LIST OF DISCONTINUITIES IN ADITS (1 of 3)

Adit No.	Crack No.	T.D. (m)		Strike&dip (°)	Width (mm)	Contained materials	Water seepage
		Left wall	Right wall				
DA-1	1		0.8	N23E 48NW	1	Serpentine	
	2		2.0	N15W 38NE	1	〃	
	3	1.9		N75E 63NW	5	Open	
	4	4.0		N62W 53NE	1	Oxide	
	5	4.0		N18E 70NW			
	6		4.8	N78E 49SE			
	7	5.4		N32E 90	10	Sheared	
	8	7.0		N80E 50SE			
	9		8.7	E-W 38S	0 ~1	Talc	
	10		10.3	N76E 46SE	0 ~1	Serpentine	
	11	11.3		N48W 60NE			
	12		11.4	N40E 80NW		Slickenside	
	13	12.2		E-W 60S			
	14	13.1		N56E 35NW	1 ~5	Serpentine+Talc	
	15		17.0	N22E 90			
	16		17.5	N34E 26NW	0 ~200	Serpentine	
	17	17.9		N80W 66NE	10~30	Oxide	
	18		18.8	N42E 34NW			
	19	20.2		N70E 90	2 ~10	Serpentine	
	20	21.6		N60W 53NE	2 ~10	〃	
	21	21.8		N77W 86NE			
	22	22.8		N28E 52NW			
	23		23.2	N32E 78NW	2 ~3	Serpentine	
	24	23.5		N63W 60NE			
	25	25.0		E-W 80N			
	26		26.3	N31E 34NW	2 ~10	Serpentine+Oxide	○
	27	26.0		N78W 64NE	5	Serpentine	
	28		32.7	N13E 34NW			
	29	33.2		N18W 37NE			
	30	34.2		N76W 65NE			
	31	34.7		N64E 66SE			
	32	36.0		N11E 47SE	1	Oxide	
	33	39.0		N77E 71NW	3 ~4(30)	Serpentine	
	34	39.4		N56E 78SE	1 ~2	〃	
	35	41.1		N77E 38NW	1 ~5	〃	
	36	43.0		N40E 23NW			

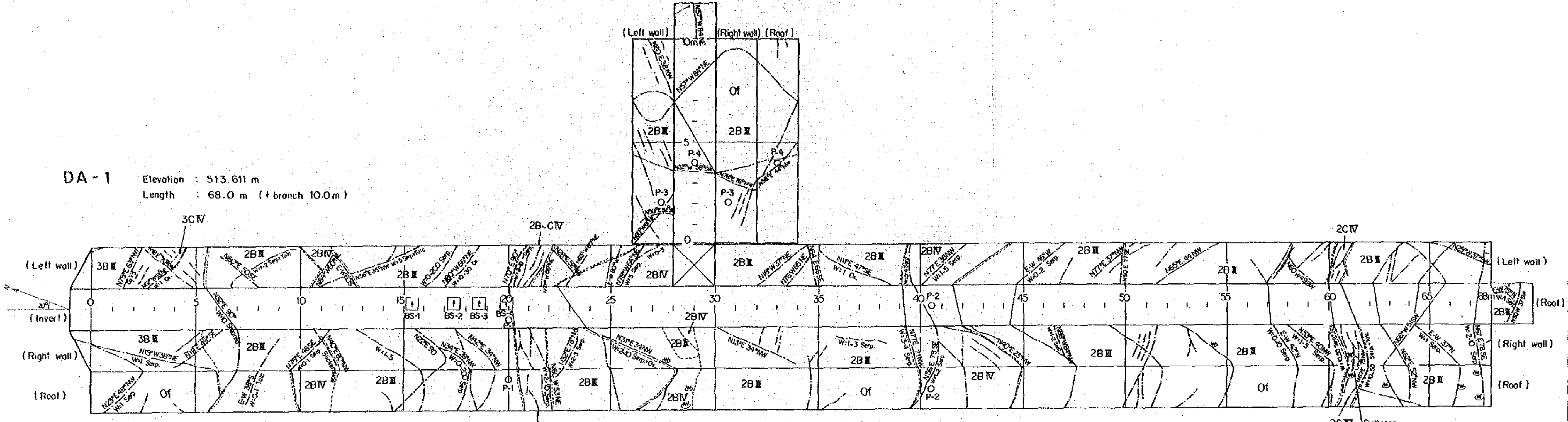
	37	45.8		E-W 46N	0 ~2	Serpentine	
	38		46.9	N86W 84NE	1 ~2	〃	
	39	49.9		N77E 37NW			
	40	49.9		N60E 77SE			
	41	53.0		N65E 44NW			○
	42	57.7		E-W 42N	0 ~10	Serpentine	
	43	58.3		N60W 49SW			
	44		59.3	N53E 40NW	1 ~5	Serpentine	
	45		61.8	N67E 75NW	10~50	Serpentine+Talc	○
	46		63.3	N62E 52NW			
	47		63.3	N66W 51SW			○
	48		65.6	E-W 37N	1	Serpentine	○
	49		67.3	N67E 78SE	2 ~10	〃	○
	50	67.5		N25W 37SW			
	51	68.0		E-W 75N	1	Serpentine	
	52	68.0		N50W 37SW			
Bran -ch	53	1.2		N60W 61NE			
	54	1.5		N50E 82SE			
	55	2.7		N58E 44NW			
	56		2.8	N76E 76NW			
	57	4.0		N32W 58SW			
	58	5.9		N57W 84NE			
	59	9.0		N80E 38NW			
	60		10.0	N57W 84NE			
DA-2	61	0		N85W 40SW	1	Oxide	
	62	3.0		N78W 43SW	5	〃	
	63	5.3		E-W 52S	2 ~5	Calcite	
	64		5.9	N65E 90			
	65		5.9	N55W 37SW	5	Serpentine	
	66	7.2		N65E 56SE	1 ~2	Calcite	
	67	8.3		N70W 34SW	0 ~1	Serpentine+Calcite	
	68	9.4		E-W 69N			
	69		10.1	N85E 73SE			
	70	12.4		N 5E 82NW	1 ~2	Serpentine+Talc	
	71		15.4	N78E 55NW		Slickenside	
	72	17.6		N48W 47NE			
	73		21.5	N-S 45E	0 ~1	Serpentine	
	74		23.5	N47E 78SE	1 ~20	〃	

LIST OF DISCONTINUITIES IN ADITS (3 of 3)

	75		24.4	N70W 52SW	1	Calcite	
	76	25.8		N30E 80SE	2 ~10	Serpentine+Calcite	
	77		27.5	N86W 60NE	1	Serpentine	
	78		28.9	N49E 79SE	1 ~2	〃	
	79		30.1	N18E 65SE	1 ~5	〃	
	80		31.4	N44E 76SE	2 ~20	〃	
	81	32.0		N28W 67SW			○
	82	33.0		N-S 59E			
	83	33.3		N80W 57NE			
	84	34.1		E-W 73N	5 ~6	Serpentine	
	85		34.1	N60E 70SE	10+15	Serpentine+Calcite	
	86	35.0		N42W 68SW			
	87		36.2	N80W 51SW	1	Serpentine	
	88		36.7	N13E 65NW	2	〃	
	89		38.5	N75W 55NE	0 ~1	〃	
	90		40.8	N81W 58SW	0 ~5	〃	○
	91		42.7	N-S 54E	1	Calcite	○
	92		43.4	N48E 46SE	5	〃	○
	93		44.3	E-W 55N	10	Serpentine+Calcite	○
	94	44.2		N86W 58NE	5	Serpentine	
	95		48.0	N45E 42SE	10	〃	
	96		48.7	N77W 63NE			
	97	50.6		N18E 57NW			○
	98		52.4	N36W 49NE			
	99	58.5		N36W 46SW			
	100	58.4		N22E 56NW			○
	101		60.3	E-W 50N	0 ~1	Serpentine	
	102		61.7	N67E 83NW	1 ~2	〃	○
	103		62.7	N76E 69NW	1 ~2	〃	○
	104		63.5	N80E 90	5	Oxide	○
Bran	105	1.8		N40W 48SW			
-ch	106	3.0		N63W 44SW	2 ~3	Calcite	○
	107		5.0	N25W 78NE			
	108		6.6	N18E 65NW	1	Oxide	
	109		8.5	N84E 58SE	2 ~10	Serpentine	
	110	10.0		N73E 88NW			
	111		10.0	N40E 63SW	0 ~1	Serpentine	

DA - 1

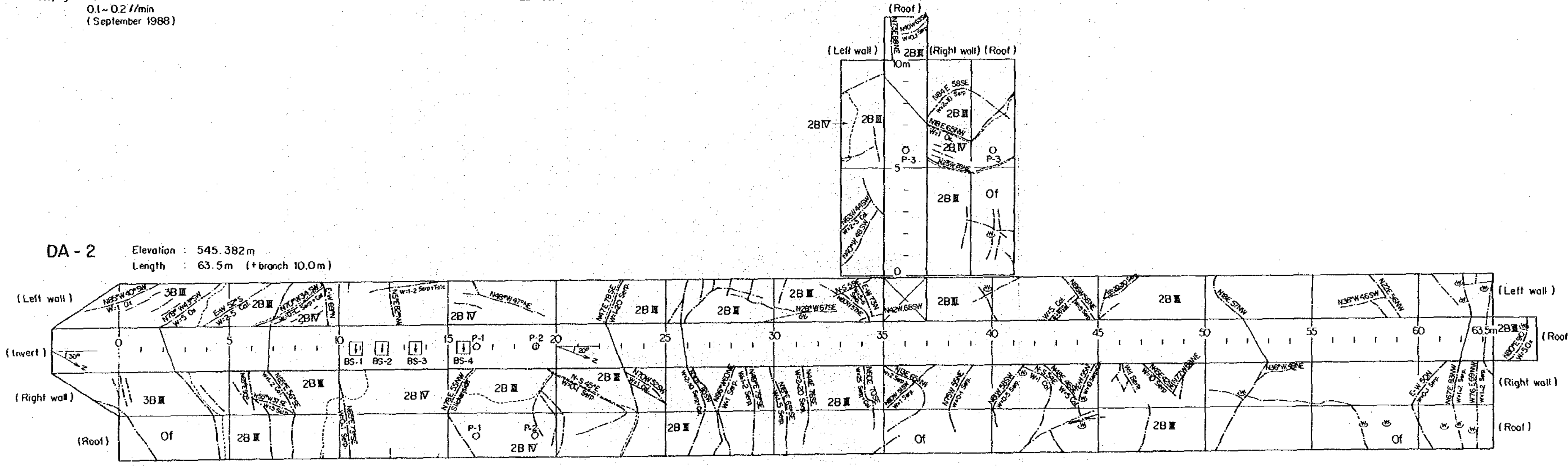
Elevation : 513.611 m
Length : 68.0 m (+ branch 10.0 m)



Water seepage : Total
0.1 ~ 0.2 l/min
(September 1988)

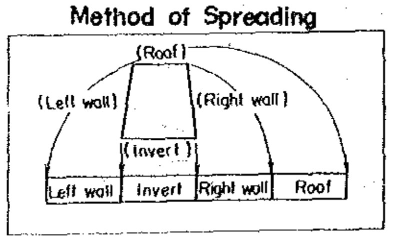
DA - 2

Elevation : 545.382 m
Length : 63.5 m (+ branch 10.0 m)



Water seepage : Total
0.2 ~ 0.3 l/min
(September 1988)

Method of Spreading



LEGEND

Of — Ophiolite (Peridotite)

W=10 Serp — Crack W = : Width of Crack (mm)
Serp : Serpentine
Cal : Calcite
Ox : Oxide

2B III / 2C IV — Boundary of Rock Classification

Water Seepage Point

BS-1 — Point of Block Shear Test (↑ : Direction of shear)

P-1 — Point of Plate Bearing Test

Standard of Rock Classification for Adit

	Weathering		Hardness		Interval of Cracks
1	Very fresh. No weathering of mineral component.	A	Very hard. Broken into knifeedged pieces by strong hammer blow.	I	Over 100cm
2	Fresh. Some minerals are weathered slightly. Usually no brown crack.	B	Hard. Broken into pieces by strong hammer blow.	II	40 ~ 100cm
3	Fairly fresh. Some minerals are weathered. Cracks are stained and with weathered meterial.	C	Brittle. Broken into pieces by medium hammer blow.	III	20 ~ 40cm
4	Weathered. Fresh portions still remain partially.	D	Very brittle. Easy broken into pieces by medium hammer blow.	IV	5 ~ 20cm
5	Strongly weathered. Most minerals are weathered and altered to second minerals.	E	Soft. Able to dig with hammer.	V	Under 5cm

0 — 10 m

ZAMANTI GÖKTAŞ HYDROELECTRIC POWER DEVELOPMENT PROJECT

GEOLOGIC LOGS OF ADITS (DA-1 and DA-2)

App. -

LIST OF ROCK ANALYSES

◎ : Carried out

Sample No.	Sampling Location	Microscopic Observation	Chemical Analysis	X-ray Diffraction
G- 1	Dam Site Adit "DA-1"	◎		
G- 2	Dam Site Right Bank	◎		
G- 3	Reservoir Upstreammost Part Left Bank		◎	
G- 4	Reservoir Upstreammost Part Right Bank	◎	◎	
G- 5	〃	◎	◎	
G- 6	Headrace Tunnel Route TB-2 Depth105.0m	◎	◎	
G- 7	Headrace Tunnel Route TB-2 Depth146.5m	◎	◎	
G- 8	Headrace Tunnel Route TB-2 Depth152.0m	◎	◎	
G- 9	Left Bank of Zamanti River 2km Downstream from KUP Mah.	◎	◎	
G-10	Powerhouse Site	◎		
G-11	Reservoir Area Near the Confluence of the Zamanti River and the Topoctas River	◎		
G-12	Dam Site Adit "DA-1" TD.57.5m	◎		
G-13	Dam Site Adit "DA-1" TD.61.0m			◎

Microscopic Observation

Project:

Locality:

Sample No. G - 1 Slice No.

Rock Name: Peridote

Texture:
Granular

Rock forming minerals:

Olivine : Subhedral(0.2 to 0.5mm)
Serpentine grows in microcracks(0.04~0.2mm in width) of olivine rarely.

Serpentine:Replace in microcracks of olivine.

Chromite:Subhedral(0.n mm),dark in color,rare.

Description:

Very fresh,olivine rich peridotite with rare chromite.

Olivine is replaced by Serpentine rarely.

Degree of alteration:

Very weak,Serpentine grows in microcracks of olivine.

Occurence:

Macroscopic Observation:

Dark color.

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G - 2 Slice No.

Rock Name: Peridotite

Texture:

Granular

Rock forming minerals:

Olivine : Subhedral(0.5 to 1.0mm)
Serpentine grows in microcracks of olivine rarely.

Serpentine:Replace in microcracks of olivine.

Chromite:Subhedral(0.n mm),dark in color,rare.

Description:

Very fresh,olivine rich peridotite with rare chromite.

Olivine is replaced by Serpentine rarely.

Degree of alteration:

Very weak,Serpentine grows in microcracks of olivine.

Occurence:

Macroscopic Observation:

Yellowish green color.

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G-4 Slice No.

Rock Name: Limestone

Texture: biomicrite

Rock forming minerals:

calcite fine grain with pale gray color
grains (0.n mm) forming material of calcite micro-vein
grains (0.0n to 0.n mm) replaces microfossils

Description:

Biomicrite is cut by calcite microveins. Many microfossils (0.2 - 0.3 mm) and rare shell (?) are observed and replaced by calcite.

Degree of alteration:

None or very weak

Occurence:

Macroscopic Observation:

Fine with pale gray color

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G-5 Slice No.

Rock Name: Limestone

Texture: granule

Rock forming minerals:

calcite	fine grain : 0.00n to 0.01 mm	
	coarse grain : 0.1 to 0.2 mm	

Description:

Coarse grained calcite are observed with dotted. Calcite micro veins are observed, rarely.

Degree of alteration:

recrystallized to granular calcite crystal grains

Occurence:

Macroscopic Observation:

fine with white color

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G-6 Slice No.

Rock Name: Limestone

Texture: biomicrite

Rock forming minerals:

calcite	fine grain, with pale gray color
	grains (0.n mm), forming material of calcit microveins with >10 mm width
	grains (0.0n to 0.n mm), replace microfossils
quartz	rarely observed (0.00n mm)
"limonite"	rarely observed in grain boundary of fine calcite
carbonaceous matter	rarely observed in grain boundary of calcite

Description:

Biomicrite is cut by calcite micro veins. Microfossils (0.2 to 0.3 mm) are replaced by calcite. Quartz grains are rarely observed and "limonite" (iron hydro oxide) and carbonaceous matter penetrated into grain boundary of fine calcite.

Degree of alteration:

Recrystallization of calcite is observed partially.

Occurence:

Macroscopic Observation:

fine with pale yellowish gray

Microscopic Observation

Project:

Locality:

Sample No. G-7 Slice No.

Rock Name: Quartz sandstone

Texture: fragmental

Rock forming minerals:

quartz	angular grain (0.1 to 0.2 mm)
clay mineral	fine lamellar grain of sericite
calcite	rare
opaque mineral	rare

Description: Angular quartz grains are cemented by clay minerals. Micro veins of lamellar quartz and sericite are cut rarely the ~~stone~~ grains. Calcite grain and opaque mineral are also observed, rarely. Some grains composed with sericite will be alteration products of feldspar grains.

Degree of alteration: Clay mineral (sericite) will be formed by hydrothermal reaction.

Occurence:

Macroscopic Observation:

fine with white color

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G-8 Slice No.

Rock Name: Limestone (muddy)

Texture:

Rock forming minerals:

calcite	fine and irregular form
	idiomorphic grain
	grain (0.n mm), forming material of calcite micro-veins
quartz	subangular grain (0.00n to 0.0n mm)
feldspar	rare
opaque	rare and iron sulfide mineral

Description: Calcite grains are cemented by pale brown muddy material. Quartz, feldspar and opaque mineral are observed, rarely. Microveins of fine calcite and muddy material and carbonaceous matter (?) cut the specimen.

Degree of alteration:

none ?

Occurence:

Macroscopic Observation:

fine with graish black color

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G-9 Slice No.

Rock Name: Quartz sandstone (pale bluish red)

Texture: fragmental

Rock forming minerals:

quartz	angular grain (0.00n to 0.0n mm)
clay mineral	fine lamellar grain of sericite
calcite	a small amount
feldspar	a small amount
mafic mineral	rare, hornblende ?
"limonite"	a small amount
hematite	rare

Description: Angular quartz grains withsmall or rare ammounts of calcite, feldspar, mafic minearl and hematiteare cemented by clay minerals. It is penetrated with limonite then colored pale brownish red.

Degree of alteration: Clay mineral (sericite) will be formed by hydrothermal reaction.

Occurence:

Macroscopic Observation:

fine with pale brownish red color

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G-10 Slice No.

Rock Name: Quartz sandstone (arkose ?)

Texture: fragmental

Rock forming minerals:

quartz	angular grain (0.0n to 0.n mm)
feldspar	K-feldspar and plagioclase
biotite	flaky grain with weakly altered in partially
hornblende	rare
calcite	cementation material of mineral grains

Description: Quartz, feldspar, biotite and hornblende grains are cemented by fine altered biotite flakes and calcite.

Degree of alteration: none or very weak

Occurence:

Macroscopic Observation:

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G-11 Slice No.

Rock Name: Peridotite

Texture: granular

Rock forming minerals:

olivine	subhedral (0.5 to 10 mm), serpentine growing as network shape
pyroxene	subhedral (0.n mm)
Ca-plagioclase	a small amount
serpentine	replace olivine grain and in microcracks in olivine
chromite	subhedral (0.n mm), dark brown in color, rare

Description: Olivine rich peridotite with Ca-plagioclase, pyroxene and rare chromite. Olivine is replaced by serpentine partially.

Degree of alteration:
Serpentine grows in cracks of olivine.

Occurence:

Macroscopic Observation:

Remarks:

Microscopic Observation

Project:

Locality:

Sample No. G-12 Slice No.

Rock Name: Peridotite

Texture: granular

Rock forming minerals:

olivine	subhedral (0.5 to 10 mm), serpentine replaced with cracks, partially
pyroxene	subhedral (0.n mm)
Ca-plagioclase	a small amount
serpentine	replace olivine grain and in microcracks of olivine
chromite	subhedral (0.0n to 0.n mm), dark brown color, rare

Description: Olivine rich peridotite with Ca-plagioclase, pyroxene and rare chromite. Olivine is replaced by serpentine partially.

Degree of alteration: serpentine grows in cracks of olivine.

