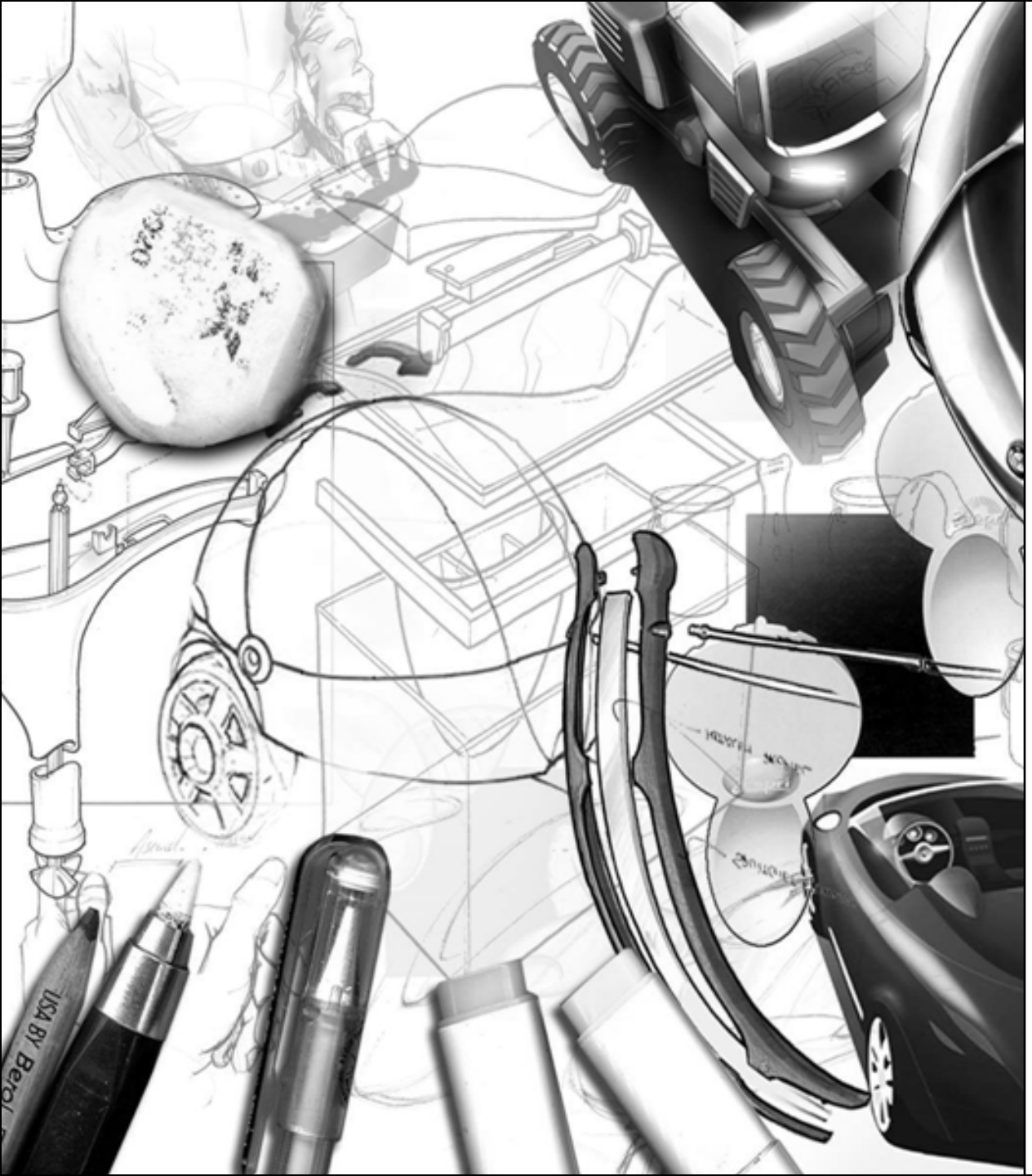
Basic Sketching Techniques for the Industrial Designer

By **Thomas Valcke**

VERSION 1.0



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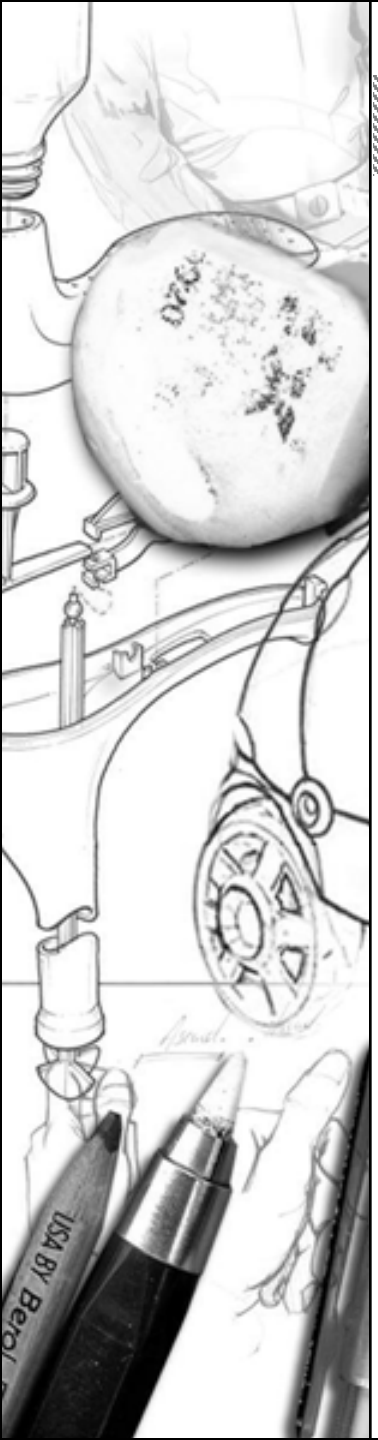


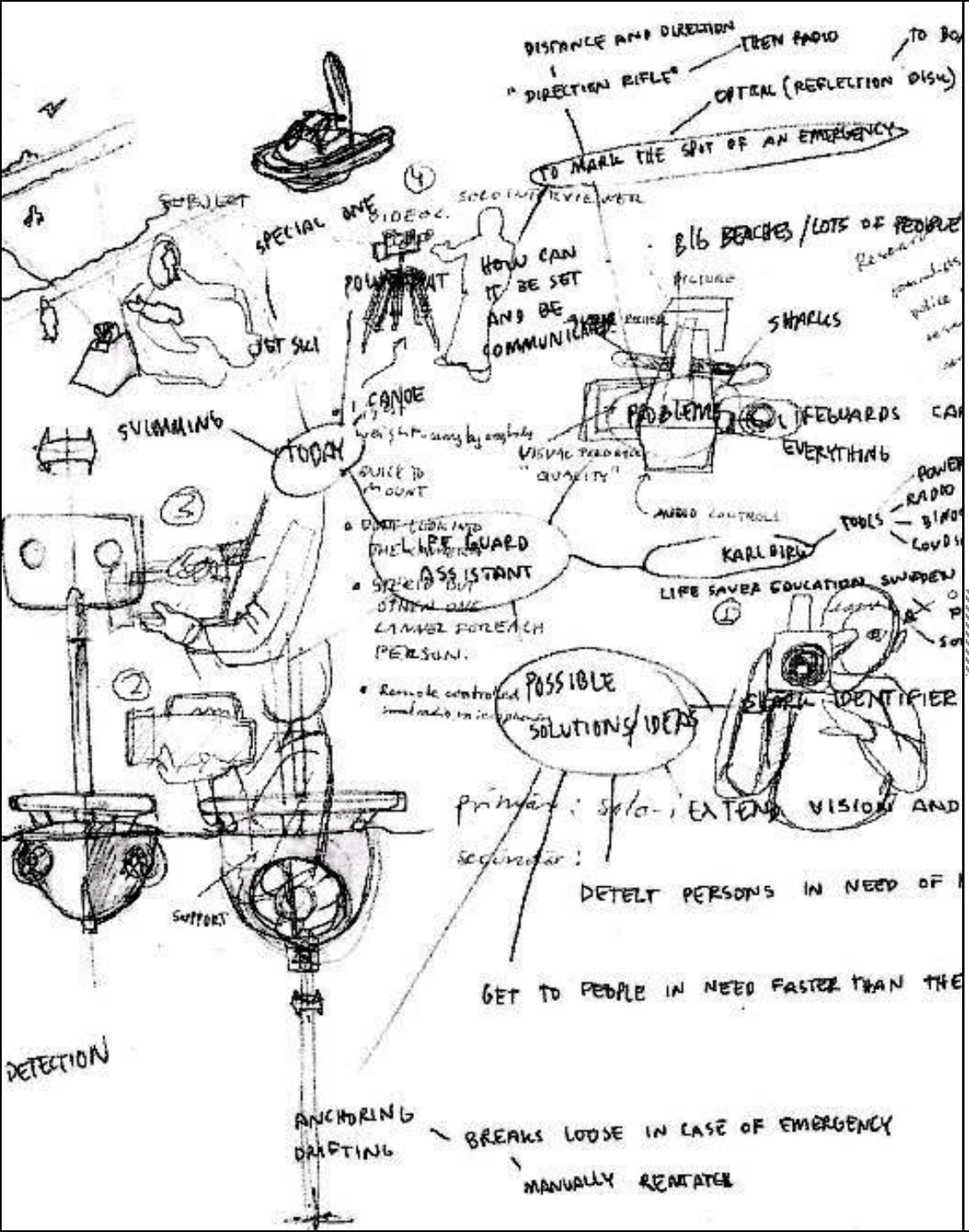
Introduction

Lately my students and others ask me if it is necessary as a designer to be a good sketch-artist. As always the truth lies somewhere in the middle. you don't need to be the best sketcher to be a product designer, but it's all about communication. Communicating what's inside your head to the other teammembers, clients, production-personnel. Off course these days designers have other tools to visualize their ideas. CAD, prototyping and even rapid prototyping nowadays. These are all great assets that makes the job easier –but also more complex-. But in a society where time is money, a designer who knows how to sketch will have more ideas visualized then someone who soluly uses a CAD-program. No CAD application will let you throw down tens or even hundreds of different design ideas in half an hour! This is where creativity usually starts. A designer who can sketch can explore countless ideas in a day. As different and as wild as he or she pleases. When it comes to being the designer whos idea gets picked this is important. You can never be fully sure what it is your boss/client is looking for. If you put up a couple of well designed, well thought out design solutions from CAD, and the guy next to you is pinning up 100 equally well thought out design solutions, the simple odds say that the boss will find what he is looking for from the other guy. He has had more time to try different things, explore different creative avenues and solutions...This investigative function of sketching is tightly connected to the early research phase of a design project. Altough sketching can also be of importance to people who are more involved in the later phases of the project. It can be quite handy to fix a last-minute problem on the production floor and some sketches to communicate your ideas with the production-chief. Off course sketching is not easy and many students give up because it is a skill that needs to be exerciced a lot. After only one year sketching you may not be happy with what you are drawing. Do not give up though. Try looking at what you drew one year ago and compare it to what you draw now. If you can see an improvement then its OK. Just keep practicing. It can take some time but in the end it's worth it.

This course is aimed at 1st-year students in Industrial Design. This course is not aimed at people who are looking for more advanced sketching techniques like shading, casting shadows and rendering.

I do hope you find this booklet to be usefull and that it'll inspire and stimulate your sketching and creativity-skills

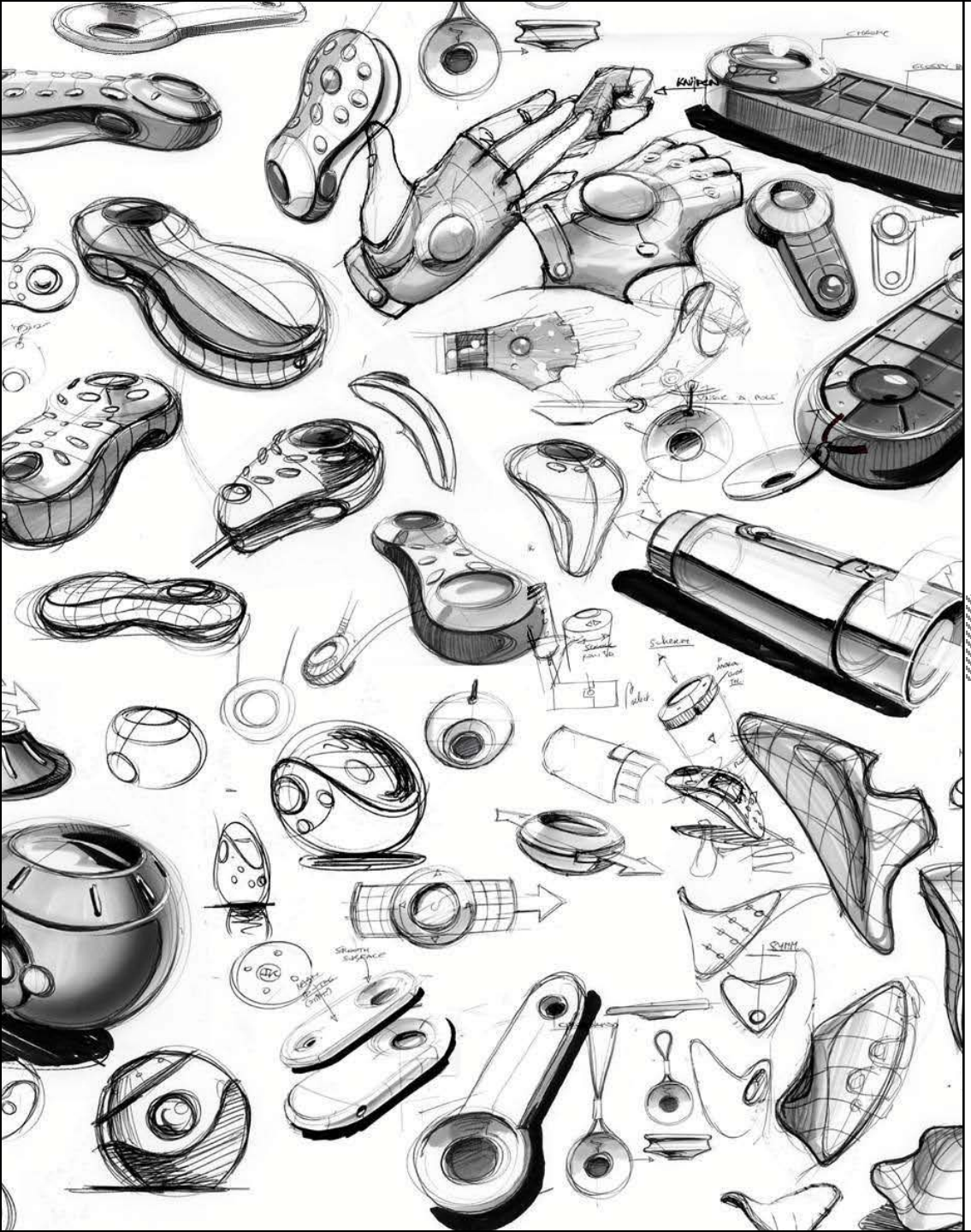
Thomas!



There are different kind of sketches in the design process. All focussing on a different goal and purpose in the following pages we'll look further into these different types of sketches;

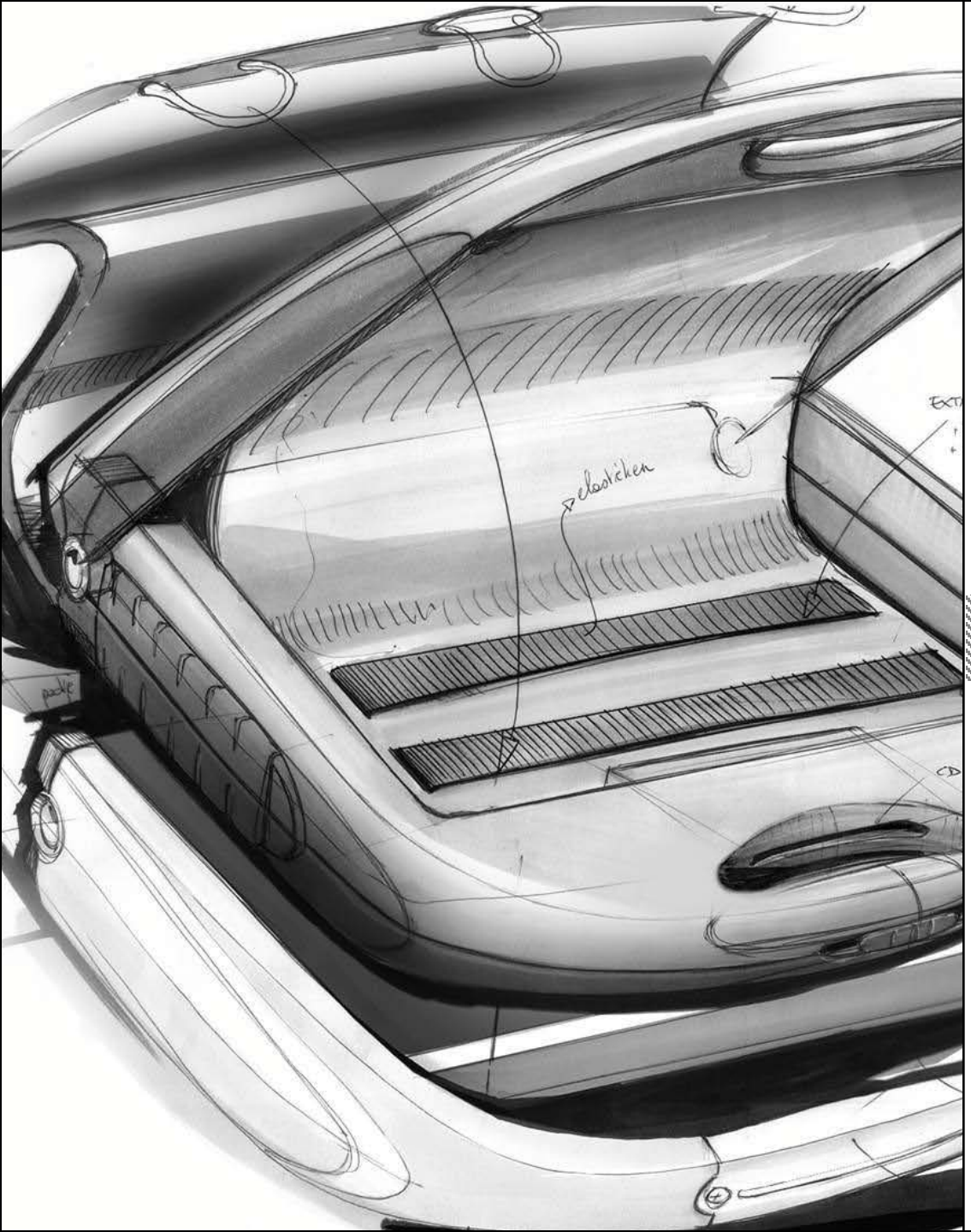
Ideation sketches

Ideation sketches is not about shape and form. It's more about understanding the assignment. What does the client want? Who's it for? What are my ressources? What does it need to do? Examining the problem space, analysing the context. These ideation sketches consist of droodels and text. It's not that important that these sketches communicate ideas to others. The purpose is to translate the assignment in your 'words'. These sketches are used to structure and understand a problem.



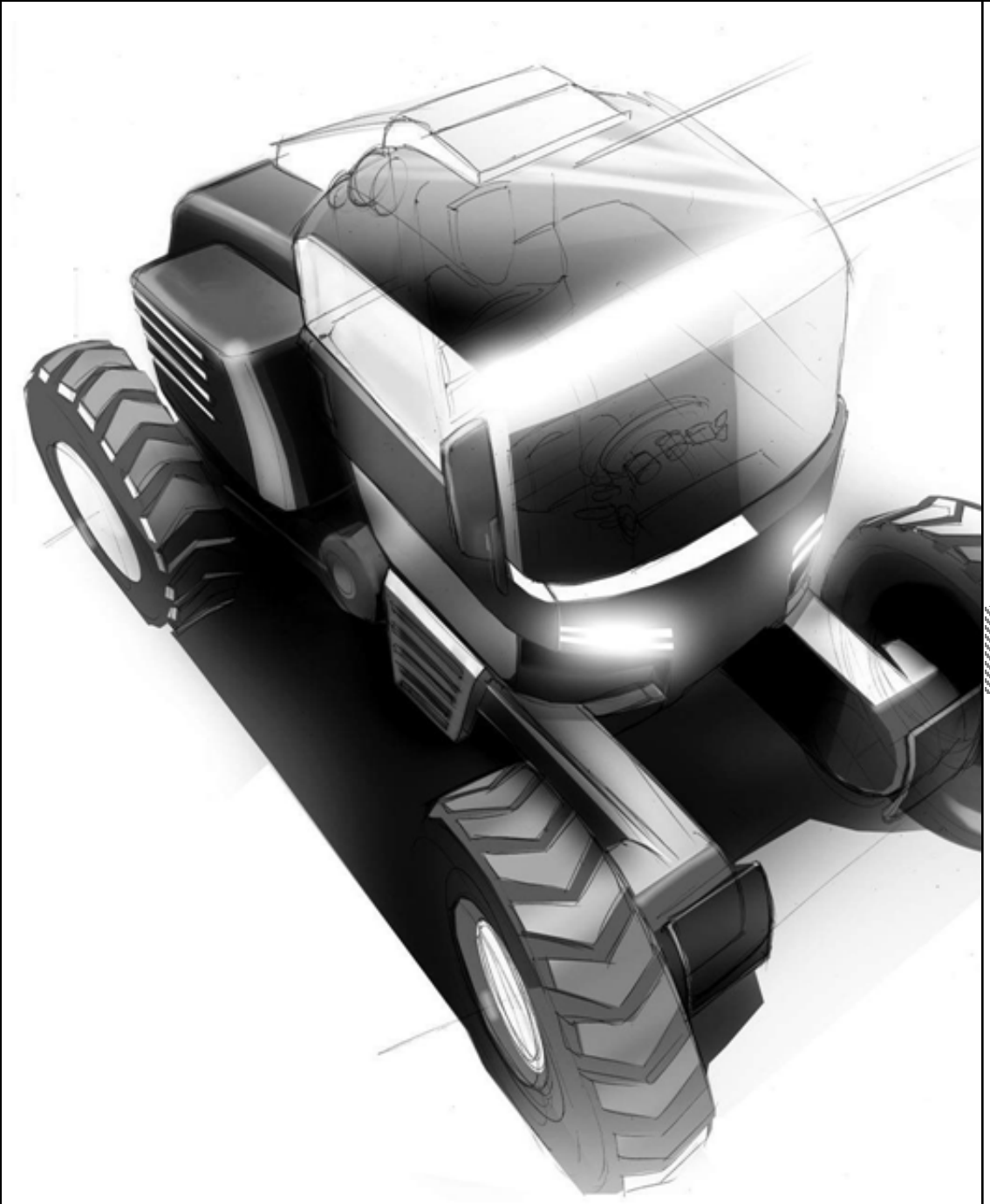
Explorative sketches

Explorative sketches are probably the most fun type of sketches. Many design proposals are generated and evaluated. These sketches are produced in large quantities. They are often very rough and do seldom make sense for others than the people directly involved in the design process. Important here is to grasp the overal idea and not to get lost in details.



Explanatory sketches

Explanatory sketches are the next step in the research stage of the design process. The amount of these type of sketches is less than the previous type of sketches. Explanatory sketches are created to explain function, structure and form. They communicate a design in a clear and neutral manner, focusing more on explaining the idea rather than selling it. Explanatory sketches must be readable to other people then those involved in the design process. The first feedback from the client usualy happens after reviewing these sketches.



Persuasive sketches

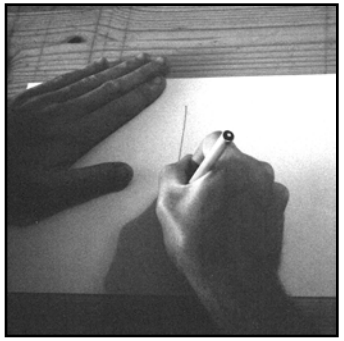
Persuasive sketches are drawn to influence the audience and to sell the design concept. Some designer tend to use a CAD-program in this stage of the design process rather then sketching the product. Altough many people find that sketches have certain invaluable and exclusive characteristics, such as expression and artistic flair wich can be difficult to achieve in 3D renderings. Unfortunately this booklet will not focus on these type of sketches Because knowledge of more advanced sketching and rendering techniques are used to create persuasive sketches

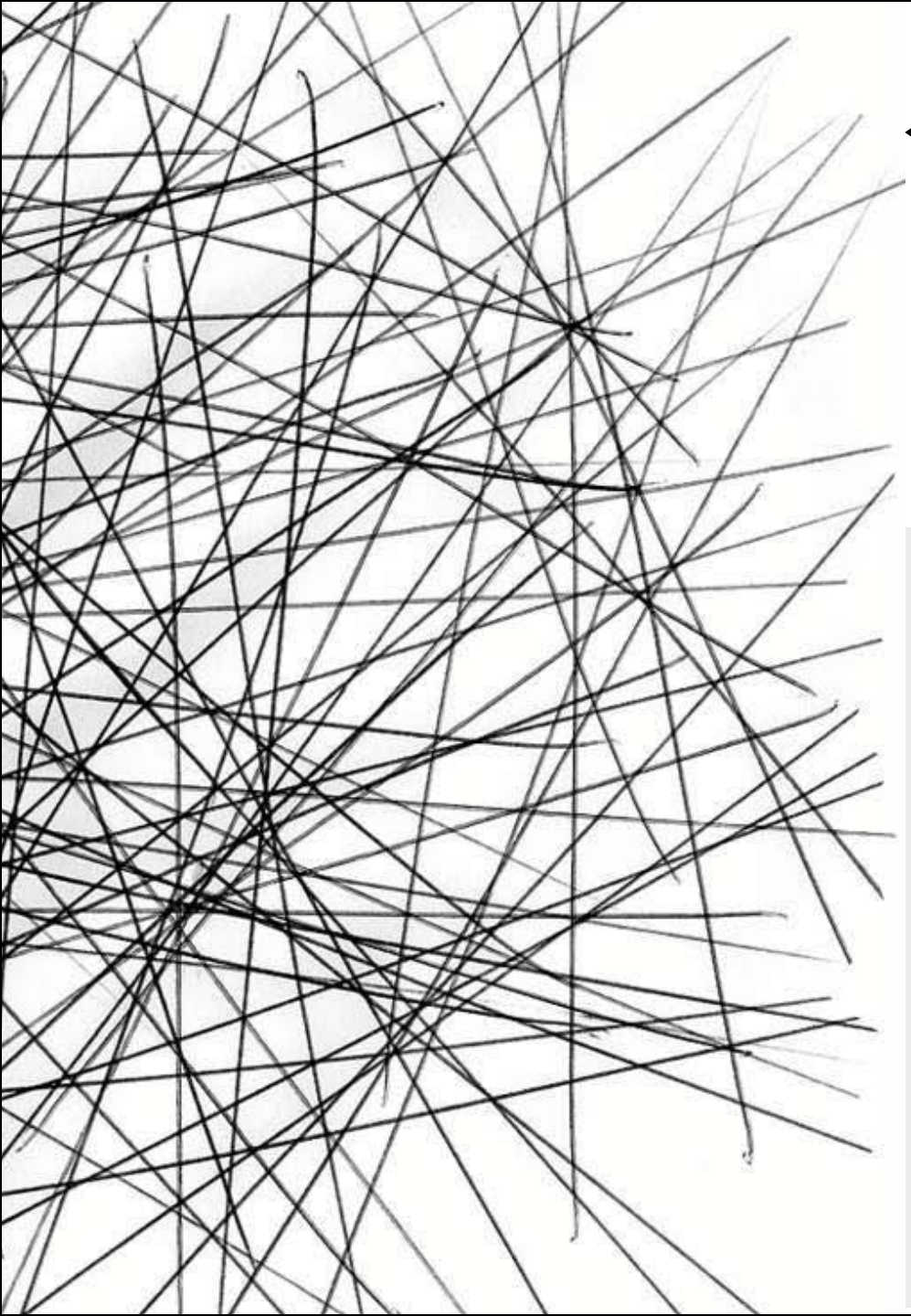
Basic sketching techniques

There is lot's of sketching material on the market and most students think that the more expensive the equipment gets the better they'll sketch. This is total nonsense. A designers drawing skill is not dependent on his material but on how well he can sketch. Therefore I would advise to use some pens in the store and buy the one that feels the most natural. I discourage the use of pencils and gums because this let's you erase your mistakes and slows you down in the creativity process. People who sketch with pens tend to learn faster then those who don't. I mostly use a real cheap ballpoint pen from Bic. Off course Soft pencils and chalks are very good tools to create a more artistic drawing. Just know when to use what.

Before we start with the real stuff there are some skills the student must practice. The first skill is how to draw a straight line without a ruler.

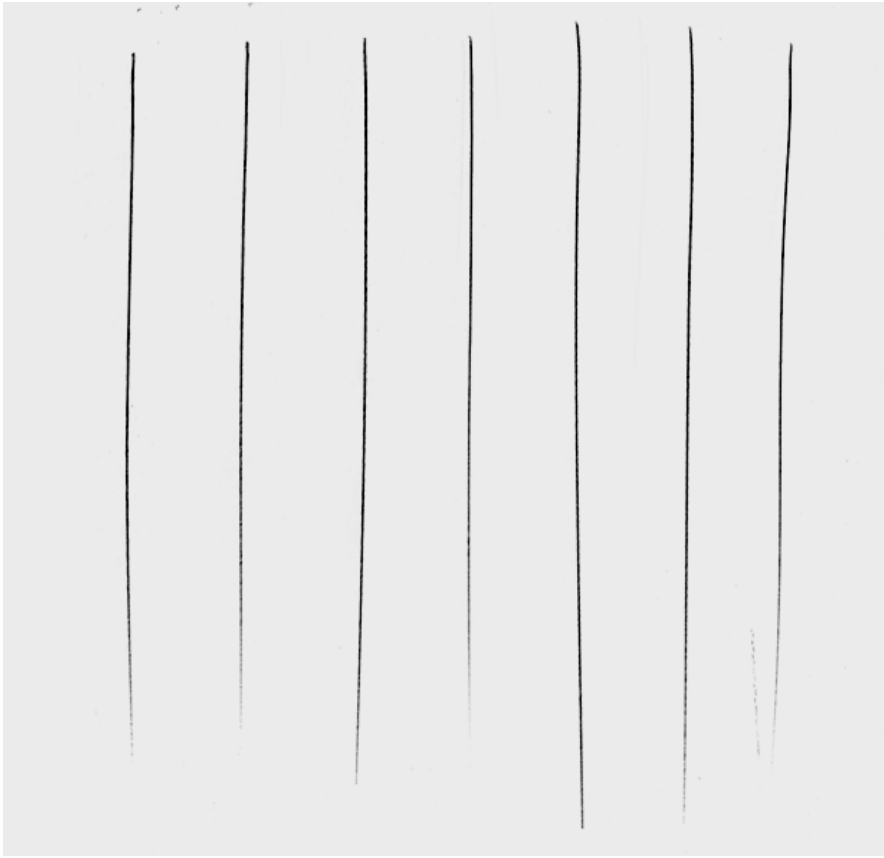
Hold the pen in front of you, alligned with your nose. Then pull the pen towards you. Rotating your elbow and wrist. These 2 rotations will result in one single straight movement. This is the easiest way to draw a straight line and It'll force you to constantly rotate your page wich is good for composition and readabilty of the drawing. Off course more experienced artist can draw a straight line in any position but for most beginners this is an excellent technique with fast results.





