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A Method of Topographical Correction upon the Intensity of Gravity and its Application to the Intensity of Vertical Gradient of Gravity

By

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Abstract

In this paper a new method of computing topographic effect upon the intensity of gravity determined at the earth's surface is described. The computation of topographic effect is done by tables of which the tabular values of the effect are obtained in microgal in order to meet the sensitivity of the modern gravimeter, 0.01 milligal(mgal) or 10 microgal(μgal).

In this method the area around a gravity station is divided into 300 sectorial compartments by 26 concentric circles with the center at the station and 12 equally spaced radial lines passing through it. Radius of the circle increases with the common ratio β which is 1.5849, the smallest and the largest radii being respectively 1 m and 100 km.

A transparent graticule, on which the above concentric circles and radial lines are drawn, is placed on a topographic map with a center at the gravity station represented on the map. The mean height of land surface within each compartment is estimated. The vertical attraction of each sectorial compartment block with its height equal to the above obtained mean height is computed in microgal by the tables and by assuming an appropriate value to the density of the block.

The accuracy of the value of the attraction thus obtained by the tables is examined by employing a model topography of which the vertical attraction at the station can be exactly calculated other than by the tables. The result is that the tabular value differs from the exact value by a little less than 0.1 mgal. The computation tables for gravity is applicable to the topographical correction upon the intensity of vertical gradient of gravity which is obtained by $(g_1-g_2)/\delta z$, where g_1 is the gravity value at a ground station and g_2 at a station at a height δz vertically above the former.

Convinient tables for obtaining the effect of near topography which may be treated as two-dimensional are obtained.

At four selected stations in the mountainous area of the central Honshû of Japan, the topographic corrections have been done by the tables mentioned above upon the intensities of gravity and its vertical gradient, and the values of the Modified Bouguer anomaly at sea-level at these stations have been obtained to prove that the Simple Bouguer anomalies at stations in a lofty mountainous area are dangerous as data to find the state of isostatic equilibrium or, generally speaking, the mass distribution below such an area.

Introduction

Since the appearance of gravimeters with an accuracy of 0.01 mgal, the

gravimetric research of subsurface geological structure and particularly the gravimetric prospecting of underground natural resources have been speedily developed. In order to infer a subsurface geological structure from the values of gravity measured on the ground surface, they must be submitted to the well-known three different corrections, namely 1) topographical correction, 2) Bouguer correction and 3) free-air correction. Among them the topographical correction is indispensable for making the best use of modern gravimeter accuracy of 0.01 mgal. In this paper is described the author's new method of topographical correction. For finding the errors involved in the topographical value at a gravity station computed by the tables which the author has constructed in this paper, they were applied to a model topography which is an assemblage to form a pyramid of simple sectorial blocks of which the vertical attraction at the same station can be exactly calculated. The error thus found was 0.07~0.11 mgal. For obtaining this error, the effect of the uncertainty in the assumption of the density of blocks is not considered in this paper.

§1. Method of topographic correction

Different methods of topographical correction for the intensity of gravity have been published by several authors such as Hayford (1912), Bowie (1917), Jung (1927), Bullard (1936), Hammer (1939), Fuchida (1948) and Matsuda (1952). The method described in this paper is based on the following principle, which is similar to the Hammer's method which may be most convenient to usage according to the author's experiences. The whole area (in a given topographic map) within a circle of radius 100 km from the gravity station, is divided by a number of concentric circles with the common center at the gravity station and equally separated radial lines drawn from the station to form a great number of sectorial compartments. The mean height of the topography in each compartment is estimated. The vertical attraction at the gravity station of the compartment block, of which the height is equal to the mean height, can be computed exactly. The summation of the vertical attractions of all the compartment blocks is the required topographical correction at the gravity station. The error involved in the thus obtained correction arises from the adoption of the mean height instead of the actual topography and also from the assumption of the density of the compartment block.

For a distant topography beyond 100 km from the gravity station, a different method of correction should be adopted taking the earth's curvature into consideration. This is out of the scope of this paper.

If r_m and r_{m+1} are respectively the inner and outer radius of the compartment block, which is standing above the horizontal plane passing through a gravity

station P at the height H above the sea-level, $2\pi/N$ the angular width of each compartment, h the height of the compartment block above the sea-level, and σ the density of the block, the vertically downward attraction Γ_m at the gravity station of the block is, the axis of Z being directed in the vertically downward direction (Fig. 1),

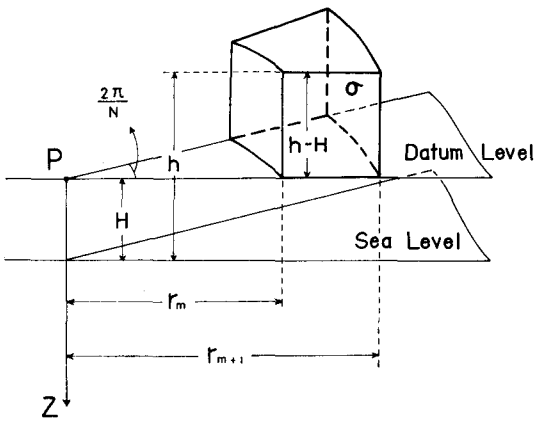

Fig. 1.

$$\Gamma_m = -\frac{2\pi\gamma}{N}\cdot\sigma\cdot\{r_{m+1}-r_m+\sqrt{r_m^2+(h-H)^2}-\sqrt{r_{m+1}^2+(h-H)^2}\}\ , \qquad \cdots(1)$$

where γ is the attraction constant, for which let us use the $6.67_3\times10^{-8}$ c.g.s.. In the following let us establish the values for N and r_m and r_{m+1} for the sake of making the table of the values of Γ_m. At the outset let us employ

$$\frac{1}{r_m}-\frac{1}{r_{m+1}}=\alpha\frac{1}{r_m}\ , \qquad \cdots\cdots(2)$$

where α is a constant. From the Eq. (2) follows

$$\frac{r_{m+1}}{r_m}=\frac{1}{1-\alpha}=\beta\ , \qquad \cdots\cdots(3)$$

where β is another constant depending on α. Then, for the first n ones of the whole concentric circles m takes the values of 1, 2, $\cdots$, n, and from the Eq. (3) we get

$$\left.\begin{aligned} r_2 &= \beta r_1 \\ r_3 &= \beta^2 r_1 \\ &\vdots \\ r_n &= \beta^{n-1} r_1\ . \end{aligned}\right\} \qquad \cdots\cdots(4)$$

Further assuming

$$r_n = 10r_1 , \quad \cdots\cdots(5)$$

we obtain

$$(n-1)\log_{10}\beta = 1 \quad \text{or} \quad \beta = 10^{1/(n-1)} . \quad \cdots\cdots(6)$$

If for the positive integer n, which is the number of the concentric circles from r_1 to $r_n=10r_1$, a suitable value is selected, the value of β can be determined from the Eq. (6), and all the values of $r_1, r_2, \cdots, r_n$ can be done from the Eq. (4). Now next, let us determine the value of N, the number of the radial lines equally separated. If we require that the shape of each compartment should be approximately a square, N is an integer nearest to the value of N' given by the Eq. (7)

$$N' = \frac{r_{m+1}+r_m}{r_{m+1}-r_m} = \pi\cdot\frac{\beta+1}{\beta-1} . \quad \cdots\cdots(7)$$

Next, let us proceed to find a suitable value for n. If we adopt a smaller value for n, the value of β increases to produce a smaller value for N' and, therefore, for N, as $dN'/d\beta$ is a negative quantity. The smaller is the value of n and, therefore, of N, the smaller is the number of the total compartment. This means the increasing of the speed of carrying out the topographical correction. However, this means the decreasing of its accuracy, because the error of the adoption of the mean height for the compartment against the adoption of the actual topography increases. Therefore, the efficiency and the accuracy of the topographical correction are contrary to each other. Selection of a suitable value for n is subject to this condition.

§2. Tabulation of the values of Γ_m

From the condition shown in the end of the foregoing article, the author has employed a value of 6 for n. By means of this value of n, the Eqs. (6) and (7) give rise to $\beta=1.5849$ and $N=12$ respectively. From the author's experience, these values of n and N are appropriate to the usual topography. Now letting the radii of the 6 concentric circles be $r_1, r_2, \cdots, r_6(=10r_1)$, and starting from $r_1=1$m, we get

$$\left.\begin{aligned} r_1 &= 1.0000\ \text{m} \\ r_2 &= 1.5849\ \text{m} \\ r_3 &= 2.5119\ \text{m} \\ r_4 &= 3.9811\ \text{m} \\ r_5 &= 6.3096\ \text{m} \\ r_6 &= 10.0000\ \text{m} . \end{aligned}\right\} \quad \cdots\cdots(8)$$

These six values of r_s given by the Eq. (8) belong to the first six concentric circles which are nearest to the gravity station.

Let the zone bounded by the two concentric circles of radii $r_1=1.0000$ m and $r_6=10.0000$ m be called A zone, beyond which there are 4 zones called B, C, D and E zones. The smallest radius of each zone is equal to the greatest radius of the preceding zone. This scheme is as follows:

$$\left.\begin{array}{l} r_1 = 1\ \text{m} \sim r_6 = 10\ \text{m} \text{ — A zone} \\ r_1 = 10\ \text{m} \sim r_6 = 100\ \text{m} \text{ — B zone} \\ r_1 = 100\ \text{m} \sim r_6 = 1\ \text{km} \text{ — C zone} \\ r_1 = 1\ \text{km} \sim r_6 = 10\ \text{km} \text{ — D zone} \\ r_1 = 10\ \text{km} \sim r_6 = 100\ \text{km} \text{ — E zone,} \end{array}\right\} \quad \cdots\cdots(9)$$

where the values of the intermediate radii r_2, r_3, r_4 and r_5 of any zone are ten times those of the preceding zone. The Eq. (1) can be rewritten as

$$\Gamma_m = -\frac{2\pi\gamma}{N}\cdot\sigma\cdot r_m\cdot\left\{\beta-1+\sqrt{1+\left(\frac{h-H}{r_m}\right)^2}-\sqrt{\beta^2+\left(\frac{h-H}{r_m}\right)^2}\right\}. \quad \cdots(10)$$

For simplicity's sake let us put

$$f_m = -\frac{2\pi\gamma}{N}\cdot r_m\cdot\left\{\beta-1+\sqrt{1+\left(\frac{h-H}{r_m}\right)^2}-\sqrt{\beta^2+\left(\frac{h-H}{r_m}\right)^2}\right\}, \quad \cdots\cdots(11)$$

when $(h-H)>0$ (Fig. 2(a)), the density σ is positive, and in this case (11) takes the form

$$\Gamma_m = f_m\cdot\sigma\,. \quad \cdots\cdots(12)$$

The Eq. (11) also holds for the case in which $(h-H)<0$ and $\sigma<0$, i.e., for the case of empty block (Fig. 2(b)), because in this case, for calculating Γ_m, the integration with respect to Z is done from $(h-H)$ to 0, whereas in the former case the same integration is from 0 to $(h-H)$.

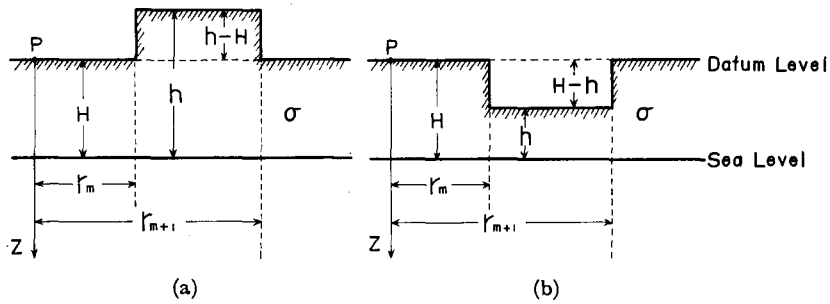

Fig. 2.

Therefore, for both the cases the same Eq. (12) holds. Since in the expression of f_m the quantity $h-H$ appears as $(h-H)^2$, for both the real and empty blocks only the absolute value $|h-H|$ is concerned. As shown by the Eq. (12), Γ_m is proportional to σ, the table for Γ_m may be constructed for $\sigma=1.00\,\mathrm{gm\cdot cm^{-3}}$, that is the table of f_m of which the unit in c.g.s. is $\mathrm{gal/gm\cdot cm^{-3}}$. As shown by the Eq. (11), f_m depends on the ratio of $h-H/r_m$, so that the table of f_m may be constructed for successive value of this ratio appropriately employed. Each zone of A, B, C, D and E is divided into 5 subzones bounded by the 6 concentric circles of the radii r_1, r_2, r_3, r_4, r_5 and $r_6(=10r_1)$, and these 5 subzones are called the subzone I, II, III, IV and V. The values of f_{I}, f_{II}, f_{III}, f_{IV} and f_{V}, of which the suffixes indicate the subzones, are then to be tabulated. At the outset, by the Eq. (11) in which $N=12$ and $\beta=1.5849$, the values of f_{I} of the most distant zone E were calculated in μgal ($=10^{-3}$mgal) for every 0.001 of the ratio $|h-H|/r_1$ for the range from 0.001 to 0.500 and with $r_1=10{,}000$ m. Multiplying these values of $|h-H|/r_1$ by 10,000 m, we obtained values of $|h-H|$ in meter. Then was constructed the table of f_{I} of the same zone E for every 10 m of $|h-H|$ ranging from 10 m to 5,000 m. Next, the values of f_{II} of the same zone E were found by making use of those of f_{I} thus obtained by a method as described in the following. For a moment let us denote the values of $|h-H|$ of a compartment of the subzone I and that of II by $|h-H|_{\mathrm{I}}$ and $|h-H|_{\mathrm{II}}$ respectively. Then, if $|h-H|_{\mathrm{II}}=\beta|h-H|_{\mathrm{I}}$, we have $|h-H|_{\mathrm{II}}/r_2=|h-H|_{\mathrm{I}}/r_1$, owing to $r_2=\beta r_1$, and, therefore, the value of f_{II} for such a value of $|h-H|_{\mathrm{II}}$ is equal to the value of βf_{I} for the above value of $|h-H|_{\mathrm{I}}(=|h-H|_{\mathrm{II}}/\beta)$. Consequently, it was able to draw a curve to represent a variation of f_{II} vs. $|h-H|_{\mathrm{II}}$. The curve thus drawn was almost linear except for the vicinity of the origin to ensure us an accurate interpolation of the curve. From this interpolation, which had been most accurately carried out, we obtained the values of f_{II} for every 20 m of $|h-H|$ from 20 m to 7,980 m to construct the table of f_{II}. From the table of f_{I}, was in the similar way constructed the table of f_{III} for every 25 m of $|h-H|$ from 25 m to 12,575 m by employing the multiplyer β^2 instead of β which had been employed in the construction of the table of f_{II}, the table of f_{IV} for every 50 m of $|h-H|$ from 50 m to 19,900 m by employing the multiplyer β^3, and finally the table of f_{V} for every 50 m of $|h-H|$ from 50 m to 31,550 m by employing the multiplyer β^4. Thus the five tables of f_{I}, f_{II}, f_{III}, f_{IV} and f_{V} all belonging to the zone E were completed.

The similar five tables belonging to the remaining zones D, C, B and A (the nearest zone) can be easily obtained, owing to the functional working of the parameter r_m in the Eq. (11), by simple, successive shifts in the leftward direction of the decimal points of the tabular figures of $|h-H|$ and f_m (m=I, II, III, IV and V) of the successively preceding zones E, D, C and B respectively.

The total results for all the zones A, B, C, D and E are given in Tables I-1, 2, 3, 4 and 5 filed in the end of this paper. The usage of the tables will be explained with the following examples. 1) Let the value of $|h-H|$ of a compartment bounded by two radial lines separated by an angle of 30° in the subzone I of the zone E be 1,550 m. Then, the value of f_{I} for this value of $|h-H|$ is read as 153.0 μgal (cf. Table I-1). 2) If $|h-H|=1{,}550$ m for the similar compartment in the subzone II of the same zone E, the value of f_{II} is 97.3 μgal, the mean of the two tabular values of 96.8 and 98.5 μgal (cf. Table I-2(a)). 3) If $|h-H|=682$ m for the subzone III of the zone D, the value of f_{III} is equal to $114.46+(115.28-114.46)\times 2.0/2.5=114.46+0.66=115.12$ μgal (cf. Table I-3(b) in which we have to employ the leftward shift of the decimal points by one figure of the tabular values of $|h-H|$ and f_{III}).

