Screw Fastenings

1. SCREW THREADS

2. BOLTS

3. STRESSES IN FASTNERS

SCREW THREADS

A screw thread is formed by cutting a helical groove on a cylindrical surface.

The threaded rod is called a screw.

It engages in a corresponding threaded hole inside a nut or a machine part.

The screws are used for Joining two parts temporary.

Therefore such a joint is known as the detachable joint or temporary joint.

Threads are generally cut on a machine called a *lathe.*

On a small-size screw, thread is often cut by means of a tool called a *die.*

A small-size hole is threaded by means of a tool called a *tap.* Such a hole is called a *tapped hole.*

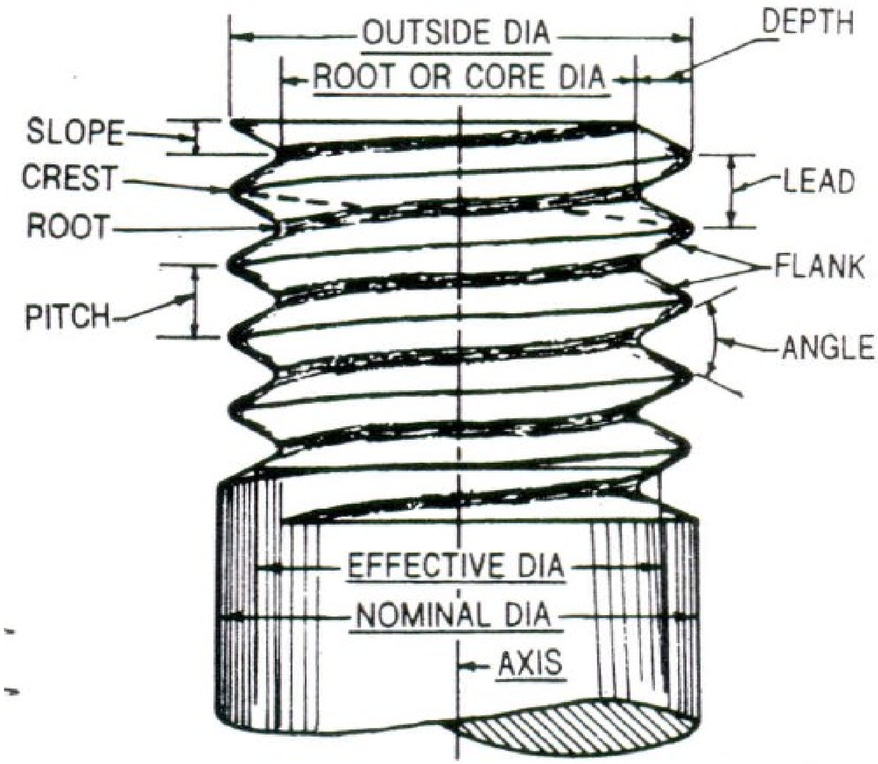
SCREW THREADS

Crest: The crest is the outer-most part of a thread.

Root: The root is the inner- most portion of a thread.

Flank: The surface between the crest and the root is called the flank of the thread.

Angle: It is the angle between the flanks measured on an axial plane.



Screw thread

Depth: The depth is the distance between the crest and the root, measured at right angles to the axis.

It is equal to half the difference between the outside diameter and Root or Core diameter

Nominal diameter:

It is the diameter of the cylindrical piece on which the thread is cut. The screw is specified by this diameter.

Outside or major diameter:

It is the diameter at the crest of the thread measured at right angles to the axis of the screw.

Core or Minor diameter:

It is the diameter at the core or root of the thread. It is the smallest diameter of the screw and is equal to the outside diameter minus twice the depth of the thread.

Effective diameter: It is equal to the length of the line perpendicular to and passing through the axis, and measured between the points where it cuts the flanks of the thread.

Pitch:

It is the distance measured parallel to the axis, between a point on one thread form and a corresponding point on the adjacent thread form, i. e. from crest to crest or root to root. It may also be described as the reciprocal of the number of thread forms per unit length, i. e. $p = 1/n$

Lead:

It is the distance measured parallel to the axis from a point on a thread to a corresponding point on the same thread after one complete revolution. It can also be described as the distance moved by a nut in the axial direction in one complete revolution. The lead is equal to the pitch in case of single-start threads.