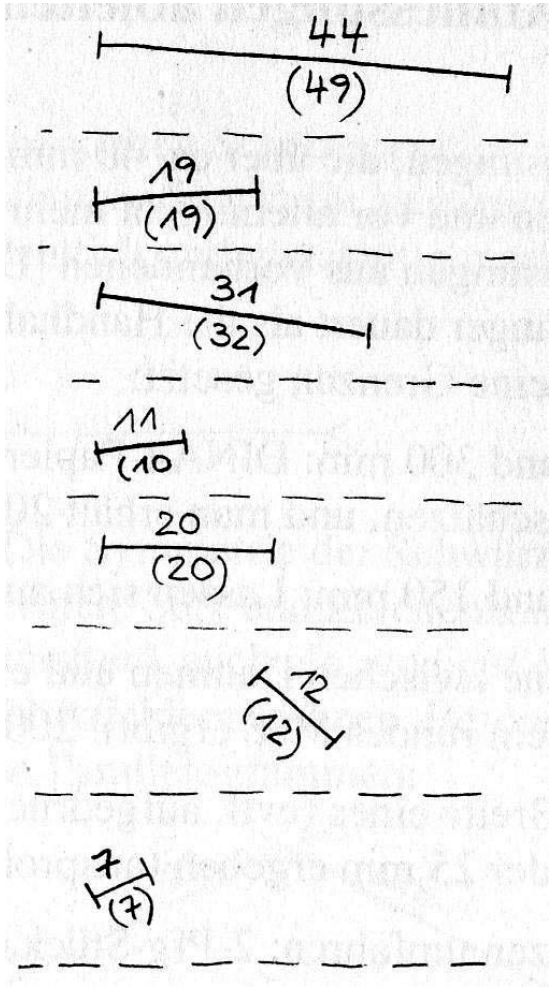
The first exercice and ideal warm-up is to draw lots of straight lines on a piece of paper. Rotate your paper if you want to change the direction of the lines. Dont stop practicing this untill the lines look straight.

The second exercice needs more skill and feeling to complete. The goal is to draw parallel lines. Lines must be straight and all in the same direction. Length is of no importance yet.



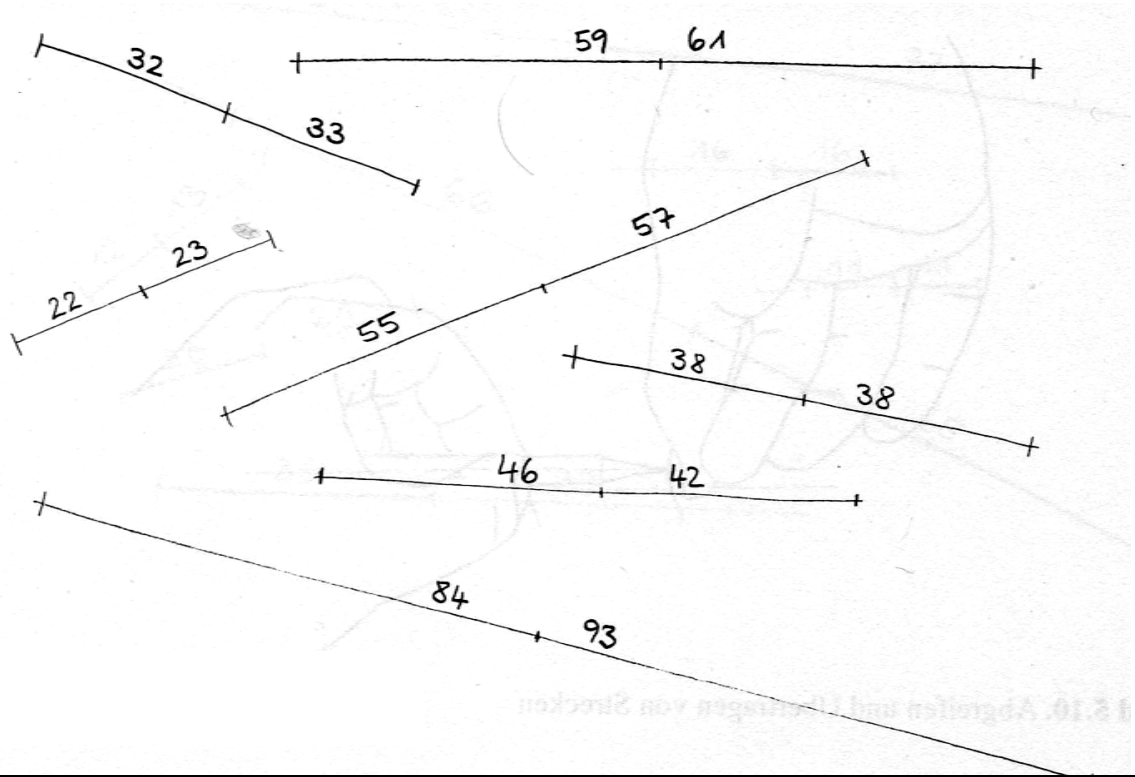
Later when skill and confidence have grown (and after lots of white pieces of paper transformed in mindless scriblles) you can continue to the third and final basic exercice. Drawing lines of a certain length without a ruler. For this exercice you need good eye-hand coordination so don't give up to quickly if this is exercice seems harder then it looks. Drawing is all about exercice, hard work and patience

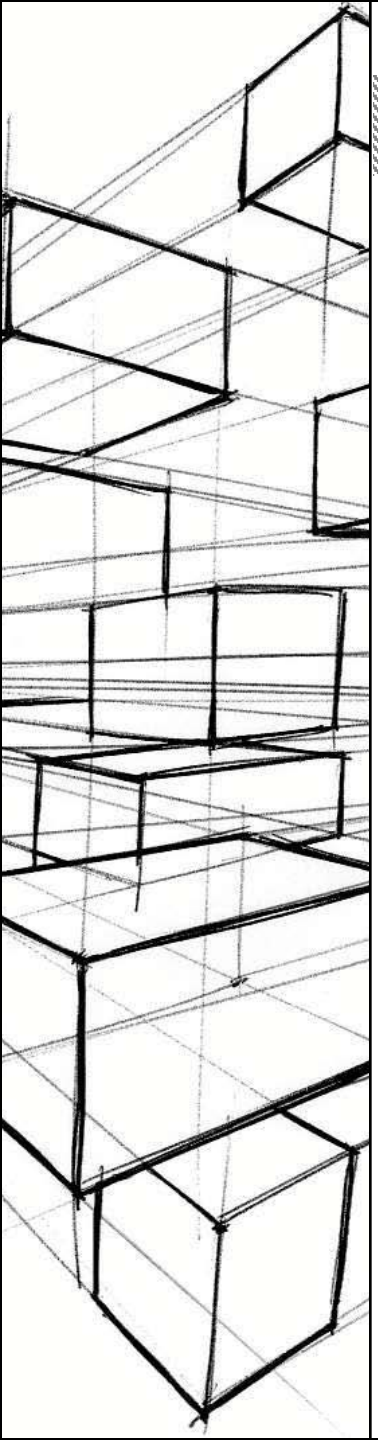
Draw straight lines of a preset value. Check them afterwards with a ruler ▶



Draw straight lines and divide them in two by eye. Measure them afterwards with a ruler.

▼

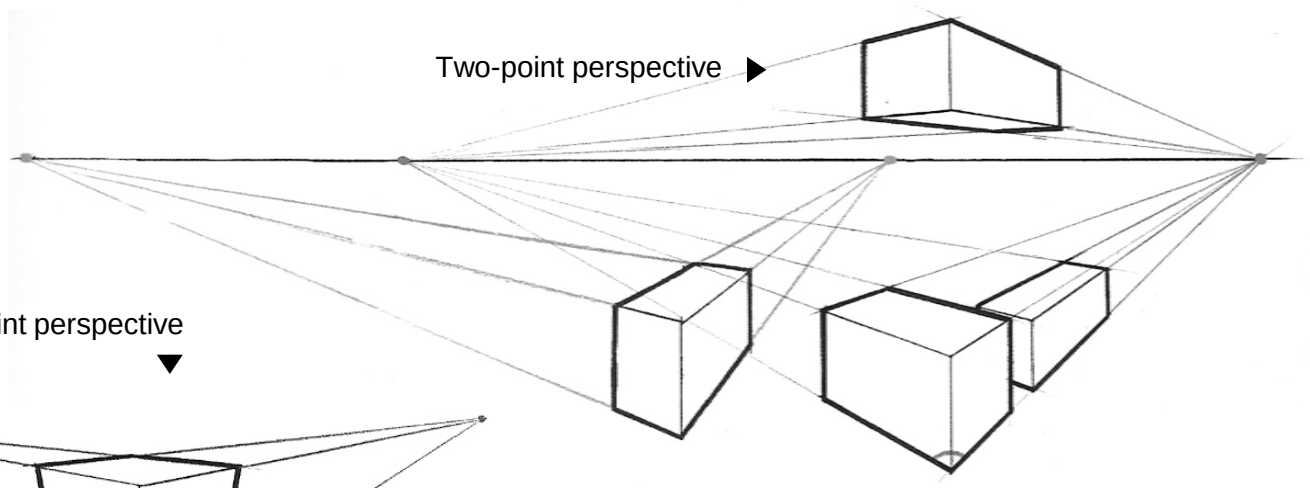




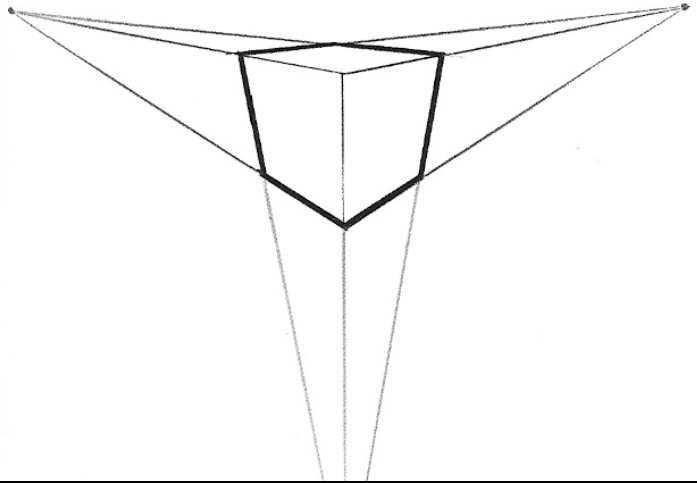
What is perspective?

In order to create believable sketches, it's imperative that a designer has an understanding of perspective theory. An audience will instinctively know when a sketch has been drawn 'out of perspective', even without knowing perspective rules. Correct perspective is also vital to be able to estimate and convey the proportions of a sketches object. There are many types of perspective-forms. But the most common are 2point-perspective and 3-point perspective. 3 point perspective is the exact translation of the real-life situation. 2point perspective is mostly used by designers because with this method we can create believable sketches faster than with the 3-point perspective. 3-point perspective is mostly used in architecture.

Two-point perspective

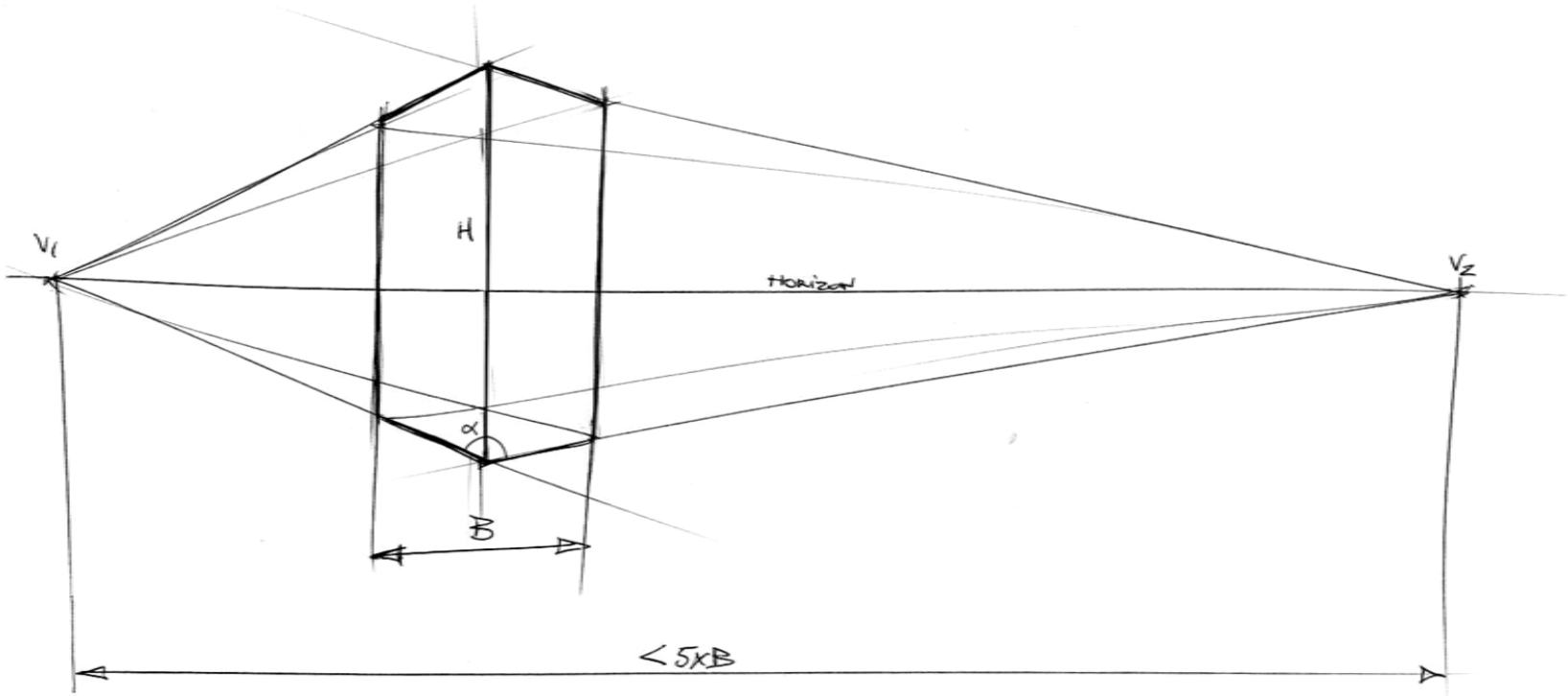


Three-point perspective



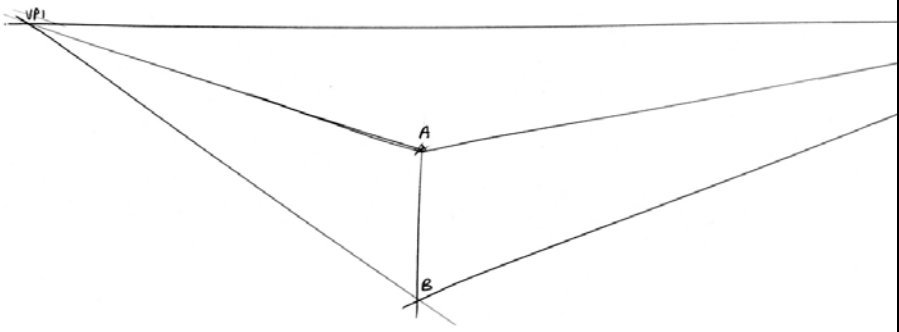
Two-point perspective

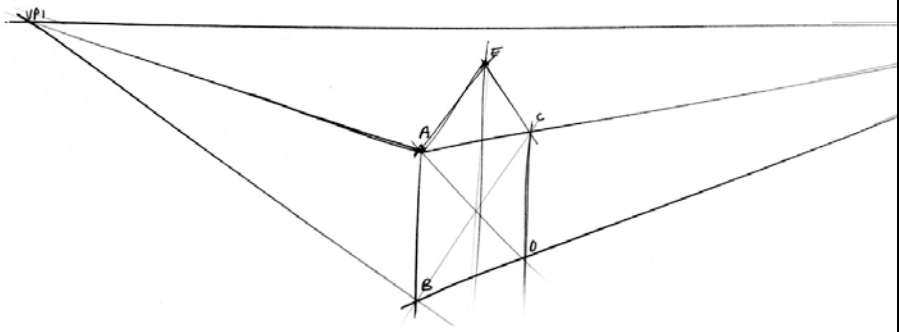
The sketch on the bottom illustrates the rules of two-point perspective. Notice that all the vertical lines on the boxes are parallel to each other, and perpendicular to the horizon line (Wich is a huge advantage towards 3-point perspective in constructing a drawing). Parallel horizontal lines on the actual object are not parallel in the sketch, but meet at specific vanishing points (V1, V2) on the horizon. These vanishing points are arbitrarily placed by the designer. Placing these vanishing points too close together results in a distorted or ‘warped’ perspective. To avoid this effect make sure that the total distance in between these vanishing point is larger than 5 times the with of the object (B). Another guideline in creating a good perspective is to make sure that a perpendicular front corner of an object (α) exceeds an agle of 90 degrees.

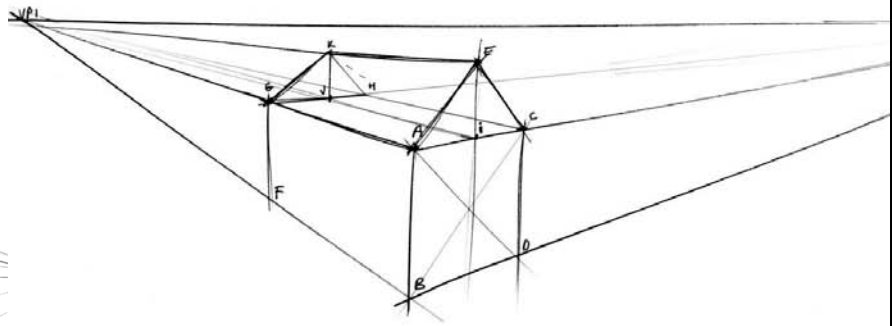


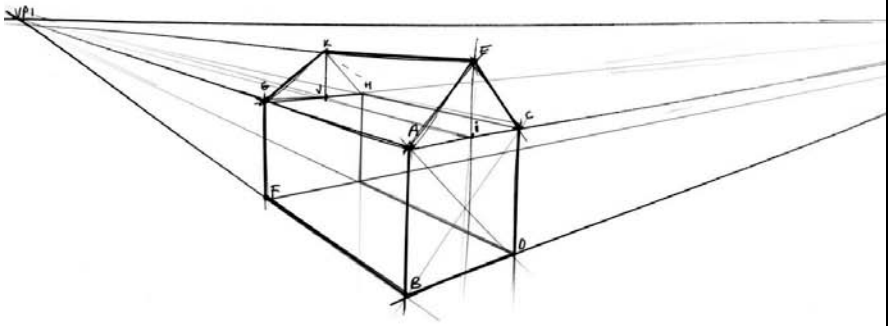
Step by step perspective

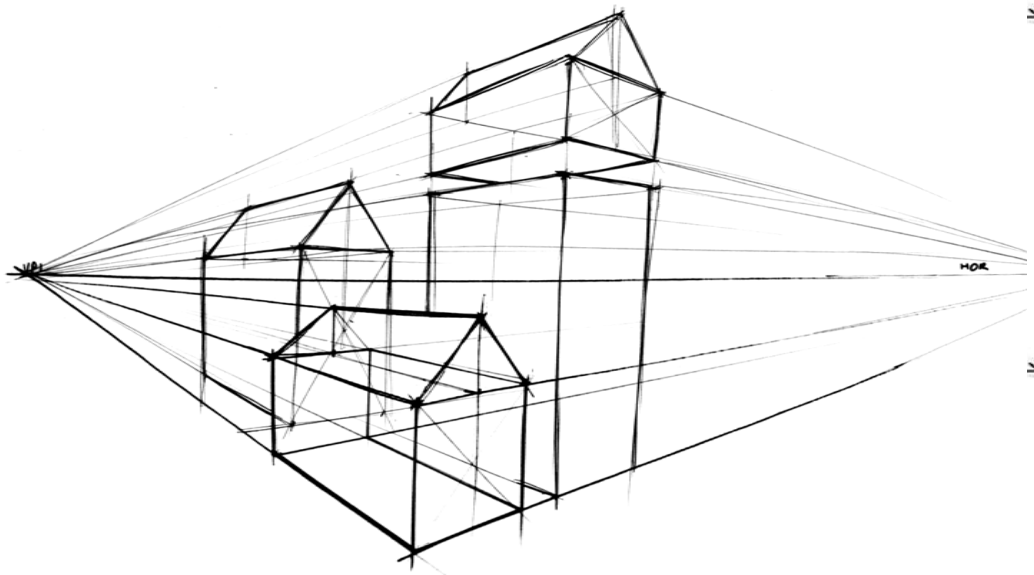
First we'll create a very basic house. We'll Start by drawing a horizontal line this will be the horizon. Create 2 Vanishing points VP1 and VP2 on the horizon. Then draw 2 diverging lines from each vanishing point. Connect the intersections with line AB. Draw a second vertical line CD. Find the center of the square you just created by drawing the diagonals. Draw another vertical line trough this center point and indicate a height F. Connect A and C with F. Now extend the created profile towards VP1. Indicate a depth F. Draw another vertical line FG. Draw a line from G to VP2. Find J and extend to K . Connect all corresponding intersections and highlight the visible edges to finisch the drawing. Apply the same principle in similar more complex exercices.





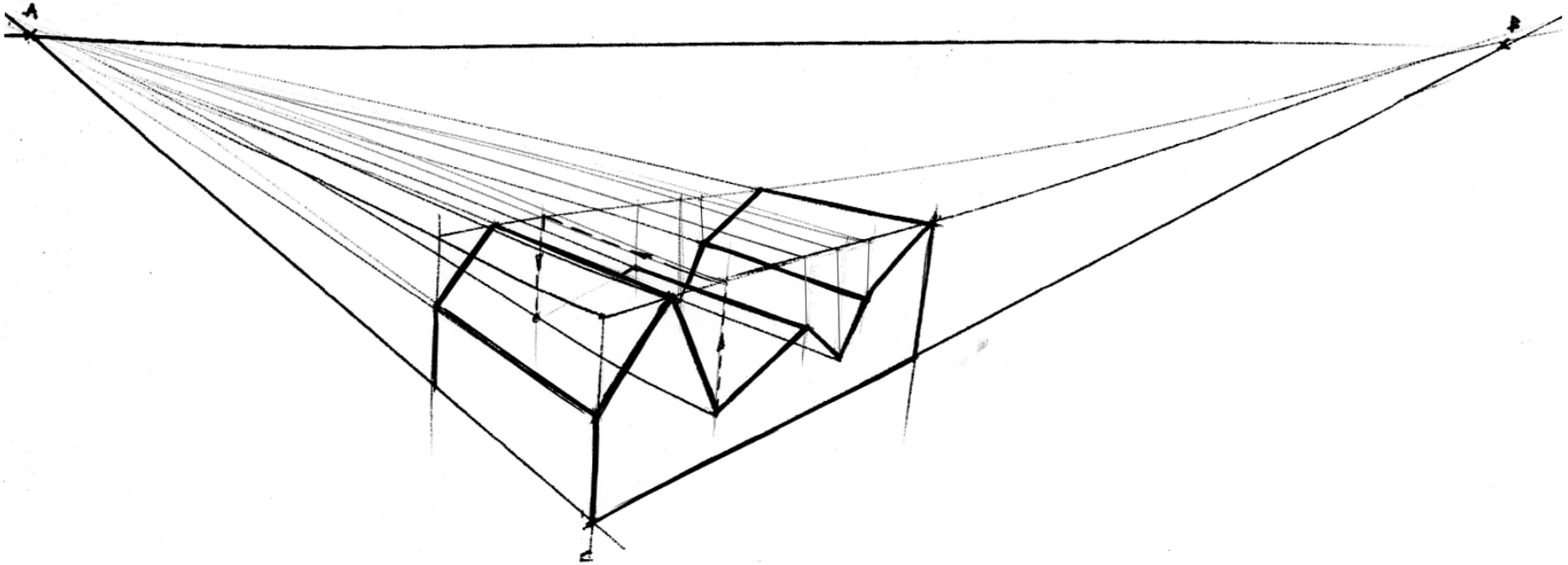






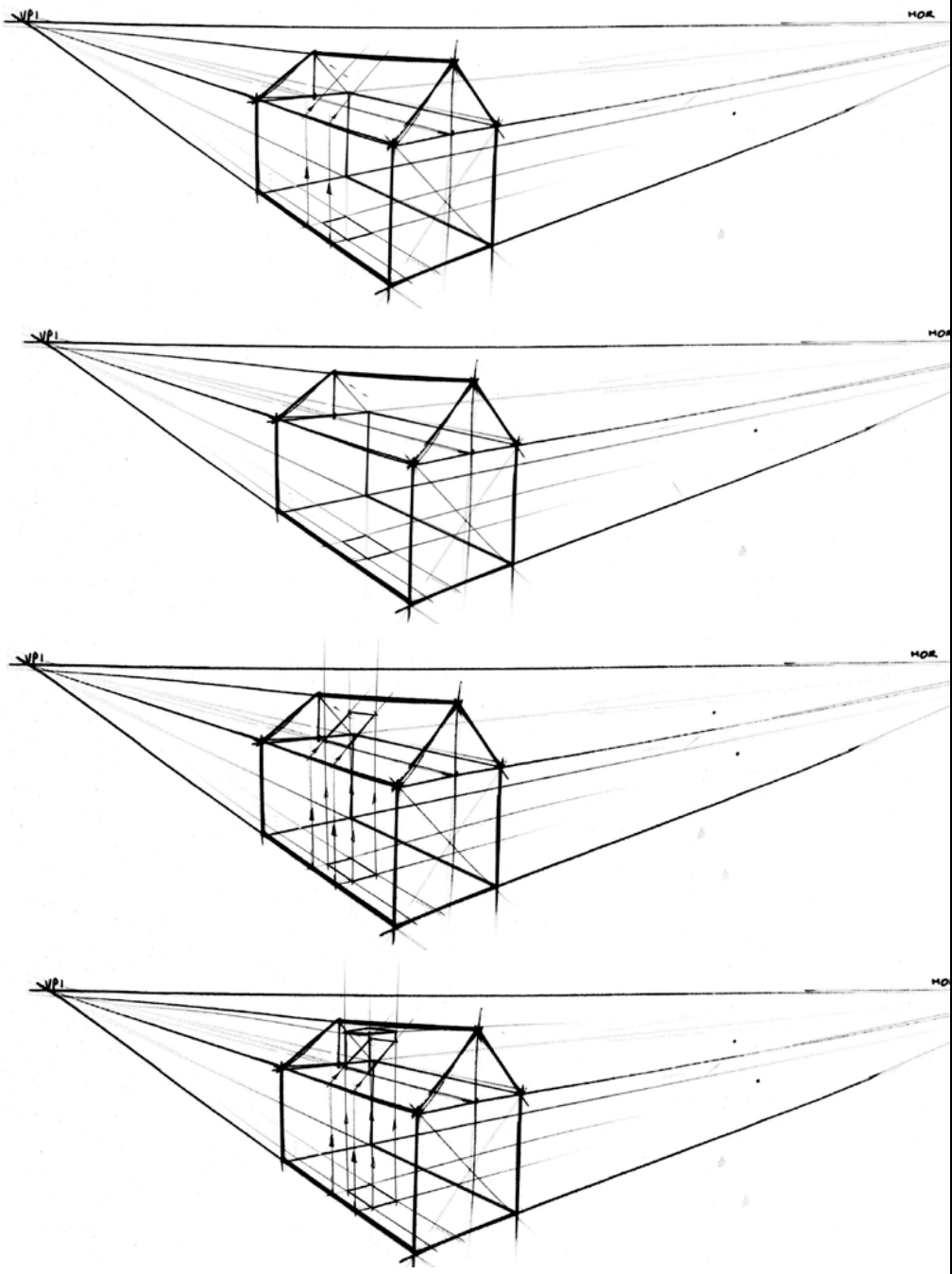
Projection

Uniform sectioned objects are easily constructed using projection. First construct a simple rectangular box. Then draw a profile curve in the front face. Extend this profile to vanisching point A. The counterparts of the points on the profile curve that intersect with the Bounding box are easily constructed. The other points can be constructed by drawing some contructionlines allong the corresponding planes and finding the intersecting points. Do this for all the points and connect the construted points in the back plane. Highlight the visible edges to finish off.



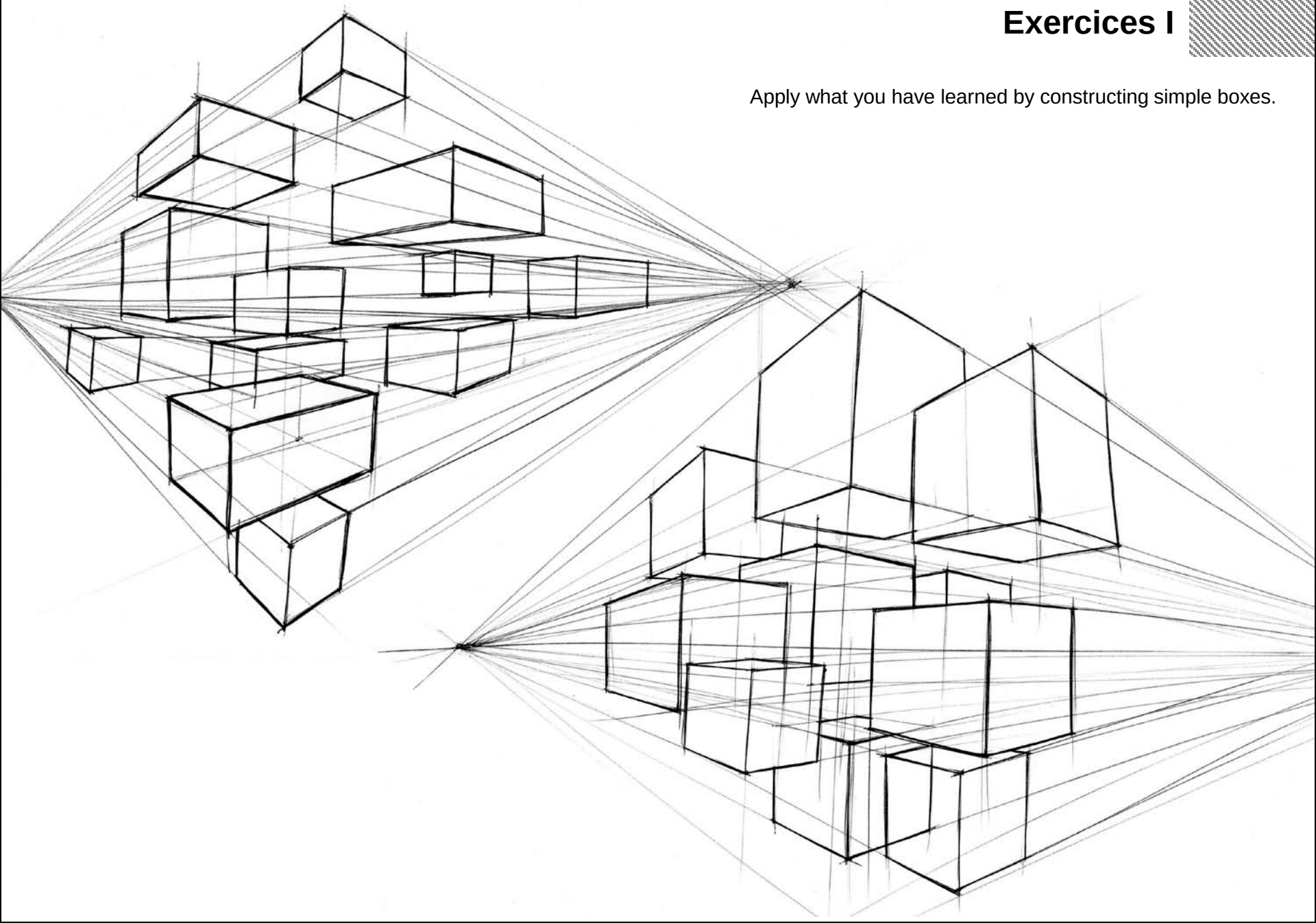
Projection II

Projection is widely used in perspective to construct shapes upon other shapes. The following exercice explains the principle of projection. We'll need projetion to construct a chimney on the roof of the house we drew earlier. First we'll define the section of the chimney by creating a square on the botom plane of the house. Extend the edges that go the the right viewpoint. Draw two verticals where they intersect with the left edge of the bottom plane. Use the edges of the roof as reference to extend these same lanes allong the roof. Draw another set of vertical from eacht corner-point of the chimney-section. Connect the intersecting lines to create the cross section between the roof and the chimney. To complete the chimney indicate a height on the vertical that is nearest to you. Complete the chimney by creating the vanishing lines and highlighting the upper plane. We could also use the front face of the house as a reference and project allong there continuing on the roof towards the vanishing point on the left. There are many ways to construct a shape in perspective but the principle is mostly the same. Using the reference planes of the bouning box and the vanisching points to construct intersections and therof planes and other shapes.

