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Calculation of Structures Lying On an Anisotropic Basis

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Abtract: The definition of the nucleus and the influence function of a transversally isotropic half-space is considered. Expressions of deflection and internal forces in an infinite base plate are obtained, taking into account their deepening into the rock mass, as well as the effect of the anisotropy of the base on the distribution of deflections and internal forces. The results obtained serve as a reference for the reconciliation of the results obtained by numerical and computer methods. This calculation algorithm allows us to estimate the bearing capacity of an anisotropic soil base.

INTROUDCTION

The formula for determining the deflection of the plate taking into account the deepening in the soil massif has the form (1):

$$w(\xi,z)=\frac{Pl^2}{2\pi D}\int_0^\infty \frac{\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)\cdot J_0(\xi\lambda)\,d\lambda}{1+\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)\cdot\lambda^3} \qquad (1)$$

We present the formulas for the resistance of the base and the internal forces in an infinite base plate lying on a transversally isotropic base, taking into account the deepening:

$$p(\xi,z)=-\frac{P}{2\pi l^2}\int_0^\infty \frac{\lambda\cdot J_0(\xi\lambda)\cdot d\lambda}{1+\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)\cdot\lambda^3} \qquad (2)$$

$$M_r(\xi,z)=\frac{P}{2\pi}\left\{\begin{aligned}&\int_0^\infty \frac{\lambda^2\left(J_0(\lambda\xi)-1/\xi\lambda\cdot J_1(\xi\lambda)\right)\cdot\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)}{1+\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)\cdot\lambda^3}d\lambda+\\&+\frac{\mu_1}{\xi}\int_0^\infty \frac{\lambda J_1(\xi\lambda)\cdot\left(\tilde{k}_2\cdot e^{-S_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-S_2\tilde{z}\lambda}\right)}{1+\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)\cdot\lambda^3}d\lambda\end{aligned}\right\}; \qquad (3)$$

$$M_\theta(\xi,z)=\frac{P}{2\pi}\left\{\begin{aligned}&\mu_1\int_0^\infty \frac{\lambda^2\left(J_0(\lambda\xi)-1/\xi\lambda\cdot J_1(\xi\lambda)\right)\cdot\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)}{1+\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)\cdot\lambda^3}d\lambda+\\&+\frac{1}{\xi}\int_0^\infty \frac{\lambda J_1(\xi\lambda)\cdot\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)}{1+\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)\cdot\lambda^3}d\lambda\end{aligned}\right\}; \qquad 4)$$

$$N_r(\xi,z)=\frac{P}{2\pi l}\int_0^\infty \frac{\lambda^3\cdot J_1(\xi\lambda)\cdot\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)}{1+\left(\tilde{k}_2\cdot e^{-s_1\tilde{z}\lambda}-\tilde{k}_1\cdot e^{-s_2\tilde{z}\lambda}\right)\cdot\lambda^3}d\lambda; \qquad 5$$

As is known, the anisotropic transversally isotropic half-space is characterized by elastic and shear modules different in the vertical *Ez, Gz* and horizontal *Er, Gr* directions. The anisotropy degree k_E of the elastic half-space is characterized by the ratio of the elastic modulus in the horizontal direction E_r: $k_E=E_z/E_r$ /1/. In the event of an equality of modules of elasticities *Ez = Er* will get a special case of the anisotropic base - isotropic half-space.

Shear modules for the isotropic case at $k_E = 1$:

$$G_z = G_r = E/2(1+\nu_0), \tag{6}$$

Where, *E* and ν_0 - modulus of deformation and Poisson's ratio of isotropic base.

The value of shear modulus Gz for an isotropic base is determined by (6), but for anisotropic base G_z – is an independent value, which is determined experimentally, but because the real soils are always quite low shear resistance, in the future you can always take its lowest value for any ratio of elastic modulus k_E. Taken from here:

If $k_E < 1$ shear modulus:

$$G_z = E_z/2(1+\nu_z), \tag{7}$$

if $k_E > 1$ shear modulus:

$$G_z = E_z/2(k_E+\nu_z). \tag{8}$$

The anisotropic base is also characterized by Poisson's ratios in the vertical $\boldsymbol{\nu_z}$ and horizontal ν_r directions and, for the case of the transversally isotropic half-space, they are assumed to be

$\nu_z = \nu_r$.

