As seen from Equation (3.2), the capacity of a cellular system is directly proportional to the number of times a cluster is replicated in a fixed service area. The factor N is called the *cluster size* and is typically equal to 4, 7, or 12. If the cluster size N is reduced while the cell size is kept constant, more clusters are required to cover a given area, and hence more capacity (a larger value of C) is achieved. A larger cluster size causes the ratio between the cell radius and the distance between co-channel cells to decrease, leading to weaker co-channel interference. Conversely, a small cluster size indicates that co-channel cells are located much closer together. The value for N is a function of how much interference a mobile or base station can tolerate while maintaining a sufficient quality of communications. From a design viewpoint, the smallest possible value of N is desirable in order to maximize capacity over a given coverage area (i.e., to maximize C in Equation (3.2)). The *frequency reuse factor* of a cellular system is given by $1/N$, since each cell within a cluster is only assigned $1/N$ of the total available channels in the system.

Due to the fact that the hexagonal geometry of Figure 3.1 has exactly six equidistant neighbors and that the lines joining the centers of any cell and each of its neighbors are separated by multiples of 60 degrees, there are only certain cluster sizes and cell layouts which are possible [Mac79]. In order to tessellate—to connect without gaps between adjacent cells—the geometry of hexagons is such that the number of cells per cluster, N, can only have values which satisfy Equation (3.3).

$$N = i^2 + ij + j^2 \tag{3.3}$$

where i and j are non-negative integers. To find the nearest co-channel neighbors of a particular cell, one must do the following: (1) move i cells along any chain of hexagons and then (2) turn 60 degrees counter-clockwise and move j cells. This is illustrated in Figure 3.2 for $i = 3$ and $j = 2$ (example, $N = 19$).

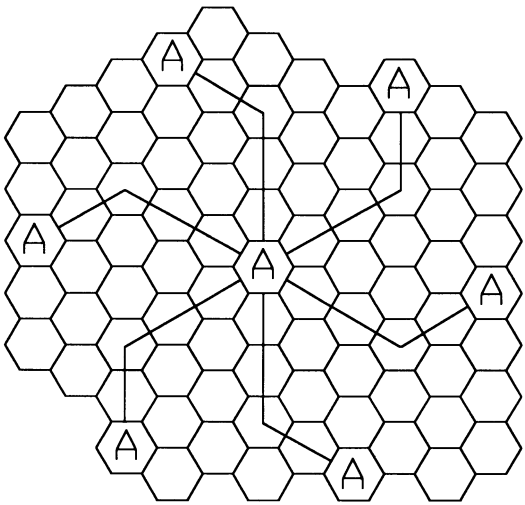

Figure 3.2 Method of locating co-channel cells in a cellular system. In this example, $N = 19$ (i.e., $i = 3$, $j = 2$). (Adapted from [Oet83] © IEEE.)