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Methodology for Teaching the Topic "Plane" in Engineering Graphics

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Abstract: The article is devoted to teaching the topic of plane in engineering graphics; some teaching methods are presented. Examples from real life are given where the intersection of planes, parallel planes, and the intersection of a straight line and a plane are used.

Keywords: descriptive geometry, engineering graphics, plane, method, interactive teaching methods, mutual intersection of planes, science and technology, development of creativity, visualization.

INTRODUCTION. The main goal of descriptive geometry is the development of spatial and constructive-geometric thinking, the ability to analyze and synthesize spatial forms and relationships based on geometric models of space, practically implemented in the form of drawings of technical objects, as well as corresponding processes and dependencies. The main goal of the engineering graphics course is to develop the knowledge, skills and abilities necessary for students to complete and read technical drawings for various purposes, sketch parts, and draw up design and technical documentation for production.

Let's give some examples from real life when the image of a plane in drawings plays an important role for design, construction, geodesy and other areas of engineering and architecture: drawings of architectural projects show the plane of the foundation, walls, ceilings and other building structures. This allows engineers and builders to accurately visualize the location and shape of building elements. In drawings of parts of mechanisms and machines, a plane is also often depicted. For example, the sectional plane of a part is shown, which helps to understand its internal structure and geometry. Drawings of utility networks (water supply, sewerage, electrical networks) show the plane of pipelines, cables and other network elements. This helps to correctly place communications and ensure safe operation. The maps show the plane of the terrain, heights, relief and other characteristics of the landscape. This is important for terrain orientation, construction planning and other purposes. Geodetic drawings and maps also use a plane image to indicate coordinates, angles, distances and other parameters.

LITERATURE ANALYSIS AND METHODS

When explaining plane traces to students, the following techniques can be used:

1. Visualization: Use demonstration materials such as graphs, drawings, models, or interactive applications to show students what plane tracks look like.

2. Examples: we will provide students with examples of problems in which it is necessary to find traces of a plane, and we will analyze their solution step by step.

3. Practical tasks: we will give students the opportunity to independently solve problems of finding traces of a plane so that they can apply the acquired knowledge in practice.

4. Discussion: We will discuss the theoretical aspects of plane traces, answer student questions and encourage active participation in the discussion.

5. Interactive teaching methods: We use games, cases, group assignments or other interactive teaching methods to make learning about plane traces more fun and memorable for students.

The mutual intersection of planes occurs in various situations and areas of life. Here are some real-life examples that can be used when teaching this topic:

1. Architecture and construction: when designing buildings and structures, engineers are often faced with the need to determine the intersection points of planes to create the correct structure.

2. Graphic Design and Art: Artists and designers use the intersection of planes to create perspective images, compositions, and effects.

3. Mechanical engineering and industry: When designing machinery and equipment, engineers are often faced with the need to take into account the intersection of planes for the correct arrangement of parts and assemblies.

4. Geodesy and cartography: In measuring and constructing maps and plans, surveyors use plane intersection methods to determine the coordinates of points on the Earth's surface.

5. Science and Technology: In various scientific and technical fields such as physics, chemistry, biology, aerospace, etc., plane intersection plays an important role in modeling and data analysis.

Providing such examples will help students see the practical application of the theory of intersection of planes and understand its significance in various fields of activity.

Studying the topic of intersection of planes is important for the development of spatial concepts in students. Here are a few ways this happens:

1. Visualization: Working with the intersection of planes requires students to be able to visualize three-dimensional objects and the relationships between them. This helps develop their spatial thinking and ability to imagine objects in three-dimensional space.

2. Problem Solving: Plane intersection problems often require the use of logical reasoning and analytical skills. Solving such problems helps students develop the ability to analyze complex spatial structures and find solutions.

3. Application in practice: Knowledge of the intersection of planes is useful not only in mathematics, but also in many other fields such as engineering, architecture, design and science. Understanding this topic will help students better navigate three-dimensional space and apply their knowledge in practice.

4. Developing Creativity: Working with intersecting planes can stimulate students' creative thinking as they can experiment with different combinations of planes and create new designs and shapes.

Studying the intersection of planes contributes to the development of spatial concepts in students, which is important for their learning and future professional activities.

