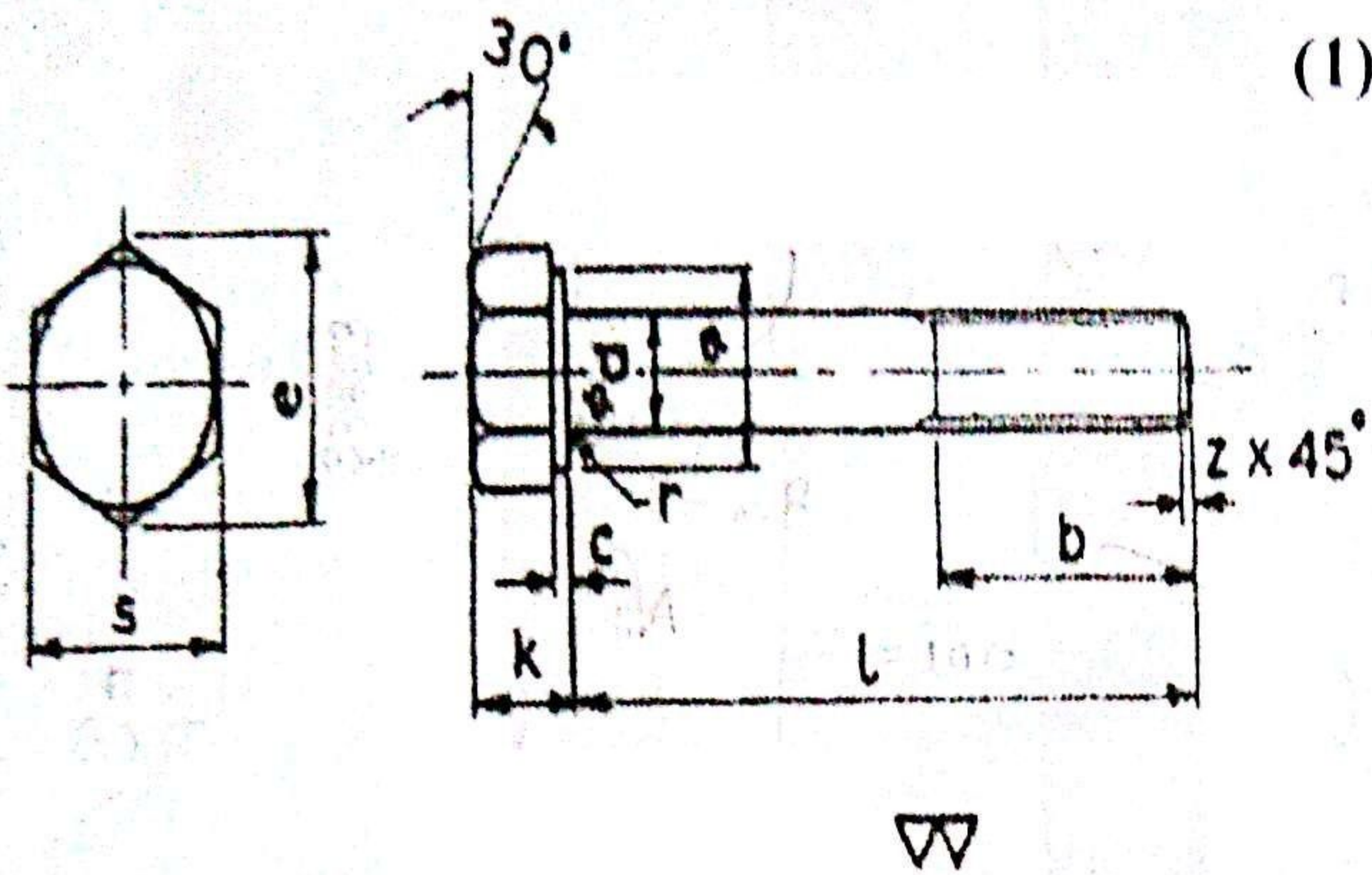


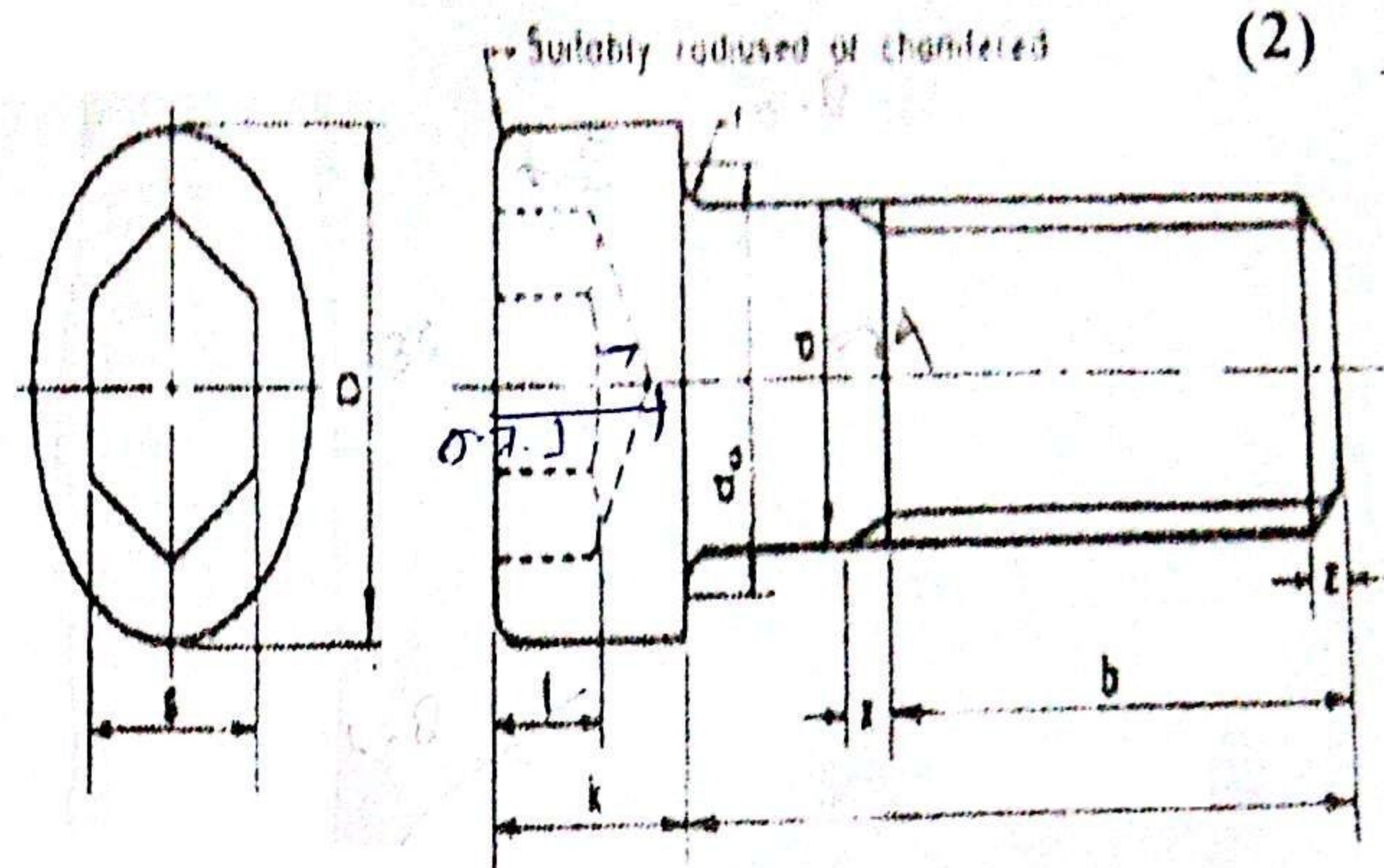
Tutorial 3: Common Machine Components

Draw the standard profiles of bolts, screws, and nuts:

