NAWIC & NEF

Building Design Program

The Shed Project

Virginia Department of Education
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About NAWIC (National Association of Women in Construction)

The National Association of Women in Construction (NAWIC) is an international organization founded in 1955 to promote women employed in the construction industry, which continues to be NAWIC's main goal. The Richmond Chapter #141 was organized in 1967. The Richmond chapter consists of more than 70 women actively working in the Central Virginia construction industry.

Education is a fundamental component of promoting the construction industry and women's roles within it. Each year, NAWIC sponsors the following NEF (NAWIC Education Foundation) K–12 Programs:

- Block Kids—Students are given interlocking blocks, cardboard, string, aluminum foil, and a rock and are instructed to design and build a model of an object, and to describe their process.
- Work It to Learn It Project—Middle school students participate.
- The Shed, The Garage, and The Commercial Projects—Middle and high school students participate.
- The Drafting Project—High school students are given a NAWIC-sponsored design problem to draw using CADD.
- Postsecondary and Career and Technical Education (CTE) scholarships—Each year, NAWIC awards more than $5,000 to students majoring in construction-related fields or who are entering a construction-related CTE program.

The NAWIC Building Design program started with one school in 1997. Over the years, students from Henrico, Chesterfield, and Hanover public schools have participated. Through the 2009 school year, more than 6,500 students have worked in this program. Please go to the Richmond chapter of NAWIC to discover more: www.nawic-richmondva.com

Introduction

The NEF (NAWIC Education Foundation) Shed Project is part of a versatile NEF Building Design Program that can easily be incorporated by Technology Education and Trade and Industrial Education instructors into their current curricula. Also included in this program are the Commercial Project, the Garage Project, and the Work It to Learn It Project. When supported by a local NAWIC (National Association of Women in Construction) chapter or other construction industry sponsor, the program may be offered as a national building-design competition. Local winners would advance to a regional competition, and one semi-finalist from each region would be entered in the national program competition.

The construction industry faces a workforce shortage that poses a serious problem for the national economy. In order to meet the demand for construction and construction-related jobs and careers, the industry needs to annually attract, educate, and train new workers.

The NEF Building Design Program introduces students to the construction industry in an effort to create an awareness of and to promote personal interest and a connection to essential professional knowledge and skills. In addition, the program helps immerse students in career exploration by exposing them to pathways within the Architecture and Construction Career Cluster.

The program is nondiscriminatory and, as such, is open to all secondary level students. All eligible students must participate through a recognized program sponsor to be considered for participation in any occurring national program competition.

Go to <http://www.nawiceducation.org> to determine current competition status.

Section 1: The Project

The Problem

You are a building design contractor. Your company has been contracted to design and build a 120 ft^2–180 ft^2 (square feet) shed on the site provided. Total cost is not to exceed $18,000.00.

You must design a shed that meets the typical needs of such a building, includes the features indicated below, meets your client's needs, and meets the above cost constraint.

Features to include:
- At least (1) window
- At least (1) exterior door
- At least (1) exterior and (1) interior light fixture
- At least (1) interior GFCI
- At least (1) sink

Benefits

Working through The Shed Project
- promotes industry awareness
- promotes industry as viable choice for careers and professions
- fosters presentation and communication skills
- fosters critical-thinking and problem-solving skills
- encourages discipline and teaches students how to follow instructions
- demonstrates the interrelationship of mathematics, science, and technology
- fosters self-esteem
- encourages teamwork
- triggers creative thinking
- enhances dexterity and crafting skills
- encourages neatness and order.

Meeting the Client's Needs

Students need to determine what their client has planned for the shed's use. Will it primarily become a tool shed, a garden shed, a sports equipment storage shed, a general storage shed, or something else?

Are there special requirements such as there are for a conditioned space?

Are there aesthetic requirements that must be met to please the client?

Can students complete the work within their client's time constraints?

Does the budget allow student teams to provide their clients with quality of work?