Occurence:

Macroscopic Observation:

Remarks:

Chemical analysis of rocks

Sample NO.	G-3	G-4	G-5	G-6	G-7	G-8	G-9
Rock Name	Limestone	Limestone	Limestone	Limestone	Sandstone	Limestone	Sandstone
	wt.%	wt.%	wt.%	wt.%	wt.%	wt.%	wt.%
SiO_2	0.05	0.99	0.08	0.18	90.10	22.48	78.82
Al_2O_3	0.02	2.26	0.42	4.36	7.20	4.96	6.26
MgO	0.16	0.79	1.67	1.82	0.39	0.33	0.16
CaO	55.03	51.89	53.20	50.52	0.58	25.80	4.17
SO_3	0.01	0.19	–	–	0.81	1.34	0.48

X－ray diffraction

1．Sample Name

" G－13 "

2．Measurement Condition

Voltage	30kV
Current	20mA (30mA for Oriented aggregate)
Target	Cu
Filter	Ni
Slit	1°DS － 0.1mm － 1°SS
Scale Range	2000cps
Time constant	2sec
Measurement Range(2θ)	2°～ 71°
Scanning Speed	2°/min
Chart Speed	2cm/min
Hardware	XD-610 (Shimadzu Corporation)
Software	DP-61 System (Shimadzu Corporation)

3．Treatment

At Oriented aggregate

Water elutriation treatment	2θ= 2° ～ 31°
Ethylene glycol treatment	2θ= 2° ～ 16°
Hydrochloric acid treatment	2θ= 2° ～ 31°

4．Identified mineral

A: Antigorite (Serpentine group) ···· Abundant

C: Chrysotile (Serpentine group) ···· Abundant

Q: Quartz ···· Rare

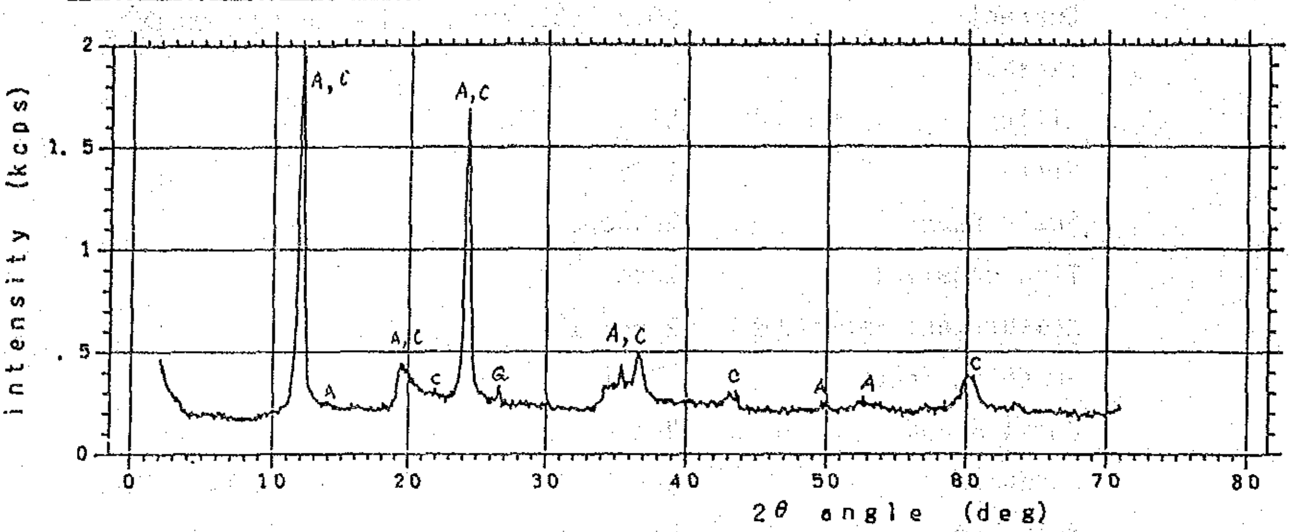
＊Other clay minerals is not detected at ethylene glycol treatment and hydlochloric acid treatment.

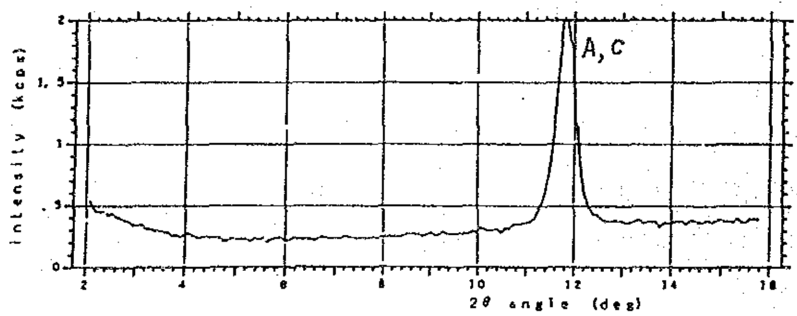
file No. = 69 [88-12-12 09:59:10]

< G-13 (Non-oriented) >

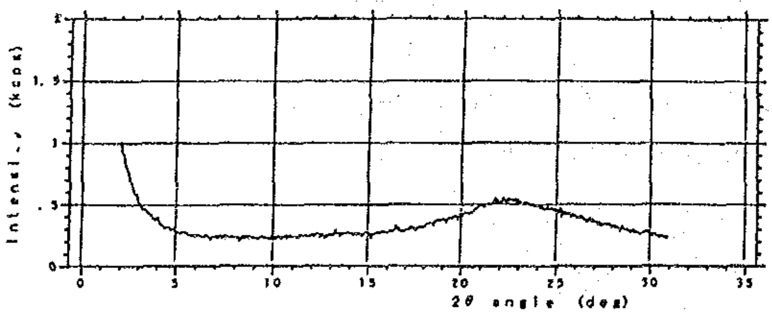
X-ray tube :	target Cu	30 kV	20 mA
slit :	(SS) 1 deg	(DS) 1 deg	(RS) . 1 mm

scan mode : CONTI
preset time : 2 (s)
step width : 08756 (deg/step)
scan speed : 2 (deg/min)





file No. = 80
[88-12-13 15:27]
< G-13 (E. G.) >
X-ray: Cu 30 kV 30 mA
slit : (SS) 1 deg
(DS) 1 deg
(RS) 1 mm



file No. = 76
[88-12-13 12:50]
< G-13 (HCL) >
X-ray: Cu 30 kV 30 mA
slit : (SS) 1 deg
(DS) 1 deg
(RS) 1 mm

3-10 Plate Bearing Test

3-10-1 Deformation for Calculation of Modulus of Elasticity and Test Result on Plate bearing Tests

Unit: 10^{-3} mm

Location		Rock Classification \ Load Condition \ No.	<1)	<2>	<3>	<4>	<5>	<6>	<7>	<8>	<9>	<10>	<11>	<12>	<13>	<14>	<15>	<16>	<17>	<18>	<19>	Test Results
			0 kgf/cm^2 / 15 kgf/cm^2	15/15	30/30	45/45	60/60	0/60	60/60	60/60	0/65	20/65	40/65	60/65	65/65	0/65	20/65	40/65	60/65	65/65	0 kgf/cm^2 / 65 kgf/cm^2	
DA - 1 P - 1 TD 20.0 m	Invert		4	9	18	30	46	10	52	71	12	17	35	48	55	17	20	39	61	64	21	D = 271,400 kgf/cm^2 Et = 251,500 kgf/cm^2 Es = 327,400 kgf/cm^2 Cf = 45 %
	Crown	2B III: b	22	28	58	91	122	73	127	137	83	92	117	140	147	92	98	123	146	151	94	D = 107,700 Et = 189,200 Es = 239,500 Cf = 19
DA - 1 P - 2 TD 40.5 m	Invert	2B IV : c	29	38	74	115	163	96	174	180	93	106	147	175	185	111	127	165	190	199	120	D = 81,200 Et = 137,400 Es = 163,500 Cf = 8
	Crown	2B IV : c	4	5	12	22	32	27	32	36	29	34	37	42	44	29	37	45	49	52	36	D. = 370,400 Et = 856,000 Es = 809,700 Cf = 80
DA - 1 P - 3 TD(B)2.1 m	Left Wall	2B III: b	83	89	116	145	171	121	182	193	130	148	175	197	204	154	170	198	215	222	164	D = 123,300 Et = 192,000 Es = 207,500 Cf = 18
	Right Wall	2B III: b	28	42	70	91	121	64	122	137	75	96	118	136	141	92	114	138	157	162	94	D = 131,000 Et = 220,600 Es = 216,400 Cf = 26
DA - 1 P - 4 TD(B)4.0 m	Invert	2B III: b	25	31	57	79	109	67	107	117	81	87	107	125	131	90	94	114	131	136	94	D = 132,100 Et = 239,600 Es = 306,900 Cf = 25
	Crown	2B III: b	77	88	107	124	139	94	137	143	98	120	133	145	148	114	121	133	144	147	116	D = 199,000 Et = 379,000 Es = 369,800 Cf = 14
DA - 2 P - 1 TD 16.2 m	Invert	2B IV : c	19	50	82	120	225	168	311	324	245	314	369	390	398	354	389	413	427	432	383	D = 55,000 Et = 179,700 Es = 142,300 Cf = 9
	Crown	2B IV : c	49	71	129	183	253	181	280	297	183	202	238	262	268	175	218	272	314	320	220	D = 56,400 Et = 126,400 Es = 137,200 Cf = 17
DA - 2 P - 2 TD 19.0 m	Invert	2B IV : c	7	16	41	77	113	49	119	148	76	93	121	145	152	77	93	123	150	156	81	D = 103,100 Et = 167,700 Es = 189,800 Cf = 41
	Crown	2B IV : c	198	291	371	458	545	423	594	665	503	578	624	652	667	510	581	628	657	663	525	D = 39,900 Et = 120,700 Es = 92,900 Cf = 42
DA - 2 P - 3 TD(B)5.8 m	Invert	2B IV : c	95	145	314	504	671	424	751	778	493	633	734	797	815	571	709	810	866	883	593	D = 19,200 Et = 57,500 Es = 46,400 Cf = 8
	Crown	2B IV : c	Canceled data																			

Note: Stress level of Et to be 20 - 65 kgf/cm^2

3-10-2 Calculation Sheets of Plate Bearing Tests

DA-1,P-1,TD20.0 m

(Invert)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 4 9 18 30 46
C(60)= 10 52 71
 12 17 35 48 55
 17 20 39 61 64
FINAL DATA= 21
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 1.2   R= 0.984

DEFORMATION MODULAS
D (KG/CM2)= 271400

CREEP RATIO CF(0/0)
 10 52 71  CF= 45

ELASTICITY MODULUS
ES(65)= 341900 31280
0
MEAN ES(65)= 327400

S= 1.226   R= 0.992
S= 0.997   R= 0.998
ET20-65= 277400 2255
00
MEAN ET20-65= 251500
RESULT CAL. END
```

(Crown)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 22 28 58 91 122
C(60)= 73 127 137
 83 92 117 140 147
 92 98 123 146 151
FINAL DATA= 94
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.476   R= 1

DEFORMATION MODULAS
D (KG/CM2)= 187700

CREEP RATIO CF(0/0)
 73 127 137  CF= 19

ELASTICITY MODULUS
ES(65)= 229700 24920
0
MEAN ES(65)= 239500

S= 0.826   R= 1
S= 0.847   R= 0.999
ET20-65= 186900 1915
00
MEAN ET20-65= 189200
RESULT CAL. END
```

DA-1,P-2,TD40.5 m

(Invert)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 29 38 74 115 163
C(60)= 96 174 180
 93 106 147 175 185
 111 127 165 190 199
FINAL DATA= 120
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.359   R=-0.996

DEFORMATION MODULAS
D (KG/CM2)= 81200

CREEP RATIO CF(0/0)
 96 174 180  CF= 8

ELASTICITY MODULUS
ES(65)= 159800 16710
0
MEAN ES(65)= 163500

S= 0.579   R= 0.992
S= 0.635   R= 0.991
ET20-65= 131000 1437
00
MEAN ET20-65= 137400
RESULT CAL. END
```

(Crown)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8.
 4 5 12 22 32
C(60)= 27 32 36
 29 34 37 42 44
 29 37 45 49 52
FINAL DATA= 36
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 1.638   R= 0.994

DEFORMATION MODULAS
D (KG/CM2)= 370400

CREEP RATIO CF(0/0)
 27 32 36  CF= 88

ELASTICITY MODULUS
ES(65)= 980200 63920
0
MEAN ES(65)= 809700

S= 4.442   R= 0.976
S= 3.126   R= 0.976
ET20-65= 1004800 707
100
MEAN ET20-65= 856000
RESULT CAL. END
```

DA-1,P-3,TD(B)2.1 m

(Left wall)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 83 89 116 145 171
C(60)= 121 182 193
 130 148 175 197 204
 154 170 198 215 222
FINAL DATA= 164
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.545   R= 1

DEFORMATION MODULAS
D (KG/CM2)= 123300

CREEP RATIO CF(0/0)
 121 182 193  CF= 10

ELASTICITY MODULUS
ES(65)= 198700 21620
0
MEAN ES(65)= 207500

S= 0.814   R= 0.998
S= 0.883   R= 0.987
ET20-65= 184200 1997
00
MEAN ET20-65= 192000
RESULT CAL. END
```

(Right wall)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 28 42 70 91 121
C(60)= 64 122 137
 75 96 118 136 141
 92 114 138 157 162
FINAL DATA= 94
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.579   R= 0.996

DEFORMATION MODULAS
D (KG/CM2)= 131000

CREEP RATIO CF(0/0)
 64 122 137  CF= 26

ELASTICITY MODULUS
ES(65)= 222800 21000
0
MEAN ES(65)= 216400

S= 1.008   R= 0.998
S= 0.943   R= 0.997
ET20-65= 227900 2132
00
MEAN ET20-65= 220600
RESULT CAL. END
```

DA-1,P-4,TD(B)4.0 m

(Invert)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 25 31 57 79 109
C(60)= 67 107 117
 81 87 107 125 131
 90 94 114 131 136
FINAL DATA= 94
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.584   R= 0.997

DEFORMATION MODULAS
D (KG/CM2)= 132100

CREEP RATIO CF(0/0)
 67 107 117  CF= 25

ELASTICITY MODULUS
ES(65)= 294100 31960
0
MEAN ES(65)= 306900

S= 1.837   R= 0.999
S= 1.082   R= 0.999
ET20-65= 234500 2447
00
MEAN ET20-65= 239600
RESULT CAL. END
```

(Crown)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 77 88 107 124 139
C(60)= 94 137 143
 98 120 133 145 148
 114 121 133 144 147
FINAL DATA= 116
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.88   R= 0.997

DEFORMATION MODULAS
D (KG/CM2)= 199000

CREEP RATIO CF(0/0)
 94 137 143  CF= 14

ELASTICITY MODULUS
ES(65)= 294100 44550
0
MEAN ES(65)= 369800

S= 1.61   R= 1
S= 1.74   R= 1
ET20-65= 364300 3936
00
MEAN ET20-65= 379000
RESULT CAL. END
```

DA-2,P-1,TD16.3 m

(Invert)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 19 50 82 120 225
C(60)= 168 311 324
 245 314 369 390 398
 354 389 413 427 432
FINAL DATA= 383
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.243   R= 0.913

DEFORMATION MODULAS
D (KG/CM2)= 55000

CREEP RATIO CF(0/0)
 168 311 324  CF= 9

ELASTICITY MODULUS
ES(65)= 96100 188500
MEAN ES(65)= 142300

S= 0.529   R= 0.95
S= 1.059   R= 0.984
ET20-65= 119700 2396
00
MEAN ET20-65= 179700
RESULT CAL. END
```

(Crown)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 49 71 129 183 253
C(60)= 181 280 297
 183 202 238 262 268
 175 218 272 314 320
FINAL DATA= 220
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.249   R= 0.997

DEFORMATION MODULAS
D (KG/CM2)= 56400

CREEP RATIO CF(0/0)
 181 280 297  CF= 17

ELASTICITY MODULUS
ES(65)= 173000 10140
0
MEAN ES(65)= 137200

S= 0.683   R= 0.989
S= 0.435   R= 0.992
ET20-65= 154500 9830
0
MEAN ET20-65= 126400
RESULT CAL. END
```

DA-2,P-2,TD19.0 m

(Invert)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 7 16 41 77 113
C(60)= 49 119 148
 76 93 121 145 152
 77 93 123 150 156
FINAL DATA= 81
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.456   R= 0.993

DEFORMATION MODULAS
D (KG/CM2)= 103100

CREEP RATIO CF(0/0)
 49 119 148  CF= 41

ELASTICITY MODULUS
ES(65)= 193500 18610
0
MEAN ES(65)= 189800

S= 0.77   R= 0.999
S= 0.713   R= 0.999
ET20-65= 174100 1613
00
MEAN ET20-65= 167700
RESULT CAL. END
```

(Crown)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 198 291 371 458 545
C(60)= 423 594 665
 503 578 624 652 667
 510 581 628 657 663
FINAL DATA= 525
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.177   R= 1

DEFORMATION MODULAS
D (KG/CM2)= 39900

CREEP RATIO CF(0/0)
 423 594 665  CF= 42

ELASTICITY MODULUS
ES(65)= 89700 96100
MEAN ES(65)= 92900

S= 0.522   R= 0.987
S= 0.545   R= 0.982
ET20-65= 118100 1232
00
MEAN ET20-65= 120700
RESULT CAL. END
```

DA-2,P-3,TD(B)5.8 m

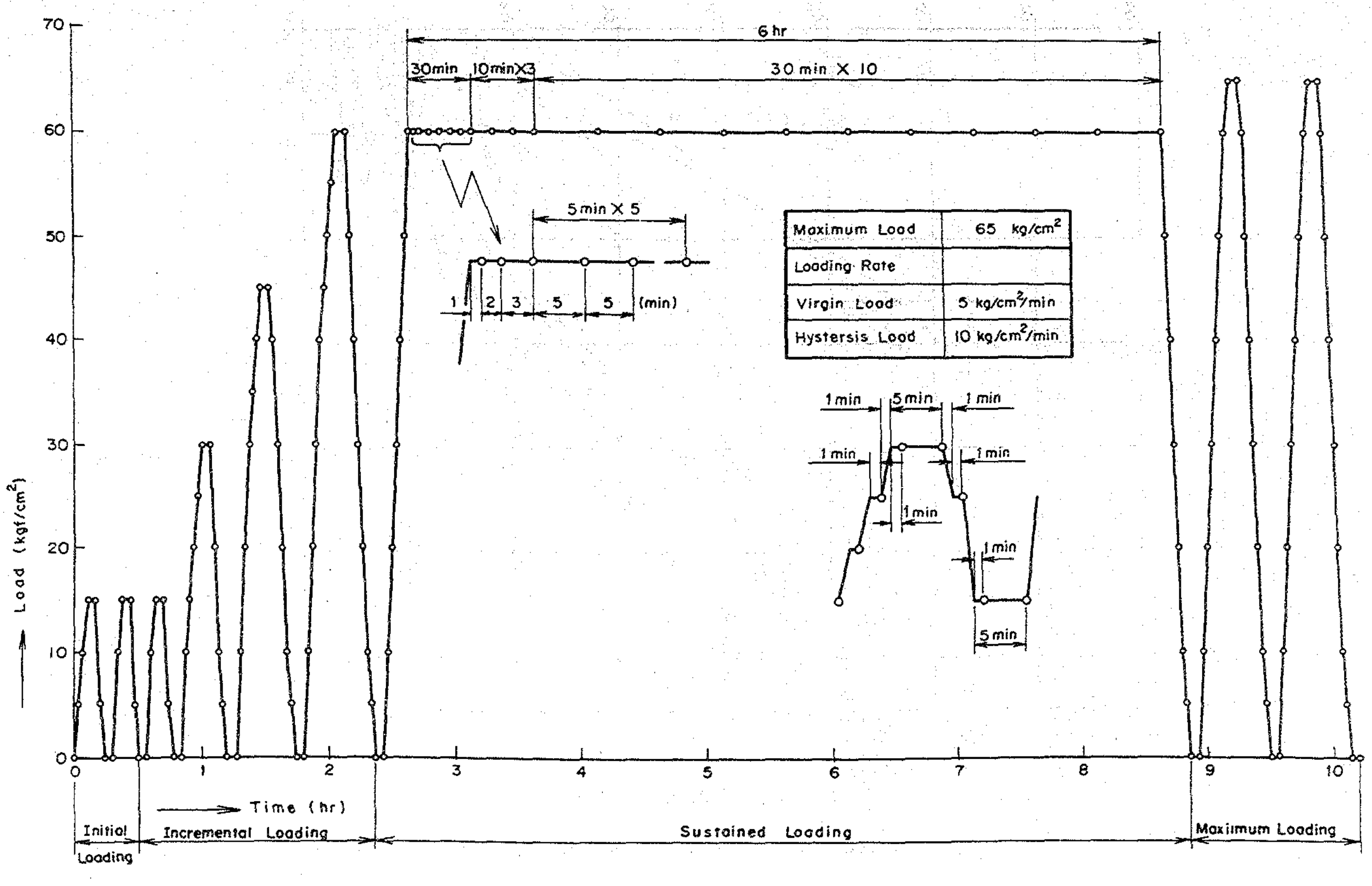
(Invert)

```
BEARING DATA IN.(P7)
DATA INPUT END

CONFIRM DATA    (P8)
 95 145 314 504 671
C(60)= 424 751 778
 493 633 734 797 815
 571 709 810 866 883
FINAL DATA= 593
DATA CONFIRMED END

BEARING.T RESULT(P9)
S= 0.085   R= 0.999

DEFORMATION MODULAS
D (KG/CM2)= 19200

CREEP RATIO CF(0/0)
 424 751 778  CF= 8

ELASTICITY MODULUS
ES(65)= 45700 47100
MEAN ES(65)= 46400

S= 0.248   R= 0.986
S= 0.259   R= 0.979
ET20-65= 56200 58700
MEAN ET20-65= 57500
RESULT CAL. END
```

