



**CREATE \* DESIGN \* Build!**

*(formerly known as Accessory Structure Project)*

## Create-Design-Build Project Summary

NEF's newest program and next generation to the NEF Shed Project. This program is a cross-curriculum team project that promotes awareness of the construction industry. It was written by and has been pilot tested by teachers with positive results.

Following are some items of interest about the program:

- Designed for grades 8-12 and perfect for 9th and 10th grade students.
- Engages the student in a construction oriented project and provides additional opportunities to improve and reinforce math and English skills.
- Promotes leadership and teamwork while giving a taste of construction trades including engineering, design and architecture.
- Teaches budgeting and time management skills while also teaching and improving research skills.
- Meets California Standards and can be mapped to meet other state's requirements.

More information regarding the project:

- Teachers to provide supplies for the entire program including card stock paper, straight pins, utility knife, glue stick, ruler. The book can be passed on each year and the teacher can replenish the supplies.
- The project duration is 10-12 classroom hours.
- Teams typically consist of 3 students working together on the project where they create their company identity, design their logo for business cards and stationery, write proposals and letters to customers, and design then build a mock up of the project they contracted to complete.
- The project is targeted for general study and technical schools as well as home school or virtual classroom settings. This also has possibilities for youth programs in general including Scouting programs and badges.

This is an opportunity for NAWIC chapters or members to sponsor the program for the workforce of tomorrow. Seriously consider supporting a local teacher or schools in making this program a reality for high school students in your community.

## **Create - Design - Build!**

You are a design-build contractor. Your company is submitting a bid to your client to design and build a nonresidential accessory project for their back yard. The structure should not exceed 120 – 180 square feet for the site provided. The total cost of the structure must not exceed \$20,000.

### **Project Deliverables:**

- 1) Floor Plan
- 2) Elevations: North, South, East and West at  $\frac{1}{2}$ " = 1'-0"
- 3) Quantity Take-off
- 4) Project Cost Worksheet
- 5) Site Plan/Layout
- 6) Business Letter and Business Cards establishing your company's name and logo
- 7) Scale Model at  $\frac{1}{2}$ " = 1'-0"

You will form design-build contracting companies of 3 people. You will choose a company name and create business cards. Determine your company philosophy and what type of structure will meet the needs of your client. Then you will write a business letter stating your intent to bid on the job and the service you will provide.

Your company will design the accessory structure based on the needs of the client and the building ordinances for the site provided. You will provide your client with the above deliverables.



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Authors: NAWIC Education Foundation, Jessica Frichtel & Tim Bingham

“Experiential Learning Opportunity”

National Center for Construction Education & Research.

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## **In Memory**

**Susan W. Carson, CIT**

~ The ultimate volunteer in cultivating career opportunities  
for high school students in the construction industry ~

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## FOREWORD

The National Association of Women in Construction (NAWIC) originally began as Women in Construction of Fort Worth, Texas. It was founded in 1953 by 16 women working in the construction industry. Knowing that women represented only a small fraction of the construction industry, the founders organized NAWIC to create a support network. Women in Construction of Fort Worth were so successful that it gained its national charter in 1955 and became the National Association of Women in Construction.

NAWIC has a membership of more than 4,500 and approximately 167 chapters, with chapters in almost every U.S. state. Since 1996, NAWIC has seen its Core Purpose grow worldwide and has International Affiliation Agreements with the Canadian Association of Women in Construction, NAWIC-Australia, NAWIC-New Zealand, NAWIC-United Kingdom and South African Women in Construction. In NAWIC's 55 years of service to its membership, NAWIC has advanced the causes of all women in construction, from tradeswomen to business owners.

Since its founding, the NAWIC Founders' Scholarship Foundation (NFSF) and NAWIC chapters nationwide have awarded more than \$4 million in scholarships to students pursuing construction-related studies.

For more than 30 years, the NAWIC Education Foundation (NEF) has offered creative and educational programs for students from grade school to high school. NEF's award-winning Block-Kids program, Building Design program and the Design Drafting competitions introduce students to careers and opportunities in construction. NEF also offers continuing education courses, which include certifications: Construction Bookkeeping Technician (CBT), Construction Document Technician (CDT), Construction Industry Specialis (CIS), Construction Industry Technician (CIT) and Estimating & Scheduling Practitioner (ESP). Other courses are offered through NEF at [www.nef-edu.org](http://www.nef-edu.org).

NEF is an IRS 501(c) (3) non-profit organization, which means all donations are deductible as a charitable donation. The Board of Trustees governs the Foundation.

Since its inception, NEF has focused on construction education and offers a number of certification programs in partnership with Clemson University. NEF is proud to be named a Quality Education Provider by the American Council for Construction Education (ACCE).

The NEF Executive Office is located in Orlando, FL.

The *Block-Kids Building Program* is a national building program competition that is sponsored on the local level by NAWIC chapters and other organizations. The award-winning program introduces children to the construction industry in an effort to create an awareness of and to promote an interest in future careers in one of the many facets of the industry. The program is open to all elementary school children in grades 1-6. The competition involves the construction of various structures with interlocking blocks and three of the following additional items: a small rock, string, foil and poster board. Local winners advance to Regional Competition and one semi-finalist from each region is entered in the National Program competitions. National prizes are awarded to the top three projects.

The Design Drafting Competition is a contest designed for senior high students. The contest provides recognition to students for creative design, successful problem solving and craftsmanship in preparing architectural drawings. Entries are evaluated for detail, accuracy and originality of work.

Objectives of the contest are to introduce the student to the construction industry in a positive and challenging manner, while fostering a sense of self-worth and building confidence. Mentoring programs between students and educators are also encouraged. Each local sponsor is furnished with a "Design Problem" that is designed by a licensed Architect or Engineer and is generic enough to meet the needs of all areas of the US and our international affiliates. Project drawings must include a minimum: a floor plan, exterior elevation and site plan and placement of structure. National winners receive prizes.

NEF launched a third K-12 program – *Building Design*. As with all our programs, NEF seeks structural platforms that are structured to introduce construction in a positive and fun manner, while presenting challenges in math, science and design. The Scale-Model Building Program is for students at the junior high/middle school level. This team building project may be offered during the school year and will involve constructing a structure from architectural drawings.

The NEF *Shed Project* is part of the versatile NEF *Building Design* Program and can easily be incorporated by Technology Education and Trade and Industrial Education instructors into their current curricula and was brought to the foundation by NAWIC Chapter Richmond #141.

The second edition, *Accessory Structure Project*, was written in collaboration with NEF, Jessica Frichtel, a high school English teacher at Kearny Construction Tech Academy in San Diego, CA and Tim Bingham, the Civil Engineering and Architecture Instructor at Construction Tech Academy. This program is a cross curricular team project that promotes awareness of the construction industry.



## Curriculum Writers



### Jessica Frichtel

Ms. Frichtel has been teaching middle and high school for eleven years in San Diego Unified. She has a Masters in Education and actively works on professional development to stay current. Ms. Frichtel teaches 9th grade English, CAHSEE Support, and a Credit Recovery class for 11<sup>th</sup> and 12<sup>th</sup> graders at Construction Tech Academy. She serves as Co-Team Lead for 9th grade, Advisor for Ladies of CTA, and English Dept. Chair.

Among her accomplishments, Ms. Frichtel has been featured in teaching videos titled “Strategic Thinking” by Stenhouse Publishers and in a chapter in Heather Lattimer’s book *Thinking Through Genre* for her Editorial Unit of Study. Her collaboration with NAWIC earned her an award as Executive of the Year in 2009.

According to Glenn Hillegas, Executive Vice President of Associated General Contractors, “Ms. Frichtel is able to bring soft skills demanded by industry, such as the allocation of resources, project planning, time management, and teamwork skills into the classroom while maintaining a balance of academic rigor focused on standards-based instruction.” Ms. Frichtel was selected as one of the Top Ten Finalists from 26,000 teachers in the 2010 – 2011 San Diego County Teachers of the Year.

### Tim Bingham



Mr. Bingham holds a Bachelor of Architecture degree from the University of Miami and has over 15 years experience working in the architecture field. Prior to graduation from college, he worked for several design-oriented architectural firms in central and southeast coastal Florida. He is actively involved with the Alumni Association of his fraternity Phi Delta Theta and the American Institute of Architects.

After graduation in 1998, Mr. Bingham relocated to San Diego and became the Associate Director of Design with 4 Design Architecture and Planning in Oceanside, California. With a strong understanding of traditional and modern architectural styles, he utilized an open-minded studio design approach, and designed and developed community-oriented projects for the firm.

Mr. Bingham led the design development and planning process on the firm’s most notable mixed-use and multi-family residential projects during his 11 years with the company. Some of those projects included Portola, The Belvedere, Montego Condominiums, Villas De Luz Condominiums, and the Seagaze Live/Work Lofts.

