Job # 7

To perform direct shear test on a plane steel bar and punching shear test on steel plate.

Apparatus:

- 10 ton Buckton UTM
- Shear jigs
- Vernier calipers
- Steel bar
- Steel plate

Objective:

To determine the direct and punching shear stress of steel samples.

Theory:

- **Shear force (V)** :

A force which tends to slide one part of a section against the adjacent is known as shear force and acts perpendicular to the axial axis is called shear force.

- **Shear stress / tangential stress** (τ):

It is the intensity of the internal forces on a plane area when the forces are acting parallel to the section.

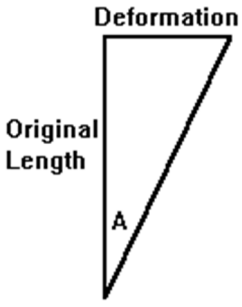
$$\boldsymbol{\tau = VQ/Ib}$$

$$\boldsymbol{\tau = V/A}$$

- **Shear strain:**

It's the amount of deformation *perpendicular* to a given line rather than *parallel* to it. The ratio turns out to be tan A, where A is the angle the sheared line makes with its original orientation.

Shear strain = deformation/original length = tan A



Types of shear stress:

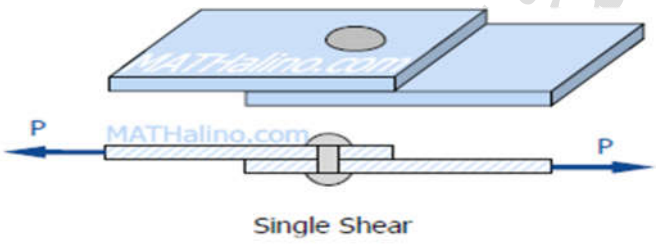
- **Direct shear**:

If the force applied is parallel to the area being sheared, then it is direct shear.

It has two also types

- **Single shear:**

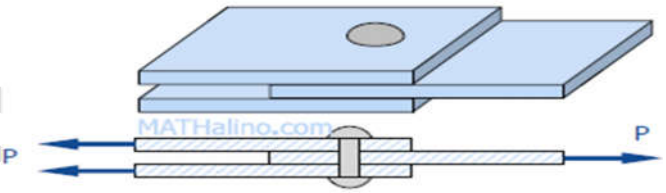
Shear stress induced due to a force causing single area of cross section to be sheared is called single shear.



Single Shear

- **Double shear:**

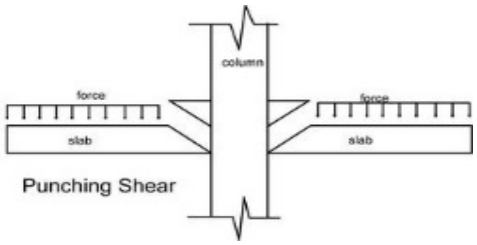
Shear stress induced due to a force causing double area of cross section to be sheared.



Double Shear

- **Punching shear:**

Shear stress induced due to a force causing one part to be punched into the other.



Punching Shear

Area being sheared is again parallel to applied load.

- **Induced shear:**

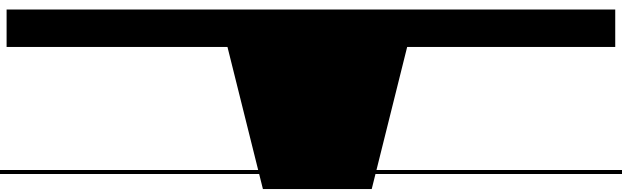
Shearing stress induced due to a force which acts at an angle to the area being sheared.

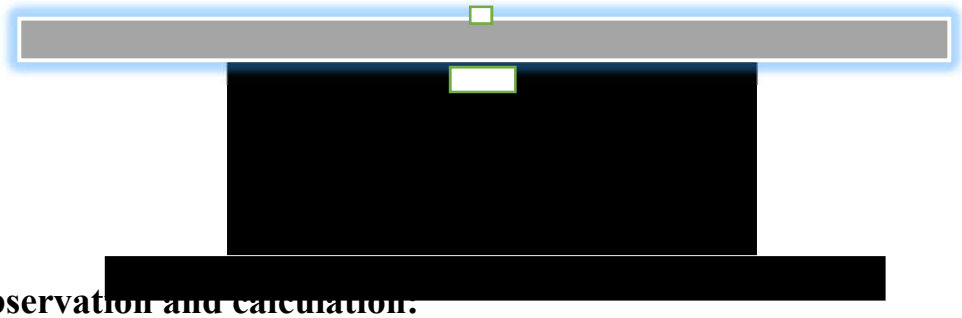
Procedure:

- Insert the specimen in position and grip one end of the attachment in the upper portion and one end in the lower position
- Switch on the UTM
- Bring the drag indicator in contact with the main indicator.
- Select the suitable range of loads and space the corresponding weight in the pendulum and balance it if necessary with the help of small balancing weights
- Operate (push) the button for driving the motor to drive the pump.
- Gradually move the head control ever in left hand direction till the specimen shears.
- Note down the load at which the specimen shears.
- Stop the machine and remove the specimen.
- Repeat the experiment with other specimens.

Diagram for direct shear test on plane steel bar:

Diagram for punching shear test on steel plate:





Observation and calculation:

For direct shear test on plane steel bar

Shear load		Diameter (d) (mm)			Avg. (d)	Area (A)	Shear strength	
Tons	N	D1	D2	D3	mm	mm2	MPa	Psi
0.635	6229.35	6.00	6.15	6.00	6.05	28.74	216.7484	31436.697
0.835	8191.35	6.00	6.15	6.00	6.05	28.74	285.0157	41338.032
0.880	8632.8	6.00	6.00	6.00	6.00	28.27	305.3696	44290.115

Average direct shear = 269.0446 MPa = 39021.69 Psi

For punching shear test on a steel plate:

Shear load		Diameter of jigs (d) (mm)		Avg. (d)	Plate thickness (t)	Shear area	Shear strength	
Tons	N	Upper jig	Lower jig	mm	mm	mm2	MPa	Psi
2.775	27213.453	14.30	15.50	14.9	1.045	48.89137	556.6106	80729.68
1.650	16180.972	14.30	15.50	14.9	1.045	48.89137	330.9576	48001.43

1.989	19505.426	14.30	15.50	14.9	1.045	48.89137	398.9544	57863.54

Average punching shear = 428.8409 Mpa = 62198.22 PSi

Comments: According to this experiment punching shear is 1.5 times more than the direct shear. The reason is that the area which is to being sheared in case of punching is more than the area in case of direct shear. Stress is inversely proportional to resisting area and directly proportional to average shear force.