

**Subject Area** Technical Drawing/CAD **Grade Level** 9-12

**Mission Statement:** It is the mission of the Elba Central School District to actualize the phrase “Elba Equals Educational Excellence for Everyone.” We are committed to providing both quality and equity. Every student will have the opportunity to develop to the best of his/her ability.

**Elba Standards:** In addition to the knowledge and basic skills they need in order to participate in society, graduates of Elba Central School will develop:

1. Empowering skills: decision making, goal setting, creative thinking and problem solving abilities;
2. Communication and social interaction skills;
3. Technological literacy;
4. Total wellness (social, physical, emotional health and self-esteem);
5. The values necessary to participate in society.

As a result of achieving these outcomes, our students will embrace lifelong learning.

**New York State Standards:**

From Learning Standards for Mathematics, Science and Technology

Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

Standard 2: Students will access, generate, process, and transfer information using appropriate technologies.

Standard 5: Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.

Standard 6: Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.

Standard 7: Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.

**MODULE: *BASIC TECHNICAL DRAWING***

**B. Drawing Equipment**

1. Used by draftspersons (T-square, triangle, lead pointer, etc.)
2. Purpose of each item
3. Use

**C. Drawing Papers and Their Uses**

1. Drawing paper
2. Tracing paper (vellum)

**D. Drawing Pencils**

1. Types
2. Hardness/softness

3. How to sharpen

E. Alphabet of Lines

1. Definition

2. Purpose of each line (border, object, section, etc.)

3. Choosing the right pencil and constructing a line

F. Horizontal, Vertical, Inclined, Parallel, and Perpendicular Lines

1. Use of T-square in line construction

2. Use of triangle in line construction

3. Use of T-square with triangles in line construction

G. Types of Scales and Their Uses

1. How to read a scale

2. Architect's scale

3. Engineer's scale

4. Mechanical draftsman's scale

H. Construction of Circles and Irregular Curves

1. The Giant Bow Set

2. Compass

3. French curve

4. Circle templates

III. Lettering

A. Origin of Letters

3. The need for standardized lettering

C. Uniformity in Lettering

1. Line thickness

2. Line slant (vertical/inclined)

3. Uppercase and lowercase

4. Numbers and fractions

D. Pencil Technique

1. Choice of pencils

2. Sharpening for lettering

E. Guidelines

1. Purpose (horizontal, vertical)

2. Spacing of guidelines

3. Guideline devices (Ames Lettering Instrument)

F. Composing Letters, Numbers, Fractions, and Words

1. Width to height comparisons of letters/numbers

2. The stroke sequence

IV. Sketching

A. Purposes

1. Communicate through pictures

2. Formulate ideas

3. Provide flexibility/design changes

4. A graphic record

B. Sketching Equipment

1. Pencils

2. Paper
3. Erasers
- F. Sketching an Object
  1. Pictorial/oblique, isometric
  2. By visualizing a single view from an object

#### 1. Geometric Construction

##### A. Importance of Geometry in Technical Drawing

1. Identification and use of instruments
2. Methods of solving geometric problems
3. Accuracy in geometric constructions

##### B. Geometric Shapes in Technical Drawing

1. Points
2. Lines - straight, parallel, intersecting, perpendicular, skew, regular and irregular
3. curved Angles - acute, right, obtuse, straight, reflex, complementary, and supplementary
4. Circle and related parts - circumference, diameter, segment, tangent
5. Triangles - right, equilateral, isosceles, scalene
6. Quadrilaterals - square, rectangle, rhombus, trapezoid
7. Polygons - pentagon, hexagon, heptagon, octagon, nonagon, decagon, dodecagon
8. Regular solids - prisms, pyramids, cones, cylinders, and tetrahedrons
10. Related terms- frustum, truncation, altitude, axis, vertex, base, element

##### C. Solving Geometric Problems - Definition of Terms, Applications, Procedures for:

1. Bisecting a line
2. Dividing a line into equal segments
3. Transferring angles and shapes
4. Bisecting angles
5. Drawing triangles to given specifications
6. Circumscribing and inscribing polygons
7. Drawing an arc through three given points
8. Transferring of an arc distance to a straight line
9. Drawing a circle tangent to a line
10. Drawing a line tangent to a point on a circle
11. Drawing an arc tangent to two straight lines
12. Drawing an arc tangent to a line and arc
13. Drawing an arc tangent to two other arcs

