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Review of Elevator Project in Honduras

FOOD & FEED GRAIN INSTITUTE
KANSAS STATE UNIVERSITY
MANHATTAN, KANSAS 66502

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Author: H. B. Pfost

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Contractor: Food and Feed Grain Institute, Kansas State University, Manhattan Kansas.

Principal Investigator: H. B. Pfost

SUMMARY STATEMENT

Kansas State University was requested to review the proposed elevator project in Honduras with particular reference to the engineering design and cost estimates.

Based upon a detailed study of the grain storage needs in Honduras made by Weitz-Hettelsater and published in September, 1965, engineering designs and cost estimates had been prepared for two major elevators: one at San Pedro Sula and Tegucigalpa. Following the completion of these designs the National Bank for Development requested bids for the construction of these two facilities. The bids for the structures were made by three firms and were reasonably close to the engineer's estimate. The bids for the equipment came from only one United States firm and were considerably above the engineer's estimate and the bank rejected the bid.

The author was requested by the AID Mission to review the design for the elevator facilities to determine if it was in conformity with good practice and if the engineering cost estimates appeared to be reasonable. The author solicited advice of a United States consulting engineering firm in reviewing the project.

The study resulted in the following conclusions. The overall design for the project appeared to be satisfactory and to conform to the original proposals contained in the Weitz-Hettelsater report. In general, the engineering designs were sound, adequate, and represented standard engineering practice. The cost estimates were, perhaps, low and should be reviewed before bids for the project are received again.

Date: November, 1969.

REVIEW OF ELEVATOR PROJECT IN HONDURAS

Prepared by

Dr. Harry B. Pfost
Department of Grain Science and Industry
Kansas State University

Prepared for the

AGENCY FOR INTERNATIONAL DEVELOPMENT

AID/csd-1588
Technical Assistance in
Food Grain Drying, Storage, Handling and Transportation

at the
FOOD AND FEED GRAIN INSTITUTE
KANSAS STATE UNIVERSITY
MANHATTAN, KANSAS 66502

Dr. William J. Hoover, Director
Dr. Harry B. Pfost, Agricultural Engineer
John R. Pedersen, Entomologist

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REVIEW OF ELEVATOR PROJECT IN HONDURAS

Introduction

The project to erect two large grain elevators in Tegucigalpa and San Pedro Sula is an outgrowth of various studies made on grain storage requirements in Honduras. The first study was made by the Central American Bank for Economic Integration (CABEI). This report was entitled, "Los Granos Basicos". Following this first report a more detailed study of the exact needs for Honduras was financed by CABEI and the study was made by Weitz-Hettelsater for the Ministry of National Resources of Honduras. This study covered thoroughly the grain production, marketing and storage situation in Honduras and was published in September 1965. The recommendation proposed the construction of two new large storage facilities to be used in conjunction with 12 smaller storage and processing elevators.

The study recommended the construction of new storage for 26,000 tons of grain at Tegucigalpa and estimated an annual turnover of 79,000 tons or about three times per year. The study further recommended the same 26,000 tons of new storage at San Pedro Sula and estimated an annual turnover of 53,000 tons or two times per year.

The study further showed that four grain types, corn, rice, beans and milo, together with some seed, would be handled in substantial quantities. The design of elevator facilities is further complicated by the fact that corn can be either white, yellow or mixed with three grades for each. Beans are of red or black varieties, rice is of upland or paddy type. This wide variety of grains contributes to a long time use of receiving and processing facilities, a need

for a great number of processing and storage bins and the necessity for many relatively small storage bins through which grain moves relatively rapidly.

Grain storage facilities may be classified into two general types depending upon their major function. One type of elevator is used primarily for the receiving, processing, (cleaning and drying), short term storage and shipment of grain. For such purposes it is important to be able to handle grain and get it into and out of storage efficiently. The other type of elevator has a function primarily related to storage. This type of elevator is usually filled at harvest time and emptied once during the year at most. The function of an elevator will greatly influence the type of structure. For the merchandising type of elevator, high vertical silos are generally used. They may be constructed of steel or concrete although concrete is more frequently used in larger elevators.

