



## **FLUX: Design Education in a Changing World**

***DEFSA International Design Education Conference 2007***

### **Use of Technical Drawing Methods to Generate 3-Dimensional Form & Design Ideas**

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# Use of Technical Drawing Methods to Generate 3-Dimensional Form & Design Ideas

## Abstract

### **Problem being addressed:**

Generally speaking technical drawing methods e.g. isometric and orthographic views are used for presentation of form and design idea. Systematically used these methods can yield fantastic results serving as a tool in the form and design generation / development process. In various product domains, especially where sheer aesthetic appeal or plurality of form is more important than functionality or utility; development of form family, variations on theme, etc. are the main design activity. This way of working will serve as an effective tool in cases where the design development process is confined mostly to the paperwork only but the product demands or has a scope for 3-Dimensional thinking e.g. industrial jewelry design.

### **Approach:**

Viewed individually, orthographic views could be interpreted in more than one way; using this ambiguity as a form manipulation device many forms or a family of forms could be developed. Further addition of spontaneous or methodical form-variation increases manifold the number and variation possibilities.

Constructing and employing various project / domain / user-specific grids as tools in the form and design development process makes it easy to handle 3-Dimensional form variations on (2-Dimensional) paper.

3-D CAD software which are primarily used for making models / prototypes, once the design is ready, also can become effective and potentially integral part of the entire form and design development process right from the initial stages.

### **Conclusion:**

Systematic use of various project / domain / user specific grids as tools makes handling of 3-Dimensional space in 2-Dimensional environment possible and easier too.

This can help the designers as well as novice students in handling relatively complex 3-Dimensional forms.

### **Key Words:**

design development, form generation, technical drawing

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## Introduction

### Human spatial perception

Our spatial perception is based on our ability to integrate the multiple views seen simultaneously or in succession while rotating the object in hand or moving around it.



Figure 1: Our spatial perception is based on our ability to integrate the multiple views

### Variety in design experience

The reality that the human eye can see only the confronting / partial view of an object can be used to provide variety in design experience or even to deceive our expectancies. Some engaging variation or surprise can be planned on the hidden or next revealing view.

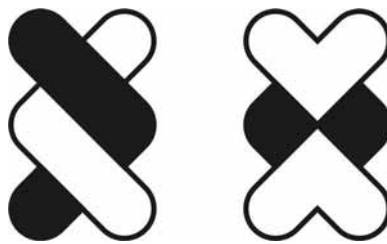


Figure 2: Design concept for two-way pendant where front and back provide two different looks

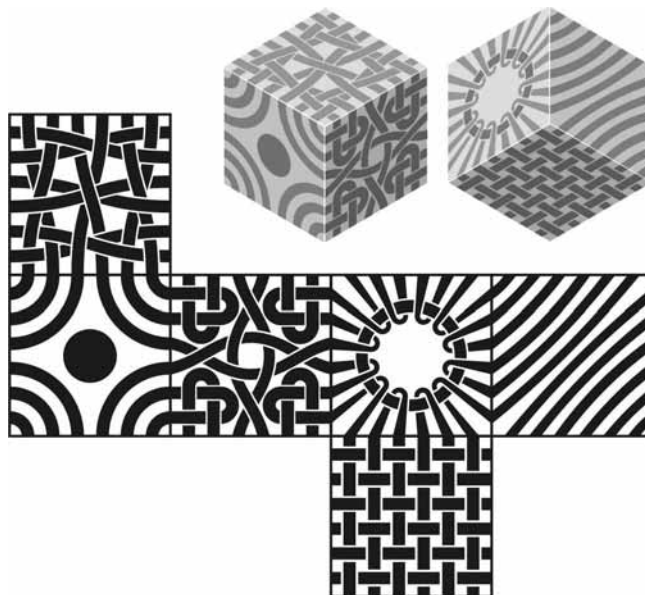
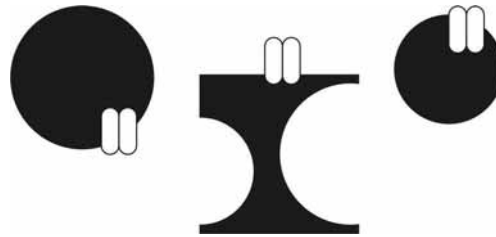


Figure 3: It is possible to provide some spatially animated experience by purposeful planning.

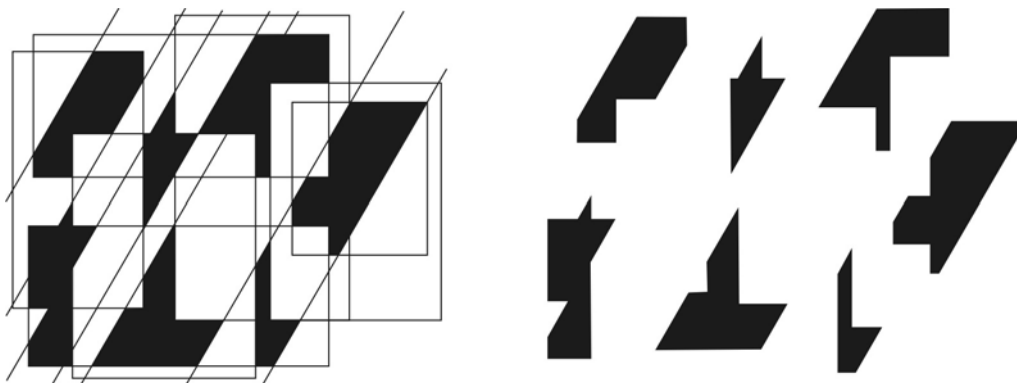
We look for 'common' elements and pattern to 'understand' the coherent relationships between the multiple views. In context of a set or a collection (of objects), group or family of forms comes in

consideration. Multiple forms having complementary or matching set of elements / characteristics form a group.

