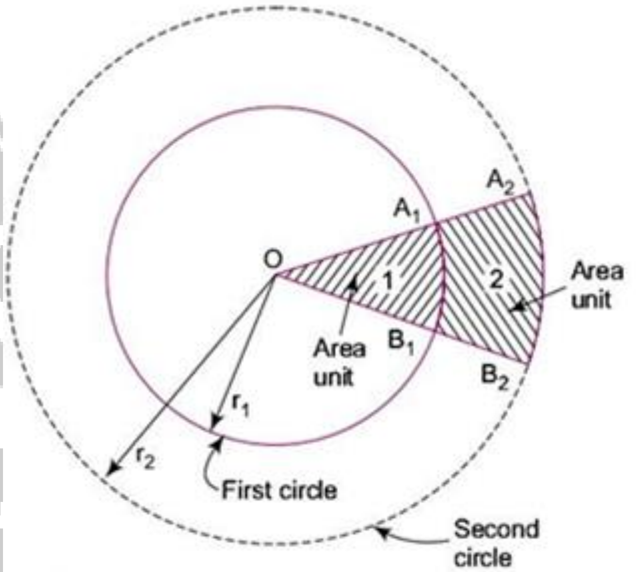
USE OF INFLUENCE CHART: [OR]

UNIFORM LOAD ON IRREGULAR AREAS [OR] NEWMARK CHART:

A more accurate method of determining the vertical stress at any point under a uniformly loaded area of a any shape is with the help of influence chart or influence diagram originally suggested by Newmark (1942). A chart, consisting of number of circles and radiating lines, is so prepared that the influence of each area unit (formed in the shape of a sector between two concentric circles and two adjacent radial lines)is the same at the center of the circles,i.e., each area unit causes the equal vertical stress at the centre of the diagram.

Let a uniformly loaded circular area of radius r_1 cm be divided into 20sectors (area units) as shown in Fig. If q is the intensity of loading, and σ_z is theVertical pressure at a depth z below the centre of the area,each unit such as OA_1B_1exerts a pressure equal to $\sigma_z/2$ at the centre.



$$\frac{\sigma_z}{20} = \frac{q}{20}\left[1 - \left\{\frac{1}{1+\left(\frac{r_1}{z}\right)^2}\right\}^{3/2}\right] = i_f q \text{ ------}(1)$$

$$i_f = \frac{1}{20}\left[1 - \left\{\frac{1}{1+\left(\frac{r_1}{z}\right)^2}\right\}^{3/2}\right]$$

if i_f be made equal to an arbitary fixed value, say 0.005 *we have*

$$\frac{\sigma_z}{20} = \frac{q}{20}\left[1 - \left\{\frac{1}{1 + \left(\frac{r_1}{z}\right)^2}\right\}^{3/2}\right] = 0.005q - - - - - (2)$$

Selecting the value of z=5cm (say), the value of r1 solved from Eq.2 comes out be1.35cm. Hence if a circle is drawn with radius r1=1.35cm and divided into 20 equal area units, each area unit will exert a pressure equal to 0.005q intensity at a depth of 5cm.

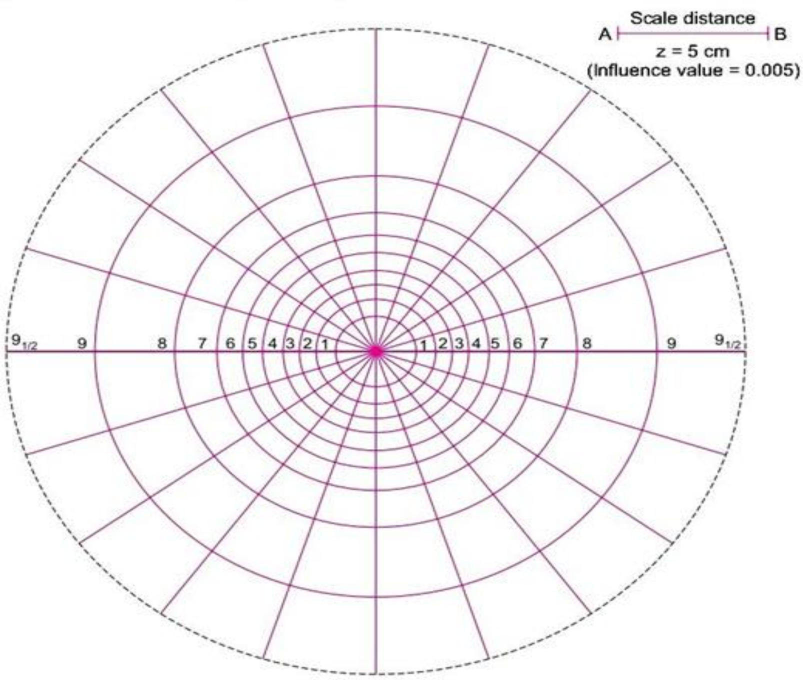


Fig.3 Newmark's influence chart

Let the radius of second concentric circle be equal to r_2 cm. By extending the twenty radial lines, the space between the two concentric circles is again divided into 20 equal area units; $A_1 A_2 B_2 B_1$ is one such area unit The vertical pressure, at the centre, due 10 each of these area units is to be of intensity 0.005q. Therefore, the total pressure due to area units $0A_1B_1$ and $A_1A_2B_2B_1$ at depth =5cm below the centre is2x0.005q.Hence fromEq.2

Vertical pressure due to $OA_1B_2 = \frac{q}{20}\left[1 - \left\{\frac{1}{1+\left(\frac{r_2}{z}\right)^2}\right\}^{3/2}\right] = 2X0.005q$

Substituting z=5cm, we get r_2=2.00cm from the above rela1ion. Similarly, the radii of 3rd, 4th, 5th, 6th, 7th, 8th, 9th circles can be calculated, as tabulated in Table1.The radius of 10^{th} circle is given by the following governing equation:

$$\frac{q}{20}\left[1 - \left\{\frac{1}{1 + \left(\frac{r_{10}}{z}\right)^2}\right\}^{3/2}\right]$$

From the above r_{10}= infinity.

Table1 Radii of concentric circles for influence chart
(z=5cm;i_f= 0.005;each circle divided into 20parts)

Number of circles	I	2	3	4	5	6	7	8	9	92	10
Radius(cm)	l.35	2.00	2.59	3.18	3.83	4.59	5.54	6.94	9.54	12.6	∞

Figure3 shows the influence chart drawn on the basis of Table1.To use the chart for determining the vertical stress at any point under the loaded area, the plan of the loaded area is first drawn on a tracing paper to such a scale that the length AB(=5cm) drawn on the chart represents the depth to the point at which pressure is required. For example, if the pressure is to be found at a depth of 5m,the scale of plan will be 5cm=5m,or 1cm=1m.The plan of the loaded area is then so placed over the chart that the point below which pressure is required coincides with the centre of the chart. The point below which pressure is required may lie with in or outside the loaded area. The total number of area units (including the fractions) covered by the plan of the loaded area is counted. The vertical pressure is then calculated from the relation:

σ_z=0.005qxN,.(where N_A=number of area units under the loaded area).--------(3)