

Introduction to Mechanical Engineering, Lecture 1

Introduction

Engineering Drawings



Lecturers/Instructors



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Course Goal

To understand engineers:
their problems and
their terminology
by doing their job
using their tools



Course purpose and objectives

The development of any class of robots and the use of robots in industry requires the engineer to have knowledge and skills in:

- the ability to read engineering drawings,
- the analysis and synthesis of mechanisms,
- the dynamic calculation of mechanisms and machines,
- the calculation stress and strain,
- understanding the technological production processes,
- modern CAD and CAE systems.



Course outline and organization

1	ср	07.06.2023 Lecture 1 (Introduction; Engineering Drawings)
2	чт	08.06.2023 CAD_DET1 (Intro to subject; History of CAD; Solid modeling)
3	сб	10.06.2023 Lecture 2 (Intro to Theory of Mechanisms and Machines; Links, Joints (Kinematic pairs); Kinematic chains, Degrees of Freedom, Mobility)
4	сб	10.06.2023 Lab 2 CAD_DET2 (Workflow, Work in groups; CAD file formats; Threads)
5	ср	14.06.2023 Lecture 3 (Types of drives: kinematics, where to find other info; Drives: friction, belts, chains, gears, universal, geneva, ballscrew)
6	чт	15.06.2023 Lecture 7 (Links, Joints, Connections; Shafts, Axles, Shaft couplings; Bearings)
7	сб	17.06.2023 Lab 3 CAD_ASM1 (Bottom-Up approach; Basics)
8	сб	17.06.2023 Lecture 11 (Basics of FDM Printing)
9	ср	21.06.2023 Lecture 8 (Connections: Detachable (Threaded, Keyed, ...); Permanent (Riveting, Welding,))
10	чт	22.06.2023 Lab 4 CAD_ASM2 (Top - Down approach: WAVE; Assembly Load Options; GOST Naming convention; Common Parts Library; Sequence (Assembling animation))
11	сб	24.06.2023 Lab 8 CAD_RENDER (Render)
12	сб	24.06.2023 Lecture 9 (Engineering Materials: Steel, Bronze, Aluminum, Titanium, Composites)
13	ср	28.06.2023 Lab 5 CAE_DYN1 (Introduction to CAE; Animation Designer; Mechatronics Concept Designer; Motion; Measure; Interference; Density; Assign Materials)
14	чт	29.06.2023 Lecture 5 (Motor sizing (selection))
15	сб	01.07.2023 Lab 6-7 CAE_DYN2 (Motion Analysis, Part 2)
16	сб	01.07.2023 Lab 6-7 CAE_DYN2 (Motion Analysis, Part 2)
17	ср	05.07.2023 Lecture 10 (Design Thinking and Manufacturing)
18	чт	06.07.2023 Lab 9 MAN1 (How to create such parts?)
19	сб	08.07.2023 Lecture 12 (Overview of Strength of Materials)
20	сб	08.07.2023 Lab 10-11 CAE_STR1 (Stress Analysis)
21	ср	12.07.2023 EXAM
22	чт	13.07.2023 COMPETITION



Grading criteria

Qz: Quizzes: 10%

CP: Competition: 20%

FE: Final Exam: 30%

HWs: Homework assignments: 40%

Extra: Slide fixes in Github: 5%

Late policy: -50% off max grade for a task

Scale:

A: 85 – 100%

B: 70 – 84.99%

C: 50 – 69.99%

D: 0 – 49.99% or less than 50% by any criterion.



Competition

To be Announced later



Engineering Drawings



Projections

Video

We work with 3D-objects which must be shown in a flat drawing. This is a problem.

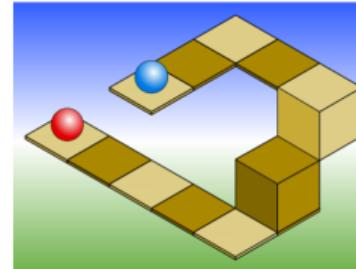
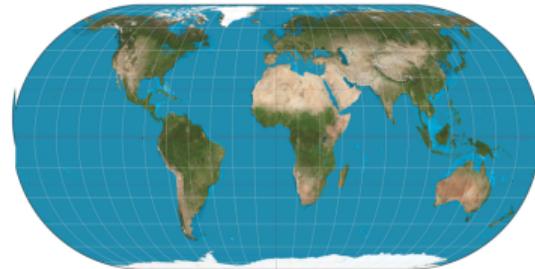
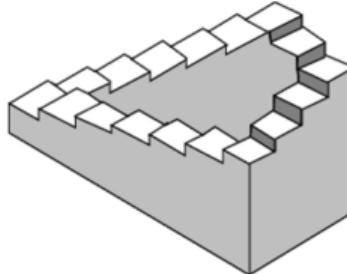




Projections

On the one hand, we cannot accurately show curved surfaces.

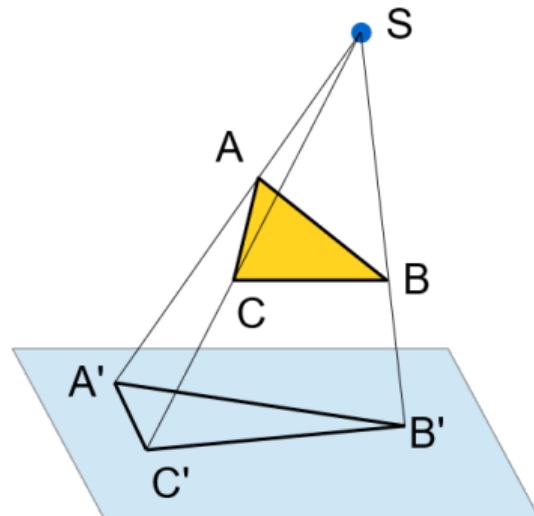
On the other hand, we can draw something absolutely impossible or something possible but unclear.