§3. Utilization of the topographic correction tables for the intensity of vertical gradient of gravity

It is necessary to make a precise topographical correction upon the observed values of the vertical gradient of gravity. When the gravity difference between two points lying on a vertical line with the height difference δz assumed to be small is δg, the vertical gradient of gravity at the middle of the two points, or approximately at the lower point usually taken at the ground surface, may be given by the ratio $\delta g/\delta z$. If the topographical effect upon the gravity value g_1 at the ground surface is $\Gamma_{(1)}$ and that upon the gravity value g_2 at the higher point $\Gamma_{(2)}$, the value of the vertical gradient of gravity corrected for the topography is

$$\frac{(g_1-\Gamma_{(1)})-(g_2-\Gamma'^{*}_{(2)})}{\delta z}=\frac{g_1-g_2}{\delta z}+\frac{\Gamma'^{*}_{(2)}-\Gamma_{(1)}}{\delta z}. \quad \cdots\cdots\cdots\cdots(13)$$

The first term at the right side of the Eq. (13) is the observed value of the vertical gradient and the second term the topographical correction. The values of g_1 and g_2 can be observed with an accuracy of a few units of 0.01 mgal by using a gravimeter, so that the same accuracy is required to $\Gamma_{(1)}$ and $\Gamma_{(2)}$. According to the tables of the topographical effect given in the present paper, the correctional value can be obtained at least down to the figure of 0.1 μgal (0.0001 mgal). For the range of the topographical correction upon the vertical gradient of gravity determined by the Eq. (13), the distance of 10 km from the gravity-gradient station is usually sufficient, according to the author's experience. Then, the total number of the compartments concerned with the vertical gradient of gravity is 240. Therefore, the computation errors in $\Gamma_{(1)}$ and $\Gamma_{(2)}$ arising from the tabular error of ± 0.0001 mgal for each compartment is

* $\Gamma'_{(2)}=\Gamma_{(2)}-2\pi\gamma\cdot\delta z\cdot\sigma$ $(=0.04193\cdot\delta z\cdot\sigma$ mgal) (cf. §6 of this paper)

$$\pm 0.0001\sqrt{240}\sigma = \pm 0.00155\sigma \text{ mgal}, \quad \cdots\cdots\cdots\cdots\cdots\cdots (14)$$

where σ is the density assumed constant for all the compartments. Hence, the error expected in $\Gamma_{(2)}-\Gamma_{(1)}/\delta z$ is

$$\frac{\pm 0.00155\sqrt{2}}{\delta z}\sigma = \frac{\pm 0.0022}{\delta z}\sigma \text{ mgal/m}. \quad \cdots\cdots\cdots\cdots\cdots\cdots (15)$$

The measurements of vertical gradient of gravity in Japan have been continued since Sept. of 1955. At the beginning, the value of δz was about 10 m when making use of fire-towers and later has been about 5 m since we began to exclusively use a jeep equipped with an extensible ladder of which the upper plate when fully extended is at a height of about 5 m above the ground surface. Therefore, the errors computed by the Eq. (15) are $\pm 0.0002\sigma$ mgal/m and $\pm 0.0004\sigma$ mgal/m for $\delta z=10$ m and 5 m respectively. If we assume 2.67 gm$\cdot$cm^{-3} for σ, those values become ± 0.00053 and ± 0.00106 mgal/m. The observation error of the vertical gradient $(g_1-g_2)/\delta z$ observed by the gravimeter and the jeep above mentioned has been found to be in the range from ± 0.001 mgal/m (=10 Eötvöses) to ± 0.002 mgal/m (=20 Eötvöses). Therefore, the topographical correction tables obtained in this paper may be safely utilized for the topographical correction upon the intensity of vertical gradient of gravity observed with the accuracy mentioned above.

§4. Actual procedure of the topographic correction

Concentric circles are drawn on a transparent sheet with the radii r_m reduced to the scale of a topographical map adopted. These circles are divided into 12 equal parts by the radial lines drawn from the center to form sectorial compartments. Next, putting this center on a gravity station plotted on the topographical map, the mean heights h above the sea-level of the topography within the compartments are estimated. If the height above the sea-level of a gravity station is H, we can obtain the values of $|h-H|$ of the compartments belonging to a selected subzone of a selected zone, from which the corresponding values of f_m can be obtained from the corresponding tables of f_m (m=I, II, III, IV and V). Multiplying the thus obtained values of f_m with the density σ of the corresponding block suitably estimated by the help of geological maps, the value of the topographical effect $\Gamma_m=f_m\cdot\sigma$ can be found. Then, the summation of all the thus obtained values Γ_m up to the greatest value of r_m, which is usually less than 100 km, is the topographic effect at the gravity station. Subtracting of the summation $\Sigma\Gamma_m$ from the gravity value observed at the station means to accomplish the topographical correction.

§5. Errors of topographic correction

The errors involved in the topographical effects $f_m \cdot \sigma (=\Gamma_m)$ obtained from Tables I–1, 2, 3, 4, 5 arise from the situation that the actual topography within each compartment is replaced by the compartment block of the mean height $|h-H|$. Errors also arise from the uncertainty of the density σ assumed to the block. However, this kind of errors is not discussed in the present paper. At first will be examined the error produced when the actual topography of a compartment has a constant slope along the radial line (Fig. 3(a) and Fig. 3(b)). If the

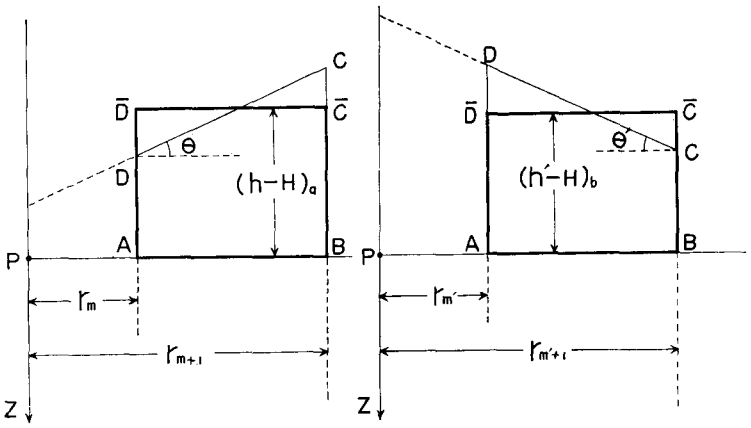

Fig. 3.

vertical attractions, directed upward and therefore negative, at a gravity station P of two compartment blocks of actual topography, whose radial cross-sections A B C D as shown in Figs. 3(a) and 3(b), are denoted by $f_z(\mathrm{A\ B\ C\ D})_a$ and $f_z(\mathrm{A\ B\ C\ D})_b$ respectively, and those at P of the two such equivalent compartment blocks of cross-sections A B $\bar{\mathrm{C}}$ $\bar{\mathrm{D}}$, where $\bar{\mathrm{C}}$ $\bar{\mathrm{D}}$ is a horizontal line, that volume A B C D = volume A B $\bar{\mathrm{C}}$ $\bar{\mathrm{D}}$, be denoted by $f_z(\mathrm{A\ B\ \bar{C}\ \bar{D}})_a$ and $f_z(\mathrm{A\ B\ \bar{C}\ \bar{D}})_b$ respectively, a simple physical consideration will easily prove

$$\left.\begin{aligned} 0 > f_z(\mathrm{A\ B\ C\ D})_a > f_z(\mathrm{A\ B\ \bar{C}\ \bar{D}})_a \quad &\text{(Fig. 3(a))} \\ f_z(\mathrm{A\ B\ C\ D})_b < f_z(\mathrm{A\ B\ \bar{C}\ \bar{D}})_b < 0 \quad &\text{(Fig. 3(b))} \end{aligned}\right\} \cdots\cdots\cdots\cdots (16)$$

The actual topography around a gravity station is usually so irregular that, as to the radial slopes of the ground surface, the ascending slopes and descending ones are nearly, equally frequent, so that the errors arising from the replacing of the compartment blocks of actual topography with their equivalent blocks with the

mean height $h-H$ nearly cancel each other, as can be judged by Eq. (16). Further, we have to examine the case in which the ground surface of a compartment block slopes in the direction perpendicular to the radial line. In Fig. 4, A B C D is the vertical cross-section of the block of the actual topography with a slope θ at a distance from P equal to $(r_m+r_{m+1})/2$, (P) is the projection of P on the inner

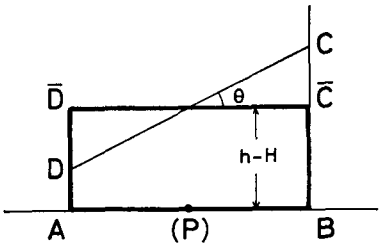

Fig. 4.

vertical wall of the block and A B $\bar{C}$ $\bar{D}$ is the cross-section of the equivalent block with its volume equal to that of the block A B C D. Then, simple calculation will prove that the sign of the error of the vertical attraction f_z(A B $\bar{C}$ $\bar{D}$) against the actual one f_z(A B C D) depends on the values of r_m, $h-H$ and θ, so that in the whole area of the topographical correction the occurrence of the positive and negative errors may be nearly, equally frequent and they may nearly cancel each other, just as in the case of the radial slopes. It can, therefore, be said that the replacing of the ground surface of a compartment block with the horizontal upper surface of its equivalent, equivoluminal block may not produce a large error. However, it would be necessary to examine the value of this kind of error by employing a model topography, and this will be done later on.

Before doing this examination, let us examine the influence of the error involved in the estimation of $|h-H|$ in the case of usual topography in which r_m is generally greater than $|h-H|$. If the error in f_m produced by the error $d(h-H)$ in the relative height $h-H$ is denoted by df_m, we get by differentiating the Eq. (11) with respect to $h-H$

$$df_m = \pm 1.2908\cdot 10^{-6}\cdot\frac{|h-H|}{r_m}|d(h-H)| \quad \text{gal/gm}\cdot\text{cm}^{-3}, \quad \cdots\cdots\cdots(17)$$

where $1.2908\cdot 10^{-6}$ is the value of $(2\pi\gamma/N)\cdot(\beta-1)/\beta$ with the values of r_m and $h-H$ expressed in meter. If we put $df_m=10^{-x}$ for one compartment, the summation of the effects of these errors for all the 276 compartments is $10^{-x}\cdot 276^{1/2}=10^{-x}\cdot 16.65$. Putting this value equal to 10^{-5} gal, the sensitivity of the gravity measurement by a gravimeter, we obtain $x=6.22$ and let us adopt $x=6$, which produces from the Eq. (17)

$$|h-H| \cdot |d(h-H)| = 0.77471 \cdot r_m \quad m^2, \quad \cdots\cdots\cdots\cdots\cdots\cdots (18)$$

which is a rectangular hyperbola with a parameter r_m, as shown by the diagrams in Fig. 5. The diagrams indicate as follows: For a given subzone of a given zone, the permissible error $d(h-H)$ in the estimated value of $|h-H|$ increases with decreasing value of it, and for a given value of $|h-H|$ within a given zone

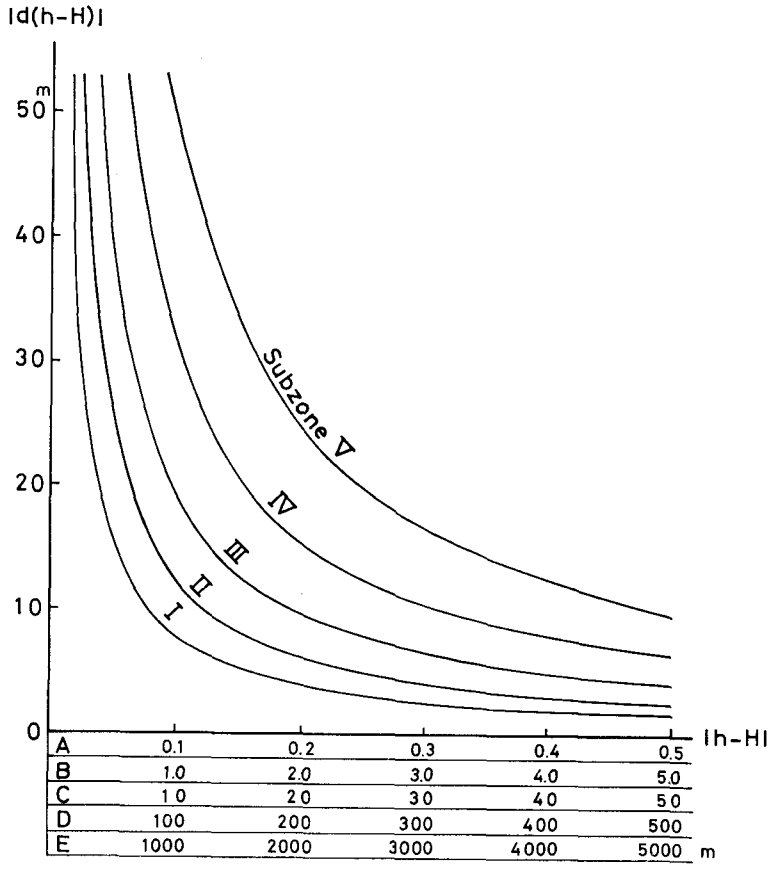

Fig. 5.

the error also increases as the distance of the subzone from the gravity station becomes greater. The ratio $|d(h-H)|/|h-H|$ with a given value of $|d(h-H)|$ in a given subzone increases with a common ratio of 10 as the zone approaches the gravity station. These diagrams will help a map reader in judging with what degree of accuracy the mean height h of the topography of a given compartment should be found.

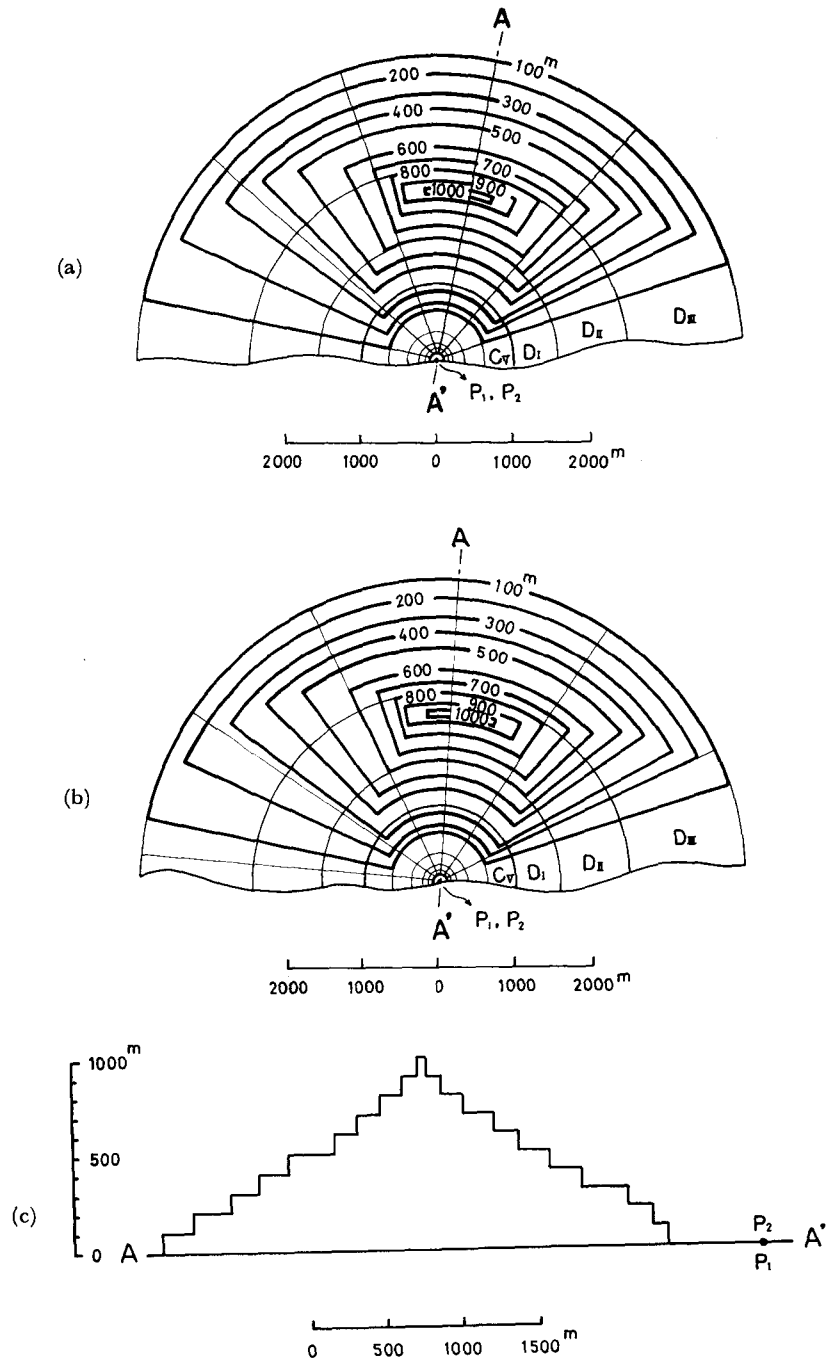
(a)
A
100m
200
300
400
500
600
700
800
900
1000
DIII
DII
CV
DI
A'
P1, P2
2000 1000 0 1000 2000m
(b)
A
100m
200
300
400
500
600
700
800
900
1000
DIII
DII
CV
DI
A'
P1, P2
2000 1000 0 1000 2000m
(c)
1000m
500
0
A
P2
P1
A'
0 500 1000 1500m

Fig. 6.

