COMPUTER AIDED DRAFTING
STUDENT INFORMATION

Area of Study: Communications

Objectives:

> Students will learn the main features of a CAD system, and through this process learn to understand the absolute coordinate system. Students will produce an orthographic drawing.

Related Occupations:

Architects

> design buildings and other related structures. They must "sell" the concept or vision of the project. The architect then must plan and coordinate the project by incorporating good design, engineering, managing skills, supervision, and communicating with clients and builders. Architects must design for clients within the client's budget. Besides the design of the project, the architect must design electrical, plumbing, heating and air-conditioning, and site plans. Architects have to earn a license to be able to be called architects and begin practice.

Draftsman checks his work
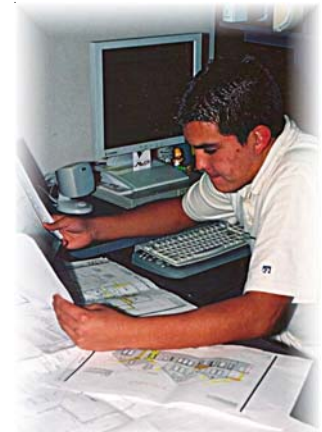*Creations West* - Mike Breen Photo

Cartographer

> map and chart the earth's surface. The job would entail collecting all kinds of data such as: latitude and longitude, distances, population levels, and even precipitation levels. They create maps using information from surveys, aerial and satellite photographs. Cartographers usually have a degree in engineering, forestry, or geography and typically work for the government or an architectural or engineering firm. Many Cartographers are finding the need to use computers more frequently with the development of Global Information Systems (GIS) which is being included in their work.

Drafter

> draw plans or sketches of structures and machinery. They prepare plans to build everything from houses, toys, spacecraft, and cars. Most drafters work at computers, however they may sit at drafting tables when doing manual drawings. Their drawings provide visual guidelines, show the technical details of the products and structures, and specify materials, dimensions, and procedures.

Landscape Architect

> design parks, playgrounds, shopping centers, golf courses, and industrial parks. They plan the location of roads, walkways, trees, shrubs, flowers, and grasses to be beautiful and compatible with the environment. A bachelors degree in landscape architecture is required to get into the profession.

Computer Aided Drafting
Occupational Choices
Focus: Drafter

Classes to take in School:

- Drafting
- Computer Aided Drafting
- Engineering Technology
- Algebra
- Geometry
- Computer Science
- General Science

After High School:

Employers prefer applicants who have completed post-secondary school training in drafting, which is offered by technical institutes, community colleges, and some 4-year universities. Training and course work vary for the type of drafting that you wish to specialize in (i.e.: Aeronautical, Architectural, Civil, Electrical, Electronics, Mechanical, and Pipeline drafters) however, the initial training will be quite similar. Students may be certified by The American Design Drafting Association (ADDA) but it is not necessary for most employers. Beginning drafters usually do routine work under close supervision of more experienced drafters.

Earnings:

Earnings for drafters vary by specialty and level of responsibility. Most Drafters Earnings in 2006 average between: $27,010- $63,310.

The median salary in May 2006 were:
Civil Drafters: $41,960
Mechanical Drafters: $43,700
Electronic Drafters :$46,830

The Work:

Drafters draw plans or sketches of structures and machinery. Most drafters work at computers, however they may sit at drafting tables when doing manual drawings. Drafters use their knowledge of standardized building techniques to draw in the details of a structure. Their drawings provide visual guidelines, show the technical details of the products and structures, and specify materials, dimensions, and procedures.

Employment Opportunities

- Architectual and Engineering Firms
- Manufacturing Industries
- Construction
- Government

Personal Characteristics

- Good Communications skills
- Good computer skills
- Ability to read technical reports, and tables.
- Must work in team situations

Key Words and Definitions:

1. **CAD** - **Computer Aided Drafting** - to produce any type of drawing using the computer - from a technical engineering drawing to a fine art drawing.

2. **Communications Technology:** the ways people have developed to send & receive messages.

3. **Coordinate** - a point on an X- and Y- axes. An example: Coordinates with a mixture of letters and numbers are called out in the game "Battleship."

4. **Hardware** - The components that make up a computer system.

5. **Horizontal** - Across the paper or screen - a line from left to right.

6**. Origin** - The starting point. The origin point is given the value of 0,0 in a coordinate system.

7. **Perpendicular** - A line which is at a 90 degree angle from another line.

8. **Plotter** - An output device that uses pens and paper to create an inked drawing. A plotter will allow bigger sheets of paper to be printed on.

9. **Software** - A set of step-by step instructions written in a language a computer can understand, which tells the computer what to do.