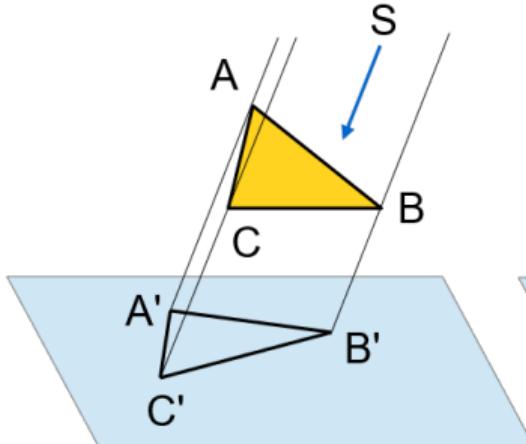
Parallel and perspective projections

Central (perspective) projection

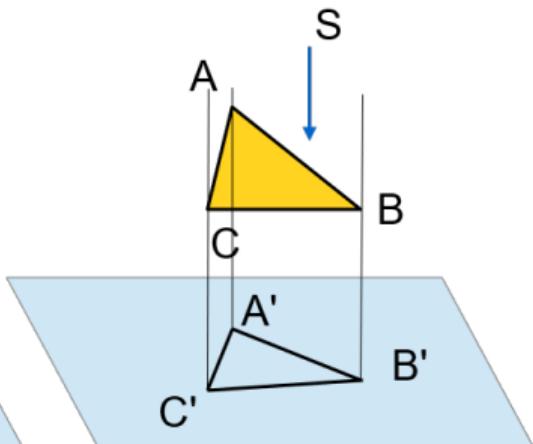


Parallel projections

General (oblique) case



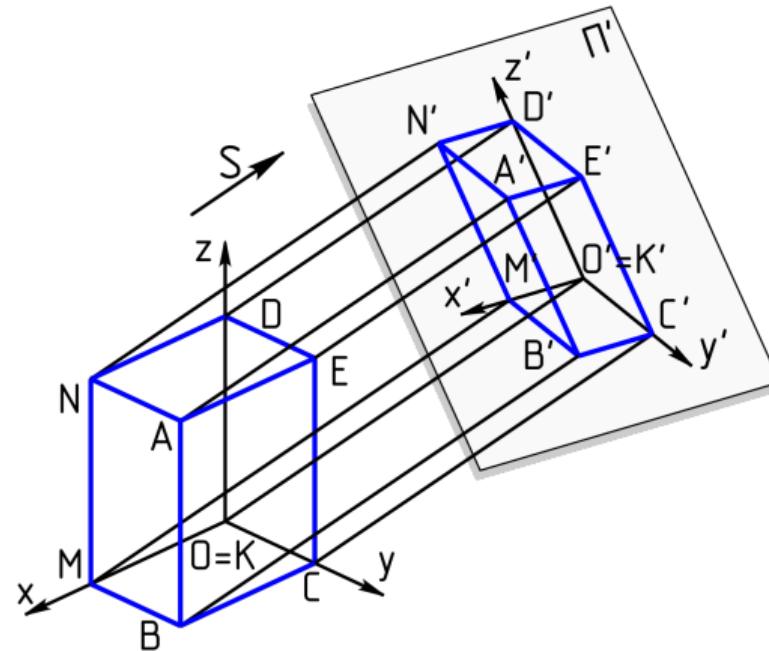
Orthographic projection





Axonometric projections

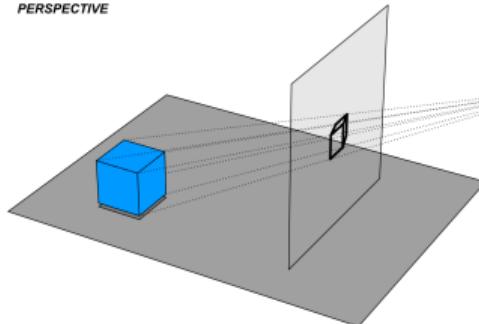
General



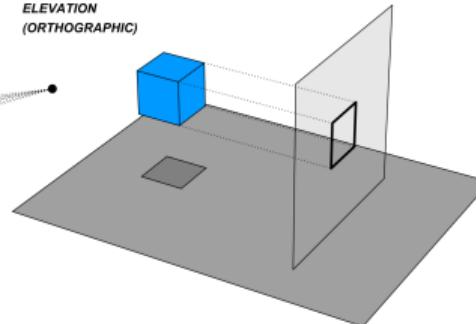


Axonometric projections

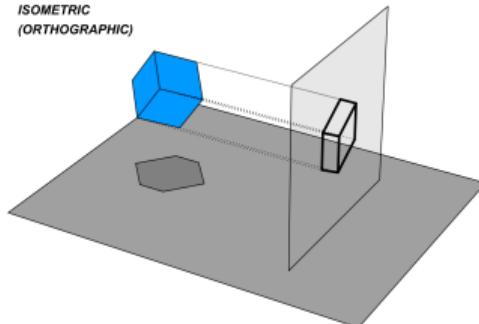
PERSPECTIVE



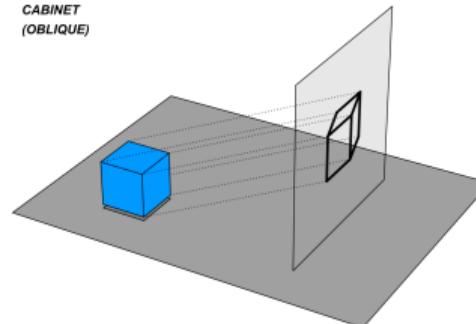
ELEVATION
(ORTHOGRAPHIC)



ISOMETRIC
(ORTHOGRAPHIC)

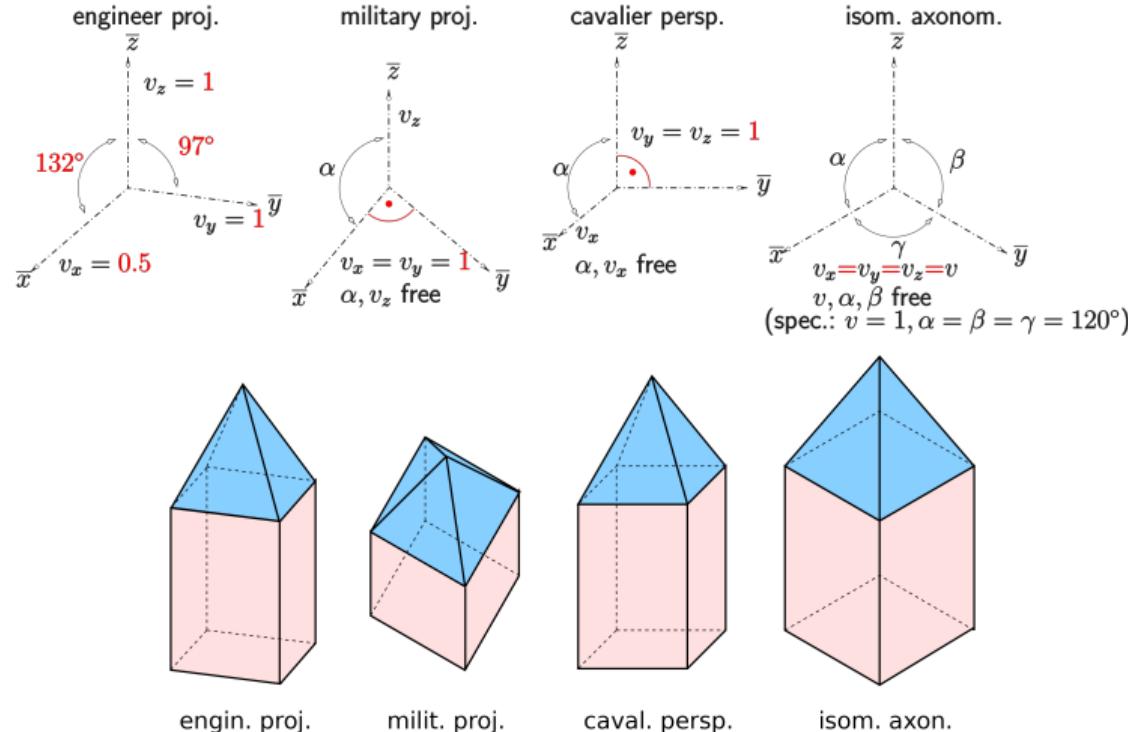


CABINET
(OBlique)





