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Electrolysis
&
Stray Traction Current Report & CC Certificate

For Proposed Building at
No. 11-13 Albert Road & 2-6 Pilgrim Ave, Strathfield

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02/02/2021	Initial Report	Domeniki Tsagaris	Moussa Zaioor
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1. CONSULTING BRIEF

ANACivil P/L were engaged to review the development plans and to identify the possible exposure to stray traction current and to provide an opinion on whether stray traction current presents a corrosion hazard to the proposed development, and if necessary, suggest appropriate remedial or mitigation actions.

The existing development on No. 11-13 Albert Road & 2-6 Pilgrim Ave Strathfield is to be demolished and a proposed thirteen (13) storey residential building including four (4) levels of basement parking are to be constructed on site (Figure 1 – Site Location). The proposed architectural plans are presented by Kennedy Associates Architects dated June 17th, 2021. An electrified rail line is located directly north of the boundary line.

This report is prepared such that the proposed development is built in accordance with Strathfield Municipal Council Conditions/Requirements.

It is a requirement of the railways and Strathfield Municipal Council Development Consent that for all developments in the vicinity of electrified tracks the existence of the stray traction current in the ground is investigated. This report is developed identifying the extent of the stray traction problem to determine what measures should be taken to ensure the stray current does not present a corrosion hazard to the proposed development.

2. PROJECT DESCRIPTION AND SUMMARY OF FINDINGS

The results of this investigation are:

2.1.1 Stray traction current can be expected to be present on the site.

2.1.2 Corrosion of the water and fire services or the electrical earth can be caused by stray traction current. Installation of an insulating fitting in the water and fire services, or the use of a non-metallic water meter or PVC pipe eliminates this hazard.

2.1.3 Simple and inexpensive measures only are required to eliminate any corrosion hazard from stray traction currents.

3. ELECTROLYSIS AND STRAY TRACTION CODES AND STANDARDS

- EP 12 10 00 13 SP 1500 V Traction System Earthing
- EP 12 10 00 20 SP Low Voltage Distribution Earthing
- EP 12 10 00 21 SP Low Voltage Installation Earthing
- EP 12 10 00 22 SP Buildings and Structures Under Overhead Lines
- EP 12 20 00 01 SP Bonding of Overhead Wiring Structures to Rail
- EP 12 30 00 01 SP Electrolysis from Stray DC Current

- ESC 510 Boundary Fences [Civil]
- SPC 511 Boundary Fences [Right of Way]

4. THE IMPACTS OF ELECTROLYSIS AND STRAY TRACTION

In Sydney, RailCorp uses a 1500-volt direct current to operate the traction system. This current is delivered by the overhead centenary cables and the return path to the substation is via the track. The track is not insulated from earth principally because of the difficulty of achieving insulation and also for safety reasons. Whilst the steel track is large in cross section, some of the current can be involved. All current obeys Ohms Law and if a low resistance metallic structure exists in the path of the "stray" current this can pick up the stray current which then flows along the structure to a point close to the substation, where it discharges back to earth, and ultimately returns to the substation. Where the "foreign" structure picks up the stray current a small measure of corrosion control or "cathodic protection" is achieved. However, where the current discharges from the foreign structure back to the soil, corrosion of the foreign structure occurs as shown in Figure 2.

In order for stray current to be a serious problem the foreign structure has to be electrically continuous. In the 1930s an enterprising engineer decided to plot failures on a map and found they were predominantly grouped around rail lines or tram lines.

Further investigation showed that they were also grouped around the sub stations associated with the tracks. He eventually identified the corrosion problem as being caused by stray current. The solution developed was to connect the foreign structure to the tracks via a simple control system. This provided a low resistance path for the stray current to return to the tracks thus eliminating the corrosion problem. The control bond could be engineered such that a degree of additional corrosion protection could be provided to the foreign structure. This led to the formation of the electrolysis committee which has representatives of the owners of all underground services, and RailCorp.

5. SITE SPECIFIC IMPACTS OF ELECTROLYSIS AND STRAY TRACTION

The main site-specific impacts of electrolysis and stray traction are outlined below.

