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Topics of descriptive geometry for students of engineering faculty

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Abstract
Descriptive Geometry (DG) is a graphical and mathematical course that describing with the empirical performance of the process indication as well as with the applied and development of object in axonometric or space by ways of conceptual drawings. Due to the changes in the programmed to the reducing portion of DG in the course of engineering studies it is on longer possible to lecture DG even incompletely to its complete extent. As support to the development of Program of "Descriptive Geometry for engineering" The graphical topics actually applied by professional engineers as well as those witch help the students straight or indirectly in increasing skills fundamental in the daily work of professional engineers are explored.

Keywords: Descriptive geometry courses, axonometric, selection of topics, projection, orthogonal, perspective and views

1. Introductions

The descriptive geometry (DG) is a since advanced in century XVIII for Gaspar Momge with the objective to enhance the design and the construction of blockhouses [4]. From there, this facts it passed to tread as military knowledge, being teaching in the military schools, until of century XIX [6, 7] and descriptive geometry is, later then, a basic discipline of Engineering graphic programed.

Although to have been shaped as project tool, the teaching of descriptive geometry dese not make relative with the project. Descriptive geometry has been preserved for teachers, conventionally, as pure ability, as physical and precise, demanding a great effort of abstraction of its learning a great effort of concept for tis learning. What it creates a paradoxical situation, therefore one of the objectives of the DG teaching is exactly to awake in the apprentice the abstraction capacity besides mounting the vision and the three – dimensional intellectual. The rearward important significances for the support stages, circumvention and, mostly, for the excellence of the learning of this science that is basic for the creation in Engineering and Architecture. The fact if that there are a few differences in the judgment of descriptive geometry in last the two centuries.

The effort reflects an advanced procedure for the teaching of descriptive geometry, in the direction to connection this science with its creative neutral: the design. By this way, the image techniques forecasts and descriptive approaches have as main approach the answer of project difficulties.

The use of design based learning is a movement in the contemporary school of Engineering and Architecture that, besides rise the impartiality of teach – learning process, it arouses the team work interdisciplinary effort.

The procedure proposal is reinforced in two basic supports that are: a new tactic in the performance of the substances, based in tangible situation, and new policy of education, where the students use the ideas of descriptive geometry in development of design.

In order to regulate the topics and ways of Descriptive Geometry (DG) which are in exact relatives' for expert engineers we will not only explain the value of the variance behaviors of projection for engineering drawings but also studies the solicitation of 3-D shapes in the engineering field of responsibility.

2. Choosing methods of projection

The subsequence features are applicable for choosing the type of projection.

- The predefinition of geometrical substances by orthogonal projection,

- The methods prediction with truthful special effects and
- The development of the exact special effects by other means.

2.1 Orthogonal plan

Engineers depend on drawing to develop projects, to find controversial areas and to find explanations about design and structure. These clarifications consume to be nearing extinction and they deliver the basis for all subsequent phases and permits the engineers to join with all the other experts intricate in the practice of building. DG shows a dynamic effect to the predefinition of geometrical designs by orthographic plot onto greater reproduction plans [1]:

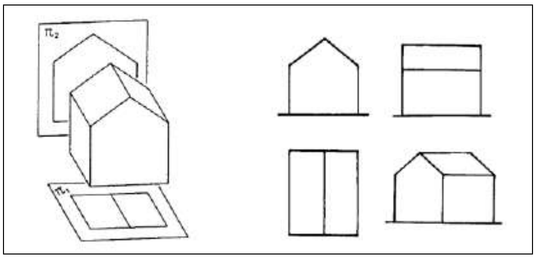

Fig 1: façade and Epure of solid

- Ground plan (the plane π_1 is horizontal) Figure 1,
- Elevation (the plane π_2 is vertical and parallel to main plane of the object),
- Side views and region (the plane perpendicular but not parallel to main plane of the object.