§6. The value of the topographic effect $\Gamma=\Sigma_m=\Gamma\Sigma(f_m\cdot\sigma)$ as compared with its exact value by employing a model topography

A model topography employed here is a pile of lots of sectorial blocks of equal thickness of 100 m forming a pyramid (Figs. 6(a), 6(b) and 6(c)). The lowest block standing on the datum level through a gravity station P_1 at the ground surface is just covered by the continuous zones C_V, D_I, D_{II} and D_{III}, where C_V, e.g., means the subzone V of the zone C, and two radial lines separated by 150°. Another station P_2 situated 5 m ($=-\delta z$) vertically above P_1 is employed for an examination of the topographic effect on the vertical gradient of gravity at P_1 as compared with its exact value. Assuming 2.67 gm/cm^3 to the density σ, the exact values of the topographical effects at P_1 and P_2, being denoted by $\Gamma_{(1)}$ and $\Gamma_{(2)}$ respectively, can be computed by making use of the Eq. (10). For tabular computation of $\Gamma_{(1)}$ and $\Gamma_{(2)}$ by tables I–1, 2, ···, 5 and $\sigma=2.67$ gm/cm^3, a transparent graticule has been prepared upon which the necessary concentric circles and radial lines are drawn, with a scale equal to the scale of the maps to be used, to show the compartments. The value of $\Gamma_{(2)}$ obtained by the tabular computation means that the empty space between the ground surface and the datum level passing through P_2 is filled with mass of density σ, so that the vertically downward attraction of an infinitely broad, horizontal plate of a thickness $\delta z(=5.00$ m) and of the density σ, $0.04193\cdot\delta z\cdot\sigma$ mgal, should be subtracted from the values $\Gamma_{(2)}$, because for both the points the topographical mass lying above the datum level through the ground station should be removed. Let $\Gamma'_{(2)}$ denote the value of $\Gamma_{(2)}$ subjected to the above subtraction. In Figs. 6(a) and 6(b) one of the radial lines passes through a point shifted to the right and left sides respectively of the middle point of the summit line of the pyramid. The comparisons between the tabular and exact values of $\Gamma_{(1)}$ and $\Gamma'_{(2)}$ are shown in Table II and III.

The above two means, 0.089 and 0.095 mgal, of the corrections to be added to the tabular values are nearly 0.1 mgal which is 10 times the sensitivity of the present portable gravimeter, 0.01 mgal. In this model the corrections are

Table II. Topographical effect $\Gamma_{(1)}=\Sigma(\Gamma_m)_{(1)}$ upon the intensity of gravity g_1 at a ground station P_1 with $\sigma=2.67$ gm/cm^3.

	Fig. 6(a)	Fig. 6(b)	Mean
	mgal	mgal	mgal
Tabular value	−3.167	−3.210	−3.184
Exact value	−3.273	−3.273	−3.273
Corr. to be added to the tabular value	−0.106	−0.072	−0.089

Table III. Topographical effect $\Gamma'_{(2)}=\Sigma(\Gamma_m)_{(2)}-0.04193\cdot\delta z\cdot\sigma$ upon the intensity of gravity g_2 at a free-air station P_2 with $\sigma=2.67$ gm/cm^3.

	Fig. 6(a)	Fig. 6(b)	Mean
	mgal	mgal	mgal
Tabular value	−3.087	−3.121	−3.104
Exact value	−3.199	−3.199	−3.199
Corr. to be added to the tabular value	−0.112	−0.078	−0.095

negative, but another model may be possible which produces positive correction. Consequently, with the actual topography within a distance of some tens of kilometers or 100 km from a gravity station, the correction to be added to the tabular value due to the total topography would not take a very large value, and it may be expected that the reliability of Tables I–1, 2, ···, 5 for the total, actual topography would be at least ± 0.1 mgal. However, examination of this reliability on more rigorous and reasonable basis is a task the author has to undertake.

In Table IV are shown the comparisons between the tablular and exact values of $(\Gamma_{(1)}-\Gamma'_{(2)})/5.00$, i.e., the topographical effect in mgal/m upon the intensity of the vertical gradient of gravity at the ground station P_1 which is obtained by $(g_1-g_2)/\delta z$ (cf. the Eq. (13)). The sensitivity of the gravimeter to

Table IV. Topographical effect $(\Gamma_{(1)}-\Gamma'_{(2)})/5.00$ upon the intensity of vertical gradient of gravity at the ground station P_1.

	Fig. 6(a)	Fig. 6(b)	Mean
	mgal/m	mgal/m	mgal/m
Tabular value	−0.0160	−0.0160	−0.0160
Exact value	−0.0148	−0.0148	−0.0148
Corr. to be added to the tabular value	+0.0012	+0.0012	+0.0012

measure g_1 and g_2 is 0.01 mgal, and therefore, the sensitivity of it as a vertical gradiometer of gravity with $\delta z=5.00$ m is $0.01\sqrt{2}/5.00=0.0028$ mgal/m, which is nearly twice or in the same order of magnitude of the value 0.0012 mgal/m, the mean of the two corrections to be added to the tabular values in the table. This is just opposite to the case in which the error involved in the tabular value of the topographic correction upon gravity value is, already mentioned, about 10 times as large as the sensitivity of the gravimeter. This result indicates that Tables I–1, 2, ···, 5 are more reliable for the vertical gradient of gravity than for gravity.

§7. Some examples of the topographic corrections for gravity and its vertical gradient

From November 1958 to October 1959, the vertical gradients of gravity were measured at 145 stations occupied at the first order bench marks in the central part of Honshû, Japan, by using a Worden gravimeter No. 127 of the scale constant=0.1004 mgal per small dial division and a jeep equipped with an extensible ladder of which the top plate to mount the gravimeter when fully extended is at a height of about 5 m above the ground surface; this height changed from 4.85 to 5.25 m according to the station. At the four stations selected from the above 145 stations, the topographic corrections were carried out by Tables I–1, 2, ···, 5 upon the intensities of gravity and its vertical gradients at these four stations to obtain their Modified Bouguer anomalies at sea-level. The results are shown in Table V. In the table Simple Bouguer anomaly, a name given to $\Delta g_0''$, is identical with Bouguer anomaly employed in the pendulum age of the gravity measurement; in this old age the topographic correction was disregarded with usual topography owing to a low accuracy of the gravity measurement and further the free-air reduction was made by the coefficient 0.3086 mgal/m, the vertical gradient of the nomal gravity near the sea-level. In the present age of a high precision gravimeter, the topographic corrections are requisite to the observed values not only of gravity and but also its vertical gradient, the latter being not observed in

Table V. Actual examples of the topographic corrections for gravity and its vertical gradient.

Station No.	Bench mark No.	Height above sea-level H	Simple Bouguer anomaly at P_1 $\Delta g_0''$	Observed value of vertical gradient of gravity $(g_1-g_2)/\delta z$
		m	mgal	mgal/m
14	644	851	−31.4 *	0.265
32	813	201	−12.8 *	0.252
43	5191	106	+ 0.4 *	0.268
58	863	17	+16.2 *	0.297

Table V (cont.).

Station No.	Topographic effect upon g_1 $\Gamma_{(1)}$	Modified Bouguer anomaly with a distance of 25 km $\Delta g_0''-\Gamma_{(1)}\equiv \Delta g_0''^{(25)}$	Topographic effect on the gradient $(\Gamma_{(1)}-\Gamma'_{(2)})/\delta z$	Vertical gradient at P_1 corrected for topography $\partial g''/\partial z$
	mgal	mgal	mgal/m	mgal/m
14	− 4.9	−26.5	−0.013	0.278
32	−10.6	− 2.2	−0.041	0.293
43	− 2.7	+ 3.1	−0.045	0.313
58	− 0.4	+16.6	−0.010	0.307

Table V (cont.).

Station No.	Anomalies in $\partial g''/\partial z$ $\partial g''/\partial z-0.309=\lambda$	Corr. to the usual free-air reduction λH	Modified Bouguer anomaly corrected for λH $\Delta g_{\underline{0}}''^{(25)}$	$\Delta g_0''-\Delta g_{\underline{0}}''^{(25)}$	$\Delta g_0''^{(25)}-\Delta g_{\underline{0}}''^{(25)}$
	mgal/m	mgal	mgal	mgal	mgal
14	−0.031	−26.4	−52.9	+21.5	+26.4
32	−0.016	− 3.2	− 5.4	− 7.4	+ 3.2
43	+0.004	+ 0.4	+ 3.5	− 3.1	− 0.4
58	−0.002	0.0	+16.6	− 0.4	0.0

* Tsuboi *et al.* (1955)

the pendulum age. Modified Bouguer anomaly means Simple Bouguer anomaly upon which the topographic correction was done for the topography within a certain distance from the gravity station. The figure 25 in the upper suffix $''(25)$ of the sign of Modified Bouguer anomaly indicates the distance in km from the gravity station within which the topographic correction has been done. This upper suffix, of which inside the brackets the figure of any desired distance is written, is what N. Kumagai has been using in his unpublished works, and is employed in this paper by his permission. The lower suffix $\underline{0}$ attached to Modified Bouguer anomaly corrected for λH, $\Delta g_{\underline{0}}''^{(25)}$, indicates that it is Modified Bouguer anomaly *at sea-level*, in contrast to which $\Delta g_0''^{(25)}$ is Modified Bouguer anomaly *at a station in free-air*. These two kinds of phrase "at sea-level" and "at a station in free-air" were already employed by N. Kumagai, *et al.* (1960). Of the three kinds of Bouguer anomalies, namely Simple Bouguer anomaly, $\Delta g_0''$, Modified one, $\Delta g_0''^{(25)}$, and Modified one corrected for λH, $\Delta g_{\underline{0}}''^{(25)}$, the most trustful one is the last mentioned one.

The errors of the above mentioned first and second Bouguer anomalies against the third are shown under the headings $\Delta g_0''-\Delta g_{\underline{0}}''^{(25)}$ and $\Delta g_0''^{(25)}-\Delta g_{\underline{0}}''^{(25)}$ in the last two columns of Table V (cont.), indicating that the error generally increases as the height of the station increases. Therefore, it can be said that both the two anomalies $\Delta g_0''$ and $\Delta g_0''^{(25)}$ in a lofty mountainous area can never be used for finding the state of the isostatic equilibrium, or generally speaking, of the mass distribution under the area and, instead, the Modified Bouguer anomalies $\Delta g_{\underline{0}}''^{(S)}$ should be used, of which S in the brackets of the upper suffix indicates the greatest distance within which the topographic effect has been removed.

§8. Method of correction for near topography assumed two-dimensional

Near the gravity station frequently appear the topographies of ascending and

descending steps which may be treated as two-dimensional with the cross-section as shown in Fig. 7(a) and 7(b). In the figures H and H' are positive quantities and the axis of Z is directed vertically downward. This kind of correction may be made, as usually done by condensation of the excess or defect of mass respectively above or below the ground level LL' upon a horizontal plane (shown by a broken line in Fig. 7(a) and 7(b)) which divides the excess or defect of mass into two equal

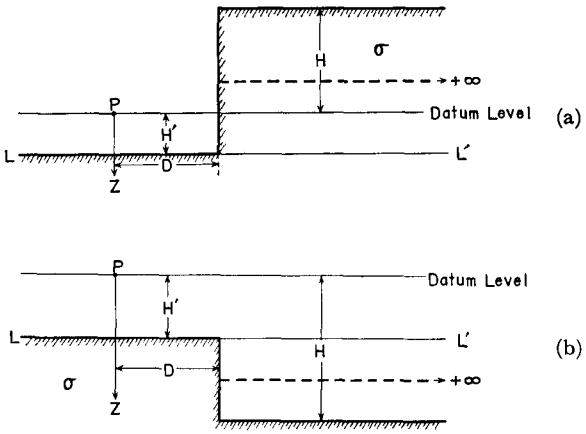

Fig. 7.

parts and by calculating the effect of such a condensed mass at the gravity station P. In this case, the larger is the ratio H/D, the larger becomes the error of the condensation. If the vertical attraction at P of the mass of the ascending step (Fig. 7(a)) above the ground level LL' is denoted by F, we have

$$F = -2\gamma\cdot\sigma\cdot\left\{\frac{\pi}{2}(H-H')+D\ln\frac{\sqrt{D^2+H'^2}}{\sqrt{D^2+H^2}}-H\tan^{-1}\frac{D}{H}+H'\tan^{-1}\frac{D}{H'}\right\}, \quad \cdots(19)$$

which can be rewritten as follows:

$$F = -\gamma\cdot\sigma\cdot D\cdot\left\{\pi\frac{H-H'}{D}+\ln\frac{1+(H'^2/D^2)}{1+(H^2/D^2)}-2\frac{H}{D}\tan^{-1}\frac{D}{H}+2\frac{H'}{D}\tan^{-1}\frac{D}{H'}\right\}. \cdots(20)$$

Further putting

$$q = -\gamma\cdot\left\{\pi\left(\frac{H}{D}-\frac{H'}{D}\right)+\ln\frac{1+(H'/D)^2}{1+(H/D)^2}-2\frac{H}{D}\cot^{-1}\frac{H}{D}+2\frac{H'}{D}\cot^{-1}\frac{H'}{D}\right\}, \cdots\cdots(21)$$

we get for both the excess and defect masses

$$F = q\cdot\sigma\cdot D\,. \quad \cdots\cdots(22)$$

In Tables VI–1 and 2 attached in the end of this paper are shown the values of $-q$ in μgal per gm$\cdot$cm^{-3} per m for every 0.05 of H'/D from 0.00 to 5.00 and of H/D from 0.05 to 5.00. The tabular values of $-q$ for high values of H'/D are useful for the measurements of the vertical gradient of gravity in which the upper station P_2 is situated at a height δz above the ground surface, which changes around 5.00 m according to station. In the tables the values of $-q$ are calculated for $H \geqslant H'$, i.e., $H/D \geqslant H'/D$. If $H<H'$, i.e., $H/D<H'/D$, the tabular values of $-q$ can be used by simply changing the minus sign with the plus. After the topographical correction is finished by these tables, the ground surface around the station takes a horizontal plane extending to the distance beyond which the distant topographical corrections are to be done by using Tables I–1, ···, 5. The height H' of the gravity station above this horizontal ground surface depends on the height of the stand on which the gravimeter is mounted. In order that the near topographical correction is consistent with the distant one, the free-air space between the above mentioned horizontal ground surface and the datum level through P should be filled with mass of density σ, that is, the attraction of $2\pi\gamma\cdot\sigma\cdot H'$ should be added to the station P. In case of the measurement of vertical gradient of gravity, the similar treatment should be done for both the two points P_1 and P_2.

When the step is descending (Fig. 7(b)) the same equation as the Eq. (12) and the addition of the attraction $2\pi\gamma\cdot\sigma\cdot H'$ to the station P hold true. When the near topography is a bank or a ditch, of which the width is l and the horizontal distances of the edges from P are D and $D+l$, the effect of the bank or ditch is $F_{(D)}-F_{(D+l)}$, where $F_{(D)}$ is the Eq. (20) and $F_{(D+l)}$ is the same equation in which D is replaced by $D+l$.

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Table I-1. Topographic effect of one compartment of the subzone I upon the intensity of gravity.

$-f_I$ in μgal for $\sigma = 1.00\,\mathrm{gm \cdot cm^{-3}}$

h−H m	00	10	20	30	40	50	60	70	80	90
ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE
	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5
100	0.6	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3
200	2.6	2.8	3.1	3.4	3.7	4.0	4.4	4.7	5.1	5.4
300	5.8	6.2	6.6	7.0	7.4	7.9	8.4	8.8	9.3	9.8
400	10.3	10.8	11.4	11.9	12.5	13.0	13.6	14.2	14.8	15.5
500	16.1	16.7	17.4	18.1	18.8	19.5	20.2	20.9	21.7	22.4
600	23.2	23.9	24.7	25.5	26.4	27.2	28.0	28.9	29.7	30.6
700	31.5	32.4	33.3	34.3	35.2	36.2	37.1	38.1	39.1	40.1
800	41.1	42.2	43.2	44.3	45.3	46.4	47.5	48.6	49.7	50.9
900	52.0	53.2	54.3	55.5	56.7	57.9	59.1	60.4	61.6	62.9
1000	64.1	65.4	66.7	68.0	69.4	70.7	72.0	73.4	74.8	76.1
1100	77.5	78.9	80.4	81.8	83.2	84.7	86.2	87.6	89.1	90.6
1200	92.2	93.7	95.2	96.8	98.4	99.9	101.5	103.1	104.8	106.4
1300	108.0	109.7	111.4	113.0	114.7	116.4	118.1	119.9	121.6	123.4
1400	125.1	126.9	128.7	130.5	132.3	134.1	136.0	137.8	139.7	141.5
1500	143.4	145.3	147.2	149.2	151.1	153.0	155.0	157.0	158.9	160.9
1600	162.9	165.0	167.0	169.0	171.1	173.1	175.2	177.3	179.4	181.5
1700	183.6	185.8	187.9	190.1	192.2	194.4	196.6	198.8	201.0	203.3
1800	205.5	207.8	210.0	212.3	214.6	216.9	219.2	221.5	223.9	226.2
1900	228.6	230.9	233.3	235.7	238.1	240.5	243.0	245.4	247.8	250.3
2000	252.8	255.3	257.8	260.3	262.8	265.3	267.8	270.4	273.0	275.5
2100	278.1	280.7	283.3	285.9	288.6	291.2	293.9	296.5	299.2	301.9
2200	304.6	307.3	310.0	312.8	315.5	318.3	321.0	323.8	326.6	329.4
2300	332.2	335.0	337.8	340.7	343.5	346.4	349.3	352.1	355.0	357.9
2400	360.9	363.8	366.7	369.7	372.6	375.6	378.6	381.6	384.6	387.6
2500	390.6	393.7	396.7	399.8	402.8	405.9	409.0	412.1	415.2	418.3
2600	421.5	424.6	427.8	430.9	434.1	437.3	440.5	443.7	446.9	450.1
2700	453.3	456.6	459.8	463.1	466.4	469.7	473.0	476.3	479.6	482.9
2800	486.3	489.6	493.0	496.3	499.7	503.1	506.5	509.9	513.3	516.7
2900	520.2	523.6	527.1	530.6	534.0	537.5	541.0	544.5	548.0	551.6
3000	555.1	558.6	562.2	565.8	569.3	572.9	576.5	580.1	583.7	587.4
3100	591.0	594.6	598.3	602.0	605.6	609.3	613.0	616.7	620.4	624.1
3200	627.9	631.6	635.4	639.1	642.9	646.7	650.4	654.2	658.0	661.9
3300	665.7	669.5	673.3	677.2	681.1	684.9	688.8	692.7	696.6	700.5
3400	704.4	708.3	712.3	716.2	720.2	724.1	728.1	732.1	736.0	740.0
3500	744.0	748.1	752.1	756.1	760.1	764.2	768.2	772.3	776.4	780.5
3600	784.6	788.7	792.8	796.9	801.0	805.1	809.3	813.4	817.6	821.8
3700	825.9	830.1	834.3	838.5	842.7	847.0	851.2	855.4	859.7	863.9
3800	868.2	872.4	876.7	881.0	885.3	889.6	893.9	898.2	902.6	906.9
3900	911.2	915.6	919.9	924.3	928.7	933.1	937.5	941.9	946.3	950.7
4000	955.1	959.5	964.0	968.4	972.9	977.3	981.8	986.3	990.8	995.2
4100	999.7	1004.3	1008.8	1013.3	1017.8	1022.4	1026.9	1031.5	1036.0	1040.6
4200	1045.2	1049.8	1054.3	1058.9	1063.5	1068.2	1072.8	1077.4	1082.0	1086.7
4300	1091.3	1096.0	1100.7	1105.3	1110.0	1114.7	1119.4	1124.1	1128.8	1133.5
4400	1138.2	1143.0	1147.7	1152.4	1157.2	1161.9	1166.7	1171.5	1176.3	1181.0
4500	1185.8	1190.6	1195.4	1200.2	1205.1	1209.9	1214.7	1219.6	1224.4	1229.3
4600	1234.1	1239.0	1243.9	1248.7	1253.6	1258.5	1263.4	1268.3	1273.2	1278.1
4700	1283.1	1288.0	1292.9	1297.9	1302.8	1307.8	1312.8	1317.7	1322.7	1327.7
4800	1332.7	1337.7	1342.7	1347.7	1352.7	1357.7	1362.7	1367.8	1372.8	1377.9
4900	1382.9	1388.0	1393.0	1398.1	1403.2	1408.3	1413.3	1418.4	1423.5	1428.6
5000	1433.7									

