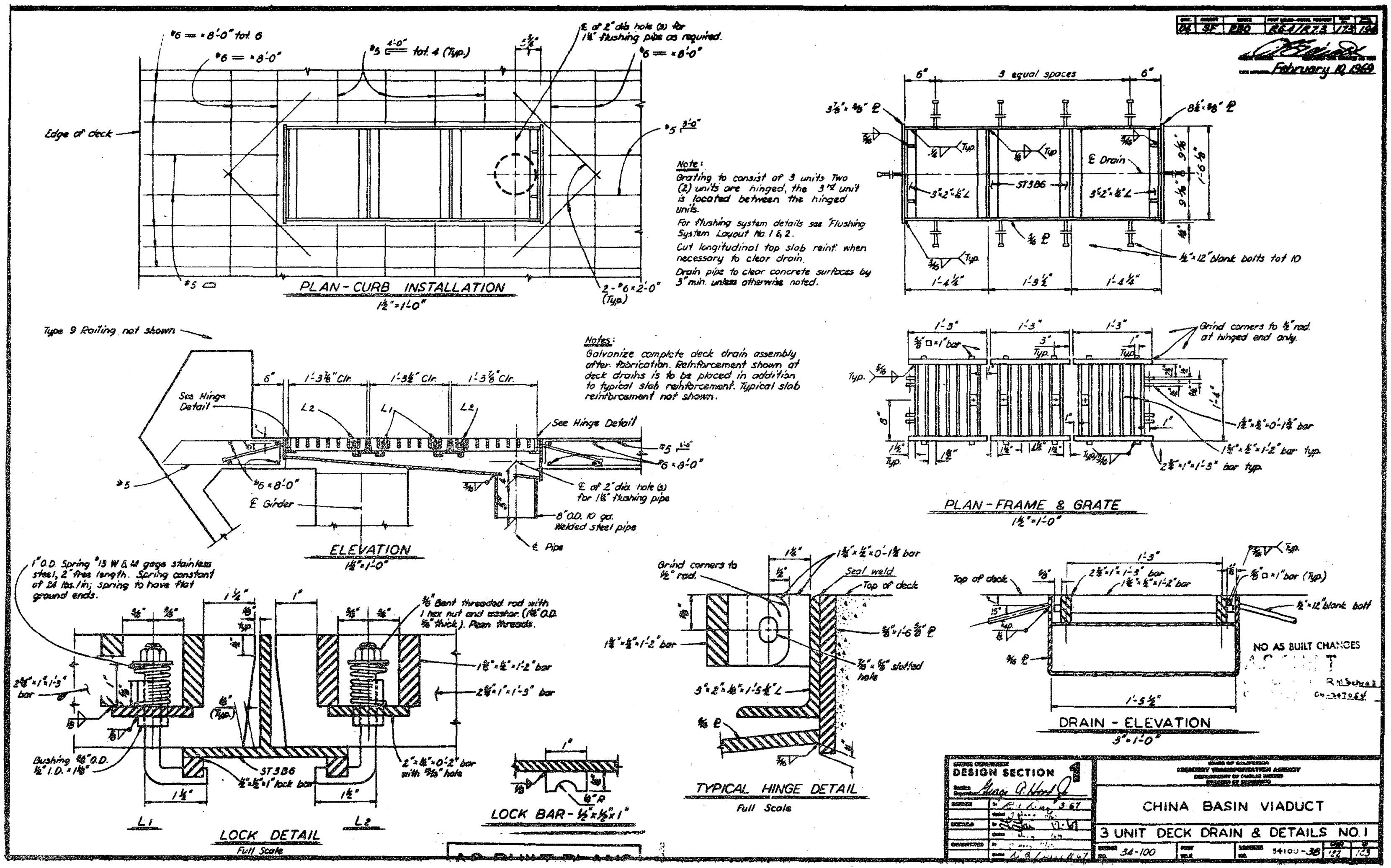
FRAME
GRATE
AT "T" BENTS
No Scale
AT COLUMN BENTS
No Scale
Mechanical Coupler typical
Slope Varies
6" steel pipe
6" steel pipe
Place pipe to clear
column reinforcing
Note:
For bent and column location see,
Bent Sheets and Bent Detail Sheets.
For flushing system details see
"Flushing System Layout No 1 & 2"
SECTION A-A
Full scale
SECTION B-B
Full scale
LOCK BAR
AT BENT 31 (RAMP)
No Scale
OUTLET DETAIL
No Scale
NO AS BUILT CHANGES
PLAN
SECTION C-C
SECTION D-D
DETAIL A
SKEW
DECK DRAIN ASSEMBLY
VIEW E-E
Half scale
Notes:
Align longitudinal drain lines to clear steel end diaphragms.
Galvanize deck drain assemblies after fabrication.
Min. slope of 6" pipe to be 1%.
Drain pipe to clear concrete surfaces by 5" min. unless otherwise noted.
AS BUILT PLANS
Contract No.
DESIGN SECTION
February 10, 1969
CHINA BASIN VIADUCT
SINGLE UNIT DECK DRAIN & DETAILS
34-100
34100-36

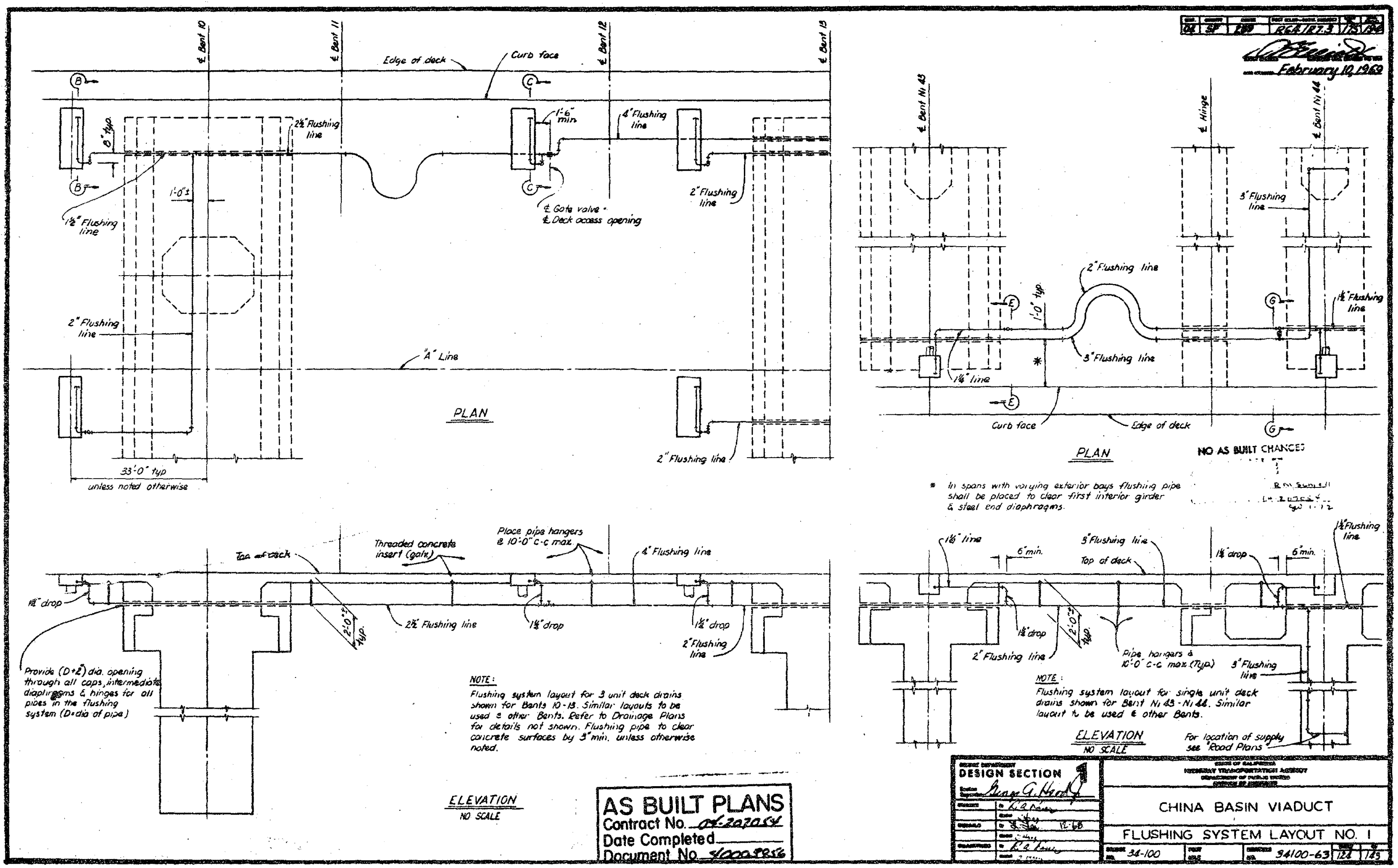
I-2



Drain Size	Dim. A	Dim. B	Dim. C	Strap Dim.
6"	⅝	6⅛	9⅝	3/16 × 1½
8"	⅝	7 9/16	11⅝	3/16 × 1⅝
12"	⅞	10⅜	15⅛	¼ × 2

I-3

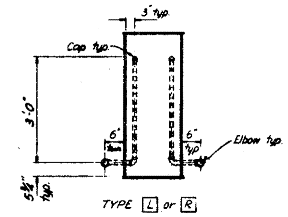

February 10, 1969
PLAN - CURB INSTALLATION
1½" = 1'-0"
Edge of deck
Note:
Grating to consist of 3 units. Two (2) units are hinged, the 3rd unit is located between the hinged units.
For flushing system details see "Flushing System Layout No. 1 & 2.
Cut longitudinal top slab reinf. when necessary to clear drain.
Drain pipe to clear concrete surfaces by 3" min. unless otherwise noted.
3 equal spaces
½"×12" blank bolts tot 10
PLAN - FRAME & GRATE
1½" = 1'-0"
Grind corners to ½" rad. at hinged end only.
Type 9 Railing not shown
Notes:
Galvanize complete deck drain assembly after fabrication. Reinforcement shown at deck drains is to be placed in addition to typical slab reinforcement. Typical slab reinforcement not shown.
See Hinge Detail
ELEVATION
1½" = 1'-0"
℄ Girder
8" O.D. 10 ga. Welded steel pipe
℄ Pipe
1" O.D. Spring #13 W & M gage stainless steel, 2" free length. Spring constant of 24 lbs./in.; spring to have flat ground ends.
LOCK DETAIL
Full Scale
LOCK BAR - ½"×½"×1"
TYPICAL HINGE DETAIL
Full Scale
Grind corners to ½" rad.
Seal weld
Top of deck
DRAIN - ELEVATION
3" = 1'-0"
Top of deck
½"×12" blank bolt
NO AS BUILT CHANGES
DESIGN SECTION 1
CHINA BASIN VIADUCT
3 UNIT DECK DRAIN & DETAILS NO. 1
34-100



℄ Bent 10
℄ Bent 11
℄ Bent 12
℄ Bent 13
Edge of deck
Curb face
2½" Flushing line
4" Flushing line
1'-6" min.
8" typ.
1'-0"±
1½" Flushing line
℄ Gate valve - ℄ Deck access opening
2" Flushing line
"A" Line
PLAN
33'-0" typ unless noted otherwise
℄ Bent N₁ 43
℄ Hinge
℄ Bent N₁ 44
3" Flushing line
2" Flushing line
1½" Flushing line
1'-0" typ.
1¼" line
3" Flushing line
Curb face
Edge of deck
PLAN
NO AS BUILT CHANGES
* In spans with varying exterior bays flushing pipe shall be placed to clear first interior girder & steel end diaphragms.
Top of deck
Threaded concrete insert (galv.)
Place pipe hangers @ 10'-0" c-c max.
4" Flushing line
1½" drop
2'-0" typ.
2½" Flushing line
1½" drop
1½" drop
2" Flushing line
Provide (D+2") dia. opening through all caps, intermediate diaphragms & hinges for all pipes in the flushing system (D=dia of pipe)
NOTE:
Flushing system layout for 3 unit deck drains shown for Bents 10-13. Similar layouts to be used @ other Bents. Refer to Drainage Plans for details not shown. Flushing pipe to clear concrete surfaces by 3" min. unless otherwise noted.
ELEVATION
NO SCALE
1½" line
6" min.
3" Flushing line
Top of deck
1½" drop
6" min.
1½" Flushing line
1½" drop
2'-0" typ.
2" Flushing line
Pipe hangers @ 10'-0" c-c max. (Typ.)
3" Flushing line
NOTE:
Flushing system layout for single unit deck drains shown for Bent N₁ 43-N₁ 44. Similar layout to be used @ other Bents.
ELEVATION
NO SCALE
For location of supply see "Road Plans"
AS BUILT PLANS
Contract No. 04-202054
Date Completed
Document No. 4000 8856
February 10, 1969
04 SF 230 R6.8/R7.3 125 144
DESIGN SECTION
CHINA BASIN VIADUCT
FLUSHING SYSTEM LAYOUT NO. 1
34-100
34100-63 124 145

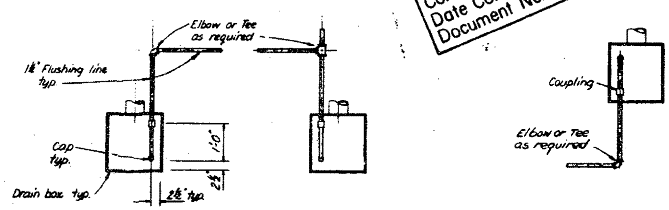
04 | SF | 280 | R4.4/R7.3 | 125 | 152

February 10, 1969



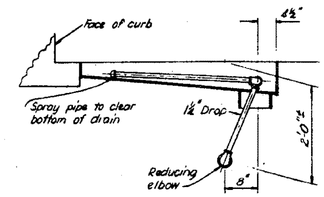
FLUSHING SYSTEM LAYOUT AT 3 UNIT DRAIN

⅜"=1'-0"



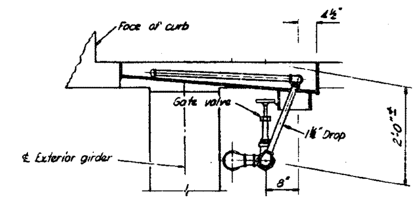
FLUSHING SYSTEM LAYOUT AT SINGLE-UNIT DRAINS

⅜"=1'-0"



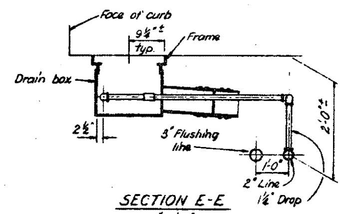
SECTION B-B

1"=1'-0"



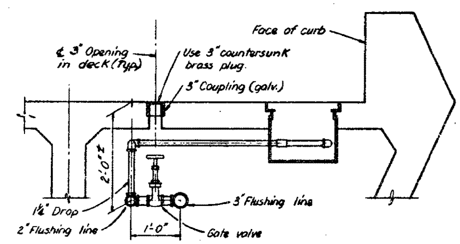
SECTION C-C

1"=1'-0"



SECTION E-E

1"=1'-0"

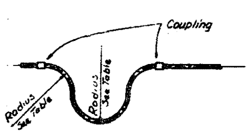


SECTION G-G

1"=1'-0"

NO AS BUILT CHANGES
R.M. Schrell
04-207054

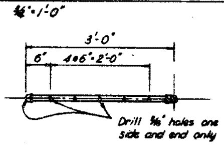
EXPANSION LOOP TABLE	
Pipe Size	Min. Radius
1½"	7½
2"	10
2½"	12½
3"	15
4"	20



EXPANSION LOOP

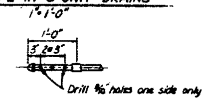
⅜"=1'-0"

Note:
Pipe expansion to be fabricated from continuous length of pipe.
All pipe & hardware to be galvanized.



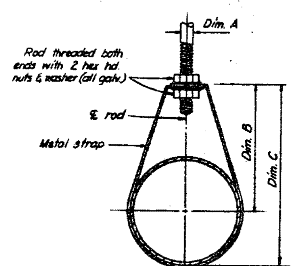
SPRAY PIPE IN 3 UNIT DRAINS

1"=1'-0"



SPRAY PIPE IN SINGLE UNIT DRAINS

1"=1'-0"



TYPICAL HANGER DETAIL

No Scale

PIPE HANGER TABLE				
Pipe Size	Dim. A	Dim. B	Dim. C	Strap Dim.
1¼"	⅜	2 9/16	3 5/16	3/16 × ⅝
1½"	⅜	2¾	3 5/16	3/16 × ⅝
2"	⅜	3	4 1/16	3/16 × ⅝
2½"	½	3⅝	5 1/16	3/16 × 1¼
3"	½	4¼	6	3/16 × 1½
4"	⅝	4⅞	7⅝	3/16 × 1¼

NOTES:
All control valves to be 125 lb bronze gate valves. Gate valve to be centered (upright) at centerline of deck opening for easy wrench access.
Align flushing lines to clear steel and diaphragms.

