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LOVE WAVE SCATTERING DUE TO A SURFACE IMPEDANCE

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The paper presents a theoretical formulation for studying the problem of Love wave scattering due to the presence of a surface impedance. The displacements are obtained in terms of Fourier transforms by using the Wiener–Hopf technique. Evaluation of the Fourier integrals along suitable contours in the complex plane gives the scattered Love waves appropriate to the surface impedance. The scattered waves have a logarithmic singularity at the tip of the scatterer and behave as decaying cylindrical waves at distant points. Numerical results for the scattering coefficient close to the scatterer and the amplitude of the reflected wave versus the wavenumber have been obtained.

Keywords: Love waves, Fourier analysis, scattering, amplitude, Wiener–Hopf analysis, wavenumber

1. Introduction

It is supposed that there is a discontinuity in the free surface such that there is a thin smooth uniform distribution of matter on half of the surface $x<0$, $z=-H$ and the other half of the surface $x>0$, $z=-H$ is free. The effect of distribution of matter is such that it exerts surface traction proportional to the acceleration in a direction perpendicular to the vertical plane through the direction of propagation.

The model can be idealized to scattering of seismic waves due to irregularities or discontinuities in the upper surface of the crust. For example, rigid boundaries on the surface of the earth may resist the motion of the waves and force the particles of the material beneath it to have horizontal polarization. GREGORY [1966] studied the attenuation of Rayleigh waves due to the presence of a surface impedance; DESHWAL and GOGNA [1987] have considered the problem of diffraction of compressional waves due to surface impedance; the problem of scattering of a Rayleigh wave due to the presence of the edge of a thin surface has also been considered by SIMONS [1976]. The mathematical formulation of the present paper is based on a paper by SATO [1961] who studied the problem of propagation of Love waves for a surface layer of variable thickness.

Here, we propose to discuss the problem of scattering of Love waves due to the presence of an impeding surface. The method of solution is the application of Fourier transformation and the Wiener–Hopf technique. A time-harmonic Love wave is incident on the impeding surface ($x<0$, $z=-H$) from the region $x>0$. The discontinuity at the surface gives rise to the Love waves appropriate to the surface impedance and the waves scattered due to the impedance.

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Let us consider a layered structure with a surface layer of thickness H with its co-ordinate system at a point in the interface between the layer and a solid halfspace *(Fig. 1)*. The velocities of shear waves and rigidities are taken to be v_1, μ_1 in the solid halfspace and v_2, μ_2 in the surface layer. Let the incident wave be [Sato 1961]

$$\begin{aligned} v_{0,1} &= A\cos(\beta_{2,N}H)\exp(-\beta_{1,N}z - ik_{1,N}x), \qquad z \geqq 0 \\ v_{0,2} &= A\cos(\beta_{2,N}(z+H))\exp(-ik_{1,N}x), \qquad -H \leqq z \leqq 0 \end{aligned} \tag{1}$$

where

$$\beta_{1,N} = \sqrt{(k_{1,N}^2 - k_1^2)}, \qquad \beta_{2,N} = \sqrt{(k_2^2 - k_{1,N}^2)}, \tag{2}$$

and $k_{1,N}$ is a root of the equation

$$\tan \beta_{2,N} H = \gamma \frac{\beta_{1,N}}{\beta_{2,N}}, \qquad \gamma = \frac{\mu_1}{\mu_2} \tag{3}$$

The wave equation in two dimensions is

$$(\nabla^2 + k_j^2)v_j = 0, \qquad j = 1, 2, \qquad |k_1| < |k_2| \tag{4}$$

and

$$k_j = \sqrt{\left(\frac{\omega^2 + i\varepsilon\omega}{v_j^2}\right)} = k_j' + ik_j'' \tag{5}$$

$\varepsilon > 0$ is a damping constant and the displacement has a time factor $\exp(-i\omega t)$. k_j is complex whose imaginary part is positive and small. We define the Fourier transforms

$$\begin{aligned} \bar{v}_j &= \int_{-\infty}^{\infty} v_j e^{ipx}\,dx, \qquad p = \xi + i\eta \\ &= \int_{-\infty}^{0} v_j e^{ipx}\,dx + \int_{0}^{\infty} v_j e^{ipx}\,dx \\ &= \bar{v}_{j-} + \bar{v}_{j+} \end{aligned} \tag{6}$$

If for given z,

$$|v_j| \sim \exp(-k_1''|x|) \qquad \text{as} \qquad |x| \to \infty \tag{7}$$

then $\bar{v}_{j+}$ is analytic for $\eta > -k_1''$ and $\bar{v}_{j-}$ for $\eta < +k_1''$.

