PYTHON PROGRAMMING FOR TAPE CORRECTION

For

Winter semester 2018-19

As a Part of The Surveying Course

(CLE1003- SURVEYING)

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CERTIFICATE

This is to certify that the Project entitled, “Tape Correction” is a Bonafide work done by group members of School of Civil Engineering in partial fulfilment of VIT’s Winter Semester 2020-21 and has been carried out under direct supervision and guidance of Mr. Sairam V (SCE).

Signature Of Faculty

ACKNOWLEDGEMENT:

I would Like to express a deep sense of thanks and gratitude to my teacher Mr. Sairam V for guiding me immensely through the course of the project. His constructive advice and constant motivation have been responsible for the successful completion of the project.

Lastly, I would like to thank all those who had helped directly or indirectly towards the successful completion of this project.

INTRODUCTION:

The Project deals with the Program created on Tape Corrections.
The project is designed for Surveying [CLE1003] course in Python. The title of the program is **Tape Corrections**. In this project one can solve numericals on Tape Surveying. Just One Thing He has to do is just Select the type of Corrections To be calculated and enter the details regarding it. The answer will be calculated by displaying the correction for that type and calculating the corrected length.

Tape Corrections:

The expression “a tape is standard at a certain temperature & under a certain pull” means that under these conditions the actual length of tape is exactly equal to its nominal length. Since tape is not used in field under standard conditions it is necessary to apply following corrections to measured length of line in order to obtain its true length:

1. Correction for Temperature
2. Correction for Pull (or tension)
3. Correction for Sag
4. Correction for slope or vertical alignment
5. Correction for Absolute length

1. Correction for Temperature:

If the temperature in the field more than the temperature at which the tape is standardized, the length of the tape increases, measured distance decreases, and the correction is additive. Similarly, if the temperature is less, the length of the tape decreases, measured distance increases, and the correction is negative. The temperature correction is

$$Ct = \alpha\ (T - Ts)\ L$$

Where, Ct is the correction for temperature,

α is the coefficient of thermal expansion,

T_0 is the temperature at which measurement is made,

T_m is the standard temperature,

L is the measured length.

2. Correction for Pull:

If the pull applied during measurement is more than the pull at which the tape is standardized, the length of the tape increases, measured distance decreases, and the correction is additive. Similarly, if the pull is less, the length of the tape decreases, measured distance increases, and the correction is negative. The correction for pull is,

$$C_p = \frac{(P - P_o)L}{AE}$$

where Cp is the pull correction,

P is the actual pull applied,

P_0 is the standard pull, L is the length of the tape,

A is the cross-sectional area,

E is the modulus of elasticity of steel ($2.1*10^7$ N/m^3)

3. Correction for Sag:

When a tape is stretched over points of support, it takes the form of a catenary. In actual practice, however, the catenary curve is assumed to be a parabola. The correction for sag (or sag correction) is the difference in length between the arc and the subtending chord (i.e., the difference between the horizontal distance between supports and the length measured along the curve). It is required only when the tape is suspended during measurement. Since the effect of the set on the tapes is to make the measured length too great this correction is always subtractive.

$$Cs = l_1 W_1^2 / 24 * P^2$$

where w is the weight of the tape,

L is distance between the support,

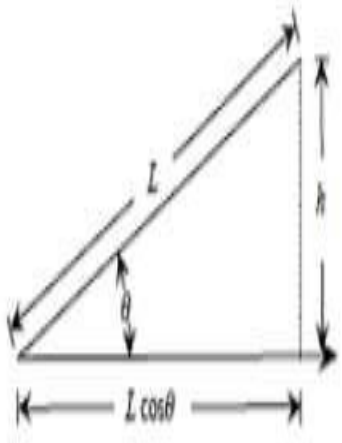
P is the applied pull.

4. Correction for Slope:

If the length L is measured on the slope, it must be reduced to its horizontal equivalent L cos θ. The required slope correction is

$$C_s = (1 - \cos\theta)L \quad (exact)$$

$$= \frac{h^2}{2L} \quad (approximate)$$



where θ is the angle of the slope,

h is the difference in elevation of the ends of the tape.