(Crown)

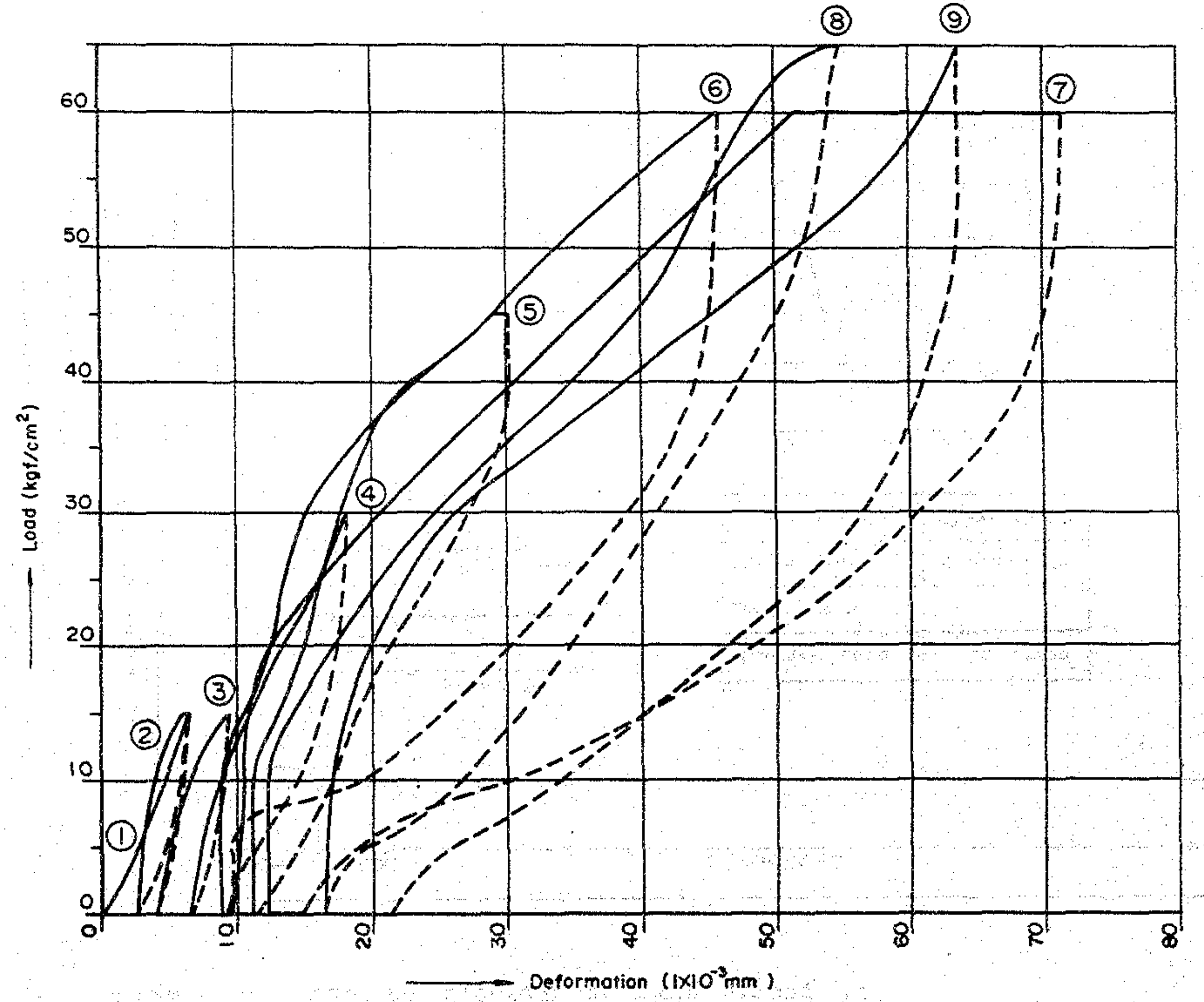
(Canceled data)

3-10-3 Loading Diagram of Plate Bearing Test



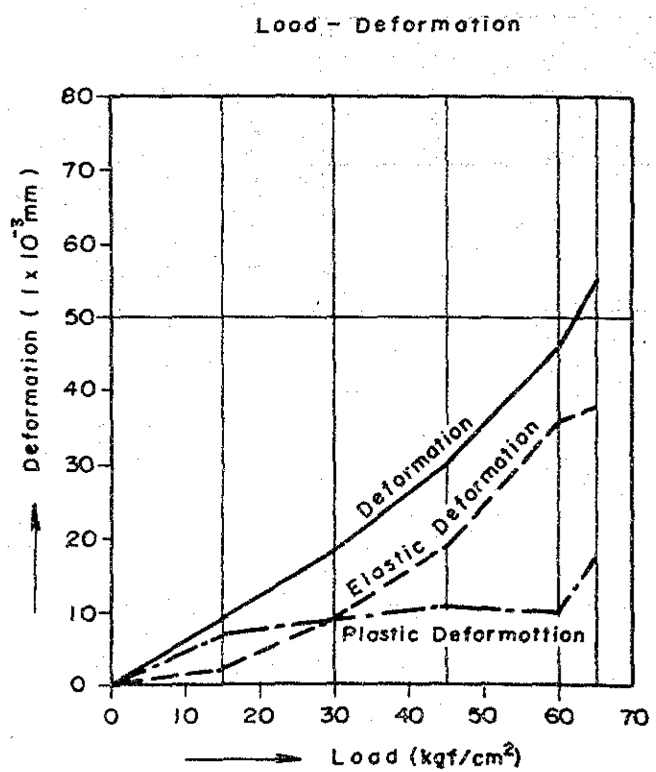
3-10-4 Load-Deformation Hysteresis of Plate Bearing Test

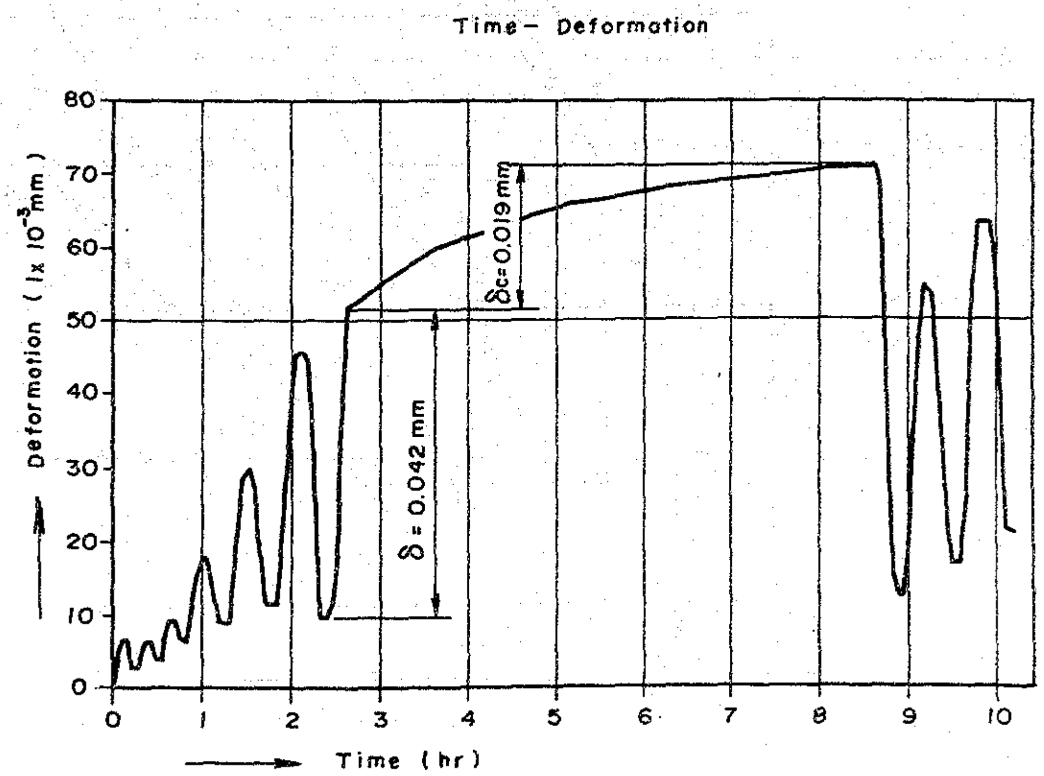
DA-1, P-1 TD=20.0m (Invert)



3-10-5 Load-Deformation and Time-Deformation of Plate Bearing Test

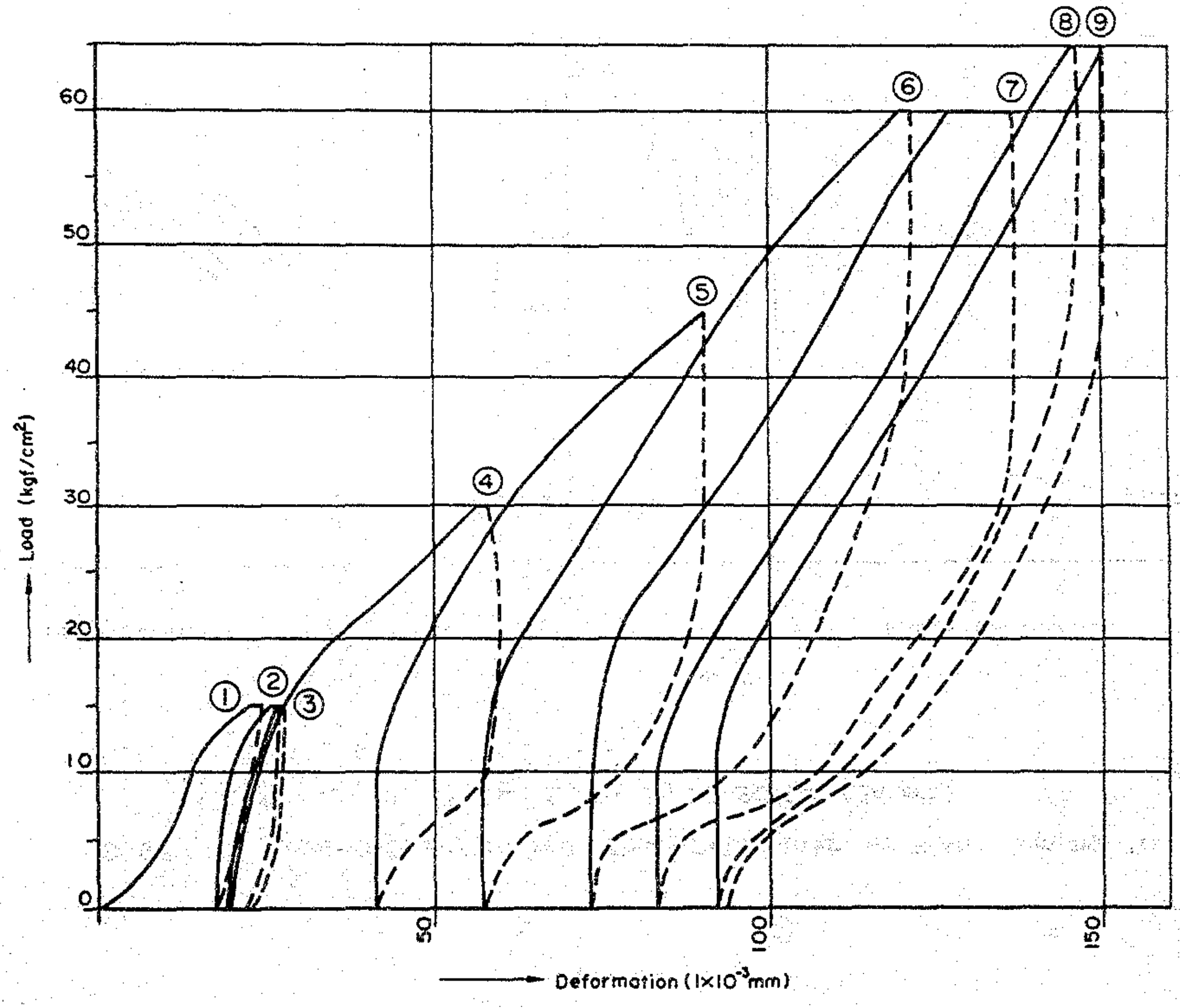
DA-1, P-1, TD 20.0m (Invert)





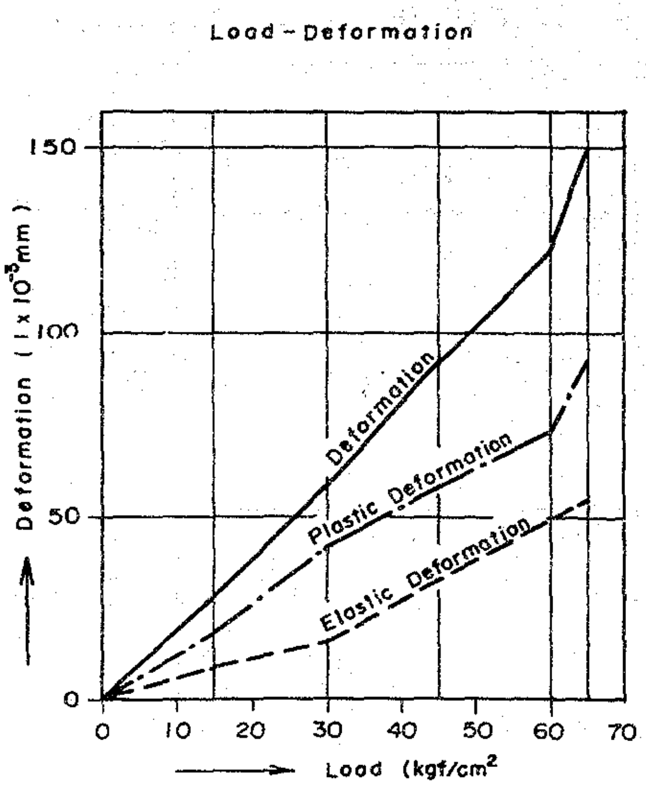
Load-Deformation Hysteresis of Plate Bearing Test

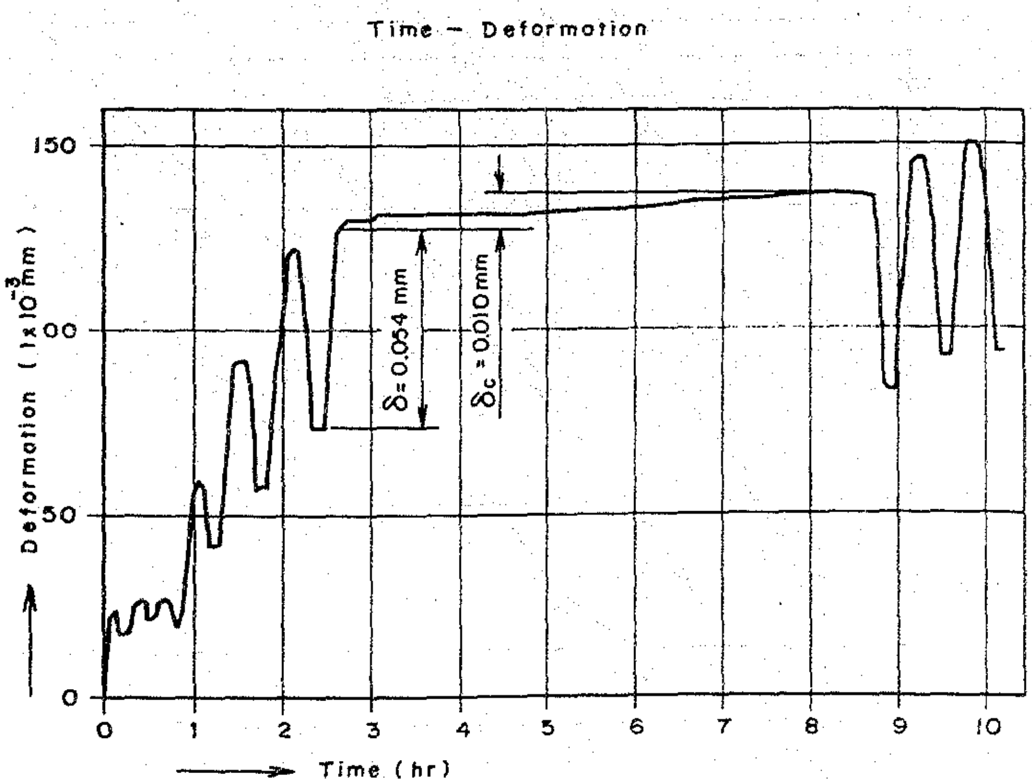
DA-1, P-1 TD=20.0m (Crown)



Load-Deformation and Time-Deformation of Plate Bearing Test

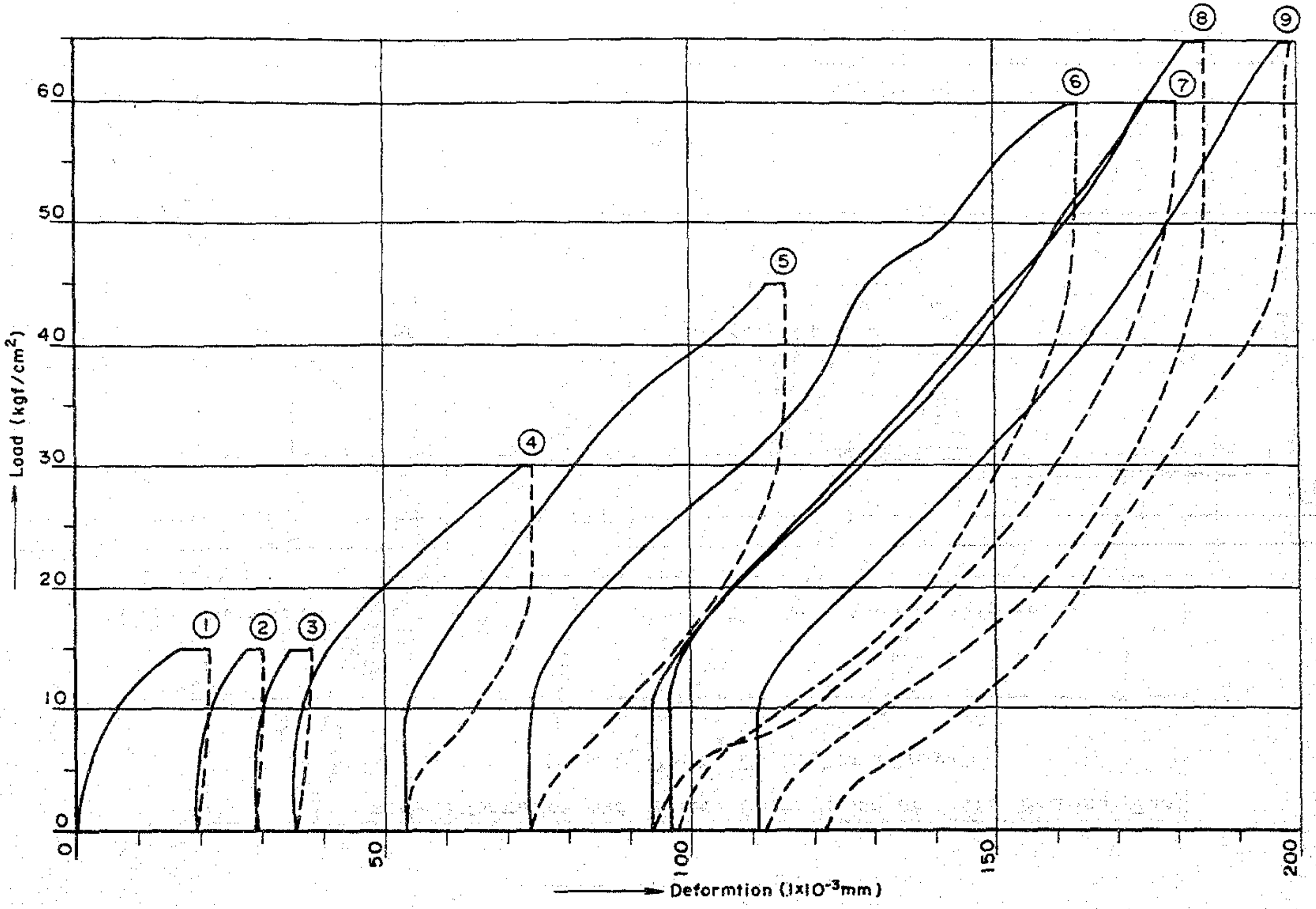
DA-1, P-1, TD 20.0m (Crown)





