5. Joint blocks

• Joint blocks: rock blocks determined entirely by joint planes without free surfaces

- Generally do not draw any significant concern in rock mechanics literature because they are hidden within rock mass.
- Affect the size and shape of blasted rock materials (Fig.5.2, 5.3).
- Affected by orientation, spacing and extent of each joint set.
- Difference with free plane-bearing blocks: more chances to have parallel joints as boundary planes.

• Intuitively derived principles in block occurrence

- Blocks made by less joints are more likely to occur (Fig. 5.5).
  Ex) 1100 vs. 1120 (2D)
- Blocks with parallel joints are more likely than those with non-parallel joins.
  Ex) 3322 > 3323 > 1120 (2D)

1) Joint blocks in 2D

- Joint blocks with no repeated joints

  - No. of all JPs:
  - No. of non-empty JPs:
  - No. of empty JPs (finite JB):

- Joint blocks with one repeated joint set

  - No. of all JPs:
  - No. of non-empty JPs:
  - No. of empty JPs (finite JB):

1) Joint blocks in 2D

- Joint blocks with two or more repeated joint sets

  - No. of all JPs:
  - No. of non-empty JPs:
  - No. of empty JPs (finite JB):

2) Joint blocks in 3D

- Joint blocks with no repeated joints

  - No. of all JPs:
  - No. of non-empty JPs:
  - No. of empty JPs (finite JB):

- Joint blocks with one repeated joint set

  - No. of all JPs:
  - No. of non-empty JPs:
  - No. of empty JPs (finite JB):

2) Joint blocks in 3D

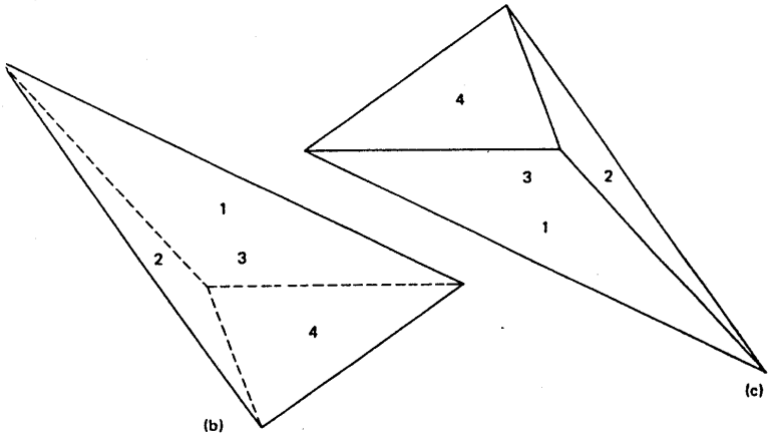
- Joint blocks with two repeated joint sets
  - No. of all JPs:
  - No. of non-empty JPs:
  - No. of empty JPs (finite JB):
- Joint blocks with three or more repeated joint sets
  - No. of all JPs:
  - No. of non-empty JPs:
  - No. of empty JPs (finite JB):

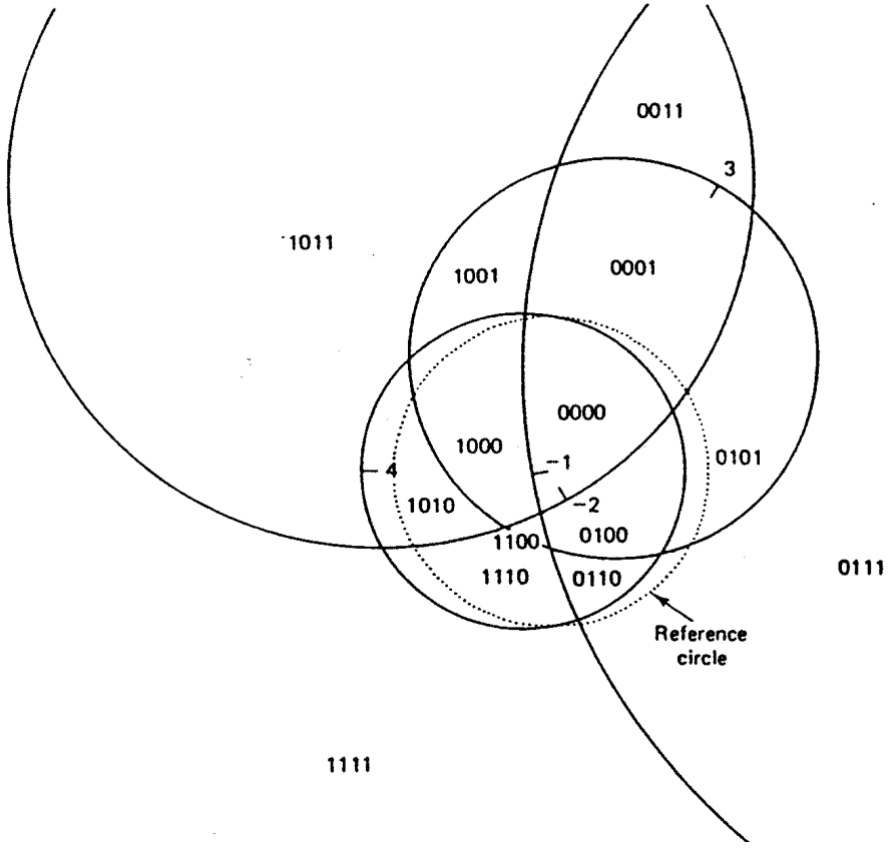
3) Stereographic projection solution for joint blocks