Storage type elevators are frequently of the flat type. The structure is frequently of steel with a flat concrete floor. Emptying this type requires more labor; since the height of the grain is less, more conveying equipment is required. When many different types and grades of grain must be stored separately, flat storage loses some of its advantage as far as investment cost is concerned.

The Weitz report recommended vertical concrete storage which would conform to usual practice for elevators having the function which the study indicated these elevators would have.

When the decision was made to design the elevators proposed by the Weitz study, the engineering firm of AICA-SACMAG, Ltda. of San Jose, Costa Rica was employed. This firm is directed by Mr. E. R. Cancio and employs 13 other

professional engineers and architects. They have designed 18 grain elevators used for grain storage alone or in connection with mills. For this project, Mr. Cancio served as Project Engineer. Mr. Dedi Hendrich served as Project Manager.

Mr. Guillermo Esquivel, an engineer who worked for several years for the National Grain Storage Agency of Costa Rica was employed on this project. Because of his previous experience in operating facilities of this type, he has a good knowledge of the special requirements required under Central American conditions.

The major structural design was handled by Mr. Rafael Tamarejo (Chairman of the Silo Committee of the American Concrete Institute) and Mr. Jose Rodriguez. Mr. Rolando Aguilar was the engineer for soil mechanics and Mr. Roberto Moncada handled the estimates on Honduran costs.

When the Banco Nacional de Fomenta (BNF) of Honduras initiated this engineering design, Mr. John Hallam was assigned to the project. Mr. Hallam is a British engineer who is employed by BNF. He has had many years of experience in British Empire in the field of grain processing.

The engineers started with the general plans suggested by the Weitz study except that the storage capacity was reduced to one half that recommended for the first phase of construction. However, the design anticipates and provides for later extension with a minimum of the basic facilities, such as the headhouse, which will be built at this time.

REVIEW OF THE PROJECT

My first meeting was with Mr. William Gardner, Jr. Engineer for the Honduras AID mission. Mr. Gardner explained the status of the project to date

and emphasized that the major reason for requesting my services was the desire for opinions regarding the suitability of the overall design, the adequacy of the equipment and the accuracy of the cost estimates. He further explained that BNF had requested bids for the project. Three firms had submitted bids for the structure work and one was near the original engineering cost estimate and was accepted. Only one bid had been submitted for the equipment and it was so far above the original estimate that it had been rejected by BNF.

Mr. Gardner was quite concerned over the fact that eight U.S. firms had qualified to bid for the equipment but only one had submitted a bid. At his request, I called Mr. James Kelly, President of the Aeroglide Corporation of Raleigh, North Carolina, in an attempt to determine why this company did not submit a bid. Mr. Kelly stated that there were two major reasons why his firm had not submitted a bid after having qualified to do so. The company was concerned about the fact that they did not know who would receive the contract for the structure and were apprehensive that this unknown factor might make the work more difficult and the cost difficult to estimate. Furthermore, the existing war situation at the time made the company apprehensive over the difficulty which might be experienced in fulfilling the contract. Mr. Kelly further stated that if BNF reopened the project for bids, that his company would again seriously consider making a bid. Information of this type was needed by BNF in making a decision regarding whether to reopen bids or to serve as their own general contractor for this phase of the project.

I talked with Mr. Carol Dayoe, Rural Development Officer for the Honduras AID mission, regarding the purpose of the project, its intended operation and its relationships to the overall plans for agricultural development in the country.

Approximately one full day was spent with Mr. John Hallam in a detailed review of the engineering design and equipment specifications. We reviewed the entire project from the Weitz study through the design and bidding to the present status.

Mr. Gardner accompanied me to San Juan, Costa Rica where we spent one day in the AICA-SACMAG offices reviewing details of the design criteria, equipment selection and cost estimating procedures. In order to obtain another engineering opinion regarding the design and the cost estimates, Mr. Gardner requested that Kansas State University consult with an engineering firm to check certain details of the design and estimates. I visited with the engineering firm of T. E. Stivers Company, of Decatur, Georgia, to review this project (a copy of that report is attached).