$\bar{v}_j$ is therefore analytic in the strip $-k_1'' < \eta < k_1''$ of the complex p plane.

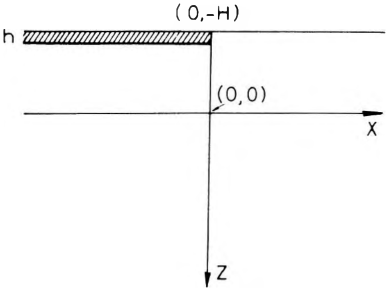

Fig. 1. The geometry of the model

1. ábra. A felvett modell

Рис. 1. Геометрия модели

2. Boundary Conditions

If the total displacements are denoted by

$$\begin{aligned} v &= v_{0,1} + v_1, \qquad z \geqq 0 \\ v &= v_{0,2} + v_2, \qquad -H \leqq z \leqq 0 \qquad -\infty < x < \infty \end{aligned} \tag{8}$$

then the conditions on the boundaries are

(i) $$v_1 = v_2 \qquad z = 0 \tag{9}$$

(ii) $$\mu_1 \frac{\partial v}{\partial z} = \mu_2 \frac{\partial v}{\partial z} \quad \text{or} \quad \gamma \frac{\partial v_1}{\partial z} = \frac{\partial v_2}{\partial z}, \qquad z = 0 \tag{10}$$

(iii) $$\mu_2 \frac{\partial v}{\partial z} = 0 \quad \text{or} \quad \frac{\partial v_2}{\partial z} = 0, \qquad z = -H, \qquad x \geqq 0 \tag{11}$$

(iv) $$\mu_2 \frac{\partial v}{\partial z} = av, \quad \text{on} \quad z = -H, \qquad x \leqq 0, \qquad \text{ie.,}$$

$$\mu_2 \frac{\partial v_2}{\partial z} - a[v_2 + A \exp(-\mathrm{i}k_{1,\mathrm{N}}\, x)], \qquad z = -H, \qquad x \leqq 0 \tag{12}$$

where a is a constant depending upon the nature of the material of the impeding surface. The boundary condition (12) may be interpreted as representing the physical situations that (i) there is a thin smooth uniform surface distribution of matter exerting surface traction proportional to the acceleration along a direction in the horizontal plane perpendicular to the vertical plane through the direction of propagation or (ii) at each point of the surface, there is a resisting or a restoring force proportional to the velocity along the normal to the vertical plane through the direction of propagation. GREGORY [1966] has given various explanations for this condition in the case of Rayleigh waves.

3. Solution of the problem

We begin by taking a Fourier transform of (4) to find

$$\frac{\mathrm{d}^2 \bar{v}_j}{\mathrm{d}z^2} - \beta_j^2 \bar{v}_j = 0, \qquad \beta_j = \pm \sqrt{(p^2 - k_j^2)} \tag{13}$$

The sign before the radical in (13) is such that the real part of $\beta_j \geqq 0$ for all p. The solution to (13) is

$$\bar{v}_1(p, z) = B(p) \exp(-\beta_1 z), \qquad z \geqq 0 \tag{14}$$

$$\bar{v}_2(p, z) = C(p) \exp(-\beta_2 z) + D(p) \exp(\beta_2 z), \qquad -H \leqq z \leqq 0. \tag{15}$$

Using the boundary conditions (9) and (10), we find

$$\bar{v}_2(p, z) = \frac{B}{\beta_2}(\beta_2 \cosh \beta_2 z - \gamma\beta_1 \sinh \beta_2 z) \tag{16}$$

$$\bar{v}_1(p, z) = \bar{v}_1(p, 0) \exp(-\beta_1 z) \tag{17}$$

$$\bar{v}_1(p, 0) = B \tag{18}$$

We use the notation $\bar{v}_1(p)$ for $\bar{v}_1(p, -H)$, etc. thus the conditions (11) and (12) result in

$$\overline{v'_2}_{+}(p) = 0 \tag{19}$$

$$\mu_2 \overline{v'_2}_{-}(p) = a\bar{v}_{2-} + \frac{aA}{\mathrm{i}(p - k_{1,N})}, \quad \eta < \mathrm{Im}(k_{1,N}). \tag{20}$$

