Lesson A3–5

Planning and Placing Concrete

Unit A. Mechanical Systems and Technology

Problem Area 3. Construction Systems

Lesson 5. Planning and Placing Concrete

New Mexico Content Standard:

Pathway Strand: Power, Structural and Technical Systems

Standard: **VIII:** Plan, implement, manage, and/or provide support services to facility design and construction; equipment design, manufacture, repair, and service; and agricultural technology.

Benchmark: **VIII-B:** Follow architectural and mechanical plans to construct building and facilities.

Performance Standard: **1.** Identify and select appropriate building materials. **9.** Construct with concrete, stone, and brick.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Describe how to plan the job.
2. Discuss preparation for the concrete pour.
3. Explain placing, finishing, and curing concrete.

List of Resources.

The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Herren, Ray V. and Elmer L. Cooper. *Agricultural Mechanics Fundamentals & Applications*. Albany, New York: Delmar Publishers, 2002. (Text, Lab Manual, and teacher's Manual—Unit 38)

Johnson, Donald M., et al. *Mechanical Technology in Agriculture*. Danville, Illinois: Interstate Publishers, Inc., 1998. (Textbook, Chapter 18)

Phipps, Lloyd J., et al. *Introduction to Agricultural Mechanics,* Second Edition. Upper Saddle River, New Jersey: Prentice Hall Interstate, 2004. (Textbook, Chapter 14)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheets
Concrete tools
Ingredients to pour concrete

Terms.

The following terms are presented in this lesson (shown in bold italics):

Bag mix
Broom finish
Bull float
Calcium chloride
Coarse aggregate
Concrete
Concrete drag
Concrete edger
Concrete form
Concrete jointer
Curing
Darby
Earthen form
Fine aggregate
Float finish
Floating
Form nails
Gallon mix
Magnesium or wooden hand float

Portland cement
Power trowel
Reinforcing bars
Reinforcing wire
Steel hand concrete finishing trowel
Striking off
Troweled finish

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Ask the students if anyone has poured and finished concrete. Talk about the advantages of using concrete. It is moldable, fire-safe, strong, resists abrasion, insect and rodent proof, storm resistant, permanent, watertight, and economical. Talk about where concrete is used (floors, footings, patios, etc.). Ask if they would like to know how to set forms, pour, and finish concrete.

Summary of Content and Teaching Strategies

Objective 1: Describe how to plan the job.

Anticipated Problem: What do you need to know before pouring concrete?

I. ***Concrete*** is a mixture of coarse aggregate, fine aggregate, portland cement, and water. ***Coarse aggregate*** is gravel. ***Fine aggregate*** is coarse sand. ***Portland cement*** is a cement that is made from burning lime, silica, iron oxide, and alumina together. Gypsum is then added. It acts as a glue that holds everything together.

A. Concrete needed for the job is figured and sold by the cubic yard. We commonly drop the word "cubic" and refer to purchasing concrete by the yard. To calculate the amount needed convert the length, width, and thickness into feet, multiply them together, and divide by 27. One cubic yard is 27 cubic feet. For example a concrete driveway 18 foot × 30 foot poured six inches thick would be 10 cubic yards (18 × 30 × .5 ÷ 27 = 10 cubic yards).

B. Select quality materials to be mixed. If soil is present in the sand or gravel, the result will be weak concrete.

C. Mix ingredients in the correct proportions. Driveways, walks, floors, and watertight foundations should be a six gallon mix, while foundation walls, footing, and mass concrete can be a seven gallon mix. The term ***gallon mix*** refers to the number of gallons of water used with a bag of cement. In general less water means stronger concrete. The term ***bag mix*** refers to the number of bags or sacks of cement used per cubic yard of concrete. A six bag mix would have, for example, six bags of cement per cubic yard. The

correct proportions for a six bag mix would be one part cement to 2¼ parts fine aggregate to 3 parts coarse aggregate.

