

## Agricultural Engineering Profession – A birds' eye view

Because of their broad educational background, professionals with agricultural engineering degree are a source of information on a wide variety of topics and can provide help with diverse technical problems. The design and management services agricultural engineers provide can be invaluable to small businesses without their own engineering departments, to agricultural producers and similar enterprises, and to large businesses or governmental agencies that want to supplement their in-house engineering departments. Consultants also can provide service to lending institutions, law firms, local units of government and planning boards, or to individuals that need expert witnesses or technical analysis.

### Expertise of Agricultural Engineering Professionals

Agricultural engineers have a diverse educational background that makes them knowledgeable about many subjects; additionally, they usually focus their expertise on one of the following areas:

- Aquaculture.
- Biological Applications.
- Energy.
- Environmental Quality.
- Food and Food Processing.
- Forestry.
- Information and Electrical Technologies.
- Power and Machinery.
- Safety.
- Soil and Water Resources.
- Structures and Environment.



### Aquaculture

Agricultural engineers assist in increasing production of aquatic animals, such as fish and shellfish to sell as food and for other uses, while decreasing costs and environmental impacts. Engineers with a background in aquaculture seek ways to improve pond and indoor fish rearing systems, reduce pollution from aquaculture discharges, and reduce excess water use.

As consulting engineers, they may advise others on the harvesting, sorting, and processing of aquatic plants or animals and are often asked to work with today's popular species such as catfish, oysters, mussels, salmon, trout, carp, shrimp, and prawns. These engineers also are involved in working with ornamental and bait fish.

### Biological Applications

Agricultural engineers work on issues dealing with cells in tissue culture, plant systems, humans, animals, or groups of animals. These engineers also work on design projects with biomaterials, biomechanics, biological systems modeling, implant design, and mass transfer in bioenvironments. Needs in medicine, biomedical engineering, environmental engineering, natural resources, agriculture, and related areas are met by these engineers.

Consulting agricultural engineers with extensive biological backgrounds work to design treatment facilities for human and animal wastes, to assess water quality, and to develop remediation plans. State and local departments seek advice from these engineers on issues of environmental quality. As consultants, these engineers work with food and pharmaceutical companies developing value-added processes. The engineers may work in biomechanical design developing prosthetics for humans and animals.



## Energy



Agricultural engineers work with systems involving all forms of energy, including electricity, gasoline, diesel fuel, hot water, and hot air. These engineers design systems to efficiently pump water, heat homes, and power agricultural equipment. They study and test energy options that help maintain modern conveniences while reducing costs and the adverse effects on the environment.

Consulting agricultural engineers work to find uses for renewable energy sources such as plants, methane, vegetable oil, wind, and solar power. These engineers often advise federal, state and local departments working with potential air contaminants that result from producing or using energy, and they work on projects to minimize the waste products that cause air and water pollution.

## Environmental Quality

Agricultural engineers are well trained and qualified to understand the biological and physical treatment of wastewater and other sources of pollution. With environmental quality having an ever-expanding role in society, these engineers are often called on to act as consultants to industry, government, regulatory agencies, and private citizens.

Consulting agricultural engineers help producers solve problems with livestock production systems that could have a negative impact on water and air quality. Many times these consultants assist state and local governments to develop guidelines to protect water and air quality. Consultants involved with environmental quality issues can work with problems related to seafood and other food processing plants that are being required to reduce emission levels.



## Food and Food Processing

Agricultural engineers combine design expertise with economical methods of large-scale manufacturing to meet industrial needs. Agricultural engineers serve as experts in food pasteurization, sterilization, freezing, dehydration, packaging, transportation, and storage. They also develop designs of microbiological processes to produce fermented foods, fuels, biochemicals and pharmaceuticals and to treat municipal, industrial, and agricultural wastes.

As consultants, agricultural engineers work with federal, state, and local government agencies in addition to pharmaceutical and health-care firms. Many manufacturers utilize agricultural engineers with food and process backgrounds to design food and drug processing equipment and layout processing plants. As consultants, these engineers design food machinery instrumentation that controls the packaging of ingredients and food materials.



## Forestry

Agricultural engineers apply physical, biological, and engineering sciences to solve problems related to the development of forest production systems. Tasks include designing and manufacturing equipment for forest access systems; studying machine/soil interaction and erosion control; and analyzing and improving forest operations. Agricultural engineers also are involved in decision modeling and in designing and manufacturing wood products.



Consulting engineers help companies develop detailed harvesting plans. Work includes finding solutions to complex operations in timber harvesting, site preparation, and road and bridge construction while conducting operations in an environmentally acceptable manner. State and local governments also seek advice from forestry engineers on the management of forest lands.



### Information and Electrical Technologies

Agricultural engineers integrate computers, sensors, and controls with mechanical systems such as automated and robotic systems. These engineers work with the use of electrical systems and controls for the farmstead, dairy, and related areas. Not only do these engineers design complex electronics and electrical systems, but they must also design these systems to withstand wide temperature swings, and wet, dusty, and corrosive environments.

Increasingly, manufacturers are asking these engineers to develop sensors and other electronics to utilize global positioning technology in site specific or precision farming systems. These consultants have been retained to develop visual sensing equipment that evaluates fruit and vegetable quality. Producers also retain consultants to evaluate problems with stray voltage in animal confinement areas.