The Communications Model:

Communications Technology refers to all the different ways in which people have developed to send and receive messages[1]. There are many different ways to send messages to one another. The device that is used to send the message is called the **medium.** In figure 1, a communication model using a computer network as the medium is shown. In this example, the drafter is sending a **message** in the form of a CAD drawing and is able to do this through a computer network. The drawing travels through the network and makes it way to the receiver of the message who views it. This "electronic travel of the message" is known as the **transmission** of the message. The message is sent to others in the workplace quickly and efficiently because of the network. If there is a problem with the drawing or message that was received, the original sender can be contacted to make adjustments. The original sender adjusts the drawing and can send it again. When a adjustment is made like this it is known as **feedback.** This communication model containing the basic elements of message, medium (device or channel used), transmission, receiver, and feedback can be applied to any communicated information.
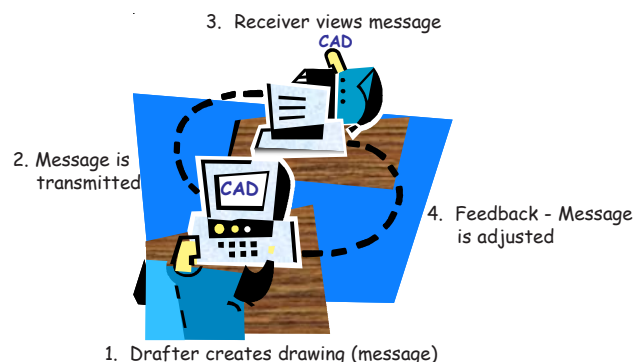

3. Receiver views message
CAD

2. Message is transmitted

CAD

4. Feedback - Message is adjusted

1. Drafter creates drawing (message)

Figure 1
Communications model using a computer network

[1]Brusic, S.

Communications Systems:

The communications model using the sum of all materials and processes through which a person sends a message and the person or machine receiving the message returns feedback is known as a communications system. Every communications system, no matter how simple or complex, (from smoke signals to an architect sending plans through a network to be approved) is designed to perform four functions which are **input** (developing the message), **process** (actions required to send the message), **output** (message being received in some form), and **feedback** (reaction to the message). [2]

What is CAD?

CAD is **C**omputer **A**ided **D**rafting. Architects use the computer to design drawings for the builder to follow when constructing a new home or store. Drafters use it to draw plans or sketches of structures and machinery.

Draftsman at a computer workstation
Creations West - Mike Breen Photo

Components Of The Computer

There are three main components of the computer. The first is the <u>hardware</u>, such as the printer or plotter, monitor, input device such as a keyboard. The second component of the computer system is the <u>software</u>. This is the information stored in the computer and on the floppy disk, CD's or DVD's. A program placed on the disk guides the computer through its operations. The third and most important component is the **<u>operator</u>**. The operator is the person who enters the information into the computer for processing. The operator is the key to making the computer function properly. The operator needs a good working knowledge of drafting and design as well as an understanding of how to operate the functions of a computer.

Before CAD

The traditional drafting and design methods used bulky drafting tools such as T- squares, triangles, drawing boards, pencils, paper, and other tools. These tools took some time to set up and use. It took many hours of hard work for an drafter to complete plans on a drawing. There was always the problem of storing the tools and the arduous task of making the drawing correctly and as neat as possible. The drawings were based on how good, or how bad, the drafter was. Any mistakes made on paper would have to be erased and drawn again. This sometimes left smudges on the paper which affected the overall appearance and quality of the work.

Draftsman hard at work in 1936
Library of Congress Photo

[2]Jones, R.

Who Uses CAD?

Architects develop floor, elevation, heating, plumbing, and electrical plans for the construction of a new home. The automobile industry uses the computer to design longer lasting tires, smaller and more efficient engines, stronger car bodies, and other designs for steering, and suspension. This industry uses CAD to design cars to protect the passenger shell in a car accident. As you can understand, computer aided design is being used in many different ways by many people.

Advantages

Using CAD has made it possible for the drafter to **get rid of those bulky tools**. The **time** it takes **to setup** a drawing has been **reduced.** The computer operator can **produce the drawing** in a much **shorter time.** The computer **output** is very **consistent** , and it has **excellent quality.** Any **mistakes are easily fixed on the computer**, and **changes** to the original plan are **much easier to implement.**

Today's Draftsman hard at work

Impacts on Society

CAD has given engineers, designers, drafters, and architects a new tool to explain a three dimensional object. Costly mistakes in design can be recognized much quicker and corrected before production even begins. CAD has had big impacts in all areas of producing a product, and building structures. Buildings are designed and variations in room layout put in original building plans to meet the needs of potential owner quickly and efficiently. Many companies manufacture products and use CAD to draw the product. Sometimes companies use CAD to design and draw the product on a computer, and transfer the drawing to machines that cut the material and make the part. When machines make a product directly from the CAD drawing, it is known as Computer-Aided Manufacturing (CAM). It can be seen that CAD is allowing companies to operate much more efficiently.