While negative-positive form-space relationship provides basis for complementary and modular group of forms; form families can be based on the premises of, same origin / underlying framework or methodology applied in the form generation / development process.



**Figure 4: Design concept for a set of pendant & earring based on negative-positive form-space relationship.**

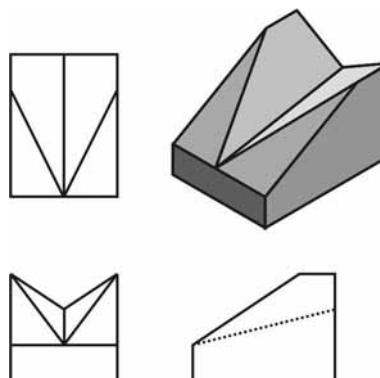


**Figure 5: Forms derived from the same origin / underlying framework produces familiar forms.**

Geometric projections are basic to all the technical drawings, understanding and developing geometric relations between different views, understanding complex form contours and structures by finding its basic geometry or relationship with the surrounding space / elements is a usual task of any one working with technical drawings. Using these very tasks as tools in 3D form generation / development is the idea explored in this paper.

### **Using technical drawings methods for 3D form generation and development**

Technical drawings (e.g. isometric, orthographic projections, etc.) are used to convey the true form and dimensions / proportions of the intended object; the objective with them is to leave no room for ambiguity and avoid any miss-interpretation.



**Figure 6: Orthographic and isometric views of an object.**

Our premises here is, systematic use of these methods yields fantastic results; serving as a tool in the form and design generation / development process. Various pictorial as well as technical drawing methods, used mainly for representing or explaining 3-D forms and objects on 2-D paper can be used methodically to conceive, view, analyze, and develop 3-D forms from various view points.

In this context we will look more into the following;

- Exploring and exploiting inherent ambiguity or deliberate plural interpretations of various orthographic views.
- Explorations of form and space using technical / pictorial drawing methods with the intentions of creation and development of form(s).
  - Developing a pre determined / finite form-space
  - Use of infinite grids
- Project or domain specific form development: an example

### Exploring and exploiting inherent ambiguity or deliberate plural interpretations of orthographic views

Orthographic views provide flat, 2-dimensional understanding of form contour and proportions without complicating it by inclined distortions. There are 6 principal sides to any form; front & back, top & bottom, and two of the sides respectively; hence 6 orthographic views. Generally 3 adjoining views provide enough information for understanding of the form in total.

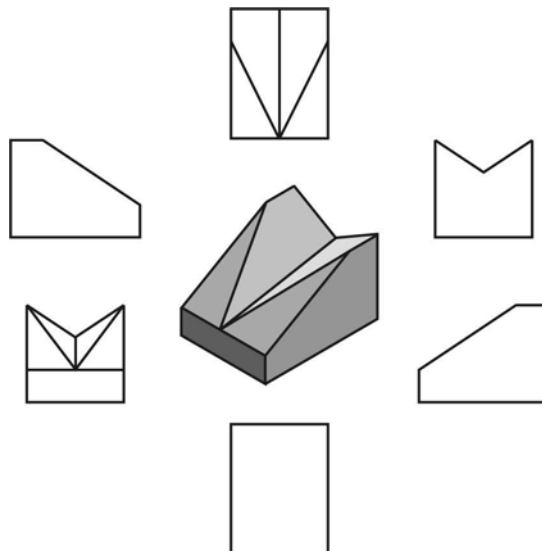


Figure 7: Six principal orthographic views

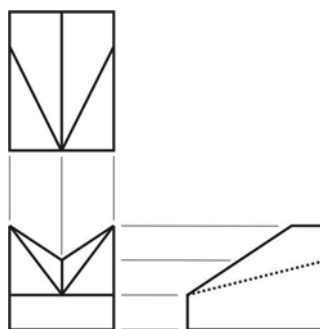
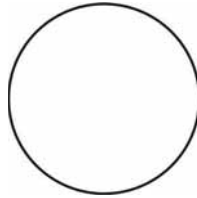


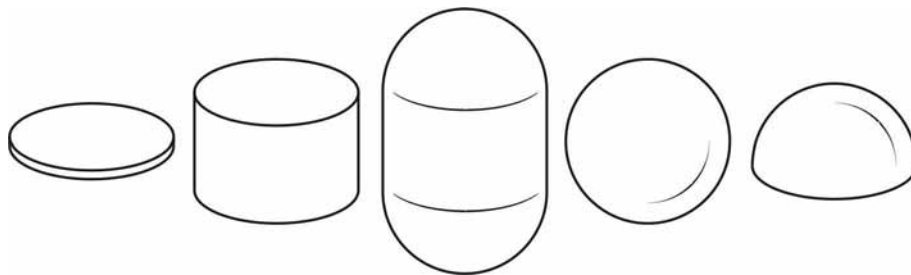
Figure 8: Three adjoining orthographic projections

Orthographic views are uniplaner projections of 3-D forms, they lack perception of depth. Representational drawings show contours and folds in line; thus orthographic views, especially seen singularly provide an opportunity for multiple interpretations.

For example a drawn circle as one of the orthographic views could be interpreted as a disk, a cylinder, a bullet, a sphere or a semi-sphere.

