Calculation of End Area Method in Earthwork

Earthwork · https://mes100.com/docs/end-area-method-in-earthwork/

End Area Method, also known as **Average End Areas** method, is a popular method to estimate the earthwork volume. Like **grid method**, it is also easy to use, easy to understand and can be carried out by someone even with minimum mathematical training.

The procedure to compute cut and fill volume from End Area Method is simple.

The Procedure

1. **Define cut sections** separated by a fix interval, say 25 m. Make sure that your cut sections adequately cover your project area in both latitude and longitude direction, as shown below.

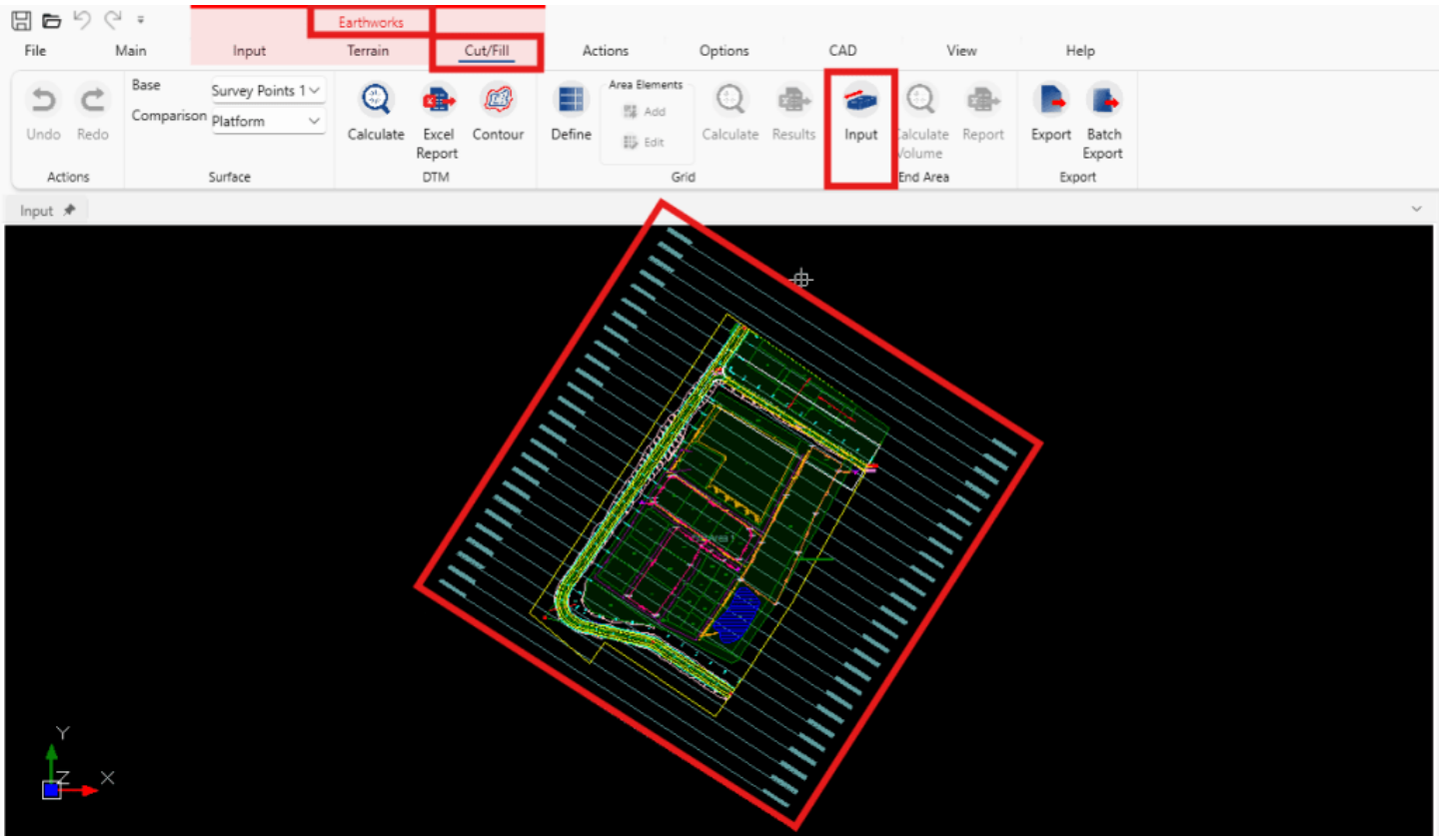


Image 1.1: End area interval input covered all the site area

2. For each section, calculate the respective cut and fill area. In MiTS, the cut and fill area for each of the end area section are stated in the cut section view. You can double check the value by measuring the area of the cut and fill by using the **CAD command**.

