

Engineering drawing

Semester I/II

Mechanical Engineering Department
Technical University of Gdańsk

Lecture 10

Three methods commonly used in fastening

- Mechanical Fastening
 - Bolts, screws, rivets, keys, pins
- Bonding
 - Welding, soldering, brazing, gluing
- Forming
 - Sheet metal, plastic snap parts

Fasteners

- nuts,
- bolts,
- screws,
- washers,
- nails,
- pins,
- keys,
- rivets,
- clips



Self-weight approx. 250kg, load capacity up to 150kg, additional acceleration forces



More than 125 Nm of torque have to be transmitted at the wheels.

Great braking forces resulting from emergency braking (300 km/h!)

Sizes of bolted joints

Midget screws



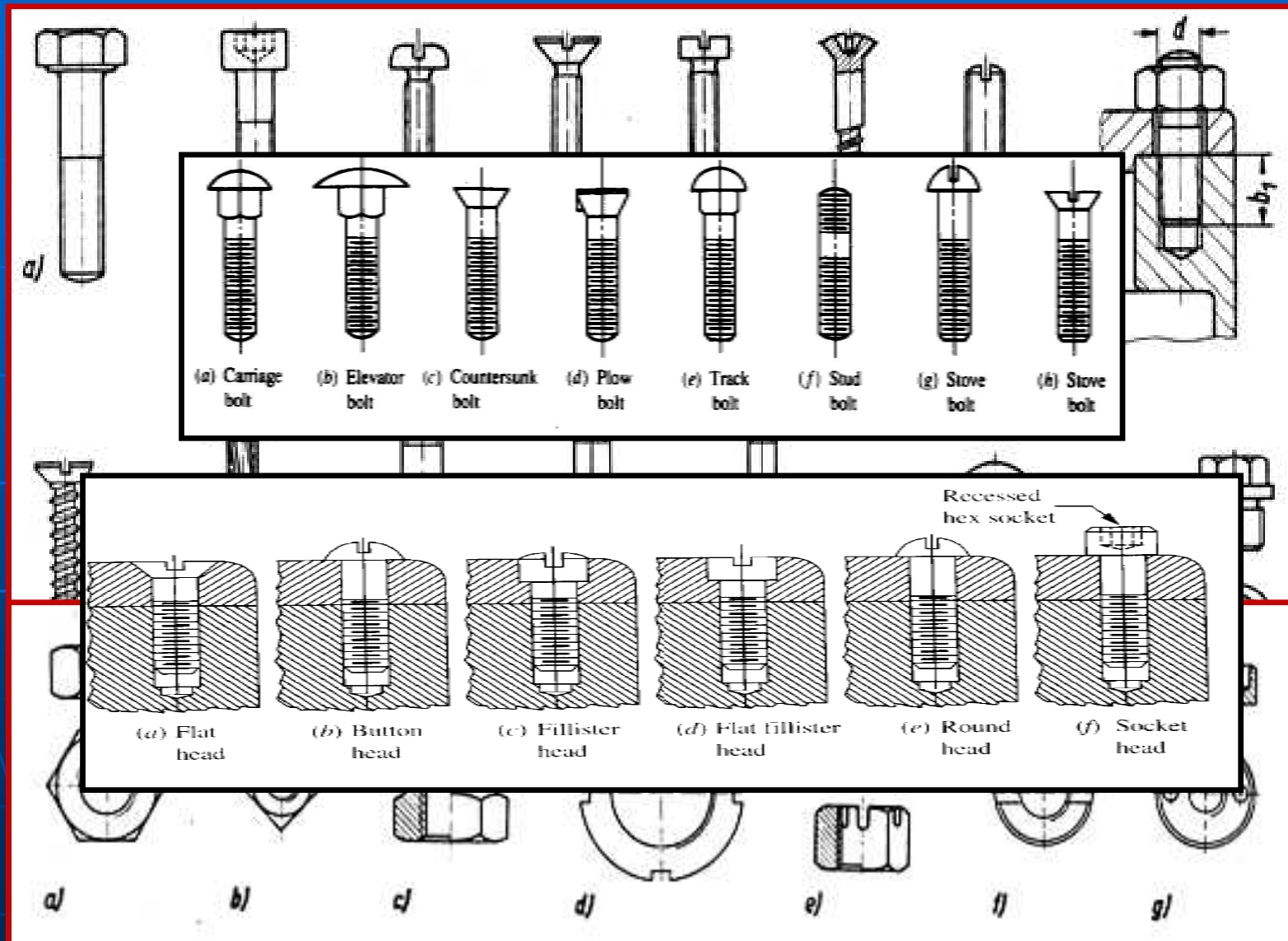
Screws in a clock

Huge screws



**Holding screws in
a compressor**

Threaded Fasteners – terminology

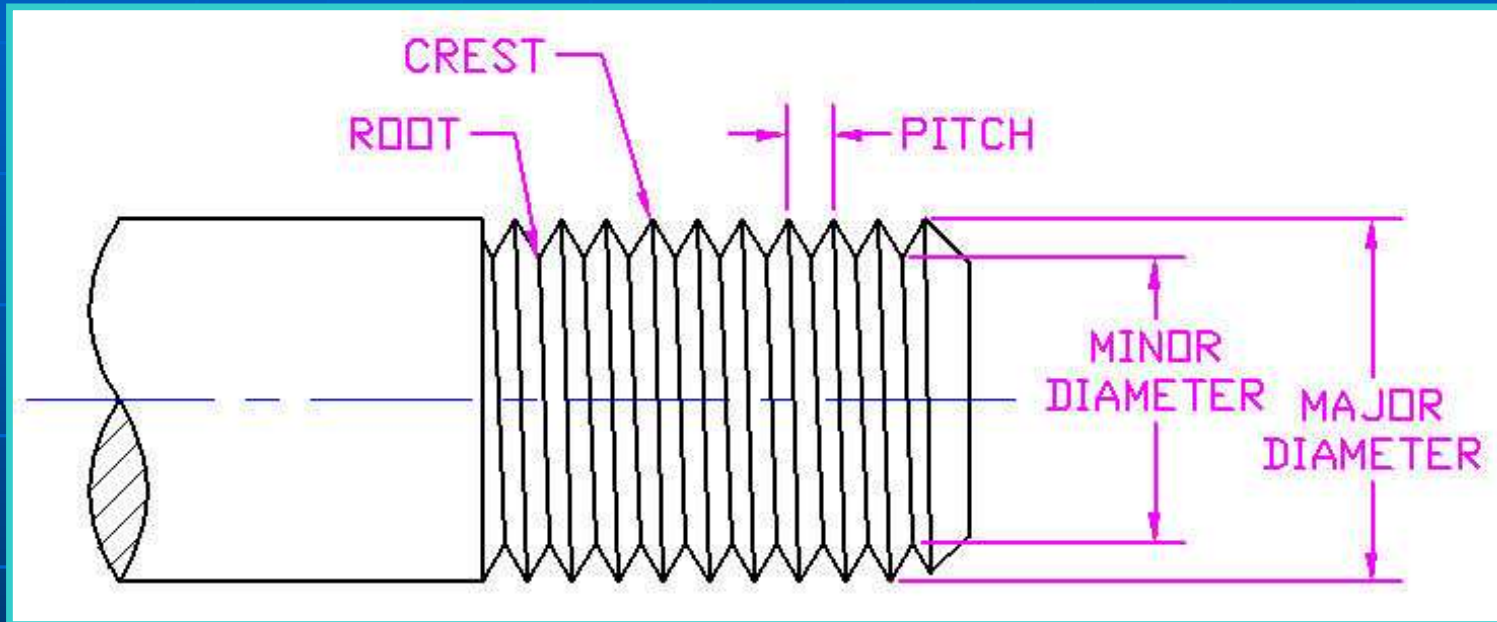


Threaded Fasteners – terminology

- Internal threads
 - Threads inside a hole
 - Made by drill & tap:
 - drill smooth hole
 - make threads with a tap
- External threads
 - Threads outside a cylinder
 - Made with a die
 - Made by rolling

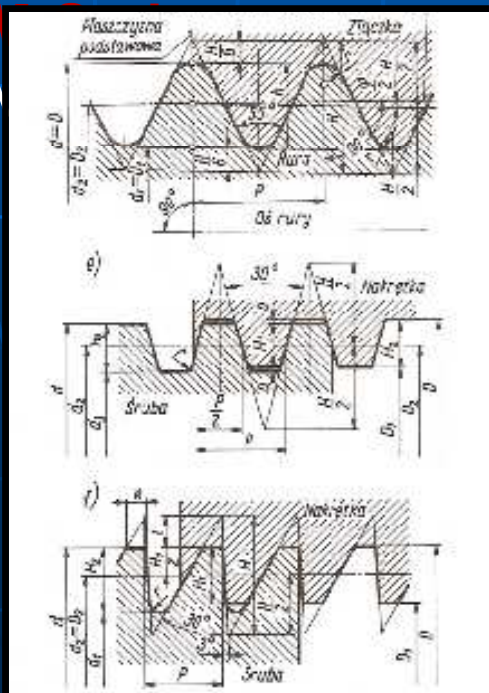
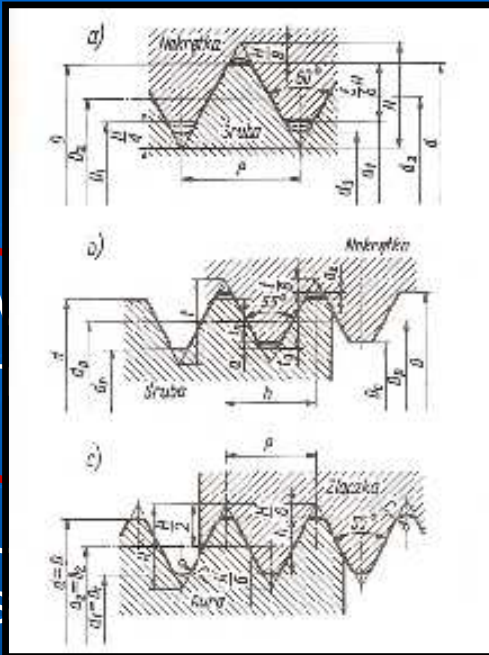