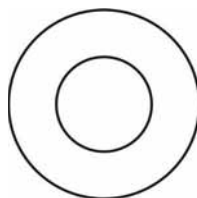


**Figure 9 a: Plan**

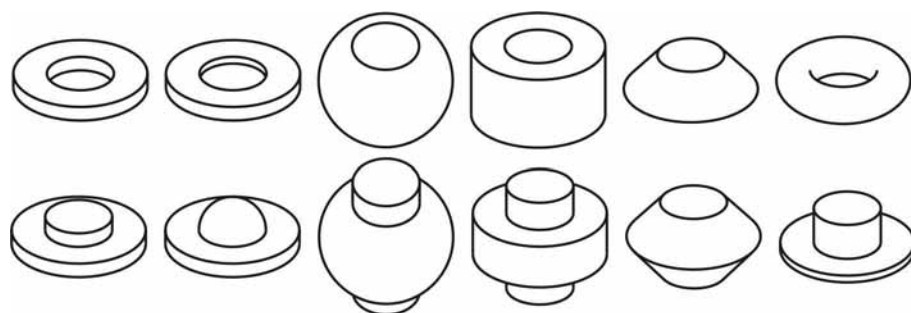


**Figure 9 b: Various possible interpretation of a plan in figure 9 a**

Add one more concentric circle to it and the inner circle could be interpreted as a negative space or a sub-form-element; this suggests several possibilities; it could be interpreted as; a disk with a hole or an elevated step, a depression, a dome or a sphere in the centre; a sphere or a cylinder with a hole or rod in the centre; a segment of a cone; a donut; a hat shape; so and so...



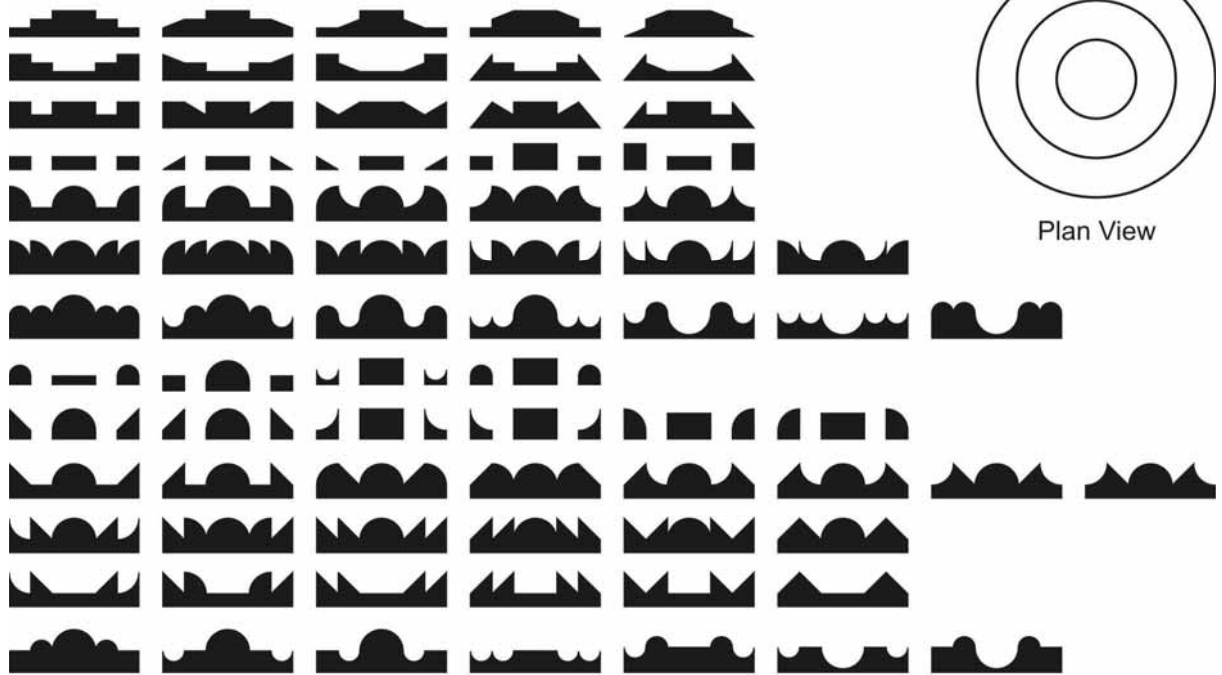
**Figure 9 c: Plan**



**Figure 9 d: Various possible interpretation of a plan in figure 9 c**

All these forms share a common plan view; a creative designer can explore and exploit this potential as a form generation tool to develop an array of familiar forms with variations. Once an exercise sparks an idea, a scheme of design, the designer is free to take creative liberties and modify the original orthographic view or forms suitably. Going beyond the obvious there are infinite possibilities with any of the views however simple they could be.

Possible Elevations (Section Views)



