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CONCRETE QUALITY REPORT

CAVE CREEK DAM
Maricopa County, Arizona

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JOHN CAROLLO ENGINEERS
3308 NORTH THIRD STREET
PHOENIX, ARIZONA

26 FEBRUARY 1969

ATTENTION: DONALD R. PREISLER

RE: CAVE CREEK DAM

JOB No. 69-36

IN ACCORDANCE WITH YOUR REQUEST, WE HAVE TAKEN TWELVE 4" CORES AND FOUR 6" CORES ON THE DOWNSTREAM FACE OF CAVE CREEK DAM. CORES WERE TAKEN AT LOCATIONS DESIGNATED IN YOUR LETTER OF 25 NOVEMBER 1968, TO THE MARICOPA COUNTY FLOOD CONTROL DISTRICT. DIRECTIONS STATED THAT THE 4" CORES WOULD BE TAKEN TO WITHIN 12" OF THE UPSTREAM FACE OF THE DAM, AND 6" CORES TO BE NOT LESS THAN 12" DEEP. NO. 3 CORE WAS TAKEN FIRST AND WAS CORED COMPLETELY THROUGH THE DAM (18 $\frac{1}{2}$ " LONG). THE LENGTH OF THE CORE CHECKS WITH THE DAM THICKNESS FOR THIS ELEVATION SHOWN ON SHEET A23-5 OF THE PLANS FOR CAVE CREEK DAM, WHILE CORES TAKEN AT DIFFERENT ELEVATIONS CORRESPONDED GENERALLY WITH THICKNESSES SHOWN ON THE PLANS. AFTER DISCUSSION WITH MR. PREISLER IT WAS DECIDED TO TAKE ALL CORES TO 12" IN DEPTH REGARDLESS OF LOCATION.

ALL 4" CORES WERE TAKEN AT CRACK LOCATIONS IN AN ATTEMPT TO DETERMINE THE DEPTH OF CRACKS AND THE CONDITION OF THE REINFORCING STEEL.

ALL 6" CORES WERE TAKEN IN SOUND AREAS TO DETERMINE THE STRENGTH OF THE CONCRETE. DATA FOR EACH CORE IS AS FOLLOWS:

CORE No. 1 - ARCH No. 6: 4" DIAMETER, $12\frac{1}{2}$ " LONG. CORED IN CRACK, 20' DOWN FROM DAM TOP AND $5'6''$ FROM EAST ABUTMENT. THE CRACK WAS SMALL, EXTENDING TO A DEPTH OF $3\frac{1}{2}$ ". CORE WENT COMPLETELY THROUGH DAM AND INDICATED GOOD DENSE CONCRETE THROUGHOUT.

CORE No. 2 - ARCH No. 8: 6" DIAMETER, 12" LONG. CORED BETWEEN JOINTS ONE AND TWO, DOWN 33' FROM DAM TOP AND $15'4''$ FROM EAST ABUTMENT. THIS CORE WAS TAKEN FOR TEST PURPOSES AND RESULTED IN A COMPRESSIVE STRENGTH OF 3842 PSI.

CORE No. 3 - ARCH No. 10: 4" DIAMETER, $18\frac{1}{2}$ " LONG. CORED IN PATCHED CRACK, DOWN $39'7''$ FROM DAM TOP AND 7' FROM EAST ABUTMENT. CORE WENT COMPLETELY THROUGH DAM, AND BROKE AT A DEPTH OF APPROXIMATELY 8" DUE TO POOR BOND WITH SOME FLAT AGGREGATE, OTHERWISE THE CONCRETE APPEARED TO BE OF GOOD QUALITY.

CORE No. 4 - ARCH No. 11: 4" DIAMETER, $19\frac{1}{2}$ " LONG. CORED BELOW CRACK IN AREA COVERED WITH BROWN MUD STAINS, DOWN $45'3''$ FROM DAM TOP AND $2'6''$ FROM EAST ABUTMENT. CORE WENT COMPLETELY THROUGH DAM, WAS STARTED BELOW A CRACK IN AN EFFORT TO INTERSECT SAME. HOWEVER, THE CRACK WAS NEVER INTERSECTED. GOOD DENSE CONCRETE EXCEPT FOR A DEPTH OF FROM 10" TO 16" WHERE SMALL VOIDS WERE NOTICED AROUND AGGREGATE ON ONE SIDE.