Threaded Fasteners – terminology



External thread

Thread types



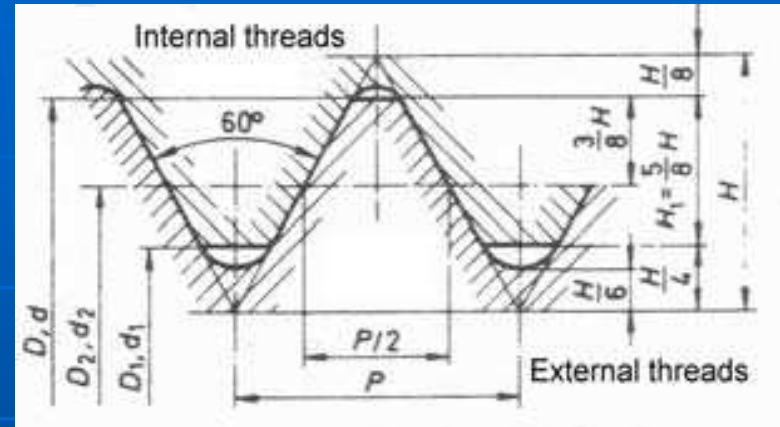
Type of thread	Designation	Sample
Metric (coarse)	M	M16
Metric (fine)	M	M16 x 1,5
Unified screw thread		1/2
Pipe thread	G	G1/4
Pipe taper thread	R	R1/4
Trapezoidal thread (symetric)	Tr	Tr24x5
Buttress thread	S	S24x5
Knuckle thread	Rd	Rd32x1/8
Left-hand thread	LH	M16LH
Multiple thread	P...	M60x4(P3)

Screw threads – metric types

- thread angle = 60°
- symmetric profiles
- identified as M
- coarse and fine pitch
- specification of the thread:

M12 x 1.75

- the metric thread designation (M)
- nominal major diameter (12 mm)
- pitch (1,75 mm)

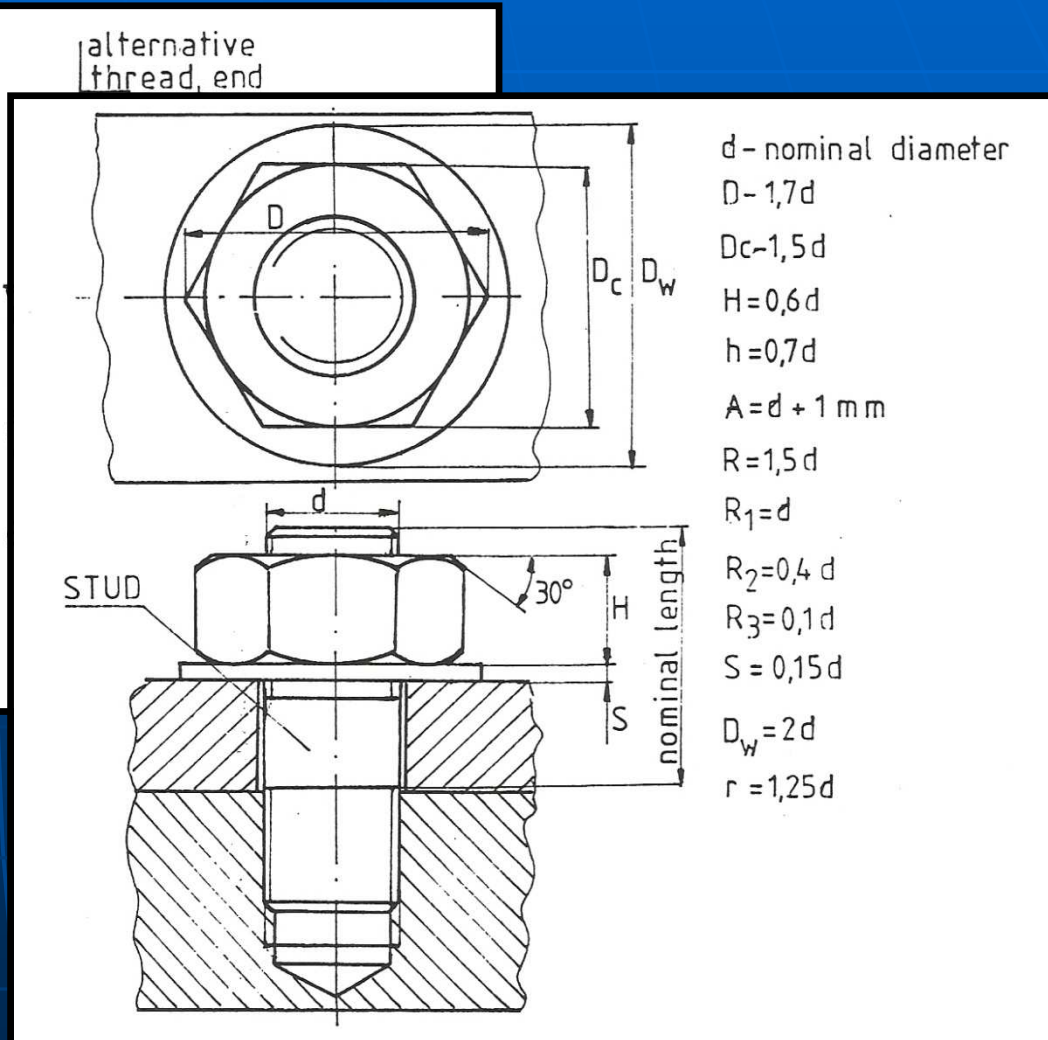
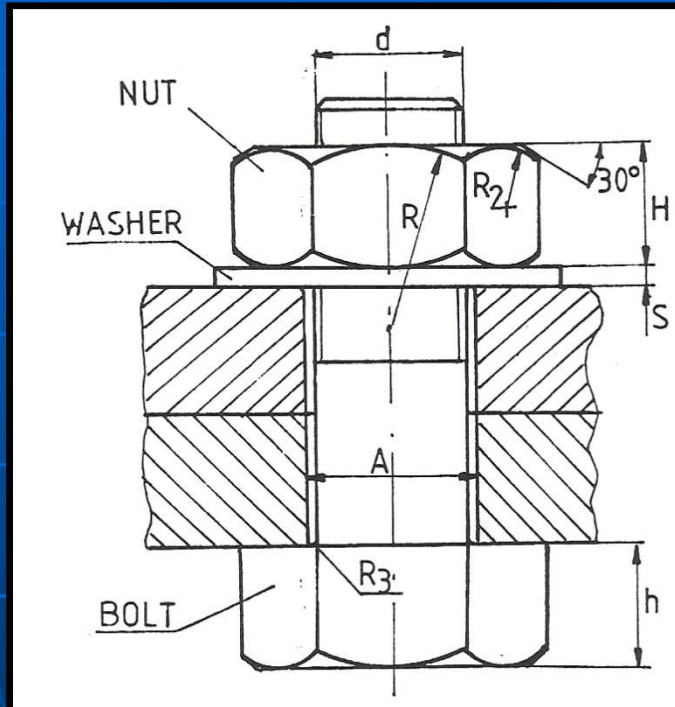


