Conductive Concrete Shield for Electronics Against Electro-Magnetic Pulse Attack

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***Abstract*—Electronic equipment and data servers contribute for storing confidential information.During high altitude EMP attack data servers and electronic equipments are hampered critically which further leads to loss of data.To prevent this mishap we provide these equipments by improving properties of concrete so as to make it conductive.Concrete is made conductive by adding and changing different materials related to it's composition. The structure is meant to provide absorption, reflection and re-reflection to the incoming EMP waves by providing a conductive path around the structure .An optimal tradeoff is selected between compressive strength and conductivity values as the materials used to increase conductivity might reduce the strength of the structure. Along with the study of conductive materials, measurement standards for attenuation is mentioned here.**

Keywords-EMP,Conductive Concrete, EM Shielding,Resistivity, EMI , Attenuation measurement standards

I.INTRODUCTION

An Electromagnetic pulse(EMP), also called as Transient Electromagnetic disturbance.It is short burst of Electromagnetic energy.The pulse originates due toNatural causes:- Lightening Strike ,Manmade causes:-Electromagnetic Weapons,Nuclear Attacks.

To protect our confidential data we can build an enclosure with shielding effectiveness to the concrete used. For this some basics have to be known, they are:-1) Electromagnetic field parameters 2) Antenna Radiation Patterns 3) Shielding Effectiveness of materials. The electromagnetic wave travels with a certain frequency and for which its penetration into the shield must be known. Since because it consist of magnetic as well as electric waves,we need to calculate the amount of each wave.So that effective shielding can be obtained against both.

By understanding the basic radiation pattern of the antenna,the power and intensity of the wave can be observed.The values can be noted when at their maximum and minimum which are again useful for shielding. The conductive material adds to the power of the wave and eventually reduces to zero thus providing good shielding effectively.

II.LITERATURE SURVEY

- Cement added with other conductive substances like graphite, coke breeze and carbon fibers hold the particles together.Thus, there forms a connection between the particles allowing the conductivity to rise gradually. The more the particle contact with its neighbor,the more the conductivity of the concrete.A certain threshold value is calculated above which the conductivity remains constant.[1]
- Grounding is essential for towers and buildings prone to chances of lightening strikes. It is necessary to provide a proper path for dissipation of the pulse generated due to this natural EMP. The research here shows the importance of “Coke” as its major constituent. By varying its volume occupancy in concrete, the effect of compressive strength as well as conductivity with its gradual variation can be observed.[2]
- Concrete in itself when made conductive becomes an heat absorbing substance. In places where weather conditions are ice-cold this concrete helps in deicing the snow accumulated on the surface of concrete structures mainly considering bridge deck. Alternating current supply is passed at the both ends of the concrete bridge deck which help in melting the ice by allowing electricity to heat up the bridge deck’s surface.[4]
- Components used in contributing to conductivity must be cost effective and environment friendly so as to increase its usability and lifetime. Graphite is one such substance which possesses both of these. Depending on its carbon content, an impact on its resistivity is also observed.[19]

III.PRINCIPLE

The motive behind this paper is to study the how the electro-magnetic pulse (EMP) can be hindered from corrupting confidential high security data and disruption of electronic equipment.Shielding methods hence safeguard

the Concrete Shelter due to its conductive properties.This study depicts solutions to both low as well as high frequency EMP radiations.

The fields analyzed include electric as well as magnetic fields which gradually propagate as plane waves with a constant value of frequency.

IV. METHODOLOGY

1. Basic knowledge of Electromagnetics ,Antennas ,Shielding,
2. Substances necessary to acquire an optimum trade-off between low resistivity and strength studied.
3. Concrete is made conductive by adding constituents.
4. Mil-std 183-L25-1 measures the attenuation.
5. Shielding Effectiveness is measured by reference & load measurements

V. MIX DESIGN

The two mix procedures are referred which are:

A. Mix Method 1:

It contains following steps:

- Pre saturation of the coke particle:-In this water is added to coke. The water occupies open pore volume that is part of volume containing air.
- The admixtures are added, which are superplasticisers, aggregates,water.
- Cement binder is added.
- By using plate compactor Compaction is performed.

B. Mix Method 2:

It contains following steps:

- Dry constituents are only mixed.
- For the moisture content,water is mixed with the dry mixture.
- The admixtures are added, which are superplasticisers, aggregates..
- Rod vibrator ensures the leveling.

