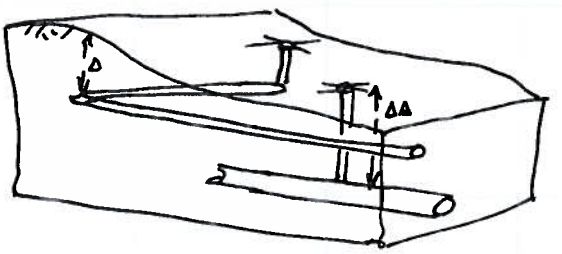
TOPOGRAPHIC MAPS & MAPPING

2D REPRESENTATIONS OF 3D SURFACES

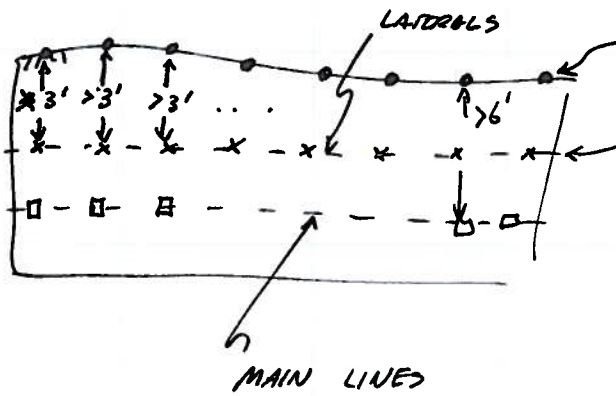
USES INCLUDE
- WATERSHED DELINEATION
- GRADING DESIGN
- OIL EXPLORATION.

SIMILAR "MAPS" ARE USED
- SUBSURFACE – OIL/GAS/AQUIFERS
- ATMOSPHERIC – RAINFALL CONTOUR PLOTS

AS A TOOL IN THIS COURSE
USEFUL FOR DESIGN PROJECT



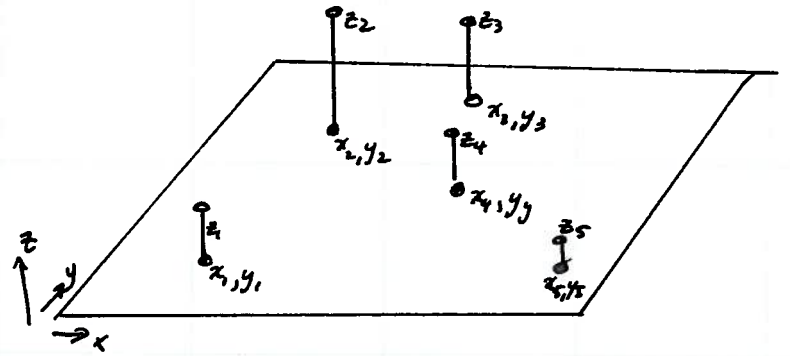
OFFSETS/INVERT/FLOWLINE ELEVATIONS



ELEVATIONS ARE VITAL IN THE HYDRAULIC MODELS USED TO SIZE PIPES, ACCOUNT FOR HEAD LOSSES, LOCATE PUMPS, HIT OUTFALL ELEV

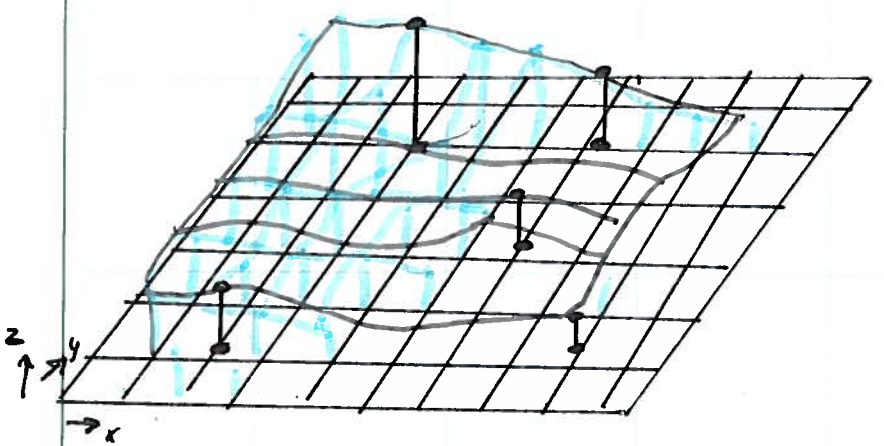
HOW TO "BUILD" CONTOUR MAPS

① ASSUME HAVE X, Y, Z DATA



THE "PROCESS" IS TO PASS A SURFACE THROUGH THESE POINTS – LIKE 3D LEAST SQUARES

② PRACTICE IS TO "GRID" THE OBSERVATIONS



THE "SURFACE" OF "GRIDDED" VALUES APPROXIMATES THE TOPOGRAPHY.

