Reflection and Transmission Coefficient for Layered Propagation Model

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I. ABSTRACT

Two types of radio propagation modals are developed on the basis of material layer structures. One is three layer propagation model consist of three different material layer. Second one is five layer propagation models which is the extension of three layer propagation models. It consist of five different material layer with their respective thickness is considered. By using these two models the reflection and transmission coefficients are obtained. Material characteristics of concrete and Ferro concrete are also obtained at different operating frequency ranges from 433 MHz to 2 GHz. These models help us to find the detection range for layered material base structures.

Keywords: Reflection Co-efficient, Transmission co-efficient, Loss tangent, MATLAB, Layered Propagation.

II. INTRODUCTION

During disasters and natural calamity buildings and furniture's are destroyed. Human body lay down below the destroyed buildings and partial destroyed structures. Search and Rescue process is the primary thing. It is considered that the destroyed structures are made from several layers of materials. Each material is characterized by different electromagnetic properties. Electromagnetic properties depend upon the conductivity and permittivity of the material. Layers with different electromagnetic properties show different attenuation level at different frequencies. The study of characteristics of material has been done. Complex permittivity of material is studied and loss tangent of material is plotted against the frequency. Layered propagation model has been used and reflection and transmission coefficient is achieved against the frequency for the three layer propagation model and this is further extended to the five layer propagation model with each layer of different material. By achieving reflection and transmission coefficient it is easier to obtain the attenuation of propagation model and also for the detection range. A first microwave life detection system was developed by using the concept of remotely observed physiological status of a wounded subject lying on ground at maximum distance of 30 meter [1] .The localization of human beings behind collapsed structure using the x band was also developed [2] .Body movements were detected at distance of 3 to 5 meter without any obstacle and of 2 meter behind a concrete wall [3] .Widespread use of mobile phones by the general public, an innovative idea to retrieve victims or to track rescue teams [4].

Third section consists of material characteristics of concrete and Ferro-concrete material. Fourth section consists of propagation models and their types out of which layered propagation model is developed for three layer and five layer propagation model. Last section consists of conclusion.

III. MATERIAL CHARECTERSTICS

Material is characterized by its electromagnetic properties permittivity, conductivity. Concrete and Ferro-concrete materials show large attenuation. Complex permittivity of some materials is given.

Table 1 Permittivity of material at different frequency [5]

Materials	1 GHz	2 GHz
Brick	3.8-0.14j	3.8-0.27j
Concrete	[5….9]-[0.4…0.7]j	[5….9]-[0.4…0.7]j
Stone	6.5-0.54j	6.5-0.3j
Glass	5.5	5.5
Wood	2.5-0.40j	2.5-0.50j

CONCRETE

Structures made from material concrete shows large spread value of attenuation.