Axonometric projections



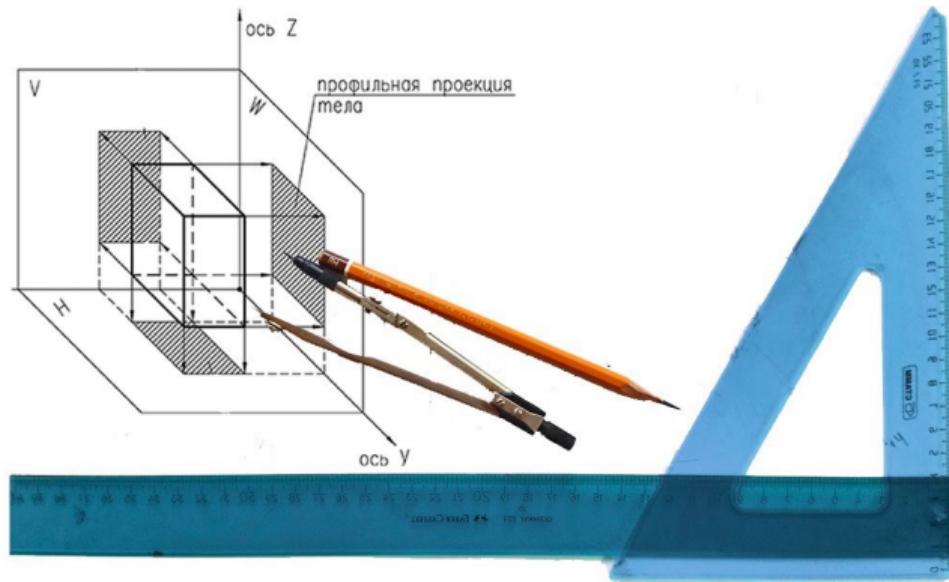


Make a line projection

Video

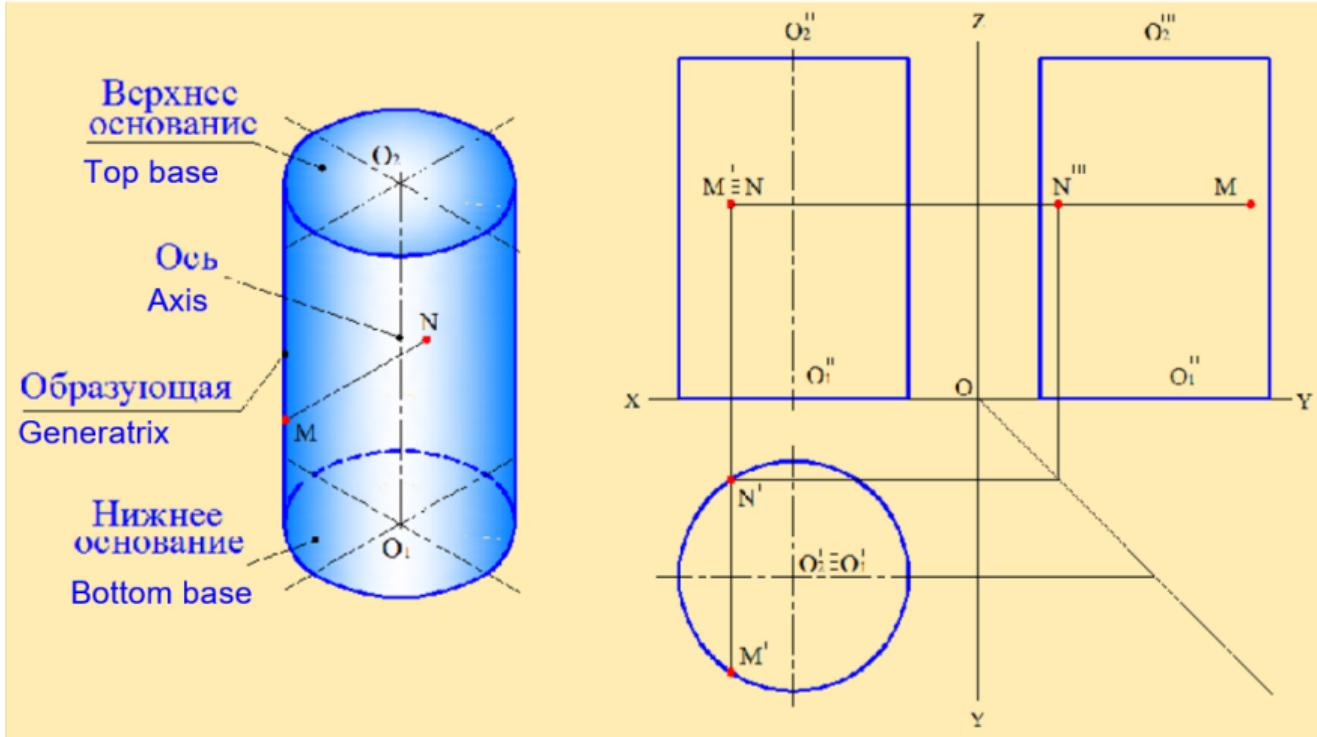
Черчение школа архитектурный ВУЗ

Построение проекции точки, отрезка, плоскости в системе ортогонального проецирования.