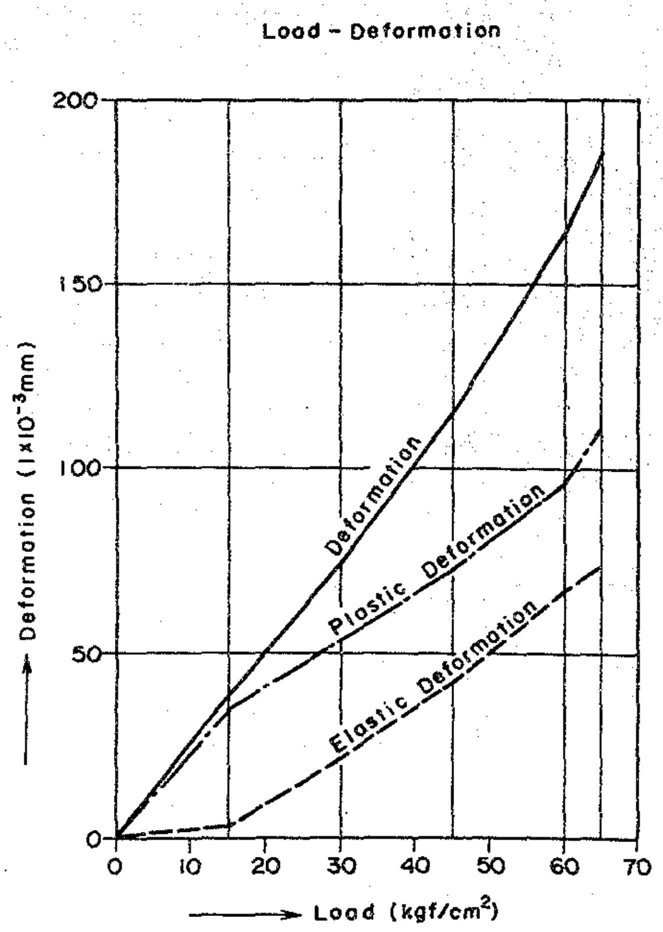
Load-Deformation Hysteresis of Plate Bearing Test

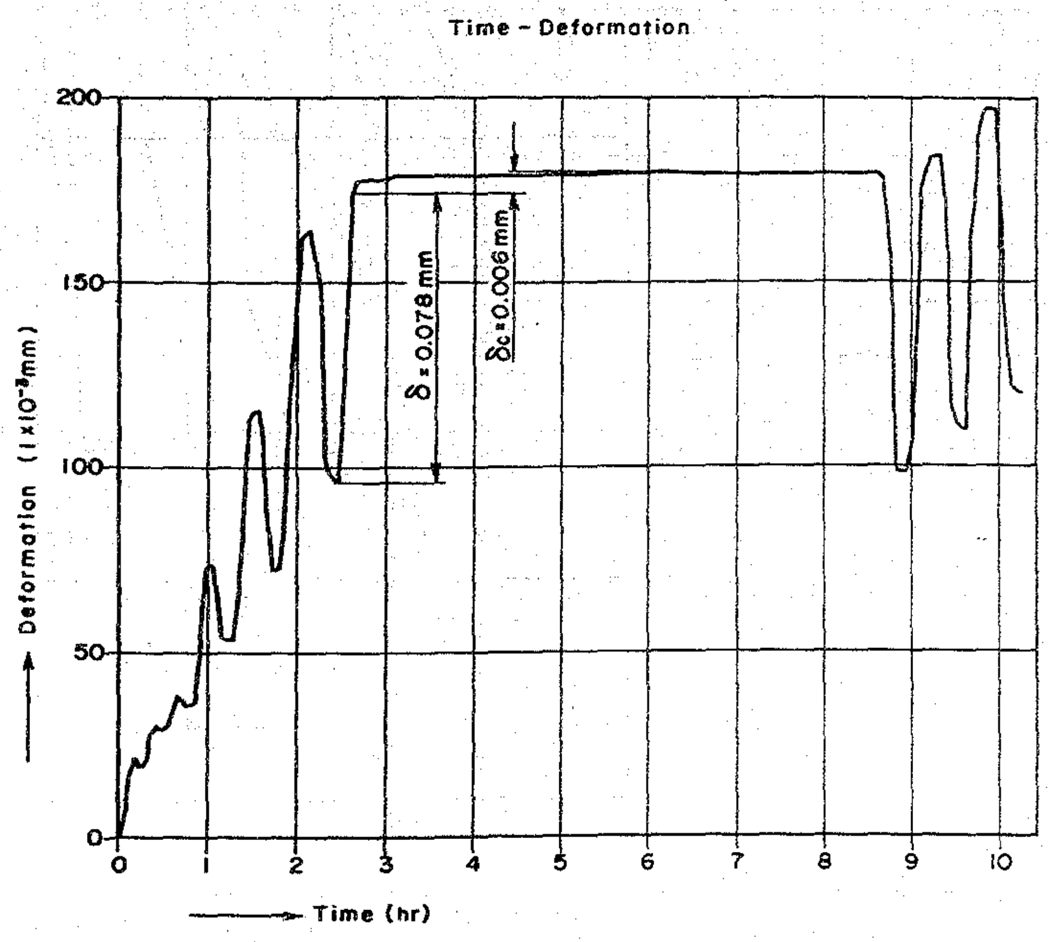
DA-1, P-2 TD=40.5m (Invert)



Load-Deformation and Time-Deformation of Plate Bearing Test

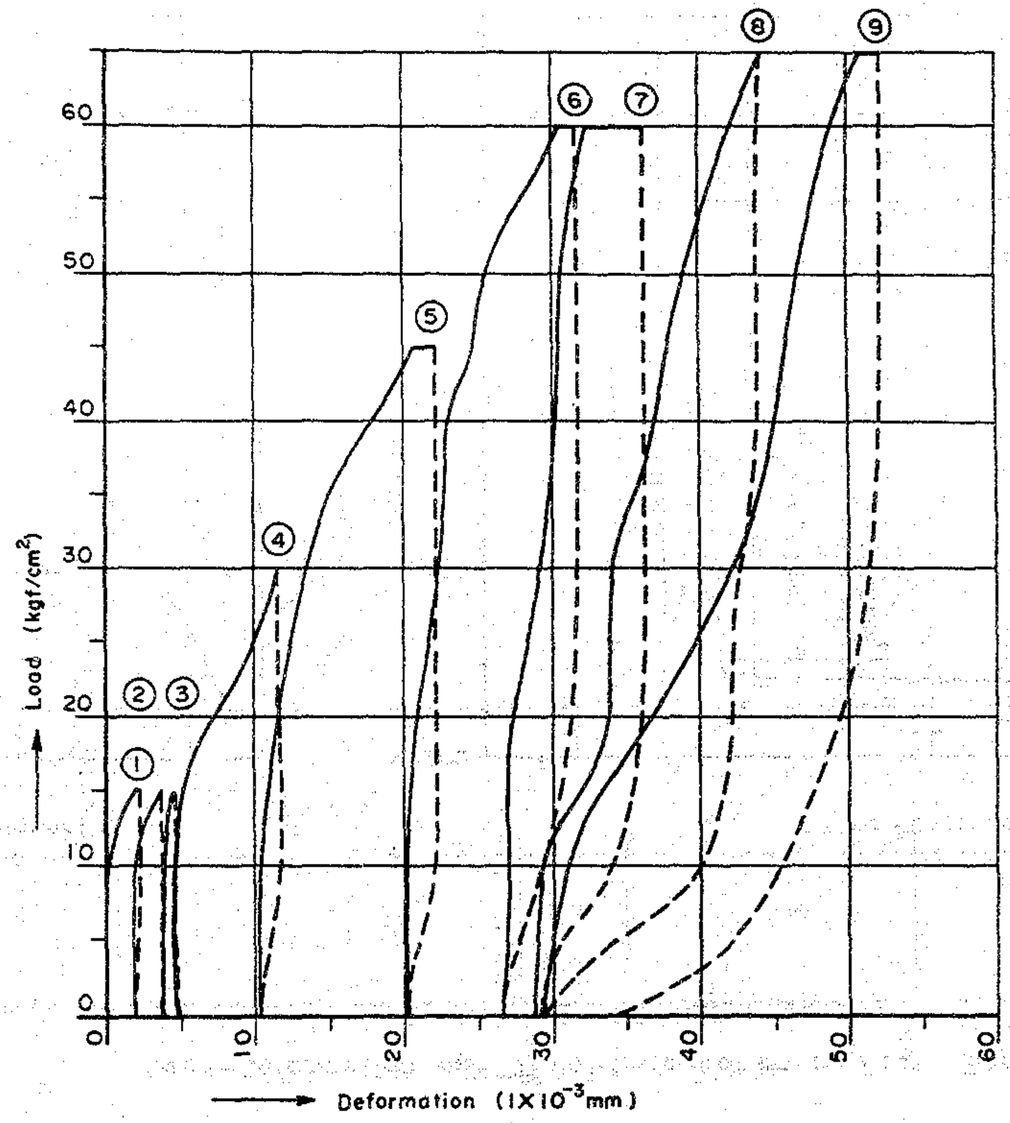
DA-1, P-2 TD 40.5m (Invert)





Load-Deformation Hysteresis of Plate Bearing Test

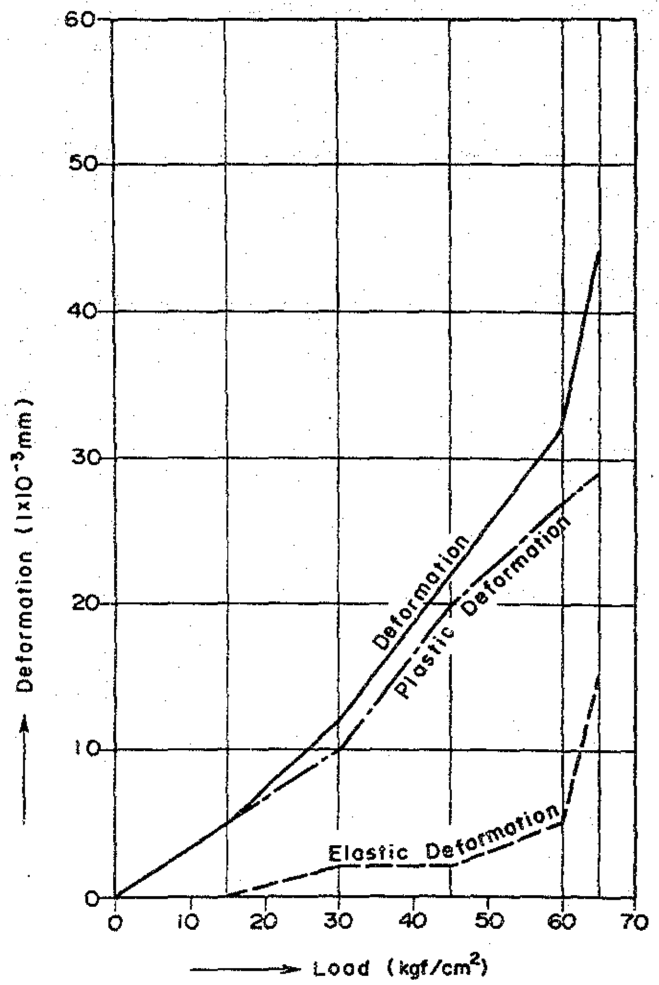
DA-1, P-2 TD 40.5m (Crown)



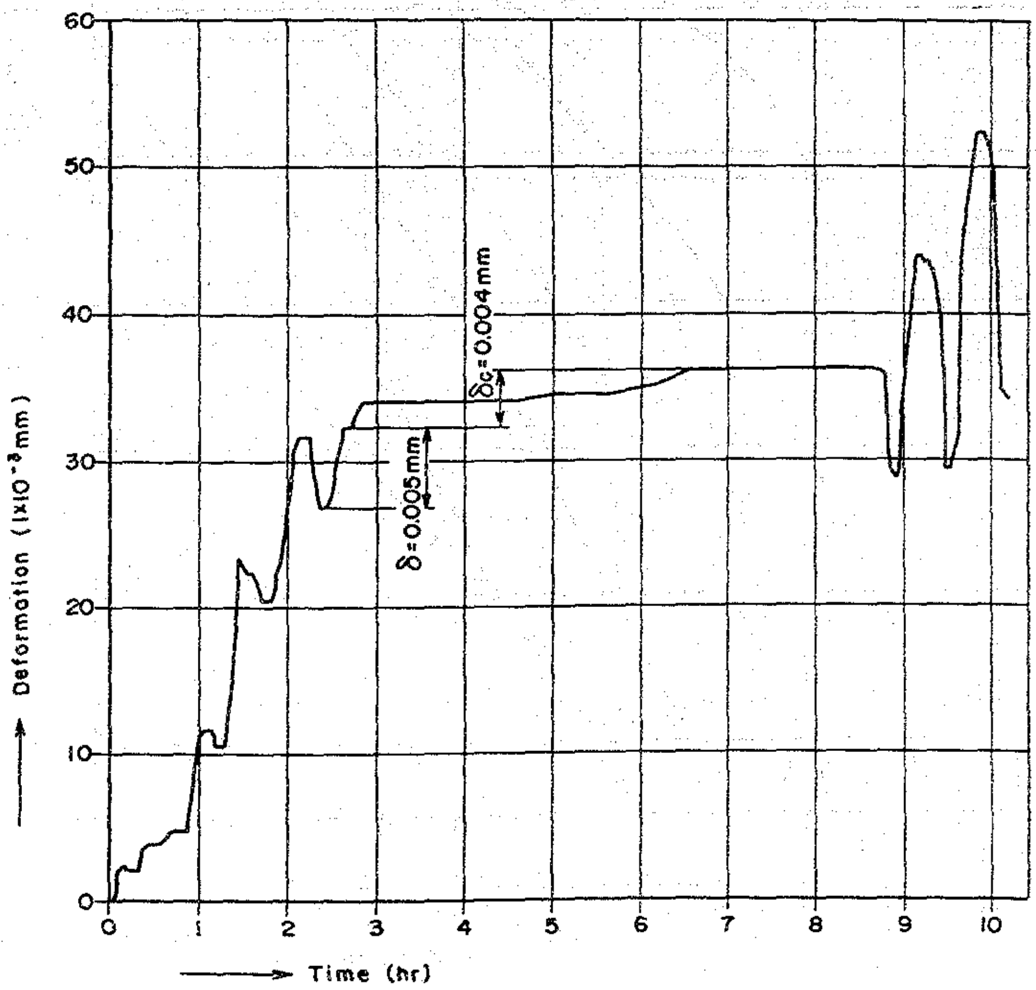
Load-Deformation and Time-Deformation of Plate Bearing Test

DA-1, P-2 TD 40.5m (Crown)

Load - Deformation

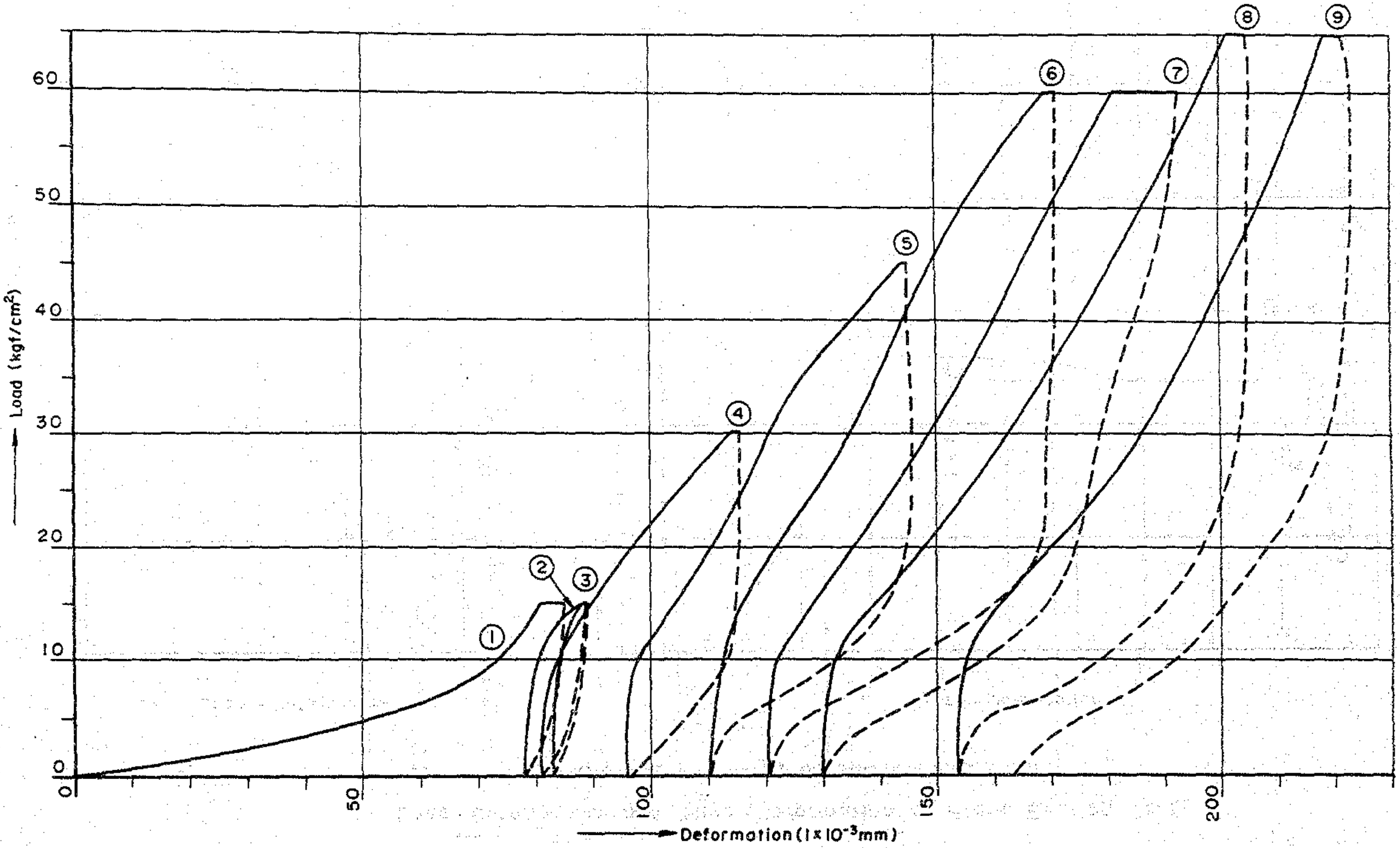


Time - Deformation



Load - Defomation Hysteresis of Plate Bearing Test

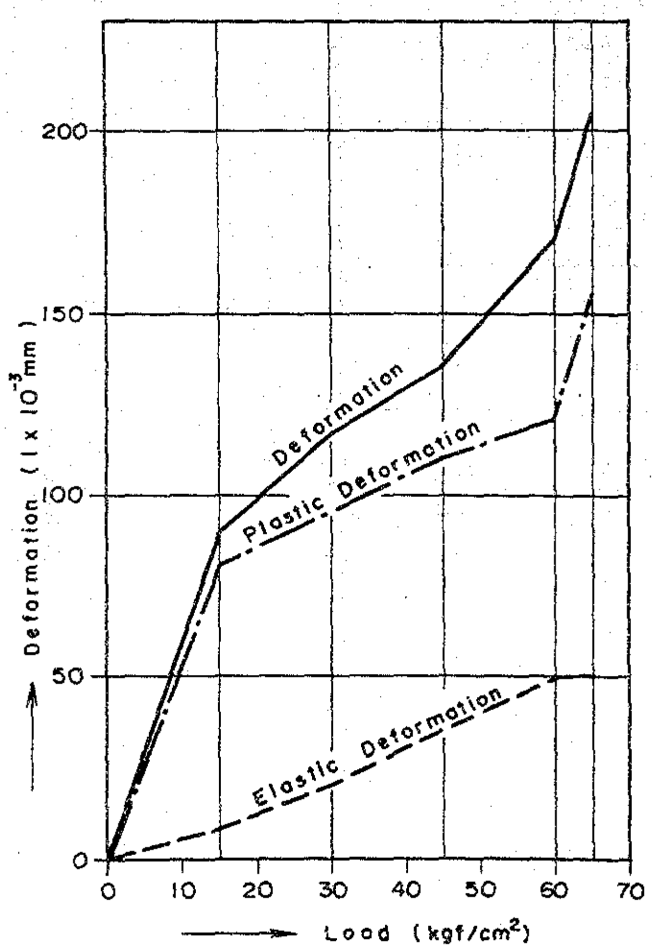
DA-1, P-3 TD(B)=2.1m (Left wall)