DESIGN SECTION 1

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

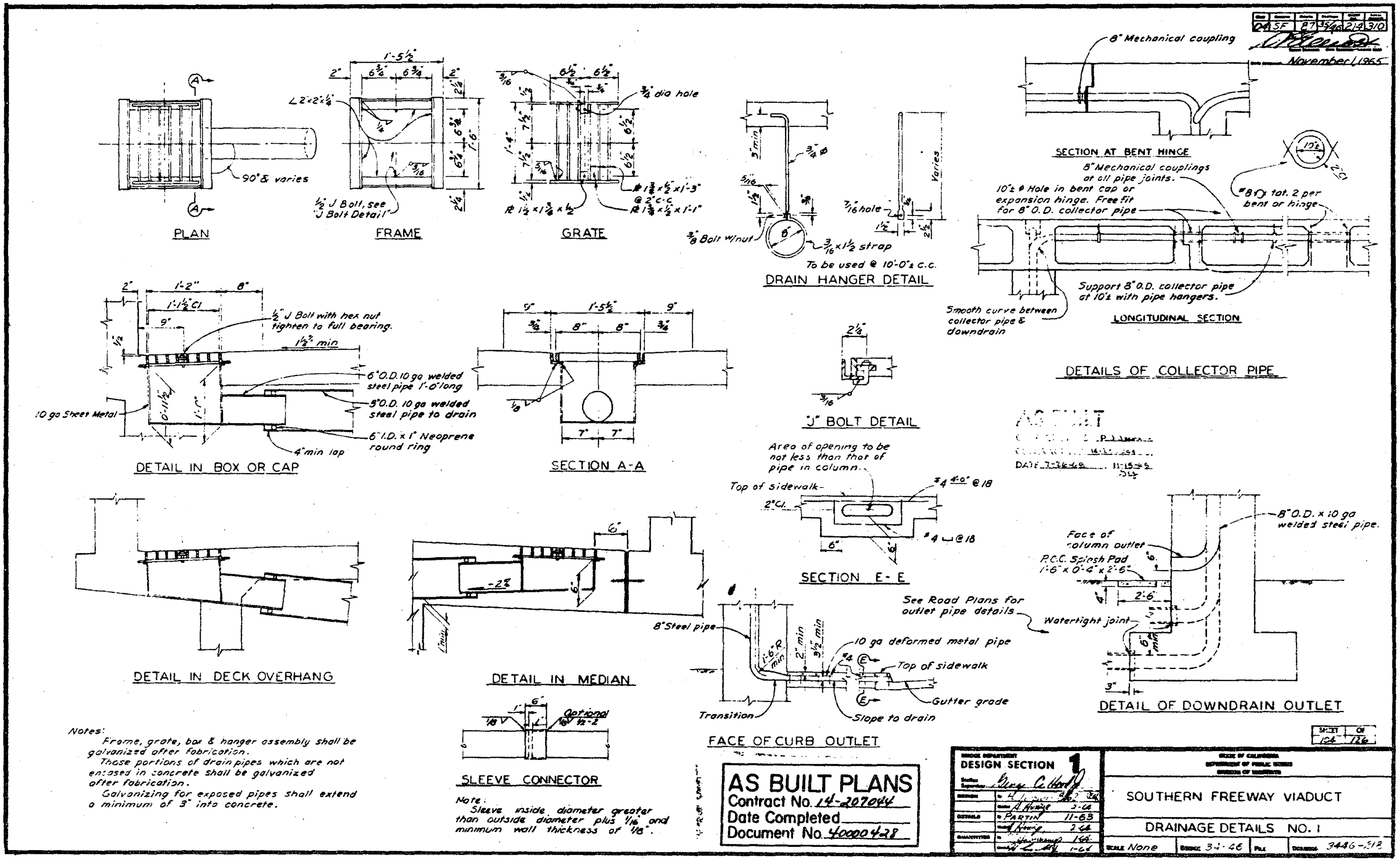
CHINA BASIN VIADUCT

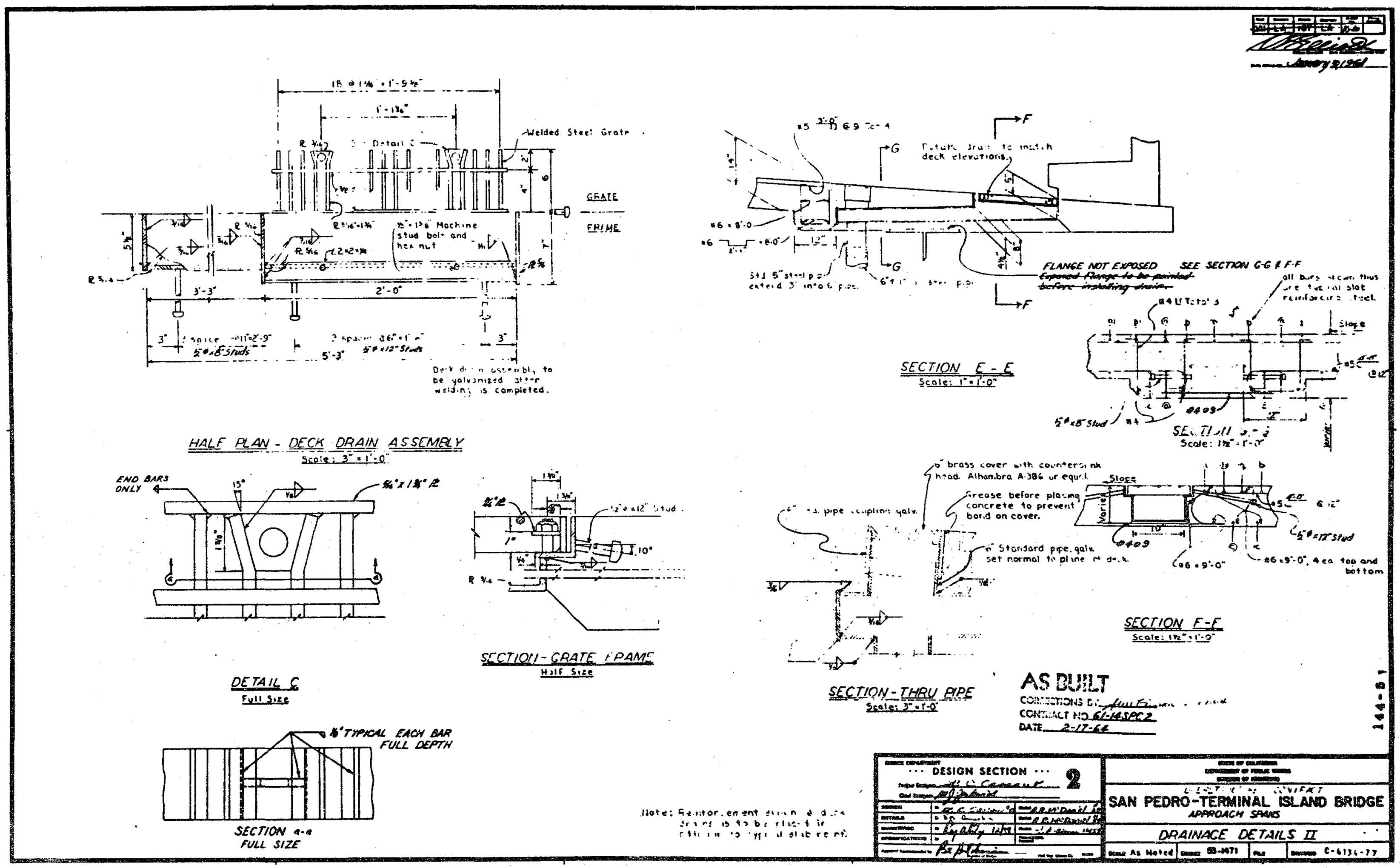
FLUSHING SYSTEM LAYOUT NO. 2

BRIDGE NO. 34-100 | DRAWING NO. 34100-48 | SHEET 125 OF 163

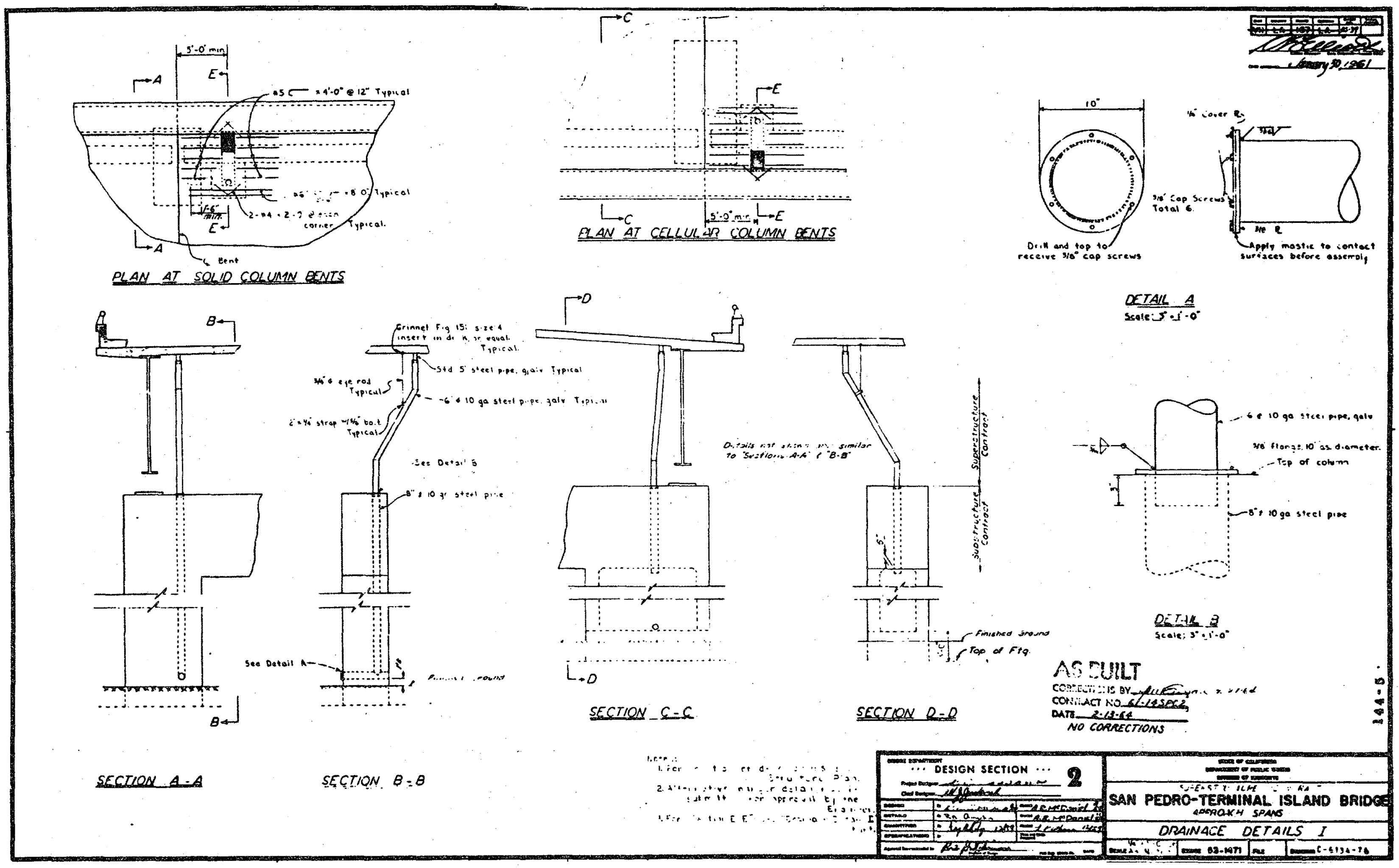
I-5

M-1

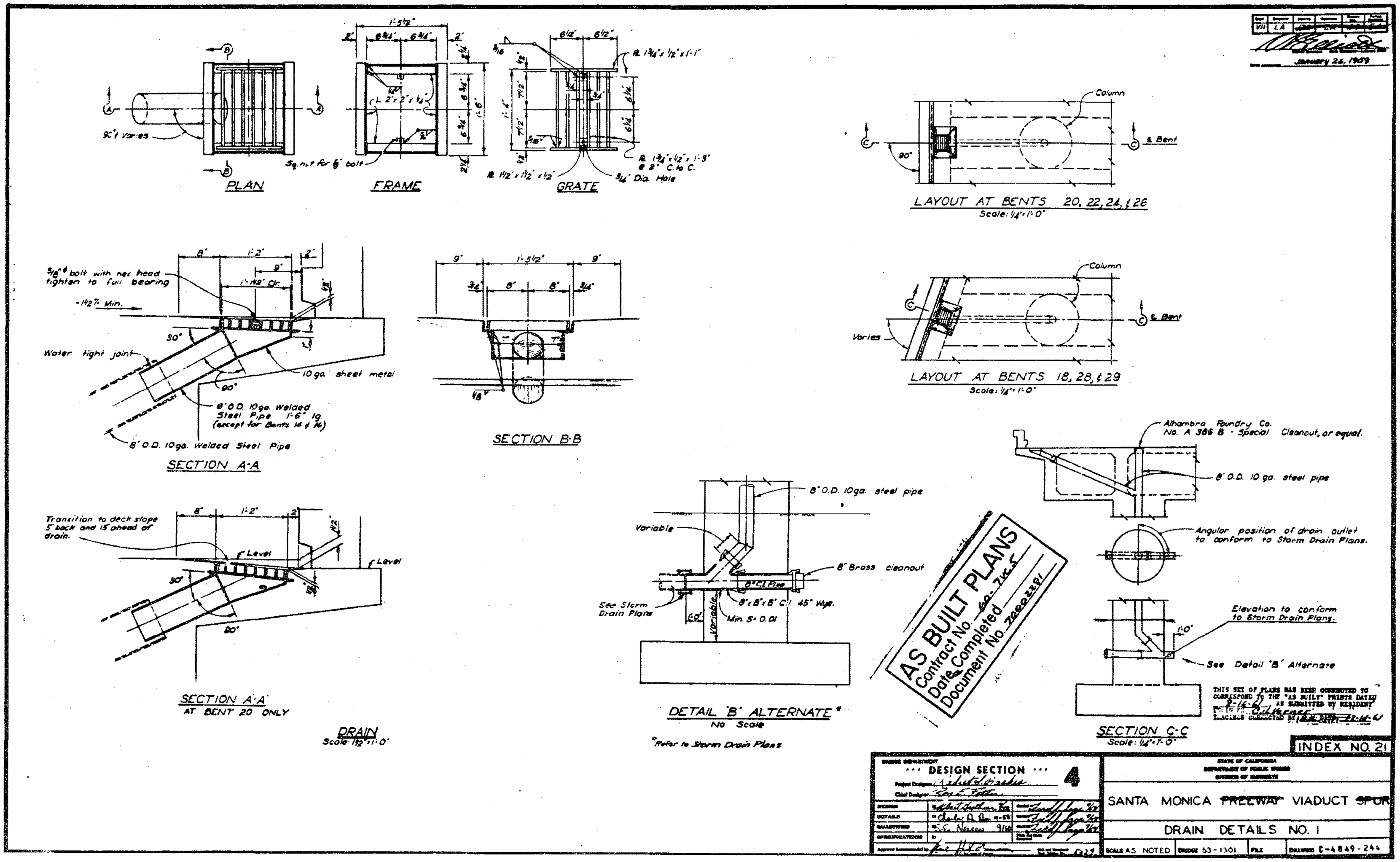

PLAN
FRAME
GRATE
90° & varies
∠2"x2"x¼
½" J Bolt, see "J Bolt Detail"
¾" dia hole
DRAIN HANGER DETAIL
⅜" Bolt w/nut
3/16" x 1½ strap
To be used @ 10'-0"± c.c.
⁷⁄₁₆ hole
Varies
8" Mechanical coupling
November 1, 1965
SECTION AT BENT HINGE
8" Mechanical couplings at all pipe joints.
10"± ϕ Hole in bent cap or expansion hinge. Free fit for 8" O.D. collector pipe
8"ϕ tot. 2 per bent or hinge
Support 8" O.D. collector pipe at 10'± with pipe hangers.
Smooth curve between collector pipe & downdrain
LONGITUDINAL SECTION
DETAILS OF COLLECTOR PIPE
½" J Bolt with hex nut tighten to full bearing.
1½" min
6" O.D. 10 ga welded steel pipe 1'-0" long
8" O.D. 10 ga welded steel pipe to drain
6" I.D. x 1" Neoprene round ring
4" min lap
10 ga Sheet Metal
DETAIL IN BOX OR CAP
SECTION A-A
"J" BOLT DETAIL
Area of opening to be not less than that of pipe in column.
Top of sidewalk
#4 4'-0" @ 18
#4 @ 18
SECTION E-E
8" O.D. x 10 ga welded steel pipe.
Face of column outlet
P.C.C. Splash Pad 1'-6" x 0'-4" x 2'-6"
See Road Plans for outlet pipe details
Watertight joint
DETAIL OF DOWNDRAIN OUTLET
DETAIL IN DECK OVERHANG
DETAIL IN MEDIAN
8" Steel pipe
10 ga deformed metal pipe
Top of sidewalk
Gutter grade
Slope to drain
Transition
FACE OF CURB OUTLET
Notes:
Frame, grate, box & hanger assembly shall be galvanized after fabrication.
Those portions of drain pipes which are not encased in concrete shall be galvanized after fabrication.
Galvanizing for exposed pipes shall extend a minimum of 3" into concrete.
SLEEVE CONNECTOR
Optional
Note:
Sleeve inside diameter greater than outside diameter plus 1/16 and minimum wall thickness of 1/8".
AS BUILT PLANS
Contract No. 14-207044
Date Completed
Document No. 40000428
DESIGN SECTION 1
SOUTHERN FREEWAY VIADUCT
DRAINAGE DETAILS NO. 1
SCALE None
BRIDGE 34-46
3446-313
SHEET 104 OF 126