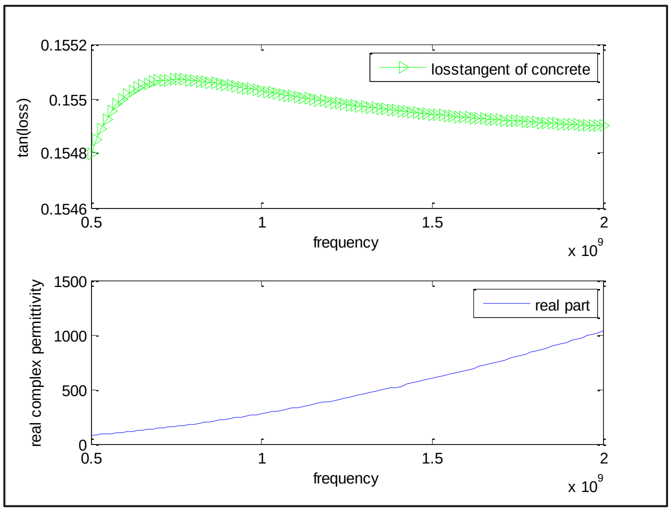

Figure 1 Material characteristics of concrete at 2 to 6 GHz

FERRO-CONCRET

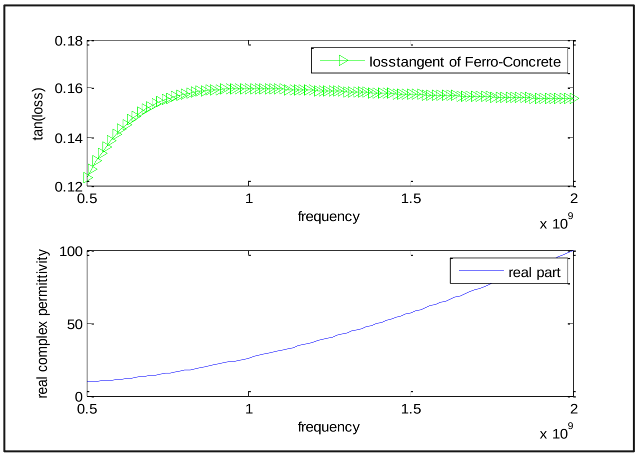

Figure 2 Material characteristics of Ferro-concrete at 2 to 6 GHz

IV. PROPAGATION MODELS

Propagation models are used for the partially collapsed structure scenarios are listed below [5].

1. Layered propagation model
2. Spherical scatter propagation model
3. Slab based propagation model

V. LAYERED PROPAGATION MODEL

Propagation model is developed by using layers of different materials. No of layers which are used to develop propagation model is of uniform thickness. Material layers are of different permittivity and conductivity with different intrinsic impedances. Propagation of Electromagnetic wave is from one layer to other layer. Then reflection and transmission of electromagnetic wave from layers are obtained. Here we present three material layer propagation models and this model extended to the five material layer propagation model with their reflection and transmission coefficient.

VI. THREE LAYER PROPAGATION MODEL

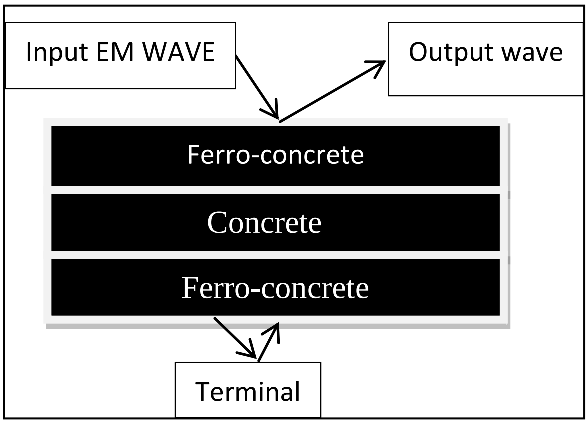

Figure 3 Three layer propagation model based on three material layers.

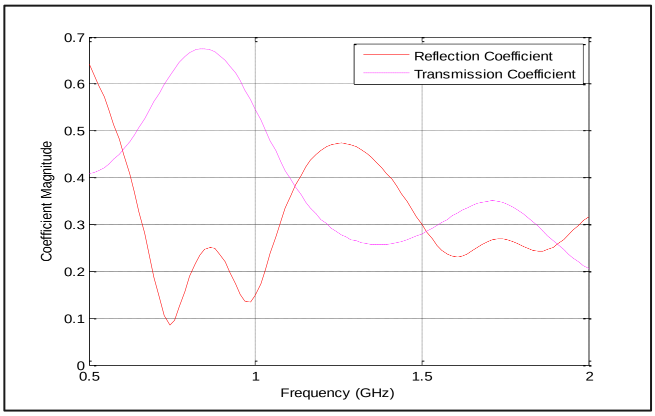

Figure 4 Reflection and transmission coefficient of three layer propagation model at 55° angle.

