



Lesson #2: Wall Framing (15 class periods)

Objectives

Students will be able to...

- Use Decimals in The Accurate Keeping of An Accounting Ledger
- Calculate the Amount of Material Required for A Wall Frame
- Use the Pythagorean Theorem to Establish/Check Layout and Framing for Square
- Develop A Bill-Of-Materials Using Linear Measurement, Perimeter, And Area to Estimate Materials Quantities
- Calculate Material Takeoffs for Floor Frames
- Layout and Construct A Scale Model Wall Using Blueprints
- Identify the Parts of a Wall
- Describe How to Mark the Positions of Framing Members That Make Up Wall Openings
- Describe How Rough Opening Framing Members Are Dimensioned
- Describe the Special Framing Configurations Put in Place Where One Wall Joins Another at Right Angles
- Describe How to Avoid Weakening Key Support Structures
- Build A Wall Frame with Window and Door Rough Opening
- Sheathe A Wall Frame
- Calculate the Correct Size for A Window Header

Standards

LS 11-12.6
RSIT 11-12.2
RLST 11-12.2
Writing 9-10.5
Geometry 5 & 8
Residential and Commercial Construction pathway D2.1, D2.2, D2.3, D3.1, D3.3, D3.5, D3.7, D4.4, D6.2, D6.3, D6.4
Problem Solving and Critical Thinking 5.1, 5.2, 5.3
Health and Safety 6.2, 6.6, 6.7, 6.8, 6.10, 6.12
Responsibility and Leadership 7.3, 7.4, 7.5, 7.6, 7.7, 9.2, 9.3, 9.6, 9.7

Materials

Wall Framing Vocabulary Worksheet

Power Point Presentation

<https://documentcloud.adobe.com/link/track?uri=urn%3Aaaid%3Aascds%3AUS%3A28732e3d-f1d8-463d-a96a-cbba73d3a109>

YouTube video <https://www.youtube.com/watch?v=p6vq-cOAI0Y>

Wall Framing Bill of Materials

Wall Framing Grading Sheet

Wall Framing Skills Rubric

Wall Framing Order of Construction

Wall Framing using the code book worksheet

Wall framing inspection guidelines

Correction notice

Power point shear walls

<https://documentcloud.adobe.com/link/track?uri=urn%3Aaaid%3Aascds%3AUS%3Aba500e7c-07c9-48fc-9ddb-2a4c27acee8d>

Shear walls worksheet

Self-Evaluation Form

Wall Framing Unit Test

Lesson Sequence

- Pass out the **wall framing vocabulary worksheet**. Have students complete their worksheet as you review the vocabulary terms by displaying the **power point** <https://documentcloud.adobe.com/link/track?uri=urn%3Aaaid%3Aascds%3AUS%3A28732e3d-f1d8-463d-a96a-cbba73d3a109>
- Demonstrate to students how to “snap” plate and detail by showing the **YouTube video** <https://www.youtube.com/watch?v=p6vq-cOAI0Y> have students take notes. Answer any questions students may have after the video.
- Pay students if they have successfully passed their “floor inspection.” Then have students figure out how much money they have in their account.
- Pass out the **Wall Framing Bill of Materials** and have each team fill theirs out.
- Pass out the **Wall Framing Grading Sheet**. Review with the students and answer any questions students may have.
- Pass out **Wall Framing Skills Rubric** and go over with students.
- Pass out **Wall Framing Order of Construction**. Review with student and answer any questions.
- Model wall construction- Have your students grab a pair of safety glasses and meet you in the shop. As your students gather around the workbench, have a couple of lumber

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packages, as well as a few prototype walls on display. Demonstrate how the model wall is constructed by reviewing the 1st step in the Order of Construction –Marking the layout on the floor.

- Complete step 2 of the order of construction using their blueprints mark out the layout of the wall on the model’s floor.
- Pass out the ***Wall Framing Using the Code Book Worksheet***. Using the code book, review the worksheet.
- When the construction teams have finished, have them look over the inspection grade sheet and wall framing inspection guidelines. A correction notice can be given if needed.
- Have students’ complete walls 2 and 3. Demonstrate for the window and door placement and top plate.
- Review the ***Power Point Shear Walls***
<https://documentcloud.adobe.com/link/track?uri=urn%3Aaid%3Ascids%3AUS%3Aba500e7c-07c9-48fc-9ddb-2a4c27acee8d> and have students complete the ***Shear Walls Worksheet***.
- Then have students work on step 7 on the order of operations-building the shear wall.
- When teams are finished have them look over the grading sheet and ask to have their second inspection. A correction notice may be given.
- Have students fill out their ***Self-Evaluation Form*** and study for the wall framing unit test.
- Pass out the ***Wall Framing Unit Test***.