5.1 CORROSION HAZARD TO THE DEVELOPMENT

The concrete reinforced slabs of the development ground floor will not be subject to a corrosion hazard from stray traction current provided the recommendations in this report are adhered to.

5.2 WATER AND GAS SERVICES

Stray traction current can cause a corrosion problem on electrically continuous metallic services such as water, fire and gas services. It is recommended an insulating flange or fitting be installed in these services at the property boundary. If the water meter is constructed of non-metallic material, this will provide the insulation function. The above will eliminate corrosion by stray traction current of the services, and the electrical earth system of the development.

6. CORROSION HAZARD FROM STRAY TRACTION CURRENT

The direct current used by the traction system can cause serious corrosion to underground metallic services and the steel reinforcement of concrete. Stray traction current flowing in the ground can be conducted by the steel reinforcement one side of the development, flow along the steelwork and discharge back to the soil on the opposite side of the building. At the discharge point of the current, corrosion of the reinforcement will occur.

The most conventional way to eliminate the corrosion hazard from stray traction current to a building is to increase the electrical resistance of the concrete to the ground. This prevents the flow of stray traction current through the reinforcement. Increasing the electrical resistance of the structure to ground for an on-ground slab is automatically achieved by the moisture barriers installed to prevent water entry into the structure. The moisture barrier is an electrically insulating membrane. Where the structure is supported on pad and/or piered footings, increasing the resistance of the structure to ground can be achieved by applying moisture barrier to the excavation into which the pad footings or piers poured. In situations where the installation of moisture barriers into the excavation is impractical, i.e. for piered footings, these can be insulated from the structure by the application of insulating sleeving to the starter bars where they tie into the building reinforcement.

7. MITIGATION OF STRAY CURRENT

The options to deal with the potential corrosion problems which can result from stray traction current to either prevent or reduce exposure of the structure to stray traction current or to install a mitigation system to offset the problem. Installation of a mitigation system is an expensive approach as it requires the establishment of infrastructure necessary for the mitigation of the problem.

7.1 ELIMINATE OR REDUCE EXPOSURE TO STRAY TRACTION CURRENT

The most efficient approaches to avoid exposure of the structure to stray traction current are described below.

7.1.1 REDUCE LENGTH OF STRUCTURE IN ALIGNMENT WITH TRACTION CURRENT PATH

The hazard from stray traction current is due to the current flowing onto and then off the metallic structure. Corrosion occurs at the point of discharge of the current back to the soil. The hazard from the stray traction current increases as the length of the conducting service increases. Stray traction corrosion is a problem because the metallic service presents a lower electrical resistance path to current flow than the alternative path through the earth. For current to flow onto and discharge from an underground structure, electrochemical reactions need to occur to generate or absorb electrons. Both these reactions require energy, which results in a resistance existing between the structure and the earth. If the structure is short in length, the combined resistance of the pickup and discharge reactions is sufficient to prevent the traction current flowing onto the structure.

In addition, the passage of the stray traction current causes development of potential gradient in the earth. For a short metallic conductor, the potential gradient to which it is exposed to is too small to allow the pickup of the current. Consequently, the shorter the length of the metallic structure the less likely it is to be affected by stray traction current.

7.1.2 ISOLATE THE STRUCTURE FROM STRAY TRACTION CURRENT

Stray traction current effects can be avoided by increasing the resistance of the structure to the soils in which stray traction current is flowing. This can be achieved by use of moisture barriers such as FORTICON which provides an electrically insulating membrane which prevents entry of stray traction current. Even if the membrane is damage, it will still provide sufficient resistance to prevent entry of stray traction current.

7.1.3 STRENGTH OF CONCRETE

The use of high strength concrete will increase the electrical resistance of the concrete. Thus, if concrete of 32 MPa is used for the underground components, this has a high resistance, due partly to the reduced water content, and acts as an electrical insulator to the entry of stray traction current.