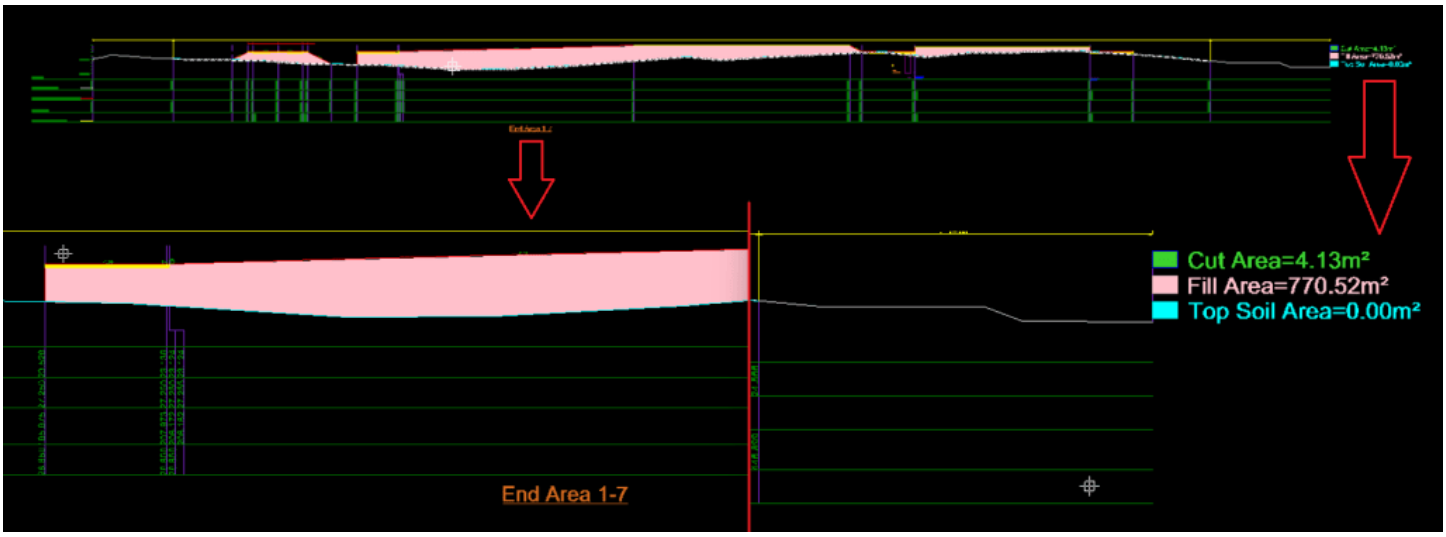


Image 1.2: Cut section of End Area 1-7

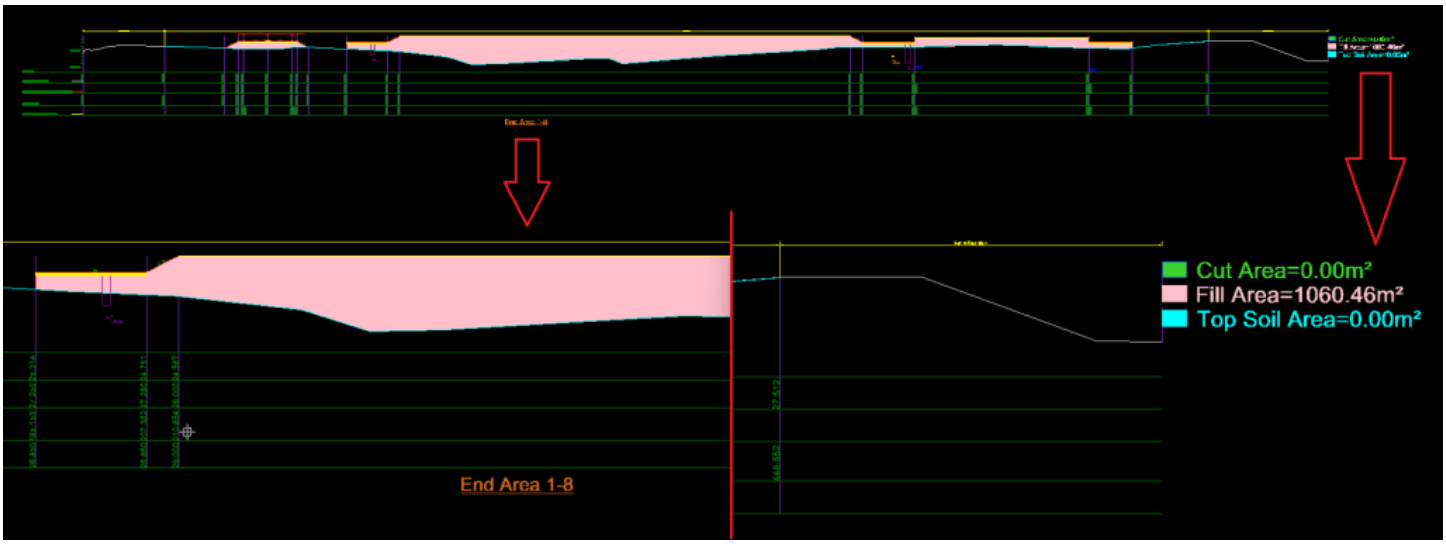


Image 1.3: Cut section of End Area 1-8

3. Compute each section volume by using the formula: $V_i = \frac{A_{i-1} + A_i}{2} \times L$

A_i = Cross-sectional area at the section

A_{i-1} = Cross-sectional area of the section before

L = Distance between the sections (end area interval)

Example:

Let's say we are calculating the volume for the End Area 1-8. Considering A_{i-1} is the End Area 1-7, the area is computed in the table below based on the cut section (Image 1.2 & Image 1.3).

	End Area 1-7	**End Area 1-8**
Measured Cut Area (m^2)	4.13	0.00
Measured Fill Area (m^2)	770.52	1060.46

Using the formula, we compute the volume for cut and fill respectively as below.

Cut Volume	**Fill Volume**
\displaystyle V=\frac{A_{i-1}+A_i}{2}\times L \displaystyle V=\frac{4.13+0.00}{2}\times25 \displaystyle V=51.62\,\mathrm{m}^3	\displaystyle V=\frac{A_{i-1}+A_i}{2}\times L \displaystyle V=\frac{770.52+1060.46}{2}\times25 \displaystyle V=22887.25\,\mathrm{m}^3

4. Tabulate the cut section area and then sum up the volume for both cut and fill in an excel spreadsheet. Then you can already get your end area cut and fill volume.
   Notice the calculated cut and fill volume example in step 3 coincide with the value in the table below. The slight difference is due to the decimal places used in the calculation.