Depending on which soils serve as the basis for the foundation slab, the values of the deformation modules can vary from a value equal to 50 MPa for gravelly sands of large and medium size, to a value of 5.0 MPa for loam, and the Poisson's coefficients of the soil take values from 0.30 for Sands and sandy loam to 0.42 for clay soils. Based on these characteristics, we find the deflection and other calculated values for different values of physical parameters, which we take as follows: E_z*=2МПа; 1МПа; 50МПа;* E_r*=10МПа;* $\nu_z = \nu_r = 0.3$. The Poisson's ratio of the plate material $\boldsymbol{\nu=1/6}$.

1. The case of isotropy: $k_E = 1$. Table 1 and figure 1 show dimensionless deflection diagrams in an infinite base plate loaded with a concentrated force *P=1* applied at the origin at different values of the depth. The reliability of the obtained results is confirmed by the exact coincidence of the obtained results for the isotropic case with the known solution of Schechter O. Ya. /3/.

Tables 2, 3, 4 show the value of values, and in figures 2, 3, 4 - diagrams of bending moments and transverse forces in an infinite foundation plate loaded with concentrated force *P=1*.

The results show that the values of deflections and internal forces of the Foundation slab decrease with increasing depth. For example, the values of deflection at the point *z = 0*, the deflection of the plate is equal to *w = 0.385*, and at *z = 10*, *w = 0.054*, i.e. the value is less than 7.1 times more than on the surface. A similar pattern is observed for internal efforts.

2. The case of anisotropy: $k_E = 5$. In tables 5,6,7,8 values of quantities are given, and in figures 5,6,7,8 - diagrams of deflections, bending moments and transverse forces in an infinite base plate loaded with concentrated force *P=1* at values *z = 0, 2, 3, 5, 10; Ez=50 MPa; Mr = 10 MPa*.

The results show a significant effect of the base anisotropy on the distribution of deflection values and internal forces with changes in the depth of the Foundation plates. For example, the values of the deflection of the plate at z

= 10 for isotropic case, equal to *w = 0.054*, and at *z = 10* for the anisotropic case, respectively – *w= 0,118*, the value of the deflection is higher by 2.2 times than the value of the deflection of isotropic plates on the basis of the same depth.

The obtained analytical expressions of deflections and internal forces in the foundation slab, taking into account its penetration into the soil mass, allow solving a number of problems in the analytical form for both infinite and finite Foundation slabs, using the methods developed in work /4/. The calculation of plates lying on the surface of an anisotropic base, i.e. at *z = 0*, is considered in works /1, 5/. The study of the regularities of the distribution of displacements inside and on the boundary of the deformable half-space under the action of a concentrated force applied to the boundary plane is carried out in /6/.

Table 1

ξ	*z=0*	*z=1*	*z=3*	*z=5*	*z=7*	*z=10*
0.0	0.385	0.324	0.173	0.108	0.078	0.054
0.2	0.376	0.319	0.173	0.108	0.078	0.054
0.4	0.359	0.305	0.171	0.107	0.077	0.054
0.6	0.338	0.288	0.168	0.107	0.077	0.054
0.8	0.315	0.269	0.164	0.106	0.077	0.054
1.0	0.291	0.25	0.159	0.104	0.076	0.054
1.2	0.268	0.232	0.153	0.103	0.076	0.054
1.4	0.247	0.215	0.147	0.101	0.075	0.054
1.6	0.226	0.198	0.141	0.099	0.074	0.053
1.8	0.207	0.183	0.135	0.097	0.073	0.053
2.0	0.19	0.169	0.129	0.095	0.072	0.053
2.2	0.174	0.157	0.123	0.092	0.071	0.052
2.4	0.159	0.145	0.117	0.09	0.07	0.052
2.6	0.146	0.135	0.111	0.088	0.069	0.051
2.8	0.134	0.125	0.106	0.085	0.068	0.051
3.0	0.124	0.117	0.101	0.083	0.067	0.05
3.2	0.115	0.109	0.096	0.08	0.066	0.05
3.4	0.106	0.102	0.092	0.078	0.064	0.049
3.6	0.099	0.096	0.088	0.076	0.063	0.049
3.8	0.093	0.09	0.084	0.073	0.062	0.048
4.0	0.087	0.085	0.08	0.071	0.061	0.048

