

## CONTENTS

---

### PAPERS

---

No.		PAGE
1827	AN ANALYSIS OF MULTIPLE-SKEW ARCHES ON ELASTIC PIERS.	
	By J. Charles Rathbun.....	1
	Discussion:	
	By B. L. WEINER .....	46
	G. D. HOUTMAN .....	56
	CHARLES L. NORD .....	56
	F. W. KEYSER .....	58
	A. A. EREMIN .....	62
	RICHARD M. HODGES .....	64
	J. CHARLES RATHBUN .....	66
1828	FINANCING STREET AND HIGHWAY IMPROVEMENTS.	
	By R. W. Crum.....	74
	Discussion:	
	By A. P. GREENSFELDER .....	82
	C. R. THOMAS .....	84
	J. C. CARPENTER .....	85
	SAMUEL ECKELS .....	91
	HORACE H. SEARS .....	97
	R. W. CRUM .....	99
1829	DESIGN OF LARGE PIPE LINES.	
	By Herman Schorer.....	101
	Discussion:	
	By L. J. MENSCH .....	120
	W. P. ROOP .....	121
	JOHANNES SKYTHE .....	122
	DONALD E. LARSON .....	128
	RAYMOND J. ROARK .....	132
	F. W. HANNA .....	137
	PAUL BAUMAN .....	138
	L. J. LARSON .....	143
	C. M. ORR .....	144
	EDWARD J. BEDNARSKI .....	146
	H. C. BOARDMAN .....	148
	R. L. TEMPLIN AND R. G. STURM .....	154
	F. KNAPP .....	167
	C. P. VETTER .....	168
	L. E. GRINTER .....	174
	OREN REED .....	176
	ROBERT E. GLOVER .....	177
	HERMAN SCHORER .....	178

No.		PAGE
<b>1830 HIGHWAY CONSTRUCTION MANAGEMENT.</b>		
	<b>By T. Warren Allen . . . . .</b>	<b>192</b>
Discussion :		
	<b>By A. E. HOLCOMB . . . . .</b>	<b>207</b>
	<b>CHESTER MUELLER . . . . .</b>	<b>208</b>
<b>1831 CONSTRUCTION MANAGEMENT.</b>		
	<b>By Richard Hopkins . . . . .</b>	<b>211</b>
Discussion :		
	<b>By EDWARD W. BUSH . . . . .</b>	<b>215</b>
	<b>A. P. GREENSFELDER . . . . .</b>	<b>215</b>
<b>1832 SOIL MECHANICS RESEARCH.</b>		
	<b>By Glennon Gilboy . . . . .</b>	<b>218</b>
Discussion :		
	<b>By J. C. MEEM . . . . .</b>	<b>240</b>
	<b>H. DE B. PARSONS . . . . .</b>	<b>241</b>
	<b>JACOB FELD . . . . .</b>	<b>241</b>
	<b>JOHN R. JAHN . . . . .</b>	<b>243</b>
	<b>C. H. EIFFERT . . . . .</b>	<b>246</b>
	<b>A. A. EREMIN . . . . .</b>	<b>251</b>
	<b>F. N. MENEFEE . . . . .</b>	<b>252</b>
	<b>E. G. WALKER . . . . .</b>	<b>257</b>
	<b>D. P. KRYNINE . . . . .</b>	<b>259</b>
	<b>J. STUART CRANDALL . . . . .</b>	<b>278</b>
	<b>FRANK ALWYN MARSTON . . . . .</b>	<b>281</b>
	<b>GEORGE PAASWELL . . . . .</b>	<b>286</b>
	<b>JOHN H. GRIFFITH . . . . .</b>	<b>287</b>
	<b>H. E. GRUNER . . . . .</b>	<b>291</b>
	<b>F. KÖGLER . . . . .</b>	<b>299</b>
	<b>GLENNON GILBOY . . . . .</b>	<b>301</b>
<b>1833 ENGINEERING FEATURES OF THE ILLINOIS WATERWAY.</b>		
	<b>By Walter M. Smith . . . . .</b>	<b>309</b>
Discussion :		
	<b>By A. W. SARGENT . . . . .</b>	<b>339</b>
	<b>E. G. WALKER . . . . .</b>	<b>340</b>
	<b>DAVID A. MOLITOR . . . . .</b>	<b>343</b>
	<b>CHARLES A. D. YOUNG . . . . .</b>	<b>351</b>
	<b>WALTER M. SMITH . . . . .</b>	<b>354</b>
<b>1834 CONSTRUCTION WORK ON A FEDERAL RECLAMATION PROJECT.</b>		
	<b>By Morris Mason . . . . .</b>	<b>362</b>
Discussion :		
	<b>By JOHN SANFORD PECK . . . . .</b>	<b>403</b>
	<b>EDWARD W. BUSH . . . . .</b>	<b>403</b>
	<b>ORBIN H. PILKEY . . . . .</b>	<b>405</b>
	<b>CLIFFORD A. BETTS . . . . .</b>	<b>406</b>
	<b>GEORGE C. IMRIE . . . . .</b>	<b>408</b>
	<b>ARTHUR RUEITZERS . . . . .</b>	<b>409</b>
	<b>MORRIS MASON . . . . .</b>	<b>414</b>