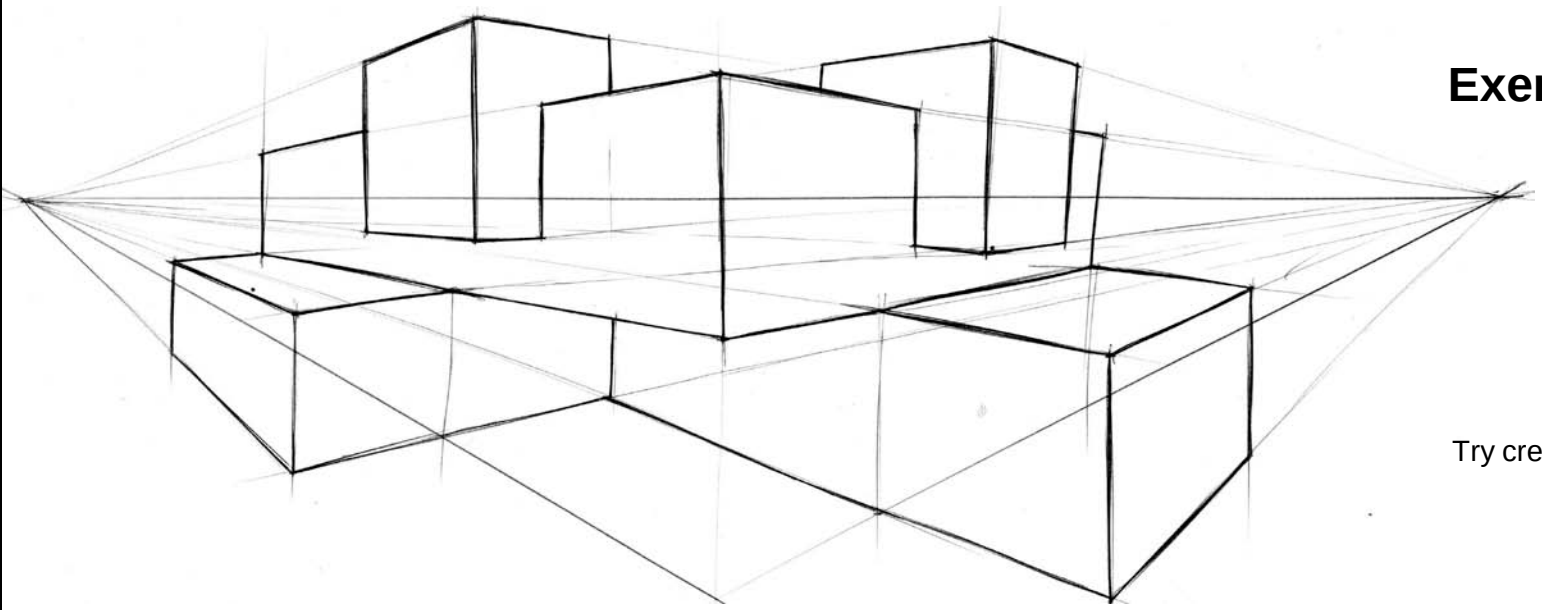


Exercices I

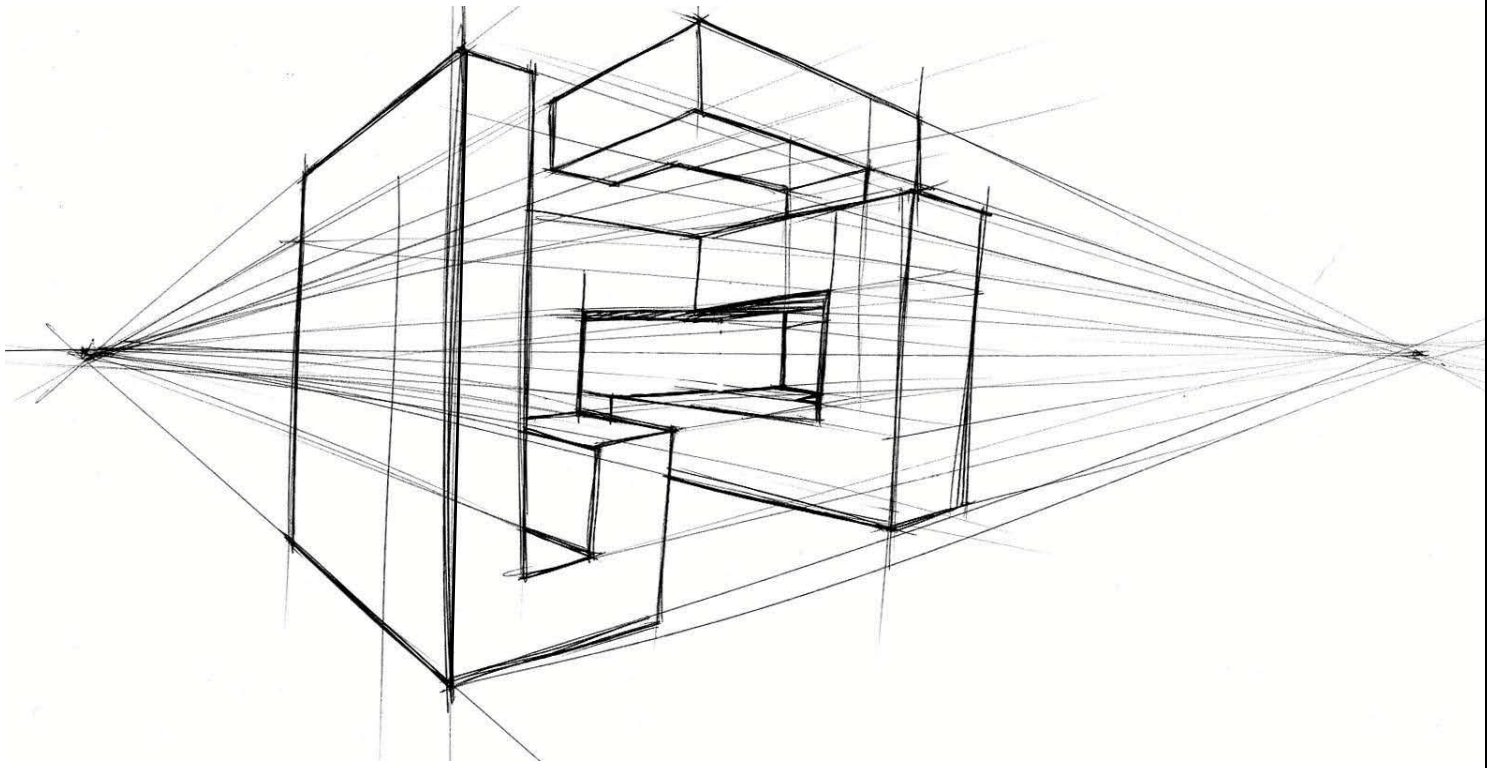
Apply what you have learned by constructing simple boxes.



Exercices II

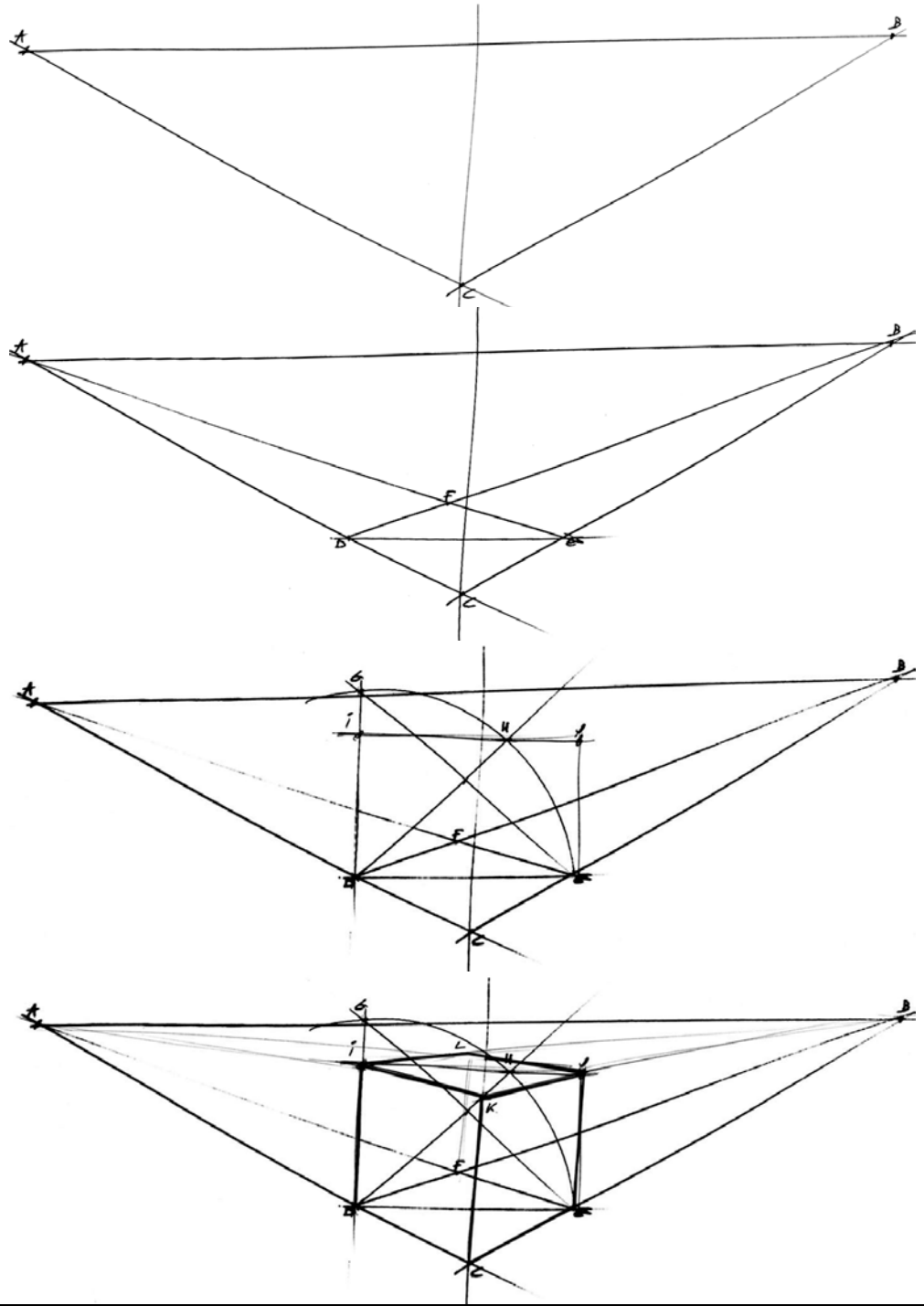


Try creating more Rectangular complex shapes.



Basic geometry

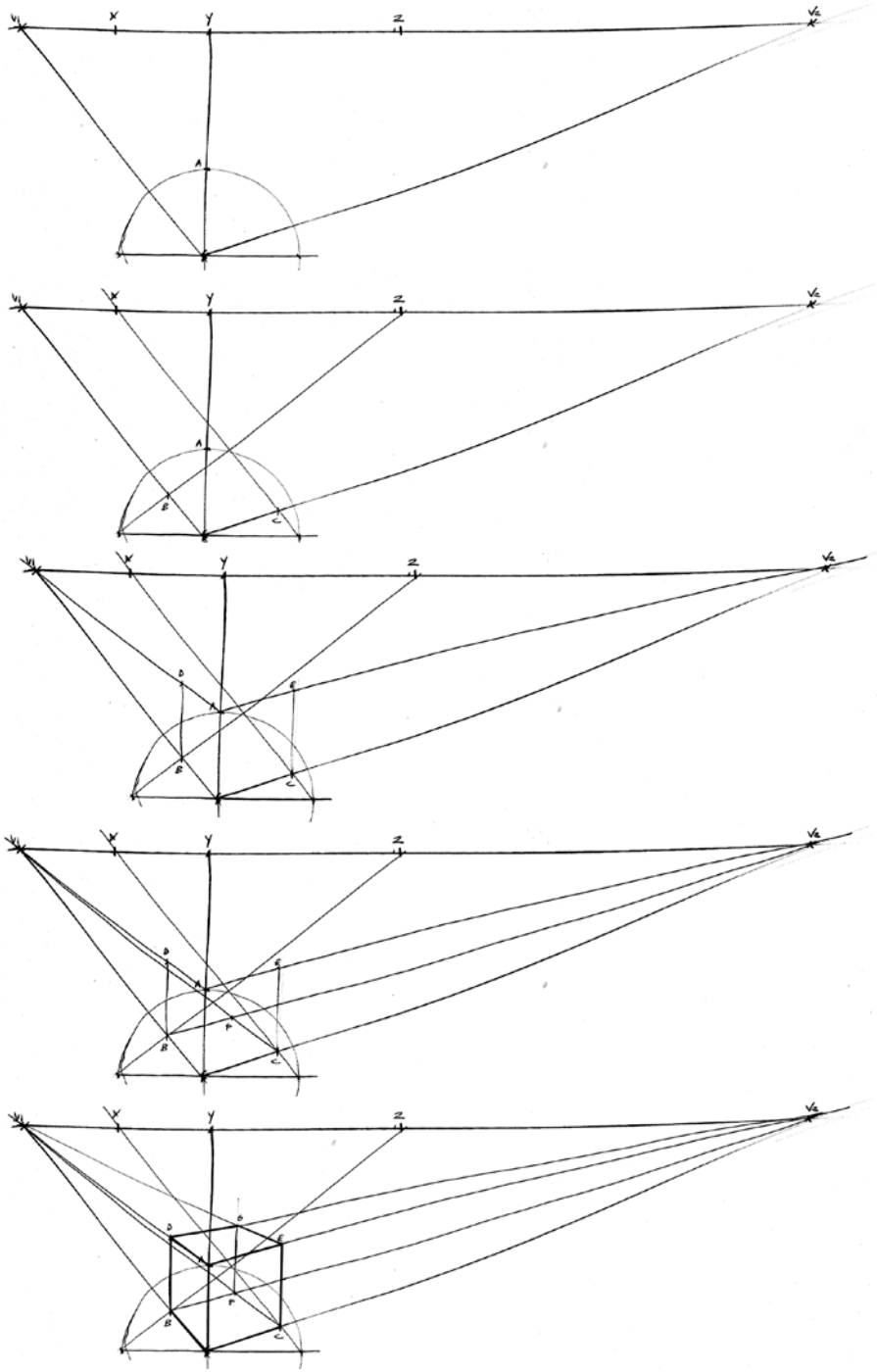
The term basic geometry is the collection of cubes, rectangles, cilinders and sphere. The term is also used to label objects that are build-up by this basic shapes. A well known example is the Ipod and most of the Apple products. Basic geometry objects are the easiest to draw. Altough things can get complex quite quickly if you want to do it right. Therefore it's necessary to have patience and try to be as accurate as possibble. The Cube is the simplest shape yet it is not easy to draw a perfect cube. It's necessary to know how to draw a exact cube because it's the building block of perspective. The construction can also be used as a unit of measurement. In this way everything is considered in proportion rather than directly measured. A dimension is assessed as being twice that of another. Rather than being 50mm. Equally you might think of a dimension as being 2.5 cubes in length. There are many books about perspective and most designers aere familiar with at least one of the mechanical methods of setting up a perspective drawing. Few designers have the time to do laboured perspectives. For this reason choose a method that is simple. The easiest is to create a cube with a CAD-program and use this as a reference. This speedens up the drawing-process, especially if you just need the cube for construction of a more complex form. CAD-programs are magnificant tools but it's not recommended to use them in the explorative phase of the design-process. Later on we'll also use grids generated from a CAD-program to speed up the drawing process but for this purpose only. If you really need to construct a freehand cube then there are 2 (easy) methods you can use. These methods will result in a 45/45-degree cube and a 30/60-degree cube. Each of these methods are described in the following pages.



The Cube

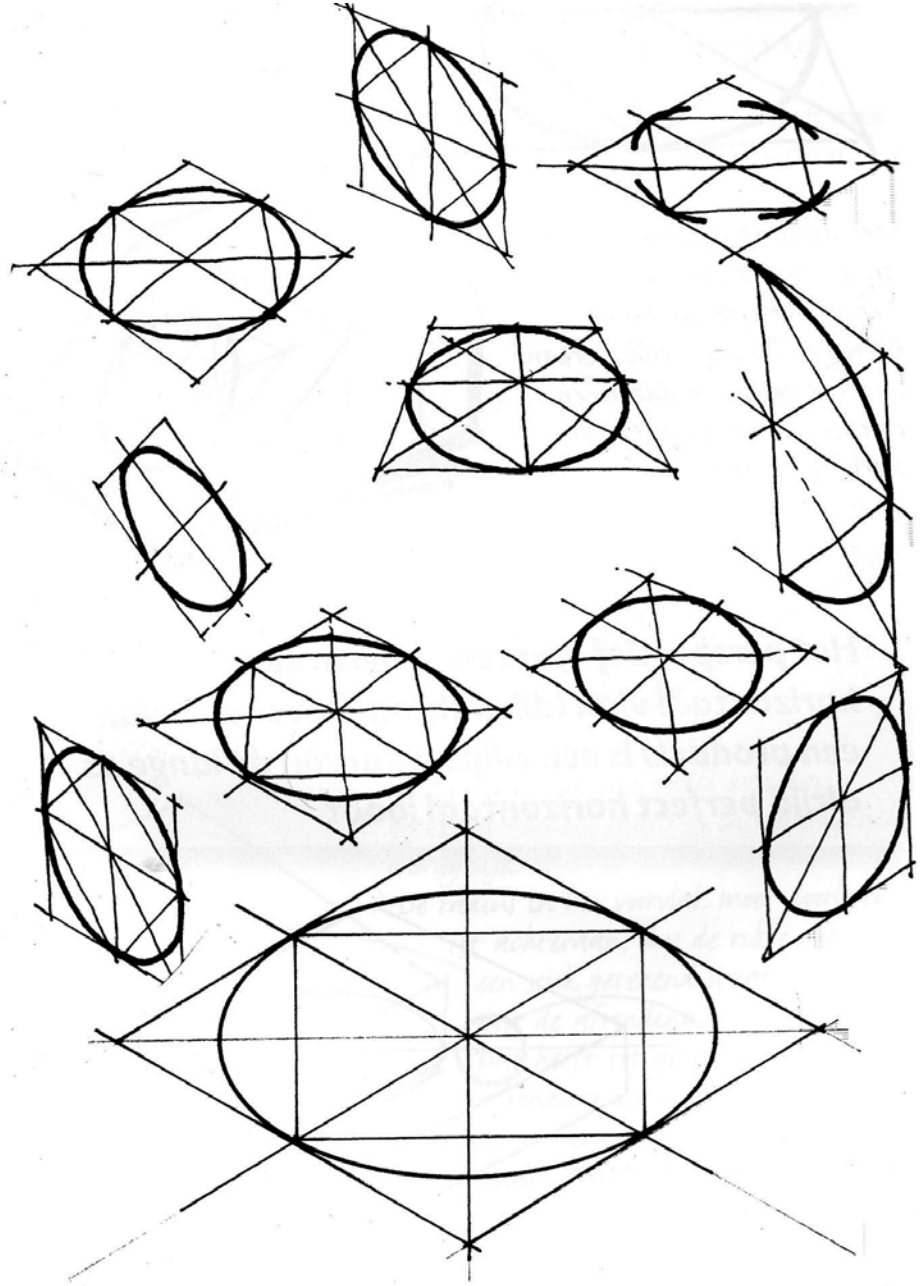
45/45-degree Cube

Draw the horizon and position the two vanishing points (A and B) on it. Bisect the distance between the vanisching points to find the diagonal vanishing points. Drop a vertical from this point and draw two lines AC and CB from A and B at the desired angle. This will be the angle at the base of the cube nearest to the viewer. Draw two more lines DB and EA. To form the perspective square CDEF. Create 2 more verticals from D and E and. Create a freehand-arc with the center in D. Draw another line from D with an inclination of approximatly 45 degrees. Locate point H at the intersection of the arc and the angled line. Draw a horizontal line trough X to locate I and J, wich completes the diagonal plane DEIJ. Now complete the top plane by drawing lines from both vanishing points trough I and J. Highlight the visible edges to complete the drawing.

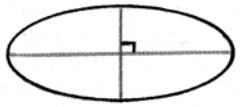


60/30-degree Cube

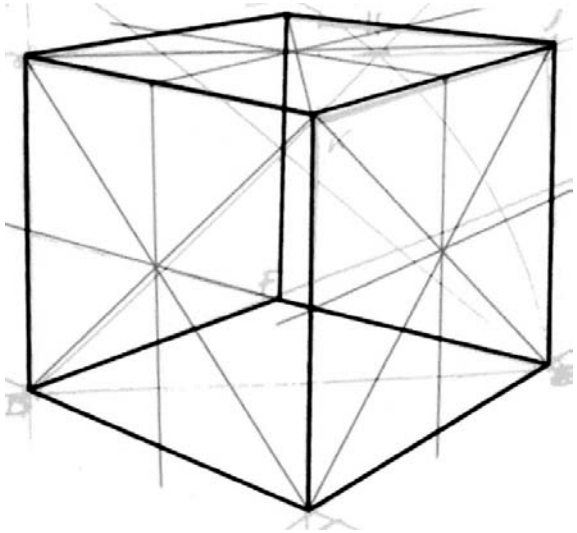
Draw the horizon and position two vanishing points (V1 and V2) on, it. Bisect the distance between the vanishing points to locate Z. Bisect the line V1/Z to find Y. Bisect the line V1/Y to find X. drop a vertical from Y and mark a point at the desired distance below the horizon. Draw lines trough this point to form the nearest angle of the cube. Draw horizontal line trough this point. Indicate the height of the cube at A. Create a freehand arc with center in the base point going trough A. Draw lines from the created intersections to X and Y thus creating two more points from the bottom plane. Draw another set of lines from A to the two vanishing points. Erect two verticals from B and C untill they intersect with the vanishing lines from the top plane. Construct the 4th corner-point of the bottom plane by constructing two more lines from B and C to their corresponding vanishing points. Complete the top plane of the cube by drawing another set of vanishing points from DE. Finish the cube by highlighting the visible edges.

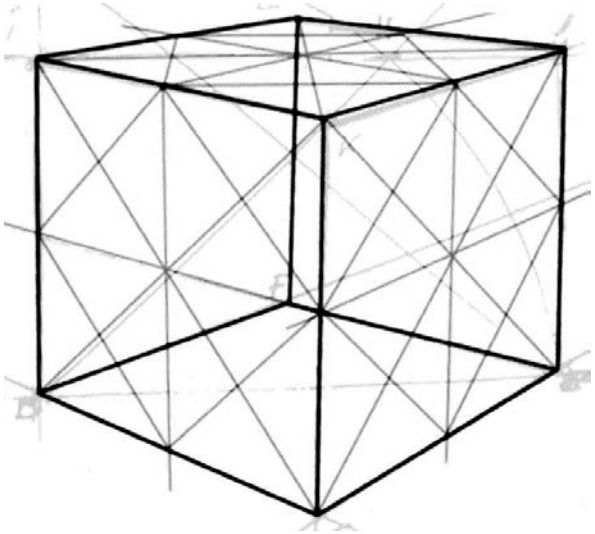


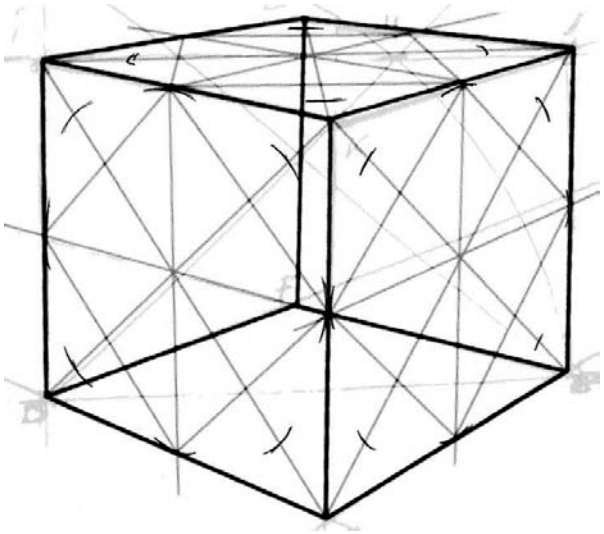
Ellipses and Circles

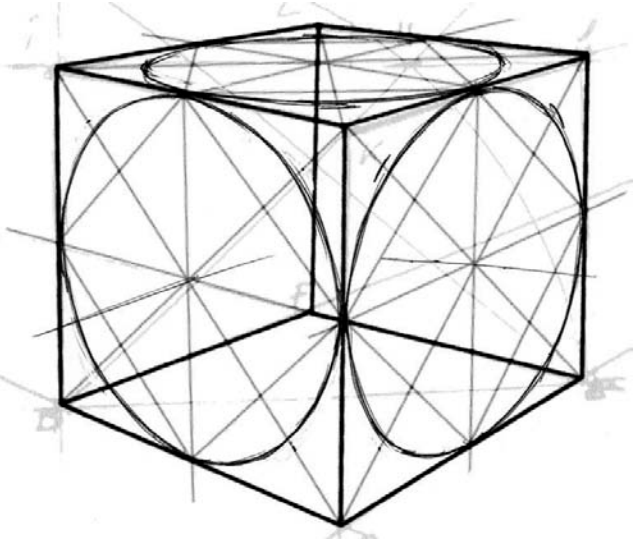


Circles can be easily drawn with a compass. But you can also draw a freehand circle by using your hand as the compass as indicated in the bottom pictures. Place your thumb on the paper. Hold the pen so it touches the paper. Then rotate your paper 360° to complete your circle. It can be shown mathematically that a circle in perspective is a true geometric ellipse. An ellipse has a major and a minor axis at right angles to each other, it's also symmetrical about both axes so that each half of each axis is the same length. When an ellipse is viewed as a circle in perspective, the axis of rotation of that circle coincides with the minor axis. If you have trouble drawing freehand ellipses, turn the paper so that the minor axis is vertical on the paper and the major axis is horizontal. To help understand a circle in perspective draw a square. Construct the diagonals and connect the mids of the opposing sides. Create another inscribed square as indicated. Divide the line between the outer and inner square in two. The ellipse must go trough these points. Altouh this is just indication and may differ a little bit. Above all it's important to have a clean ellipse. So construction is just an aid and reference.





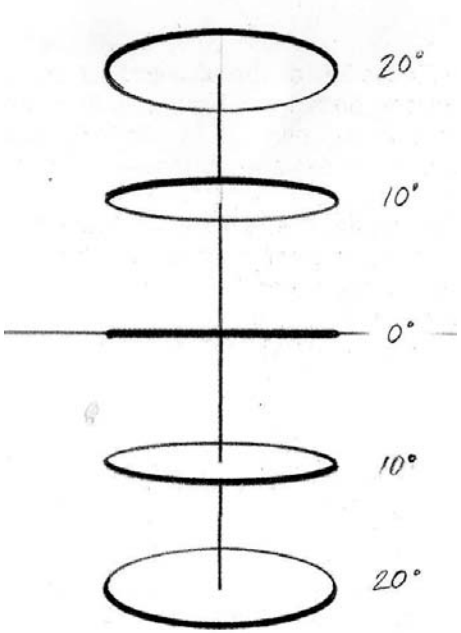


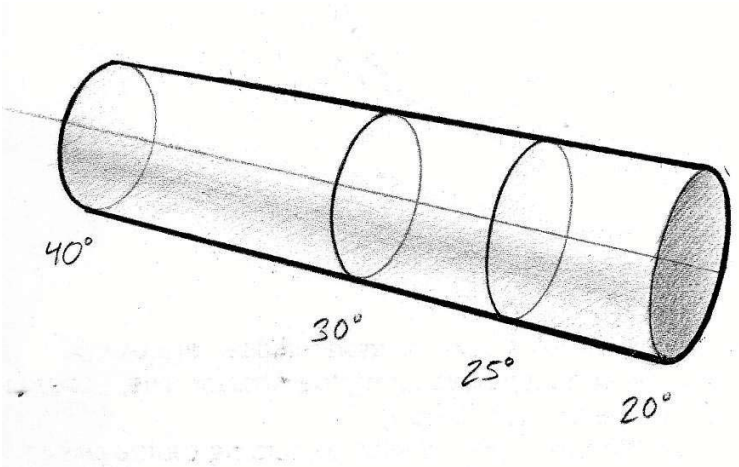


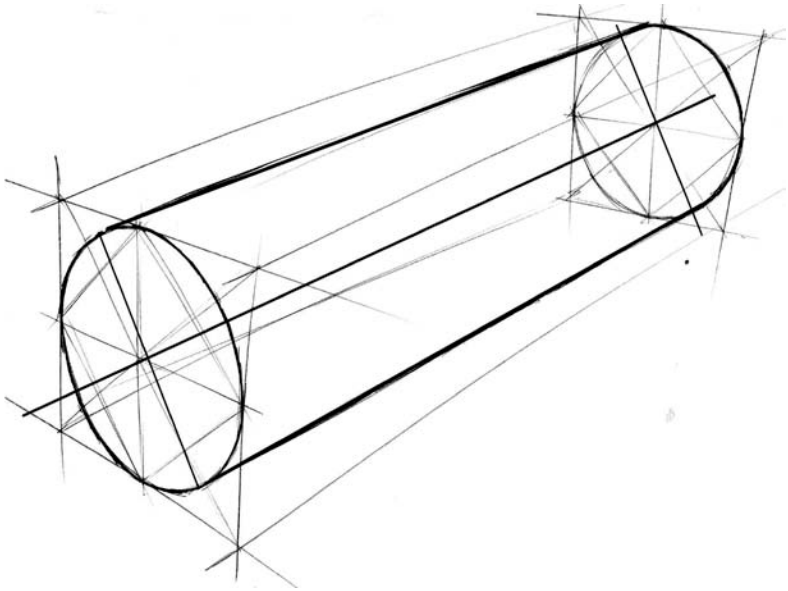
To trully see what circles look like in perspective we'll place them in a cube. First find the center of all visible planes by drawing the diagonals. Do the same with the opposing mid-points. Construct the innerscribed squares. Divide the lines between the squares in two and start constructing the ellipses, It tends to go better if you turn your page when you go allong. What is most noticible is the skew-effect that occurs in the tow vertical planes. This is important to keep in mind when free-sketching. It wilIl give the sketch that extra credibility and flair.