CORE No. 5 - ARCH No. 13: 4" DIAMETER, $12\frac{3}{4}$ " LONG. CORED IN MUD STAINED AREA, $16'3''$ DOWN FROM DAM TOP AND $21'6''$ FROM EAST ABUTMENT. CORE WENT COMPLETELY THROUGH DAM. STARTED CORING BELOW A CRACK AND ENCOUNTERED SAME AT A DEPTH OF 2" IN. THE CRACK EXTENDED COMPLETELY THROUGH DAM, WITH THE BROWN STAIN NOTICEABLE THROUGHOUT. CUT THROUGH $\frac{3}{4}$ " REINFORCING BAR AT $9\frac{1}{2}$ " DEPTH, ONE FACE OF WHICH WAS EXPOSED IN THE CRACK. THIS FACE WAS SLIGHTLY RUSTY WITH NO PITTING EVIDENT. CONCRETE APPEARED TO BE GOOD, DENSE CONCRETE.

CORE No. 6 - ARCH No. 13: 6" DIAMETER, 12" LONG. CORED IN SAME AREA AS No. 5, 15'6" DOWN FROM DAM TOP AND 20'3" FROM EAST ABUTMENT. THIS CORE WAS TAKEN FOR TEST PURPOSES AND RESULTED IN A COMPRESSIVE STRENGTH OF 3103 PSI.

CORE No. 7 - ARCH No. 16: 4" DIAMETER, 12" LONG. CORED IN CRACK 43'7" DOWN FROM DAM TOP AND 25' FROM EAST ABUTMENT. CRACK EXTENDED TO A DEPTH OF 4 $\frac{1}{2}$ ". CUT THROUGH $\frac{3}{4}$ " REINFORCING BAR 3 $\frac{1}{4}$ " IN. NO RUST ON BAR AND CONCRETE APPEARED TO BE GOOD AND DENSE THROUGHOUT.

CORE No. 8 - ARCH No. 18: 4" DIAMETER, 12 $\frac{1}{2}$ " LONG. CORED IN CRACK, HEAVY BROWN STAIN ALONG WITH HEAVY EFFERVESCENCE, 48'5" DOWN FROM DAM TOP AND 6'4" FROM EAST ABUTMENT. CRACK EXTENDED TO A DEPTH OF 5 $\frac{1}{2}$ ". CUT THROUGH $\frac{3}{4}$ " REINFORCING BAR 3 $\frac{1}{2}$ " IN. NO RUST ON BAR AND CONCRETE APPEARED TO BE GOOD AND DENSE THROUGHOUT.

CORE No. 9 - ARCH No. 22: 4" DIAMETER, 12" LONG. CORED IN CRACK, HEAVY EFFERVESCENCE, 34' DOWN FROM DAM TOP AND 17' FROM EAST ABUTMENT. CRACK EXTENDED TO A DEPTH OF 3 $\frac{1}{2}$ ". CORE BROKE OFF AT END DUE TO CONCENTRATION OF AGGREGATE. OTHERWISE, CONCRETE APPEARED TO BE GOOD AND DENSE THROUGHOUT.

CORE No. 10 - ARCH No. 22: 6" DIAMETER, 12" LONG. CORED 34'9" DOWN FROM DAM TOP AND 18'6" FROM EAST ABUTMENT. THIS CORE WAS TAKEN FOR TEST PURPOSES AND RESULTED IN A COMPRESSIVE STRENGTH OF 2933 PSI.

CORE No. 11 - ARCH No. 25: 4" DIAMETER, 12" LONG. CORED IN CRACK 21' DOWN FROM DAM TOP AND 34'8" FROM EAST ABUTMENT. STARTED BELOW CRACK AND ENCOUNTERED CRACK AT A DEPTH OF 5". CRACK WAS IN THE APPROXIMATE CENTER AT THE END OF THE CORE. CONCRETE APPEARED TO BE GOOD AND DENSE THROUGHOUT.