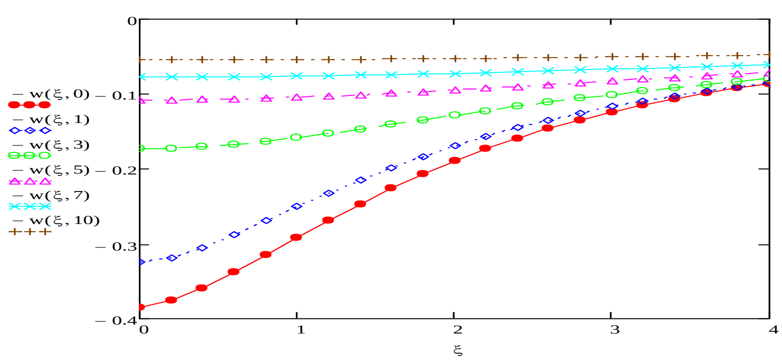

Figure 1. Diagram deflection in infinite plate at $k_E = 1$ loaded by concentrated force *P=1*, taking into account the recess at *z = 0, 1, 3, 5, 7, 10*.

Table 2

bv	*Mr(ξ,0)*	*Mr(ξ,1)*	*Mr(ξ,3)*	*Mr(ξ,5)*	*Mr(ξ,7)*	*Mr(ξ,10)*
0.0	0.952	0.367	0.043	0.01	0.00372	0.001233
0.2	0.305	0.287	0.042	0.01	0.0037	0.00123
0.4	0.17	0.151	0.039	0.009793	0.003689	0.001285
0.6	0.097	0.072	0.034	0.009366	0.003607	0.001271
0.8	0.052	0.037	0.029	0.008798	0.003494	0.001251
1.0	0.022	0.015	0.023	0.008115	0.003354	0.001226
1.2	0.00263	$1.46\cdot10^{-6}$	0.017	0.007347	0.00319	0.001197
1.4	-0.01	$-9.475\cdot10^{-3}$	0.012	0.006523	0.003	0.001163
1.6	-0.019	-0.015	0.00725	0.005674	0.002805	0.001124
1.8	-0.024	-0.018	0.00358	0.004827	0.002592	0.001082
2.0	-0.027	-0.02	0.00073	0.004	0.002371	0.001037
2.2	-0.028	-0.021	-0.00138	0.003227	0.002146	0.000982

2.4	-0.027	-0.02	-0.00286	0.002506	0.001921	0.000939
2.6	-0.026	-0.019	-0.00386	0.001852	0.001699	0.000818
2.8	-0.025	-0.018	-0.00448	0.001269	0.001482	0.000834
3.0	-0.023	-0.017	-0.00482	0.000758	0.001274	0.0007797
3.2	-0.021	-0.016	-0.00495	0.000319	0.001076	0.0007252
3.4	-0.019	-0.014	-0.00495	$-5.173\cdot10^{-5}$	0.000889	0.0006708
3.6	-0.017	-0.013	-0.00485	-0.00036	0.000715	0.0006168
3.8	-0.016	-0.012	-0.00469	-0.000611	0.000555	0.0005636
4.0	-0.014	-0.01	-0.004489	-0.000812	0.000408	0.0005115

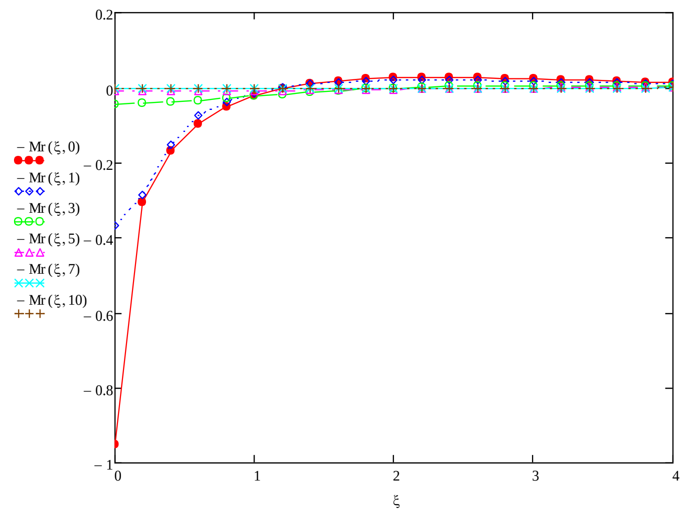

Figure 2. Diagram of bending radial moments in an infinite plate at $k_E=1$ loaded by a concentrated force $P=1$, taking into account the deepening at $z = 0, 1, 3, 5, 7, 10$.