Assessment

Informal assessment throughout the whole Wall framing project
Use rubrics and project guidelines to grade student’s final projects
Use Wall Framing Unit Final to assess student learning of floor framing concepts

Accommodations/Modifications

Strategic Partner Pairing
One on One Support
Calculators
Extra Time If Needed
Additional Visuals
Check for Understanding

Wall Framing Vocabulary Worksheet

1. Bottom plate:

2. Stud:

3. Cripple:

4. Rough sill:

5. Trimmer:

6. King stud:

7. Header:

8. Top plate:

9. Double top plate:

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10. Stud-block-stud:

11. Channel:

12. Let-in brace:

13. Fire blocks:

14. Platform framing:

15. Shear panel:

Wall Framing Grading Sheet

When you have completed framing your model walls, you must have it inspected/graded before you can move on. The following are the criteria by which your wall framing will be graded, including the points available for each area.

The walls are parallel, the corners are at right angles and the dimensions match the plans.	30 points _____
Were the walls mapped out on the floor before building?	5 points _____
Are the window and door placed accurately?	15 points _____
Is the exterior walls' top plate doubled and then overlapped at the corners?	25 points _____
All framing parts are accurately placed (i.e. king studs, top plates, etc.)	30 points _____
Has the shear wall been nailed in a staggered pattern?	20 points _____
Total points for floor framing	125 points _____

Wall Framing Skills Rubric

A qualified carpenter...

- Performs all tasks efficiently, with a high level of accuracy
- Understands the application of theoretical principles in the workplace
- Demonstrates sophisticated problem-solving skills when various problems are encountered
- Can teach their peers
- Maintains a safe and clean working environment

Element	4 – Advanced	3 – Proficient	2 – Basic	1 – Below Basic
Floor Framing	<p>The student demonstrates a qualified knowledge of required technical skills through the following behaviors:</p> <ul style="list-style-type: none"> • Identifies all major components involved in the framing of a floor on a raised foundation. • Accurately estimates all materials needed for the construction of a given floor • Constructs floor from sill plating through sub-flooring while maintaining industry standards • Locates and constructs head-outs • Identifies and implements nail schedule • Identifies applicable codes and locates them in code book. • Adheres to all safety rules, and wears appropriate safety gear • Correctly operates and maintains all equipment 	<p>The student exhibits a working knowledge of required technical skills through the following behaviors:</p> <ul style="list-style-type: none"> • Identifies most components involved in the framing of a floor on a raised foundation • Applies appropriate methods of materials estimation • Constructs floor from sill plating through sub-flooring with minimal assistance • Identifies nail schedule • Identifies applicable codes • Adheres to all safety rules, and wears appropriate safety gear • Correctly operates and maintains all equipment 	<p>The student exhibits limited knowledge of required technical skills through the following behaviors:</p> <ul style="list-style-type: none"> • Identifies some of the components involved in the framing of a floor on a raised foundation • Assists in the construction of a floor from sill plating through sub-flooring • Aware of nail schedule • Aware of applicable codes • Does not adhere to all safety rules, and/or does not wear all appropriate safety gear • Lacks knowledge of the proper care and operation of some equipment 	<p>The student exhibits little or no knowledge of required technical skills involved in the estimation and construction of a floor frame.</p>

Wall Framing Order of Construction

Wall framing always looks simple and straightforward, but a mistake here - a wall that's too short or a window opening slightly too small - wastes lots of time and effort later.

In order to make efficient use of your companies' "manpower" you will need to have people or pairs working on different components of the wall frame simultaneously.

For example:

- > One pair could be laying out the wall lines, plating, and detailing,
- > Someone else is building all the outside corners and channels.
- > Another group or individual could be cutting the door and window 'packages' (headers, trimmers, rough sills, and cripples). Just make sure that the person or persons cutting the door and window packages **labels** every member with the symbol for the door or window they belong to as recorded on the prints. Otherwise, your team is going to waste a lot of time trying to figure out which cripple goes to what window, etc.