Adding (19) and (20), we find

$$\overline{v'_2}(p) = \frac{a\bar{v}_{2-}}{\mu_2} + \frac{aA}{\mathrm{i}\mu_2(p - k_{1,N})} \tag{21}$$

From (16), it is obtained that

$$\bar{v}_2(p, z) = \frac{\beta_2 \cosh \beta_2 z - \gamma\beta_1 \sinh \beta_2 z}{\beta_2 \cosh \beta_2 H + \gamma\beta_1 \sinh \beta_2 H}\bar{v}_2(p) \tag{22}$$

and from here, we get

$$\overline{v'_2}(p) = -\beta_2 \frac{\beta_2 \sinh \beta_2 H + \gamma\beta_1 \cosh \beta_2 H}{\beta_2 \cosh \beta_2 H + \gamma\beta_1 \sinh \beta_2 H}\bar{v}_2(p) \tag{23}$$

From (21) and (23), we obtain

$$\frac{a\bar{v}_{2-}}{\mu_2} + \frac{aA}{\mathrm{i}\mu_2(p - k_{1,N})} = -\beta_2 \frac{[\beta_2 \sinh \beta_2 H + \gamma\beta_1 \cosh \beta_2 H]\bar{v}_2(p)}{\beta_2 \cosh \beta_2 H + \gamma\beta_1 \sinh \beta_2 H} \tag{24}$$

We can solve the functional equation (24) for $\bar{v}_{2+}$ and $\bar{v}_{2-}$ by invoking the Wiener–Hopf technique.

Let us write

$$L(p) = \frac{F_1(p)}{F_2(p)} = \frac{\beta_2 \cosh \beta_2 H + \gamma\beta_1 \sinh \beta_2 H}{\beta_2 \sinh \beta_2 H + \gamma\beta_1 \cosh \beta_2 H} \tag{25}$$

$L(p)$ tends to 1 as $|\xi|$ tends to infinity. By an infinite product theorem [Noble 1958], $L(p)$ can be factorized. Let $\pm p_{1n}$ and $\pm p_{2n}$ ($n = 1, 2, \ldots$) be the zeros of $F_1(p)$ and $F_2(p)$ respectively. Then

$$L(p) = \left[\prod_{n=1}^{\infty} \frac{(p^2 - p_{1n}^2)}{(p^2 - p_{2n}^2)}\right] \frac{P_1(p)}{P_2(p)} \tag{26}$$

where

$$P_1(p) = F_1(p)/\prod_{n=1}^{\infty}(p^2 - p_{1n}^2)$$
$$P_2(p) = F_2(p)/\prod_{n=1}^{\infty}(p^2 - p_{2n}^2) \tag{27}$$

are non-zero functions of p. Further if

$$P(p) = P_1(p)/P_2(p) = P_+(p)P_-(p) \tag{28}$$

then

$$\log P_+(p) = \frac{1}{2\pi i}\int_T \frac{\log P(\zeta)}{\zeta - p}\,d\zeta$$
$$= \frac{1}{2\pi i}\int_T \frac{\log F_1(\zeta)}{\zeta - p}\,d\zeta - \frac{1}{2\pi i}\int_T \frac{\log F_2(\zeta)}{\zeta - p}\,d\zeta \tag{29}$$
$$= \frac{1}{\pi}\int_0^{\infty} \frac{\Phi_1 - \Phi_2}{u - ip}\,du - \frac{1}{\pi}\int_0^{k_1} \frac{V_1 - V_2}{u + p}\,du - \frac{1}{\pi}\int_{k_1}^{k_2} \frac{du}{u + p}$$

and $P_-(p) = P_+(-p)$
where

$$\tan \Phi_1 = \beta \cos \beta H/\gamma \sqrt{(u^2 + k_1^2)} \sin \beta H$$
$$\tan \Phi_2 = \gamma \sqrt{(u^2 + k_1^2)} \cos \beta H/\beta \sin \beta H$$
$$\tan V_1 = \beta' \cos \beta' H/\gamma \sqrt{(k_1^2 - u^2)} \sin \beta' H \tag{30}$$
$$\tan V_2 = \gamma \sqrt{(k_1^2 - u^2)} \cos \beta' H/\beta' \sin \beta' H$$
$$\beta = (u^2 + k_2^2)^{1/2}, \qquad \beta' = (k_2^2 - u^2)^{1/2}$$