Metric threads

Thread diameter series			Pitch	Thread dimensions					
1	2	3							
M4 M4 × 0,5			0,7 —	4	3,545 3,675	3,242 3,459	3,078 3,343	0,07 0,05	7,44 8,76
	M4,5 M4,5 × 0,5		0,75 —	4,5	4,013 4,175	3,688 3,959	3,514 3,843	0,075 0,05	9,68 11,6
M5 M5 × 0,5			0,8 —	5	4,480 4,675	4,134 4,459	3,948 4,343	0,08 0,05	12,2 14,8
		M5,5 × 0,5	—	5,5	5,175	4,959	4,843	0,05	18,4
M6 M6 × 0,75 M6 × 0,5			1 — —	6	5,350 5,513 5,675	4,917 5,188 5,459	4,684 5,014 5,343	0,1 0,075 0,05	17,2 19,7 22,4
		M7 M7 × 0,75 M7 × 0,5	1 — —	7	6,350 6,513 6,675	5,917 6,188 6,459	5,684 6,014 6,343	0,1 0,075 0,05	25,3 28,4 31,6
M8 M8 × 1 M8 × 0,75 M8 × 0,5			1,25 — — —	8	7,188 7,350 7,513 7,675	6,647 6,917 7,188 7,459	6,355 6,684 7,014 7,343	0,125 0,1 0,075 0,05	31,7 35,0 38,6 42,3
		M9 M9 × 1 M9 × 0,75 M9 × 0,5	1,25 — — —	9	8,188 8,350 8,513 8,675	7,647 7,917 8,188 8,459	7,355 7,684 8,014 8,343	0,125 0,1 0,075 0,05	42,5 46,3 50,4 54,6
M10 M10 × 1,25 M10 × 1 M10 × 0,75 M10 × 0,5			1,5 — — — —	10	9,026 9,188 9,350 9,513 9,675	8,376 8,647 8,917 9,188 9,459	8,026 8,355 8,684 9,014 9,343	0,15 0,125 0,1 0,075 0,05	50,6 54,9 59,2 63,8 68,5
		M11 M11 × 1 M11 × 0,75 M11 × 0,5	1,5 — — —	11	10,026 10,350 10,513 10,675	9,376 9,917 10,188 10,459	9,026 9,684 10,014 10,343	0,15 0,1 0,075 0,05	64,0 73,6 78,5 83,3
M12 M12 × 1,5 M12 × 1,25 M12 × 1 M12 × 0,75 M12 × 0,5			1,75 — — — — —	12	10,683 11,026 11,188 11,350 11,513 11,675	10,106 10,376 10,647 10,917 11,188 11,459	9,698 10,026 10,355 10,684 11,014 11,343	0,175 0,15 0,125 0,1 0,075 0,05	73,9 78,5 84,9 89,9 95,0 100