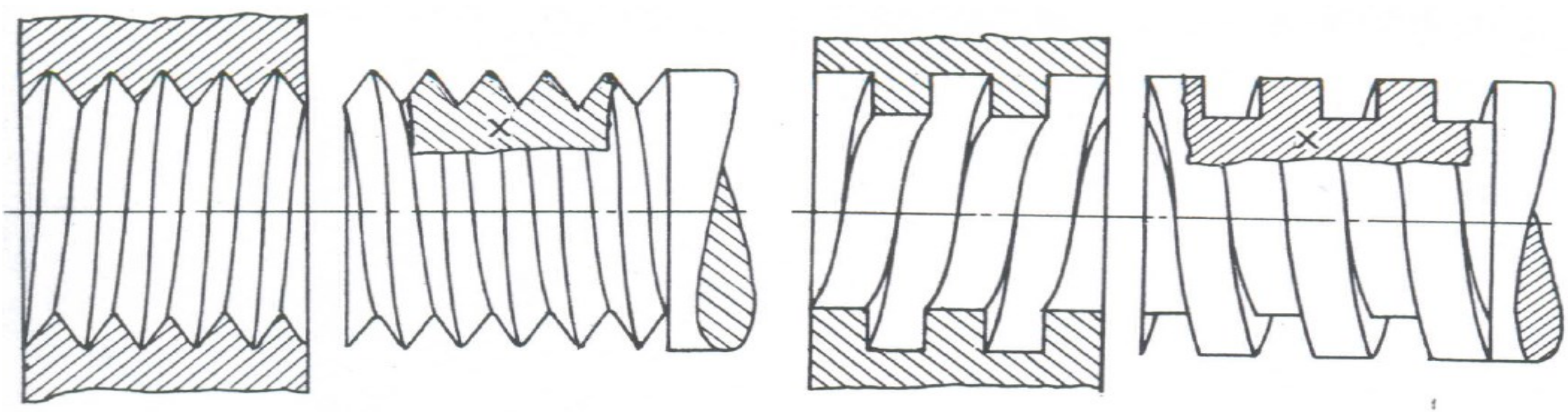
Slope: The slope of a thread is equal to half the lead.

FORMS OF SCREW THREADS

Triangular or V thread and Square Thread

A thread cut on the surface of a screw, is called an external thread,

while that cut in a hole, is called an internal thread.



TRIANGULAR OR V THREADS

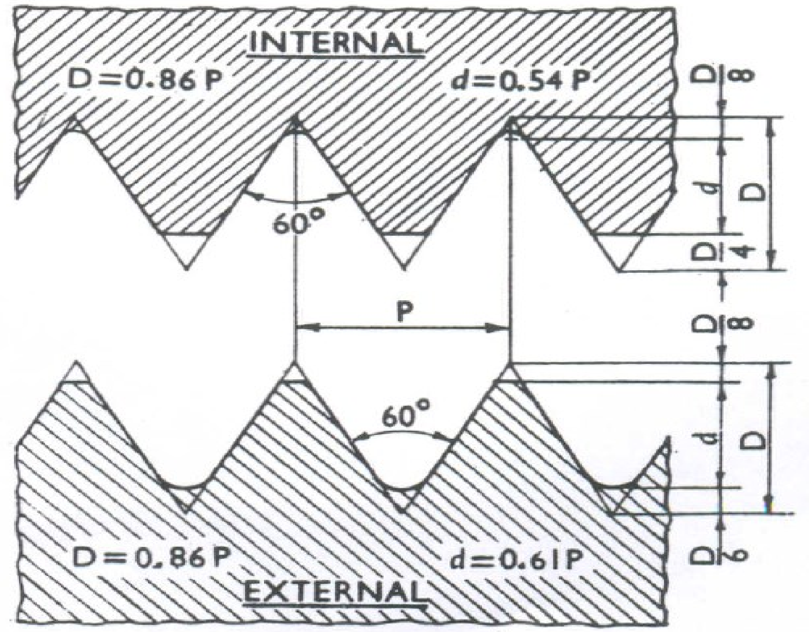
Unified thread

Unified screw thread profile – Basic I.S.O. basic profile.

Two separate I.S.O. series based on inch and metric systems of measurement, with this common basic profile for threads.

The external thread (on a screw) varies slightly in shape from the internal thread (inside a nut) as can be seen from fig.

The angle of the thread is 60°.



