Oakland CUSD #5

Ag Mech
May 4 - 8, 2020

Jeff Coon

Week ofMay 4-10, 2020

All of these assignments are on google classroom. You must pick one of the 3 listed and complete by next Monday May 16th for credit. If you would like to use google docs to complete the work that would be most efficient, just remember to start a new copy with your own work please. Paper copies can be returned to the school.

Class	Choice 1	Choice 2	Choice 3
Ag Science	CDE	DNA	Ag and Environment
Ag Business Mang	Investments	Life Insurance	Bus. Plan
BSAA	Seed Germination	Animal Diseases	Ag and Environment
Landscape Design	Soil Erosion	Annuals and perennials	Building walls and decks
Intro To Ag	FFA Meetings	FFA opportunities	Role of Agriculture
Ag Mech.	Concrete	Hydraulics	GIS

Ag Mech. Coon option 1 Concrete May 4 Name

Checking Your Knowledge:

1. What are the different components of concrete?

2. What is hydration?

3. Explain how to use the absolute volume method.

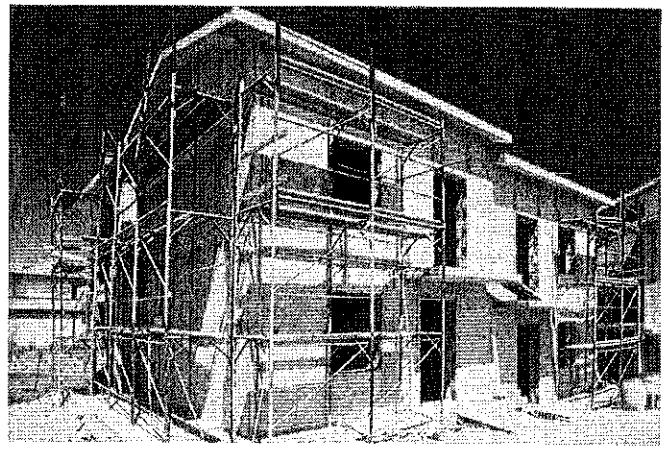
4. Describe each type of concrete reinforcement.

5. List each type of tool used in finishing concrete as well as its function.

Ag Mech 5-4 - #1

Concrete Components and Tools

CONCRETE is a versatile construction material that can be formed into any desired shape. It is often used as a building foundation material. However, it is also used for sidewalks, driveways, roads, and more. Building a quality concrete project requires the proper ingredients and the proper finishing.



Objective:

Identify concrete components, proportions, and tools used in a project.

Key Terms:

absolute volume method
aggregates
binder
bleed water
concrete
hydration
reinforced concrete
slump

Understanding Concrete Components and Tools

Concrete is a heavy, pourable construction material made from a paste and aggregates that creates a strong, stone-like material when set. It comes in many forms and compositions for various uses.

CONCRETE COMPONENTS AND CHARACTERISTICS

Concrete comes in many mixes and types. Each has characteristics that make it an excellent construction medium. When tooled correctly, the result is an attractive and functional concrete structure.

Forms of Concrete

Three types of concrete are ready-mix, precast, and prepackaged mixes. Ready-mix concrete is batched at a local plant and delivered in a truck with a rolling drum. It accounts for three-

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quarters of all concrete sold. In contrast, precast concrete consists of products made from molds cast in a factory with tight quality-control measures. One of the most common precast products is concrete blocks, but products range from molded septic tanks to concrete planters.

Prepackaged concrete mixes are concrete aggregates and dry paste materials batched and sold in 40-, 60-, and 80-pound bags. The contents of the package are mixed with water by the end user. Bags of prepackaged concrete are usually sold at home improvement stores and are most often used for small projects (e.g., sidewalk repair and setting fence posts).

Composition of Concrete

Concrete is composed of several elements, one of which is binder. **Binder** is a dry powder that forms a paste when mixed with water and glues the aggregates together when it cures. When the paste cures (hardens), it holds, or binds, the aggregates together. Binders are most often made from Portland cement.

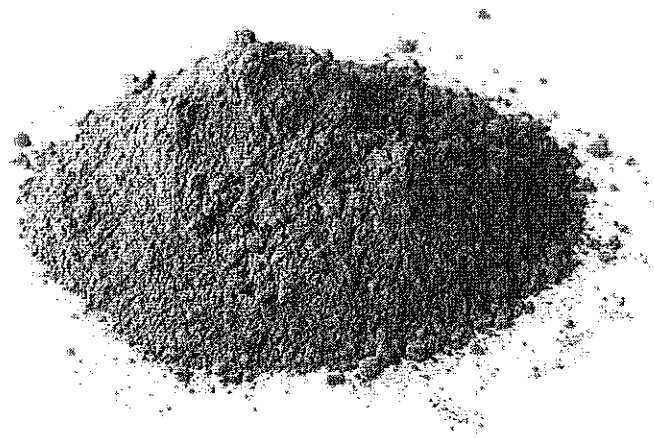

FIGURE 1. Portland cement is a dry powder that forms a paste when mixed with water.

Portland cement is limestone, shells, and chalk mixed with shale, clay, slate, blast furnace slag, silica sand, and/or iron ore. Then it is heated to form a rock-like substance that is ground into a powder to form the binder known as Portland cement. Binders tend to be the most expensive element of concrete.

Aggregates

The **aggregates** are sand, gravel, or crushed stone that create the "skeleton" of the concrete and provide it with strength. Concrete aggregate accounts for 60 to 80 percent of the total volume of a concrete mix. The desired characteristics of the concrete determine the type, size, and amount of aggregate.

Aggregate material may be sand or coarse stone and comes in two main sizes: coarse and fine. Coarse granules are greater than $^3/_{16}$ of an inch. Fine granules are typically sand or broken down rock, gravel, or industrial particles less than $^3/_{16}$ of an inch.

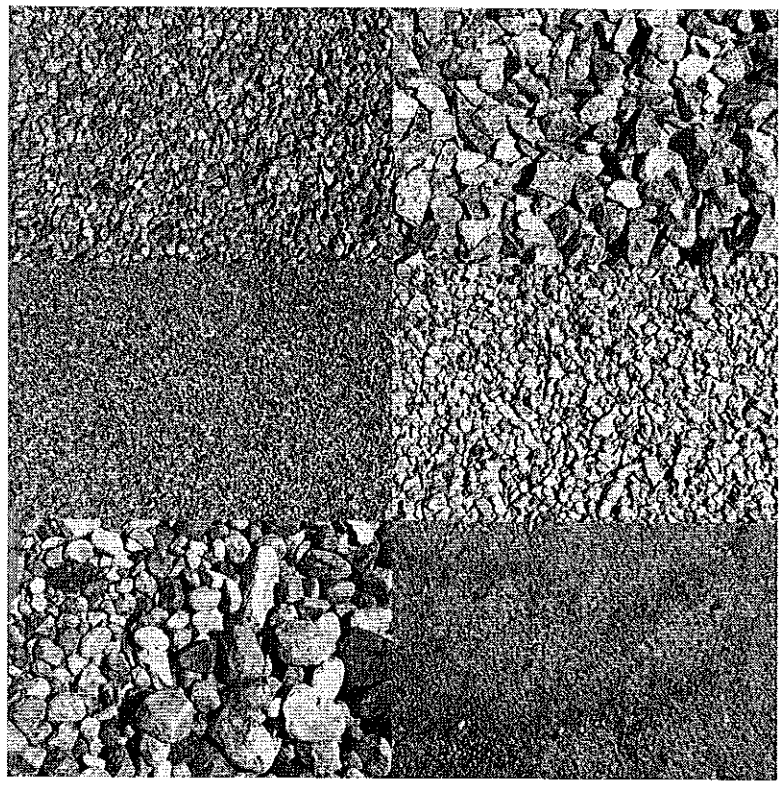

FIGURE 2. Concrete aggregate is sand, gravel, or crushed stone that creates the "skeleton" of the concrete and provides it with strength.

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ON THE JOB...

CAREER CONNECTION: Concrete Engineer

A concrete engineer designs and oversees construction projects that use concrete as a structural member. A concrete engineer is a civil engineer who specializes in the science behind concrete design. As a specialist in concrete, the engineer often earns $80,000 a year. A Bachelor of Science in Civil Engineering is required to be hired by many companies. Also, a concrete engineer often is required to obtain a professional engineer license. To obtain the license, the engineer must work under someone with a license for at least four years and pass an exam. Some of the job duties are determining the project budget, determining the ingredients of a concrete mix for a project, and ensuring that the use of the concrete will construct a safe, strong, and long-lasting structure.

