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A Report of A Preliminary Corrosion Survey at the Proposed Stanislaus State College Site

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Division of Highways
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**16. ABSTRACT**


I. Introduction

On September 27, 1960, Mr. Aldo Crestetto, Civil Engineer Supervisor, Division of Architecture, requested by letter that the Materials and Research Department perform a soil resistivity survey at the proposed site of the Stanislaus State College near near Turlock, California.

It was requested that a corrosion survey be made for the purpose of protecting future underground utility installations from accelerated corrosion at the proposed building site.

Representatives of the Materials and Research Department performed the preliminary corrosion survey on August 9, 1961, and the results are included in this report.

II. Summary and Conclusions

Corrosive soils were found at the proposed site. It is estimated that a bare 3/4" steel pipe could be perforated by corrosion in these low resistivity soils in approximately 15 years.

As noted on Exhibit I, the areas where high resistivity soils are adjacent to low resistivity soils will result in a corrosive environment to steel pipe; therefore, cathodic protection of the pipe is recommended.


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STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

# A REPORT OF
# A PRELIMINARY CORROSION SURVEY AT THE
# PROPOSED STANISLAUS STATE COLLEGE SITE



MATERIALS & RESEARCH DEPARTMENT
SAGACITAS - SCIENTIA - STVDIVM

State of California
Department of Public Works
Division of Highways
Materials and Research Department

September 1961

Inter-Agency Agreement
S.A. -2337
W.O. MP4300GC-60
Lab Auth. 6231-72-S

Mr. Anson Boyd
State Architect
Division of Architecture
Sacramento, California

Attention: Mr. Aldo Crestetto
Civil Engineer Supervisor

Dear Sir:

Submitted for your consideration is:

A REPORT OF

A PRELIMINARY CORROSION SURVEY AT THE

PROPOSED STANISLAUS STATE COLLEGE SITE

Study made by . . . . . Structural Materials Section
Under general direction of. . . . . J. L. Beaton
Work supervised by. . . . . R. F. Stratfull
Report prepared by. . . . . R. F. Stratfull, W. S. Maxwell and G. R. Steffens

Very truly yours,

F. N. Hveem
Materials & Research Engineer

By John L. Beaton

J. L. Beaton
Supervising Highway Engineer

RFS/WSM/GRS:lk
cc: O.E.Anderson
I.Shultz

# I. INTRODUCTION

On September 27, 1960, Mr. Aldo Crestetto, Civil Engineer Supervisor, Division of Architecture, requested by letter that the Materials and Research Department perform a soil resistivity survey at the proposed site of the Stanislaus State College near Turlock, California.

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## II. SUMMARY AND CONCLUSIONS

Corrosive soils were found at the proposed site. It is estimated that a bare 3/4" steel pipe could be perforated by corrosion in these low resistivity soils in approximately 15 years.

As noted on Exhibit I, the areas where high resistivity soils are adjacent to low resistivity soils will result in a corrosive environment to steel pipe; therefore, cathodic protection of the pipe is recommended.

## III. RECOMMENDATIONS

1. That cathodic protection be applied to the underground pipe at the time of the construction of the facility.

2. All steel pipe placed underground shall be coated in accordance with the Standard Specifications for Mechanical Work, dated 1960, Division of Architecture.

3. All steel pipe placed underground shall be electrically continuous and electrically bonded together by a pipe connection or an AWG number 2 TW Jumper Wire.

4. All underground steel pipe that makes an ingress into any building shall be electrically insulated from any reinforcing steel or other metals within the structure.

5. Where steel pipe enters a building through a riser that is atmospherically exposed, an electrical insulating device shall be placed in the section of pipe that is exposed to the atmosphere. This location will also be prior to the point of entry of the pipe through the building wall or floor.

6. At locations where buried steel pipe enters a building, the following shall apply.

   A. The wall, footing or slab shall contain a non-metallic pipe sleeve as described in Section 2M, article 2M-22-d of the Standard Specifications for Mechanical Work.

   B. Within six (6) inches of the floor or wall of the structure, an electrical insulating device shall be placed in the pipe. A warning sign in the form of a copper bearing metal tag labeled "Do Not Electrically Bond Across this Fitting" shall be attached to the pipe where the insulating device is installed.

7. No steel pipe which is to be installed beneath concrete slabs shall lie within 12" of the slab or aggregate base material except at locations where the pipe rises to enter a building or other structure.

8. All electrical insulating devices that are installed in underground pipe shall be installed with wires that are attached to the pipe so that performance of the insulator may be checked without excavation, etc.