T is the contour shown in *Fig. 2.* Thus

$$L(p) = \prod_{n=1}^{\infty} \frac{(p^2 - p_{1n}^2)}{(p^2 - p_{2n}^2)} P_+(p)P_-(p) = L_+(p)L_-(p) \tag{31}$$

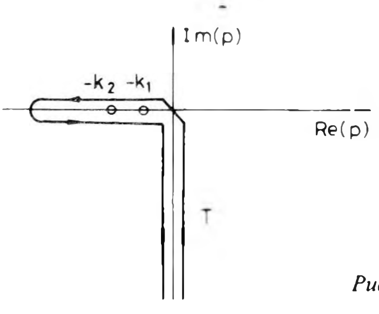

Fig. 2. Contour of integration in the complex plane

2. ábra. Az integrálási kontúr a komplex síkban

Рис. 2. Контур интегрирования в комплексной плоскости where

$$L_{\pm}(p) = \prod_{n=1}^{\infty} \frac{(p \pm p_{1n})}{(p \pm p_{2n})} P_{\pm}(p)$$

We decompose (24) as

$$\frac{1}{L_{+}(p)}\left[\sqrt{(p+k_2)}\bar{v}_{2-} - \bar{v}_{2-}(-p_{1n})\sqrt{(k_2-p_{1n})}\right] +$$

$$+ \frac{L_{-}(p)}{\sqrt{(p-k_2)}}\left[\bar{v}_{2-} + \frac{A}{\mathrm{i}(p-k_{1,N})}\right]\frac{a}{\mu_2} = \tag{32}$$

$$= -\frac{\sqrt{p+k_2}\,\bar{v}_{2+}}{L_{+}(p)} - \frac{\sqrt{k_2-p_{1n}}\,\bar{v}_{2-}(-p_{1n})}{L_{+}(p)}$$

$\beta_2 = 0$ is not a singularity in the decomposition. The left hand member of (32) has no singularity at the zeros $p = -p_{1n}$ of $L_{+}(p)$ as it reduces to $\frac{0}{0}$ form. There is a pole at $p = k_{1,N}$ and branch points at $p = \pm k_2$. Therefore the member is analytic in the region $\eta < \mathrm{Im}(k_1) = k_1''$, where $|k_1| < |k_{1,N}| < |k_2|$. Similarly the right hand member is analytic in the region $\eta > -k_1''$. By analytic continuation, they represent an entire function analytic in the strip $-k_1'' < \eta < k_1''$ and having the value $-\sqrt{k_2 - p_{1n}}\,\bar{v}_{2-}(-p_{1n}) = -\lambda$ as $|p| \to \infty$. By Liouville's theorem, each member in (32) has the constant value $-\lambda$.
Hence

$$\bar{v}_2(p) = -\frac{a}{\mu_2\beta_2}\left[\bar{v}_{2-} + \frac{A}{\mathrm{i}(p-k_{1N})}\right]L(p) \tag{33}$$

where

$$\bar{v}_{2-} = \frac{\mu_2\sqrt{p-k_2}}{\mu_2\beta_2 + aL(p)}\left[\lambda - \lambda L_{+}(p) - \frac{aAL(p)}{\mathrm{i}\mu_2\sqrt{p-k_2}(p-k_{1,N})}\right] \tag{34}$$

The displacement inside the layer is given by

$$v_2(x, z) = \frac{1}{2\pi}\int_{-\infty+\mathrm{i}\eta}^{\infty+\mathrm{i}\eta} \bar{v}_2(p, z)e^{-\mathrm{i}px}\,\mathrm{d}p$$

$$= \frac{1}{2\pi}\int_{-\infty+\mathrm{i}\eta}^{\infty+\mathrm{i}\eta} \frac{\beta_2\cosh\beta_2 z - \gamma\beta_1\sinh\beta_2 z}{\beta_2\cosh\beta_2 H + \gamma\beta_1\sinh\beta_2 H}\bar{v}_2(p)e^{-\mathrm{i}px}\,\mathrm{d}p \tag{35}$$

where $-k_1'' < \eta < k_1''$ and $\bar{v}_2(p)$ is given by (33).

