

# **Glen Ridge Public Schools –Visual & Performing Arts Curriculum**



**Course Title:** CAD III

**Subject:** Visual and Performing Arts

**Grade Level:** 11-12

**Duration:** Full year

**Prerequisite:** CAD III

**Elective or Required:** Elective

## **Computer Science, Engineering, and Technology Mission Statement:**

Since computational thinking and problem solving are integral parts of our lives and 21st century learning, students must be actively involved in their Computer Science, Engineering, and Technology (CSET) education. The CSET curricula will emphasize thinking skills through a balance of computation, intuition, common sense, logic, design, analysis, and technology. Students will use a combination of technology and critical thinking to solve real-world problems. To achieve these goals, students will be taught a standards-based curriculum that is aligned with the New Jersey Curriculum Standards.

## **Course Description:**

Upon the successful completing of Computer Aided Design & Drawings I & II, students develop their knowledge and skill for careers in engineering, architecture, industrial design and construction. This is an advanced level course that continues the progression from previous CAD courses with an emphasis on engineering and architectural design. This experience will allow the students to be creative and explore new techniques while reinforcing CAD skills. Autodesk AutoCAD, Inventor, and Revit software will be utilized during this course.

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**Date Submitted:** Summer 2016



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## **Course Name**

CAD III

## **Topic/Unit:**

Review of CAD and Career Preparation

**Approximate # Of Weeks: 3-4 Weeks**

### **Essential Questions:**

- How do the rules of geometry affect a CAD drawing?
- Why should you use specific snap commands and dimensional constraints when controlling geometry in a drawing?
- How can geometric constraints be applied to increase efficiency in producing a drawing?
- What careers can one pursue with CAD experience, post High School and, post college?
- What skills are necessary to be successful in the work force?
- How does a portfolio help individuals obtain college acceptance and employment?

### **Upon completion of this unit students will be able to:**

- Understand the method of retrieving private files through the public network and have a positive approach to original design. (8.1.12.D.1)
- Draw and dimension 2D mechanical parts with increasing difficulty and apply shortcut functions in CAD. (8.2.12.C.5)
- Apply geometric concepts and constraints to advanced 2D drawings to solve technical problems. (M.G-MG.A.3)
- Demonstrate an understanding of mathematic principles as they relate to a CAD drawing. (M.G-MG.A.1)
- Use Boolean operations; extrude 2D drawing in to 3D models for the creation of a product. (8.2.12.D.3)
- Assess the advantages of mastering 2D CAD and 3D CAD systems in terms of skills and career paths. (9.2.12.C.3)
- Apply the design process in the creation of prototypes to solve real-life technical problems. (8.2.12.D.1)
- Apply good elements of design when creating products. (9.3.12.AR-VIS.2)
- Use arrays in the creation of objects with mutable incenses. (M.G-CO.A.5)
- Understand how CAD and 3D modeling plays a critical role in designing solutions for STEM-related careers. (9.3.ST.4)
- Design three-dimensional models that have both function and form. (9.3.12.AR-VIS.3)

### **Interdisciplinary Standards**

**Math**

- **M.G-CO.A.5:** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
- **M.G-MG.A.1:** Use geometric shapes, their measures, and their properties to describe objects.
- **M.G-MG.A.3:** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).\*

### **Technology**

- **8.1.12.D.1:** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
- **8.2.12.C.5:** Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
- **8.2.12.D.1:** Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
- **8.2.12.D.3:** Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

### **21<sup>st</sup> Century Life and Careers**

- **9.2.12.C.3:** Identify transferable career skills and design alternate career plans.

### **Career and Technical Education**

- **9.3.12.AR-VIS.2:** Analyze how the application of visual arts elements and principles of design communicate and express ideas.
- **9.3.12.AR-VIS.3:** Analyze and create two and three-dimensional visual art forms using various media.
- **9.3.ST.4:** Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

### **Activities:**

- Students will review procedures for creating a CAD drawing.
- Students will create a series of 2D CAD drawing related to the previous years' drawings.
- Students will dimension drawings for size, location and accuracy.
- Students will apply shortcuts and snap operations to enhance their skills and efficiency when producing a CAD drawing.

- Students will use geometric constraints when producing advanced two-dimensional drawings.
- Students will extrude two-dimensional drawings into three-dimensional models.

### **STEAM Activity:**

- Head Phone Stand: Design and create a headphone holder that has both form and function. It show allows for secure resting and while providing a high end design for the intended user. It must be made with the use of the 3D printer.
- Sports equipment: Re-design a sporting equipment to enhance the safety of the players. (e.i. Concussion proof helmet, shock-absorbing foot wear.)