Wood Materials Bundle

Each company will receive a wood materials bundle containing a 1x12x4' piece of pine planed to 1/2" thick and ripped 28 times at 3/16. This will provide all the 2x material needed by one company. (1) 30" strip of 1/2 x 1/2 pine will cover one company's header needs.

Wood Cut List

1. (12) 2x4x20 [$\frac{3}{16} \times \frac{1}{2} \times 20$] Plating
2. (132) 2x4x8 [$\frac{3}{16} \times \frac{1}{2} \times 8$] Studs, Outside Corners (Stud-Block-Stud), Channels, Trimmers, Rough Sills, Cripples, Fire-Blocking
3. (3) 4x4x10' [$\frac{1}{2} \times \frac{1}{2} \times 10$] Headers

You will need to cut your wood to the desired length as stated in your blueprints.

Check off each step when it has been completed.

_____ 1. **Create Bill of Materials for walls**

_____ 2. **Mark the layout on the floor**

- Eliminate mistakes by chalking a full-size map of your walls directly on the floor.
- Begin by measuring in $\frac{1}{2}$ inch at each corner in both directions.
- Then take a framing square and connect the marks with a straight line. These lines are called "control lines," and we use them to ensure that the walls are straight
- Mark the location of interior walls as well and snap chalk lines on both sides of interior wall locations to ensure correct plate positions.
- Beginning at one end of the house, install all your through-wall plating. Remind your students that through walls go from corner to corner. There will be three through-walls. (through walls go from corner to corner) There will be three through-walls.
- Then measure and cut a top and bottom plate for each. Double-check lengths by setting the plates in their exact position. Tack the plates to one another and the floor with three to four micro-pins.
- Next, install the butt-wall plating. Use a corner marker or square to mark the locations where the butt walls hit the through walls. This is where the stud layout starts. Remember when possible, we always want to have both ends of our walls 'match.'
- Double-check all your layout lines to make sure the walls are parallel; the corners are at right angles and the dimensions match the plans.

_____ 3. **Windows and doors first**

- Find the center of each window and door opening.
- Then divide the "rough opening" (given on your plan) by two and measure out to the left and right of the center mark.
- Write a "T" to the outside of both marks to indicate trimmer locations. Measure over 1-1/2 in. and draw another line.
- Next, measure out $\frac{3}{16}$ of an inch from the trimmer layout line, and draw another line. Mark this with a "K" for "King" stud.
- Mark an "X" outside these marks for the full-height king studs.
- After you have laid out all the doors and windows on your two demonstration walls, you can begin laying out for studs and corners.

4. Transfer layout marks

- Set the plates side by side and transfer the marks from the top plate to the bottom plate using a square.
- Tack the pairs of plates together after marking them so they don't get separated and mixed with other plates.
- Then set them aside until you're ready to build that wall.
- Be sure to mark any and all outside corners and channels as you go.
- When layout is complete, pull one wall at a time up and frame them. Spreading the plates approximately eight inches apart, fill in between with studs on the layout lines.
- Be sure not to place studs in between the king studs of a rough opening. Install studs up to either side of the king studs, and that's it.
- Keep fingers no closer than three quarters of an inch to the joint between the stud and the plate, you may get 'hit' by a pin that 'strays' (comes out of the wood).

5. Headers and cripples

- In wall plans that have openings with cripples above the header, cut and nail together the king studs and trimmers first.
- After the headers are cut, lay them against the plate between their kings, and transfer layout to them. Referring to your door and window cut list for the measurements,
- Measure and cut the top cripples you will need. It seems easiest when working with these small-scale cripples to install them first to the plate by through nailing them on layout.
- On the header, put a dab of glue on each layout mark, and butt the header up against the bottom of the cripples. Install by thru nailing the header to the kings (two pins is plenty) and toe nail the cripples to the header with a single micro-pin.
- Next, assemble your stud-block-stud outside corners, and your three stud channels.
- Once these are complete, install them.
- Next, install the blocking off the corners, and openings.
- Install the blocks at about the middle of the wall, and you should 'stagger' them (one above the line, one below the line, repeat) so you can thru-nail them (try to avoid having to toenail as much as possible, as it really does not work well on the models).
- After the blocks are in, go ahead and cut and install the trimmers, along with any necessary rough sills and bottom cripples. Refer to your door and window cut list for these measurements. Remember that you can check their calculated measurements against the physical walls you have framed and make any necessary adjustments.