Project Elements

Floor Plan
- Must be drawn to 1/2″ = 1′ scale
- Must be dimensioned
- Must label all areas of the shed
- Must show location of exterior and interior walls, doors, windows, and plumbing fixtures

Elevations: Front, Rear, Left, Right
- Must be drawn to 1/2″ = 1′ scale
- Must be labeled
- Must be dimensioned
- Must have one elevation per page
- Must show location of all exterior doors and windows

Quantity Take-off
- Must be completely filled in
- Must be accurate according to floor plan

Project Cost
- Must be completely filled in (don't forget to double-check calculations)
- Must be accurate according to floor plan and quantity take-off
- Must not exceed the allowable budget

Site Layout
- Must show location of the shed
- Must adhere to all setbacks and easements

Career Report
- Must be legible; may be handwritten or typed
- Must be written about a construction related career
- Must be approximately one half page long

Project Report
- Must be legible; may be handwritten or typed
- Must describe the students' experience with this project from the design phase to the construction of the model
- Must be approximately one page long

Model
- Must be built to 1/2″ = 1′ scale
- Must be accurate compared to floor plan and elevations
- Must have base size no larger than 16″ x 16″
- May be embellished as desired

Element 1—Floor Plan

Project Criteria

- The maximum size is 120–180 sq. ft.
- The total cost is $18,000 or less.
- The shed must provide
  - at least one window
  - at least one exterior door
  - at least one exterior and one interior light fixture
  - at least one interior GFCI
  - one sink.

Flow (Circulation)

Flow or circulation is the movement from one area 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 congestion as possible. Students may need to consider some of the following design issues:

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

Element 2—Elevations

Before completing elevations, it is best to complete the *Quantity Take-off* and *Project Cost* portions of the project. This will allow any additions or deletions to occur without having to redraw the elevations.

Building elevations are pictorial representations of how buildings will appear from the outside. Elevations typically show

- exterior doors
- exterior windows
- exterior finish (e.g., vinyl siding, brick)
- roof slope
- roofing material (e.g., shingles, metal).

Students must include in their final project, documentation of the following elevations:

- Front
- Rear
- Left
- Right

Directions and Decisions

1. From the floor plan, students should draw lines from outside edges, exterior doors, and windows.

2. Students should determine the height of the garage, which is typically 8'–10' for a shed on block foundation.

3. Door heights are typically 6'–8'.

4. Window heights vary. (See *Project Cost Worksheet* for window size options.)

5. Height to top of roof should be calculated by referring to *Project Quantity Take-off*.

Element 3—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, he or she estimates or has a "take-off person" calculate the quantities of all materials or types of construction involved. To standardize the take-off process, many items are priced according to an established unit value such as square footage, square yards, cubic yards, linear feet, and quantity of each. The following table represents items under their typical unit value type found on a quantity take-off sheet.

Square Feet	Linear Feet	Quantity/Each
Roofing	Cabinets	Doors
Concrete slab	Shelving	Windows
Exterior siding		Electrical outlets
Flooring (sq. yards)		Light fixtures
Exterior walls		Plumbing fixtures
Interior walls		

Element 4—Project Cost

Students should use the quantity of items found with the *Quantity Take-off* to determine the estimated project cost (see *Project Cost Worksheet*). If the cost of the project is less than the allowable amount, you can maximize value by altering material selections or adding items to the shed. Options may include

- adding items, such as shelving, a bike rack, or a tool rack
- using more expensive materials, such as brick rather than vinyl siding
- adding additional square footage. (This step may require students to start over, so it should be used as a last alternative.)

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

Element 5—Site Layout

The shed must fit proportionally on the site. Designers should consider the following:

- Are there any utility easements? Are there any minimum setbacks required by the locality or by the subdivision on the site? The shed cannot sit within any of those areas.
- Are there any elements on the lot you wish to maintain (e.g., trees, special shrubs, plants, existing buildings)?
- Which direction do you want your shed to face? Toward the road, toward a creek or river, or toward the east to get sun in the morning? Use of available light can be important.
- Where will the entry doors be located?
- Is there a plan to create an addition to the shed or any other buildings on the property in the near future?
- Do you plan to build additional outbuildings?

