# New Teaching Method To Teach Projection & Development Of Solids

Prof. S.N. Upadhye

(Mechanical, VVPIET/ Sholapur University, Maharashtra/India)

Prof. S.M. Shaikh

(Mechanical, VVPIET/ Sholapur University, Maharashtra/India)

Prof. T.B. Yalsangikar

(Mechanical, VVPIET/ Sholapur University, Maharashtra/India)

## *Abstract*

*Professors and teachers find it quite difficult to teach Engineering graphics. Since it contains the concepts of orthographic projection, isometric projection & perspective projection. Projection of solids, section of solids etc.It is very difficult to explain by conventional methods the three dimensional concepts to the students with less visualization ability. These students find great difficulty in understanding the three dimensional concepts, necessary for understanding of the subject. I suggest a concept for teaching Engineering Graphics which uses physical models developed by the students at the time of learning process. Use of above tool, has greatly enhanced understanding of basic concepts of Engineering Graphics by students and made the professors' job easy. The paper does not underestimate the benefits of using designing and drawing software's or says that the new technology is ridicules but author feels that the rapid changes in teaching engineering drawing and graphics is making use of software's like AUTOCAD PRO-E, CATIA, etc. which has made it very easy to visualize the concepts of that particular subject. But the use of software is a supportive thing to teach graphics. What teachers should do is to go back to the basics and use physical models created by students for teaching a drawing subject such that students get the proper visualization and imagination of the problems.*

## *Appendices*

*1. Table No.1- Passing percentage analysis.*
*2. Table No.2- Percentage analysis of students after interchange.*
*3. Table No.3- Teaching hours required to spend.*
*3. Figure No.1- Projection of a hexagonal pyramid with one of its sides parallel on H.P.*
*4. Figure No.2- Development of a hexagonal pyramid.*
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*6. Figure No.4- Crafted model of pyramid.*
*7. Figure No.1a- Projection of a pentagonal pyramid with respect to H.P. & V.P.*
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*10. Figure No.4a- Crafted model of pyramid.*

***Keywords:****-V.P- Vertical Plane, H.P. - Horizontal Plane.*



## INTRODUCTION

The engineering education starts with some of the basic subjects which are possibly useful for further educational and professional life. Subjects like engineering graphics in the first year have a greater impact on students. The main objective of the subject is to create students with greater imagination skills and visualization skills. Since it is related to Mechanical & Civil engineering branches students from other branches takes it very lightly. They think it is the first and the last time they have to face it. This tendency of students makes this subject difficult to understand and the objective of the subject gets failed. Author is trying to say that teacher should make the use of the curios nature of the student. In this paper a sample research has been carried out on two groups of 30 students each. One of the groups is taught by

regular method of teaching on blackboards and the other one used the method of modeling or crafting the problem by themselves. Students of group which has been taught by this method of making model are provided with paper sheets, scissors, gum, and all the required tools and material.

## Why Modeling?

"People learn more quickly by doing something or seeing something done." - Gilbert Highet

Roberts and Baynes have stated that "Making' is recognized by anthropologists, cognitive scientists, psychologists and educationalists as one of the most fundamental aspects of human beings. Every known human society has used making as a way of shaping its environment. But making is also crucial in personal development not only because of its practical usefulness but also because it interacts creatively with other aspects of intelligence. In child development, making is so fundamental that there is a danger of it being taken for granted. In fact, all children depend on handling materials and working creatively and experimentally with a variety of tools in order to attain basic knowledge about the world." [1]One of the advantages of three dimensional modeling is that it involves the student in making. Modeling answers the questions like what a model is, why modeling is an important issue to address for design and technology educators, why modeling can be considered the language of design, what the relationship is between modeling and designing, why models are used and what forms of modeling are available. A model is a representation of something which exists, or in the case of design and engineering, something that could be produced. A model has only some of the attributes of what it is representing. Different types of models can represent different attributes and some can demonstrate particular attributes better than others. [2]

Basically models are classified as follows according to whether they provide a visual representation, a diagrammatic form or abstract code:

Iconic models ~ those that represent an aspect of a object by looking like that aspect e.g. a drawing or 3D model of a pyramid or prism, paper, Sketching, card, foam, clay and wooden 3D models are all forms of iconic models. Analogues models ~ those where diagrams, using symbols, are being used to represent a system or product. Symbolic models - these are models which use an abstract code to represent aspects of an existing or possible product or system such as a mathematical model to represent some aspects of a new bridge. [2]

**Science thinking skills associated with making and using models.**

Recognizing the similarity between models and the things they represent, e.g. recognizing what is and isn't a model.

