

( )

:

\*

( // : // : )

:

( )

( )

( )

( , )

( )

- 
1. Plane Surface Method
  2. Least Square Method
  3. Fixed Volume Center Method
  4. Average Profile Method
  5. Weighted Average Method
  6. Symmetrical Residuals Method

: :

)

.( )

.(

)

( )

(

D

D/2

.( )

.( , , , )

( )

.( )

.( )

( )

- 
1. Four point method
  2. Prismoidal Formula and Summation method
  3. Shih and Kriz Method
- End Area Method

$$d = \frac{1+R}{2RN} (R \sum F - \sum C) \quad ($$

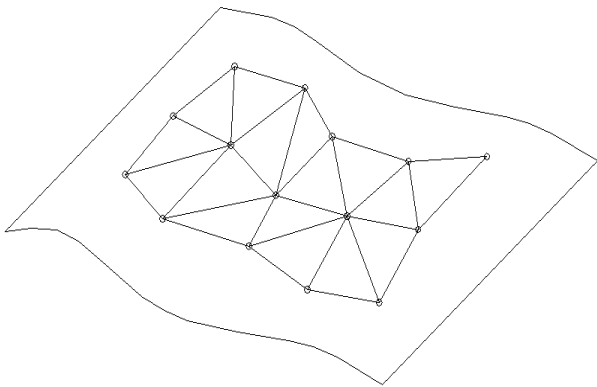
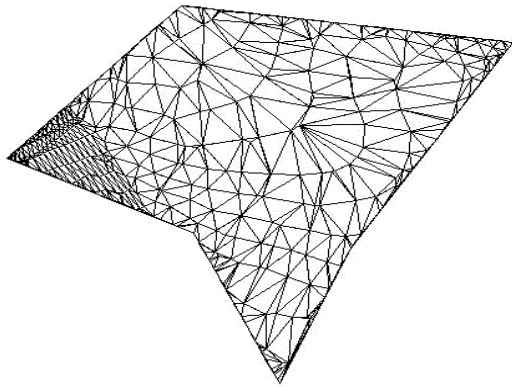
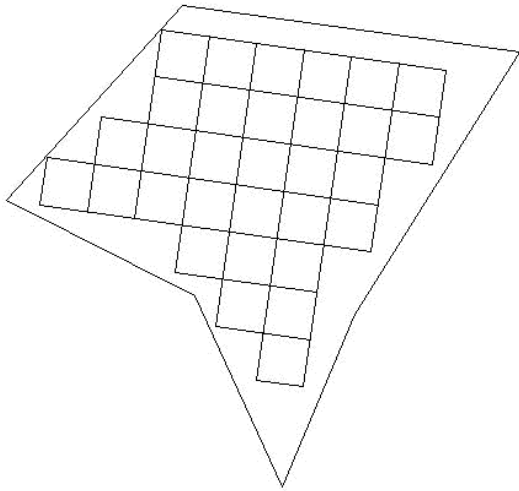
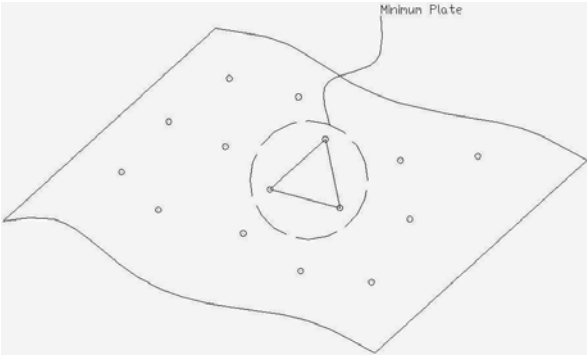
R , d  
F N C

( ) d

### Composite

( ) ( ) :  
( )  
( )

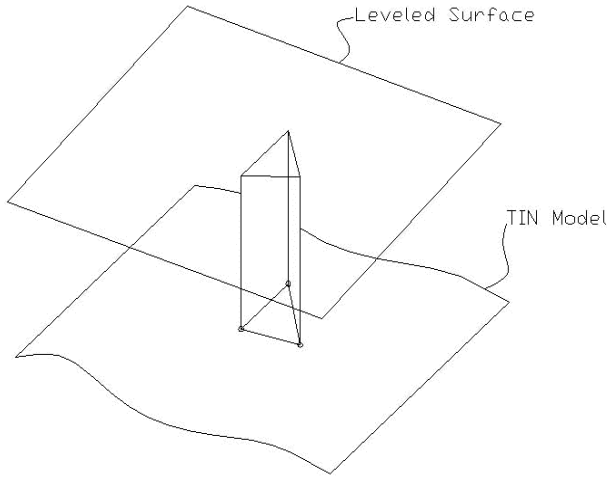
( )



Composite

)  
(

( )



( )

TIN

( )

( )

$$V = A \left( \sum_{i=1}^3 h_i \right) / 3$$

$h_i$                    $A$                    $V$

$$Z(X, Y) = S_x(X) + S_y(Y) + Z_{(0,0)}$$

$Y$        $X$                    $Z(X, Y)$                    $Z(0, 0)$   
 $S_y$   $S_x$   
 $Y$     $X$

TIN

( )

( )

$$V = A(h/3)$$

$h$                    $A$                    $V$

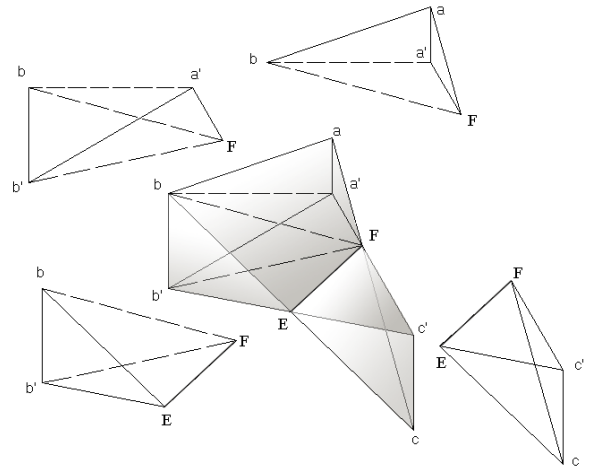
abc  
a'b'c'