6. Top plates

- Once the rough openings are complete, you can install the double top ('cap') plate. Make sure that you need to break the top plate over channels to allow for the 'ear' of the butt wall that attaches to it to lap over and tie-in.
- At the ends, if you have a through wall, you need to cut the plate back to allow for the ear of the intersecting butt wall to lap and tie-in. If the end is a butt, then you need to leave a 1/2 inch ear hang over so that it can lap over the through wall end, and tie-in.

7. Shear wall

- If the wall you are framing is to be shear paneled, it is easiest to square the wall up while lying down and attaching the shear to it. (pull the diagonals to establish square)
- Put a few dabs of glue where the shear is to go, and then tack it in place with a few pins.
- Stiffness in shear walls is also a function of nailing. The closer the nails are spaced on the edge of the plywood, the stiffer the shear wall.
- Recheck the wall for square, and if it is still good, nail the shear panel off with enough pins to hold it in a staggered pattern (12- 24 will usually do it depending on warp).
- Then position and nail them to the plates.
- Set the header on the trimmers and nail through the king studs to hold it in place.
- Then measure and nail the cripples into place.

8. Plumb and line the walls

- After all the walls are framed, stood, and tied-off (nailed together) we can plumb and line them. Plumb and line ensures that as we frame either the next floor or roof on top of the walls, that they are vertically true and straight.

Wall Framing Using the Code Book Worksheet

Directions: Using the *IRC for One- and Two-Family Dwellings*, find the answers to the following questions:

1. What chapter and section numbers do you find the codes governing wall framing?
chapter: _____ section numbers: _____
2. What are the 3 minimum stud grades that can be used to frame a wall?
a. _____ b. _____ c. _____
3. How far apart (in feet) must joints in the top plates be?
a. _____
4. Under what section number will you find the code addressing the bottom or sole plate?
a. _____
5. According to Table R602.3(1) what size nails and how many of those nails must be used to end nail studs to the top and bottom plate?
quantity: _____ size: _____
6. Using the appropriate tables in section 602.3(5) find the maximum on-center spacing of 2x4 studs when supporting one floor, roof, and ceiling. Please state your answer in inches.
a. _____
7. According to Figure R602.3(1), what section will you find the provisions for drilling and notching studs?
a. _____
8. According to Figure R602.3(1), what do we call a wall that carries a load from above?
a. _____
9. According to Table R602.3.1, what is the maximum allowed height of a 2x6 stud when spaced at 16" OC and supporting only a roof? (state you answer in feet).
a. _____
10. Using the figures R602.6(1) and (2), what **percentage** of a stud's width can be bored out to allow for plumbing, electrical, etc.?
a. _____

Wall Framing Using the Code Book Worksheet – *Answer Key*

1. Chapter 6 Section R602
2. No. 3; standard; stud grade lumber
3. No less than 24 inches
4. R602.3.4
5. 4-5 d box; 2 ½" X 0.113"
6. 24 inches
7. R 502.8
8. Typical wall
9. 20 feet
10. 40%

Wall Framing Inspection Guidelines

When inspecting, or being inspected, two criteria must be met.

1. Is the structure built to code?
2. Does the structure build to the prints?

If either of these criteria are not met at any time during the construction of any structure, then that structure will fail inspection. Failed inspections can hurt your production schedule, budget, and ultimately your company.

1. Are the corners all at right angles and the dimensions match the plans? _____
2. Was the wall mapped out on the floor before building? _____
3. If there are windows and doors are, they placed accurately? _____
4. Are the exterior walls' top plates doubled and then overlapped at the corners? _____
5. All framing parts are accurately placed (i.e. king studs, top plates, etc.) _____
6. Has the shear wall been nailed in a staggered pattern? _____

To successfully pass inspection, the model of the construction company you are inspecting must meet **all** the above codes and specifications (specs). Even if only one code or spec is not met, the model (and the company that built it) will fail the inspection.