Unified thread

TRIANGULAR OR V THREADS

Roots of both - internal and external threads are rounded, while the crests are cut parallel to the axis of the screw.
The root of the internal thread is rounded *within* the depth of D/8 as shown in the figure.
The maximum depth of engagement between the external & the internal threads is 5D/8

Types of thread	Thread angle	Theoretical depth D	Actual depth d
External thread	60°	0.866P	0.61P
Internal thread	60°	0.866P	0.54P

UNIFIED SCREW THREADS

Nominal dia. Inches	No. of threads per inch (N)	Core dia. Inches
$\frac{1}{4}$	20	0.1837
$\frac{5}{16}$	18	0.2443
$\frac{3}{8}$	16	0.2983
$\frac{7}{16}$	14	0.3499
$\frac{1}{2}$	13	0.4056
$\frac{9}{16}$	12	0.4603
$\frac{5}{8}$	11	0.5135
$\frac{3}{4}$	10	0.6273
$\frac{7}{8}$	9	0.7387
1	8	0.8466
$1\frac{1}{8}$	7	0.9497
$1\frac{1}{4}$	7	1.0747
$1\frac{3}{8}$	6	1.1705
$1\frac{1}{2}$	6	1.2955
$1\frac{3}{4}$	5	1.5056
2	$4\frac{1}{2}$	1.7274

Note: Pitch in inches = $1 \div N$

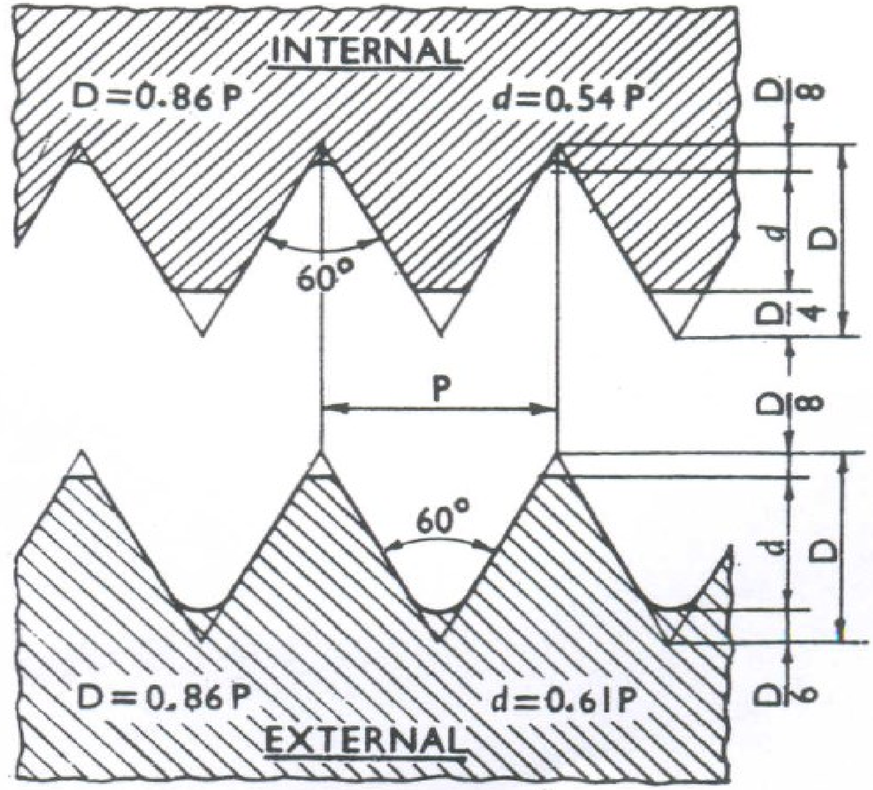
TRIANGULAR OR V THREADS

Metric thread:

In this system, the pitch of the thread (instead of the number of threads per unit length) is fixed.

Metric thread is designated by the letter M followed by the nominal diameter,

e. g. M 20, where 20 is the nominal diameter of the screw in millimeters. Refer to IS: 4218: 1976 and IS: 11698: 1986.