Table I-2. Topographic effect of one compartment of the subzone II upon the intensity of gravity.

$-f_{II}$ in μgal for $\sigma=1.00\,gm\cdot cm^{-3}$

(a)

lh–Hl m	00	20	40	60	80
ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE
	0.0	0.0	0.1	0.2	0.3
100	0.4	0.6	0.8	1.0	1.3
200	1.6	2.0	2.4	2.8	3.2
300	3.7	4.2	4.7	5.2	5.8
400	6.4	7.1	7.8	8.6	9.4
500	10.2	11.0	11.9	12.8	13.7
600	14.6	15.6	16.6	17.7	18.8
700	20.0	21.1	22.2	23.4	24.7
800	26.0	27.3	28.7	30.0	31.4
900	32.9	34.4	35.9	37.4	39.0
1000	40.6	42.3	44.0	45.6	47.3
1100	49.0	50.8	52.6	54.5	56.4
1200	58.4	60.4	62.4	64.4	66.4
1300	68.5	70.6	72.7	74.9	77.2
1400	79.5	81.7	84.0	86.3	88.7
1500	91.1	93.5	96.0	98.5	101.0
1600	103.6	106.2	108.8	111.4	114.1
1700	116.8	119.6	122.4	125.3	128.1
1800	130.9	133.8	136.7	139.7	142.7
1900	145.7	148.8	151.9	155.0	158.2
2000	161.4	164.5	167.7	171.0	174.3
2100	177.7	181.1	184.5	188.0	191.5
2200	194.9	198.4	202.0	205.6	209.2
2300	212.9	216.7	220.4	224.1	227.8
2400	231.6	235.4	239.2	243.0	247.1
2500	251.1	255.1	259.0	263.0	267.0
2600	271.2	275.4	279.6	283.8	288.0
2700	292.3	296.5	300.8	305.1	309.5
2800	313.9	318.3	322.7	327.2	331.7
2900	336.2	340.8	345.5	350.2	354.8
3000	359.5	364.3	369.1	373.9	378.6
3100	383.4	388.3	393.2	398.1	403.1
3200	408.2	413.2	418.2	423.2	428.2
3300	433.4	438.7	443.9	449.1	454.3
3400	459.5	464.8	470.2	475.6	481.0
3500	486.3	491.7	497.2	502.7	508.2
3600	513.7	519.3	524.9	530.6	536.3
3700	542.0	547.7	553.4	559.2	565.0
3800	570.8	576.6	582.5	588.5	594.5
3900	600.4	606.3	612.3	618.4	624.4
4000	630.4	636.5	642.7	649.0	655.3
4100	661.5	667.7	673.9	680.3	686.7
4200	693.0	699.4	705.8	712.3	718.8
4300	725.3	731.8	738.4	745.0	751.6
4400	758.2	764.8	771.4	778.0	784.7
4500	791.4	798.2	805.1	812.0	819.0
4600	825.8	832.6	839.5	846.5	853.5
4700	860.5	867.5	874.5	881.6	888.7
4800	895.8	902.9	910.0	917.2	924.5
4900	931.8	939.1	946.3	953.6	961.0
5000	968.4	975.8	983.3	990.7	998.2

(b)

lh–Hl m	00	20	40	60	80
ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE
5100	1005.7	1013.2	1020.6	1028.2	1035.8
5200	1043.4	1051.1	1058.8	1066.5	1074.2
5300	1081.9	1089.7	1097.5	1105.2	1113.0
5400	1120.9	1128.8	1136.7	1144.5	1152.3
5500	1160.2	1168.3	1176.4	1184.4	1192.4
5600	1200.4	1208.5	1216.6	1224.8	1232.9
5700	1241.0	1249.3	1257.5	1265.6	1273.8
5800	1282.0	1290.4	1298.7	1307.1	1315.5
5900	1323.9	1332.3	1340.8	1349.3	1357.7
6000	1366.2	1374.8	1383.3	1391.9	1400.5
6100	1409.0	1417.6	1426.3	1435.0	1443.7
6200	1452.5	1461.1	1469.9	1478.8	1487.5
6300	1496.2	1505.0	1513.7	1522.6	1531.5
6400	1540.4	1549.3	1558.2	1567.2	1576.3
6500	1585.3	1594.2	1603.2	1612.3	1621.4
6600	1630.6	1639.6	1648.7	1657.9	1667.2
6700	1676.4	1685.6	1694.8	1704.0	1713.3
6800	1722.6	1731.9	1741.1	1750.4	1759.8
6900	1769.2	1778.6	1788.0	1797.4	1806.9
7000	1816.5	1826.0	1835.5	1845.0	1854.6
7100	1864.2	1873.7	1883.2	1892.7	1902.3
7200	1911.9	1921.7	1931.4	1941.1	1950.7
7300	1960.4	1970.3	1980.2	1990.0	1999.8
7400	2009.6	2019.4	2029.2	2039.0	2048.8
7500	2058.6	2068.5	2078.5	2088.5	2098.5
7600	2108.4	2118.4	2128.4	2138.4	2148.5
7700	2158.5	2168.7	2178.9	2188.9	2199.0
7800	2209.1	2219.2	2229.4	2239.5	2249.6
7900	2259.9	2270.2	2280.5		
8000					

Table I-3. Topographic effect of one compartment of the subzone III upon the intensity of gravity.

$-f_{III}$ in μgal for $\sigma = 1.00\ \mathrm{gm \cdot cm^{-3}}$

(a)

lh–Hl m	00	25	50	75
ABCDE	ABCDE	ABCDE	ABCDE	ABCDE
	0.0	0.0	0.1	0.1
100	0.3	0.4	0.6	0.8
200	1.0	1.3	1.6	1.9
300	2.3	2.7	3.2	3.6
400	4.1	4.7	5.2	5.8
500	6.4	7.0	7.7	8.5
600	9.2	10.0	10.8	11.7
700	12.6	13.5	14.4	15.4
800	16.4	17.5	18.6	19.7
900	20.8	21.9	23.1	24.3
1000	25.5	26.8	28.2	29.6
1100	31.0	32.4	33.8	35.3
1200	36.9	38.4	40.0	41.7
1300	43.4	45.1	46.8	48.5
1400	50.2	52.0	53.8	55.7
1500	57.6	59.6	61.6	63.5
1600	65.5	67.6	69.7	71.9
1700	74.0	76.2	78.4	80.7
1800	82.9	85.2	87.5	89.9
1900	92.4	94.8	97.3	99.8
2000	102.3	104.8	107.4	110.0
2100	112.7	115.5	118.3	121.0
2200	123.7	126.5	129.4	132.2
2300	135.2	138.2	141.2	144.1
2400	147.2	150.2	153.3	156.4
2500	159.6	162.8	166.1	169.4
2600	172.6	175.9	179.2	182.6
2700	186.0	189.5	193.0	196.5
2800	200.1	203.6	207.2	210.7
2900	214.3	218.0	221.8	225.6
3000	229.3	233.1	236.9	240.7
3100	244.6	248.6	252.6	256.6
3200	260.7	264.8	268.9	273.0
3300	277.1	281.2	285.4	289.7
3400	294.0	298.3	302.6	307.0
3500	311.3	315.7	320.2	324.7
3600	329.2	333.7	338.3	342.9
3700	347.6	352.3	356.9	361.6
3800	366.3	371.1	376.0	380.9
3900	385.7	390.6	395.5	400.4
4000	405.3	410.3	415.4	420.6
4100	425.8	430.9	436.0	441.2
4200	446.4	451.7	457.0	462.3
4300	467.6	473.0	478.4	483.8
4400	489.2	494.7	500.2	505.8
4500	511.4	517.0	522.6	528.3
4600	534.0	539.7	545.4	551.1
4700	556.8	562.8	568.8	574.7
4800	580.6	586.6	592.6	598.7
4900	604.7	610.7	616.8	622.9
5000	629.0	635.1	641.3	647.6

(b)

lh–Hl m	00	25	50	75
ABCDE	ABCDE	ABCDE	ABCDE	ABCDE
5100	654.0	660.3	666.7	673.0
5200	679.3	685.7	692.1	698.6
5300	705.1	711.7	718.3	724.9
5400	731.4	738.0	744.6	751.3
5500	758.0	764.8	771.6	778.3
5600	785.1	792.0	798.9	805.8
5700	812.7	819.7	826.8	833.9
5800	840.9	847.9	855.0	862.0
5900	869.0	876.2	883.5	890.8
6000	898.0	905.3	912.6	920.0
6100	927.3	934.7	942.2	949.8
6200	957.3	964.8	972.3	979.8
6300	987.4	995.0	1002.6	1010.2
6400	1018.0	1025.8	1033.5	1041.2
6500	1049.0	1056.9	1064.8	1072.6
6600	1080.5	1088.4	1096.3	1104.2
6700	1112.2	1120.2	1128.2	1136.4
6800	1144.6	1152.8	1160.9	1169.1
6900	1177.2	1185.3	1193.5	1201.8
7000	1210.2	1218.6	1227.0	1235.5
7100	1243.9	1252.3	1260.8	1269.3
7200	1277.7	1286.2	1294.8	1303.5
7300	1312.2	1320.7	1329.2	1337.9
7400	1346.7	1355.5	1364.2	1372.9
7500	1381.7	1390.4	1399.3	1408.3
7600	1417.3	1426.2	1435.2	1444.2
7700	1453.2	1462.1	1471.1	1480.1
7800	1489.3	1498.5	1507.7	1516.8
7900	1525.9	1535.0	1544.2	1553.4
8000	1562.7	1572.1	1581.5	1590.9
8100	1600.4	1609.9	1619.2	1628.7
8200	1638.2	1647.6	1657.0	1666.6
8300	1676.3	1685.9	1695.4	1704.9
8400	1714.4	1724.0	1733.8	1743.6
8500	1753.4	1763.2	1773.0	1782.8
8600	1792.6	1802.5	1812.4	1822.4
8700	1832.3	1842.2	1852.2	1862.2
8800	1872.2	1882.2	1892.2	1902.2
8900	1912.3	1922.6	1932.9	1943.1
9000	1953.2	1963.4	1973.7	1983.9
9100	1994.1	2004.4	2014.8	2025.3
9200	2035.7	2046.0	2056.3	2066.7
9300	2077.2	2087.7	2098.2	2108.7
9400	2119.2	2129.6	2140.0	2150.6
9500	2161.4	2172.2	2183.0	2193.7
9600	2204.3	2214.9	2225.6	2236.3
9700	2247.0	2257.7	2268.6	2279.6
9800	2290.5	2301.4	2312.3	2323.2
9900	2334.1	2345.0	2356.0	2367.0
10000	2378.0	2389.0	2400.0	2411.0

(c)

lh–Hl m	00	25	50	75
ABCDE	ABCDE	ABCDE	ABCDE	ABCDE
10100	2422.2	2433.3	2444.5	2455.7
10200	2466.9	2478.1	2489.4	2500.6
10300	2511.8	2523.1	2534.4	2545.7
10400	2557.1	2568.4	2579.7	2591.0
10500	2602.4	2613.9	2625.3	2636.9
10600	2648.4	2659.9	2671.5	2683.0
10700	2694.5	2706.0	2717.7	2729.3
10800	2740.9	2752.5	2764.2	2775.8
10900	2787.4	2799.0	2810.8	2822.7
11000	2834.5	2846.3	2858.1	2869.9
11100	2881.6	2893.3	2905.2	2917.2
11200	2929.2	2941.2	2953.1	2965.0
11300	2977.0	2988.9	3000.8	3012.8
11400	3024.9	3037.1	3049.3	3061.5
11500	3073.7	3085.8	3097.9	3110.0
11600	3122.1	3134.2	3146.4	3158.6
11700	3170.8	3183.0	3195.2	3207.5
11800	3219.8	3232.1	3244.5	3257.0
11900	3269.5	3282.0	3294.4	3306.8
12000	3319.2	3331.6	3344.1	3356.6
12100	3369.1	3381.6	3394.0	3406.4
12200	3419.0	3431.6	3444.2	3456.8
12300	3469.4	3482.1	3494.8	3507.4
12400	3520.0	3532.6	3545.3	3558.1
12500	3570.9	3583.7	3596.8	3609.8

Table I-4. Topographic effect of one compartment of the subzone IV upon the intensity of gravity.