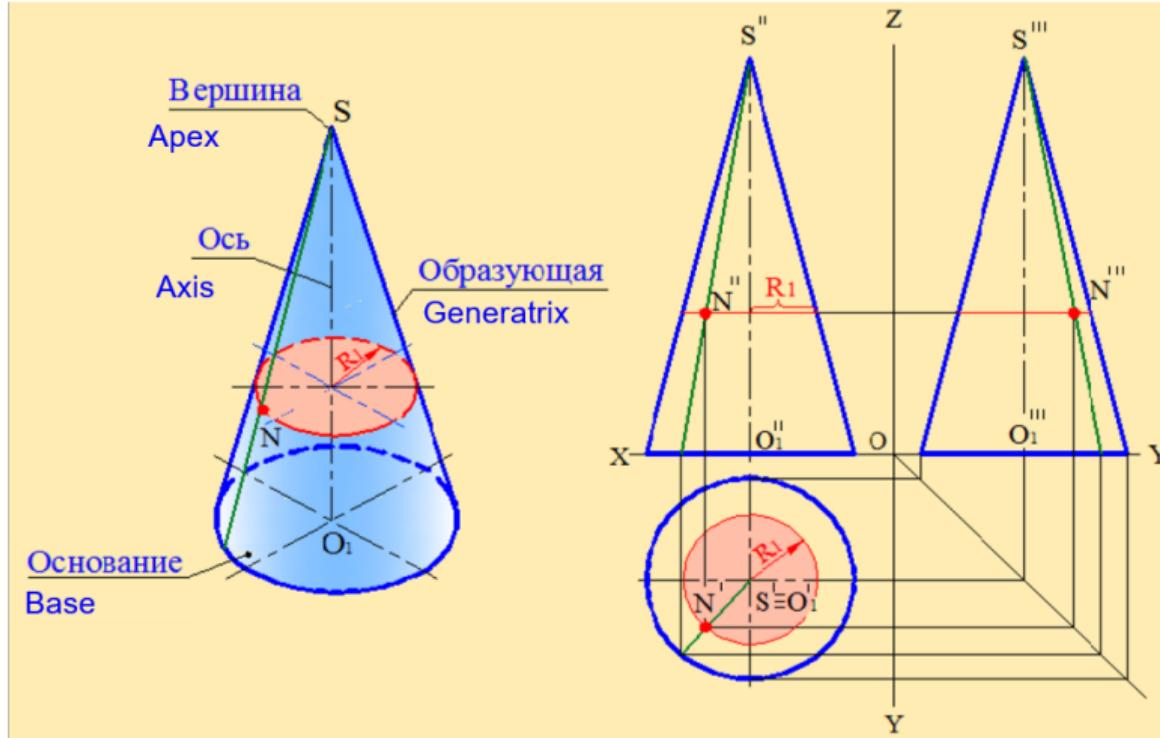


Orthographic Multiview projections



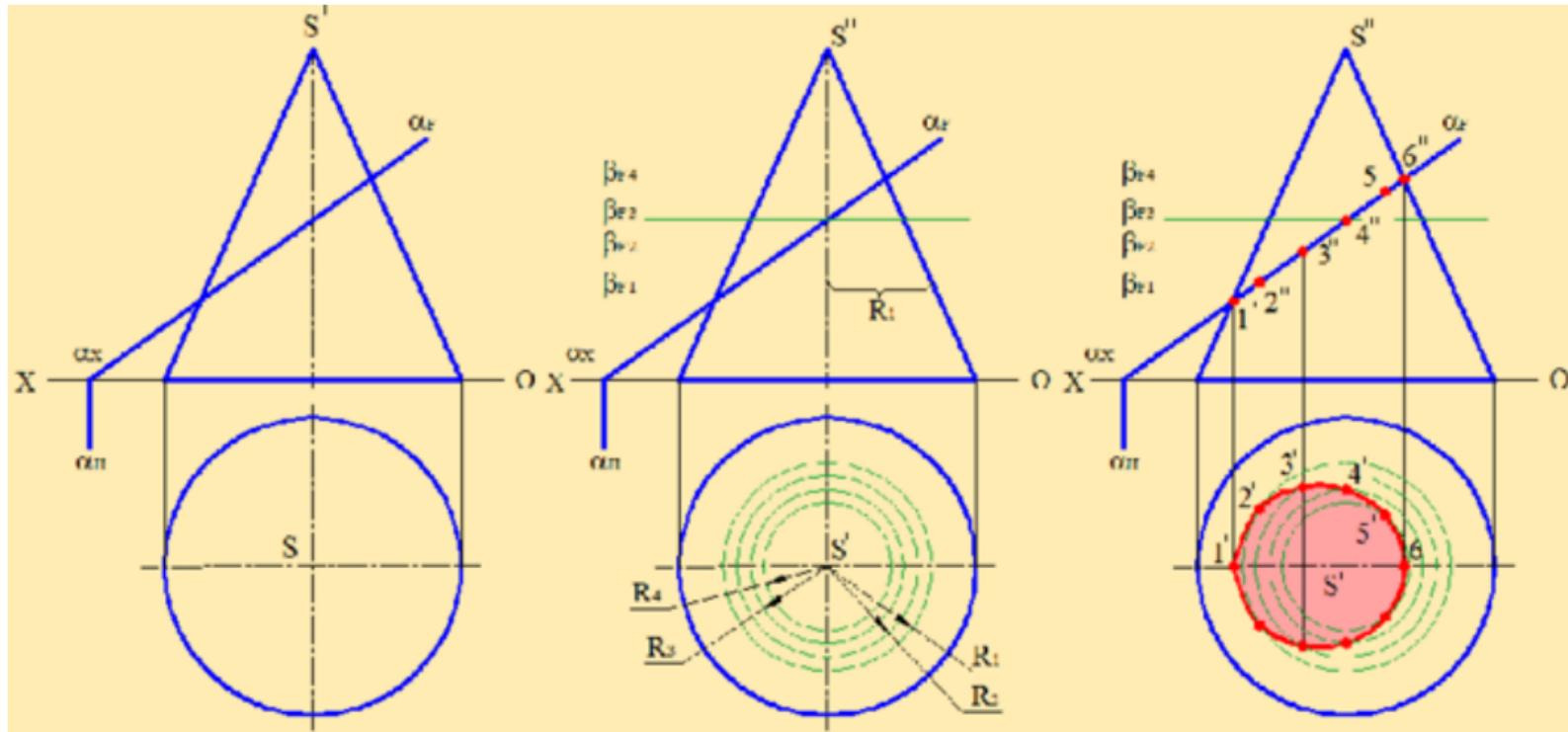


Orthographic Multiview projections



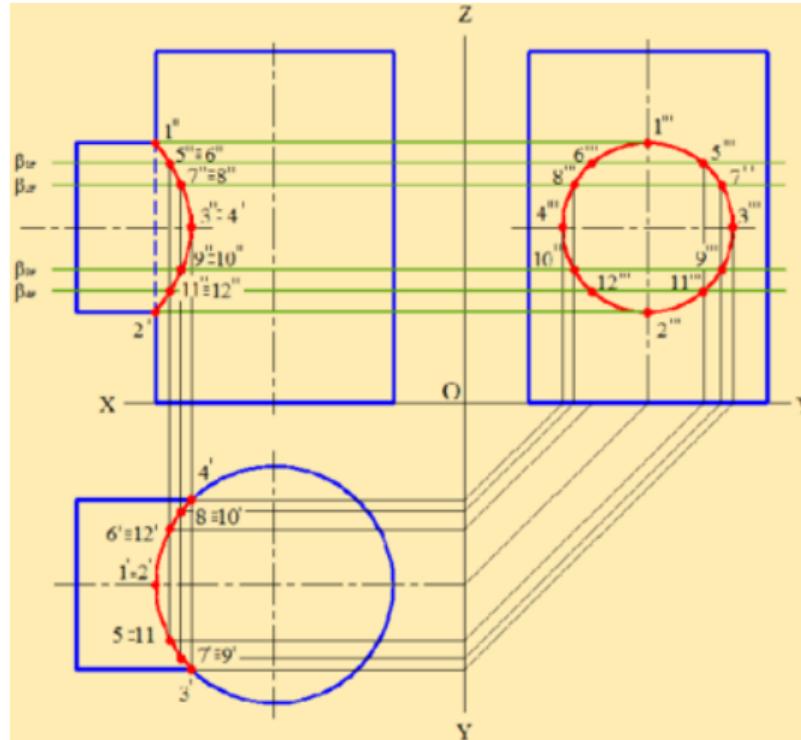


Orthographic Multiview projections





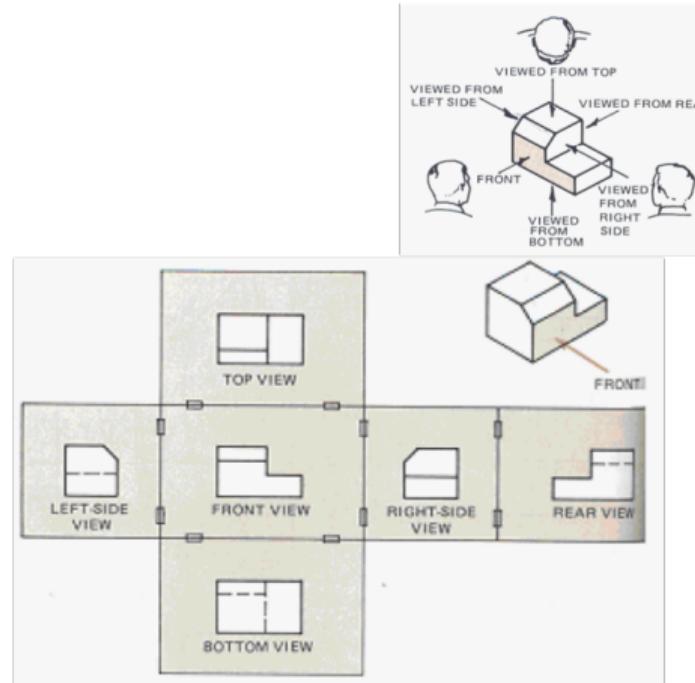
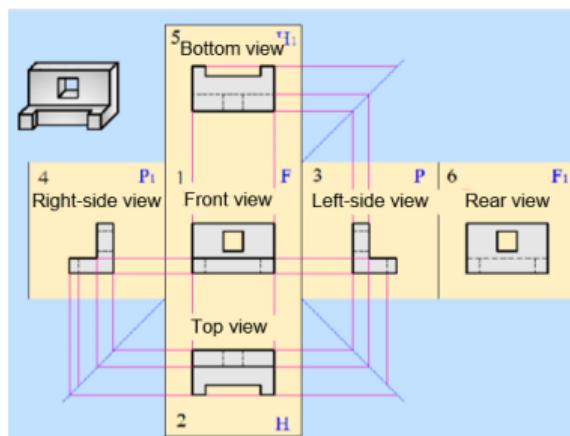
Orthographic Multiview projections





