

Chapter

1

The World Class CAD Mechanical Training Method

In this chapter, you will learn 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 like problems**
 - **Using training material where repetition and coaching improves drawing techniques and therefore quality**
 - **Using video gaming techniques of passing through levels or gates before learning new tools**
 - **Adding competition among the students to challenge them to the next level**
 - **Returning to a basic tool or concept that is now visually understood at a later time to add complexity**
 - **Guaranteeing success in like problems when finishing a training problem**
 - **Guaranteeing drawing speed that are a fraction of those trained by other methods**
 - **A high percentage of individuals (85%) that are able to achieve the World Class CAD standard**
 - **Provides continual training throughout one’s career**

Computer Aided Drafting (CAD) Start to Replace Drafting Boards

In the late 1970's, a few individuals volunteered for training in computer aided drafting and design at a major corporations which would replace 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 the newest of engineering technologies. Select groups of electrical and mechanical designers were instructed in basic drawing tools using lines, circle and arcs. The training methods developed were a continuation of post World War II drafting manuals which involve determining perimeter size, geometric erection of center points, centerlines and tangent points, and projection lines. Those of us in the initial startup had no trouble with association to pencil drawing since all of us had spent nearly a decade diagramming hundreds and in some cases thousands of detailed paper drawings. Those structured manuals explaining the precise methods of constructing intersections of lines and arcs were invaluable in the first ten years before more complex modifying tools such as Fillet, Extend and Trim made construction lines antiquated.

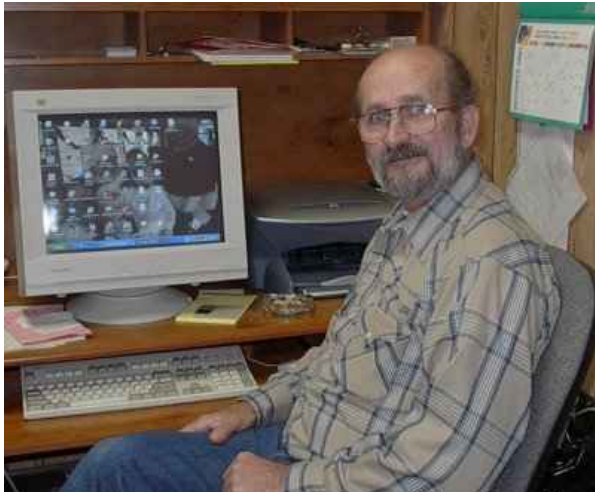


Figure 1.1 – A World Class CAD Expert

By the late 1980's, any instruction in board drafting methods using construction lines actually added a level of complexity to the detailing process and drawing times in many architectural and engineering departments continued to remain the same although CAD software companies like Autodesk were developing more powerful modification tools. By the late 1980's and throughout the 1990's, I removed from any curriculum all drafting board courses using older techniques. Whether retraining seasoned professionals or new talented college and high school students, the computer was the starting point.

The Creation of the CAD Training “Bible”

When I started to teach computer aided design as a department manager and later in college in the heart of the American industrial zone, new methods for utilizing all the power 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 no one since the late 1940's had developed an industry standard in instructing the complexity of the engineering orthographic drawing while guaranteeing the speed that is supposed to come with the software and hardware capability. Pick up any twenty-first century software training manual or CAD “bible”, since most of these books weigh a few pounds with nearly a thousand pages of instruction and you will find a small tolerance range of explanations covering every concocted scheme for drawing

a line, circle or arc. You see, when companies like Microsoft or Autodesk add another tool or capability to their revised software package, the software writer never removes the older tool or capability. Many trainers 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 like they were, (1940-s to 1970's style) will try to instruct their new pupil in many of these methods in the same week. Why? Who knows? When only the current drawing technique should be taught, these groups spend little to no time training the basics of the orthographic drawing technique which composes nearly 100% parallel and perpendicular lines for the Architectural industry and almost 100% curves and draft angles for the Engineering industry. Watching many trained professionals with multiple years of training from the regional colleges and academies, I have become shocked by the lack of detail knowledge of the basics in computer-aided design. The new method that is needed should ignore outdated techniques and concentrate on achieving the basic skills needed to efficiently create a new CAD drawing.

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 software development and training for fire controls systems such as the US Army Mortar Ballistic Computer (MBC), commanding and training US Armor M1 Tank companies, a decade and a half of industrial control engineering and 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 continuation of the twentieth century drafting manual.

