Step 1: Cell Area Calculation

Area = πR^2

Zone	Radius (km)	Cell (area) sq. km
1	25	1963.5
2	30	2827.4
3	15	706.9

Typically cell radius in GSM is:
Urban (1-3km)
Semi-urban (3-5km)
Rural (5-10km)

Z1 is urban (i.e semi-urban) due to moderate density, medium area. Z2 is urban due to largest area & moderate density & Z3 is rural area.

Step 2: Subscriber Density.

Zone	Cell area (sq km)	Subscribers	Sub. Density
1	25	10000	1000/1963.5 ≈ 5.1
2	30	15000	≈ 5.3
3	15	5000	≈ 7.07

If density is low ⇒ fewer users ⇒ large cell can cover more area without congestion.

If density is high ⇒ more users ⇒ cells must be small to manage load.

Hence, our zonal classification is correct.

Step 3: Blocking Probability

Assumption

Avg call duration = 3mins

Busy hour call attempts = 10%.

Blocking Prob = 2%.

Traffic per subscriber = $\frac{0.1 \times 3}{60}$ = 0.005 E

21	10000	0.005	Total Traffic = 50E
22	15000	0.005	= 75E
23	5000	0.005	= 25E

We use Erlang Table for 2% Blocking.

21 ~ 70 channels

22 ~ 90 channels.

23 ~ 40 channels

But we only have 10 channels. Hence we do not have (70+90+40 = 200 channels) So we go for freq. reuse strategy.

Step 4: Freq. Reuse strategy

Zone 1 has 10,000 subscribers. It is semi-urban with 50E traffic. We need high capacity. Choose N=4. (high reuse)

Zone 2 we choose N=7 due to urban crowd & high traffic.

Zone 3 we can choose either 9 or 7. We choose 7 because we have less users only 5000.

For Zone1: Channel/Cell = 10/4 = 2.5
Cell 1 → Chanel 1, 2
Cell 2 → Channel 3, 4
Cell 3 → Channel 4, 5
Cell 4 → Channel 7, 8
Reserve 9, 10 for dynamic or load balancing

For Zone 2: Channel/Cell ≈ 1.4
Cell 1 → Chanel 1
2 → Channel 2
3 → Channel 3
4 → 4
5 5
6 6
7 7
Reserve 8, 9, 10 for dynamic load distribution

Zone 3: Same as Zone 2.

Step 5: Cochannel interferance:

Zone 1 (N=4) we have higher interferance but acceptable because traffic is high & capacity is more imp. than quality. Zone 2 has moderate reuse and co-channels cells are further. As 15,000 subscribers get/need service N=7 gives good balance b/w capacity & interferance. Zone 3 has very low interferance always due to rural region.

Step 6: GoS & Call serviced

Zone 1: Sub: 10000
Busy hour call attempts = 10% = 1000
B.P = 2%.
∴ Blocked calls = 1000 × 0.2 = 20
Served calls = 980 ∵ (0.98 × 1500).

Zone 2: Blocked = 1500 × 0.2 = 30
Served = 1470

Zone 3: Blocked = 500
Served = 490.

No. of clusters = $\frac{\text{No. of cells}}{N}$

Zone 1: r = 2km → Hexagonal cell radius
cell area = $\frac{3\sqrt{3}}{2} r^2$

Zone 1 = 10.39 sq.km

Zone 2: r = 5
∴ cell area = 64.95 sq.km

Zone 3: r = 8
cell area = 166.24 sq.m

∴ No. of cells :

Zone	No. of cells	No. of cluster
1	1963.5 / 10.39 = 189	189/40 = 48
2	2827.4 / 64.95 = 189/44	44/7 = 7
3	706.9 / 166.2 = 5	5/7 = 1

Step 7: Strategic Implementation

→ Borrowing: Zone 2 has max traffic so it can borrow from Zone 3 to prevent blocking. Zone 2 must do cell sectoring (3×120°) to improve signal strength & triple capacity without needing new traffic.

→ Zone 1 is semi-urban. So we should use dynamic allocation only when needed. Cell borrowing can also be done.

→ Zone 3 no dynamic actions needed.

Step 8: Zonal Analysis & Implementation:

Zone	Immediate Strategy	Fallback
1	GSM + EDGE	3G
2	GSM + EDGE + Sectoring	3G
3	Basic GSM	2G.