9. At all locations that steel pipes cross, but are not in mechanical contact, a jumper wire shall be installed to electrically bond the pipes.

10. Where steel pipes are placed within 5 ft. of each other and are on a parallel alignment, a jumper wire shall be installed every 1,000 ft. to electrically connect the pipes.

11. The joints of cast iron pipe shall be so constructed that each length of pipe shall be electrically insulated from its adjacent section.

12. All underground electrical conduit is to be made of non-metallic materials.

13. All underground telephone cables shall be coated with a reinforced neoprene jacket.

14. All underground conduit shall be free-draining so as to remain free of standing water.

15. Calcium chloride or chloride containing additives shall not be used in concrete containing reinforcing steel or radiant heating systems.

16. Within 30 days after the contract for construction is let, the contractor shall notify in writing all major utility companies in the area of the State's intentions to cathodically protect the underground pipe.

17. Electrical insulating couplings shall be placed in the piping at the following locations:

    A. At all connections between state piping and those of private utilities.

    B. At all connections of copper to steel pipe.

18. No piping placed in the same excavation shall lie across or otherwise be in mechanical or electrical contact with other pipe except at designated locations.

19. Where mechanically feasible, use a non-metalic pipe.

20. Do not ground electrical system to underground utility pipe.

21. All electrical ground wires that are within underground conduit shall have a TW coating or equal.

# IV. TESTS

## A. WATER

Two samples of water that could be used at the facility were obtained: (1) from a (well water) water tap at the eastern part of the site (2) from a concrete lined irrigation ditch Southwest of the site at the intersection of Geer and Taylor Roads. The results of a chemical analysis of this water are as follows:

**Tests**

| | Results | |
|---|---|---|
| | Well Water | Ditch Water |
| **Anions** | | |
| Chloride (CL) ppm | 10 | Nil |
| Sulfates ($SO_4$) ppm | 20 | 5 |
| **DETERMINATIONS** | | |
| Total alkalinity as ($CaCO_3$) ppm | 160 | 50 |
| Calcium as ($CaCO_3$) ppm | 75 | 15 |
| Total solids at 105° C ppm | 325 | 45 |
| (Hydrogen Ion Conc.) pH | 7.8 | 7.6 |
| Resistivity (ohm-cm) | 2500 | 12,800 |

From an empirical corrosion test it is estimated that a 3/4" bare steel pipe could be perforated by internal corrosion of the pipe by (1) well water in approximately 35 years (2) ditch water in excess of 50 years.

From a calculation based upon the Langliar Index, (1) the well water has a scaling tendency. (2) ditch water has a corrosive tendency.

B. SOIL

The soil resistivity measurements of the site are plotted on Exhibit I, Equi-Resistivity Contour Plan. As will be noted on Exhibit I, the soil resistivity ranged from 800 ohm-cm to 15,000 ohm-cm. The average electrical resistivity of the soil at the site was 5,500 ohm-cm.

Laboratory tests were performed on soil samples obtained from selected locations throughout the site. Results of these tests are as follows:

1. The pH varied from 6.5 to 7.3.

2. The resistivity varied from 800 to 15,000 ohm-cm. These tests indicate that the soil is corrosive to underground steel pipe.

C. SOIL, PIPE BACKFILL

It is suggested that soils which are considered to be suitable for pipe backfill material shall conform with the physical characteristics as outlined in the Division of Architecture Standard Specifications, section 2M, article 2M-12; also the soils shall not have a specific resistance of less than 2,000 ohm-cm nor a sand equivalent test value of less than 30. The specific resistance and the sand equivalent tests of the soil are California Division of Highway Test Methods No. 643-A and 217-C respectively.

Soil samples obtained from this site indicated the following test values:

| Sample No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Sand Equivalent | 34 | 32 | 26 | 25 |
| Resistivity-ohm-cm | 7000 | 3500 | 2100 | 16000 |

*Note: A sand equivalent (S.E) of 0 represents a clay soil and a S.E. of 100 is a clean sand.

Based upon these test values, it appears that there are adequate locations in which the native soils may be suitable as backfill material for underground pipe.

## V. CORROSION CONTROL

The cathodic protection of the underground facilities at this site can be accomplished in the following manner.

Phase I

At the completion of the installation of the underground pipe at Stanislaus State College site, tests should be performed to determine the feasibility of using impressed or galvanic currents for corrosion control.

Design of the cathodic protection system should be based upon field tests of the existing facilities.

A preliminary cost estimate of the Cathodic protection facilities can be made when working drawings are available. However, the actual design of the system will require a field test of the in-place facilities.

Phase II

Install required cathodic protection facilities.