Leaving the firm to become the Architectural Project Manager at an award winning international interior design firm, Mr. Bingham became a leading contributor in the design of a number of projects from coastal private residential projects to the development of a multi-family residential project in Saudi Arabia.

Mr. Bingham’s passion for architecture and his desire to teach that passion to the next generation of architects led him to obtain a designated subjects credential from the State of California, and take the Civil Engineering and Architecture Instructor position at Construction Technology Academy in San Diego in 2009. He is a certified Project Lead The Way instructor, a member of the California Drafting Technology Consortium, is actively involved in the California Industrial Technology Education Association, and serves as the faculty advisor for the ACE Mentors organization at Construction Tech Academy.

Starting in the fall of 2011, Mr. Bingham will, in addition, take a faculty position with Cuyamaca Community College as a design and drafting instructor.

## Project Potential

The opportunity to bridge the gap between core classes and electives, as well as the gap between school and career, is what students need to hammer home essential concepts. The *Accessory Structure Project* is authentic, creative and provides academic rigor for many different levels depending on how the teacher adapts the curriculum to their students' needs.

This curriculum is appropriate for grades 8-12 and can accommodate the varying levels of experience. Technology can be used to generate the business letters as well as create the elevations. Students can be given the zoning ordinances and the building envelope or they can research it for themselves. The project serves as a way to teach new English and math concepts or act as a refresher of concepts. The project can become a competition where students present their elevations and scale model to real clients and the best is chosen. The architecture, engineering and construction fields are going "Green". You can encourage your students to consider eco-friendly building materials and conservation methods.

The basic project elements are provided and can be adjusted for the participating students. The sample elevations are included as well as a template for a business letter. Students become most creative when they have truly flushed out a hypothetical client or have a real client to please. One idea is to create hypothetical clients on cards and randomly hand them out to the companies to demonstrate that we often don't choose what we want to design and build. A design-build contractor's job is to get to know the clients well and build their vision.

We recommend the team of teachers/instructors doing a mock run of the project themselves to determine the amount of work time that will be required for their particular students. The project was used for 9<sup>th</sup> graders who had no prior experience. It took the groups of 3 students approximately 10-12 class hours to complete the project. These 10 hours did include the instructional time needed to teach the necessary skills for the project.

**~Jessica Frichtel and Tim Bingham**

## **NEF Create \* Design \* Build! Cross Curricular Skills**

### **Entry Level – Advanced**

#### **English**

Proper Business Letter Format  
Persuasive Writing  
English Mechanics  
Reading and Writing Technical Documents  
Audience  
Voice

#### **Geometry**

Pythagorean Theorem  
Area of a Variety of Shapes  
Multiplication  
Square Feet  
Linear Feet  
Accurate Computations  
Problem Solving

#### **Architecture/Design**

Floor Plan  
Elevation Drawings  
Design Process  
Scale Models  
Use of Scale  
Plan View  
Elevation View  
3-D Modeling

#### **Construction Industry**

Flow/Space Considerations  
Zoning Considerations  
Career Technical Terminology  
Quantity Take-Off  
Budget

#### **Soft Career Skills**

Presentation and Communication Skills  
Critical Thinking and Problem Solving  
Teamwork  
Creativity  
Leadership  
Meeting Deadlines

## Specific Skills Addressed According to California State Standards and College and Career Technical Education Competencies

### Industry Competencies and Standards for **Project Lead the Way**

Students will:

- A 3.1 Develop an understanding of the characteristics and resources implicating a residential property
- A 3.2 Demonstrate an understanding of all the design limitations and all the necessary information related to the proposed site
- A 4.1 Develop an understanding of engineering and design, propose design alternatives and select between alternative viable solutions
- A 3.0 Develop an understanding of the engineering and architecture fields
- A 2.1 Document processes and procedures and communicates them to different audiences using appropriate oral and written techniques
- A 4.1 Demonstrate and develops an understanding of the arrangement of the design components that satisfy the design requirements within the proposed site layout
- A 8.1 Understand industry finance

### California 9<sup>th</sup> and 10<sup>th</sup> Grade English Language Arts Standards

Students will:

- 2.1 Analyze the structure and format of functional workplace documents, including graphics and headers and their purpose
- 1.3 Demonstrate an understanding of proper English usage and control of grammar, paragraph and sentence structure, diction and syntax
- 1.4 Produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization
- 2.5 Write a business letter demonstrating proper format
- 3.9 Demonstrate an understanding of how voice, diction, and tone affect the credibility of a text

### California Geometry Standards

Students will:

- 8.0 Know, derive, and solve problems involving perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.
- 9.0 Compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; students commit to memory the formulas for prisms, pyramids, and cylinders.
- 10.0 Compute areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids.
- 11.0 Determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.
- 15.0 Use the Pythagorean Theorem to determine distance and find missing lengths of the sides of right triangles.

## **Materials:**

Each group should receive a package containing the following materials:

- 1) Exacta knife or box cutter
- 2) 5 foam core square boards 1'x1'
- 3) 1 foam core base 16"x16"
- 4) 6 pieces of card stock 8.5"x11"
- 5) Ruler
- 6) Sewing stick pins (30+)
- 7) Glue stick

Students may decide to be creative and bring in additional materials to portray the unique qualities of their scale models. It is up to teacher discretion.

If this is a contest, firm up the rules for acceptable decorative materials at the explanation of the project to the students.

## **Project Deliverables:**

- 1) Business Letter and Business Cards establishing their company
- 2) Floor Plan (either hand drawn or computer generated)
- 3) Elevations: North, South, East and West (either hand drawn or computer generated)
- 4) Quantity Take-off
- 5) Project Cost Worksheet
- 6) Site Plan Layout (either hand drawn or computer generated)
- 7) Scale Model

## Glossary of Industry Terms

**Area, Lot, Parcel or Site:** The horizontal area within the property lines excluding public-access corridors, vehicular access easements, easements for major overhead electrical transmission lines, permanently maintained open space easements or lots, and areas to be included in future street rights-of-way as established by easement, dedication or ordinance.

**Building envelope:** The three dimensional space created by the designated setbacks and height restrictions in place for a zoning district. This is the allowable area to build within.

**Easement:** The right to use the real property of another without possessing it – which means if an individual owns a piece of property, sometimes a neighboring property owner will have an easement to cross his property for egress or maybe for a sewer line. In most cases, the city or an agency (water or utility company) will have the right to use or cross an individual owner’s property for use of their lines, roads, etc.

**Elevation:** The drawing of an exterior of a structure

**Project:** Any proposal for new or changed use or for new construction, alteration or enlargement of any structure that is subject to the provisions of this ordinance.

**Scale:** The ratio between the size of something and a representation of it; “the scale of the map”; “the scale of the model”.

**Setback Line:** A line within a lot, parallel to a corresponding lot line, which is the boundary of any specified front, side or rear yard, or the boundary of any public right-of-way whether acquired in fee, easement or otherwise, or a line otherwise established to govern the location of buildings, structures or uses. Where no minimum front, side or rear yards are specified, the setback line shall be coterminous (exactly the same as) as the corresponding lot line.

**Site:** A lot, or group of contiguous lots not divided by an alley, street, other right-of-way, or city limit that is proposed for development in accord with the provisions of this ordinance or has multiple owners, all of whom join in an application for development.

**Slope:** An inclined ground surface, the inclination of which is expressed as a ratio of horizontal distance to vertical distance. Property boundaries shall not be used to establish slope or hillside limits.

**Use, Accessory:** A use that is appropriate, subordinate and customarily incidental to the main use of the site and which is located on the same site as the main use.

**Quantity Take-off:** An itemization of the entire number of items that are necessary to complete a building project as it appears on the blueprint.

**Yard, Rear:** A yard extending across the full width of a site, the depth of which is the minimum horizontal distance between the rear property line and a line parallel thereto on the site, except that on a corner lot the rear yard shall extend to the side yard abutting the street.

**Zoning Ordinance:** Local or municipal laws that establishing building codes and land usage regulations for properties in a specified area.

## Beginning Level Students

### **Business Letter:**

Students will determine a company name and logo and write a business letter about their company's customer service policy and their intent to design and build an accessory structure to meet their client's needs. At the beginning level, provide a template of the business letter format and a model.

### **Elevations, Floor Plan and Site Plan at a scale of 1/2" = 1'-0":**

Students will create hand drawings of the North, South, East and West elevations as well as the floor plan. Models are included to teach them the basic architectural techniques.

### **Quantity Take-Off and Cost Worksheet:**

Students will complete the quantity take-off and the cost worksheet for the bid. Informational worksheets are included to help them in the process with the math.

### **Scale Model:**

Students will use foam core board and basic techniques to create a scale model at a scale of 1/2"=1'-0". This is the same scale used for the elevation drawings they created.

## Advanced Level Students

### **Business Letter and Business Cards:**

They may not need the business letter format or the model. They should use computers to create their own logos and business cards.