CORE No. 12 - ARCH No. 27: 4" DIAMETER, 16" LONG. CORED IN CRACK, HEAVY EFFERVESCENCE IN THIS AREA, 43' DOWN FROM DAM TOP AND 22'10" FROM EAST ABUTMENT. CUT THROUGH $\frac{3}{4}$ " REINFORCING BAR $2\frac{3}{4}$ " IN. BAR SHOWED NO RUST, BUT CONCRETE AREA SHOWED A SMALL CRACK FROM FACE OF BAR TO THE FACE OF THE DAM. CORE BROKE AT DEPTHS INCLUDING LOCATIONS AT REBAR ON END (16") AND AT 8" IN WHERE A LARGE ROCK WAS BUT, $6\frac{1}{2}$ " OF WHICH WAS IN THE CORE. ROCK WAS BONDED WELL TO THE OTHER SECTION OF THE CORE. WITH THE EXCEPTION OF THE CRACK AND ROCK, THE CONCRETE APPEARED TO BE GOOD AND DENSE.

CORE No. 13 - ARCH No. 29: 4" DIAMETER, $12\frac{1}{2}$ " LONG. CORED IN CRACK, HEAVY BROWN STAIN AREA, 44' DOWN FROM DAM TOP AND 17'6" FROM EAST ABUTMENT. STARTED CORING BELOW CRACK, ENCOUNTERED CRACK AT A DEPTH OF $8\frac{1}{2}$ " AND CORE BROKE AS CRACK ANGLED ACROSS IT. CONCRETE APPEARED TO BE GOOD AND DENSE WITH THE EXCEPTION OF SMALL CHECK CRACKS IN AREA 3" TO 6" IN ON THE CORE.

CORE No. 14 - ARCH No. 33: 4" CORE, $10\frac{1}{2}$ " LONG. CORED IN CRACK WHERE CONCRETE SURFACE WAS COVERED WITH A BROWN STAIN AND HEAVY EFFERVESCENCE, 42'3" DOWN FROM DAM TOP AND 28'6" IN FROM EAST ABUTMENT. CRACK EXTENDED TO A DEPTH OF $5\frac{1}{2}$ ". CORED 12" BUT CORE BROKE AT $10\frac{1}{2}$ " DUE TO LARGE FLAT ROCK. CONCRETE APPEARED TO BE GOOD AND DENSE.

CORE No. 15 - ARCH No. 33: 6" DIAMETER, 12" LONG. CORED IN SAME AREA AS No. 14, 42'10" DOWN FROM DAM TOP AND 19'6" IN FROM EAST ABUTMENT. THIS CORE WAS TAKEN FOR TEST PURPOSES AND RESULTED IN A COMPRESSIVE STRENGTH OF 4061 PSI.

CORE No. 16 - ARCH No. 36: 4" DIAMETER, 12" LONG. CORED IN CRACK AND SPALLED AREA, 44'4" DOWN FROM DAM TOP AND 7'3" FROM EAST ABUTMENT. STARTED CORING BELOW CRACK AND ENCOUNTERED CRACK 3" TO 11"

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CONTINUOUSLY FROM DEPTH WHERE IT EMANATED AWAY FROM CORE AREA. CRACK WAS COVERED THROUGHOUT WITH A HEAVY BROWN STAIN. CONCRETE APPEARED GOOD AND DENSE THROUGHOUT.

PICTURES SHOWING AREAS WHERE CORES WERE TAKEN ARE ENCLOSED. CLOSEUPS WERE TAKEN TO SHOW CORED AREAS AND OTHERS WERE TAKEN TO SHOW THE GENERAL CONDITION OF THE CONCRETE IN THE ENTIRE ARCH SECTIONS.