Figure 1

Student Activity I

In this activity coordinates are going to be used to draw the objects. Therefore, it is important to understand coordinate systems. A coordinate system uses two crossed lines as in **figure 1**. The left-to-right (horizontal) line is called the **X-axis**. The up-and-down (perpendicular) line is called the Y-axis. At the crossing (intersection) of these two lines is the beginning point for all coordinate systems. This intersection is called the **origin** point**.**

In a coordinate system , this point is given the value of 0. How can you use the X- and Y - axes to locate other points? On the graph in **figure 2**, there are equally-spaced short lines crossing the X-axis and the Y-axis. These lines divide the axis lines into units which can be used to measure distances away from the point of origin.
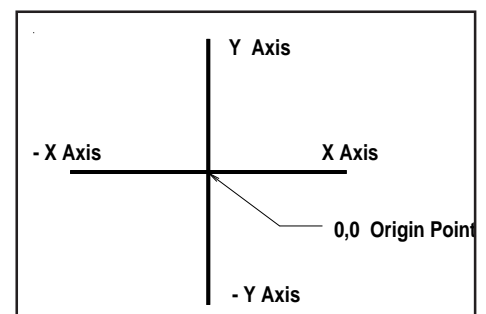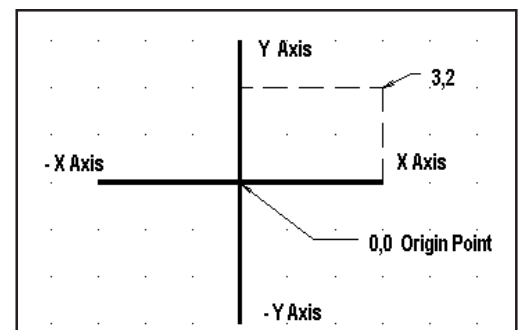

Figure 2

The values that correspond to these units are called coordinates. Any point can be located by giving its coordinate values. *The <u>horizontal</u> value is always given first in a set of coordinates.* To locate a point by using the coordinates on the graph, follow these steps and refer to **figure 3.**

Figure 3

1. Begin at the origin point.
2. Count 3 units to the right along the X-axis.
3. Draw a vertical line up from this point.
4. Go back to the origin point.
5. Measure 2 units up along the Y-axis.
6. Draw a horizontal line to the right   from this point until it crosses the vertical line drawn before.
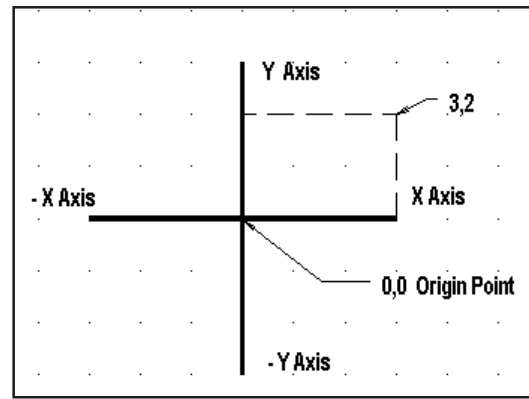
The point where the two lines cross has the coordinates 3, 2. This means that it is 3 units to the right of the origin point on the X-axis and 2 units up from the origin point on the Y-axis.

All points to the left of the origin point on the X-axis will use a negative sign. Those below the origin point will show a negative sign for the Y-axis value. This is shown in **figure 4** with the points located below the X Axis. This information is presented because the drawing in this activity will be produced by typing in a value or a **coordinate**.
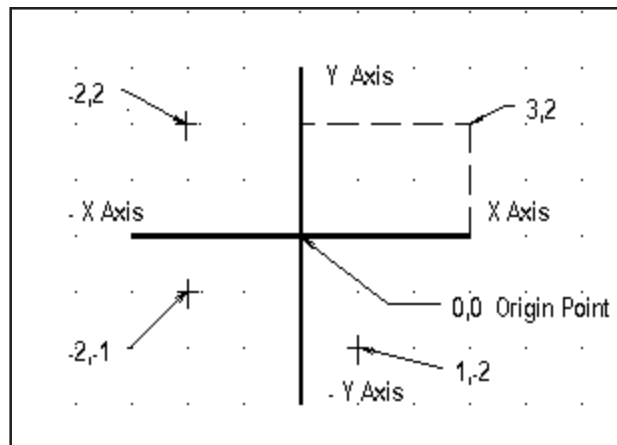
Figure 4

At this time refer to the question sheet and answer questions 1 - 5. After completing the questions, continue on with Student Activity II.
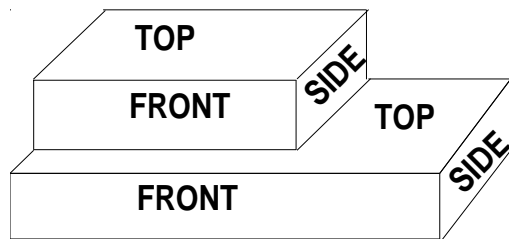
Student Activity II

Figure 5
"A Pictorial Drawing"

In mechanical drafting, most drawings can be categorized into two main types: pictorial (picture) drawings and **orthographic** (multi-view) drawings. In this activity an orthographic drawing of a block of steel that has been fabricated to the shape in **figure 5** will be shown. Orthographic means to show **three views** of an object. Generally, the three views shown are the **FRONT, TOP,** and **RIGHT SIDE.**

During this activity, you will have the opportunity to construct an orthographic (multi-view) drawing using the computer. This is the type of activity that a **Mechanical Drafter** would commonly do. Much of the time, Mechanical Drafting involves the drawing of specific parts of a machine. In this activity, you will be drawing an orthographic drawing of a cut out block.