7.2 STRAY TRACTION CURRENT MITIGATION

Stray traction current mitigation is achieved by providing a low resistance path from the structure to allow discharge of any stray traction current directly back to the rail.
Provision of a mitigation system involves the following:

a. The reinforcement of the concrete must be made electrically continuous. This might involve tack welding all members of the reinforcement cages.
b. Testing must be undertaken to provide evidence to the railway that a stray traction current corrosion hazard exists.
c. If the resting identifies a corrosion hazard to the steel reinforcement does exist, installation of a "railway drainage bond" can proceed.

Note: the installation of a mitigation system is a particularly expensive option.

8. RECOMMENDATIONS

The recommendations for the relevant building components from ANA Civil are measures to ensure any issues due to stray traction current exposure are eliminated are described below.

8.1 CONCRETE PIERS, FOUNDATIONS & ON GROUND SLABS

- All piers, foundations and slabs in contact with the ground are affected.
- The excavation will be supported by reinforced concrete piers. The concrete to nominated should be minimum 32MPa with a minimum of 65mm cover. This is considered to have sufficiently high electrical resistance to prevent the conduction of stray traction current.
- Affected slabs are the on-ground slab and on-ground car parking areas.
- The structures are relatively "short" in length and as such will have too high a resistance to act as a conductor for stray traction current.

Provide plastic under on-ground slab, minimum 200um thick. Recommended is Orange Forticon. Ensure lapping of minimum 200mm upon joining.

8.2 FOOTINGS

Strip footings/Pads will be provided under load bearing areas. Concrete strength in footings/Pads should be nominated to be Min. 32 MPa with min. 65 mm of cover. Concrete

strength in on ground slabs should be nominated to be Min. 32 MPa with 30 mm of top cover.

8.3 PILING

Shoring reinforced concrete piles will be installed along the northern boundary of the site facing the rail line. Piles to be specified with Min. 32MPa and 65mm of clear cover.

8.4 GROUND ANCHORS

Ground anchors are to have a concrete casing of 500mm. Given that temporary ground anchors will be used, it will not be affected by stay current traction current.

8.5 LIFT PITS & PUMP WELLS

Lift pits and pump wells to be constructed from concrete specified at 32 MPa concrete with a minimum of 50 mm of concrete cover. The walls of the pits will be of rediwall/Dencil/Blocks construction fitted with a waterproof membrane(Lift). The concrete nominated for the construction of the pits is sufficiently high strength to resist conduction of stray traction current.

8.6 DINCEL WALLS

The balance of the excavation will be provided with DINCEL construction. DINCEL walls are immune to corrosion hazards from stray traction currents.

8.7 INCOMING WATER & GAS SERVICES

Stray traction current can affect metallic water, fire and gas services. Should stray traction current be picked up by the services, this can result in a corrosion problem on;
a. The services.
b. The Development's electrical earth system. This is because the earth and the water service have a direct interconnection via the MEN system. Current picked up by the water and/or fire services can discharge back to the earth via the earth system resulting in corrosion of the earth grid or stake.

This problem can be eliminated by installation of an insulating fitting, or non-metallic sections in the services at or close to the boundary of the property.
Further comments are:

a. If the water meter, or the internal water service is of non-metallic construction this will provide the insulation required.
b. The gas service can be expected to incorporate an insulating fitting at the meter. Agility provides cathodic protection systems. Alternately if the service is non-metallic, this provides the necessary insulating properties.

Insulation flange kits consist of:

a. A set of insulating sleeves and washers which fit on the bolts and electrically isolate the bolts form the flange. The bolt sleeves are designed to fit within the flange bolt holes (except for the table flanges).
b. A heavy non water adsorbent gasket.

The insulating flange kits are available from Savcor Art, Tel 96632322.

9. CONCLUSION

The construction of the proposed development at No. 11-13 Albert Road & 2-6 Pilgrim Ave Strathfield is to be carried out as recommended in this report. In summary, provided the recommendations in Section 8 of this report are implemented the proposed development will meet the requirements of this report and Strathfield Municipal Council requirements and Sydney Trains Requirements, as well as prevent any possible corrosive effects of stray traction currents.

