Final Exam

December 13th, 2022

1. Explain the theorems of finiteness and removability. [15]

2. The great circles below are of the stereographic projection of 4 joint sets whose orientations are shown in the Table. Determine
1) Finite and infinite joint blocks (obtain JP code), respectively, ① when there are no repeated joint sets and ② when the joint set 2 is repeated. [12]
2) Failure mode of each JP when the resultant force on each block is oriented downward (gravitational force). [18]
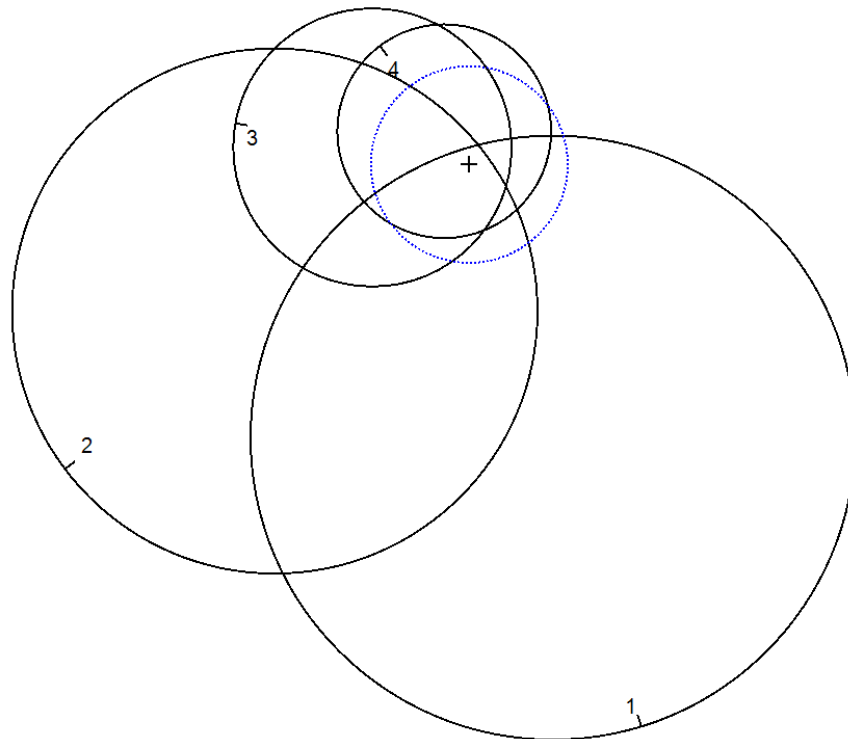

Table. Orientation of 4 joint sets

Set	Dip	Dip direction
1	71	163
2	68	233
3	45	280
4	23	323

3. There are 4 joint sets in a rock slope site of which orientations are as in the Table of Problem 2 (Set 1~4). Draw a trace map on the rock slope (10 m × 6 m) whose great circle is expressed as a red circle in the stereographic projection. Assume that the mean trace length of each joint is about 2 m and the joints belonging to the same set are parallel to each other. Let the left of the trace map is toward the west (not exactly west though) and the right toward the east. Express the angle between a joint trace and the horizontal boundary of the trace map as theta (Θ_1, Θ_2, Θ_3, or Θ_4) whose relative magnitude are determined from the stereographic projection. Set spacing of the joint traces in the slope can be set randomly from 2 m to 4 m. Show Θ_1, Θ_2, Θ_3, and Θ_4 not only in the trace map but also in the stereographic projection additionally provided for this problem (submit the projection sheet too). [25]
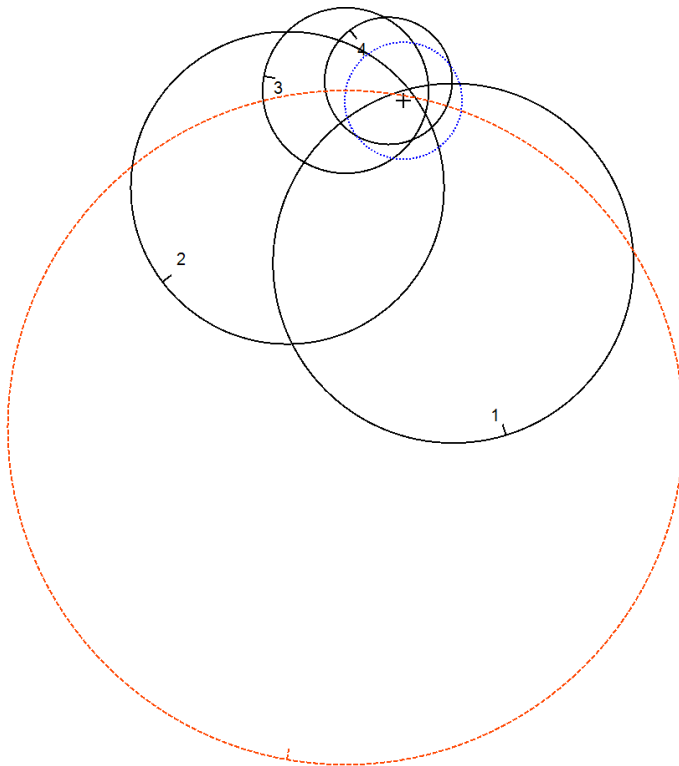

