

Chapter

1

The World Class CAD Training Method

In this chapter, you will cover the following to World Class standards:

- **Computer Aided Drafting (CAD) Starts to Replace Drafting Boards**
- **The Creation of the CAD Training “Bible”**
- **The Origin of the World Class CAD Training Method**
 - **Mastering a Single Tool or Concept in Conjunction with a Believable Drawing or Problem**
 - **Grouping a single tool or concept together in logical sequences for similar problems**
 - **Using repetition and coaching to improve drawing techniques and quality**
 - **Using the video-gaming technique of passing through levels before learning new tools**
 - **Promoting competition among the students to challenge them to the next level**
 - **Returning to a basic tool or concept already visually understood to add complexity**
 - **Guaranteeing success in similar problems when finishing a training problem**
 - **Guaranteeing drawing speeds that are a fraction of those trained by other methods**
 - **Insuring that a high percentage of individuals (85%) that are able to achieve the World Class CAD standard**
 - **Providing continual training throughout the student’s career**

Computer Aided Drafting (CAD) Replace Drafting Boards

In the late 1970's, a few individuals volunteered for training in Computer Aided Drafting and Design (CADD) at major corporations. This method of using a computer software package replaced the older manual drafting done with pen, pencil and vellum. At that time the costly workstations were connected to a mainframe computer and only a few selected individuals were allowed to utilize this newest of engineering technologies. Select groups of designers and engineers were instructed in basic drawing tools using lines, circles, and arcs. The CADD training methods developed were a continuation of concepts used in post-World War II drafting manuals, which used construction techniques to determine paper size and geometric methods of finding center points, centerlines, tangent points, and projection lines. Those of us in the initial CADD startup had no trouble utilizing these concepts since all of us had spent nearly a decade diagramming hundreds and in some cases thousands of detailed paper drawings. The new structured CADD manuals showed the precise methods of making details such as intersections of lines and arcs. They were invaluable in the first ten years before more complex modifying tools such as Fillet, Extend, and Trim made construction lines antiquated.

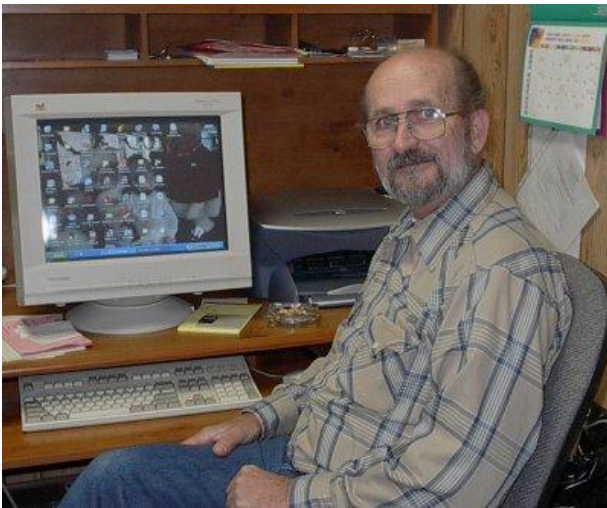


Figure 1.1 – A World Class CAD Expert

By the late 1980's, any instruction in board drafting methods using construction lines actually added an unnecessary level of complexity to the detailing process. Throughout the decade, many architectural and engineering departments' drawing times continued to remain the same, although CAD software companies like Autodesk were continually developing more powerful modification tools. While other training methods remained the same into the 1990's, we removed from our curriculum all drafting board techniques using construction lines.

The Creation of the CAD Training “Bible”

When I started to teach computer aided design as a department manager, and then later in college in the heart of the American industrial zone, new methods for utilizing all the powerful tools incorporated in a software package needed to be developed. The problem in our business, for those of us who chose to teach modern engineering, was that since the late 1940's there had been no development of an industry standard for the education of orthographic drawing that stayed consistent with the advancement of drafting technology. Pick up any twenty-first century software-training manual or CAD “bible,” so-called because most of these