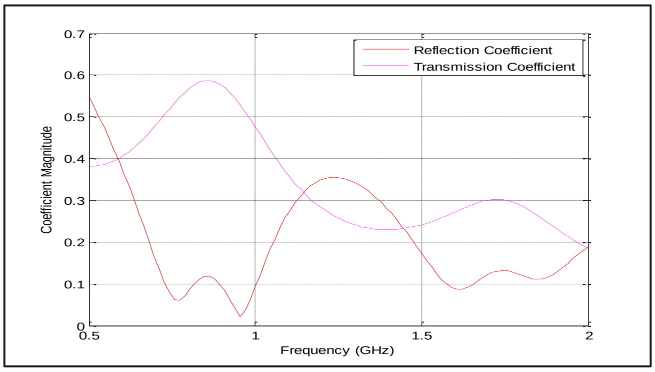

Figure 5 Reflection and transmission coefficient of three layer propagation model at 65° angle

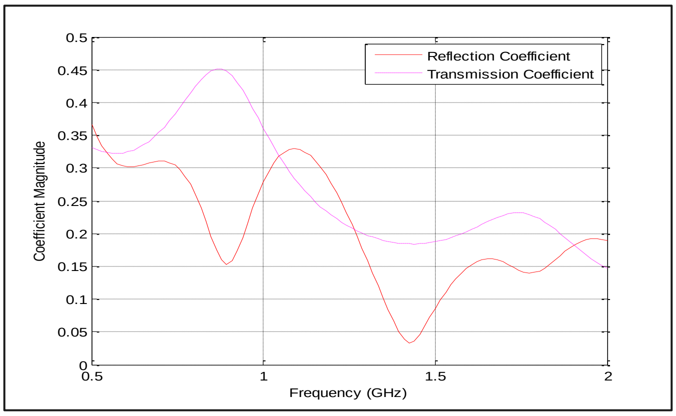

Figure 6 Reflection and transmission coefficient of three layer propagation model at 75° angle

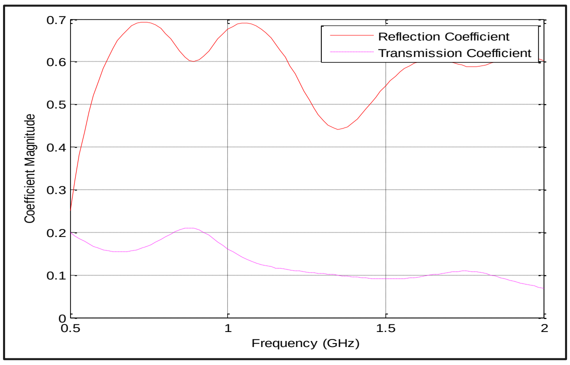

Figure 7 Reflection and transmission coefficient of three layer propagation model at 85° angle

VII. FIVE LAYER PROPAGATION MODEL

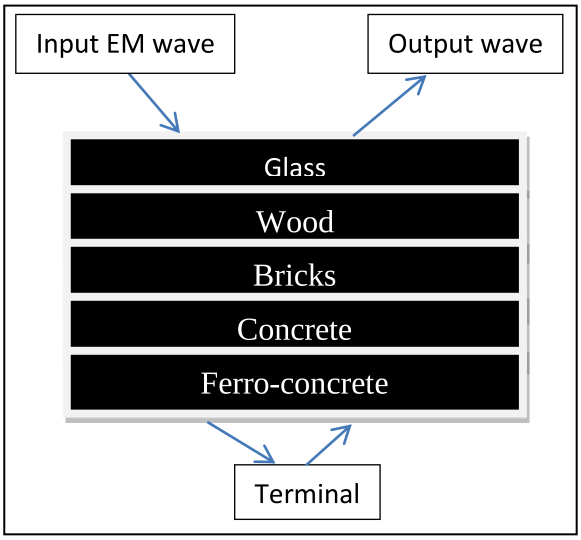

Figure 8 Five layer propagation model based on five different material layers.