Beside with those orthogonal projections all tasks of three-dimensional geometry valid to expert engineer can be determined by blend of only eleven basic task:

1. Resolve of a forth pint of a plane,
2. Intersection of a straight line and a plane,
3. Resolve of a line orthogonal to a plane,
4. Resolve of a plane orthogonal to a line,
5. Revolving a point about a straight line,
6. Accurate length of a line segment,
7. Accurate size of the angle between a line and the image plane,
8. Accurate size or the angle between a plan and the image plane,
9. Accurate size of the angle between two intersecting lines,
10. Accurate size and shape of a plan figure.

Due to the great import of this substance the structures of orthogonal projection quoted above should shape the main part of instruction DG for students of fundamental design. For knowledge we distinguish these subjects are for students the most thought-provoking ones to understand. Once assumed, the enthusiastic engineer works with these methods every day. Therefore most of them overlook that they had to learn it once and that this was a hard job.

2.2 Ways of projection with realistic effects

Engineers apply truthful sights meaningfully less than orthographic views. Truthful sights are principally cast-off to display laymen the effect of the architectural project. For the engineer it is significant that these pictures come as close likely to reality [2]. The more the projective rays and optical rays (of the observer) agreed, the well the straight result of a drawing. In most cases the askew parallel projection is uncomplimentary, because the outline of a sphere is an ellipse. The orthographic comparable projection is helpful; the framework of a sphere of influence is circle the central projection is idyllic because the projective rays and the visual lines can actually related; the outline of a sphere is circle. But the outcome of a central projection will be negative when the watcher looks from the incorrect location: if the central of the sphere of effect is not on the main painterly ray, the outline of sphere is an ellipse or even another conic Figure 2.

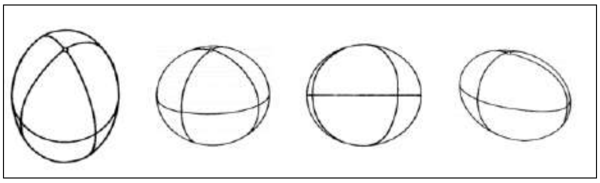

Fig 2: Sphere drawing

Regarding this, the four ways of projection with the most faithful significances are determined:

- Axonometric: The orthographic parallel projection onto an inclined image plane has exclusively good effects and is easy to draw Figure 3.

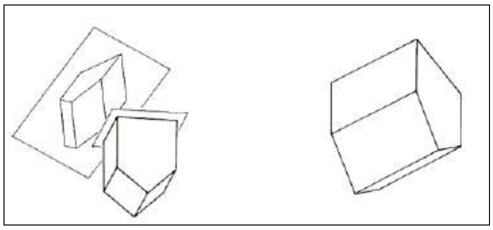

Fig 3: Inclined axonometric projection

- Birds- eye- view: Even however the sloping parallel projection against a horizontal image plane has disadvantages in regard of its realistic effects it should be skilled it is easiest realistic drawing Figure 4.

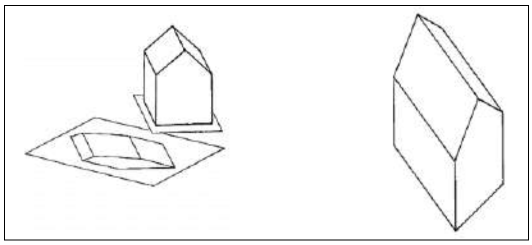

Fig 4: Axonometric projection

- Perspective: The central projection onto a vertical image has the best realistic effect; with this perspective the architect can show design in the most favorable way Figure 5.

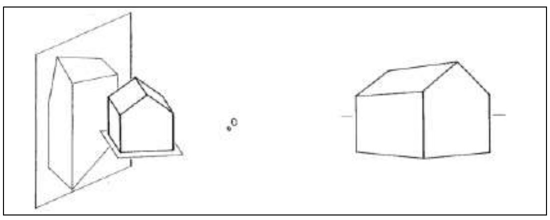

Fig 5: Perspective projection in vertical image plan

- Frontal perspective: the central projection onto an image plane parallel to the elevation plane is a special case of the perspective: The object cannot be shown from every angle but the method of construction is easier Figure 6.