The larger the size of coarse aggregate, the less binder is needed. Fine aggregate is used to fill the space between the coarse aggregate and to increase the workability of the concrete. When mixing concrete, the spaces between the aggregate must be filled with binder material.

Hydration

Water is used to create a paste out of the dry cement binder and moisten the surfaces of the aggregate. When water is added to the binder, a chemical reaction is created between the cement and water called hydration. **Hydration** is a chemical reaction between the compounds in a binder that form chemical bonds with water molecules. Hydration begins the hardening process—curing—of concrete. The byproducts of the chemical reactions are newly formed compounds and the release of heat. When the hydration process is complete, a synthetic rock-like substance is formed called concrete.

PROPORTIONING CONCRETE

Concrete is made by proportionally adding each ingredient by volume to the concrete mix. The purpose of selecting proportions is to produce an adequate quality of concrete appropriate for its intended use, while considering the cost to produce the material.

Concrete Design Characteristics

Before proportioning a concrete mix, know the desired size, shape, and strength required of the concrete project. This aids in choosing aggregate sizes and types. Consider the following factors when designing a concrete mixture: workability, strength, durability, appearance, and economy. Each of these factors will influence the decisions that determine the proportions of each element of the concrete.

Absolute Volume Method

The proportions required of each ingredient for the concrete mix are determined by the **absolute volume method**, which is a process of selecting volumes of concrete mixture

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Absolute Volume Formula:

Absolute Volume ft^3 / yd^3 = Weight/ (specific gravity of material *62.4 lb.-$ft.^3$)

Where:

- 62.4 lb.-ft.3 = the density of water
- Specific Gravity = a measurement of how dense a material is

FIGURE 3. The absolute volume method is the most common method used for determining concrete mix proportions.

ingredients based on the mass of the ingredients per cubic yard. The proportions of concrete ingredients determine the volume of each ingredient needed to make 1 cubic yard, or 27 cubic feet, of concrete. Absolute volume is measured in cubic feet per cubic yard.

The absolute volume formula is Absolute Volume $ft.^3 / yd.^3$ = Weight / (Specific Gravity of Material * 62.4 lb. - $ft.^3$). Specific gravity is a measurement of how dense a material is compared to water. Several steps are used to determine concrete ingredient proportions through the absolute volume method.

Determine Slump

First, determine the desired **slump**—a measure of the consistency of freshly mixed concrete. The American Concrete Institute, ACI, sets slump recommendations for various types of concrete applications. Slump is measured by using a slump cone, which is a 12-inch high cone with an 8-inch base and a 4-inch top. Then the cone is filled level with concrete and is lifted straight up to remove. With the concrete free from the support of the cone, it is allowed to fall or slump from its original height. Finally, slump is measured by the distance the concrete slumps from its original height. It is measured to the nearest $1/4$ inch.

TABLE 1. Slump Recommendations for Various Types of Concrete Applications

Types of Construction	Slump, in.	
	Maximum+	Minimum
Reinforced foundation walls and footings	3	1
Plain footings, caissons, and substructure walls	3	1
Beams and reinforced walls	4	1
Building columns	4	1
Pavements and slabs	3	1
Mass concrete	2	1

Source: ACI 211.1-91, *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete*. Reproduced with permission from the American Concrete Institute.

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Determine Aggregate Size

Identify the coarse maximum aggregate size needed to properly proportion concrete. Coarse aggregate should never be larger than 1/5 the distance between side forms, 1/3 the depth of a slab, or 3/4 the distance between rebar. For example, a 6-inch thick slab would have a maximum coarse aggregate size of 2 inches. Using a large coarse aggregate produces fewer voids in the concrete than smaller sizes. As a result, concrete with the larger-sized aggregates requires less binder per mix.

Determine Water Content

The ACI sets the quantity of estimated water needed per unit volume of concrete to produce a desired slump. The quantity is dependent on the size, shape, and grading of the aggregates. Water content is determined in pounds per cubic yard.

TABLE 2. Estimated Water Needed to Produce a Desired Slump

Water, lb. / yd.^{3} of concrete for indicated maximum sizes of aggregate								
Slump, in.	**3/8 in.**	**1/2 in.**	**3/4 in.**	**1 in.**	**1 1/2 in.**	**2 in.**	**3 in.**	**6 in.**
1 to 2	350	335	315	300	275	260	220	190
3 to 4	385	365	340	325	300	285	245	210
6 to 7	410	385	360	340	315	300	270	--

Source: ACI 211.1-91, *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete*. Reproduced with permission from the American Concrete Institute.

Water-to-Cement Ratio

The water-to-cement ratio (w/c) determines the strength and durability of the concrete. The ratio is given in pounds per cubic yard. The ACI has developed recommendations for the w/c ratio based on strength, but ratio may vary depending on specific materials used.

TABLE 3. Recommendations for the W/C Ratio Based on Strength

	Water/Cement Ratio, by Weight
Compressive Strength at 28 Days, psi	**Concrete**
6,000	0.41
5,000	0.48
4,000	0.57
3,000	0.68
2,000	0.82

Source: ACI 211.1-91, *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete*. Reproduced with permission from the American Concrete Institute.

Determine the Binder Amount

The amount of binder required for a mix is determined using the estimated water content and the water-to-cement ratio. Divide the estimated water content by the w/c ratio. The result is the needed pounds of binder per cubic yard.

Determine the Amount of Coarse Aggregate

The fineness modulus is used to determine the amount of coarse aggregate needed in a concrete mix. The fine modulus describes the degree of coarseness or fineness of the fine aggregate. A small number indicates a fine textured, fine aggregate. In contrast, a large number indicates coarse textured, fine aggregate. Once the fineness modulus is identified, determine the volume of coarse aggregate needed per unit of concrete mix.

TABLE 4. Determining the Volume of Coarse Aggregate

Maximum Size of Aggregate (in.)	Volume of Dry Coarse Aggregate per Unit Volume of Concrete for Different Fineness Moduli of Sand			
	2.40	2.60	2.80	3.00
3/8	0.50	0.48	0.46	0.44
1/2	0.59	0.57	0.55	0.53
3/4	0.66	0.64	0.62	0.60
1	0.71	0.69	0.67	0.65
1 1/2	0.75	0.73	0.71	0.69
2	0.78	0.76	0.74	0.72
3	0.82	0.80	0.78	0.76
6	0.87	0.85	0.83	0.81

Source: ACI 211.1-91, *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete*. Reproduced with permission from the American Concrete Institute.

Multiply the volume of coarse aggregate per cubic yard by 27 cubic feet per cubic yard. Lastly, multiply the answer by the aggregate dry weight per cubic foot to obtain the total weight per cubic yard of concrete.

Determine the Amount of Fine Aggregate

All ingredients for the concrete mix have been estimated except for the fine aggregate. Fine aggregate can be determined by subtracting the total volume of all the ingredients (i.e., water, cement, and coarse aggregate) from 1 unit volume of concrete: 1 cubic yard or 27 cubic feet. Three steps can determine the volumes required for each ingredient of a concrete mix.

- First, identify the specific gravity of each ingredient. Then use the absolute formula and determined weight per cubic yard proportion of each ingredient to determine the volume of each ingredient required using the formula: V = Weight / (SG * 62. 4).

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Absolute Volume Formula:

Volume = Weight / (SG *62.4)

Volume of Fine Aggregate Formula:

Volume Fine Aggregate = Total Volume – Volume of Water – Volume of Binder – Volume of Course Aggregate

FIGURE 4. These are formulas for determining the amount of fine aggregate.

- Next, use the formula: Volume of Fine Aggregate = Total Volume – Volume of Water – Volume of Binder – Volume of Coarse Aggregate to determine the volume of fine aggregate.
- Last, determine the weight of the fine aggregate by using the absolute volume formula.

CONCRETE REINFORCEMENTS

Concrete has great limitations when it is pulled apart by tension. **Reinforced concrete** is concrete that has had a reinforcing agent embedded in its composition to increase its tensile strength, ductility, and/or durability. It is used when added strength or durability is required. Various types of reinforcement agents are used in the concrete industry: steel concrete reinforcement, fiber-reinforced polymer, and fiber reinforcement.

Steel Concrete Reinforcement

Steel concrete reinforcement comes in a variety of forms. One form is deformed steel bars—steel bars with ribs rolled into the surface of the bar during manufacturing. The ribs create a mechanical bond between the concrete and steel. Deformed steel bars are the most common type of reinforcement used in structural concrete, such as house foundations. Also, they are often referred to as rebar in home improvement stores. Deformed steel bars are overlapped and tied with a wire when more length is needed to reach the desired length.

