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THE DEVELOPMENT OF FOREST ENGINEERING

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SUMMARY: Forest Engineering became an accepted academic discipline early in the 20th century when leaders in higher education and industry recognized the unique skills and knowledge necessary to engineer forest harvesting operations in the Pacific Northwest. The development of the forest engineering profession and academic discipline are discussed.

KEYWORDS: Forest Engineering, Logging, Harvesting, Curriculum, History

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The early years...

The Royal Engineering College at Copper's Hill (in Great Britain) may have been the first to marry engineering with forestry when they established a chair of forestry in 1884 (Fernow, 1913). The charge of the school at Cooper's Hill was to teach technical material to prepare individuals for employment in the Colony of India. The forestry program prepared individuals who would aid in the exploitation of India's forests. The program was moved to Oxford in 1905, marking a transition toward what we now view as modern forestry instead of an area of applied engineering.

In the Southeastern United States, the Biltmore Forest School operated from 1898 to 1913 under the direction of Dr. C.A. Schneck. The school did not have a Forest Engineering curriculum but did emphasize the practical aspects of forestry, including substantial attention given to logging (see O'Hearne, 1913). The Biltmore school would likely have become an eastern focal point for forest engineering had declining enrollment (due largely to competition with new forestry programs at Cornell and Yale) not led to the school's closure in 1913.

Turn of the century loggers in the Pacific Northwest well understood the value of a capable engineer. Western loggers were contending with steep rugged terrain, big trees, and logging technology that was based on cable systems and railroads. They needed persons who could survey railroad lines and property boundaries as well as oversee road layout and construction. Many civil and mechanical engineers had the necessary background but two problems prevented these engineers from being employed by the logging firms. First, young engineering graduates were not compatible with the loggers. The Pacific Northwest was extremely rural, logging enterprises operated out of camps, and the climate was, true to the northwest's reputation, conducive to wet socks and webbed feet for those who undertook an engineering career in the outdoors. Engineers were finding employment in more urban settings with more reasonable salaries. Further, the logging business did not know what to do with the engineers. It was not appropriate to

turn an engineer into an overpaid logger yet with no existing career track for engineers in the business, there did not exist means for an engineer to become sufficiently familiar with the business.

The second problem was an outgrowth of the first. When civil and mechanical engineers were employed by the logging firms the results were frequently disastrous. E.T. Clark (Clark, 1912) describes a case where a logging firm engaged a civil engineering firm to locate some boundary lines. The surveyors, not understanding the nature of logging, located the section corners but, to the loggers dismay (and too late discovery) did not blaze the boundary lines for the fallers. Clark also told of a logging company that hired a "gang of civil engineers" to survey a few miles of rail line. The construction crew discovered that the newly surveyed line would have required excavation at a cost not justifiable by the timber to be extracted. The company then called in their own timber cruiser (note: probably an educated forester) to "spot in a road that could be built without bankrupting the company."

In August of 1908, George Cornwall, editor of a trade magazine called The Timberman, and Edward English, an influential logging firm owner from Mt. Vernon, Washington, visited in the Dillar Hotel in Seattle (Cornwall, 1909). At that meeting Mr. Cornwall proposed his ideas for a meeting that was to become the Pacific Logging Congress. The congress would be a "friendly powwow of other loggers for an exchange of ideas (pertaining to logging)." It is evident that Cornwall understood the nature of the men operating logging operations and the importance of their perceptions thus he allowed that "the idea of this congress was therefore a mutual and simultaneous inspiration."

Cornwall subsequently met with Dean Frank G. Miller and Professor Hugo Winkenwerder of the University of Washington to discuss the upcoming Pacific Logging Congress (the congress would be held on the campus of the University of Washington in Seattle). Dean Miller and Professor Winkenwerder had recognized the growing need for engineering talents in the logging camps and were interested in establishing a program in logging engineering. But, they too recognized that the success of their endeavor would depend on acceptance by the loggers, and that the easiest way to attain acceptance was to allow the idea to come from the loggers themselves. George Cornwall, for his part, needed little convincing and took it upon himself to become a champion for the effort to establish a "new" profession. So, the profession and academic field of "logging engineering" became an important component of the Congress' mission.