### **Building Envelope:**

Students can research and determine the building envelope by understanding the functional documents such as zoning ordinances and building codes. They should create a site plan based on the building ordinances.

### **Elevations, Site Plan and Floor Plan:**

Students can use **REVIT** or another computer aided drawing program to create the elevations, floor plan and site plan instead of hand drawings.

### **Scale Model:**

Students will use foam core board to create a scale model at a scale of 1/2"=1'-0".

## Nonresidential Accessory Structures: Zoning Ordinance

1. Nonresidential Accessory Structure Criteria: A nonresidential accessory structure shall not contain a stove, shower or tub. It may contain a refrigerator, toilet or sink but cannot be used as a livable space.
2. Location: Except as provided in this subsection, nonresidential accessory structures shall not occupy a required front or corner side yard or court, or project beyond the front building line of the principal structure on a site. No accessory uses shall be permitted off-site.
3. Maximum Height: The maximum height of a nonresidential accessory structure shall be 12 feet, subject to the provisions of this subsection, provided that pitched roofs shall not exceed a height of 15 feet.
4. Relation to Property Lines:
  - A. A nonresidential accessory structure shall be located a minimum of 4 feet from a rear property line and shall meet the front yard and side yard setback requirements of the zoning district in which it is located.
  - B. Detached nonresidential accessory structures with a projected roof area less than or equal to 120 square feet that are used as tool and storage sheds, playhouses, or similar uses may occupy a required side or rear yard area. Such structures may not exceed 12 feet in height and shall meet the front yard and corner side yard setback requirements of the zoning district in which they are located.
  - C. Patio Covers, Patio Enclosures, Balconies and Gazebos: These structures shall be located a minimum of 10 feet from rear property line and shall meet the front yard, corner side yard and side yard setback requirements of the zoning district in which it is located.
  - D. Uncovered patios and porches, terraces, platforms, decks and other similar structures less than 30 inches in height: These structures may occupy a required front, corner side, side, or rear yard, but must be located a minimum of 3 feet from a side yard for a length of 15 feet parallel to the adjoining property line.
  - E. Garages: Any garage taking access from a corner side yard or the secondary street frontage on a double frontage to the property line shall be setback a minimum of 20 feet, as measured from the front of the garage to the property line, back of sidewalk or back of curb, whatever is most restrictive. Garages taking access off an alley shall meet the general requirements of this ordinance.
5. Measurement of Height: Where a finished grade elevation, different than the existing grade elevation is approved as part of a discretionary application such as Tentative Map, Development Plan, Use Permit, Variance or Coastal Permit, height shall be measured from the approved finished grade elevation at all points on the site. In approving a finished grade elevation of adjacent and surrounding properties shall be considered.



## Create \* Design \* Build! Project Overview

You are a design-build contractor. Your company is submitting a bid to your client to design and build a nonresidential accessory project for their back yard. The structure should not exceed 120 – 180 square feet for the site provided. The total cost of the structure must not exceed \$20,000.

### **Project Deliverables:**

- 1) Floor Plan
- 2) Elevations: North, South, East and West at  $\frac{1}{2}$ " = 1'-0"
- 3) Quantity Take-off
- 4) Project Cost Worksheet
- 5) Site Plan/Layout
- 6) Business Letter and Business Cards establishing your company's name and logo
- 7) Scale Model at  $\frac{1}{2}$ " = 1'-0"

You will form design-build contracting companies of 3 people. You will choose a company name and create business cards. Determine your company philosophy and what type of structure will meet the needs of your client. Then you will write a business letter stating your intent to bid on the job and the service you will provide.

Your company will design the accessory structure based on the needs of the client and the building ordinances for the site provided. You will provide your client with the above deliverables.

## **Meeting the Client's Needs:**

Students must determine what their client will use the accessory structure for. The following questions must be answered by their team. This promotes creativity and makes each project individual.

- 1) What is the planned use for the structure?
- 2) Are there special requirements such as for a conditioned space?
- 3) Are there aesthetic requirements you must meet to please the client?
- 4) Are you able to complete the work within the time constraints?
- 5) Will they need electrical, plumbing, windows, unique flooring, etc.?
- 6) Are you clients concerned about their environmental impact?
- 7) Do they want to use eco-friendly, reclaimed or recycled products?
- 8) Do they want to implement energy and water conservation methods?

## THE FLOOR PLAN – FLOW/SPACE CONSIDERATIONS

**Flow or Circulation is the movement from one room to another.**

Successful circulation means that there are convenient pathways between areas that have the most connecting traffic. It is the designer's responsibility to design the shed with the least amount of traffic as possible. Some items to consider when designing:

- Storage near entry/exit for convenient access
- Proper lighting/ventilation over/near work area as needed
- Proper electrical outlets/receptacles near work area as required
- Benefit of natural lighting/sun
- Storage cubbies for supplies
- Sink convenient to work area as needed
- Outside spigot convenient to access as needed

## QUANTITY TAKE-OFF

The Quantity Take-Off is a listing of all material quantities needed to construct a project. When a contractor looks at a set of plans, the first thing they do is have the estimator or "Take-Off person" go through and calculate the quantities of all materials or types of construction involved. In order to aid in the pricing process, many items are priced according to a unit value, i.e.: square feet (sf or ft<sup>2</sup>), cubic yard (cy or yd<sup>3</sup>), linear feet (lf) and quantity of each. Some different items and their Take-Off units are listed below: (see the Quantity Take-Off Worksheet and Project Cost Worksheet for units in this project).

<b>Square Feet</b>	<b>Linear Feet</b>	<b>Quantity/Each</b>
Concrete Slab	Cabinets	Door
Roofing Material	Shelving	Windows
Exterior Siding		Electrical Outlets
Flooring (square yards)		Light Fixtures
Walls		Plumbing Fixtures

## Quantity Take-Off Worksheet

This worksheet will explain how to do a quantity Take-Off of the work items shown in the Project Cost Worksheet.

### Concrete Footing and Slab on Grade:

The floor of your shed will be a concrete slab with an integrated footing (monolithic slab) placed at or slightly above the grade of the surrounding soil. This item is measured in square feet (sf or ft<sup>2</sup>).

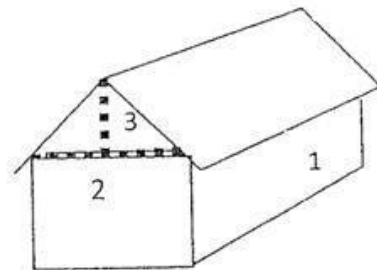
Area of Slab on Grade: (If Structure is rectangular or square)	(Length) x (Width)
---	--------------------

Calculations:

### Exterior Walls and Siding:

The exterior walls are measured in square feet (sf or ft<sup>2</sup>). Divide the exterior walls into sections where the area can be easily calculated. The example to the right was divided into (3) Sections:

- Section 1 = Length of Structure x Height
- Section 2 = Width x Height
- Section 3 =  $(1/2 \times \text{Base} \times \text{Height}) \times 2$   
Area of an isosceles triangle



If your structure is rectangular:	Area = (Section 1 + Section 2 + Section 3) x 2
If your structure is not rectangular:	Find the area of each exterior wall and combine.

Calculations:

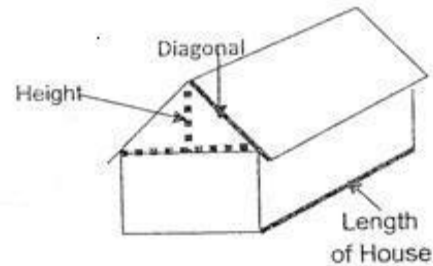
## **Roof Framing and Roofing Material:**

Roof Framing measures the area of the Roof. Because the roof is not flat, the area must be calculated using the Pythagorean Theorem.

### **PYTHAGOREAN THEOREM:**

$$(1/2) \text{ Width squared} + \text{Height squared} = \text{Diagonal squared}$$

$$\text{Diagonal} = \text{square root of } (1/2 \text{ W squared} + \text{H squared})$$



If your structure is rectangular:	Roof area is equal to the diagonals times the length of the structure times two. (Multiply times two, because the roof has two equal sides).
If your structure is not rectangular:	Divide the roof into rectangular sections, follow the steps above for each section and add all the sections together.

Calculations:

## **Interior Walls:**

This item is measured in square feet (sf or ft<sup>2</sup>).

Add the lengths of all interior walls and multiply times the height of the walls. Typically, walls are 8' high; be sure to use height that is applicable to your specific project.

Calculations:

**Storage Base and Wall Cabinets:**

These items are measured in linear feet (lf).

Measure the length of the wall where the cabinets will be located.

Calculations:

**Flooring:**

These items are measured in square feet (sf) or square yards (sy).

Calculate the area of each different type of flooring. This is done by multiplying the length of the room by the width of the room.