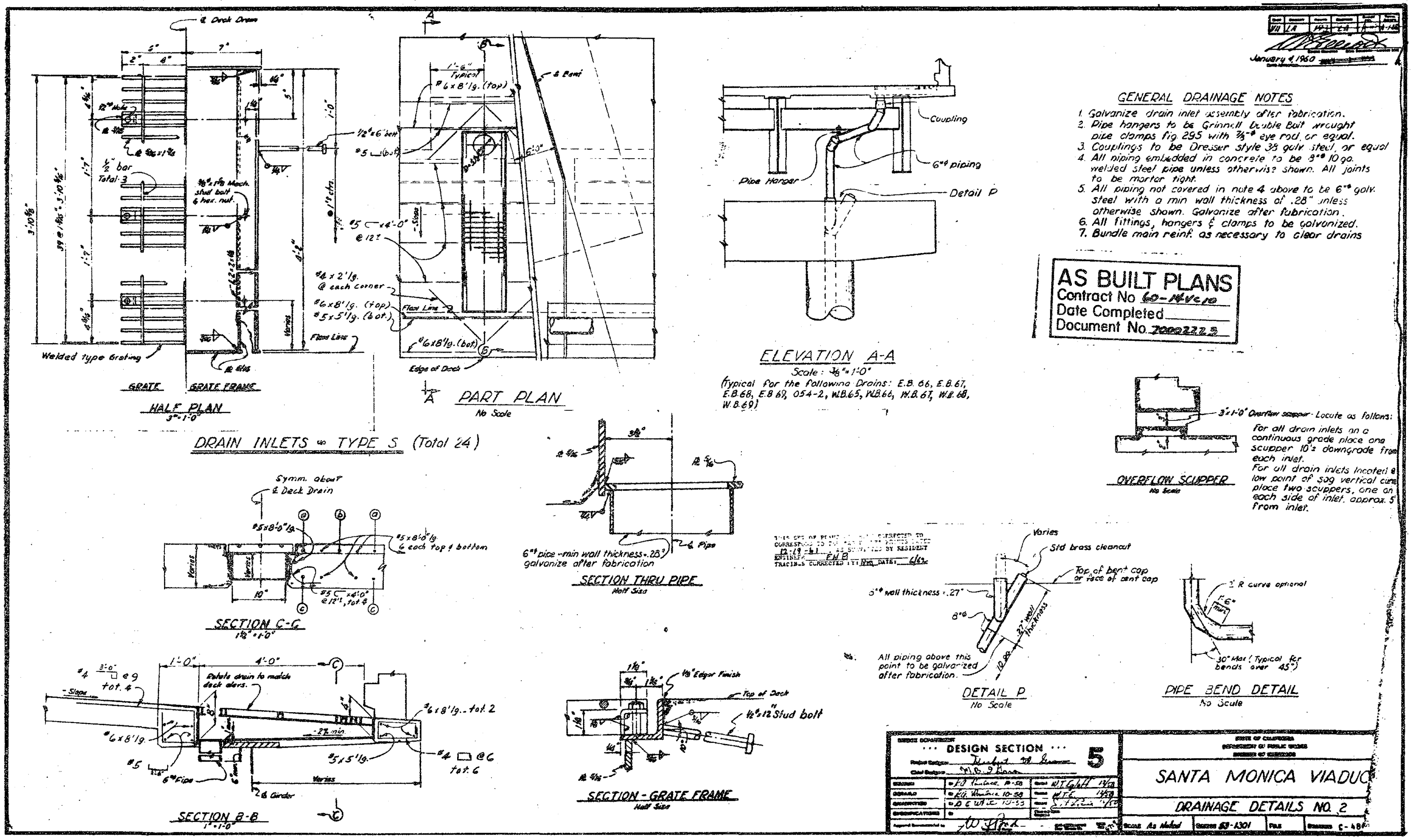
HALF PLAN - DECK DRAIN ASSEMBLY
Scale: 3" = 1'-0"
Welded Steel Grate
GRATE
FRAME
Detail C
½" × 1½" Machine stud bolt and hex nut
Deck drain assembly to be galvanized after welding is completed.
DETAIL C
Full Size
END BARS ONLY
SECTION - GRATE FRAME
Half Size
SECTION a-a
FULL SIZE
⅛" TYPICAL EACH BAR FULL DEPTH
SECTION E - E
Scale: 1" = 1'-0"
Rotate drain to match deck elevations.
FLANGE NOT EXPOSED
SEE SECTION G-G & F-F
SECTION - THRU PIPE
Scale: 3" = 1'-0"
6" brass cover with countersink head. Alhambra A-386 or equal.
Grease before placing concrete to prevent bond on cover.
6" Standard pipe, galv. set normal to plane of deck.
SECTION F-F
Scale: 1½" = 1'-0"
Note: Reinforcement shown in this drawing is to be placed in addition to typical slab reinf.
AS BUILT
CONTRACT NO. 61-14SPC2
DATE 2-17-64
DESIGN SECTION 2
SAN PEDRO-TERMINAL ISLAND BRIDGE
APPROACH SPANS
DRAINAGE DETAILS II
Scale As Noted
59-1471
C-6134-77
144-51


PLAN AT SOLID COLUMN BENTS
PLAN AT CELLULAR COLUMN BENTS
5'-0" min
#5 ⊏ × 4'-0" @ 12" Typical
2-#4 × 2-0 @ each corner Typical.
℄ Bent
DETAIL A
Scale: 3" = 1'-0"
10"
¼" Cover Pl
⅜" Cap Screws Total 6.
Drill and tap to receive ⅜" cap screws
Apply mastic to contact surfaces before assembly
Grinnel Fig 151 size 4 insert in deck or equal. Typical.
Std 5" steel pipe, galv. Typical
⅜" ø eye rod Typical
6" ø 10 ga steel pipe, galv. Typical
See Detail B
8" ø 10 ga steel pipe
See Detail A
Details not shown are similar to Sections A-A & B-B
Superstructure Contract
Substructure Contract
Finished Ground
Top of Ftg.
6" ø 10 ga steel pipe, galv
⅜" Flange 10" ø diameter
Top of column
8" ø 10 ga steel pipe
DETAIL B
Scale: 3" = 1'-0"
SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
AS BUILT
CORRECTIONS BY
CONTRACT NO. 61-14SPC2
DATE 2-13-64
NO CORRECTIONS
DESIGN SECTION 2
SAN PEDRO-TERMINAL ISLAND BRIDGE
APPROACH SPANS
DRAINAGE DETAILS I
53-1971
C-6134-76
January 10, 1961
144-5

O-1

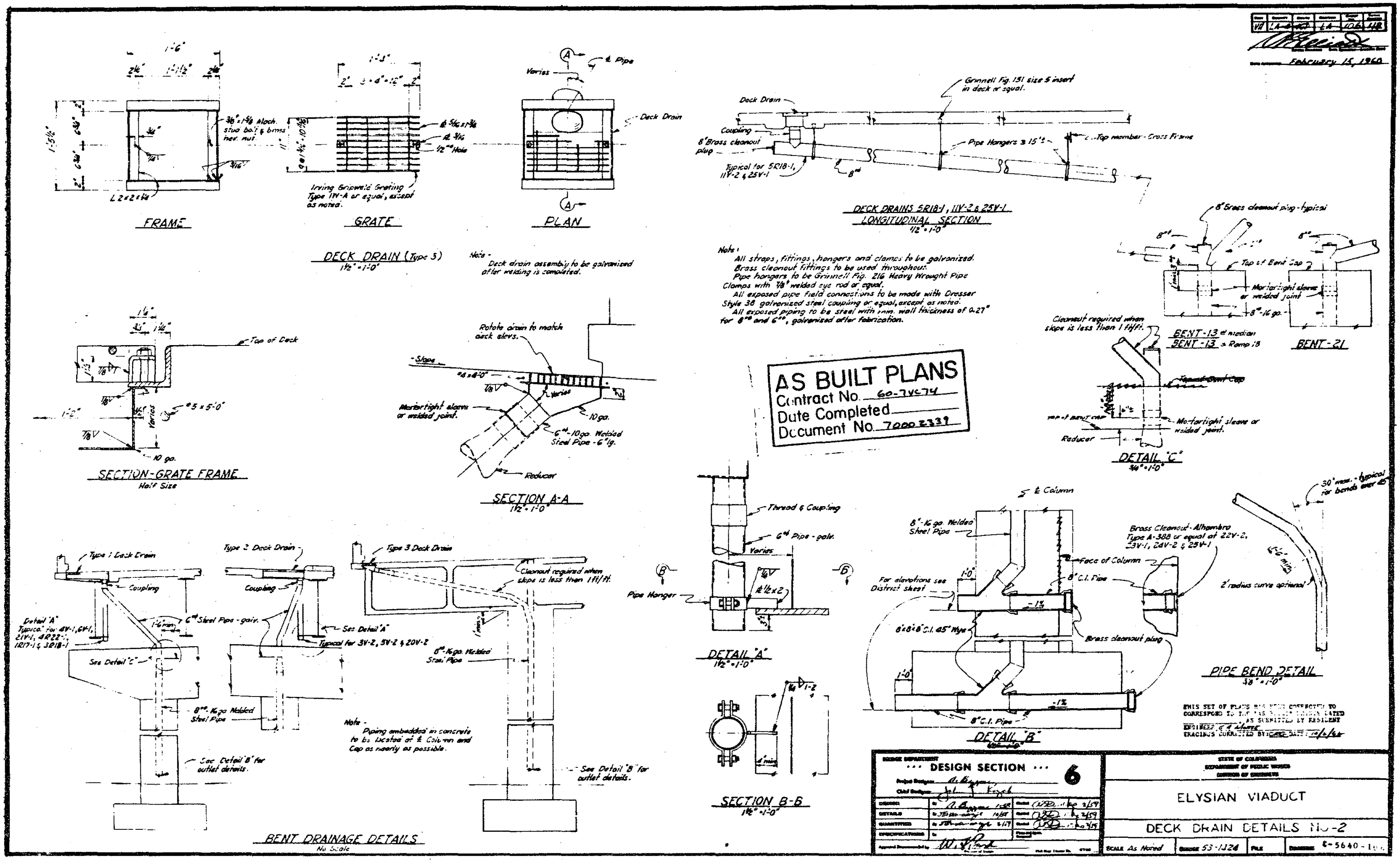


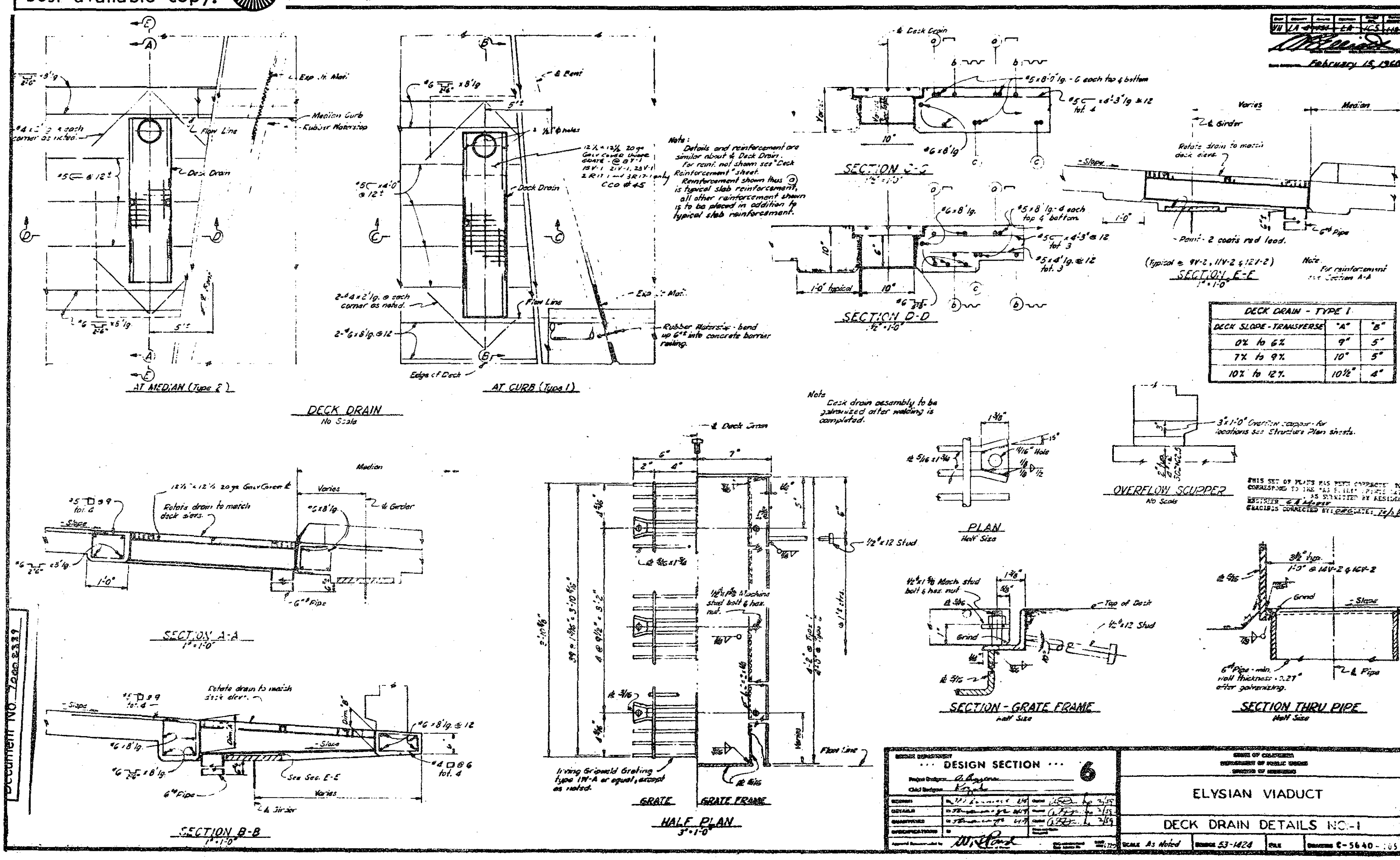
January 26, 1959
PLAN
FRAME
GRATE
Sq. nut for 5/8" bolt
L 2" x 2" x 1/4"
PL 1 3/4" x 1/2" x 1-1"
PL 1 3/4" x 1/2" x 1-3" @ 2" C. to C.
PL 1 1/2" x 1 1/2" x 1/2"
3/4" Dia. Hole
90° ℄ Varies
LAYOUT AT BENTS 20, 22, 24, & 26
Scale: 1/4" = 1'-0"
Column
℄ Bent
LAYOUT AT BENTS 18, 28, & 29
Scale: 1/4" = 1'-0"
Varies
5/8" ϕ bolt with hex head tighten to full bearing
1 1/2" % Min.
Water tight joint
10 ga. sheet metal
8" O.D. 10 ga. Welded Steel Pipe 1'-6" lg (except for Bents 14 & 16)
8" O.D. 10 ga. Welded Steel Pipe
SECTION A-A
SECTION B-B
Transition to deck slope 5' back and 15' ahead of drain.
Level
SECTION A-A
AT BENT 20 ONLY
DRAIN
Scale 1 1/2" = 1'-0"
8" O.D. 10 ga. steel pipe
Variable
8" Brass cleanout
8" C.I. Pipe
See Storm Drain Plans
8" x 8" x 8" C.I. 45° Wye.
Min. S = 0.01
DETAIL 'B' ALTERNATE *
No Scale
* Refer to Storm Drain Plans
Alhambra Foundry Co. No. A 386 B - Special Cleanout, or equal.
8" O.D. 10 ga. steel pipe
Angular position of drain outlet to conform to Storm Drain Plans.
Elevation to conform to Storm Drain Plans.
See Detail 'B' Alternate
SECTION C-C
Scale: 1/4" = 1'-0"
AS BUILT PLANS
Contract No. 60-7VC5
Date Completed
Document No. 70002281
THIS SET OF PLANS HAS BEEN CORRECTED TO CORRESPOND TO THE "AS BUILT" PRINTS DATED 8-16-61 AS SUBMITTED BY RESIDENT
INDEX NO. 21
BRIDGE DEPARTMENT
··· DESIGN SECTION ··· 4
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
SANTA MONICA ~~FREEWAY~~ VIADUCT ~~SPUR~~
DRAIN DETAILS NO. 1
SCALE AS NOTED
BRIDGE 53-1301
FILE
DRAWING C-4849-244