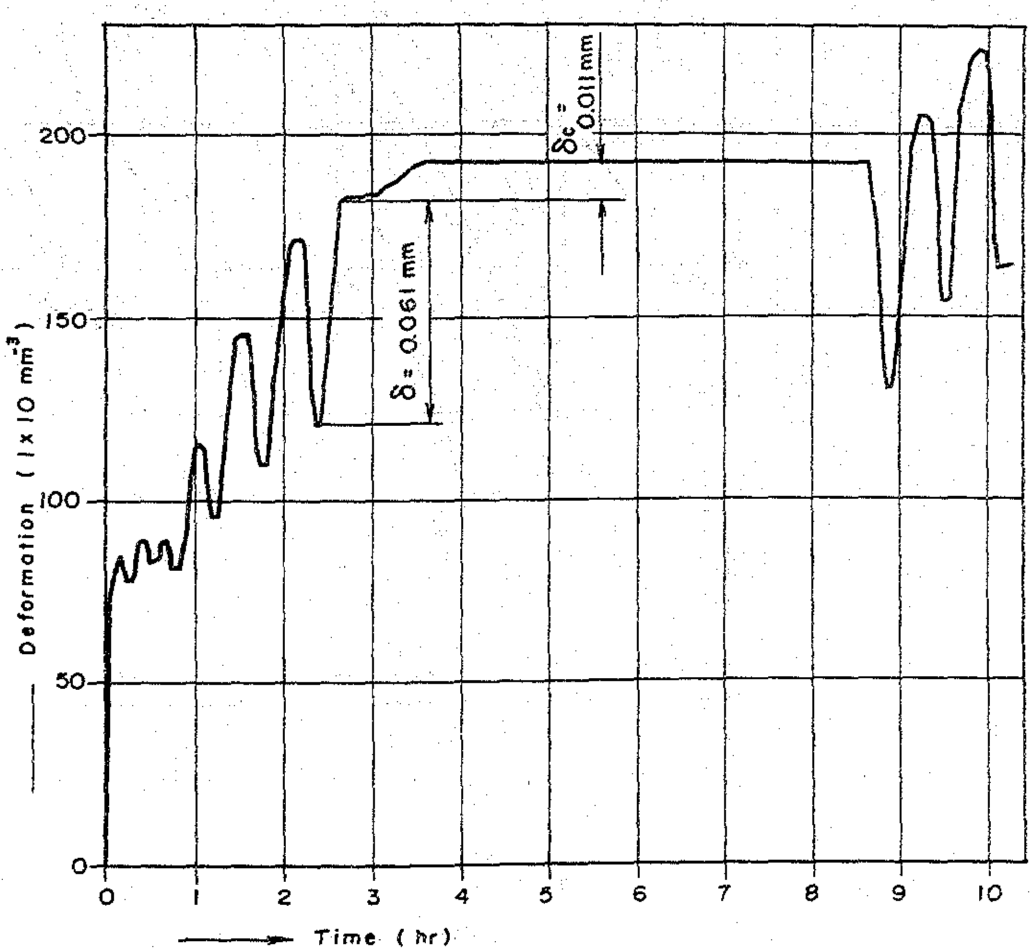
Load–Deformation and Time–Deformation of Plate Bearing Test

DA – 1, P – 3 TD(B) 2.1 m (Left wall)

Load — Deformation

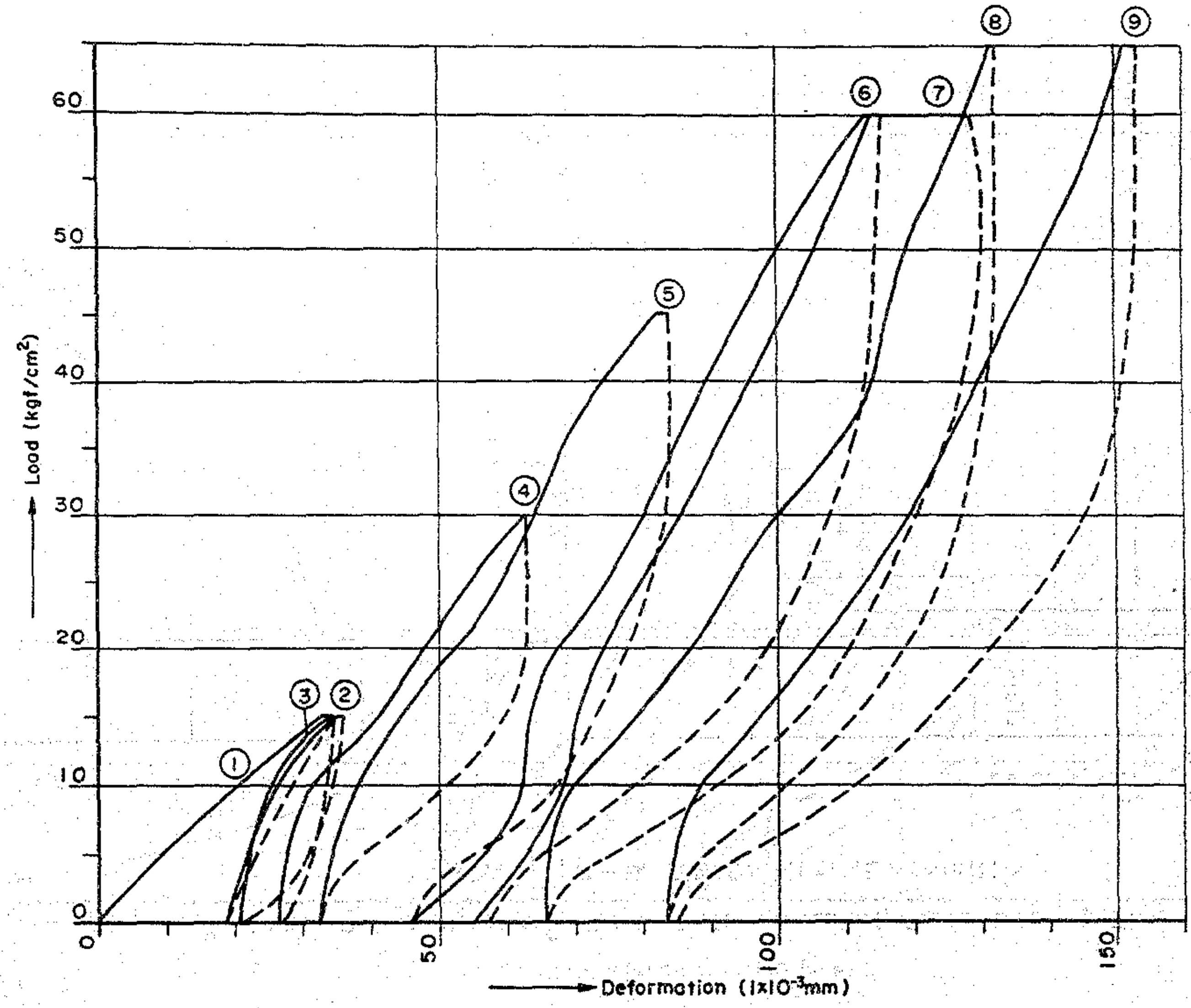


Time — Deformation



Load-Deformation Hysteresis of Plate Bearing Test

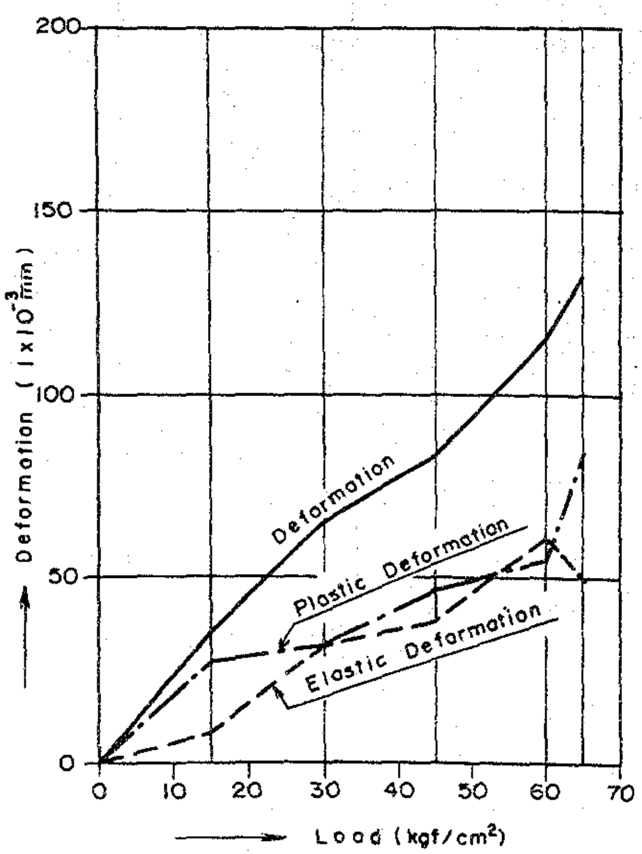
DA-1, P-3 TD(B) 2.1m (Right wall)



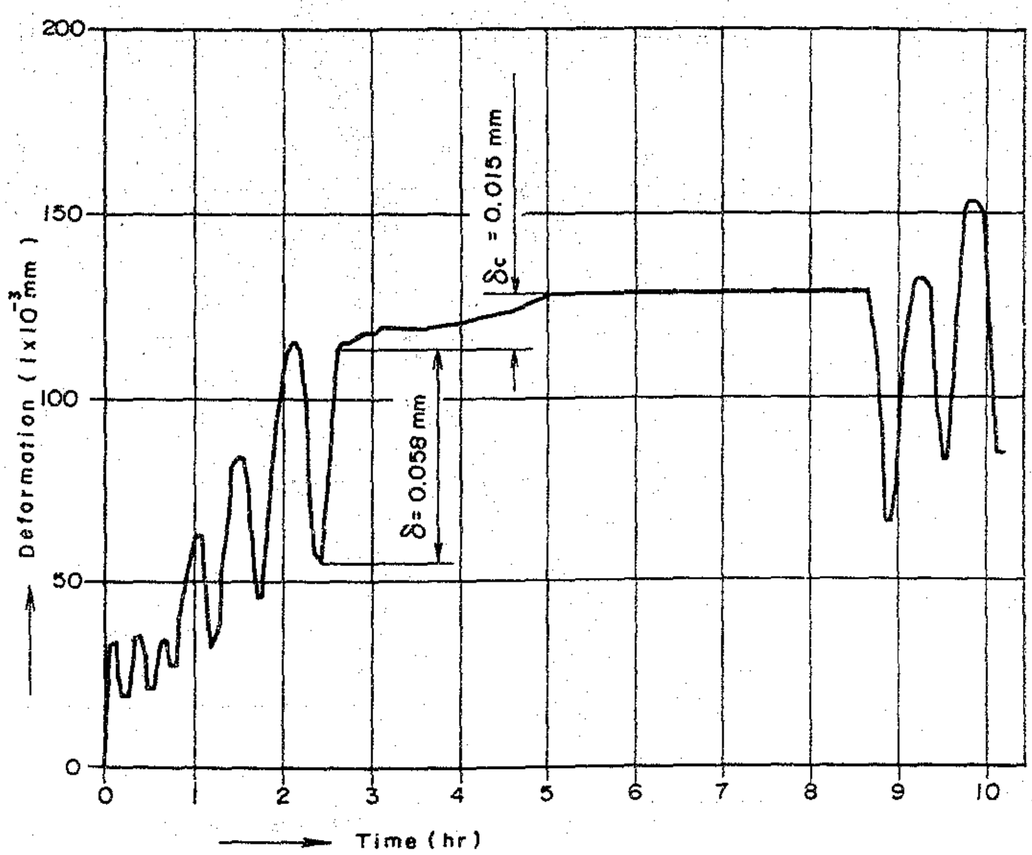
Load-Deformation and Time-Deformation of Plate Bearing Test

DA-1, P-3 TD(B) 2.1 m (Right wall)

Load - Deformation

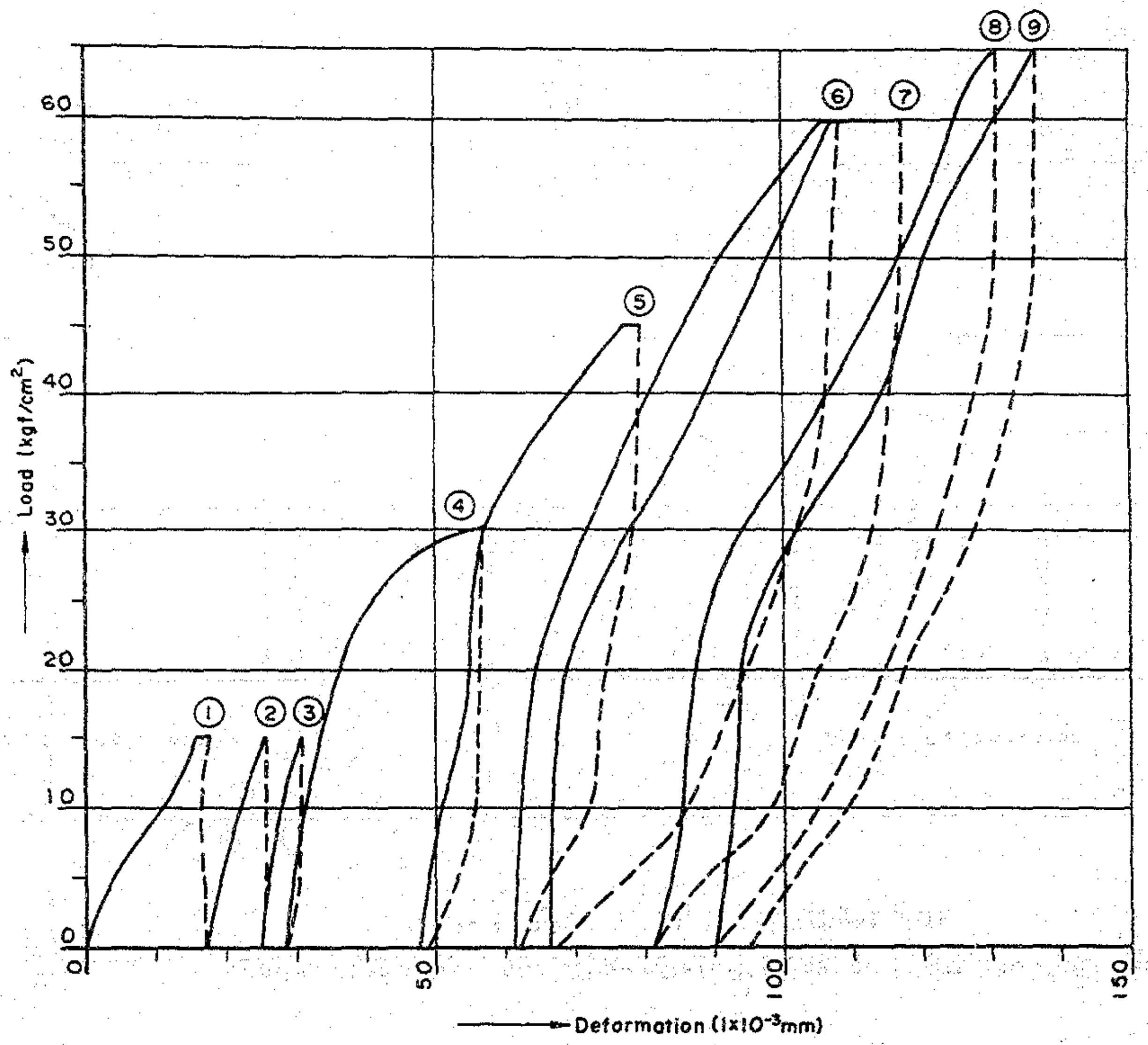


Time - Deformation



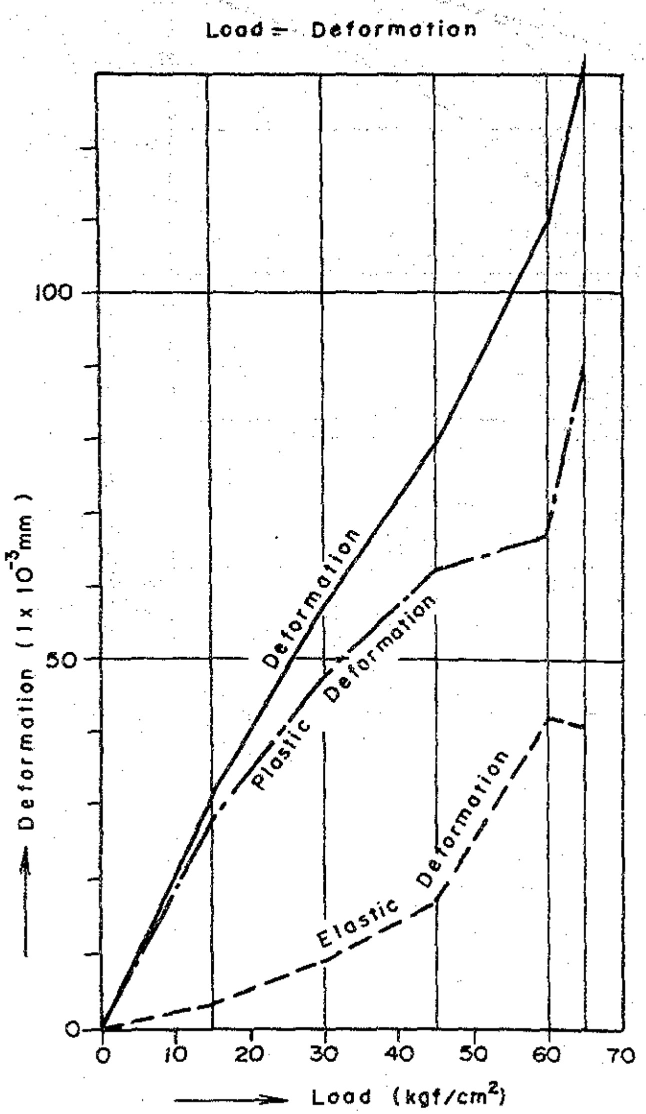
Load-Deformation Hysteresis of Plate Bearing Test

