Lecture 15

HITCH SYSTEMS AND HITCHING OF TILLAGE IMPLEMENTS

Hitching System:

- A plow or implement may be well designed and built of high-grade material but unless properly hitched it cannot give the best performance.
- Primary objective of proper hitching of pull-type implements having adjustable pull members is to establish location and/or magnitude of the resultant parasitic support forces (Q or Q_v) and pull (P or P_v).

- These are desirable from the stand point of the effects of the pulling forceupon tractor and magnitude and distribution of parasitic forces acting upon the implement.

- Force relations for mounted or semi-mounted implements are determined primarily by the design of hitch linkage and implement and by the method of controlling implement depth, rather than by hitch adjustments.

Mould Board trailing Plow Hitches:

- Perfect hitch for a trailing plow to have the **center of pulled load directly behind the centre of power unit** but this condition can rarely be obtained because of

- different widths of different size tractors and the different widths and sizes of plows or pulled units.

Hitch Systems and Hitching Tillage Implements:

Force relation is involved in hitching pull type of implements.

Independent force variables:

Useful soil forces components L, S, V and implements gravitational force W

Dependent variables :

Parasitic soil forces Q and pull P are influenced by hitch arrangement.

Analysis of force relation considering horizontal components R, Q, P and W is horizontal hitching and components of these forces in vertical plane **is vertical hitching.**

Primary objective of proper hitching for pull type implements having adjustable pull members is to establish the location and magnitude of the resultant parasitic support force (Q_h or Q_v) and pull (P_h or P_v).

Force relation for mounted or semi-mounted implements is determined by design of hitch linkage and implement and

by method of controlling implement depth, rather than by hitch adjustments.

Horizontal hitching of pull type Implement:

M.B. plow, disk plow, offset disk harrow are not symmetrical about their longitudinal center lines.

Most of other implements are **symmetrical about their longitudinal center lines**, side components of soil forces are balanced, **horizontal centre of resistance is at centre of tilled width and horizontal line of pull is in direction of travel.**

Plows and offset disk harrows can withstand substantial amounts of side draft (lateral component of pull) so proper hitching is must to minimize adverse effects on tractor and implement.

M.B. plows absorb side forces through landsides,

disc plows through furrow wheels,

offset disk harrows by automatically changing disk angles to create a difference between soil-force side components for front and rear gangs.

It is not always possible to have a horizontal centre of resistance of an implement directly behind the centre of pull of tractor particularly for narrow implements and wide-tread tractors.

This implement can withstand side force, alternatives are:

- Central angled pull passing through centre of pull of tractor

- offset straight pull,-offset angled pull

If implement cannot withstand side force only alternative is:

- an offset straight pull.

Centre of pull of tractor is midway between rear wheels and slightly ahead of axle as differential divides torque to wheels equally.

Central angled pull does not affect tractor steering but offset pull does.

Angled pull introduces a side force on tractor rear wheels and is undesirable with same implement even though implement can resist side force.

So a compromise in hitching is best with a part of adverse effect absorbed by tractor and part by implement.

<u>Horizontal Hitching of pull type MBP implement:-</u>

Location of horizontal control of resistance, H for a M.B. plow is determined by the point of intersection of parasitic force Q_h acting upon landside and R_h (Fig. 1).

Lateral location of H varies depending upon soil conditions, length of landside, amount of side force taken by rear furrow wheel etc.