To convert to square yards, divide the square footage by 9.

$$1 \text{ sy} = 9 \text{ sf}$$

Calculations:

**TOTAL SQUARE FOOTAGE OF STRUCTURE**

<u>Room</u>	<u>Length</u>	<u>X</u>	<u>Width</u>	<u>TOTAL (SF)</u>
Work Area				
Storage				
Other:				
			<b>TOTAL:</b>	

# PROJECT COST WORKSHEET

**Group Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

	DESCRIPTION	COST		QUANTITY	TOTAL
<b>Footings and Slab</b>					
	Concrete Flooring and Slab on Grade	\$ 7.00	/	ft <sup>2</sup>	\$
<b>Exterior Walls</b>					
	2" x 4" wood studs, 4" faced insulation	\$ 5.00	/	ft <sup>2</sup>	\$
	1/2" OSB exterior sheathing				
	2" x 4" wood studs, no insulation	\$ 4.50	/	ft <sup>2</sup>	\$
	1/2" OSB exterior sheathing				
	1/2" drywall on exterior walls	\$ 2.25	/	ft <sup>2</sup>	\$
<b>Siding</b>					
	Vinyl	\$ 4.00	/	ft <sup>2</sup>	\$
	Hardi-Plank	\$ 6.00	/	ft <sup>2</sup>	\$
	Cedar	\$ 8.00	/	ft <sup>2</sup>	\$
	Stucco	\$ 10.00	/	ft <sup>2</sup>	\$
	Brick	\$ 15.00	/	ft <sup>2</sup>	\$
	Field Stone	\$ 22.00	/	ft <sup>2</sup>	\$
<b>Roofing</b>					
	Roof Framing	\$ 6.50	/	ft <sup>2</sup>	\$
	Shingles, 25-yr. – Three Tab	\$ 3.00	/	ft <sup>2</sup>	\$
	Shingles, 40-yr. - Architectural	\$ 3.75	/	ft <sup>2</sup>	\$
	Shingles, Premium Architectural	\$ 4.50	/	ft <sup>2</sup>	\$
	Gutters	\$ 4.00	/	lf	\$
	Gutters with Leaf Guard	\$ 8.50	/	lf	\$
<b>Interior Walls</b>					
	2"x4" wood studs, 1/2" drywall each side	\$ 6.25	/	ft <sup>2</sup>	\$
	4" Insulation in interior walls	\$ 0.75	/	ft <sup>2</sup>	\$
<b>Doors</b>					
	Interior 2'6" x 6'8-0"	\$ 285.00	/	ea	\$
	Interior 3'-0"x 6'8-0"	\$ 295.00	/	ea	\$
	Exterior 3'-0"x6'8-0"	\$ 375.00	/	ea	\$
	Exterior Barn Door 6'-0"x6'-8"	\$ 750.00	/	ea	\$
<b>Windows</b>					
	Double Hung, 2'-4"x4'-6"	\$ 320.00	/	Ea	\$
	Double Hung, 2'-0"x3'-0"	\$ 265.00	/	Ea	\$
<b>Storage</b>					
	12" Wall Cabinets	\$ 65.00	/	lf	\$
	24" Base Cabinets	\$ 90.00	/	lf	\$
	24" Counter Top	\$ 20.00	/	lf	\$
	12" Wall Shelving	\$ 10.00	/	lf	\$
	Hooks	\$ 10.00	/	ea	\$

## PROJECT COST WORKSHEET

**Group Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

	DESCRIPTION	COST		UNIT	QUANTITY	TOTAL
	Peg Board (for tool storage)	\$ 1.50	/	ft <sup>2</sup>		\$

**Painting**

	Walls	\$ .75	/	ft <sup>2</sup>		\$
	Doors	\$ 40.00	/	ea		\$
	Windows	\$ 40.00	/	ea		\$

**Flooring**

	Vinyl Composition Tile (VCT) 12" x 12"	\$ 2.50	/	ft <sup>2</sup>		\$
	Concrete Sealer	\$ .75	/	ft <sup>2</sup>		\$
	Sheet Vinyl	\$ 3.00	/	ft <sup>2</sup>		\$
	Epoxy	\$ 5.00	/	ft <sup>2</sup>		\$

**Plumbing**

	Water from House to Structure	\$ 1,000.00	/	ea		\$
	Sink	\$ 700.00	/	ea		\$
	Outside Spigot	\$ 300.00	/	ea		\$

**Electrical**

	Power to Structure	\$ 500.00	/	ea		\$
	Receptacles	\$ 50.00	/	ea		\$
	GFCI Receptacles	\$ 60.00	/	ea		\$
	Light Fixtures - Interior	\$ 200.00	/	ea		\$
	Light Fixtures - Exterior	\$ 150.00	/	ea		\$
	Exterior Light Motion Sensor	\$ 75.00	/	ea		\$

**Building Permit**

	\$ 75.00	/	ea		\$	
<b>SUB-TOTAL:</b>						
Overhead and Profit, 15%						
<b>TOTAL:</b>						



## PROJECT COST

Use the number of items found with the Quantity Take-Off to determine the estimated project cost: (use the Project Cost Worksheet enclosed). If the cost of the project is less than the allowed amount, you can maximize money usage by altering material selections or adding items to the Structure:

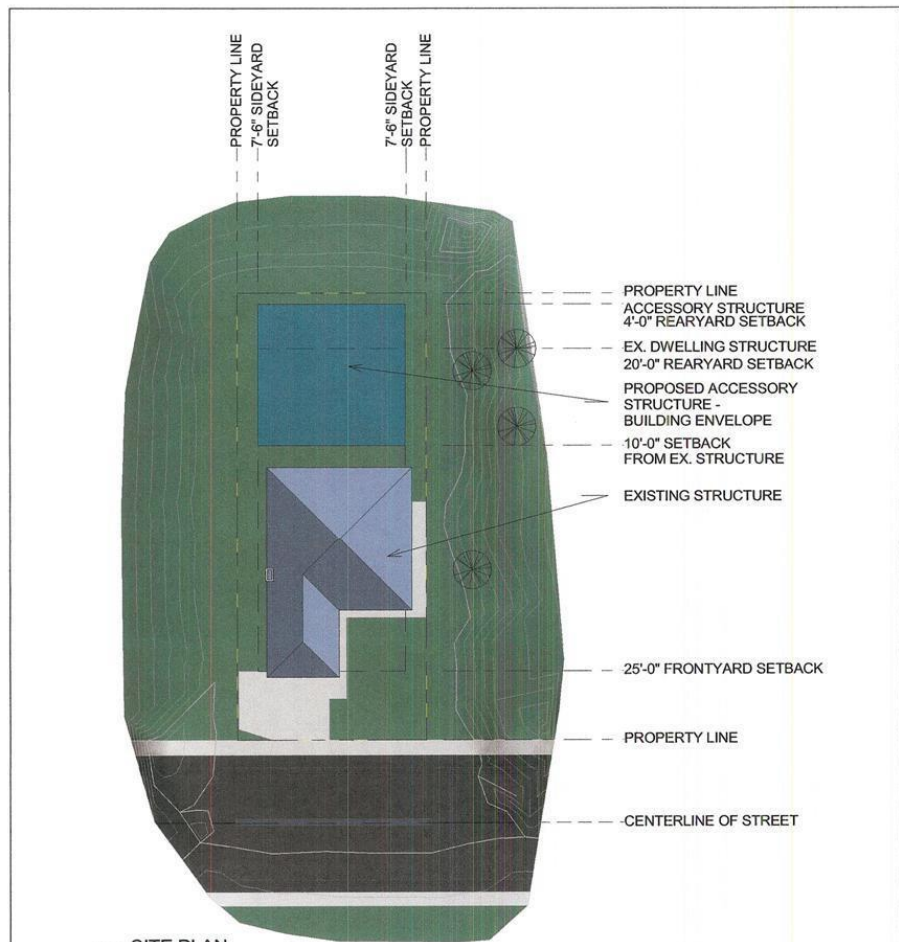
- Add features: shelving, tool rack, bike rack, etc.
- Use more expensive items: brick, rather than vinyl siding
- Add additional square footage: This method could possibly exceed the time line for project completion. However, if you think you can enlarge the structure and re-do the Floor Plans, Elevations, Quantity Take-Off and Project Cost Worksheet, then go for it!

If the cost of the project exceeds the allowed amount, then do the opposite of the suggestions above.

