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L.O.

NATIONAL RESEARCH COUNCIL
DIVISION OF MECHANICAL ENGINEERING
OTTAWA, CANADA

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FILE

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LABORATORY MEMORANDUM

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SUBJECT

CUTTING REINFORCED CONCRETE BY OXYGEN-
LANCE METHOD: SOME EXPERIMENTS IN
CUTTING.

PREPARED BY

G.J. DELAND

ISSUED TO

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CUTTING REINFORCED CONCRETE BY OXYGEN-LANCE METHOD:
SOME EXPERIMENTS IN CUTTING

SUMMARY

An opening eleven feet, five inches, in diameter had to be cut in the south wall of No. 4 test cell exhaust enclosure. This wall, sixteen to eighteen inches in thickness, is made of concrete, reinforced with one-inch-by-three-inch vertical steel bars on 24-inch centers, in addition to conventional reinforcing.

The common method of demolition, using a compressed-air concrete breaker, was discarded, due to the possibility of deterioration or destruction of the remaining structure, which is supported on weathered rock a very short distance below the opening.

Oxygen-lance cutting was then proposed and adopted experimentally, to avoid shattering and spalling of the wall, particularly the narrow section on the weathered rock.

INTRODUCTION

Little information was available regarding the use of the oxygen lance, and the method would seem to be capable of development to a greater extent. However, after some initial failures, while trying lances and charge materials of various sizes, a point was reached where the scheme was found sufficiently dependable and economical to warrant further use without additional experimentation.

THE LANCE

The lance serves as fuel, and is also the medium by which oxygen is fed to the burning concrete. In this instance, a half-inch diameter black iron pipe was selected because it would produce a hole of the required diameter. The pipe was filled from end to end with 1/8-inch diameter mild steel welding rods. This charge forms a massive but permeable core, allowing the oxygen to flow from the quick-opening valve in the operator's hands, to the hot end. The lances and welding rods were cleaned with carbon tetrachloride, to avoid the hazard of explosion, possible when using oxygen with greasy or oily materials.

The lance was consumed at the rate of one foot for two inches of penetration into the wall. A weight of two hundred pounds, applied by the crew men on the lance, was found necessary to assure a steady combustion and penetration. The best results were obtained when the oxygen pressure was maintained at 125 psi.

The time required to cut one hole was two to three minutes, depending on the nature of the material encountered inside the wall.

A center hole was cut first to accommodate an axle, on which was installed a radius arm, a shield and a lance guide, (Figures 2 and 3). One hundred and twenty holes were cut around the circumference of the opening. Finally, a compressed-air concrete breaker was used to chip the thin webs between the holes. Where steel reinforcing was encountered, oxy-acetylene flame cutting was used without difficulty.

The holes, varying in diameter from two to three inches, were reasonably symmetrical on the starting side of the wall (Figure 4), but the pattern was erratic on the other side, the lance generally deviating to the easiest way through.

Six men were required continuously during this particular operation. Two men operated and applied pressure to the lance. Two men were required to clean the materials, charge new lances, and move equipment. One man heated the contact end of the lance to the melting point. This was done with a No. 5 oxy-acetylene welding tip extended to a length of 48 inches (Figure 1). One man kept the oxygen delivery at a constant 125 psi, under instructions to shut off quickly the supply in case of emergency.

The following is a description of various materials used which did not produce satisfactory results.

- (A) A 1/4-inch diameter black iron pipe charged with 1/16-inch diameter steel welding rods. The time required to cut one hole, using this type of lance, was five minutes, and a 1-inch hole was produced which was considered too small.
- (B) A 1/2-inch diameter black iron pipe charged with 1/4-inch diameter steel rods. The lance flamed out twice during the attempt. Only four 1/4-inch diameter rods could be inserted in the 1/2-inch diameter lance. This left large channels for the oxygen to flow through and blow out the flame.

A second attempt was made, using the same materials at a reduced oxygen pressure, from 125 psi to 90 psi. No blow-out occurred, but a slow combustion resulted. Six minutes were required to cut through the wall.

The type of lance described in the fifth paragraph, page two, of this Memorandum, was then adopted.

TOTAL AMOUNT OF MATERIAL USED

1260 feet of 1/2-inch diameter black iron pipe.

720 pounds of 1/8-inch diameter steel welding rods.

48 Oxygen "K" cylinders.

REMOVAL OF DISC

The concrete disc was removed by a mobile crane (Figures 5, 6 and 7). Total weight, 11 tons.