In **figure 6**, an orthographic drawing of **figure 5** has been drawn. This is what you will be drawing for this activity. Notice that the right side view aligns up with the front view, and that the top view lines up with the front view. **READ** each direction thoroughly before you move on to the next set of directions as you proceed through the problem presented. The directions are step by step. If you get confused or have a problem understanding what is you are to do; ASK your instructor.

TOP

FRONT

RIGHT SIDE
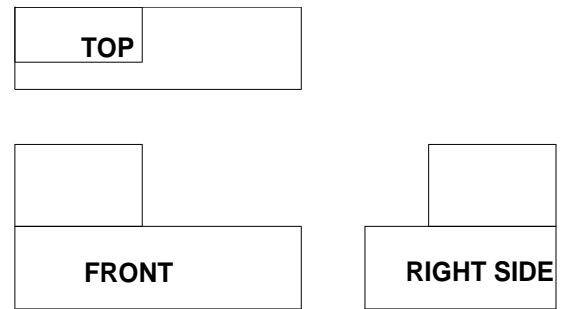
Figure 6

Save your work at the end of the period as most people do not finish in 1 period. **Look ahead to page 14 on how to save your work.** After familiarizing yourself with how to save your work, continue on with Student Activity III.

Student Activity III

Welcome To Auto-Sketch

1. Turn on the computer if it is not already on.

Figure 7

2. After the computer has loaded and the desktop appears, move the cursor with the mouse to the Auto-Sketch icon on the desktop as seen in **figure 7** and double click to open the software program.

3. A prompt box will appear as seen in **figure 8.** Select The "Create Precision Drawing" wizard. Click on the O.K. box.

Figure 8

4. A box will appear that will ask for information.
   a. under *"drawing title"* enter: **Multiview 1.**
   b. under *"project name"* enter: **CAD**
   c. under *"your name"* enter: **Name**
   d. under *"your companies name"*
      enter: Your **school's name** if it
         isn't filled in for you.

5. Click the Next button. The program defaults to *"set scale automatically."* Click Next again.

6. We will use the Architects Scale, and the object size should be set at 7.5" for width and 10" for height as in **figure 9**.
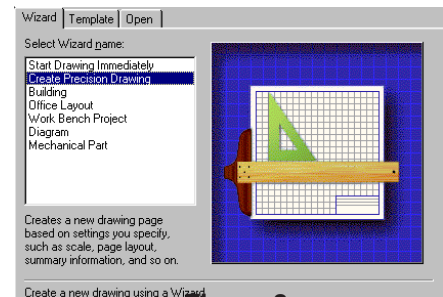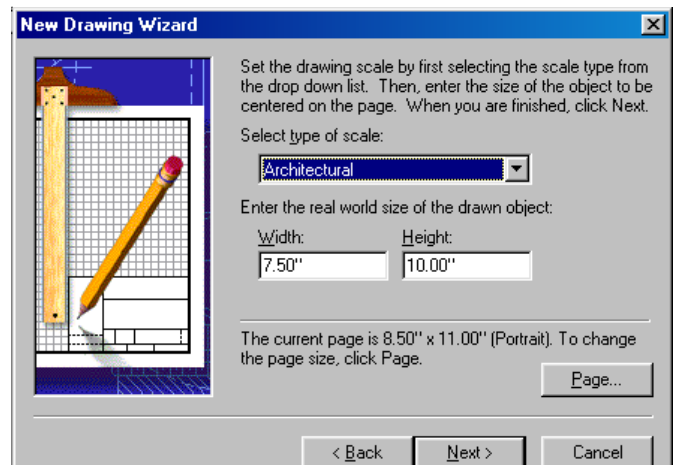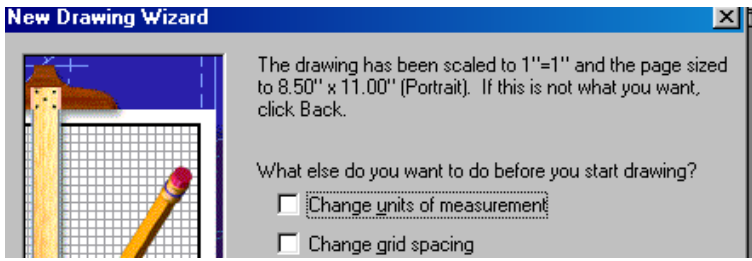
Figure 9

Figure 10

7.   This will bring up the next screen. It is important to note that it states that your drawing is *scaled 1" to 1" and the page sized to 8.50" x 11.00" Portrait* as in **figure 10**. (If this is not what it states, you will need to click back one step and by clicking on the page button set the page correctly.) Click on the Next button.

