DISCIPLINE **ELECTRICAL**		LOCATION **CHLORINE** **CONTACT TANK**
SUBJECT: **EARTHING SYSTEM**		

3.1.1.6 Grounding Electrodes

A grounding electrode shall be provided for each down conductor. A driven ground shall extend into the earth for a distance of not less than 3.0 meters. Ground rods shall be set not less than 900 mm, nor more than 2.5 m, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 5 ohms. Using the soil resistance, calculate the resistance of the ground rods. When these calculations indicate a combination of two ground rods will exceed 50 ohms or the system ground resistance will exceed 5 ohms, provide a counterpoise. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 48 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 50 ohms, the Contracting Officer will be notified immediately. A counterpoise, where required, shall be of No. 1/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 600 mm deep at a distance not less than 900 mm nor more than 2.5 m from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors or their equivalent in the form of metal strips or wires are then buried in the trenches.

1-DETERMINE LEVEL OF EARTING CONNECTION BY SURVEYOR DEPEND ON SPEC'S AND STRUCTURAL DRAWING, AS THE FOLLWING

Please find attached file of the approved IFC structural drawing for the Chlorine Contact Tank noting that the F.G.L around this tank is equal to (+578.75) and as per project's specification (Highlighted below) the copper cable will be laid in trench not less than 600mm deep so you are kindly requested to apply the connection at the same level (around + 578.15) or deeper.

2- MAKE GOOD CONNECTION BETWEEN REBAR (AFTER STELL WIRE MESH FINISHED) AND BARE COPPER CONDYCTOR BY CLAMP.

***USE VERTICAL REBAR TO CONNECTION.**

3-INSTALL THIS SMALL PIPE BETWEEN REBAR AND EARTHING TERMINAL TO ELIMENATE THE SPACE BETWEEN EARTHING TERMINAL AND THE EDG OF CONCRETE AFTER REMOVING FORM WORK AND CASTEING WILL BE FINISHED,TOM MAKE SMALL CHIPPING IN BEAM TO PULL TERMINAL AT CONNECTION LEVEL.

4- INCREASE THE LENGTH OF EARTING TERMINAL AROUND 3M TO FUTURE CONNECYION AFTER CASTING.

GENERAL VIEW OF TANK

For Building # 17 – CHLORINE CONTACT TANK :-

Chlorine Contact Tank grounding calculation will be based on schwarz's grounding design methods.

R1= ρ/Π.Lc*{ln (2Lc/ a') + (K1.Lc/$\sqrt{A}$)-K2}.
R2 = ρ/2 Π.nr.Lr*{ln(2Lr/b)-1 + (2k1.Lr/$\sqrt{A}$).($\sqrt{}$(nr-1)^2 }.
Rm = ρ/Π.Lc * { ln (2Lc/ Lr)+(K1.Lc/$\sqrt{A}$)-k2 +1}.
RG= R1.R2-Rm^2/R1+R2-2Rm

Where:-

R_1 :- ground resistance of grid conductors in Ω
R_2 :- ground resistance of all ground rods in Ω
R_m : - mutual ground resistance between the group of grid conductors, R_1,and group of ground rods, R_2 in Ω
ρ :- is the soil resistivity in Ω·m
L_c : -is the total length of all connected grid conductors in m
2a :- is the diameter of conductor in m
a' :- is$\sqrt{1*2h}$ for conductors buried at depth h in m, or
a' :- is a for conductor on earth surface in m
h :- is conductors buried depth in m
A : - is the area covered by conductors in m2
k_1, k_2:- are the coefficients [see Figure 25(a) and (b)]
L_r : -is the length of each rod in m
2b :- is the diameter of rod in m
n_r :- number of rods placed in area A
Input data:-
(ρ_s = 126.1 Ω·m) , (L_c= 74.3 m) ,(2a = 0.0124 m), (a' = $\sqrt{1*2h} = \sqrt{0.0062*2*0.6}$ = 0.086 m) , (h = 0.6 m),(A = 342.7 m_2), (L_r= 3 m) ,(b= 0.0095m) ,(n_r = 4)

For K_1:-

Length to width ration = 20/17= 1.17
For h=0.6m curve B will be used
So K_1 = -0.05*1.17+1.2 = 1.14

For K_2:-

Length to width ration = 20/3=6.67
For h=0.6m curve B will be used
So K_2 = -0.1*6.67+4.68 = 4.01

