Types of Errors in chain surveying

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Types of Errors in chain surveying:

It is always very difficult practically to measure length accurately. The permissible-error with a steel tape is 1 in 2000 in a flat country and 1 in 3000 for a rough undulating country. The error in chaining may happen in various ways. Sometimes there may be mistakes or confusion in reading the tallies such as 30 and 70. There may be also omission of chain lengths due to miscounting or when chaining is interrupted by buildings, canals, etc. The error may also be either cumulative or compensating. Cumulative errors are these which may either go on increasing or decreasing when a chain is shorter or longer than its standard length. When the chain is too short, the measured length of the line is too great. i.e., greater than its true length and therefore, the error is positive and the correction is negative. Again when the chain is too long the measured length is too short, i.e., less than its true length. So the error is negative and the correction is positive. Compensating errors are those which cancel one an other and finally their total effect remains approximately same.

While stretching a chain one may pull it less than the standard pull of that chain. Again one may stretch it with a greater pull than the standard one. As a result the measured length in the former case will be less and in the latter case will be higher. But when these two lengths are added, the two errors will compensate each other.

Correction of Errors in chain surveying:

(a) Correction in Length, Area and Volume :

Let Le be the incorrect length of the chain and Lc the correct length of the chain.

The correct distance, $L = Le/Lc$ X measured length by the the incorrect chain or tape.

The correct area, $A = (Le/Lc)^2$ X Calculated incorrect area

The correct volume, $V = (Le/Lc)^3$ X Calculated incorrect volume

Example: The road from Dhaka to Mirpur is actually 25320 ft long. This distance was measured by an Engineer's defective chain and was found to be 25273 ft. How much correction does the chain need ?

$L = (Le/Lc)$ X measured incorrect length

Le = (L * Lc) / Measured length

=(25320 * 100)/ 25270

= 1000.197 ft

So the chain should be shortened by 0.197 ft

Example : The length and breadth of a plot of land were measured by an Engineer's chain exactly 100 ft. in length at the beginning. But it was found to be 100.3 ft. long at the end of the survey work. The area of the plot drawn to a scale 1 inch=100 ft. was 25.60 sq. inches. What was the true area of the plot 7

True area $A = (Le/Lc)^2$ X Calculated incorrect area

$=(100.3/100)^2 * 25.6$ sq. in

=25.70 sq.in

From the scale on the map 1 $in^2 = 100^2 = 10{,}000$ sq. ft.

Area of the plot= (25.70 x 10,000) / 43560 (1 acre=43560 sq ft.)

=5.89 acres

Example : The length, breadth and depth of a pond were measured by an incorrect Gunter's chain. The volume of the pond was calculated to be 1,60,000 cft. The chain was tested at the end of the measurement of the tank.

True volume,= $(Le/Lc)^3 \times$ incorrect volume

$=(65.8/66)^2 \times 160000$

=159200 cft

(b) Correction for Pull :

Sometimes, a steel tape is pulled in excess of the pull at standardization, then the correction to be made is as follows :

Correction. $C_p = L(F_i - F_s)/ AE$

Where L=length of tape, A=cross-sectional area of tape. Fi=pull applied in the field, Fs = pull at standardization, and E= Young's Modulus of Elasticity (for steel, $E=30 \times 10^6$ p.s i.)

Since the effect of pull on tape is to make the measured length too short the correction is always positive.

Example : A steel tape of 100 ft. length, standardized at 25 lb. pull, was used in the field with a pull of 35 lbs. The cross-sectional area of the tape is 0.025 sq. inch. Take the value of Young's Modulus of Elasticity for steel, 30×10^6 p.s i. Calculate the correction for excess pull.

$$\text{Correction} = 100(35-25)/(0.025\times30\times10^6)$$

$$= 0.00134 \text{ ft} \quad \text{(positive)}$$

(C) Correction for sag:

$$\text{Correction, } C3 = W^2L/ 24 Fr^2$$

Where, W=wt. of the tape in lb., L=length of the tape in ft. and Fr =pull applied in the field in lb. Since the effec of sag on tape is to make the measured length too large the correction is always negative.

Example : A steel tape of 100 ft. length weighing L lbs. As pulled with a force of 20 lbs. in the field to measure a certain distance. Calculate the correction for sag.

$$\text{Correction, } C3 = W^2L/ 24 Fr^2$$

$$=(1.2)^2\times100/(24\times20^2)$$

$$=0.15 \text{ ft (negative)}$$

Temperature correction:

Since the length of the tape is increased as temperature is raised, where measured distance in too small, it is therefore. essential to apply this correction.

$$\text{Correction, } L= a\ (tf- ts) \times L$$

Where, L=measured length in ft., tf=temperature at which the tape was standardized, ts=temperature at which the tape is used in the field, and a =coefficient of thermal expansion of the tape per degree °F per foot length. The co-efficient of thermal expansion of steel varies from 5.5×10^{-6} to 6.85×10^{-6} per degree °F. The sign of the correction is greater or 'less than ts. The steel tapes are generally standardized at 65°F.

Example : A distance of 1840 ft. was measured with a steel tape which was exactly 100 ft. long at 65°F. The temperature during measurement in the field vials 85°F.