

Louisiana are more suited for the establishment and maintenance of a levee system than are those of the delta and sub-delta marshes.

The decision to construct impoundments should be based upon findings of a thorough geological investigation on the area.

In areas where the canals created by the excavation for levee material are to be used as access routes for boats, erosion may be expected to occur over the years to the extent where the impoundment levee system may be severely damaged or destroyed. Construction of impoundment levees from staggered borrow pits create less disturbance to marsh areas but tends to be more expensive. Perpetual maintenance of levee systems and water control structures is essential. Subsidence of levee systems may be expected to continue through the life of the levee and periodic raising of a levee is necessary to maintain the required elevations for proper water management. Initial costs of construction and maintenance of impoundment levees are extremely high. Investigation of other development techniques should be considered before the decision to construct levees and install water control structures is made.

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"CONTRACTING vs. USE OF OWNED EQUIPMENT"

BY JOHN E. BUXTON

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Mr. Chairman and Gentlemen:

I have always thought that I was an average person in most respects, that my ability, reactions and motives were at least pretty close to that of the other fellow's; so, in attempting to analyze problems that involve a lot of personal ramifications—and what problems don't involve them—I sort of think that things that effect one will effect most in at least a similar fashion.

I have had some experience along the lines of this subject here in Arkansas, both with the Arkansas State Highway Department and the Game and Fish Commission. I was State Maintenance Engineer for the Highway Department four years and with the Arkansas Game and Fish Commission for ten years.

It is the prerogative of the elderly to reminisce; any way, prerogative or not, we do it whenever we have a captive audience; so before I start to answer the question, I'm going to talk about some of my experiences:

I went with the Highway Department in 1933. That was before some of you had started to work, and it was during the Big Depression. Actually, the Depression started in 1929, and when Franklin Roosevelt took office in 1933, things were bad all over. The Bank Holiday, the Blue Eagle, the WPA, the PWA, and other agencies I can't recall and too numerous to mention sprang up over night.

Arkansas Road Improvement Districts had defaulted on bond pay-

ments, and a refunding of these bonds backed by the "full faith and credit" of the state was negotiated with bondholders. The agreement provided that all revenues from gasoline tax and automobile licenses sales would be set aside for debt service except \$2,000,000 annually, which was to be used by the state for the maintenance of our road system; and shortly thereafter, I became Chief of Maintenance.

The \$2,000,000 was all the state had that was available for highway work. All salaries from Director to Janitor were paid from it, and all material and equipment purchased had to be paid for from it. By way of comparison, the department spends that amount now for signs and markings (\$16,000,000 annually on maintenance) starting with the salary of the maintenance engineer and no other overhead or legal costs. This is to emphasize why it was necessary and important to stretch every dollar to the limit. We only counted money paid out as cost. No rental or amortization of equipment and no equipment replacement account. Everyone wanted a job, and contracting was fiercely competitive.

We could get good men and they worked, and I can state categorically that we accomplished much more with our two million by using our purchase-and-hire system than we could have by using contractors.

Of course, times have changed and most agencies require a realistic approach to comparative costs now, which include all the factors that go into figuring costs of a job.

Before proceeding, let me explain that certain jobs that require a large amount of heavy and special equipment and involve large quantities can best be contracted because it would be necessary to secure so much additional equipment and personnel that it would be tantamount to organizing for that specific job. This discussion does not apply to them.

A couple of years ago I heard a paper which later appeared in an engineering periodical, that listed the costs which went into a certain job that Brown & Roots had taken. There were literally dozens of items that contributed nothing toward the physical completion of the work and classed as overhead.

At this time I think we should consider the items that go to make up the completion of a construction job, and then take them singly and discuss them relatively from the standpoint of the contractors and agencies:

1. Overhead, covering a multitude of costs.
2. Planning.
3. Supervision.
4. Labor, including liability insurance, unemployment insurance, and all other payroll taxes.
5. Material.
6. Equipment.
7. Profit.

1. OVERHEAD—First, with most of us, the inclusion of some purchase and hire work does not greatly increase the overhead. Office space, some office help, transportation and the like are only slightly increased, and a large number of items such as figuring, bidding, and miscellaneous cost that must be absorbed by a contractor are non-existent. Also, facilities for purchasing and the handling of payrolls, especially on medium size jobs, are usually adequate without any additional costs. Overhead costs are less for the State.

2. PLANNING—The planning must be done before any job can be started, either by contract or State forces. On other types of work, this is sufficient for the agency but the contractor must start from scratch. Planning costs should be less for the State.

3. SUPERVISION OF WORK—This is the place where the contractor usually has the advantage. As a matter of fact, it is only by increased efficiency in the prosecution of the work that he is able to compensate for additional costs and the necessary profit. Let me quote from Charles C. Gibbons (Administrative Research Consultant, The Upjohn Company):

"Many engineers are poorly prepared for administrative work because they lack the temperament and the experience that would qualify

them for effectively directing the work of others. The engineer who is promoted to a supervisory position is often selected for his technical competence as an engineer rather than for his ability to work with people. He feels more comfortable working with processes, equipment, and data than he does in dealing with human relationships.

"An engineer is inclined to see things as being either black or white and to be intolerant to the compromises that are necessary in every organization. He is inclined to rely too heavily on data of various kinds and to overlook the importance of the human factors in the situation.

"By temperament and training, the engineer would like to have all the facts before reaching a decision. Unfortunately, the engineer who becomes a supervisor will find that he cannot wait for all of the facts before reaching a decision."