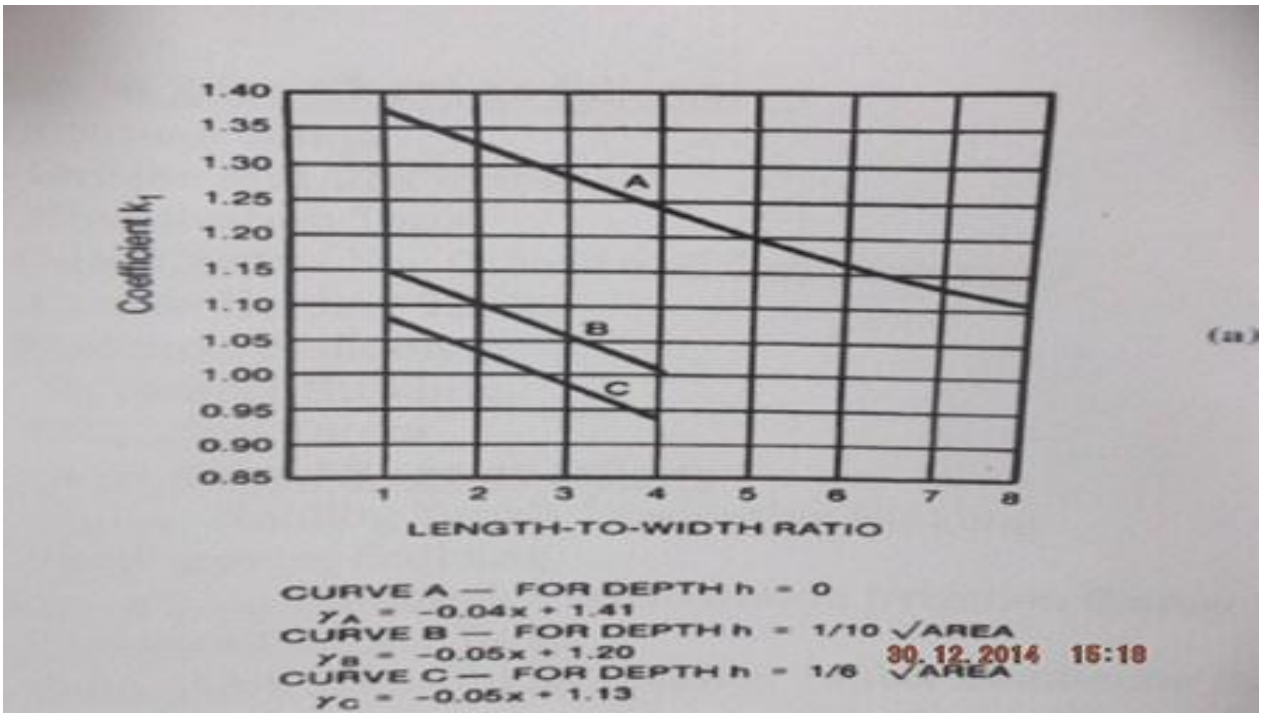
Calculation & Result :-
R1=1.39Ω.
R2=9.7 Ω.
Rm=3.0 Ω.