Table 3

ξ	*Mθ(ξ,0)*	*Mθ(ξ,1)*	*Mθ(ξ,3)*	*Mθ(ξ,5)*	*Mθ(ξ,7)*	*Mθ(ξ,10)*
0.0	0.952	0.366	0.043	0.01	0.003707	0.001085
0.2	0.415	0.319	0.043	0.01	0.003747	0.001083
0.4	0.276	0.229	0.041	0.009943	0.003718	0.00129
0.6	0.199	0.161	0.038	0.009695	0.00367	0.001282
0.8	0.148	0.118	0.035	0.009361	0.003605	0.00127
1.0	0.112	0.089	0.031	0.008955	0.003523	0.001256
1.2	0.086	0.068	0.027	0.008491	0.003426	0.001239
1.4	0.066	0.052	0.023	0.007984	0.003316	0.001219
1.6	0.051	0.04	0.02	0.007449	0.003195	0.001196
1.8	0.039	0.031	0.017	0.0069	0.003065	0.001171
2.0	0.03	0.024	0.014	0.006351	0.002929	0.00144
2.2	0.023	0.019	0.012	0.005812	0.002787	0.00116
2.4	0.018	0.015	0.009879	0.005292	0.002642	0.001085
2.6	0.014	0.012	0.008284	0.004797	0.002497	0.0008249
2.8	0.01	0.009109	0.006961	0.004332	0.002352	0.00102
3.0	0.007949	0.007188	0.005867	0.003901	0.002208	0.0009864
3.2	0.006064	0.005694	0.004961	0.003503	0.002068	0.0009519
3.4	0.004618	0.00453	0.00421	0.003141	0.001932	0.0009169
3.6	0.003518	0.003622	0.003586	0.002812	0.0018	0.0008818
3.8	0.002694	0.002915	0.003065	0.002515	0.001675	0.0008465
4.0	0.002056	0.002362	0.00263	0.002248	0.001555	0.0008115

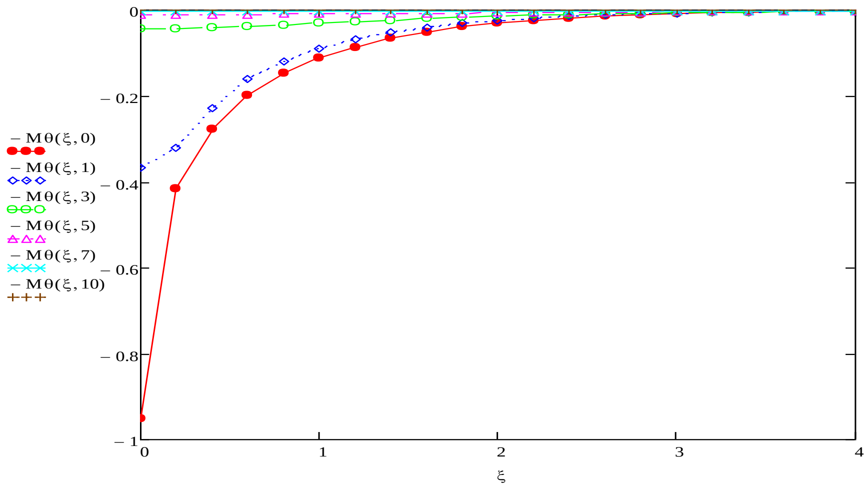

Figure 3. Diagram of bending tangential moments in an infinite plate at k_E=*1* loaded by concentrated force *P=1* with allowance for deepening at *z* = *0, 1, 3, 5, 7, 10*.