GENERAL DRAINAGE NOTES
1. Galvanize drain inlet assembly after fabrication.
2. Pipe hangers to be Grinnell Double Bolt wrought pipe clamps fig 295 with ⅝"ϕ eye rod, or equal.
3. Couplings to be Dresser style 38 galv steel, or equal
4. All piping embedded in concrete to be 8"ϕ 10 ga. welded steel pipe unless otherwise shown. All joints to be mortar tight.
5. All piping not covered in note 4 above to be 6"ϕ galv. steel with a min wall thickness of .28" unless otherwise shown. Galvanize after fabrication.
6. All fittings, hangers & clamps to be galvanized.
7. Bundle main reinf. as necessary to clear drains
AS BUILT PLANS
Contract No 60-14VC10
Date Completed
Document No
January 4, 1960
HALF PLAN
GRATE
GRATE FRAME
Welded type Grating
PART PLAN
No Scale
Edge of Deck
Flow Line
DRAIN INLETS - TYPE S (Total 24)
ELEVATION A-A
Coupling
6"ϕ piping
Pipe Hanger
Detail P
(Typical for the following Drains: E.B. 66, E.B. 67, E.B. 68, E.B 69, 054-2, W.B.65, W.B.66, W.B. 67, W.B. 68, W.B. 69)
OVERFLOW SCUPPER
No Scale
3"x1'-0" Overflow scupper - Locate as follows:
For all drain inlets on a continuous grade place one scupper 10'± downgrade from each inlet.
For all drain inlets located at low point of sag vertical curve place two scuppers, one on each side of inlet, approx. 5' from inlet.
SECTION C-C
Symm. about ℄ Deck Drain
SECTION THRU PIPE
Half Size
6"ϕ pipe - min wall thickness = .28" galvanize after fabrication
DETAIL P
No Scale
Std brass cleanout
Top of bent cap or face of bent cap
All piping above this point to be galvanized after fabrication.
PIPE BEND DETAIL
No Scale
2' R curve optional
30° Max (Typical for bends over 45°)
SECTION B-B
Rotate drain to match deck slope.
6"ϕ Pipe
℄ Girder
SECTION - GRATE FRAME
Half Size
⅛" Edge Finish
Top of Deck
½"x12" Stud bolt
DESIGN SECTION 5
SANTA MONICA VIADUCT
DRAINAGE DETAILS NO. 2
Scale As Noted

0-2

P-1

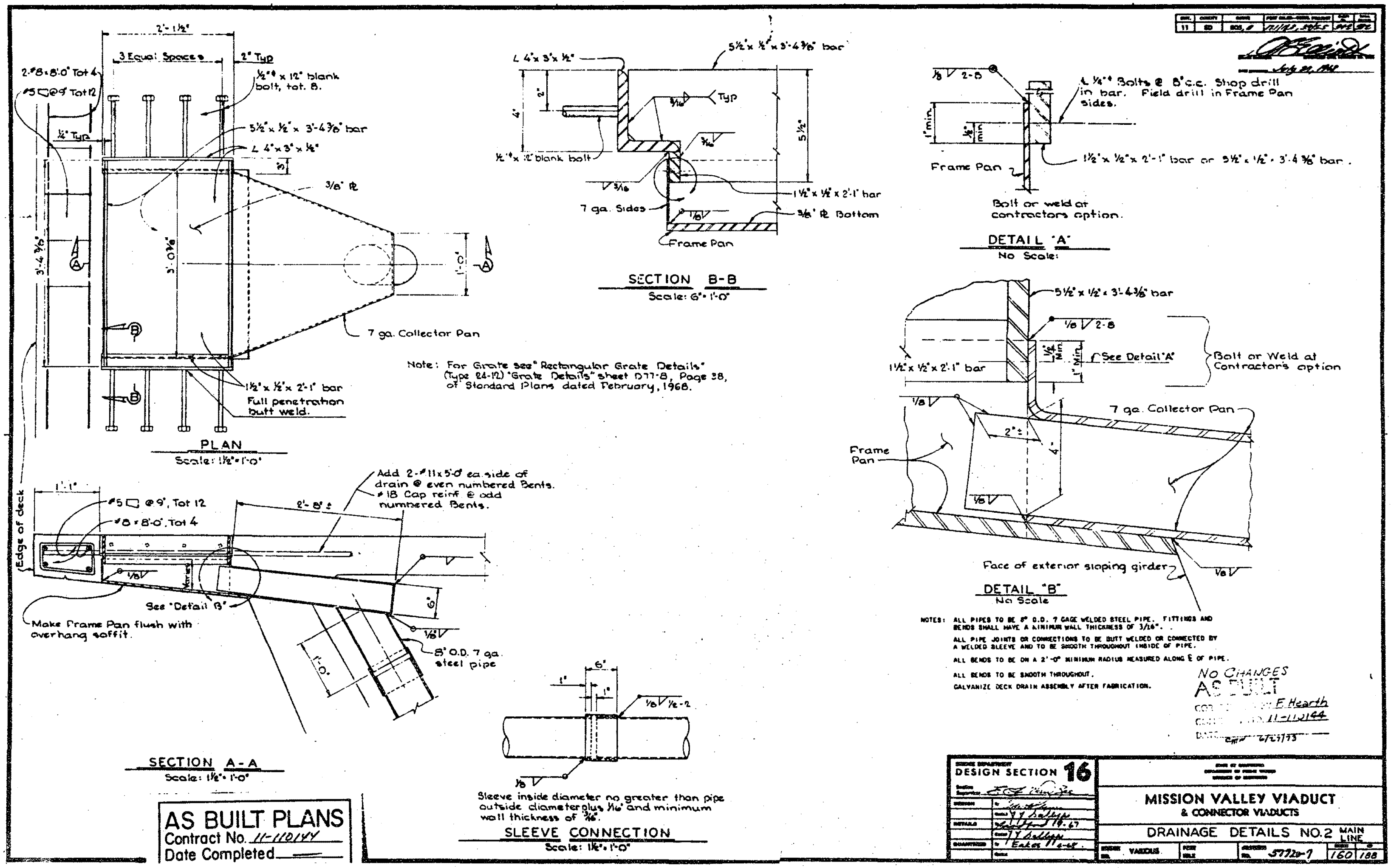

FRAME
GRATE
PLAN
DECK DRAIN (Type 5)
Irving Gridweld Grating Type IIV-A or equal, except as noted.
Deck drain assembly to be galvanized after welding is completed.
DECK DRAINS 5R18-1, 11V-2 & 25V-1 LONGITUDINAL SECTION
Grinnell Fig. 151 size 5 insert in deck or equal.
Pipe Hangers @ 15'±
All straps, fittings, hangers and clamps to be galvanized.
Brass cleanout fittings to be used throughout.
SECTION-GRATE FRAME
Half Size
SECTION A-A
AS BUILT PLANS
Contract No. 60-7VC74
Date Completed
Document No. 7000 2339
BENT-13
BENT-21
DETAIL "C"
DETAIL "A"
SECTION B-B
DETAIL "B"
PIPE BEND DETAIL
BENT DRAINAGE DETAILS
No Scale
THIS SET OF PLANS HAS BEEN CORRECTED TO CORRESPOND TO THE "AS BUILT" CHANGES DATED AS SUBMITTED BY RESIDENT
DESIGN SECTION 6
ELYSIAN VIADUCT
DECK DRAIN DETAILS NO-2
SCALE As Noted
53-1324
February 15, 1960

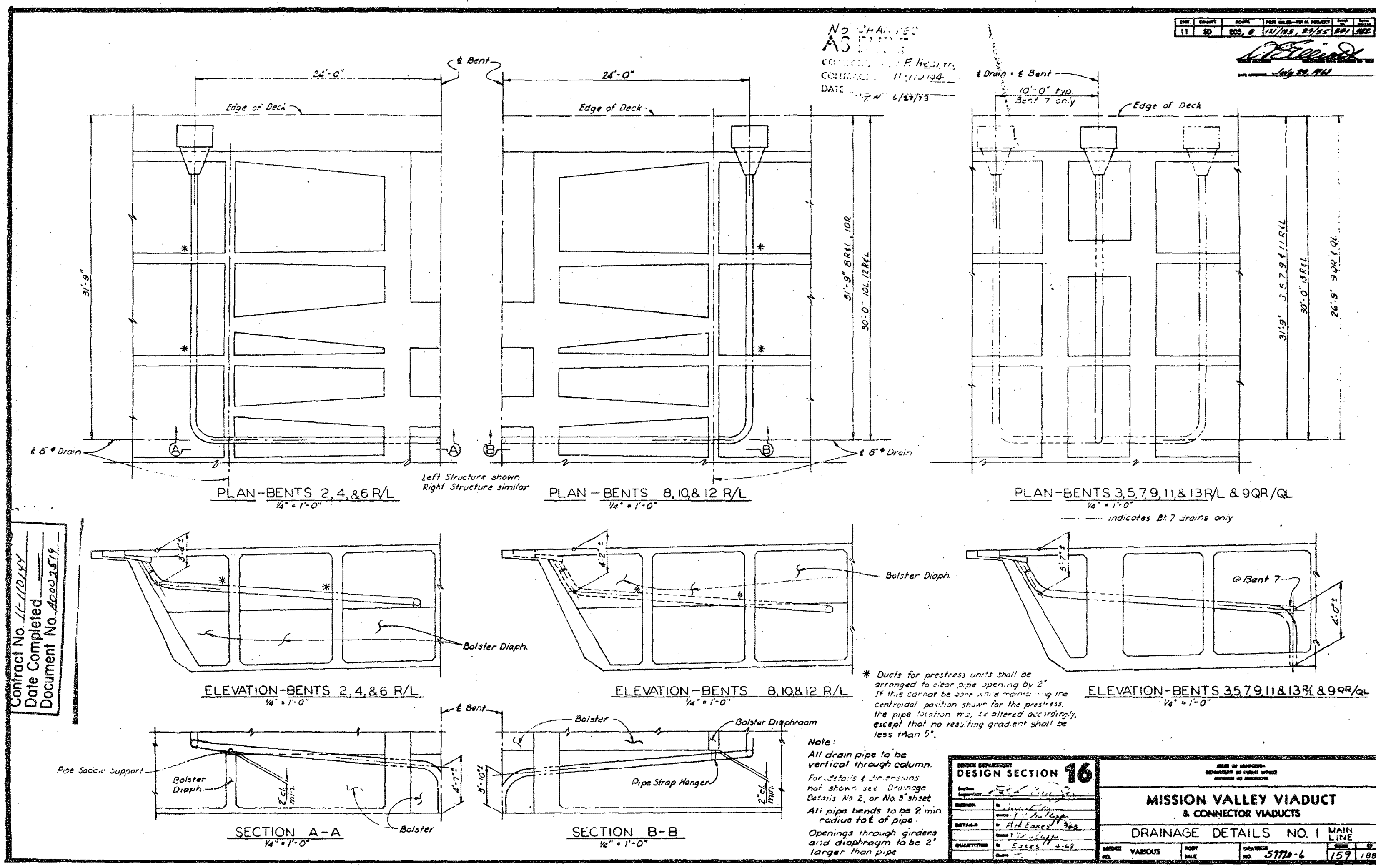


AT MEDIAN (Type 2)
AT CURB (Type 1)
DECK DRAIN
No Scale
Note:
Details and reinforcement are similar about ℄ Deck Drain.
For reinf. not shown see "Deck Reinforcement" sheet.
Reinforcement shown thus (a) is typical slab reinforcement, all other reinforcement shown is to be placed in addition to typical slab reinforcement.
SECTION C-C
SECTION D-D
SECTION E-E
Paint - 2 coats red lead.
DECK DRAIN - TYPE 1
DECK SLOPE - TRANSVERSE
"A"
"B"
0% to 6%
9"
5"
7% to 9%
10"
5"
10% to 12%
10½"
4"
Note
Deck drain assembly to be galvanized after welding is completed.
OVERFLOW SCUPPER
No Scale
SECTION A-A
SECTION B-B
GRATE
GRATE FRAME
HALF PLAN
PLAN
Half Size
SECTION - GRATE FRAME
Half Size
SECTION THRU PIPE
Half Size
Irving Griswold Grating type 1W-A or equal, except as noted.
February 15, 1960
DESIGN SECTION 6
ELYSIAN VIADUCT
DECK DRAIN DETAILS NO-1
Scale As Noted
53-1424
Document No.