CORES TAKEN SHOW THAT POUR, OR COLD JOINTS, EXTEND THROUGH THE DAM. THIS CONDITION ACCOUNTS FOR THE GENERAL APPEARANCE OF THE DOWNSTREAM DAM FACE. BROWN STAINS WHICH POSSIBLY COULD BE CAUSED BY REINFORCING STEEL RUSTING, ARE MORE PROBABLY CAUSED BY LEACHING OF ROCKS OR SOIL, NATIVE TO THE AREA. SINCE THE DAM WAS BUILT FOR FLOOD CONTROL PURPOSES, THE STORAGE AREA ABOVE THE DAM IS NORMALLY DRY AND THE REINFORCING BARS WHICH MAY BE EXPOSED IN THE JOINT AREAS ARE NOT SUBJECT TO RUST AS WAS SHOWN IN REINFORCING BARS CUT IN THESE AREAS. MUD STAINS ARE EVIDENT BELOW ALMOST EACH JOINT IN THE DAM FACE AND DEPOSITS ARE HEAVIER AT LOWER ELEVATIONS. CALCIUM EFFERVESCENCE IS ALSO COMMON, PRIMARILY AT THE LOWER JOINTS, PROBABLY DUE TO INCREASED PRESENCE OF WATER AND ALSO SUBJECTED TO GREATER HYDROSTATIC PRESSURE.

GENERAL APPEARANCE OF THE DAM SHOWS THE CONCRETE TO BE IN EXCELLENT SHAPE, PARTLY DUE TO WEATHER CONDITIONS IN THE PHOENIX AREA, AND IN VIEW OF THE DAM BEING 45 YEARS OLD, CORES AND TESTS TAKEN SHOW THE CONCRETE TO BE OF EXCELLENT QUALITY.

THE 6" CONCRETE CORES TESTED GIVE A LOW COMPRESSIVE STRENGTH OF 2993 PSI AND A HIGH OF 4061 PSI WHICH FURTHER INDICATES THAT THE CONCRETE IS OF EXCELLENT QUALITY, ESPECIALLY CONSIDERING THE CONCRETE MIXING AND PLACING METHODS USED IN 1922.

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PICTURES OF THE CORES ARE ENCLOSED. ALL DIAGONAL CRACKS ARE DUE TO DRILLING THROUGH THE COLD OR POUR JOINTS. IT WAS DIFFICULT TO FOLLOW THE CRACKS THROUGH THE DAM, SINCE THE DAM FACE IS CURVED, BOTH VERTICALLY AND HORIZONTALLY. THE DRILL WAS FASTENED TO THE DAM FACE, SO THE CORE WAS DRILLED NORMAL TO THE SURFACE, WHILE THE COLD OR POUR JOINT WAS FORMED IN A HORIZONTAL PLANE. BY STARTING THE CORE DRILL BELOW THE CRACK, THE CRACK WAS ENCOUNTERED AT DIFFERENT DISTANCES IN FROM THE DAM FACE AND AS HAS BEEN STATED, SOME OF THE CORES SHOWED THE JOINT COMPLETELY THROUGH THE DAM.

THE LARGEST ROCK ENCOUNTERED IS SEEN IN CORE No. 8. EVIDENTLY NATIVE ROCK FROM THE AREA WAS USED AS AGGREGATE AND IN GENERAL IT CONSISTS OF GOOD DENSE ROCK.

THIS REPORT, WITH DESCRIPTIONS OF TESTS MADE, IS SUBMITTED TO YOUR FIRM FOR YOUR INFORMATION AND CONCLUSIONS.

ENGINEERS TESTING LABORATORIES, INC.


PAUL H. PETERS, P.E.