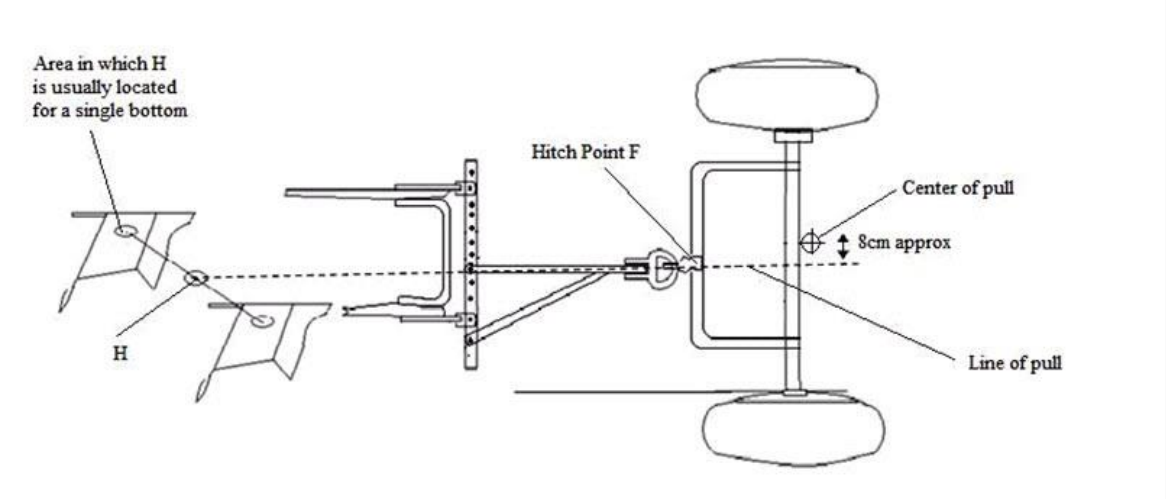

Fig. 1 Horizontal hitching for a mouldboard plough pulled by wider tractor

For hitching, its location can be assumed to be one-fourth of the width of cut over from landside and little behind the rear edge of the share.

Line of pull is determined by location of H and location of drawbar hitch point F **as pull members are laterally rigid.**

Ideal hitch is obtained when tractor tread can be adjusted so the control of pull is directly ahead of horizontal centre of resistance.

Normal tread of 52 inches can be adjusted to 48 inches.

Horizontal hitching of a pull type disc plow:-

All the side thrust must be taken through the wheels and pull members, which is a free link in regard to horizontal forces.

Horizontal line of pull for a disk plow is determined by location of hitch points D & F (Fig. 17.2).

The position of horizontal centre of resistance H and location of resultant side force Q_h are established by point of intersection of P_h and R_h.

Side forces are divided equally between front and rear furrow wheels.

Line of Q_h must pass midway between them.

If hitch point D is moved to left of plow frame, H and Q_h move toward the rear of plow, and rear furrow wheel will have more side thrust.

Moving D to left or F to left, pull puts more side force on front wheel.

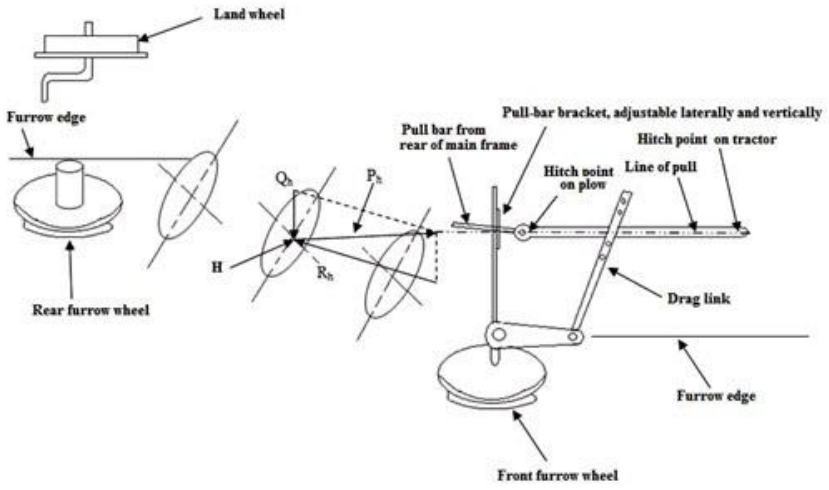

Fig. 17.2 Horizontal force relations and hitching for a pull-type disc plow.

Vertical Hitching of Pull Type Implement

Types of Vertical Hitching Systems:

Pull-type tillage implements fall into one of the following three categories:-

1. Implements with hinged pull members that have support wheels or support runners to gage the depth. The pull members act as a free link in the vertical plane,

   e.g., M.B plow, disc plow and drag type spring tooth harrow, etc.

2. Implements with hinged pull members that do not have gage wheels or runners. The only support is through soil-working units and parasitic forces cannot be separated from useful soil forces,

   e.g., disc harrows without wheels, spike tooth harrows and tandem-gang rotary hoes.

3. Single-axle implements with rigid pull members,

e.g., field cultivators, chisels, sub-soiler.