### **Enrichment Activities:**

- Sample drawings for each assigned drawing will be used.
- Drawings will be use to enhance student's knowledge of CAD operations.
- Drawings should use layers for centerlines, hidden lines, extension lines and dimensioning.
- Sample real life objects will be used to that the students are drawing.
- Tessellation: Students will design an original tessellation. This drawing will use the circular array function.
- Discussion on college portfolios and applications. Specific items to include in them.

### **Methods of Assessments/Evaluation:**

- Quizzes on measuring, dividing and decimal equivalencies.
- Questions of the day. (Commands, careers & computer stations)
- AutoCAD drawing quiz, and vocabulary quiz.
- Peer evaluation of drawings.
- Assessment rubrics to ensure drawings meet the requirements specified.
- Students will be assessed on the accuracy and proper use of dimensions in their drawings.
- Students will complete assigned drawing by the determined due date.
- Students will keep a digital portfolio of their drawings.
- Students will make all necessary revisions for final flawless drawing to include in their digital portfolios.

### **Resources:**

- Digital handouts of 2D drawings references
- Textbooks: *Mechanical Drawing*, & *Technical Drawing*
- Computers with AutoCAD and Inventor installed
- Plotter/Printers
- 3D printer
- Projector and screen
- Calculator

- Rulers
- Calipers

**Online Resources:**

- Mr. Shohen's page: <http://www.glenridge.org/Page/3607>

Headphone Stand:

- <https://www.youtube.com/watch?v=j7ZwQa8vYnY>
- <http://www.tested.com/tech/accessories/1823-tips-to-make-your-own-awesome-headphone-stand/>
- <https://www.pinterest.com/pin/419538521512931785/>

## **Course Name**

CAD III

## **Topic/Unit:**

Advanced Mechanical Engineering

**Approximate # Of Weeks: 5-6 Weeks**

### **Essential Questions:**

- How has parametric modeling with advanced 3D software changed the drafting industries?
- Is there more than one way to set up a drawing?
- Is efficiency and speed more or less important than accuracy when creating 3D models?
- How can different techniques for assembly drawing be applied to increase efficiency?
- What kinds of object require an auxiliary view for surface representation?
- What are the advantages of creating multi-view and pictorial drawings when you can create three-dimensional models?
- How could a drawing with a minor error impact the manufacturing process?

### **Upon completion of this unit students will be able to:**

- Create complex three-dimensional objects and produce, multi-view, isometric, full and half section drawings and dimension them. (8.2.12.C.5)
- Draw advanced 3D solid models using revolves, sweeps, lofts and arrays to produce accurate representations of objects. (9.3.12.AR-VIS.3)
- Use parametric modeling software to transfer drawing from the textbook to the computer program. (8.2.12.D.3)
- Create industrial drawings for the manufacturing of a part or product. (9.3.MN.6)
- Build technical vocabulary by understanding key terms used in CAD and geometry. (M.G-MG.A.1)
- Design and manufacture a prototype of a product and provide a description of how the product could be manufactured. (8.2.12.D.1)
- Draw real life objects that can be full and half sectioned by using cut planes. (M.G-GMD.B.4)
- Draw real life technical objects that are on non-perpendicular angles. (9.3.MN.6)

### **Interdisciplinary Standards**

**Math**

- **M.G-GMD.B.4:** Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
- **M.G-MG.A.1:** Use geometric shapes, their measures, and their properties to describe objects.

### **Technology**

- **8.2.12.C.4:** Explain and identify interdependent systems and their functions.
- **8.2.12.C.5:** Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
- **8.2.12.D.1:** Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
- **8.2.12.D.3:** Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

### **Career and Technical Education**

- **9.3.12.AR-VIS.3:** Analyze and create two and three-dimensional visual art forms using various media.
- **9.3.MN.6:** Demonstrate workplace knowledge and skills common to manufacturing.

### **Activities:**

- Students will create a series of CAD drawings containing multi-views, isometric, full and half section, and auxiliary drawings
- Finish the sketch and extrude to a three dimensional object.
- Add concentric and linear holes by applying the hole tool.
- Students will use parametric modeling software to draw sectional vies of objects with increasing difficulties.
- Students will use parametric modeling software to draw auxiliary projections of objects with increasing difficulties.
- Multi-View CAD Drawings: Students will recreate multi-view drawings from a drafting textbook to include in their portfolio. Each drawing will be dimensioned using proper dimensioning rules.

### **STEAM Activities:**

- Aviation Design: The students will design detailed drawing of an aeronautic object using multi view projection and dimensioning.

- Chess Set: Use advanced techniques in Inventor to create a 3D chess set with a design theme. Use revolves, sweeps, lofts and mesh modeling to create the figures.