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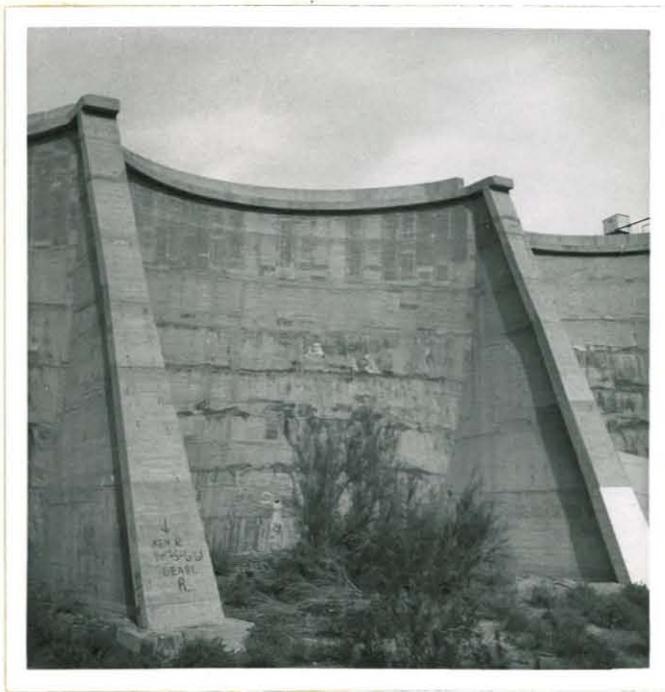
COPIES TO: ADDRESSEE (4)



4" CORE No. 1
ARCH No. 6



4" CORE No. 1
ARCH No. 6



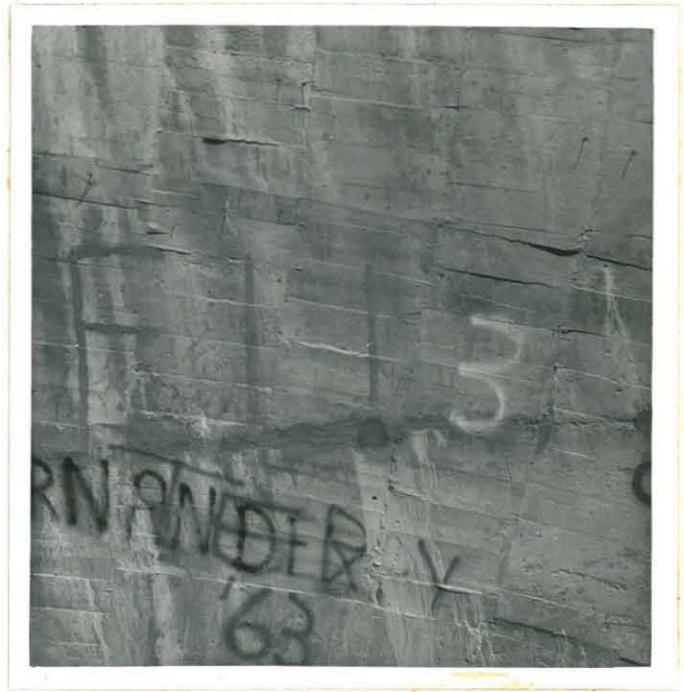
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ARCH No. 8



6" CORE No. 2
ARCH No. 8



4" CORE No. 3
ARCH No. 10



4" CORE No. 3
ARCH No. 10



4" CORE No. 4
ARCH No. 11



4" CORE No. 4
ARCH No. 11



4" CORE No. 8
ARCH No. 18



4" CORE No. 8
ARCH No. 18



4" CORE No. 9
6" CORE No. 10
ARCH No. 22



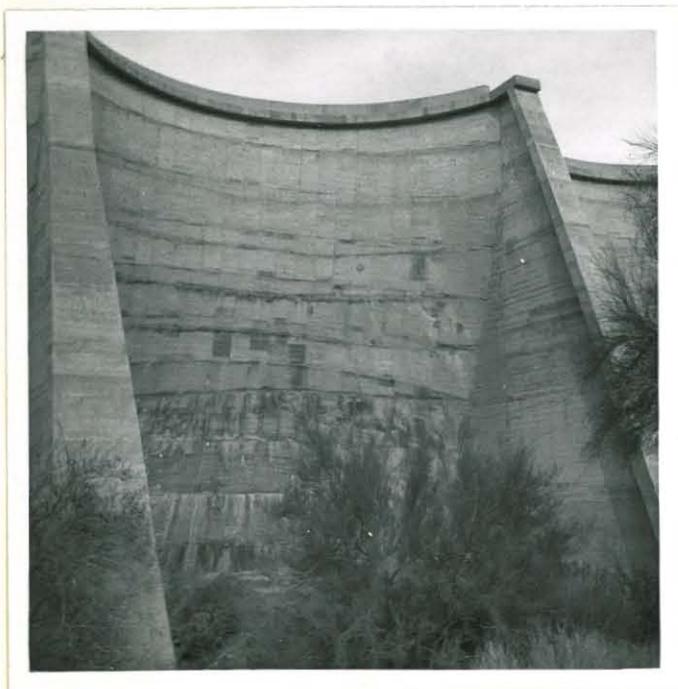
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6" CORE No. 10
ARCH No. 22