Thread diameter series			Pitch	Thread dimensions					
1	2	3							
M16 M16 × 1,5 M16 × 1 M16 × 0,75 M16 × 0,5			2 — — — —	16	14,701 15,026 15,350 15,513 15,675	13,835 14,376 14,917 15,188 15,459	13,369 14,026 14,684 15,014 15,343	0,2 0,15 0,1 0,075 0,05	141 154 170 177 184
		M17 × 1,5 M17 × 1	— —	17	16,026 16,350	15,376 15,917	15,026 15,684	0,15 0,1	177 194
	M18 M18 × 2 M18 × 1,5 M18 × 1 M18 × 0,75 M18 × 0,5		2,5 — — — — —	18	16,376 16,701 17,026 17,350 17,513 17,675	15,294 15,835 16,376 16,917 17,188 17,459	14,712 15,369 16,026 16,684 17,014 17,343	0,25 0,2 0,15 0,1 0,075 0,05	170 186 201 222 227 235
M20 M20 × 2 M20 × 1,5 M20 × 1 M20 × 0,75 M20 × 0,5			2,5 — — — — —	20	18,376 18,701 19,026 19,350 19,513 19,675	17,294 17,835 18,376 18,917 19,188 19,459	16,712 17,369 18,026 18,684 19,014 19,343	0,25 0,2 0,15 0,1 0,075 0,05	219 238 254 272 284 293
	M22 M22 × 2 M22 × 1,5 M22 × 1 M22 × 0,75 M22 × 0,5		2,5 — — — — —	22	20,376 20,701 21,026 21,350 21,513 21,675	19,294 19,835 20,376 20,917 21,188 21,459	18,712 19,369 20,026 20,684 21,014 21,343	0,25 0,2 0,15 0,1 0,075 0,05	275 296 314 336 346 356
M24 M24 × 2 M24 × 1,5 M24 × 1 M24 × 0,75			3 — — — —	24	22,051 22,701 23,026 23,350 23,513	20,752 21,835 22,376 22,917 23,188	20,054 21,369 22,026 22,684 23,014	0,3 0,2 0,15 0,1 0,075	317 360 380 405 415
		M25 × 2 M25 × 1,5 M25 × 1	— — —	25	23,701 24,026 24,350	22,835 23,376 23,907	22,369 23,026 23,684	0,2 0,15 0,1	394 415 441
		M26 × 1,5	—	26	25,026	24,376	24,026	0,15	452
	M27 M27 × 2 M27 × 1,5 M27 × 1 M27 × 0,75		3 — — — —	27	25,051 25,701 26,026 26,350 26,513	23,752 24,835 25,376 25,907 26,188	23,054 24,369 25,026 25,684 26,014	0,3 0,2 0,15 0,1 0,075	419 468 491 519 531
		M28 × 2 M28 × 1,5 M28 × 1	— — —	28	26,701 27,026 27,350	25,835 26,376 26,917	25,369 26,026 26,684	0,2 0,15 0,1	507 531 560

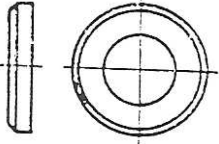
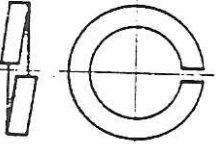
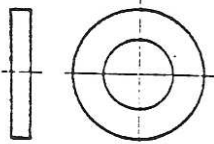
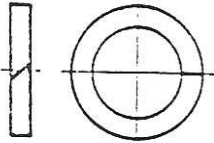




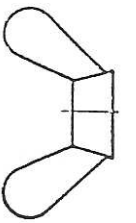
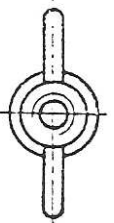
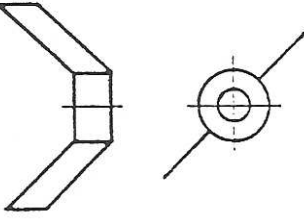