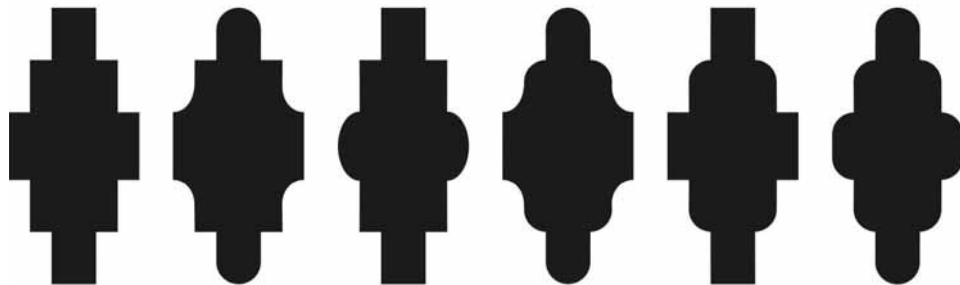
Further Possibilities



Still Further Possibilities



Even Further Possibilities



...And Even Further

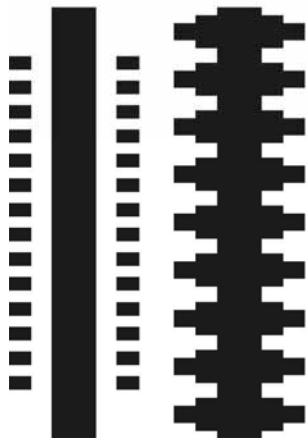


Figure 9 e: Innumerable possibilities from a single plan view

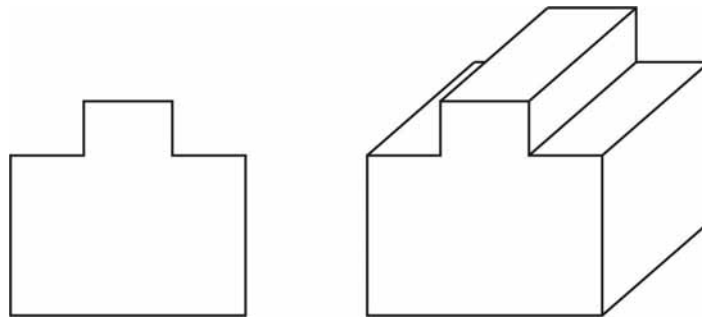
## Explorations of form and space using technical / pictorial drawing methods with the intentions of creation and development of form(s)

Pictorial drawing methods (e.g. oblique, isometrics, perspective drawing, etc.), are used mainly for representing 3-D forms and objects on 2-D paper. They represent the form in a pictorial manner i.e. also showing the depth in a single view (as against orthographic views where more than one view is needed to provide adequate information).

Any of the pictorial drawing methods could be used in form explorations; it is only a matter of individual convenience, complexity of form and time at hand. Here we will look into oblique views as they can be realized from orthographic views in a quick manner and isometric drawings as they provide a balanced viewing angle with adjoining sides representing all three dimensions at a glance.

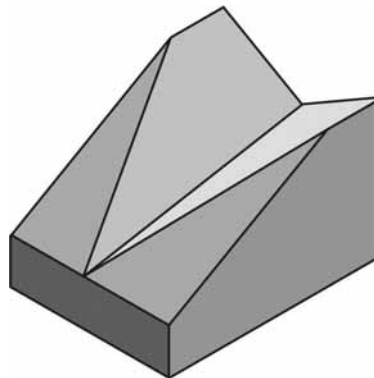
### ***Oblique View***

Oblique views provide a simple pictorial realization of 3-D form by adding the missing depth to an appropriate (generally front) orthographic view with extended oblique lines.



**Figure 10: Oblique views enable the designer to add the missing depth to any of the orthographic views and get the pictorial perception in a quick manner.**

### ***Isometric View***

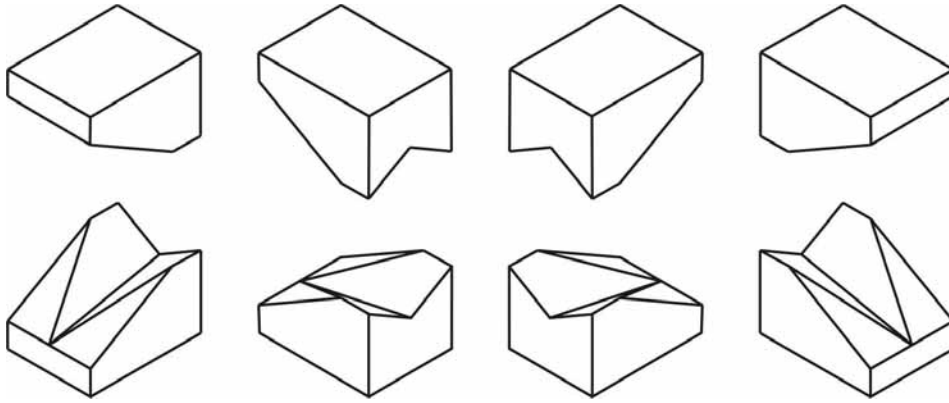


**Figure 11: Isometric view shows three principal dimensions at a glance**

Isometric projections and drawings provide the optimum possible and balanced viewing angle of the form by showing 3 principal dimensions, 3 adjoining sides at a glance. By providing even better a pictorial view than an oblique view this helps in perceiving the spatial relations among the form contours as well as dimensional proportions.

There are 8 possible isometric viewing angles representing 8 corners of any 3-dimensional form. Drawings of all the important ones in proximity provide the designer with simultaneous understanding of the form in its entirety and a basis for visualization of possible variations, modifications and developments or reorganization of sub-form elements. Step by step methodical developments transform the basic form to its aesthetic perfection or provide a range of options depending on the designer's objective.





**Figure12: Possible isometric viewing angles representing 8 corners**

Practical understanding and skillful handling of 3-D drawing methods, makes exploration / experimentation / realization part in a designing process faster, easier and interesting. Apart from conceiving, viewing, analyzing, and developing 3-D forms this methodology helps also in problem solving related to mechanisms, measurements, etc. This practice also helps in developing logical thinking ability, very crucial for any 3-D designer.

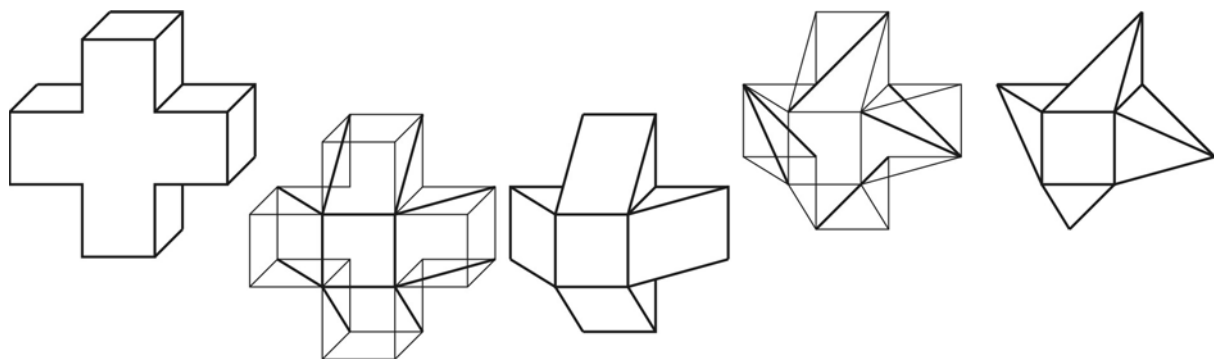
### **Possible approaches in form development using 3 D / pictorial drawing methods**

There can be possibly two approaches in form development by using 3D drawing methods; developing a finite space, where a suitable or predetermined finite space can be used as a starting point or use of infinite grid of suitable units.