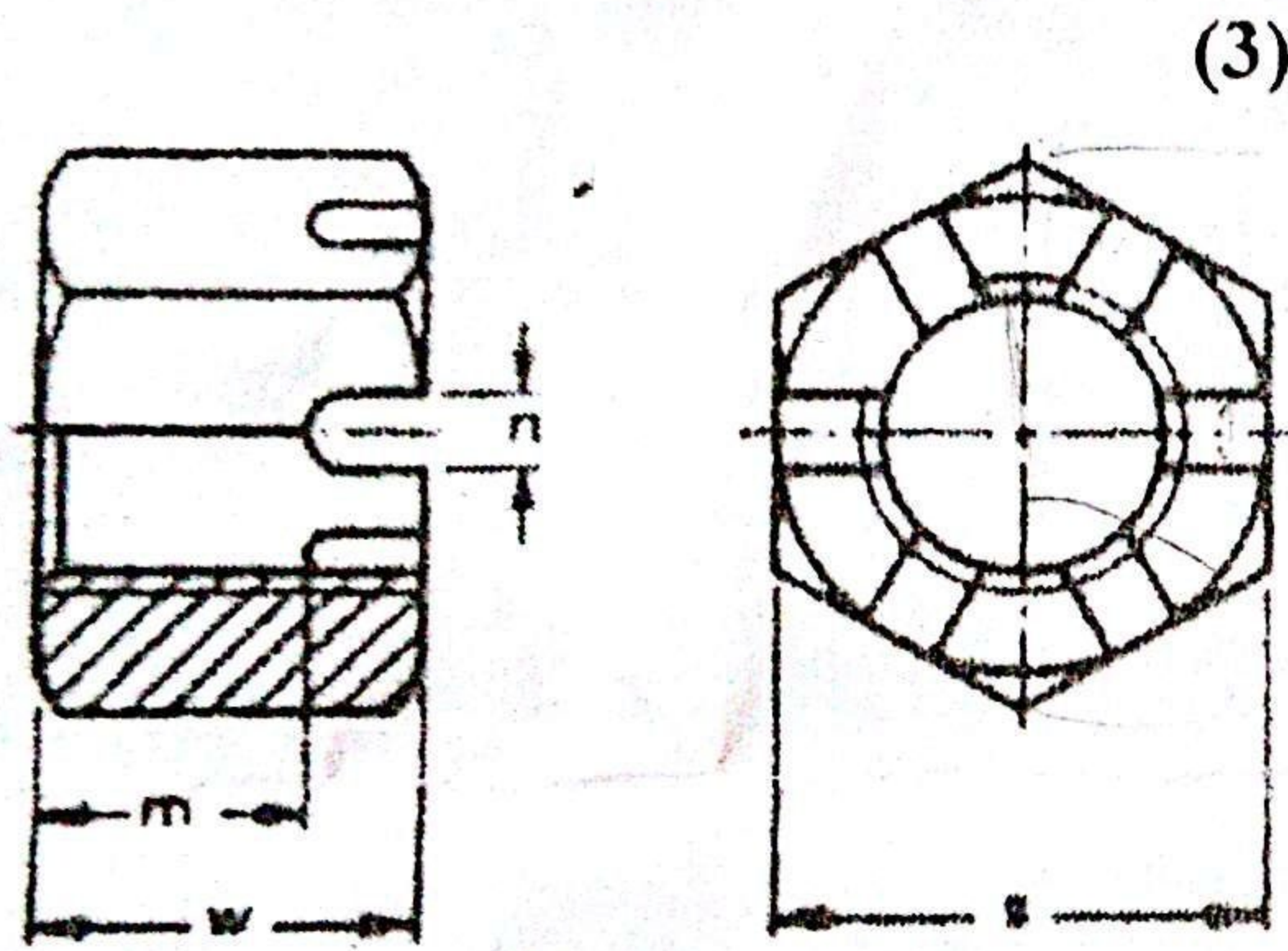
- Fig. 1: Hexagonal headed bolt of size M20.
- Fig. 2: Hexagonal socket head screw of size M24.
- Fig. 3: Slotted nut of size M10.



(1)



(2)



(3)

| | |
|-----|---------------------|
| M10 | $d = 10 \text{ mm}$ |
| M20 | $d = 20 \text{ mm}$ |
| M24 | $d = 24 \text{ mm}$ |