The first Pacific Logging Congress (PLC) was held July 19-21, 1909 in the Hoo-Hoo House at the Alaska Yukon Pacific Exposition

in Seattle. At that first PLC George Cornwall, discussing the PLC, stated (Cornwall, 1909):

> "Logging is an engineering science and as such it must be considered in the future to a greater extent than it has in the past. The country is doing bigger things in every department of human activity, and the logging business is no exception to the rule. It takes close application and a high grade of engineering skill to be able to lay out the proper location of roads, which will intersect and draw to one common point the greatest amount of timber in any one tract. The grasp of this one problem is the deciding factor in determining the ability of the engineer, which often can be realized only after the tract is well opened up. There is a growing field on the Pacific Coast for young men with a knowledge of engineering, both civil and mechanical, who will devote their time to a study of Pacific Coast logging requirements, with a view of being able to present in an intelligent and practical manner a working plan for opening up and logging a tract of timber. This is practically an unoccupied field, and one of the underlying motives which dominated the congress."

Although Cornwall may well have been the one to coin the term logging engineering, Frank Lamb is one of the earliest to use the term in publication. In a paper (Lamb, 1909) presented to the first PLC, Lamb of Lamb Timber Company in Hoquium, Washington, discussed some of the subjects that compose logging engineering, and suggested:

> "I hope that I have briefly outlined a few of the subjects comprised under the general term logging engineering, and while it would not make us more valuable men or more successful in our business, yet I think that if we practical men were to call ourselves logging engineers instead of simply loggers or boss loggers it might give us a greater pride in our profession.
>
> "I use the term profession advisedly, because I think the act of drawing logs out of the woods to the markets of the world is fully as elevating, fully as useful an occupation as is the drawing of useless teeth out of another man's head, and if one is a profession so should the other be."

The following year, 1910, a short course in logging engineering was taught at the University of Washington by Professor W.T. Andrews (Andrews, 1925). One year later Elias T. Clark was hired to take charge of the forest engineering program at the University of Washington. The strength of that program was in the extensive use of a capstone field exercise (Clark, 1912) that is still the trademark of the program today (Schiess et al., 1988).

Oregon State University (then Oregon State Agricultural College) established a department of logging engineering in 1913 and graduated their first logging engineer in 1915 (Davies, 1951), A well respected logger from industry, J.P. Van Orsdel was hired as the programs first professor of logging engineering. The new curriculum was outlined to the PLC as follows (Van Orsdel, 1916):

> "In the student's freshman year he is taught, aside from (citizenship, executive training, military training), trigonometry, analysis, general forestry, elementary mensuration, plane surveying, general chemistry, and wood work. In the second year, engineering physics, blacksmithing, tool making and tempering, machine shop, practice, mechanical drawing, topographic surveying, railroad surveying and dendrology and mensuration. In the third year this is followed up by advanced mensuration, forest appraisals and reports, log scaling, logging railroads, logging machine design, elements of steam engineering and steam laboratory, mechanism, lumber rates and tariffs. The senior year is devoted entirely to specialized work and the following ground is covered: Topographic logging plans, logging devices and equipment, logging methods, timber technology and testing, and lumber manufacture."

By 1920 logging engineering programs had been established at the University of California (Berkeley), Oregon State University, the University of Washington, the University of Idaho, and the University of British Columbia. These early curricula, like the one described by Van Orsdel, stressed traditional forestry, logging planning and setting layout, surveying (land and railroad), topographic maps, and steam engines. However, by 1920, the very nature of logging engineering was beginning to change.

A Changing Scope...

Two forces were acting to change logging engineering. First, technology was changing. Due in part to world war I, advancements in the internal combustion engine and manufacturing processes were enabling the development of tractors and motor trucks that were suitable for logging. The result was a change in logging methods that was reducing the dependence on railroads. Second, concern for the forest resource was building, and with the concern came increased interest in regeneration and selective logging.

In 1919 the Oregon Engineers Registration Law was passed and logging engineering was included as one of the branches (Davies, 1951). The passing of legislation that provided for professional licensing of logging engineers was an acknowledgement of the importance of engineering to the protection of forest resources.