- Finite joint blocks with no repeated joint sets

TABLE 5.3

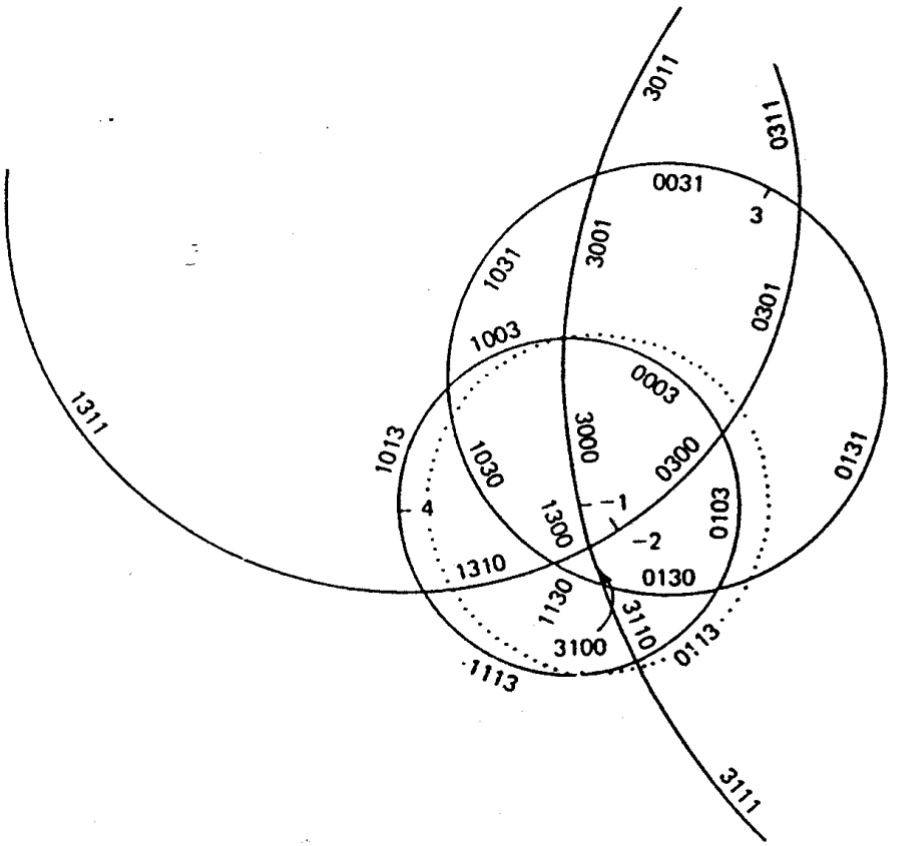
Set	Dip, α (deg)	Dip Direction, β (deg)
1	75	80
2	65	330
3	40	30
4	10	270