Assessing the strengths and limitations of models in explaining and predicting the behavior of the objects or phenomena they represent. Physical models are a great way to both educate and motivate the student and can significantly improve student learning. Physical models feed many of the fifteen methods that Wankat and Oreovicz [6] cite in their excellent compendium of what works in the classroom creating models to explain things that cannot be observed directly e.g. acquiring images and understandings that come from drawing, painting, sculpting etc.

Using models to raise questions, communicate ideas, and test hypotheses in many different contexts. [4]

## How to do this?

Today in any engineering institutes Engg. Graphics is taught with the help of Blackboard-chalk, PowerPoint presentations, LCD projection of animated drawings etc. That means the teaching methodology is changing from 2D drawing on a blackboard to 3D visualization of the objects on wall. Students of First Year of Engineering are at the age of around 17-18 years of age are having curiosity about anything new they come around so students should given some practical work to study this subject of engineering graphics.

Today's curriculum of engineering graphics probably contains only drawing approach that is only 2D drawing of an object is taught to the students with expectation of students using their imagination skills. Many of the students draw it mechanically, without absorbing it in their subconscious mind. The problem arises here and goes on and on for years. When these students go to industry as designers they come to know that they can draw any diagram with ease but the imagination skill they were using from their education life is not adapted to the new situations so they have to work hard to achieve this again. Gabel and Sherwood showed that the application of models in teaching had a

positive impact on memorizing. There are very good reasons why modeling in engineering graphics should receive much more attention.

Modeling is a fundamental thing of designing. First the student is explained everything about the idea theoretically and with that idea in mind the students is make to work on a prototype or crafted model. The next thing student observe immediately after theoretical briefing is a self made model of the problem they are about to solve. All of these models have some aspects of the final product or system missing or difference is its color, mass, size etc. If somebody is teaching engineering graphics by the regular methodologies the students can get the idea but some of them with less imagination skills cannot imagine that means one has to minimize the reluctance among undergraduates to use models to help themselves to develop ideas. The most obvious is that it is impossible for anyone else to share the ideas. It is also difficult for most people to develop their ideas significantly just in the mind. Another difficulty with the imaginative or virtual model in mind is the ability to test and evaluate the model just in the mind. It is for these reasons that other forms of modeling are used, to help to communicate to others, [3] while some would say that sketching is the key method or designing, it has limitations and although it is a very important modeling tool for designing, in some cases its importance maybe overstated and again it has been observed that undergraduates have been unable to imagine the tilting etc of the solids. So the students should be given assignments of subject in the form of making models of solids such as Pyramid, Cylinders, etc. one may not be agree with this concept but a sample research has been carried out on two groups of students and the result shown that this concept improved results.

Engineering graphics has different concepts to study such as projection of solids, Planes, lines, section of solids, development of solids, isometric views, perspective views etc.

The following steps are followed during the method.

Step-1 Problem analysis: A hexagonal pyramid of base side of 30mm and height of about 70mm is resting on H.P. it is first it is tilted on one of its corner such that its one side is parallel to H.P. Draw the projection.

Step-2 After the analysis of problem it is solved by regular method that is on the blackboard with students are asked to solve the problem on the sheet. Which look like figure No.1 shown here.

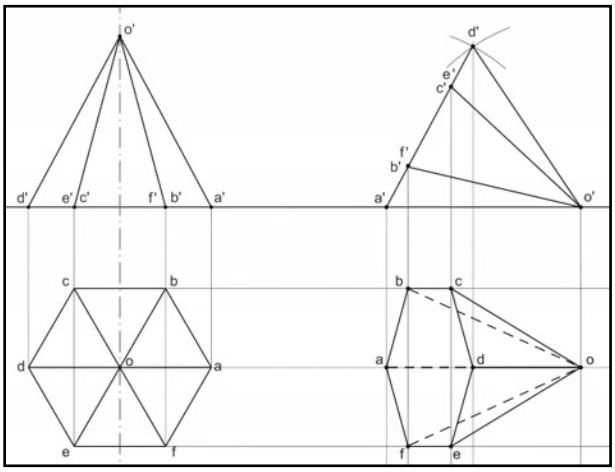

Figure No.1

Step-3 In this step problem is directly linked with development of solids where developing the pyramid is taught. Further the development is drawn on the sheet provided to students as shown in figure no. 2 with proper dimensions & methods.