5. Correction for Absolute Length:

If the absolute length (or actual length) of the wire or tape is not equal to its nominal length or designated length, a correction will be applied to the measured length of the line. If the absolute length of the tape is greater than the nominal length, the measured length will be too short, and the correction is additive. Similarly, If the absolute length of the tape is lesser than the nominal length, the measured length will be too great, and the correction is subtractive.

$$Ca = \frac{L.c}{l}$$

where Ca is the correction for absolute length,

c is the correction,

l is the nominal length,

L is the measured length.

USES OF PYTHON PROGRAMMING:

Python is a readable and maintainable coding software.

It is compatible with many platforms and systems.

They simplify complex software development and makes it user friendly.

Thus, using python programming for tape correction would make the calculation much easier and accurate for us to refer back in order to obtain a correct and accurate reading. The process of using python program for tape correction involves giving the input of certain measured data and basic arithmetic operations in python using the data received to obtain the most accurate correction.

1. Correction for Temperature:

INPUT:

```
print("\nCORRECTION FOR ABSOLUTE TEMPERATURE:");
L=int(input("Enter the measured length(in mts): "));
print("Materialistic property of the tape 1.Steel or Unknown 2.Known");
a1=int(input());
if a1==1:
  a=0.0000035;
else:
  a=float(input("Enter the coefficient of expansion(per C): "));
tm=int(input("Enter the mean temperature during measurement(in C): "));
t0=int(input("Enter the temperature at which the tape is standardised(in C): "));
ct=a*((tm-t0)*L);
print("Correction for Temperature= ",ct);
```

2. Correction for Pull:

INPUT:

```
P=int(input("Enter the applied pull(in kg): "));
P0=int(input("Enter the pull under which the tape is standardised(in kg): "));
L=int(input("Enter the measured length(in mts): "));
A=float(input("Enter the cross sectional area of tape(in sq.cm)"));
print("Materialistic property of the tape 1.Steel or Unknown 2.Known");
a1=int(input());
if a1==1:
   E=2100000;
else:
  E=int(input("Enter the modulus of elasticity of steel(in N\m^3): "));
cp=((P-P0)*L)/(A*E)
print("Correction for Tension=",cp);
```

3. Correction for Sag:

INPUT:

```
print("Correction for sagging");
l1 = float(input("Enter the distance between supports(in mts): "));
M=float(input("Enter the mass of the tape(in kg): "));
P=float(input("Enter the applied pull( in kg): "));
cs=l1*(M*9.81)**2/(24*(P)**2);
print("Correction for sagging= ",cs);
```

4. Correction for Slope:

INPUT:

```
print("\nCORRECTION FOR SLOPE:");
L=int(input("Enter the measured length(in mts): "));
h=float(input("Enter the difference in elevation of ends of tape(in mts): "));
cv=(h*h)/(2*L);
print("Correction for slope = ",cv)
```

5. Correction for Absolute Length:

INPUT:

```
L=int(input("Enter the measured length of a line(in mts):"));
l=float(input("Enter the nominal length(in mts):"));
e=float(input("Enter the elongation(in mts):"));
c=(e)/(2);
print("Correction = ",c);
ca=(L*(c))/l;
print("Correction for absolute length= ",ca);
T=int(L+ca)
print("The true length of the line measured is (in mts) = ",T);
```

OUTPUT SCREEN

1. Correction for Temperature:

2. Correction for Pull:

```
P=int(input("Enter the applied pull(in kg): "));
P0=int(input("Enter the pull under which the tape is standardised(in kg): "));
L=int(input("Enter the measured length(in mts): "));
A=float(input("Enter the cross sectional area of tape(in sq.cm)"));
print("Materialistic property of the tape 1.Steel or Unknown 2.Known");
a1=int(input());
if a1==1:
 E=2100000;
else:
 E=int(input("Enter the modulus of elasticity of steel(in N\m^3): "));
cp=((P-P0)*L)/(A*E)
print("Correction for Tension=",cp);
```

```
Enter the applied pull(in kg): 16
Enter the pull under which the tape is standardised(in kg): 10
Enter the measured length(in mts): 20
Enter the cross sectional area of tape(in sq.cm)0.051
Materialistic property of the tape 1.Steel or Unknown 2.Known
1
Correction for Tension= 0.0011204481792717086
>
```