#### **Enrichment Activities:**

- Sample drawings for each assigned project and each assigned drawing.
- Sample real life objects for the students to draw.
- The Parametric Modeling text can be used for basic tutorials of how to draw advanced three- dimensional parts.
- Parts can be drawn from the Parametric Modeling Text or the Engineering Drawing and design Text.
- Each drawing should be dimensioned using proper dimensioning rules.
- Drawings should allow students to become efficient with the process of creating a 2D sketch and extruding the sketch to 3D.

#### **Methods of Assessments/Evaluation:**

- Applying parametric modeling for an original design.
- Quizzes on mechanical fasteners and standards.
- Assessment rubrics to ensure drawings meet the requirements specified.
- Students will be assessed on the accuracy and proper use of dimensions in their drawings.
- Students will complete assigned drawing by the determined due date.
- Students will keep a portfolio of their drawings.
- Students will make all necessary revisions for final flawless drawing to include in their digital portfolios.

#### **Resources:**

- Digital handouts of drawings and procedures.
- Parametric Modeling Textbook.
- Textbooks: *Mechanical Drafting*, *Technical Drawing: Engineering Drafting And Design*.
- Computers with AutoCAD and Inventor installed
- Plotter/Printers
- 3D printer
- Projector and screen
- Calculator
- Rulers
- Calipers

#### **Online Resources:**

- Mr. Shohen's page: <http://www.glenridge.org/Page/3607>

Chess Set:

- <https://www.youtube.com/watch?v=z7xv9bUXAVc>
- <https://www.youtube.com/watch?v=TiPN6NyfcsU>



## Course Name

CAD III

## Topic/Unit:

Geometric Dimensioning and Tolerance

**Approximate # Of Weeks: 1-2 Weeks**

### Essential Questions:

- What general guidelines must be followed when applying dimensions?
- How are manufactures and designers affected by the demission and tolerance methods?
- Is true position theoretically an exact location for finding features on a drawing?
- What would happen if dimensions were exact with no tolerance?
- How does dimensioning affect the cost of products?
- How can dimensioning and tolerance be applied to cases and packaging to reduce waste materials?

### Upon completion of this unit students will be able to:

- Create and extrude 3D mechanical sub-assemblies and assemblies with parts lists and dimensions. (8.2.12.C.5)
- Draw and assemble 3D solid models from several smaller parts by aligning planes mating surfaces and inserting shafts and hardware. (8.2.12.C.4)
- Import or create fasteners for mechanical assemblies. (9.3.12.AC-DES.8)
- Apply notes for type of hard ware and thread sizes. (9.3.MN.6)
- Create threads by using the coil cut command to create screws, bolts and mating nuts using the reverse coil cut command. (9.3.MN.6)
- Design and prototype products that use threads and coils. (8.2.12.D.3)
- Create sheet metal parts though the use of surface development. (M.G-MG.A.1)
- Assign materials to parts and create a materials list for exploded views of assemblies. (8.2.12.C.5)
- Produce mechanical motion and part interaction by creating surface contacts. (9.3.ST.1)
- Determine the amount of tolerance accumulation in a simple assembly. (M.G-MG.A.3)
- Communicate with peers to design an original mechanical device or re-create an existing mechanical device. (8.2.12.D.1)

### Interdisciplinary Standards

#### Math

- **M.G-MG.A.1:** Use geometric shapes, their measures, and their properties to describe objects.

- **M.G-MG.A.3:** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).★

### **Technology**

- **8.2.12.C.4:** Explain and identify interdependent systems and their functions.
- **8.2.12.C.5:** Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
- **8.2.12.D.1:** Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
- **8.2.12.D.3:** Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

### **Career and Technical Education**

- **9.3.12.AR-VIS.3:** Analyze and create two and three-dimensional visual art forms using various media.
- **9.3.12.AC-DES.8:** Apply standards, applications and restrictions pertaining to the selection and use of construction materials, components and assemblies in the project design.
- **9.3.MN.6:** Demonstrate workplace knowledge and skills common to manufacturing.
- **9.3.ST.1:** Apply engineering skills in a project that requires project management, process control and quality assurance.

### **Activities:**

- Students will create a series of CAD drawings containing multi-views, assemblies, and exploded views.
- Students will become acquainted with reading and understanding fasteners, materials, and standards as they relate to manufacturing of parts.
- Students will use modeling software to create advanced 3D parts of increasing difficulty with concern for geometric tolerance.
- Students will use 3D CAD to produce plastic mating parts for fabrication.
- Students will use 3D CAD to produce sheet metal parts and layouts.
- Students will create parts with threads using ANSI standards.