If you pass a model's wall framing, you must justify your decision in writing. You must explain how/why the model wall framing passed inspection as opposed to failed. Your report must be at least one half of a page long, and spelling and grammar count. If these writing requirements are not met, then all the employees of your company will be penalized by a loss of points on the assignment.

If you fail a company for a violation of any of the codes/specs listed above, you must record why they failed, and what they must do to correct the problem(s). You must fill out a "Correction Notice" and leave it with the company president of the model wall you are inspecting. Your construction team will inspect the wall as a group, but writing the report is done by only one member of the company.

There will be five inspections: (2) for floor framing, (2) for wall framing, and (1) for roof framing.

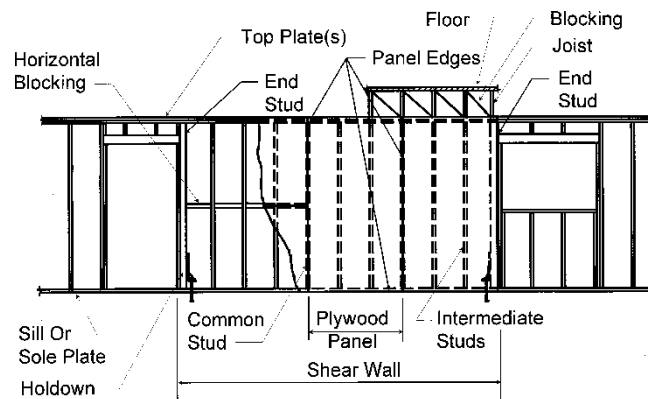
Every member of your company must take a turn writing at least one report during the construction phase of this project.

Shear Walls Worksheet

The requirement for bracing conventional wood frame dwellings is not new. For years, homes have been successfully braced using a variety of techniques, even before the first building codes in the United States required it. Conventional wood frame dwellings must be adequately braced to resist lateral (racking) forces due to wind and earthquakes. To achieve this structural safety objective, several wall bracing options and requirements are offered prescriptively in the 2009 International Residential Code IRC Section R602.10, Wall Bracing.

2305.1 General. Structures using **wood-frame shear walls or wood-frame diaphragms to resist wind, seismic or other lateral loads shall be designed and constructed in accordance with AF&PA SDPWS** and the applicable provisions of Sections 2305, 2306 and 2307.

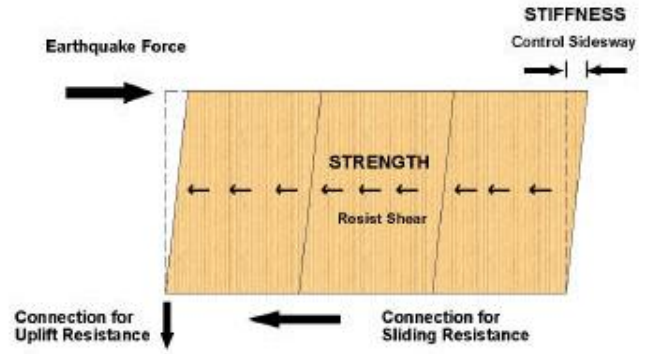
What are shear walls?



Where should shear walls be located?

What types of forces do shear walls resist?

What are the functions of a shear wall?



How do shear walls provide strength?

How do shear walls work?

