UNIVERSITY OF NAIROBI

COLLEGE OF ARCHITECTURE & ENGINEERING

DEPARTMENT OF ENVIRONMENTAL & BIOSYSTEMS ENGINEERING

FEB 441: POWER AND MACHINERY II (PRACTICAL)

T R A C T I O N

1. *INTRODUCTION*

The power of a tractor engine may be transmitted through P.T.O. shaft, the hydraulic system or through hitch. Traction mechanics which support design of efficient tractive devices is of great interest. When a wheel works on soil, the soil is compressed and thus soil shear strength increased which in turn increase the wheel thrust. Wheel slip must occur to provide adequate thrust but too high slippage is inefficient. The soil strength is an important factor in traction mechanics and is represented by the cone index.

The performance of the tractor can be expressed in many ways. The criterion that best describes the performance depends largely upon the intended use of the tractor.
Drawbar power, tractive efficiency, coefficient of traction, motion resistance coefficient and wheel slip are important parameters of evaluating agricultural tractor performance.

2. *OBJECTIVE*

To test tractor performance in terms of:

- Drawbar pull/power
- Engine torque
- Motion resistance coefficient
- Ballasting and weight transfer characteristics
- Fuel consumption
- Gross coefficient of traction

- Net coefficient of traction
- Traction efficiency
- Mobility number
- Wheel numeric

3. *EQUIPMENT*

Tractors
Hand pocket penetrometer
Tape measure
Dynamometer
Stopwatch
Ruler, pegs
Mould board plow
Measuring cylinder (1lt)
Soil moisture meter

4. *METHODOLOGY*

(a) Run the tractor with the implement in top speed and 2nd gear, low range and record the following:

(i) Ground distance covered by 10 rear wheel revolutions
(ii) Time taken
(iii) Velocity

This is the designated No – slip (Theoretical Velocity).

(b) Run the tractor with the implement engaged at the same gear and speed selection as in (a) above. You have obtained the "slip" (actual) velocity

(c) Measure the average ploughing width and depth.

(d) Calculate the percentage slip

$$S = 1 - \frac{V_a}{V_t}$$

V_a = actual velocity

V_t = theoretical or reference velocity

(e) Using a dynamometer, measure draft force

Calculate field specific soil resistance and drawbar power required by your implement.

(f) Mark and plough an area of 40m by 6m. Record total time taken and time for headland turning and any break down in the field.

How many hectares would you plough in an hour under your prevailing conditions?

Calculate field efficiency (%) , effective and theoretical field capacity

4.2 Rolling resistance and associated wheel slip will be determined by measuring the drawbar pull required to roll and idle tractor (gears disengaged). Other parameters required for measurement and analyses are:

- Cone index
- Soil aggregate and moisture content
- Tyre size width, diameter, section height and deflection under load
- Tyre rolling radius
- Pull
- Tyre contact area

5. *ASSIGNMENT*

(ii) Show that the drawbar pull is estimated by: $P\cos\alpha = H - TF$

Where $P\cos\alpha$ is the horizontal component of the drawbar pull at angle α^O

TF is rolling resistance and H is the wheel thrust.

(ii) Determine from your data the following parameters

(a) $C_n = \frac{CIbd}{W}$

Where C_n is a unit-less constant known as wheel numeric, CI-cone index, *b* -tyre width and *d*-tyre diameter before deflection.

(b) Mobility number

$$Bn = \frac{CI\, b\, d}{W}\left(\frac{1+5\delta/h}{1+3b/d}\right) \quad \text{Or} \quad Bn = \frac{CIbd}{W}\left(\frac{\delta}{h}\right)^{\frac{1}{2}}\left(\frac{1}{1+\frac{b}{2d}}\right)$$

where,

Bn = mobility number
CI = cone index
b = unloaded tyre section height
d = unloaded tyre overall diameter
δ = tyre deflection
h = tyre section height

(c) Coefficient of traction

(d) Motion resistance coefficient

(e) Tractive efficiency

(f) Drawbar power and estimate ballasting number

(g) Specific soil resistance

Reference books

- FMO (Tillage) – 1976 John Deere and Cr
- Engineering Principles of Agricultural Machines – by Srivastava etc
- Tractor and their power units – by Lillljedahl, Carleton Turnouist Smith
- American Society of Agricultural Engineers (1989). ASAE Standards. 36th Edition. American Society of Agricultural Engineers, St. Joseph, MI.
- American Society of Agricultural Engineers (1996). ASAE Standards. 43th Edition. American Society of Agricultural Engineers, St. Joseph, MI.

THE REPORT SHOULD BE HANDED OVER IN A WEEK'S TIME

Show all your calculations.