### **STEAM Activities:**

**Clock It:** Students will design a mechanical gear clock for the 3D printer or a 3D sculpture to add a clock inset or mechanical hand movement. Students will

focuses on creating parts with proper geometric tolerance to allow for interaction between other corresponding parts.

Wood Mechanical Assembly: As part of a team the students will choose a wooden mechanical device that can produce motion. The device can be recreated by using existing dimensions from a book or plan. The students will use 3D modeling software to draw parts individually to be assembled as a team. The final presentations should include orthographic views, an Isometric view, exploded assembled view with a parts list and an animation with a presentation of the working device. The device can be printed using the three-dimensional printer as a fully functional part or to be assembled using hardware.

### **Enrichment Activities:**

- The *Parametric Modeling* text can be used for basic tutorials of how to draw advanced three-dimensional parts using the boss feature command.
- Parts can be drawn from the *Parametric Modeling Text* or the *Engineering Drawing and Design Text*.
- Students can recreate parts from the *Parametric Modeling Text* or the *Engineering Drawing and Design text* to be assembled and include in their portfolio. Each drawing should be dimensioned and tolerances should be placed using proper dimensioning rules.
- 3D Modeling competition: See Synergis for current competition: <http://www.synergis.com/industries/education>
- Extreme Re-Design 3D printing Challenge: The students will re-design an existing product to enhance its capabilities. Students can also invent a new product.  
<http://www.stratasys.com/industries/education/extreme-redesign>

### **Methods of Assessments/Evaluation:**

- Assembly quiz, quizzes on terminology use assembly views, and questions from text.
- ANSI quiz on threads.
- Assessment rubrics to ensure drawings meet the requirements specified.
- Students will be assessed on the accuracy and proper use of dimensions in their drawings.
- Students will complete assigned drawing by the determined due date.
- Students will keep a portfolio of their drawings.
- Students will make all necessary revisions for final flawless drawing to include in their digital portfolios.

### **Resources:**

- Digital handouts of drawings and procedures.
- Parametric Modeling Textbook. *Parametric Modeling with Autodesk*

*Inventor*

- Textbooks: *Mechanical Drafting, Technical Drawing: Engineering Drafting And Design.*
- Computers with AutoCAD and Inventor installed
- Plotter/Printers
- 3D printer
- Projector and screen
- Calculator
- Rulers
- Calipers

**Online Resources:**

- Mr. Shohen's page: <http://www.glenridge.org/Page/3607>
- Clock:
- <https://www.youtube.com/watch?v=I9BgXWP1Jag>
  - <https://pinshape.com/items/1128-3d-printed-number-clock-frame>

## Course Name

CAD III

## Topic/Unit:

Advanced 3D Modeling & 3D Printing

### Approximate # Of Weeks: 7-8 Weeks

#### Essential Questions:

- Why skills are needed for designing advanced mechanical parts?
- How can a designed enhance their ability by using 3D modeling and 3D printing in the creation of mechanical parts and systems?
- How is redesigning during the manufacturing process improved with the use of history-based part modification?
- How do engineers use contact presentations to show the interactions between parts?
- How can 3D printed models be used as a prototypes and finished products?

#### Upon completion of this unit students will be able to:

- Use plans or design plans to create complex 3D moles for mechanical systems. (8.2.12.C.4)
- Export parts for the 3D printer and evaluate their interaction. (9.3.MN.6)
- Create products following guidelines for 3D modeling competitions. (8.2.12.D.3)
- Create parts with advanced features such as lofts, sweeps, coils, engraving, embossing and decaling. (9.3.12.AR-VIS.3)
- Create appropriate views, exploded views and a parts list for assembly drawings and produce balloons for individual parts for presentation purposes. (8.2.12.C.5)
- Demonstrate mathematics knowledge and skills required to produce a mechanical motion through an assembly working drawing. (M.G-MG.A.3)
- Develop and deliver a presentations using CAD software to engage and inform audiences. (9.3.ST.1)
- Work with a team to establish goal and set a timeline to complete the assigned drawings and project. (8.2.12.D.1)

#### Interdisciplinary Standards

##### Math

- **M.G-MG.A.3:** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).\*

##### Technology

- **8.2.12.C.5:** Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.

- **8.2.12.C.6:** Research an existing product, reverse engineer and redesign it to improve form and function.
- **8.2.12.D.1:** Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
- **8.2.12.D.3:** Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

### **Career and Technical Education**

- **9.3.12.AR-VIS.3:** Analyze and create two and three-dimensional visual art forms using various media.
- **9.3.ST.1:** Apply engineering skills in a project that requires project management, process control and quality assurance.
- **9.3.MN.6:** Demonstrate workplace knowledge and skills common to manufacturing.

