INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

AGRICULTURAL AND FOOD ENGINEERING DEPARTMENT

FARM MACHINERY AND POWER

SUBJECT- TRACTOR SYSTEMS LABORATORY-II (AG69004)

LABORATORY 9: Tractor Drawbar Performance Prediction.

Submitted by:

GROUP C

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Python code for prediction of tractor drawbar performance:

```
# Tractor details
Wt=float(input('Enter the total weight of the tractor (in kg)'))
WB=float(input('Enter Wheal base  (in m): '))
xt=float(input('Enter location of CG ahead of rear axle center (in m
): '))
xl=float(input('Enter hitch piont location fron the rear axle center
 (in m): '))
h1=float(input('Enter tractor CG height above the ground level (in m
)'))
Hv=float(input('Enter tractor hitch height above the ground (in m)')
)
gear=eval(input('Enter the gear no :'))
Vt=float(input('Enter theoretical velociy: (Km/hr)'))
tyre=input('Enter the type of tyre').lower()
bf1=float(input('Enter tyre section width for front wheel (in inch)'
))
df1=float(input('Enter rim diameter for front wheels (in inch)'))
br1=float(input('Enter tyre section width for rear wheels (in inch)'
))
dr1=float(input('Enter rim diameter for rear wheels (in inch)'))

#Implement details
implement=input('Enter the type of implement:').lower()
Wm=float(input('Enter the weight of implement (in kg)'))
w=float(input('Enter width of cut (in m): '))
h=float(input('Enter depth of cut (in cm): '))
n=float(input('Enter no. of tynes/bottoms'))

#Soil parameters
soil=input('Enter soil conditition (firm/medium/coarse)').lower()
bita=float(input('Enter the ground slope (in degrees)'))
CI=eval(input('Enter cone index of soil (in KPa):'))

bf=0.0254*bf1
df=1.06*0.0254*df1+2*0.75*bf
br=0.0254*br1
dr=1.06*0.0254*dr1+2*0.75*br

#Calculations
from math import cos, radians, sin
s=0.1
while s<=0.45:
    Va=Vt*(1-s)
    if implement=='mbplough':
        A,B,C=652,0,5.1
        F1,F2,F3=1,0.7,0.45
        W=w*n
```

```
    elif implement=='cultivator':
        A,B,C=46,2.8,0
        F1,F2,F3=1,0.85,0.65
        W=n*0.2
    elif implement=='discharrow':
        A,B,C=364,18.8,0
        F1,F2,F3=1,0.88,0.78
        W=0.95*n*0.3-0.6*0.4
    if soil=='firm':
        F=F1
    elif soil=='medium':
        F=F2
    elif soil=='coarse':
        F=F3
    D=F*(A+B*Va+C*(Va)**2)*W*h
    P=D+Wm*9.81*sin(radians(bita))
    V=P*sin(radians(bita))
    row_r=0.04
    Fr=D+Wt*9.81*row_r+(Wt/9.81)*0+Wt*9.81*sin(radians(bita))
    ef=row_r*df/2
    er=row_r*dr/2
    Rr=(Wt*9.81*(WB-
xt+ef)+Wm*9.81*h1*(0/9.81+sin(radians(bita)))+V*(WB+xl+ef)-
D*Hv)/(WB+ef-er)
    Rf=Wt*9.81*cos(radians(bita))+V-Rr
    e=2.718
    if tyre=='bias ply':
        A1,A2,A3,A4,A5,A6,A7=0.88,0.1,7.5,0.04,5,3,1
    elif tyre=='radial ply':
        A1,A2,A3,A4,A5,A6,A7=0.88,0.1,9.5,0.032,5,3,0.9
    Bn=CI*1000*br*dr/(Rr/2)*((1+A5*0.2)/(1+A6*(br/dr)))
    row_m=A7/Bn+A4+0.5*s/(Bn)**0.5
    if abs(row_m-row_r)<=0.02:
        ug=A1*(1-e**(-A2*Bn))*(1-e**(-A3*s))+A4
        Fb=ug*Rr*2
    else:
        row_r=row_r+0.01
    if abs(Fb-Fr)<=2000:
      print('*'*10 +'\033[91m'+' Tractor Drawbar Performance '+'\033
[0m' + '*'*10)
      print(f'The draft is: {D} N')
      print(f'The slip is: {s*100} %')
      print(f'The actual velocity is: {Va} Km/hr')
      NTR=P/(Wt*9.81)
      print(f'The NTR is:%.3f'%NTR)
      GTR=Fb/(Wt*9.81)
      print(f'The GTR is:%.3f'%GTR)
      TE=(P/Fb)*(1-s)*100
```

```
        print(f'The TE is:%.2f'%TE)
        print('*'*50)
        break
    else:
        s=s+0.1
```

❖ **Inputs:**

1. Tractor details:-

   - Enter the total weight of the tractor (in kg): 2000
   - Enter Wheal base (in m): 2
   - Enter location of CG ahead of rear axle center (in m): 0.7
   - Enter hitch point location from the rear axle center (in m): 0.4
   - Enter tractor CG height above the ground level (in m): 0.8
   - Enter tractor hitch height above the ground (in m): 0.4
   - Enter the gear no : 2
   - Enter theoretical velocity (Km/h): 5
   - Enter the type of tire :bias ply
   - Enter tire section width for front wheel (in inch): 6
   - Enter rim diameter for front wheels (in inch): 16
   - Enter tire section width for rear wheels (in inch): 13.6
   - Enter rim diameter for rear wheels (in inch): 28

2. Implement details:-

   - Enter the type of implement: mbplough
   - Enter the weight of implement (in kg): 600
   - Enter width of cut (in m): 0.36
   - Enter depth of cut (in cm): 15
   - Enter no. of tines/bottoms: 4

3. Soil parameters:-

   - Enter soil condition (firm/medium/coarse): medium
   - Enter the ground slope (in degrees): 8
   - Enter cone index of soil (in Kpa): 1250

❖ **Output :**

```
********** Tractor Drawbar Performance **********
the draft is: 11419.758 N
The slip is: 10.0 %
The actual velocity is: 4.5 Km/h
The NTR is: 0.624
The GTR is: 0.671
The TE is: 83.62
%
**************************************************
```

```
********** Tractor Drawbar Performance **********
The draft is: 11419.758 N
The slip is: 10.0 %
The actual velocity is: 4.5 Km/hr
The NTR is:0.624
The GTR is:0.671
The TE is:83.62 %
**************************************************
```

Fig. 01 Output

- **Link to run the code:-**

  https://colab.research.google.com/drive/1v3OB7e98WtpnyAL-AJ24bFNZ0tpDD6SJ?usp=sharing