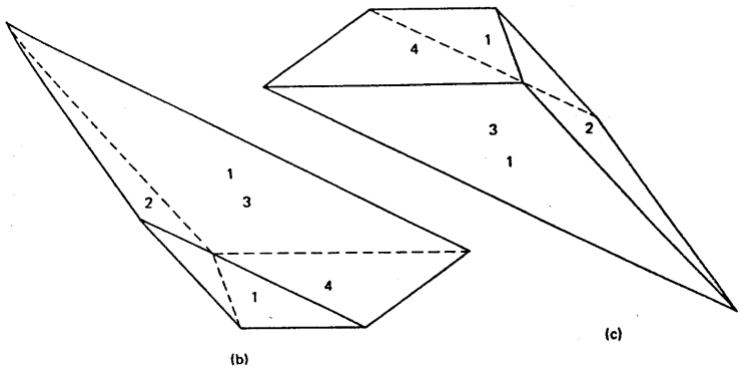


3) Stereographic projection solution for joint blocks

- Finite joint blocks with one repeated joint set



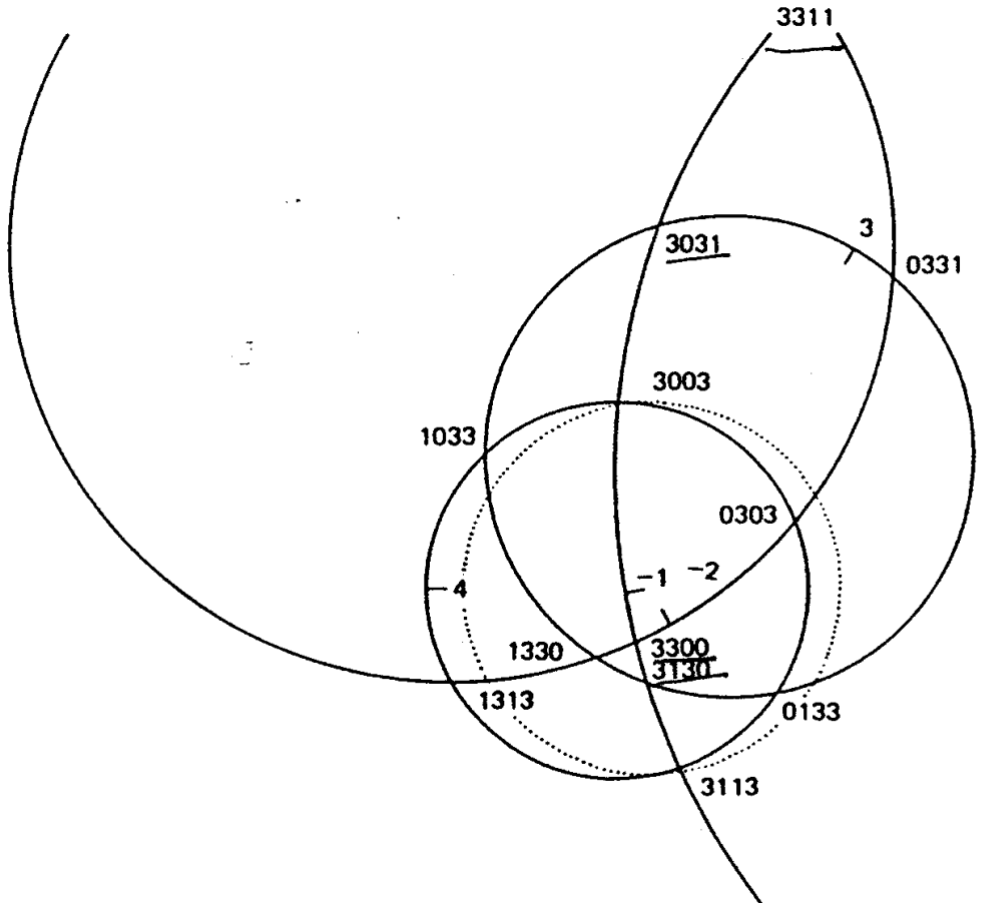
(a)

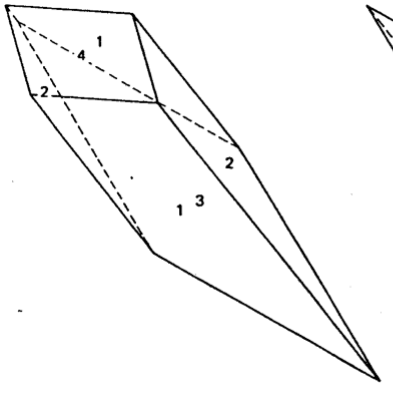


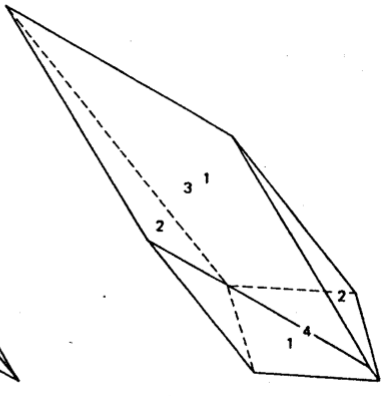
(b) (c)