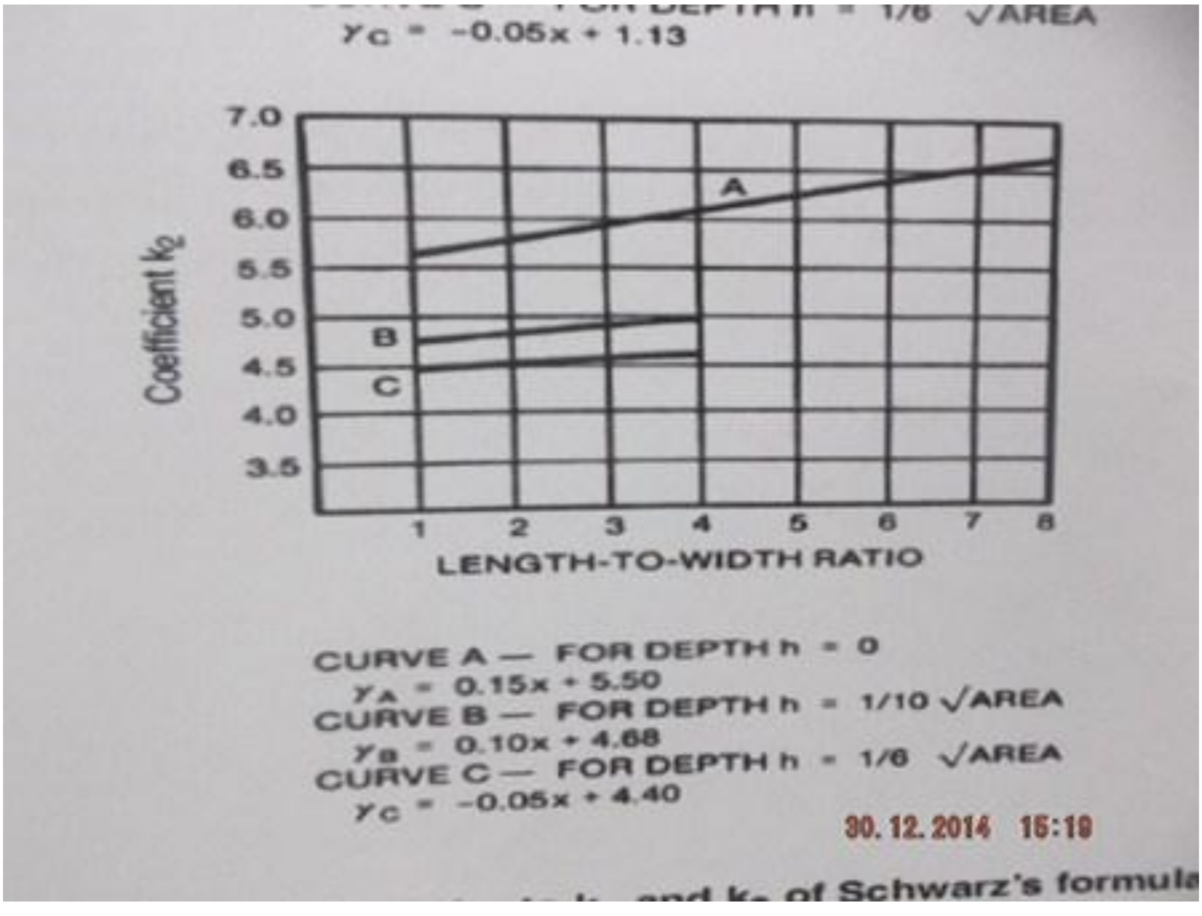
Rg= (4.39*9.7-(3)^2/4.39+9.7-(2*3) = 4.15 <5Ω.

