CONSTRUCTION TECHNOLOGIES
46.0400.20
EMBEDDED MATH CROSSWALK

The Construction Technologies program has been recognized by the Arizona State Board of Career and Technical Education (CTE) as being eligible for consideration by local governing boards to grant 1 credit of 4th-year high school math. This document is the result of a committee analysis completed in 2019.

Construction Standards	Math Standards	Reasoning/Rationale
STANDARD 1.0 MAINTAIN A SAFE WORK ENVIRONMENT [in accordance with OSHA (Occupational Safety and Health Administration)]		
1.1 Explain the content and the purpose of SDSs (Safety Data Sheets)		
1.2 Use basic PPE (Protective Equipment) appropriate for the job (i.e., safety goggles, hard hats, gloves, safety vests, work boots, etc.)		
1.3 Explain types of fires and the appropriate use of fire extinguishers		
1.4 Maintain worksite safety and housekeeping (i.e., lighting, safety, etc.), including a safety plan for emergency situations		
1.5 Describe situations requiring first-aid and emergency care; Apply basic first-aid techniques		
1.6 Practice appropriate procedures for lifting heavy objects		
1.7 Recognize common fall hazards and employer requirements to protect workers from falls	**G.G-SRT.C.7** Explain and use the relationship between the sine and cosine of complementary angles.	Length of the ladder to keep a safe angle from the wall Pythagorean theorem and ratios
1.8 Recognize caught-in or caught-between hazards and employer requirements to protect workers from caught-in or caught-between hazards		
1.9 Demonstrate safe work procedures around electrical hazards		
1.10 Recognize correct procedures for lockout/tagout		
1.11 Identify procedures for reporting safety hazards		
Construction Standards		**Reasoning/Rationale**
STANDARD 2.0 RECOGNIZE HAND AND POWER TOOLS AND EQUIPMENT		
2.1 Identify and inspect hand tools		
2.2 Identify and inspect portable power tools, powder-actuated tools, pneumatic tools, and extension cords		

Standards used in Crosswalk: ADE CTE Construction Technologies revised in 2020 and Math revised in 2016.

2.3 Refer to user manuals and manufacturer's guidelines for how to use and maintain hand and power tools and equipment		
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 3.0 USE APPLIED MATHEMATICS AND MEASUREMENTS		
3.1 Perform measurements (e.g., read tape measure to 1/16" and convert from tenths of a foot to feet and inches)	**G.G-SRT.A.1** Verify experimentally the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	Using scale factor and dilation to connect measurement
3.2 Explain conversion from metric to imperial (e.g., length, area, volume, and mass)	**G.G-GMD.A.1** Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.	Use volume formulas to calculate conversions. i.e. ft^3 – yd^3
3.3 Perform calculations (e.g., add and subtract fractions in feet and inches and convert fractions to decimals and decimals to fractions)		
Construction Standards		**Reasoning/Rationale**
4.1 Identify terms relating to plans and drawings (i.e., O.C., ",', Scale, AFF, WxHxL, DISP, DW, WD, etc.)		
4.2 Identify symbols relating to plans and drawings [i.e., single gang receptacle, single pole switch, 2x4 studs, 2x6 studs), line types (i.e., extension, cut, dimension, etc.)]		
4.3 Identify plans and drawings scales (i.e., ½"=1'.0", ¾"=1".0", N.T.S., etc.)	**G.G-SRT.A.1** Verify experimentally the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	Use scale factors from blueprints to the actual building
4.4 Recognize notes and material schedules [(i.e., key notes, GSN (General Structural Notes), etc.]		
4.5 Relate information on plans and drawings to actual locations	**G.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data	Interpreting plans (shape) to actual locations (transformations and origins)

	displays, include utilizing real-world context.	
4.6 Identify and use drawing dimensions		
4.7 Explain the importance of and resources for building codes (i.e., National Electric Code, IBC, Plumbing Code, state/county/city codes, etc.)		
4.8 Describe types of technology used in construction management (i.e., smartphones and mobile apps to drones and robots, etc.)		
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 5.0 RECOGNIZE SITE AND BUILDING LAYOUT		
5.1 Describe the use and care of standard measuring instruments (i.e., tape measure, laser, total station, builder's level, Theodolite, etc.)	Nd.	
5.2 Explain building lines and recognize trade-specific layout	**G.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays, include utilizing real-world context.	Interpreting plans (shape) to actual locations (transformations and origins)
5.3 Explain a builder's level or transit and differential leveling procedures to determine site and building elevations	**A1.A-REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	Use x = HI – FS at X then use the next control potion and repeat the process.
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 6.0 PERFORM MASONRY WORK		
6.1 Describe basic masonry units [i.e., concrete masonry unit, Bond Beam concrete masonry unit, Rebar, Mortar, Grout, etc.]	**G.G-GMD.A.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems utilizing real-world context.	Use a formula to mix mortar and grout to specific tolerances
6.2 Describe the components/accessories of a masonry wall (i.e., wall ties, horizontal ladders, rebar positioners, etc.)		
6.3 Describe the components of mortar and grout and how to properly mix mortar and grout	**QR.CR.2** Compare, reason and communicate about proportional and non-proportional models utilizing real-world contexts.	Communicate proportional reasoning for the ratio of H_2O, sand, and partial cement
6.4 Demonstrate proper use of tools for masonry (e.g., trowel, sled runner, soft brush, brick hammer, tape measure, mason line, line block, line trigs, marking crayons, chalk line, mason level, margin trowel, wire cutters, sharpie, saw wrench, construction calculator, folding rule, and saw)		

Standards used in Crosswalk: ADE CTE Construction Technologies revised in 2020 and Math revised in 2016.