3. Correction for Sag:

```
print("Correction for sagging");
l1 = float(input("Enter the distance between supports(in mts): "));
M=float(input("Enter the mass of the tape(in kg): "));
P=float(input("Enter the applied pull( in kg): "));
cs=l1*(M*9.81)**2/(24*(P)**2);
print("Correction for sagging= ",cs);
```

```
Correction for sagging
Enter the distance between supports(in mts): 50
Enter the mass of the tape(in kg): 1.52
Enter the applied pull( in kg): 150
Correction for sagging=  0.02058739680000005
>
```

4. Correction for Slope:

main.py Run Shell Clear

```
print("\nCORRECTION FOR SLOPE:");
L=int(input("Enter the measured length(in mts): "));
h=float(input("Enter the difference in elevation of ends of tape(in mts): "));
cv=(h*h)/(2*L);
print("Correction for slope = ",cv);
```

```
CORRECTION FOR SLOPE:
Enter the measured length(in mts): 30
Enter the difference in elevation of ends of tape(in mts): 0.8
Correction for slope =  0.010666666666666668
>
```

5. Correction for Absolute Length:

main.py

```
L=int(input("Enter the measured length of a line(in mts):"));
l=float(input("Enter the nominal length(in mts):"));
e=float(input("Enter the elongation(in mts):"));
c=(e)/(2);
print("Correction = ",c);
ca=(L*(c))/l;
print("Correction for absolute length= ",ca);
T=int(L+ca)
print("The true length of the line measured is (in mts) = ",T);
```

Shell

```
Enter the measured length of a line(in mts):1500
Enter the nominal length(in mts):20
Enter the elongation(in mts):0.08
Correction =  0.04
Correction for absolute length=  3.0
The true length of the line measured is (in mts) =  1503
>
```

---

1. Correction for Temperature:

main.py

```
print("\nCORRECTION FOR ABSOLUTE TEMPERATURE:");
L=int(input("Enter the measured length(in mts): "));
print("Materialistic property of the tape 1.Steel or Unknown 2.Known");
a1=int(input());
if a1==1:
  a=0.0000035;
else:
  a=float(input("Enter the coefficient of expansion(per C): "));
tm=int(input("Enter the mean temperature during measurement(in C): "));
t0=int(input("Enter the temperature at which the tape is standardised(in C): "));
ct=a*((tm-t0)*L);
print("Correction for Temperature= ",ct);
```

Shell

```
CORRECTION FOR ABSOLUTE TEMPERATURE:
Enter the measured length(in mts): 35
Materialistic property of the tape 1.Steel or Unknown 2.Known
1
Enter the mean temperature during measurement(in C): 20
Enter the temperature at which the tape is standardised(in C): 10
Correction for Temperature=  0.001225
>
```

2. Correction for Pull:

main.py

```
P=int(input("Enter the applied pull(in kg): "));
P0=int(input("Enter the pull under which the tape is standardised(in kg): "));
L=int(input("Enter the measured length(in mts): "));
A=float(input("Enter the cross sectional area of tape(in sq.cm)"));
print("Materialistic property of the tape 1.Steel or Unknown 2.Known");
a1=int(input());
if a1==1:
    E=2100000;
else:
   E=int(input("Enter the modulus of elasticity of steel(in N\m^3): "));
cp=((P-P0)*L)/(A*E)
print("Correction for Tension=",cp);
```