4" CORE No. 12
ARCH No. 27



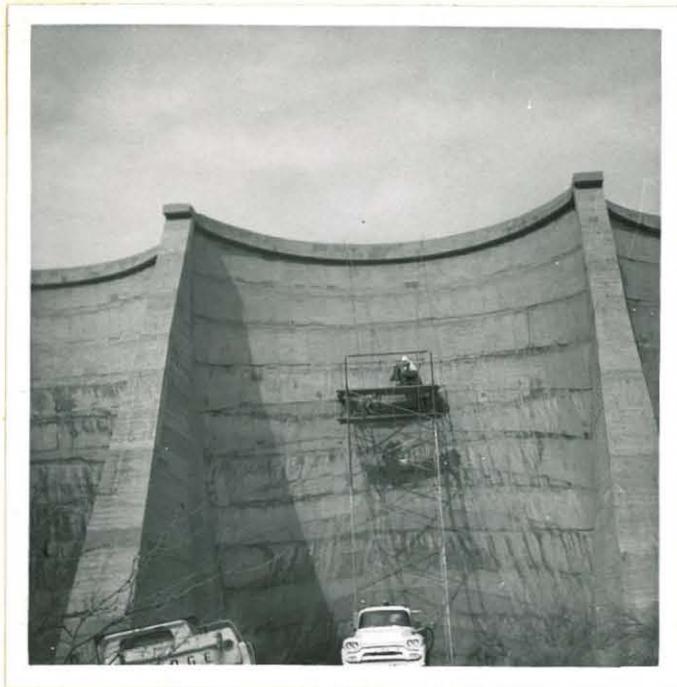
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ARCH No. 27
NOTE: HOLES FROM
RIFLE BULLETS



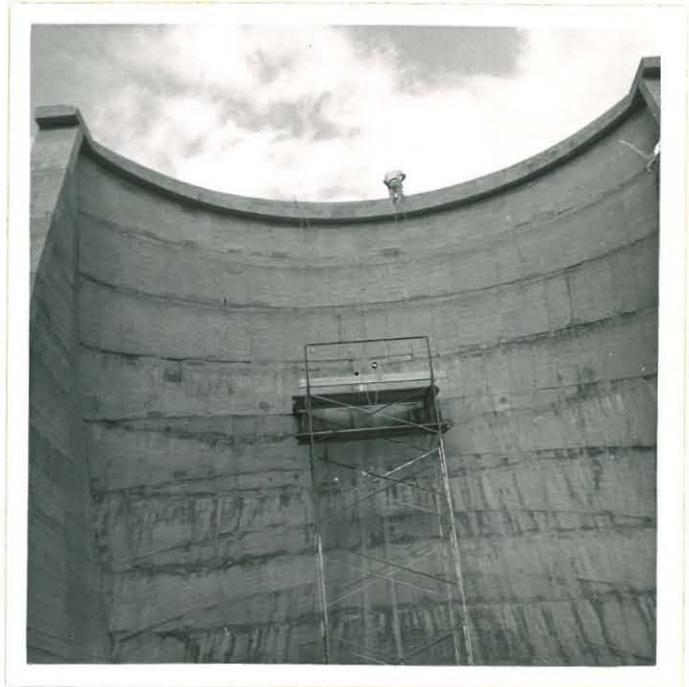
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ARCH No. 29