$-f_{IV}$ in μgal for $\sigma = 1.00\,\mathrm{gm \cdot cm^{-3}}$

(a)

lh−Hl m	00	50
ABCDE	ABCDE	ABCDE
	0.0	0.0
100	0.2	0.4
200	0.6	1.0
300	1.5	2.0
400	2.6	3.2
500	4.0	4.9
600	5.8	6.9
700	8.0	9.2
800	10.4	11.8
900	13.2	14.6
1000	16.2	17.8
1100	19.6	21.4
1200	23.4	25.3
1300	27.4	29.5
1400	31.7	34.0
1500	36.4	38.8
1600	41.4	44.0
1700	46.7	49.5
1800	52.4	55.3
1900	58.4	61.5
2000	64.7	68.0
2100	71.4	74.8
2200	78.3	81.8
2300	85.5	89.2
2400	93.1	97.0
2500	101.0	105.1
2600	109.2	113.4
2700	117.7	122.1
2800	126.6	131.2
2900	135.9	140.5
3000	145.3	150.2
3100	155.1	160.1
3200	165.2	170.4
3300	175.7	181.1
3400	186.5	192.0
3500	197.6	203.3
3600	209.0	214.8
3700	220.7	226.7
3800	232.7	238.8
3900	245.1	251.4
4000	257.8	264.2
4100	270.7	277.3
4200	284.1	290.8
4300	297.6	304.5
4400	311.6	318.7
4500	325.8	333.0
4600	340.4	347.8
4700	355.2	362.8
4800	370.5	378.1
4900	385.8	393.7
5000	401.7	409.7

(b)

lh−Hl m	00	50
ABCDE	ABCDE	ABCDE
5100	417.7	425.9
5200	434.2	442.5
5300	450.8	459.3
5400	467.9	476.4
5500	485.0	493.8
5600	502.7	511.8
5700	520.8	529.8
5800	539.0	548.3
5900	557.6	566.9
6000	576.4	586.0
6100	595.6	605.2
6200	615.0	624.9
6300	634.9	644.8
6400	654.7	664.9
6500	675.2	685.5
6600	695.8	706.2
6700	716.7	727.3
6800	737.9	748.7
6900	759.5	770.4
7000	781.3	792.3
7100	803.5	814.6
7200	825.8	837.1
7300	848.5	860.0
7400	871.6	883.2
7500	894.8	906.6
7600	918.4	930.4
7700	942.4	954.5
7800	966.6	978.7
7900	990.9	1003.3
8000	1015.7	1028.2
8100	1040.7	1053.2
8200	1065.9	1078.7
8300	1091.6	1104.6
8400	1117.6	1130.6
8500	1143.7	1156.9
8600	1170.0	1183.3
8700	1196.8	1210.3
8800	1223.9	1237.4
8900	1251.0	1264.8
9000	1278.8	1292.7
9100	1306.6	1320.7
9200	1334.8	1348.9
9300	1363.0	1377.2
9400	1391.6	1406.1
9500	1420.6	1435.2
9600	1449.9	1464.7
9700	1479.4	1494.2
9800	1509.2	1524.2
9900	1539.2	1554.2
10000	1569.4	1584.8

(c)

lh−Hl m	00	50
ABCDE	ABCDE	ABCDE
10100	1600.2	1615.5
10200	1630.9	1646.4
10300	1662.0	1677.5
10400	1693.2	1709.0
10500	1725.0	1740.9
10600	1757.0	1773.1
10700	1789.2	1805.2
10800	1821.4	1837.7
10900	1854.0	1870.4
11000	1886.9	1903.5
11100	1920.2	1936.8
11200	1953.6	1970.4
11300	1987.3	2004.2
11400	2021.3	2038.4
11500	2055.5	2072.5
11600	2089.7	2107.0
11700	2124.4	2141.9
11800	2159.4	2177.0
11900	2194.6	2212.3
12000	2230.0	2247.8
12100	2265.7	2283.7
12200	2301.6	2319.6
12300	2337.7	2355.9
12400	2374.2	2392.5
12500	2410.9	2429.3
12600	2447.8	2466.3
12700	2484.9	2503.6
12800	2522.3	2541.1
12900	2559.9	2578.8
13000	2597.7	2616.8
13100	2635.8	2654.9
13200	2674.1	2693.3
13300	2712.6	2731.9
13400	2751.4	2770.9
13500	2790.3	2809.9
13600	2829.5	2849.2
13700	2868.9	2888.8
13800	2908.7	2928.6
13900	2948.5	2968.5
14000	2988.7	3008.9
14100	3029.0	3049.2
14200	3069.5	3089.9
14300	3110.4	3130.9
14400	3151.3	3171.9
14500	3192.5	3213.2
14600	3234.0	3254.9
14700	3275.7	3296.5
14800	3317.4	3338.5
14900	3359.5	3380.6
15000	3401.8	3423.1

(d)

lh−Hl m	00	50
ABCDE	ABCDE	ABCDE
15100	3444.4	3465.6
15200	3486.9	3508.3
15300	3529.8	3551.4
15400	3573.0	3594.6
15500	3616.4	3638.1
15600	3659.8	3681.6
15700	3703.5	3725.4
15800	3747.5	3769.5
15900	3791.6	3813.7
16000	3835.8	3858.0
16100	3880.3	3902.6
16200	3925.0	3947.5
16300	3970.0	3992.6
16400	4015.1	4037.7
16500	4060.4	4083.1
16600	4105.9	4128.7
16700	4151.6	4174.
16800	4197.3	4220.3
16900	4243.3	4266.4
17000	4289.6	4312.7
17100	4335.9	4359.2
17200	4382.6	4406.0
17300	4429.4	4452.9
17400	4476.4	4499.8
17500	4523.4	4547.1
17600	4570.8	4594.5
17700	4618.2	4642.0
17800	4665.9	4689.8
17900	4713.8	4737.8
18000	4761.9	4785.9
18100	4809.9	4834.1
18200	4858.3	4882.5
18300	4906.8	4931.2
18400	4955.5	4979.9
18500	5004.3	5028.9
18600	5053.4	5078.0
18700	5102.6	5127.2
18800	5151.9	5176.6
18900	5201.4	5226.2
19000	5251.2	5276.1
19100	5301.0	5325.9
19200	5350.8	5375.9
19300	5401.0	5426.1
19400	5451.3	5476.5
19500	5501.8	5527.1
19600	5552.5	5577.7
19700	5603.1	5628.4
19800	5653.9	5679.5
19900	5705.1	

Table I-5. Topographic effect of one compartment of the subzone V upon the intensity of gravity.
$-f_V$ in μgal for $\sigma = 1.00\ \mathrm{gm \cdot cm^{-3}}$

(a)			(b)			(c)			(d)			(e)			(f)			(g)		
lh−Hl m	00	50	lh−Hl m	00	50	lh−Hl m	00	50	lh−Hl m	00	50	lh−Hl m	00	50	lh−Hl m	00	50	lh−Hl m	00	50
ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE
	0.0	0.0																		
100	0.1	0.2	5100	264.8	270.0	10100	1029.0	1039.1	15100	2264.4	2279.0	20100	3927.8	3946.2	25100	5965.0	5987.1	30100	8316.0	8340.7
200	0.4	0.7	5200	275.2	280.6	10200	1049.2	1059.2	15200	2293.6	2308.4	20200	3964.8	3983.4	25200	6009.4	6031.7	30200	8365.5	8390.4
300	0.9	1.3	5300	286.0	291.4	10300	1069.5	1079.8	15300	2323.0	2337.8	20300	4002.2	4021.2	25300	6053.8	6075.9	30300	8415.5	8440.6
400	1.7	2.1	5400	296.8	302.4	10400	1090.2	1100.6	15400	2352.6	2367.5	20400	4040.1	4058.9	25400	6098.1	6120.2	30400	8465.6	8490.6
500	2.6	3.1	5500	308.0	313.5	10500	1111.0	1121.5	15500	2382.4	2397.1	20500	4077.9	4096.9	25500	6142.3	6164.6	30500	8515.7	8540.9
600	3.7	4.4	5600	319.0	324.6	10600	1131.9	1142.5	15600	2412.0	2427.0	20600	4115.8	4134.7	25600	6186.9	6209.4	30600	8566.0	8591.2
700	5.0	5.8	5700	330.5	336.4	10700	1153.0	1163.7	15700	2442.1	2457.3	20700	4153.8	4172.9	25700	6231.8	6254.3	30700	8616.2	8641.4
800	6.6	7.4	5800	342.3	348.1	10800	1174.5	1185.2	15800	2472.6	2487.9	20800	4191.9	4210.8	25800	6276.8	6299.3	30800	8666.5	8691.7
900	8.4	9.3	5900	354.2	360.1	10900	1195.8	1206.7	15900	2503.1	2518.4	20900	4229.9	4249.2	25900	6321.9	6344.4	30900	8716.8	8742.1
1000	10.3	11.3	6000	366.1	372.3	11000	1217.6	1228.5	16000	2533.6	2549.0	21000	4268.5	4287.9	26000	6367.0	6389.6	31000	8767.5	8793.0
1100	12.4	13.5	6100	378.5	384.7	11100	1239.4	1250.4	16100	2564.4	2579.7	21100	4307.2	4326.6	26100	6412.3	6434.9	31100	8818.4	8843.9
1200	14.7	16.0	6200	390.9	397.2	11200	1261.4	1272.6	16200	2595.2	2610.7	21200	4346.1	4365.4	26200	6457.7	6480.4	31200	8869.3	8894.8
1300	17.3	18.7	6300	403.5	409.8	11300	1283.9	1295.2	16300	2626.4	2642.0	21300	4384.8	4404.4	26300	6503.1	6525.8	31300	8920.0	8945.4
1400	20.1	21.5	6400	416.3	422.8	11400	1306.4	1317.7	16400	2657.6	2673.4	21400	4423.9	4443.4	26400	6548.8	6571.7	31400	8970.8	8996.4
1500	23.0	24.6	6500	429.3	436.0	11500	1328.9	1340.2	16500	2689.1	2704.8	21500	4462.9	4482.6	26500	6594.6	6617.4	31500	9021.8	
1600	26.1	27.8	6600	442.6	449.3	11600	1351.6	1363.0	16600	2720.7	2736.6	21600	4502.4	4522.1	26600	6640.4	6663.4			
1700	29.5	31.3	6700	456.0	462.8	11700	1374.6	1386.2	16700	2752.5	2768.4	21700	4541.8	4561.7	26700	6686.3	6709.2			
1800	33.1	34.9	6800	469.7	476.6	11800	1397.9	1409.7	16800	2784.2	2800.2	21800	4581.6	4601.4	26800	6732.2	6755.2			
1900	36.8	38.8	6900	483.5	490.4	11900	1421.4	1433.2	16900	2816.3	2832.2	21900	4621.2	4641.1	26900	6778.3	6801.4			
2000	40.8	42.8	7000	497.4	504.6	12000	1444.9	1456.7	17000	2848.6	2864.8	22000	4661.2	4681.0	27000	6824.6	6847.9			
2100	45.0	47.2	7100	511.7	518.9	12100	1468.6	1480.6	17100	2881.2	2897.5	22100	4701.0	4721.0	27100	6871.3	6894.7			
2200	49.4	51.7	7200	526.0	533.3	12200	1492.7	1504.7	17200	2913.7	2930.2	22200	4741.2	4761.4	27200	6918.1	6941.5			
2300	54.0	56.4	7300	540.8	548.3	12300	1516.7	1528.7	17300	2946.5	2963.0	22300	4781.6	4801.9	27300	6964.8	6988.0			
2400	58.8	61.2	7400	555.8	563.2	12400	1540.9	1553.2	17400	2979.4	2995.8	22400	4822.1	4842.3	27400	7011.2	7034.5			
2500	63.7	66.4	7500	570.8	578 3	12500	1565.4	1577.7	17500	3012.3	3029.0	22500	4862.5	4882.8	27500	7057.9	7081.5			
2600	69.0	71.7	7600	585.9	593.5	12600	1590.0	1602.6	17600	3045.6	3062.3	22600	4903.3	4923.8	27600	7105.0	7128.7			
2700	74.4	77.2	7700	601.1	608.9	12700	1615.0	1627.5	17700	3079.0	3095.7	22700	4944.1	4964.5	27700	7152.3	7176.0			
2800	80.0	82.9	7800	616.9	624.8	12800	1640.0	1652.5	17800	3112.5	3129.4	22800	4985.0	5005.6	27800	7199.6	7223.3			
2900	85.8	88.8	7900	632.7	640.7	12900	1665.0	1677.6	17900	3146.4	3163.3	22900	5026.2	5046.9	27900	7247.0	7270.7			
3000	91.9	95.0	8000	648.7	656.7	13000	1690.4	1703.1	18000	3180.2	3197.3	23000	5067.7	5088.4	28000	7294.4	7318.0			
3100	98.1	101.2	8100	664.8	673.1	13100	1716.0	1729.0	18100	3214.5	3231.5	23100	5109.1	5129.8	28100	7341.8	7365.7			
3200	104.5	107.7	8200	681.4	689.5	13200	1741.9	1754.8	18200	3248.4	3265.4	23200	5150.5	5171.4	28200	7389.6	7413.5			
3300	111.0	114.5	8300	697.8	706.2	13300	1767.7	1780.8	18300	3282.5	3299.8	23300	5192.4	5213.3	28300	7437.5	7461.4			
3400	117.9	121.4	8400	714.5	723.0	13400	1794.0	1807.1	18400	3317.2	3334.4	23400	5234.1	5255.0	28400	7485.3	7509.3			
3500	125.0	128.5	8500	731.5	740.0	13500	1820.3	1833.4	18500	3351.9	3369.4	23500	5276.0	5297.0	28500	7533.4	7557.5			
3600	132.1	135.9	8600	748.5	757.2	13600	1846.6	1859.9	18600	3386.9	3404.4	23600	5318.1	5339.2	28600	7581.5	7605.6			
3700	139.6	143.4	8700	765.8	774.7	13700	1873.2	1886.5	18700	3421.8	3439.3	23700	5360.4	5381.5	28700	7629.7	7653.9			
3800	147.2	151.2	8800	783.6	792.4	13800	1899.8	1913.3	18800	3456.6	3474.1	23800	5402.7	5424.0	28800	7678.0	7702.2			
3900	155.2	159.2	8900	801.3	810.2	13900	1926.8	1940.5	18900	3491.7	3509.6	23900	5445.3	5466.6	28900	7726.4	7750.6			
4000	163.2	167.2	9000	819.1	828.2	14000	1954.1	1967.8	19000	3527.5	3545.4	24000	5487.9	5509.3	29000	7774.9	7799.3			
4100	171.4	175.6	9100	837.3	846.4	14100	1981.5	1995.2	19100	3563.3	3581.3	24100	5530.6	5552.1	29100	7823.7	7848.1			
4200	179.8	184.2	9200	855.6	864.8	14200	2008.8	2022.6	19200	3599.2	3617.2	24200	5573.6	5595.0	29200	7872.4	7896.9			
4300	188.5	192.9	9300	874.2	883.5	14300	2036.4	2050.4	19300	3635.1	3653.2	24300	5616.4	5638.0	29300	7921.4	7945.8			
4400	197.3	201.8	9400	892.9	902.3	14400	2064.3	2078.3	19400	3671.2	3689.2	24400	5659.6	5681.1	29400	7970.3	7994.7			
4500	206.4	211.0	9500	911.7	921.2	14500	2092.4	2106.6	19500	3707.2	3725.3	24500	5702.9	5724.7	29500	8019.2	8043.8			
4600	215.6	220.3	9600	930.7	940.2	14600	2120.8	2135.0	19600	3743.5	3761.6	24600	5746.4	5768.1	29600	8068.4	8093.1			
4700	225.0	229.9	9700	949.9	959.7	14700	2149.2	2163.4	19700	3779.9	3798.3	24700	5789.8	5811.5	29700	8117.8	8142.5			
4800	234.8	239.7	9800	969.5	979.2	14800	2177.7	2192.0	19800	3816.8	3835.3	24800	5833.3	5855.1	29800	8167.3	8192.1			
4900	244.6	249.6	9900	989.0	999.0	14900	2206.2	2220.6	19900	3853.8	3872.2	24900	5877.1	5899.0	29900	8216.9	8241.7			
5000	254.6	259.7	10000	1009.0	1019.0	15000	2235.1	2249.7	20000	3890.7	3909.2	25000	5920.8	5942.9	30000	8266.4	8291.2			

Table VI-1. Effect of two-dimensional near topography.

$-q$ in μgal/(gm·cm^{-3}·m)