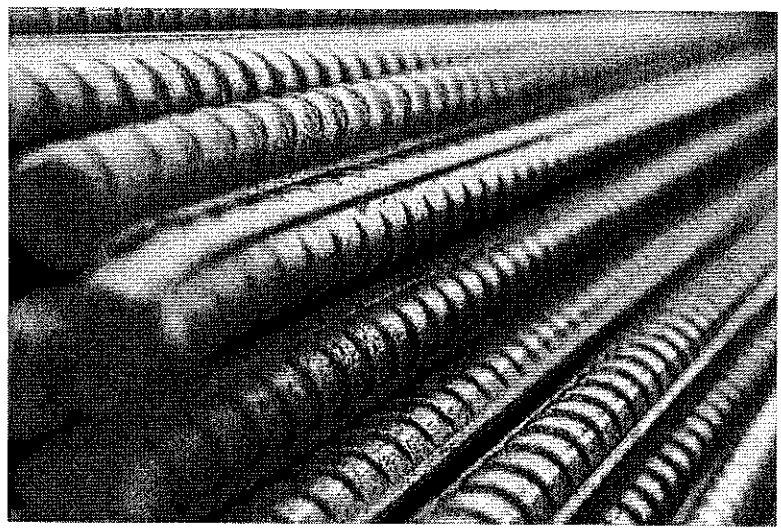

FIGURE 5. Deformed steel bars are known as rebar in home improvement stores.

Threaded steel bars are similar to deformed steel, but they can be spliced with couplers or threaded

to a steel plate. These bars are used when reinforcement needs to be anchored close to a concrete edge. During long runs of reinforcement, the couplers provide an alternative to lapping deformed bars.

Welded wire fabric is a rectangular mesh of wires welded where one wire intersects another. Wire fabric is used in concrete slabs to aid against cracks caused from shrinkage and temperature changes.

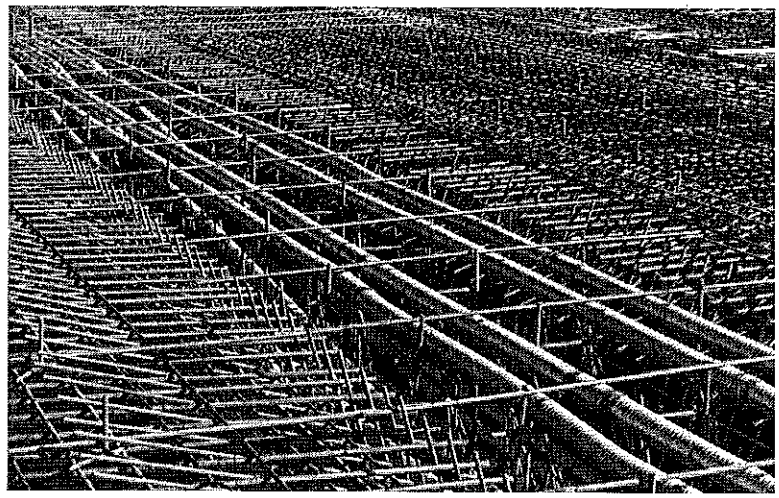

FIGURE 6. Welded wire fabric is used to reinforce concrete slabs.

Fiber-Reinforced Polymer

Fiber-reinforced polymer is sometimes used as an alternative to steel reinforcement when there is a likelihood of corrosion of the steel bars. It is also used when sensitive electrical or magnetic equipment might be affected from a large amount of steel reinforcement. Fiber-reinforced polymer is available in bars, cables, grids, sheets, and plates.

Fiber Reinforcement

Fiber reinforcement is simply concrete mixed with tiny fibers made of steel, glass, synthetic material, or natural materials. The fiber mixed into the concrete mix reduces the amount of cracking and the width of the crack from curing. Fiber reinforcement increases the durability of concrete and is used on agricultural buildings and storage structures, driveways, sidewalks, and roads as well as many other applications.

CONCRETE TOOLS

Concrete tools are designed for a specific role while placing and finishing concrete. Several kinds exist, and each tool is critical to achieving a quality concrete pour and finish.

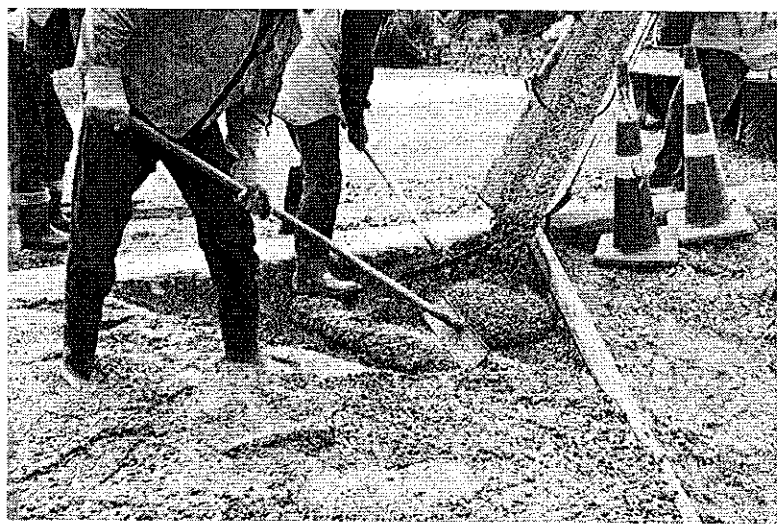

FIGURE 7. The purpose of the concrete spreader is to place the concrete as close to the finish level as possible.

Concrete Spreader

The concrete spreader often is referred to as a concrete placer or leveler. It allows freshly poured

concrete to be pushed and pulled into place. The purpose of the tool is to place the concrete as close to the finish level as possible. A square end shovel works well as a substitute for a spreader, but it is not advised to use a round-edged shovel, as it will not spread the concrete evenly.

Concrete Screed

A concrete screed, which is also referred to as a straightedge or strike off, is used to level off freshly placed concrete to make it as level as possible before finishing. A straight 2 × 4 can be used as a screed as long as it is straight and free of any warp.

Concrete Tamper

A concrete tamper pushes the coarse aggregate below the concrete surface. It is also called a jitterbug. Tamping should be done on concrete with a slump of less than 3 inches. In concrete with slumps greater than 3 inches, the coarse aggregate naturally sinks below the surface. When it is tampered in this scenario, it causes the concrete to segregate.

Bull Float and Darby

The bull float and darby are tools used to level ridges and fill voids produced from the screed. A darby is a straight-edged tool that is 3 to 8 feet long. A bull float is used in areas too large to be reached by a darby. A bull float often produces a wavier surface than a darby.

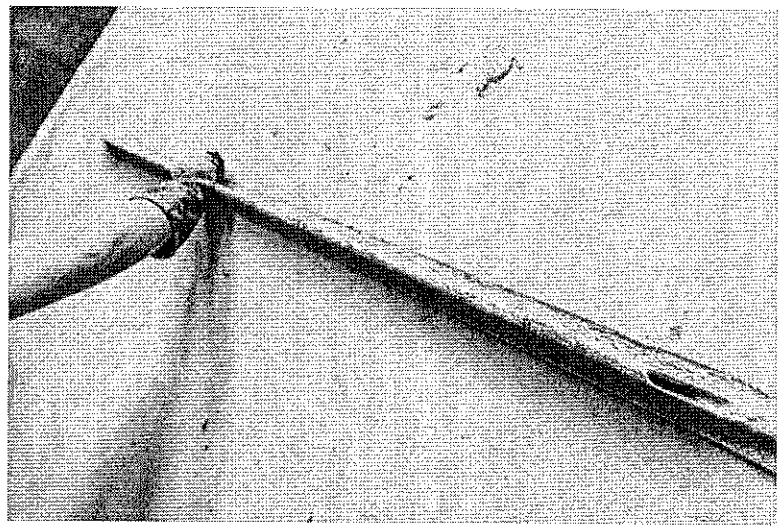

FIGURE 8. A darby is used to level ridges and fill voids produced from the screed.

Hand Float

Bull floats and darbies tend to pull concrete away from edges or push it toward the edges. A hand float is used to level and smooth areas so they match the rest of the concrete that has been floated with a bull float or darby. It is used to smooth concrete around pipes, drains, or any other obstacle on the surface of the concrete.

Concrete Trowel

A trowel is used to produce a smooth, hard, and dense surface after the poured concrete has been floated. It looks similar to a hand float, with a thinner blade. The thinner blade allows it to flex more while working the hardening concrete.

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Concrete Edger

A concrete edger is a tool used to create a rounded corner or edge on the perimeter or edge while finishing concrete. It reduces chipping on the concrete edge. Edging should be done after the **bleed water**, which is the process by which the water in the concrete mix rises to the top of the concrete and disappears.

FIGURE 9. Concrete edgers are used to create a rounded edge on the perimeter of the concrete to reduce chipping.