Table 4

ξ	*N_r(ξ,0)*	*N_r(ξ,1)*	*N_r(ξ,3)*	*N_r(ξ,5)*	*N_r(ξ,7)*	*N_r(ξ,10)*
0.0	-0.0007956	$-5.623\cdot10^{-6}$	$-6.519\cdot10^{-8}$	$-5.274\cdot10^{-9}$	$-1.128\cdot10^{-9}$	$-1.991\cdot10^{-10}$
0.2	-1.291	-0.846	-0.013	-0.001084	-0.0002053	-0.00003974
0.4	-0.728	-0.761	-0.024	-0.002117	-0.0004056	-0.00007898
0.6	-0.497	-0.396	-0.032	-0.003053	-0.0005963	-0.0001172
0.8	-0.328	-0.232	-0.037	-0.003855	-0.0007731	-0.0001539
1.0	-0.203	-0.167	-0.038	-0.004495	-0.0009324	-0.0001597
1.2	-0.13	-0.117	-0.036	-0.00496	-0.001071	-0.0001947
1.4	-0.098	-0.08	-0.033	-0.005248	-0.001188	-0.0002215
1.6	-0.083	-0.056	-0.028	-0.00537	-0.001281	-0.0002459
1.8	-0.064	-0.039	-0.024	-0.005341	-0.00135	-0.0002677
2.0	-0.04	-0.027	-0.019	-0.005187	-0.001396	-0.0002869
2.2	-0.019	-0.018	-0.015	-0.004932	-0.001419	-0.0003032
2.4	-0.009771	-0.012	-0.011	-0.004605	-0.001422	-0.0003168
2.6	-0.009539	-0.006903	-0.008616	-0.004229	-0.001406	-0.0003275
2.8	-0.009621	-0.003619	-0.006404	-0.003827	-0.001375	-0.0003354
3.0	-0.00478	-0.00132	-0.004694	-0.003418	-0.001329	-0.0003407
3.2	0.002563	0.0002567	-0.003391	-0.003017	-0.001273	-0.0003434
3.4	0.006659	0.001303	-0.002407	-0.002633	-0.001208	-0.0003438
3.6	0.005363	0.001963	-0.001668	-0.002275	-0.001138	-0.0003419
3.8	0.002038	0.002344	-0.001115	-0.001947	-0.001063	-0.000338
4.0	0.00125	0.002526	-0.0007024	-0.001652	-0.000986	-0.0003323

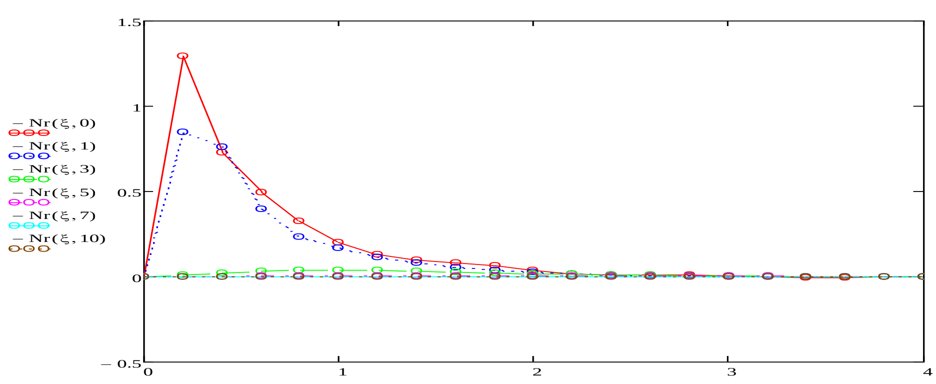

Figure 4. Diagram of transverse forces in an infinite plate at k_E = *1*, loaded with concentrated force *P=1*, taking into account the deepening at *z* = *0, 1, 3, 5, 7, 10*.