## THE SITE

The Structure must proportionately fit on the site. Some items for your Client to consider:

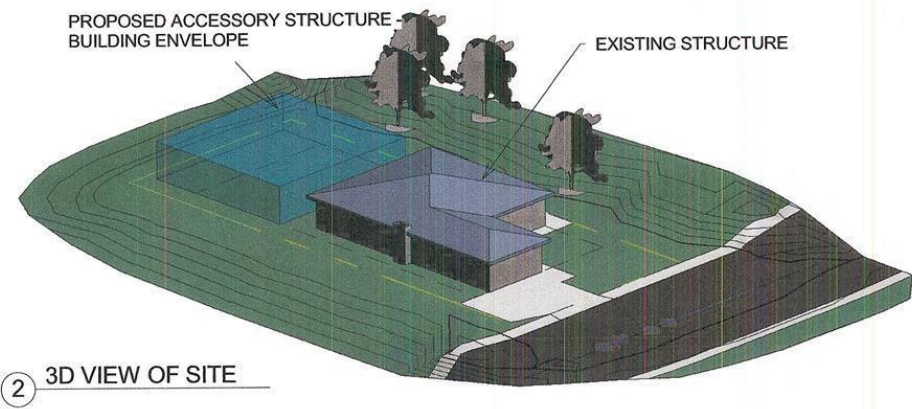
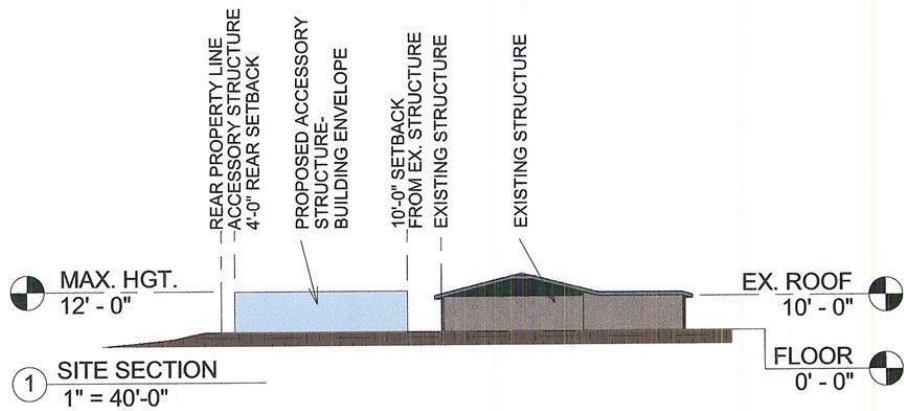
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- Are there any elements on the lot you wish to maintain? For example: trees, special shrubs and/or plants, existing buildings?
- Which direction do you want your Structure to face? Toward the road, toward a creek or river, or toward the East to get sun in the morning? Placement in relation to the sun can have a big impact on the light coming through windows.
- Where are your entry doors going to be located?
- Do you plan to add on to the Structure or any other buildings on your property in the future?
- Do you plan to build additional out buildings?



① SITE PLAN  
1" = 40'-0"

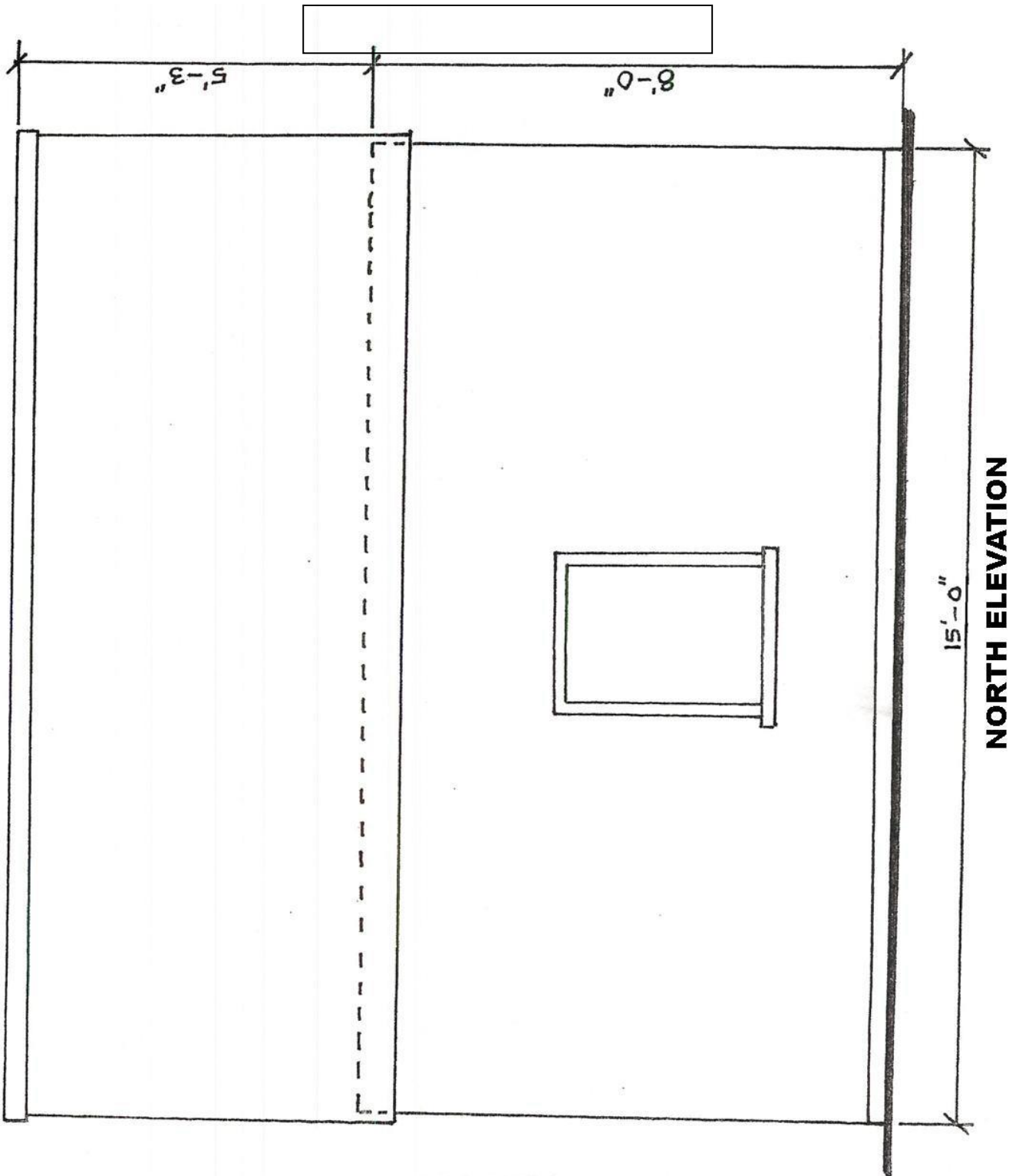
Autodesk Revit® www.autodesk.com/revit	ACCESSORY STRUCTURE PROJECT	SITE PLAN	
		Project number 101	A-1
Date JULY 2010			
Drawn by TB			
Checked by BINGHAM	Scale 1" = 40'-0"		