FINDINGS AND RECOMMENDATIONS

This project should serve two major functions from an overall national economic standpoint. It should provide higher prices for farmers and lower prices for consumers than the existing marketing system. In addition, it will provide facilities which will reduce grain losses due to poor drying, storage and insect control. An example of the success of a system of this type can be found in Costa Rica where 32,000 tons (metric) of storage provided for handling 56,000 tons of grain in 1966.

Present plans for using the facilities in Honduras are being formulated. A particularly critical problem will be the assembly of the grain from the farmers. I discussed this with both Mr. Deyoe and Mr. Hallam who feel that the mechanism will be attained with major emphasis on marketing cooperatives. The success in Costa Rica illustrates that new marketing structures are attainable.

The decision to reduce the total amount of storage should insure more complete utilization and a faster turnover. This decision is verified again by the Costa Rican experience.

In the brief time available, it was impossible to check every engineering calculation and cost estimate made by the engineers. Mr. Gardner and I selected certain specific equipment items and checked the design criteria, specifications, and cost estimating procedures in detail with the project engineers.

The designs used for conveying equipment, belt conveyors and bucket elevators, were taken from Link Belt Catalog No. 1000. This catalog is a standard guide to the design of such equipment. The design will be conservative but is frequently used when conveyors will be used a large number of hours per year. Cheaper equipment and designs may be used when equipment is used fewer hours per year. In my opinion, the design is acceptable because of the large number of hours of use per year and the difficulties of obtaining spare parts, maintenance, etc., in the area.

Specifications for dryers were written to provide major functional performance ratings related to drying capacity and operating temperature requirements. The specifications were written in such a way that most good commercial dryers would be eligable for consideration during bidding.

The design criteria for aeration equipment provided for a minimum of 1/20 cfm/bu, when aerating milo with higher rates for other grains. Normal practice in the United States provides 1/20 to 1/10 cfm/bu. USDA recommendations regarding pressure drop were used correctly.

Other items of major importance such as truck and receiving scales, spouting, spout valves were reviewed to determine that standard, commercially available and used equipment had been specified and price quotations had been obtained.

The engineers had written to more than one U.S. firm for price quotations on all equipment checked. Price quotations were received during the last half of the year, 1968. These quotations are as late as could be expected under the circumstances but may need some slight revision due to recent price increases. As an example of the way in which prices were used to obtain final cost estimates, price quotations on six bucket elevators, five belt conveyors, two belt trippers, one screw conveyor and 62 rack and pinion slide gates were received from the Link Belt Company in a letter dated December 18, 1968. This was the only set of quotations received for this equipment, although other firms had been asked to submit prices. The quotation included crating for overseas shipment and delivery to the ship in a U.S. port. Using this basic machine price the following percentages were added:

Ocean freight and insurance	10%
Inland (Honduras) Freight	2%
Installation	15%
Contingency	5%
Bonding	3%
Profit	15%

Mr. Gardner confirmed that the percentages, excluding installation, appear normal. Installation costs are relatively difficult to judge by United States standards. A few skilled supervisors must be employed from the United States at an estimated cost of U.S. wages plus 25% plus $500 per month living expenses plus travel. Local labor is estimated at: labor, $1.50/day; skilled craftsman (electricians, carpenters, etc.) $.75/hour. The rates for skilled crafts were estimated by Mr. Gardner to reflect the scarcity of Salvadorian labor, which formally dominated the skilled labor market in Honduras. The productivity of local craftsman are estimated to be about 60% of that of U.S.

Using these estimates of labor costs, etc., the T. E. Stivers Company stated that the 15% figure used for estimating installation costs appeared to

be low. They further state that most U. S. contractors will calculate profit at about 20%.

CONCLUSIONS

1. Based upon the requirements for grain storage in Honduras, there is no reason to question the Weitz-Hettelsater recommendations. The original design concept is standard practice for grain elevators of this type. The amount of storage proposed is not excessive for a nation of this size and type of agriculture as shown by the experience in Costa Rica. The type of storage structure and equipment proposed are standard for elevators performing similar grain merchandising and storage functions.