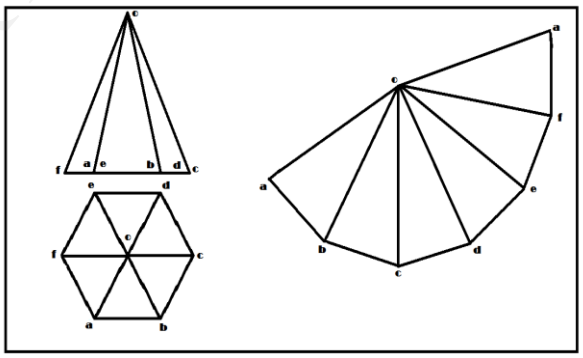

Figure No.2

Step-4 After solving the problem on sheet the sheet is cut as shown in figure no.3 below such that it's crafting is possible with the help of gum and other tools.

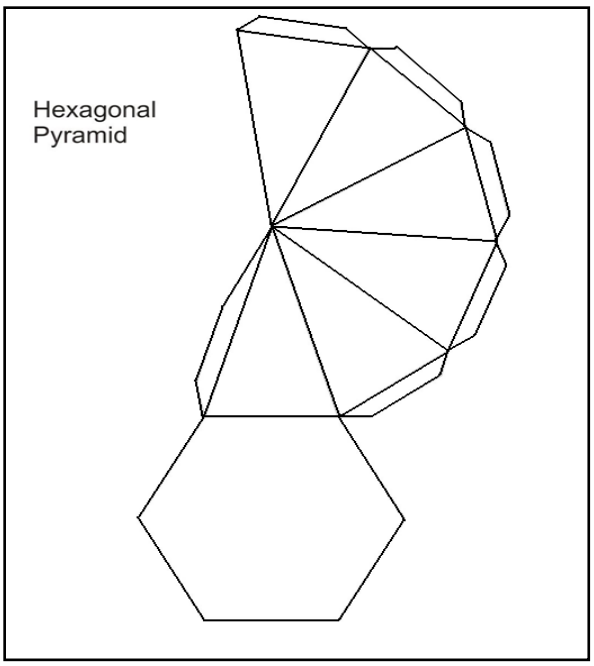


Figure No.3

Step-5 Now the crafting is carried out and a model of pyramid is prepared by every student in the class. As shown in the figure no.4 [5] below.

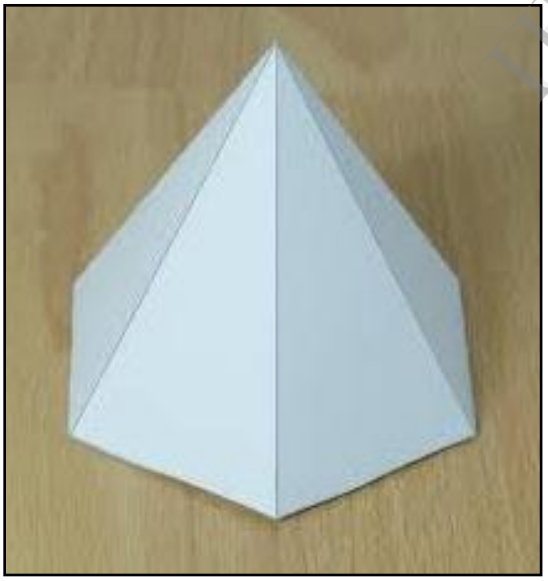

Figure No.4 [5]

Step-6 Next step is to show tilting and projection etc with respect to V.P. and H.P.

This makes them easy to understand the concept of solids and its projection, development and section etc.