D. An important part of planning is purchasing material to build concrete forms and assembling tools needed for digging, building and setting forms, installing reinforcement, pouring concrete, and finishing concrete.

Learn the terms and definitions in this section. Either of the recommended texts should be helpful to students in accomplishing this. Have them read the suggested chapters in either reference. Use TM: A3–5A and LS: A3–5A to practice figuring the amount of materials needed to complete a concrete job.

Objective 2: Discuss preparation for the concrete pour.

Anticipated Problem: What do I need to do before the concrete arrives?

II. Concrete may be mixed in a wheelbarrow using a shovel or the ingredients may be shoveled into a small electric or gasoline powered mixer. Most people purchase ready-mixed concrete from a local supplier.

A. In many cases the area where concrete is to be poured or placed must be dug out. For example, driveways and sidewalks are generally one inch above the ground level when finished. Small areas may be dug with a shovel but larger areas need a backhoe, grader blade, or loader bucket to speed up the job. In some cases, like a floor, the concrete should be level while in other situations, like a driveway, the concrete should slope away from the house.

B. A ***concrete form*** is a frame or mold that holds new concrete in shape until it has set or hardened. The forms must be strong and rigid to prevent sagging, bulging, and spreading. Freshly poured concrete exerts great pressure. A trench dug in the ground with solid walls is an ***earthen form*** that is used for concrete footing. When wooden forms are used they must be tight to prevent the escape of the water-cement paste. A tightly stretched nylon line is useful to set the forms in a straight line. Wooden stakes are used to hold the form boards in position. For small jobs, a four foot level on top of the form can be used to either set the forms level or sloping. A surveying level is needed to set larger jobs. ***Form nails***, also called scaffold nails, are a double-headed nail used to fasten the boards to the stakes. Coating forms with used motor oil or diesel fuel and using form nails make form removal much easier.

C. Once the forms are set, fill sand or rock should be added if the area is too deep. A drag board can be used as fill is added so that the recommended thickness of concrete will be poured. The fill, especially sand, should be packed or tamped down so that it is solid. Do not use soil as fill because it will settle later leaving a void or hole under the concrete.

D. Consider placing a sheet of plastic on top of the fill if the weather is very warm and you would like to slow down drying and curing time. Also concrete floors with plastic under them are less likely to be damp.

E. Areas where heavy equipment will drive over concrete or where freezing and thawing are a problem, should be reinforced. ***Reinforcing bars*** are steel bars with ridges that bond

with the concrete. They are commonly seen in the construction of highways and bridge decks. ***Reinforcing wire*** comes in rolls with wire rectangles or squares approximately 6 inches on center. It is used in lighter construction such as patios and sidewalks.

F. In hot weather consider spraying the area to be poured with water when the concrete arrives.

G. Whether you mix your own or buy ready-mixed concrete be sure there are no dry clumps and the concrete is thoroughly mixed. The water content is very important. Extra water will result in weak concrete but concrete that is too dry is very difficult to pour and level off. Watch experienced concrete finishers or hire one to help the first time you pour concrete.

H. Fiberglass fibers may be added to the concrete as it is mixed at the ready-mix plant as a way to reinforce it.

I. If concrete is poured in cold weather ***calcium chloride*** is added to prevent the concrete from freezing as it cures. Building paper or straw can be used to cover the concrete after it is finished and while it is curing.

Visit a site where forms are being set in preparation for pouring concrete. Visit the local ready-mix plant or use a concrete finisher as a guest speaker. Before visiting the sites, use the recommended texts to provide students with more information. Look for an opportunity in the school or community to set forms for a concrete pour. Use LS: A3–5B to make the forms for pouring stepping stones.

Objective 3: Explain placing, finishing, and curing concrete.

Anticipated Problem: How is concrete placed, finished, and cured?

III. Placing and finishing concrete should not be attempted without having plenty of labor. Once concrete is mixed the drying and curing process begins and you are working against the clock. Be sure all the placing and finishing tools you need are on hand.