Threaded fasteners - sections



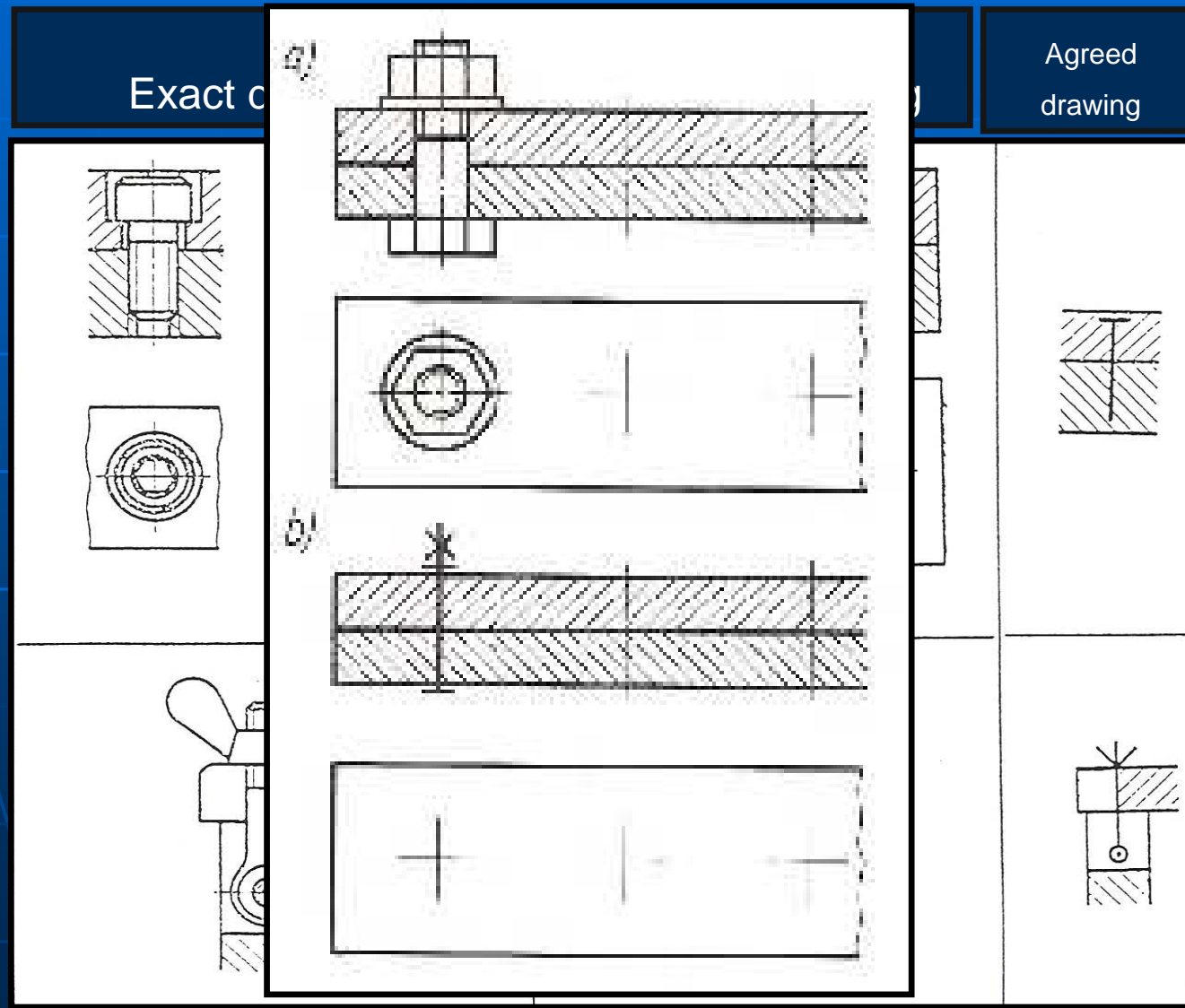
Simplified representation of bolts and screws

	Exact drawing	Simplified drawing	Agreed drawin
4			
5			
6			
7			
8			

Simplified representation of nuts and washers

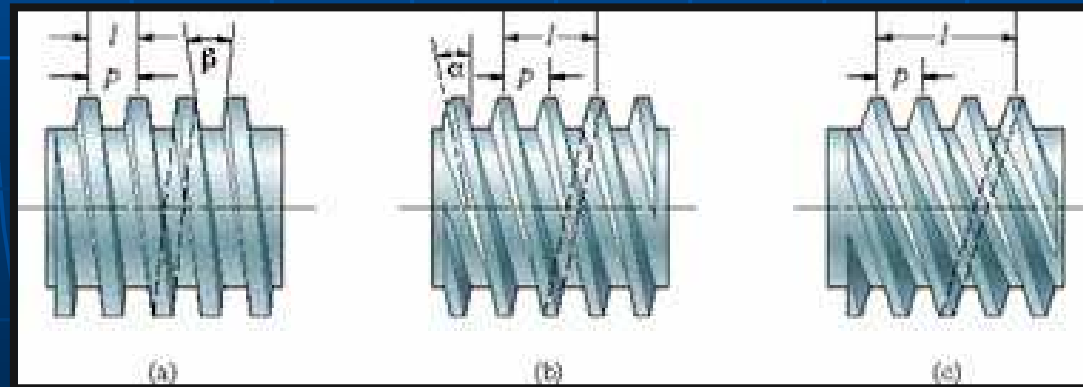
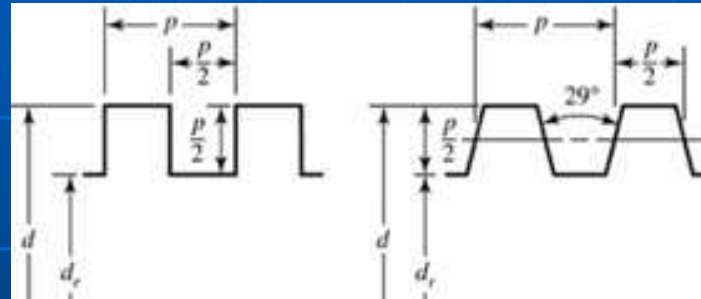
	Exact drawing	Simplified drawing	Agreed drawing
1	 	 	
2			
2	 		