3) Stereographic projection solution for joint blocks

- Finite joint blocks with two repeated joint sets





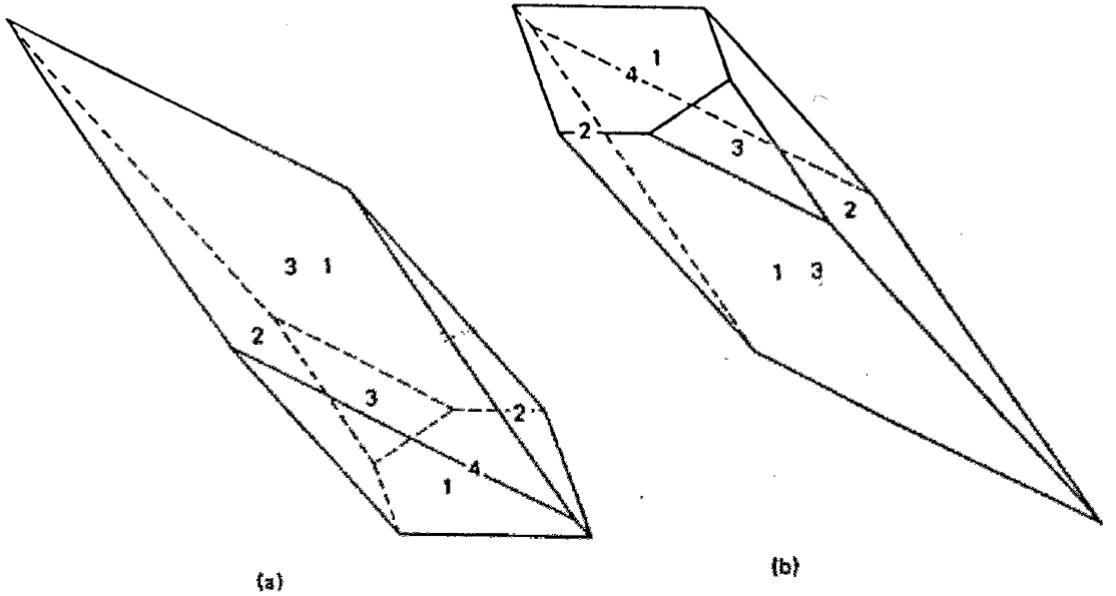


3) Stereographic projection solution for joint blocks

- Finite joint blocks with three or more repeated joint sets

TABLE 5.6 Empty Joint Pyramids with Three Repeated Joint Sets for the Joint System of Table 5.3

Repeated Joint Sets	Empty Joint Pyramids
2, 3, 4	0333, 1333
1, 3, 4	3033, 3133
1, 2, 4	3303, 3313
1, 2, 3	3330, 3331



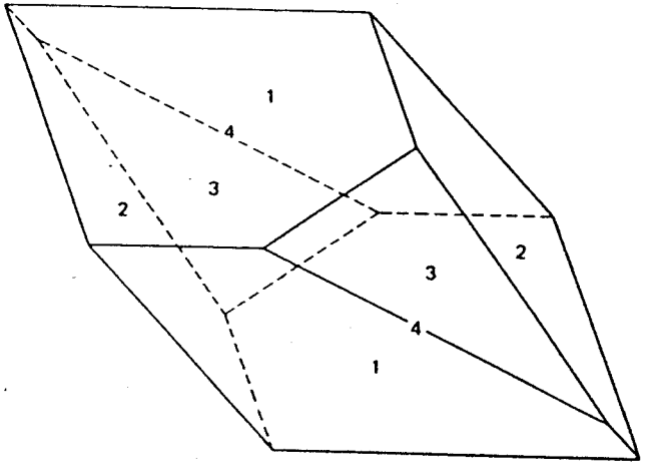


Figure 5.20 Finite block 3333.