#### ***Developing a finite space***

A simple cubic (or any other geometric solids) space could be developed in to a meaningful interesting form by methodical and logical use of some internal (or external) reference points to add and / or subtract a space / form element.

To initiate a form development process, apart from any basic or improvised geometric solid form, it is also possible to begin with any other existing or developed form for the purpose. Similarly any 2 D form also can be projected in any of the suitable 3 D drawing methods and by adding appropriate depth to it to be used as an initiating form.

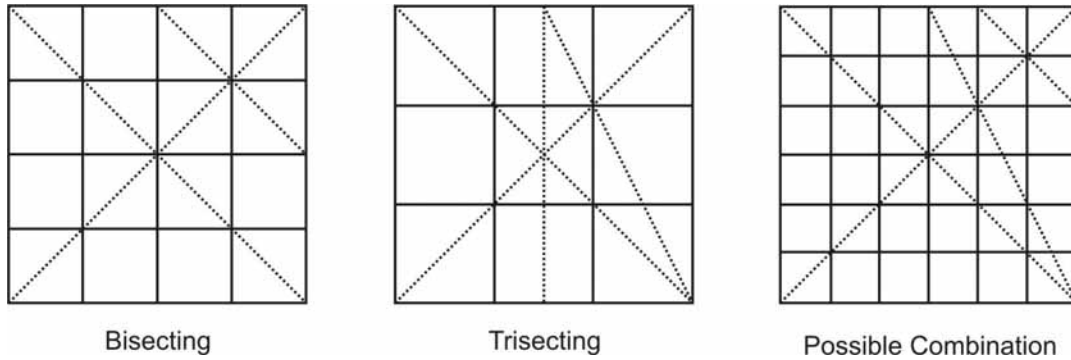


**Figure 13: Some internal or external reference points related to the finite space could be used in form modification / development**

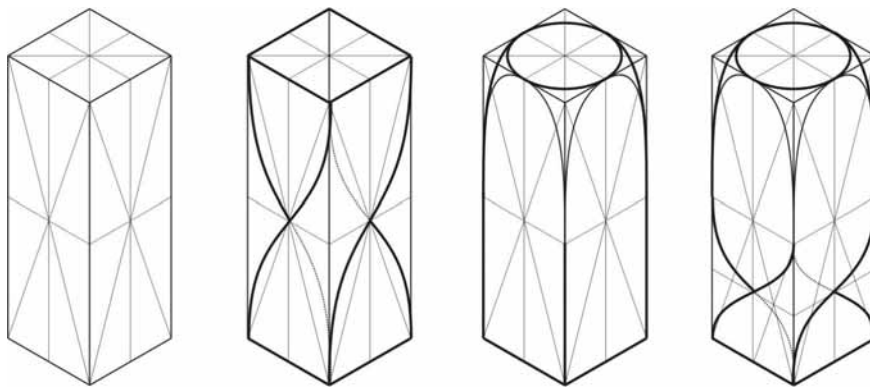
Further, to carryout measured modifications, the designer needs to mark some logical reference points within or outside the form. This could be done by logical use of form contour, by dividing the form space, or using some scaling device. These reference points could be then used to modify the form by addition, deletion, modification or reorganization, etc.

### ***Use of space division methods***

Methodical space division provides an internal grid of reference points within the space. These reference points can be used to mark, divide, subtract or add space in a proportionate manner. This not only provides the designer a systematic tool for manipulation of form, it also helps in developing forms with inherently structured proportions.



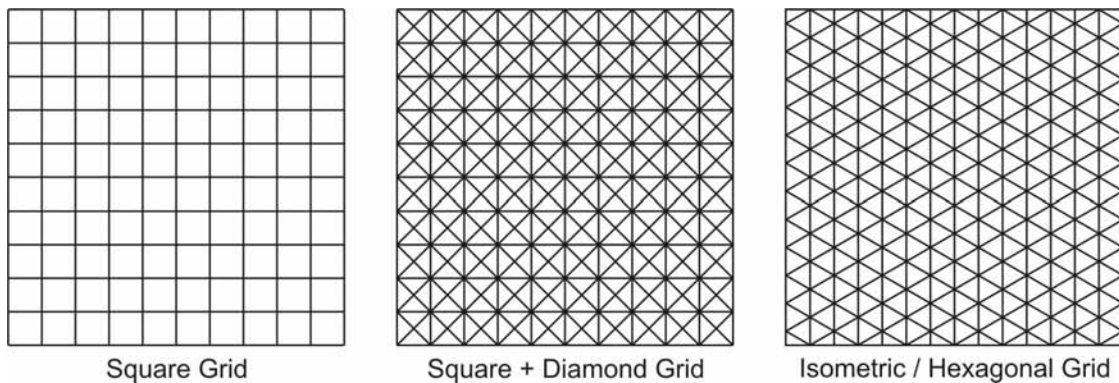
**Figure 14: Space division methods**



**Figure 15: Form development by space division methods**

### ***Use of grids***

Made of self repeating units, grids are of infinite nature. It is useful to use relevant basic grids to help quick realization of form on paper; respectively square grid for orthographic views, combined square & diamond grid for oblique views and hexagonal grid for isometric views are especially useful.