Cilinders

Ellipses have certain values, indicated in degrees. This is because they are related towards the bounding squares that widen in perspective. The values state how much of the circular area is seen at that point.The lower the value, the closer ellipse to the view point and the shorter the minor axis of the ellipse will be. The same rules apply to horizontally placed circular areas. The easiest way to draw a cilinder is to draw a bounding box and construct ellipses in the front and back plane. The axis of the cilinder you want to draw is the minor axis of both ellipses. Draw a line perpendicular on this axis to find the ellipses Maximum. Connect the corresponding maximum of the ellipses with each other to complete the cilinder. When this basic theory is understood you can start practicing drawing cilinders without the bounding box and build up from the axis line and the knowledge that the minor axis shrink when closer to the viewpoint. To achieve perfect ellipses, guides can be used.

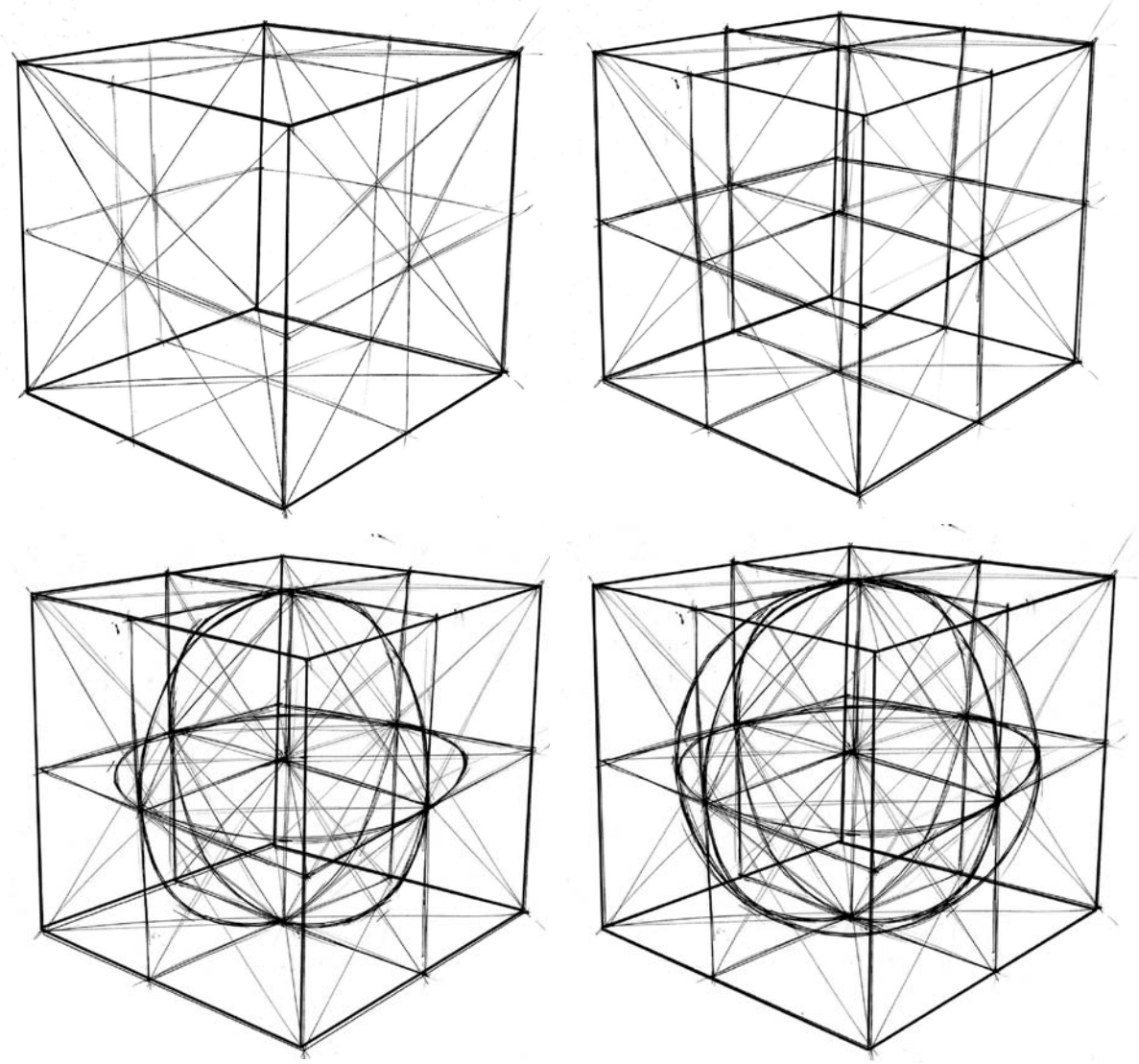






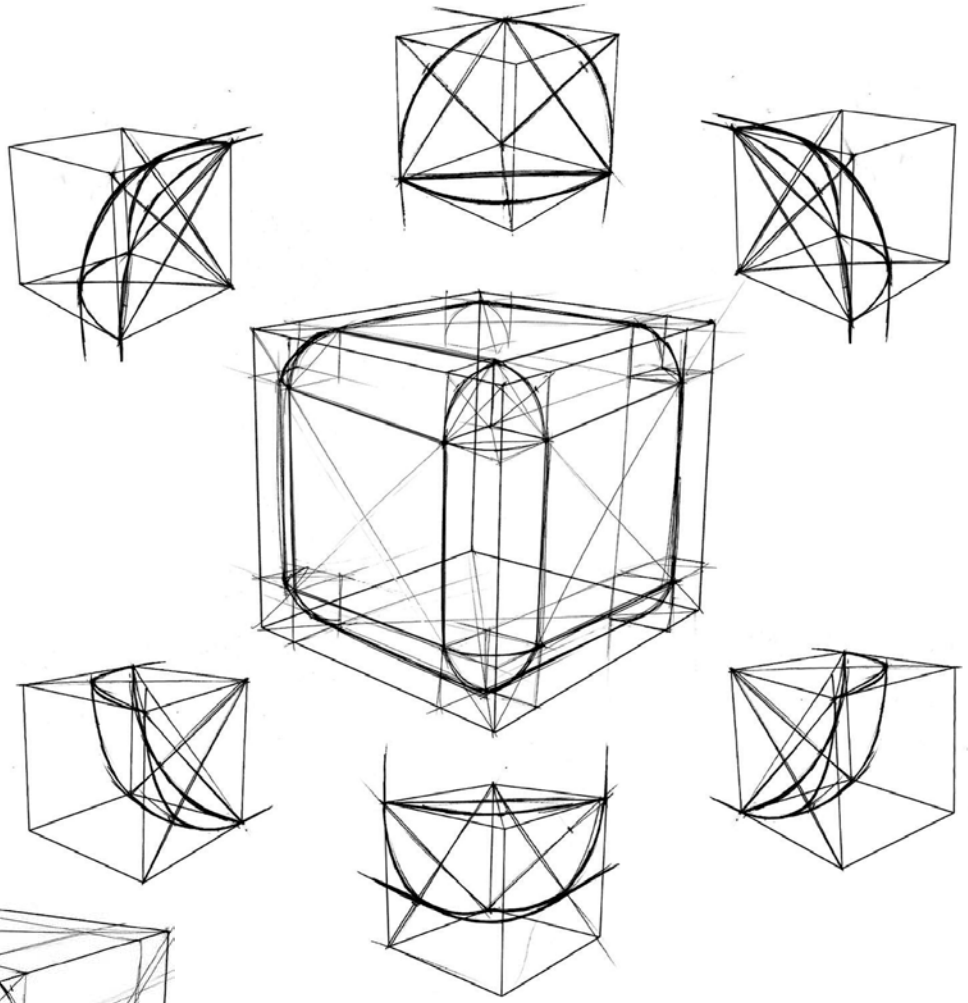
The Sphere

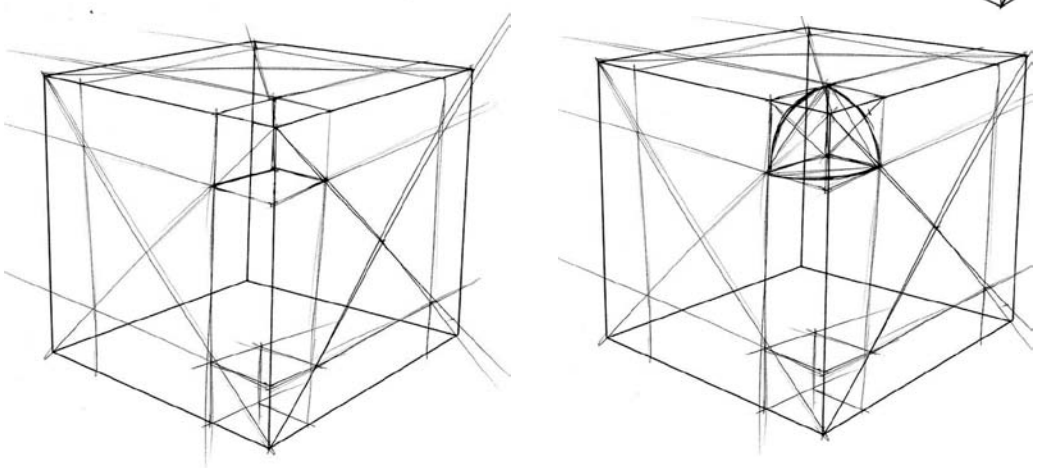
A sphere in perspective off course is a perfect geometrical circle. And can be easily drawn with the freehand-circle method or a compass. Altough sometimes this is insufficient because more detail is required or because the spherical part must relate to another part. Therefore the following method. Start off by constructing diagonals and mid-point crosses in all planes. Use the center points and mid-points to construct 3 mid-planes. Again construct the diagonals and mid-point crosses in these planes. Be accurate and focusses or you'll get lost in the maze of lines. Then draw the corresponding ellipses in all 3 mid-planes. Locate the maxima of each ellipse and draw a circle trough them. You can always measure how good you did with a compass or guide.



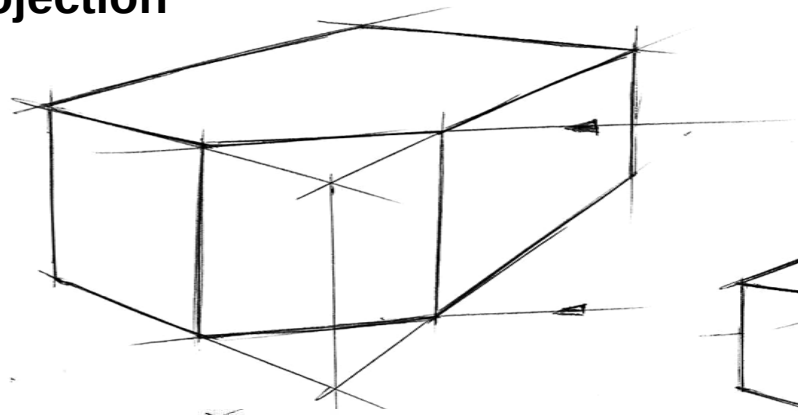
Rounded Cube

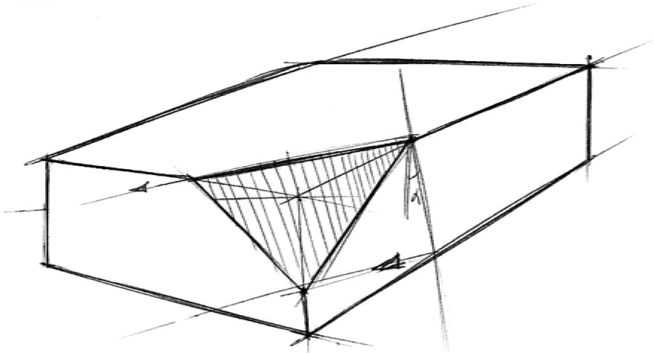
Radi are a common characteristics of modern-day-products. The following method explains how to apply radi on a cube but is applicable to all shapes. First Locate the center by constructing The diagonals. Then construct a line that will indicate the extremities of the radi. Use the diagonals to project this extrimity to all planes. Use the constructed squares to create boxes on the corners of the cube. Now construct the arches in these cubes as indicated in the figure by using the construction of an ellipse in only one quadrant. Connect the extremities with each other and the rounded cube is finished.

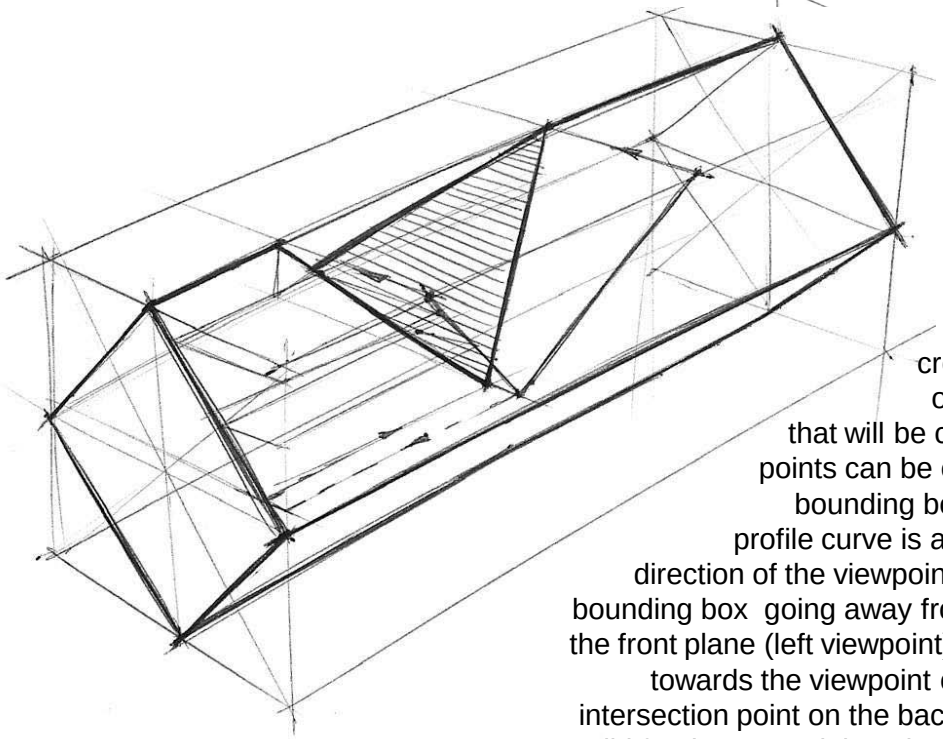




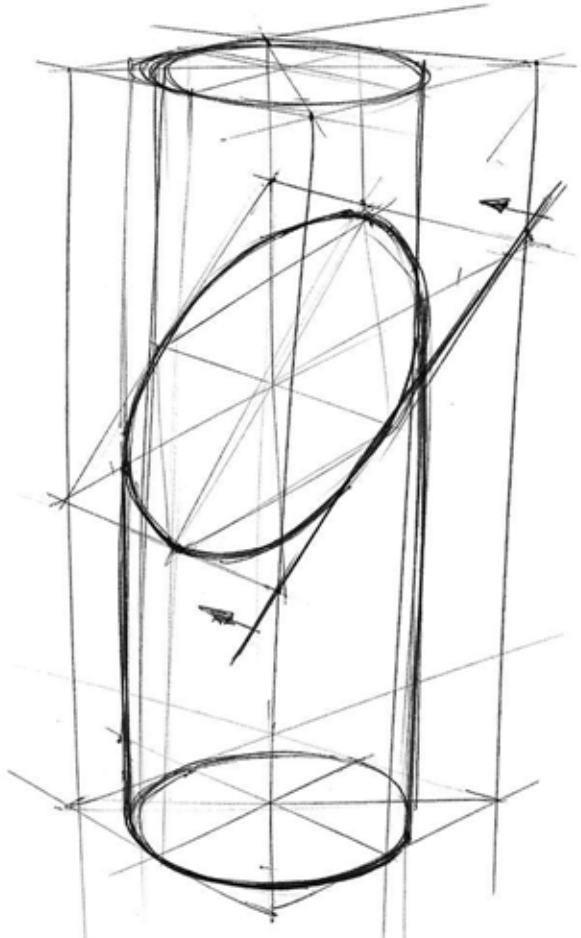
Advanced Projection

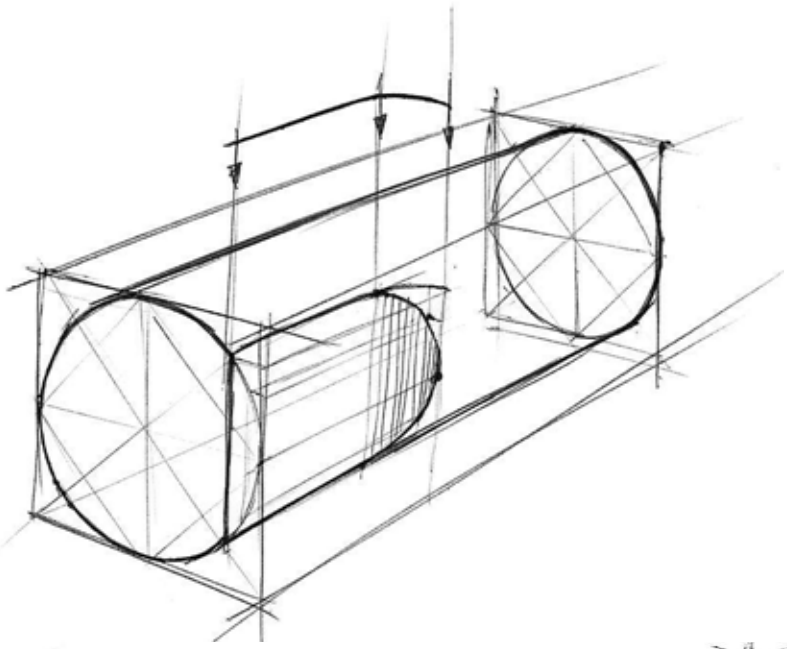


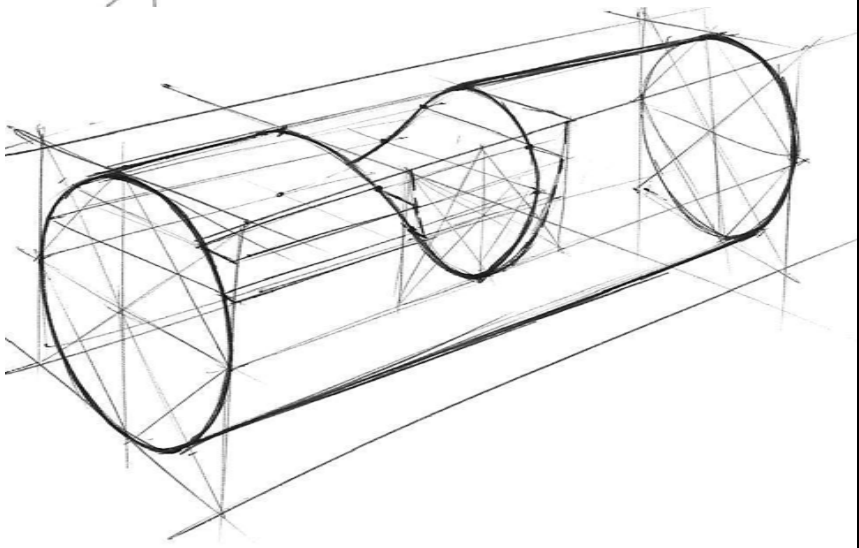




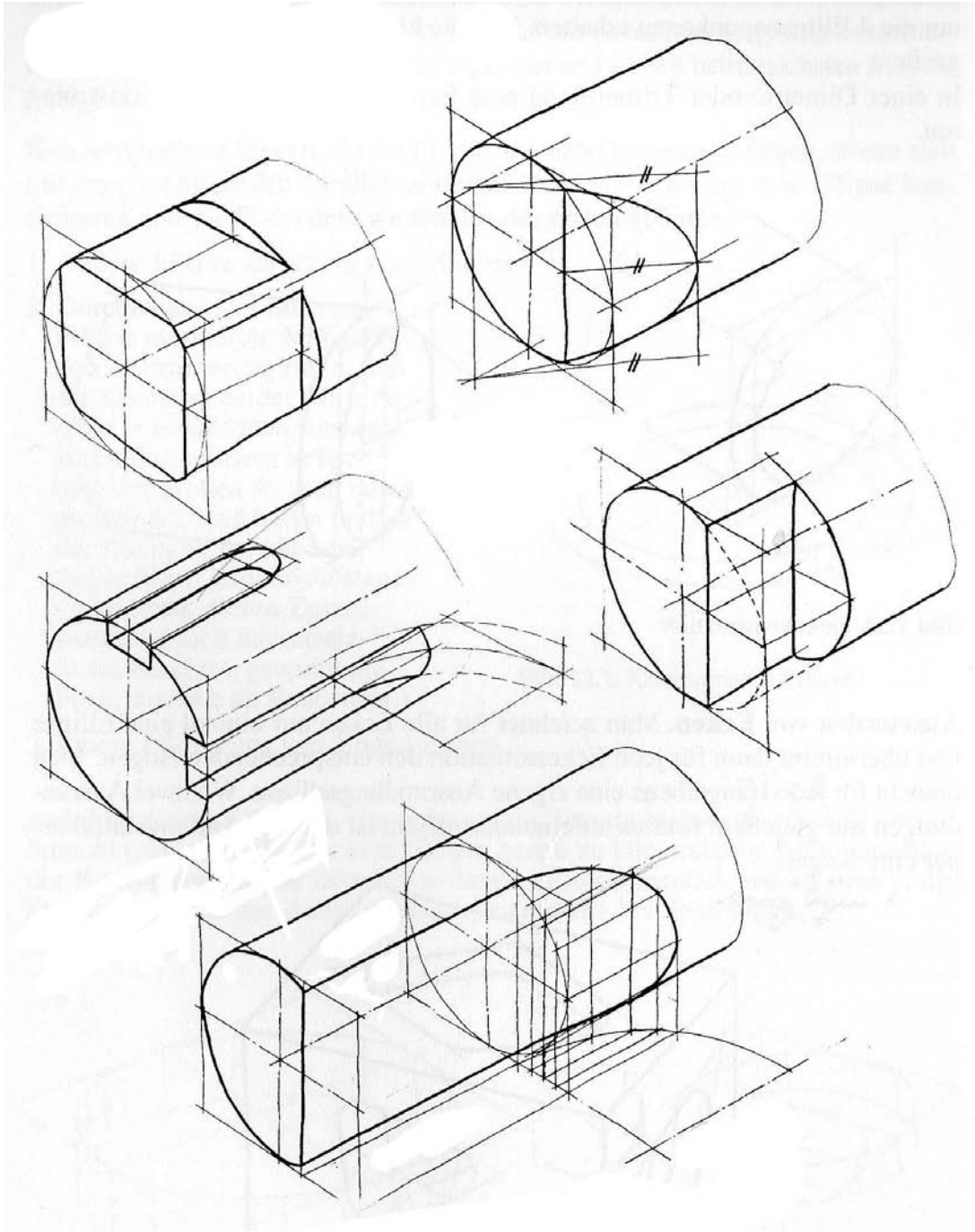
Most of the time the product we use aren't that simple that we can just define them with one basic shape. Most of the time the basic buidling block has cutouts and protrusions. A simple way to construct cutouts is projection. The same method we used to create a chimney on the house. Always draw a profile curve in one of the planes from the bounding box. This will indicate the section that will be cutout from the solid shape drawn in the bounding box. The edge points can be easily projected onto the solid because it shares a plane with the bounding box. So there's no need to change planes. The middle point of the profile curve is a little more complex. First of we draw al line from this point in the direction of the viewpoint on the right. Then we draw another line in the right plane of the bounding box going away from the right viewpoint. Change planes and follow the direction of the front plane (left viewpoint) untill you intersect with the constructed solid. Draw another line towards the viewpoint on the right and another intersection point is constructed. For the intersection point on the back side. Continue on the front plane untill you cut the intersect the solid for the second time then draw a line to the viewpoint on the right. Connect the lines and highlight the visble edges. There are other ways of construction this cutout by using the same principle. It's a good exercice to try to create the same drawing using another 'path'.



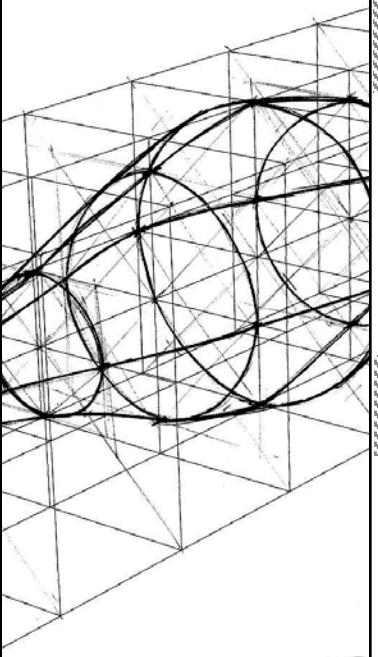


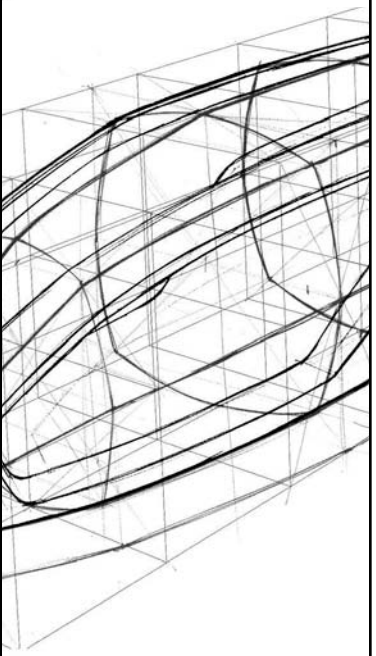


The same method can be applied on all sorts of shapes. But the complexer the surfaces the more points you'll need to project onto the solid. When cutting a rectangular shape with a line then the cutout will also be straight. This is not applicable when one of the shapes is curved, either the solid or the profile. As you can see in the cutouts of both cilinders. When a cilinder is sliced by a straight edge then we can use another trailed method. Just construct the plane defined by the profile curve and construct an ellipse in. It'll be much more time consuming and less accurate if you construct the section with the projection-principle.



Some more examples of how projection is used to cutout sections of cilinders. Off course construction is just a reference and guide in creating a believable drawing and therefore you can sheet a bit and just construct some intersection points and sketch the profile section with less points. But in the beginning it's advisable that you use as much points as needed. I'll improve your sketching abbilities and accuracy.

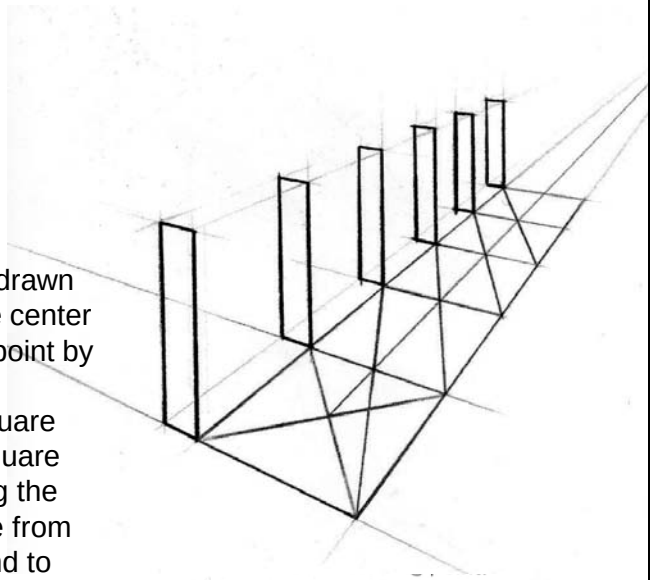




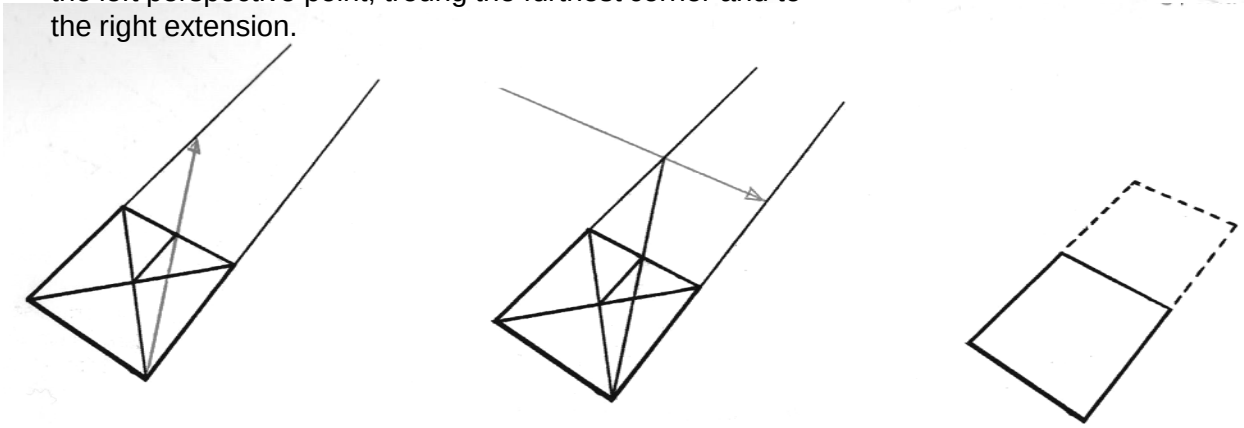
Complex geometry

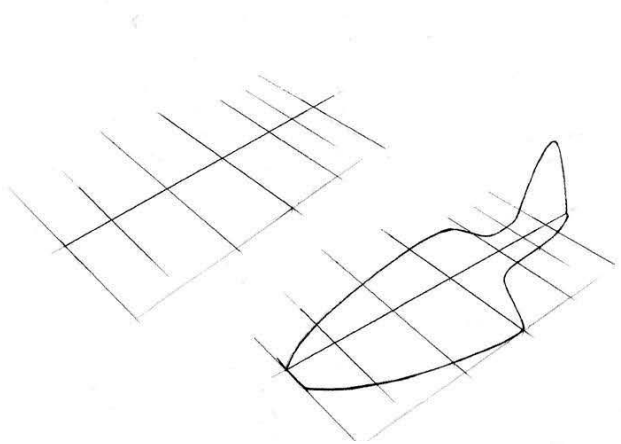
Off course not all modern-day products are build up from basic geometry. Some are axi-symmetrical. Others are just symmetrical in one direction and others are completely assymetrical Those objects are freeform-objects. In order to create these freeform objects we still need to use basic geomtry as a construction guideline. One of the fastest methods used in creating reference planes and boxes is the multiply-principle

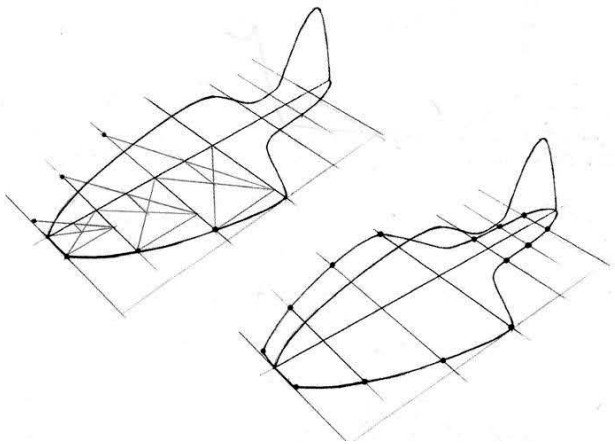
Multiply

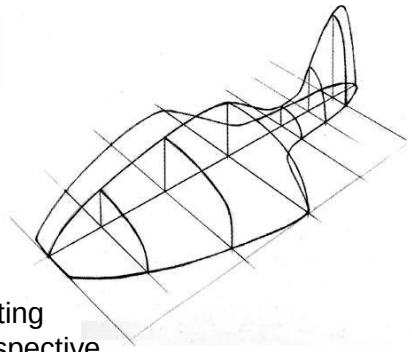


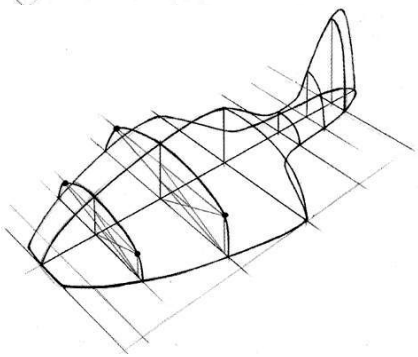
The multiply method allows us to draw the correct proportions of two or more equally sized objects in perspective. This example shows a second square is drawn proportionally to the original square. First mark out the center of the square by drawing the diagonals. Find the mid-point by drawing a line from the square's center towards the vanishing point. Find the furthest corner ot the new square by drawing a line from the closest corner of the first square trough the mid-point of the opposing side and reaching the side extension. Complete the square by drawing a line from the left perspective point, trouhg the furthest corner and to the right extension.