P-2

T-6

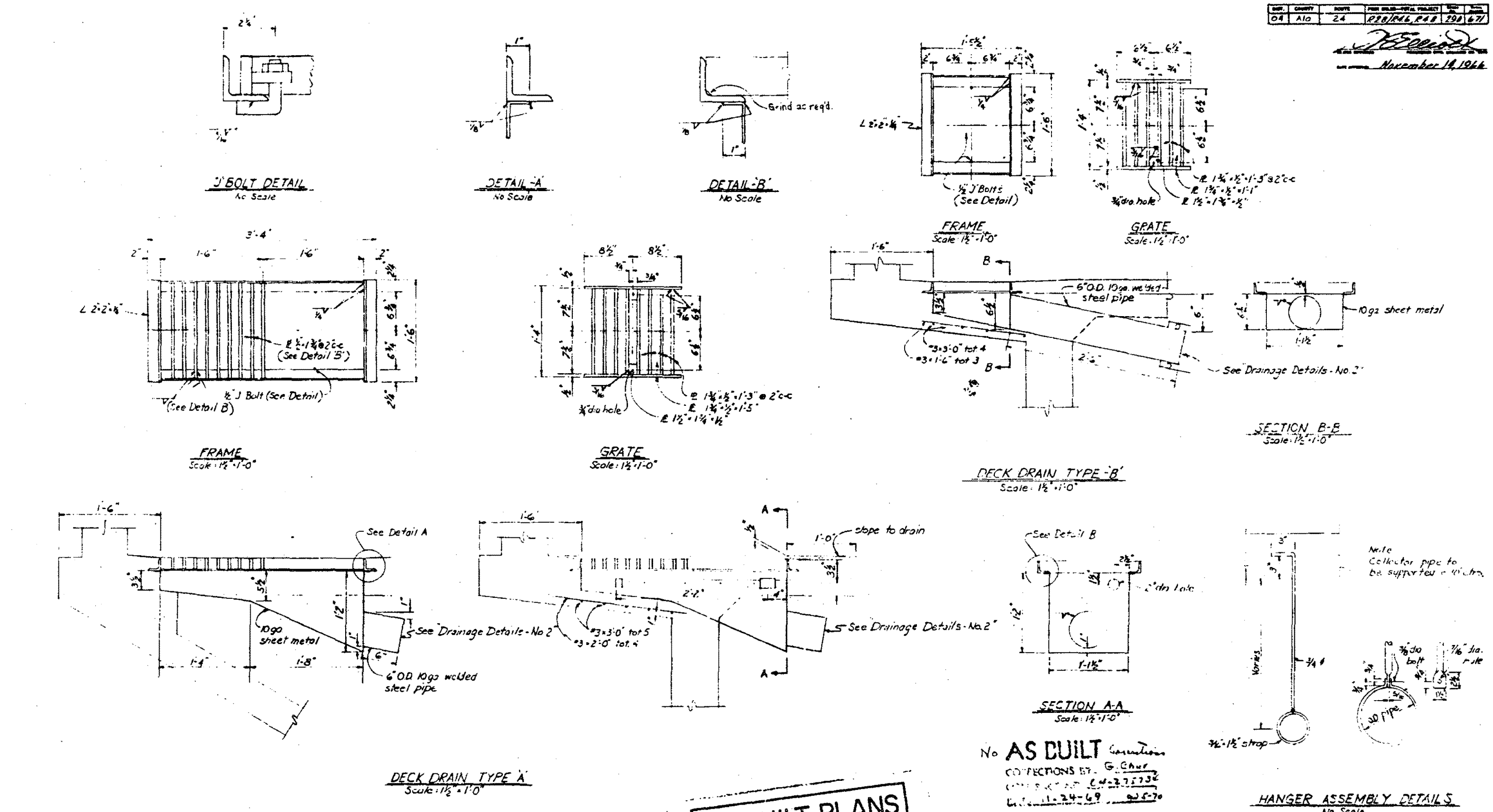

PLAN
Scale: 1½" = 1'-0"
2'-1½"
3 Equal Spaces
2" Typ
2-#8 × 8'-0" Tot 4
#5 ☐ @9" Tot 12
½"# × 12" blank bolt, tot. 8.
5½" × ½" × 3'-4⅜" bar
∠ 4" × 3" × ½"
⅜" ℞
7 ga. Collector Pan
1½" × ½" × 2'-1" bar
Full penetration butt weld.
Note: For Grate see "Rectangular Grate Details" (Type 24-12) "Grate Details" sheet D77-B, Page 38, of Standard Plans dated February, 1968.
SECTION B-B
Scale: 6" = 1'-0"
∠ 4" × 3" × ½"
5½" × ½" × 3'-4⅜" bar
½"# × 12" blank bolt
7 ga. Sides
1½" × ½" × 2'-1" bar
⅜" ℞ Bottom
Frame Pan
DETAIL "A"
No Scale
¼"# Bolts @ 8" c.c. Shop drill in bar. Field drill in Frame Pan sides.
1½" × ½" × 2'-1" bar or 5½" × ½" × 3'-4⅜" bar.
Frame Pan
Bolt or weld at contractors option.
DETAIL "B"
No Scale
5½" × ½" × 3'-4⅜" bar
See Detail "A"
Bolt or Weld at Contractor's option
1½" × ½" × 2'-1" bar
7 ga. Collector Pan
Frame Pan
Face of exterior sloping girder
SECTION A-A
Scale: 1½" = 1'-0"
Edge of deck
#5 ☐ @9", Tot 12
#8 × 8'-0", Tot 4
Add 2-#11 × 5'-0" ea. side of drain @ even numbered Bents. #18 Cap reinf @ odd numbered Bents.
See "Detail B"
Make Frame Pan flush with overhang soffit.
8" O.D. 7 ga. steel pipe
SLEEVE CONNECTION
Scale: 1½" = 1'-0"
Sleeve inside diameter no greater than pipe outside diameter plus 1⁄16" and minimum wall thickness of ⅛".
NOTES: ALL PIPES TO BE 8" O.D. 7 GAGE WELDED STEEL PIPE. FITTINGS AND BENDS SHALL HAVE A MINIMUM WALL THICKNESS OF 3/16".
ALL PIPE JOINTS OR CONNECTIONS TO BE BUTT WELDED OR CONNECTED BY A WELDED SLEEVE AND TO BE SMOOTH THROUGHOUT INSIDE OF PIPE.
ALL BENDS TO BE ON A 2'-0" MINIMUM RADIUS MEASURED ALONG ℄ OF PIPE.
ALL BENDS TO BE SMOOTH THROUGHOUT.
GALVANIZE DECK DRAIN ASSEMBLY AFTER FABRICATION.
NO CHANGES
AS BUILT
E. Hearth
11-110144
AS BUILT PLANS
Contract No. 11-110144
Date Completed
DESIGN SECTION 16
MISSION VALLEY VIADUCT
& CONNECTOR VIADUCTS
DRAINAGE DETAILS NO. 2 MAIN LINE
VARIOUS
57720-7
160 188



℄ Bent
24'-0"
24'-0"
Edge of Deck
Edge of Deck
31'-9"
31'-9" 8R&L, 10R
30'-0" 10L, 12R&L
℄ 6" ⌀ Drain
℄ 6" ⌀ Drain
PLAN-BENTS 2, 4, & 6 R/L
1/4" = 1'-0"
Left Structure shown
Right Structure similar
PLAN - BENTS 8, 10, & 12 R/L
1/4" = 1'-0"
℄ Drain · ℄ Bent
10'-0" typ.
Bent 7 only
Edge of Deck
31'-9" 3, 5, 7, 9 & 11 R&L
30'-0" 13R&L
26'-9" 9QR & QL
PLAN-BENTS 3, 5, 7, 9, 11, & 13 R/L & 9QR/QL
1/4" = 1'-0"
indicates Bt 7 drains only
Bolster Diaph.
Bolster Diaph.
@ Bent 7
4'-0" ±
ELEVATION-BENTS 2, 4, & 6 R/L
1/4" = 1'-0"
ELEVATION-BENTS 8, 10 & 12 R/L
1/4" = 1'-0"
ELEVATION-BENTS 3, 5, 7, 9, 11 & 13 R/L & 9 QR/QL
1/4" = 1'-0"
* Ducts for prestress units shall be arranged to clear pipe opening by 2". If this cannot be done while maintaining the centroidal position shown for the prestress, the pipe location may be altered accordingly, except that no resulting gradient shall be less than 5°.
℄ Bent
Pipe Saddle Support
Bolster Diaph.
2" cl. min.
Bolster
SECTION A-A
1/4" = 1'-0"
Bolster
Bolster Diaphragm
Pipe Strap Hanger
2" cl. min.
SECTION B-B
1/4" = 1'-0"
Note:
All drain pipe to be vertical through column.
For details & dimensions not shown see Drainage Details No. 2, or No. 5 sheet
All pipe bends to be 2' min. radius to ℄ of pipe.
Openings through girders and diaphragm to be 2" larger than pipe.
Contract No. 11-110144
Date Completed
Document No. A0002519
DESIGN SECTION 16
Art Eakes
Eakes 4-62
MISSION VALLEY VIADUCT
& CONNECTOR VIADUCTS
DRAINAGE DETAILS NO. 1 MAIN LINE
VARIOUS
57-170-6
159
188

Q-2

FS-1



Note:
Frame, grate, box and hanger assembly shall be galvanized after fabrication.
Those portions of drain pipes which are not encased in concrete shall be galvanized.
Galvanizing for exposed pipes shall extend a minimum of 3" into concrete.

AS BUILT PLANS
Contract No. 04-275734
Date Completed
Document No. 4/0003898

No AS BUILT Corrections
CORRECTIONS BY G. Chur
CONTRACT NO. 04-275734
DATE 11-24-69 9-5-70

BRIDGE DEPARTMENT
DESIGN SECTION 1

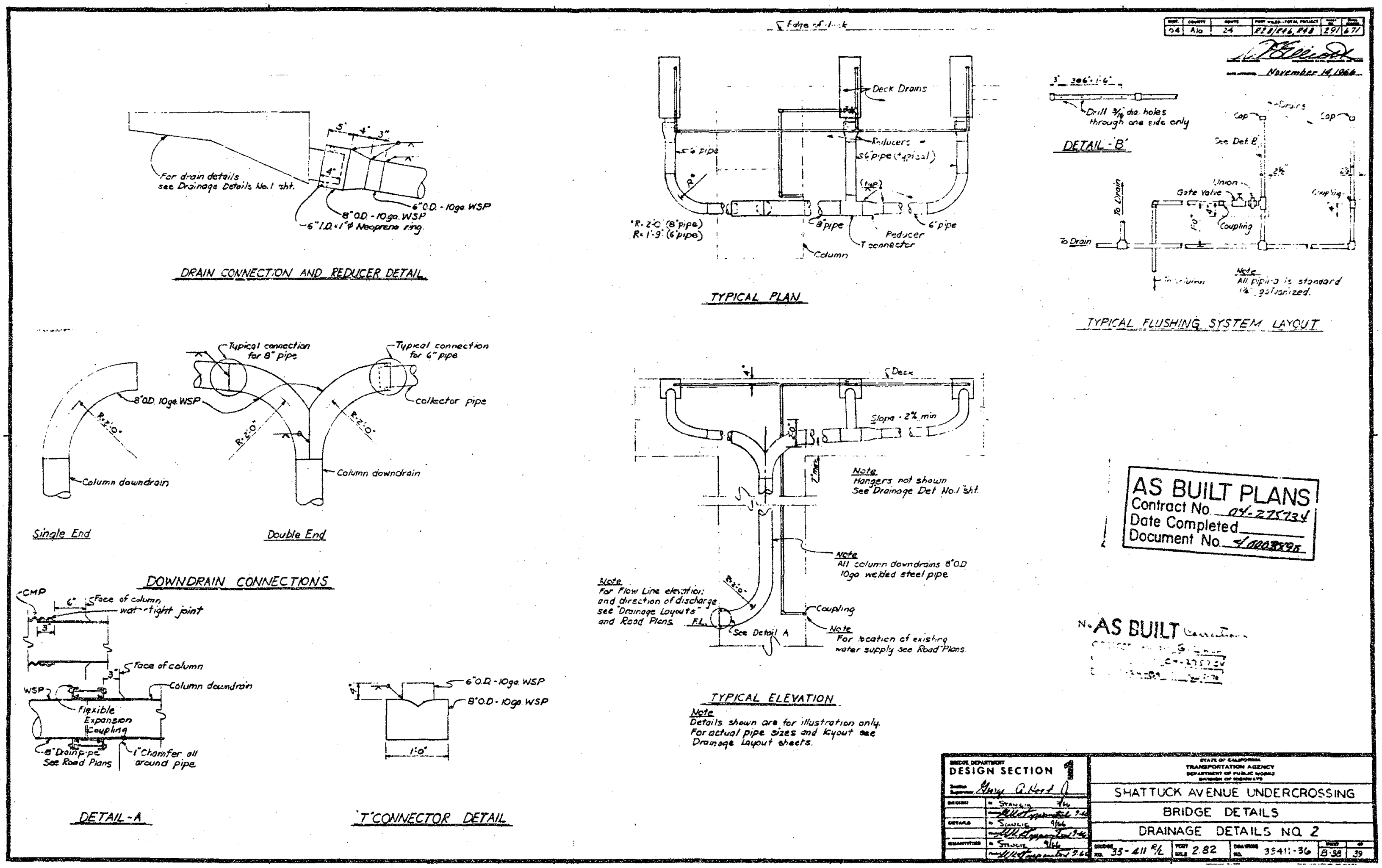
STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHATTUCK AVENUE UNDERCROSSING
BRIDGE DETAILS
DRAINAGE DETAILS NO. 1

BRIDGE NO. 33-411 R/L | POST MILE 2.82 | DRAWING NO. 33411-35 | SHEET B-37 | OF 39

November 14, 1966

FS-2

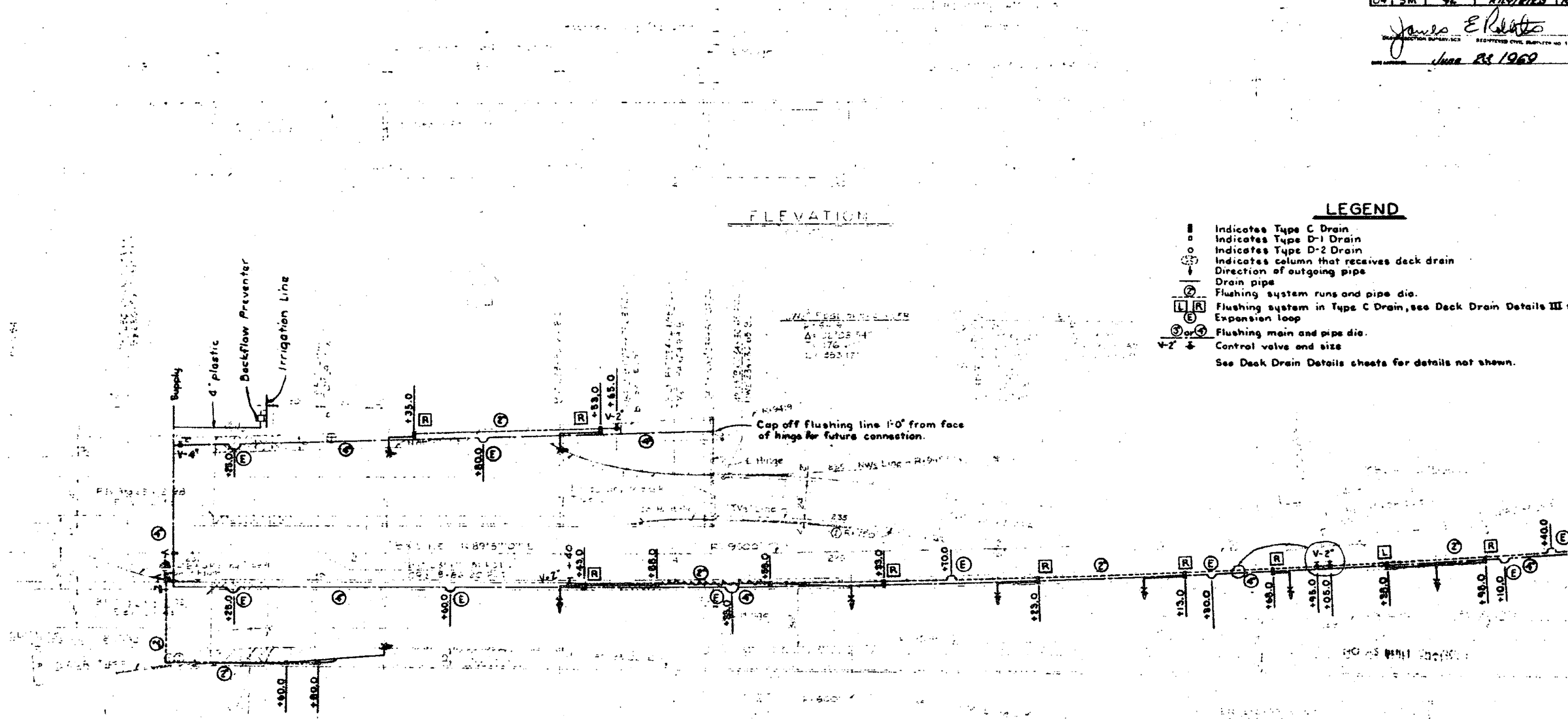


DRAIN CONNECTION AND REDUCER DETAIL
For drain details see Drainage Details No.1 sht.
6" O.D. - 10ga. WSP
8" O.D. - 10ga. WSP
6" I.D. × 1" ø Neoprene ring
TYPICAL PLAN
Deck Drains
Reducers
6" pipe (typical)
6" pipe
8" pipe
Reducer
T connector
Column
R = 2'-0" (8" pipe)
R = 1'-9" (6" pipe)
DETAIL 'B'
Drill 3/16" dia. holes through one side only
TYPICAL FLUSHING SYSTEM LAYOUT
Gate Valve
Union
Coupling
To Drain
See Det. B
Note
All piping is standard 1½" galvanized.
November 14, 1966
DOWNDRAIN CONNECTIONS
Typical connection for 8" pipe
Typical connection for 6" pipe
8" O.D. 10ga. WSP
collector pipe
Column downdrain
Single End
Double End
TYPICAL ELEVATION
Slope = 2% min
Note
Hangers not shown
See Drainage Det. No.1 sht.
Note
All column downdrains 8" O.D. 10ga welded steel pipe
Coupling
Note
For location of existing water supply see Road Plans.
Note
For Flow Line elevation and direction of discharge see "Drainage Layouts" and Road Plans.
See Detail A
Note
Details shown are for illustration only. For actual pipe sizes and layout see Drainage Layout sheets.
AS BUILT PLANS
Contract No. 04-275734
Date Completed
Document No.
AS BUILT
DETAIL - A
CMP
Face of column
water-tight joint
Face of column
Column downdrain
WSP
Flexible Expansion Coupling
8" Drain pipe See Road Plans
1" Chamfer all around pipe
"T" CONNECTOR DETAIL
6" O.D. - 10ga. WSP
8" O.D. - 10ga. WSP
1'-0"
BRIDGE DEPARTMENT
DESIGN SECTION 1
STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
SHATTUCK AVENUE UNDERCROSSING
BRIDGE DETAILS
DRAINAGE DETAILS NO. 2
BRIDGE NO. 33-411 R/L
POST MILE 2.82
DRAWING NO. 35411-36
SHEET B-38 OF 39

FS-3

04	SM	92	R11.6/R12.3	157	166

June 23 1969



LEGEND

- Indicates Type C Drain
- Indicates Type D-1 Drain
- Indicates Type D-2 Drain
- Indicates column that receives deck drain
- Direction of outgoing pipe
- Drain pipe
- (2) Flushing system runs and pipe dia.
- [L] [R] Flushing system in Type C Drain, see Deck Drain Details III sheet.
- (E) Expansion loop
- (3) or (4) Flushing main and pipe dia.
- V-2" Control valve and size

See Deck Drain Details sheets for details not shown.

FLOW LINES	
BENT NO.	OUTGOING PIPE F.L.
2L	5.4
2R	4.5
3L	5.0
3R	4.6
5R	5.0
6R	5.0
7R	5.5
8R	5.5
9R	6.0

This sheet accurate for drainage details only.