4" CORE No. 13
ARCH No. 29



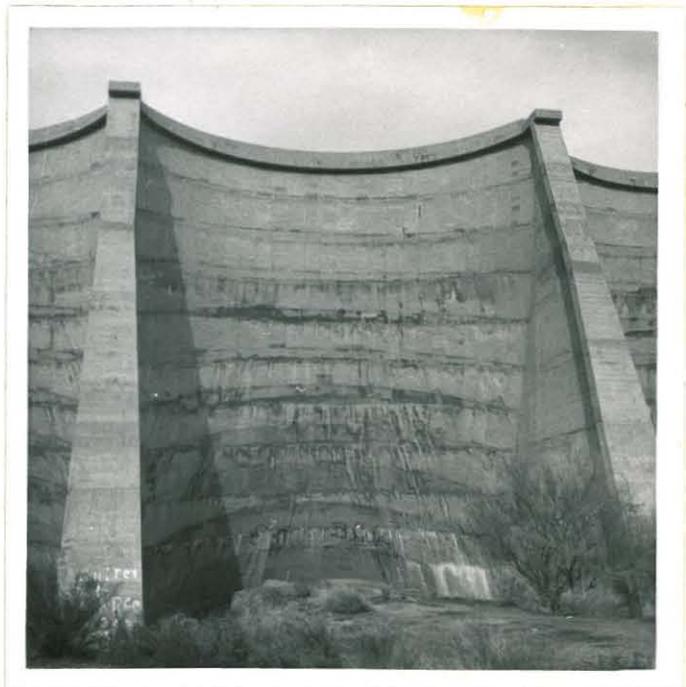
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6" CORE No. 6
ARCH No. 13



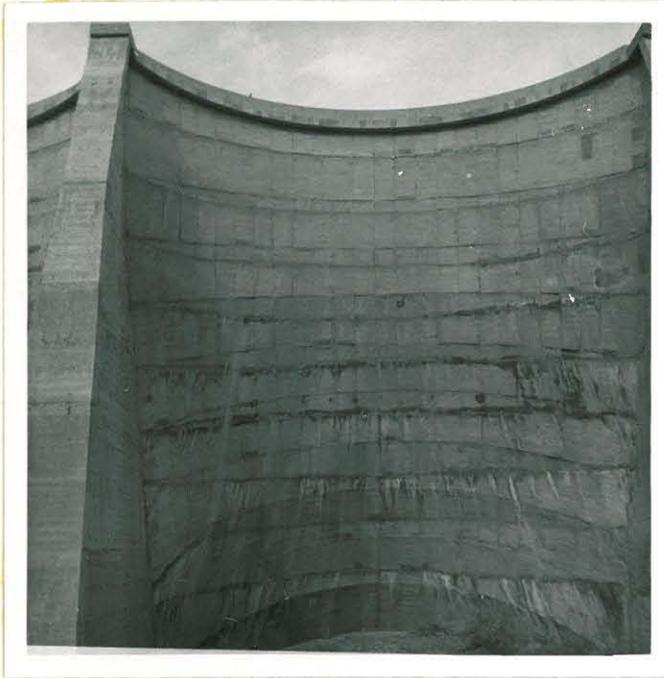
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4" CORE No. 5
ARCH No. 13



4" CORE No. 7
ARCH No. 16



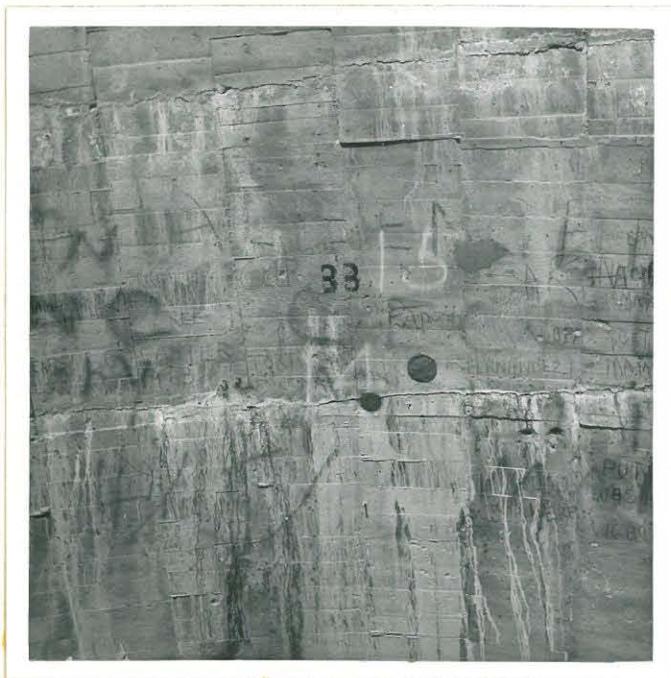
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ARCH No. 16