### **Activities:**

- Students will work in groups to create an assembly working drawing of advanced mechanical devices with several motions.
- Students will use CAD software to assemble each part and create working drawings.
- Students will use CAD software to produce an exploded assembly view of the device. Each part should be numbered with balloons.
- Students will create a parts list on the final drawing.
- Students will test the operation of their device by using the contact solver.
- Students will present the drawing through animation of the working parts and a final print using the dimension three-dimensional printer.

### **STEAM Activities:**

- **Cam motion device:** Students will design a device that uses a cam or camshaft to create mechanical motion. (Example: Marble Mover with a cam or automata mechanical toy.)
- **Assembly Modeling:** As part of a team the students will choose a mechanical device that can produce several motions. Students can pre order advanced plans for this unit. Example drawings: Combination lock, Mechanical or cam toy, gear clock, marble mover, engine, bike or fishing reel. The device can be recreated by using calipers or existing dimensions from a textbook or plan. The students will use 3D modeling software to draw parts individually to be assembled as a team. The final presentations should include orthographic views, Sectional or auxiliary views, an Isometric view, exploded assembled view with a parts list and an animation with a presentation of the working device. The device can

- be printed using the three-dimensional printer as a fully functional part or to be assembled using hardware.
- Mechanical devices can incorporate an electric motor to show motion for the prototype.

**Enrichment Activities:**

- Sample drawings for each assigned project and each assigned drawing.
- Sample real life objects for the students to draw.
- Drawings should allow students to become familiar with assembling parts and creating presentation of animation and exploded views.
- Drawings should allow students to become familiar with the process of creating a mechanical part with motion
- Wind Turbine Parts: The students can use the parts drawn from the previous unit to be assembled in order to create a wind turbine. The wind turbines can be placed in a presentation in order show basic motion of parts.

**Methods of Assessments/Evaluation:**

- Practical quiz on mechanical assembly and contact solver using prepared components.
- Assessment rubrics to ensure drawings and projects meet the requirements specified.
- Students will be assessed on the accuracy and proper use of dimensions in their drawings analog with the creation of parts lists and balloons.
- Students will complete assigned drawing by the determined due date.
- Students will keep a portfolio of their drawings.
- Students will make all necessary revisions for final flawless drawing to include in their digital portfolios.

**Resources:**

- Digital handouts of drawings and procedures.
- Parametric Modeling Textbook. *Parametric Modeling with Autodesk Inventor*
- Textbooks: *Mechanical Drafting, Technical Drawing: Engineering Drafting And Design.*
- Computers with AutoCAD and Inventor installed
- Plotter/Printers
- 3D printer
- Projector and screen
- Calculator
- Rulers
- Calipers

**Online Resources:**

- Mr. Shohen's page: <http://www.glenridge.org/Page/3607>

Cam Devices:

- <https://www.youtube.com/watch?v=UAzyRKIT7I0>
- [https://www.youtube.com/watch?v=m\\_3qTO-e0bl](https://www.youtube.com/watch?v=m_3qTO-e0bl)
- <https://www.pinterest.com/pin/451626668861225448/>
- <http://www.mr-dt.com/graphics/camwheelcard.htm>

## **Course Name**

CAD III

## **Topic/Unit:**

Advanced Architecture & Survey Planning

**Approximate # Of Weeks: 9-10 Weeks**

### **Essential Questions:**

- How have modern CAD systems and the use of Building Information Modeling (BIM) allowed the client to be more influential in the design process of the building?
- How can an architect design the best possible plan for a client while following national and local building codes?
- How do modern architects design for specific spaces and client's needs while limiting materials and cost?
- Is it better to redesign existing spaces or rebuild existing spaces?
- What skills are necessary to be a professional surveyor?
- Why do you need a surveying drawing?
- Typical site plan drawings contain what features?
- What are the key items in an architectural portfolio?

### **Upon completion of this unit students will be able to:**

- Use an architectural designing program to draw and dimension a residential building from the foundation to the roof. (9.3.12.AC.2)
- Apply modern architectural 3D modeling equipment to design residential homes. (9.3.12.AC.6)
- Identify and draw local architectural styles and roof styles. (9.3.12.AC.4)
- Generate interior and exterior elevation drawings. (9.3.12.AC-DES.6)
- Construct a table for window and door schedules. (9.3.12.AC-CST.4)
- Draw an electrical schematic plan for a residential house. (9.3.12.AC.1)
- Create a ledger for the electrical schematic plan. (9.3.12.AC.1)
- Construct a plot and survey plan by manually entering in elevations. (M.G-MG.A.3)
- Import terrain from Google earth GPS elevations. (9.3.12.AC.2)
- Design spaces that allows for standard room appliances and furniture. (8.2.12.C.3)
- Follow local and national building codes when designing a residential floor plan. (9.3.12.AC-DES.4) & (9.3.12.AC.3)
- Import components into the plan from inside the program and from on line resources. (9.3.12.AC-DES.8)
- Create interior and exterior renderings of spaces. (9.3.12.AR-VIS.3)
- Develop an understanding of career opportunities in architecture by producing plans for architectural CAD competitions. (9.3.12.AC.7)
- Create structures and models of high craftsmanship for architectural

competitions. (9.3.12.AC-DES.7)