FIG. 1 FIRST STEP: HEATING THE LANCE TIP TO MELTING POINT

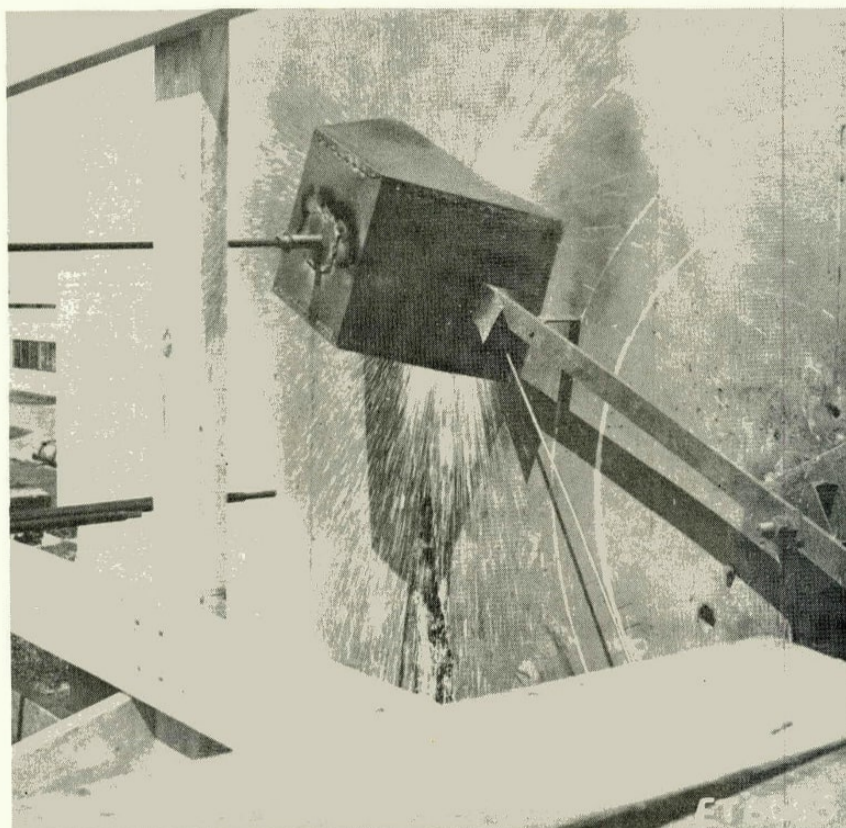


FIG. 2 THE LANCE CONTACTS THE WALL.

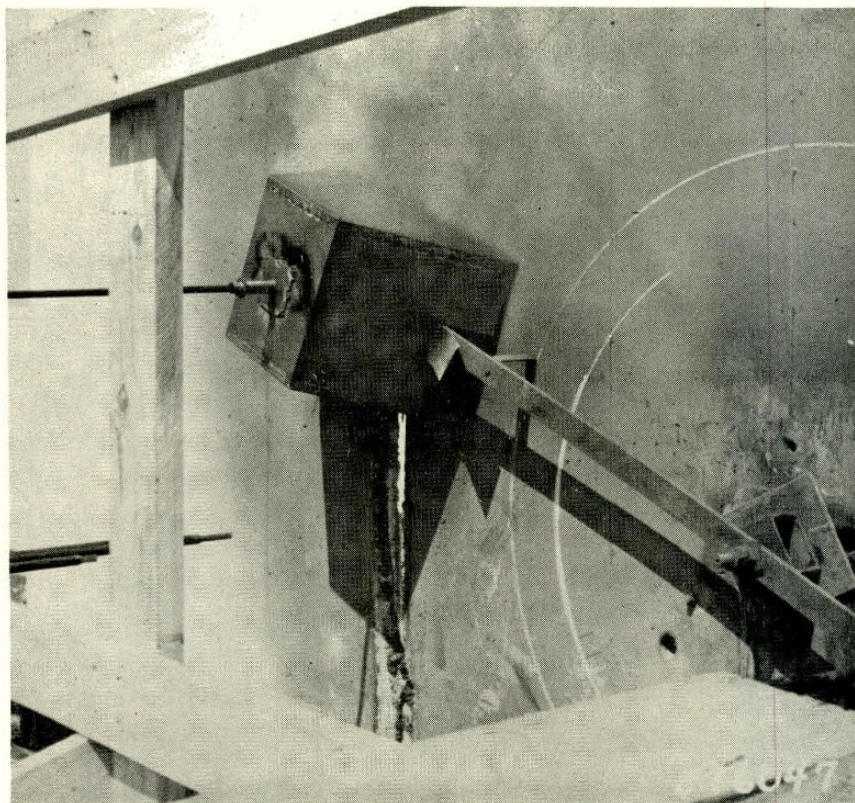


FIG. 3 90 SECONDS LATER, HALFWAY THROUGH THE WALL.