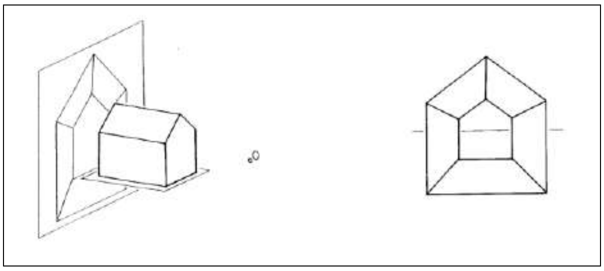

Fig 6: Frontal perspective.

These imitations suggest that the birds-eye- view and the perspective are mainly significant to engineers and therefore should be taught in full detail. The axonometric and the frontal perspective are also elective to be included in the curriculum.
In order to present a brief and humble method of drawing views for engineers , a configuration course has been calculated which works for all ways of projection, needs slight purpose and allows drawing of every object. The basis of the configuration practice contains of four steps Figures 7. (a) Birds-eye- view, (b) axonometric, (c) perspective, (d) frontal perspective

I. Choice of view:

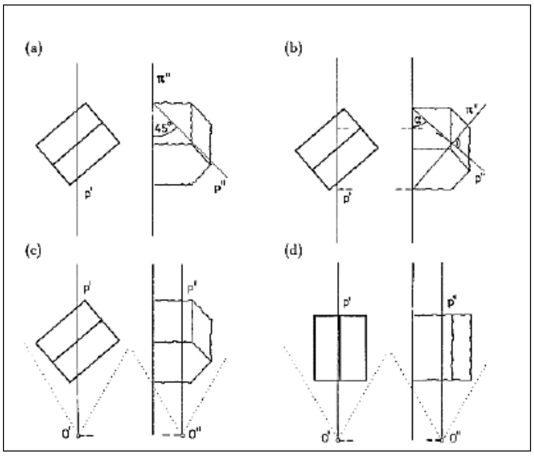

Fig 7a: Configuration stapes of engineering drawings.

II. Determining the ground plan:

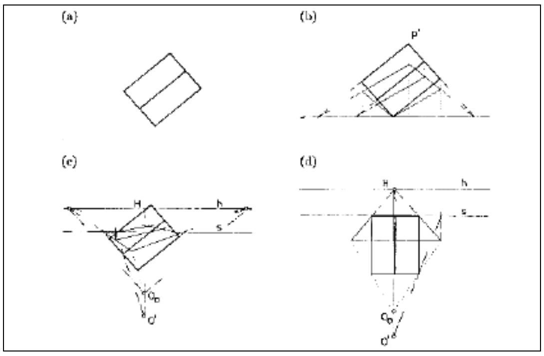

Fig 7b: Four positions of ground level.

III. Protracting the heights

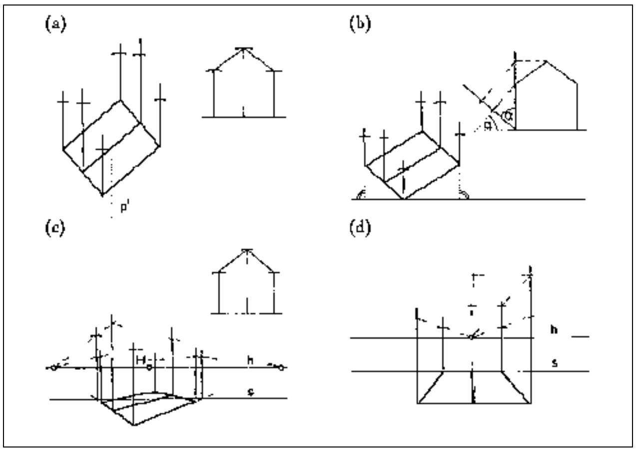

Fig 7c: Assignment of Height.