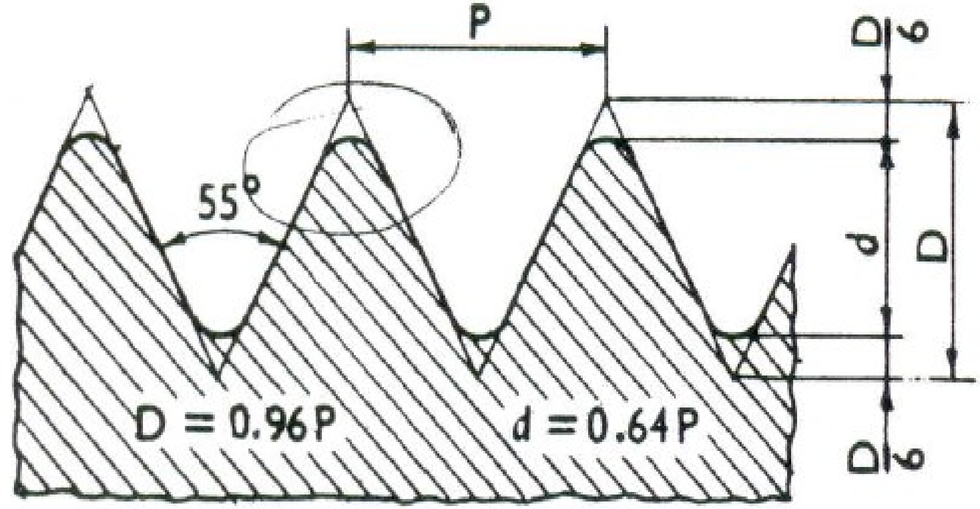
Unified thread

TRIANGULAR OR V THREADS

Whitworth thread **:**

This form of thread is also known as British Standard Whitworth (B.S.W.) thread. The angle is 55°.

The theoretical depth O = *0.96P,* where *P* is the pitch of the thread.



Whitworth thread

1/6 of the theoretical depth is rounded off at the top and at the bottom.

Therefore. the actual depth *d = 0.64P.*

TRIANGULAR OR V THREADS

British Standard Fine (B.S.F) and British Standard Pipe (B.S.P.) threads:

These have the same Whitworth profile but their pitches are finer and hence, the depths smaller.

Thus, they have large effective and core diameters than the B.S.W. threads.

B.S.F threads are generally used in automobile and aircraft work.

B.S.P. threads are used for gas, steam or water pipes.

They are specified by the bore of the pipe and not by the outside diameter.

Thus, the outside diameter of a threaded pipe having a bore of 1" nominal diameter is 1.309".

Pipes of 1" to 6" diameters have the same number of threads per inch, viz. 11.

The Bureau of Indian Standards recommends pipe threads according to IS: 2643: 1975.

TRIANGULAR OR V THREADS

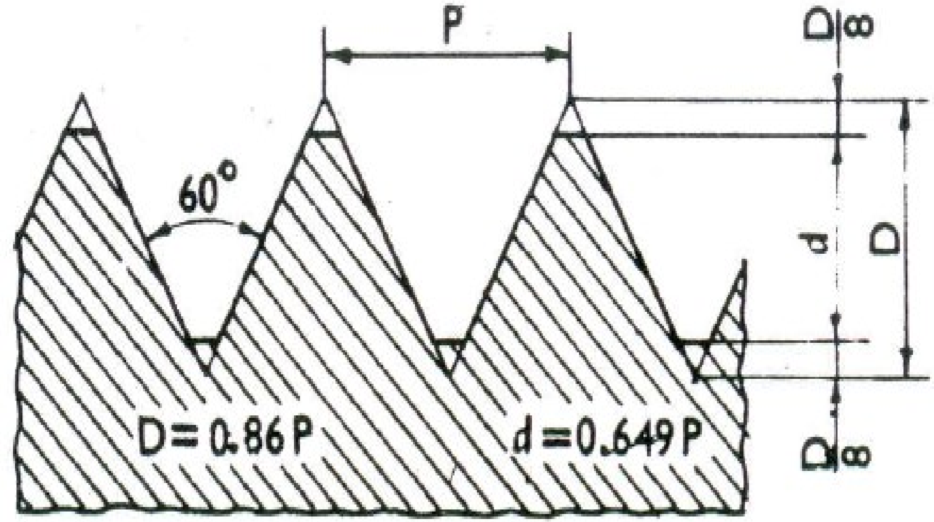
***Sellers thread*:**

This form of thread is adopted as a standard form in U.S.A.

It has an angle of 60°.

One-eighth of the theoretical depth is cut-off parallel to the axis of the screw at the top and at the bottom.

The crests and the roots of this thread are therefore flat.



Sellers thread

Theoretical Depth = 0.866P,

Actual Depth = ¾ D= 0.649P.