4) Computation of emptiness of joint pyramids using vectors

TABLE 5.7

Joint Set	X	Y	Z
1	0.9512	0.1677	0.2588
2	−0.4531	0.7848	0.4226
3	0.3213	0.5566	0.7660
4	−0.1736	0	0.9848

- With no repeated joint sets: 0100 (p.148)

$$0.9512X + 0.1677Y + 0.2588Z \geq 0$$
$$0.4531X - 0.7848Y - 0.4226Z \geq 0$$
$$0.3213X + 0.5566Y + 0.7660Z \geq 0$$
$$-0.1736X + 0.9848Z \geq 0$$

4) Computation of emptiness of joint pyramids using vectors

- With one repeated joint set: 1310

$$
\begin{aligned}
&-0.9512X - 0.1677Y - 0.2588Z \geq 0\\
&-0.4531X + 0.7848Y + 0.4226Z = 0\\
&-0.3213X - 0.5566Y - 0.7660Z \geq 0\\
&-0.1736X \quad + \quad 0.9848Z \geq 0
\end{aligned}
$$

- With two repeated joint sets: 3031

$$
\begin{aligned}
&0.9512X + 0.1677Y + 0.2588Z = 0\\
&-0.4531X + 0.7848Y + 0.4226Z \geq 0\\
&0.3213X + 0.5566Y + 0.7660Z = 0\\
&+0.1736X \quad - \quad 0.9848Z \geq 0
\end{aligned}
$$