**Figure 16: Useful basic grids**

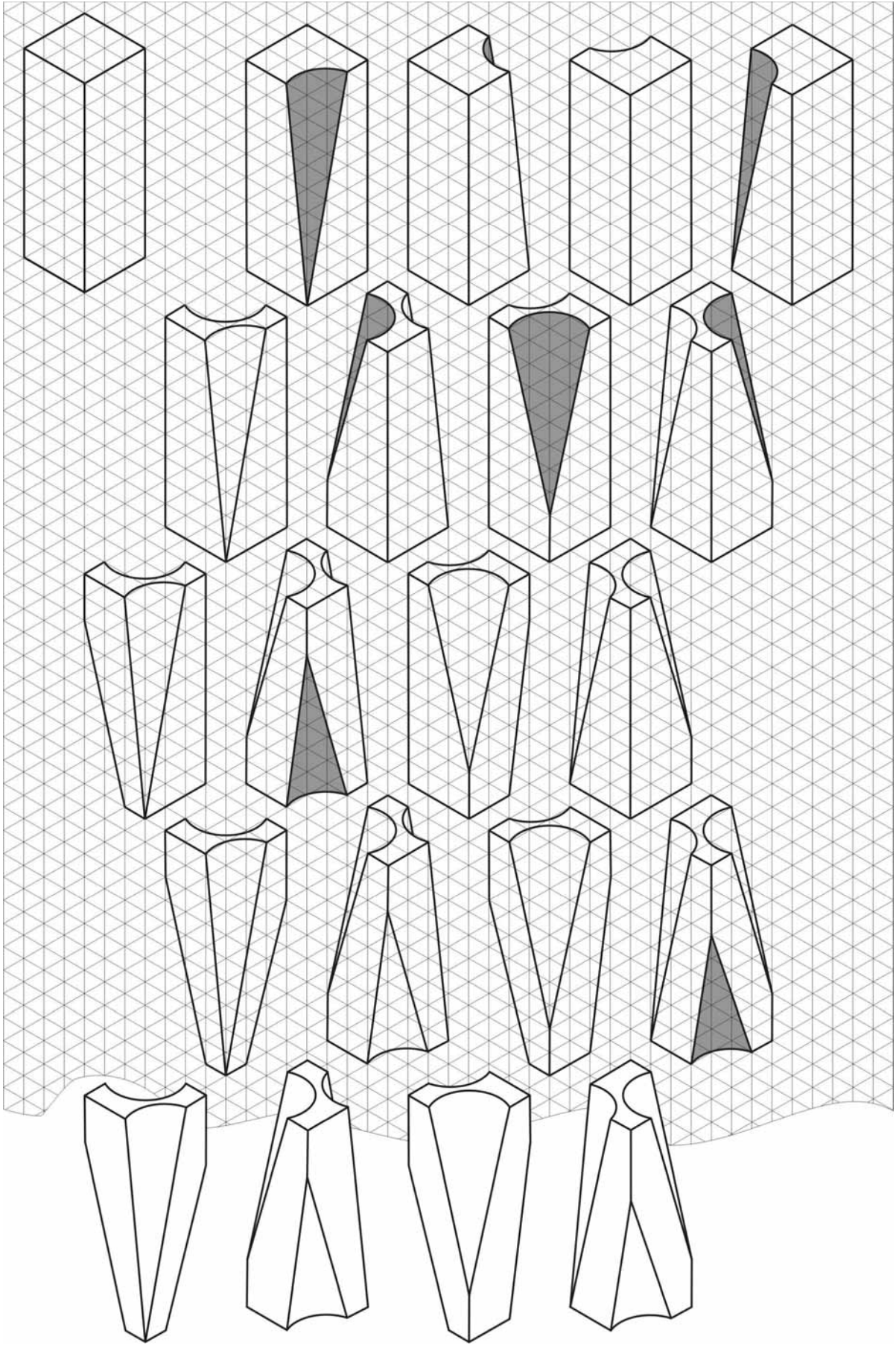
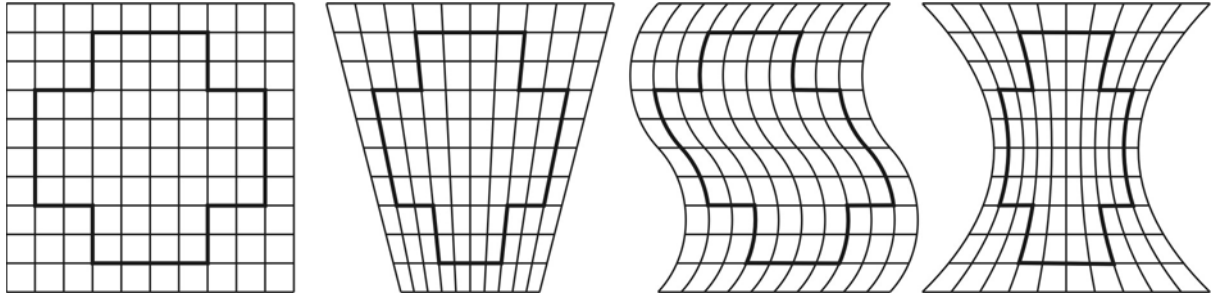


Figure 17: 3D form development example

Apart from basic grids it is also possible to use various different kinds of grids in the form development process; many variants, combinations and distortions of basic grids are possible.

It is possible to use methodical distortions in the form development process. Contour proportions and form specific internal reference points could be manipulated in distortion of forms in a logical methodical manner.

The basic grids could be distorted with certain parameters and used to realize the distorted forms in an efficient manner.