4. Evaluation of the integral

If $a=0$ then $v_2(x, z) = 0$, i.e. if there is no impedance on the surface, there is no wave other than the incident wave. Let us evaluate the integral (35) along a closed contour in the upper part $\eta > -k_1''$ of the complex plane. In order that the integral along the contour at infinity vanishes $x<0$. There is a contribution due to the pole at $p=k_{1,N}$

$$v_{2,1} = -A \cos \beta_{2,N}(z+H) \exp(-ik_{1,N}x) \tag{36}$$

which cancels the incident wave. We have the poles of the equation a $L(p)+ +\mu_2\beta_2 = 0$

$$\text{i.e.} \qquad \frac{\beta_2 \cosh \beta_2 H + \gamma\beta_1 \sinh \beta_2 H}{\beta_2 \sinh \beta_2 H + \gamma\beta_1 \cosh \beta_2 H} = -\frac{\mu_2\beta_2}{a} \tag{37}$$

Let $k_{2,N}$ ($N = 1, 2, 3, \ldots$) be a root of this equation. $k_{2,N}$ represents the Nth-mode of Love waves due to the impeding surface. If we take

$$\beta'_{2,N} = \sqrt{(k_2^2 - k_{2,N}^2)}, \qquad \beta'_{1,N} = \sqrt{(k_{2,N}^2 - k_1^2)} \tag{38}$$

then (37) has the form

$$\tan \beta'_{2,N}(H-h) = \gamma\beta'_{1,N}/\beta'_{2,N} \tag{39}$$

where

$$\tan \beta'_{2,N}h = a/\mu_2\beta'_{2,N} \tag{40}$$

The impeding surface behaves as a surface layer. The pole at $p=k_{2,N}$ contributes

$$v_{2,2} = -\frac{a\beta'_{2,N}}{\cos \beta'_{2,N}(H-h)} \left[\frac{\lambda(L_+(k_{2,N})-1)}{\sqrt{(k_2+k_{2,N})}} - \frac{A}{i(k_{2,N}-k_{1,N})} \right] \cdot \frac{\cos \beta'_{2,N}(z+H-h) \exp(-ik_{2,N}x)}{G(k_{2,N})} \tag{41}$$

where

$$G(p) = \frac{d}{dp}[a(\beta_2 \cosh \beta_2 H + \gamma\beta_1 \sinh \beta_2 H) + \\ + \mu_2\beta_2(\beta_2 \sinh \beta_2 H + \gamma\beta_1 \cosh \beta_2 H)] \tag{42}$$

These are damped Love waves appropriate to the impeding surface.

Let us now take the contour in the lower part $\eta < k_1''$ of the complex plane. It has a branch point at $p=-k_2$ and the contour includes a branch cut as shown in *Fig. 3*. The integral along the infinite circular arc vanishes if $x>0$. The branch cut is obtained by taking Real $(\beta_2)=0$ [Ewing et al. 1957], and Im(β_2) changes sign along the branch cut. The contribution at the branch point $p=-k_2$ comes from its neighbourhood and we put $p=-k_2-iu$ in (35), where u is small. Since β_2 is imaginary along the branch cut, β_2^2 is negative. Therefore

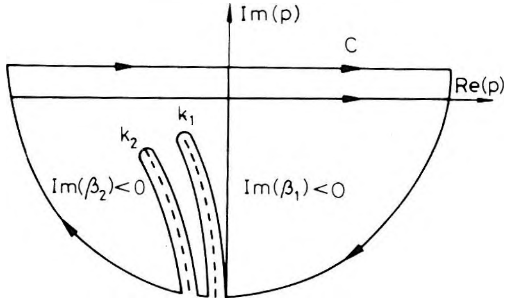

Fig. 3. The contour of integration in the complex plane with branch cuts

3. ábra. Az integrálási kontúr a komplex síkban, kettős bevágással

Рис. 3. Контур интегрирования в комплексной плоскости с двойным врезом

$$\beta_2^2 = (-k_2 - \mathrm{i}u)^2 - k_2^2 = 2\mathrm{i}u(k_2' + \mathrm{i}k_2'') - u^2 = -(2k_2''u + u^2), \qquad k_2' = 0$$