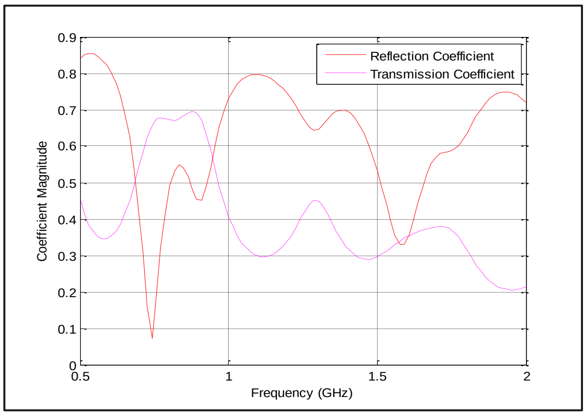

Figure 9 Reflection and transmission coefficient of five layer propagation model at 55° angle

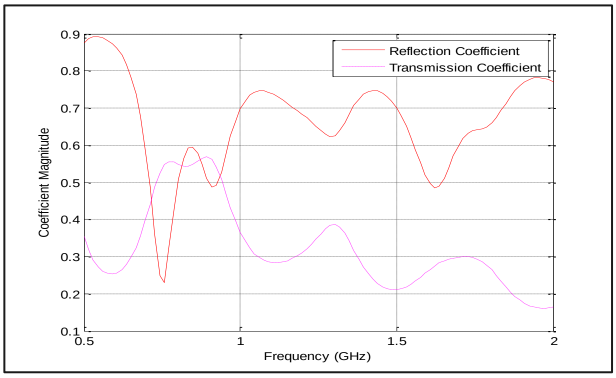

Figure 10 Reflection and transmission coefficient of five layer propagation model at 65° angle

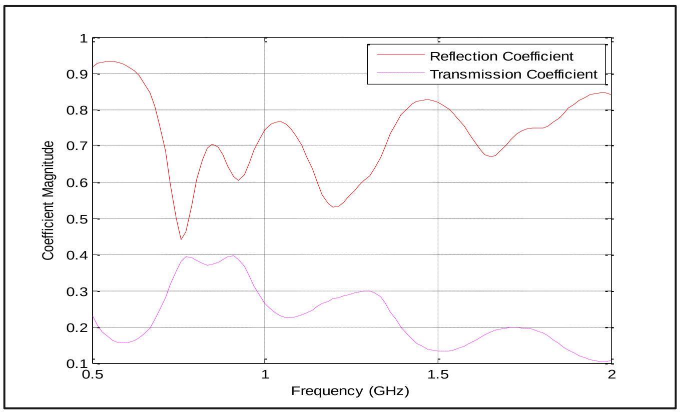

Figure 11 Reflection and transmission coefficient of five layer propagation model at 75° angle

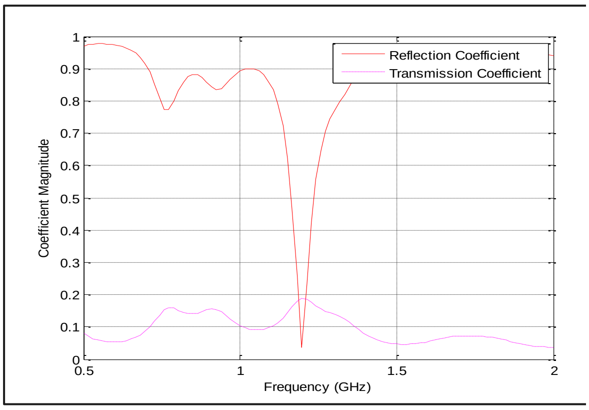

Figure 12 Reflection and transmission coefficient of five layer propagation model at 85° angle

VIII. CONCLUSION

Ferro-concrete provides higher loss tangent than concrete that gives more reflection of input EM wave than that of concrete. Sharp peak is obtained in reflection and transmission coefficient for both the models. Sharp peak varies according to the angle of incident of wave and material characteristics. It may help to obtain the detection range of both the transmission models (three material layer and five material layer propagation model).

IX. FUTURE WORK

Present work has been done for parallel slab structure made of different materials. The same work proposed to be done for edge surfaces and spherical scatter type structures.

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