## **Interdisciplinary Standards**

### **Math**

- **M.G-MG.A.3:** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).\*

### **Technology**

- **8.2.12.C.3:** Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).

### **Career and Technical Education**

- **9.3.12.AC.1:** Use vocabulary, symbols and formulas common to architecture and construction.
- **9.3.12.AC.2:** Use architecture and construction skills to create and manage a project.
- **9.3.12.AC.3:** Comply with regulations and applicable codes to establish and manage a legal and safe workplace.
- **9.3.12.AC.4:** Evaluate the nature and scope of the Architecture & Construction Career Cluster and the role of architecture and construction in society and the economy.
- **9.3.12.AC.6:** Read, interpret and use technical drawings, documents and specifications to plan a project.
- **9.3.12.AC.7:** Describe career opportunities and means to achieve those opportunities in each of the Architecture & Construction Career Pathways.
- **9.3.12.AC-DES.4:** Apply building codes, laws and rules in the project design.
- **9.3.12.AC-DES.6:** Apply the techniques and skills of modern drafting, design, engineering and construction to projects.
- **9.3.12.AC-DES.7:** Employ appropriate representational media to communicate concepts and project design.
- **9.3.12.AC-DES.8:** Apply standards, applications and restrictions pertaining to the selection and use of construction materials, components and assemblies in the project design.
- **9.3.12.AR-VIS.3:** Analyze and create two and three-dimensional visual art forms using various media.

### **Activities:**

- Students will design and produce series of advanced architectural drawings.

- Students will complete exercises for developing design skills in architecture.
- Students will complete a bill of materials chart to determine the cost of lumber for their design.
- Students will construct a scale model following client or competition requirements.
- Students will complete classroom exercises on architectural details.
- Students will design residential structures for specific client needs.
- Students will redesign spaces for specific client needs.
- Students will design surveys and plot plans that follow clients and competition requirements.

### **STEAM Activity:**

- Green Architectural renovation: Given a basic residential model students will design and construct a scale model of “green” architectural renovation/additional feature to add to the house. Design and build a feature to make the home more energy efficient and reduce negative impacts on the environment.
- Scale Residential Model: Following rules from an architectural design competition, students will develop a set of architectural plans and related materials for an architectural design challenge and construct a physical, as well as a computer-generated model, to accurately depict their design.

### **Enrichment Activities:**

- Sample drawings for each assigned project and each assigned drawing.
- Sample model for the students to use as examples.
- Visual examples from past competition winners.
- Real life architectural plans may be shown to display working architectural drawings.
- Design a house showing – (floor plans, elevations, section views, detail views and window and door schedules).
- Design a one story restaurant with the following details: Entry, Reception area, Waiting area, Restrooms, Bar/lounge area (separate), Beverage area for wait staff, Dining room, Tables, chairs and/or booths, Kitchen, Food delivery area, Windows & doors.
- Designing an electrical schematic system for a house that shows switches, outlets, GFCI outlets, lighting, wire, smoke detectors, phone jacks and the power panel.
- Architecture competition: See Synergis for current competition: <http://www.synergis.com/industries/education>
- NJTSA competition: <http://njtsa.pages.tcnj.edu> for current competition.

### **Methods of Assessments/Evaluation:**

- Performance-based assessment on architectural standards as used in industry.
- Assessment on the creation of detailed drawings in the following areas:
  1. Foundation
  2. Footing and floor plan
  3. Electrical Plans and ledges.
  4. Kitchen Plans incorporating the work triangle
  5. Bathroom design following building codes for minimum distances.
  6. Detailed wall section with building materials
  7. Roof structure plan showing slope
  8. Elevations
  9. Building to be placed on Civil Engineering/Survey plot plan assignment.
  10. Detailed rooms
  11. Render drawing of building
- Quizzes —Architectural styles, Kitchens, Bathrooms and electrical codes.