Shell

```
Enter the applied pull(in kg): 20
Enter the pull under which the tape is standardised(in kg): 10
Enter the measured length(in mts): 35
Enter the cross sectional area of tape(in sq.cm)0.05
Materialistic property of the tape 1.Steel or Unknown 2.Known
1
Correction for Tension= 0.0033333333333333335
>
```

3. Correction for Sag:

main.py

```
print("Correction for sagging");
l1 = float(input("Enter the distance between supports(in mts): "));
M=float(input("Enter the mass of the tape(in kg): "));
P=float(input("Enter the applied pull( in kg): "));
cs=l1*(M*9.81)**2/(24*(P)**2);
print("Correction for sagging= ",cs);
```

Shell

```
Correction for sagging
Enter the distance between supports(in mts): 25
Enter the mass of the tape(in kg): 1.5
Enter the applied pull( in kg): 10
Correction for sagging=  2.25553359375
>
```

4. Correction for Slope:

main.py

```
print("\nCORRECTION FOR SLOPE:");
L=int(input("Enter the measured length(in mts): "));
h=float(input("Enter the difference in elevation of ends of tape(in mts): "));
cv=(h*h)/(2*L);
print("Correction for slope = ",cv);
```

Shell

```
CORRECTION FOR SLOPE:
Enter the measured length(in mts): 45
Enter the difference in elevation of ends of tape(in mts): 0.8
Correction for slope =  0.007111111111111112
>
```

5. Correction for Absolute Length:

main.py

```
L=int(input("Enter the measured length of a line(in mts):"));
l=float(input("Enter the nominal length(in mts):"));
e=float(input("Enter the elongation(in mts):"));
c=(e)/(2);
print("Correction = ",c);
ca=(L*(c))/l;
print("Correction for absolute length= ",ca);
T=int(L+ca)
print("The true length of the line measured is (in mts) = ",T);
```

Shell

```
Enter the measured length of a line(in mts):35
Enter the nominal length(in mts):25
Enter the elongation(in mts):2
Correction =  1.0
Correction for absolute length=  1.4
The true length of the line measured is (in mts) =  36
>
```

---

1. Correction for Temperature:

main.py

```
print("\nCORRECTION FOR ABSOLUTE TEMPERATURE:");
L=int(input("Enter the measured length(in mts): "));
print("Materialistic property of the tape 1.Steel or Unknown 2.Known");
a1=int(input());
if a1==1:
  a=0.0000035;
else:
  a=float(input("Enter the coefficient of expansion(per C): "));
tm=int(input("Enter the mean temperature during measurement(in C): "));
t0=int(input("Enter the temperature at which the tape is standardised(in C): "));
ct=a*((tm-t0)*L);
print("Correction for Temperature= ",ct);
```

Shell

```
CORRECTION FOR ABSOLUTE TEMPERATURE:
Enter the measured length(in mts): 20
Materialistic property of the tape 1.Steel or Unknown 2.Known
2
Enter the coefficient of expansion(per C): 12
Enter the mean temperature during measurement(in C): 15
Enter the temperature at which the tape is standardised(in C): 30
Correction for Temperature=  -3600.0
>
```

2. Correction for Pull:

main.py

```
P=int(input("Enter the applied pull(in kg): "));
P0=int(input("Enter the pull under which the tape is standardised(in kg): "));
L=int(input("Enter the measured length(in mts): "));
A=float(input("Enter the cross sectional area of tape(in sq.cm)"));
print("Materialistic property of the tape 1.Steel or Unknown 2.Known");
a1=int(input());
if a1==1:
    E=2100000;
else:
   E=int(input("Enter the modulus of elasticity of steel(in N\m^3): "));
cp=((P-P0)*L)/(A*E)
print("Correction for Tension=",cp);
```

Shell

```
Enter the applied pull(in kg): 40
Enter the pull under which the tape is standardised(in kg): 20
Enter the measured length(in mts): 35
Enter the cross sectional area of tape(in sq.cm)0.10
Materialistic property of the tape 1.Steel or Unknown 2.Known
1
Correction for Tension= 0.0033333333333333335
>
```