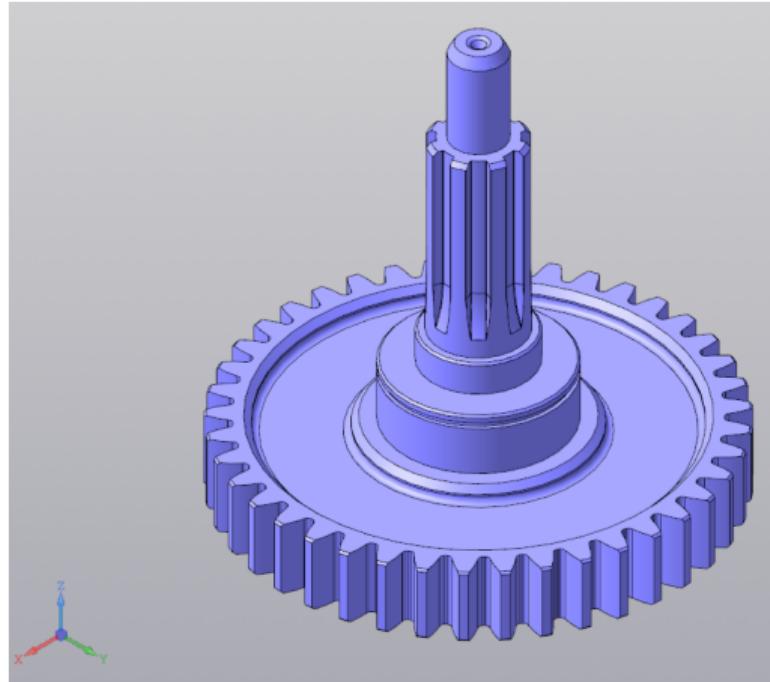
Orthographic Multiview projections

The difference between European and American standards

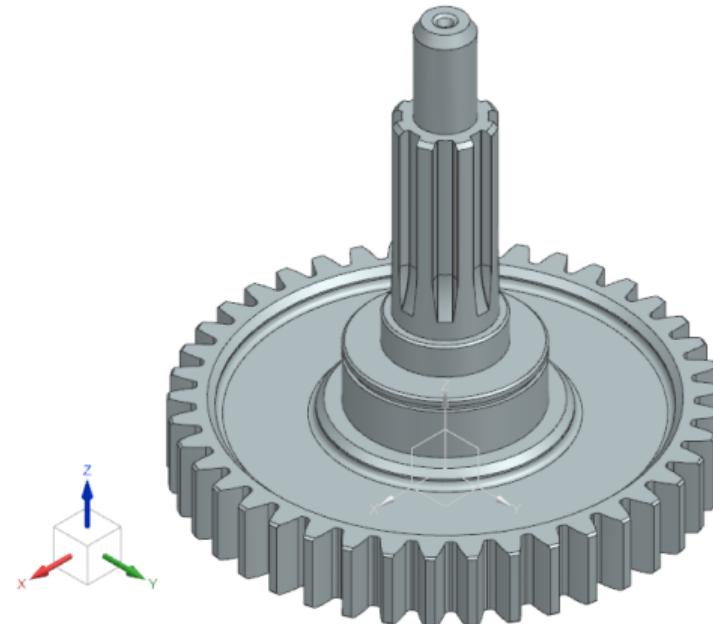




Orthographic Multiview projections



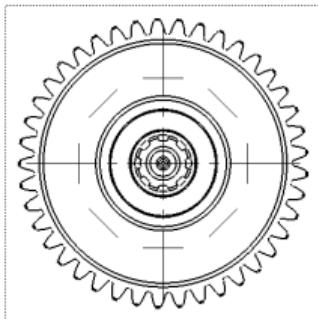
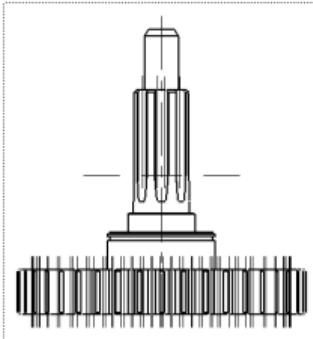
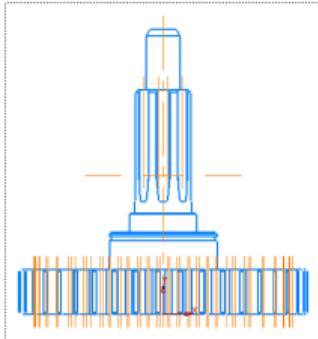
Kompas 3D



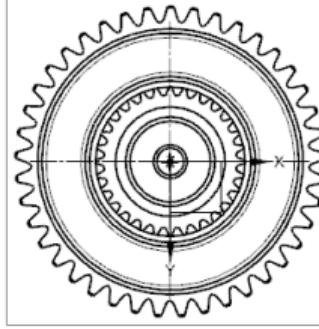
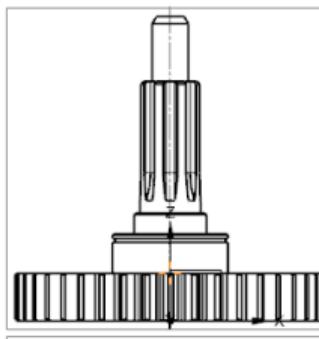
Siemens NX



Orthographic Multiview projections

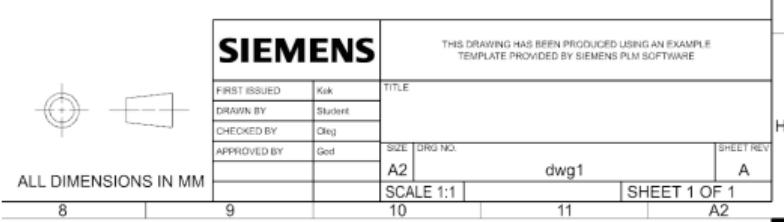


Kompas 3D (European system)



Siemens NX (American system)

Drawing standards

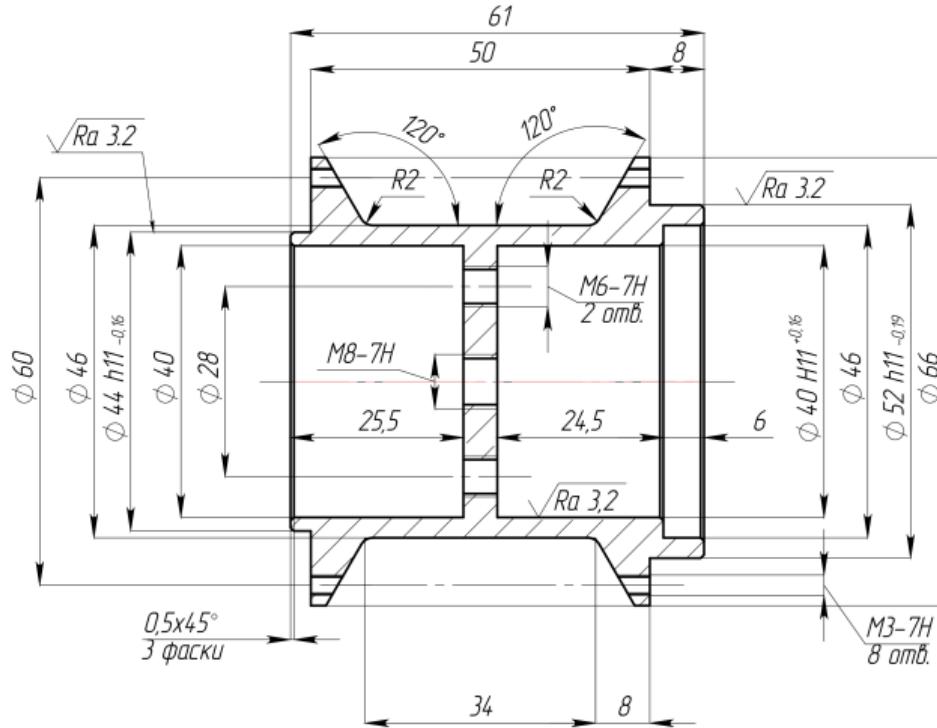


ANSI standard Title Block

GOST standard Title Block

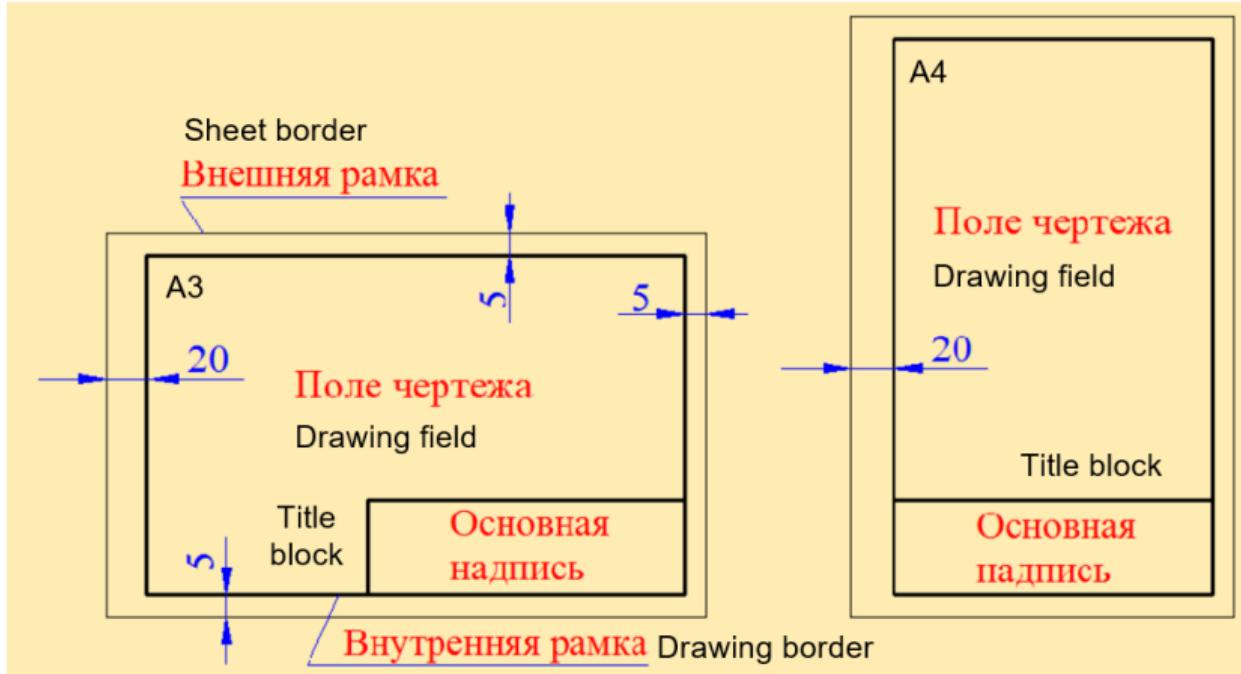


GOST Drawing Example





GOST Drawings





GOST Drawing Title Block





Scale

Scale

Drawings may be made actual size, or they may be made smaller or larger than the actual size of the object. A drawing that is twice the actual size of the part would show a scale of $2 = 1$ or $2:1$. A drawing made half the actual size of a part would be in a scale of $1/2 = 1$ or simply $1:2$.