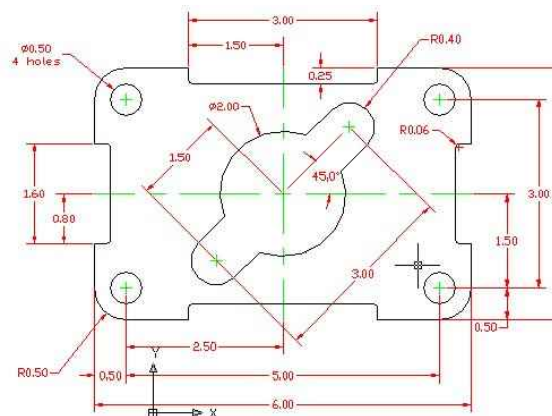


Figure 1.2 – The Rectangle Problem

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 like problems
3. Using training material where repetition and coaching improves drawing techniques and therefore quality
4. Using video gaming techniques of passing through levels or gates before learning new tools
5. Adding competition among the students to challenge them to the next level
6. Returning to a basic tool or concept that is now visually understood at a later time to add complexity
7. Guaranteeing success in like problems when finishing a training problem
8. Guaranteeing drawing speed that are a fraction of those trained by other methods

9. A high percentage of individuals (85%) that are able to achieve the World Class CAD standard
10. Provides continual training throughout one's career

Ever since the World Class CAD training method was developed in 1996, almost a thousand college graduates dominate an industry in the central United States where drawing speed and quality is vital.

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

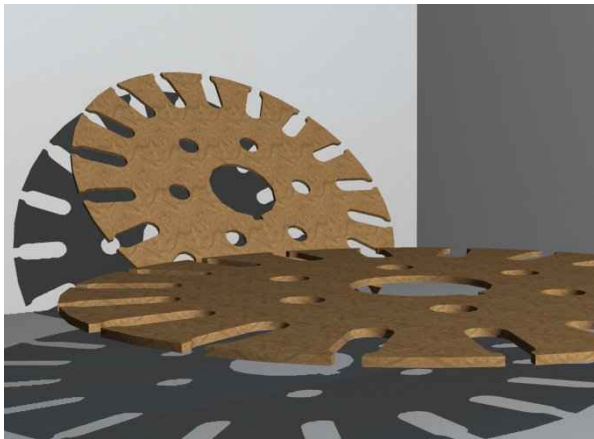


Figure 1.3 – The models of the Circular Problem displayed in a marketing image

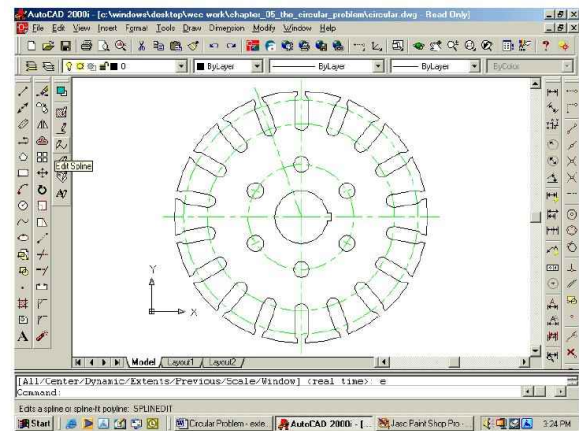
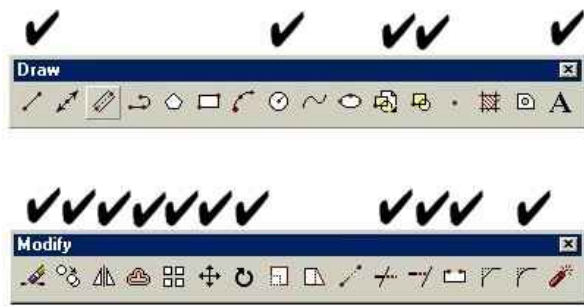


Figure 1.4 – The Circular Problem part drawing

Throughout one's schooling, energy is spent by the student practicing drills and learning the basics principles when many times that common sequence of processes is totally disconnected from any 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 the user, giving them the feeling of bewilderment. The units in this series of training manuals, starting with the Fundamentals of 2D Drawing, are put together with the goal of finishing a simple part drawing. It has been our experience in the last decade that the majority of the students comprehend the part drawings like the Rectangular or Circular Problem and nearly 100% 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. Comparing this capability where completing a single orthographic detail in a matter of minutes to many experienced degreed professionals and that is when this method of instruction starts to separate from the previous drafting board and software tool oriented training. Students know where they are going with commands like the Line, Circle or Move and train diligently to master them.



Many of the tools on a CAD programs' toolbar are either 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 use a tool once on a two or three year cycle. This usually obtains a comment in the professional office like "I just used the Ellipse Tool today". In figure 1.5, there are checks on the Draw and Modify toolbars showing the high payoff tools that are indispensable to the CAD drafter, designer or higher degreed professional.

Figure 1.5 – The Circular Problem part drawing

Grouping a Single Tool or Concept Together in a Logical Sequence for Like 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 confidence when the skill set is acquired, allowing the student to move ahead 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 to create a final product that can be used for similar architectural and engineering problems. For example, on the Rectangular Problem, the perimeter, which usually involves a closed set of lines, is initially drawn followed by the placement of centerlines. Immediately following, another set of lines are offset off 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 Training Material Where Repetition and Coaching Improves Drawing Techniques and Therefore Quality