or

$$\beta_2 = \pm \mathrm{i}\beta_2', \qquad \beta_2' = \sqrt{(2k_2''u + u^2)}$$

Integrating (35) along the two sides of the branch cut, we have

$$v_{2,3} = \frac{1}{2\pi} \int_0^\infty [[\bar{v}_2(p, z)]_{\beta_2 = \mathrm{i}\beta_2'} - [\bar{v}_2(p, z)]_{\beta_2 = -\mathrm{i}\beta_2'}] e^{-k_2''x} e^{-ux} \, \mathrm{d}u =$$

$$= -\frac{a\lambda}{\pi} e^{-k_2''x} \int_0^\infty \left[\frac{G_1(u) \cos \sqrt{(2k_2''u + u^2)}\,(z + H)}{\sqrt{(2k_2'' + u^2)}} + \right.$$

$$\left. + \frac{G_2(u) \sin \sqrt{2k_2''u + u^2}\,(z + H)}{2k_2''u + u^2} \right] e^{-ux} \, \mathrm{d}u \tag{43}$$

where

$$G_1(u) = \frac{(\beta_2' \cos \beta_2' H + \gamma \beta_1' \sin \beta_2' H)\bar{\beta}_2}{\mu_2 \beta_2' + aL'(u)}$$

$$G_2(u) = \frac{\beta_2'(\beta_2' \sin \beta_2' H - \gamma \beta_1' \cos \beta_2' H)\bar{\beta}_2}{\mu_2 \beta_2' + aL'(u)}$$

$$L'(u) = \frac{\beta_2' \cos \beta_2' H + \gamma \beta_1' \sin \beta_2' H}{-\beta_2' \sin \beta_2' H + \gamma \beta_1' \cos \beta_2' H},$$

and

$$\bar{\beta}_2 = \sqrt{-\mathrm{i}(2k_2'' + u)}, \qquad \beta_1' = \sqrt{(k_2 + \mathrm{i}u)^2 - k_1^2}$$

Since u is small, we shall retain only $G_1(0)$ and $G_2(0)$. The integrals in (43) are Laplace integrals. We use a result obtained by OBERHETTINGER and BADII [1973], viz.

$$K_0(k_2'' r) = e^{-k_2'' x} \int_0^\infty \frac{\cos \sqrt{2k_2'' u + u^2}\,(z+H)}{\sqrt{2k_2'' u + u^2}} e^{-ux}\,du \tag{44}$$

where K_0 is the modified Hankel function of zero order and $r = \sqrt{x^2 + (z+H)^2}$. Thus

$$v_{2.3} = -\frac{a\lambda}{\pi}\left[G_1(0)\,K_0(k_2'' r) + G_2(0) \int_{-H}^{z} K_0(k_2'' s)\,dt\right] \tag{45}$$

where

$$G_1(0) = \frac{\sqrt{2k_2''}\,(1+\gamma\bar{\beta}_1 H)\gamma\bar{\beta}_1 \exp(-i\pi/4)}{a(1+\gamma\bar{\beta}_1 H) + \mu_2\gamma\bar{\beta}_1},$$

$$G_2(0) = -\frac{\sqrt{2k_2''}\,(\gamma^2\bar{\beta}_1^2)\exp(-i\pi/4)}{a(1+\gamma\bar{\beta}_1 H) + \mu_2\gamma\bar{\beta}_1} \tag{46}$$

and

$$\bar{\beta}_1 = \sqrt{(k_2^2 - k_1^2)}, \qquad s = \sqrt{(x^2 + (t+H)^2)} \tag{47}$$

Conclusions

The scattered wave in (45) and the reflected wave in (41) corresponding to the impedance surface are absent if $a=0$, that is, if there is no impedance condition. For small values of r, $K_0(k_2'' r) \sim (\log z - \log r - c)$ and for large r, $K_0(k_2'' r) \sim \exp(-k_2'' r)/\sqrt{r}$. The scattered wave has a logarithmic singularity at the tip of the scatterer and behaves as a decaying cylindrical wave at distant points. Numerical computations are made by taking $r=0.1$ km, $z=-H$, $h=0.01$ km, $\gamma = \mu_1/\mu_2 = 2$, $H=6$ km, $v_2/v_1 = 3/4$, $v_2/v = 6/7$ and $k_{1N} = k_2$. The amplitude of the reflected wave *(Fig. 4.)* has been plotted versus the wavenumber k for the case $\lambda=0$. It reaches the greatest value around $k=32.5$ and then falls to attain a minimum value around $k=60$. The scattering coefficient *(Fig. 5.)* grows gradually as k increases slowly. It can be seen in (40) that it depends upon both the material and thickness of the impeding surface.