Type of Scales	Scale Values
Enlargement Scale	$50:1$ $25:1$ $10:1$ $5:1$ $2:1$
Full Scale	$1:1$
Reduction Scale	$1:2$ $1:3$ $1:5$ $1:10$ $1:100$

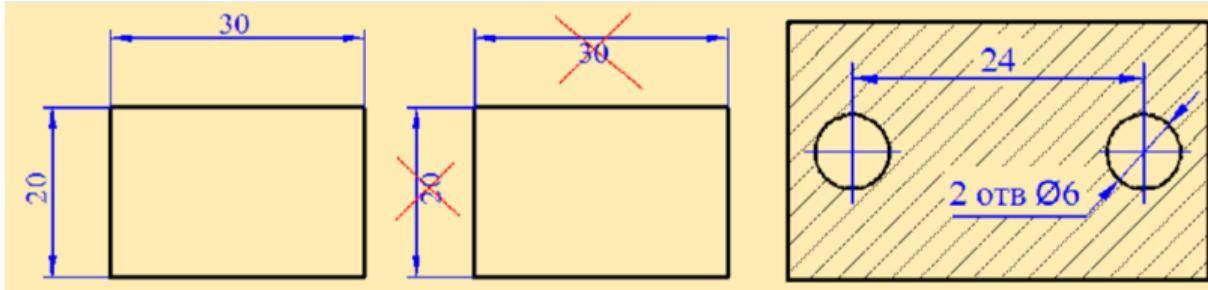
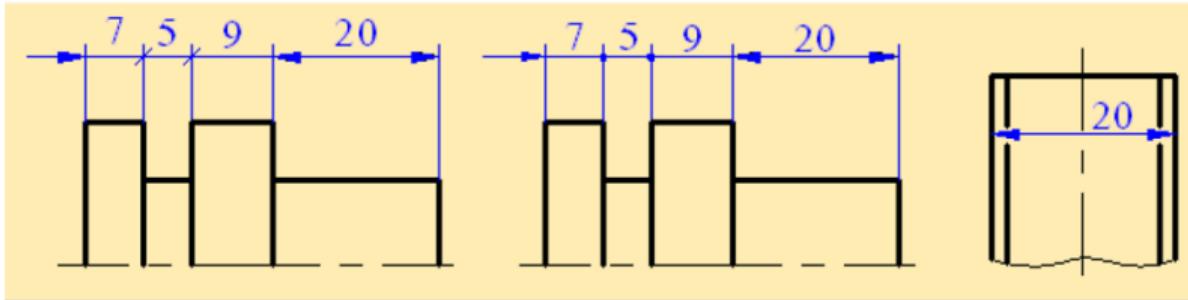


Type of lines

Наименование	Начертание	Толщина линии	Основное назначение
Сплошная толстая основная		S	Линии видимого контура
Сплошная тонкая		от S/3 до S/2	Линии контура наложенного сечения, линии размерные и выносные, линии штриховки
Сплошная волнистая		от S/3 до S/2	Линии обрыва, линии разграничения вида разреза
Штриховая		от S/3 до S/2	Линии невидимого контура
Штрихпунктирная тонкая		от S/3 до S/2	Линии осевые, центровые
Разомкнутая		от S до 1.5S	Линии сечений
Сплошная тонкая с изломами		от S/3 до S/2	Длинные линии обрыва

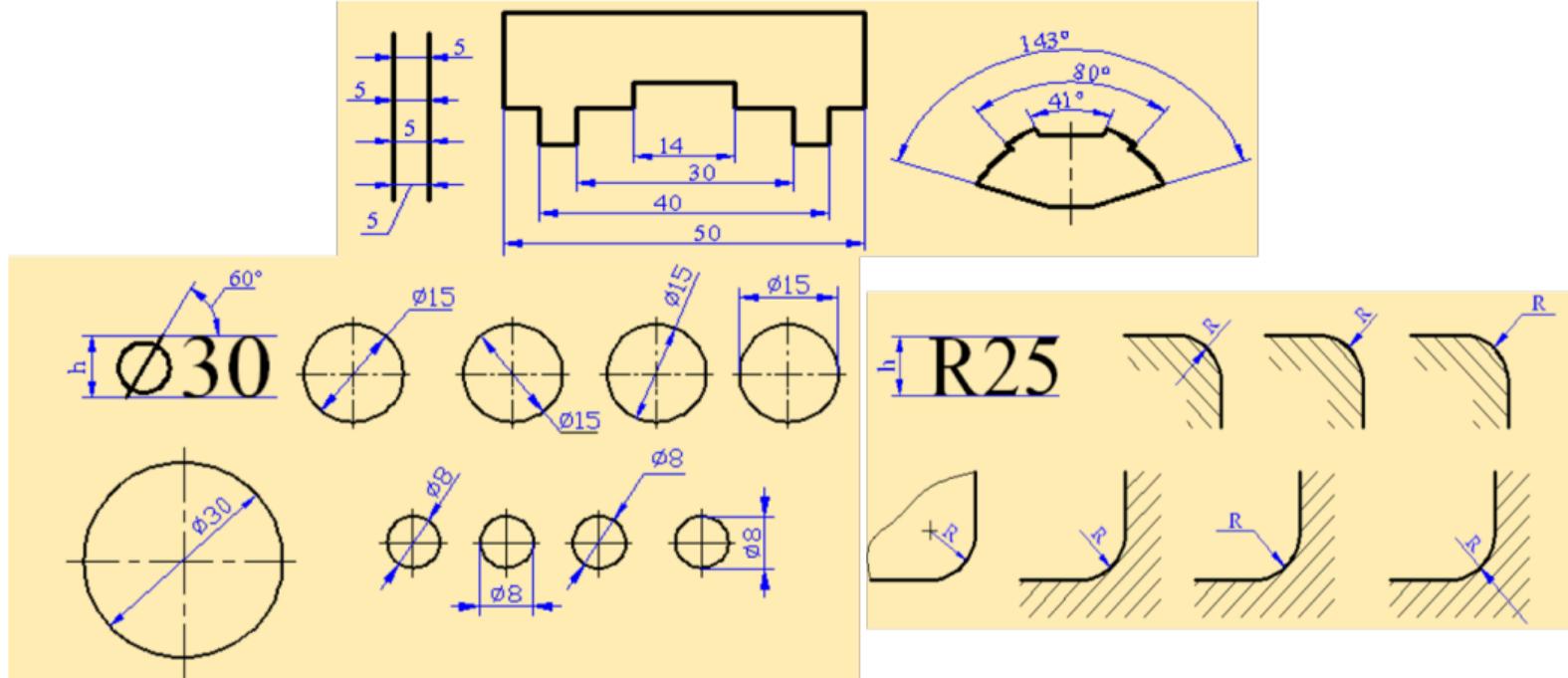


GOST Standard



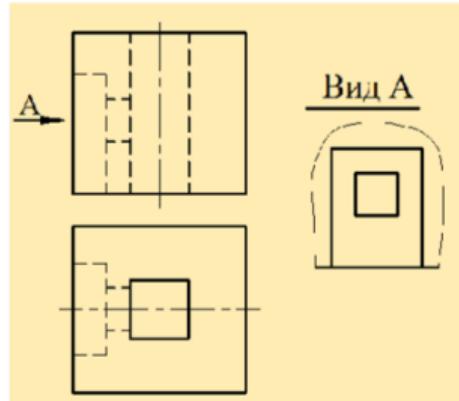
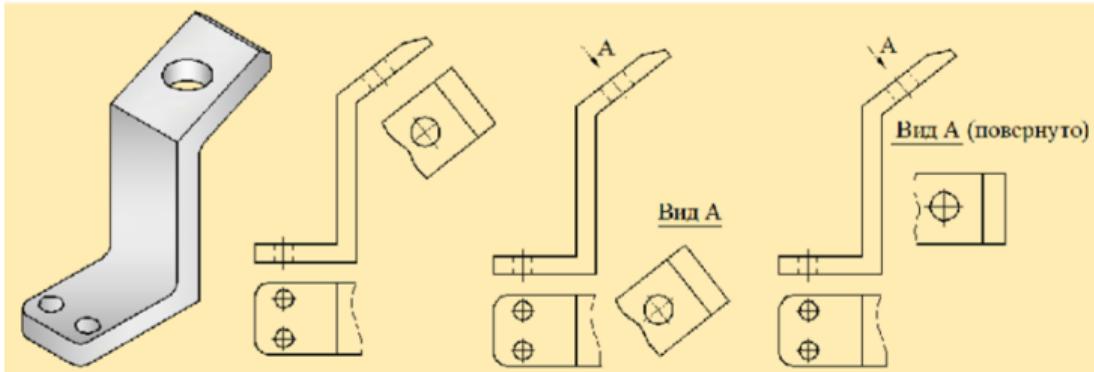