Table. Orientation of 4 joint sets and a free plane (rock slope)

Set	Dip	Dip direction
1	71	163
2	68	233
3	45	280
4	23	323
Slope (red)	80	190

4. A circular tunnel is excavated horizontally from the south to the north in rock mass which has 4 joint sets as in Problem 2.

1) Find out JPs of infinite blocks. [5]

2) draw the 2D maximum removable area of a block whose JP is '1110' with the tunnel in the vertical section normal to the tunnel axis. Denote the angles between a horizontal line and boundary lines (limiting edges) of the maximum removable area as ϕ_1 and ϕ_2 on the stereographic projection below (submit this page too). [15]

3) Calculate the exact angles: ϕ_1 and ϕ_2. [10]
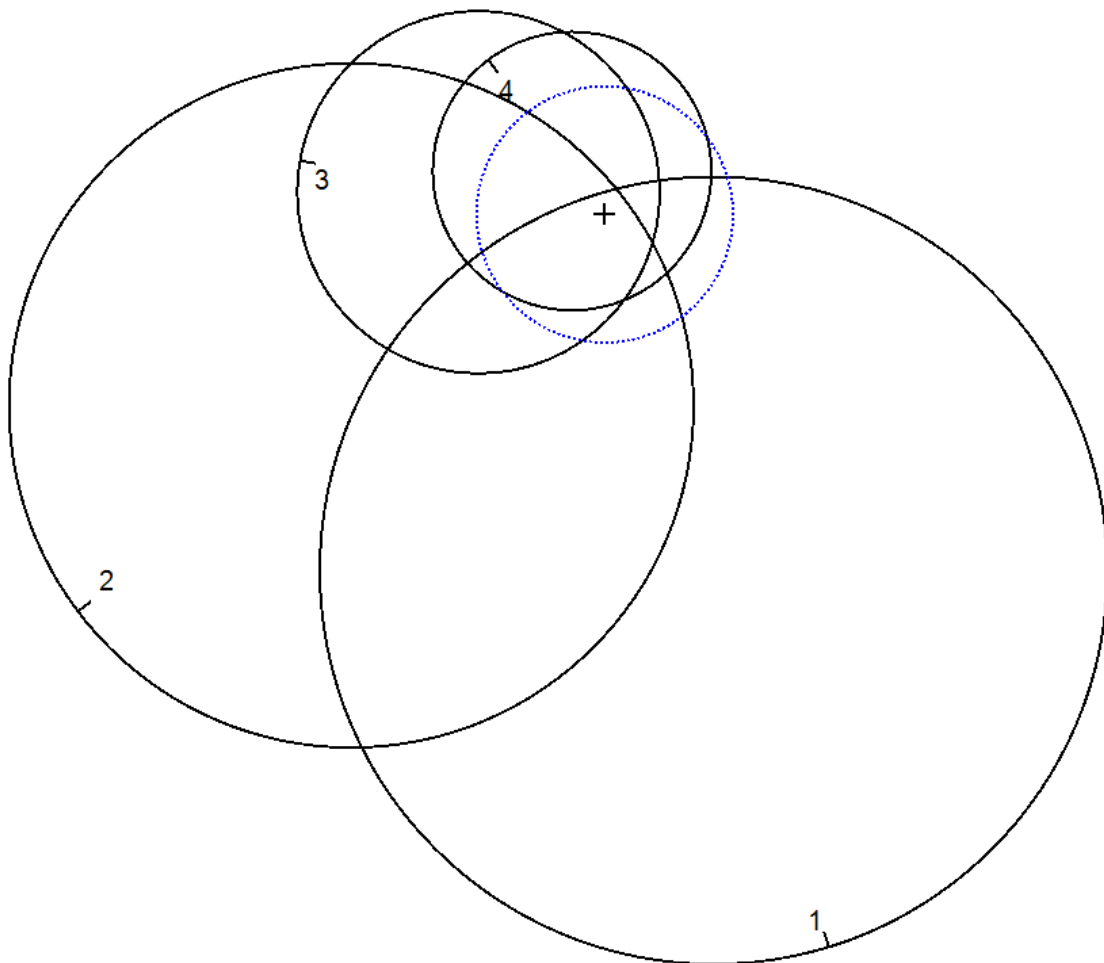
An additional stereographic projection drawing for Problem 2
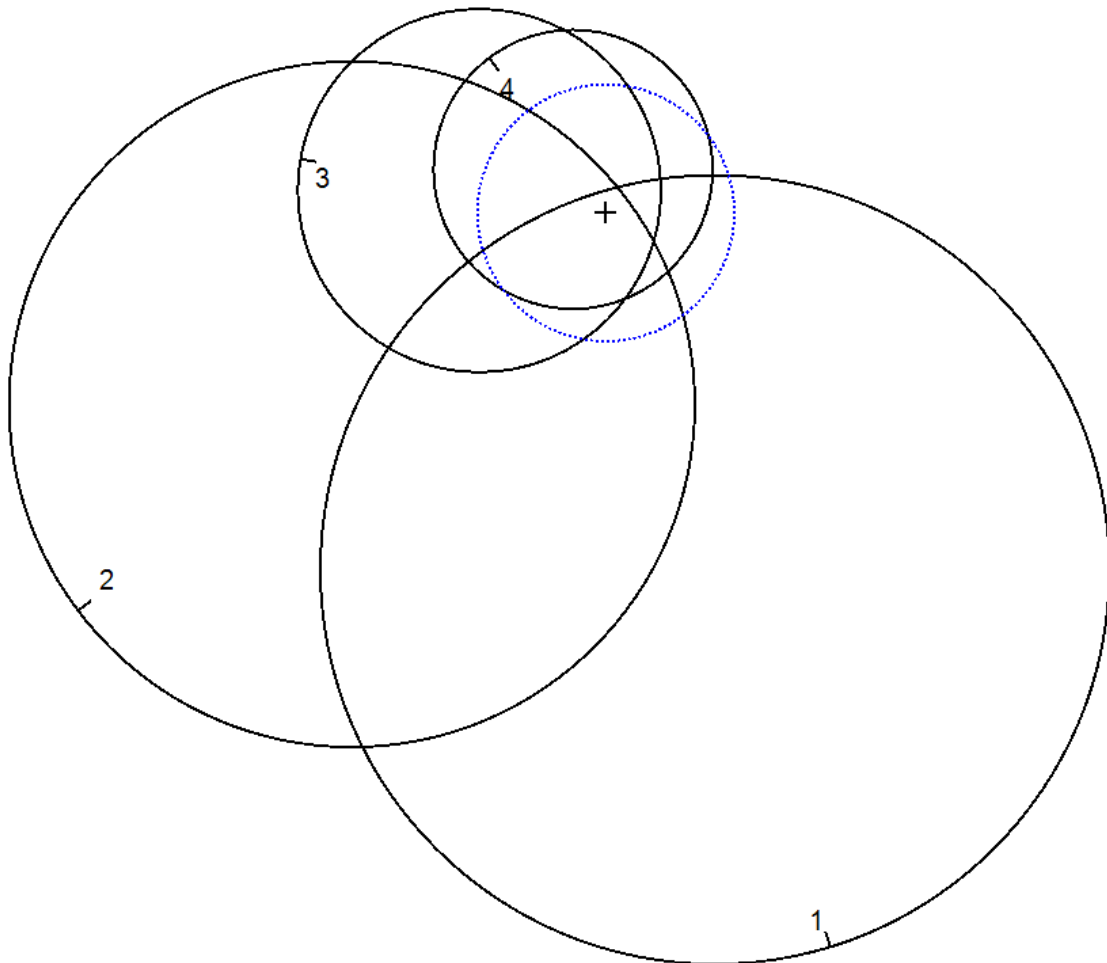
A stereographic projection drawing for Problem 3 (submit this sheet)