books weigh a few pounds with nearly a thousand pages of instruction, and you will find many explanations covering every concocted scheme for drawing a line, circle or arc. When companies like Microsoft or Autodesk add another tool or capability to their revised software package, the software writer seldom removes the older tool or capability. Either from inexperience in a production engineering department, where low drawing times and quality of the drawing are paramount, or from the want to educate new CAD students in the same manner they were trained (probably sometime between the 1940's to 1970's), many trainers will try to instruct their new pupil in many of these methods in the same week. Why? Who knows? When only the current drawing techniques should be taught, these groups spend little to no time training the basics of the orthographic drawing, which is composed of nearly 100% parallel and perpendicular lines for the architectural industry and almost 100% curves and draft angles for the Engineering components. Watching many professionals with multiple years of training from regional colleges and academies, I am shocked by the lack of detailed knowledge of the basics in computer-aided design from new graduates. A better method should ignore outdated techniques and concentrate on teaching the basic skills needed to efficiently create new CAD drawing and designs.

The Origin of the World Class CAD Training Method

Developing a new training method that will guarantee drawing speed and quality is quite an undertaking and takes many years of dedication by a team of designers. With a background in both software development and training, we have developed a method to accomplish the task. My experience with fire controls systems such as the US Army Mortar Ballistic Computer (MBC), training armor units and a decade and a half of industrial control engineering has shown me techniques that work. In addition, experiencing the retraining of the US Army in the 1980's gave me insights into a system that might become functional and replace the antiquated "twentieth century drafting manual."

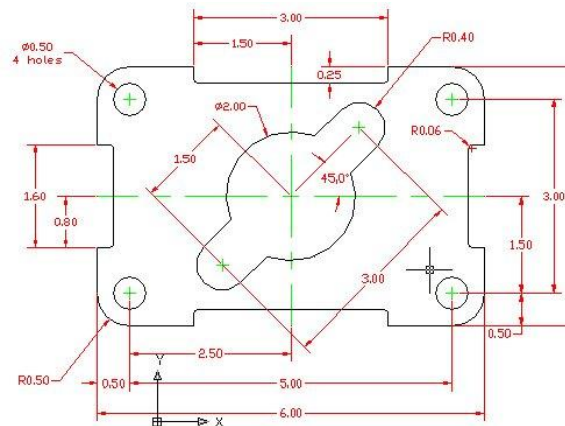


Figure 1.2 – The Rectangle Problem

Here are ten basic principles that we developed at World Class CAD:

The World Class CAD system of learning integrates the following ten principles:

1. Mastering a Single Tool or Concept in Conjunction with a Believable Drawing or Problem
2. Grouping a single tool or concept together in logical sequences for similar problems
3. Using repetition and coaching to improve drawing techniques and quality
4. Using the video-gaming technique of passing through levels before learning new tools

5. Promoting competition among the students to challenge them to the next level
6. Returning to a basic tool or concept already visually understood to add complexity
7. Guaranteeing success in similar problems when finishing a training problem
8. Guaranteeing drawing speeds that are a fraction of those trained by other methods
9. Insuring that a high percentage of individuals (85%) that are able to achieve the World Class CAD standard
10. Providing continual training throughout the student's career

Ever since we developed the World Class CAD training method in 1996, thousands of professionals from our industry and from campuses around the world are achieving great advances in the timely creation of accurate drawings.

Mastering a Single Tool or Concept in Conjunction with a Believable Drawing or Problem