8.   The last prompt is do you wish to save this drawing as a template. Leave it as no and select the *Finish* button.

9.   A drawing area will appear on the screen which will look like the one in **figure 11.** If at any time you make a mistake, and want to remove an object from your screen open the edit menu and click on the undo command. This same command is in your menu and looks like a curved arrow. It is circled in green in the tool bar covering the top of the screen in **figure 11.** The undo command will let you clear many previous actions. In the undo menu, you can keep clicking undo to clear the previous work or a drop down menu will appear and you can clear several things at once as shown in **figure 12.**
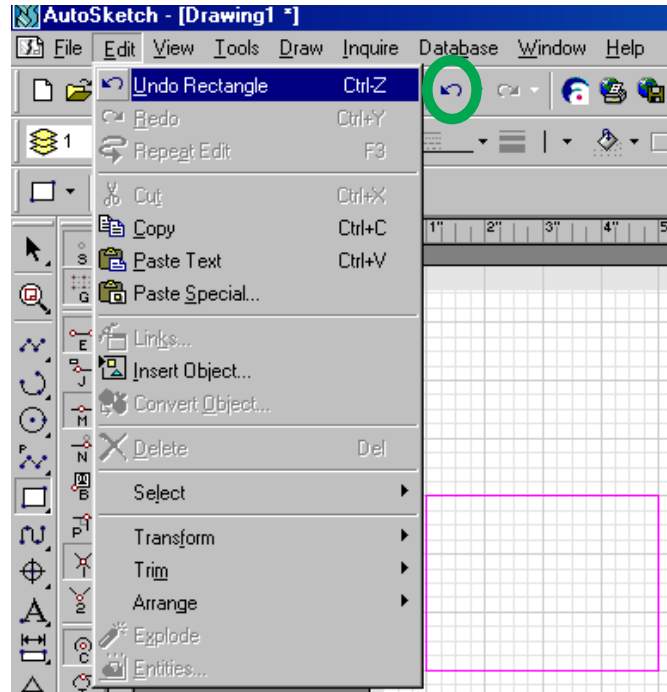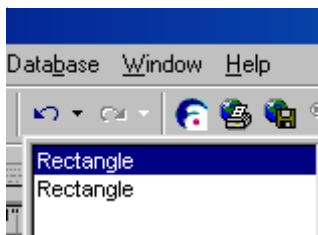

Figure 11

Figure 12

Another way to clear an object is to select the object with the mouse and then push the delete key on the keyboard. To make this happen the "direct select button" must be activated this is shown in **figure 13**. Once this is done, select the object you wish to remove by clicking on it with the mouse; then push the delete button on the keyboard.

Figure 13

Top View

1. The first step is to make sure that our lines snap into position. On the snap menu, make sure that the "snap" and Grid point snap" are both activated as shown in **figure 14**. Activating these two will only allow lines to be drawn on the grid lines that you see on the "paper."

Figure 14

It is important to understand that there are two different ways of drawing the project. The method that many default to is drawing with the mouse. Clicking and drawing the lines necessary is an important way of drawing. If you choose this method on this drawing, you will have to pay close attention to the rulers on the top and the left side of the drawing area as the points that you are to draw to are listed in this ruler. Once you are done drawing a rectangle or line, click the right mouse button to let the program know you are done with that particular point.

The easier method, in this case, is to enter absolute coordinates on the X and Y axis. The directions will ask the computer operator to enter in data from the keyboard and the computer will draw the lines from the data that you enter. This drawing is done this way so that you may get a better understanding of what an orthographic projection or multiview drawing is. We will begin.

Figure 16

2. Select the white rectangle drawing tool in the drawing menu as illustrated in **figure 15.**
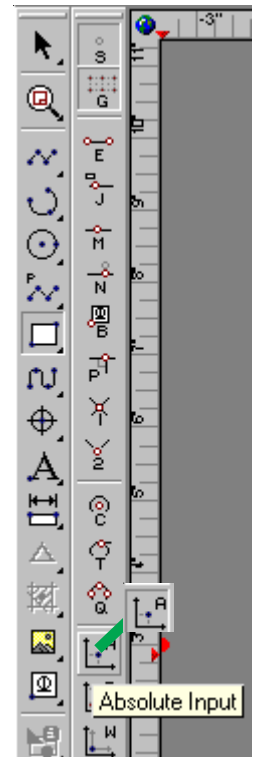
Figure 15