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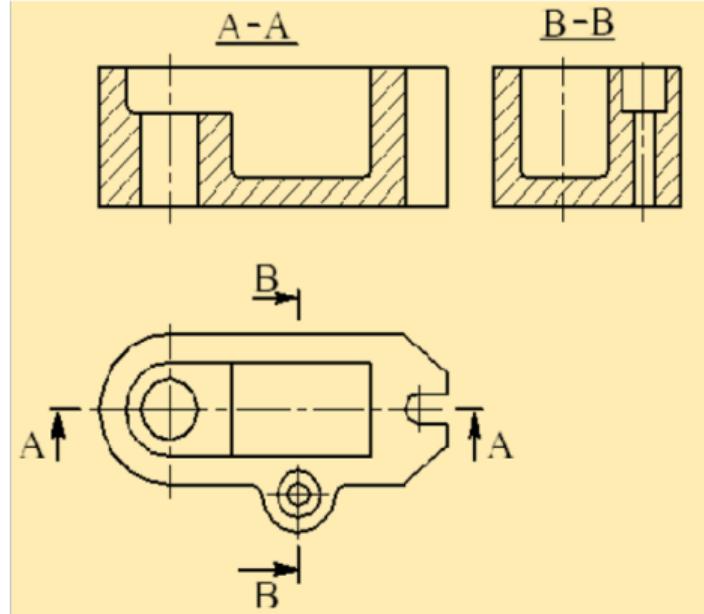
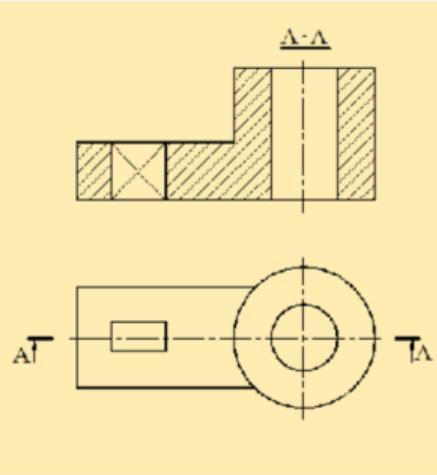
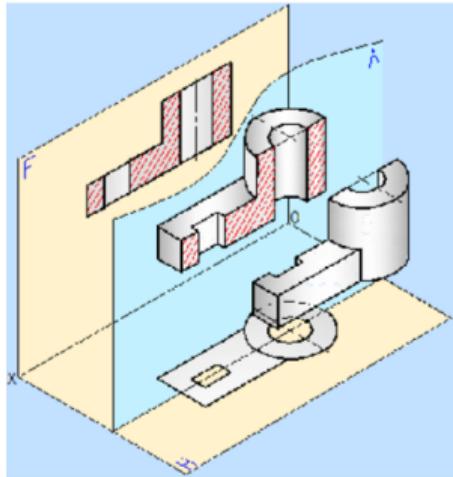




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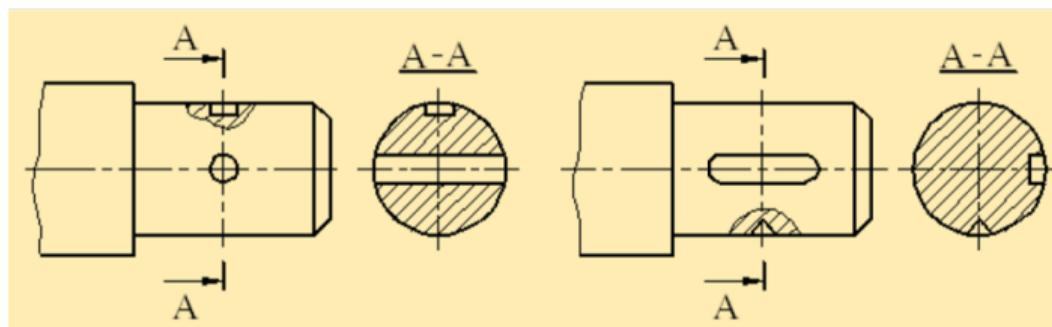
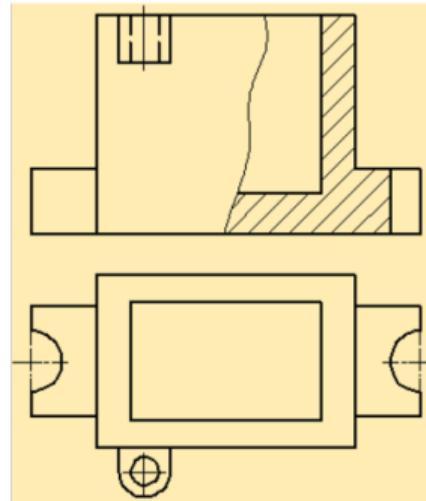
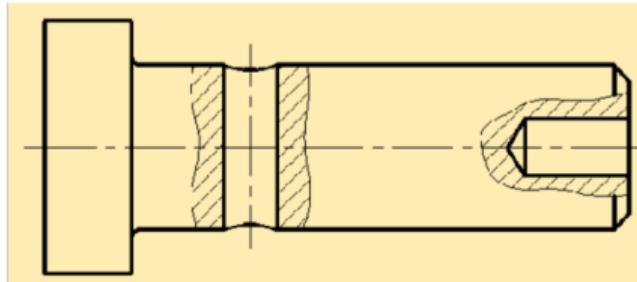


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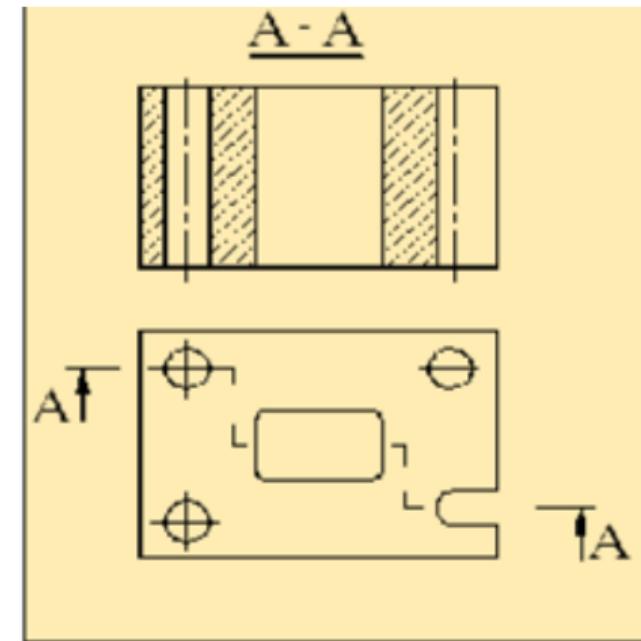
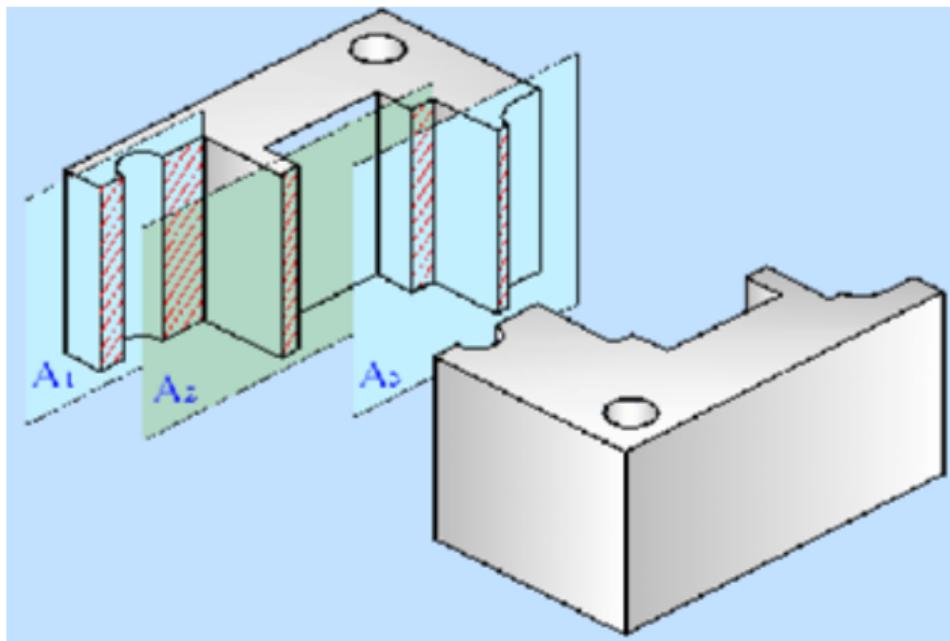


