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Status report of research project on improving design of a hopper dredge pump, May 1960

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STATUS REPORT OF RESEARCH PROJECT
ON
IMPROVING DESIGN OF A HOPPER DREDGE PUMP

Prepared by
John B. Herbich

Prepared for
U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
Corps of Engineers
Philadelphia 29, Pennsylvania
Contract No. DA-36-109-CIVENG-59-112
May 1960
Bethlehem, Pennsylvania
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STATUS REPORT OF RESEARCH PROJECT
ON
IMPROVING DESIGN OF A HOPPER DREDGE PUMP

I. INTRODUCTION

The following report summarizes the studies performed during the month of April 1960, at the Hydraulics Division of Fritz Engineering Laboratory, under terms of Contract No. DA-36-109-CIVENG-59-112. Earlier work was described in Status Reports dated: December 1958(1)*, February 1959(2), April 1959(3), June 1959(4), December 1959(6), February 1960(7), March 1960(9), April 1960(10), and a Project Report dated September 1959(5).

II. EXPERIMENTAL STUDIES

A. General Comments

Another test is planned to obtain pump characteristics for silt-clay-water mixture concentrations of about 1380 grams per liter. As the concentration of mixture was only about 1320 grams per liter, some additional amounts of heavily concentrated silt-clay mixture were placed in the tank. It appears that the mixture concentration is still below the required amount, and it will be allowed to settle to permit the siphoning out of the clear water.

* Numbers in parentheses refer to References, page 4
B. Pressure Tests

Analysis of pressure tests around periphery of the volute taken during the previous months is under way.

C. High-Speed Moving Pictures

Analysis of high-speed moving pictures taken last year has been completed. A separate Memorandum (Number M-11) is being prepared and will be submitted to the Sponsor in June 1960.

III. RECOMMENDATIONS FOR IMPELLER DESIGN CHANGES

Design work on developing the vane profile according to the logarithmic spiral and the involute curve method is under way. The following impeller vane designs were completed:

(1) Trial Design I
Shape of vane: involute curve
Entrance angle: 45 degrees
Exit angle: 35 degrees

(2) Trial Design III
Shape of vane: logarithmic spiral
Entrance angle: 45 degrees
Exit angle: 35 degrees

(3) Trial Design IV
Shape of vane: logarithmic spiral
Entrance angle: 45 degrees
Exit angle: 22-1/2 degrees
Sketches of Trial Designs I, III, and IV, are presented in the Appendix.

IV. EXPERIMENTAL TEST PROGRAM

A. General Comments

The involute curve method (Trial Design I) was originally suggested, as it was thought to be the most readily applicable method in the case when the entrance and exit angles have different values. However, it was also discovered that a logarithmic spiral may also be drawn in such a case.

The impeller vane of Trial Design III was ordered on April 28, 1960, and delivery was expected about June 1, 1960. (This order was cancelled on May 13, 1960, following the Sponsor's request).

The sketch showing Trial Design IV was forwarded to the Sponsor for approval on May 6, 1960.
REFERENCES

(1) Herbich, J.B. STATUS REPORT OF RESEARCH PROJECT ON IMPROVING DESIGN OF A HOPPER DREDGE PUMP. Fritz Engineering Laboratory Memorandum No. M-1 Lehigh University, December 1958

(2) Herbich, J.B. STATUS REPORT OF RESEARCH PROJECT ON IMPROVING DESIGN OF A HOPPER DREDGE PUMP. Fritz Engineering Laboratory Memorandum No. M-2 Lehigh University, February 1959

(3) Herbich, J.B. STATUS REPORT OF RESEARCH PROJECT ON IMPROVING DESIGN OF A HOPPER DREDGE PUMP. Fritz Engineering Laboratory Memorandum No. M-3 Lehigh University, April 1959

(4) Herbich, J.B. STATUS REPORT OF RESEARCH PROJECT ON IMPROVING DESIGN OF A HOPPER DREDGE PUMP. Fritz Engineering Laboratory Memorandum No. M-4 Lehigh University, June 1959

(5) Herbich, J.B. CHARACTERISTICS OF A MODEL DREDGE PUMP Fritz Engineering Laboratory Project Report No. 31 Lehigh University, September 1959

(6) Herbich, J.B. STATUS REPORT OF RESEARCH PROJECT ON IMPROVING DESIGN OF A HOPPER DREDGE PUMP. Fritz Engineering Laboratory Memorandum No. M-5 Lehigh University, December 1959

(7) Herbich, J.B. Weiss, W.L. Waddington, W. STATUS REPORT OF RESEARCH PROJECT ON IMPROVING DESIGN OF A HOPPER DREDGE PUMP. Fritz Engineering Laboratory Memorandum No. M-6 Lehigh University, February 1960

(8) Weiss, W.L. SUGGESTED DESIGN CHANGES FOR A CENTRIFUGAL PUMP IMPELLER HANDLING DREDGED MUD Fritz Engineering Laboratory Special Report Lehigh University, November 1959
(9) Herbich, J.B.  STATUS REPORT OF RESEARCH PROJECT ON IMPROVING DESIGN OF A HOPPER DREDGE PUMP. Fritz Engineering Laboratory Memorandum No. M-8 Lehigh University, March 1960

(10) Herbich, J.B.  STATUS REPORT OF RESEARCH PROJECT ON IMPROVING DESIGN OF A HOPPER DREDGE PUMP. Fritz Engineering Laboratory Memorandum No. M-9 Lehigh University, April 1960
IMPELLER VANE DEVELOPMENT

SCALE 1" = 1 ft.

LEGEND

A = 13 3/32" R
B = 14 31/32" R
C = 17 13/64" R
D = 19 49/64" R
E = 22 11/64" R
F = 26 7/64" R
G = 30" R
H = 34 31/64" R
IMPELLER VANE
TRIAL DESIGN 4

LEHIGH UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
FRITZ ENGINEERING LABORATORY
HYDRAULICS DIVISION

IMPELLER VANE DEVELOPMENT
SCALE 1 1/2" = 1 FT.

5 VANES SPACED 72° APART

SMOOTH CURVE

45° ENTR. L

22 1/2 EXIT L

50" DIA.

20 3/4 R

19 1/4 R

17 3/4 R

DRAWN: WLW
MAY 1960
CONTRACT NO. DA-36-019 CIV. ENG.59-112