Element 6—Career Report

The *Career Report* is designed to provide students the opportunity to research a construction-related career of their choice. The report should highlight any job title within the Virginia Architectural and Construction Career Cluster (http://www.doe.virginia.gov/VDOE/Instruction/CTE/careerclusters/Arch-portal.html). The report should be approximately one half page in length. Report should include

- job description
- education required
- salary expectations.

Helpful Web sites include

- Know How Virginia (http://www.knowhowvirginia.org/)
- Trailblazers (http://www.ctetrailblazers.org/live_data/live_site_page.php)
- Virginia Career VIEW (http://www.vacareerview.org/)
- Virginia's Career Planning System (http://va.kuder.com/)
- The Career Planning Guide (http://www.cteresource.org/cpg/)
- O*NET (http://online.onetcenter.org/).

Element 7—Project Report

The *Project Report* is designed to provide students the opportunity to write a summary report of their experience with the project, just as construction firms often do. The report should include

- any problems encountered in the design process
- the process of determining the design
- what was learned during the project
- things the student might have done differently.

Element 8—The Model

Models are typically constructed using foam core. Students must be very careful when cutting this material. It is best to cut on a glass or mirror surface for sharp edges and to protect the surface below. The model will be based on the final floor plan. The model base is to be no larger than 16″ x 16″. The model must be in 1/2″ scale to match the floor plan and elevations. Students may embellish the model with interior finishes, siding, roofing, exterior trees, grass, and driveways. However, any additional effort put into the model will not help in the overall project evaluation, though it may score points in the bonus category. (Refer to *The Shed Evaluation Form* for a detailed rubric.)

Section 2: Project Forms

Project Checklist

- ❑ Floor plan
- ❑ Elevations: front, rear, left, right
- ❑ *Quantity Take-off Worksheet*
- ❑ *Project Cost Worksheet*
- ❑ Site layout
- ❑ *Career Report*
- ❑ *Project Report*
- ❑ Model

School _____

Teacher _____

Company name _____

Team members _____

_____

_____

NAWIC representative_____

Quantity Take-off Worksheet

Please show all calculations.

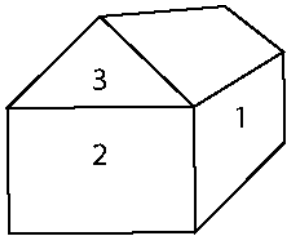
The values from this worksheet are entered into the *Project Cost Worksheet* to calculate the total cost of the shed.

Concrete footing and slab on grade—The floor for the 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 ft²).

Area of slab on grade: (if shed is rectangular or square)	(length) x (width)

Calculations:

Exterior walls and siding—The exterior walls are measured in square feet. Divide the exterior walls into sections where the area can be easily calculated.

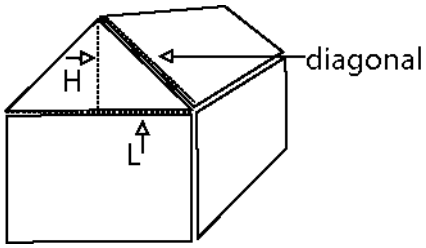


The example to the right was divided into three sections.

Section 1 = Length of garage x height
Section 2 = Width x height
Section 3 = (1/2 x base x height of roof) x 2
Area of an isosceles triangle

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

Roof framing and roofing—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
Length^2+ Height^2= Diagonal^2 L
(Note the L in this equation is equal to 1/2 of the total Width of your shed.)
Diagonal = $\sqrt{(L2 + H2)}$

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

Calculations:

Interior walls—This item is measured in square feet. Add the lengths of all interior walls and multiply by the height. Typically, shed wall heights are 8′.

