The fields obtained from (2) and (3) are the so-called "transverse" electric fields since $E_z(m, n)$ vanishes.

Following an identical procedure, the $\overline{N}$ solution leads to

$$E'_{m,n} = \overline{N}_{m,n} = -\frac{j}{\gamma_0}\nabla \times \nabla \times \left\{ \hat{u}_z[K_3 J_m(\beta r) + K_4 Y_m(\beta r)]e^{\pm jm\theta} \cos\left(\frac{n\pi}{b} z\right)\right\}$$

$$m, n = 0, 1, 2 \cdots. \quad (4)$$

Again the corresponding magnetic field, $\overline{H}'_{m,n}$, can be found using (3). These fields are the so-called "transverse" magnetic fields since $H'_{z(m,n)} = 0$.

It is also possible to derive the magnetic fields from the $\overline{M}$ and $\overline{N}$ solutions by requiring that $\hat{n}\cdot\overline{M} = \hat{n}\cdot\overline{N} = 0$ at $z = 0$ and $z = b$, and then use (3) to determine the components of the electric fields.

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Surface Waves on Symmetrical Three-Layer Sandwiches*

The theory of surface waves on plane dielectric slabs has been presented by Plummer and Hansen.[1] Additional numerical results are shown in Figs. 1 and 2 for the lowest order TM and TE modes that can exist on a grounded dielectric slab. The slab has thickness d_s, and a relative dielectric constant of 4. It is separated by an air gap of thickness a from the ground plane. c/v represents the ratio of the velocity of light in free space and the phase velocity of the surface wave. By image theory, these modes (TM_0 and TE_1) can also exist on a symmetrical, three-layer, air-core sandwich to which the given numerical data also apply.

Figs. 3 and 4 show similar data for the TM_1 and TE_0 modes. These modes disappear if a ground plane is inserted at the center of the sandwich. For this reason, these modes are usually ignored in the literature.

The fields of a surface wave decay as $e^{-\alpha x}$, with distance from the surface of the plane structure. The attenuation constant α, is not independent but is directly related to the phase velocity by $(\alpha\lambda_0)^2 = 4\pi^2[(c/v)^2 - 1]$, as shown in Fig. 5. This may be called a universal curve of $\alpha\lambda_0$ vs c/v, because it applies to TE and TM modes on any lossless plane structure.

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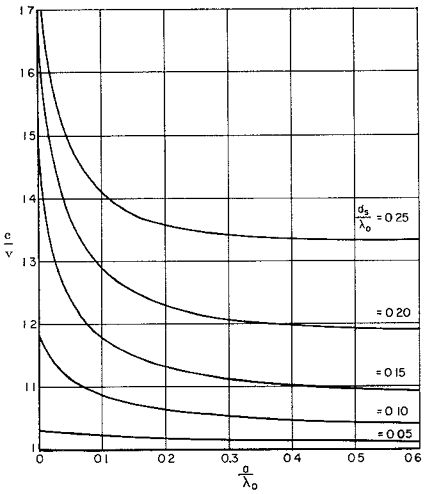

Fig. 1—Phase velocity ratio vs core thickness for the TM_0 mode on an air-core sandwich. (Data also apply to a single slab over a ground plane, with an air space.)

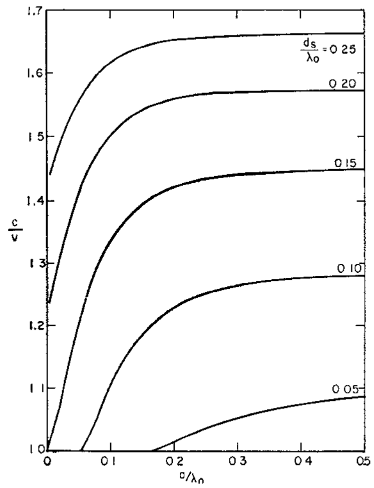

Fig. 2—Phase velocity ratio vs core thickness for the TE_1 mode on an air-core sandwich. (Data also apply to a single slab over a ground plane, with an air space.)

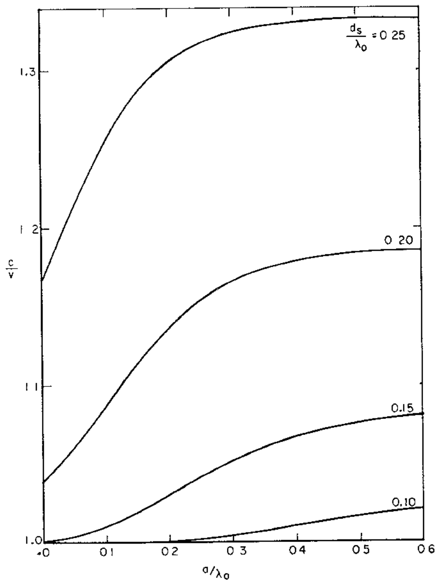

Fig. 3—Phase velocity ratio vs core thickness for the TM_1 mode on an air-core sandwich.

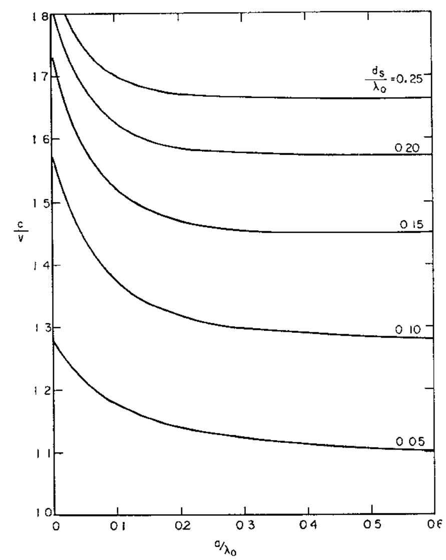

Fig. 4—Phase velocity ratio vs core thickness for the TE_0 mode on an air-core sandwich.

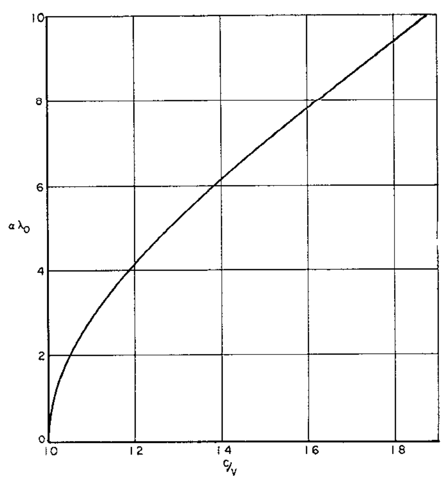

Fig. 5—Universal curve of $\alpha\lambda_0$ vs c/v.

* Received by the PGMTT, June 20, 1960.

[1] R. Plummer and R. Hansen, *Proc. IEE*, pt. C, mono. 238R; May, 1957.