EXPERIMENTAL STUDY ON THE SHIELDING OF EMF RADIATION ON EARTHEN BUILDING

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Abstract— The purpose of this study is to provide shielding for earthen structure from Electro Magnetic Frequency (EMF) radiations that are incident on it. These radiations are harmful to the human body when exposed to in large quantities. The natural source of EMF radiations is the Sun, and other sources include mobile transmission towers, radio waves, satellite DTH, etc. Shielding the structure from these radiations helps in reducing the temperature of the structure. Tests were conducted using different samples of soil along with various proportions of cement and fibers to get the optimum ratio of materials and finally constructed a prototype to test the amount of radiations that were being allowed into the structure. A micro-fiber mesh was used, with a pore size of about 2.5 cm diameter which acted as a reinforcement layer between the walls of the prototype structure which were of 40 cm thickness. Metal plates are used to form the roof and door of the structure. The earthen structure is compared with a concrete structure from EMF shielding properties, reduction in temperature, and relative humidity. Thus, the results obtained by this study could help in shielding from Electromagnetic Frequency radiations.

Keywords— EMF shielding, Earthen structure, thermal comfort, Electro magnetic wave shielding.

I. INTRODUCTION

Smart phones, television, wifi, blue tooth devices, etc. are part and parcel of routine life. It also brings in harmful side effects. A century ago most homes generated electric and magnetic fields only in the range of 50 - 60 HZ. Today, The generation of Electro magnetic field from the personal computers, wifi and mobile phones has amplified into multi-fold.
Urbanisation and the materials used for construction retains huge amount of Electro magnetic radiation in the thermal region and wireless communications is bombarding vibrations in microwave regions . Hence, An attempt was made to check and regulate the EM radiations to enter the living space. The advantage of reducing the radiation helps in human comfort and well being.
Earthen structures are usually environmental friendly and use very little energy consumption by way of manufactured or processed materials. The amount of energy consumed in construction is low therefore reducing the environmental impact.

EM radiation in buildings

Electro magnetic radiations could exist in buildings in various forms such as very low frequency (VLF), earth radiation, photon line, 400 meter grid earth magnetic grid line, water vein over 1000mm wide (ground floor only), EM radiations from electrical systems, Radio frequency and micro wave fields from Wifi/smart meters and appliances, Digital TV beams.
EM radiation gets stored in human body in the form of energy, meaning the molecules in issue directly exposed to radiation get excited (in other words they heat up). We are subjected to natural radiation all day long to terrestrial radiation, cosmic radiation, etc.

Compared to concrete structures, Earthen structure with extra thickness to walls gives it an added protection against the EM radiations. Usually earthen structures do not have reinforcement inside them, as they can withstand large amount of compressive forces. Thus, reinforcement are added to counteract the tension in the structures.
According to Dr. Edward group, global healing center (28 Apr, 2014), Many individuals report nausea, problems in sleeping and concerntrating and even hyper activity as a result of constant EM and radio frequency (RF) exposure. EM radiation is nearly impossible to get away from. There are different methods by which its radiation can be reduced such as using

- Y-shield paint and air pure paint, using EM
- EM/RF shielding film
- Micro fiber mesh etc.,

The scientific community remains unsure of the long-term effects of EM/RF exposure has on our health, especially at the levels we experience today. We do know a great many individuals complain of symptoms related to chronic frequency exposure, symptoms that often go away once the EM/RF source is reduced or eliminated.

The sustainable architecture encourages the usage of locally available materials and earthen buildings as a replacement for reducing usage of cement as construction mateial. The earthen buildings in addition to reducing EM radiations that enter the building, It reduces temperature and the humidity of the structure thereby providing thermal comfort inside the buildings and reducing formation of urban heat islands(UHI).

II. DETAILS EXPERIMENTAL

Materials and Procedures

Experimental investigations done on the soil samples, the tests conducted on the different mix design ratios and details on the construction of the model structure. The basic properties of the materials used for constructing earthen and concrete structure was done. The compressive strength of blocks with different proportion of cement was red soil computed. The EM radiation measurement were compared for earthen and concrete structures.

Sieve analysis was conducted on the soil samples to get their optimum grain size distribution. The results obtained for alluvial and red soil respectively. Graphs are plotted to give optimum size of the soil samples.

The inference from the tests conducted on both the soil states that, most of the alluvial soil particles lie in the range of 600 micron, whereas the particles of red soil lie in the range of 300 -150. Thus, red soil is preferred for the construction of the model over alluvial soil.

Construction of model

A model was constructed based on the finalized mix proportion of materials. The dimensions of the model are 3 feet height with 4 feet on sides and with 40 cm thick wall with micro fiber mesh at the center.

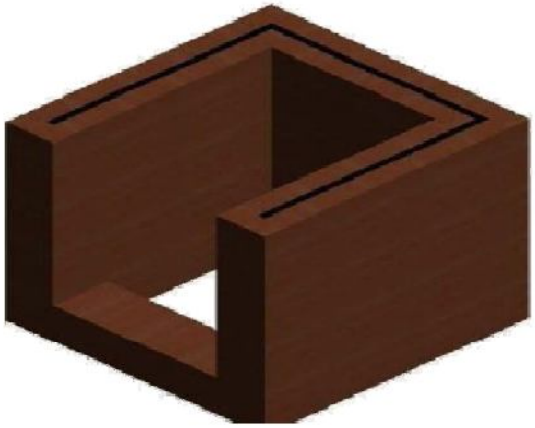


Figure 2.1 Earthen structural model.