## Sample research of the Method

This method of teaching has been applied on two groups of 30 students each and following data has been collected.

| No. Of Groups Participated | | | | 2 |
|---|---|---|---|---|
| No. of students per group | | | | 30 |
| Duration of Classes (teaching) | | | | 1 hour |
| Problem on projection of hexagonal pyramid<br>Time of the test- 30minutes | | | | |
| | | No. of students passed | No. of students failed | Percentage of passing |
| Group A | 30 | 30 | 1 | 99 |
| Group B | 30 | 21 | 9 | 70 |

Table No.1

The table above shows the impact of this teaching method or concept on students. A group of 30 students who were taught by this method undergone a test of 20 marks where the result was 99% passing of the students. The other group of 30 students who were taught by regular methods showed the result of 70% which is good but not satisfactory to the level.

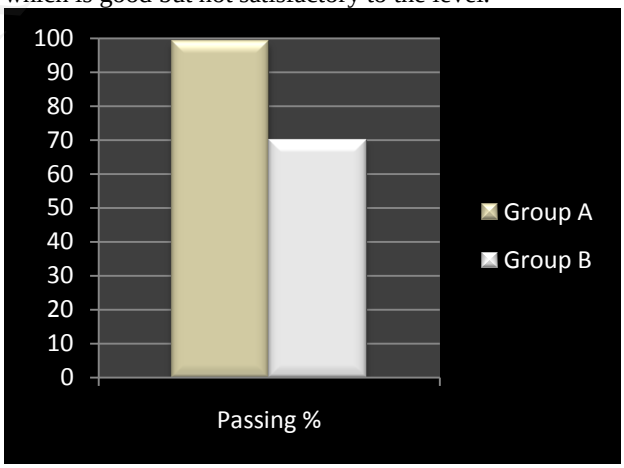


Chart No.1 for Table No.1

Again further to confirm the method statistics we rearranged the scenario by interchanging 10 randomly selected and successful candidate from group A send them to group B and vice versa. Again the test with different problem conducted and following data is collected.

Step-1 Problem analysis: A pentagonal pyramid of base side of 40mm and height of about 70mm is resting on V.P. at a distance of 30mm from

V.P. It is tilted on one of its sides such that its one base side is parallel to V.P. Draw the projection.

Step-2 After the analysis of problem it is solved by regular method that is on the blackboard with students are asked to solve the problem on the sheet. That looks like figure No.1 shown here.

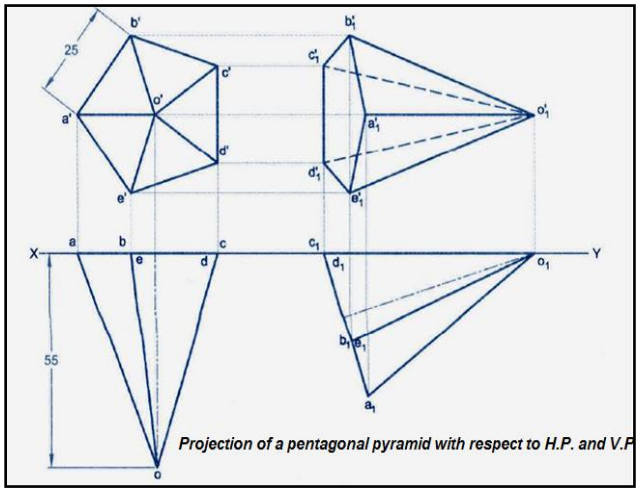


Figure No.1a

Step-3 In this step problem is directly linked with development of solids where developing the pyramid is taught. Further the development is drawn on the sheet provided to students as shown in figure no. 2 with proper dimensions & methods.

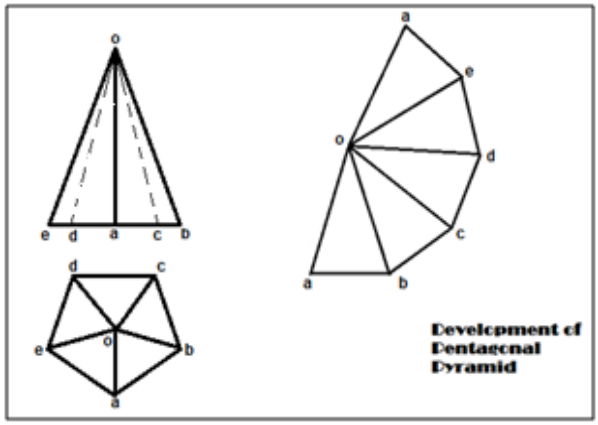


Figure No.2a

Step-4 After solving the problem on sheet the sheet is cut as shown in figure no.3 below such that it's crafting is possible with the help of gum and other tools.

