DESIGN OF WIRE MESH SHIELD AND TESTING OF ITS PERFORMANCE.

Soumya Biswas, Piyali Rakshit, ***ECE, JIS College of Engineering, Kalyani, Nadia, W.B., India, e-mail: soumya04@rediffmail.com***

T.K. Dey, ***Co-Coordinator, Kanchrapara Study Center, IGNOU, Kanchrapara, N-24 Pgs.,W.B.India, e-mail: ignou_kanch@sify.com***

ABSTRACT

Shields are used

1) To confine or 2) to prevent radiated energy to / from a region. The authors of this paper dealt with only the shield concerning non-ionizing electromagnetic energy. In this paper the shield designed is only to protect human beings from electromagnetic radiation. For that purpose a partition like shield has been designed. Now-a-day a considerable number of human beings have to work or reside in places where EMI is considerable. So they suffer physically or psychologically. Hence EMI-shield has become a necessity.

Human beings receiving EMI are suggested to wear specially designed aprons. But to protect human beings from electric, magnetic and electromagnetic fields use of apron with multilayer shields are the recommendation.

As for example Copper may be used to reflect electric field and mu-metal may be taken to absorb magnetic field. But the piece of mu-metal must be thick. This makes the apron weightier. So there should be optimization between the weight of shield and the magnetic field to cancel by the electromagnetic shield.

Design of wire mesh shields:

In this regard wire mesh shield is the best. The shielding effectiveness (S.E.) of a wooven material

For electric field.

i. Decreases with increase in frequency, and ii. Increases with increase in the density of weave And

For magnetic field.

i. Increases with increase in frequency,
ii. Increases with increase in density of wooven material, and
iii. Increases with increase in permeability of the material of the shield.

Honeycomb materials should not be used with the shield as it increases weight. The human body itself increases the mechanical strength of the shield.

The authors designed the wire mesh shield in two steps. At first a shield with multiple apertures was designed. During design the following precautions have been taken:

i. All the apertures are of same dimensions.
ii. The centres of any two consecutive apertures are placed at a distance 'c' which is less than half of the wavelength of the field ($\lambda/2$) i.e. d< $\lambda/2$ [in this case reduction in shielding effectiveness becomes minimum].
iii. The apertures are placed at a distance (edge to edge) 's', where s< $\lambda/2$ and $s=\sqrt{n}$, where n=total number of apertures.
iv. Loss due to reflection=R= 20log (λ/2d) - 10log (n).
v. s< λ/2>d>t, where 't' is the thickness of the shield.

In second step a wire mesh shield has been designed. The following points were recommended during design:

i. Each intersection has a good electrical contact.
ii. Point (i) to (v) of previous design were undertaken.

When thickness is much greater than the diameter of the mesh or hole and the distance(r) between the source and shield is much lesser than the diameter of the hole then the shielding effectiveness is (S.E.)= 20log (λ/2d) - 10log (n)+27.3(t/w) , where w=d for circular holes. This design was also tested under real world situation and found in good agreement with the theoretical value of S.E.That was done for different frequencies and thickness.

For the protection of human body the mass of the shield should be considered in such a way that it must not create any discomfort to the user .The shields designed by the authors may easily be acceptable to human beings for the protection of entire body except the eyes.