6.5 Use a level to evaluate masonry work	**G.G-CO.C.9** Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	Using parallel and perpendicular lines.
6.6 Lay brick/block to specification		
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 7.0 LAY OUT AND INSTALL FLOOR AND CEILING FRAMING		
7.1 Identify components of floor systems (i.e., wood, steel metal deck, etc.)		
7.2 Explain ceiling components and accessories for a frame building		
7.3 Describe the procedure for setting posts	**G.G-CO.C.9** Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	Using parallel and perpendicular lines to set posts
7.4 Describe the correct fasteners used in construction of floor systems		
7.5 Calculate the amount of material needed to frame a floor assembly	**QR.FR.2** Understand and apply strategies to monitor income and expenses, plan for spending, implement a diversified investment strategy, and save for future goals.	Apply strategies to monitor expenses and plan for spending

7.6 Lay out and construct floor systems		
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 8.0 DEMONSTRATE WALL FRAMING		
8.1 Lay out wall lines including plates, corner posts, door and window openings, pony/half wall, partition Ts, bracing, and fire stops	**G.G-CO.C.9** Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	Using parallel and perpendicular lines
8.2 Assemble wood and metal stud walls	**G.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.	Cuts are cross-sections of different 3-D shapes
8.3 Assemble, erect, and brace exterior walls for a frame building	**G.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.	Cuts are cross-sections of different 3-D shapes
8.4 Calculate the materials required to frame walls	**QR.NR.4** Use and justify estimation skills, and know why, how, and when to estimate results. Assess and justify the reasonableness of estimations using the context and comparisons to other known values. **QR.FR.2** Understand and apply strategies to monitor income and expenses, plan for spending, implement a diversified investment strategy, and save for future goals.	Estimating and planning for spending
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 9.0 DEFINE ROOF FRAME AND FINISH		
9.1 Recognize components of roof framing and finishing (i.e., crickets, scuppers, penetrations, truss, flashing, vents, etc.)	**G.G-CO.D.13** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle; with a variety of tools and methods.	Using speed-square, and tri-square to measure angles
9.2 Recognize types and styles of sheathing and coverings (i.e., flat, tile, shingles, etc.)		
9.3 Illustrate a roof opening		
9.4 Define parapet		

9.5 Estimate the materials used in framing and sheathing a roof (i.e., spans, materials, sizing, etc.)	**QR.NR.4** Use and justify estimation skills, and know why, how, and when to estimate results. Assess and justify the reasonableness of estimations using the context and comparisons to other known values.	Use and justify estimating skills
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 10.0 IDENTIFY ENVIRONMENTAL COMPONENTS IN BUILDING ENVELOPE AND OCCUPIED SPACES		
10.1 Identify types and use of thermal insulation, vapor barriers, R-values, and U-values	**A2.F-BF.B.4** Find inverse functions. a. Understand that an inverse function can be obtained by expressing the dependent variable of one function as the independent variable of another, recognizing that functions f and g are inverse functions if and only if f(x) = y and g(y) = x for all values of x in the domain of f and all values of y in the domain of g. b. Understand that if a function contains a point (a, b), then the graph of the inverse relation of the function contains the point (b, a). c. Interpret the meaning of and relationship between a function and its inverse utilizing real-world context.	R from u regarding thermal transfer is an inverse relation.
10.2 Describe the function of an HVAC system		
10.3 Describe various types of energy efficient systems [e.g., solar electricity, solar water heating, cocoon insulation systems, gray water systems, turbines, economization, VRF (Variable Refrigerant Flow), and multi-speed and variable speed motors]		
10.4 Identify conditioned occupied spaces and explain how they relate to overall building performance and energy efficiency		
10.5 Describe the purpose and components of door and window systems Note: In this document i.e. explains or clarifies the content and e.g. provides examples of the content that must be taught		
10.6 Describe correct installation methods to eliminate water intrusion and heat transfer (i.e., flashing, caulking, insulated door, weather stripping, thermally broken windows, relief vents, etc.)		