No.		PAGE
1850	<b>CONSTRUCTION METHODS ON THE WELLAND SHIP CANAL.</b>	
	By E. G. Cameron.....	1142
1851	<b>STRESSES IN INCLINED ARCHES OF MULTIPLE-ARCH DAMS.</b>	
	By George E. Goodall and Ivan M. Nelidov.....	1200
	Discussion :	
	By VICTOR H. COCHRANE .....	1221
	PAUL BAUMAN .....	1228
	LARS R. JORGENSEN .....	1232
	FRED A. NOETZLI .....	1233
	W. J. STICH .....	1234
	GEORGE E. GOODALL AND IVAN M. NELIDOV .....	1236
1852	<b>DEVELOPMENT OF HYDRO-ELECTRIC POWER AS AN AID TO IRRIGATION.</b>	
	By Charles C. Cragin.....	1240
	Discussion :	
	By A. H. MARKWART .....	1253
	R. V. MEIKLE .....	1253
1853	<b>IMPROVEMENT OF THE HUDSON RIVER BY NARROWING THE NAVIGABLE FAIRWAY.</b>	
	By Lynne J. Bevan.....	1255
	Discussion :	
	By WILLIAM B. MOSS .....	1263
	LYTLE BROWN .....	1269
	H. A. MARMER .....	1270
	LYNNE J. BEVAN .....	1273
1854	<b>APPLICATION OF DURATION CURVES TO HYDRO-ELECTRIC STUDIES.</b>	
	By G. H. Hickox and G. O. Wessenauer.....	1276
	Discussion :	
	By PAUL F. KRUSE .....	1291
	DONALD H. MATTERN .....	1291
	JAMES E. STEWART .....	1292
	DON JOHNSTONE .....	1293
	L. T. GUY .....	1297
	JOEL D. JUSTIN .....	1298
	C. MAXWELL STANLEY .....	1300
	F. KNAPP .....	1303
	ROBERT F. EWALD .....	1305
	G. H. HICKOX AND G. O. WESSENAUER .....	1306
1855	<b>THE COMPENSATED ARCH DAM.</b>	
	By A. V. Karpov.....	1309
	Discussion :	
	By R. A. SUTHERLAND .....	1346
	LARS R. JORGENSEN .....	1347
	L. T. EVANS .....	1349
	H. W. SIBERT .....	1350
	EUGENE KALMAN .....	1353
	A. V. KARPOV .....	1372