III. RESULTS AND DISCUSSION

3.1 Compressive test results

Red soil samples have more compressive strength and its strength in MPa for different mix design are given in the table.

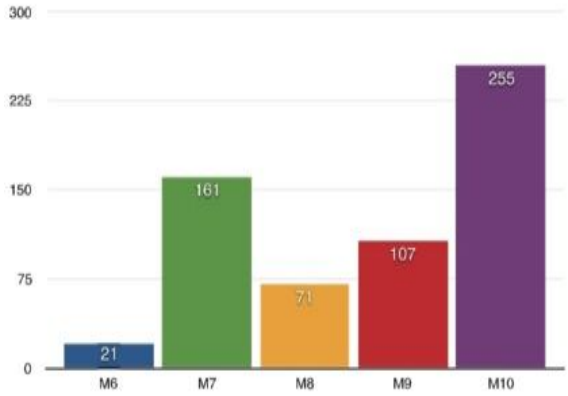
Table 3.1 Mix Design and compressive strength

Mix design	Compressive strength (MPa)	Mix design	Compressive strength (MPa)
M1	0.9	M6	1.7
M2	1	M7	4.17
M3	1	M8	2.4
M4	1	M9	2.9
M5	1.4	M10	4.95

Comparing the strength of the cubes, M5was selected as the base specimen. It provides a compressive strength of 1.4MPa, where as M8 provides a compressive strength of 2.4MPa, which is a 71.4% increase in the compressive strength. M7 provides a compressive strength of 4.17 which is about 160% increase.. Since the reduction of cement is one of the main aims of an earthen structure, the optimum specimen is agreed as M9, consisting of 10% of the overall cement content.

MIX DESIGN	PERCENTAGE INCREASE
M6	21%
M8	71%
M7	161%
M10	255%
M9	107%

The table and the graph provide the increase in the percentage of compressive strength given by different mix ratios.



3.2. EM reduction performance

The structure was tested for the amount of EM radiation that were present in the outside environment and inside the structure. The amount of EM radiations generated naturally by the environment, and by a transmission of about 8mWwere tested both inside and outside the earthen structure. Comparison of the performance of concrete structure was also done and significant radiations enter the concrete structures but Earthen walls shield the radiations.

Comparison of EM radiation inside and outside the earthen structure without transmission.

Table3.2 Earthen structure without transmission

Transmitted Power (mW)	Outside structure nW	Inside structure nW	Location of instrument
0	143	-249	Center
0	149	-216	Corner
0	131	-212	Corner
0	127	-191	Corner
0	116	-185	Corner

It can be inferred that the normal outside radiations are not able to penetrate inside the earthen structure when the radiation present outside the structure is between the range of 100nW to 180nW. Similar comparison is made with the outside and the environment inside the structure while transmitting a frequency of 8mW, the results obtained are tabulated.

Table 3.3 Earthen structure with transmission

Transmitted Power (mW)	Outside structure nW	Inside structure nW	Location of instrument
8	465	-296	Center
8	483	-212	Corner
8	667	-271	Corner
8	371	-191	Corner
8	218	-185	Corner

Similar test was conducted in the concrete structure and the results are tabulated.

Table 3.4 Concrete structure without transmission

Transmitted Power (mW)	Outside structure nW	Inside structure nW	Location of instrument
0	95	31	Center
0	107	33.5	Corner
0	81	31	Corner
0	61	23	Corner
0	53	21	Corner

Table 3.5 Concrete structure with transmission

Transmitted Power (mW)	Outside structure nW	Inside structure nW	Location of instrument
3	310	109	Center
3	316	117	Corner
3	288	103	Corner
3	216	95	Corner
3	193	89	Corner

3.3. Temperature and humidity performance

The temperature and relative humidity of earthen and concrete structures along with the environment were studied at about 2 p.m., The results are as noted in the table.

Table Earthen structure thermal comfort

Location	Temperature ^{0}C	Relative Humidity
Outside structure	36.1	56%
Inside structure	35.5	61%

Table 3.6 Concrete structure thermal comfort

Location	Temperature ^{0}C	Relative Humidity
Outside structure	34.7	63%
Inside structure	35.5	59%

CONCLUSION

From this experimental study, It is evident that earthen structure can shield the EM radiations which leads to a better environment for indoor space. Electromagnetic frequency radiations like mobile phones, wifi, microwave ovens, digital meters etc. Thus, this type of structure can also be used for defence structures which need to be hidden bunkers and various other storage units where reactive chemicals and other materials are stored.

Comparing the earthen structure with a concrete structure, It is inferred that the concrete structure allows about 40% of the radiations to pass through whereas the earthen structure completely shields itself from the radiations. Thus, the earthen structure along with micro-fiber mesh inside is significant in reducing temperature, increasing the humidity levels and the reduction in EM radiations than concrete structures. Further research is required to check the performance and suitability of earthen structures for reducing Urban heat Island (UHI) effect.

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