A. When pouring concrete, common tools such as shovels, spades, rakes, and concrete drags are needed to move and spread the material. Since concrete is so heavy, it is best to move it downhill with a chute. The closer the concrete chute is to where the concrete is needed, the less work is required. In areas where the chute cannot reach use a wheelbarrow. The concrete should be pushed, pulled, or lowered rather than lifted. A ***concrete drag*** is a solid blade with a handle used to push or drag concrete into low spots. ***Striking off*** concrete is using a drag board that is usually a 2 × 4 or a 2 × 6 that is used to "saw" back and forth to level the concrete. One person is needed at each end of the drag board and a third person with rubber boots and a concrete drag in the middle of the concrete make a good team for placing concrete. Other workers are needed to operate the wheelbarrows and shovels. A drag board vibrator can be clamped to two drag boards. One person with the drag board vibrator can do the same work as two people without it. The concrete should be dragged twice before going on to the next step.

B. Use a hammer to tap the form boards or a spade jabbing up and down inside the form board to vibrate the fine material next to the form board.

C. The next step, ***floating***, pushes the rocks down and brings the sand-cement paste to the surface and begins the smoothing process. A ***magnesium*** or ***wooden hand float*** is used to smooth the area near the edge of the work area. A ***darby*** is a two handed float usually 18" long that is also used near the edge. A ***bull float*** is a 36 or 42 inch float with a long round handle used to reach the areas away from the edge.

D. A ***concrete edger*** is used to push the rocks down near the form board to round the edge prevents a chipping or breaking when the form board is removed.

E. A ***concrete jointer*** is used to put grooves across concrete areas like sidewalks. The joint helps the appearance and provides a relief area making cracks in concrete less noticeable. After floating, edging, and jointing, it is time to finish the concrete.

F. A ***float finish*** leaves a rough finish that is acceptable for a livestock feeding floor or footing. A ***troweled finish*** is a very smooth finish used for basement and garage floors. A ***steel hand concrete finishing trowel*** is used for small jobs and near the edge on large jobs. A ***power trowel*** is a gasoline powered trowel with three or four blades used to finish large areas. A ***broom finish*** is made by using a coarse bristle concrete broom or floor broom either after floating or after troweling. The broom finish is often used on driveways and sidewalks for added traction.

G. ***Curing*** is the process of concrete drying and hardening. The slower the moisture leaves, the stronger the concrete will be. Spraying the concrete with water every day of the first week and covering the concrete with plastic or a tarp is helpful. Allow the concrete to cure for at least 7 days prior to driving vehicles on it.

The recommended textbooks do a good job of walking students through the content of this objective. Have them read the appropriate chapters. Show the tools needed to place and finish concrete. Use TM: A3–5B to help students identify concrete tools. Look for an opportunity in the school or community to pour and finish concrete. Use LS: A3–5B to pour and finish concrete stepping stones.

Review/Summary. Have each student pick up a concrete tool to identify and tell the class how that particular tool would be used. Review the process of selecting the right bag mix and calculating the quantity needed. Have a student volunteer place the steps involved in pouring and finishing in order on the chalk board (striking off, floating, edging, jointing, troweling). Review the types of finish and situation where each is recommended.

Application. Use the lab sheets to calculate the amount of concrete needed, build concrete forms, pour concrete, and finish concrete.

Evaluation. Give the written test and evaluate the skill displayed through the use of the lab work.

Answers to Sample Test:

Part One: Matching

1 = c, 2 = a, 3 = d, 4 = e, 5 = f, 6 = b, 7 = g, 8 = h

Part Two: Completion

1. Concrete
2. coarse sand
3. gravel
4. oil, diesel fuel
5. 27
6. less
7. curing
8. bars, wire

Part Three: Short Answer

1. Float finish is the roughest, followed by the broom finish, with the trowel finish the smoothest.
2. Six bags of cement/cubic yard of concrete.
3. Seven gallons of water used per bag of cement.
4. Cement is one of the ingredients in concrete.