Simplified representation of bolts and nuts in assembling



Threads for power screws

- Used for power transmission
- These have preferred sizes but also can vary
- Modifications to these threads are easy



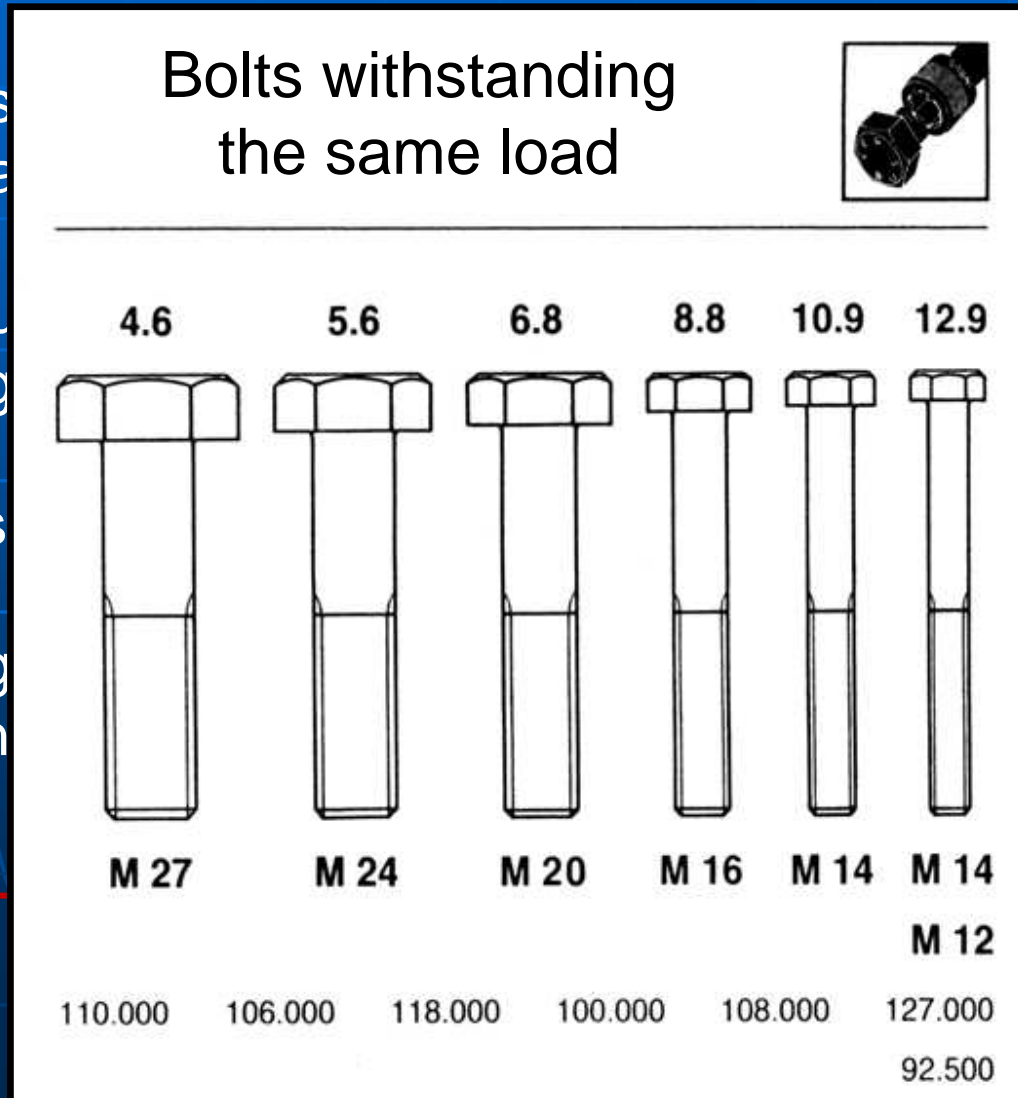
(a) Single, (b) double, (c) triple threaded screws.