IV. Simplifications for the reproduction of parallel

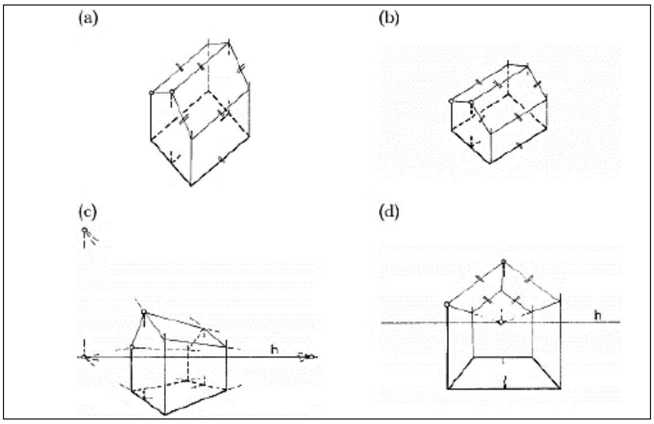

Fig 7d: Final drawings.

Additional basics are established which are able to reduce the effort in shop even more:
V. Spreads for the portion of lines,
VI. Simple copy of figures in vertical planes,
VII. Simple unpretentious of figures in inclined planes,
VIII. Reconstruction of the constraints of a projection.

2.3 Upgrading of accurate effects

The truthful result of ground plans can be improved by including shadows; this technique is often also useful for progresses, axonometric and perspectives. The compatible geometrical ideas should be part of the programme. The construction of shadows is likely by means of the eleven above mentioned basic tasks Figure 8.

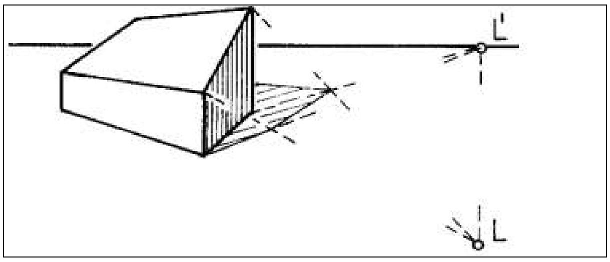

Fig 8: Drawing equipped with shadows.

Drawings of reflections in engineering pictures are not really necessary.

On the other hand there are some slight unusual which are worth in the obligatory course Figure 9.

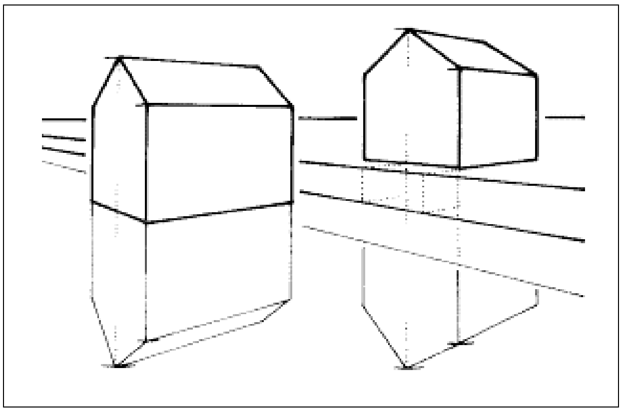

Fig 9: Drawing equipped with reflection.

3. Selection of objects

The following substances are to differentiate: Polyhedral, curved surfaces and crossings of curved surfaces.

3.1. Polyhedral

Polyhedral characterize the spatial being most significant to engineers. Everybody will settle that the more influential part of geometry is shaped by prisms and cuboids whereas pyramids are seldom used and consistent polyhedral are almost never found. On the other hand there are a lot of over-all polyhedral in architecture. To handle polyhedral in illustrations the architect must be able to master only the eleven above cited basic tasks. Some easement of labor can be attained by using attraction or perceptivity when a prism or a pyramid is cut by a plane Figures 10.