AS BUILT PLANS
Contract No. 04-134684
Date Completed
Document No. 40007330

T.F. Martes
04-134684
9-5-72 / 10-12-72

DESIGN SECTION 2

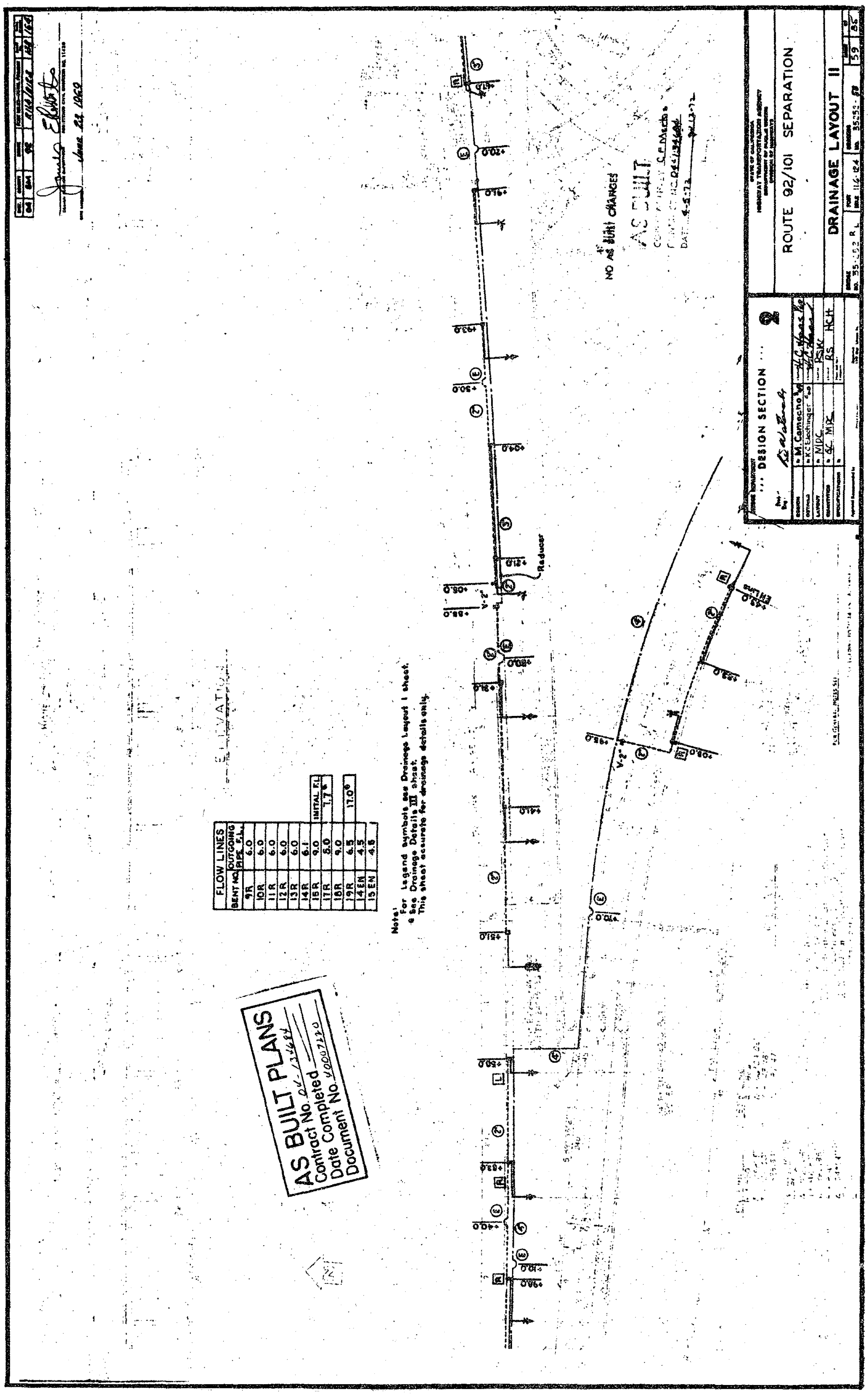
DESIGN	M. Camacho		
DETAILS	KC Blechinger		
LAYOUT	MPC		RSW
QUANTITIES	GC MPC		RS BCH
SPECIFICATIONS			

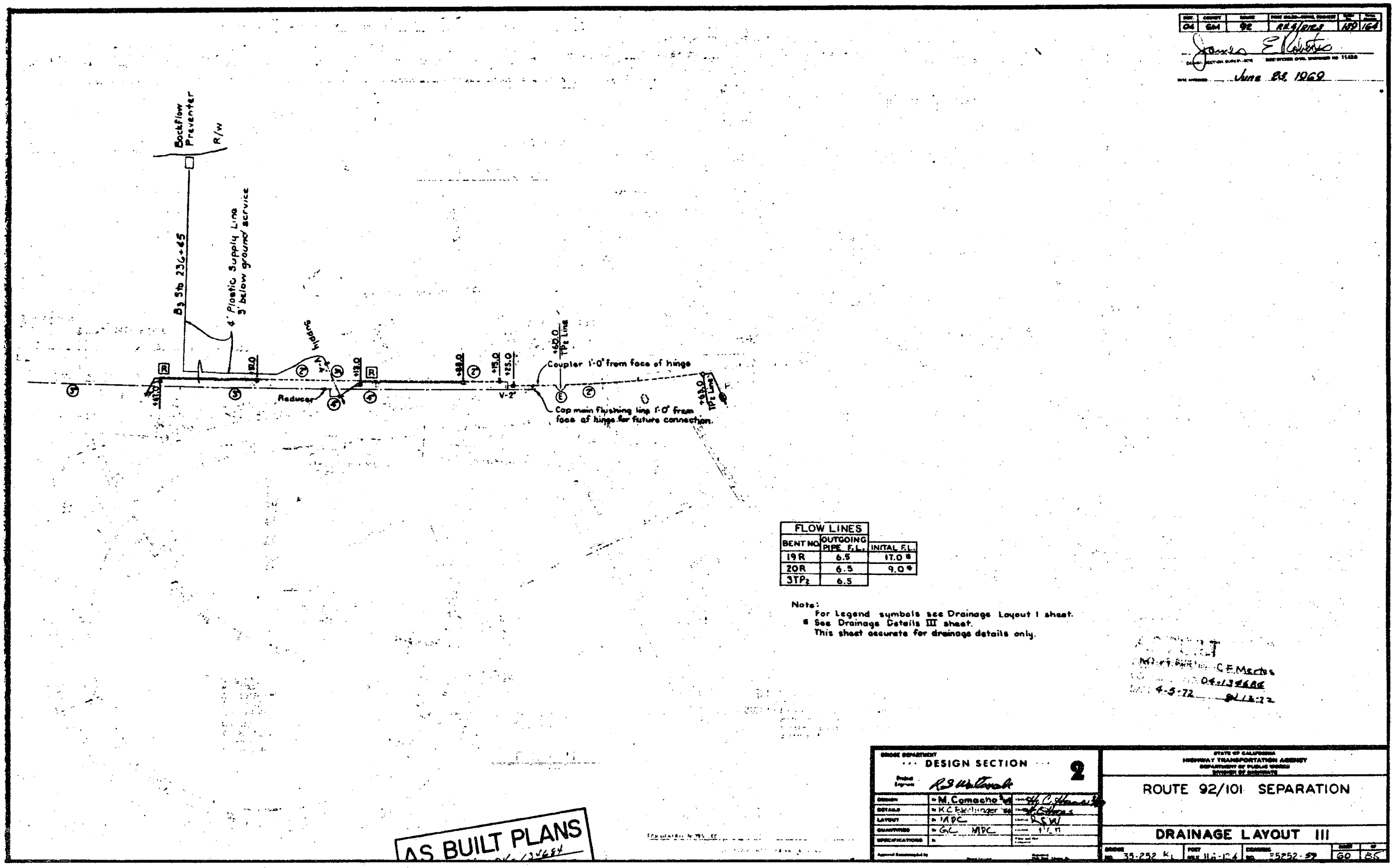
TRANSPORTATION AGENCY

ROUTE 92/101 SEPARATION
LOCATED IN THE CITY OF SAN MATEO

DRAINAGE LAYOUT 1

BRIDGE NO. 35-252 R,L · POST MILE R11.6-12.4 · DRAWING NO. 35252-57 · SHEET 58 OF 85


FLOW LINES
BENT NO. | OUTGOING PIPE F.L.
9R 6.0
10R 6.0
11R 6.0
12R 6.0
13R 6.0
14R 6.1
15R 9.0 INITIAL F.L.
17R 5.0 7.7*
18R 9.0
19R 6.5 17.0*
14EN 4.5
15EN 4.8
Note:
For Legend symbols see Drainage Layout I sheet.
* See Drainage Details III sheet.
This sheet accurate for drainage details only.
AS BUILT PLANS
Contract No. 04-134684
Date Completed
Document No. 40007120
Reducer
NO AS BUILT CHANGES
AS BUILT
DESIGN SECTION
M. Camacho
K.C. Eschinger
ROUTE 92/101 SEPARATION
DRAINAGE LAYOUT II
June 23, 1969

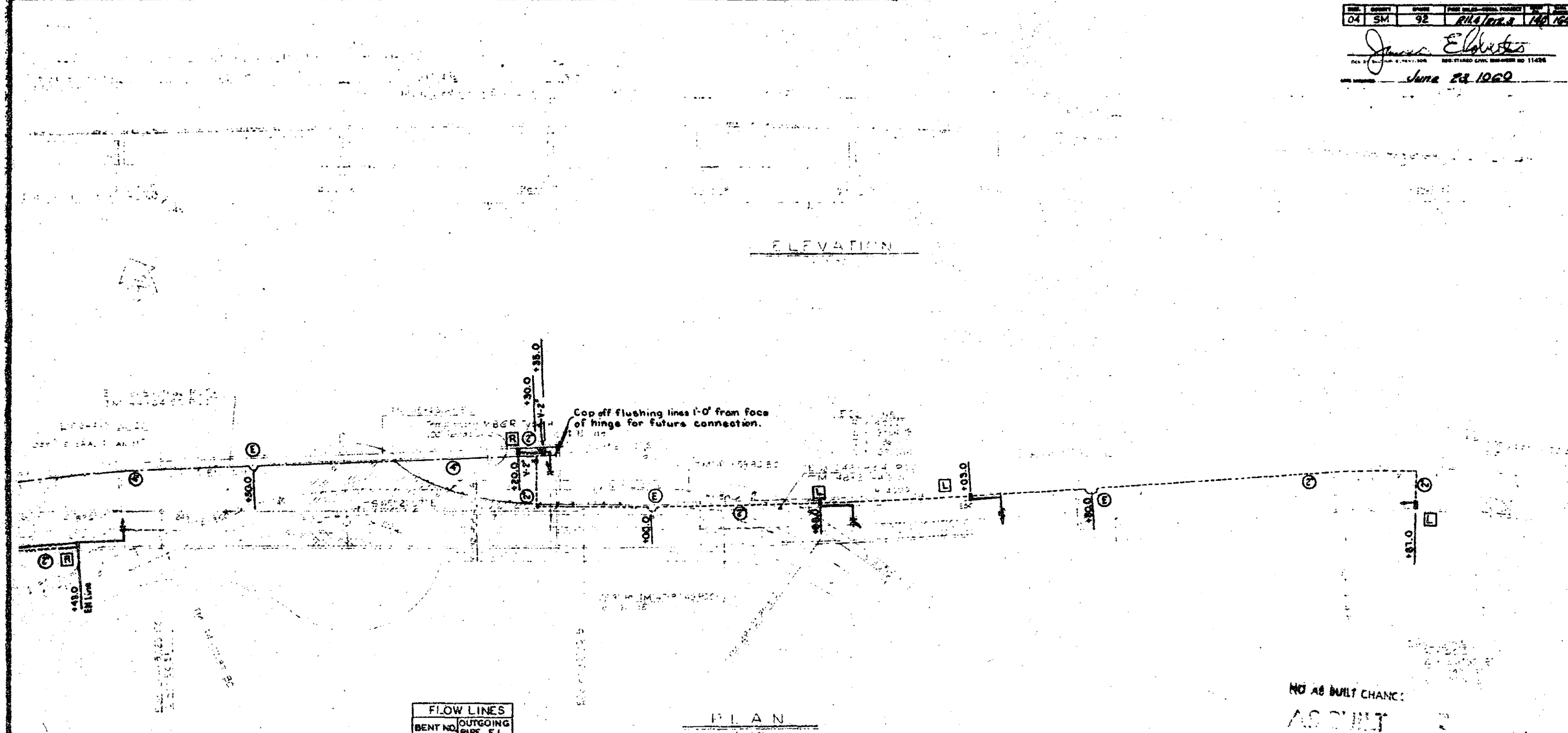

Backflow Preventer
R/W
B3 Sta 236+45
4" Plastic Supply Line
3' below ground service
Supply
V-4
Reducer
V-2
Coupler 1'-0" from face of hinge
Cap main flushing line 1'-0" from face of hinge for future connection.
TP2 Line
FLOW LINES
BENT NO. | OUTGOING PIPE F.L. | INITIAL F.L.
19R | 6.5 | 17.0 *
20R | 6.5 | 9.0 *
3TP2 | 6.5
Note:
For Legend symbols see Drainage Layout I sheet.
* See Drainage Details III sheet.
This sheet accurate for drainage details only.
June 23, 1969
C.E. Mertes
04-134686
4-5-72
DESIGN SECTION 2
M. Camacho
K.C. Eichlinger
MPC
GC MPC
ROUTE 92/101 SEPARATION
DRAINAGE LAYOUT III
35-252
AS BUILT PLANS

HS-6

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SM	92	R11.4/R12.3	140	164

REGISTERED CIVIL ENGINEER NO 11426

June 23 1969



FLOW LINES	
BENT NO.	OUTGOING PIPE F.L.
15 EN	4.5
17 ES_2	4.0
19 ES_2	3.3
20 ES_2	3.0

Note:
For Legend symbols see Drainage Layout I sheet.
This sheet accurate for drainage details only.

NO AS BUILT CHANGES
AS BUILT
C.E. Martes
04-134684
4-5-73 80-13-76

AS BUILT PLANS
Contract No. 04-134684
Date Completed
Document No. 40007220

FOR GENERAL NOTES SEE

DESIGN SECTION 2

Project Engineer: R.S. Wolpaaibe

DESIGN	M. Camacho		
DETAILS	K.C. Blachinger		
LAYOUT	MPC		RSW
QUANTITIES	GC MPC		HCH
SPECIFICATIONS			

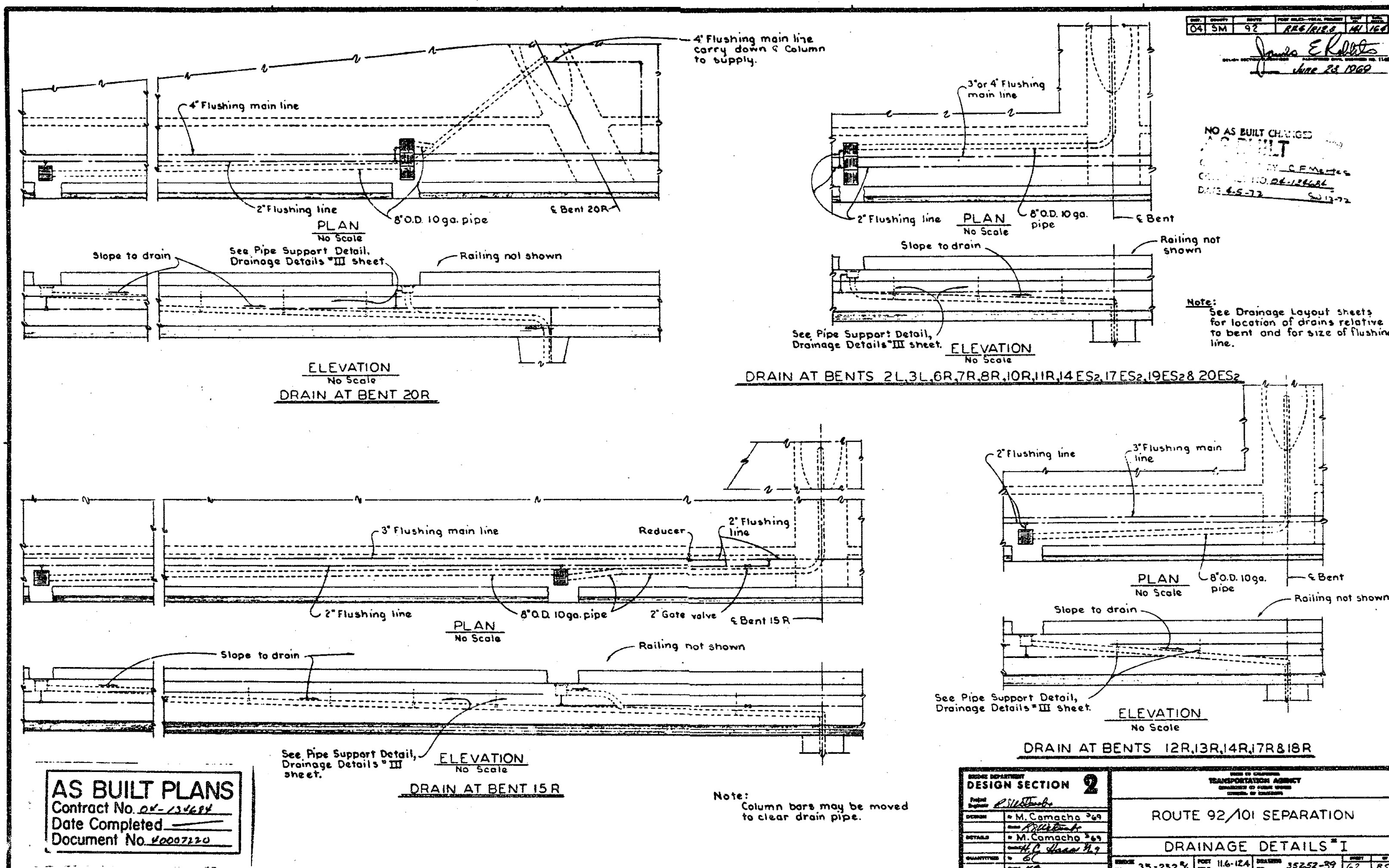
STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