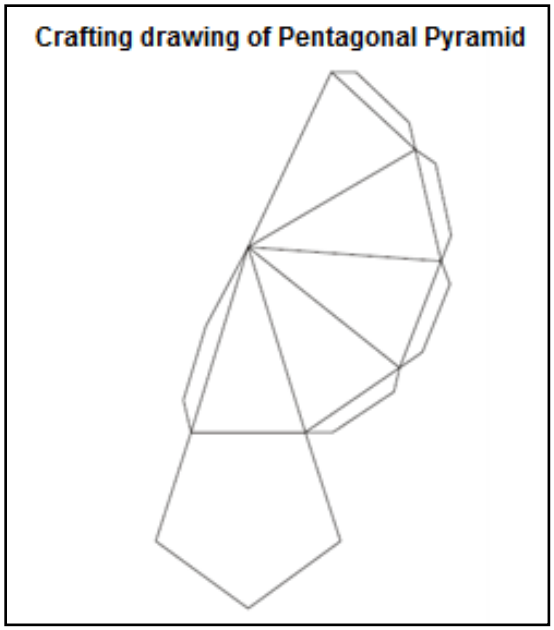


Figure No.3a

Step-5 Now the crafting is carried out and a model of pyramid is prepared by every student in the class. As shown in the figure no.4 [5] below.

Figure No.4a [5]

Step-6 Next step is to show tilting and projection etc with respect to V.P. and H.P.

Table no.2 shows the result of the second test with different problem and interchanged students .Here we observed that though the passing percentage of group

A is reduced, the passing of the group B is increased by a good margin hence we can conclude that the method we are using here is really helpful for the students of first year

Table No.2

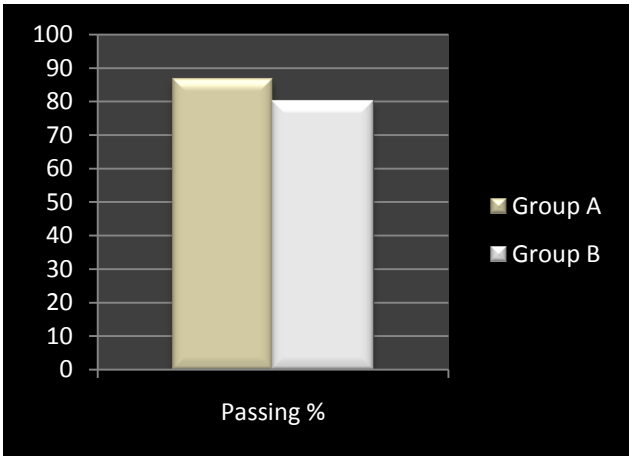


Chart No.2 for Table No.2

## Is it practically applicable to the curriculum?

The method discussed in the paper seems to be time consuming at the first impression. It is quite true if someone is considering only the time factor. If the modeling or physical model making of the solids is carried out at the time of practical's of 2hrs it will be beneficial to the teachers as well as students.

| | No. of students | Time consumed to teach by our method |
|---|---|---|
| Problem no. 1 | 30 | One hr. |
| Problem no. 2 | 30 | One hr. |

Table No.3

## Conclusion

The solution provided in this paper and sample research highlights the need of going back to the basics of teaching but the new technology and computer integrated teaching could not be neglected. The concept has proved its utility for students and teachers to better understand the subject engineering graphics. Another finding here is the time required for teaching, the time required is 25% more as compared to traditional teaching methods. Which author feels, can be tolerated if the method is included in the practical hours of the curriculum.

| Problem on projection of pentagonal pyramid<br>Time of the test- 30minutes | | | | |
|---|---|---|---|---|
| | | No. of students passed | No. of students failed | Percentage of passing |
| Group A | 30 | 26 | 4 | 86.66 |
| Group B | 30 | 24 | 6 | 80 |

## References

[1]Roberts and Baynes (1998)
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[4] JSSS teacher's support material.
[5]http://korthalsaltes.com/mobile/modelm.php?name_en=multi%20side%20base%20pyramids
[6] Wankat, P.C. and F.S. Oreovicz, "Teaching Engineering," McGraw-Hill, New York, NY, 1993, p. 6, 7.