Sample Test Name _____

Test

Lesson A3–5: Planning and Placing Concrete

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. bull float	d. edger	g. striking off
b. concrete drag	e. hand trowel	h. vibrator
c. darby	f. jointer	

_____ 1. A two-handed concrete float.

_____ 2. A concrete float that is usually 42 inches long with a magnesium pole handle.

_____ 3. Used to round the concrete next to the form board.

_____ 4. Used near the edge of the concrete to do the final smoothing.

_____ 5. Used to put a groove across a concrete sidewalk every three or four feet.

_____ 6. Used to remove excess concrete near the drag board.

_____ 7. The process of leveling using a drag board.

_____ 8. Can be attached to a drag board to help level the concrete.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. _____ is a mixture of coarse aggregate, fine aggregate, cement, and water.
2. Fine aggregate is actually _____ _____.
3. Coarse aggregate is actually _____.
4. Form boards will be easier to remove if they have been coated with _____ or _____ _____ before the concrete is poured.
5. There are _____ cubic feet in one cubic yard.
6. In general the _____ water used the stronger the concrete.
7. The process where concrete dries out and hardens is called _____.
8. Concrete can be strengthened by using reinforcing _____ or reinforcing _____.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. Compare the float, broom, and trowel finish:

2. What is meant by a 6-bag mix?

3. What is meant by a 7-gallon mix?

4. How are concrete and cement different?

TM: A3–5A

CONCRETE MIXTURE RECOMMENDATIONS

Foundation Footing and Walls

1 : 2¾ : 4 – 7

Parts (cu ft) of Cement	Parts (cu ft) of Sand	Parts (cu ft) of Aggregate	Gallons of Water

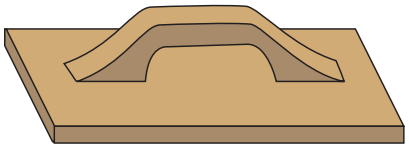
Water-tight Floors and Foundations

1 : 2¼ : 3 – 6

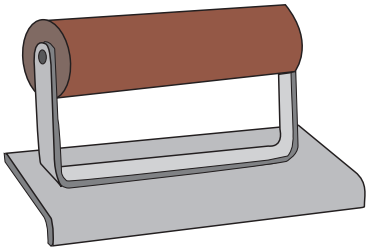
Parts (cu ft) of Cement	Parts (cu ft) of Sand	Parts (cu ft) of Aggregate	Gallons of Water