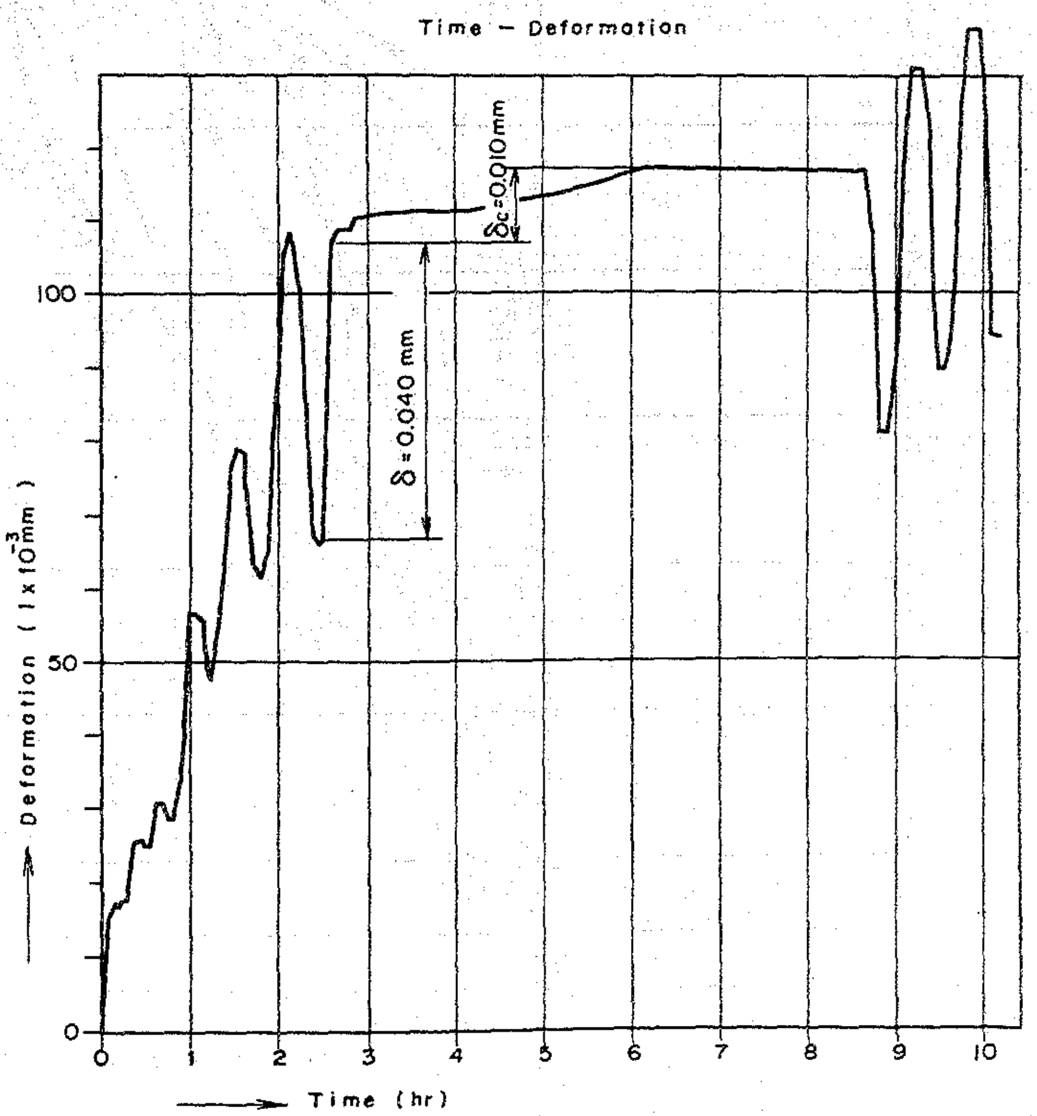
DA-1, P-4   TD(B)=4.0m (Invert)



Load-Deformation and Time-Deformation of Plate Bearing Test

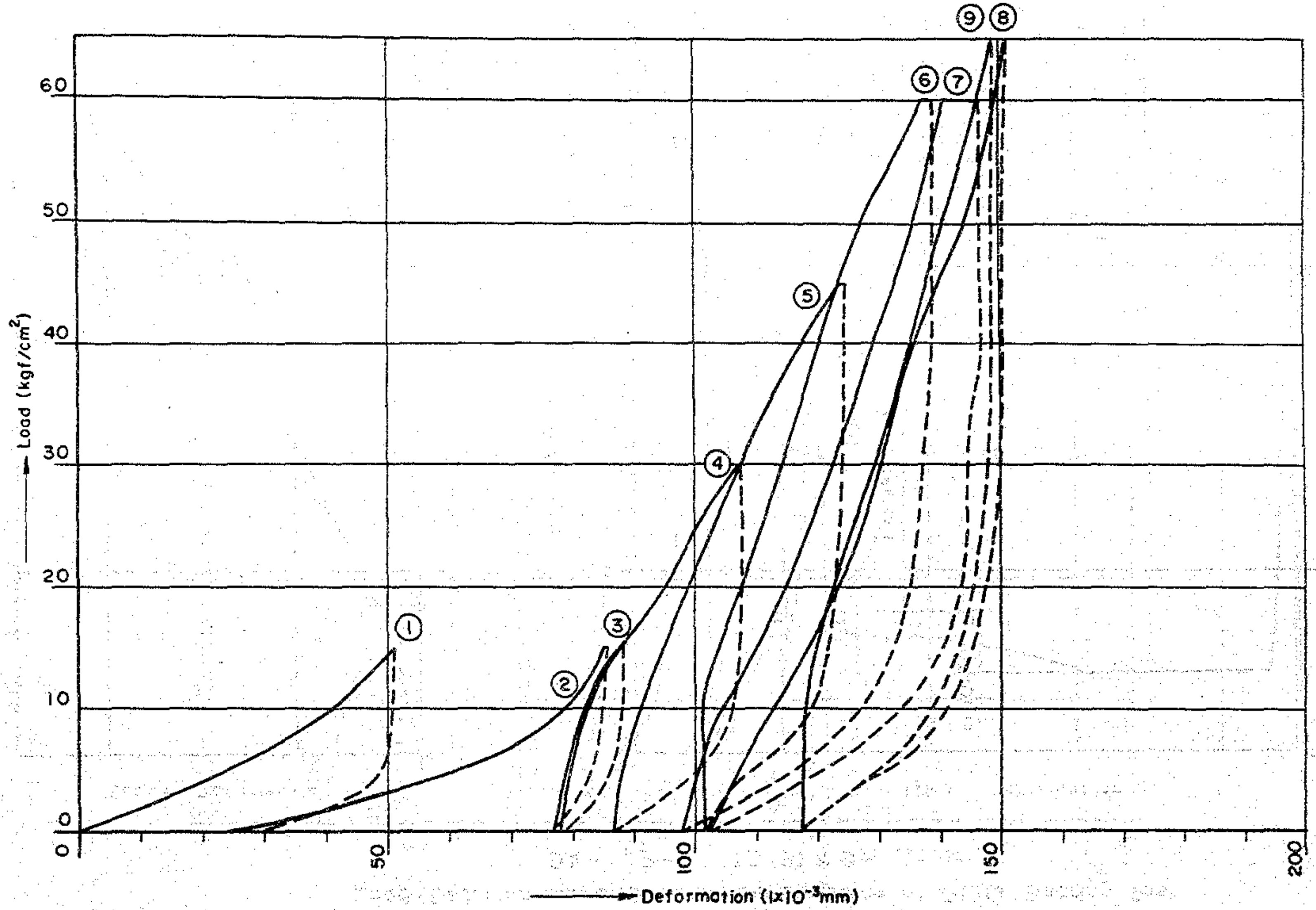
DA-1, P-4 TD(B) 4.0m (Invert)





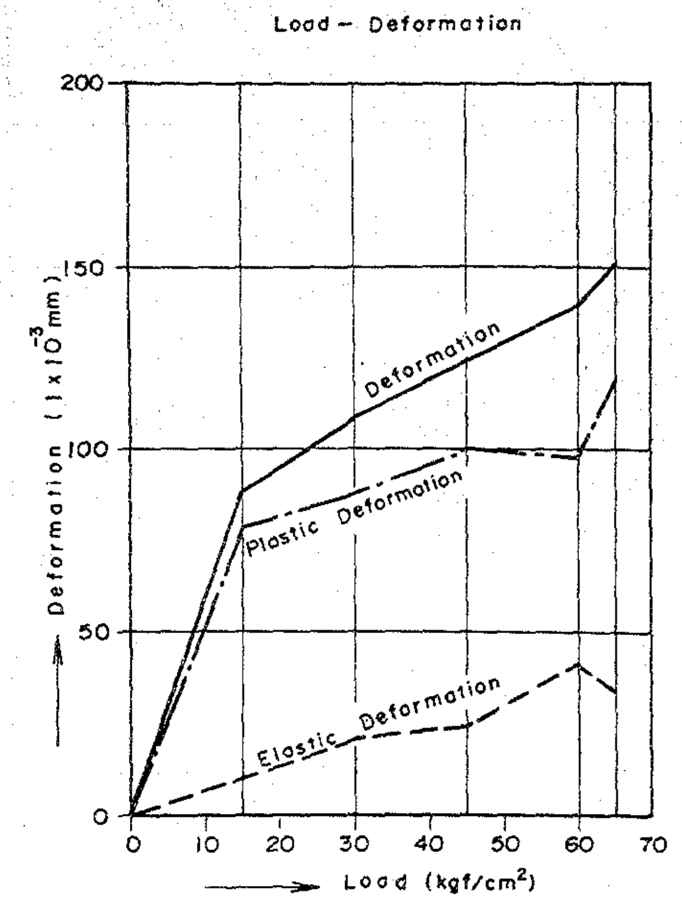
Load-Deformation Hysteresis of Plate Bearing Test

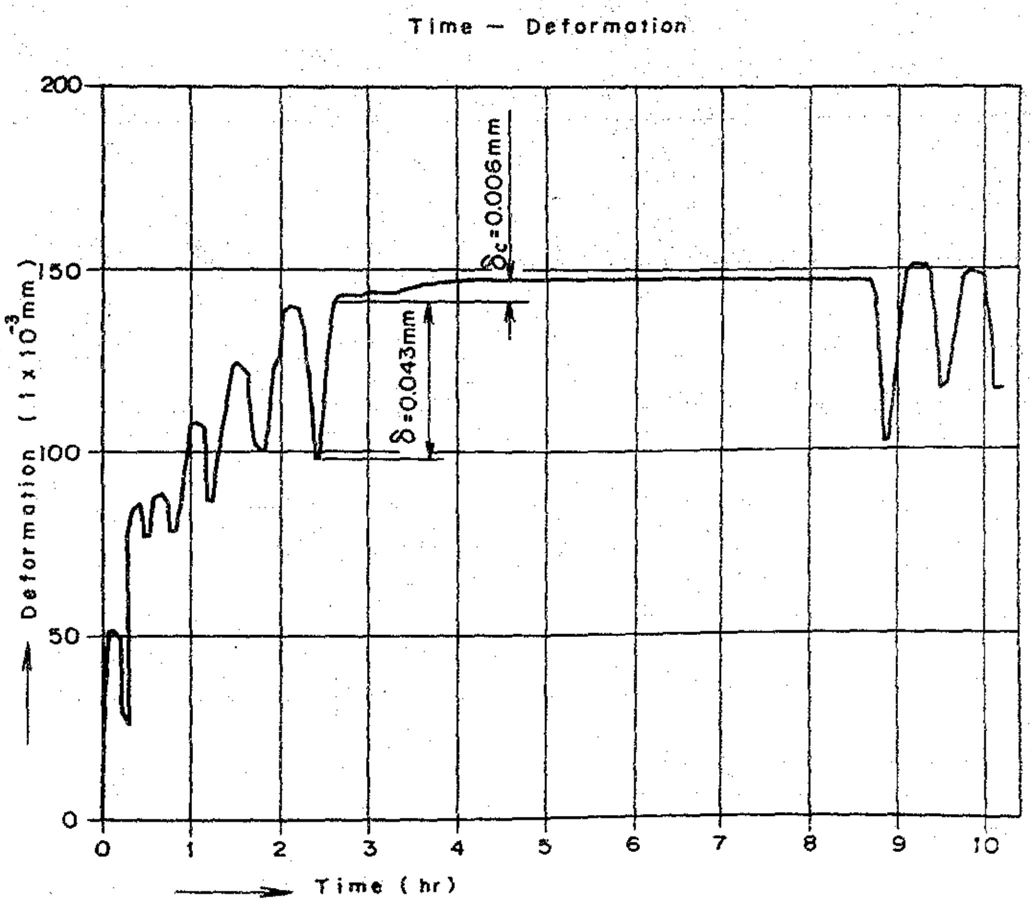
DA-1, P-4 TD(B) 4.0m (Crown)



Load-Deformation and Time-Deformation of Plate Bearing Test

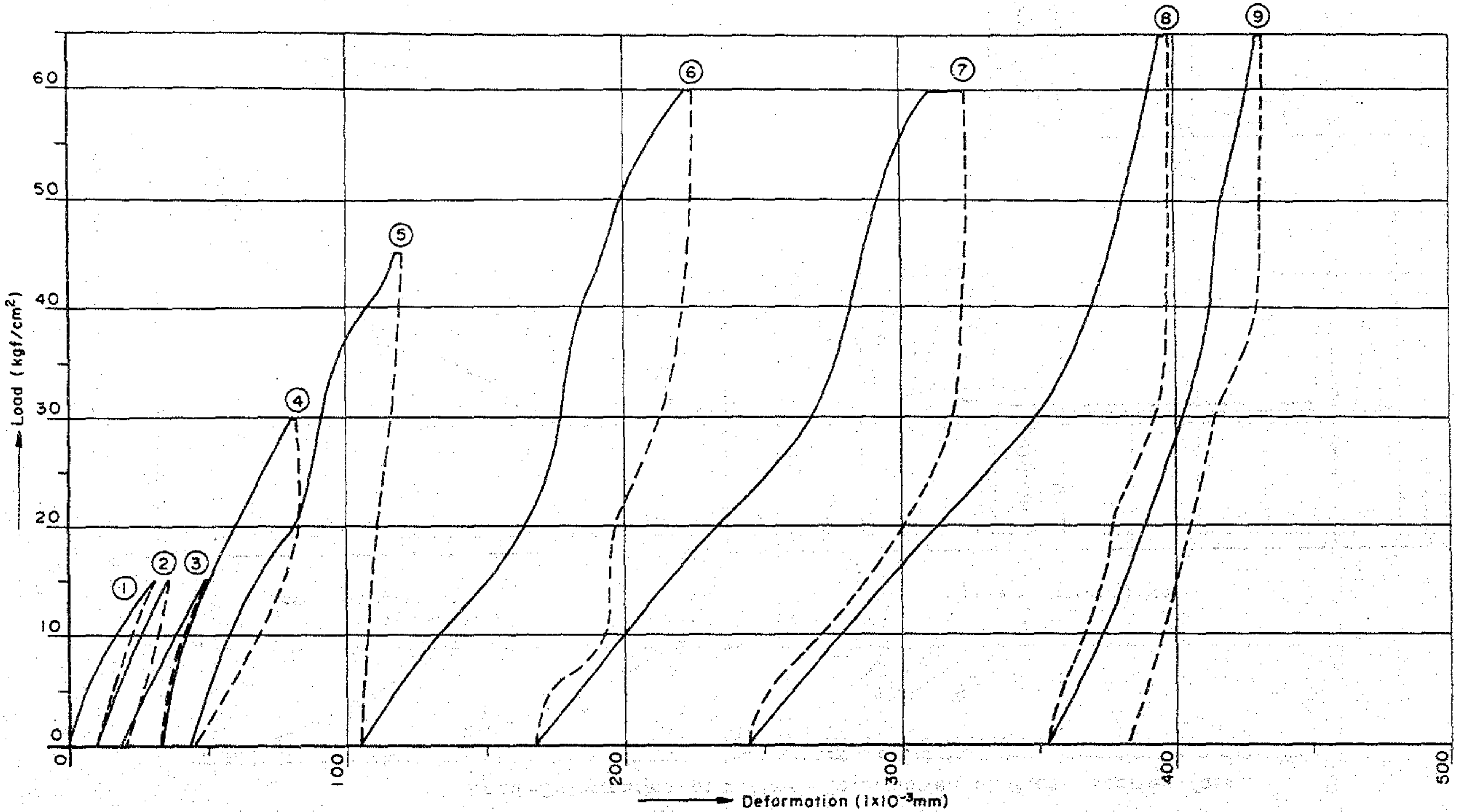
DA-1, P-4 TD(B) 4.0m (Crown)





Load-Deformation Hysteresis of Plate Bearing Test

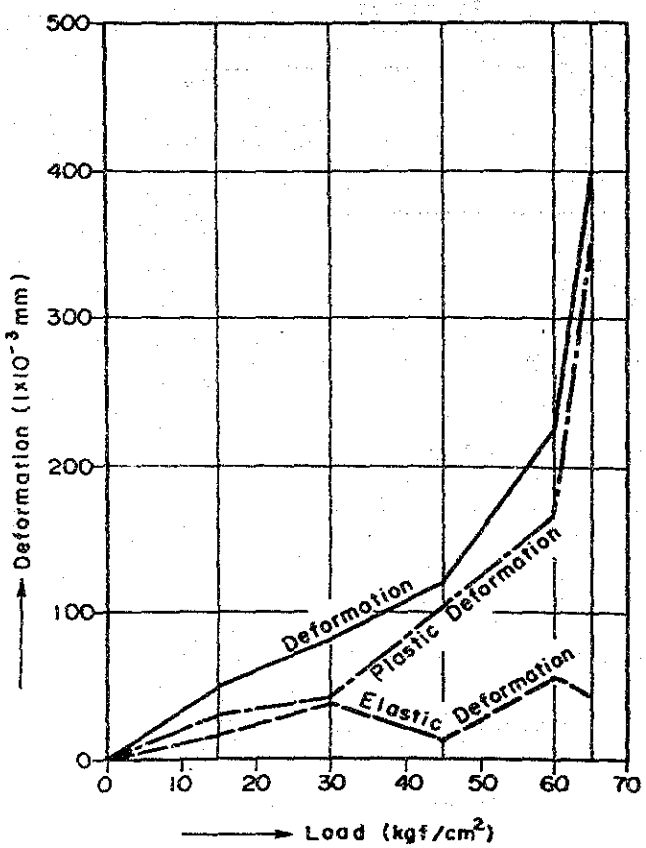
DA-2, P-1 TD 16.3m (Invert)



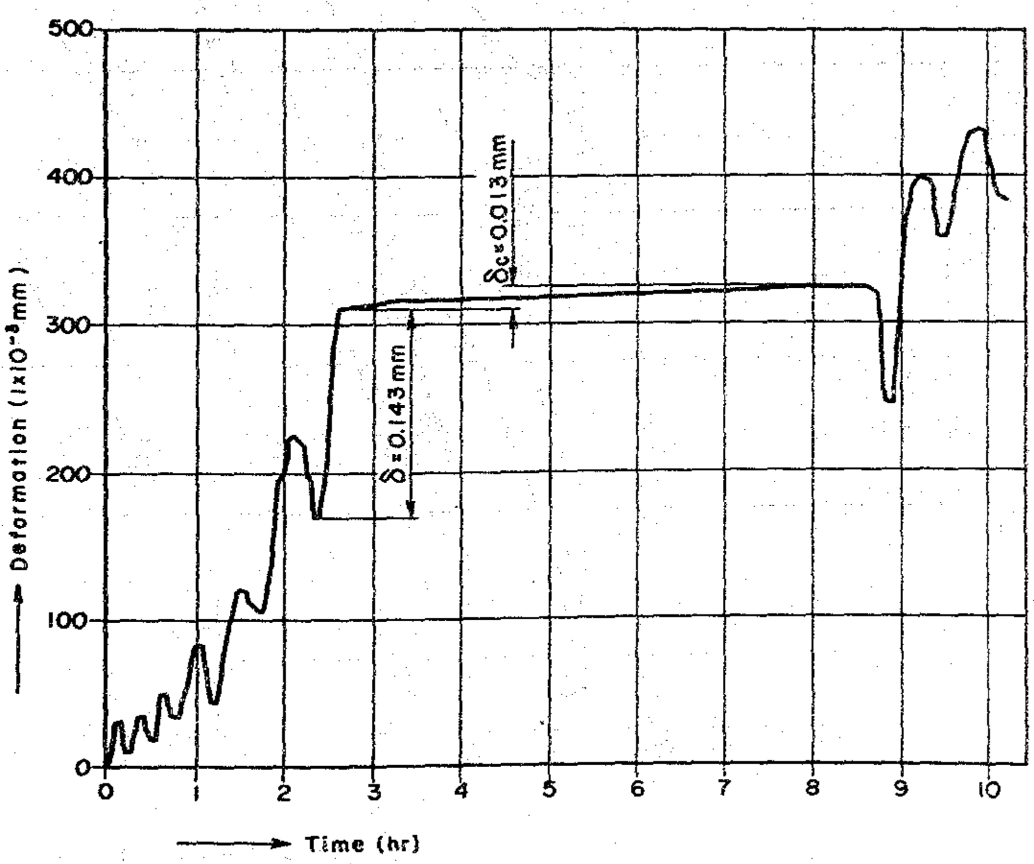
Load-Deformation and Time-Deformation of Plate Bearing Test

DA - 2, P - 1 TD 16.3 m (Invert)