H/D \ H'/D	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
0.05	0.02	0									
0.10	0.07	0.05	0								
0.15	0.15	0.13	0.08	0							
0.20	0.27	0.25	0.20	0.12	0						
0.25	0.41	0.39	0.34	0.26	0.14	0					
0.30	0.59	0.57	0.52	0.44	0.32	0.18	0				
0.35	0.80	0.78	0.73	0.65	0.53	0.39	0.21	0			
0.40	1.04	1.02	0.97	0.89	0.77	0.63	0.45	0.24	0		
0.45	1.31	1.29	1.24	1.16	1.04	0.90	0.72	0.51	0.27	0	
0.50	1.60	1.58	1.53	1.45	1.33	1.19	1.01	0.80	0.56	0.29	0
0.55	1.93	1.91	1.86	1.78	1.66	1.52	1.34	1.13	0.89	0.62	0.33
0.60	2.28	2.26	2.21	2.13	2.01	1.87	1.69	1.48	1.24	0.97	0.68
0.65	2.65	2.63	2.58	2.50	2.38	2.24	2.06	1.85	1.61	1.34	1.05
0.70	3.04	3.02	2.97	2.89	2.77	2.63	2.45	2.24	2.00	1.73	1.44
0.75	3.46	3.44	3.39	3.31	3.19	3.05	2.87	2.66	2.42	2.15	1.86
0.80	3.90	3.88	3.83	3.75	3.63	3.49	3.31	3.10	2.86	2.59	2.30
0.85	4.36	4.34	4.29	4.21	4.09	3.95	3.77	3.56	3.32	3.05	2.76
0.90	4.84	4.82	4.77	4.69	4.57	4.43	4.25	4.04	3.80	3.53	3.24
0.95	5.34	5.32	5.27	5.19	5.07	4.93	4.75	4.54	4.30	4.03	3.74
1.00	5.86	5.84	5.79	5.71	5.59	5.45	5.27	5.06	4.82	4.55	4.26
1.05	6.39	6.37	6.32	6.24	6.12	5.98	5.80	5.59	5.35	5.08	4.79
1.10	6.94	6.92	6.87	6.79	6.67	6.53	6.35	6.14	5.90	5.63	5.34
1.15	7.50	7.48	7.43	7.35	7.23	7.09	6.91	6.70	6.46	6.19	5.90
1.20	8.08	8.06	8.01	7.93	7.81	7.67	7.49	7.28	7.04	6.77	6.48
1.25	8.67	8.65	8.60	8.52	8.40	8.26	8.08	7.87	7.63	7.36	7.07
1.30	9.27	9.25	9.20	9.12	9.00	8.86	8.68	8.47	8.23	7.96	7.67
1.35	9.89	9.87	9.82	9.74	9.62	9.48	9.30	9.09	8.85	8.58	8.29
1.40	10.52	10.50	10.45	10.37	10.25	10.11	9.93	9.72	9.48	9.21	8.92
1.45	11.16	11.14	11.09	11.01	10.89	10.75	10.57	10.36	10.12	9.85	9.56
1.50	11.81	11.79	11.74	11.66	11.54	11.46	11.22	11.01	10.77	10.50	10.21
1.55	12.47	12.45	12.40	12.32	12.20	12.06	11.88	11.67	11.43	11.16	10.87
1.60	13.14	13.12	13.07	12.99	12.87	12.73	12.55	12.34	12.10	11.83	11.54
1.65	13.82	13.80	13.75	13.67	13.55	13.41	13.23	13.02	12.78	12.51	12.22
1.70	14.51	14.49	14.44	14.36	14.24	14.10	13.92	13.71	13.47	13.20	12.91
1.75	15.21	15.19	15.14	15.06	14.94	14.80	14.62	14.41	14.17	13.90	13.61
1.80	15.91	15.89	15.84	15.76	15.64	15.50	15.32	15.11	14.87	14.60	14.31
1.85	16.63	16.61	16.56	16.48	16.36	16.22	16.04	15.83	15.59	15.32	15.03
1.90	17.35	17.33	17.28	17.20	17.08	16.94	16.76	16.55	16.31	16.04	15.75
1.95	18.08	18.06	18.01	17.93	17.81	17.67	17.49	17.28	17.04	16.77	16.48
2.00	18.81	18.79	18.74	18.66	18.54	18.40	18.22	18.01	17.77	17.50	17.21
2.05	19.55	19.53	19.48	19.40	19.28	19.14	18.96	18.75	18.51	18.24	17.95
2.10	20.30	20.28	20.23	20.15	20.03	19.89	19.71	19.50	19.26	18.99	18.70
2.15	21.06	21.04	20.99	20.91	20.79	20.65	20.47	20.26	20.02	19.75	19.46
2.20	21.82	21.80	21.75	21.67	21.55	21.41	21.23	21.02	20.78	20.51	20.22
2.25	22.58	22.56	22.51	22.43	22.31	22.17	21.99	21.78	21.54	21.27	20.98
2.30	23.36	23.34	23.29	23.21	23.09	22.95	22.77	22.56	22.32	22.05	21.76
2.35	24.13	24.11	24.06	23.98	23.86	23.72	23.54	23.33	23.09	22.82	22.53
2.40	24.92	24.90	24.85	24.77	24.65	24.51	24.33	24.12	23.88	23.61	23.32
2.45	25.70	25.68	25.63	25.55	25.43	25.29	25.11	24.90	24.66	24.39	24.10
2.50	26.49	26.47	26.42	26.34	26.22	26.08	25.90	25.69	25.45	25.18	24.89
2.55	27.29	27.27	27.22	27.14	27.02	26.88	26.70	26.49	26.25	25.98	25.69
2.60	28.09	28.07	28.02	27.94	27.82	27.68	27.50	27.29	27.05	26.78	26.49
2.65	28.90	28.88	28.83	28.75	28.63	28.49	28.31	28.10	27.86	27.59	27.30
2.70	29.71	29.69	29.64	29.56	29.44	29.30	29.12	28.91	28.67	28.40	28.11
2.75	30.52	30.50	30.45	30.37	30.25	30.11	29.93	29.72	29.48	29.21	28.92
2.80	31.34	31.32	31.27	31.19	31.07	30.93	30.75	30.54	30.30	30.03	29.74
2.85	32.16	32.14	32.09	32.01	31.89	31.75	31.57	31.36	31.12	30.85	30.56
2.90	32.98	32.96	32.91	32.83	32.71	32.57	32.39	32.18	31.94	31.67	31.38
2.95	33.81	33.79	33.74	33.66	33.54	33.40	33.22	33.01	32.77	32.50	32.21
3.00	34.64	34.62	34.57	34.49	34.37	34.23	34.05	33.84	33.60	33.33	33.04
3.05	35.48	35.46	35.41	35.33	35.21	35.07	34.89	34.68	34.44	34.17	33.88
3.10	36.32	36.30	36.25	36.17	36.05	35.91	35.73	35.52	35.28	35.01	34.72
3.15	37.16	37.14	37.09	37.01	36.89	36.75	36.57	36.36	36.12	35.85	35.56
3.20	38.00	37.98	37.93	37.85	37.73	37.59	37.41	37.20	36.96	36.69	36.40
3.25	38.85	38.83	38.78	38.70	38.58	38.44	38.26	38.05	37.81	37.54	37.25
3.30	39.70	39.68	39.63	39.55	39.43	39.29	39.11	38.90	38.66	38.39	38.10
3.35	40.55	40.53	40.48	40.40	40.28	40.14	39.96	39.75	39.51	39.24	38.95
3.40	41.41	41.39	41.34	41.26	41.14	41.00	40.82	40.61	40.37	40.10	39.81
3.45	42.27	42.25	42.20	42.12	42.00	41.86	41.68	41.47	41.23	40.96	40.67
3.50	43.13	43.11	43.06	42.98	42.86	42.72	42.54	42.33	42.09	41.82	41.53
3.55	43.99	43.97	43.92	43.84	43.72	43.58	43.40	43.19	42.95	42.68	42.39
3.60	44.86	44.84	44.79	44.71	44.59	44.45	44.27	44.06	43.82	43.55	43.26
3.65	45.73	45.71	45.66	45.58	45.46	45.32	45.14	44.93	44.69	44.42	44.13
3.70	46.60	46.58	46.53	46.45	46.33	46.19	46.01	45.80	45.56	45.29	45.00
3.75	47.47	47.45	47.40	47.32	47.20	47.06	46.88	46.67	46.43	46.16	45.87
3.80	48.35	48.33	48.28	48.20	48.08	47.94	47.76	47.55	47.31	47.04	46.75
3.85	49.23	49.21	49.16	49.08	48.96	48.82	48.64	48.43	48.19	47.92	47.63
3.90	50.11	50.09	50.04	49.96	49.84	49.70	49.52	49.31	49.07	48.80	48.51
3.95	50.99	50.97	50.92	50.84	50.72	50.58	50.40	50.19	49.95	49.68	49.39
4.00	51.87	51.85	51.80	51.72	51.60	51.46	51.28	51.07	50.83	50.56	50.27
4.05	52.76	52.74	52.69	52.61	52.49	52.35	52.17	51.96	51.72	51.45	51.16
4.10	53.64	53.62	53.57	53.49	53.37	53.23	53.05	52.84	52.60	52.33	52.04
4.15	54.53	54.51	54.46	54.38	54.26	54.12	53.94	53.73	53.49	53.22	52.93
4.20	55.43	55.41	55.36	55.28	55.16	55.02	54.84	54.63	54.39	54.12	53.83
4.25	56.32	56.30	56.25	56.17	56.05	55.91	55.73	55.52	55.28	55.01	54.72
4.30	57.21	57.19	57.14	57.06	56.94	56.80	56.62	56.41	56.17	55.90	55.61
4.35	58.11	58.09	58.04	57.96	57.84	57.70	57.52	57.31	57.07	56.80	56.51
4.40	59.01	58.99	58.94	58.86	58.74	58.60	58.42	58.21	57.97	57.70	57.41
4.45	59.91	59.89	59.84	59.76	59.64	59.50	59.32	59.11	58.87	58.60	58.31
4.50	60.81	60.79	60.74	60.66	60.54	60.40	60.22	60.01	59.77	59.50	59.21
4.55	61.71	61.69	61.64	61.56	61.44	61.30	61.12	60.91	60.67	60.40	60.11
4.60	62.62	62.60	62.55	62.47	62.35	62.21	62.03	61.82	61.58	61.31	61.02
4.65	63.52	63.50	63.45	63.37	63.25	63.11	62.93	62.72	62.48	62.21	61.92
4.70	64.43	64.41	64.36	64.28	64.16	64.02	63.84	63.63	63.39	63.12	62.83
4.75	65.34	65.32	65.27	65.19	65.07	64.93	64.75	64.54	64.30	64.03	63.74
4.80	66.25	66.23	66.18	66.10	65.98	65.84	65.66	65.45	65.21	64.94	64.65
4.85	67.16	67.14	67.09	67.01	66.89	66.75	66.57	66.36	66.12	65.85	65.56
4.90	68.08	68.06	68.01	67.93	67.81	67.67	67.49	67.28	67.04	66.77	66.48
4.95	68.99	68.97	68.92	68.84	68.72	68.58	68.40	68.19	67.95	67.68	67.39
5.00	69.91	69.89	69.84	69.76	69.64	69.50	69.32	69.11	68.87	68.60	68.31

H/D \ H'/D	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
0.55	0									
0.60	0.35	0								
0.65	0.72	0.37	0							
0.70	1.11	0.76	0.39	0						
0.75	1.53	1.18	0.81	0.42	0					
0.80	1.97	1.62	1.25	0.86	0.44	0				
0.85	2.43	2.08	1.71	1.32	0.90	0.46	0			
0.90	2.91	2.56	2.19	1.80	1.38	0.94	0.48	0		
0.95	3.41	3.06	2.69	2.30	1.88	1.44	0.98	0.50	0	
1.00	3.93	3.58	3.21	2.82	2.40	1.96	1.50	1.02	0.52	0
1.05	4.46	4.11	3.74	3.35	2.93	2.49	2.03	1.55	1.05	0.53
1.10	5.01	4.66	4.29	3.90	3.48	3.04	2.58	2.10	1.60	1.08
1.15	5.57	5.22	4.85	4.46	4.04	3.60	3.14	2.66	2.16	1.64
1.20	6.15	5.80	5.43	5.04	4.62	4.18	3.72	3.24	2.74	2.22
1.25	6.74	6.39	6.02	5.63	5.21	4.77	4.31	3.83	3.33	2.81
1.30	7.34	6.99	6.62	6.23	5.81	5.37	4.91	4.43	3.93	3.41
1.35	7.96	7.61	7.24	6.85	6.43	5.99	5.53	5.05	4.55	4.03
1.40	8.59	8.24	7.87	7.48	7.06	6.62	6.16	5.68	5.18	4.66
1.45	9.23	8.88	8.51	8.12	7.70	7.26	6.80	6.32	5.82	5.30
1.50	9.88	9.53	9.16	8.77	8.35	7.91	7.45	6.97	6.47	5.95
1.55	10.54	10.19	9.82	9.43	9.01	8.57	8.11	7.63	7.13	6.61
1.60	11.21	10.86	10.49	10.10	9.68	9.24	8.78	8.30	7.80	7.28
1.65	11.89	11.54	11.17	10.78	10.36	9.92	9.46	8.98	8.48	7.96
1.70	12.58	12.23	11.86	11.47	11.05	10.61	10.15	9.67	9.17	8.65
1.75	13.28	12.93	12.56	12.17	11.75	11.31	10.85	10.37	9.87	9.35
1.80	13.98	13.63	13.26	12.87	12.45	12.01	11.55	11.07	10.57	10.05
1.85	14.70	14.35	13.98	13.59	13.17	12.73	12.27	11.79	11.29	10.77
1.90	15.42	15.07	14.70	14.31	13.89	13.45	12.99	12.51	12.01	11.49
1.95	16.15	15.80	15.43	15.04	14.62	14.18	13.72	13.24	12.74	12.22
2.00	16.88	16.53	16.16	15.77	15.35	14.91	14.45	13.97	13.47	12.95
2.05	17.62	17.27	16.90	16.51	16.09	15.65	15.19	14.71	14.21	13.69
2.10	18.37	18.62	17.65	17.26	16.84	16.40	15.94	15.46	14.96	14.44
2.15	19.13	18.78	18.41	18.02	17.60	17.16	16.70	16.22	15.72	15.20
2.20	19.89	19.54	19.17	18.78	18.36	17.92	17.46	16.98	16.48	15.96
2.25	20.65	20.30	19.93	19.54	19.12	18.68	18.22	17.74	17.24	16.72
2.30	21.43	21.08	20.71	20.32	19.90	19.46	19.00	18.52	18.02	17.50
2.35	22.20	21.85	21.48	21.09	20.67	20.23	19.77	19.29	18.79	18.27
2.40	22.99	22.64	22.27	21.88	21.46	21.02	20.56	20.08	19.58	19.06
2.45	23.77	23.42	23.05	22.66	22.24	21.80	21.34	20.86	20.36	19.84
2.50	24.56	24.21	23.84	23.45	23.03	22.59	22.13	21.65	21.15	20.63
2.55	25.36	25.01	24.64	24.25	23.83	23.39	22.93	22.45	21.95	21.43
2.60	26.16	25.81	25.44	25.05	24.63	24.19	23.73	23.25	22.75	22.23
2.65	26.97	26.62	26.25	25.86	25.44	25.00	24.54	24.06	23.56	23.04
2.70	27.78	27.43	27.06	26.67	26.25	25.81	25.35	24.87	24.37	23.85
2.75	28.59	28.24	27.87	27.48	27.06	26.62	26.16	25.68	25.18	24.66
2.80	29.41	29.06	28.69	28.30	27.88	27.44	26.98	26.50	26.00	25.48
2.85	30.23	29.88	29.51	29.12	28.70	28.26	27.80	27.32	26.82	26.30
2.90	31.05	30.70	30.33	29.94	29.52	29.08	28.62	28.14	27.64	27.12
2.95	31.88	31.53	31.16	30.77	30.35	29.91	29.45	28.97	28.47	27.95
3.00	32.71	32.36	31.99	31.60	31.18	30.74	30.28	29.80	29.30	28.78
3.05	33.55	33.20	32.83	32.44	32.02	31.58	31.12	30.64	30.14	29.62
3.10	34.39	34.04	33.67	33.28	32.86	32.42	31.96	31.48	30.98	30.46
3.15	35.23	34.88	34.51	34.12	33.70	33.26	32.80	32.32	31.82	31.30
3.20	36.07	35.72	35.35	34.96	34.54	34.10	33.64	33.16	32.66	32.14
3.25	36.92	36.57	36.20	35.81	35.39	34.95	34.49	34.01	33.51	32.99
3.30	37.77	37.42	37.05	36.66	36.24	35.80	35.34	34.86	34.36	33.84
3.35	38.62	38.27	37.90	37.51	37.09	36.65	36.19	35.71	35.21	34.69
3.40	39.48	39.13	38.76	38.37	37.95	37.51	37.05	36.57	36.07	35.55
3.45	40.34	40.99	39.62	39.23	38.81	38.37	37.91	37.43	36.93	36.41
3.50	41.20	40.85	40.48	40.09	39.67	39.23	38.77	38.29	37.79	37.27
3.55	42.06	41.71	41.34	40.95	40.53	40.09	39.63	39.15	38.65	38.13
3.60	42.93	42.58	42.21	41.82	41.40	40.96	40.50	40.02	39.52	39.00
3.65	43.80	43.45	43.08	42.69	42.27	41.83	41.37	40.89	40.39	39.87
3.70	44.67	44.32	43.95	43.56	43.14	42.70	42.24	41.76	41.26	40.74
3.75	45.54	45.19	44.82	44.43	44.01	43.57	43.11	42.63	42.13	41.61
3.80	46.42	46.07	45.70	45.31	44.89	44.45	43.99	43.51	43.01	42.49
3.85	47.30	46.95	46.58	46.19	45.77	45.33	44.87	44.39	43.89	43.37
3.90	48.18	47.83	47.46	47.07	46.65	46.21	45.75	45.27	44.77	44.25
3.95	49.06	48.71	48.34	47.95	47.53	47.09	46.63	46.15	45.65	45.13
4.00	49.94	49.59	49.22	48.83	48.41	47.97	47.51	47.03	46.53	46.01
4.05	50.83	50.48	50.11	49.72	49.30	48.86	48.40	47.92	47.42	46.90
4.10	51.71	51.36	50.99	50.60	50.18	49.74	49.28	48.80	48.30	47.78
4.15	52.60	52.25	51.88	51.49	51.07	50.63	50.17	49.69	49.19	48.67
4.20	53.50	53.15	52.78	52.39	51.97	51.53	51.07	50.59	50.09	49.57
4.25	54.39	54.04	53.67	53.28	52.86	52.42	51.96	51.48	50.98	50.46
4.30	55.28	54.93	54.56	54.17	53.75	53.31	52.85	52.37	51.87	51.35
4.35	56.18	55.83	55.46	55.07	54.65	54.21	53.75	53.27	52.77	52.25
4.40	57.08	56.73	56.36	55.97	55.55	55.11	54.65	54.17	53.67	53.15
4.45	57.98	57.63	57.26	56.87	56.45	56.01	55.55	55.07	54.57	54.05
4.50	58.88	58.53	58.16	57.77	57.35	56.91	56.45	55.97	55.47	54.95
4.55	59.78	59.43	59.06	58.67	58.25	57.81	57.35	56.87	56.37	55.85
4.60	60.69	60.34	59.97	59.58	59.16	58.72	58.26	57.78	57.28	56.76
4.65	61.59	61.24	60.87	60.48	60.06	59.62	59.16	58.68	58.18	57.66
4.70	62.50	62.15	61.78	61.39	60.97	60.53	60.07	59.59	59.09	58.57
4.75	63.41	63.06	62.69	62.30	61.88	61.44	60.98	60.50	60.00	59.48
4.80	64.32	63.97	63.60	63.21	62.79	62.35	61.89	61.41	60.91	60.39
4.85	65.23	64.88	64.51	64.12	63.70	63.26	62.80	62.32	61.82	61.30
4.90	66.15	65.80	65.43	65.04	64.62	64.18	63.72	63.24	62.74	62.22
4.95	67.06	66.71	66.34	65.95	65.53	65.09	64.63	64.15	63.65	63.13
5.00	67.98	67.63	67.26	66.87	66.45	66.01	65.55	65.07	64.57	64.05