Concrete Groover

A concrete groover creates a groove on the surface of the concrete, called a control joint, to control the location of cracks when the concrete shrinks from curing and temperature changes. The most common groover is 6 inches long and 4½ inches wide. The bit depth—the protruding metal that creates the groove—should be at least one-fourth the concrete slab thickness to create a sufficient point weakness where the slab can crack.

Summary:

Concrete is one of the most basic yet most important components of construction. It comes in a variety of forms. The composition of concrete plays a vital role in its strength and usability. It is important to properly mix and proportion concrete to produce a quality project. Several reinforcement agents can be embedded into the composition of the concrete to increase its durability.

Various tools have been designed to aid in the pouring and finishing process. These tools are essential for creating a smooth, level finish. From start to finish, careful consideration of all the details involved in laying concrete will produce rewarding results.

Checking Your Knowledge:

1. What are the different components of concrete?
2. What is hydration?
3. Explain how to use the absolute volume method.

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4. Describe each type of concrete reinforcement.
5. List each type of tool used in finishing concrete as well as its function.

Expanding Your Knowledge:

Create a science fair project by testing different concrete mixtures and their strength.

Web Links:

Concrete
http://matse1.matse.illinois.edu/concrete/concrete.html

Concrete and Drying
http://www.cement.org/for-concrete-books-learning/education/concrete-in-the-classroom-%28grades-7-12%29/lesson-5-so-you-think-concrete-dries-out-

PSI Strength of Concrete
https://www.youtube.com/watch?v=eAUfJ90QtDY

Ag Mech Coon option 2 Hydraulics May 4 Name

Checking Your Knowledge:

1. List and describe the two major hydraulic operating systems.

2. Define Pascal's law and the law of conservation of energy.

3. What are the two types of hydraulic actuators found on agricultural equipment?

4. Explain how to inspect and repair hydraulic systems.

5. List and describe three careers in the hydraulic industry.

Ag Mech 5-09 #2

Hydraulic Systems

HAVE YOU EVER SEEN a crane, bulldozer, or excavator in action? These machines are able to move, pick up, and push objects that seem impossible to move. The concept behind this technology that makes it possible is fluid power or hydraulics. Hydraulic systems use the pressure of liquids to transfer and multiply forces.

Objective:

Describe the basic principles of hydraulics, primary hydraulic components, safety issues, and possible career areas in the industry.

Key Terms:

- connectors
- cycle time
- directional control valve
- energy
- filters
- flow rate
- hydraulic actuator
- hydraulics
- hydrodynamics
- hydrostatics
- law of conservation of energy
- linear actuator
- micron
- multiplication of force
- Pascal's law
- piping
- positive displacement pump
- pressure gauge
- pressure relief valve
- prime mover
- pump
- reservoir
- rotary actuator
- strainers

Understanding Hydraulic Systems

Hydraulics is the branch of physics dealing with the mechanical properties and practical applications of fluids in motion. Hydraulic systems do not create power. They transfer power from an outside source. The outside power source for hydraulics is the **prime mover**. For example, the hydraulic pump on a tractor moves the fluid that does the work, but the hydraulic pump is powered by the tractor's engine. In this case, the tractor engine is the prime mover.

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HYDRAULIC OPERATING SYSTEMS

The applications of hydraulics can be classified into two major operating systems: hydrodynamics and hydrostatics.

Hydrodynamics

Hydrodynamics is the use of liquids at high flow and low pressure to perform work. An old-fashioned grist mill operates on the principle of hydrodynamics. As the stream's moving water turns the mill wheel, the mill wheel transmits the rotating force to machinery inside the mill to grind grain.

Hydrostatics

Hydrostatics is the use of liquids at high pressure and low flow to perform work. The oil in a tractor's hydraulic system moves at a relatively slow rate. However, the oil is under great pressure and can create a large amount of force. With hydrostatics, the goal is magnified force, not speed of movement.

HYDRAULIC COMPONENTS

Hydraulic systems all have the same basic components. Each component contributes to the overall operation of the system.

Reservoir

A **reservoir** is a chamber that supplies oil to the hydraulic pump and stores oil that returns after passing through the hydraulic circuit. The design and location of the reservoir will depend on the application and design of the hydraulic system.

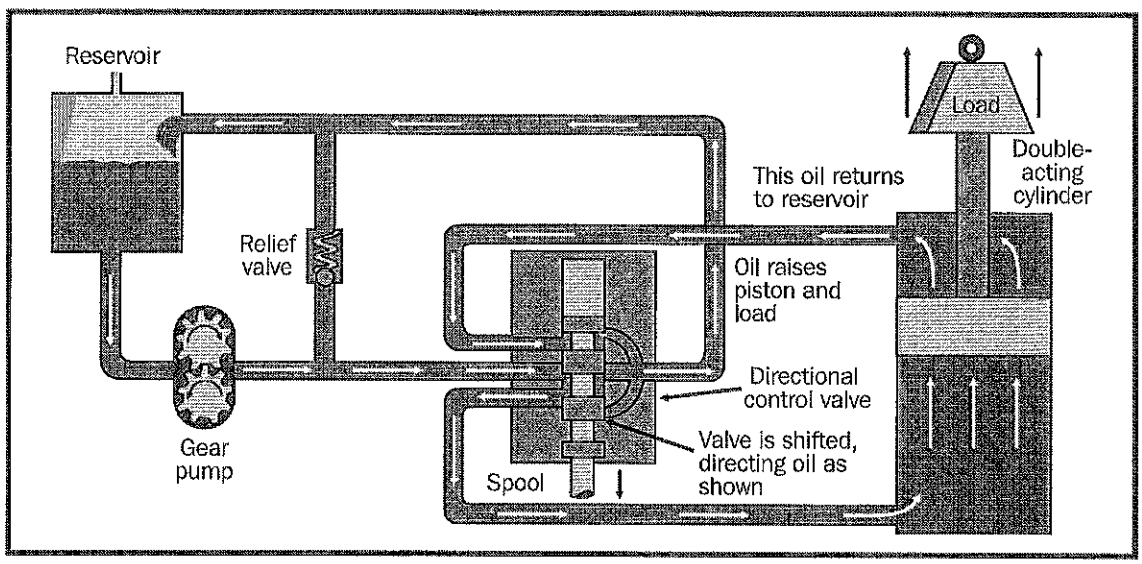

FIGURE 1. These are the primary components of a hydraulic system.

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Strainers and Filters

Hydraulic oil must be kept clean from impurities that may disrupt system operation. Strainers and filters perform similar functions through different methods.

Strainers

Strainers are devices that direct hydraulic oil through an element made of fine mesh screens on a metal core. They are located on the supply side of the circuit and can catch particles larger than the screen openings.

Filters

Filters are devices that direct hydraulic oil on a round-about path where it passes through one or more porous layers that trap particles as small as one micron. A **micron** is a unit equal to 39 millionths of an inch. Filters are typically found on the return side of the circuit.

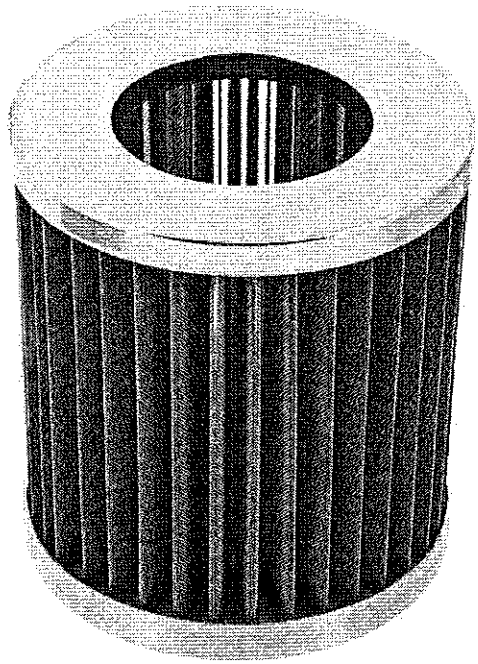

FIGURE 2. This hydraulic oil strainer has a metal element.

Pump

The hydraulic **pump** is a device that uses mechanical power to cause hydraulic oil to flow through the circuit. It changes mechanical power into fluid power. An agricultural hydraulic system is a **positive displacement pump**, which is a device that delivers the same volume of oil per cycle, regardless of the pressure at the pump outlet.

Gauge and Valves

A **pressure gauge** is a device that measures and indicates the pressure being produced in a hydraulic system. The gauge is important on equipment where system pressure must be adjusted or changed manually.

The **pressure relief valve** is a device that limits the pressure in the hydraulic system to a preset maximum level. When this maximum pressure is reached, the valve opens and diverts the pump's output back to the reservoir to avoid damaging the system because of an overload.