But, the primary emphasis of the early logging engineering programs was directed at the problem of economic development of a timber resource located on difficult terrain. The requisite system of railroads and cable yarders represented a substantial capital investment. Poor harvest design, resulting in high logging costs, were of constant concern. The preparation of boundary and topographic maps, the development of a rail and cable transport system, and the actual railroad survey, design and location clearly called for the skills of an engineer. That forestry knowledge was also required in equal measure was not as clear. Indeed it was not until the early twenties when public concern about sustained forest yield became a political issue -- in 1924 the director of the newly formed experiment station, T.T. Munger, called logging without forest replacement "industrial suicide" (Munger, 1924) -- that forestry skills were accorded significant recognition in the conduct of harvesting operations. In 1922 George Cornwall, writing for the industry (Cornwall, 1922), observes:

> "From now forward the growing of timber will become a recognized and essential part in logging. A good fundamental knowledge of forestry will be helpful, in fact necessary, in conducting logging operations in the future; where the question of how best to remove the present crop with a view of providing for a continuous future supply, will be regarded as a test of efficiency."

It was during this period that the term "forest engineer" appeared in the Pacific Northwest. As noted by Cornwall in the same paper, it was felt that the name of "logging engineer" should be widened to "forest engineer" to adequately reflect the scope of these new responsibilities. It is interesting to note that the term "forest engineer" was not new. The Canadian Society of Forest Engineers existed from 1908 until 1950 (publishing the journal

Forestry Chronicle). In 1950 the organization changed their name to The Canadian Institute of Forestry, more accurately reflecting their scope and interests as a professional forestry organization as opposed to an engineering organization.

A second factor was also at work - the advancing technology of timber harvest. Crawler tractors and trucks had made their appearance in the woods and while they would not become well established until the thirties their potential was obvious to many in logging. For the forest engineer; aka, logging engineer, the engineering content of his work was inexorably changing. Engineering skill was less critical in developing a successful truck road and tractor setting as compared to a railroad accessed cable setting. The advent of the bulldozer and truck road would reduce the importance of careful advanced planning by the engineer. Capital costs were moving from the woods to the mill and with it the attention of upper management.

It was then a confluence of advancing technology and increasing concern about the forest resource that forced a reconsideration of the role of the logging engineer. If logging (forest) engineers would once again enjoy a high profile in corporate operations it was thought that it would be because of the broader issues of forest resources management and the ability of forest engineers to address those issues with a uniquely appropriate set of skills.

During the economic depression of the thirties and the Second World War the interest of the forest industry focused on short term economic efficiency. Logging time and cost studies were increasingly applied, and the forest engineer began to use many of the techniques popularized by industrial engineers. Interest in the broader role of the forest engineer in forest resource management seems to have waned.

Steep terrain harvesting technology continued to advance through the forties with the appearance of track mounted steel towers, wide use of rubber and track mounted cable loaders and the wide acceptance of the power chain saw in felling and bucking operations. Along with the improvements in technology came greater interest in forestry as a component of logging engineering. During the 1940s the logging engineering curricula began to show changes reflecting new emphasis. The program at Oregon State University was renamed to forest engineering (Davies, 1951) and the program at the University of British Columbia was changed to add more english, technical forestry, and forest products in place of the applied engineering courses (Besley, 1951).

In Washington a tax law designed to encourage forestry on private land was passed in 1941 (Baisinger, 1941). The first forest practices act for the state was passed in 1945 (Webster, 1945). Further significant forest practices legislation would not

be seen again until the early seventies. In 1949 logging engineering was granted recognition as a distinct branch of engineering by the Washington State legislature (Markworth, 1951).

If technology was easing the job of the forest engineer the physical environment was not. Logging operations during the fifties and sixties were moving into higher and more rugged terrain. Access to these areas even by truck road was difficult. The contribution of the forest engineer to a successful logging operation under these conditions was easily recognized.