H/D \ H'/D	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50
1.05	0									
1.10	0.55	0								
1.15	1.11	0.56	0							
1.20	1.69	1.14	0.58	0						
1.25	2.28	1.73	1.17	0.59	0					
1.30	2.88	2.33	1.77	1.19	0.60	0				
1.35	3.50	2.95	2.39	1.81	1.22	0.62	0			
1.40	4.13	3.58	3.02	2.44	1.85	1.25	0.63	0		
1.45	4.77	4.22	3.66	3.08	2.49	1.89	1.27	0.64	0	
1.50	5.42	4.87	4.31	3.73	3.14	2.54	1.92	1.29	0.65	0
1.55	6.08	5.53	4.97	4.39	3.80	3.20	2.58	1.95	1.31	0.66
1.60	6.75	6.20	5.64	5.06	4.47	3.87	3.25	2.62	1.98	1.33
1.65	7.43	6.88	6.32	5.74	5.15	4.55	3.93	3.30	2.66	2.01
1.70	8.12	7.57	7.01	6.43	5.84	5.24	4.62	3.99	3.35	2.70
1.75	8.82	8.27	7.71	7.13	6.54	5.94	5.32	4.69	4.05	3.40
1.80	9.52	8.97	8.41	7.83	7.24	6.64	6.02	5.39	4.75	4.10
1.85	10.24	9.69	9.13	8.55	7.96	7.36	6.74	6.11	5.47	4.82
1.90	10.96	10.41	9.85	9.27	8.68	8.08	7.46	6.83	6.19	5.54
1.95	11.69	11.14	10.58	10.00	9.41	8.81	8.19	7.56	6.92	6.27
2.00	12.42	11.87	11.31	10.73	10.14	9.54	8.92	8.29	7.65	7.00
2.05	13.16	12.61	12.05	11.47	10.88	10.28	9.66	9.03	8.39	7.74
2.10	13.91	13.36	12.80	12.22	11.63	11.03	10.41	9.78	9.14	8.49
2.15	14.67	14.12	13.56	12.98	12.39	11.79	11.17	10.54	9.90	9.25
2.20	15.43	14.88	14.32	13.74	13.15	12.55	11.93	11.30	10.66	10.01
2.25	16.19	15.64	15.08	14.50	13.91	13.31	12.69	12.06	11.42	10.77
2.30	16.97	16.42	15.86	15.28	14.69	14.09	13.47	12.84	12.20	11.55
2.35	17.74	17.19	16.63	16.05	15.46	14.86	14.24	13.61	12.97	12.32
2.40	18.53	17.98	17.42	16.84	16.25	15.65	15.03	14.40	13.76	13.11
2.45	19.31	18.76	18.20	17.62	17.03	16.43	15.81	15.18	14.54	13.89
2.50	20.10	19.55	18.99	18.41	17.82	17.22	16.60	15.97	15.33	14.68
2.55	20.90	20.35	19.79	19.21	18.62	18.02	17.40	16.77	16.13	15.48
2.60	21.70	21.15	20.59	20.01	19.42	18.82	18.20	17.57	16.93	16.28
2.65	22.51	21.96	21.40	20.82	20.23	19.63	19.01	18.38	17.74	17.09
2.70	23.32	22.77	22.21	21.63	21.04	20.44	19.82	19.19	18.55	17.90
2.75	24.13	23.58	23.02	22.44	21.85	21.25	20.63	20.00	19.36	18.71
2.80	24.95	24.40	23.84	23.26	22.67	22.07	21.45	20.82	20.18	19.53
2.85	25.77	25.22	24.66	24.08	23.49	22.89	22.27	21.64	21.00	20.35
2.90	26.59	26.04	25.48	24.90	24.31	23.71	23.09	22.46	21.82	21.17
2.95	27.42	26.87	26.31	25.73	25.14	24.54	23.92	23.29	22.65	22.00
3.00	28.25	27.70	27.14	26.56	25.97	25.37	24.75	24.12	23.48	22.83
3.05	29.09	28.54	27.98	27.40	26.81	26.21	25.59	24.96	24.32	23.67
3.10	29.93	29.38	28.82	28.24	27.65	27.05	26.43	25.80	25.16	24.51
3.15	30.77	30.22	29.66	29.08	28.49	27.89	27.27	26.64	26.00	25.35
3.20	31.61	31.06	30.50	29.92	29.33	28.73	28.11	27.48	26.84	26.19
3.25	32.46	31.91	31.35	30.77	30.18	29.58	28.96	28.33	27.69	27.04
3.30	33.31	32.76	32.20	31.62	31.03	30.43	29.81	29.18	28.54	27.89
3.35	34.16	33.61	33.05	32.47	31.88	31.28	30.66	30.03	29.39	28.74
3.40	35.02	34.47	33.91	33.33	32.74	32.14	31.52	30.89	30.25	29.60
3.45	35.88	35.33	34.77	34.19	33.60	33.00	32.38	31.75	31.11	30.46
3.50	36.74	36.19	35.63	35.05	34.46	33.86	33.24	32.61	31.97	31.32
3.55	37.60	37.05	36.49	35.91	35.32	34.72	34.10	33.47	32.83	32.18
3.60	38.47	37.92	37.36	36.78	36.19	35.59	34.97	34.34	33.70	33.05
3.65	39.34	38.79	38.23	37.65	37.06	36.46	35.84	35.21	34.57	33.92
3.70	40.21	39.66	39.10	38.52	37.93	37.33	36.71	36.08	35.44	34.79
3.75	41.08	40.53	39.97	39.39	38.80	38.20	37.58	36.95	36.31	35.66
3.80	41.96	41.41	40.85	40.27	39.68	39.08	38.46	37.83	37.19	36.54
3.85	42.84	42.29	41.73	41.15	40.56	39.96	39.34	38.71	38.07	37.42
3.90	43.72	43.17	42.61	42.03	41.44	40.84	40.22	39.59	38.95	38.30
3.95	44.60	44.05	43.49	42.91	42.32	41.72	41.10	40.47	39.83	39.18
4.00	45.48	44.93	44.37	43.79	43.20	42.60	41.98	41.35	40.71	40.06
4.05	46.37	45.82	45.26	44.68	44.09	43.49	42.87	42.24	41.60	40.95
4.10	47.25	46.70	46.14	45.56	44.97	44.37	43.75	43.12	42.48	41.83
4.15	48.14	47.59	47.03	46.45	45.86	45.26	44.64	44.01	43.37	42.72
4.20	49.04	48.49	47.93	47.35	46.76	46.16	45.54	44.91	44.27	43.62
4.25	49.93	49.38	48.82	48.24	47.65	47.05	46.43	45.80	45.16	44.51
4.30	50.82	50.27	49.71	49.13	48.54	47.94	47.32	46.69	46.05	45.40
4.35	51.72	51.17	50.61	50.03	49.44	48.84	48.22	47.59	46.95	46.30
4.40	52.62	52.07	51.51	50.93	50.34	49.74	49.12	48.49	47.85	47.20
4.45	53.52	52.97	52.41	51.83	51.24	50.64	50.02	49.39	48.75	48.10
4.50	54.42	53.87	53.31	52.73	52.14	51.54	50.92	50.29	49.65	49.00
4.55	55.32	54.77	54.21	53.63	53.04	52.44	51.82	51.19	50.55	49.90
4.60	56.23	55.68	55.12	54.54	53.95	53.35	52.73	52.10	51.46	50.81
4.65	57.13	56.58	56.02	55.44	54.85	54.25	53.63	53.00	52.36	51.71
4.70	58.04	57.49	56.93	56.35	55.76	55.16	54.54	53.91	53.27	52.62
4.75	58.95	58.40	57.84	57.26	56.67	56.07	55.45	54.82	54.18	53.53
4.80	59.86	59.31	58.75	58.17	57.58	56.98	56.36	55.73	55.09	54.44
4.85	60.77	60.22	59.66	59.08	58.49	57.89	57.27	56.64	56.00	55.35
4.90	61.69	61.14	60.58	60.00	59.41	58.81	58.19	57.56	56.92	56.27
4.95	62.60	62.05	61.49	60.91	60.32	59.72	59.10	58.47	57.83	57.18
5.00	63.52	62.97	62.41	61.83	61.24	60.64	60.02	59.39	58.75	58.10

H/D \ H'/D	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00
1.55	0									
1.60	0.67	0								
1.65	1.35	0.68	0							
1.70	2.04	1.37	0.69	0						
1.75	2.74	2.07	1.39	0.70	0					
1.80	3.44	2.77	2.09	1.40	0.70	0				
1.85	4.16	3.49	2.81	2.12	1.42	0.72	0			
1.90	4.88	4.21	3.53	2.84	2.14	1.44	0.72	0		
1.95	5.61	4.94	4.26	3.57	2.87	2.17	1.45	0.73	0	
2.00	6.34	5.67	4.99	4.30	3.60	2.90	2.18	1.46	0.73	0
2.05	7.08	6.41	5.73	5.04	4.34	3.64	2.92	2.20	1.47	0.74
2.10	7.83	7.16	6.48	5.79	5.09	4.39	3.67	2.95	2.22	1.49
2.15	8.59	7.92	7.24	6.55	5.85	5.15	4.43	3.71	2.98	2.25
2.20	9.35	8.68	8.00	7.31	6.61	5.91	5.19	4.47	3.74	3.01
2.25	10.11	9.44	8.76	8.07	7.37	6.67	5.95	5.23	4.50	3.77
2.30	10.89	10.22	9.54	8.85	8.15	7.45	6.73	6.01	5.28	4.55
2.35	11.66	10.99	10.31	9.62	8.92	8.22	7.50	6.78	6.05	5.32
2.40	12.45	11.78	11.10	10.41	9.71	9.01	8.29	7.57	6.84	6.11
2.45	13.23	12.56	11.88	11.19	10.49	9.79	9.07	8.35	7.62	6.89
2.50	14.02	13.35	12.67	11.98	11.28	10.58	9.86	9.14	8.41	7.68
2.55	14.82	14.15	13.47	12.78	12.08	11.38	10.66	9.94	9.21	8.48
2.60	15.62	14.95	14.27	13.58	12.88	12.18	11.46	10.74	10.01	9.28
2.65	16.43	15.76	15.08	14.39	13.69	12.99	12.27	11.55	10.82	10.09
2.70	17.24	16.57	15.89	15.20	14.50	13.80	13.08	12.36	11.63	10.90
2.75	18.05	17.38	16.70	16.01	15.31	14.61	13.89	13.17	12.44	11.71
2.80	18.87	18.20	17.52	16.83	16.13	15.43	14.71	13.99	13.26	12.53
2.85	19.69	19.02	18.34	17.65	16.95	16.25	15.53	14.81	14.08	13.35
2.90	20.51	19.84	19.16	18.47	17.77	17.07	16.35	15.63	14.90	14.17
2.95	21.34	20.67	19.99	19.30	18.60	17.90	17.18	16.46	15.73	15.00
3.00	22.17	21.50	20.82	20.13	19.43	18.73	18.01	17.29	16.56	15.83
3.05	23.01	22.34	21.66	20.97	20.27	19.57	18.85	18.13	17.40	16.67
3.10	23.85	23.18	22.50	21.81	21.11	20.41	19.69	18.97	18.24	17.51
3.15	24.69	24.02	23.34	22.65	21.95	21.25	20.53	19.81	19.08	18.35
3.20	25.53	24.86	24.18	23.49	22.79	22.09	21.37	20.65	19.92	19.19
3.25	26.38	25.71	25.03	24.34	23.64	22.94	22.22	21.50	20.77	20.04
3.30	27.23	26.56	25.88	25.19	24.49	23.79	23.07	22.35	21.62	20.89
3.35	28.08	27.41	26.73	26.04	25.34	24.64	23.92	23.20	22.47	21.74
3.40	28.94	28.27	27.59	26.90	26.20	25.50	24.78	24.06	23.33	22.60
3.45	29.80	29.13	28.45	27.76	27.06	26.36	25.64	24.92	24.19	23.46
3.50	30.66	29.99	29.31	28.62	27.92	27.22	26.50	25.78	25.05	24.32
3.55	31.52	30.85	30.17	29.48	28.78	28.08	27.36	26.64	25.91	25.18
3.60	32.39	31.72	31.04	30.35	29.65	28.95	28.23	27.51	26.78	26.05
3.65	33.26	32.59	31.91	31.22	30.52	29.82	29.10	28.38	27.65	26.92
3.70	34.13	33.46	32.78	32.09	31.39	30.69	29.97	29.25	28.52	27.79
3.75	35.00	34.33	33.65	32.96	32.26	31.56	30.84	30.12	29.39	28.66
3.80	35.88	35.21	34.53	33.84	33.14	32.44	31.72	31.00	30.27	29.54
3.85	36.76	36.09	35.41	34.72	34.02	33.32	32.60	31.88	31.15	30.42
3.90	37.64	36.97	36.29	35.60	34.90	34.20	33.48	32.76	32.03	31.30
3.95	38.52	37.85	37.17	36.48	35.78	35.08	34.36	33.64	32.91	32.18
4.00	39.40	38.73	38.05	37.36	36.66	35.96	35.24	34.52	33.79	33.06
4.05	40.29	39.62	38.94	38.25	37.55	36.85	36.13	35.41	34.68	33.95
4.10	41.17	40.50	39.82	39.13	38.43	37.73	37.01	36.29	35.56	34.83
4.15	42.06	41.39	40.71	40.02	39.32	38.62	37.90	37.18	36.45	35.72
4.20	42.96	42.29	41.61	40.92	40.22	39.52	38.80	38.08	37.35	36.62
4.25	43.85	43.18	42.50	41.81	41.11	40.41	39.69	38.97	38.24	37.51
4.30	44.74	44.07	43.39	42.70	42.00	41.30	40.58	39.86	39.13	38.40
4.35	45.64	44.97	44.29	43.60	42.90	42.20	41.48	40.76	40.03	39.30
4.40	46.54	45.87	45.19	44.50	43.80	43.10	42.38	41.66	40.93	40.20
4.45	47.44	46.77	46.09	45.40	44.70	44.00	43.28	42.56	41.83	41.10
4.50	48.34	47.67	46.99	46.30	45.60	44.90	44.18	43.46	42.73	42.00
4.55	49.24	48.57	47.89	47.20	46.50	45.80	45.08	44.36	43.63	42.90
4.60	50.15	49.48	48.80	48.11	47.41	46.71	45.99	45.27	44.54	43.81
4.65	51.05	50.38	49.70	49.01	48.31	47.61	46.89	46.17	45.44	44.71
4.70	51.96	51.29	50.61	49.92	49.22	48.52	47.80	47.08	46.35	45.62
4.75	52.87	52.20	51.52	50.83	50.13	49.43	48.71	47.99	47.26	46.53
4.80	53.78	53.11	52.43	51.74	51.04	50.34	49.62	48.90	48.17	47.44
4.85	54.69	54.02	53.34	52.65	51.95	51.25	50.53	49.81	49.08	48.35
4.90	55.61	54.94	54.26	53.57	52.87	52.17	51.45	50.73	50.00	49.27
4.95	56.52	55.85	55.17	54.48	53.78	53.08	52.36	51.64	50.91	50.18
5.00	57.44	56.77	56.09	55.40	54.70	54.00	53.28	52.56	51.83	51.10