NO.		PAGE
<b>1835 WATER PRESSURES ON DAMS DURING EARTHQUAKES.</b>		
By H. M. Westergaard.....		418
Discussion :		
By THEODOR VON KARMAN .....	434	
PAUL BAUMAN .....	436	
R. ROBINSON ROWE .....	439	
L. PRANDTL .....	443	
CECIL E. PEARCE .....	443	
JOHN H. A. BRAHTZ AND C. H. HEILBRON, JR.....	452	
BORIS A. BAKHMETEFF .....	460	
N. MONONOKE .....	468	
H. M. WESTERGAARD .....	471	
<b>1836 WESTERN HIGHWAY PRACTICE, WITH SPECIAL REFERENCE TO CALIFORNIA.</b>		
By C. S. Pope.....		473
Discussion :		
By J. S. BRIGHT .....	490	
R. D. RADER .....	492	
H. S. KERR .....	494	
E. Q. SULLIVAN .....	496	
T. A. CORRY .....	497	
CHARLES T. LEEDS .....	498	
G. S. PAXSON .....	508	
C. S. POPE .....	510	
<b>1837 LOW-COST BITUMINOUS ROADS.</b>		
By Walter N. Frickstad.....		514
Discussion :		
By H. J. SPELMAN .....	524	
J. T. L. MCNEW .....	525	
ROGER M. LEE .....	529	
E. Q. SULLIVAN .....	530	
HUGH W. SKIDMORE .....	533	
A. H. HINKLE .....	540	
CLAUDE P. OWENS .....	547	
CARLTON N. CONNER .....	552	
HAROLD L. TILTON .....	556	
L. I. HEWES .....	560	
<b>1838 EFFECTS OF BENDING WIRE ROPE.</b>		
By Frederick C. Carstarphen.....		562
Discussion :		
By ROBERT C. STRACHAN .....	590	
C. D. MEALS .....	591	
O. P. ERICKSON .....	602	
F. W. DECK .....	603	
O. G. JULIAN AND J. C. DAMON .....	606	
A. S. RAIRDEN .....	613	
FREDERICK C. CARSTARPHEN .....	618	

NO.		PAGE
1839	<b>LAKE CHAMPLAIN BRIDGE.</b>	
	By Charles M. Spofford.....	622
	Discussion :	
	By ROBERT W. ABBETT .....	654
	HENRY W. TROELSCH .....	655
	JACOB FELD .....	656
	CLARENCE W. HUDSON .....	657
	CHARLES M. SPOFFORD .....	657
1840	<b>CONSTRUCTION PLANT AND METHODS FOR ERECTING STEEL BRIDGES.</b>	
	By A. F. Reichmann.....	660
	Discussion :	
	By HOWARD P. TREADWAY .....	673
	BENJAMIN WILDER GUPPY .....	673
	R. A. VAN NESS .....	674
	J. G. TRIPP .....	674
	A. A. EREMIN .....	675
	A. F. REICHMANN .....	676
1841	<b>FULTON STREET, EAST RIVER TUNNELS, NEW YORK, N. Y.</b>	
	By Miles I. Killmer.....	677
	Discussion :	
	By H. J. KING .....	697
	S. M. SWaab .....	697
	JACOB FELD .....	699
	OLE SINGSTAD .....	700
	JOHN F. O'ROURKE .....	700
	H. H. HATCH .....	708
	MILES I. KILLMER .....	707
1842	<b>WIND-BRACING CONNECTION EFFICIENCY.</b>	
	By U. T. Berg.....	709
	Discussion :	
	By DAVID CUSHMAN COYLE .....	724
	WILLIAM R. OSGOOD .....	725
	O. G. JULIAN .....	727
	HAROLD S. RICHMOND .....	731
	ROBINS FLEMING .....	732
	L. E. GRINTER .....	734
	C. R. YOUNG .....	738
	C. H. SANDBERG .....	741
	N. A. RICHARDS .....	743
	JACOB FELD .....	744
	DANA YOUNG .....	745
	A. J. WILCOX .....	748
	R. D. DALTON .....	750
	JOHN J. GOULD .....	751
	W. C. HUNTINGTON AND PAUL NIELSEN .....	754
	A. TORIGGINO AND ERLE L. COPE .....	756
	R. A. CAUGHEY .....	761
	U. T. BERG .....	765