TM: A3–5B

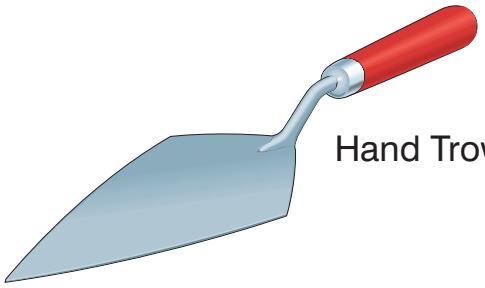
CONCRETE PLACING AND FINISHING TOOLS



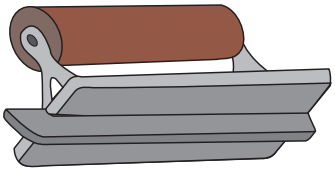
Concrete Hand Float



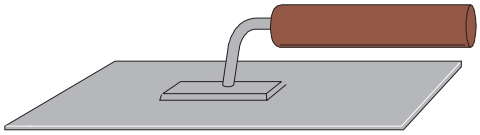
Concrete Edger



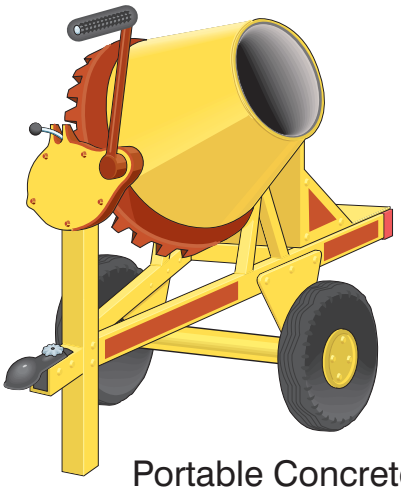
Hand Trowel



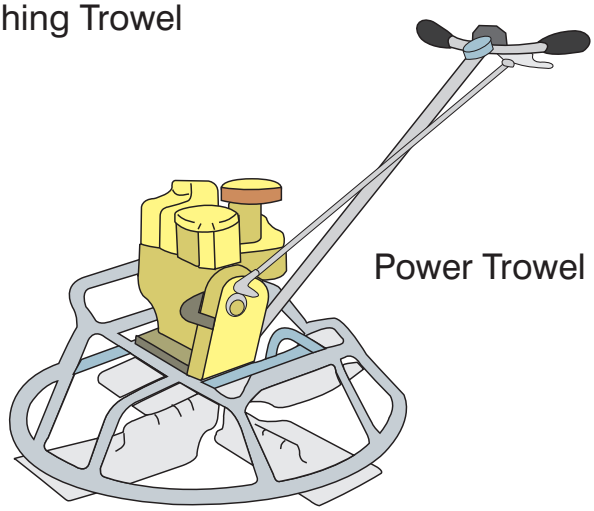
Concrete Jointer



Concrete Hand Finishing Trowel



Portable Concrete Mixer



Power Trowel

(Courtesy, Interstate Publishers, Inc.)

Name _____

Lab Sheet

Calculating Concrete Needed

1. How much concrete would you order for a 30 foot × 40 foot shop floor 4 inches thick?

2. How much concrete would you order for an 18 foot × 30 foot driveway 5 inches thick?

3. Given information: 10 cubic yard of a 6-bag 7-gallon mix
   a. How many bags of cement would be needed?

   b. How many gallons of water would be needed?

   c. How many pounds of sand are needed?
   (14 cu. ft./cu. yd. and 91 pounds/cu. ft)

   d. How many pounds of gravel are needed?
   (19 cu. ft./cu. yd. and 100 pounds /cu. ft.)

LS: A3–5B Name_____

Lab Sheet

Making Concrete Stepping Stones

1. Determine the size and style of stepping stones you want to make.
2. Make a top view drawing, cutting list, and bill of materials. The most common sizes are 12 inch and 18 inch square.
3. Build forms. Use 1 × 4 or 2 × 4 screwed together.
4. Coat the inside of the forms with used motor oil so they can easily be removed after the concrete cures.
5. Mix a 1:2:3 mixture in a wheelbarrow.
6. Pour the concrete into the form. Strike off the concrete with a piece of 2 × 4.
7. Use a trowel to jab down along the inside of form to push the rocks away and bring the cement paste to the edge. Also tap the outside of the form with a hammer.
8. Use a concrete edger to round the edge of the concrete.
9. Float the surface leaving a slightly rough surface. Color pigment add can be floated into the surface if desired.
10. For an aggregate finish add a layer of pea gravel or landscape rocks and float it into the concrete surface so that half of the pebbles are embedded in the concrete. Use water and a stiff brush to clean the concrete coating off of the pebble surfaces as the concrete hardens.
11. After the concrete has cured one day, take out the screws and remove the forms.

 Name_____

Lab Sheet Key

Calculating Concrete Needed

1. (30 × 40 × 4/12) / 27 = 14.8 cubic yards
2. (18 × 30 × 5/12) / 27 = 8.3 cubic yards
3. a. 6 *bags/yd* ×*10 cu. yds* = *60 bags*
   b. 60 bags × 7 gal/bag = 420 gallons of water
   c. 10 cu. yds. × 14 cu. ft./cu. yd. = 140 cu. ft.
      140 cu. ft. × 91 pounds/cu. ft. = 12,740 pounds
   d. 10 cu. yds × 19 cu. ft/cu. yd. = 190 cu. ft.
      190 cu. ft. × 100 pounds/cu. ft. = 19,000 pounds