This item of supervision is so closely related to the next one, labor, that what I'm going to say now relates almost equally to both.

4. To really get production from Labor, there must of course be good Supervision and organization, but there should also be incentive. Wages are the normal incentive but there are others — such as rivalry, goals, etc. To use another personal experience, when I was post engineer at Camp Barkley, we decided to salvage the lumber, windows and doors used in the construction of some temporary barracks:—

We had a German P.O.W. (Prisoner of War) Camp there, and these men were available to do the work. I sent three of my best carpenters to wreck, remove nails and pile the material from one of the barracks building, according to a sketch plan I had prepared, and it took them nearly a full day to complete the task.

I decided to assign four P.O.W. to a building as a day's task. The first day they fooled along and quit about 4:00, thinking they could call it a day, but I had arranged with the Camp Commander to hold them 'til they finished.

When they understood that there'd be no supper until they finished, business picked up and most finished before dark. The ones that didn't had to complete the original task next morning and another building.

By the end of the third day, many crews had finished before 4:00 and no crew would help a slower one.

In a couple of weeks I decided to take the crews back to the compound as soon as they were through with their task.

Many finished before three, and very few were working at four.

All visitors who were there in the forenoon were amazed at their speed and wanted to know how I did it. "Incentive," I said. "There's shade in the compound, and it's mighty hot out there."

The next is a sort of warning to emphasize the quote from the Gibbons article:

On Contract work, the contractor and his foreman are striving to finish as quickly and as inexpensively as possible.

Your state forces do not have that incentive and it is one of the problems that an engineer in a supervisory capacity must solve. In other words, there is no resistance to suggestions or orders that will increase the time and therefore the cost of the work.

Your own crews will "sandpaper" a job just as long as they think you want them to—longer if they get started and no one stops them, and your 20% edge can be sandpapered away before you know it.

4. LABOR — Hiring practices which affect the quality of the personnel is also a factor. If the employee is more or less immune to the superintendent or foreman, once he is employed, it follows that he will not make as much effort and will not produce. Of course, wages are an important factor, and, "portal to portal" results in less productive time.

5. & 6. MATERIALS AND EQUIPMENT can be purchased by a State agency at a price competitive with what a contractor will have to pay, so there should be no advantage here either way.

7. PROFIT — The last item of profit applies only to the contractor, so it all boils down to planning, supervision and quality of Labor. In plain language, a good (state) bulldozer or dragline operator can move as much dirt with a state-purchased dozer or dragline as another man working for a contractor with equipment purchased by the contractor.

Maintenance of equipment can be the difference between profit and loss for a contractor, and it therefore follows that the quality of maintenance could make a "purchase-and-hire" job cost more than a contract job. Considering overhead, taxes, material, equipment and profit, you should have an advantage of up to 20%.

One other advantage about owning equipment is that it safeguards against abnormally high bids. Sometimes and under certain conditions, the low bid is much too high. Re-advertising doesn't always produce lower bids. Personally, I think it would be a good practice to have the engineering department fix a maximum price, or in other words, bids on jobs which they are able to perform. I know this practice is being used by big corporations within their own organization. For example: The Singer Manufacturing Company, who at one time manufactured 90% of the sewing machines used in the world, has a subsidiary at Truman—in the state, wholly owned by them, called the Poinsett Lumber and Manufacturing Company, and it is the largest woodworking plant in the state. It represents an investment of many millions of dollars, but the plant must bid against anyone on all the parts it produces, and unless it is low, the job goes to the outsider.

All of this adds up to this: State agencies should own and operate enough equipment to perform needed maintenance, phase construction, and let us say—smaller construction jobs for the following reasons:—

1. Work can be performed for less money (a very important one), or put it another way, you can do more work for the same money. We are all limited by the funds available.

2. You will develop an organization that will perform the particular type of work you need "efficiently and without continuous inspection."

3. You will have at your disposal "men and equipment that can be used as you wish in emergency."

4. You will have protection from vagaries of bidding.

5. You may, if you desire, or it is expedient to do it, waive certain provisions of the specifications if it has developed that this may be safely done at an increased savings to the state.

TO DO THIS, YOU MUST AT LEAST, IN MANY RESPECTS, MOVE ACROSS THE TABLE AND THINK LIKE A CONTRACTOR!

THE USE OF AVAILABLE MATERIAL AND ITS INFLUENCE ON EMBANKMENT DESIGN¹

There are only two good reasons that I know for building any dam. You either want to prevent water from doing something that is undesirable or you want to make water do something that is desirable. Either of these objectives may be accomplished independently, but more often than not in the accomplishment of one we also accomplish the other to some degree, as a special dividend or as a sort of by-product. Most dams are built for both reasons. It is much easier to justify the expense of building a dam if it is to serve two purposes rather than one. It is the same old idea of buy one and get the second one free.

There are all kinds of dams, depending on what kind of yardstick or criteria you use for purposes of classification. There are storage dams, detention dams, and diversion dams depending on, shall we say, the functional use of the storage basin. If we take water use as a criterion we may have power dams, irrigation dams, water supply dams (municipal, industrial, etc.), flood prevention dams, fish and wildlife dams and recreational dams. There is evidently room for much overlapping in these classifications. As has been demonstrated by the Soil Conservation Service's small watershed program, multi-purpose

¹ Presented at the conference of the Southeastern Association of Fish and Game Commissioners at Hot Springs, Arkansas, September 30 - October 2, 1963, by Hal C. Normand, Civil Engineer (Soil Mechanics), Engineering and Watershed Planning Unit, SCS, Fort Worth, Texas.