Table 5

ξ	z=0	z=2	z=3	z=5	z=7	z=10
0	0.385	0.347	0.322	0.225	0.166	0.118
0.2	0.336	0.353	0.321	0.225	0.166	0.118
0.4	0.359	0.363	0.317	0.223	0.166	0.118
0.6	0.338	0.364	0.311	0.221	0.165	0.118
0.8	0.315	0.349	0.301	0.218	0.164	0.117
1	0.291	0.319	0.289	0.214	0.162	0.117
1.2	0.268	0.286	0.274	0.21	0.16	0.116
1.4	0.247	0.262	0.258	0.204	0.158	0.115
1.6	0.226	0.247	0.241	0.198	0.156	0.114
1.8	0.207	0.235	0.225	0.191	0.153	0.113
2	0.19	0.22	0.209	0.184	0.15	0.112
2.2	0.174	0.201	0.195	0.176	0.146	0.111
2.4	0.159	0.181	0.181	0.169	0.143	0.109
2.6	0.146	0.165	0.169	0.161	0.139	0.108
2.8	0.134	0.154	0.158	0.153	0.135	0.106
3	0.124	0.146	0.147	0.145	0.131	0.105
3.2	0.115	0.137	0.138	0.138	0.127	0.103
3.4	0.106	0.126	0.129	0.131	0.122	0.101
3.6	0.099	0.115	0.121	0.124	0.118	0.099
3.8	0.093	0.105	0.113	0.118	0.114	0.097
4	0.087	0.099	0.106	0.112	0.109	0.095

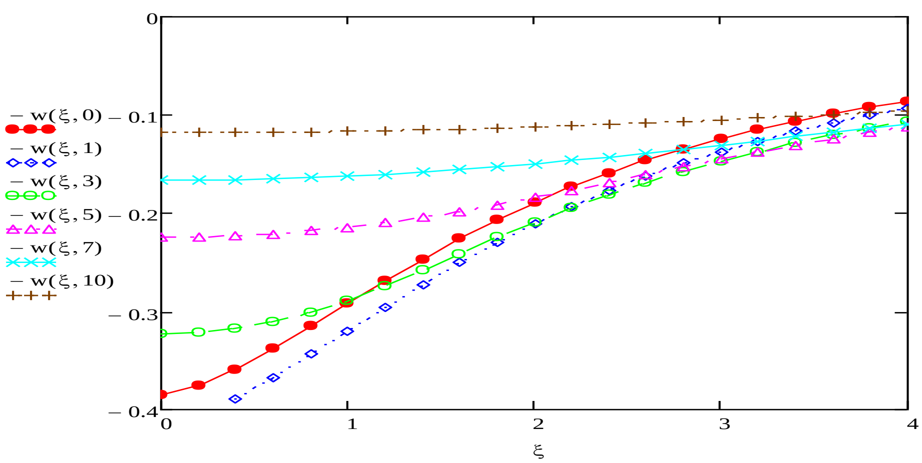

Figure 5. Diagram deflection in infinite plate at $k_E = 5$ loaded by concentrated force *P=1*, taking into account the recess at *z=0, 2, 3, 5, 7, 10*.

Table 6

ξ	Mr(ξ,0)	Mr(ξ,2)	Mr(ξ,3)	Mr(ξ,5)	Mr(ξ,7)	Mr(ξ,10)
0	0.952	-0.445	0.08	0.027	0.012	0.003779
0.2	0.305	-0.208	0.084	0.028	0.011	0.003911
0.4	0.17	0.197	0.089	0.028	0.011	0.003911
0.6	0.097	0.477	0.093	0.028	0.011	0.003909
0.8	0.052	0.417	0.09	0.028	0.011	0.003904
1	0.022	0.107	0.078	0.027	0.011	0.003895
1.2	0.00263	-0.177	0.057	0.026	0.011	0.003879
1.4	-0.01	-0.232	0.033	0.024	0.011	0.003855
1.6	-0.019	-0.079	0.00961	0.021	0.01	0.003819
1.8	-0.024	0.099	-0.00759	0.018	0.009695	0.00377

2	-0.027	0.143	-0.017	0.015	0.009092	0.003703
2.2	-0.028	0.04	-0.021	0.011	0.008358	0.003619
2.4	-0.027	-0.094	-0.02	0.006744	0.007502	0.003513
2.6	-0.026	-0.139	-0.018	0.003154	0.006545	0.003386
2.8	-0.025	-0.073	-0.016	0.00002318	0.005515	0.003236
3	-0.023	0.026	-0.014	-0.002539	0.004444	0.003064
3.2	-0.021	0.067	-0.013	-0.004496	0.003369	0.00287
3.4	-0.019	0.025	-0.013	-0.005876	0.002323	0.002657
3.6	-0.017	-0.048	-0.013	-0.006748	0.001337	0.002426
3.8	-0.016	-0.081	-0.013	-0.007202	0.0004359	0.002181
4	-0.014	-0.051	-0.013	-0.007335	-0.000363	0.001925