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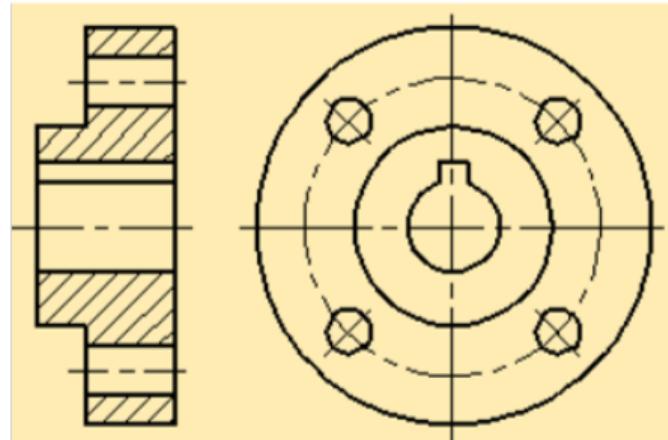
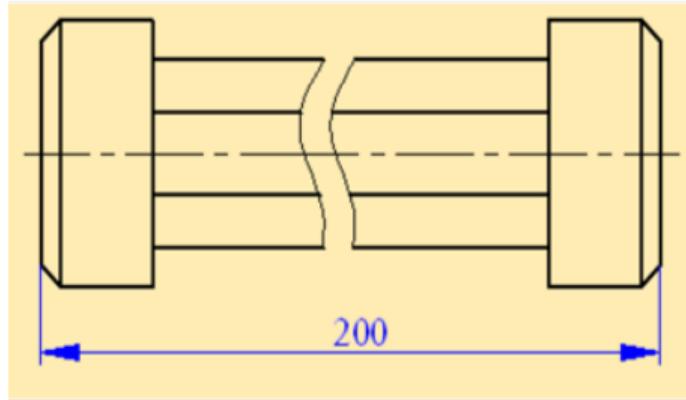




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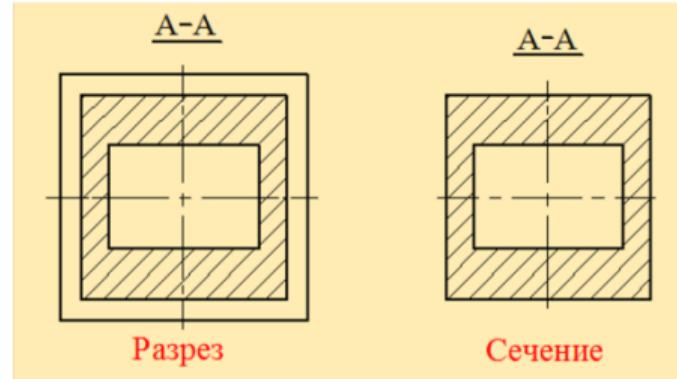
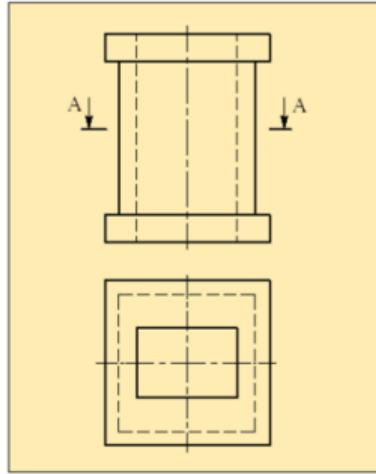
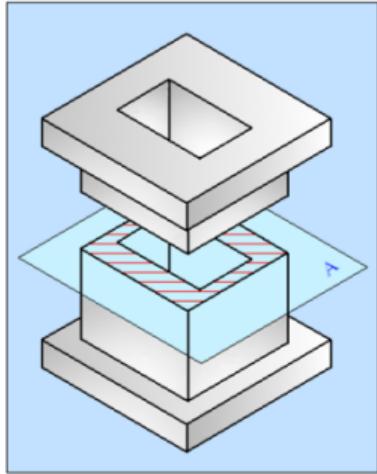


GOST Standard





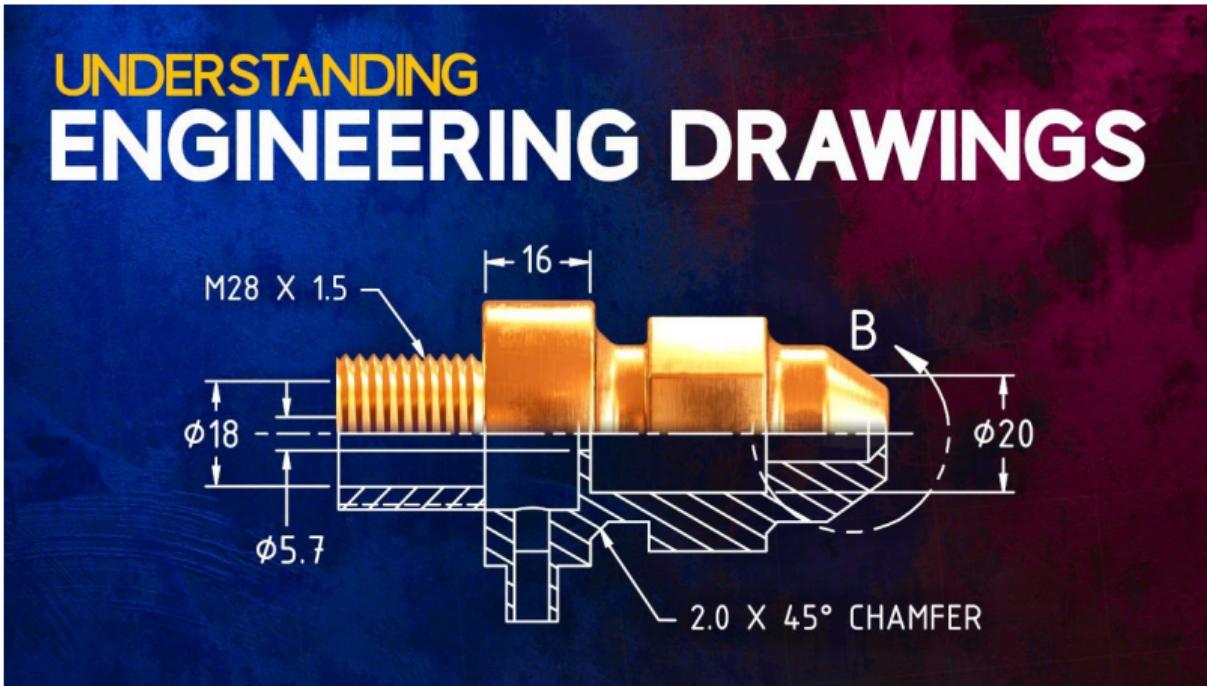
GOST Standard





Understanding Engineering Drawings

Video





Reference Materials

1. Title Block
2. Методы проецирования (RUS)
3. Инженерная графика (RUS)

Deserve “A” grade!

– Oleg Bulichev

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↗ @Lupasic

🚪 Room 105 (Underground robotics lab)