ROUTE 92/101 SEPARATION

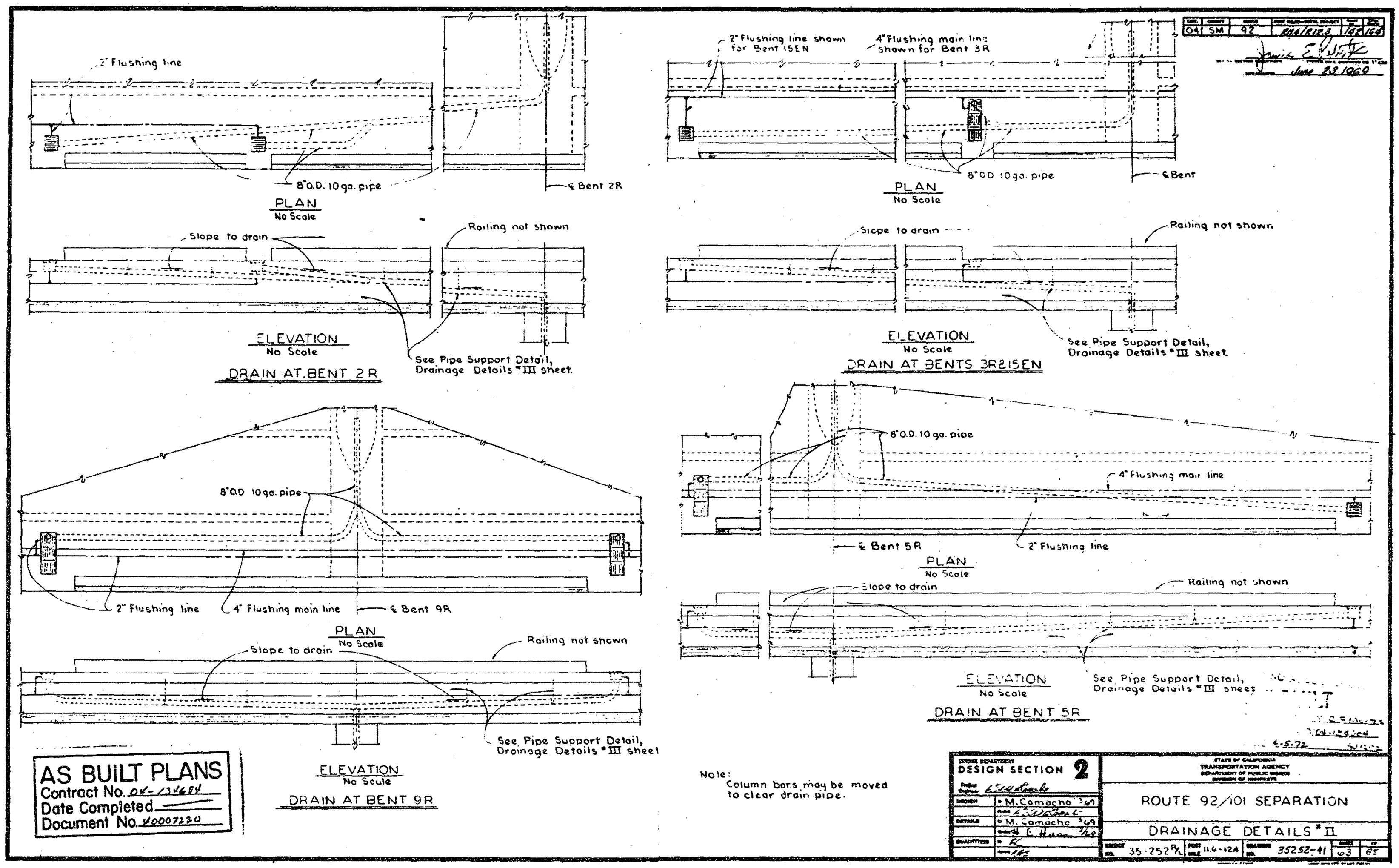
DRAINAGE LAYOUT IV

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
35-252 R/L	11.6-12.4	35252-84	61	85

FS-7

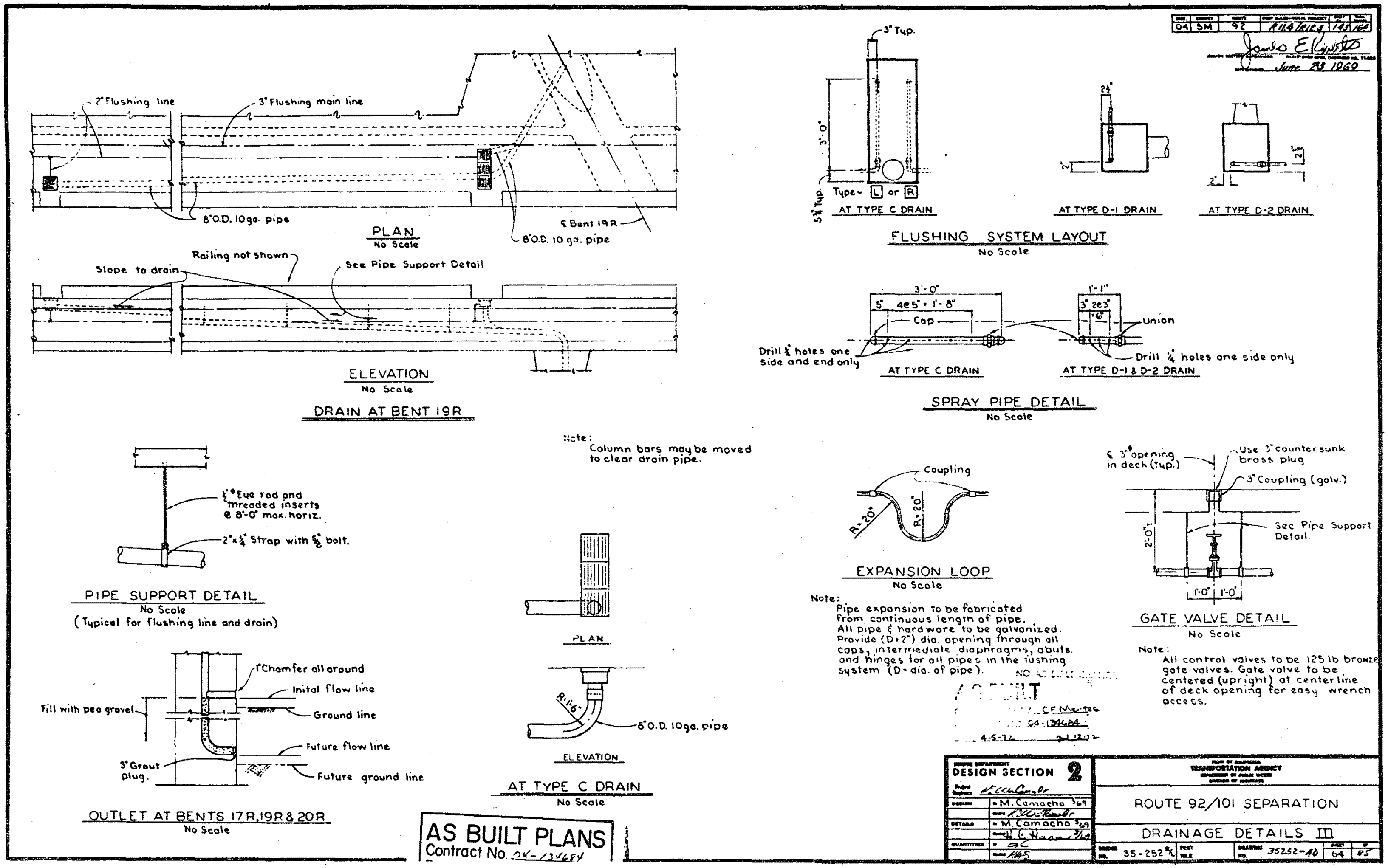

4" Flushing main line carry down ℄ Column to supply.
4" Flushing main line
2" Flushing line
8" O.D. 10ga. pipe
℄ Bent 20R
PLAN
No Scale
Slope to drain
See Pipe Support Detail, Drainage Details #III sheet.
Railing not shown
ELEVATION
No Scale
DRAIN AT BENT 20R
3" or 4" Flushing main line
2" Flushing line
8" O.D. 10ga. pipe
℄ Bent
PLAN
No Scale
Slope to drain
Railing not shown
See Pipe Support Detail, Drainage Details #III sheet.
ELEVATION
No Scale
Note:
See Drainage Layout sheets for location of drains relative to bent and for size of flushing line.
DRAIN AT BENTS 2L,3L,6R,7R,8R,10R,11R,14ES2,17ES2,19ES2 & 20ES2
NO AS BUILT CHANGES
3" Flushing main line
Reducer
2" Flushing line
2" Flushing line
8" O.D. 10ga. pipe
2" Gate valve
℄ Bent 15R
PLAN
No Scale
Slope to drain
Railing not shown
See Pipe Support Detail, Drainage Details #III sheet.
ELEVATION
No Scale
DRAIN AT BENT 15R
Note:
Column bars may be moved to clear drain pipe.
2" Flushing line
3" Flushing main line
8" O.D. 10ga. pipe
℄ Bent
PLAN
No Scale
Slope to drain
Railing not shown
See Pipe Support Detail, Drainage Details #III sheet.
ELEVATION
No Scale
DRAIN AT BENTS 12R,13R,14R,17R & 18R
04 SM 92
June 28 1969
AS BUILT PLANS
Contract No. 04-134694
Date Completed
Document No. 40007220
DESIGN SECTION 2
M. Camacho 3-69
M. Camacho 3-69
TRANSPORTATION AGENCY
ROUTE 92/101 SEPARATION
DRAINAGE DETAILS #I
35-252 R/L
11.6-12.4
35252-39
62 85

FS-8

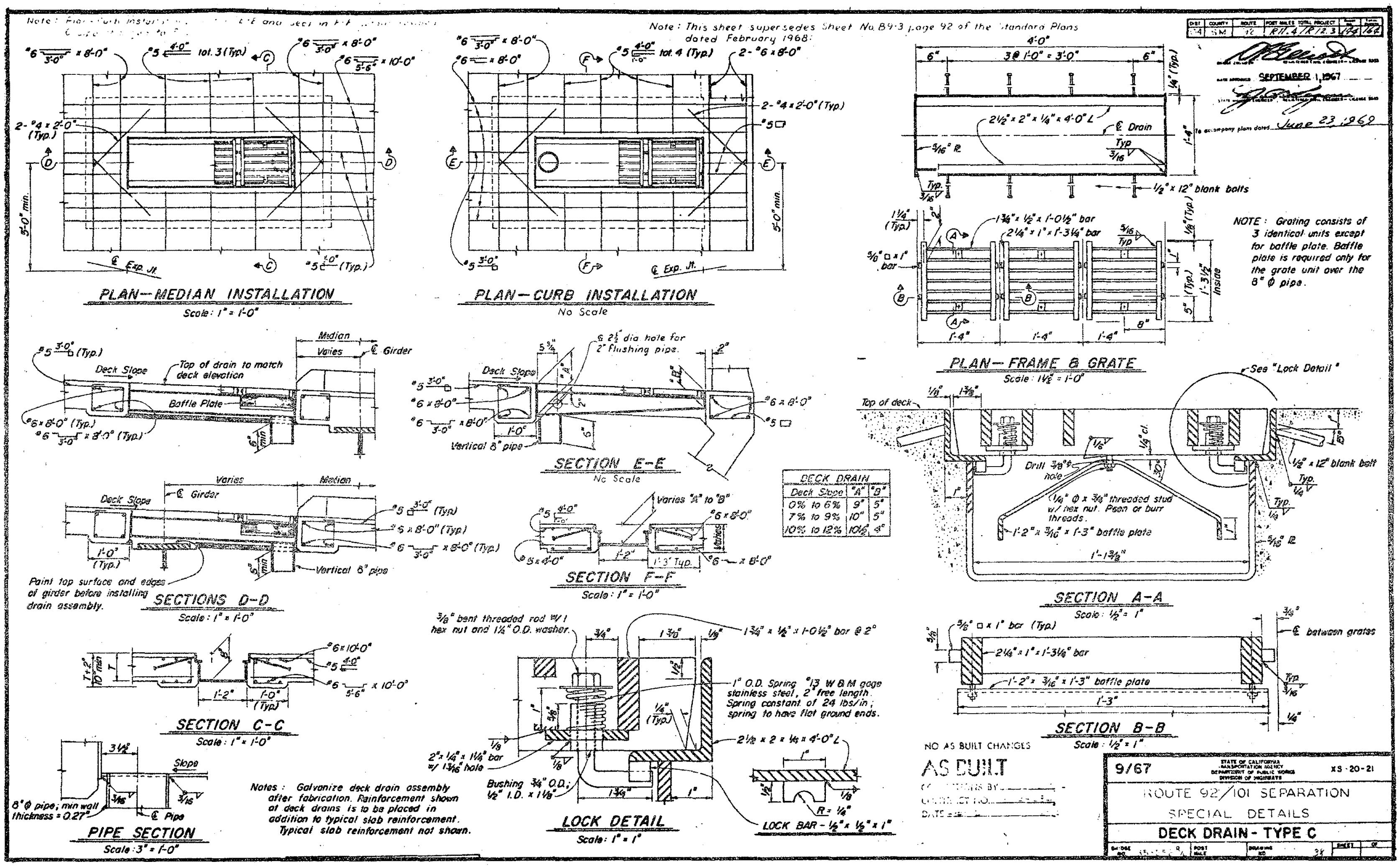


2" Flushing line
8"O.D. 10ga. pipe
℄ Bent 2R
PLAN
No Scale
Slope to drain
Railing not shown
ELEVATION
No Scale
See Pipe Support Detail, Drainage Details #III sheet.
DRAIN AT BENT 2R
2" Flushing line shown for Bent 15EN
4" Flushing main line shown for Bent 3R
8"OD 10ga. pipe
℄ Bent
PLAN
No Scale
Slope to drain
Railing not shown
ELEVATION
No Scale
See Pipe Support Detail, Drainage Details #III sheet.
DRAIN AT BENTS 3R&15EN
8"O.D. 10ga. pipe
2" Flushing line
4" Flushing main line
℄ Bent 9R
PLAN
No Scale
Slope to drain
Railing not shown
See Pipe Support Detail, Drainage Details #III sheet
ELEVATION
No Scale
DRAIN AT BENT 9R
8"O.D. 10ga. pipe
4" Flushing main line
℄ Bent 5R
2" Flushing line
PLAN
No Scale
Slope to drain
Railing not shown
ELEVATION
No Scale
See Pipe Support Detail, Drainage Details #III sheet
DRAIN AT BENT 5R
Note:
Column bars may be moved to clear drain pipe.
AS BUILT PLANS
Contract No. 04-134684
Date Completed
Document No. 40007220
04 SM 92
June 23 1969
DESIGN SECTION 2
M. Camacho
M. Camacho
STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
ROUTE 92/101 SEPARATION
DRAINAGE DETAILS #II
35-252R/L
11.6-12.4
35252-41
63
85