3. Correction for Sag:

main.py

```
print("Correction for sagging");
l1 = float(input("Enter the distance between supports(in mts): "));
M=float(input("Enter the mass of the tape(in kg): "));
P=float(input("Enter the applied pull( in kg): "));
cs=l1*(M*9.81)**2/(24*(P)**2);
print("Correction for sagging= ",cs);
```

Shell

```
Correction for sagging
Enter the distance between supports(in mts): 20
Enter the mass of the tape(in kg): 2.5
Enter the applied pull( in kg): 10
Correction for sagging=  5.012296875000001
>
```

4. Correction for Slope:

main.py Run Shell Clear

```
print("\nCORRECTION FOR SLOPE:");
L=int(input("Enter the measured length(in mts): "));
h=float(input("Enter the difference in elevation of ends of tape(in mts): "));
cv=(h*h)//(2*L);
print("Correction for slope = ",cv);
```

```
CORRECTION FOR SLOPE:
Enter the measured length(in mts): 45
Enter the difference in elevation of ends of tape(in mts): 0.8
Correction for slope =  0.007111111111111112
>
```

5. Correction for Absolute Length:

main.py Run Shell Clear

```
L=int(input("Enter the measured length of a line(in mts):"));
l=float(input("Enter the nominal length(in mts):"));
e=float(input("Enter the elongation(in mts):"));
c=(e)/(2);
print("Correction = ",c);
ca=(L*(c))/l;
print("Correction for absolute length= ",ca);
T=int(L+ca)
print("The true length of the line measured is (in mts) = ",T);
```

```
Enter the measured length of a line(in mts):40
Enter the nominal length(in mts):20
Enter the elongation(in mts):1
Correction =  0.5
Correction for absolute length=  1.0
The true length of the line measured is (in mts) =  41
>
```

EXAMPLE:

A line was measured with steel tape which was exactly 30 m at 18°c and a pull of 50N and the measured length was 459.242m. Temperature during measurement was 28°c and the pull applied was 100 N. The tape was uniformly supported during the measurement. Find the true length of the line if cross-sectional area of tape was $0.02cm^2$, the coefficient of expansion per °C = 0.0000117 and the modulus of elasticity = 21×10^6 N/cm^2.

Soln:

Correction per tape length = $\alpha (T_m - T_o) L$

$= 0.0000117 (28-18) 30$

$= 0.00351 m (+ve)$

Sag correction per tape length = 0.

Pull correction per tape length = $\frac{(P_m - P_o) L}{AE}$

$= \frac{(100-50)30}{0.02 \times 21 \times 10^6}$

$= 0.00357 m (+ve)$

∴ combined correction = $0.00351 + 0.00357 m$

$= 0.00708 m$.

True length of tape = 30.00708m

True length of line = $\frac{30.00708}{30} \times 459.242$

$= 459.350 m$.

INFERENCE

Measuring the horizontal distance of the slope can be determined by using breaking the tape method. This is the best way to determine the horizontal distance since the slope has a steep and we cannot measure the horizontal distance using the whole tape. It may contain errors but this is the accurate method in determining the horizontal distance. If we are working somewhere were temperature doesn't remain same, it changes drastically so there can be varying chain length we get, so by applying correction for temperature to do survey with more accuracy. While covering large distances the sags can be observed more frequently that create difficulties getting true length so we have correction for sag formula to get length of line more precisely.Working with steel tape is such a tough task because of steel's mechanical properties that change under a certain expansion and contraction that also creates problem as mass of steel gets distributed non uniformly throughout the length so we apply correction for pull and tension to minimize this defect and hence to get readings with more accuracy.

LIMITATIONS AND SUGGESTIONS

- User have to enter calculated values.
- Invalid Input Leads to failure of code execution.
- User have to enter the details of all types of Tape Corrections.

BIBLIOGRAPHY

- Computer Science with python: Sumita Arora
- Surveying books by T. P Kanetkar, S.V Kulkarani
- www.surveyofindia.com