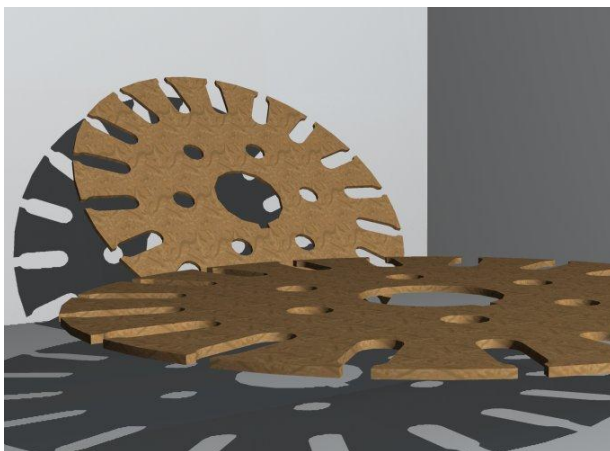


Figure 1.3 – The models of the Circular Problem displayed in a marketing image

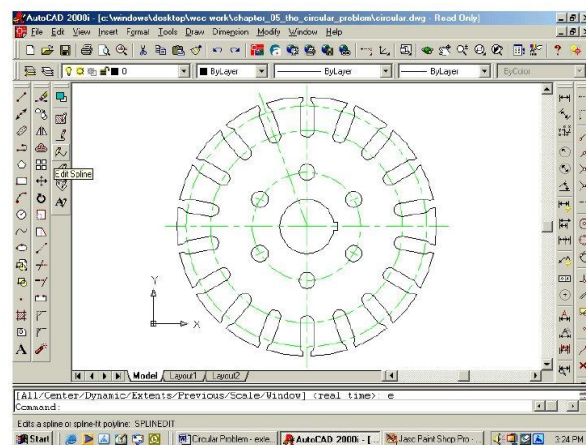
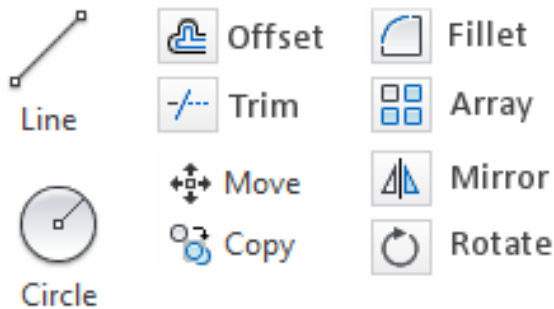


Figure 1.4 – The Circular Problem part drawing

The average student's academic career seemingly consists mostly of drills and problems that have little to no real-world application. At the fundamental level of training in our discipline, we have lost many potential graduates just because they could not figure out the purpose of the hundreds of software application tools available to them, giving them a feeling of bewilderment. The units in this series of training manuals, starting with the Fundamentals of 2D Drawing, give the student a goal of finishing a simple part drawing. It has been our experience that the majority of students comprehend the part drawings like the Rectangular or Circular Problem and nearly all of the students will be able to meet the drawing times and quality standards for these two objectives after five weeks or 15 hours of CAD training. Students have a simple and attainable objective that requires them to use commands like the Line, Circle, or Move, and they train diligently to master them.

The basic CAD skills learned in the Fundamentals of 2D Drawing pass right to the

understanding 3D CAD design. 2D and 3D CAD have many similarities. Individuals who bypass the 2D orthographic process will miss that training. The 2D layout process gives the designer a great tutorial on processes and language of drafting.



Discovering powerful CAD functions is important in the expansive software applications that are in use today. Many of the tools available in a CAD program either are for the more advanced user or are essentially out of date. There are hundreds of tools in AutoCAD that should not be in the basic CAD display, and even experts are amazed when they the rare use of a tool even once on a two or three year cycle. This usually elicits a comment in the professional office like, “I just used the Ellipse Tool today.”

Figure 1.5 – AutoCAD Common Tools

Grouping a single tool or concept together in logical sequences for similar problems

Basic proficiency training is imperative in a successful plan, but placing the expertise into a instruction set that is realistic adds a level of personal assurance when the skill set is acquired, allowing the student to move ahead confidently in the exercise. The Rectangular Problem contains a challenging but repeatable perimeter like the exterior walls of a residential floor plan and contains an interior detail that requires attention to the construction detail. The task involves learning how to use multiple tools in a logical sequence that can be used for similar architectural and engineering problems to create a final product. For example, on the Rectangular Problem, the perimeter, which usually involves a closed set of lines, initially is drawn followed by the placement of centerlines. Immediately following, another set of lines are offset from the initial set of lines to create another group of object lines. This second set of lines is modified by trimming, extending, or filleting. This sequence is to be done in a clockwise or counter-clockwise method starting in the lower left-hand corner of the drawing. Therefore, in the Rectangular Problem, the student learns how to assemble a series of tools together to accomplish an array of tasks while building a greater understanding and gaining efficiency.