FS-9



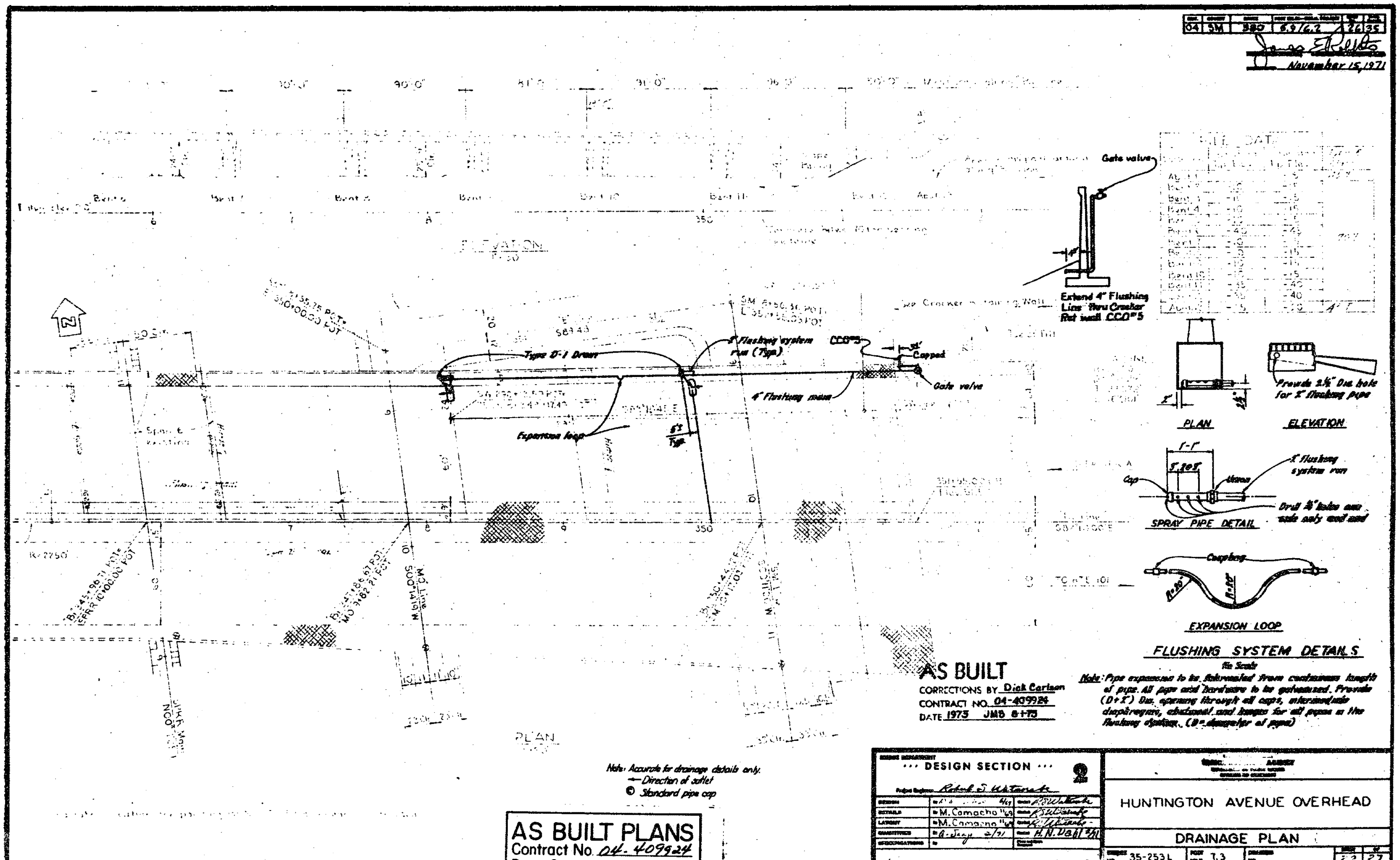
2" Flushing line
3" Flushing main line
8" O.D. 10ga. pipe
PLAN
No Scale
℄ Bent 19R
8" O.D. 10 ga. pipe
Railing not shown
Slope to drain
See Pipe Support Detail
ELEVATION
No Scale
DRAIN AT BENT 19R
Note:
Column bars may be moved to clear drain pipe.
3" Typ.
3'-0"
Type- L or R
AT TYPE C DRAIN
AT TYPE D-1 DRAIN
AT TYPE D-2 DRAIN
FLUSHING SYSTEM LAYOUT
No Scale
3'-0"
Cap
Drill ⅛" holes one side and end only
AT TYPE C DRAIN
Union
Drill ⅛" holes one side only
AT TYPE D-1 & D-2 DRAIN
SPRAY PIPE DETAIL
No Scale
¾" Eye rod and threaded inserts @ 8'-0" max. horiz.
2"x¼" Strap with ⅝" bolt.
PIPE SUPPORT DETAIL
No Scale
(Typical for flushing line and drain)
PLAN
R=1'-6"
8" O.D. 10ga. pipe
ELEVATION
AT TYPE C DRAIN
No Scale
Coupling
R=20"
EXPANSION LOOP
No Scale
Note:
Pipe expansion to be fabricated from continuous length of pipe.
All pipe & hardware to be galvanized.
Provide (D+2") dia. opening through all caps, intermediate diaphragms, abuts. and hinges for all pipes in the flushing system (D=dia. of pipe).
℄ 3" opening in deck (Typ.)
Use 3" countersunk brass plug
3" Coupling (galv.)
See Pipe Support Detail.
2'-0"
1'-0" 1'-0"
GATE VALVE DETAIL
No Scale
Note:
All control valves to be 125 lb bronze gate valves. Gate valve to be centered (upright) at centerline of deck opening for easy wrench access.
1" Chamfer all around
Inital flow line
Ground line
Fill with pea gravel
Future flow line
3" Grout plug.
Future ground line
OUTLET AT BENTS 17R, 19R & 20R
No Scale
04 SM 92
June 23 1969
DESIGN SECTION 2
M. Camacho
TRANSPORTATION AGENCY
ROUTE 92/101 SEPARATION
DRAINAGE DETAILS III
35-252
35252-40
64
AS BUILT PLANS
Contract No. 04-134684



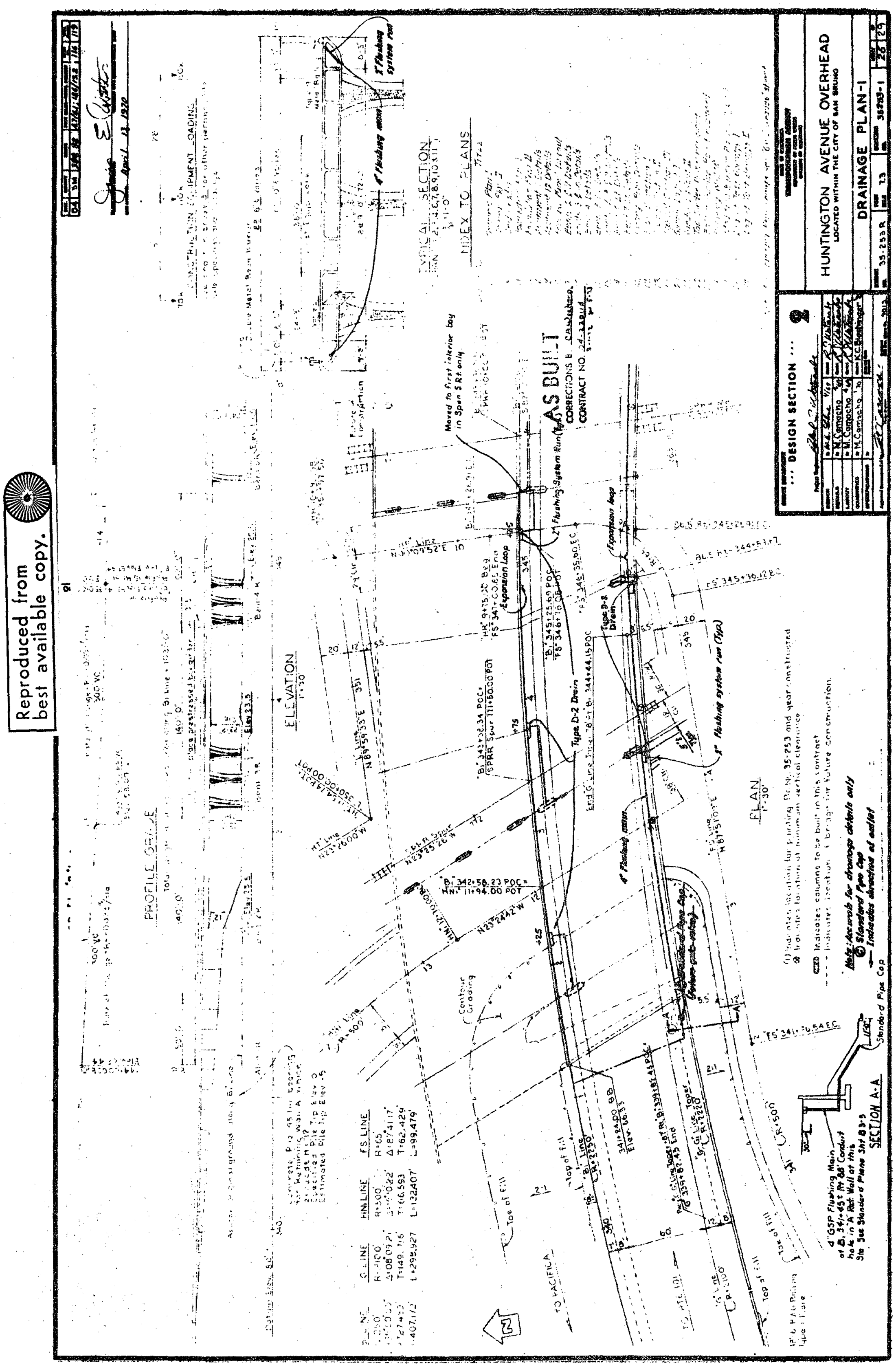
Note: This sheet supersedes Sheet No. B9-3 page 92 of the Standard Plans dated February 1968.
PLAN—MEDIAN INSTALLATION
Scale: 1" = 1'-0"
PLAN—CURB INSTALLATION
No Scale
PLAN—FRAME & GRATE
Scale: 1½" = 1'-0"
NOTE: Grating consists of 3 identical units except for baffle plate. Baffle plate is required only for the grate unit over the 8" Ø pipe.
SECTIONS D-D
Scale: 1" = 1'-0"
Paint top surface and edges of girder before installing drain assembly.
SECTION E-E
No Scale
SECTION F-F
Scale: 1" = 1'-0"
DECK DRAIN
Deck Slope | "A" | "B"
0% to 6% | 9" | 5"
7% to 9% | 10" | 5"
10% to 12% | 10½" | 4"
SECTION A-A
Scale: ½" = 1"
SECTION C-C
Scale: 1" = 1'-0"
SECTION B-B
Scale: ½" = 1"
PIPE SECTION
Scale: 3" = 1'-0"
8" Ø pipe; min wall thickness = 0.27"
Notes: Galvanize deck drain assembly after fabrication. Reinforcement shown at deck drains is to be placed in addition to typical slab reinforcement. Typical slab reinforcement not shown.
LOCK DETAIL
Scale: 1" = 1"
1" O.D. Spring #13 W & M gage stainless steel, 2" free length. Spring constant of 24 lbs/in; spring to have flat ground ends.
LOCK BAR - ½" x ½" x 1"
NO AS BUILT CHANGES
AS BUILT
SEPTEMBER 1, 1967
To accompany plans dated June 23, 1969
9/67
STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS
XS-20-21
ROUTE 92/101 SEPARATION
SPECIAL DETAILS
DECK DRAIN - TYPE C

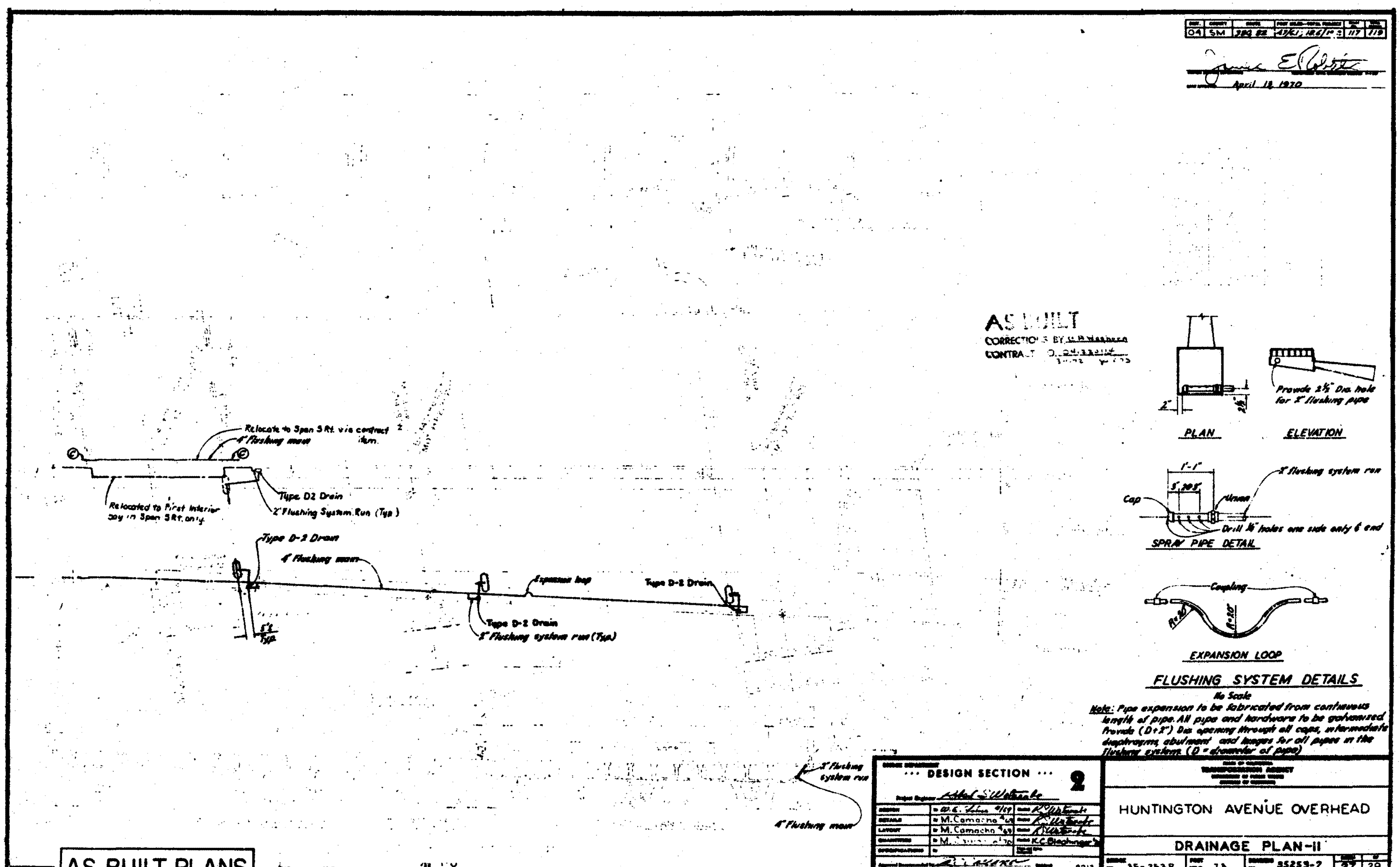
XS-10

FS-11



04 SM 380 6.9/6.2 176 35
November 15, 1971
Gate valve
Extend 4" Flushing Line thru Cracker Rot wall CCO#5
Type D-1 Drain
Expansion loop
4" Flushing main
4" Flushing system run (Typ.)
CCO#5
Capped
Gate valve
PLAN
ELEVATION
Provide 2½" Dia. hole for 2" flushing pipe
SPRAY PIPE DETAIL
2" Flushing system run
Cap
Union
EXPANSION LOOP
Coupling
FLUSHING SYSTEM DETAILS
No Scale
AS BUILT
CORRECTIONS BY Dick Carlson
CONTRACT NO. 04-409924
DATE 1973
PLAN
ELEVATION
Note: Accurate for drainage details only.
Direction of outlet
Standard pipe cap
AS BUILT PLANS
Contract No. 04-409924
DESIGN SECTION 2
M. Camacho
HUNTINGTON AVENUE OVERHEAD
DRAINAGE PLAN
35-253L


HUNTINGTON AVENUE OVERHEAD
LOCATED WITHIN THE CITY OF SAN BRUNO
DRAINAGE PLAN-1
DESIGN SECTION
AS BUILT
PROFILE GRADE
ELEVATION
PLAN
INDEX TO PLANS
TYPICAL SECTION
SECTION A-A
Flushing System Run
Expansion Loop
Type D-2 Drain
TO PACIFICA



Relocate to Span 5 Rt. via contract item.
4" Flushing main
Type D2 Drain
2" Flushing System Run (Typ)
Relocated to First interior bay in Span 5 Rt. only
Type D-2 Drain
4" Flushing main
Expansion loop
Type D-2 Drain
Type D-2 Drain
2" Flushing system run (Typ)
3" Flushing system run
4" Flushing main
AS BUILT
PLAN
ELEVATION
Provide 3½" Dia. hole for 3" flushing pipe
SPRAY PIPE DETAIL
Cap
Union
2" flushing system run
Drill ¼" holes one side only 6 cnd
Coupling
EXPANSION LOOP
FLUSHING SYSTEM DETAILS
No Scale
Note: Pipe expansion to be fabricated from continuous length of pipe. All pipe and hardware to be galvanized. Provide (D+2") Dia opening through all caps, intermediate diaphragms, abutment and hangers for all pipes in the flushing system. (D = diameter of pipe)
DESIGN SECTION 2
M. Camacho
M. Camacho
K.C. Bischinger
HUNTINGTON AVENUE OVERHEAD
DRAINAGE PLAN-II
35-253R
55253-2
27
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April 13, 1970
AS BUILT PLANS