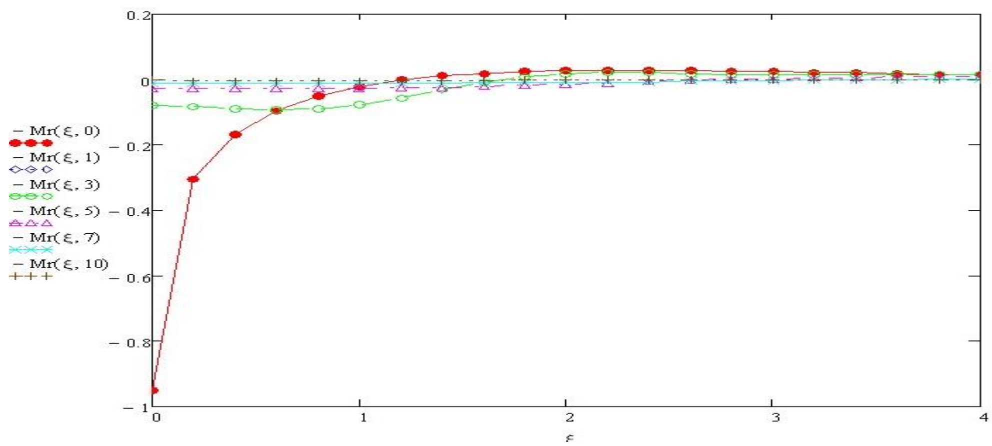

Figure 6. Diagram of bending radial moments in an infinite plate at $k_E = 5$ loaded by a concentrated force $P=1$, taking into account the deepening at $z=0, 2, 3, 5, 7, 10$.

Table 7

ξ	*Mθ(ξ,0)*	*Mθ(ξ,2)*	*Mθ(ξ,3)*	*Mθ(ξ,5)*	*Mθ(ξ,7)*	*Mθ(ξ,10)*
0	0.952	-0.557	0.077	0.027	0.013	0.003471
0.2	0.415	-0.287	0.083	0.028	0.011	0.003911
0.4	0.276	-0.033	0.086	0.028	0.011	0.003911
0.6	0.199	0.193	0.089	0.028	0.011	0.00391
0.8	0.148	0.263	0.09	0.028	0.011	0.003908
1	0.112	0.183	0.085	0.027	0.011	0.003903
1.2	0.086	0.059	0.076	0.027	0.011	0.003896
1.4	0.066	-0.006628	0.064	0.026	0.011	0.003884
1.6	0.051	0.011	0.05	0.025	0.011	0.003867
1.8	0.039	0.061	0.039	0.023	0.01	0.003843
2	0.03	0.082	0.029	0.021	0.01	0.003811
2.2	0.023	0.055	0.023	0.019	0.009728	0.003769
2.4	0.018	0.007698	0.018	0.017	0.009293	0.003718
2.6	0.014	-0.018	0.015	0.015	0.008796	0.003655
2.8	0.01	-0.007643	0.013	0.013	0.008248	0.003581
3	0.007949	0.02	0.011	0.011	0.00766	0.003494
3.2	0.006064	0.034	0.009218	0.008993	0.007048	0.003396
3.4	0.004618	0.023	0.007573	0.007517	0.006427	0.003287
3.6	0.003518	-0.000720	0.006084	0.006273	0.005813	0.003167
3.8	0.002694	-0.015	-0.00481	0.00524	0.005217	0.003037
4	0.002056	-0.009513	-0.00380	0.004394	0.00465	0.002899

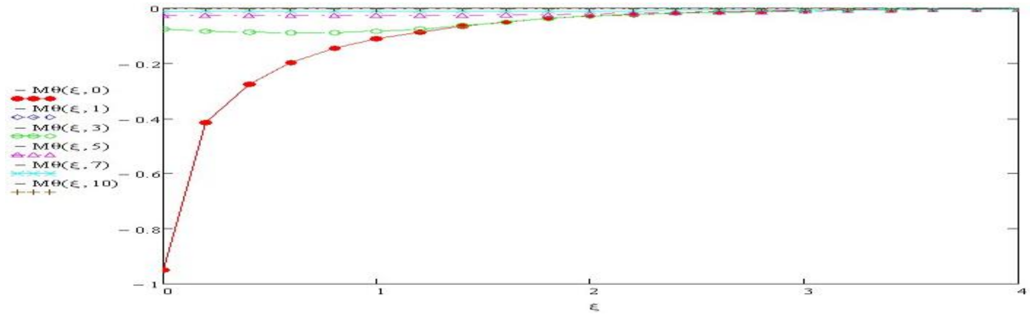

Figure 7. Diagram of bending tangential moments in an infinite plate at $k_E = 5$ loaded by concentrated force $P=1$ taking into account the deepening at $z=0, 2, 3, 5, 7, 10$.