Load - Deformation

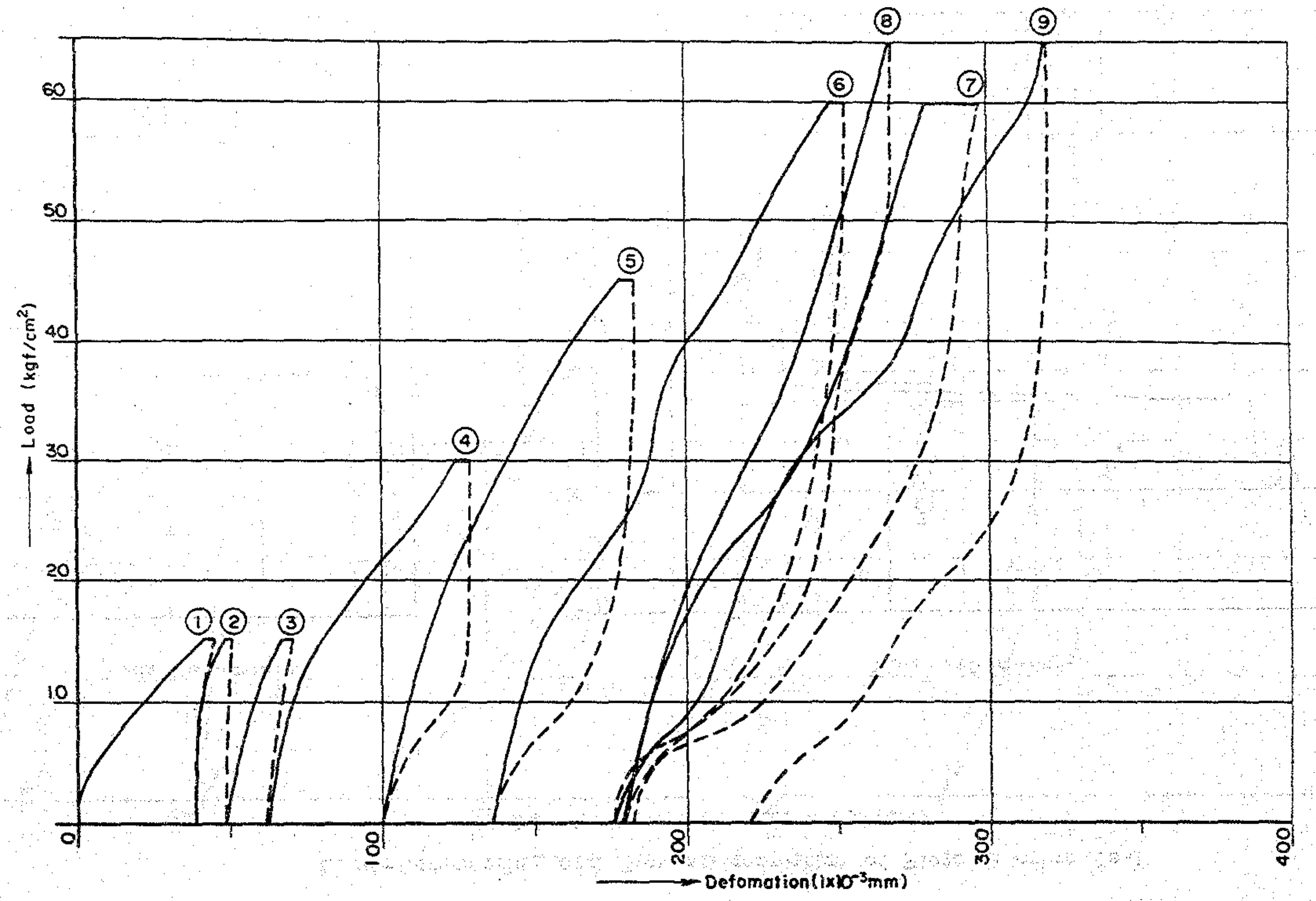


Time - Deformation



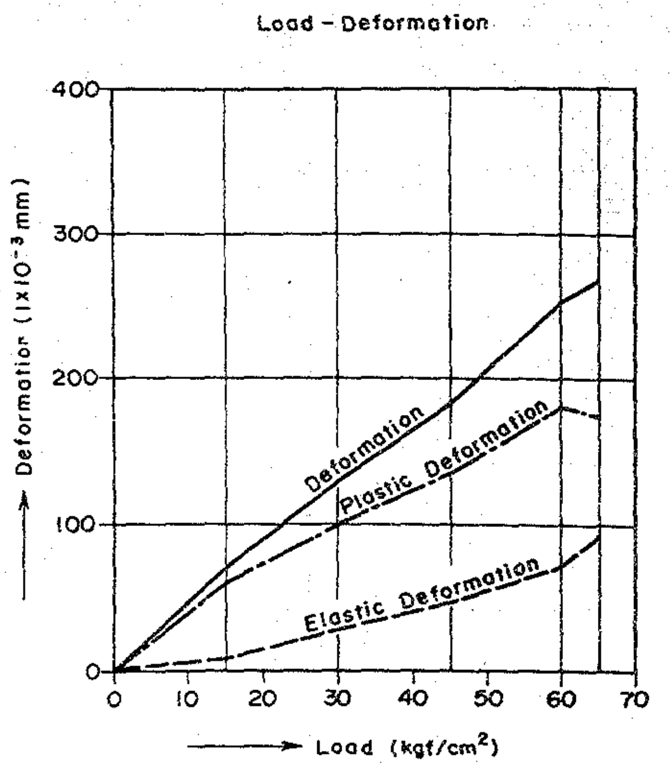
Load-Deformation Hysteresis of Plate Bearing Test

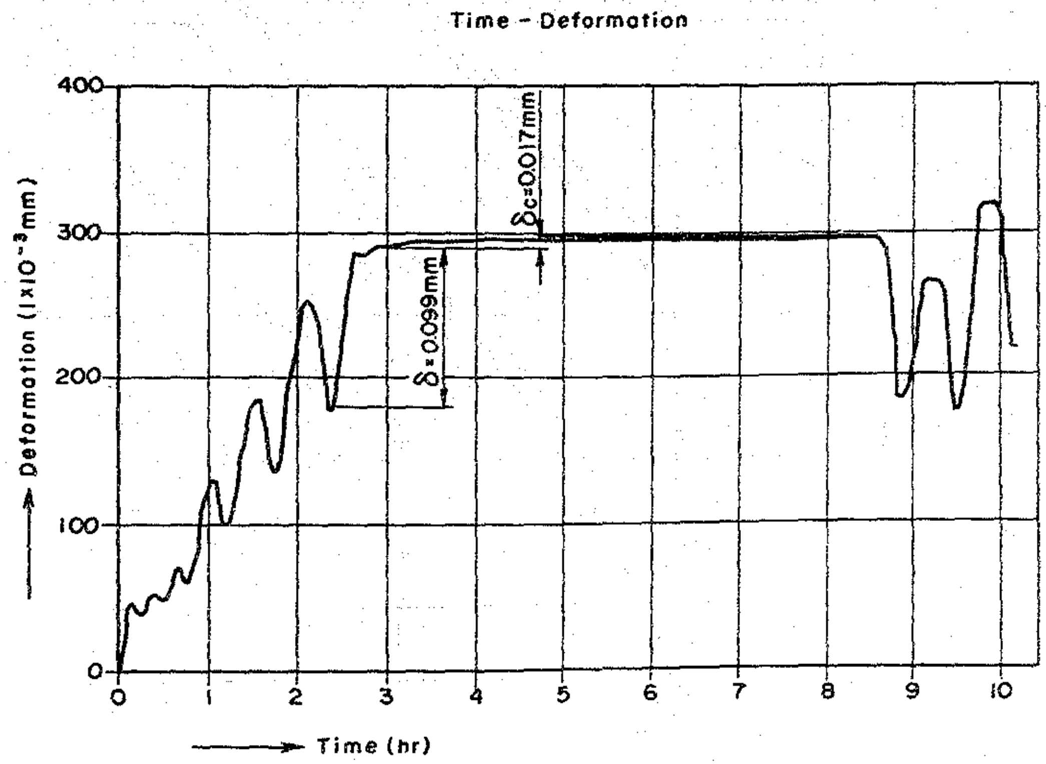
DA-2, P-1 TD16.3m (Crown)



Load-Deformation and Time-Deformation of Plate Bearing Test

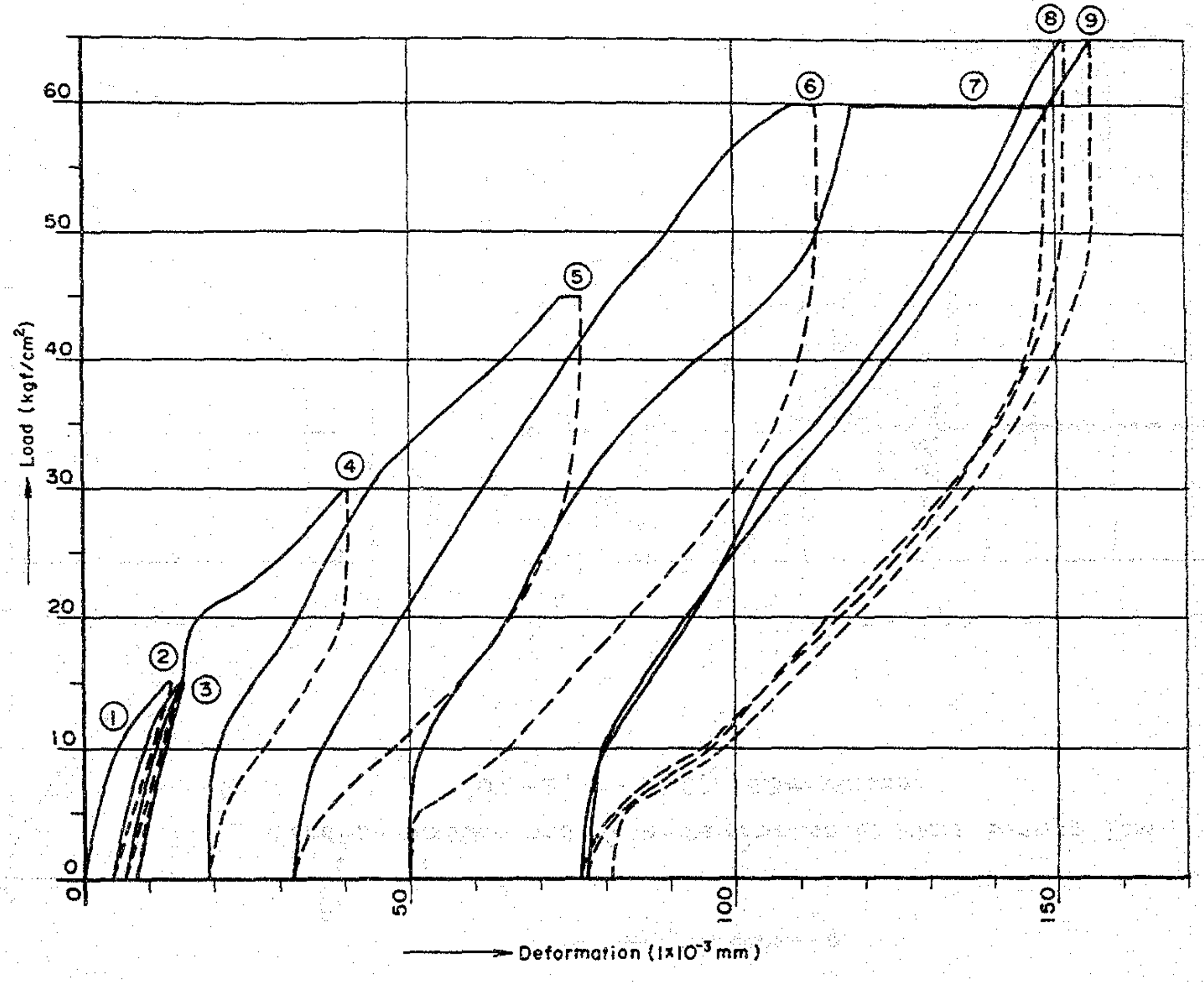
DA-2, P-1 TD 16.3m (Crown)





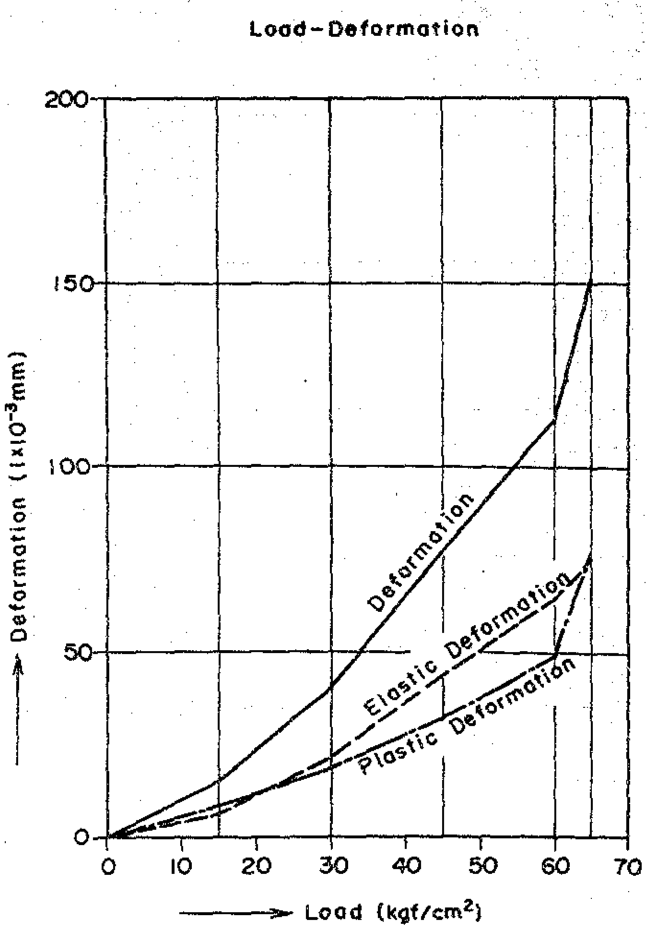
Load – Deformation Hysteresis of Plate Bearing Test

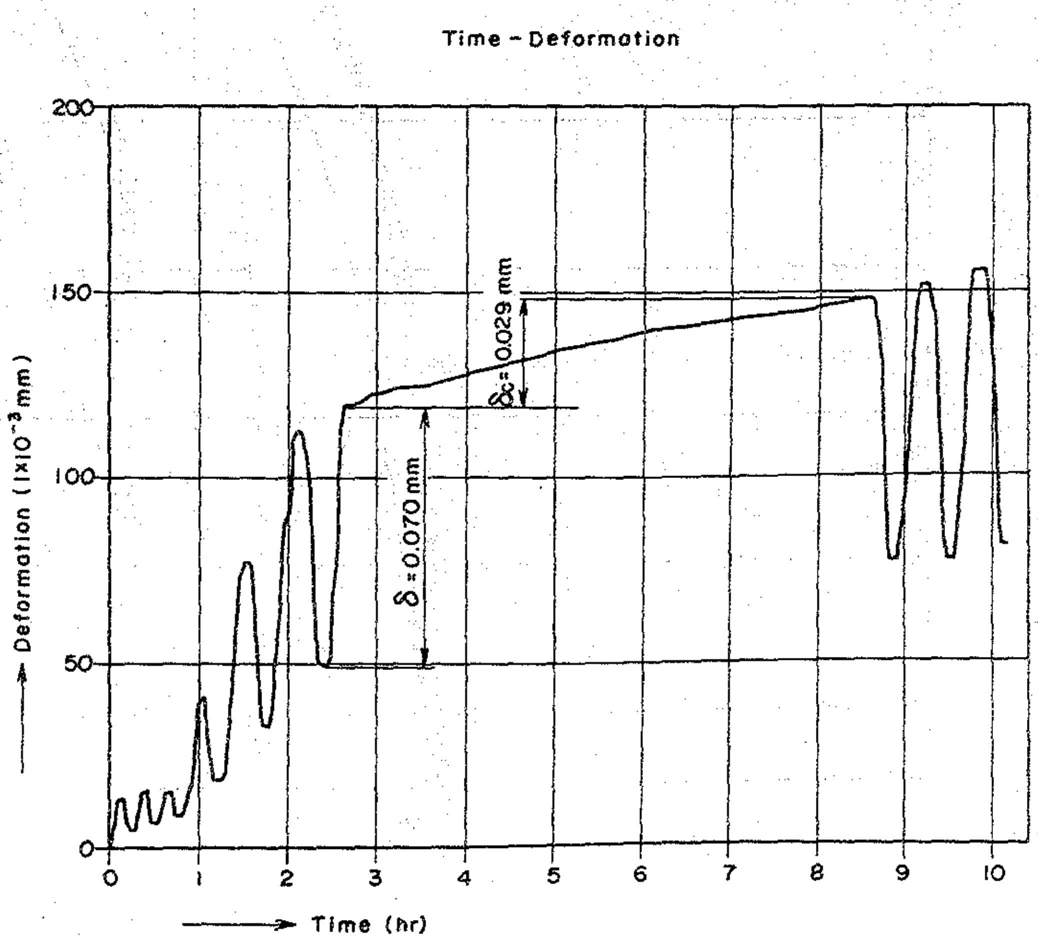
DA - 2 , P - 2 TD 19.0m (Invert)



Load-Deformation and Time-Deformation of Plate Bearing Test

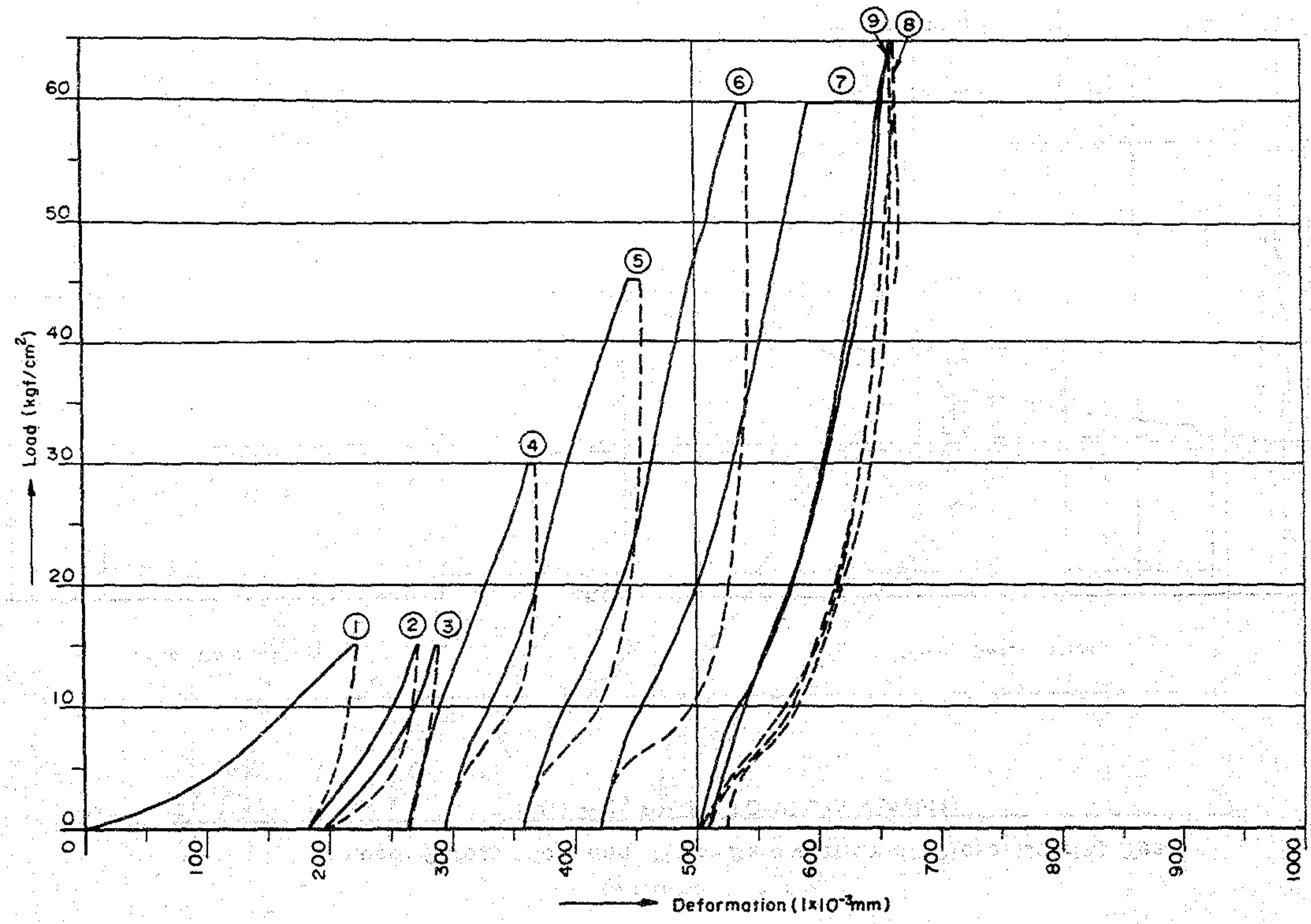
DA-2, P-2 TD 19.0m (Invert)