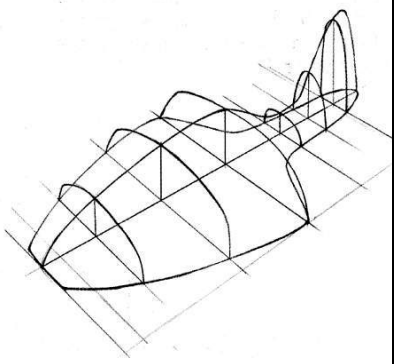




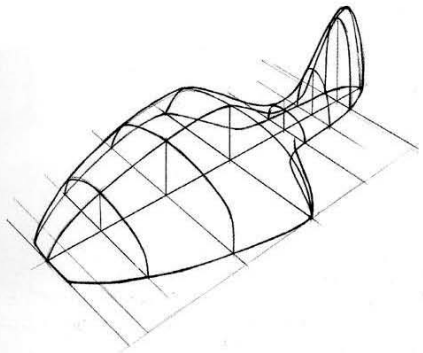


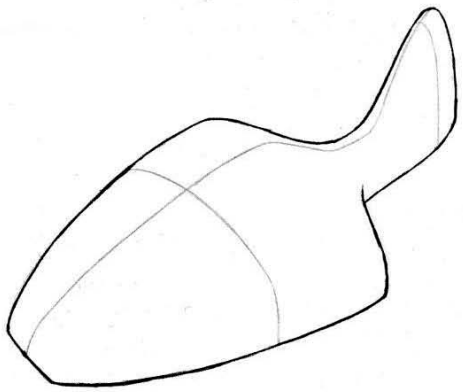


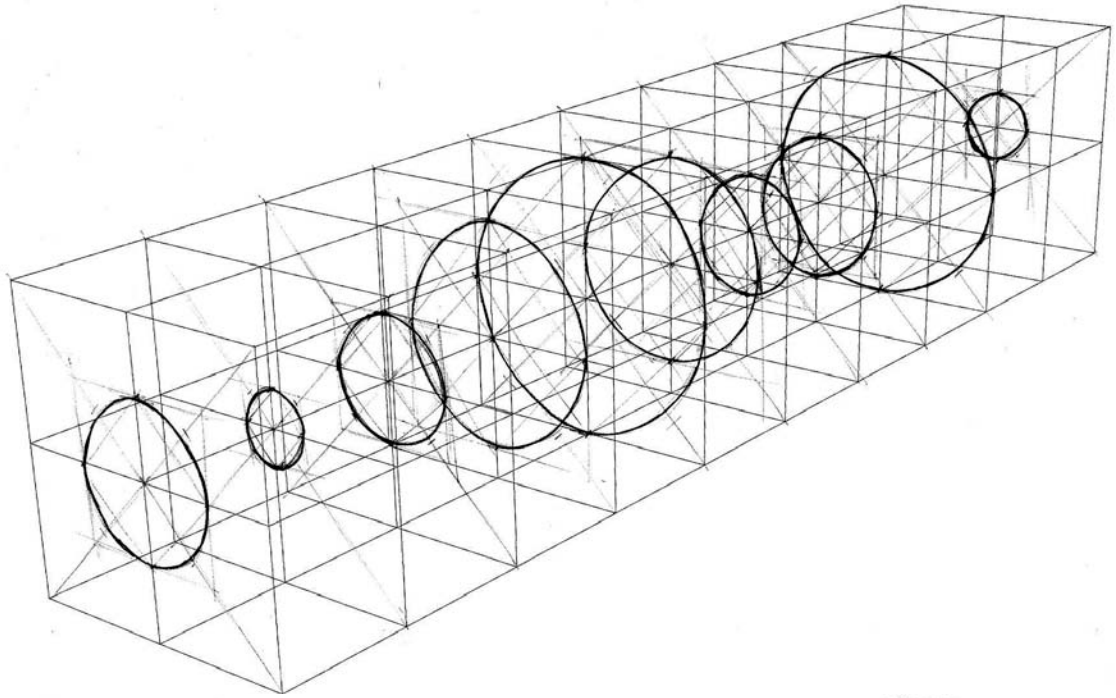


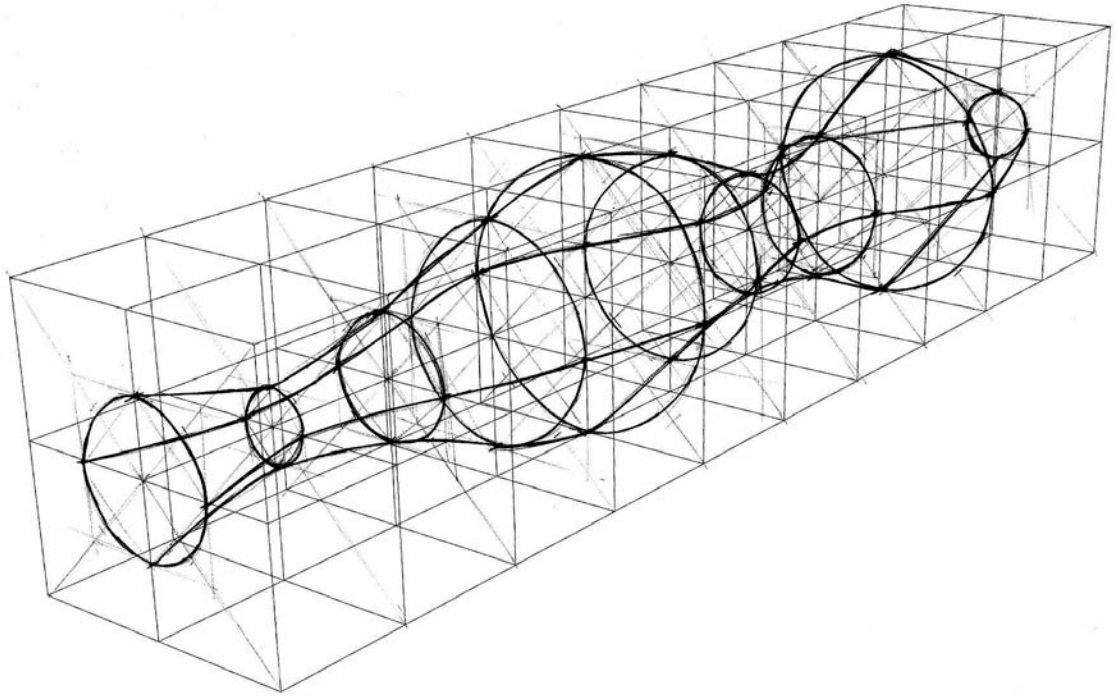


The multiply method can be used in creating symmetrical complex shapes. First a perspective grid is set up. Next contour lines are drawn in the vertical and horizontal plane. To create the correct shape of the top view outline, chosen points on the near half of the top view are mirorred across using the multiply-method. The mirrored points are then connected completing the top view contour. Then the front view-sections of the near half of the form are drawn. These cross sections are also mirrored using the same method. . Now all of these cross sections make up a shape describing skeleton that shows the correct form in perspective. With this skeleton, the contours of the form can be drawn accurately.

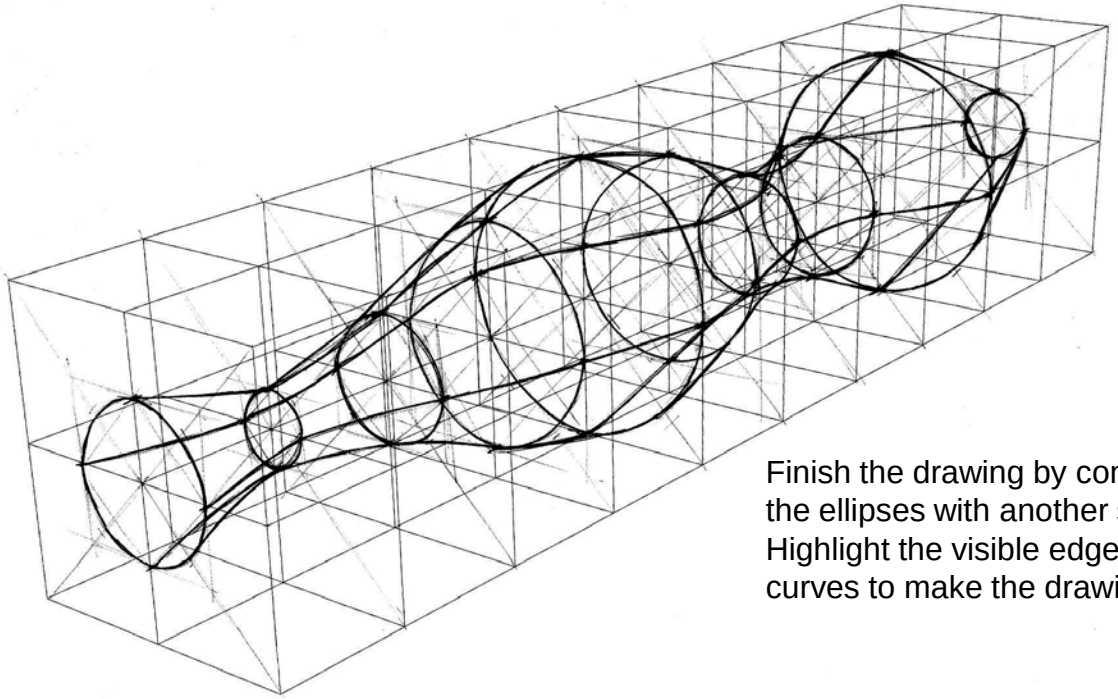




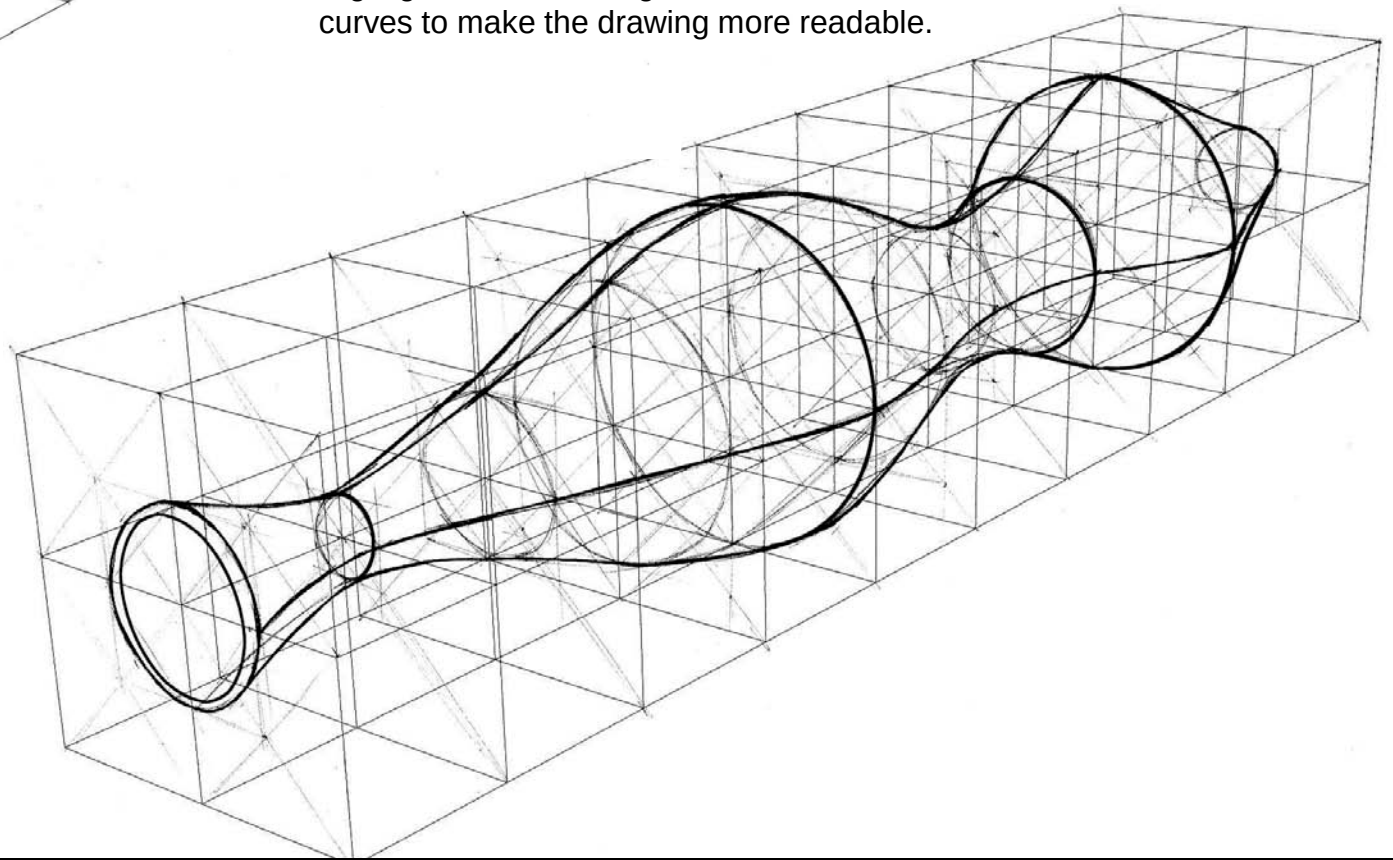


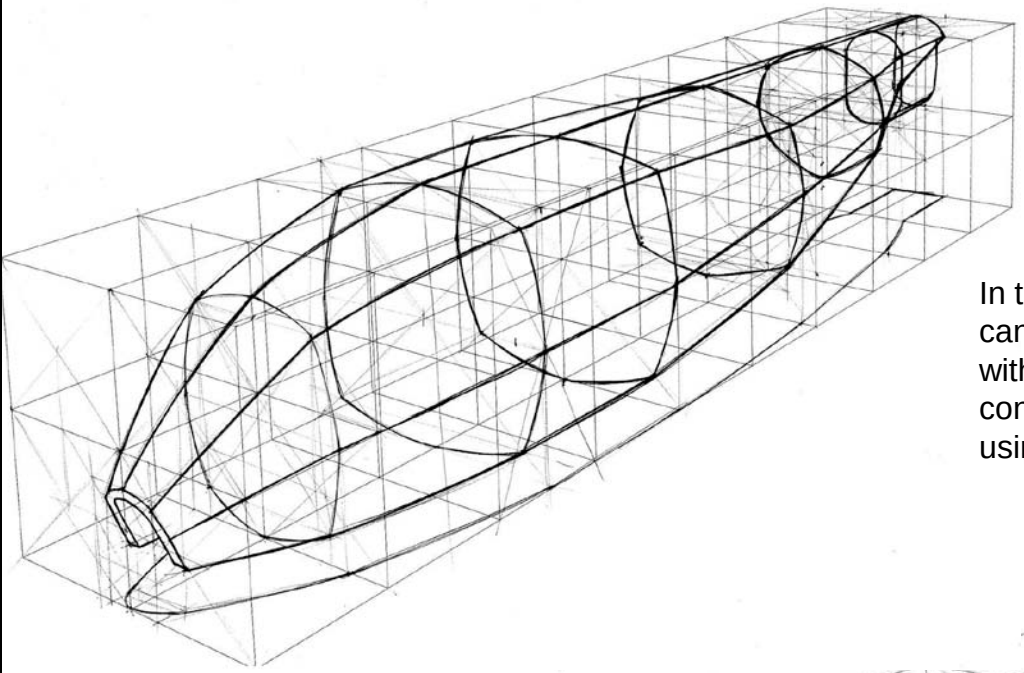


Sometimes it’s really difficult and time-consuming to draw freeform-object without some help our friend Mr computer. With a simple CAD-program we can construct a simple bounding box. Divide this bounding box in cubes and search for the right viewpoint. Once found. Print out the grid and start drawing. It’s fairly easy to create a axi-symmetrical shape. Define a profile curve In one of the Mid-section planes of the bounding box. You can also define this profile curve first on a piece of paper in a side-or top view of the grid. Create the corresponding squares and ellipses where the profile curve intersects with the grid corresponding to the chosen plane. Once all the ellipses. are constructed connect the quadrants with eacht other. These define the other profile curves in the top and vertical plane of the bounding box.

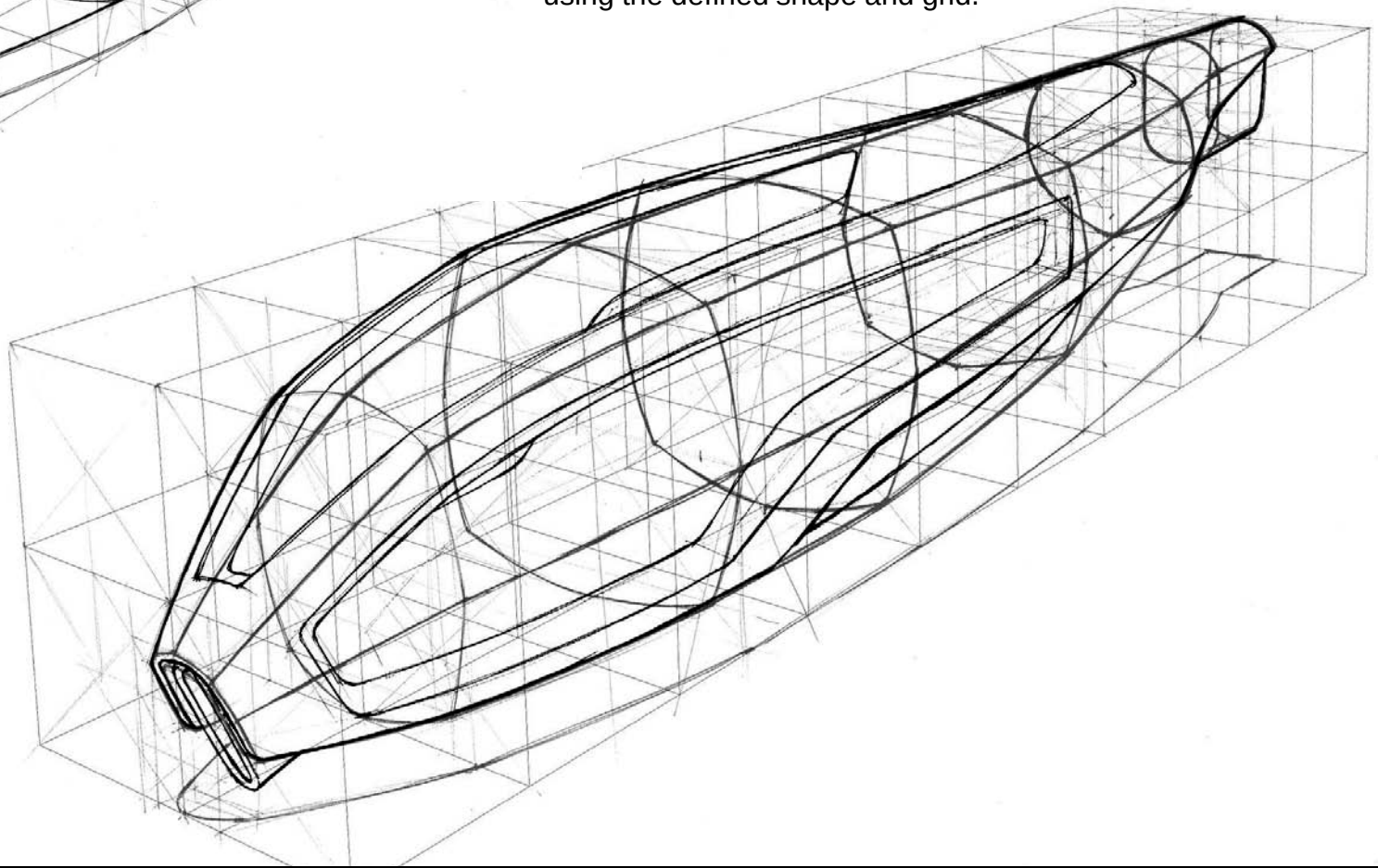


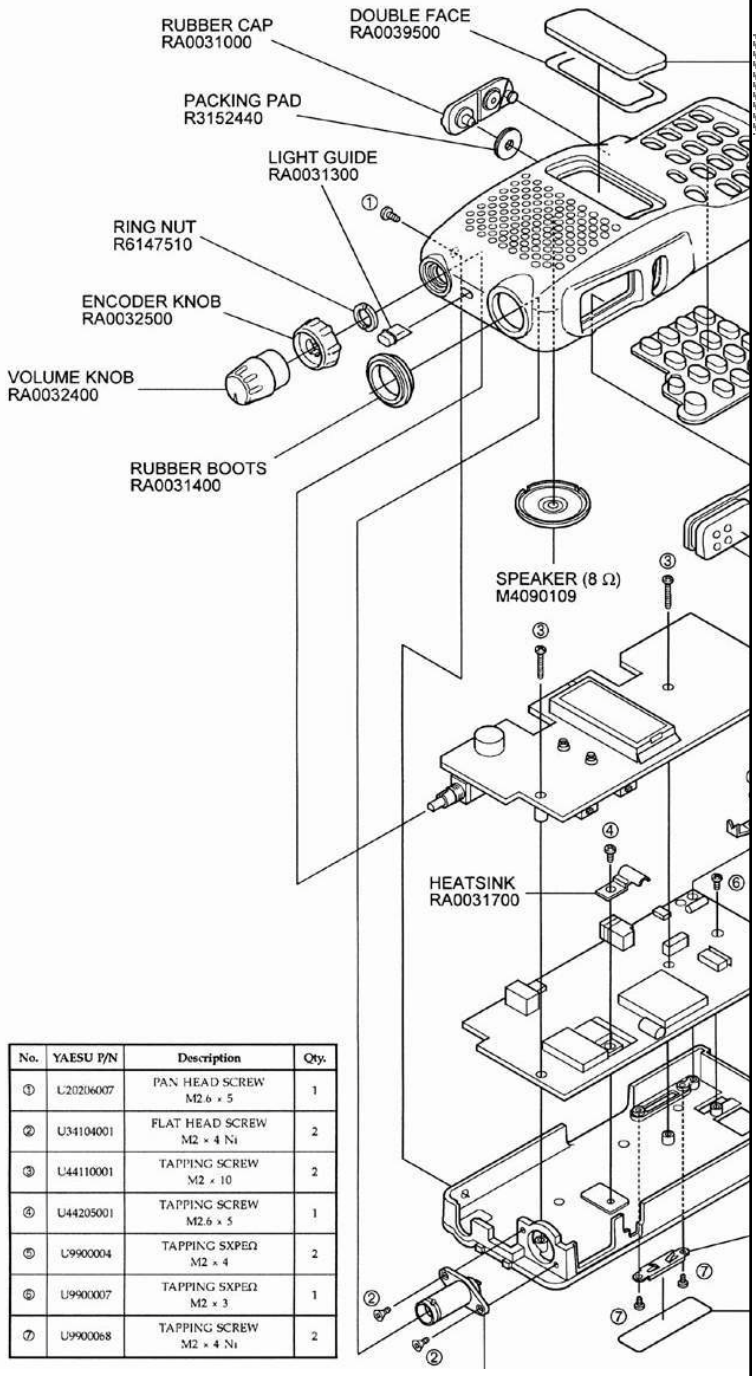
Finish the drawing by connecting the maxima of the ellipses with another set of profile curves. Highlight the visible edges and some section curves to make the drawing more readable.





In the same way more complex non assymetrical shapes can be created. Construct some freeform shapes by playing with profile (contour) curves and section curves. After construction is completed you can add some more details using the defined shape and grid.





No.	YAESU P/N	Description	Qty.
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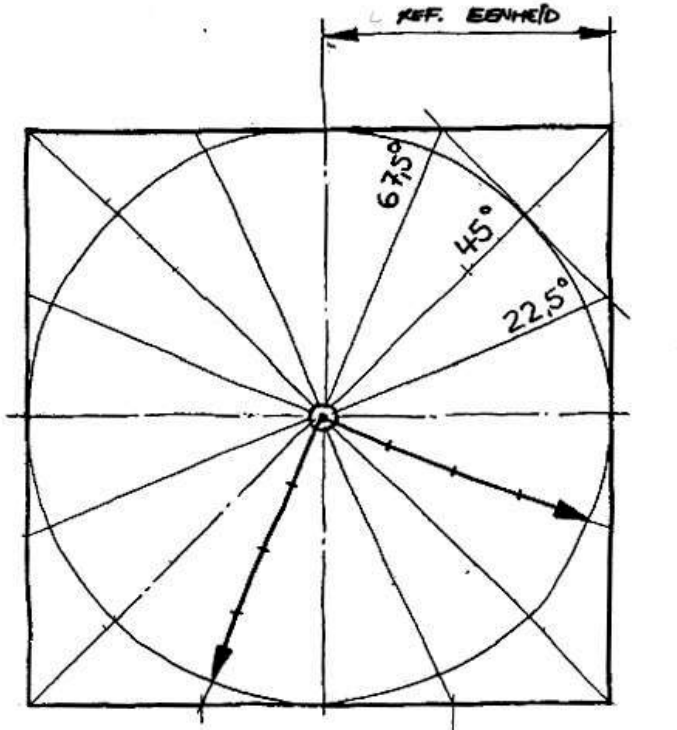
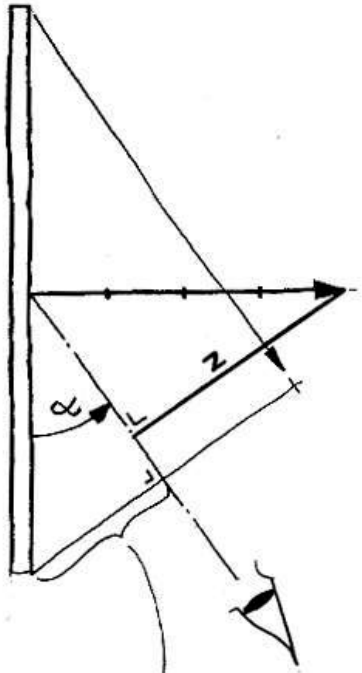
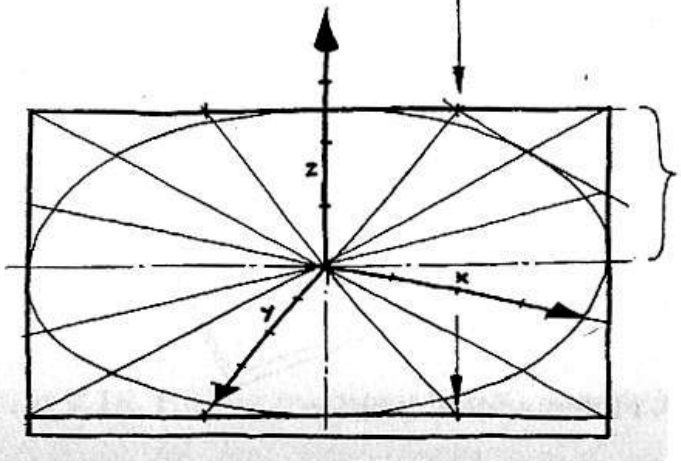
②	U34104001	FLAT HEAD SCREW M2 × 4 Ni	2
③	U44110001	TAPPING SCREW M2 × 10	2
④	U44205001	TAPPING SCREW M2.6 × 5	1
⑤	U9900004	TAPPING SXPEΩ M2 × 4	2
⑥	U9900007	TAPPING SXPEΩ M2 × 3	1
⑦	U9900068	TAPPING SCREW M2 × 4 Ni	2

Exploded view

Few designers get involved inreally accurate explode views because they can take a very long time to construct. Altough this kind of 'shematic' drawing is enormously useful in explaining the disposition of the parts, the method of assembly and the general layout. Engineers are also very found of these kinds of drawings because they can see immediatly the pros and cons of the product from a moulding and construction point of view. Before we had the opportunity to use CAD-programs and computers. Exploded views had to be build up from scratch. Designers in those days used the 'compass' to define the perspective and coresponding grid. The basic layout is detailed on the following page. Basically a circle is constructed and divided in sections like a real compass. If we would think of looking at an angle at this circle then we would see an ellipse. this ellipse is constructed with some geometrical trick. The height will define the total shape of the cube that will act as a unit in the grid. From this unit we can construct a grid by using the multiply rule. Off course this method is very time-consuming and also less accurate as a computer-generated grid. Almost al exploded views are drawn in isometric perspective. This means that all sided of the reference cube are all equally visible. In A dimetrical perspective just 2 planes are equal in visibility. A trimetrical perspective will show the cube with a different visibility for all 3 planes.