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 or square yards (sy). Calculate the area of each type of flooring. This is done by multiplying the length of the area by the width of the area. To convert square feet to square yards, divide the square footage by 9.
1 yd^2 = 9 ft^2

Calculations:

Room	**Length**	**X**	**Width**	Total (FT^2)
Work area				
Storage				
Others				
Total sq. ft. of garage:				

Project Cost Worksheet

Date _____ **Group Name** _____

	DESCRIPTION	COST	QUANTITY	TOTAL
Footings and Slab				
	Concrete footing and slab on grade	$7.00/ft^2		$ -
Exterior Walls				
	2" x 4" wood studs, 4" faced insulation	$5.00/ft^2		$ -
	1/2" OSB exterior sheathing			
	2" x 4" wood studs, no insulation	$4.50/ft^2		$ -
	1/2" OSB exterior sheathing			
	1/2" drywall on exterior walls	$2.25/ft^2		$ -
Siding				
	Vinyl	$4.00/ft^2		$ -
	Hardboard	$6.00/ft^2		$ -
	Cedar	$8.00/ft^2		$ -
	Stucco	$10.00/ft^2		$ -
	Brick	$15.00/ft^2		$ -
	Field stone	$22.00/ft^2		$ -
Roofing				
	Roof framing	$6.50/ft^2		$ -
	Shingles, 25 yr.—three tab	$3.00/ft^2		$ -
	Shingles, 40 yr.—architectural	$3.75/ft^2		$ -
	Shingles, premium architectural	$4.50/ft^2		$ -
	Gutters	$4.00/lf		$ -
	Gutters with leaf guard	$8.50/lf		$ -
Interior Walls				
	2" x 4" wood studs, 1/2" drywall each side	$6.25/ft^2		$ -
	4" insulation in walls	$0.75/ft^2		$ -
Doors				
	Interior 2'-6" x 6'-8"	$285.00/ea		$ -
	Interior 3'-0" x 6'-8"	$295.00/ea		$ -
	Exterior 3'-0" x 6'-8"	$375.00/ea		$ -
	Exterior barn doors 6'-0" x 6'-8"	$750.00/ea		$ -

	DESCRIPTION	COST	QUANTITY	TOTAL
Windows				
	Double hung, 2'-4" x 4'-6"	$320.00/ea		$ -
	Double hung, 2'-0" x 3'-0"	$265.00/ea		$ -
Storage				
	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		$ -
	Peg board (for tool storage)	$1.50/ft^2		$ -
Painting				
	Walls	$0.75/ft^2		$ -
	Doors	$40.00/ea		$ -
	Windows	$40.00/ea		$ -
Flooring				
	Vinyl composition tile (VCT) 12" x 12"	$2.50/ft^2		$ -
	Concrete sealer	$0.75/ft^2		$ -
	Sheet vinyl	$3.00/ft^2		$ -
	Epoxy	$5.00/ft^2		$ -
Plumbing				
	Water from house to shed	$1,000.00/ea		$ -
	Sink	$700.00/ea		$ -
	Outside spigot	$300.00/ea		$ -
Electrical				
	Power to shed	$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		$ -
		SUBTOTAL		$ -
		Overhead and Profit, 15%:		$ -
		TOTAL		$ -

The Shed Project Evaluation Form

School _____ **Group Name** _____

CATEGORY		Points Possible	Points Given	Notes
Overall Layout and Appearance of Folder		10		
Drawings				
	Floor plan	12		
	Front elevation	2		
	Rear elevation	2		
	Left elevation	2		
	Right elevation	2		
Quantity Take-off Worksheet				
	Accuracy	8		
	Show mathematics	2		
Project Cost Worksheet				
	Mathematical accuracy	4		
	Under cost constraint	2		
	Use of different items	2		
	Accurate per floor plan	2		
Career Report				
	Content	10		
Project Report				
	Originality	3		
	Content	7		
Project Model				
	Construction	15		
	Follows floor plan and views	6		
	Detail	9		
Bonus Points (max of 10)		0		
	TOTAL (without bonus points)	**100**		
Evaluator's (name)				