These mixtures uses air, plastic and burlap curing methods.Compressive strength is calculated consequtively beginning on the 3rd day following the 7th andthen terminated on the 28th day from the formation of the concrete block. Ratios and proportions required can be predetermined based on the conductivity desired.

VI. MEASUREMENT STANDARDS

Shielding measurement is measuring attenuation value provided by material.

It contains two measurements:

- Reference measurement: In this incident waves are measured on receiver side excluding the conductive block .
- Load measurement: In this transmitted signal is measured on receiver side with the shielded material.

Standards prevalent to measure shielding effectiveness are:

- ASTM ES7-83: It is used for frequency ranges 0 to 5 GHz having lower contact resistance.
- ASTM D4935-99: Used for frequencies 30 MHz upto 1.5 GHz and extended till 18GHz.
- ASTM E1851: Used for three frequency bands 1) **300 upto 500 MHz, 2)900 upto 1000MHz & 3)8.5 upto 10.5 GHz and extended from 50 Hz upto 40 GHz.**
- MIL-STD-285: it is used for the frequency range **100 KHz upto 10,000 MHz .**
- IEEE-1997: Range of frequency from **9 kHz upto 18 GHz (can be decreased to 50 Hz and increased to 100 GHz).**
- MILSTD 188 -125: Military Standard 188 is mainly used for tactical and long-haul communications. The MILSTD 188 series is classified into series 100 for tactical & long haul communications; 200 series, includes methods made for tactical communication exclusively; and 300 series for long-haul communication only.
- MILSTD 188-125A:H-EMP hardening for on-ground fixed facilities performing critical and time-urgent C41missions.
- MILSTD 188-125 1)**:**H-EMP hardening for facilities that are fixed.
- MILSTD 188-125 2): H-EMP hardening made fore systems that are transportable .

VII. EXPERIMENTAL SETUP

Measurement procedure:

Loop antenna, transmitter antenna is separated from test area by 30 cm.It is placed outside the barrier made up of shielded material i.e electromagnetic barrier & focused on test area .Receiver antenna is placed inside the barrier.The measurements are taken in two ways:

a) Stationary measurement:

In this antenna on receiver side is focused on test area in such a way that loop are in same plane as transmitting one.
For transmitting antenna polarization, frequency and test area received signal strength is measured on receiver side.

b) Swept measurement:

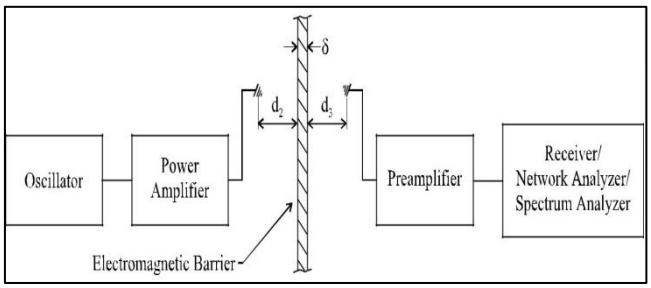
In this, receiver loop antenna is rotated over test area approximately 5cm to 60cm distance from test area .it is rotated till maximum strength is obtained.Here strength measured is denoted by Vm.

Calibration procedure:

In this signal strength is measured for frequency, transmitting antenna polarization,Antennas are at least 1 m above the ground.Receiving antenna is moved +-30cm from it's nominal position to get maximum radiation.

Here strength measured is denoted by Vc.So shielding measured is

$$SE = 20 \log \left(\frac{V_c}{V_m} \right)$$



VIII. APPLICATIONS

Conductive concrete which we exclusively used for building enclosure is used for defence can be used for other applications like :

- Anti-static flooring in electronic instrumentation industry & in hospitals.
- Cathodic protection of steel reinforcement in concrete structures such as bridges and parking garages.
- Used for heating(de-icing) during snowfall.
- It has the potential to address other applications, including grounding and heating

IX. CONCLUSION

EM waves are guided along the building structure due to conductive materials used .These materials cause reflections, absorption and re-reflection of incident electric and magnetic fields. This attenuates passing of EM fields through the walls .Further,corrosion may occur due addition of excess water for coke and regular water cement ratio, leading to reversal and annulment of conductivity.Thus properties of coke breeze are verified for its effect of compressive strength as well as coke and regular water cement ratio, leading to reversal and annulment of conductivity.Thus properties of coke breeze can be verified for its effect of compressive strength as well.

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