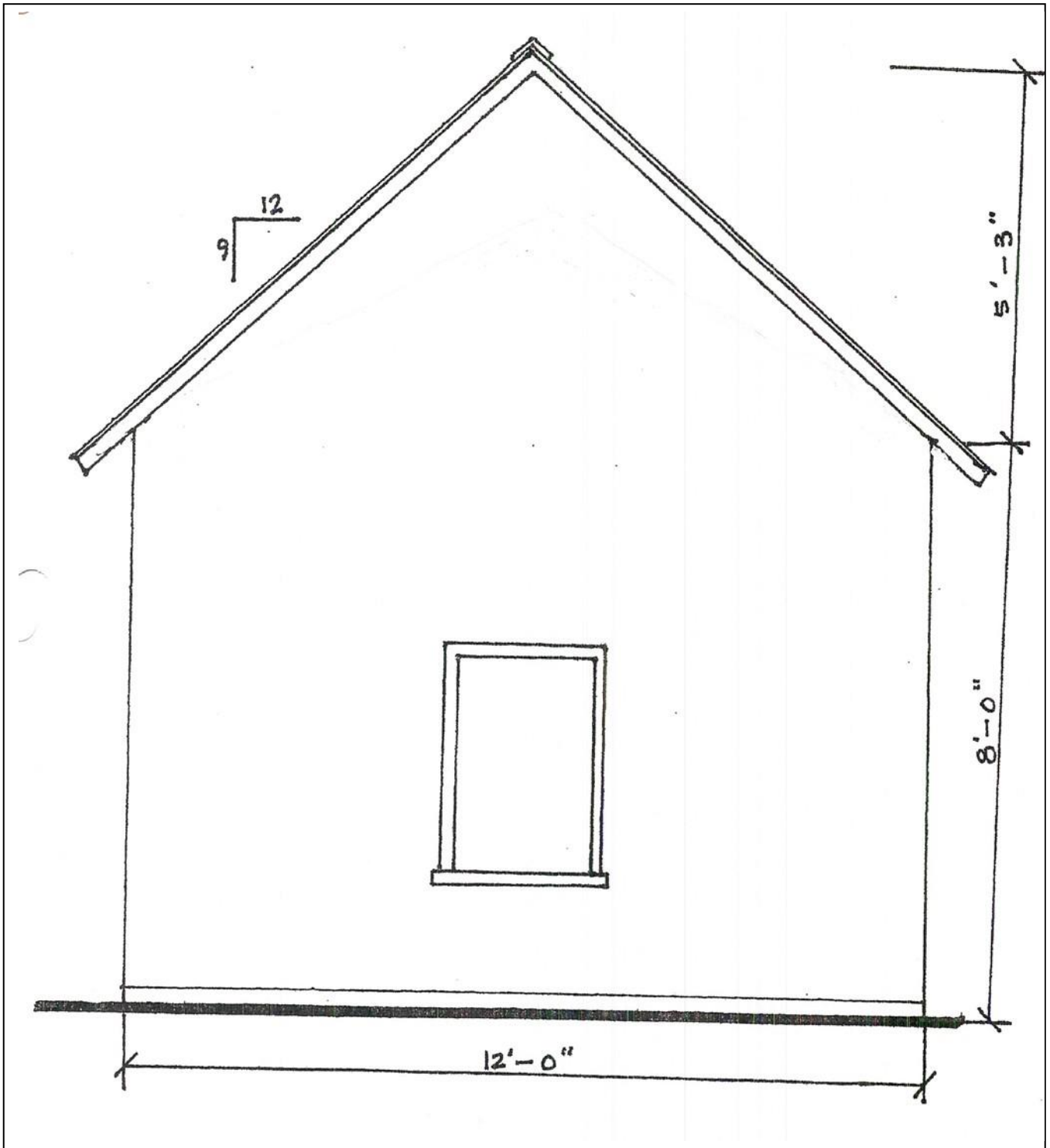
8/30/2010 9:36:16 AM



Autodesk® Revit®  www.autodesk.com/revit	ACCESSORY STRUCTURE PROJECT	SITE SECTION / 3D VIEW	
		Project number 101 Date JULY 2010 Drawn by TB Checked by BINGHAM	A-2 Scale 1" = 40'-0"

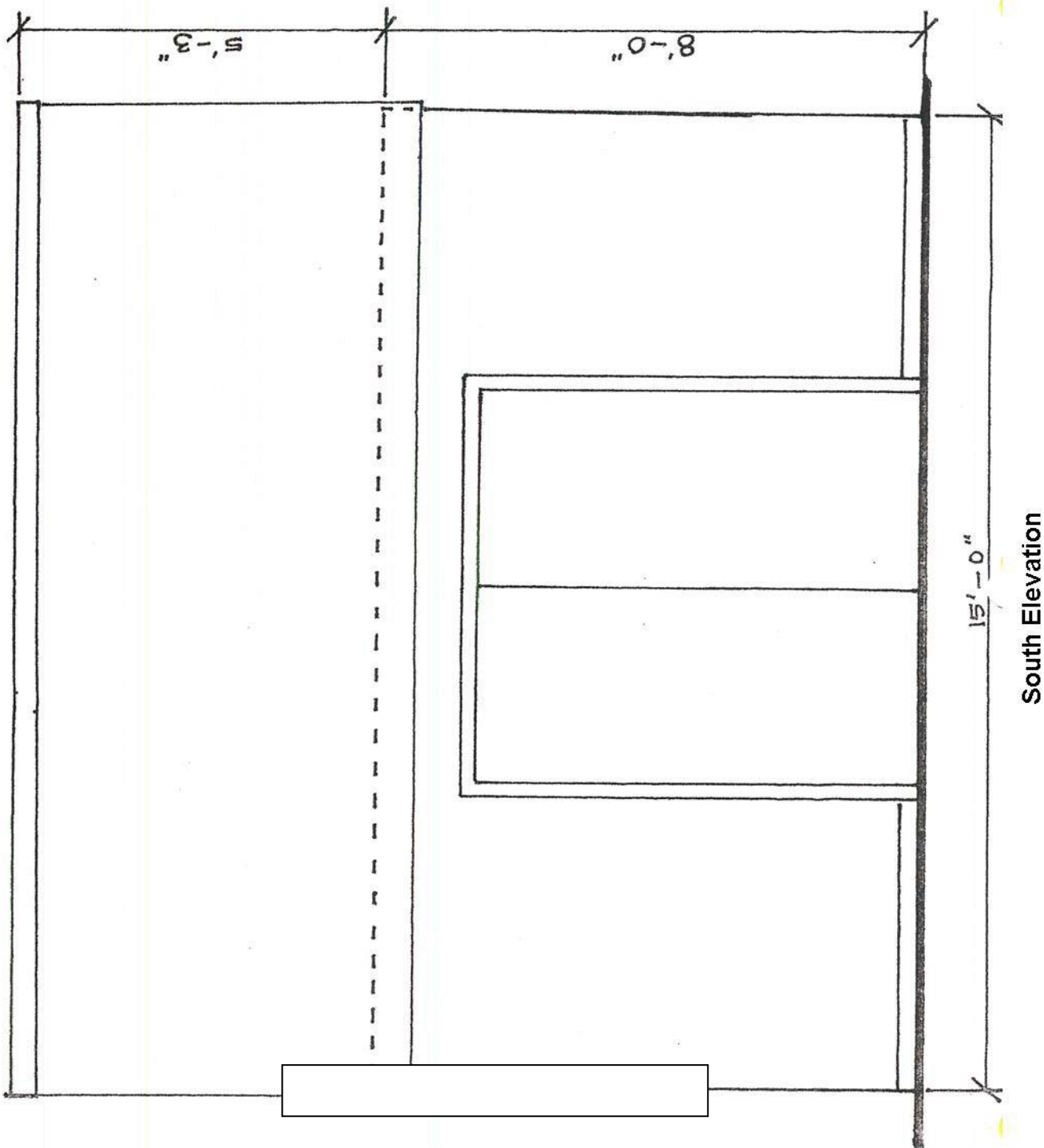
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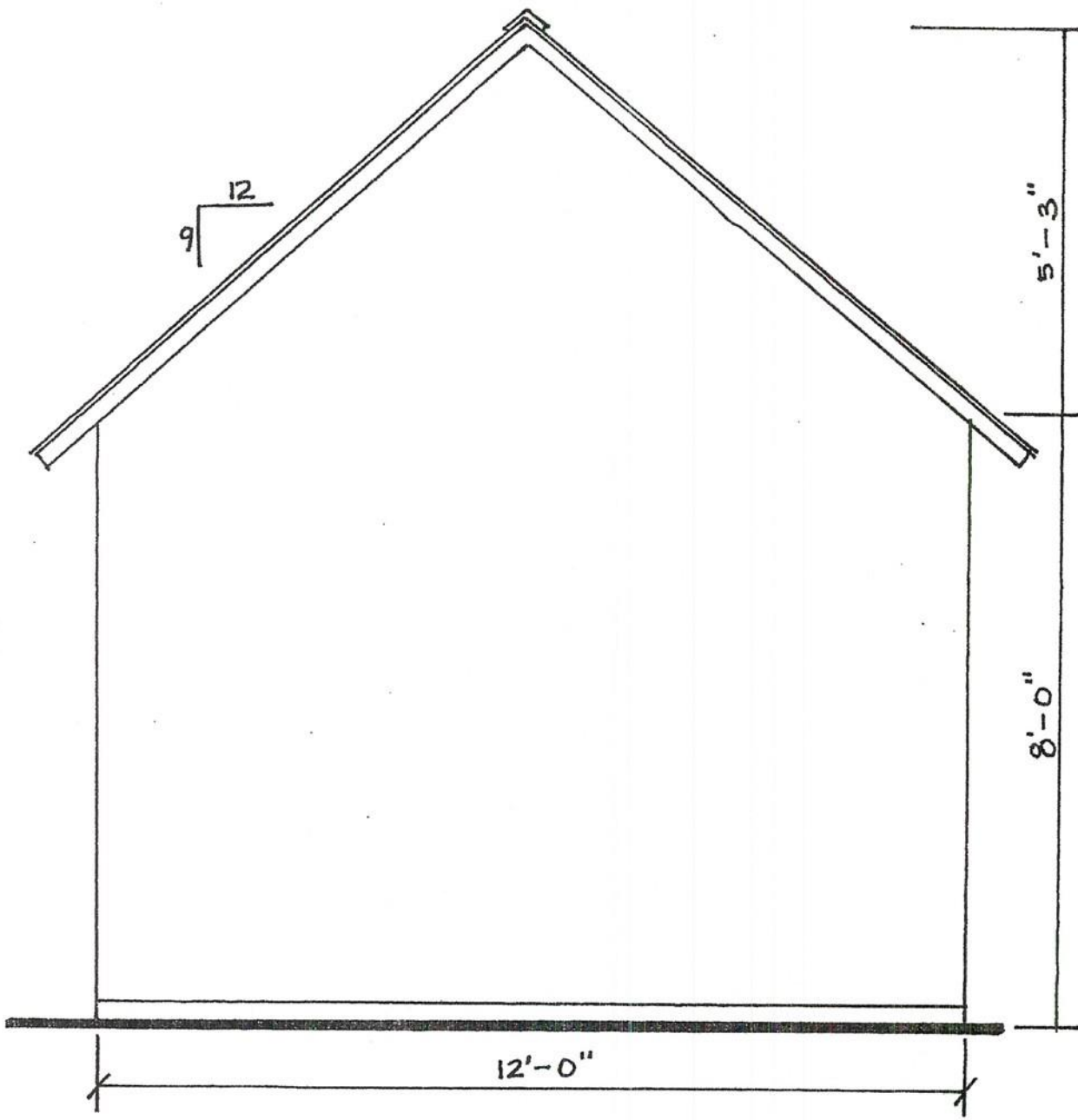