5) Application of block theory: an example

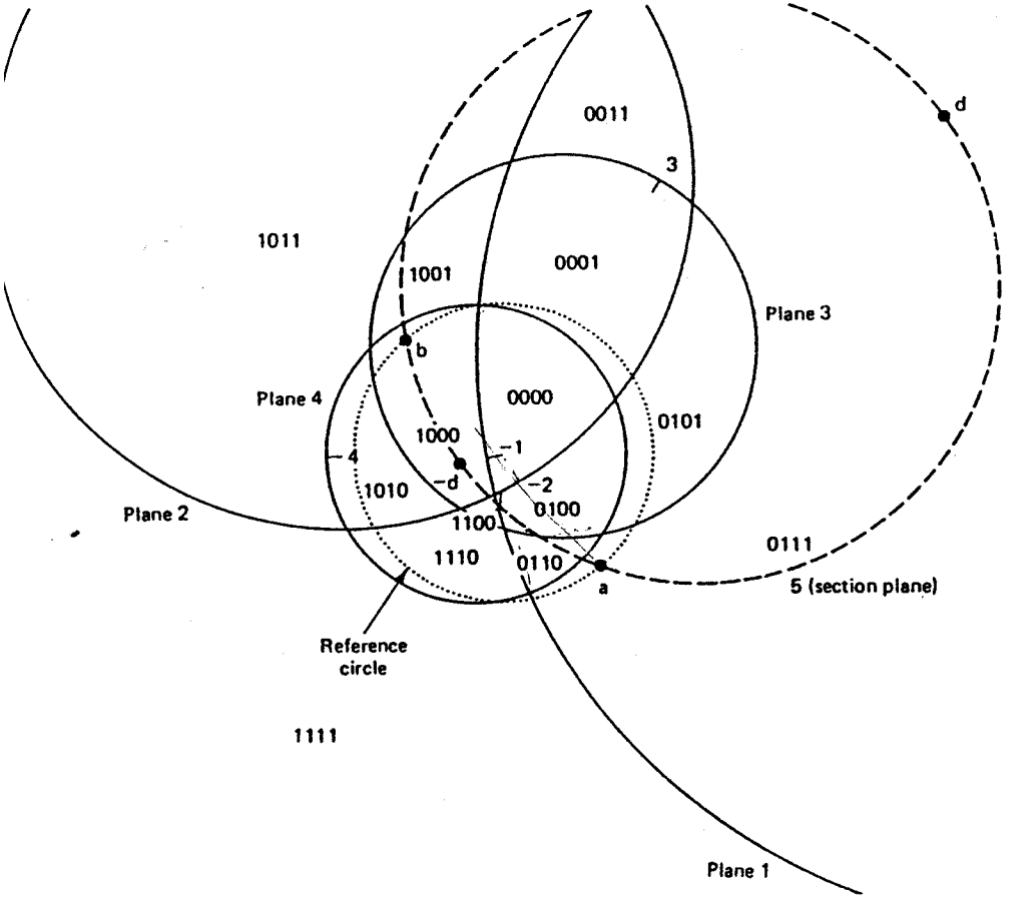
- Joint spacing

- Constructing a trace map in any section plane

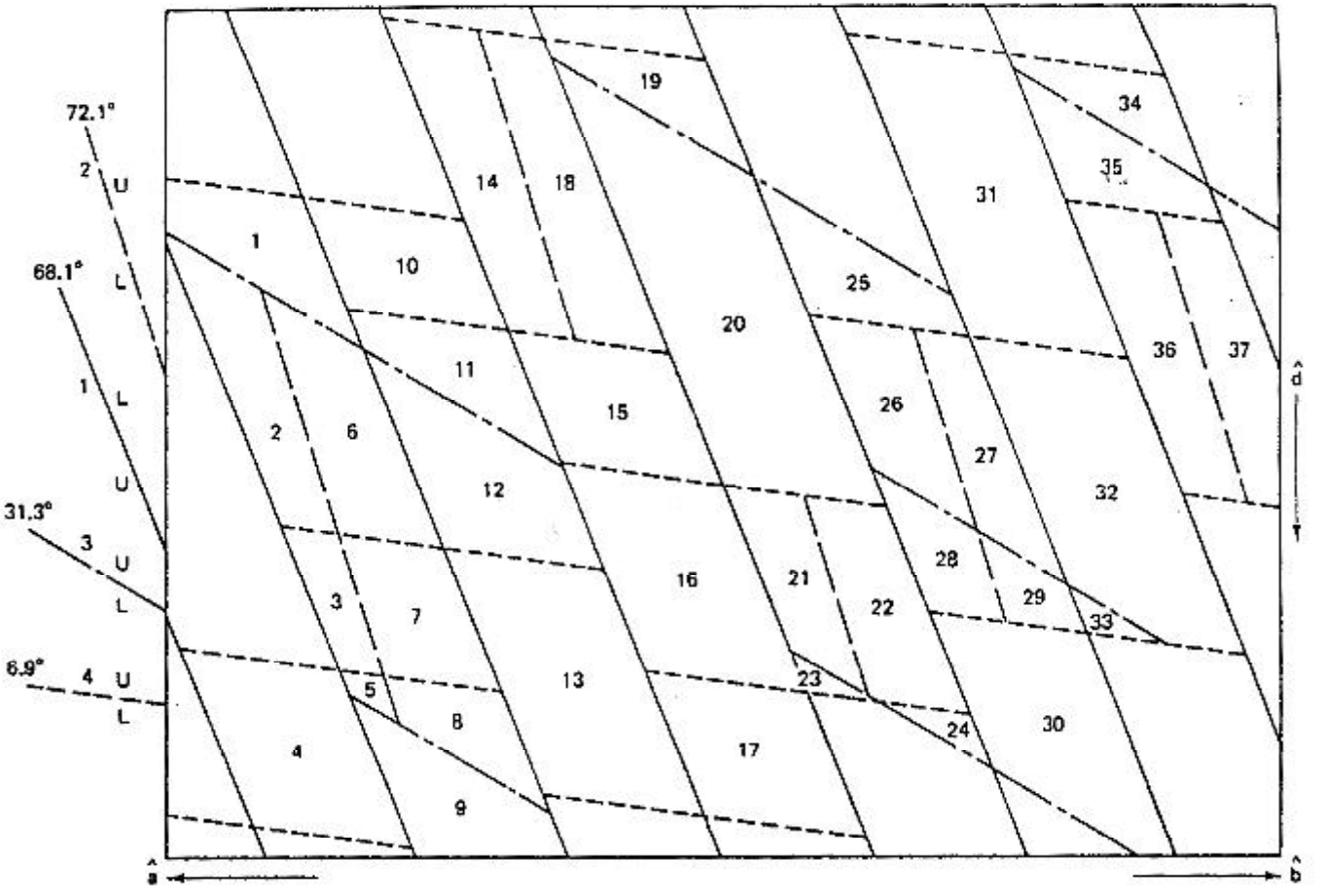
- The ratio of finite to infinite blocks as a rock mass index

5) Application of block theory: an example

- Constructing a trace map in any section plane



5) Application of block theory: an example



5) Application of block theory: an example

- The ratio of finite to infinite blocks as a rock mass index

Complete polygons: 37
Finite joint blocks: 11
Infinite joint blocks: 26
Semi-continuous rock mass – relatively higher powder factor than the case of discontinuous rock mass is required.