Earthworks Volume Detail Report (End Area Method)											
Cut Section	Top Soil (m^2)	Cut Area (m^2)	Cut Area (with Expansion Factor) (m^2)	Fill Area (m^2)	Fill Area (with Shrinkage Factor) (m^2)	Interval (m)	Top Soil Volume (m^3)	Expanded Cut Volume (m^3)	Fill Volume before shrink(m^3)	Volume (m^3)	Cumulative Volume (m^3)
End Area 1-0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
End Area 1-1	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00
End Area 1-2	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00
End Area 1-3	0.00	6.31	6.31	4151.60	4151.60	25.00	0.00	78.90	51895.02	-51816.12	-51816.12
End Area 1-4	0.00	0.00	0.00	4174.95	4174.95	25.00	0.00	78.90	104081.91	-104003.01	-155819.14
End Area 1-5	0.00	0.00	0.00	3900.76	3900.76	25.00	0.00	0.00	100946.37	-100946.37	-256765.51
End Area 1-6	0.00	0.63	0.63	54.65	54.65	25.00	0.00	7.88	49442.66	-49434.77	-306200.28
End Area 1-7	0.00	4.13	4.13	770.52	770.52	25.00	0.00	59.45	10314.66	-10255.20	-316455.48
End Area 1-8	0.00	0.00	0.00	1060.46	1060.46	25.00	0.00	51.57	22887.22	-22835.65	-339291.13
End Area 1-9	0.00	0.00	0.00	808.07	808.07	25.00	0.00	0.00	23356.63	-23356.63	-362647.76
End Area 1-10	0.00	0.00	0.00	1059.92	1059.92	25.00	0.00	0.00	23349.92	-23349.92	-385997.68
End Area 1-11	0.00	0.00	0.00	1292.78	1292.78	25.00	0.00	0.00	29408.82	-29408.82	-415406.49
End Area 1-12	0.00	47.06	47.06	535.25	535.25	25.00	0.00	588.21	22850.38	-22262.18	-437668.67
End Area 1-13	0.00	0.00	0.00	1042.90	1042.90	25.00	0.00	588.21	19726.79	-19138.58	-456807.25
End Area 1-14	0.00	0.00	0.00	1171.66	1171.66	25.00	0.00	0.00	27681.92	-27681.92	-484489.17
End Area 1-15	0.00	18.16	18.16	801.70	801.70	25.00	0.00	227.00	24666.99	-24439.99	-508929.16
End Area 1-16	0.00	78.89	78.89	567.91	567.91	25.00	0.00	1213.18	17120.19	-15907.01	-524836.17
End Area 1-17	0.00	86.14	86.14	553.71	553.71	25.00	0.00	2062.92	14020.25	-11957.34	-536793.51
End Area 1-18	0.00	31.60	31.60	478.13	478.13	25.00	0.00	1471.70	12897.99	-11426.29	-548219.79
End Area 1-19	0.00	1.36	1.36	486.41	486.41	25.00	0.00	412.00	12056.84	-11644.84	-559864.63
End Area 1-20	0.00	52.08	52.08	75.76	75.76	25.00	0.00	668.08	7027.15	-6359.07	-566223.70
End Area 1-21	0.00	1.39	1.39	333.45	333.45	25.00	0.00	668.41	5115.14	-4446.73	-570670.43
End Area 1-22	0.00	9.31	9.31	22.73	22.73	25.00	0.00	133.80	4452.34	-4318.54	-574988.97
End Area 1-23	0.00	0.00	0.00	2.69	2.69	25.00	0.00	116.43	317.85	-201.42	-575190.39
End Area 1-24	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	33.68	-33.68	-575224.06
End Area 1-25	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	-575224.06
End Area 1-26	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	-575224.06
End Area 1-27	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	-575224.06
						Sum	0.00	8426.64	583650.70	-575224.06	

Table 1.1: Detail calculation of cut and fill volume

Discussion

1. Although End Area Method is a popular cut and fill method, but it is by no means the most accurate method. This title goes to **DTM (Digital terrain method)**
2. The reason being, like grid method, it depends on the cut section interval. You will have to use extremely small interval to capture accurate earthwork results, if your cross section varies a lot over short interval of space.
3. Also, the cut section is generated from the interpolation of the ground level, which itself is an approximation. So when you are taking the volume as a function of the two subsequent cut section areas, then it is a double approximation, which further reduces the accuracies.
4. Read also on **how pavement thickness affect the cut/ fill area** and **how to ensure cut section tally with the report** for more information.

Related



Ngu Soon Hui

I’m the Benevolent Dictator for Life for MiTS Software cum Editor of this website. Read more here.

You can also contact me at soonhui@mes100.com