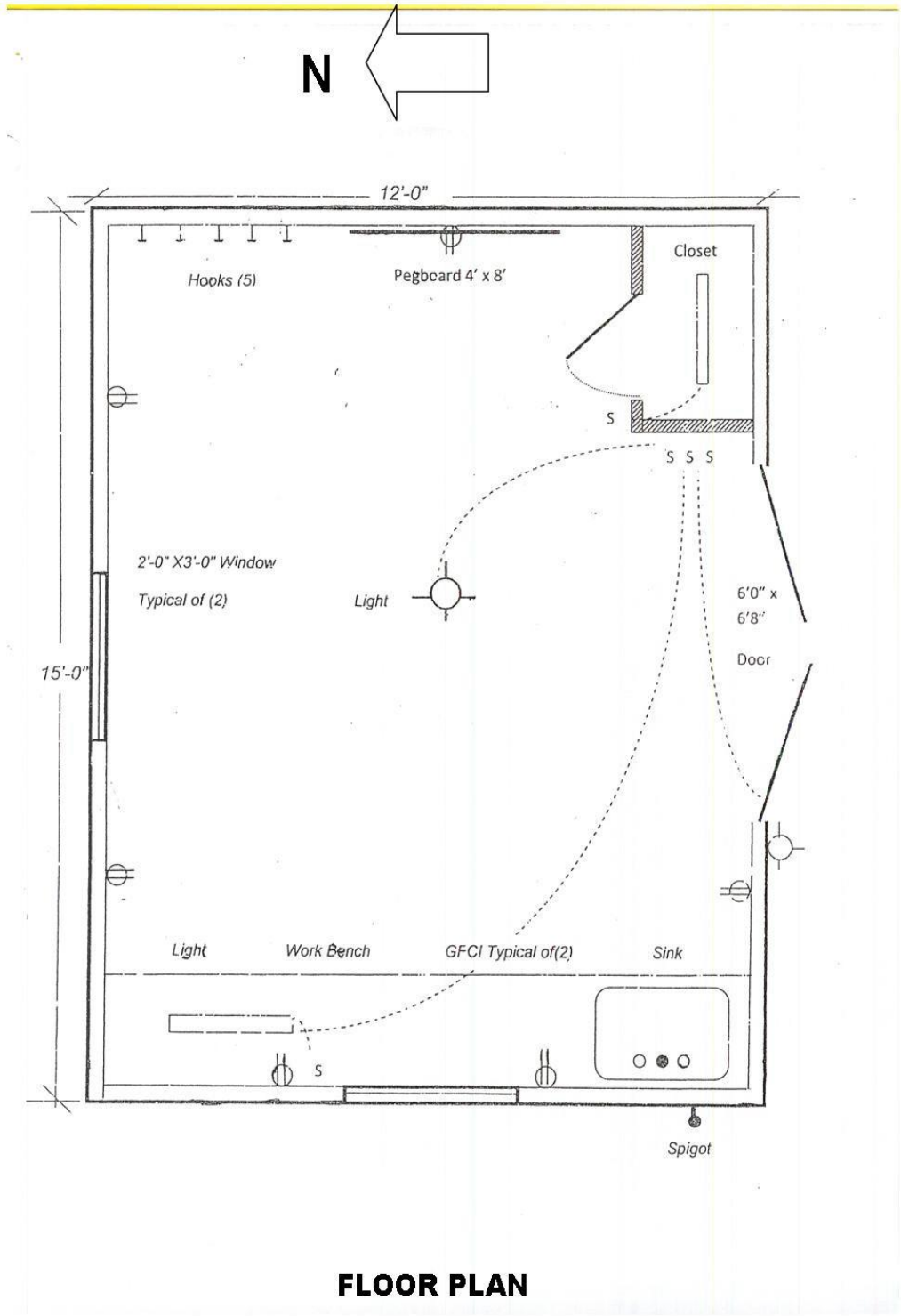
**East Elevation**







**West Elevation**



**FLOOR PLAN**



SAMPLE



## ABLE DESIGN & CONSTRUCTION, INC.

1530 55<sup>TH</sup> St., Suite 119  
San Diego, CA 92101  
Ph: (123) 555-4481  
Fax (123) 555-7210  
[www.ABLE.construction.com](http://www.ABLE.construction.com)

October 11, 2010

Mr. & Mrs. Green  
1530 Palm Rd.  
San Diego, CA 80303

Dear Clients:

ABLE is a General Contracting firm located in San Diego, California, and was established in 1987. We have earned a well-deserved reputation for satisfying our clients. We personally work closely with each one to define every project's scope, schedule, and budget in order to deliver superior service and quality products. Providing a safe and stable work environment requires the utmost attention to detail. Adhering to standards of conduct from OSHA Safety Regulations to Building Code requirements is not a matter of requirement but of pride. In a business where cutting corners can lead to a smaller bottom line, ABLE's are squarely formed.

We understand per our meeting that you would like to build a nonresidential accessory structure in your backyard. You need a space that would serve as a dance studio and a work-out room for your family. After getting to know you, we understand that you would like to use recycled and eco-friendly materials as much as possible. We will prepare a bid proposal as well as a site plan, floor plan and scale model to demonstrate the service we can provide by \_\_\_\_\_(due date).

Sincerely,

Jessica Frichtel  
Construction Superintendent  
ABLE Design and Construction, Inc.

## Accessory Structure Project Scoring Guide

\_\_\_\_\_ / points – Floor Plan

- Drawn to  $\frac{1}{2}$ " = 1'-0" scale
- All areas must be clearly labeled
- Show location of all walls, doors, windows, plumbing fixtures
- Dimensioned

\_\_\_\_\_ / points – Elevations

- Drawn to  $\frac{1}{2}$ " = 1'-0" scale
- Labeled (North, South, East and West)
- One elevation per page
- Show location of doors, windows
- Dimensioned

\_\_\_\_\_ / points – Quantity Take-Off

- Completely filled in
- Accurate according to floor plan

\_\_\_\_\_ / points – Project Cost Worksheet

- Completely filled in with accurate math computations
- Accurate according to floor plan and Quantity Take-Off

\_\_\_\_\_ / points – Site Plan/Layout

- Shows location of the nonresidential accessory building
- Abides by all setbacks and easements

\_\_\_\_\_ / points – Business Letter

- Formatted like a proper business letter
- Speaks to a specific audience
- Proper spelling and mechanics
- Content is informative and thorough

\_\_\_\_\_ / points – Business Cards

- Business name and contact information included
- Appropriate and unique logo
- Content is informative and without errors in English mechanics

\_\_\_\_\_ / points – Scale Model

- Accurate according to Floor Plan and Elevations
- Base size no larger than 16"x16"
- Expresses design intent by providing unique details
- Neat and clean craftsmanship



NAWIC Education Foundation

**CREATE** - **DESIGN** - **Build!**

---

# Student Handout

Authors: NAWIC Education Foundation, Jessica Frichtel & Tim Bingham

“Experiential Learning Opportunity”

National Center for Construction Education & Research.

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## Nonresidential Accessory Structures: Zoning Ordinance

1. Nonresidential Accessory Structure Criteria: A nonresidential accessory structure shall not contain a stove, shower or tub. It may contain a refrigerator, toilet or sink but cannot be used as a livable space.
2. Location: Except as provided in this subsection, nonresidential accessory structures shall not occupy a required front or corner side yard or court, or project beyond the front building line of the principal structure on a site. No accessory uses shall be permitted off-site.
3. Maximum Height: The maximum height of a nonresidential accessory structure shall be 12 feet, subject to the provisions of this subsection, provided that pitched roofs shall not exceed a height of 15 feet.
4. Relation to Property Lines:
  - A. A nonresidential accessory structure shall be located a minimum of 4 feet from a rear property line and shall meet the front yard and side yard setback requirements of the zoning district in which it is located.
  - B. Detached nonresidential accessory structures with a projected roof area less than or equal to 120 square feet that are used as tool and storage sheds, playhouses, or similar uses may occupy a required side or rear yard area. Such structures may not exceed 12 feet in height and shall meet the front yard and corner side yard setback requirements of the zoning district in which they are located.
  - C. Patio Covers, Patio Enclosures, Balconies and Gazebos: These structures shall be located a minimum of 10 feet from rear property line and shall meet the front yard, corner side yard and side yard setback requirements of the zoning district in which it is located.
  - D. Uncovered patios and porches, terraces, platforms, decks and other similar structures less than 30 inches in height: These structures may occupy a required front, corner side, side, or rear yard, but must be located a minimum of 3 feet from a side yard for a length of 15 feet parallel to the adjoining property line.
  - E. Garages: Any garage taking access from a corner side yard or the secondary street frontage on a double frontage to the property line shall be setback a minimum of 20 feet, as measured from the front of the garage to the property line, back of sidewalk or back of curb, whatever is most restrictive. Garages taking access off an alley shall meet the general requirements of this ordinance.
5. Measurement of Height: Where a finished grade elevation, different than the existing grade elevation is approved as part of a discretionary application such as Tentative Map, Development Plan, Use Permit, Variance or Coastal Permit, height shall be measured from the approved finished grade elevation at all points on the site. In approving a finished grade elevation of adjacent and surrounding properties shall be considered.