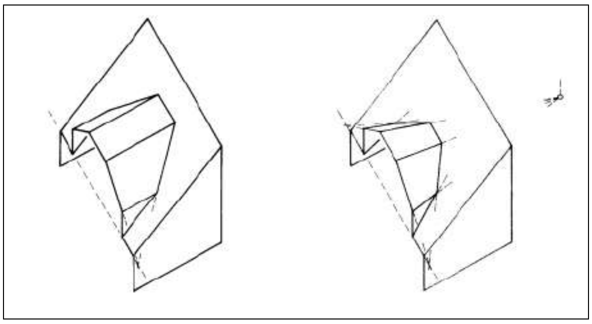

Fig 10: General polyhedral

3.2. Curved surfaces

Conventional cylinders are frequently used as architectural basics; the benefit of conventional cylinders is that they are shaped by straight lines (beams) and circles of the same size, therefore the prefabrication is easy to plan. The conventional cylinder is mostly located level or vertically [3]. Elliptical, parabolic and general cylinder are rarely used in architecture: The straight lines and the replication of the same curves on the surface are beneficial, but the bending differs in each point of the cures. There are only few straight circular cones in architecture (and nearly no general cones): The shortcoming is that all straight lines interest in one point and all the circles in their radius. To switch cylinders and cones in drawings the architect can fall back on the systematic frilliness of prisms and pyramids. Also ellipses, the structure of angles and the expansion of the shells have to be dealt with figure 11.

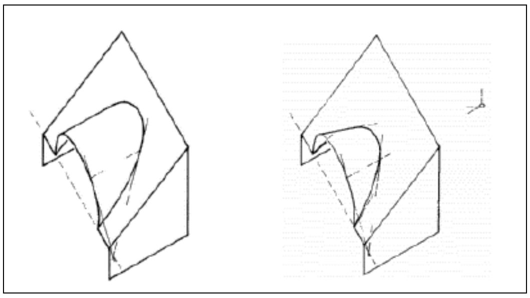

Fig 11: Curved Surface.

There is a restricted digit of circles in architecture: Due to its double bending a sphere can be made as a shell and will convey a many of its own mass. But the creation of spheres is exclusive Figure 12.

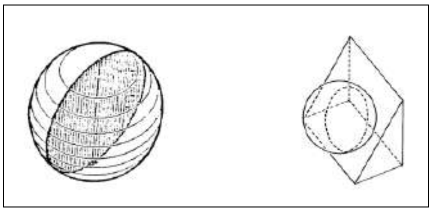

Fig 12: Curved Surface

General surface of revolution are less suitable as part of structure: the meridians can be factory-made frequently in the same form, but the equivalent circles on the surface differ size. Most example of surfaces of revolution in architecture are tori (rotated circles) or one – sheet hyperboloids of revolution (rotated straight lines) [2] Figure 13.

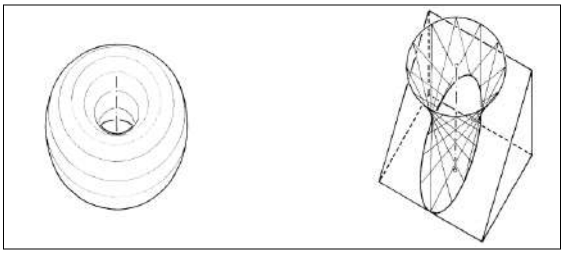

Fig 13: General curved tori surfaces

Over-all shells made by the construing a bend do not supply the geometry with explanations for his tasks. The only exclusion is the hyperbolic paraboloid: On its surface there are two units of straight lines, therefore from panels can be used for its erection. Also two cohorts of parables are on the surface which luckily divert the forces. So great spans with small construction heights are possible Figure 14.

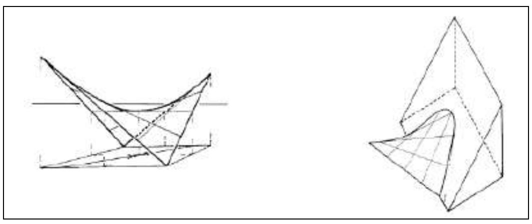

Fig 14: Hyperbolic Parabolized surfaces.