Once the hydraulic oil is in the circuit, a directional control valve is used. A **directional control valve** is a device that directs the flow of fluid within the system though the opening and closing of ports found in the system components.

Actuators

Mechanical work is done in a hydraulic system through the use of actuators. A **hydraulic actuator** is a device that converts fluid energy into mechanical energy. The primary types of actuators in agriculture are hydraulic cylinders and hydraulic motors.

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Linear Actuator

A hydraulic cylinder is a **linear actuator**—a device in which the output of the cylinder occurs in a straight line manner as the cylinder extends or retracts.

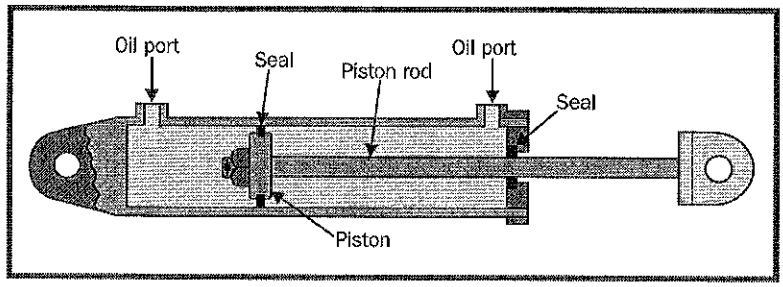

FIGURE 3. Primary parts of a typical hydraulic cylinder.

Rotary Actuator

A hydraulic motor is a **rotary actuator**—a device in which the output of the motor is a rotating force. Opposite of a hydraulic pump, the motor is pushed by the hydraulic oil to create the rotating force.

Lines

Piping is a general term used to describe the fluid conducting lines that connect the various components. **Connectors** are devices used to join pieces of piping together or to connect piping to system components (e.g., pumps or cylinders). Both piping and connectors must be able to withstand extremely high pressures without leaking or failing.

HYDRAULIC SCIENTIFIC PRINCIPLES

All areas of science are governed by principles that help in explaining how concepts work. Hydraulics is part of the area of physical science and is governed by the same laws and principles.

Pascal's law is a principle that states because fluid is practically uncompressible, the pressure applied to a confined fluid is transmitted in all directions at the same pressure, acts in equal force on all areas, and acts at right angles to the walls of the container.

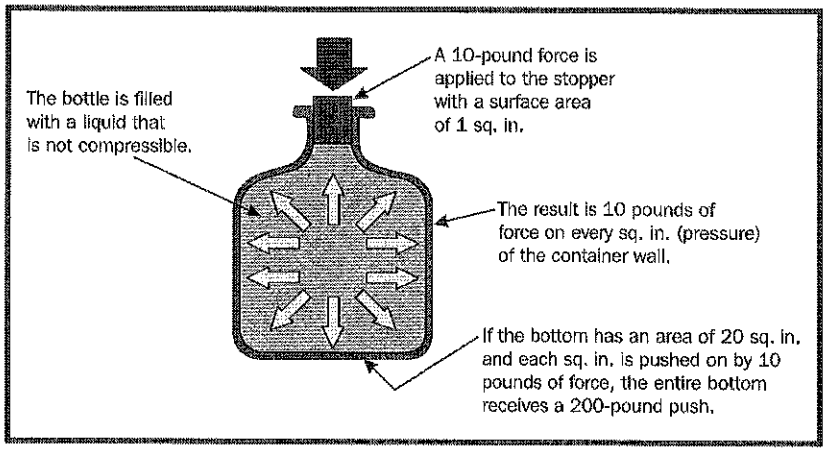

FIGURE 4. A simple application of Pascal's law.

The **law of conservation of energy** is a principle that energy cannot be created or destroyed; it can only change from one form into another. **Energy** is available power or the capacity to do work. In a hydraulic system, output energy can never be greater than input energy. However, it can be transformed into a different form to perform a certain task.

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Multiplication of Force

Hydraulic systems are generally used to produce a multiplication of force. **Multiplication of force** is the fact that a hydraulic system can take a relatively small input force and transform it into a much larger output force because of differing cylinder sizes.

The **cycle time** (for a hydraulic application) is the amount of time required for one complete set of operations to occur. For example, if a cylinder takes 16 seconds to extend and 12 seconds to retract, the cycle time is 28 seconds. The cycle time is dependent on the volume of the cylinder and the flow rate of the hydraulic fluid. **Flow rate** is the measure of how many gallons per minute of hydraulic fluid would run into a container.

ADVANTAGES AND DISADVANTAGES

Hydraulic systems are used widely in agriculture because of their numerous advantages. Despite those advantages, hydraulic systems have some associated disadvantages.

TABLE 1. Advantages and Disadvantages Associated with Hydraulic Systems

Advantages	Disadvantages
Increased flexibility—Hydraulic hoses can be routed around obstructions.	High pressures—They operate under extremely high pressure and require heavy tubing and hoses, tight joints, and careful maintenance.
Variable speed—Hydraulic cylinder or pump speed can be considerably varied by controlling the flow rate of the pump.	Need for cleanliness—Components can easily be damaged by dirt, rust, or corrosion. Cleanliness is essential.
Multiplication of force—A small input force can be multiplied to create a large output force; multiplication of force can be achieved with a mechanical power transmission system. It is a much simpler process using hydraulics.	Safety hazards—Systems operate under high pressure. They pose unique safety hazards. Never attempt to locate a leak with your hands. Always wear the appropriate personal protective equipment.
Reduced wear—They involve less metal-to-metal contact. Also, hydraulic fluid lubricates parts, so there is less wear on the hydraulic system.	
Reversibility—Systems can be designed so cylinders and motors may be reversed or operate in either direction.	

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SAFETY WITH HYDRAULICS

Safety should always be the highest priority when using or working with hydraulic systems. Damaged or broken machinery cause a loss in productivity and efficiency. In addition, (as you read in the Table) hydraulic systems pose serious risks that may result in injuries or death.

Safety Hazards

Identifying safety hazards in hydraulics can help the operator know how to keep equipment working properly and eliminate potential dangers in the workplace.

Leaks

Hydraulic systems work under extremely high pressure, some as high as 10,000 pounds per square inch (psi). A rupture in a hydraulic hose or coupling can cause hydraulic fluid to spray out with great velocity. As you read in the Table above, even a pinhole leak in a hydraulic hose can result in fluid with enough pressure easily piercing your skin. So do not check for a leak in a hydraulic line with your bare hands, as this can lead to injection of hydraulic fluid under the skin.

Flammability

Hydraulic fluid can be flammable, posing a fire hazard if the leaking fluid is exposed to flames or sparks.

Burns

Under normal operating conditions, hydraulic fluid can become extremely hot, posing a burn risk if the fluid leaks onto skin or clothing.

Poisoning

Hydraulic fluid in the eyes, mouth, or under the skin can result in hydraulic fluid poisoning. If this fluid reaches the bloodstream, serious health risks could result in amputations or death.

Unexpected Machine Movement

Hydraulic fluid often powers the movement of heavy equipment. Loss of hydraulic pressure due to a rupture or leak could cause the machinery to move or drop at an unexpected time and injure someone nearby.

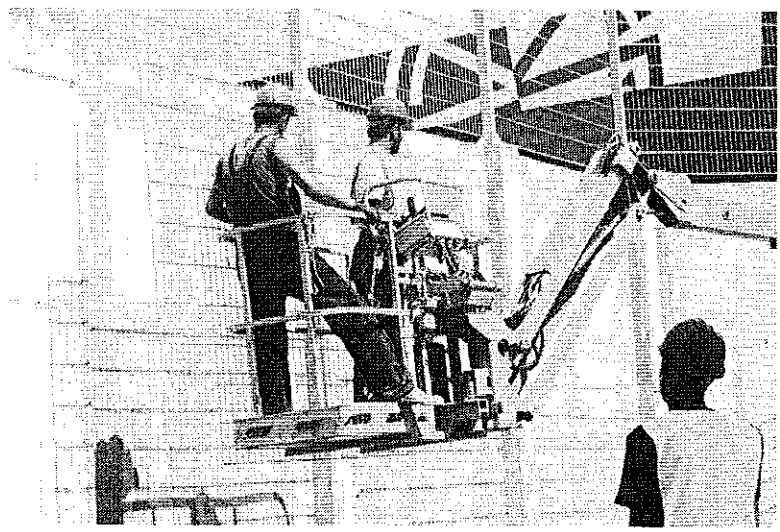

FIGURE 5. Many hazards exist in hydraulic applications.

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Safety Precautions

By taking certain safety precautions, many of the risks of working with hydraulics can be minimized, not eliminated.