Main factors in calculations

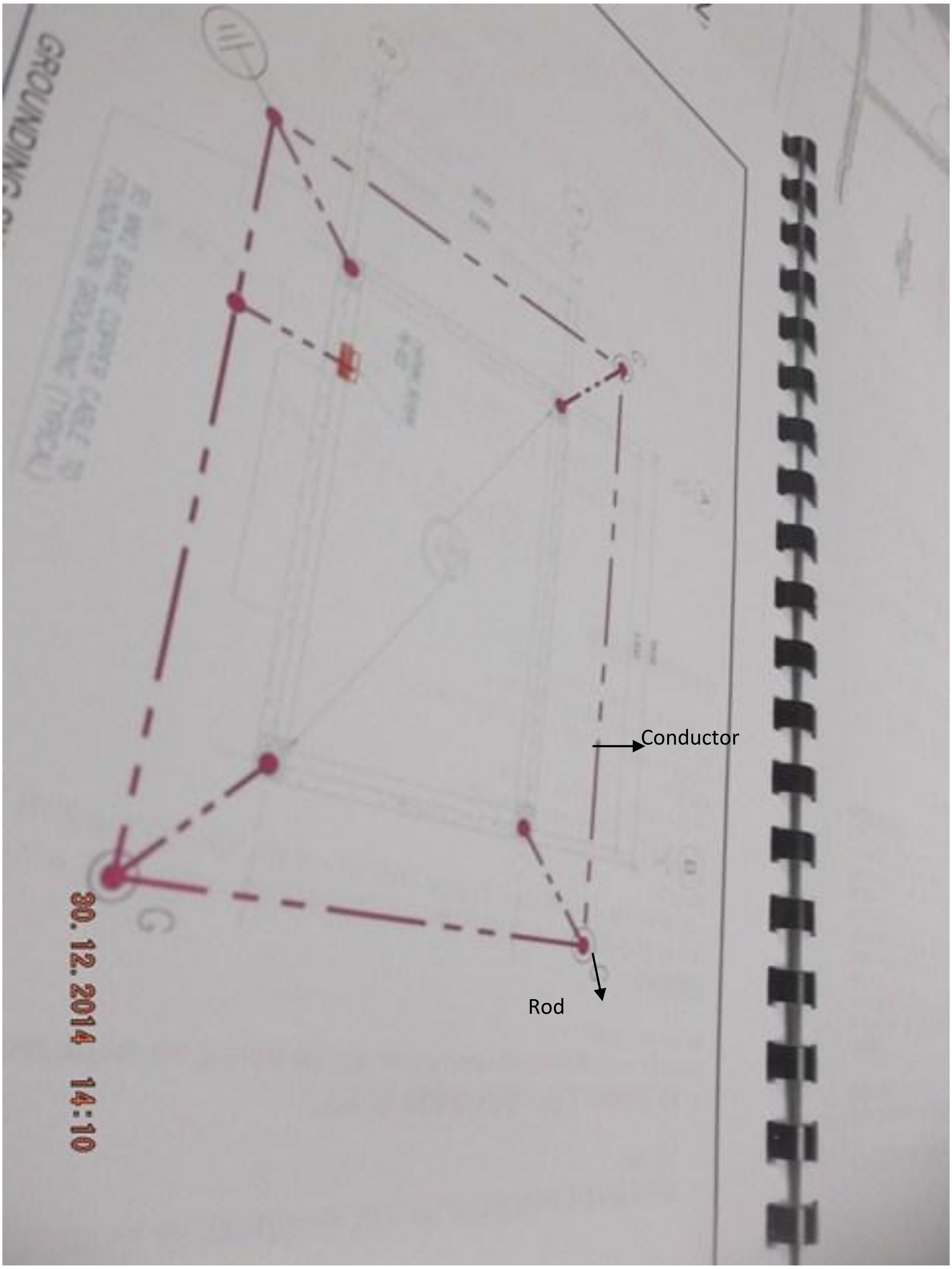
1- **Soil resistivity in Ω.m.**
2- **The diameter and cross section of conductor ,**
   Depend of this factor we can decide the cable conductor cross section 95 $mm^{2,}$ 95 $mm^{2,}$ 70,16 mm^2,…………….,etc.
3- **The conductor buried depth h ,**
   Determined by civil eng and surveyor, in our spec's 60cm from F.F.L,
   Usually this depth is used.
4- **The length of each rod in m,**
   Depend of this factor we can decide The length of each rod 3m,2.4m,1.8m,……….,etc.
5- **No of rods placed in area.**

Figure 25—Coefficients k_1 and k_2 of Schwarz's formula: (a) coefficient k_1, (b) coefficient k_2





<u>**GROUNDING SYSTEM LAYOUT**</u>



SOIL RESISTIVITY CALCULATION

1.1 WENNER'S PROCEDURE (ASTM-G57)

A. General

a. Purpose

This document was developed as a guideline and process for understanding the concepts, and determining soil resistivity.

b. Scope

This document presents the theory and methodology of soil resistivity testing, the equipment required, a detailed test procedure and forms. It also explains the use of the soil resistivity data in designing grounding systems to meet specific performance requirements.

c. Introduction

Soil resistivity data is the key factor in designing a grounding system for a specific performance objective. All soil conducts electrical current, with some soils having good electrical conductivity while the majority has poor electrical conductivity.

The resistivity of soil varies widely throughout the world and changes dramatically within small areas. Soil resistivity is mainly influenced by the type of soil (clay, shale, etc.), moisture content, the amount of electrolytes (minerals and dissolved salts) and finally, temperature.

When designing a grounding system for a specific performance objective, it is necessary to accurately measure the soil resistivity of the site where the ground is to be installed. Grounding system design is an engineering process that removes the guesswork and "art" out of grounding. It allows grounding to be done "right, the first time".

The result is a cost savings by avoiding change orders and Ground "enhancements".