**Resources:**

- Digital Handouts of drawings and procedures.
- Textbooks: *Architecture Residential Drafting and Design*
- Computers with AutoCAD, AutoCAD Architecture and Rivet installed
- Plotter/Printers
- 3D printer
- Projector and screen
- Calculator
- Rulers
- Foam core
- Balsa wood
- Modeling tools

**Online Resources:**

- Mr. Shohen's page: <http://www.glenridge.org/Page/3606>
- Revit City: <http://www.revitcity.com/index.php>
- Autodesk Seek: <http://seek.autodesk.com/>
- House Plans: <https://www.houseplans.com/>
- Bathroom Design Rules:  
[http://starcraftcustombuilders.com/bath.design.rules.htm#.V6t-iSMrK\\_E](http://starcraftcustombuilders.com/bath.design.rules.htm#.V6t-iSMrK_E)
- Kitchens Design and Codes:  
[http://starcraftcustombuilders.com/kitchen.design.rules.htm#.V6t-2CMrK\\_E](http://starcraftcustombuilders.com/kitchen.design.rules.htm#.V6t-2CMrK_E)

Foam Modeling:

- <https://www.pinterest.com/pin/188517934375114846/>
- <https://www.youtube.com/channel/UCb5TRJQQDUFDbIVYbTGvh8w>

TSA:

- [http://tsa.mountainview.groupfusion.net/modules/locker/files/get\\_group\\_file.phtml?gid=4786004&fid=29485514](http://tsa.mountainview.groupfusion.net/modules/locker/files/get_group_file.phtml?gid=4786004&fid=29485514)

Green architecture:

- <http://science.howstuffworks.com/engineering/structural/5-elements-of-green-architecture.htm>
- <http://architecture.about.com/od/greenconcepts/g/green.htm>

## **Course Name**

CAD III

## **Topic/Unit:**

Commercial & Structural Design

**Approximate # Of Weeks: 9-10 Weeks**

### **Essential Questions:**

- Is building with steel a valid alternative to conventional stick framing?
- What legal obligations must one consider when designing commercial and community spaces?
- How will the renovation and beatification of community-shared spaces positively impact the residents of the communities?
- What environmental, and size constraints do engineers face when design commercial structures?
- Why would planed structures never get built?
- How are public stadiums designed to maximize the experience for all patrons?

### **Upon completion of this unit students will be able to:**

- Apply design elements of for commercial architecture through conceptualization, planning and drawing structures. (M.G-MG.A.3).
- Implement a creative approach to designing architecture for public spaces. (9.3.12.AC.2) & (9.3.12.AC-DES.5)
- Design public spaces for clients' needs while adding their own influence to the structure. (9.3.12.AC-DES.3)
- Work independently to research, plan, and develop solutions for community and shared spaces. (9.3.12.AC-DES.8)
- Work cooperatively with a partner to design separate spaces that will later be attached in the completion of a larger project. (9.3.12.AC-DES.2)
- Draw, and dimension floor plans for community buildings. (9.3.12.AC.1)
- Use architectural software to generate exterior elevation drawings. (9.3.12.AC-DES.6)
- Use architectural software to generate renderings of walkthroughs. (9.3.12.AC-DES.7) & (9.3.12.AR-VIS.2)
- Create interior and exterior renderings of spaces. (9.3.12.AR-VIS.3)
- Complete a professional series of drawings to display buildings for clients. (9.3.12.AC.6)
- Create a Title page and Design Criteria, abbreviations & General Structural Notes page. (W.11-12.4)
- Develop an understanding of Green building materials and designing for environmental sustainability. (8.2.12.B.2)
- Research the LEED and design and create a "green" model of an architectural structure. (HS-ETS1-3)

## Interdisciplinary Standards

### Math

- **M.G-MG.A.3:** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).\*

### English Language Arts

- **W.11-12.4:** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

### Science

- **HS-ETS1-3:** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

### Technology

- **8.2.12.B.2:** Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.

### Career and Technical Education

- **9.3.12.AC.1:** Use vocabulary, symbols and formulas common to architecture and construction.
- **9.3.12.AC.2:** Use architecture and construction skills to create and manage a project.
- **9.3.12.AC.6:** Read, interpret and use technical drawings, documents and specifications to plan a project.
- **9.3.12.AC-DES.2:** Use effective communication skills and strategies (listening, speaking, reading, writing and graphic communications) to work with clients and colleagues.
- **9.3.12.AC-DES.3:** Describe the requirements of the integral systems that impact the design of buildings.
- **9.3.12.AC-DES. 5:** Identify the diversity of needs, values and social patterns in project design, including accessibility standards.
- **9.3.12.AC-DES.6:** Apply the techniques and skills of modern drafting, design, engineering and construction to projects.
- **9.3.12.AC-DES.7:** Employ appropriate representational media to communicate concepts and project design.