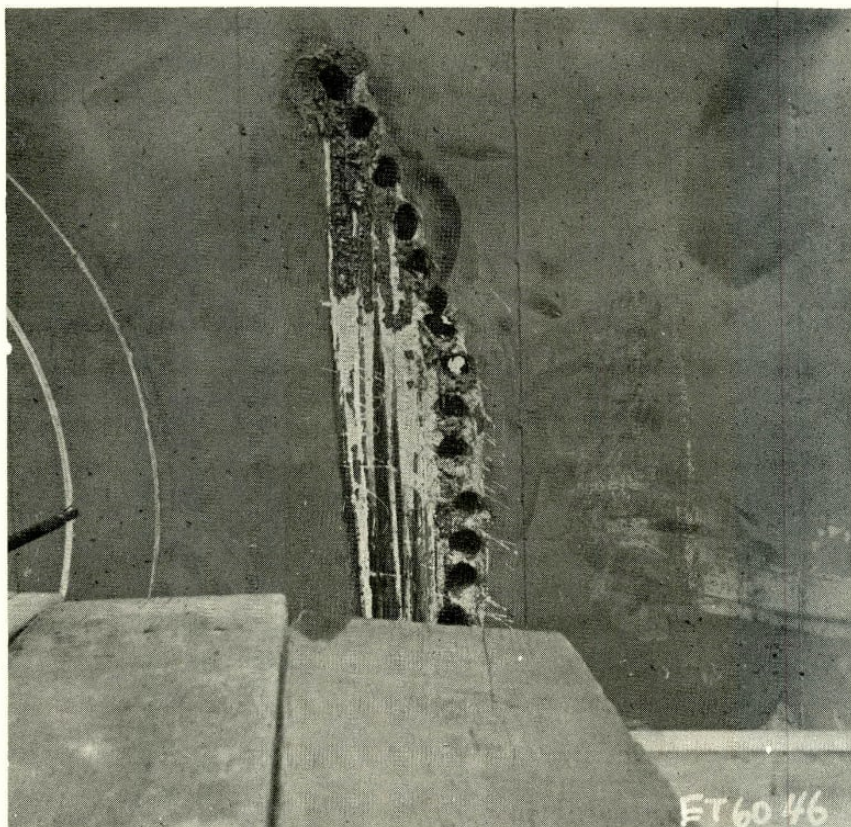


FIG. 4 STARTING SIDE SHOWING HOLES AND WEBS.



FIG. 5 REMOVAL OF CONCRETE DISC.



FIG. 6 25-TON CRANE TAKES THE LOAD.

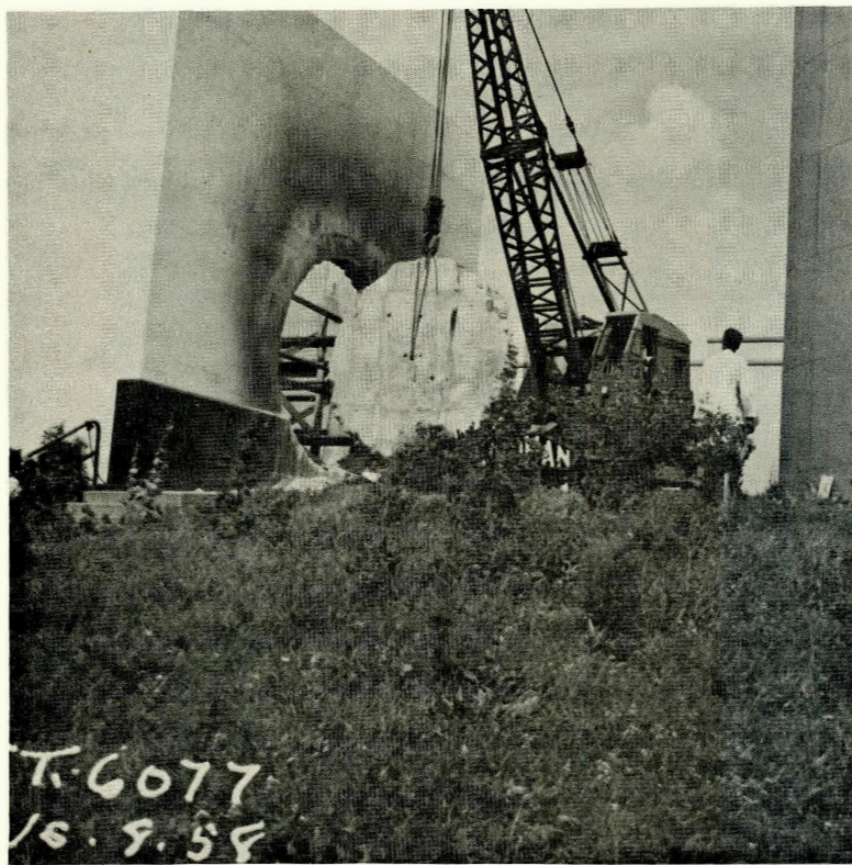


FIG. 7 FINAL STEP