Routine Inspection and Maintenance

Routine inspection and maintenance is critical for safe operation of hydraulic equipment. It is important to check all hoses, couplings, pumps, and actuators regularly for signs of wear, leaking, and potential rupture.

Proper Protective Equipment

Always wear the proper protective equipment (e.g., safety glasses or goggles, protective gloves, and clothing that covers exposed skin) when servicing, inspecting, and repairing hydraulic equipment.

Fire Extinguisher

Keep a fire extinguisher rated for use on hydraulic oil handy. If possible, mount the fire extinguisher in an easily accessible location.

Safety Locks

When servicing or inspecting hydraulic equipment, be sure that all safety locks are in place before beginning work, and never work or crawl under equipment supported solely by hydraulic actuators.

INSPECTION AND REPAIR

Most hydraulic systems are composed of a few basic components that should be inspected regularly and repaired if necessary. Hoses, connectors, and couplings are common fail points in hydraulic systems and should be given the closest and most regular inspections.

FURTHER EXPLORATION...

ONLINE CONNECTION: Hydraulic Training Modules

Hydraulics is used in a variety of machines that perform numerous tasks to make our lives easier. But how exactly do these machines work? How does pushing a lever in the cab of a tractor actually make the scoop bucket move up, down, or tilt?

Access the Web site listed below to explore the various training modules associated with hydraulics. Carefully work your way through each module to understand how hydraulic systems work and what exactly is going on inside the system. Choose one of the modules to prepare a presentation to give to your class about what you learned.

https://www.wisc-online.com/learn/technical/hydraulics-pneumatics

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Hoses

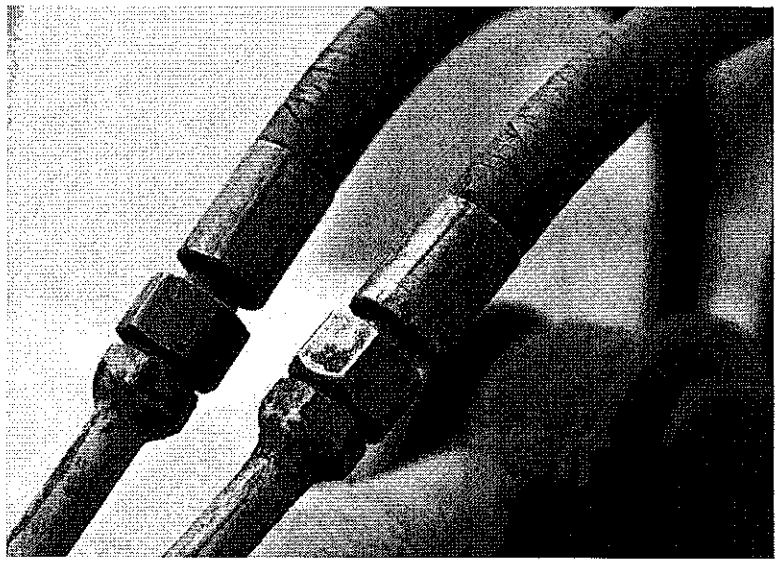

FIGURE 6. These hydraulic hoses are showing signs of wear.

A hydraulic system is only as strong as the hoses delivering fluid to and from the actuators. Hydraulic hoses should be inspected for any signs of wear, cracking, bulging, and tearing. If any of these conditions are found, the hose(s) should be replaced immediately.

Hoses should be the proper material and size as well as the appropriate temperature rating, fluid delivery rating, and pressure rating for the application of the hose in the equipment. Hoses that do not meet machine demands are a sure way for leaks or ruptures to occur. Cracks and bulges in hoses are signs that the hoses are exposed to heat or ozone from the machinery or are underrated for the pressure needed and used in the machinery.

Connectors

Connectors or couplings are typically crimped onto the ends of hydraulic hoses, which allow the hoses to be attached to a hydraulic pump system. It is important to ensure that the hose end connector and the machinery side connector are meant to be used together. Otherwise a blow off could occur when pressure is applied.

Connectors and couplings should be inspected for signs of leaking or seepage of hydraulic fluid. A buildup of oily dirt and foreign material around a connector could be an indicator of a hydraulic leak. Excessive or under-crimping of hydraulic connectors could lead to hoses leaking or rupturing. All connectors must be crimped properly to insure the safety of hoses.

Routing of Hoses

Finally, the routing of hoses should be inspected to insure that no crimps or bends exist in the hose that could cause disruption of fluid flow. Hoses should not be twisted or routed where they could rub on moving parts and cause wear. If poor routing of hoses is found, shut down the machine, and repair and/or reroute the hoses before continuing use.

HYDRAULIC CAREERS

Even though the use of hydraulic equipment has been around for many years, the number of careers and jobs associated with hydraulic systems continues to grow in agriculture and other industries.

Ag Mech 5-4 #2

Engineers

Mechanical engineers are responsible for designing and overseeing the manufacturing of new hydraulic systems or upgrading existing systems for better efficiency. Engineers must be able to troubleshoot problems in a system and suggest corrections to solve these problems.

Mechanics

Hydraulic mechanics construct the hoses, pumps, and other system components and install them into equipment. Mechanics are typically responsible for inspection and repair of existing hydraulic systems.

Product and Sales Managers

Product managers work with engineers and hydraulic sales departments to insure that the product being produced is what is desired by customers. Managers must be able to see trends in the industry and suggest advancements necessary to meet the growing demands for hydraulics.

Sales managers work with manufacturers and retail outlets to provide the equipment that consumers want to purchase. Managers must work with customers, retailers, and manufacturers. Therefore, people skills are a must for sales work.

Shop Technicians

Shop technicians are entry-level careers that involve the maintenance and repair of hydraulic equipment. Technicians must be able to read and understand repair manuals and schematics. In addition, they must be able to perform physically demanding work.

EDUCATION

The education required for a career in hydraulic systems varies with each area. For instance, a mechanical engineer will require a bachelor's degree in engineering or a related field, while a hydraulic mechanic may require an associate's degree. Some areas, such as a shop technician, may just require a high school diploma, but employers often search for candidates with more education or for those willing to further their education as they work.

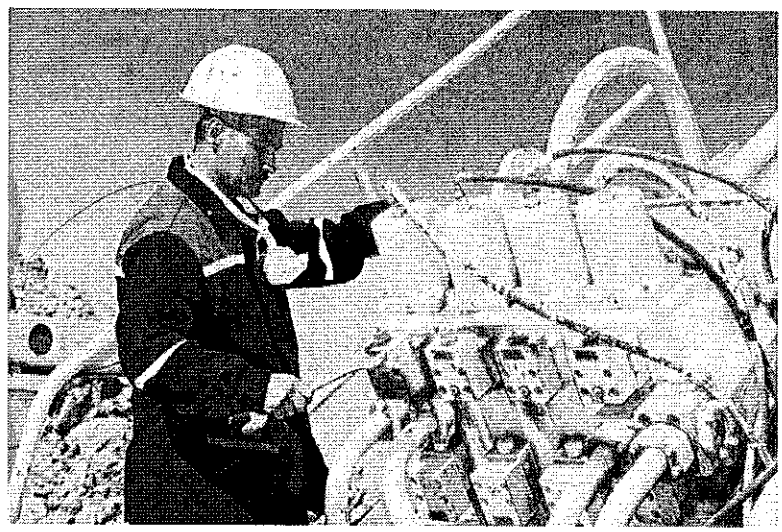

FIGURE 7. Many career areas exist in the hydraulic industry.

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Summary:

Hydraulics is the branch of physics dealing with the mechanical properties and practical applications of fluids in motion. Hydraulic systems do not create power; they transfer power from an outside source. The applications of hydraulics can be classified into two major operating systems: hydrodynamics and hydrostatics. All areas of science are governed by principles that explain how concepts work. Hydraulics is part of the area of physical science and is governed by the same laws and principles.

In a hydraulic system, output energy can never be greater than input energy; it can only be transformed into a different form to perform a certain task. Hydraulic systems do have a number of advantages over other mechanical systems, including increased flexibility, variable speed, multiplication of force, reduced wear, and reversibility. Identifying safety hazards in hydraulics can help the operator know how to keep equipment working properly and eliminate potential dangers in the workplace.

Most hydraulic systems are composed of a few basic components that should be inspected regularly and repaired if necessary. Hoses, connectors, and couplings are common fail points in hydraulic systems and should be given the closest and most regular inspections. Even though the use of hydraulic equipment has been around for many years, the number of careers and jobs associated with hydraulic systems continues to grow.