To determine the point of intersection of a generic straight line with a generic plane in descriptive geometry, the projection method is usually used. This method consists in drawing a plane of particular position (for example, projecting) through this line, which intersects the original plane.

The projection method makes it possible to more conveniently determine the point of intersection of a general line with a general plane in descriptive geometry.

To explain things more clearly to students, you can use the following example:

Imagine that you have a straight line in space and a plane that intersects this straight line. To find the point of intersection of a line with a plane, we can use the projection method.

First, we draw a plane that passes through a given line and is perpendicular to the plane in which the line is located. This plane is called the projection plane. After the projecting plane has intersected the original plane, we obtain the point of intersection of the straight line with the projecting plane.

We then use the projections of this point on the base plane (where the line is) and the projection plane to determine the desired intersection point of the line with the source plane.

Thus, the projection method helps us find the point of intersection of a line with a plane more clearly and efficiently.

When constructing the line of intersection of two planes (when the planes are defined by two triangles), we will use this method. Let's imagine that we have two triangles, each of which lies in its own plane. Our task is to find the line of intersection of these two planes, that is, the intersection point of two triangles.

To do this we can use the projection method. First we draw a projection plane through one of the triangles so that it intersects the other triangle. We then find the intersection point of this projection plane with the other triangle.

Next, we use the projections of this point onto the first triangle and the projection plane to determine the point where our line of interest intersects the first triangle.

Thus, using the projection method, we can find the intersection line of two planes defined by two triangles and determine their intersection points more clearly and systematically.

Let's consider an example of using the projection method to find the line of intersection of two planes in engineering and technology. Let's imagine that we have two planes, which are defined by two surfaces of parts, for example, the cover and body of the device. We need to find the intersection point of these surfaces to determine the exact position of the elements in the assembly.

Using the projection method, we can create a projection plane that intersects both surfaces. Then, using the projections of this plane onto each of the surfaces, we will find their intersection points. This will allow us to determine the exact position of the line of intersection of the two planes and provide engineers with information about the fit of the parts.

Thus, the projection method can be effectively applied in engineering and technology to solve problems of precise positioning and analysis of the relative position of structural elements.

The mutual intersection of planes in descriptive geometry is widely used in industry, especially in the engineering and design industries. Some applications include:

1. Design of mechanisms and machines: When designing complex mechanisms and machines, it is often necessary to determine the exact relative position of various parts and structural elements. The mutual intersection of planes makes it possible to determine the geometric parameters and relative position of the parts.

2. Design and manufacture of equipment: In industry, there is often a need to design and manufacture various equipment, such as piping, frames, structures, etc. Knowledge of methods for mutual intersection of planes allows you to optimize the design and manufacturing process.

3. Development of engineering diagrams: When developing engineering diagrams, for example, in civil or mechanical engineering, it is necessary to take into account the mutual intersection of various elements to ensure the correct assembly and functioning of the system.

4. Quality control: Mutual intersection of planes is also used to control the quality of manufactured parts and structures. Geometric methods can be used to verify that the size, shape and position of parts meet the required standards.

Mutually parallel planes also have wide applications in various fields, including engineering, architecture, geometry and others. Some applications of mutually parallel planes include:

1. Construction and architecture: In the process of designing buildings and structures, parallel planes are often used to determine the location of walls, ceilings, windows and doors. This helps ensure the correct ratio of sizes and shapes of structural elements.

2. Engineering Modeling: When creating 3D models and drawings, engineers often work with parallel planes to determine the position and shape of parts. This makes it easier to visualize and design complex objects.

3. Geodesy and cartography: In geodesy and cartography, parallel planes are used to construct maps, site plans and other geographical features. This helps present information about the area more clearly and accurately.

4. Manufacturing and Fabrication: In industry, parallel planes are used to control the quality of parts being manufactured, as well as to ensure that parts are positioned correctly on the production line. This helps reduce the likelihood of errors and improve production processes.

CONCLUSION. Thus, knowledge and ability to apply methods of mutual intersection of planes in descriptive geometry plays an important role in the process of design, manufacturing and quality control of products in industry. Understanding and ability to work with mutually parallel planes is an important skill for specialists in various fields where precise determination of the location and shape of objects is required.

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