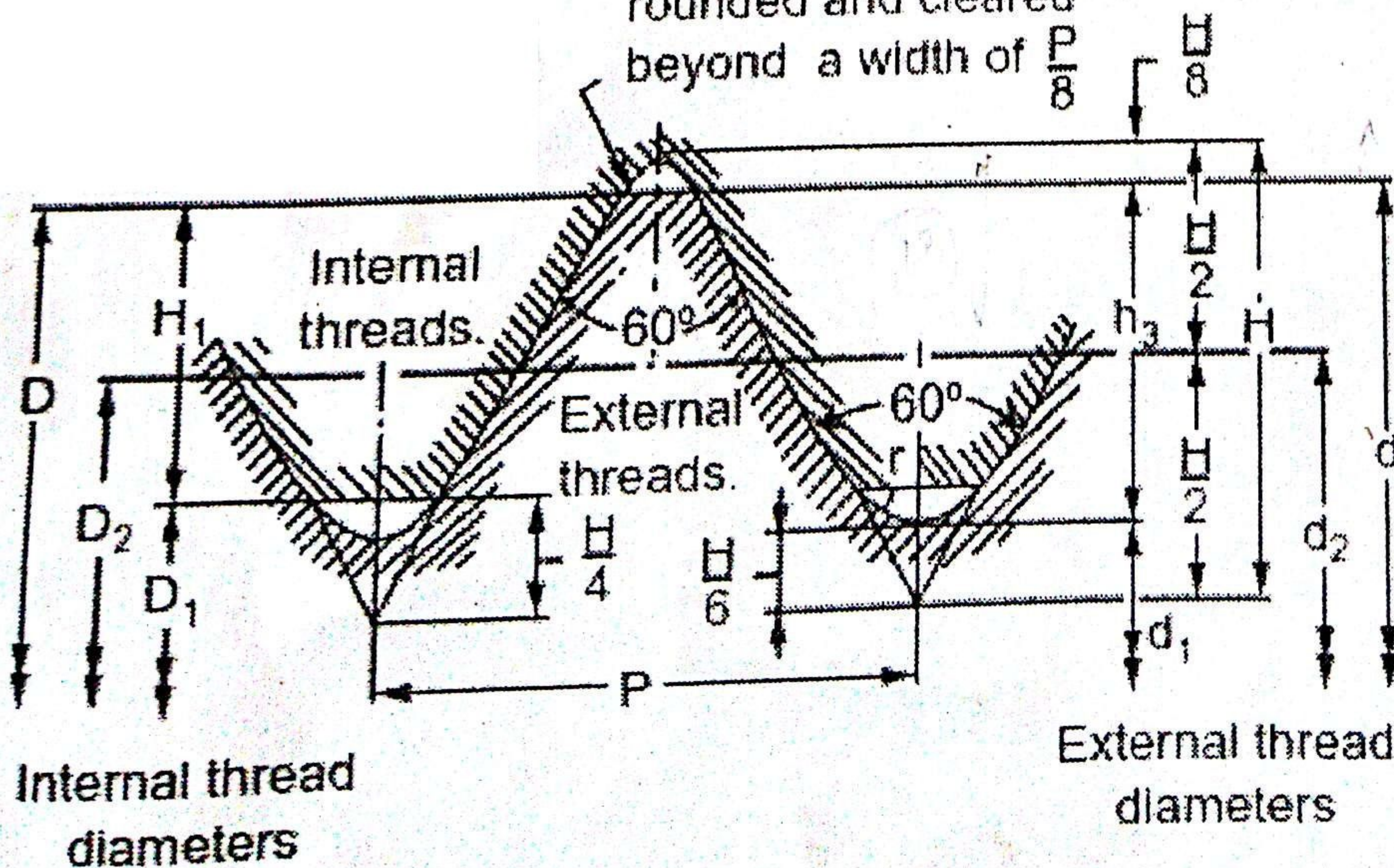
Slotted Nut

For nut: $w = 12$; $m = 8$; $n = 2.8$; $s = 17$; and $e = 19$

Draw the design profiles of ISO metric screw threads corresponding to M24:

In practice the root is rounded and cleared beyond a width of $\frac{P}{8}$

Pitch, $P = 3 \text{ mm}$



Internal thread diameters

External thread diameters

Hexagonal headed bolts:

All dimensions in mm

| Size | M5 | M6 | M8 | M10 | M12 | M16 | M20 | M24 | M30 |
|----------------------------|-------|-------|-------|--------|--------|--------|--------|--------|--------|
| <i>d</i> max | 5.00 | 6.00 | 8.00 | 10.00 | 12.00 | 16.00 | 20.00 | 24.00 | 30.00 |
| <i>d</i> min | 4.82 | 5.82 | 7.78 | 9.78 | 11.73 | 15.73 | 19.67 | 23.67 | 29.67 |
| <i>s</i> max | 8.00 | 10.00 | 13.0 | 17.00 | 19.00 | 24.0 | 30.00 | 36.00 | 46.00 |
| <i>s</i> min | 7.85 | 9.78 | 12.73 | 16.73 | 18.67 | 23.67 | 29.67 | 35.38 | 45.38 |
| <i>k</i> max | 3.65 | 4.15 | 5.65 | 7.18 | 8.18 | 10.18 | 13.22 | 15.22 | 19.26 |
| <i>k</i> min | 3.35 | 3.85 | 5.35 | 6.82 | 7.82 | 9.82 | 12.78 | 14.78 | 18.74 |
| <i>b</i> min for $l < 130$ | 16.00 | 18.00 | 22.00 | 26.00 | 30.00 | 38.00 | 46.00 | 54.00 | 66.00 |
| for $130 < l < 300$ | | 24.00 | 28.00 | 32.00 | 36.00 | 44.00 | 52.00 | 60.00 | 72.00 |
| for $l > 200$ | | | | | | 57.00 | 65.00 | 73.00 | 85.00 |
| <i>φ</i> min | 7.20 | 9.00 | 11.70 | 15.30 | 17.10 | 21.60 | 27.00 | 32.40 | 41.40 |
| <i>c</i> - | 0.20 | 0.30 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.50 | 0.50 |
| <i>e</i> min | 8.87 | 11.05 | 14.38 | 18.90 | 21.10 | 26.75 | 33.53 | 39.98 | 51.28 |
| <i>r</i> min | 0.20 | 0.25 | 0.40 | 0.40 | 0.60 | 0.60 | 0.80 | 0.80 | 1.0 |
| <i>z</i> max | 0.80 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.50 | 3.00 | 3.50 |
| <i>l</i> | 30-75 | 30-80 | 30-90 | 35-120 | 40-120 | 50-220 | 60-220 | 70-220 | 90-220 |