No.		PAGE
1843	<b>STEREO-TOPOGRAPHIC MAPPING.</b>	
	By C. H. Birdseye.....	771
	Discussion :	
	By THERON M. RIPLEY .....	795
	O. S. READING .....	795
	LOWELL O. STEWART .....	797
	F. H. PETERS .....	799
	W. H. CROSSON .....	802
	DWIGHT F. JOHNS .....	803
	DOUGLAS H. NELLES .....	804
	R. E. BALLESTER .....	805
	T. P. PENDLETON .....	806
	OTTO LEMBERGER .....	808
	E. R. POLLEY AND LEON T. ELIEL .....	819
	C. H. BIRDSEYE .....	822
1844	<b>PUBLIC SUPERVISION OF DAMS: A SYMPOSIUM.....</b>	827
	RECOMMENDATIONS FOR LEGISLATION AND FOR APPLICATION OF LAW.	
	By A. H. Markwart.....	828
	NECESSITY FOR, AND PENALTIES FOR LACK OF, SUPERVISION.	
	By M. C. Hinderlider.....	836
	Discussion :	
	By H. DE B. PARSONS .....	850
	WILLIAM P. CREAGER .....	852
	M. M. O'SHAUGHNESSY .....	853
	N. A. ECKART .....	854
	R. C. JOHNSON .....	856
	F. W. HANNA .....	857
	JOEL D. JUSTIN .....	859
	I. C. STEELE AND WALTER DREYER .....	860
	FRED A. NOETZLI .....	864
	GEORGE N. CARTER .....	865
	GEORGE W. HAWLEY .....	867
	H. K. BARROWS .....	872
	HARRY W. DENNIS .....	873
	N. KELEN .....	874
	FORD KURTZ .....	878
	WILLIAM W. TEFFT .....	880
	A. H. MARKWART .....	882
	M. C. HINDERLIDER .....	883
1845	<b>ECONOMIC PROPORTIONS AND WEIGHTS OF MODERN HIGHWAY CANTILEVER BRIDGES.</b>	
	By J. A. L. Waddell.....	888
	Discussion :	
	By HENRY C. TAMMEN .....	920
	ROBERT W. ABBETT .....	926
	FRANK W. SKINNER .....	926
	CHARLES M. SPOFFORD .....	927
	R. WAYNE LINCOLN .....	928
	HAROLD E. WEISSMAN .....	929
	HERSCHEL H. ALLEN AND WILSON T. BALLARD .....	931
	J. A. L. WADDELL .....	935

NO.		PAGE
1846	DESIGN CHARACTERISTICS OF THE READING OVERTURE TRANSMISSION LINE.	
	By Frederick W. Deck.....	944
	Discussion :	
	By E. E. R. TRATMAN .....	967
	PERCIVAL S. BAKER .....	967
	FREDERICK W. DECK .....	968
1847	DETERMINATION OF PRINCIPAL STRESSES IN BUTTRESSES AND GRAVITY DAMS.	
	By W. H. Holmes.....	971
	Discussion :	
	By W. J. STICH .....	994
	HAKAN D. BIRKE .....	995
	DIRK A. DEDEL .....	1002
	FRED A. NOETZLI .....	1006
	EUGENE KALMAN .....	1009
	I. M. NELIDOV .....	1013
	H. E. VON BERGEN .....	1017
	HOWARD L. COOK .....	1021
	HERMAN SCHORER .....	1024
	A. FLORIS .....	1025
	W. C. HUNTINGTON .....	1025
	CALVIN V. DAVIS .....	1029
	W. H. HOLMES .....	1030
1848	STRESSES IN REINFORCED CONCRETE DUE TO VOLUME CHANGES.	
	By C. P. Vetter.....	1039
	Discussion :	
	By SEARCY B. SLACK .....	1054
	CHARLES S. WHITNEY .....	1055
	M. HIRSCHTHAL .....	1055
	WALTER DREYER .....	1058
	RALPH E. SPAULDING .....	1060
	A. H. BEYER AND A. G. SOLAKIAN .....	1064
	LESTER L. MEYER .....	1070
	C. P. VETTER .....	1072
1849	SUSPENSION BRIDGES UNDER THE ACTION OF LATERAL FORCES.	
	By Leon S. Moisseiff and Frederick Lienhard.....	1080
	Discussion :	
	By P. L. PRATLEY .....	1096
	CHARLES A. ELLIS .....	1097
	E. L. PAVLO .....	1107
	RALPH A. TUDOR .....	1117
	F. H. CONSTANT .....	1119
	CHARLES DERLETH, JR. .....	1121
	A. A. EREMIN .....	1123
	ELMER C. OSGOOD .....	1125
	CHARLES M. SPOFFORD AND JOHN B. WILBUR .....	1129
	GLENN B. WOODRUFF .....	1136
	LEON S. MOISSEIFF AND FREDERICK LIENHARD .....	1137

No.		PAGE
1856	FINAL REPORT OF THE SPECIAL COMMITTEE ON STEEL COLUMN RESEARCH .....	1376
1857	A CENTURY OF CIVIL ENGINEERING IN THE UNITED STATES: ADDRESS AT THE ANNUAL CONVENTION, CHICAGO, ILLINOIS, JUNE 27, 1933. By Alonzo J. Hammond .....	1463