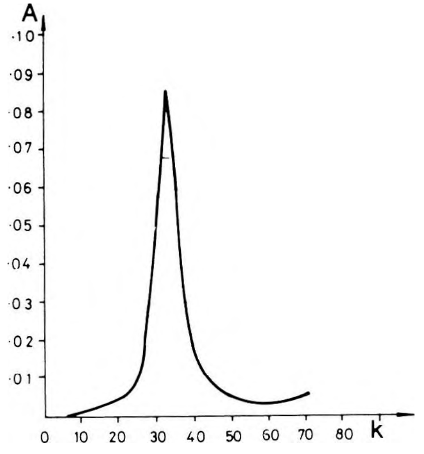

Fig. 4. Amplitude of reflected wave versus wavenumber

4. ábra. A reflektált hullámok amplitúdója a hullámszám függvényében

Рис. 4. Амплитуды отраженных волн как функция волновых чисел

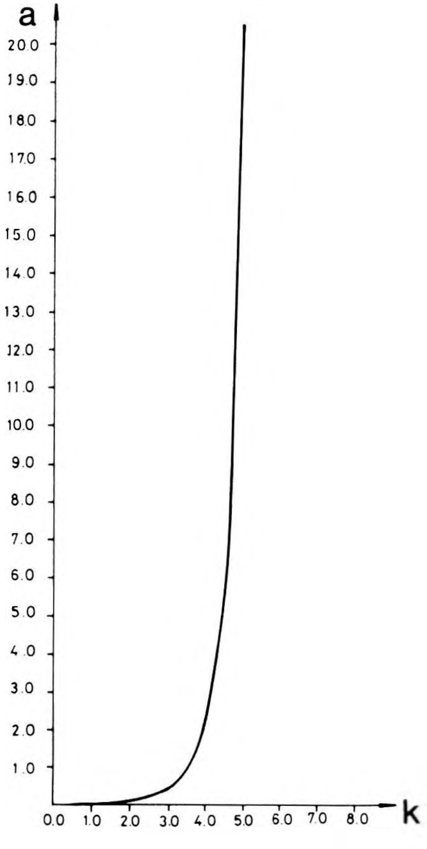

Fig. 5. Scattering coefficient versus wavenumber

5. ábra. Szórási együttható a hullámszám függvényében

Рис. 5. Коэффициенты дисперсии как функция волновых чисел

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LOVE-HULLÁM SZÓRÓDÁS KIÉKELŐDŐ, NAGY AKUSZTIKUS IMPEDANCIÁJÚ VÉKONY FELSZÍNI RÉTEGEN

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A felszíni impedancián keletkező Love-hullám szóródás problémájának tanulmányozására elméleti megoldást javasol. Az elmozdulásokat Fourier-transzformáltakkal fejezi ki a Wiener–Hopf technika alkalmazásával. A Fourier-integráloknak a komplex síkban alkalmas vonalak mentén történő kiszámításával megadja a felszíni impedanciának megfelelő szórt Love-hullámokat. A szórt hullámoknak a szórási felület csúcsán logaritmikus szingularitásuk van és úgy viselkednek, mint csillapodó hengeres hullámok távoli pontokban. A szórási felület közelében a szórási együtthatóra és a reflektált hullám amplitúdójára numerikus eredményeket ad a hullámszám függvényében.

ДИСПЕРСИЯ ВОЛН ЛАВА ОТ ВЫКЛИНИВАЮЩЕГОСЯ ПРИПОВЕРХНОСТНОГО СЛОЯ С ВЫСОКИМ АКУСТИЧЕСКИМ ИМПЕДАНСОМ

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Предлагается теоретическое решение проблемы дисперсии волн Лава, возникающих на приповерхностном импедансе. Смещения выражаются трансформантами Фурье с использованием техники Винера–Гопфа. Путем вычисления интегралов Фурье вдоль подходящих линий в комплексной плоскости определяются рассеянные волны Лава, соответствующие импедансу на поверхности. На вершине поверхности дисперсии рассеянные волны обладают логарифмической сингулярностью и ведут себы так, как затухающие цилиндрические волны в удаленных точках. Даются цифровые результаты как функция волновых чисел для коэффициента дисперсии и амплитуды отраженных волн вблизи от поверхности дисперсии.