2. The engineering design which has been prepared accurately reflects the functional requirements specified by the Weitz-Hettelsater study. The engineers have used good design criteria. The equipment specified conforms to good engineering and design practice for such installations, considering the local operating conditions.

3. The cost estimates were carefully made. Quotations were obtained from U.S. equipment manufacturers and adjusted for freight, installation and other costs in conformity with good engineering practice except that the allowance for installation may be low.

4. The investment in these facilities appear to be justified under the original assumptions of the Weitz-Hettelsater report and the success of similar facilities in adjacent countries.

5. Careful planning needs to be done to insure that the grain can be purchased from the farmers in sufficient quantities to utilize the proposed facilities efficiently.

6. I recommend, in view of the stivers' opinion regarding installation costs, that the cost estimates be reatudied to properly evaluate the next bids.

T.E. STIVERS COMPANY
Consulting Engineers

547 Church Street Decatur, Georgia 30031

October 13, 1969

Department of Grain Science & Industry
Kansas State University
Manhattan, Kansas 66502

Attn: Dr. Harry Pfost

RE: BANAFOM GRAIN STORAGE & PROCESS PLANTS
REPUBLIC OF HONDURAS

Gentlemen:

This letter will confirm our partial review and opinions as discussed with Dr. Pfost on October 10, 1969 concerning the plans and equipment specifications for the Banafom Grain Elevator & Storage in Honduras, as prepared by Aica Sacmag.

The general overall design of the elevator facility is a vertical hopper slip form type which would be used today in many areas of the United States to perform a similar function.

This elevator is equipped with greater flexibility, so far as storage, working bins and flow of material is concerned, than most similar facilities in the United States. However, this would appear to be justified because of the large number of grades of grain being handled.

The structural drawings generally adhere to good engineering practices. The horizontal grain pressure in the lower part of the silos was calculated by us and the wall reinforcing bars and concrete were found to be adequate. The foundation mat on 6000 PSI soil appears to be adequate based on the soil design data provided.

Mechanical specifications were reviewed for the lower belt conveyors, bucket elevators and aeration system. We find these items to be adequate, except that the drives for the horizontal conveyors may need to be enlarged if and when the future expansion is carried out.

The grain dryer specifications are reasonable and should permit competitive bids, provided, however, that bidders are only required to meet the general characteristics and performance requirements, not the exact dimensions or other detailed characteristics.

Three recommendations are offered to improve the design, namely:

(1) to increase the gauge of the spouting to 10 gauge.
(2) to review the dust collecting system, including the venting of bins to see that it is adequate.
(3) spouting for 150 TPH should be a minimum of 12"ϕ (now 10"ϕ).

In reviewing the method of arriving at the estimated cost, we have the following comments.

(1) It has been our experience in cost estimates of this type that installation costs for equipment, including supporting and miscellaneous steel and spout installation, but less the electrical, will be in the area of 35% to 40% of the cost of the equipment, or considerably over the 15% estimated. Actually, rather than using percentages, our normal method of estimating this is to estimate man hours and materials, to come up with more detailed and accurate costs. However, we would estimate a percentage of 35% to 40% would be more reasonable.

(2) Overhead and profit if possible is usually figured at 10% + 10% above other costs. This item can vary depending on many factors. On some highly competitive jobs it could be as low as 5 and 5. A broad average, if such can be estimated, might be 10 and 5. In any case, if progress payments are expected to be delayed this cost may have to be increased to allow for cost of money to the contractor.

(3) During the past year, one particular difficulty in maintaining an accurate cost estimate has been the rate of inflationary cost increases. For this type of work the inflation cost has increased at least 7% during this calendar year.

This review is not in any way meant to be a complete analysis of design, engineering or cost, but does represent our best opinion for the time devoted to the review.

Very truly yours,

T. E. STIVERS COMPANY

W. B. Briggs, PE
Manager of Engineering

Georgia Registered Professional Engineer
No. 5826

Enc: Two (2) extra copies.

cc: Mr. T. E. Stivers, PE