Construction Standards	Math Standards	Reasoning/Rationale
STANDARD 11.0 APPLY EXTERIOR FINISHES		
11.1 Identify frieze boards or soffit		
11.2 Identify exterior moldings and trim		
11.3 Identify various types of siding		
11.4 Explain installation of various finishes (i.e., stucco, siding, soffits, wainscot, etc.)	**G.G-GMD.A.1** Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.	Use a formula to determine the amount of stucco used
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 12.0 APPLY INTERIOR TRIM AND STAIRS		
12.1 Determine the number and sizes of risers and treads required for a stairway		
12.2 Build a small stair unit	**A1.F-LE.B.5** Interpret the parameters in a linear or exponential function with integer exponents utilizing real world context.	Trend and rise Horizontal and vertical change in stairs (slope) pitch
12.3 Explain and identify types of millwork (i.e., cabinets, moldings, casings, baseboards, etc.)		
Construction Standards	**Math Standards**	**Reasoning/Rationale**
STANDARD 13.0 ASSEMBLE PIPING, WASTE, AND VENT DISTRIBUTION SYSTEMS		
13.1 Identify the major components of a drainage and water distribution system		
13.2 Assemble a soil, waste, and vent system		
13.3 Assemble a water distribution system		
13.4 Explain the function of plumbing fixtures and equipment (i.e., boilers, water heaters, etc.)		
13.5 Measure, cut, and join plastic and copper piping	**G.G-GMD.A.1** Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.	Circles, circumference, etc.
13.6 Describe the functions of a drainage and water distribution system and how they may malfunction		
13.7 Identify how an efficient system affects water usage	**A1.A-REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	Use linear formula (slope is water per flush)

Construction Standards	Math Standards	Reasoning/Rationale
STANDARD 14.0 INSTALL ELECTRICAL COMPONENT/SYSTEM(S)		
14.1 Recognize basic electrical theory [i.e., Ohm's law (the relationship among voltage resistance and amperage in a circuit), etc.]	**A1.A-CED.A.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R. **A2.F-BF.B.4** Find inverse functions. a. Understand that an inverse function can be obtained by expressing the dependent variable of one function as the independent variable of another, recognizing that functions f and g are inverse functions if and only if f(x) = y and g(y) = x for all values of x in the domain of f and all values of y in the domain of g. b. Understand that if a function contains a point (a, b), then the graph of the inverse relation of the function contains the point (b, a). c. Interpret the meaning of and relationship between a function and its inverse utilizing real-world context.	Can rearrange Ohm's Law to solve for unknown variables The inverse function of Ohm's Law
14.2 Reference the NFPA 70E standards (i.e., minimum approach distance, arc flash boundaries, lockout/tagout, appropriate PPE, etc.)		
14.3 Identify materials (i.e., enclosures, wiring systems, devices, overcurrent protection, raceways, etc.)		
14.4 Rough in electrical enclosures (e.g., switch boxes, outlet boxes, conduit fabrication, wire pulling, raceway, and box capacity) and cable	**A2.F-TF.B.5** Create and interpret sine, cosine and tangent functions that model periodic phenomena with specified amplitude, frequency, and midline.	Using trig functions to determine the distance of conduit and angles for materials being used
14.5 Define conductor properties (e.g., aluminum, copper, conductor sizing, and insulation types)		
14.6 Demonstrate the termination of electrical devices, appliances, light fixtures (luminaires), and ceiling fans		
14.7 Recognize various types of electrical systems (i.e., three-phase, single-phase, medium voltage, line voltage, low voltage, etc.)		

Construction Standards	Math Standards	Reasoning/Rationale
STANDARD 15.0 INSTALL INTERIOR WALL AND CEILING FINISH		
15.1 Identify types of wall and ceiling finishes [i.e., drywall, ACT (Acoustical Ceiling Tile), etc.]		
15.2 Identify finishing tools (i.e., hand trowel, silica, sanders, screw guns, etc.)		
15.3 Recognize the proper techniques for handling, staging, storing, and cutting drywall and drywall materials (i.e., silica awareness, etc.)		
15.4 Fasten drywall to walls (i.e., screws, nails, etc.)	**G.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.	Make 3D cuts and 2D cross sections to figure out the area and materials
15.5 Demonstrate proper finishing techniques (i.e., apply joint compound, use tape/mesh appropriately, install corner bead, etc.)	**G.G-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context.	Drywall and join compound
15.6 Demonstrate proper material use and methods of paint application	**G.G-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context.	To find the total paint

Construction Standards	Math Standards	Reasoning/Rationale
STANDARD 16.0 PERFORM CONCRETE WORK		
16.1 Review the history and uses of concrete and tools (i.e., footings, flatwork, post-tensions, walls, tilt-ups, bull float, darby float, etc.)		
16.2 Describe the components of concrete (i.e., formwork, aggregates, grading, rebar, wire mesh, admixtures, compressive strength, slump, etc.)		
16.3 Describe types of finishes (i.e., broom, troweled, stamped, mag, etc.)		
16.4 Prepare, place, and finish concrete	**G.G-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context. **G.G-GMD.A.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems utilizing real-world context.	Construct the form in various geometric shapes Use formulas