### Power and Machinery

Agricultural engineers design and test the tractors and tillage systems, the planters and sprayers, and the combines necessary for the production of traditional agricultural products such as corn, soybeans, and small grain. These engineers also are responsible for developing the machines used in the culture, harvest, and handling of fruits and vegetables and forest and forestry products.



Agricultural engineering consultants often are retained by medium to large companies involved in the manufacturing of farm and industrial off-highway equipment. Companies in allied industries such as turf and landscape equipment manufacturing look to retain the services of these consultants.

### Safety



Agricultural engineers are familiar with safety standards used to design equipment, and many times are on national committees that develop new standards. Safety engineers also may join committees to develop these standards. Equipment manufacturers want to provide equipment that can be operated and maintained safely and look to the services provided by agricultural engineers to help meet that goal.

As consultants, agricultural engineers may be used to evaluate the safety of machinery before it is manufactured. They also are employed to check worker safety in manufacturing plants, construction companies, and other industries. Government agencies often seek assistance from consulting engineers when evaluating issues related to safety and safety compliance.

## Soil and Water Resources

Agricultural engineers are experts in agricultural hydrology and hydraulic principles pertaining to drainage, erosion control, and irrigation. These engineers are watershed management specialists who understand the interactions that occur between human and natural processes needed to manage watersheds. These engineers also work with crop water requirements, seek ways to control soil erosion, and study the environmental effects of sediment on water quality.

As consultants, agricultural engineers design, build, operate, and maintain drainage and irrigation systems, water control structures for reservoirs, floodways, and channels. They monitor drainage and irrigation water quality, and they design equipment for applying fertilizers and pesticides through irrigation systems.



## Structures and Environment

Agricultural engineers have extensive knowledge in the analysis and design of construction projects and in the use of construction materials. They have technical knowledge in the design of light-framed steel structures, wood structures, concrete structures, and grain bins. They are specialists in grain aeration systems, indoor air quality in livestock facilities, farmstead layouts, animal flow, and manure management.



Livestock producers often retain consulting engineers to develop farmstead layouts for animal production facilities, including siting buildings and manure storages, and developing manure management plans. Federal, state, and local governments seek advice from these consultants when developing regulations that can affect livestock operations. These consultants design facilities for commercial greenhouses. Agricultural engineers are retained to develop animal laboratories or specialized plant growth chambers. Consultants in this area also assist large and medium companies in the design of grain elevators, feed mills, and foodprocessing plants.

## When Should a Consulting Engineer Be Considered?

As consultants, agricultural engineers frequently provide services in building construction. They often serve as expert witnesses in legal cases involving building failure, livestock housing, or manure management. They work as accident investigators, and they frequently provide advice for designing and evaluating new products. Consider retaining a consulting engineer for a construction project when dealing with complex designs or needing technical assistance with permitting issues. You also may want to retain a consultant in any instance that deserves an unbiased technical analysis or a reliable, high-quality second opinion.

## Construction Services



Services typically provided by consulting engineers involve preliminary investigations, feasibility studies, cost comparison of alternatives, design, bid letting, contract negotiation, and construction monitoring and inspection. Most often, the best facility planning teams consist of professional engineers, who are familiar with, but impartial to, design and construction techniques, and the eventual operator, who is familiar with the particular needs and performance requirements of the operation. Once the planning team has been established, the professional engineer leads the planning team through the design procedure.

## Expert Witness

As expert witnesses, consulting engineers provide preliminary investigation, technical investigation, consultation, and testimony. In the role of expert witness, the consulting engineer serves as an unbiased professional who provides testimony based upon technical expertise. The academic preparation of agricultural engineers qualifies them to deal with a broad spectrum of case types.



## Accident Investigation

In situations involving personal injury or property damage, the consulting engineer often can be an invaluable resource. Often there are no eye witnesses, or witnesses are confused as to what happened. An engineer often can do the best job of reconstructing an incident. The engineer knows what is physically possible and can make the appropriate calculations. Engineering intuition and imagination help to develop reasonable reconstructions. Engineering training is invaluable in the technical analysis of assumed possibilities. Engineers also have the advantage of working with materials and knowing how materials react.

## Product Development or Evaluation

Many companies retain consulting engineers to provide specific, short-term expertise. Often a company may choose to retain a consulting engineer to ease the work load on regular permanent staff, thereby procuring *niche* expertise that is not resident or is not required on a regular basis. In so doing, companies often secure the services of a uniquely qualified individual (as opposed to simply excellent technical competence) for a specific project. The consultant provides fresh ideas or concepts, often from alternative disciplines, and contributes unbiased evaluations of the projects or designs under consideration.

Consulting opportunities available to power and machinery engineers are a good example of this trend. To keep up with the growing demand for innovative, high-tech equipment, farm equipment manufacturers need more engineers than are graduating from universities. As a result, many smaller companies and some of the larger ones retain consultants for new product design. Power and machinery consultants design agricultural or industrial equipment and make the initial tests on it before turning it over to the company for manufacturing. Consultants are involved in projects ranging from small lawn and garden machines to giant mining and earth moving equipment.