- **9.3.12.AC-DES.8:** Apply standards, applications and restrictions pertaining to the selection and use of construction materials, components and assemblies in the project design.
- **9.3.12.AR-VIS.2** Analyze how the application of visual arts elements and principles of design communicate and express ideas.
- **9.3.12.AR-VIS.3:** Analyze and create two and three-dimensional visual art forms using various media.

### **Activities:**

- Students will create a series of commercial & structural drawings using an architectural modeling program.
- Students will calculate loads and determine proper supports for the weight of the structure.
- Students will complete structural details exercises including renderings of interior and exterior spaces.
- Students will work independently and with partners to design structures with given client requirements.
- Students will create advanced survey drawings.
- Students will develop a model presentation with, drawings, renderings and a site plan.

### **STEAM Activities:**

- Leadership in Energy and Environmental Design (LEED): Students will demonstrate an understanding of green construction and develop an aptitude for architectural design in the development of plans, for sustainable design. Students will choose one commercial architecture project from the list below and create a “green” model of the structure.
- Green architecture may have many of these features:
  - Ventilation systems designed for efficient heating and cooling
  - Energy-efficient lighting and appliances
  - Water-saving plumbing fixtures
  - Landscapes planned to maximize passive solar energy
  - Alternate power sources such as solar power or wind power
  - Efficient use of space
  - Optimal location on the land, maximizing sunlight, winds, and natural sheltering

### **Enrichment Activities:**

- Convenience Store / Gas Station:
  - Outside:
  - Parking Area

- o Gas Pumps (6-10)
- o Gas signs
- o Inside:
- o Food and Beverage isles
- o Offices
- o Public restrooms (male and female) Handicapped stalls
- o 2 Exterior Exits
  
- Modern Condo: (Modern or Craftsman style)
  - o One car garage
  - o Basement with utilities
  - o 2 Bedrooms and 2.5 bathrooms
  - o Parking areas and walkways
  - o Exterior Lighting
  - o Trees and shrubs
  
- Community Center:
  - o Entry foyer
  - o Offices (2 or 3)
  - o Public restrooms
  - o Handicapped accessibility
  - o Party rooms (1 large banquet hall & 2 smaller party rooms)
  - o Dance Floor
  - o Gymnasium
  - o Lock rooms (male and female)
  - o Bathrooms & showers for each
  - o Official's locker room
  - o Game room
  - o Exercise room (with equipment)
  
- Stadium:
  - o Field of your choice
  - o Locker rooms for each team
  - o Stadium seating
  - o Parking lot
  - o Grand entrance
  - o Public restrooms (male and female) Handicapped stalls
  
- College Dorm:
  - o Entry foyer (Desk)
  - o Offices (2 or 3)
  - o Public restrooms
  - o Handicapped accessibility
  - o Game room
  - o Exercise room (with equipment)

- o Dorm suite (With bedrooms and living spaces)
- o Shared Kitchen and Bathroom

**Methods of Assessments/Evaluation:**

- Performance-based assessment on architectural standards as used in industry.
- Assessment on the creation of detailed drawings in the following areas:
  1. Floor plans properly dimensioned exterior walls
  2. Room tags filled in correctly
  3. Elevations produced
  4. Detailed wall section with specifications of materials
  5. Roof structure plan showing slope
  6. Survey and plot with specified exterior elements
  7. Detailed rooms with furnishings and fixtures
  8. Render drawing of building interior and exterior spaces.
- Quizzes — General knowledge quiz on structural vocabulary.

**Resources:**

- Digital Handouts of drawings and procedures.
- Textbooks: *Architecture Residential Drafting and Design*
- Computers with AutoCAD, AutoCAD Architecture and Rivet installed
- Plotter/Printers
- 3D printer
- Projector and screen
- Calculator
- Rulers
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- Autodesk Seek: <http://seek.autodesk.com/>
- House Plans: <https://www.houseplans.com/>
- LEED/Green
  - <http://www.leed.net/>
  - [http://www.greenhomebuilding.com/sustainable\\_architecture.htm](http://www.greenhomebuilding.com/sustainable_architecture.htm)
  - [http://curriculum.autodesk.com/student/public/Level2/overview/project\\_id/19](http://curriculum.autodesk.com/student/public/Level2/overview/project_id/19)
- Title Sheet
  - <http://www.nist.gov/el/nzertf/upload/NZERTF-Architectural-Plans1-June2011.pdf>
- Green Condo

- <http://www.gerdingedlen.com/ge-news/press-releases/article/controller/News/action/detail/item/the-casey-is-the-nations-first-leed-platinum-high-rise-condominium/>

#### LEED Stadium

- <http://www.levisstadium.com/2014/07/stadium-becomes-first-us-venue-kind-earn-leed-gold-certification/>