## Create - Design - Build! Overview

You are a design-build contractor. Your company is submitting a bid to your client to design and build a nonresidential accessory project for their back yard. The structure should not exceed 120 – 180 square feet for the site provided. The total cost of the structure must not exceed \$20,000.

### **Project Deliverables:**

- 1) Floor Plan
- 2) Elevations: North, South, East and West at  $\frac{1}{2}'' = 1'-0''$
- 3) Quantity Take-off
- 4) Project Cost Worksheet
- 5) Site Plan/Layout
- 6) Business Letter and Business Cards establishing your company's name and logo
- 7) Scale Model at  $\frac{1}{2}'' = 1'-0''$

You will form design-build contracting companies of 3 people. You will choose a company name and create business cards. Determine your company philosophy and what type of structure will meet the needs of your client. Then you will write a business letter stating your intent to bid on the job and the service you will provide.

Your company will design the accessory structure based on the needs of the client and the building ordinances for the site provided. You will provide your client with the above deliverables.

## **Meeting the Client's Needs:**

Students must determine what their client will use the accessory structure for. The following questions must be answered by their team. This promotes creativity and makes each project individual.

- 1) What is the planned use for the structure?
- 2) Are there special requirements such as for a conditioned space?
- 3) Are there aesthetic requirements you must meet to please the client?
- 4) Are you able to complete the work within the time constraints?
- 5) Will they need electrical, plumbing, windows, unique flooring, etc.?
- 6) Are you clients concerned about their environmental impact?
- 7) Do they want to use eco-friendly, reclaimed or recycled products?
- 8) Do they want to implement energy and water conservation methods?

## THE FLOOR PLAN – FLOW/SPACE CONSIDERATIONS

**Flow or Circulation is the movement from one room to another.**

Successful circulation means that there are convenient pathways between areas that have the most connecting traffic. It is the designer's responsibility to design the shed with the least amount of traffic as possible. Some items to consider when designing:

- Storage near entry/exit for convenient access
- Proper lighting/ventilation over/near work area as needed
- Proper electrical outlets/receptacles near work area as required
- Benefit of natural lighting/sun
- Storage cubbies for supplies
- Sink convenient to work area as needed
- Outside spigot convenient to access as needed

## QUANTITY TAKE-OFF

The Quantity Take-Off is a listing of all material quantities needed to construct a project. When a contractor looks at a set of plans, the first thing they do is have the estimator or "Take-Off person" go through and calculate the quantities of all materials or types of construction involved. In order to aid in the pricing process, many items are priced according to a unit value, i.e.: square feet (sf or ft<sup>2</sup>), cubic yard (cy or yd<sup>3</sup>), linear feet (lf) and quantity of each. Some different items and their Take-Off units are listed below: (see the Quantity Take-Off Worksheet and Project Cost Worksheet for units in this project).

<b>Square Feet</b>	<b>Linear Feet</b>	<b>Quantity/Each</b>
Concrete Slab	Cabinets	Door
Roofing Material	Shelving	Windows
Exterior Siding		Electrical Outlets
Flooring (square yards)		Light Fixtures
Walls		Plumbing Fixtures

## Quantity Take-Off Worksheet

This worksheet will explain how to do a quantity Take-Off of the work items shown in the Project Cost Worksheet.

### Concrete Footing and Slab on Grade:

The floor of your shed will be a concrete slab with an integrated footing (monolithic slab) placed at or slightly above the grade of the surrounding soil. This item is measured in square feet (sf or ft<sup>2</sup>).

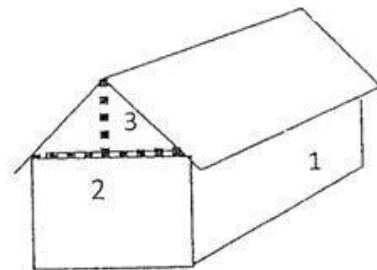
Area of Slab on Grade: (If Structure is rectangular or square)	(Length) x (Width)
---	--------------------

Calculations:

### Exterior Walls and Siding:

The exterior walls are measured in square feet (sf or ft<sup>2</sup>). Divide the exterior walls into sections where the area can be easily calculated. The example to the right was divided into (3) Sections:

- Section 1 = Length of Structure x Height
- Section 2 = Width x Height
- Section 3 = (1/2 x Base x Height) x 2  
Area of an isosceles triangle



If your structure is rectangular:	Area = (Section 1 + Section 2 + Section 3) x 2
If your structure is not rectangular:	Find the area of each exterior wall and combine.

Calculations:



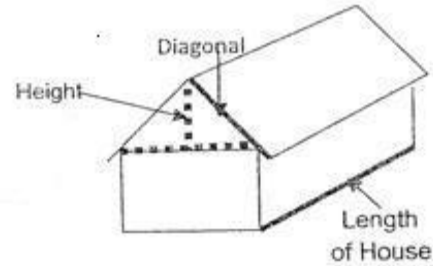
## **Roof Framing and Roofing Material:**

Roof Framing measures the area of the Roof. Because the roof is not flat, the area must be calculated using the Pythagorean Theorem.

### **PYTHAGOREAN THEOREM:**

**(1/2) Width squared + Height squared =  
Diagonal squared**

**Diagonal = square root  
of (1/2 W squared + H squared)**



If your structure is rectangular:	Roof area is equal to the diagonals times the length of the structure times two. (Multiply times two, because the roof has two equal sides).
If your structure is not rectangular:	Divide the roof into rectangular sections, follow the steps above for each section and add all the sections together.

Calculations:

## **Interior Walls:**

This item is measured in square feet (sf or ft<sup>2</sup>).

Add the lengths of all interior walls and multiply times the height of the walls. Typically, walls are 8' high; be sure to use height that is applicable to your specific project.

Calculations:

**Storage Base and Wall Cabinets:**

These items are measured in linear feet (lf).

Measure the length of the wall where the cabinets will be located.

Calculations:

**Flooring:**

These items are measured in square feet (sf) or square yards (sy).

Calculate the area of each different type of flooring. This is done by multiplying the length of the room by the width of the room.

To convert to square yards, divide the square footage by 9.

$$1 \text{ sy} = 9 \text{ sf}$$

Calculations:

**TOTAL SQUARE FOOTAGE OF STRUCTURE**

<u>Room</u>	<u>Length</u>	<u>X</u>	<u>Width</u>	<u>TOTAL (SF)</u>
Work Area				
Storage				
Other:				
			<b>TOTAL:</b>	

## PROJECT COST WORKSHEET

**Group Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

	DESCRIPTION	COST		QUANTITY	TOTAL
<b>Footings and Slab</b>					
	Concrete Flooring and Slab on Grade	\$ 7.00	/	ft <sup>2</sup>	\$
<b>Exterior Walls</b>					
	2" x 4" wood studs, 4" faced insulation	\$ 5.00	/	ft <sup>2</sup>	\$
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## PROJECT COST WORKSHEET

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	Walls	\$ .75	/	ft <sup>2</sup>		\$
	Doors	\$ 40.00	/	ea		\$
	Windows	\$ 40.00	/	ea		\$

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	Exterior Light Motion Sensor	\$ 75.00	/	ea		\$

**Building Permit**

	\$ 75.00	/	ea		\$
<b>SUB-TOTAL:</b>					
Overhead and Profit, 15%					
<b>TOTAL:</b>					

## PROJECT COST

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- Where are your entry doors going to be located?
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- Do you plan to build additional out buildings?

SAMPLE



## ABLE DESIGN & CONSTRUCTION, INC.

1530 55<sup>TH</sup> St., Suite 119  
San Diego, CA 92101  
Ph: (123) 555-4481  
Fax (123) 555-7210  
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October 11, 2010

Mr. & Mrs. Green  
1530 Palm Rd.  
San Diego, CA 80303

Dear Clients:

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Sincerely,

Jessica Frichtel  
Construction Superintendent  
ABLE Design and Construction, Inc.