Solid parts caused by a screwing motion can only found at spiral staircases and ramps Figure 15.

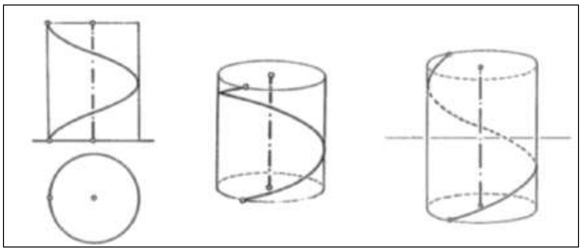

Fig 15: Cylinders Surface.

All the planes cured until now can moderately easily be created by a effort of a curve. Of course there are other surfaces which can be appropriate for solving engineering tasks.

As they do not follow humble geometrical rules and their arrangement is very multipart to handle. These shells are not part of the curriculum of DG. On the other hand it should be noted that only those parts of building are to produce easily and carefully, which are easy to draw. If the engineer still aims to use a general surface, he has to use a model or a computer specialist.

Brief it can be resisted, that conventional cylinders are most often used as geometry basics among curved surfaces; therefore students of engineering filed should be taught the necessary knowledge of cylinders thoroughly.

Overall cylinders, conventional circle cones and spheres can be dealt with in a straighter way.

Some other surfaces (e.g. hyperbolic parapoloid and spiral surfaces) can be touched briefly in a mandatory DG course and should be dealt with in an advanced and optional course.

3.3. Crossings of rounded surfaces

As cited above, curved surface are rarely used in engineering drawings; even more occasionally these surface are located in a way that they intersect Figure 15.

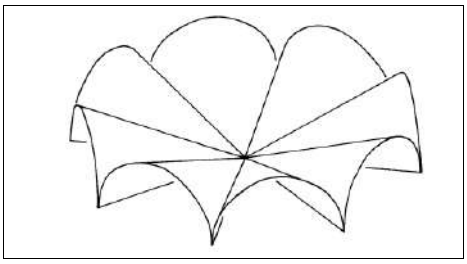

Fig 15: Conic surface intersections

Most of these rare cases are built by intersecting straight cylinders. Combining two cylinders in positive cases the line of intersection lays in a plane. The cases are easier to handle and cheaper to build than curved lines Figure 16.

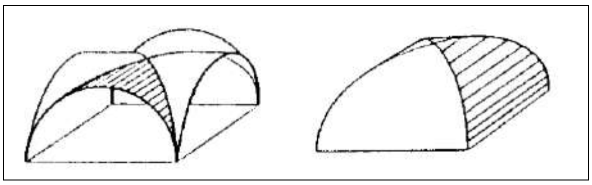

Fig 16: Combined cylinder surfaces

Inters sections of curved surfaces are very rare in engineering drawings and can therefore be neglected in the curriculum Figure 17.

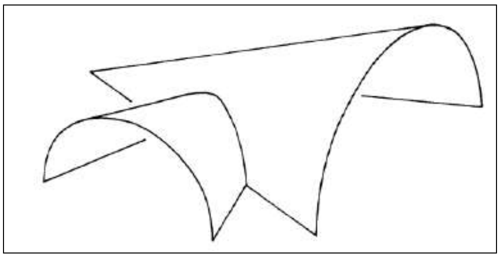

Fig 17: Combined cone Surfaces

Though, then even two traditional circle cylinders can cross in a curved line, students of engineering faculty should be taught the basic values dealing with intersection and with intersections, e.g. the methods of auxiliary plans to find points of intersection, and the method of oblique planes to find the angles of curved line.

4. Conclusion

This choice of subjects in a DG option allow students of engineering to resolve geometrical task which happen in their upcoming jobs. Moreover they are talented to capably notify themselves with the backings to solve exceptional geometrical complications if they occur in repetition. The outcomes of this work can be used for unindustrialized a curriculum for teaching geometry at university and they represent the basis to tie the teaching of Descriptive Geometry to other subjects within the study of architecture.

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