---

1. Triangular Irregular Network (TIN)

$K(h)$

( )



$h+\Delta h$   $h$   $K(h)$   
( )

$$K(h) = \lim_{\Delta h \rightarrow 0} \left( \frac{K(h) - K(h + \Delta h)}{\Delta h} \right) \quad ( )$$

Composite

$$V = f(h) \quad ( )$$

$h$   $V$   $f$

$V$   $h$   $( )$

$$V = f(h) = \begin{cases} V_{cut} = f_c(h) \\ V_{fill} = f_f(h) \end{cases} \quad ( )$$

$R$

$$R = \frac{V_{cut}}{V_{fill}} = \frac{f_c(h)}{f_f(h)} = G(h) \quad ( )$$

$h$   $R$

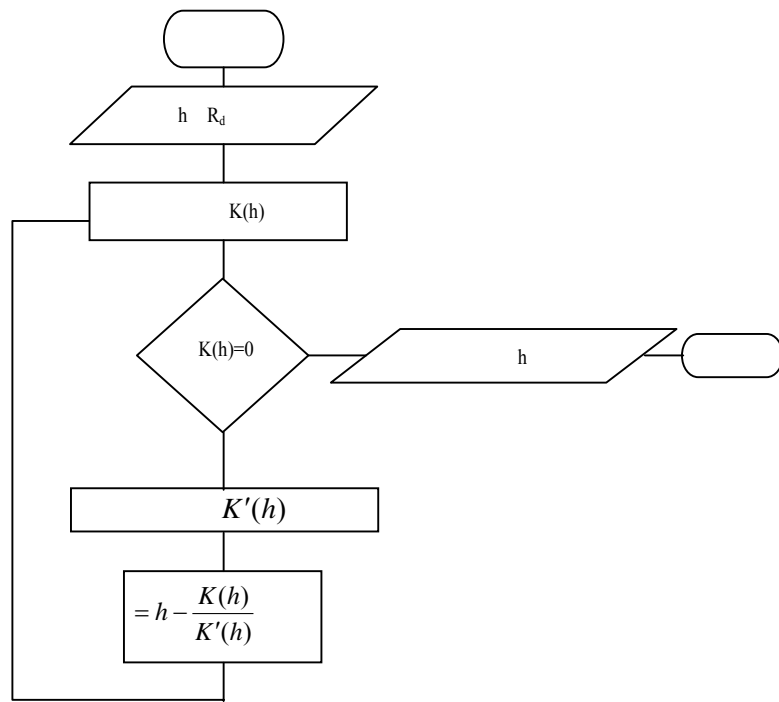
TIN

TIN

$$G(h) = R_d \quad ( )$$

$R_d$

$$K(h) = G(h) - R_d \quad ( )$$



DOLF<sup>1</sup>

(.)

400m<sup>2</sup>

|                    |                |   |
|--------------------|----------------|---|
| m <sup>3</sup> ( ) | m <sup>2</sup> | m |
|                    | /              |   |
|                    | /              |   |



|           |       |
|-----------|-------|
| $m^3$ ( ) | $m^2$ |
|           | /     |
|           | /     |

( )

|   |   |
|---|---|
| / | / |
| / | / |

|   |   |   |
|---|---|---|
| / | / | / |
| / | / | / |
| / | / | / |
| / | / | / |

( )

$$\text{Error}(\%) = \frac{(\text{An} - \text{Cal})}{\text{An}} \times 100 \quad ($$

An ,                      Error(%)

Cal ,

**REFERENCES**

2. Afshar, A. & Mariño, MA. 1992. An optimum land leveling technique for surface irrigation. International Journal of Engineering Vol. 3(1a): 31-42.
3. Anderson, C. 1980. Land shaping In: Design and Operation of Farm Irrigation System. American society of Agricultural Engineers, St. Joseph, Mich., 281-314.
4. Chuangyin, D. 1995. Triangulations and Simplicial Methods, Pub. Springer-Verlag, 196 pages

5. Easa, S. M. 1989. Direct land grading design of irrigation of irrigation plane surface. J. Irrig. And Drain. Engrg., ASCE, Vol. 115(2) : 285-301.
6. Paul, L. G. & Houtman, B., 1998. Delauney Triangulation and Meshing: Application to Finite Elements, Pub. Kogan Page Ltd, 413 pages
7. Raju, V. 1960. Land grading for irrigation. Trans. American Society of Agricultural Engineers. Vol. 3(1) : 38-41
8. Scaloppi, E. & Willardson, L. 1986. Practical land grading based on least squares. J. Irrig. And Drain. Engrg., ASCE, Vol 112(2) : 98-109.
9. Shih, S. & Kriz, G. 1971. Symmetrical residuals method for land forming design. Trans. American Society of Agricultural Engineers. Vol. 14(6):1195-1200
10. Sowell, R., Shih, S. & Kriz, G. 1973. Land forming design by linear programming. Trans. American Society of Agricultural Engineers. Vol. 16(3): 296-301
11. Soil Conservation Service, 1961. Land leveling. In Section 15, Irrigation, Soil Conservation Service Handbook, U. S. Dept. of agriculture, Washington, D. C.
12. Utah State University, 1992. Level Gram User manual. Irrigation and Reclamation Dept., Utah, USA.