Checking Your Knowledge:

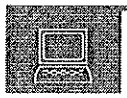
1. List and describe the two major hydraulic operating systems.
2. Define Pascal's law and the law of conservation of energy.
3. What are the two types of hydraulic actuators found on agricultural equipment?
4. Explain how to inspect and repair hydraulic systems.
5. List and describe three careers in the hydraulic industry.

Expanding Your Knowledge:

Research the use of additives in hydraulic fluids. What are the advantages of using additives? What types of additives would be used? How can using the right fluid help with efficiency, time, and cost? Prepare a presentation on using additives in hydraulic fluids.

Ag Mech 5-4 #2

Web Links:



How Hydraulic Machines Work

http://science.howstuffworks.com/transport/engines-equipment/hydraulic.htm

Hydraulic Tutorials

http://www.hydraulicsupermarket.com/technical.html

Hydraulics Explained

http://www.explainthatstuff.com/hydraulics.html

Agricultural Career Profiles

http://www.mycaert.com/career-profiles/

Ag. Mech Coon option3 Global Info Systems ~~May~~ May 4 Name

Checking Your Knowledge:

1. What is a Geographic Information System (GIS)?

2. How can GIS be used with a soil survey data to benefit farmers?

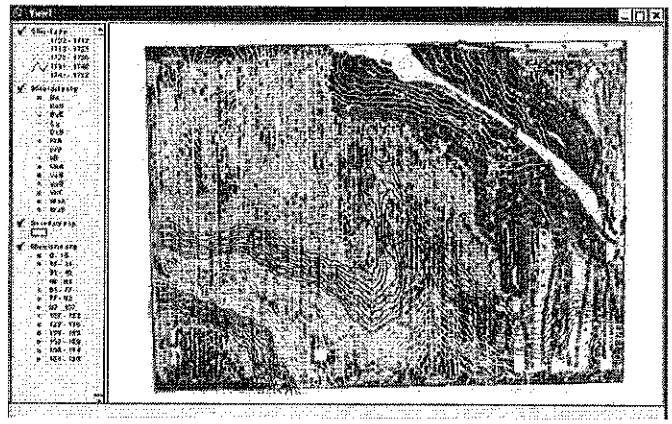
3. Why would topographic maps be an important layer in GIS?

4. List and describe three non-farm uses for GIS.

5. Describe a situation where a farmer could use field management data to make decisions for the following year.

Ag Mech 5-4 #3

Geographic Information Systems



GEOSPATIAL TECHNOLOGY is quickly changing the agriculture industry. Only a few years ago, a farmer's only way to make management decisions about a field was to physically observe it and create a plan for the entire area. Today, a growing number of agriculturalists are using a Geographic Information System to capture, store, analyze, manage, and present data to improve management practices. The applications are far reaching as farmers, ranchers, horticulturalists, natural resource conservationists, and many others adapt to using GIS.

Objective:

Describe a Geographic Information System (GIS).

Key Terms:

base map
crop scouting report
field boundary
Geographic Information System (GIS)
remote sensing
soil sample
soil survey
topographic map
variety map
yield data

Understanding Geographic Information Systems (GIS)

A **Geographic Information System (GIS)** is a database that stores and analyzes information about specific points within a map. A GIS is the basis for precision farming or site-specific crop management. All decisions that involve using variable rate technology (VRT) are based on information provided by GIS.

Ag Mech 5-4 #3

GIS COMPONENTS

A Geographic Information System (GIS) has several purposes that utilize farmers.

Grids

A GIS breaks down areas into small grids. In addition, it gathers, stores, manages, and displays information about the points within that grid. A GIS uses many layers of maps and data—each layer with its own specific information—to produce an overall "picture" so precise decisions can be made on the small areas within the map.

Physical Attributes in Grids

A Geographic Information System partitions fields into grids and then maps them for physical attributes for each grid segment. Maps can be made for soil fertility (N, P, K); pesticide residue; soil type and texture; drainage; water-holding capacity; and the past year's yield data.

Layering of Maps

Computerized GIS allows the layering of these maps, giving a site-specific picture of a field on a meter-by-meter basis. Producers can use the data to make customized management decisions for their fields.

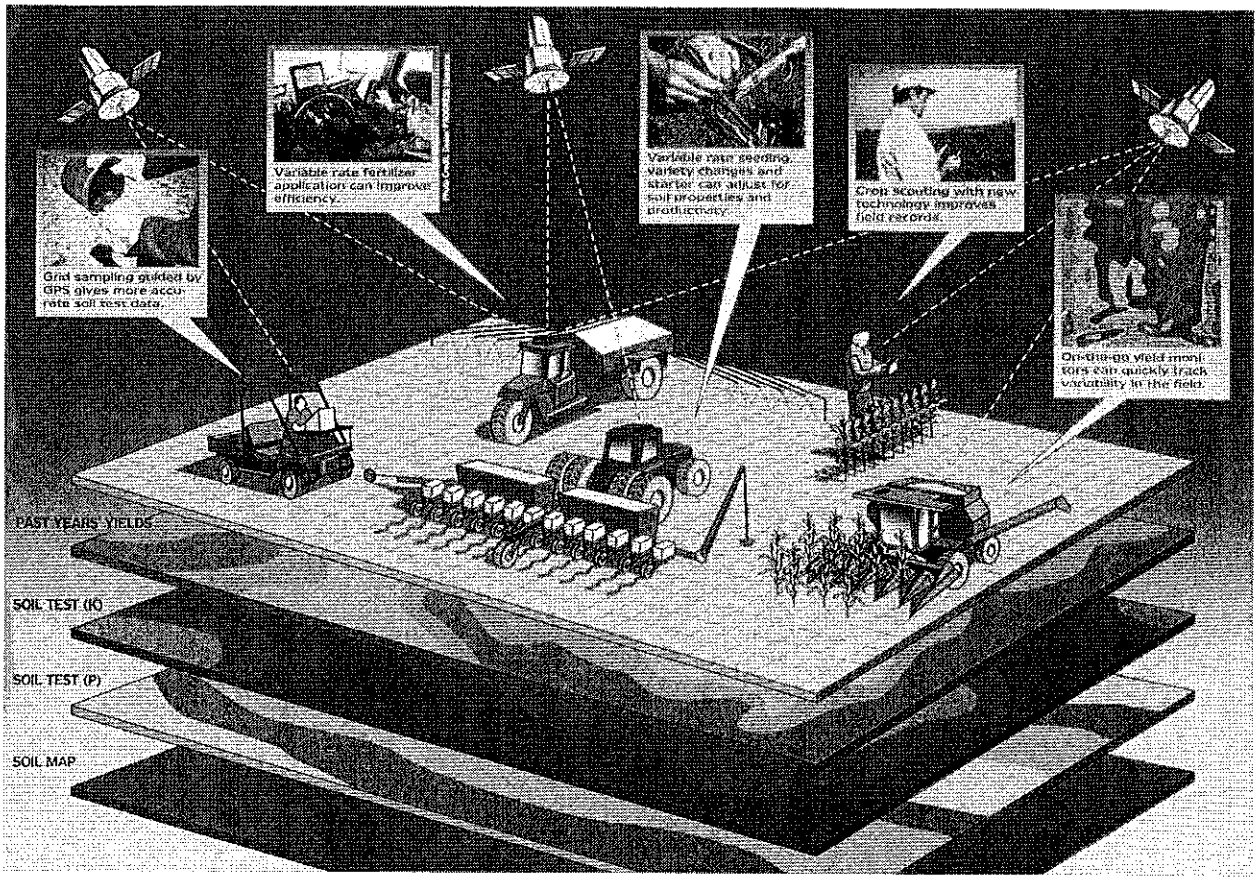


FIGURE 1. GIS applications in agriculture.

Ag Mech 5-4 #3

TYPES OF GIS DATA

Geographic Information Systems contain huge amounts of data when they are developed. This data can be a challenge for computer systems to adequately organize and analyze. Yield monitor information alone can generate up to 500 data points per acre. A virtually unlimited number of data layers can contribute to this large amount of information. The following are a few examples of data that could be used to create a GIS for a farming operation.

Soil Surveys

A **soil survey** is a report provided by the Natural Resource Conservation Service (NRCS) that provides information on soil types and classifications, soil locations, drainage, productivity, and recommended uses.

For more localized soil information, a soil sample can be taken. A **soil sample** is a small amount of soil pulled from specific points in the field and tested for various fertility amounts. These samples can be gathered by a farmer or a retail fertilizer dealer. GPS equipment should be used to record where each sample was taken. Each nutrient test in the soil sample can be used to create its own data layer in the GIS.