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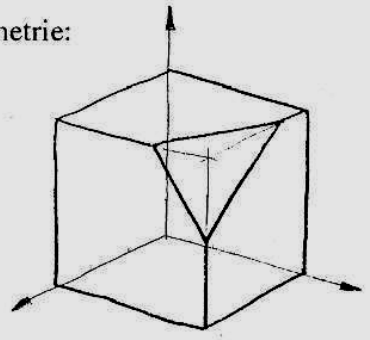

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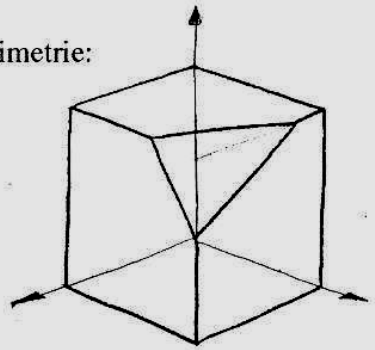
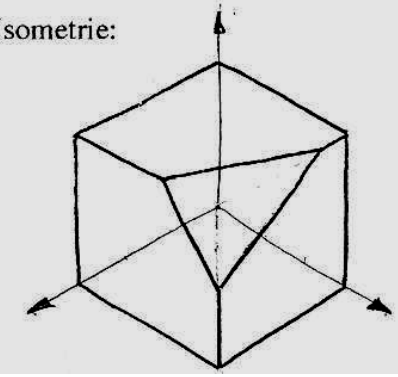
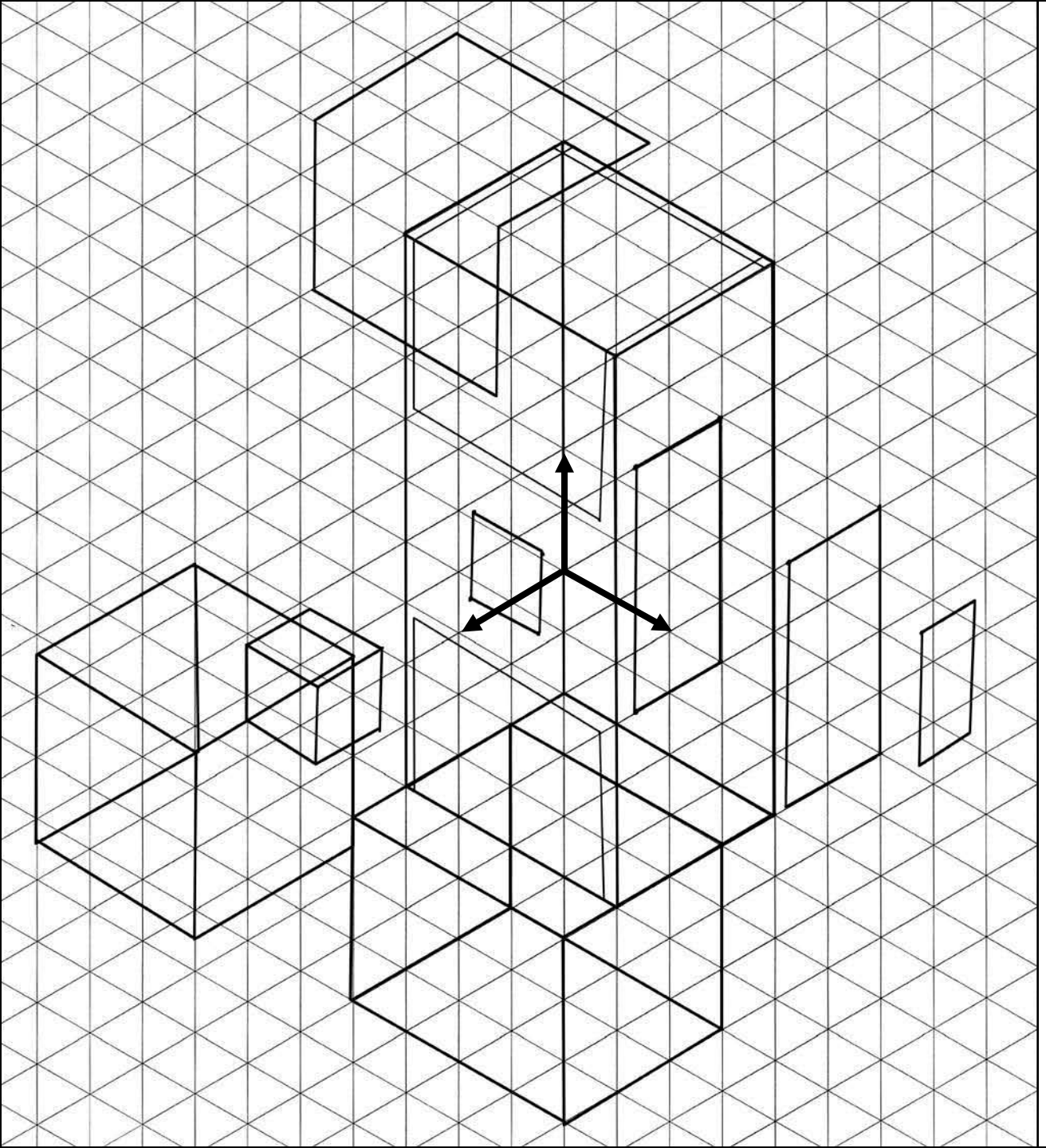
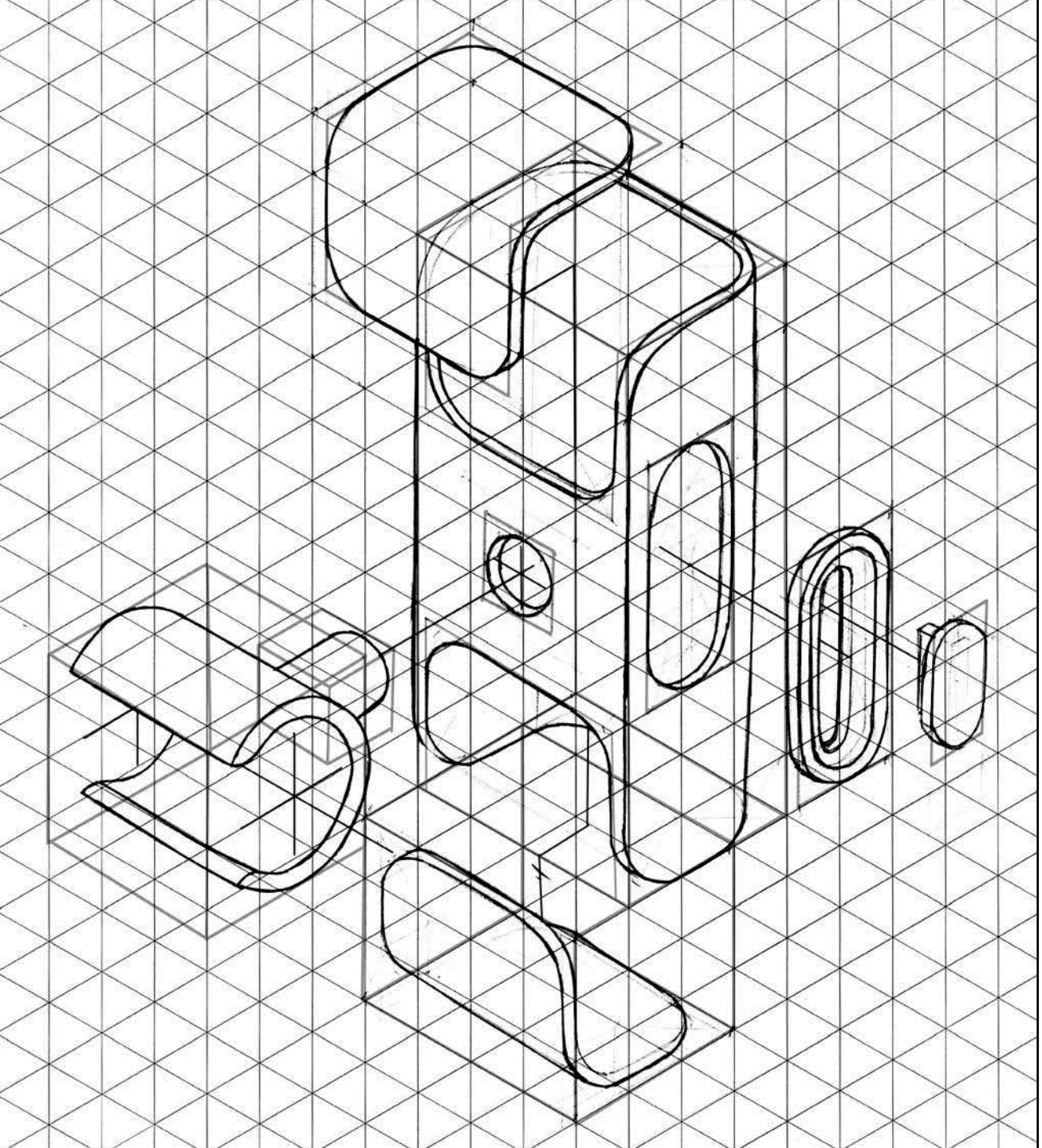


Isometrie:

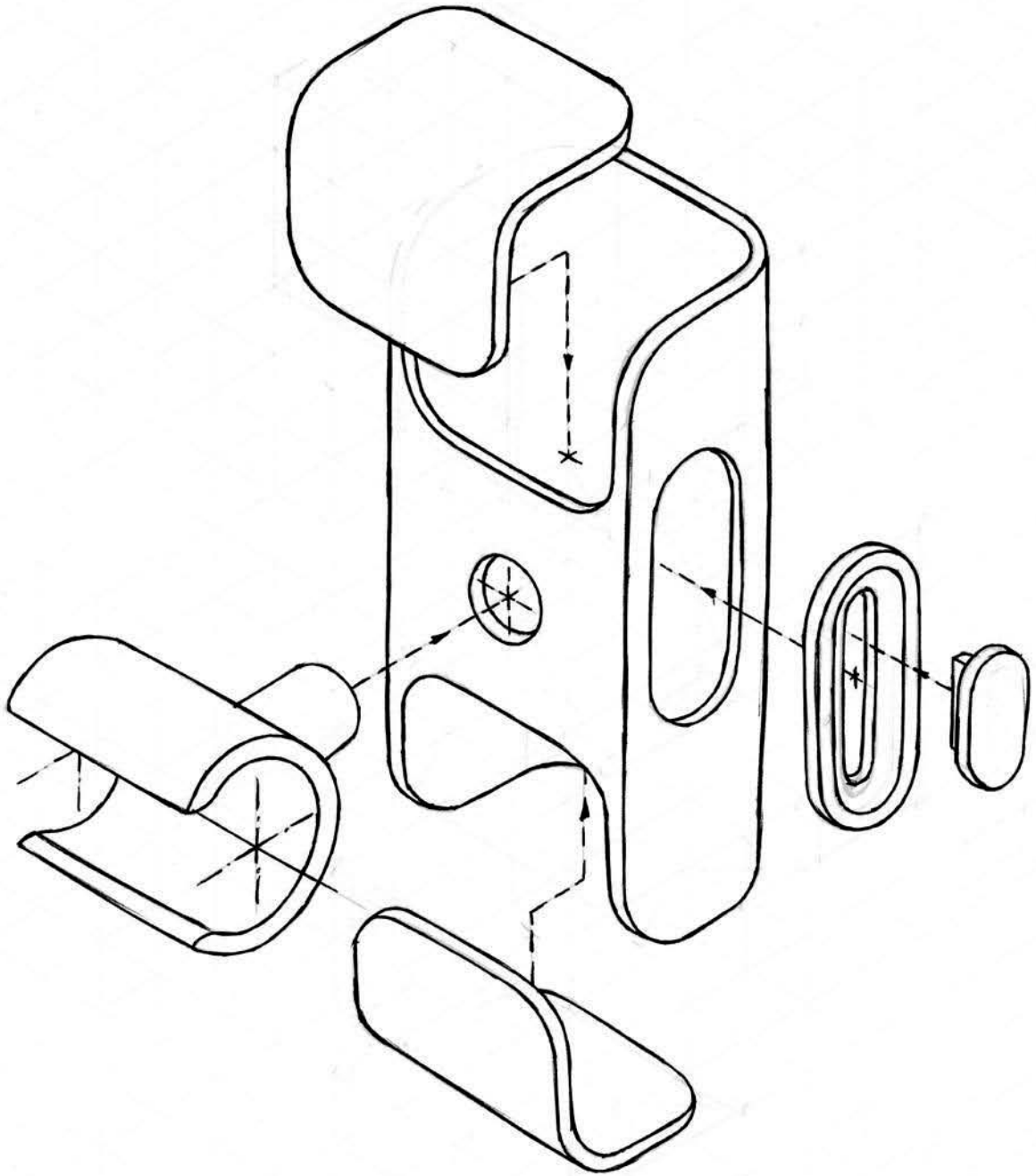




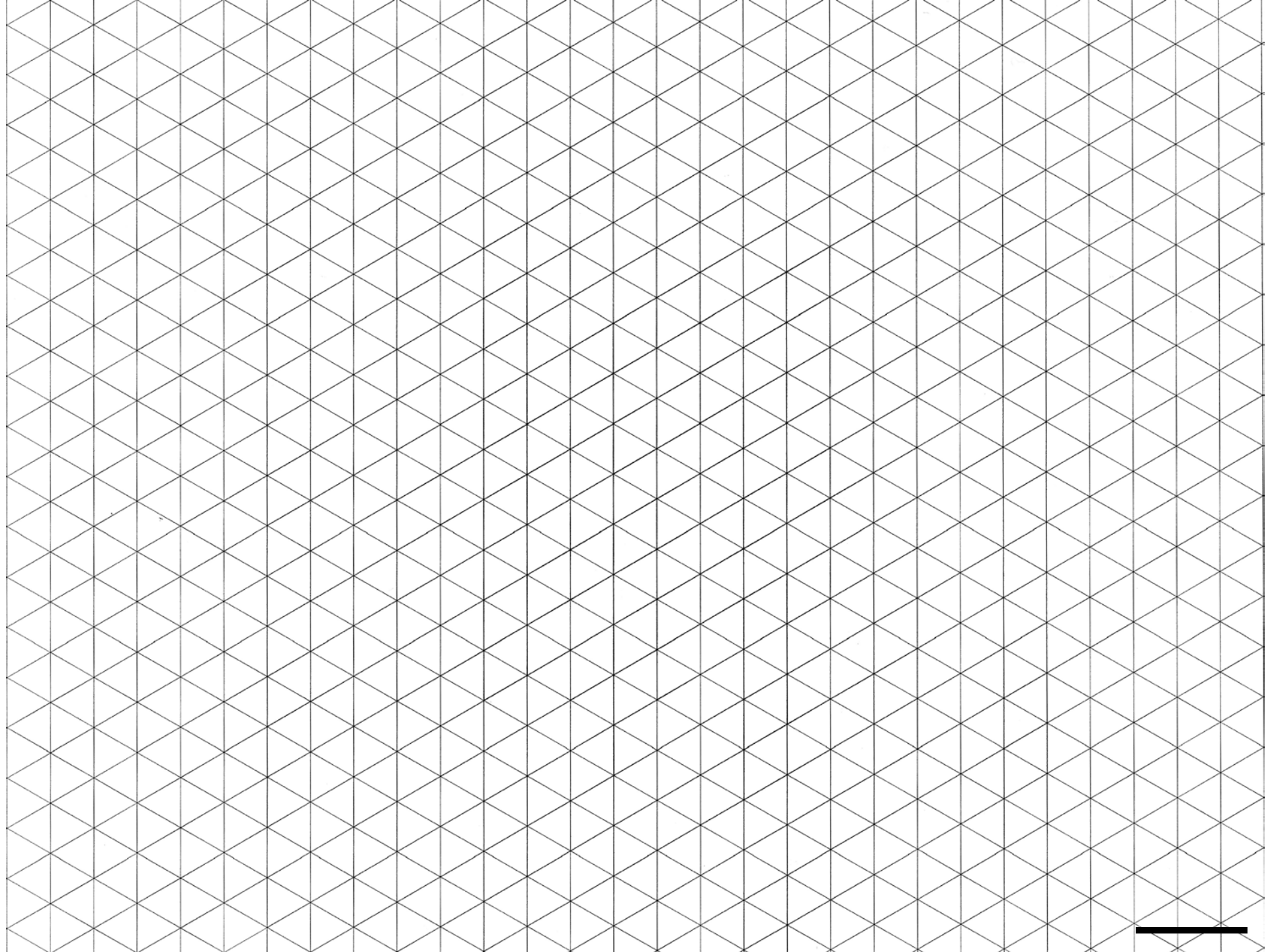
Creating a exploded view with an isometric perspective grid is fairly simple. But off course this all depends on the complexity of the objects. First we start off by constructing a bounding box. Then we define all the different parts that make up the product with some simple construction lines. These lines need to be 'copied' in the direction of assembly. Parts that are placed in the top surface of the product must be copied following the vertical lines. Parts that are connected onto the side faces of the product need to be copied in the two corresponding horizontal directions. Make sure that the bounding boxes of the sub parts are well placed on your drawing so it's easy 'readable' avoid intersections. Top parts may be drawn above the base part but only if they don't hide any valuable information. Also if copieing the bounding boxes interferes with lay-out or readibility then create a corner in your centerlines.

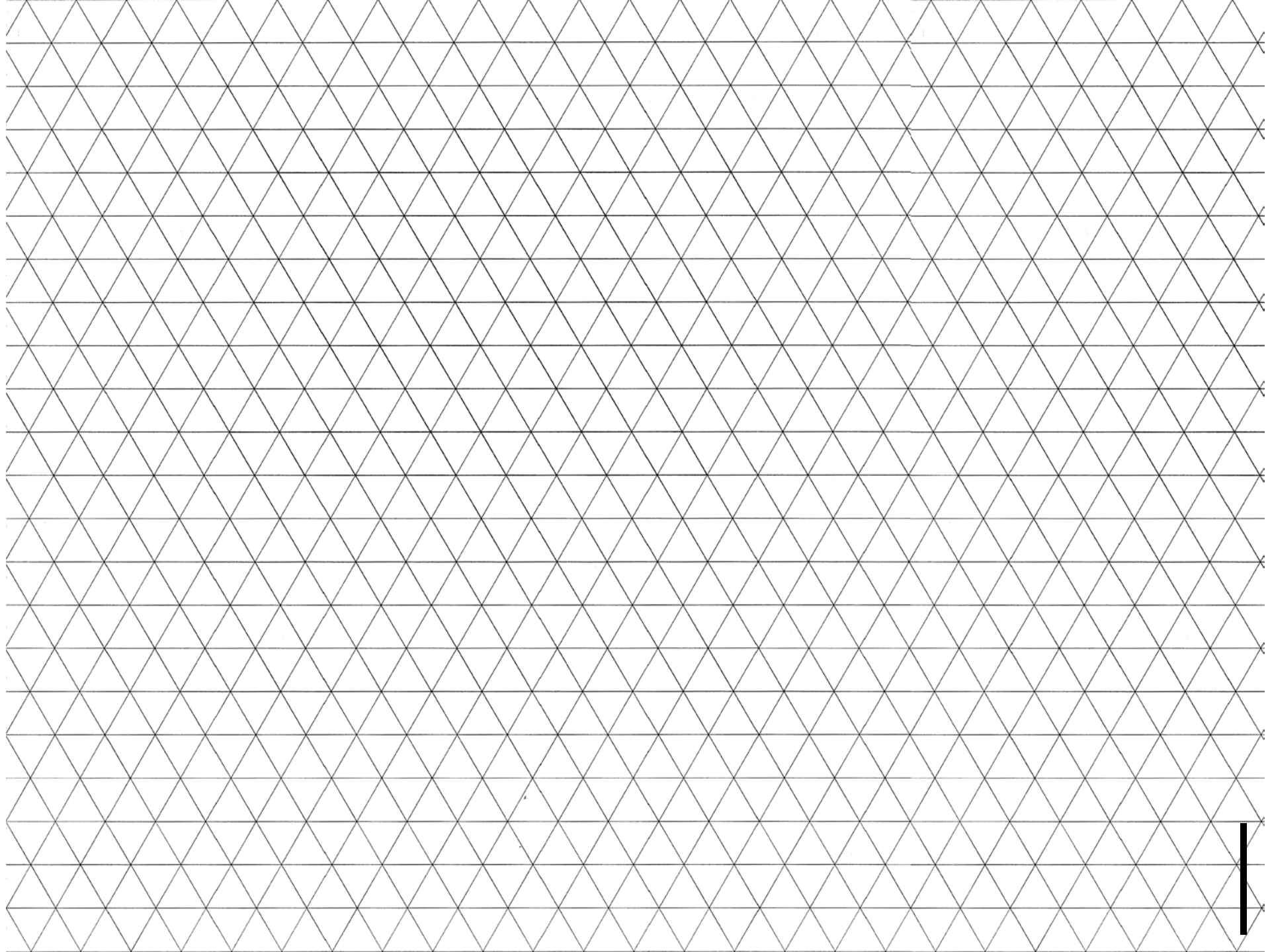


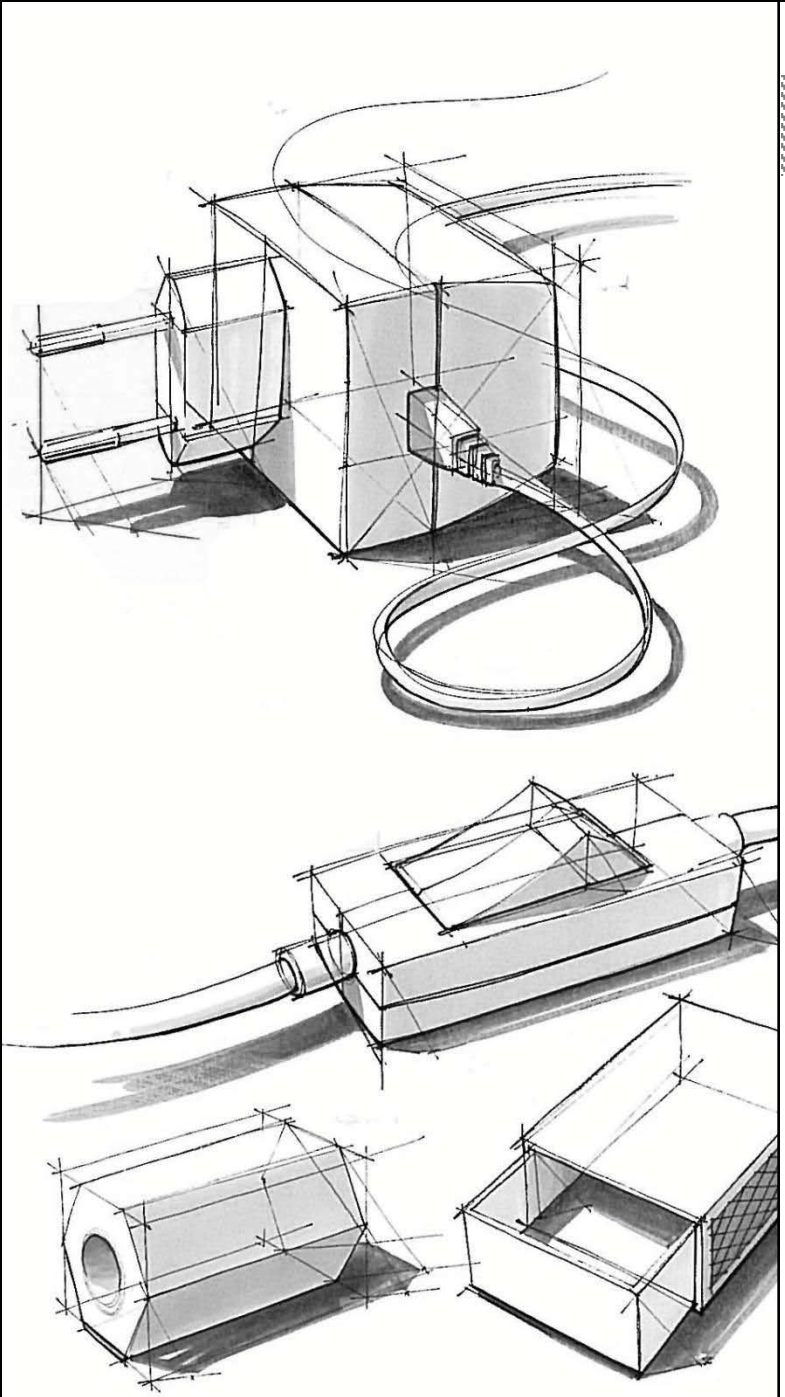
When all the bounding boxes are in place and the layout is approved you can start by detailing the parts. Again the isometric grid helps us in creating arc and ellipses in a fairly easy way. Be patient and accurate for this and dont get lost in the grid.



Finally the visible edges are highlighted and assembly lines are added. Also center lines can make the drawing more readable and give it that technical tough. Further detaling like snaps can be applied if necessary.

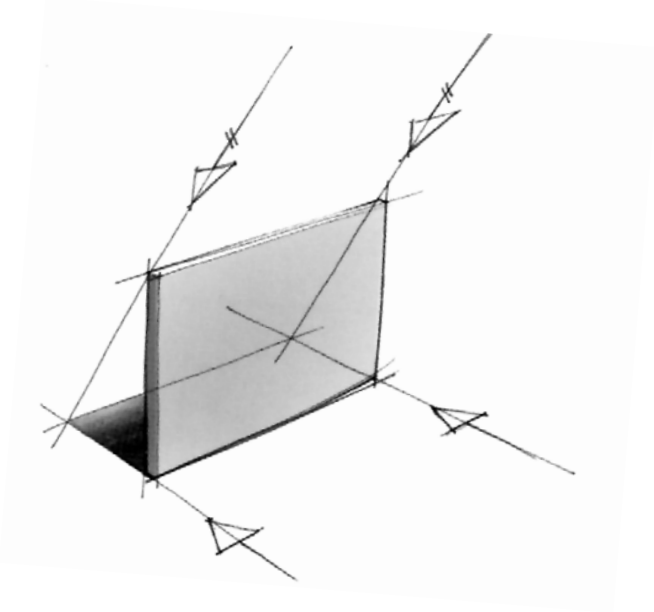


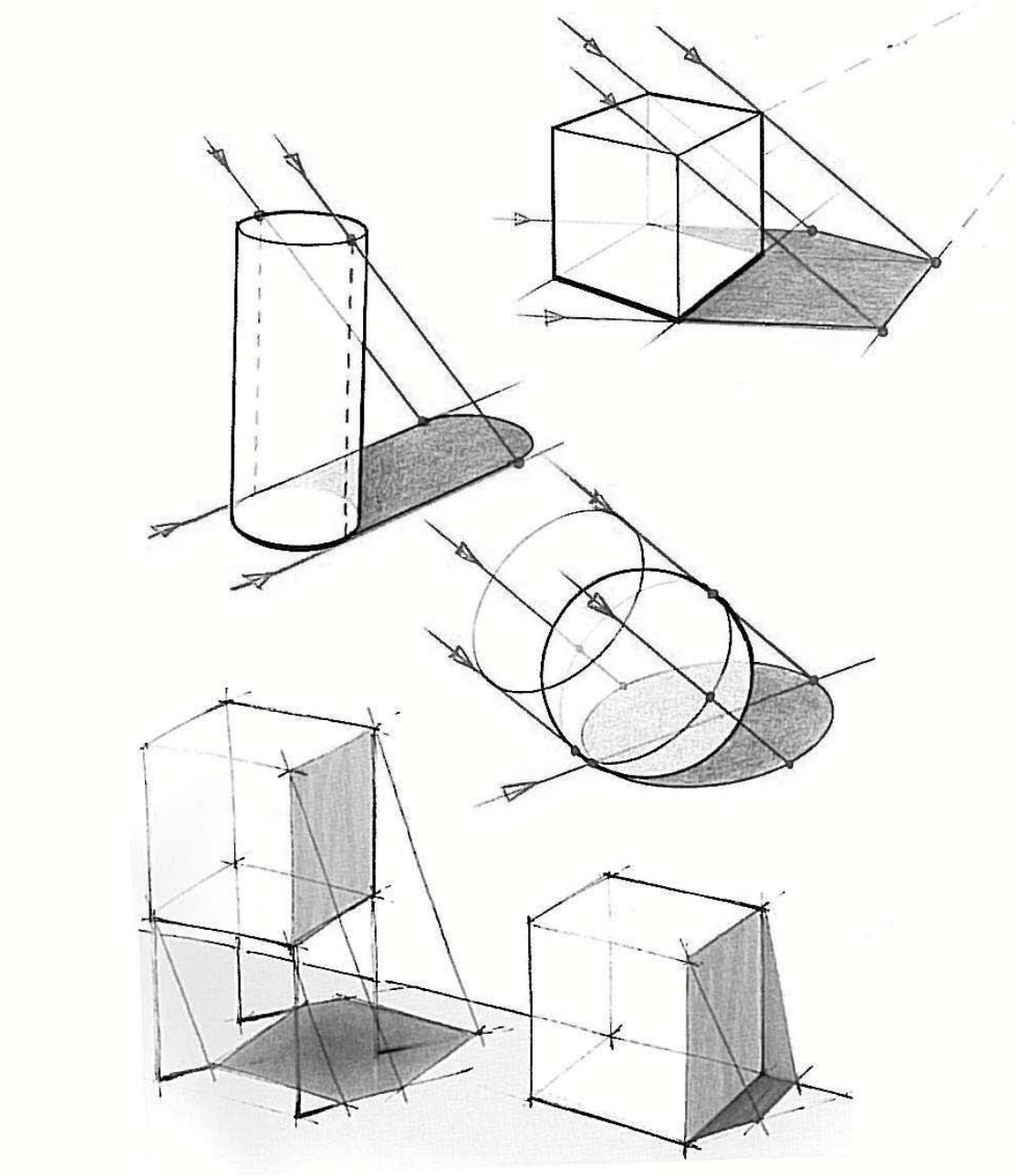




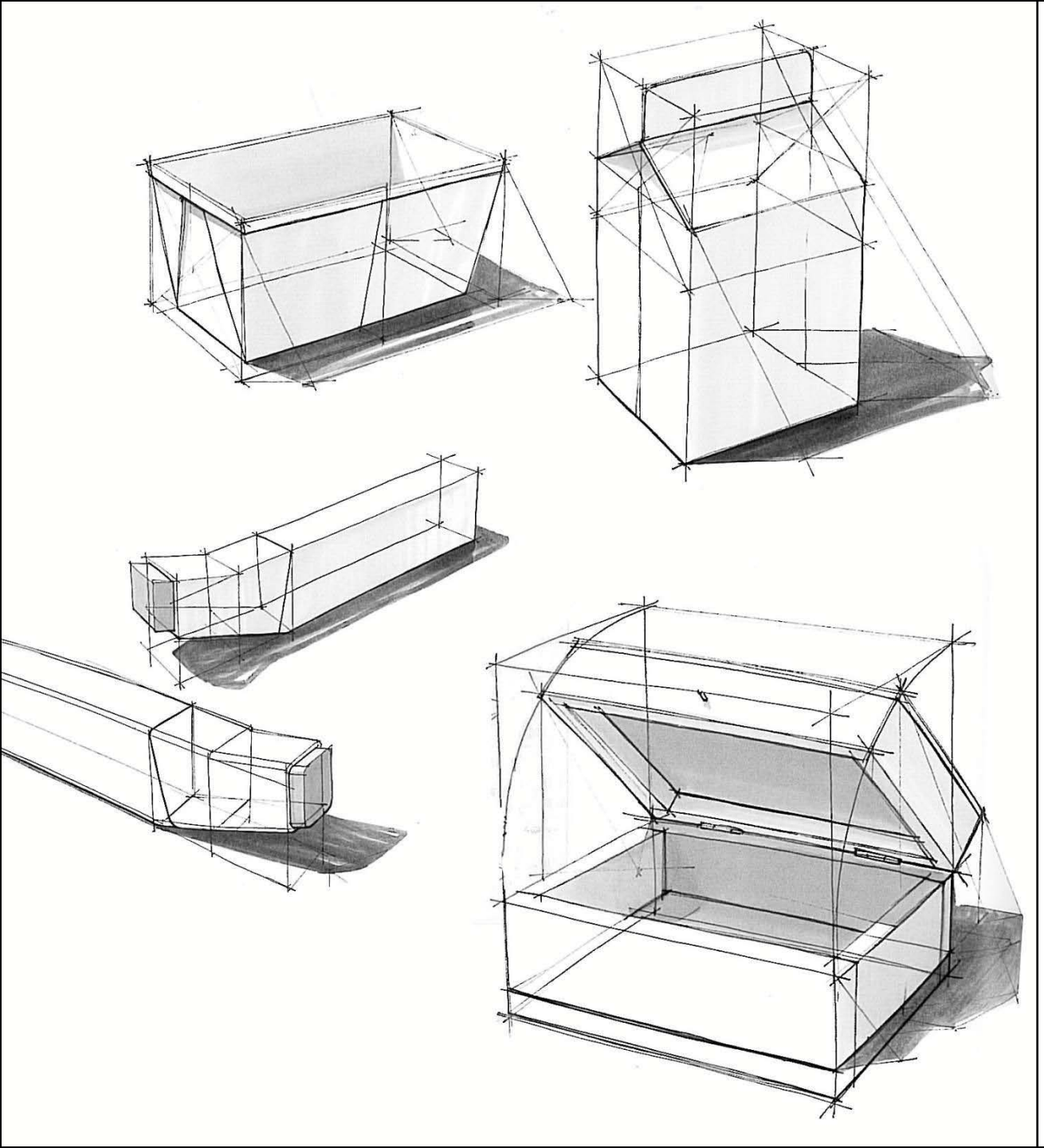
Object Shadows

Every basic shape has a characteristic cast shadow. A cast shadow should be large enough to emphasize the shape of an object. It should support the object, and not be so large as to disturb the layout of the drawing. It can be quite a work to get a cast shadow right, especially if the object itself is complex. So try to keep it simple and fast. If it looks good its probably right. The object itself should always be the main focus point.
The cast shadow of an object can be found using two guidelines: the angle and direction of light. These guidelines stay parallel if our objects are lit by sunlight. This is the easiest and quickest way and delivers believable results.