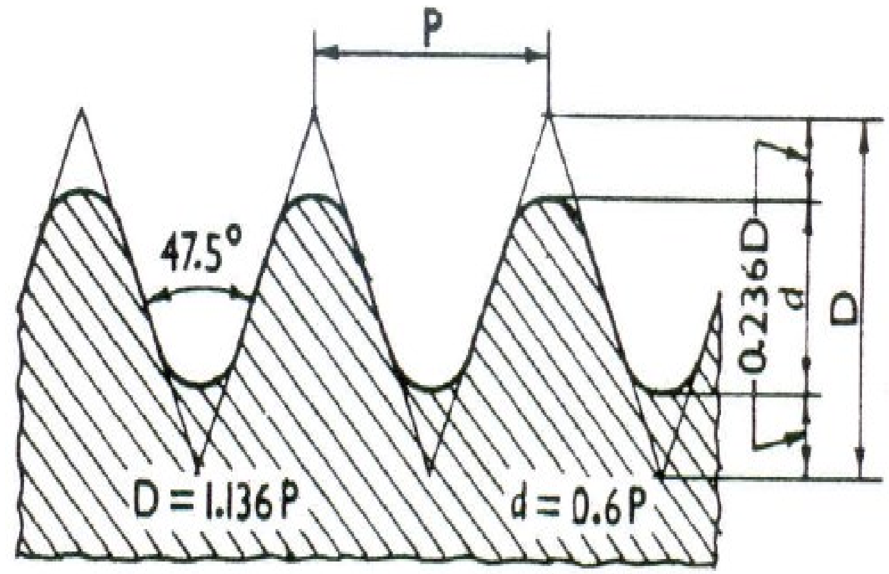
TRIANGULAR OR V THREADS

British Association (B.A.) thread:

It is generally used for small instrument screws.

The angle of the thread is 47.5°.

0.236 of the theoretical depth is rounded off at the top and at the bottom, leaving the actual depth equal to 0.*6P.*



British Association thread

Theoretical depth, D= *1.13BP*

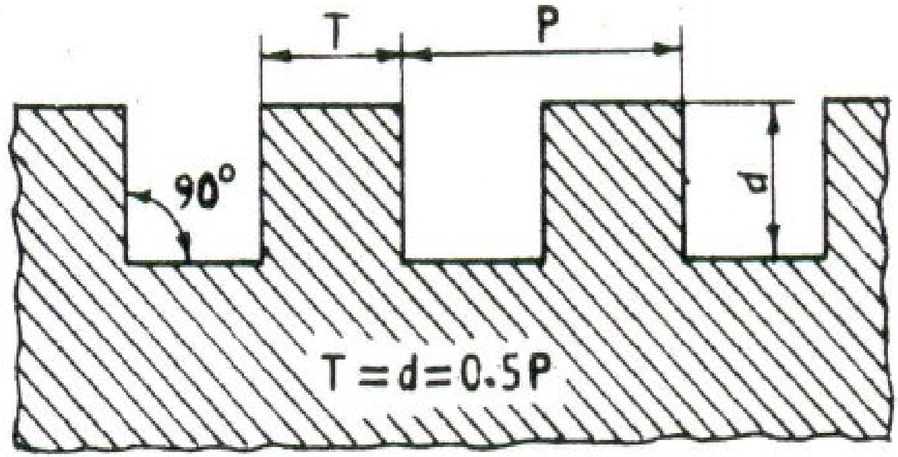
Actual depth, *d = 0.6P.*

SQUARE THREADS

Square thread :

It is generally used for transmission of power.

It is also used for obtaining larger axial movement of the nut or the screw per revolution.



Square thread

For the same nominal diameter of the screws, the pitch of the square thread is usually greater than that of the triangular thread.

The depth and the thickness of the thread are each equal to half the pitch.

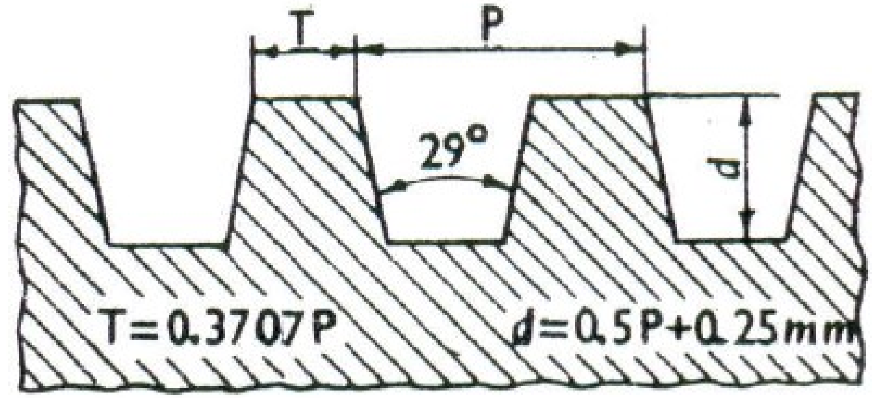
They are used in lead-screw of lathe machine, jack screws and vices.

SQUARE THREADS

Acme thread IS: 700a-1988:

It is easier to cut and is stronger at the root than the square thread.

It is particularly used where the nut, which is made in two parts, is required to engage with or disengage from a screw at frequent intervals as in the leading screw of the lathe.



Acme thread

The thread angle is 29°.

Depth $d = 0.5P + 0.25$ mm.

The thickness of the thread at the crest is equal to 0.3707 P.