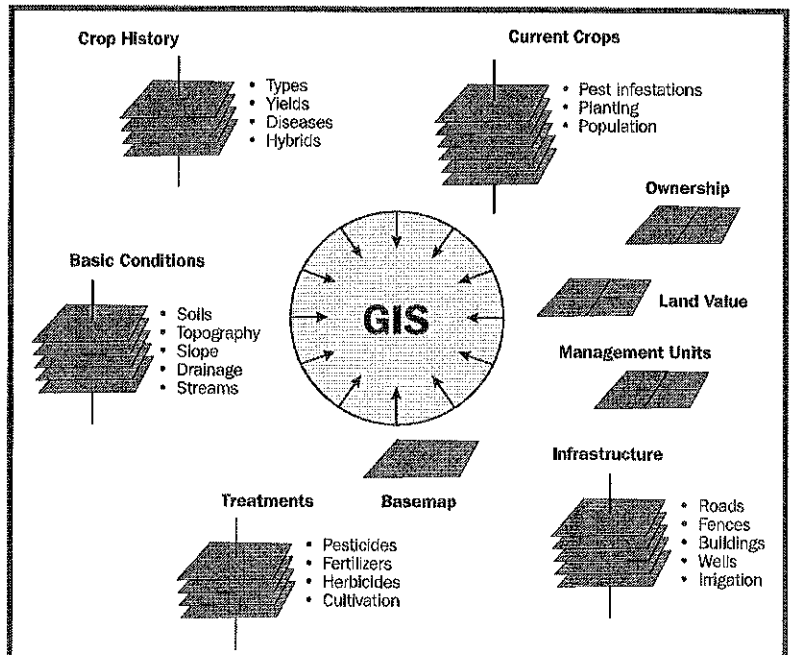


FIGURE 2. GIS data layers used in agriculture.

Yield Data

As a combine is harvesting a crop, yield data can be collected. **Yield data** is information about the amount of crop harvested at any given point in the field. Again, this data is complied with GPS coordinates to give the farmer a better picture of the field's potential.

Topography Map

A **topographic map** is a document that details the differences in elevation of an area and provides another layer of information in the GIS.

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Field Boundary

A **field boundary** is accurate information regarding the outside field border. This GPS plotted map is often referred to as the **base map**—a document that only identifies the outside edge of the field and serves as the base layer of the GIS.

Remote Sensing

Remote sensing is data recorded from aerial photography or satellite means. Remote sensing data can identify data based on reflectivity of the electromagnetic spectrum, providing insight into crop health.

Crop Scouting Report

A **crop scouting report** is a document created by an individual who physically visits the field and collects firsthand data on plant health and growing conditions. The information is combined with other data to lend credibility to the overall GIS report.

Variety Map

A **variety map** is a document that indicates where differences in variety within a field exist. The "variety" refers to the seed type being grown in a particular field. This information can be added to the GIS report to give farmers an overall image of field productivity.

ON THE JOB...

CAREER CONNECTION: Precision Agriculture Technicians

With the advent of precision agriculture, a new occupational field has emerged: precision agriculture technicians. These people are trained in the use of geospatial technology for agricultural purposes.

Precision agriculture technicians have a wide variety of responsibilities. They collect information about soil and field conditions as well as yield data and field boundaries. In addition, they create, layer, and analyze maps showing crop yield, soil characteristics, input applications, terrain, drainage patterns, and past field management.

These technicians document and maintain precision agriculture records. Whether helping farmers save and store the information themselves or uploading it to cloud storage, these technicians must be current on the latest technologies. They help farmers diagnose and repair hardware and software issues—often in the field. Technicians also help farmers analyze data and develop site-specific crop management plans. Technicians usually complete a two- to four-year college program in precision agriculture to gain the skills necessary to meet the demands of this ever-changing career.

GIS AS A MANAGEMENT TOOL

GIS provides a vast amount of information that can be used to make management decisions. However, GIS is not restricted to agricultural use. A variety of GIS information can help people make management decisions about a wide range of concerns. The GIS does not analyze the data; it provides data for the producer or consultant. A person's knowledge and experience with GIS improves the interpretation and usefulness of the data.

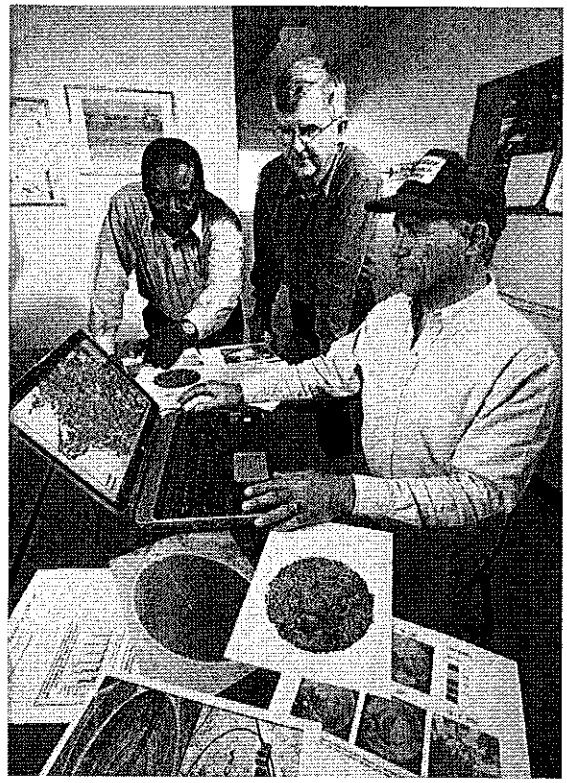

FIGURE 3. Specialists use GIS to assess nitrogen management at field and regional scales. (Courtesy, Agriculture Research Service, USDA)

Crop Management

Obviously, the most important use of GIS for farmers is as a crop management tool. But GIS can provide other useful data to farmers, such as field drainage information, flooding history and potential, dry areas, and past crop data.

Conservation Management

Conservation management can use GIS to provide information to make recommendations on water usage, conditions of wetlands, habitat loss or restoration, and forest conditions.

Urban Development

Urban development and sprawl is always a concern for the agriculture industry. GIS can provide historical data on the growth of urban areas and help predict future urban expansion.

Weather Patterns

Climatologists can use GIS to analyze changes in the Earth's weather patterns and climate systems. GIS can provide data on the size of ice caps and glaciers as well as the amount of deforestation in rainforests.

Monitor Natural Disasters

Disasters (e.g., floods and wildfires) obviously are unwanted, but GIS can help responders decide on the best course of action and monitor the extent of the damage. GIS can even help governments identify potential environmental hazards and recommend a potential course of action.

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FIELD MANAGEMENT DATA

With all the data collected from the many data layer maps, management decisions can be made based on statistical data. The ability of the farmer (or consultant) to analyze this data will directly result in making management decisions that could save or cost thousands of dollars.

Changes in Yield

Changes in yield within a field can be compared to other data maps for conclusions to be drawn as to why that part of the field did not yield as well as others. A variety of maps can be used to see where that particular spot varies from other parts of the field.

A crop scouting report may indicate weed pressure, or a topography map may indicate a low area subject to ponding. These maps would help determine the cause of the low yield. If weed issues are the cause of the lower yield, the farmer could choose crop protection products to adequately control the weeds in the future. Soil test maps may indicate the need for increased fertilizer if they match up with the low yielding areas. Variable rate technology could be used the following year to apply fertilizer to maximize yields.

Economic Benefit

While the initial cost of setting up GIS can be quite high, the economic benefit comes from applying the correct amount of nutrients on each acre and from making other management decisions to improve the long-term value of the farmland.

Summary:

A Geographic Information System (GIS) is a database that stores and analyzes information about specific points on a map. It is the basis for precision farming. A GIS breaks down areas into small grids. In addition, it gathers stores, manages, and displays information about the points within that grid. The data GIS provides includes soil surveys, soil samples, yield data, topography maps, field boundary, remote sensing, crop scouting reports, and variety maps.

The GIS does not analyze the data; it only provides it for the producer or consultant. A person's knowledge and experience with GIS improves the interpretation and usefulness of the data. With all the data collected from the data layer maps, management decisions can be made based on statistical data. The ability of the farmer (or consultant) to analyze this data will directly result in making management decisions that could save or cost thousands of dollars.

Ag Mech 5-4 #3

Checking Your Knowledge:

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5. Describe a situation where a farmer could use field management data to make decisions for the following year.

Expanding Your Knowledge:

Contact a community college or university in your area or an agricultural business that offers information on geospatial technology. Explore the career possibilities associated with that field. If you have an interest, dig deeper to discover the requirements for a degree. Share your findings with your class.

Web Links:

GIS

http://www.esri.com/what-is-gis

Remote Sensing

http://www.amesremote.com/

Activities

http://landsat.gsfc.nasa.gov/?page_id=2378

Agricultural Career Profiles

http://www.mycaert.com/career-profiles/