In many architectural and engineering departments the quality of the drawing product is never reached because the CAD professional's drawing method is of little difference than 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 since creating a new batch of

drawings using new ideas takes an absorbent amount of time. This has been a problem for over a decade in two-dimensional drawing arena and now is reappearing in again in the construction of three-dimensional models. When a CAD drafter does not have full command of the basic tools, then that individual will return to a trial by error scheme of computer aided design, which is time consuming and usually contains many errors. But quality is achieved in the CAD department by understanding the basic software tools, quickly creating the detail, and then having the time to check and correct the drawing. Coaching the student through the World Class CAD problems causes one to practice a skill to the point that the professional no longer thinks about the menial tasks involved in drawing. So when the professional does not have to ponder the use of a software tool, they 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 Video Gaming Techniques of Passing Through Levels or Gates Before Learning New Tools

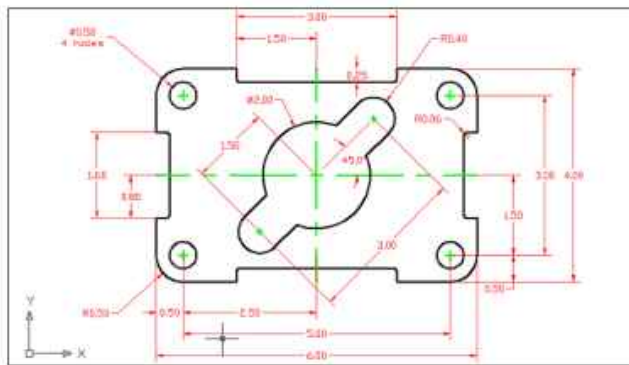


Figure 3.38 – Finished dimensioning the rectangular problem

* 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 involves mastering basic techniques in order to advance ahead in the quest to capture a prize and win the match. 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 one must make increasingly difficult deflections to defeat the level. 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 a roadblock is discovered, the individual can train primarily on the difficulty by returning to the specific page in the training manual for reinforcement.

When creating a pencil or pen drawing prior to computer drawing programs, times to complete the work was determined by drawing size, which were set to departmental standards such as:

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. For the last decade, my colleagues and I have used the 5 seconds per entity such as line segment, circle, arc, associated dimension or text to judge the appropriate 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.

Adding Competition Among the Students to Challenge Them to the Next Level



The results of the World Class CAD Challenge located at the end of a unit can be compared to other students and professionals' scores by posting them on the World Class CAD website. Drawing times and a copy of the computer file need to be submitted to the World Class CAD team. Your editing time and amount of errors will be calculated, and then the time and score will be posted on the Units' Results webpage. Having the ability to see your name, organization such as school or company, your score and time 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 that is Now Visually Understood at a Later Time to Add Complexity

You want to understand how to selectively Trim a line, arc or circle by selecting each cutting object instead of pressing Enter and having all of the entities operate as a cutting line. This is done in these training units. The next time you see one of your Drawing or Modifying tools

being shown in the instruction manual, the visual and written explanation is being presented for your next level of skill enhancement. That way the new concept and the associated sequence of events are present for the student to comprehend.

Guaranteeing Success in Like Problems when Finishing a Training Problem

In the Mechanical Design training manual, there are five major training objectives; design a part with extruded or rolled material, design a part from a casting, design a part with gears, design using pins and screws, and design with springs. At the conclusion of each major unit, 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 like designs and drawings. These should not be attempted until your instructor has approved your completion of the preceding major objective.

Guaranteeing Drawing Speed that are a fraction of those Trained by other Methods

All students of the World Class CAD method are fast drawers and designers. In many organizations in which I have been associated; there were only one or two designers that are 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 everyday they changed the problem since that would happen to the student once they entered their professional life, so they did not have time to practice the basics. I could not disagree more. Nearly one hundred percent of my graduates go to their professional employment and do the same type of drawing everyday and the ability to understand the basics of CAD are their ticket for success. As a college professor and lab instructor, I have had the majority of 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 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 2D part drawings, 3D models and part drawings, Assemblies and Programmer, operate above the 90 percentile of CAD drawers in their group.

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 those who were able to achieve success in the first three weeks of training. Many years we came close to meeting that goal of obtaining high levels of Design, Programming and CAD skills and providing a large market with highly trained junior engineers. Most of the younger students or 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 proceed to the next levels.

Provides Continual Training Throughout One's Career



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

We begin the World Class CAD training with the Fundamentals of 2D Drawing starting with the basics of orthographic drawing and dimensioning, but will proceed towards the highest level of engineering and architectural documentation. Since the 1990's, many companies are in demand of individuals with 3D drawing skills, where their customers want to see what the part or assembly will look like. That is our next level of training, as we become experts in 3D part drawing technique 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 Design Concepts (5 rapid design projects)	10 weeks
Machine Design (mechanics)	10 weeks
Visual Basic for AutoCAD	10 weeks
Civil Engineering	10 weeks
Finite Element Analysis	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 the product or dwelling. 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 part and the insights into their action with the study of Finite Element Analysis, in the future all designs will be entirely examined before the first real material is constructed.

Welcome to the program.

Charles Robbins

*** World Class CAD Challenge 08-00 * - Complete this textbook in 40 hours of classroom training. Pass your Mechanical Design Levels 1, 2 and 3 certifications to be ranked among the best in the world.**