3. Select the absolute input button in the snap menu as shown in **figure 16.**

4. A dialogue box will appear. The next step is to enter in the coordinates for the top, left hand-corner of the box. In this box, enter in the number **1** for the X coordinate. Then select the **TAB** key on the keyboard. This moves the selection data to the Y coordinate. Enter the number **8** for the Y coordinate as shown in **figure17**. Use the keyboard and to **select** the **Enter** key (The mouse can be used to enter the data, but it takes longer to do it this way). The 1, and 8 will appear in the coordinates last entered as seen in **figure 18.** It may also be noted in this figure that a dot appears on the drawing area that shows where the coordinate is as circled in **figure 18.**
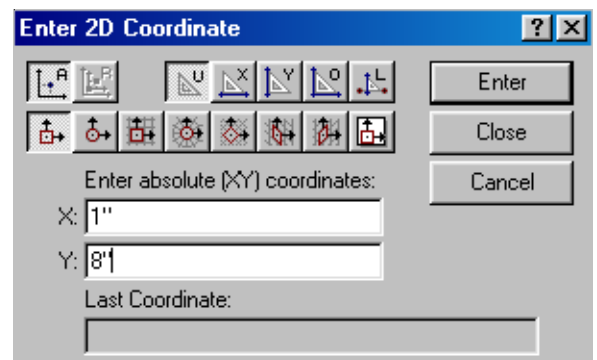
Figure 17

6.   The next step is to give the coordinates of the bottom right hand corner   of the box (opposite diagonal   corner). For the X coordinate enter: **4**. Select the TAB key on the keyboard. The Y coordinate will be **6**. Select the Enter key on the keyboard.
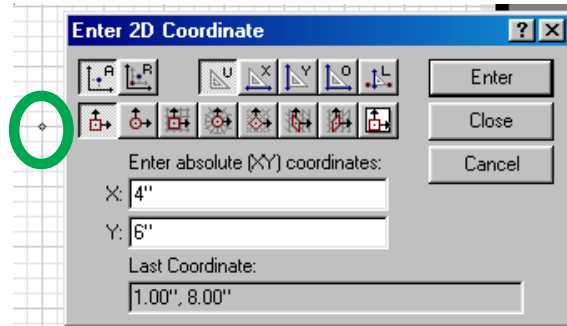

Figure 18

A rectangle forms on the drawing area.

7.   To finish the top view the inner box coordinates will be entered in the same manner.
- **X = 1**
  Press TAB
- **Y = 8**
Select **Enter** on the keyboard.

Then enter:
- **X = 3**
  Press TAB
- **Y = 7**
Select **Enter** on the keyboard.
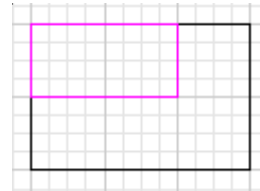
Figure 19

This completes the top view which should resemble that of **figure 19.**

Front View

Figure 20 again shows the entire project to be drawn again. Remember the front view must line up with the top view. Consequently, the X coordinate will be 1. If one inch is left between the views, then the Y coordinate will be a 5.
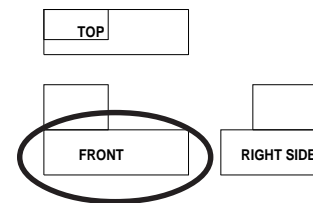

Figure 20

8. The next step is to enter in coordinates.

- **X = 1**
  Press TAB
- **Y = 5**
Select **Enter** on the keyboard.

- **X = 3**
  Press TAB
- **Y = 4**
Select **Enter** on the keyboard..

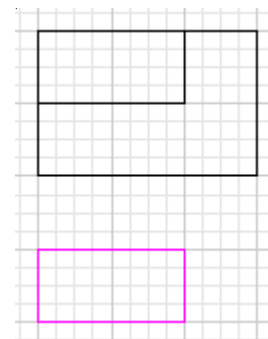The drawing will now look similar to that of **figure 21.**

Figure 21

The bottom box of this front view needs to be finished.

9. The next step is to enter in coordinates.

Figure 22

- **X** = **1**
  Press TAB
- **Y** = **4**
Select **Enter** on the keyboard.

Then enter:
- **X** = **4**
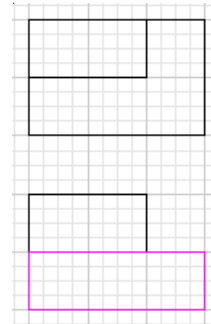 **Press TAB**
- **Y** = **3**
Select **Enter** on the keyboard.

This completes the front view which should resemble that of **figure 22.**

Right Side View

Now lets draw the right side view. To see what is to be drawn refer to **figure 23.** The right side view must line up with the front view. Consequently, the bottom of the right side view would be a 3 to line up with the front view. This is the Y coordinate. Again if the one inch is left between the views, then the X coordinate would be a 5.
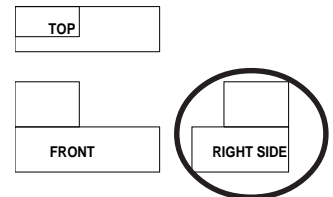

Figure 23

10. The next step is to enter in coordinates.

- **X** = **5**
  Press TAB
- **Y** = **3**
Select **Enter** on the keyboard.