Should you require further explanations, please do not hesitate to contact us.

Yours sincerely,

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10. APPENDIX

Figure 1 - Site Location

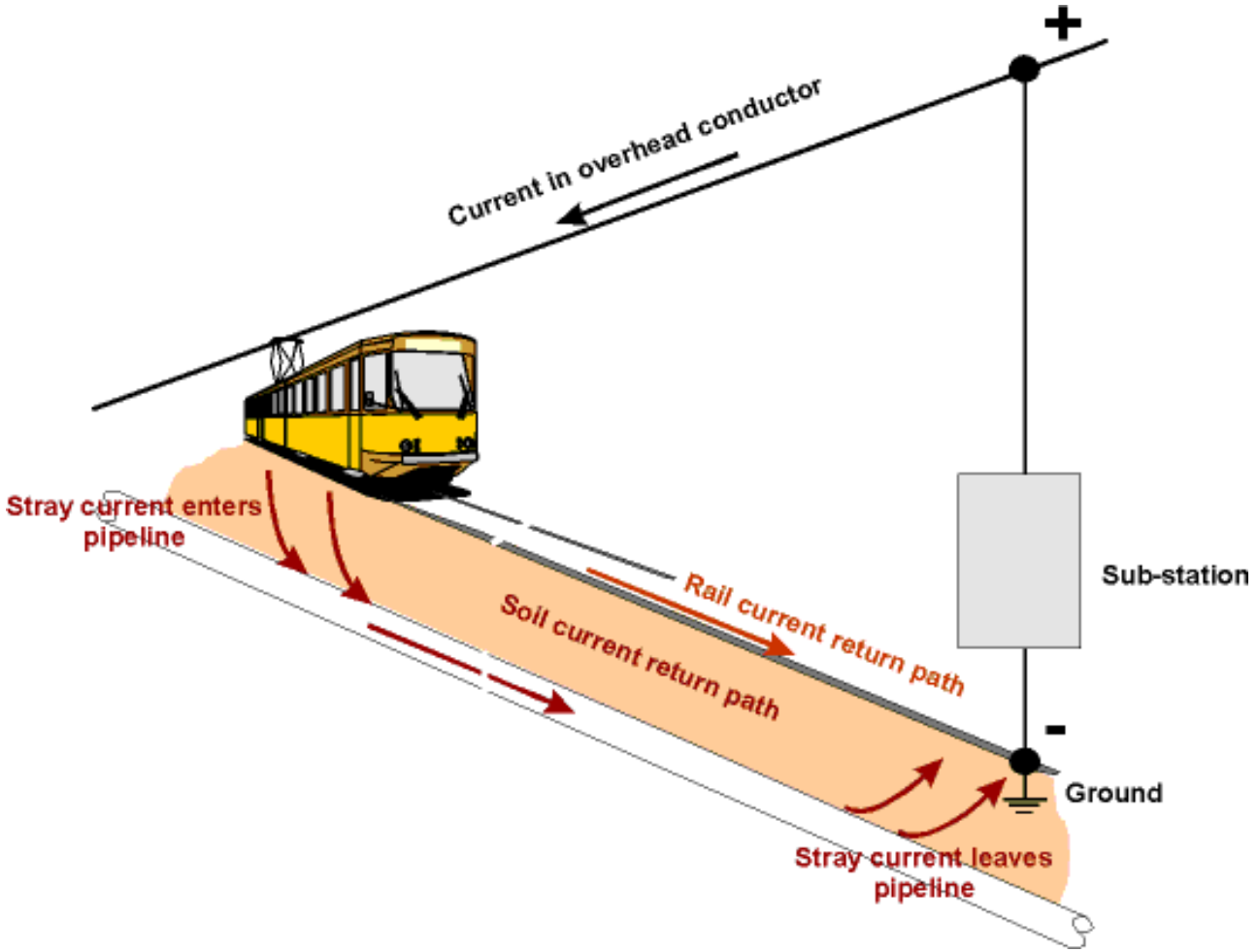

Figure 2 - Stray Traction Current