Screw class property

4.6 5.6 6.8 8.8 10.9 12.9

Bolt materials

- The design strength which
- The first figure strength
- The second stress point)
- If the two figure nomin



ss.
two figures

al tensile

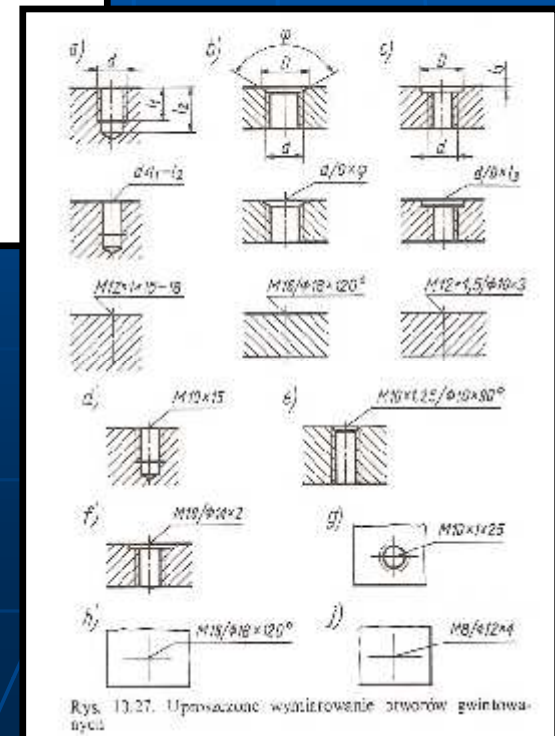
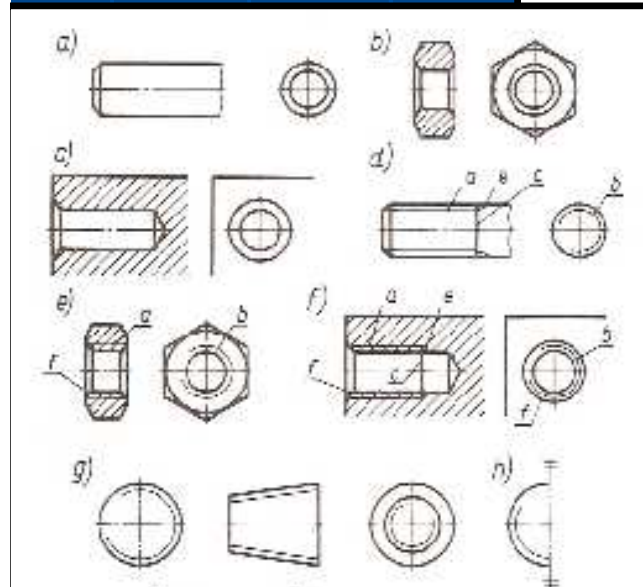
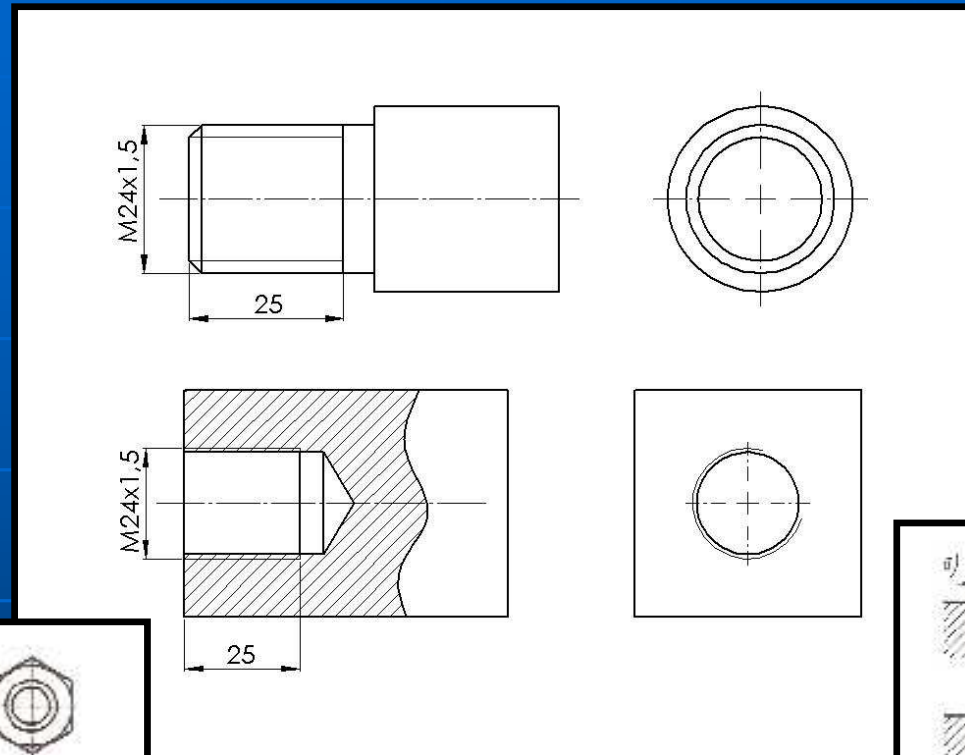
nominal yield
(ratio yield

a tenth of the

5.6

0 MPa

Thread dimensioning



1413,0.SLDPRT
Złożenie1.SLDASM