Using repetition and coaching to improve drawing techniques and quality

Many architectural and engineering departments never reach the best quality in their drawing products because the average CAD professional's drawing method is not much different from that of their predecessors on the drafting board. Many companies use the CAD file for easy replication of one project to another but shy away from new construction because creating a new batch of drawings using new ideas takes a significant amount of time. This has been a problem for over a decade in the two-dimensional drawing arena and now is reappearing again in the construction of three-dimensional models. When a CAD drafter does not have full command of the basic tools, that individual will return to a trial-by-error scheme of computer-aided design, which is time consuming and usually results in many errors. Successful CAD departments achieve quality by understanding the basic software tools, quickly creating details, and then having the time to check and correct their drawings. Coaching the student through the World Class CAD problems causes them to practice a skill to the point that he/she no longer thinks about the menial tasks involved in drawing. When a professional does not have to ponder the use of a software tool, he will be able to concentrate on the design task at hand. The final goal of the student should be to treat the CAD software and the use of the tools similar to the simple use of the keyboard by an experienced executive assistant.

Using the video-gaming technique of passing through levels before learning new tools

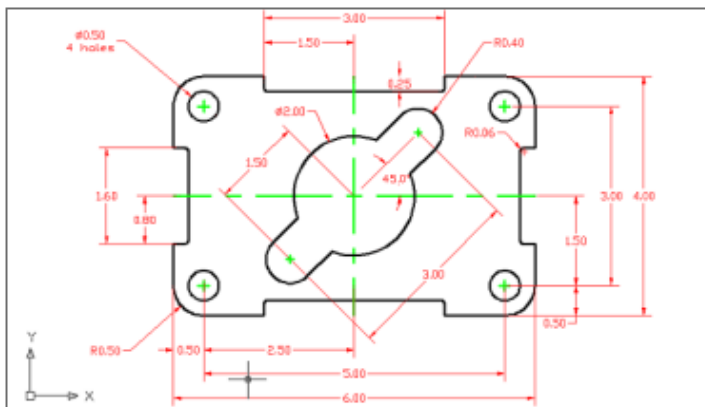


Figure 3.38 – Finished dimensioning the rectangular problem

* World Class CAD Challenge 02-08 * - Close this drawing file. Create a New file and draw the entire rectangular problem on proper layers, using proper dimensions on the drawing. Continue this drill four times, each time completing the drawing under 10 minutes to maintain your World Class ranking. If you are under 10 minutes, you may proceed to the next chapter, the Circular Problem.

Video gaming often involves mastering basic techniques in order to advance and win the game. In everyone's favorite game, Pong, one must master the art of deflecting the pong ball in such a way so that the computer foe is unable to rebound the ball. As the game goes on, the computer is able to move faster, so that the player must make increasingly difficult deflections to defeat it. World Class CAD periodically employs the same concept in the form of Challenges. These "tests of skill" encourage the student to accomplish a sequence of related tasks consistently in a specified period of time.

Figure 1.6 – A World Class CAD Challenge

World Class CAD Challenges actually assist the student in learning more difficult concepts by breaking them down into smaller segments and setting demanding objectives to increase the student's proficiency. The level of a trainee's confidence and the success rate of problem completion are both increased. When students discover a roadblock, they can focus primarily on the obstacle by returning to the specific page in the training manual for reinforcement.

Prior to computer drawing programs such as AutoCAD, the time required to create a pencil or pen drawing was determined by drawing size. Departments would set standards that might look like this:

ANSI Size A (8.5 x 11)	1 hour
ANSI Size B (11 x 17)	2 hours
ANSI Size C (17 x 22)	4 hours
ANSI Size D (22 x 34)	8 hours

The manager made the judgment based upon how much space was on the paper. When creating a CAD detail or drawing, the CAD Department Manager can be much more scientific in their approach to judge drawing speed. My colleagues and I feel that 5 seconds per entity (such as line segment, circle, arc, associated dimension or text) is an appropriate way to calculate satisfactory time to completion. All the manager has to do for a two-dimensional drawing is select all the entities in the graphic display, record the number listed on the command line and multiply by five seconds. Divide by 60 to calculate the minutes. These times per drawing entity can be listed on an evaluation form to determine the success of the drafter.

Promoting competition among the students to challenge them to the next level



Trainees can compare the results of their World Class CAD Challenges located at the end of the units by posting them on the World Class CAD website. Just submit drawing times and a copy of the computer file to the World Class CAD team. We will calculate the editing time and number of errors, and then post the time and score on the challenge's results webpage. Having the ability to see names, organizations such as schools or companies, scores, and times will allow anyone to place him or herself among the world ranking of CAD drafters, designers and degreed professionals.