#### V. One- and Two-View Drawings

##### A. Purpose of One- and Two-View Drawings

1. Simplicity
2. Elimination of duplication

##### B. Process of Visualization

1. Center lines
2. Hidden lines
3. Contours
4. Views that illustrate most detail

### C. Process of Implementing One- and Two-View Drawings

1. Drawing center lines
2. Drawing hidden lines
3. Drawing appropriate line weights

## VII. Three-View Drawings

### A. Purpose of Multi-View Drawings

### B. Process of Visualization and Implementation

#### 2. Drawing the visualized object

#### 3. "Glass box" method

### C. Planes of Projection in Multi-View

#### 1. Top view and dimensions (width and depth)

#### 2. Front view and dimensions (width and height)

#### 3. Right side view and dimensions (height and depth)

### D. Relationship of Views

#### 1. Proper placement

#### 2. Alignment

### E. Types of Lines

#### 1. Hidden lines

##### a. Purpose

##### b. Method of constructing dashes and spaces

##### c. Weight of line

#### 2. Center lines

##### a. Purpose

##### b. Method of constructing in views containing circles

##### c. Weight of line

#### 3. Visible/object lines

##### a. Purpose

##### b. Weight of line

#### 4. Construction lines

##### a. Purpose

##### b. Weight of line

## VI. Dimensioning

### A. ANSI Standard Dimensioning Practices

#### 1. Dimension lines used

#### 2. Dimension line weights

#### 3. Dimension placement

#### 4. Arrowheads

#### 5. Inch marks

#### 6. Dimension figures

#### 7. Dimension notes

### D. Specialized Dimensions

#### 1. Angles

#### 2. Arcs

#### 3. Fillets and rounds

4. Finish marks
5. Continuous curves
6. Mating parts

MODULE: *APPLICATIONS OF BASIC TECHNICAL DRAWING*

II. Sectioning

A. Purpose of Section Drawing

1. Preferred means of communicating an idea over a multi-view drawing
2. Process of visualizing sections

B. Understanding Special Terms

1. Cutting plane line
2. Direction of sight

3. Section lines

4. Break lines

5. Ribs/webs

C. Types of Sectional Views

1. Full section
2. Half section
3. Broken out section
4. Revolved section
5. Removed section (locating/labeling)
6. Rotated section
7. Ribs and spikes in section

D. Section Lines

1. Angle/direction
2. Weight of lines
3. Spacing

**CAD**

I. MODULE: *FUNDAMENTALS OF CAD*

Topics:

- A. Evolution of CAD and its Terminology
- B. Application of Computers for Design and Drafting
- C. Benefits, Careers, and Impact of Computer Aided Design

IV. MODULE: *DRAWING DEVELOPMENT AND EDITING*

Topics:

- A. Drawing Functions
- B. Editing Functions
- C. Display Control Functions
- D. Information Retrieval

V. MODULE: *CAD APPLICATIONS*

Topics:

- A. Technical Drawings
- B. Industrial Standards and Codes

- C. Dimensioning and Annotating Drawings
- D. Plotting Drawings

**National Standards:**

- Standard 1: Students will develop an understanding of the characteristics and scope of technology.
- Standard 2: Students will develop an understanding of the core concepts of technology.
- Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
- Standard 8: Students will develop an understanding of the attributes of design.
- Standard 9: Students will develop an understanding of engineering design.
- Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- Standard 11: Students will develop abilities to apply the design process.
- Standard 12: Students will develop abilities to use and maintain technological products and systems.
- Standard 13: Students will develop abilities to assess the impact of products and systems.

**Performance Indicators:**

- Demonstrate correct usage of drafting tools.
- Sketch and draw to scale objects using single view, multi-view, isometric, and oblique.
- Replicate drawings from examples, by hand and using AutoCAD.
- Measure objects for drawing using both the English and Metric Systems.

<b>Assessment:</b>	<b>Acceptable Performance Level</b>
Local Exams	70% or higher
Drawings	70% or higher

**Scope:** Students will get an introduction to the design and drafting occupations through class work and drawings. All drafting will be done in class. Students will learn the mathematical aspects of drafting. Visualization and communication of drawings will be stressed.

**Sequence:**

- A. Drafting
  - I. Sketching
    - a. Single View
    - b. Three-View
    - c. Isometric View
    - d. Oblique View
  - II. Basic Lines
    - a. Construction
    - b. Visible
    - c. Hidden

- d. Curves
- III. Lettering
  - a. Single-Stroke Vertical Letters
  - b. Single-Stroke Vertical Numbers
- IV. Equipment
  - a. Use and care of
    - 1. Pencils
    - 2. Eraser shield
    - 3. Dividers
    - 4. Compass
    - 5. T-Square
    - 6. Scales
    - 7. Templates
    - 8. Triangles
    - 9. Brush
- V. Measuring to 1/16"
- VI. Border and Title Block
- VII. Geometric Constructions
  - a. Dividing a Line
  - b. Bisecting Lines and Curves
  - c. Perpendicular Lines
  - d. Parallel Lines
  - e. Triangles
  - f. Circles
  - g. Tangent Lines
  - h. Tangent Arc
  - i. Polygons
  - j. Reduce or Enlarge a Drawing
- VIII. Multiview Drawing
- IX. Dimensioning
  - a. Dimension Lines
  - b. Extension Lines
  - c. Leader Lines
  - d. Arrows
  - e. Placement
- X. Isometric Drawing
- XI. Orthographic Drawing
- XII. Auxiliary Views
- XIII. Section Views
- B. AutoCAD
  - I. Icons & Toolbars
  - II. Model and Paper Space
  - III. Layers
  - IV. Color and Linetype
  - V. Basic Lines and Shapes
  - VI. Creating a Block

- VII. Fillets and Chamfers
- VIII. Dimensioning
- IX. Offset, Array, Rotate, Scale
- X. Multi-View Drawings
- XI. Isometric and Oblique

**Methodology:** 40% technical drafting (by hand) 50% AutoCAD drawing. 10% lecture and textbook learning.