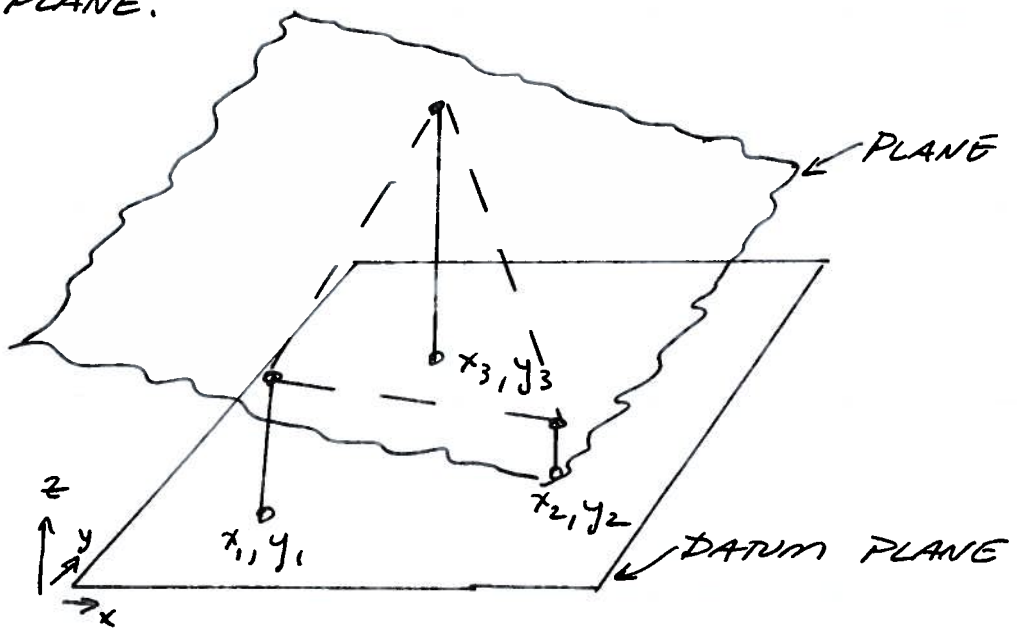
LEVEL SETS FROM THIS SURFACE ARE CONTOUR LINES

PLOT OF ALL LEVEL SETS IS THE CONTOUR MAP

③ ONCE WE HAVE THE "GRID" – THE OFFSETS (INVERTS) ARE STRAIGHTFORWARD TO OBTAIN BY SUBTRACTING THE OFFSET VALUE

INSTRUCTIVE "ASIDE"

SUPPOSE HAVE 3 POINTS, WANT TO DEFINE A PLANE.



EQUATION OF A PLANE

$$ax + by + cz + d = 0$$

ANOTHER REPRESENTATION

$$ax + by + d = z$$

WE WANT TO KNOW a, b, & d (WE SET c=1)

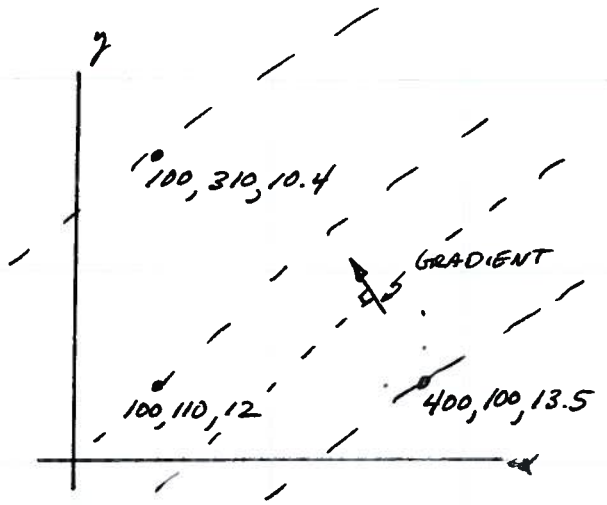
WRITE AS SIMULTANEOUS SYSTEM

$$ax_1 + by_1 + d = z_1$$
$$ax_2 + by_2 + d = z_2$$
$$ax_3 + by_3 + d = z_3$$

$$\begin{pmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{pmatrix} \begin{pmatrix} a \\ b \\ d \end{pmatrix} = \begin{matrix} z_1 \\ z_2 \\ z_3 \end{matrix}$$

← SOLVE THIS LINEAR SYSTEM FOR a, b, d

THEN CAN REPRESENT THE PLANE AS A FUNCTION



$$\begin{pmatrix} 100 & 110 & 1 \\ 400 & 100 & 1 \\ 100 & 310 & 1 \end{pmatrix}\begin{pmatrix} a \\ b \\ d \end{pmatrix}=\begin{pmatrix} 12 \\ 13.5 \\ 10.4 \end{pmatrix}$$

$$\begin{pmatrix} a \\ b \\ d \end{pmatrix}=\begin{pmatrix} 0.00473 \\ -0.008 \\ 12.406 \end{pmatrix}$$

$$\therefore \quad 0.00473x - 0.008y + 12.406 = z$$

IF FIX A VALUE FOR Z, THEN (x,y) THAT "SOLVES" THE EQUATION IS A LEVEL SET.
A PLOT OF (x,y) IS A CONTOUR LINE

THE GRADIENT IS EVEN MORE USEFUL:

$$\nabla = -0.00473\underline{i} + 0.008\underline{j}$$

MAGNITUDE: $\sqrt{0.0047^2 + 0.008^2} = 0.0093$

— NOW IN PRACTICE WE DON'T PASS "EQUATIONS" THROUGH POINTS. BUT USE LINEAR INTERPOLATION TO GRID DATA AND APPROXIMATE THE SURFACE