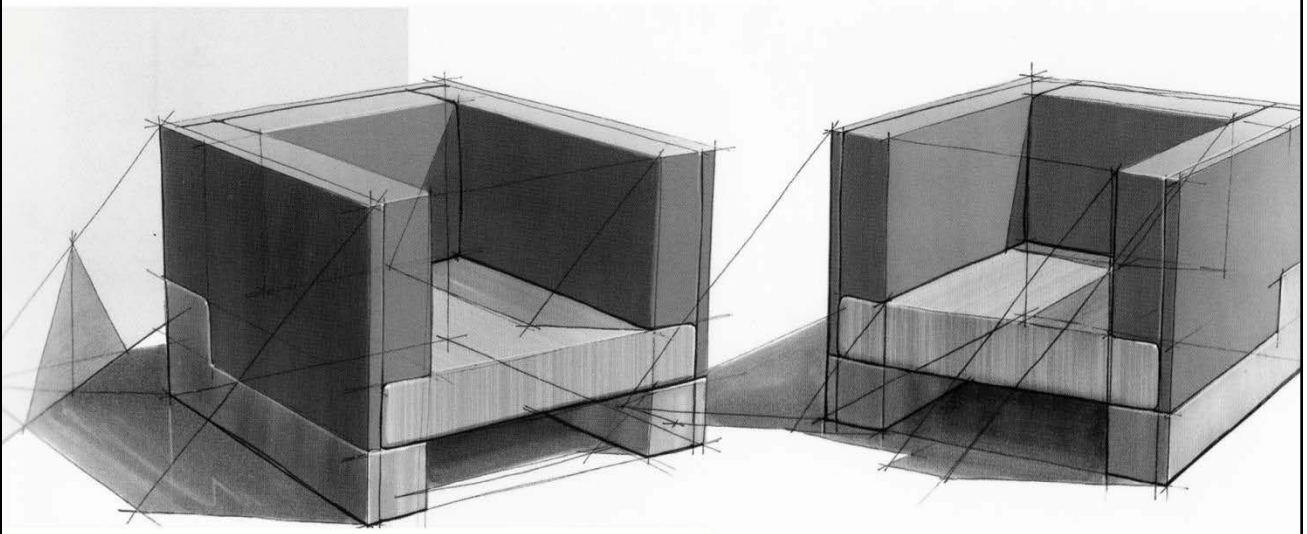


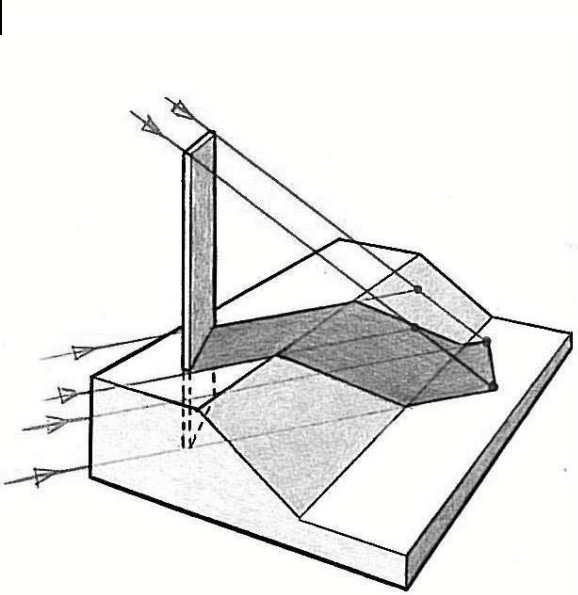


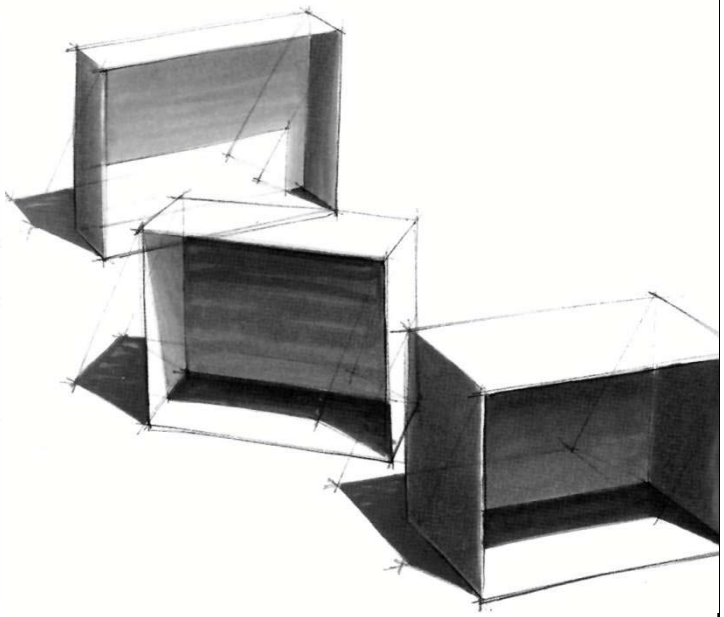
With this method we can create cast shadows of all sorts of objects. On the left are some examples. If you find it hard to cast a shadow from an object then start by constructing the bounding box of the object itself. And continue from thereon.
A cast shadow can also indicate an objects elevation. It does not differ too much from normal the construction. Just extend the object to the bottom plane as seen in the drawing in the bottom left corner.



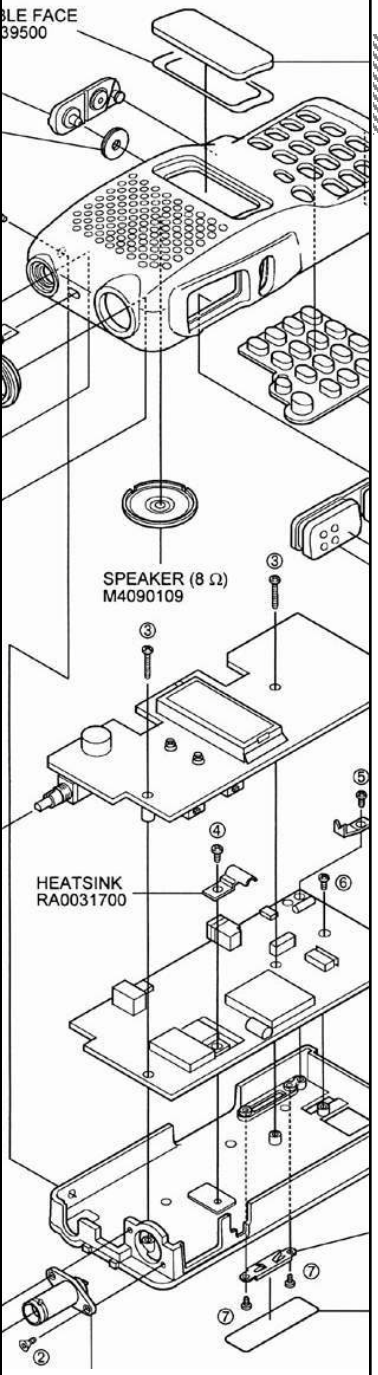
As you can see on these drawings it is far more important to have a good object drawing. Sometimes a hint of shadow may help a lot for ‘reading’ the drawing just don’t overconstruct it. Time is money so focus more on the object itself.







Again by aplieng the same simple method we can create some complex object shadows. Even object shadows cast on another object. With some common sense and patience you should be able to create some intricate compositions.



Exercices

In the following pages you'll find pictures of products and their corresponding sketch. These sketches are all created with the knowledge of what has been learned in a loose and fast way. Construcion and accuracy are one thing but a designer must be able to sketch fast. In the beginning you'll need the construction to create believable drawings. The first step should be to draw bounding boxes in perspective without needing to draw a horizon and two vanishing points. Because most of the time this will result in small drawing on a big piece of paper. If you dont succeed in this then you'll need some more perspective exercice just untill you can 'see' the vanishing points without actually having to draw them. Another step in speeding up the process can be achieved by drawing ellipses just by sketching the minor and major axes. The more you'll exercice the faster you'll be able to draw and therefore the more ideas you can explore. Wich is off course the ultimate goal. Being able to get loose from construction is also necessary to create your own style this will give your work that personal and artistic tough.

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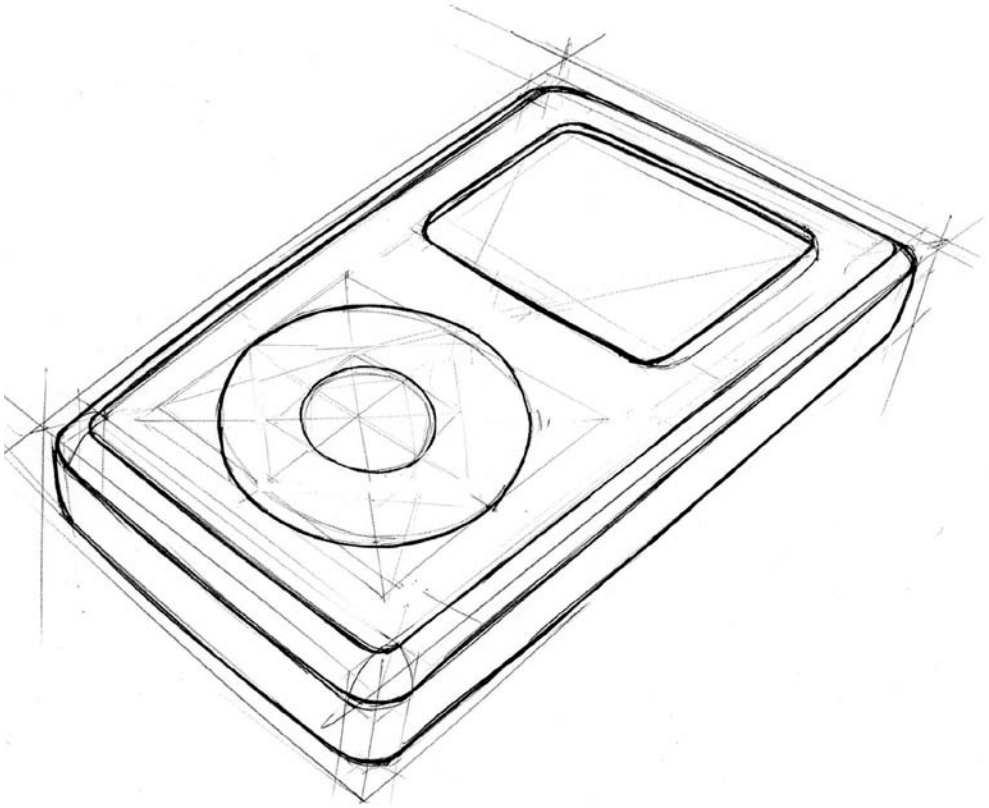

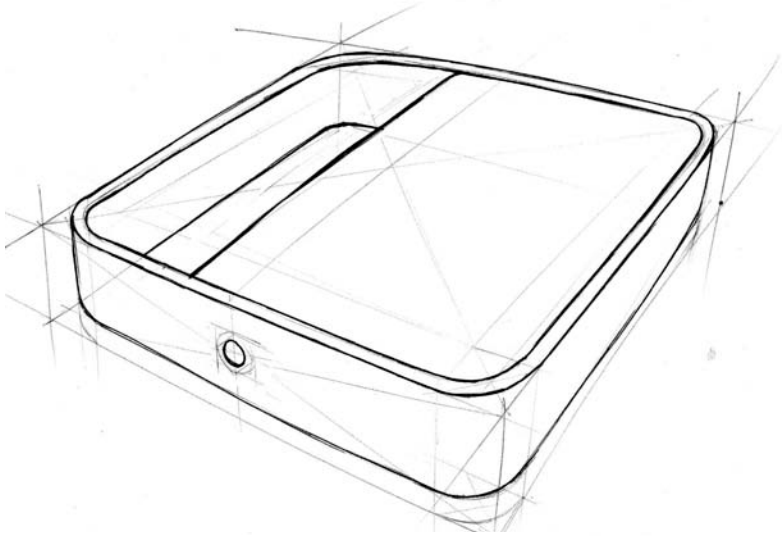

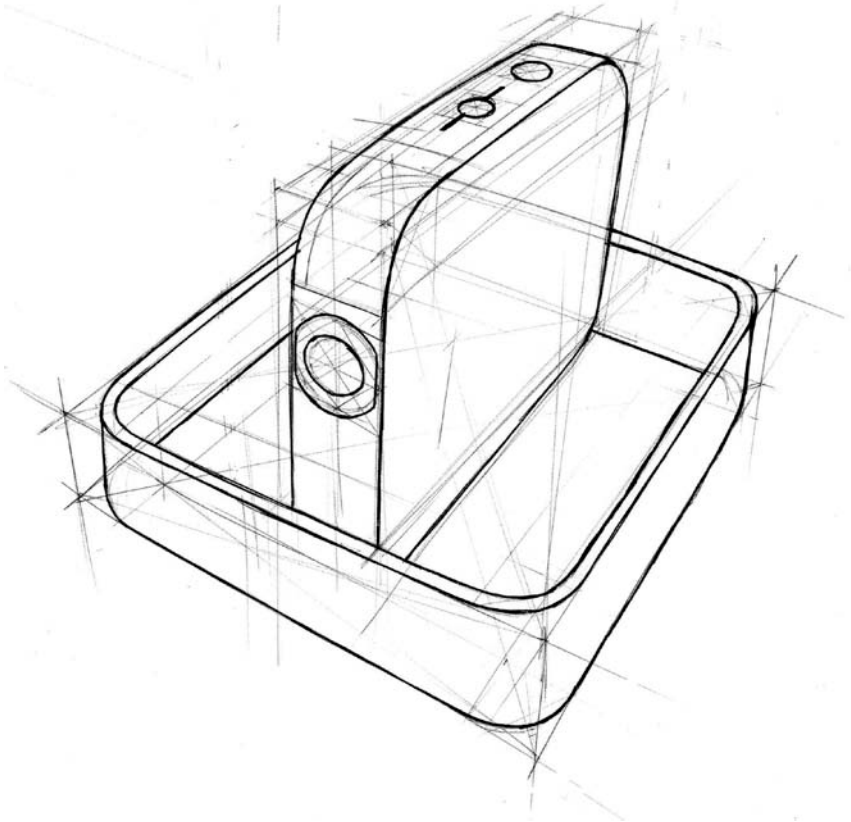

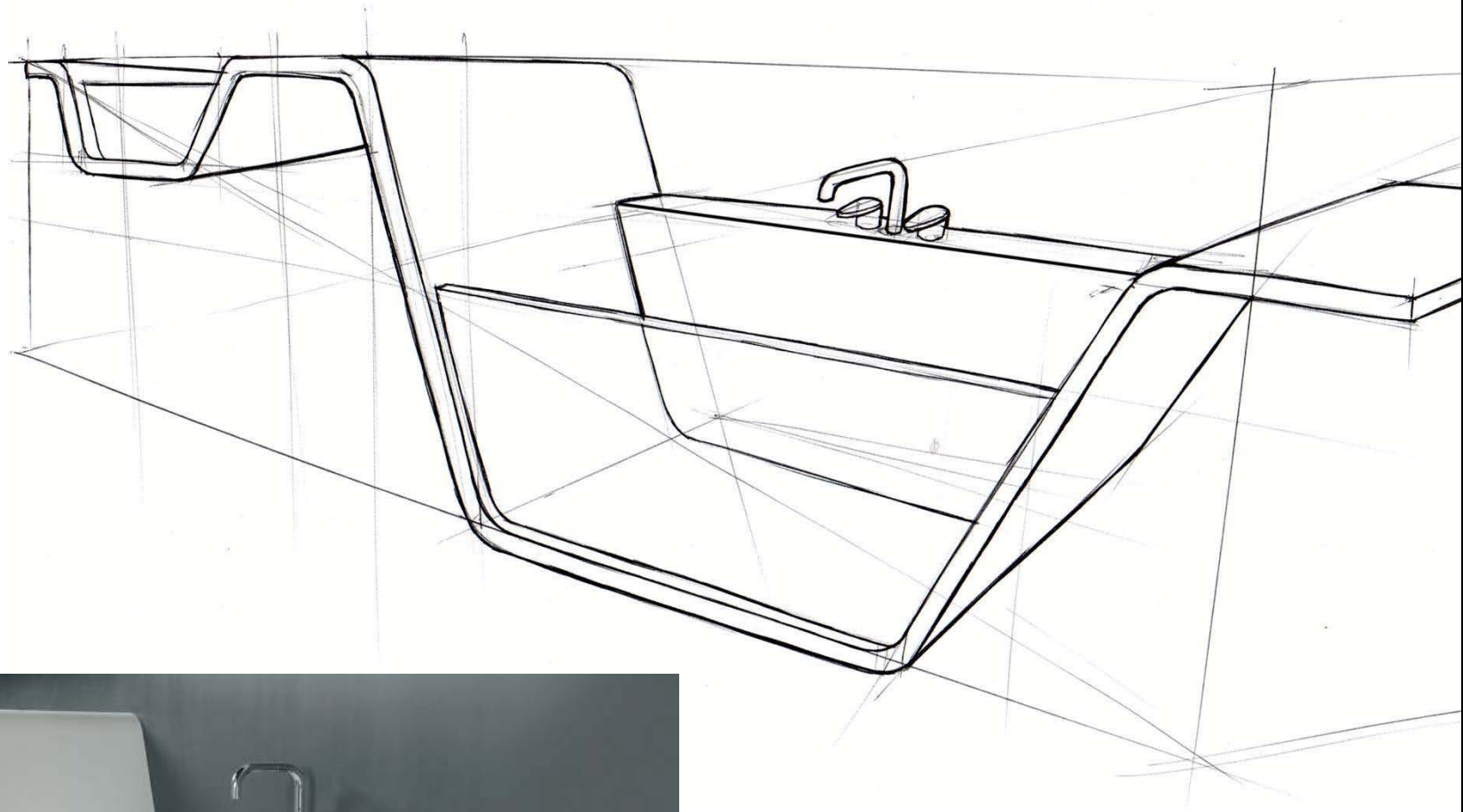

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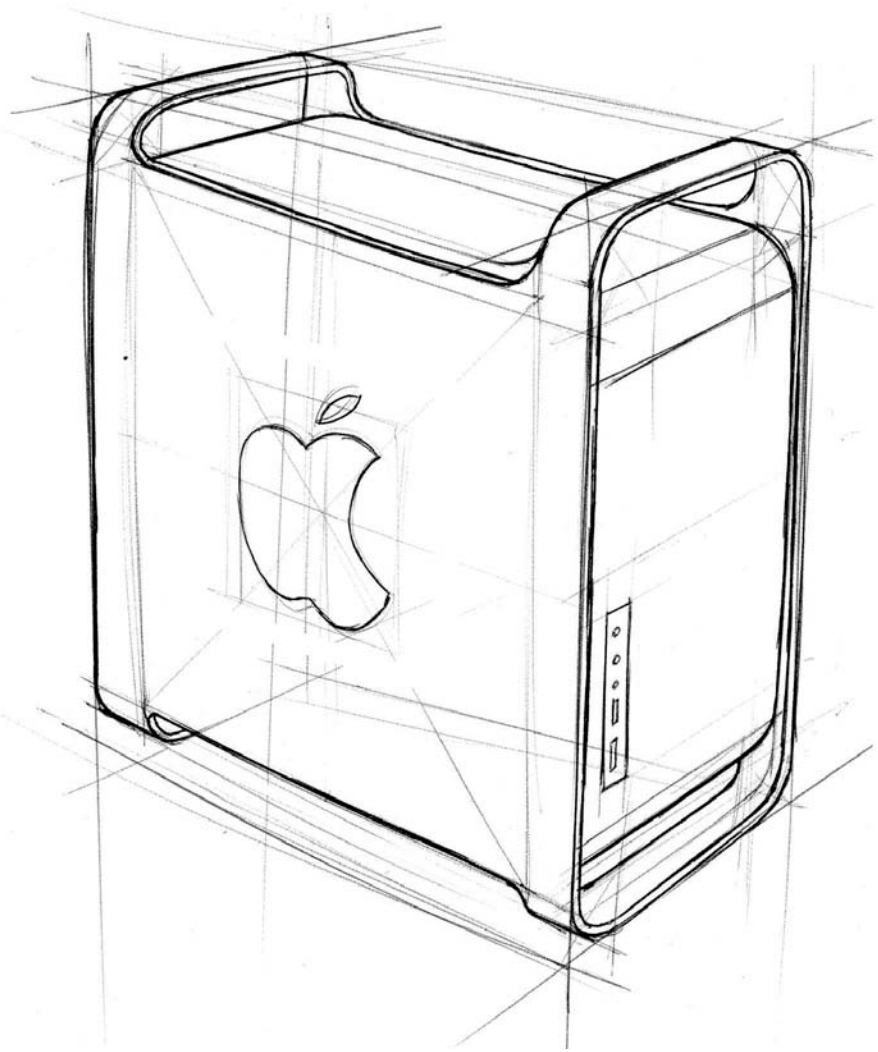

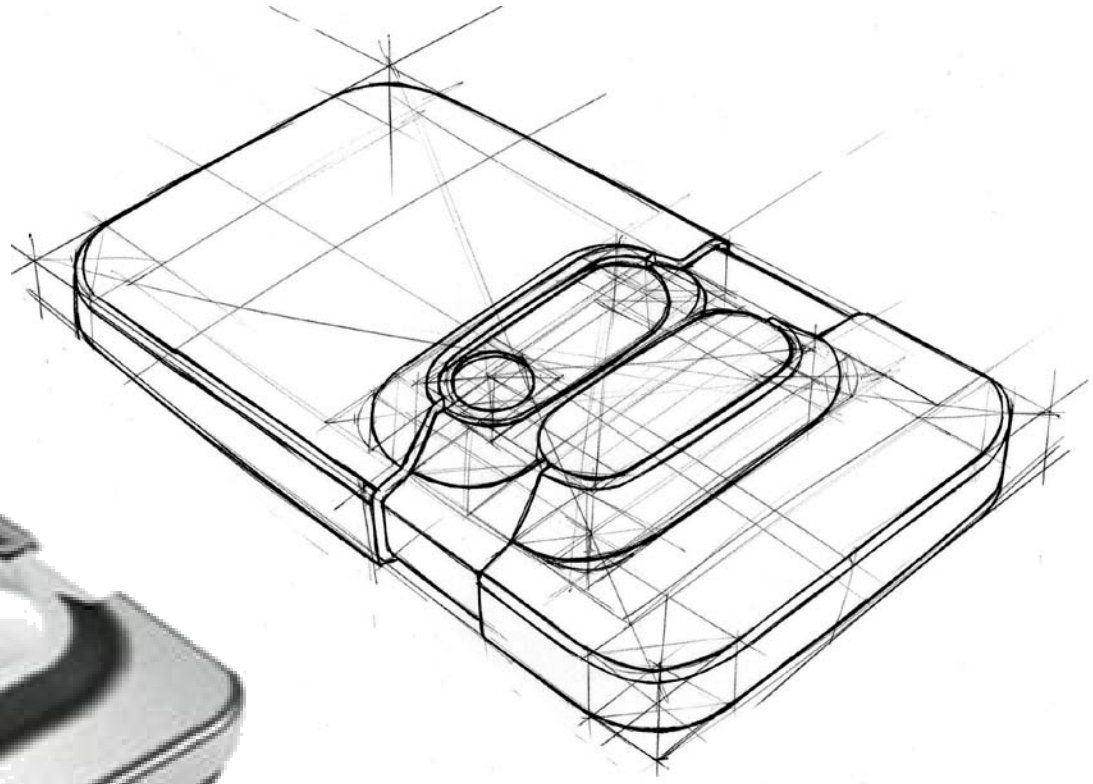

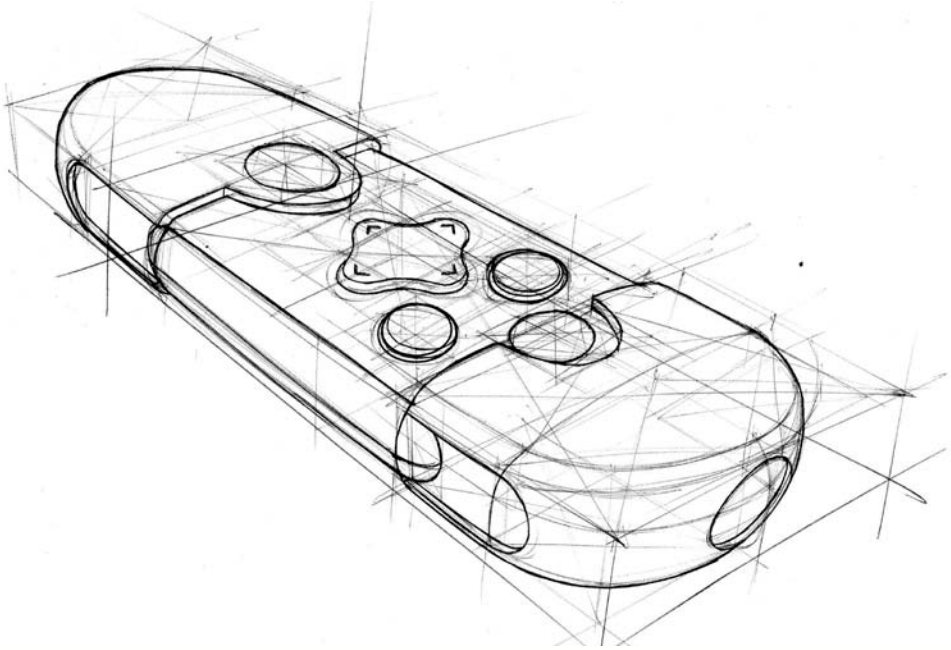

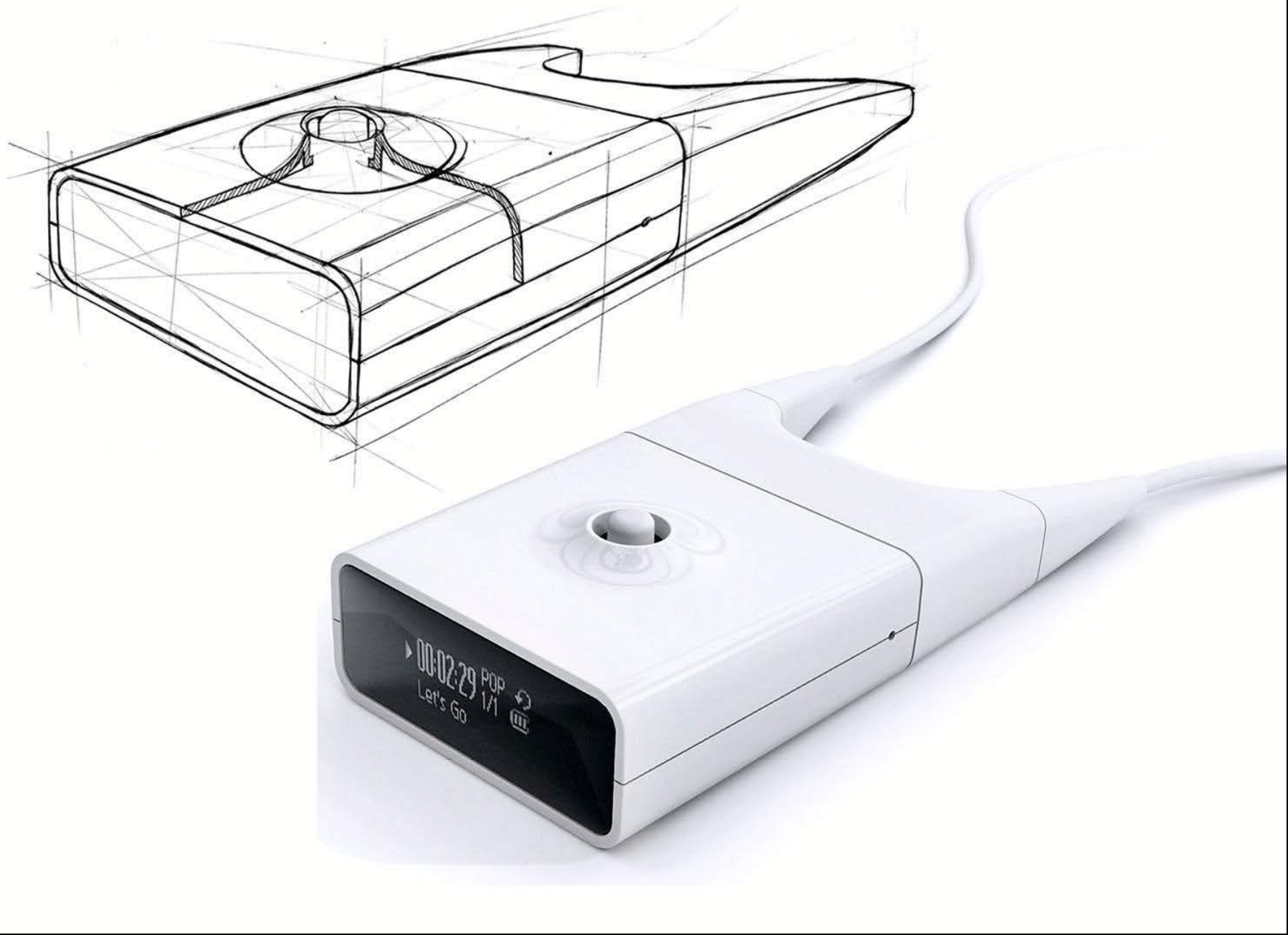
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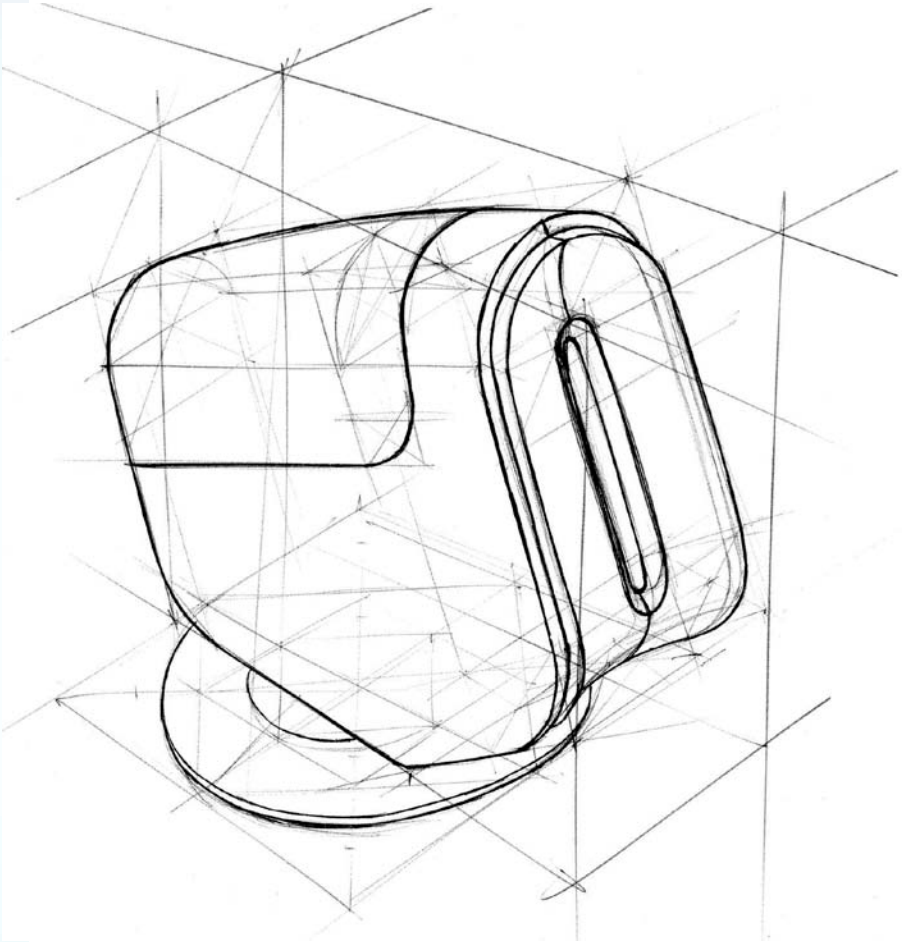