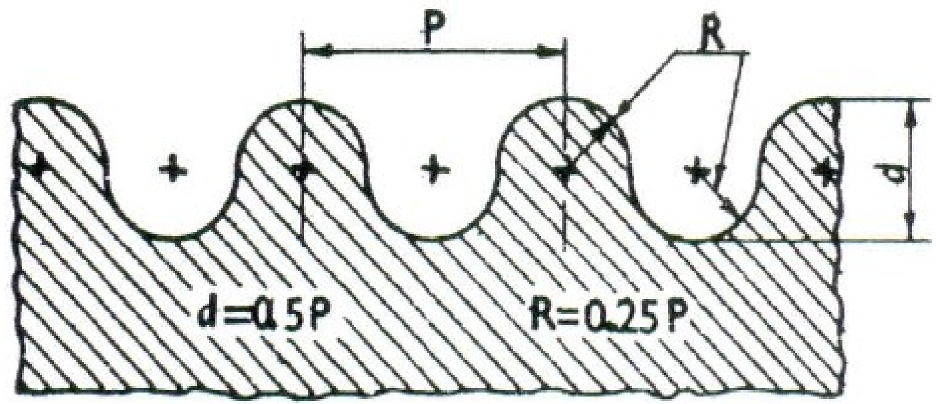
SQUARE THREADS

Knuckle thread:

It is formed by rounding off the corners of the square thread to such an extent that it has a completely rounded profile.

Its section comprises of semi- circles of radius *R* = *0.25P.*

The depth *d* = *0.5P.*



Knuckle thread

This thread can withstand heavy wear and rough usage.

They are used in coupler of railway carriages and electrical bulbs.

SQUARE THREADS

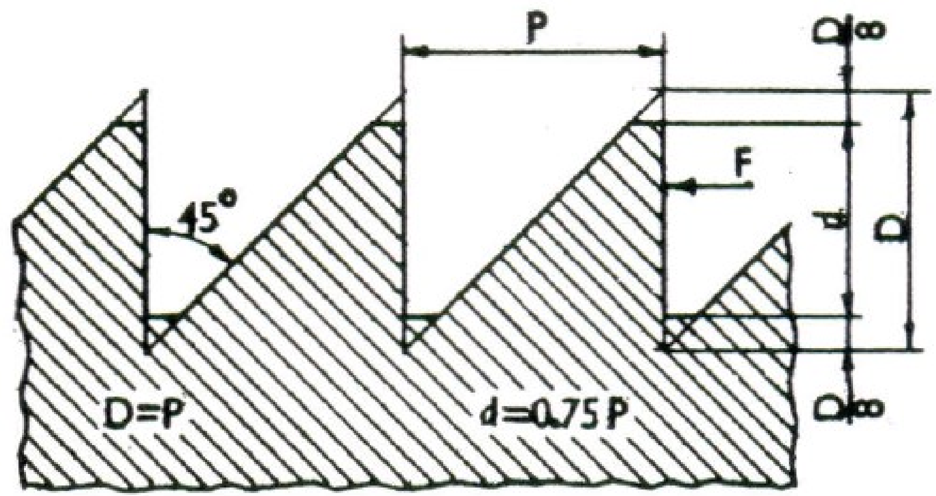
Buttress thread:

This thread is the combination of the triangular and the square threads.

One flank of the thread is perpendicular to the axis of the screw.

The angle between its two flanks is 45°.

The theoretical depth is equal to the pitch, one-eighth of which is cut-off parallel to the axis at the crest and at the root.



Buttress thread

Theoretical depth D = *P*
Actual depth d = ¾ D

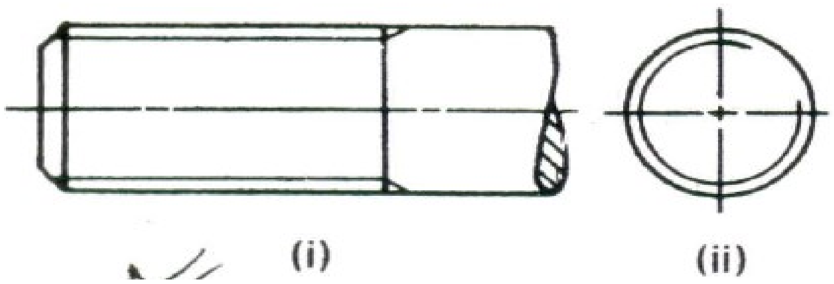
This thread is suitable only when the force acts entirely in one direction as shown by the arrow *F.* Its use is commonly made in the screw of a bench-vice.