Then enter:
- **X** = **7**
  Press TAB
- **Y** = **4**
Select **Enter** on the keyboard.

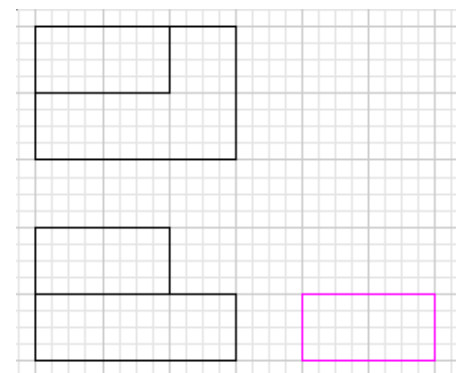The drawing should now resemble that of **figure 24.**

Figure 24

The next step is to give the coordinates of the bottom right-hand corner of the top of the box in the right side view. It would actually be the same corner that was just finished.

11. The next step is to enter in coordinates.

- **X = 7**
  Press TAB
- **Y = 4**

Select **Enter** on the keyboard.

Then enter:
- **X = 6**
  Press TAB
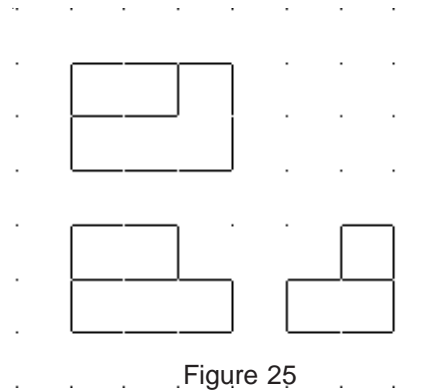- **Y = 5**

Select **Enter** on the keyboard.

Figure 25

Your drawing should now look like that of **figure 25.**

To finish the drawing it must be given a title. A title block is generally where the title, name, and date is given.

Title Block

12. To create your title block enter in coordinates.

- **X = 4**
  Press TAB
- **Y = 2**

Select **Enter** on the keyboard.

Then enter:
- **X = 8**
  Press TAB
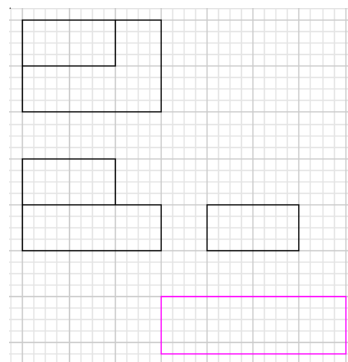- **Y = .75**

Select **Enter** on the keyboard.

Figure 26

The drawing should now look like that in **figure 26.**

13. Close the absolute dialogue box and click on the absolute button to deselect it.

14. The outline of the title block needs to be entered with information. In the drawing menu on the far left side of the screen, use the mouse to click on the text point command which resembles the letter A as in **figure 27**. This activates the command which will allow you to enter text into the title block. Move the mouse over the title block and click the left mouse button over the coordinates:

- **X = 4.5**
- **Y = 1**
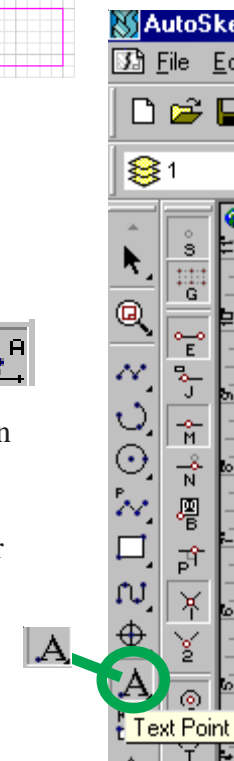
This point will be located as the dot in **figure 28.**

Figure 27

Click **Enter** with the mouse or keyboard.

15.   Type in the words: **TITLE: ORTHOGRAPHIC** in all capital letters. Push the **Enter Key** on the keyboard.
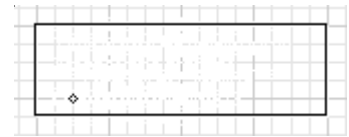

Figure 28

16.   Type in the words: **NAME:** in all capital letters and then enter your name behind it.
       Push the **Enter Key** on the keyboard.

17.   Type in the words: **DATE:** in all capital letters. Behind the word date, enter the actual date that the drawing was created.

18.   The words in the title block will need to be adjusted to fit in properly. To do this remove the snap command on the snap menu. Click on the snap tool to deselect it as shown in **figure 29.**
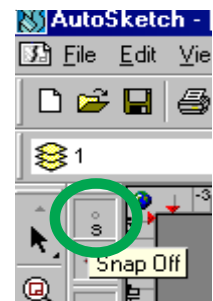

19.   Then click on the Select Direct command in the draw menu as shown in **figure 30**. Move the mouse cursor over the text and left click it and continue to hold the mouse button down. Drag and position the text so that it looks appropriate within the box that has been drawn.

