Structural Geology Lab – Week 1
Attitudes of Lines and Planes in 3-D
Read and Complete Lab 1 in the Rowland and Dubendorfer Manual. The following are basic notes to accompany the lab. Use the Math/Trigonometry Review sheets to help you in your solutions.

I.   Basic Orientation of Lines and Planes in Structural Geology

       A.   Orientation of plane in space

              1.   Attitude: orientation of structural element in space

                    a.   planes: strike and dip
                    b.   lines: trend and plunge
              2.   Bearing: compass direction orienting line in space relative to horizontal plane
                    a.   Azimuth vs. Quadrant

              3.   Strike: compass bearing of horizontal line on a plane, formed by line of intersection between horizontal plane and inclined plane.

                    a.   infinite no. of parallel strike lines for any inclined plane
                    b.   data representation: azimuth direction

              4.   Dip: vertical angle between inclined plane and horizontal plane measured perpendicular to strike direction
                    a.   data: angle + direction of down dip orientation
                          (1)   (i.e. direction water would run down the plane)

              5.   Apparent Dip: vertical angle between an inclined plane and a horizontal plane that is NOT measured perpendicular to strike direction

                    a.   Apparent dip will always be < than true dip

       B.   Orientation of Lines

              1.   Trend: compass bearing of line orientation
              2.   Plunge: vertical angle measured between a line and the horizontal
              3.   Pitch or Rake: angle measured within an inclined plane between a horizontal line and the line in question

I.   Solving Problems of Apparent Dip (Chapter 1 in lab manual, p. 1-9).

       A.   Problem: many outcrops are 2-D cuts in quarry walls, or road cuts

              1.   the road or quarry cut may not be oriented truely perpendicular to the strike of the beds

                    a.   hence, any dip angles measured in that cut will be represented as "Apparent Dip"

                          (1)   In structural analysis, we need to convert the apparent dip,

to true dip angle

        (2)   Chapter 1 outlines procedures for converting apparent dip to true dip

B.   Solution Techiques

    1.   Graphical solution using scaled drawings and measurement

        a.   Drawing Terminology

            (1)   N.L. =North line
            (2)   S.L. =strike line oriented relative to azimuth
            (3)   D.L.= Dip line representing the direction of dip (perpendicular to strike)
            (4)   C.L. =arbitrary construction line used to make geometric solutions
            (5)   F.L. = fold line, imaginary line used as a fold axis to solve a problem in the 3rd dimension of the paper (i.e. to turn out items from below the plane of the paper).

        b.   Solving Apparent Dip Problem
            (1)   known: strike = 25, apparent dip direction = 270, apparent dip angle = 40
                 (a)   Question: what is true dip angle?

            (2)   Technique
                 (a)   draw north line, strike line and apparent dip line, intersecting at a common center point
                 (b)   draw a true dip line perpendicular to strike line, but not at the intersection point
                 (c)   turn apparent dip line into fold line, and draw a construction line from intersection point with angle of 40 degrees
                 (d)   draw line d, perpendicular to fold line, representing depth from surface to top of bed
                 (e)   draw a second line of length d, from from the intersection of the apparent dip and dip lines
                 (f)   turn true dip line into fold line, and draw a line from intersection of dip and strike lines, to end of line d from step e above.
                 (g)   measure the true dip using a protractor

    2.   Trigonometric Solution

        a.   Tan (T.D.) = tan (A.D.)/Sin(B)

            (1)   where T.D. = true dip angle, A.D. = apparent dip angle, B = acute angle between strike and apparent dip azimuth

    3.   Nomogram solution

        a.   see page 10 in lab manual for using nomogram.