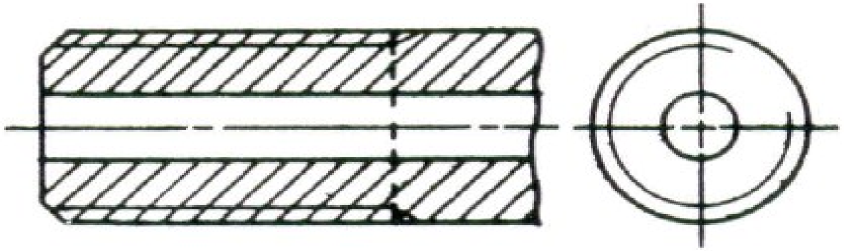
Conventional representation of threads IS: 696-1972:

Threads are usually shown by conventional methods.

Method I:

This conventional method is recommended for use by the Bureau of Indian Standards for Metric screw threads and square threads for which Standards have been published.

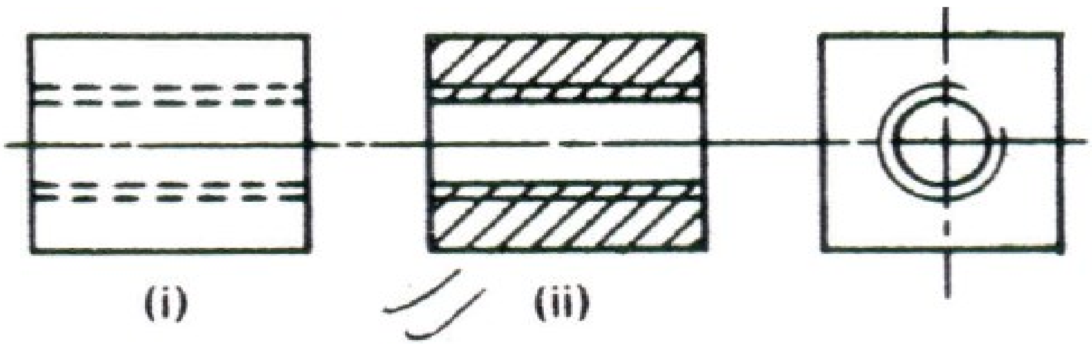


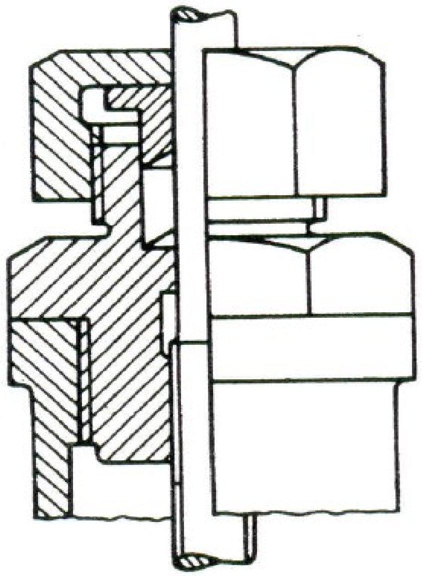


External threads

Internal threads

In sectional views where threaded parts are assembled together, externally threaded parts are always shown covering the internally threaded parts.





Method II:

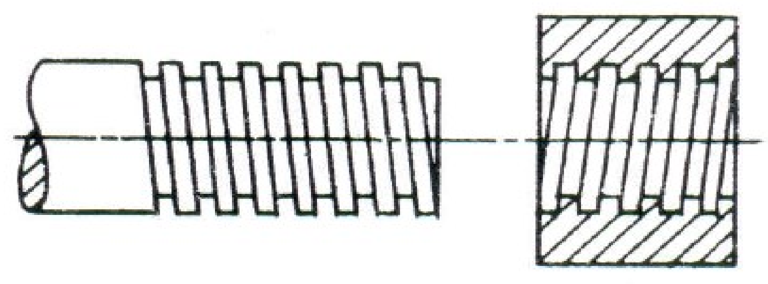
(a) External V Thread: This thread in its outside view is shown by sloping straight lines alternately thin and thick, and spaced one-half the pitch apart.

The slope is kept equal to half the lead.

The thick lines are drawn shorter than the thin lines by a distance equal to one-half the pitch on each side, thus indicating the roots of the thread.

(b) *Internal V thread:* In its outside view, this thread is shown as described in method I.

In its sectional view, it is shown by thick and thin lines, the slope of the lines being opposite to that of the external thread, because the other side is visible.



(i) (ii)

(c) *External square thread:* This thread is represented by sloping parallel lines spaced one-half the pitch apart as shown in fig.

The depth of the thread is also equal to one-half the pitch.

In case of a square thread of large size, the back portion of the thread is also drawn as shown in fig.