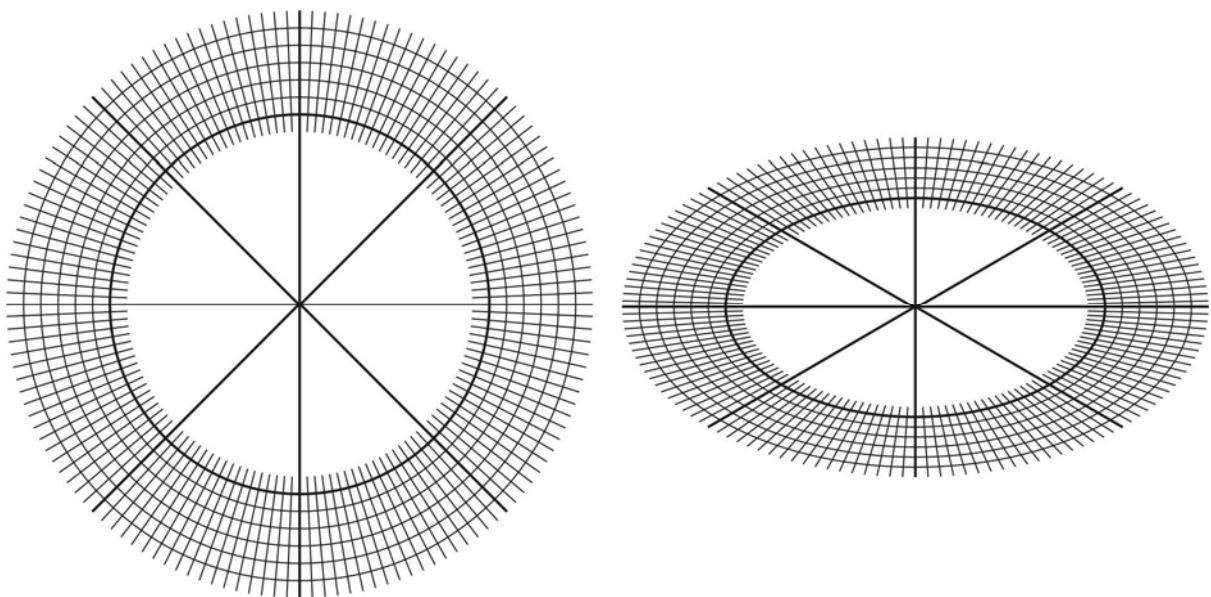
**Figure 18: Distorted Grid / Form Examples**

### **Project or domain specific form development: an example of bangles bracelets**

Project or domain specific grids (and set of rules / constraints) could be developed for directing or ease of working in the form development process; in achieving certain characteristics or kind of forms or accommodating prefixed elements in an overall scheme.

Here we will see domain specific example of using specially developed grids to generate design ideas for bangle bracelets. Bangle bracelets are either circular or oval-shaped, we will see circular. They are either slip-on type fixed or hinged to open. Both types are possible to be designed using these grids. It is also possible to develop designs with overall self repeating pattern, or designs with asymmetrical sections.

First grid is circular grid with even divisions to generate plan views. The second one is the same grid projected on isometric plane, to develop the plan view for depth and work on elevation.