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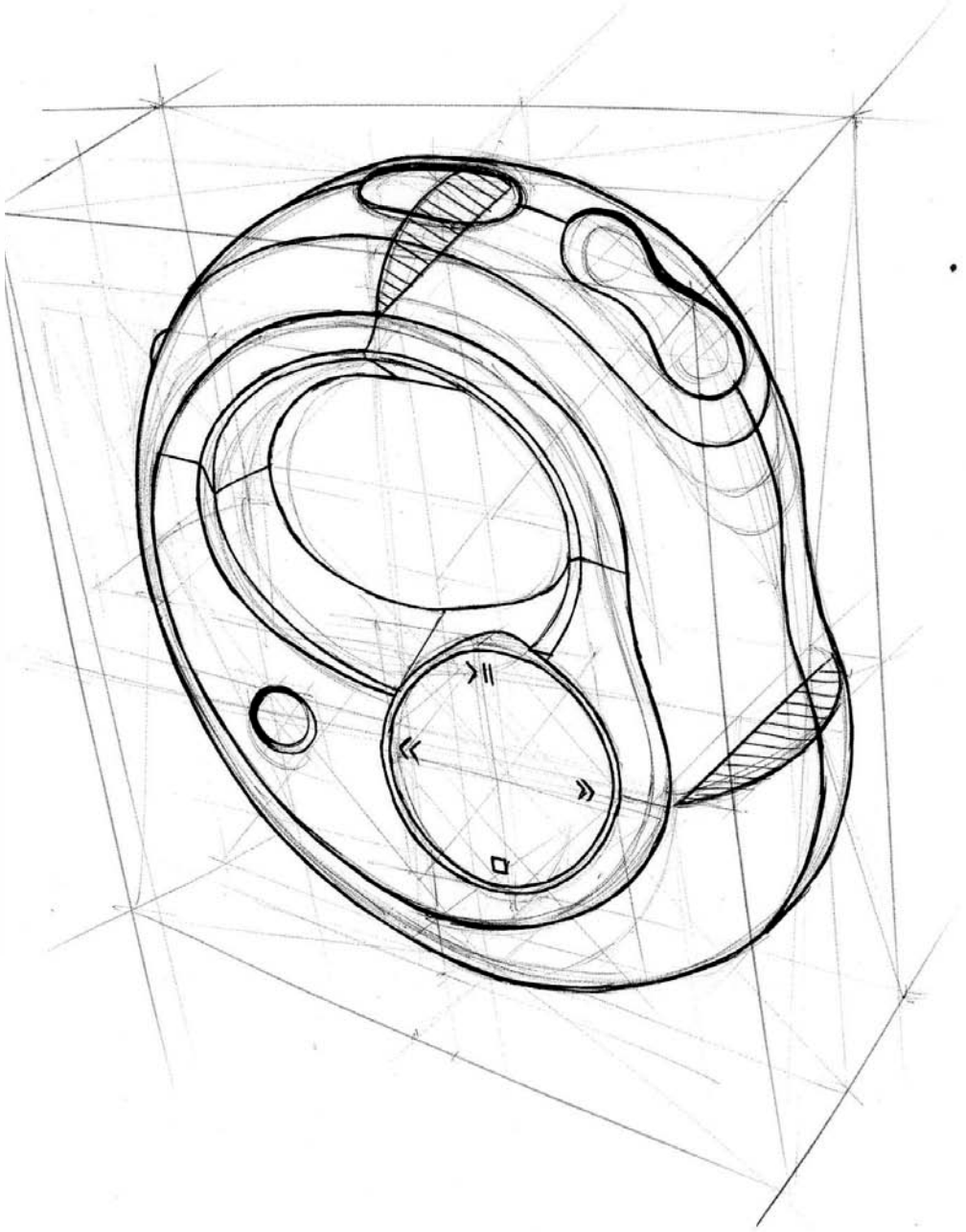

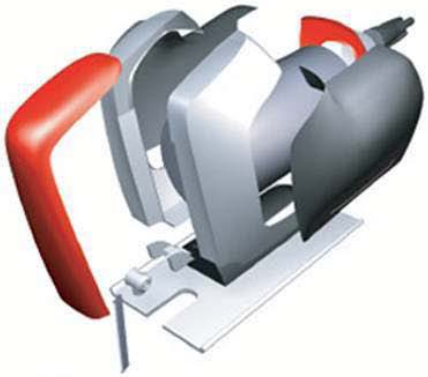

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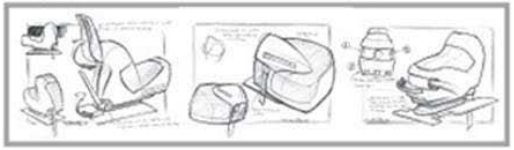

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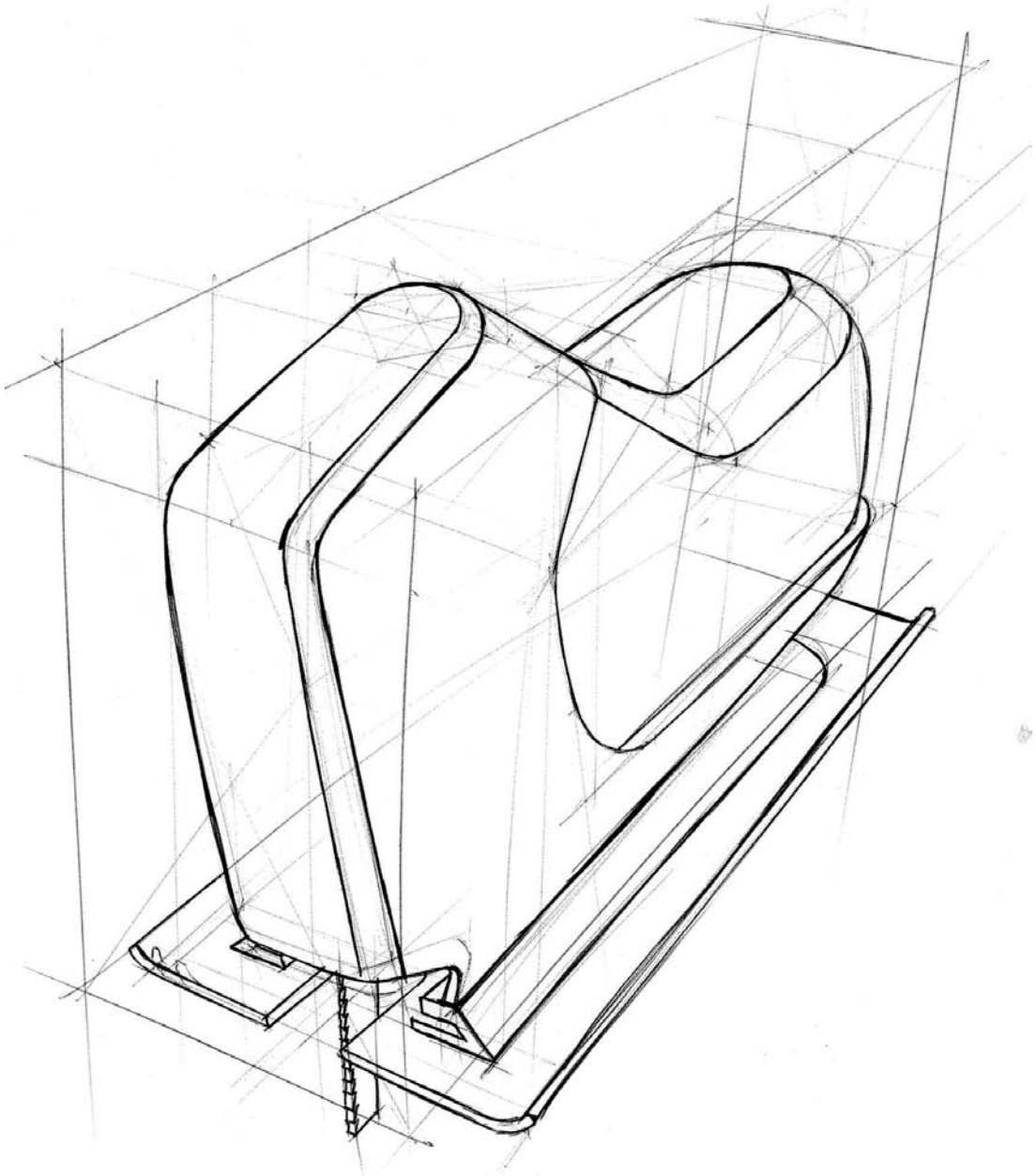

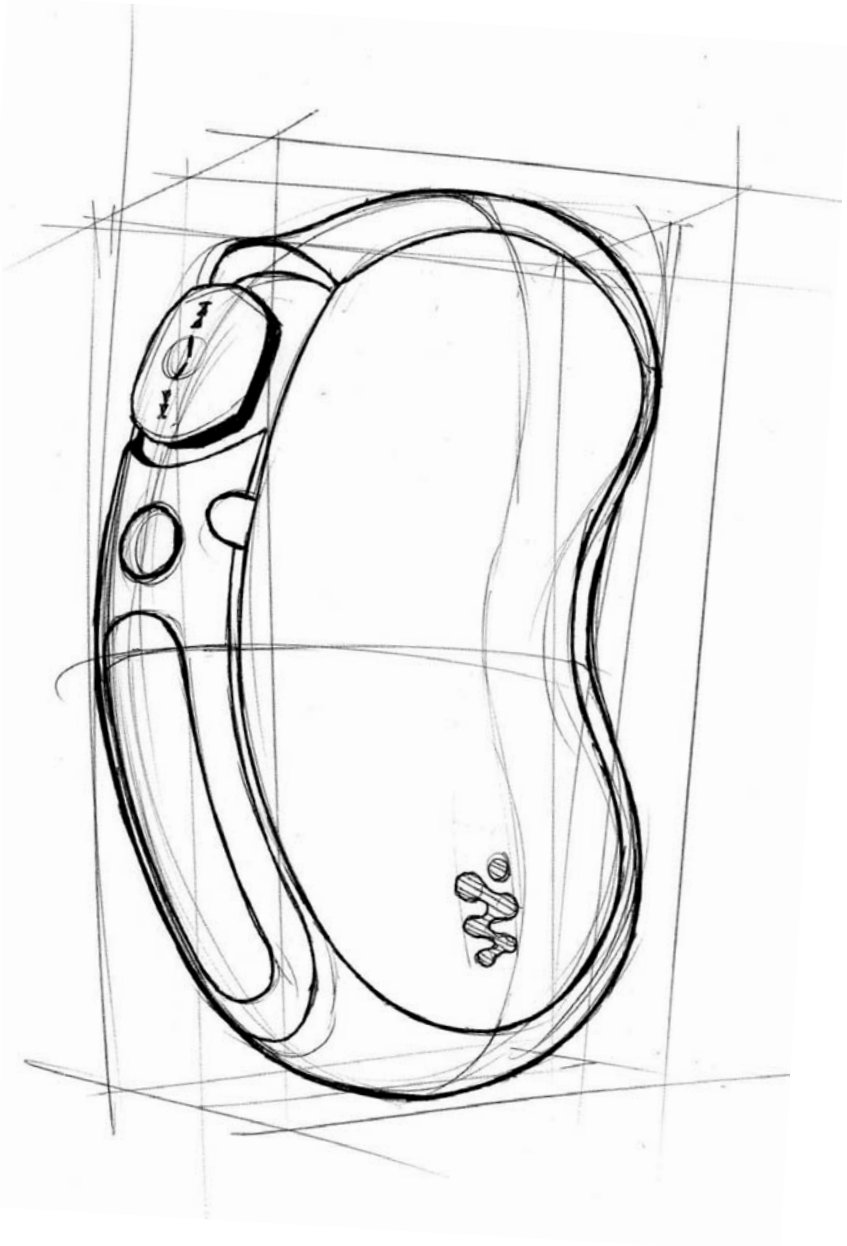

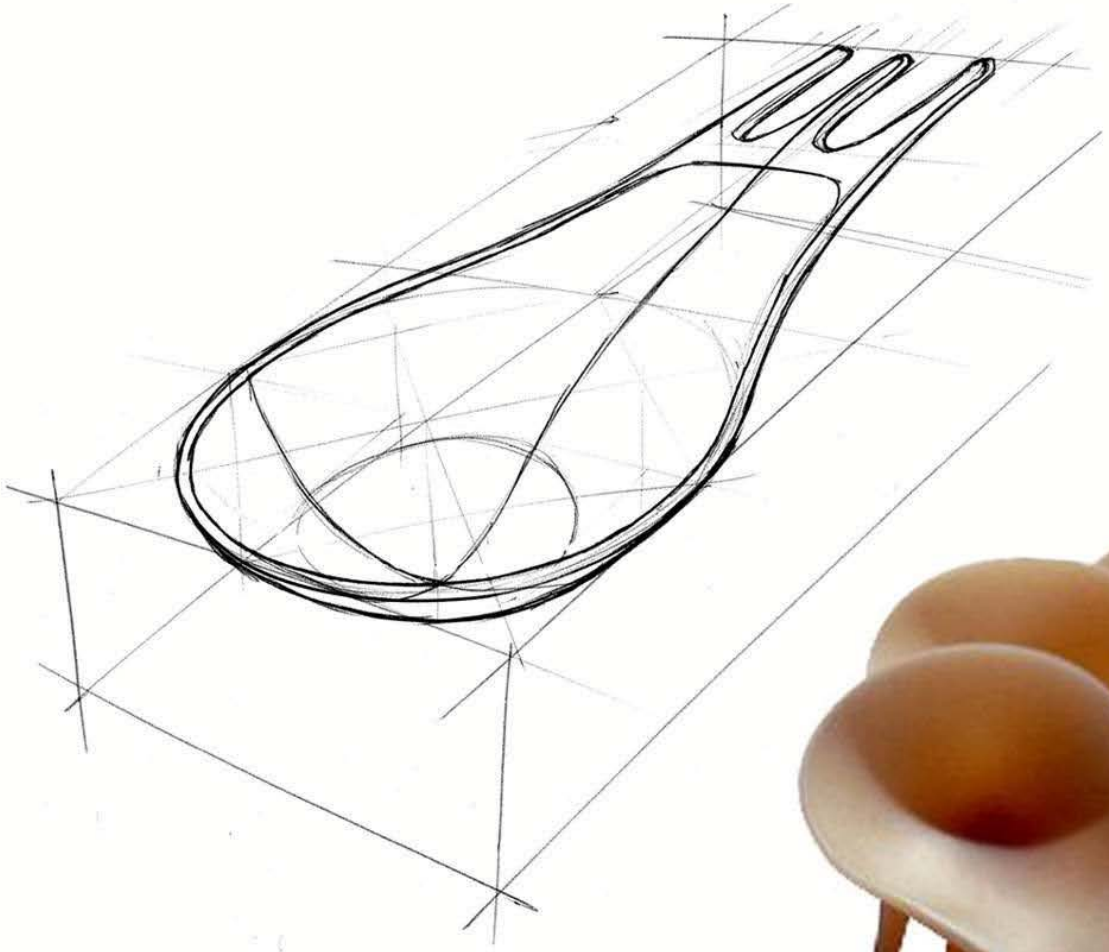

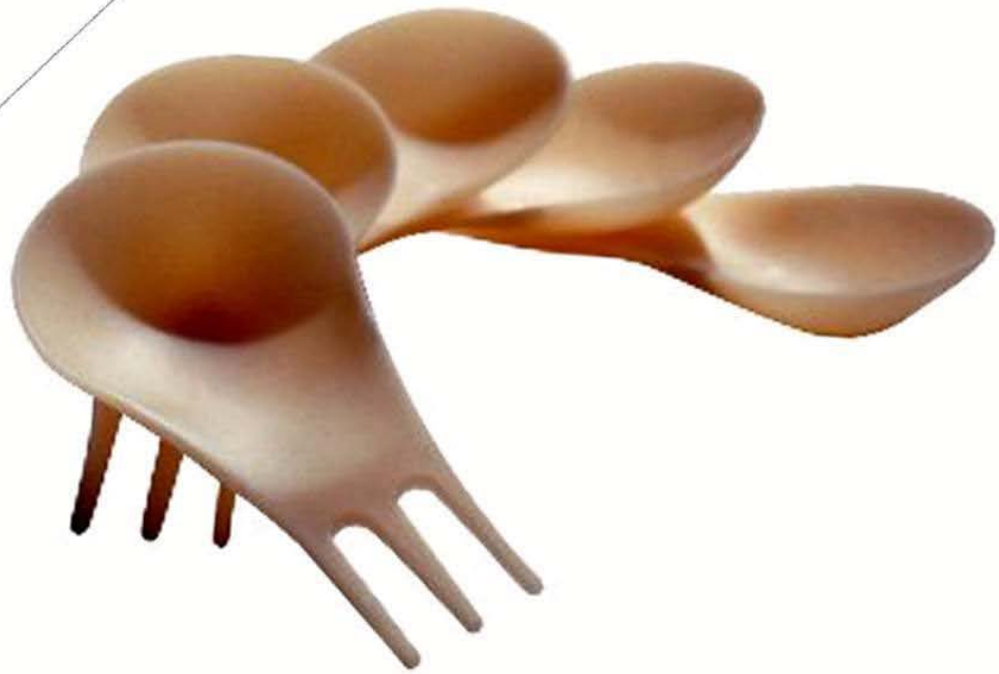

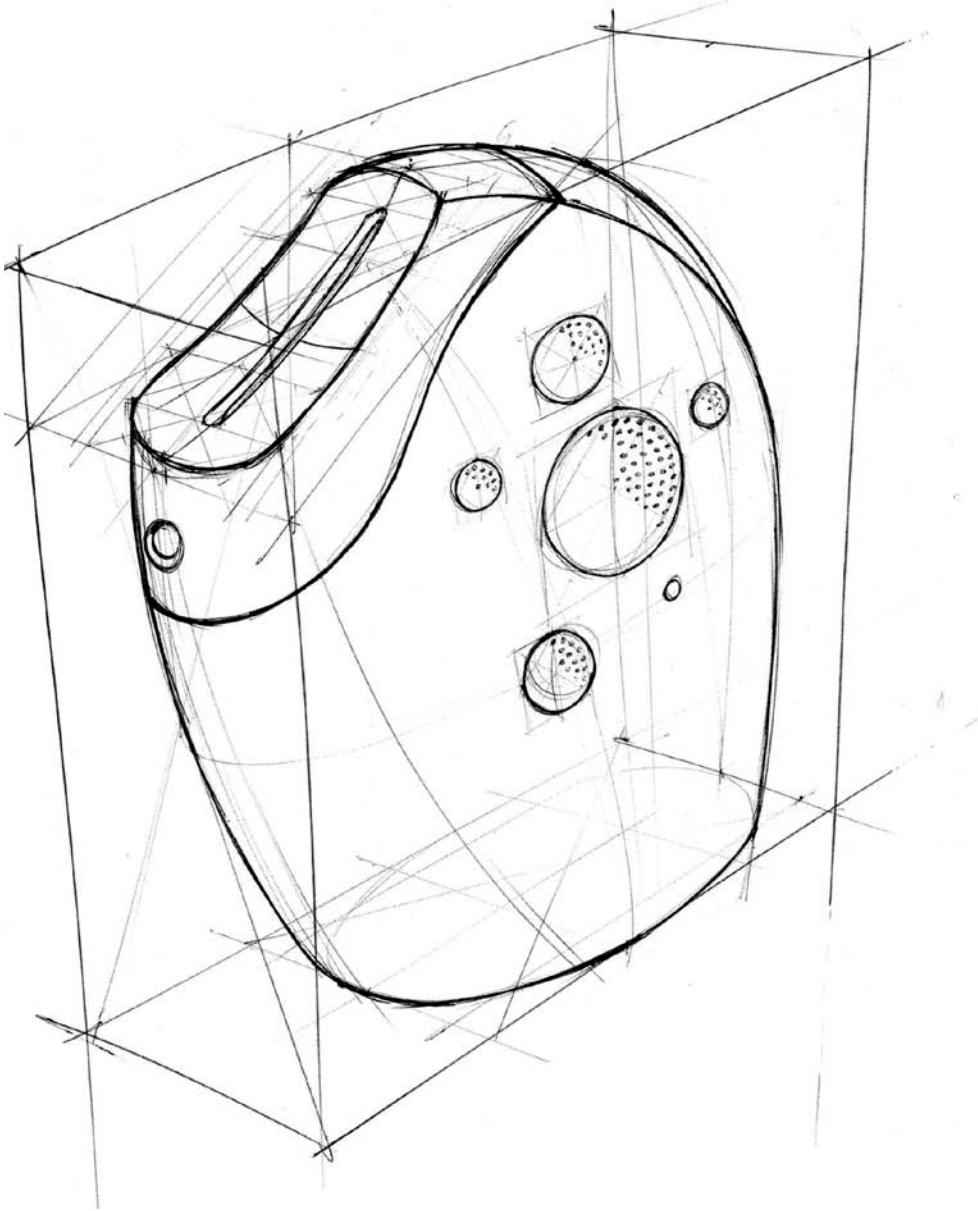

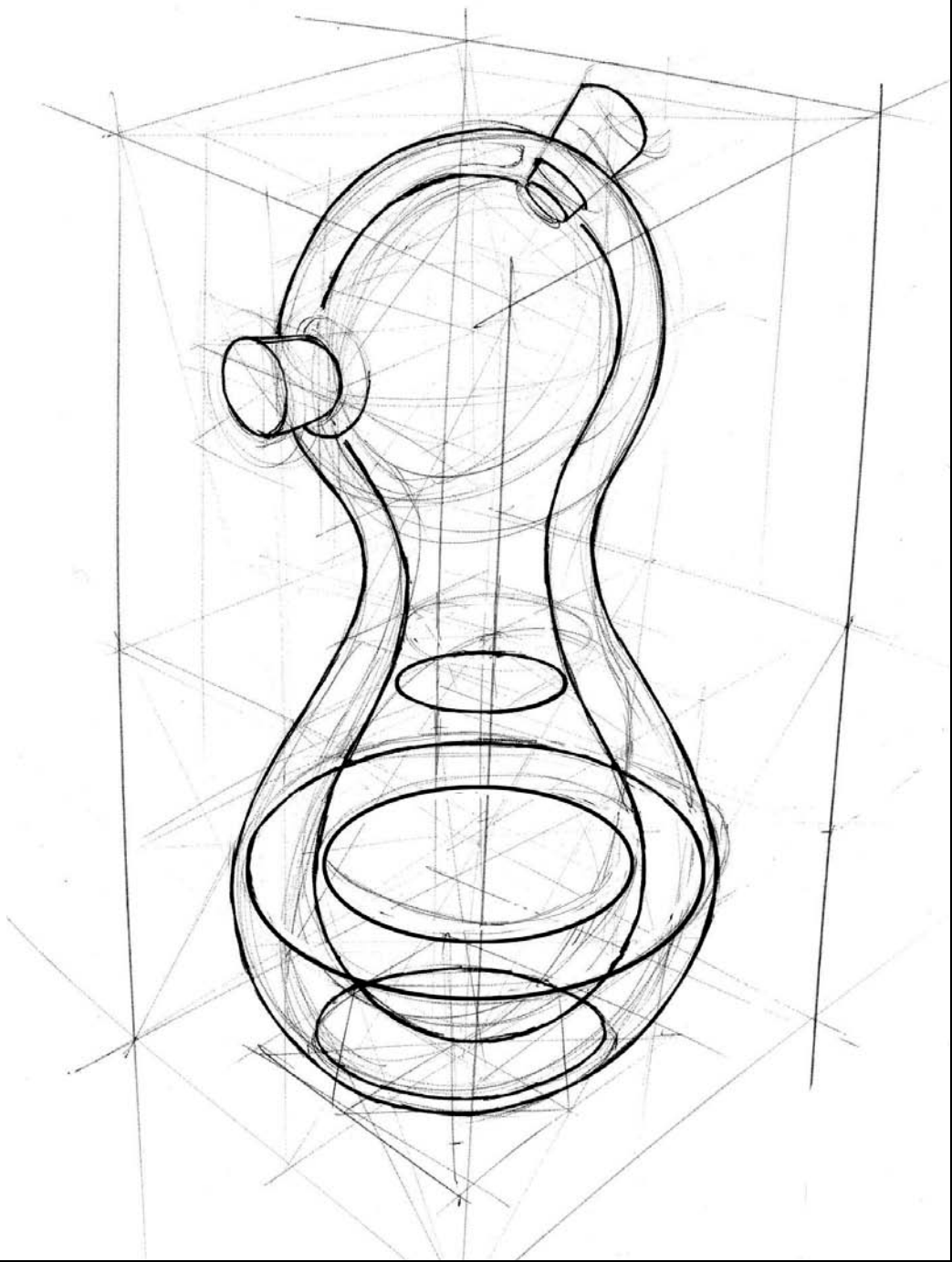

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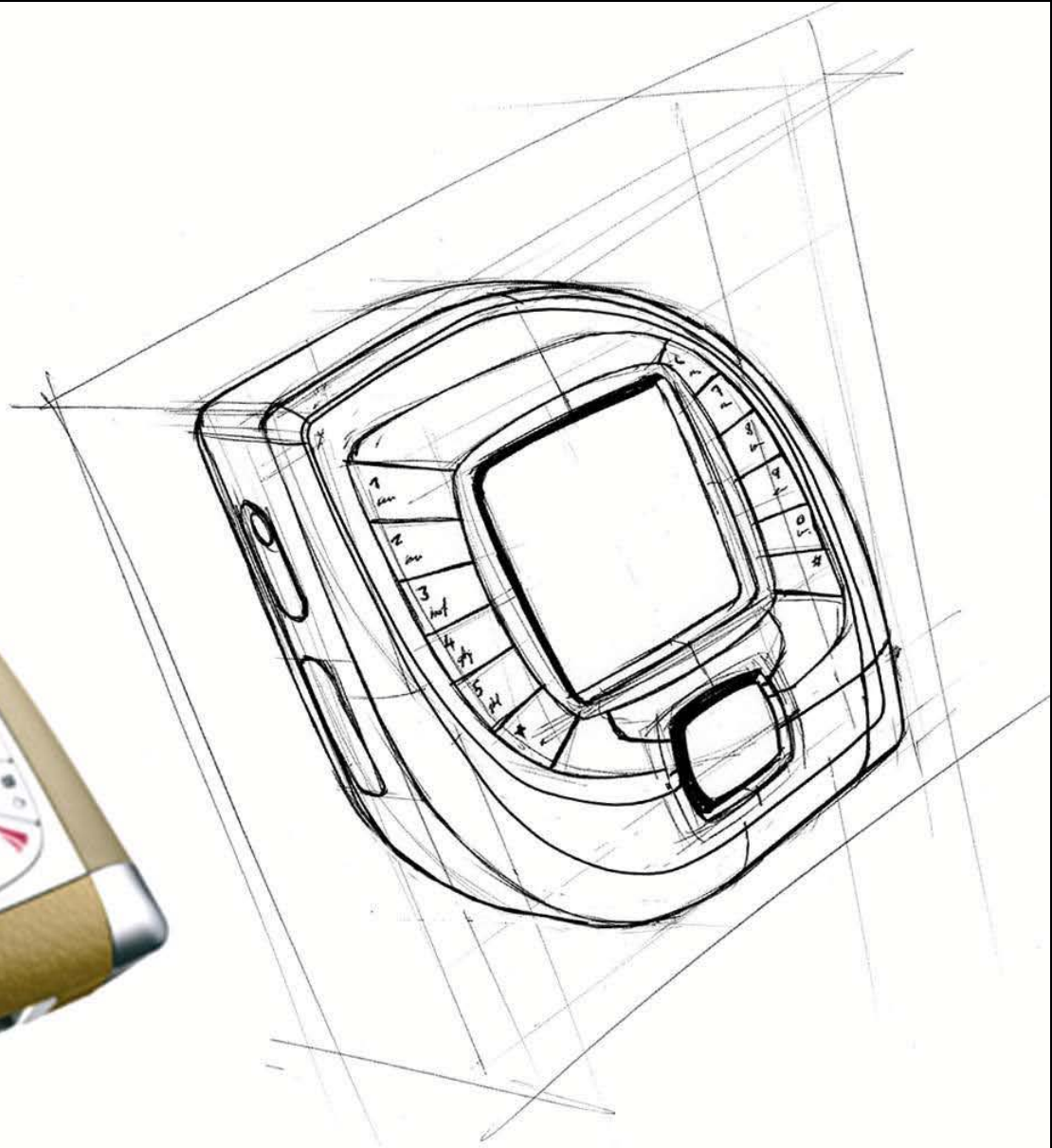

Epilogue

Everybody has seen those amazing sketches from car designers or some other linedrawing that seemed to fit perspectively and consisted of nothing more than a few lines and some curves, yet it explained all it needed to in a beautifull essence and simpleness. Many students try to imitate these sketches and end up frustrated because there's always something off. Know then that those amazing artist also started off at the bottom. They also needed to learn construction and all it's tricks. They needed to see what happens to forms in perspective by constructing them over and over. Year after year. And after a while, because they exerciced so much they can feel the shape and just draw it. It's a quality not many posess and those who do trained hard to be that skilled. Being a good sketcher is all about hard work, patience and many many pieces of paper. Don't be frustrated if it doensn't go great from the beginning. Keep picking up that pen and exercice a lot, Everywhere. And don't forget to let things inspire you. Collect pictures of products and other objects that you like, classify them in categories. See styles and trends. Tag them with lots of keywords and use them for moodboards and brainstorm sessions. Try and don't be affraid to fail, the most important lessons are learned from failures .Do things. If you have an idea and you can test it quickly do so, no need to stick with an idea that won't work. Try different things. Try to do all things. Experiment and above all....Enjoy

Thomas!

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