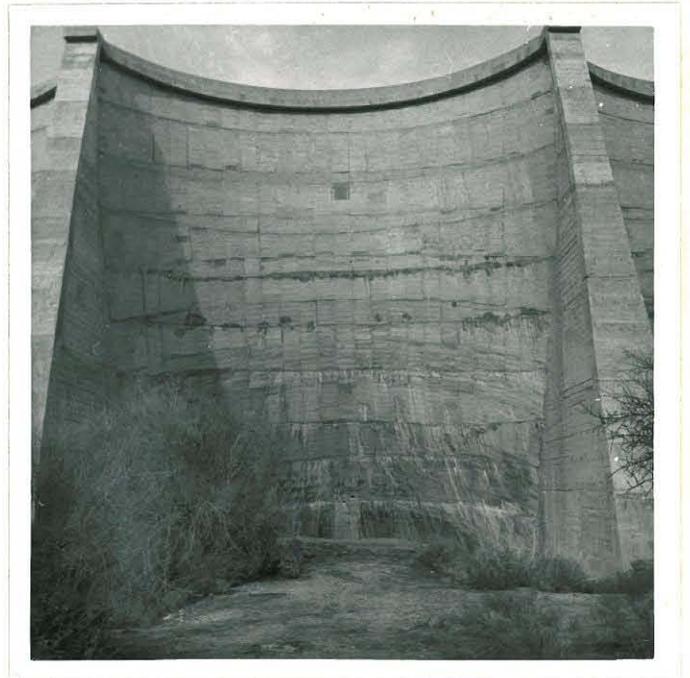
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ARCH No. 25



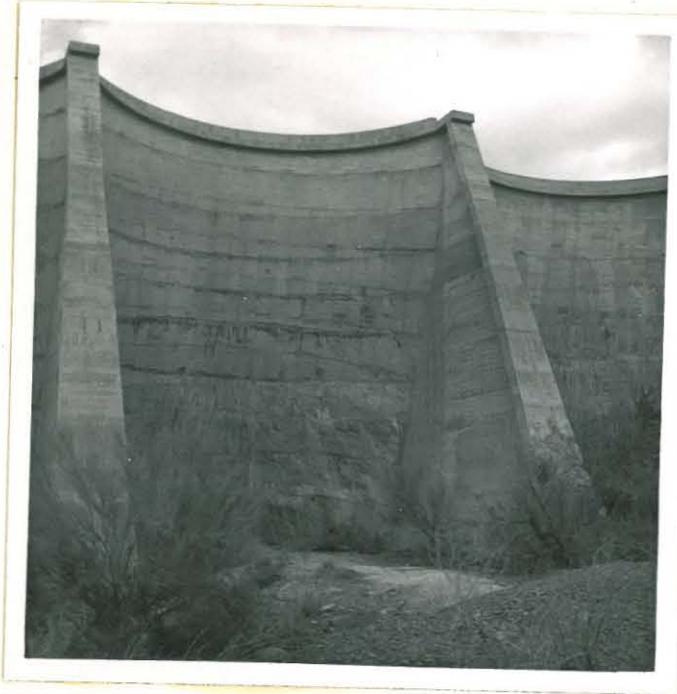
4" CORE No. 11
ARCH No. 25



6" CORE No. 15
ARCH No. 33
4" CORE No. 14



6" CORE No. 15
4" CORE No. 14
ARCH No. 33



4" CORE No. 16
ARCH No. 36



4" CORE No. 16
ARCH No. 36



CONCRETE CORES



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