In the late sixties and early seventies protection of the public resources adversely affected by forest harvesting operations became a front page political issue. The increased public awareness sparked interest in forest engineering among other disciplines. The American Society of Agricultural Engineers (ASAE) held two forest engineering conferences in 1968 and 1969. The interest of the ASAE serves to illustrate that 1) the public concern for the forest resources was sparking interests of professionals outside of forestry and 2) the broader scope of forest engineers (discussed by Cornwall and others in the 1920s) was becoming recognized. B.Y. Richardson (Richardson, 1968) wrote in the Forward to the proceedings of the first ASAE sponsored forest engineering conference that:

> "Good engineering is also required in site preparation, regeneration, cultural and protective functions. these needs take the form of design, development and testing of machines for precise planting, seeding, fertilizer application, nursery operations, as well as insect, disease and fire control."

The second ASAE sponsored forest engineering conference, held in 1969, is significant because it is the first conference held since the early Pacific Logging Conferences that was directed at teaching and curricula in forest engineering. (The Pacific Logging Congress is still going strong but it has evolved so as to place dominant emphasis on the business and occupation of logging as opposed to the profession and discipline of forest engineering). S.J. Coughran (Coughran, 1969) noted in the opening remarks of the conference that "...it was quite evident that the subject matter to be explored in this conference is extremely controversial." The controversy he refers to was one of determining whether forest engineers are/should be foresters or engineers. George Cornwall's notion of a distinct profession of forest engineering had perhaps become forgotten.

By the end of the seventies most of the western states had toughened and enlarged the scope of their forest practice legislation. Companies engaged in the harvest of a very valuable timber resource were operating on difficult terrain under

restrictive forest practices acts. Forest engineers were again in high demand. The forest engineering programs in the Northwest were strong and numerous others had materialized throughout the country. Some of the newer programs had affiliation with Agricultural Engineering Departments. In 1979 a forest engineering conference was held in Corvallis, Oregon. This conference marked the formation of the Council on Forest Engineering (COFE) a nearly professional organization for persons interested in forest engineering. At that first meeting of COFE it was decided that no affiliation should be sought with either the ASAE or the Society of American Foresters. The "controversy" of the 1969 meeting was still a concern. By the beginning of the eighties however even the forest engineering profession was impacted by the industry wide recession. Academic concerns were replaced by pragmatic concerns as employment opportunities and student enrollment declined.

Challenges for the Future...

As the eighties come to a close the forest engineering profession in the West once again faces a serious challenge. Many companies are now operating in low elevation second-growth stands. These stands, as compared to the old growth stands of former years, have more homogeneous timber located on gentler terrain. Road location and logging are not as challenging in this regard. Computers have greatly reduced office engineering time, thus a given quantity of design activity can be accomplished with fewer engineer hours. Construction and harvesting technology, especially when combined with easier ground conditions, have reduced the obvious financial benefit associated with careful planning. Most of these factors militate against the recognition of the forest engineer as a necessary part of the harvesting operation.

If planning and conducting the roading and harvesting operation have been made easier by technology, in at least two aspects it has become, and will become, much more important and difficult. First, the large and highly valuable logs have been replaced with small diameter lower value logs. This change in log size and value has made log handling critical to the profitability of a logging enterprise. The homogeneous nature of the timber resource better lends itself to mechanized harvesting and handling operations than did the "old growth" timber. Successful mechanized logging operations are highly engineered systems. Second, increased recognition and legislation for the protection of the public resources of air, water, fish and wildlife have placed major constraints on timber harvesting and other forest management activities. The resources belonging to society at large can not be dismissed as illegitimate or ephemeral concerns. It is here that the forest engineer can make a substantial contribution to the forest industry and to society. The engineering design of forest roads, harvest systems, or other forest management operations is key to the integration of the many constraints currently placed on

forest management and utilization. To the extent that engineering skills and accountability can contribute to the identification and implementation of environmentally acceptable as well as financially attractive management and harvesting activities the forest engineer should be involved.

The future of the profession depends on practicing forest engineers and educational institutions cooperating to redefine the areas of technology or bodies of knowledge that are forest engineering. The continued development of forest engineering should address the technology and problems of today and anticipating those of tomorrow. It is also the time to examine the profession not as a question of engineer with some forestry, foresters with some engineering, or even a hybrid engineer-forester, but as a distinct profession and academic discipline.

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