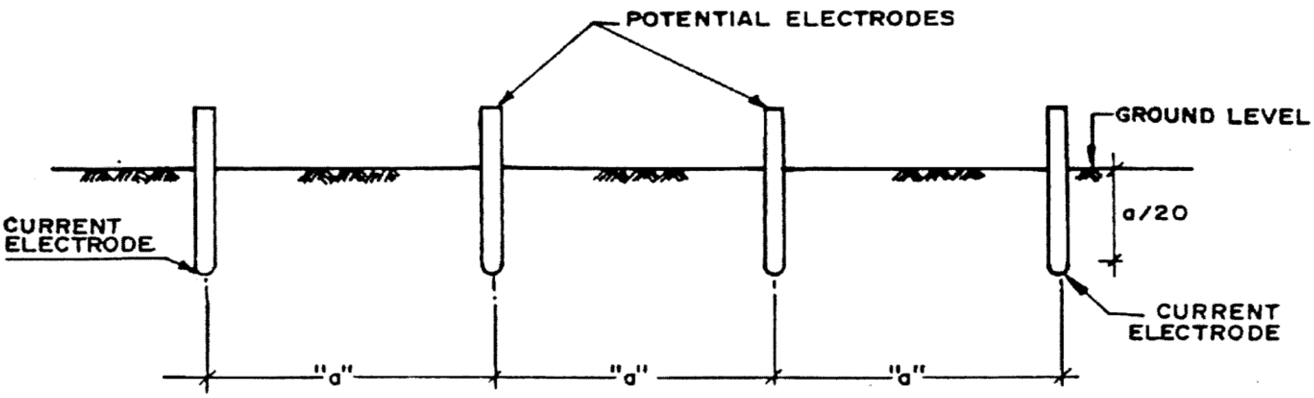
d. Theory

The best method for testing soil resistivity is the Wenner Four Point method. It uses a 4-pole digital ground resistance meter, such as the Megger 5/4 or the AEMC 4500 meters, probes, and conductors.

It requires inserting four probes into the test area. The probes are installed in a straight line and equally spaced (See Figure 1-1). The probes establish an electrical contact with the earth.

The four pole test meter injects a constant current through the ground via the tester and the outer two probes. The current flowing through the earth (a resistive material) develops a voltage / potential difference. This voltage drop resulting from the current flow is then measured between the two inner probes.

The meter then knows the amount of current that is flowing through the earth and the voltage drop across the two center probes. With this information the meter uses ohms law (R=E/I) to calculate and display the resistance in ohms this displayed resistance value is in ohms and must be converted to ohms-meter, which are the units of measure for soil resistivity.



$$R = 2\pi \times a \times r$$

Where R = Resistivity in Ohm – meter

a = Electrode spacing in meter

r = Resistance in Ohms.

furse

Earth rods

Furse copperbond earth rods probably offer to the installer the best and most economical earth rods available. They are made by molecularly bonding 99.9% pure electrolytic copper onto a low carbon steel core.

Furse rods are not of the sheathed type. They are highly resistant to corrosion, and because the steel used has a very high tensile strength, they can be driven by power hammers to great depths.

The counter-bored couplings are made from high copper content alloy, **commercial brass is not used**. This again ensures excellent corrosion resistance and high strength.

Copper thickness minimum 250 microns.

Threaded copperbond earth rod

Nominal diameter	Length	Thread diameter 'B'	Shank diameter 'A'	Weight each	Part No.
½"	1200mm	9/16"	12.7mm	1.18kg	RB105
½"	1500mm	9/16"	12.7mm	1.55kg	RB110
½"	1800mm	9/16"	12.7mm	1.76kg	RB115
½"	2400mm	9/16"	12.7mm	2.36kg	RB125
⅝"	1200mm	⅝"	14.2mm	1.53kg	RB205-FU
⅝"	1500mm	⅝"	14.2mm	1.88kg	RB210
⅝"	1800mm	⅝"	14.2mm	2.29kg	RB215
⅝"	2100mm	⅝"	14.2mm	2.51kg	RB220-FU
⅝"	2400mm	⅝"	14.2mm	3.00kg	RB225
⅝"	3000mm	⅝"	14.2mm	3.79kg	RB235
¾"	1200mm	¾"	17.2mm	2.19kg	RB305
¾"	1500mm	¾"	17.2mm	2.73kg	RB310
¾"	1800mm	¾"	17.2mm	3.27kg	RB315
¾"	2100mm	¾"	17.2mm	3.83kg	RB320-FU
¾"	2400mm	¾"	17.2mm	4.35kg	RB325
¾"	3000mm	¾"	17.2mm	5.44kg	RB335

Copper thickness minimum 250 microns.

Earth rods to BS EN 50164-2, BS 7430, UL467
Fittings to BS EN 50164-1

Fittings

Type	Weight each	Part No.
½" Coupling	0.09kg	CG170
⅝" Coupling	0.08kg	CG270
¾" Coupling	0.13kg	CG370
½" Driving stud	0.05kg	ST100
⅝" Driving stud	0.08kg	ST200
¾" Driving stud	0.12kg	ST300