H/D \ H'/D	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50
2.05	0									
2.10	0.75	0								
2.15	1.51	0.76	0							
2.20	2.27	1.52	0.76	0						
2.25	3.03	2.28	1.52	0.76	0					
2.30	3.81	3.06	2.30	1.54	0.78	0				
2.35	4.58	3.83	3.07	2.31	1.55	0.77	0			
2.40	5.37	4.62	3.86	3.10	2.34	1.56	0.79	0		
2.45	6.15	5.40	4.64	3.88	3.12	2.34	1.57	0.78	0	
2.50	6.94	6.19	5.43	4.67	3.91	3.13	2.36	1.57	0.79	0
2.55	7.74	6.99	6.23	5.47	4.71	3.93	3.16	2.35	1.59	0.80
2.60	8.54	7.79	7.03	6.27	5.51	4.73	3.96	3.17	2.39	1.60
2.65	9.35	8.60	7.84	7.08	6.32	5.54	4.77	3.98	3.20	2.41
2.70	10.16	9.41	8.65	7.89	7.13	6.35	5.58	4.79	4.01	3.22
2.75	10.97	10.12	9.46	8.70	7.94	7.16	6.39	5.60	4.82	4.03
2.80	11.79	11.04	10.28	9.52	8.76	7.98	7.21	6.42	5.64	4.85
2.85	12.61	11.86	11.10	10.34	9.58	8.80	8.03	7.24	6.46	5.67
2.90	13.43	12.68	11.92	11.16	10.40	9.62	8.85	8.06	7.28	6.49
2.95	14.26	13.51	12.75	11.99	11.23	10.45	9.68	8.89	8.11	7.32
3.00	15.09	14.34	13.58	12.82	12.06	11.28	10.51	9.72	8.94	8.15
3.05	15.93	15.18	14.42	13.66	12.90	12.12	11.35	10.56	9.78	8.99
3.10	16.77	16.02	15.26	14.50	13.74	12.96	12.19	11.40	10.62	9.83
3.15	17.61	16.86	16.10	15.34	14.58	13.80	13.03	12.24	11.46	10.67
3.20	18.45	17.70	16.94	16.18	15.42	14.64	13.87	13.08	12.30	11.51
3.25	19.30	18.55	17.79	17.03	16.27	15.49	14.72	13.93	13.15	12.36
3.30	20.15	19.40	18.64	17.88	17.12	16.34	15.57	14.78	14.00	13.21
3.35	21.00	20.25	19.49	18.73	17.97	17.19	16.42	15.63	14.85	14.06
3.40	21.86	21.11	20.35	19.59	18.83	18.05	17.28	16.49	15.71	14.92
3.45	22.72	21.97	21.21	20.45	19.69	18.91	18.14	17.35	16.57	15.78
3.50	23.58	22.83	22.07	21.31	20.55	19.77	19.00	18.21	17.43	16.64
3.55	24.44	23.69	22.93	22.17	21.41	20.63	19.86	19.07	18.29	17.50
3.60	25.31	24.56	23.80	23.04	22.28	21.50	20.73	19.94	19.16	18.37
3.65	26.18	25.43	24.67	23.91	23.15	22.37	21.60	20.81	20.03	19.24
3.70	27.05	26.30	25.54	24.78	24.02	23.24	22.47	21.68	20.90	20.11
3.75	27.92	27.17	26.41	25.65	24.89	24.11	23.34	22.55	21.77	20.98
3.80	28.80	28.05	27.29	26.53	25.77	24.99	24.22	23.43	22.65	21.86
3.85	29.68	28.93	28.17	27.41	26.65	25.87	25.10	24.31	23.53	22.74
3.90	30.56	29.81	29.05	28.29	27.53	26.75	25.98	25.19	24.41	23.62
3.95	31.44	30.69	29.93	29.17	28.41	27.63	26.86	26.07	25.29	24.50
4.00	32.32	31.57	30.81	30.05	29.29	28.51	27.74	26.95	26.17	25.38
4.05	33.21	32.46	31.70	30.94	30.18	29.40	28.63	27.84	27.06	26.27
4.10	34.09	33.34	32.58	31.82	31.06	30.28	29.51	28.72	27.94	27.15
4.15	34.98	34.23	33.47	32.71	31.95	31.17	30.40	29.61	28.83	28.04
4.20	35.88	35.13	34.37	33.61	32.85	32.07	31.30	30.51	29.73	28.94
4.25	36.77	36.02	35.26	34.50	33.74	32.96	32.19	31.40	30.62	29.83
4.30	37.66	36.91	36.15	35.39	34.63	33.85	33.08	32.29	31.51	30.72
4.35	38.56	37.81	37.05	36.29	35.53	34.75	33.98	33.19	32.41	31.62
4.40	39.46	38.71	37.95	37.19	36.43	35.65	34.88	34.09	33.31	32.52
4.45	40.36	39.61	38.85	38.09	37.33	36.55	35.78	34.99	34.21	33.42
4.50	41.16	40.51	39.75	38.99	38.23	37.45	36.68	35.89	35.11	34.32
4.55	42.16	41.41	40.65	39.89	39.13	38.35	37.58	36.79	36.01	35.22
4.60	43.07	42.32	41.56	40.80	40.04	39.26	38.49	37.70	36.92	36.13
4.65	43.97	43.22	42.46	41.70	40.94	40.16	39.39	38.60	37.82	37.03
4.70	44.88	44.13	43.37	42.61	41.85	41.07	40.30	39.51	38.73	37.94
4.75	45.79	45.04	44.28	43.52	42.76	41.98	41.21	40.42	39.64	38.85
4.80	46.70	45.95	45.19	44.43	43.67	42.89	42.12	41.33	40.55	39.76
4.85	47.61	46.86	46.10	45.34	44.58	43.80	43.03	42.24	41.46	40.67
4.90	48.53	47.78	47.02	46.26	45.50	44.72	43.95	43.16	42.38	41.59
4.95	49.44	48.69	47.93	47.17	46.41	45.63	44.86	44.07	43.29	42.50
5.00	50.36	49.61	48.85	48.09	47.33	46.55	45.78	44.99	44.21	43.42

Table VI-2. Effect of two-dimensional near topography.
$-q$ in μgal/(gm·cm^{-3}·m)

H'/D \ H/D	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00	3.05	3.10	3.15	3.20	3.25	3.30	3.35	3.40	3.45	3.50	3.55	3.60	3.65	3.70	3.75	3.80	3.85	3.90	3.95	4.00	4.05	4.10	4.15	4.20	4.25	4.30	4.35	4.40	4.45	4.50	4.55	4.60	4.65	4.70	4.75	4.80	4.85	4.90	4.95	5.00
2.55	0																																																	
2.60	0.80	0																																																	
2.65	1.61	0.81	0																																																	
2.70	2.42	1.62	0.81	0																																															
2.75	3.23	2.43	1.62	0.81	0																																														
2.80	4.05	3.25	2.44	1.63	0.82	0																																													
2.85	4.87	4.07	3.26	2.45	1.64	0.82	0																																												
2.90	5.69	4.89	4.08	3.27	2.46	1.64	0.82	0																																											
2.95	6.52	5.72	4.91	4.10	3.29	2.47	1.65	0.83	0																																										
3.00	7.35	6.55	5.74	4.93	4.12	3.30	2.48	1.66	0.83	0																																									
3.05	8.19	7.39	6.58	5.77	4.96	4.14	3.32	2.50	1.67	0.84	0																																									
3.10	9.03	8.23	7.42	6.61	5.80	4.98	4.16	3.34	2.51	1.68	0.84	0																																								
3.15	9.87	9.07	8.26	7.45	6.64	5.82	5.00	4.18	3.35	2.52	1.68	0.84	0																																							
3.20	10.71	9.91	9.10	8.29	7.48	6.66	5.84	5.02	4.19	3.36	2.52	1.68	0.84	0																																						
3.25	11.56	10.76	9.95	9.14	8.33	7.51	6.69	5.87	5.04	4.21	3.37	2.53	1.69	0.85	0																																					
3.30	12.41	11.61	10.80	9.99	9.11	8.36	7.54	6.72	5.89	5.06	4.22	3.38	2.54	1.70	0.85	0																																			
3.35	13.26	12.46	11.65	10.84	10.03	9.21	8.39	7.57	6.74	5.91	5.07	4.23	3.39	2.55	1.70	0.85	0																																		
3.40	14.12	13.32	12.51	11.70	10.89	10.07	9.25	8.43	7.60	6.77	5.93	5.09	4.25	3.41	2.56	1.71	0.86	0																																		
3.45	14.98	14.18	13.37	12.56	11.75	10.93	10.11	9.29	8.46	7.63	6.79	5.95	5.11	4.27	3.42	2.57	1.72	0.86	0																																		
3.50	15.84	15.04	14.23	13.42	12.61	11.79	10.97	10.15	9.32	8.49	7.65	6.81	5.97	5.13	4.28	3.43	2.58	1.72	0.86	0																																		
3.55	16.70	15.90	15.09	14.28	13.47	12.65	11.83	11.01	10.18	9.35	8.51	7.67	6.83	5.99	5.14	4.29	3.44	2.58	1.72	0.86	0																																		
3.60	17.57	16.77	15.96	15.15	14.34	13.52	12.70	11.88	11.05	10.22	9.38	8.54	7.70	6.86	6.01	5.16	4.31	3.45	2.59	1.73	0.87	0																																	
3.65	18.44	17.64	16.83	16.02	15.21	14.39	13.57	12.75	11.92	11.09	10.25	9.41	8.57	7.73	6.88	6.03	5.18	4.32	3.46	2.60	1.74	0.87	0																															
3.70	19.31	18.51	17.70	16.89	16.07	15.26	14.44	13.62	12.79	11.96	11.12	10.28	9.44	8.60	7.75	6.90	6.05	5.19	4.33	3.47	2.61	1.74	0.87	0																													
3.75	20.18	19.38	18.57	17.76	16.95	16.13	15.31	14.49	13.66	12.83	11.99	11.15	10.31	9.47	8.62	7.77	6.92	6.06	5.20	4.34	3.48	2.61	1.74	0.87	0																												
3.80	21.06	20.26	19.45	18.64	17.83	17.01	16.19	15.37	14.54	13.71	12.87	12.03	11.19	10.35	9.50	8.65	7.80	6.94	6.08	5.22	4.36	3.49	2.62	1.75	0.88	0																											
3.85	21.94	21.14	20.33	19.52	18.71	17.89	17.07	16.25	15.42	14.59	13.75	12.91	12.07	11.23	10.38	9.53	8.68	7.82	6.96	6.10	5.24	4.37	3.50	2.63	1.76	0.88	0																										
3.90	22.82	22.02	21.21	20.40	19.59	18.77	17.95	17.13	16.30	15.47	14.63	13.79	12.95	12.11	11.26	10.41	9.56	8.70	7.84	6.98	6.12	5.25	4.38	3.51	2.64	1.76	0.88	0																									
3.95	23.70	22.90	22.09	21.28	20.47	19.65	18.83	18.01	17.18	16.35	15.51	14.67	13.83	12.99	12.14	11.29	10.44	9.58	8.72	7.86	7.00	6.13	5.26	4.39	3.52	2.64	1.76	0.88	0																								
4.00	24.58	23.78	22.97	22.16	21.35	20.53	19.71	18.89	18.06	17.23	16.39	15.55	14.71	13.87	13.02	12.17	11.32	10.46	9.60	8.74	7.88	7.01	6.14	5.27	4.40	3.52	2.64	1.76	0.88	0																								
4.05	25.47	24.67	23.86	23.05	22.24	21.42	20.60	19.78	18.95	18.12	17.28	16.44	15.60	14.76	13.91	13.06	12.21	11.35	10.49	9.63	8.77	7.90	7.03	6.16	5.29	4.41	3.53	2.65	1.77	0.89	0																							
4.10	26.35	25.55	24.74	23.93	23.12	22.30	21.48	20.66	19.83	19.00	18.16	17.32	16.48	15.64	14.79	13.94	13.09	12.23	11.37	10.51	9.65	8.78	7.91	7.04	6.17	5.29	4.41	3.53	2.65	1.77	0.88	0																						
4.15	27.24	26.44	25.63	24.82	24.01	23.19	22.37	21.55	20.72	19.89	19.05	18.21	17.37	16.53	15.68	14.83	13.98	13.12	12.26	11.40	10.54	9.67	8.80	7.93	7.06	6.18	5.30	4.42	3.54	2.66	1.77	0.89	0																				
4.20	28.14	27.34	26.53	25.72	24.91	24.09	23.27	22.45	21.62	20.79	19.95	19.11	18.27	17.43	16.58	15.73	14.88	14.02	13.16	12.30	11.44	10.57	9.70	8.83	7.96	7.08	6.20	5.32	4.44	3.56	2.67	1.79	0.90	0																			
4.25	29.03	28.23	27.42	26.61	25.80	24.98	24.16	23.34	22.51	21.68	20.84	20.00	19.16	18.32	17.47	16.62	15.77	14.91	14.05	13.19	12.33	11.46	10.59	9.72	8.85	7.97	7.09	6.21	5.33	4.45	3.56	2.68	1.79	0.89	0																	
4.30	29.92	29.12	28.31	27.50	26.69	25.87	25.05	24.23	23.40	22.57	21.73	20.89	20.05	19.21	18.36	17.51	16.66	15.80	14.94	14.08	13.22	12.35	11.48	10.61	9.74	8.86	7.98	7.10	6.22	5.34	4.45	3.57	2.68	1.78	0.89	0																
4.35	30.82	30.02	29.21	28.40	27.59	26.77	25.95	25.13	24.30	23.47	22.63	21.79	20.95	20.11	19.26	18.41	17.56	16.70	15.84	14.98	14.12	13.25	12.38	11.51	10.64	9.76	8.88	8.00	7.12	6.24	5.35	4.47	3.58	2.68	1.79	0.90	0														
4.40	31.72	30.92	30.11	29.30	28.49	27.67	26.85	26.03	25.20	24.37	23.53	22.69	21.85	21.01	20.16	19.31	18.46	17.60	16.74	15.88	15.02	14.15	13.28	12.41	11.54	10.66	9.78	8.90	8.02	7.14	6.25	5.37	4.48	3.58	2.69	1.80	0.90	0												
4.45	32.62	31.82	31.01	30.20	29.39	28.57	27.75	26.93	26.10	25.27	24.43	23.59	22.75	21.91	21.06	20.21	19.36	18.50	17.64	16.78	15.92	15.05	14.18	13.31	12.44	11.56	10.68	9.80	8.92	8.04	7.15	6.27	5.38	4.48	3.59	2.70	1.80	0.90	0										
4.50	33.52	32.72	31.91	31.10	30.29	29.47	28.65	27.83	27.00	26.17	25.33	24.49	23.65	22.81	21.96	21.11	20.26	19.40	18.54	17.68	16.82	15.95	15.08	14.21	13.34	12.46	11.58	10.70	9.82	8.94	8.05	7.17	6.28	5.38	4.49	3.60	2.70	1.80	0.90	0								
4.55	34.42	33.62	32.81	32.00	31.19	30.37	29.55	28.73	27.90	27.07	26.23	25.39	24.55	23.71	22.86	22.01	21.16	20.30	19.44	18.58	17.72	16.85	15.98	15.11	14.24	13.36	12.48	11.60	10.72	9.84	8.95	8.07	7.18	6.28	5.39	4.50	3.60	2.70	1.80	0.90	0							
4.60	35.33	34.53	33.72	32.91	32.10	31.28	30.46	29.64	28.81	27.98	27.14	26.30	25.46	24.62	23.77	22.92	22.07	21.21	20.35	19.49	18.63	17.76	16.89	16.02	15.15	14.27	13.39	12.51	11.63	10.75	9.86	8.98	8.09	7.19	6.30	5.41	4.51	3.61	2.71	1.81	0.91	0						
4.65	36.23	35.43	34.62	33.81	33.00	32.18	31.36	30.54	29.71	28.88	28.04	27.20	26.36	25.52	24.67	23.82	22.97	22.11	21.25	20.39	19.53	18.66	17.79	16.92	16.05	15.17	14.29	13.41	12.53	11.65	10.76	9.88	8.99	8.09	7.20	6.31	5.41	4.51	3.61	2.71	1.81	0.90	0					
4.70	37.14	36.34	35.53	34.72	34.91	33.09	32.27	31.45	30.62	29.79	28.95	28.11	27.27	26.43	25.58	24.73	23.88	23.02	22.16	21.30	20.44	19.57	18.70	17.83	16.96	16.08	15.20	14.32	13.44	12.56	11.67	10.79	9.90	9.00	8.11	7.22	6.32	5.42	4.52	3.62	2.72	1.81	0.91	0				
4.75	38.05	37.25	36.44	35.63	34.82	34.00	33.18	32.36	31.53	30.70	29.86	29.02	28.18	27.34	26.49	25.64	24.79	23.93	23.07	22.21	21.35	20.48	19.61	18.74	17.87	16.99	16.11	15.23	14.35	13.47	12.58	11.70	10.81	9.91	9.02	8.13	7.23	6.33	5.43	4.53	3.63	2.72	1.82	0.91	0			
4.80	38.96	38.16	37.35	36.54	35.73	34.91	34.09	33.27	32.44	31.61	30.77	29.93	29.09	28.25	27.40	26.55	25.70	24.84	23.98	23.12	22.26	21.39	20.52	19.65	18.78	17.90	17.02	16.14	15.26	14.38	13.49	12.61	11.72	10.82	9.93	9.04	8.14	7.24	6.34	5.44	4.54	3.63	2.73	1.82	0.91	0		
4.85	39.87	39.07	38.26	37.45	36.64	35.82	35.00	34.18	33.35	32.52	31.68	30.84	30.00	29.16	28.31	27.46	26.61	25.75	24.89	24.03	23.17	22.30	21.43	20.56	19.69	18.81	17.93	17.05	16.17	15.29	14.40	13.52	12.63	11.73	10.84	9.95	9.05	8.15	7.25	6.35	5.45	4.54	3.64	2.73	1.82	0.91	0	
4.90	40.79	39.99	39.18	38.37	37.56	36.74	35.92	35.10	34.27	33.44	32.60	31.76	30.92	30.08	29.23	28.38	27.53	26.67	25.81	24.95	24.09	23.22	22.35	21.48	20.61	19.73	18.85	17.97	17.09	16.21	15.32	14.44	13.55	12.65	11.76	10.87	9.97	9.07	8.17	7.27	6.37	5.46	4.56	3.65	2.74	1.83	0.92	0
4.95	41.70	40.90	40.09	39.28	38.47	37.65	36.83	36.01	35.18	34.35	33.51	32.67	31.83	30.99	30.14	29.29	28.44	27.58	26.72	25.86	25.00	24.13	23.26	22.39	21.52	20.64	19.76	18.88	18.00	17.12	16.23	15.35	14.46	13.56	12.67	11.78	10.88	9.98	9.08	8.18	7.28	6.37	5.47	4.56	3.65	2.74	1.83	0.91	0
5.00	42.62	41.82	41.01	40.20	39.39	38.57	37.75	36.93	36.10	35.27	34.43	33.59	32.75	31.91	31.06	30.21	29.36	28.50	27.64	26.78	25.92	25.05	24.18	23.31	22.44	21.56	20.68	19.80	18.92	18.04	17.15	16.27	15.38	14.48	13.59	12.70	11.80	10.90	10.00	9.10	8.20	7.29	6.39	5.48	4.57	3.66	2.75	1.83	0.92	0