(d) *Internal square thread:* In its outside view, this thread also is shown as described in method I.

In its sectional view it is shown by parallel lines sloping in opposite direction.

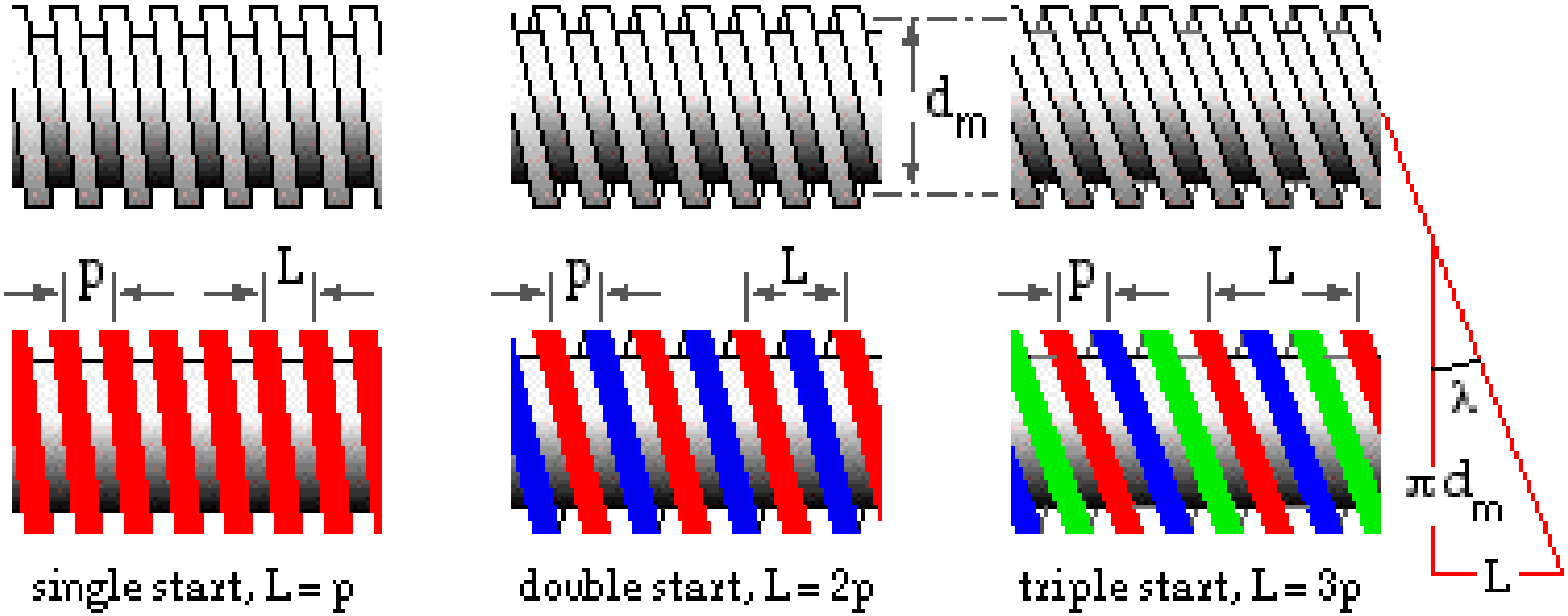
The depth of the thread is shown at right angles to the axis.

Multiple-start threads:

In a single-start thread. the pitch is equal to the lead. Since the depth of the thread is dependent on the pitch, greater the lead greater will be the depth of the thread and smaller will be the core diameter.

When a nut is required to move a considerably long axial distance in one revolution (i. e. when the lead is large) the core diameter of the screw, in a single-start thread, will be so much reduced as to make the screw too weak . This is avoided by cutting what are known as multiple-start threads, in which two or more threads having the same pitch as in a single-start thread, but with increased lead run parallel to one another. The pitch being the same the depth of the thread remains the same as in a single-start thread and the core diameter also remains unaffected. The depth of the thread in each case remains the same. i.e. D = ½ *p.* while the slope *S* is equal to one-half the corresponding lead *L.* The relationship between lead and pitch is shown in table.

No. of start	Pitch, P	Lead, L
Single start	P	$L = P$
Double start	P	$L = 2P$
Triple start	P	$L = 3P$


p
L
p
L
p
L
d_m
πd_m
λ
L
single start, L = p
double start, L = 2p
triple start, L = 3p

Right-hand and left-hand threads:

If a nut. when turned in clockwise direction screws on a bolt, the thread is a right-hand thread; but if it screws off the bolt when turned in the same direction, the thread is said to be a left-hand thread.