**Figure 19: Project specific grids devised for development of forms suitable for bangle bracelets**

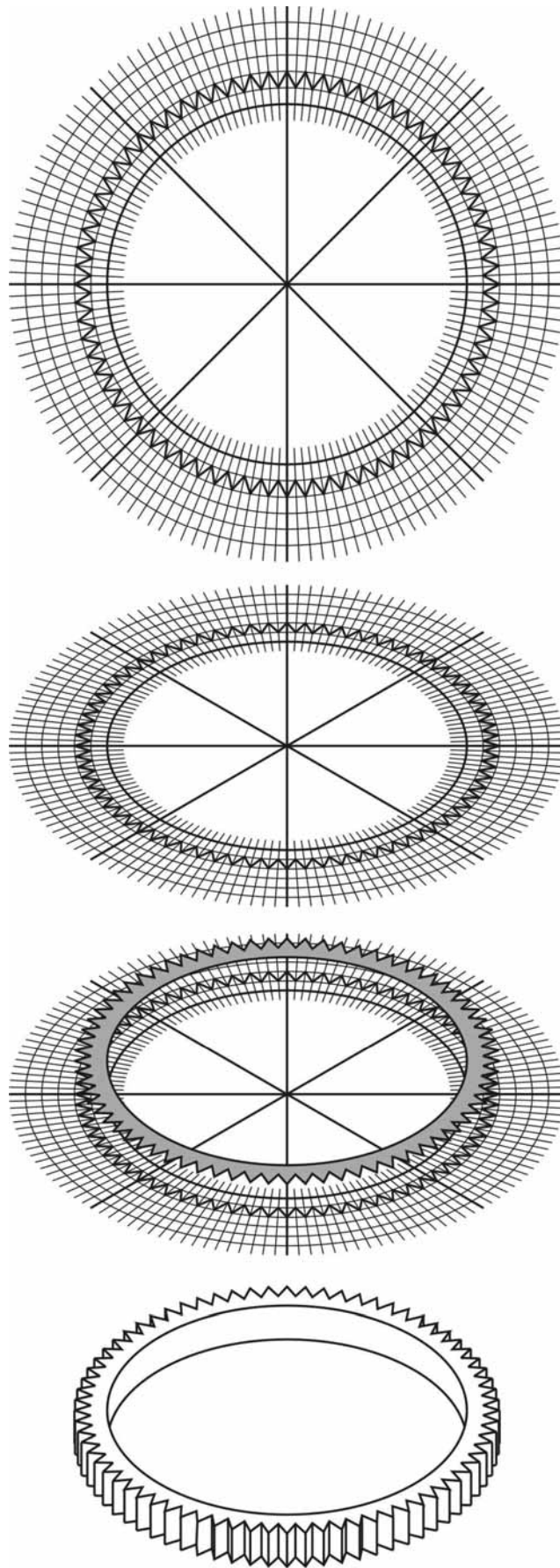


Figure 20: Basic steps involved in developing a simple bangle form patterns

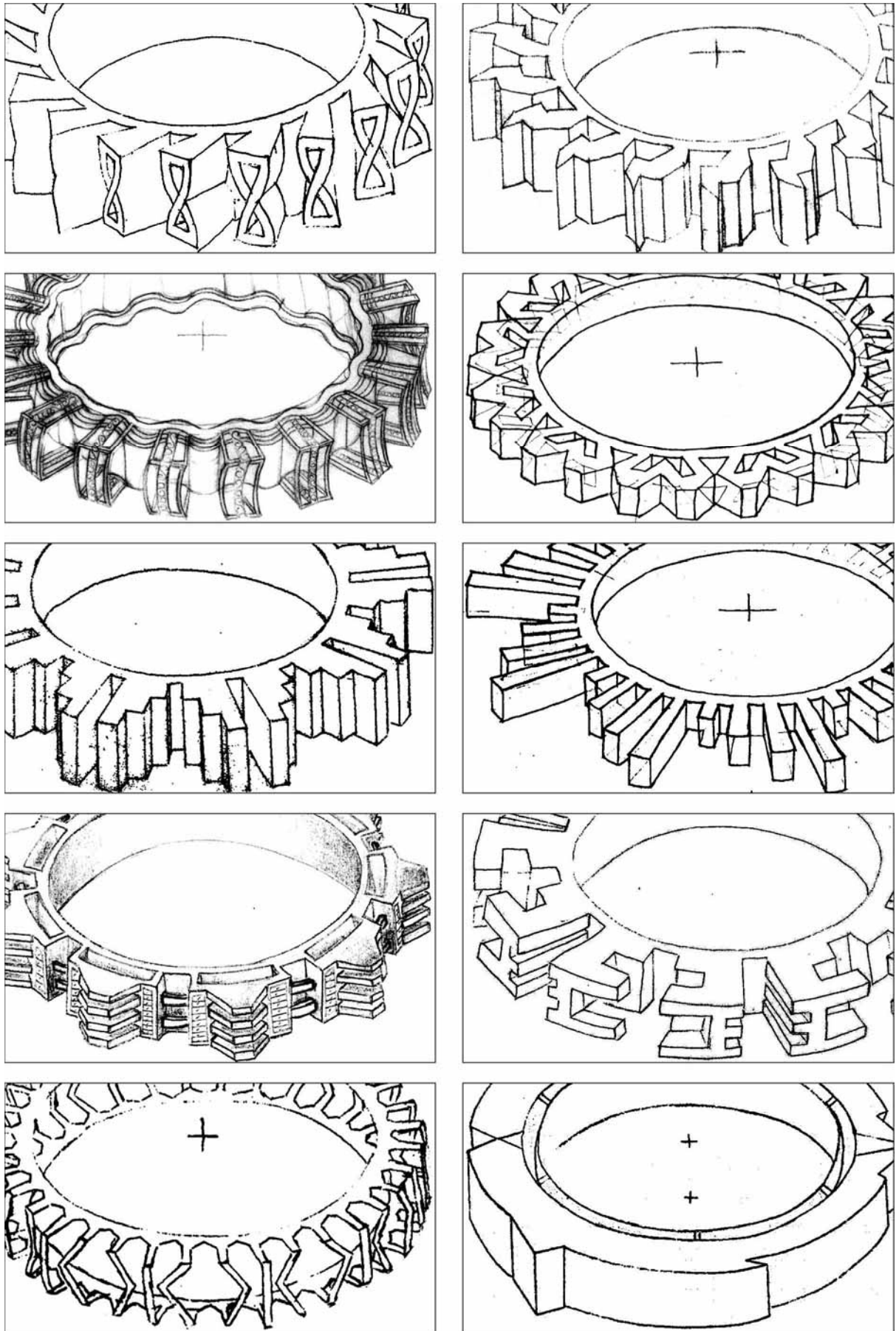


Figure 21: Some of the bangle forms developed by the students using grids

## Conclusion

To provide variety, an important aspect in the design experience, it is basically essential to look at various possibilities. When a singular form needs to look interesting from all the viewing points; multiple forms must compliment each other or share some common characteristics.

The very tasks involved in technical drawing making can be used as effective tools in 3D form generation / development with inherently structured proportions.

Orthographic views, especially seen singularly provide an opportunity for multiple interpretations.

Any of the pictorial drawing methods could be used in form explorations; either by developing a suitable / predetermined finite space where the methodical space division provides an internal grid of reference points or by using an infinite grid of suitable units.

It is also possible to develop project or domain specific grids for directing the form development process to achieve certain characteristics or kind of forms.

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## **CURRICULUM VITAE**

A graduate in Applied Arts from Sir J J Institute of Applied Arts, Mumbai; Raja Gondkar is currently heading the Design Department of the Indian Institute of Gems & Jewellery, Mumbai, India. Here he is responsible for development and running of design related courses, training of faculty and students.

He has been active for now over 20 years in various art & design domains like advertising graphics, product design, poetry and other literary arts, apart from Jewellery. Last over a decade he has diverted to the academic side of Jewellery and has been involved in development of various courses ranging from short term to longer duration diplomas; training materials, study manuals and imparting training in the field of Jewellery Design & Manufacture with several institutions in India.

He has many awards in Jewellery Design to his credit including Overall winner prize in bridal-wear category and a Scholarship to Europe in 1997 De Beers Indian Jewellery Design Competition. Since he has been a judge to several design competitions and writes columns for some Jewellery related magazines.