Self-Evaluation Form

1. What I had learned from this project ...

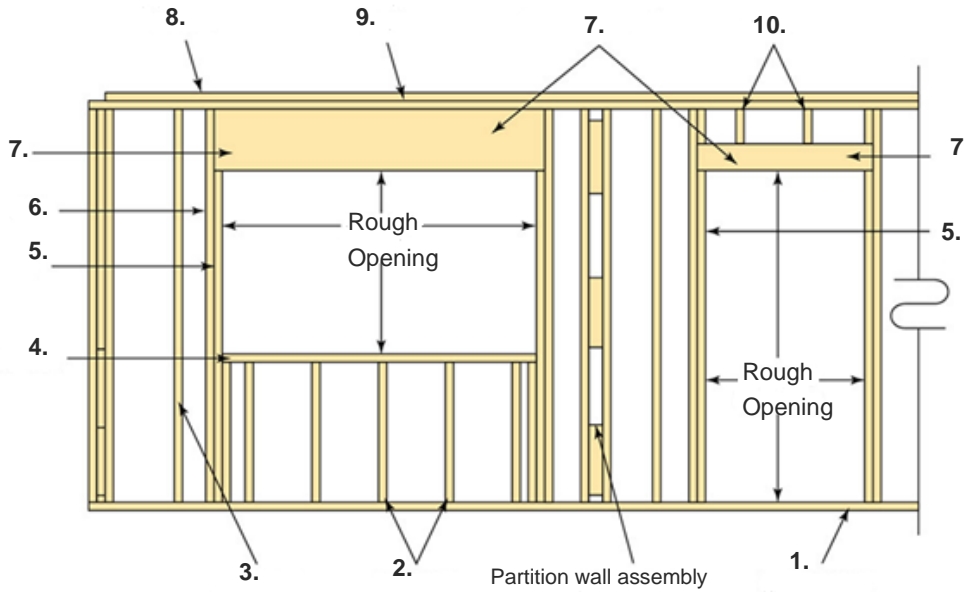
2. Parts of the project I am most proud of ...

3. Safety practices I have been observing...

4. What I have learned that I should be doing, from this point on, to ensure any other projects have an excellent outcome.

Wall Framing Unit Test

Directions: Identify the numbered wall components.



1.	6.
2.	7.
3.	8.
4.	9.
5.	10.

11. What is the main vertical member of a wall?

- A. Stud B. Plate C. Spacer D. Trimmer

12. What member of a wall holds up the header?

- A. Stud B. Plate C. Spacer D. Trimmer stud

13. What is the member of a wall that goes directly over the opening for a window or door?

- A. Footer B. Header C. Stud D. Trimmer

14. What is the name of the member of a wall that goes directly next to the trimmer stud?

- A. Jack stud B. Cripple stud C. King stud D. John stud

15. What is the lowest horizontal member of a wall?

- A. Bottom Plate B. Double Plate C. Stud D. Header

16. What is the uppermost horizontal member of a wall?

- A. Double plate B. Top plate C. Sill plate D. Upper plate

17. What horizontal member of a wall forms the bottom of the window opening?

- A. Rough seal B. Rough plate C. Rough stud D. Rough sill

18. What is the vertical member of a wall that is shorter than a common stud and either goes between the header and the top plate or between the sill and the bottom plate?

- A. Trimmer stud B. Cripple stud C. Unique stud D. King stud

19. What horizontal member of the wall lays directly below the double plate and has studs nailed to it?

- A. Lower plate B. Sill plate C. Cripple plate D. Top plate

20. What is the plywood layer called that lays directly between the floor joists and the bottom plate?

- A. Floor B. Subfloor C. Top floor D. Quarter floor

Basic Stud Frame Construction

Directions: Fill in the blanks.

21. Stud framing has a _____ plate (sole plate) which is connected to the _____.
22. Placing an "X" on one side of both the _____ plate and _____ plate, indicates that they go together.
23. In choosing a top and bottom plate, lay the boards side-by-side to ensure they are equal in _____.
24. Two common distances in measuring are _____ inch centers and _____ inch centers.
25. When installing cripples in corners, nail the cripple _____ with the stud at then _____.
26. Wall structures are built _____ and then stood in place.
27. The _____ _____ of a standard door is six-foot 10 inch to six-foot 10 inch.
28. A _____ is placed at the top of the door opening with a _____ between two boards.
29. When framing a door, _____ should be placed where _____ should be.
30. When a top plate is spliced, it is spliced directly _____ a stud.

Wall Framing Unit Test – Answer Key

1. Sole plate, bottom plate
2. Cripple stud
3. Common stud
4. Rough sill
5. Trimmer stud
6. King stud
7. Header
8. Double top plate
9. Top plate
10. Cripple stud
11. A
12. D
13. B
14. C
15. A
16. A
17. D
18. B
19. D
20. B



Wall Framing Bill of Materials

Part #	Description	Material Type	Dimensions (calculate footage)		Footage (bd/ft, lin/ft, sq/ft)	Quantity Of Parts	Unit Cost	Total Cost
				=				\$-
				=				-
				=				-
				=				-
				=				-
				=				-
				=				-
				=				-
				=				-
To calculate board feet with all measurements in inches:					<u>T x W x L</u>			
					144			
							Total Cost:	\$-