Figure 1.7 – www.worldclasscad.com

Returning to a basic tool or concept already visually understood to add complexity

As part of your 2D training you will want to understand how to selectively trim a line, arc or circle by selecting each cutting object, rather than having all of the entities operate as cutting lines. These training units cover both methods. The next time you see one of your Drawing or Modifying tools shown in the instruction manual, the visual and written explanation will also be presented for your next level of skill enhancement. That way the student will grasp the exact, specific new concept and its associated sequence of events.

Guaranteeing success in similar problems when finishing a training problem

In the 2D drawing training manual, there are four major training objectives: draw the Rectangular Problem, the Circular Problem, the Bracket Problem and the Floor Plan. At the conclusion of each major objective, there are a series of three reinforcement problems to try. These additional exercises are available to strengthen your skills and build confidence in your ability to create similar drawings. These should not be attempted until your instructor has approved your completion of the preceding major objective.

8. Guaranteeing drawing speeds that are a fraction of those trained by other methods

All students of the World Class CAD method are fast drawers. Many organizations I have been associated had only one or two expert level CAD operators. Why is that? Well, to give you an example, a few years ago a high school CAD instructor told me that every day they changed the problem in an attempt to replicate what would happen to the students once they entered their professional life. But the students did not have time to practice the basics. I could not disagree more with this method. Nearly one hundred percent of my graduates go to their professional employment and do the same type of drawing every day; the ability to understand the basics of CAD are their tickets for success. As a college professor and lab instructor, I have had many students who have been in CAD training academies and vocational programs for up to four years that cannot finish a two to three view orthographic drawing, including dimensions, notes and a title block in less than two hours. Well, as you have heard before in this chapter, those kinds of times are associated with pen and pencil drawings. A World Class CAD graduate at their skill level, whether drawing 2D parts, 3D models and part drawings, assemblies, or writing their own programs, operates at a highly efficient rate.

Insuring that a high percentage of individuals (85%) that are able to achieve the World Class CAD standard

Once I entered the collegiate level, my goal was to graduate 85% of students who were able to achieve success in the first three weeks of training. Many years we came close to meeting that goal, which resulted in the students obtaining high skill levels in design, programming and CAD, and providing a large market with highly trained junior engineers. Many younger students and older architects and engineers will be nervous about whether they can meet the standards early in the training. Over the years, we have found that most of those who work hard for three weeks will gain the necessary skills to go the distance.

Providing continual training throughout the student's career



Figure 1.2 – The Bracket from the Bracket Problem displayed in a marketing image

We begin World Class CAD training with the Fundamentals of 2D Drawing, starting with the basics of orthographic drawing and dimensioning. But eventually we proceed towards the highest level of engineering and architectural documentation. Since the 1990's, many companies have shown demand for individuals with 3D drawing skills because their customers want to see what the part or assembly will look like in a rendered image. That is the next level of training: becoming expert in 3D part drawing techniques and simple XREF assemblies. Before heading into studying the principles of architectural, civil and mechanical design, our third area of concentration is in the fundamentals of programming. With our templates for constructing a successful sequence of code, any 2D or 3D part can be easily drawn in seconds after inputting answers for the variables. These programs are so easy to write that we teach code construction early.

Other manuals are available in these areas of study

Name of Manual	Time to learn
Residential Architecture	10 weeks
Commercial Architecture	10 weeks
Basic Mechanical Design	10 weeks
Basic Electrical Design	10 weeks
Basic Design Concepts (5 rapid design projects)	10 weeks
Mechanics	10 weeks
Visual AutoLISP Training Method	10 weeks
Visual Basic for AutoCAD	10 weeks
Civil Engineering	10 weeks
3D Animation	10 weeks

The basic courses in design are to teach the student what they need to know about designing and building products or structures. More advanced subjects allow the professional to look into complex areas of design and to determine whether they will be functional prior to production of the design.

With the addition of material to the construction of 3D parts and the insights into their action with the study of Finite Element Analysis, in the near future all designs will be entirely examined before the first real material is constructed.

Welcome to the program.

Charles Robbins

*** World Class CAD Challenge 02-00 * - Complete this textbook in 40 hours of classroom training. Pass your 2D Levels 1, 2 and 3 certifications to be ranked among the best in the world.**