Table 8

ξ	$N_r(\xi,0)$	$N_r(\xi,2)$	$N_r(\xi,3)$	$N_r(\xi,5)$	$N_r(\xi,7)$	$N_r(\xi,10)$
0	-0.0007956	0.00001855	2.169E-07	3.67E-09	9.93E-10	-9.22E-10
0.2	-1.291	2.136	0.026	0.0004097	0.00001301	1.16E-05
0.4	-0.728	2.571	0.034	0.0004119	-0.00001104	-7E-06
0.6	-0.497	1.082	0.012	-0.0003401	-0.0001065	-1.8E-05
0.8	-0.328	-0.927	-0.035	-0.0002072	-0.000302	-3.7E-05
1	-0.203	-1.803	-0.092	-0.0004834	-0.000618	-6.8E-05
1.2	-0.13	-1.124	-0.134	-0.0008461	-0.001064	-0.00011
1.4	-0.098	0.194	-0.146	-0.013	-0.001635	-0.00017
1.6	-0.083	0.944	-0.129	-0.017	-0.002313	-0.00024
1.8	-0.064	0.659	-0.093	-0.02	-0.003067	-0.00033
2	-0.04	-0.176	-0.055	-0.023	-0.00385	-0.00043
2.2	-0.019	-0.721	-0.025	-0.024	-0.004612	-0.00054
2.4	-0.009771	-0.559	-0.006837	-0.023	-0.005298	-0.00067
2.6	-0.009539	0.04	0.0004201	-0.021	-0.005859	-0.0008
2.8	-0.009621	0.478	0.0005551	-0.019	-0.006257	-0.00093
3	-0.00478	0.409	-0.002303	-0.016	-0.006466	-0.00106
3.2	0.002563	-0.012	-0.005065	-0.013	-0.00648	-0.00118
3.4	0.006659	-0.351	-0.006175	-0.009499	-0.00631	-0.0013
3.6	0.005363	-0.324	-0.005432	-0.006851	-0.005979	-0.0014
3.8	0.002038	-0.015	-0.003464	-0.004663	-0.005521	-0.00148
4	0.00125	0.256	-0.001147	-0.002951	-0.004973	-0.00154

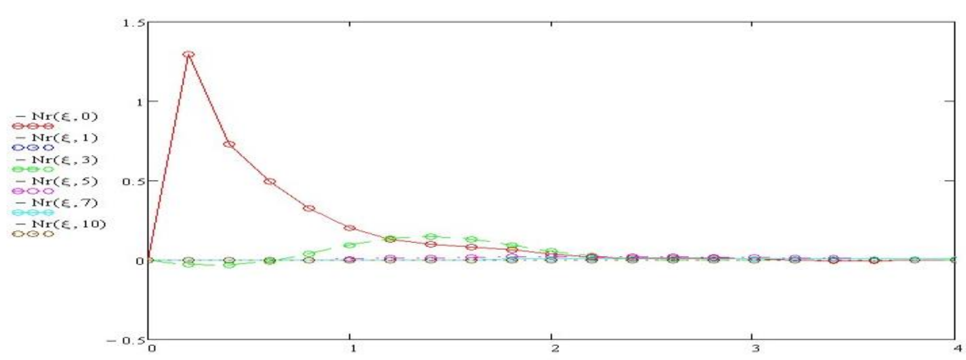

Figure 8. Diagram of transverse forces in an infinite plate at $k_E = 5$, loaded with concentrated force $P=1$, taking into account the deepening at $z = 0, 2, 3, 5, 7, 10$.

The results obtained in this paper can also serve as a criterion for evaluating the reliability of the results obtained in numerical scientific research.

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