Hexagonal socket head screws:

All dimensions in millimetres

| Size | M3 | M4 | M5 | M6 | M8 M8 x 1 | M10 M10 x 1.25 | M12 M12 x 1.25 | (M14) (M14 x 1.5) | M16 M16 x 1.5 | (M18) (M18 x 1.5) | M20 M20 x 1.5 | (M22) (M22 x 1.5) | M24 M24 x 2 |
|--------------------------|-------|-------|-------|-------|--------------|-------------------|-------------------|----------------------|------------------|----------------------|------------------|----------------------|----------------|
| <i>b</i> { • † | 12 | 14 | 16 | 18 | 22 | 26 | 30 | 34 | 38 | 42 | 46 | 50 | 54 |
| | ----- | ----- | ----- | ----- | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 |
| <i>d</i> (h 13) { Nom | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| <i>d</i> (h 13) { Max | 3.00 | 4.00 | 5.00 | 6.00 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 |
| <i>d</i> (h 13) { Min | 2.86 | 3.82 | 4.82 | 5.82 | 7.78 | 9.78 | 11.73 | 13.73 | 15.73 | 17.73 | 19.67 | 21.67 | 23.67 |
| <i>D</i> (h 13) { Nom | 5.5 | 7 | 8.5 | 10 | 13 | 16 | 18 | 21 | 24 | 27 | 30 | 33 | 36 |
| <i>D</i> (h 13) { Max | 5.50 | 7.00 | 8.50 | 10.00 | 13.00 | 16.00 | 18.00 | 21.00 | 24.00 | 27.00 | 30.00 | 33.00 | 36.00 |
| <i>D</i> (h 13) { Min | 5.32 | 6.78 | 8.28 | 9.78 | 12.73 | 15.73 | 17.73 | 20.67 | 23.67 | 26.67 | 29.67 | 32.67 | 35.61 |
| <i>k</i> (h 13) { Nom | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| <i>k</i> (h 13) { Max | 3.00 | 4.00 | 5.00 | 6.00 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 |
| <i>k</i> (h 13) { Min | 2.86 | 3.82 | 4.82 | 5.82 | 7.78 | 9.78 | 11.73 | 13.73 | 15.73 | 17.73 | 19.67 | 21.67 | 23.67 |
| <i>S</i> (D 12) { Nom | 2.5 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 | 14 | 17 | 17 | 19 |
| <i>S</i> (D 12) { Max | 2.61 | 3.11 | 4.15 | 5.15 | 6.15 | 8.19 | 10.19 | 12.23 | 14.23 | 14.23 | 17.23 | 17.23 | 19.28 |
| <i>S</i> (D 12) { Min | 2.52 | 3.02 | 4.03 | 5.03 | 6.03 | 8.04 | 10.04 | 12.05 | 14.05 | 14.05 | 17.05 | 17.05 | 19.06 |
| <i>c</i> { Max | 1.70 | 2.40 | 3.10 | 3.78 | 4.78 | 6.25 | 7.50 | 8.70 | 9.70 | 10.70 | 11.80 | 12.40 | 14.00 |
| <i>c</i> { Min | 1.30 | 2.00 | 2.70 | 3.30 | 4.30 | 5.50 | 6.60 | 7.80 | 8.80 | 9.80 | 10.70 | 11.30 | 12.90 |
| <i>r</i> Min | 0.1 | 0.2 | 0.2 | 0.25 | 0.4 | 0.4 | 0.6 | 0.6 | 0.6 | 0.6 | 0.8 | 0.8 | 0.8 |
| <i>d_s</i> Max | 3.6 | 4.7 | 5.7 | 6.8 | 9.2 | 11.2 | 14.2 | 16.2 | 18.2 | 20.2 | 22.4 | 24.4 | 26.4 |