Figure 29

This completes the introduction to CAD. At this time, **a printed copy will need to be turned in.** The finished drawing should resemble that of **figure 31.** If your drawing does not look like that in the figure, use the undo command and go back to the point where you think you made the mistake. You do not have to start all over.
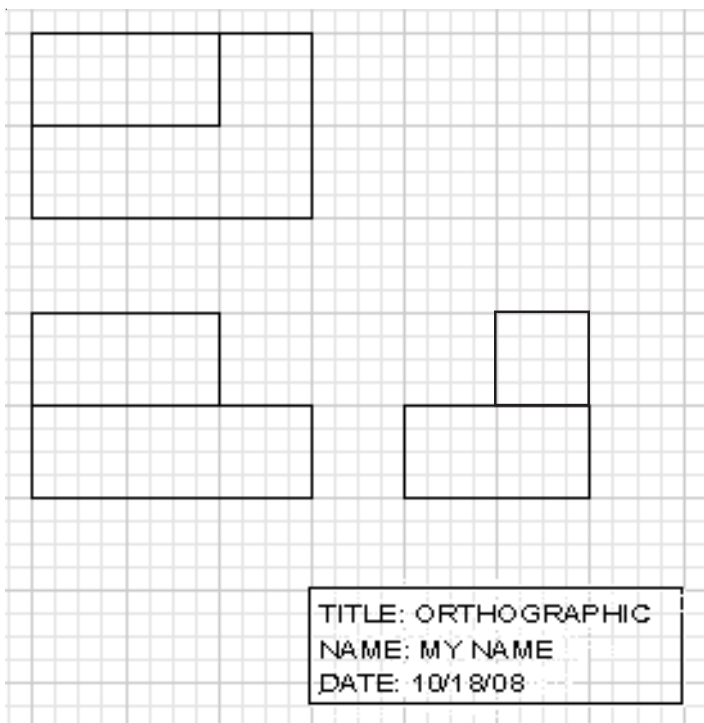

Figure 30

To Print:

If the printer or plotter is not on let your instructor know. To print a drawing:

20. Choose **Print** from the drop down **File** Menu.

TITLE: ORTHOGRAPHIC
NAME: MY NAME
DATE: 10/18/08

Figure 31

To Save

       Different instructors may want the student to save in different places. You may save to a network drive, the hard drive, or a floppy disk. Wherever you save, you will need to find the correct "path" to where you are saving the information.

1.   The first step is to open the **File** menu and choose **Save As.** This will bring up the Save Drawing File dialog box in **figure 32**. Using the toggle button select the place that you have been directed to save your work (i.e.: floppy drive, hard drive, or network drive, under your name on the network drive).

2.   Enter in the name that you are going to use to recall the file. In most cases this would be the computer operators first or last name. However, **keep the SKF extension** as you save it as shown in **figure 33.**

Toggle Button

Figure 32

Figure 33
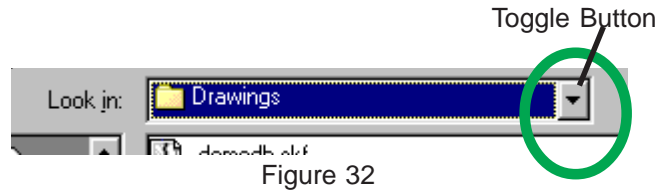
3. Once you have entered in the data click the **Save** button to save the file.

To Quit

       Move the cursor arrow to the word **File** in the menu bar at the top of the screen. **Click** and hold down the mouse button and drag to the word **Exit.** When it is highlighted release the mouse button.   Your document will close and go back into the proper folder.

       Congratulations!!   You have completed the CAD activity.

       Make sure you fill out the work sheet and hand in the hard copy of your drawing to your instructor for a grade.

Computer Aided Drafting (CAD)
Student Worksheet

Name: _____ Period: _____ Date: _____

Directions: In the blank on the left, write the correct answer to the statement or question.

1. _____   _____ Technology refers to all the different ways that people have developed to send and receive messages.

2. _____   The acronym "CAD" stands for _____   _____ _____.

3. _____   The most important component of a CAD system is the _____.

4. _____   Give three advantages of a CAD system over the traditional methods of drafting.

_____

_____

5. _____   In a coordinate system, the left-to-right (horizontal) line is called the _____ -axis.

6. _____   The intersection or crossing of the horizontal line and the vertical line in a coordinate system is known as the _____ point or 0,0.

7. _____   The drawing will be produced using a mouse or by typing in a value called a _____.

8. _____   The drawing that will be produced is known as an _____ or multi-view drawing.

9. _____   Multi-view drawings have _____views.

10. _____   The most common views are the Top, Front, & ____ _____.

The next 5 questions are on the back of the worksheet.

Directions: For the coordinate locations in the drawing, list X and Y values for each point in the provided spaces *(Hint: remember your negative sign & refer to pages. 5 & 6).*

Questions 11 - 15:

11. Point 1: ———

12. Point 2: ———

13. Point 3: ———

14. Point 4: ———

15. Point 5: ———