---

## MEMOIRS OF DECEASED MEMBERS

---

	PAGE
JOHN RIPLEY FREEMAN, PAST-PRESIDENT AND HON. M. AM. SOC. C. E.....	1471
GEORGE FILLMORE SWAIN, PAST-PRESIDENT AND HON. M. AM. SOC. C. E.....	1476
WILLIAM BARCLAY PARSONS, HON. M. AM. SOC. C. E.....	1485
FREDERICK WILHELM ALBERT, M. AM. SOC. C. E.....	1492
TRUMAN HEMINWAY ALDRICH, M. AM. SOC. C. E.....	1493
HENRY CLAYTON ALLEN, M. AM. SOC. C. E.....	1497
CHRISTIAN ANDERSEN, M. AM. SOC. C. E.....	1499
HERBERT LEANDER AULLS, M. AM. SOC. C. E.....	1501
FRANCIS WHEELWRIGHT BELKNAP, M. AM. SOC. C. E.....	1505
LOUIS DAVID BLAUVELT, M. AM. SOC. C. E.....	1506
WILLARD LEWIS BOWKER, M. AM. SOC. C. E.....	1509
CON MORRISON BUCK, M. AM. SOC. C. E.....	1510
HARRY BURGESS, M. AM. SOC. C. E.....	1511
HARRY EZRA CAMERON, M. AM. SOC. C. E.....	1513
FRANK TAYLOR CHAMBERS, M. AM. SOC. C. E.....	1514
ROBERT MORRIS CLAYTON, M. AM. SOC. C. E.....	1517
BRANCH HARRIS COLBY, M. AM. SOC. C. E.....	1519
WINFIELD WALKER CONARD, M. AM. SOC. C. E.....	1522
ALGER ADAMS CONGER, M. AM. SOC. C. E.....	1523
HERBERT CHAPIN DAGGETT, M. AM. SOC. C. E.....	1526
LOUIS CHRISTIAN DATZ, M. AM. SOC. C. E.....	1527
ARTHUR LINCOLN DAVIS, M. AM. SOC. C. E.....	1529
PAUL DIDIER, M. AM. SOC. C. E.....	1531
BOYD EHLE, M. AM. SOC. C. E.....	1534
ARTHUR JOHN ELA, M. AM. SOC. C. E.....	1537
ROBERT LEE FARIS, M. AM. SOC. C. E.....	1539
JOHN MOYER FARLEY, M. AM. SOC. C. E.....	1541
WALTER HAMER GAHAGAN, M. AM. SOC. C. E.....	1545
EMERSON WARREN GRANT, M. AM. SOC. C. E.....	1546
EVERETT ADDISON HADLEY, M. AM. SOC. C. E.....	1547
FERDINAND FINNEY HARRINGTON, M. AM. SOC. C. E.....	1550
RUSSELL THEODORE HARTMAN, M. AM. SOC. C. E.....	1552
HARRISON WASHBURN HAYWARD, M. AM. SOC. C. E.....	1554
ARTHUR RASCO HIRST, M. AM. SOC. C. E.....	1555
CHARLES WARREN HUNT, M. AM. SOC. C. E.....	1557
BENJAMIN OLIVER JOHNSON, M. AM. SOC. C. E.....	1562
WARREN BYRON KEIM, M. AM. SOC. C. E.....	1564
JEREMIAH JOSEPH KENNEDY, M. AM. SOC. C. E.....	1565
MORRIS KNOWLES, M. AM. SOC. C. E.....	1567
THOMAS MONAGHAN LAVELLE, M. AM. SOC. C. E.....	1570
SIDNEY FRANCIS LEWIS, M. AM. SOC. C. E.....	1572
JOHN WILLIAM LINK, M. AM. SOC. C. E.....	1574
HERBERT PRESCOTT LINNELL, M. AM. SOC. C. E.....	1575
HENRY ROBERTSON LORDLY, M. AM. SOC. C. E.....	1577
JOHN ROBERT CLARKE MACREDIE, M. AM. SOC. C. E.....	1580
CARL ARTHUR MCCLAIN, M. AM. SOC. C. E.....	1582