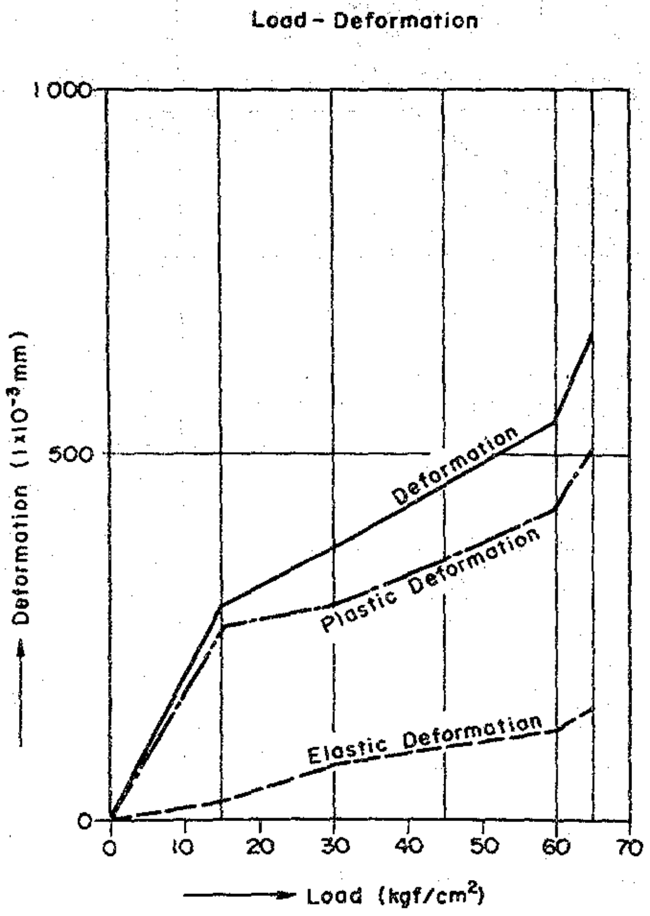
Load - Deformation Hysteresis of Plate Bearing Test

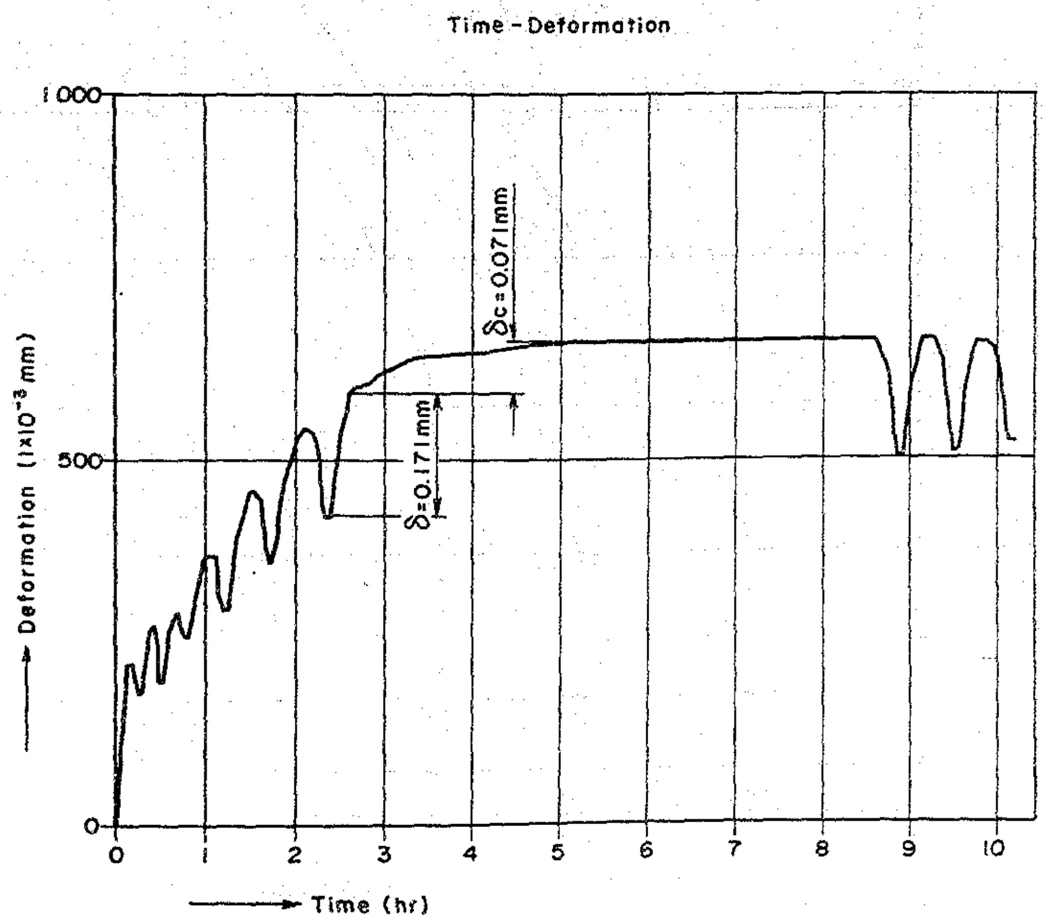
DA-2, P-2 TD=19.0m (Crown)



Load-Deformation and Time-Deformation of Plate Bearing Test

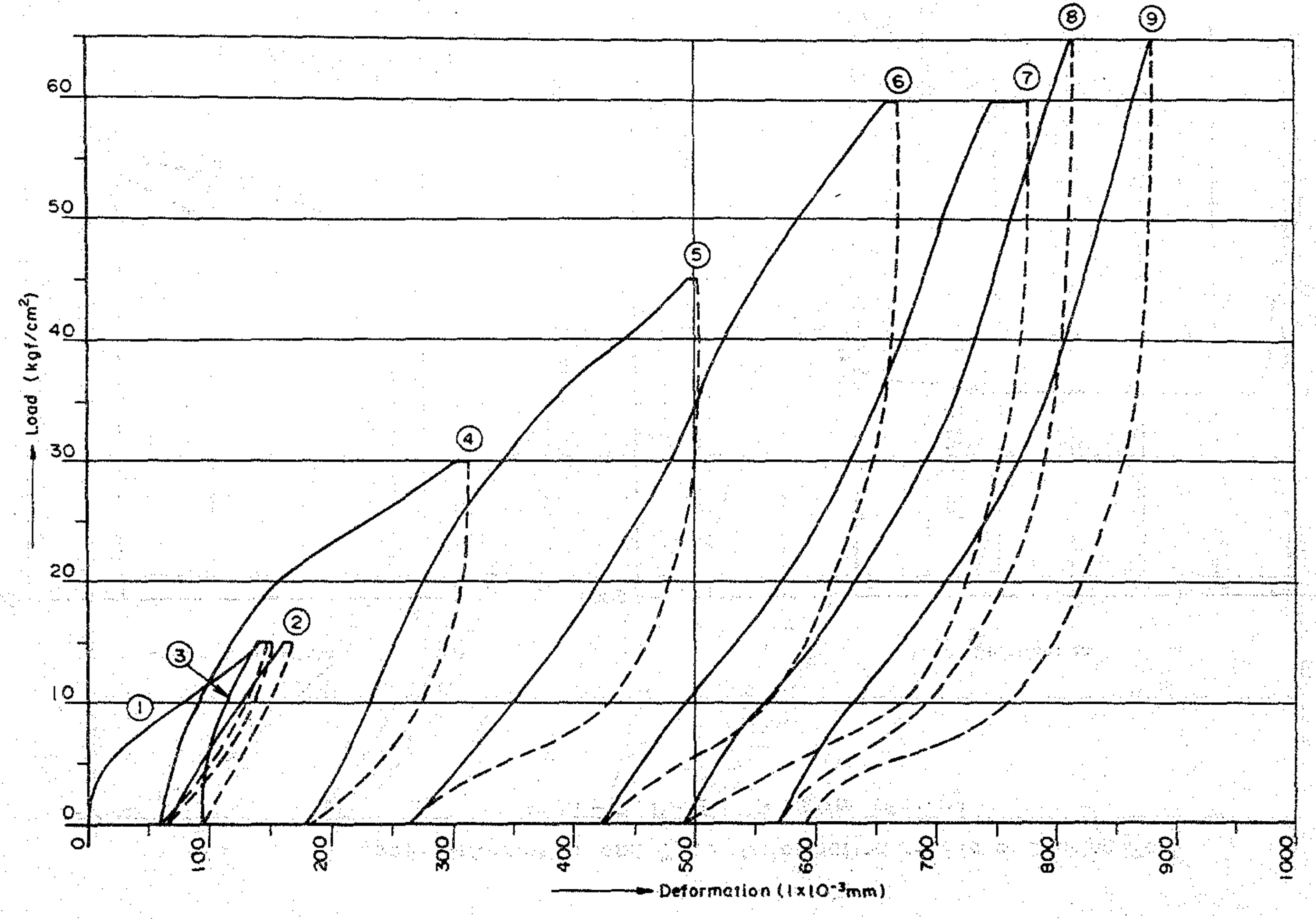
DA - 2, P - 2 TD 19.0m (Crown)





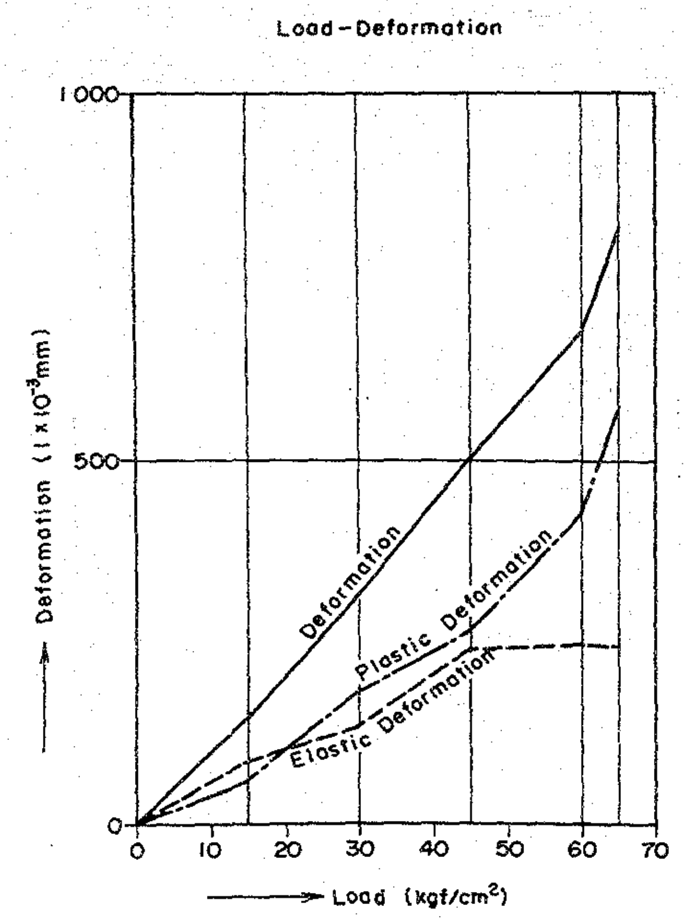
Load - Deformation Hysteresis of Plate Bearing Test

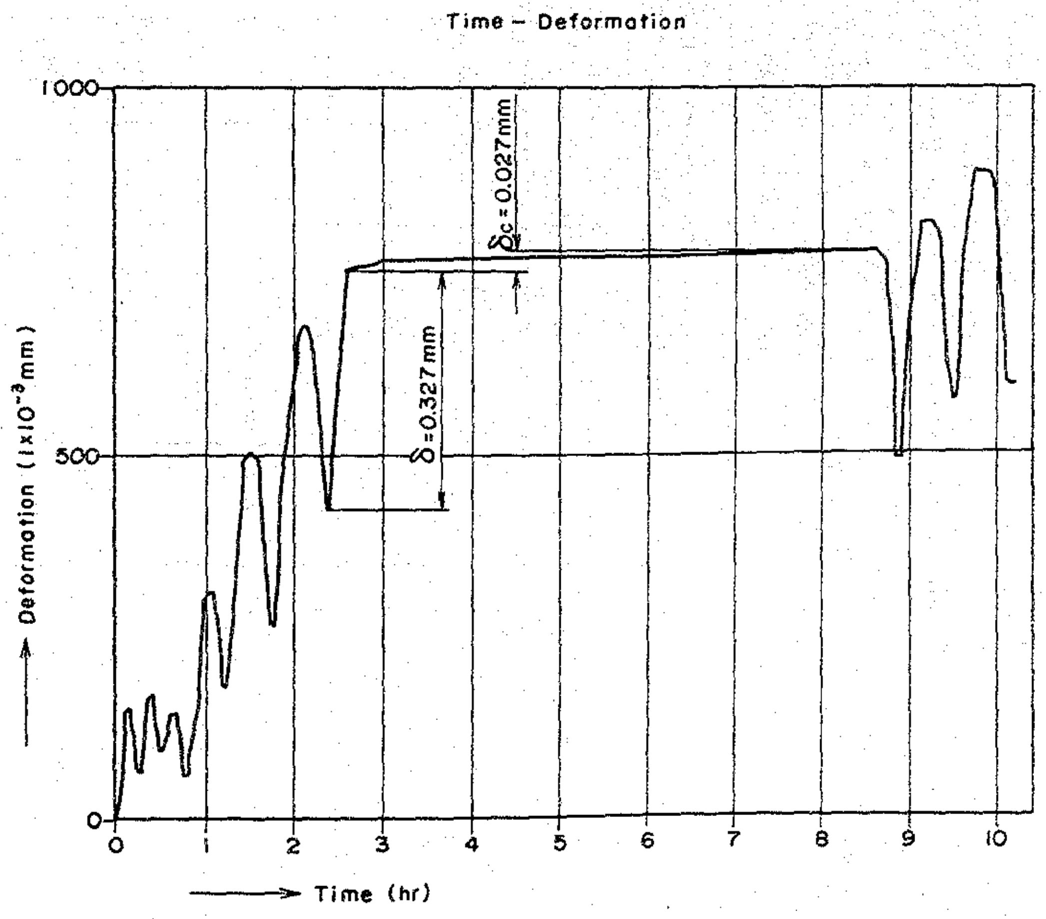
DA-2, P-3 TD(B) 5.8m (Invert)



Load-Deformation and Time-Deformation of Plate Pearing Test

DA-2, P-3 TD(B) 5.8m (Invert)





3-10-6 Plate Bearing Test Results and Data Sheet

PLATE BEARING TEST RESULTS

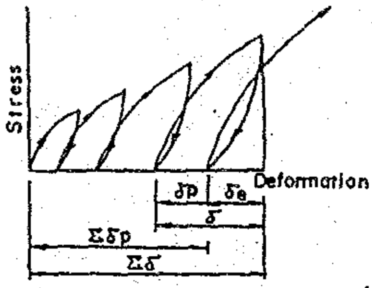
Test Location	DA-1, P-1, TD 20.0m	Measuring Point	Invert
Loading Plate Radius	a = 15 cm	Date Measured	24 Nov. 1988
Geological Classification	Ophiolite	Measured by	
Rock Grade	2B III (b)		

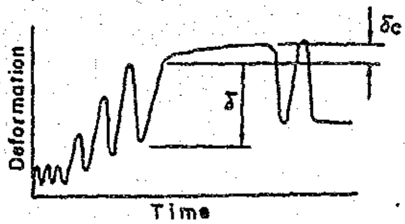
Deformation Measurement Results

Stress (kgf/cm²)	Deformation ($\times 10^{-3}$ mm) δ	δ_e	δ_p	$\Sigma\delta$	$\Sigma\delta_p$	Creep Deformation δ_c ($\times 10^{-3}$ mm)	Creep Factor Cf (%)
15	6	3	3	6	3		
15	3	2	1	6	4		
15	5	2	3	9	7		
30	11	9	2	18	9		
45	21	19	2	30	11		
60	35	36	-1	46	10		
60	42 (61)	30 (59)	12 (2)	52 (71)	12	19	45
65	43	38	5	55	17		
65	47	43	4	64	21		

Remarks

$$Cf = \frac{\delta_c}{\delta} \times 100 = \frac{19}{42} \times 100 = 45$$





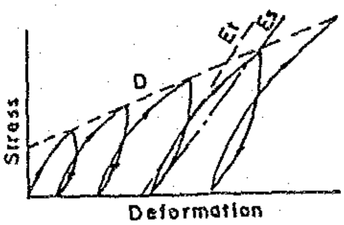
δ : Total deformation
δ_e : Elastic deformation
δ_p : Plastic deformation
$\Sigma\delta$: Cumulative total deformation
$\Sigma\delta_p$: Cumulative plastic deformation
δ_c : Creep deformation

Coefficients Related to Deformation

Modulus of Deformation D (kgf/cm²)	Tangential Modulus of Elasticity Et (kgf/cm²)	Stress Level (kgf/cm²)	Secant Modulus of Elasticity Es (kgf/cm²)
271,400	251,500	20 ~ 65	327,400

Modulus of Deformation, Modulus of Elasticity Calculation Formula

$$D \text{ or } E = \frac{(1-\nu^2)}{2a}\cdot\frac{\Delta F}{\Delta W} = \frac{\pi a(1-\nu^2)}{2}\cdot\frac{\Delta\sigma}{\Delta\delta}$$



ν : Poisson's ratio (0.2~0.3)   a : Plate radius (cm)
ΔF : Load increment (kgf) ΔW : Deformation increment due to ΔF
$\Delta\sigma$: Stress increment (kgf/cm²) $\Delta\delta$: Deformation increment due to $\Delta\sigma$

Remarks

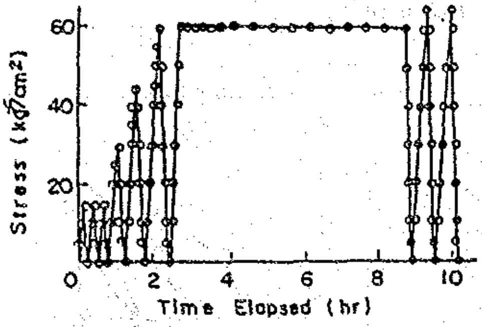
PLATE BEARING TEST — DATA SHEET (1)

Test Location: DA-1, P-1, TD200.0 m — Measuring Point: Invert — Geological Classification: Ophiolite

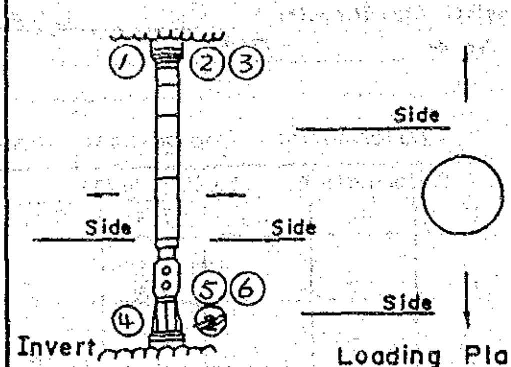
Loading Plate Radius: a = 15 cm — Date Measured: 24 Nov. 1988 — Rock Grade: 2BIII : (b)

Jack Capacity: 200 ton — Max. Oil Pressure: 1100 kg/cm² — Measured by:

Ram Diameter: φ 15.24 cm



Loading Pattern (Example)



Loading Plate

Time	Time Elapsed	Stress (kgf/cm²)	Jack Pressure (kgf/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading ①	②	③	(①+②+③)/3	Σδ	Remarks
	0	0		0	0	0	0	0	
	2	5		3	2	3	2.7	2.7	
	4	10		3	2	1	2	4.7	
	6	15		2	1	2	1.7	6.4	
	10	15		0	0	0	0	6.4	
	12	5		-2	-2	-1	-1.7	4.7	
	14	0		-2	-1	-2	-2	2.7	
	18	0		0	0	0	0	2.7	
	20	10		4	1	3	1.3	4	
	22	15		3	1	2	2	6.0	
	26	15		0	1	0	0.3	6.3	
	28	5		-1	-1	-1	-1	5.3	
	30	0		-2	-1	-1	-1.3	4.0	
<1>	34	0		0	0	0	0	4.0	(4)
	36	10		5	1	2	2.7	6.7	
	38	15		3	2	3	2.7	9.4	
<2>	42	15		0	0	0	0	9.4	(9)
	44	5		-1	-1	-2	-1.3	8.1	
	46	0		-1	-1	-2	-1.3	6.8	
	50	0		-1	0	0	-0.3	6.5	
	52	10		3	2	2	2.3	8.8	
	54	15		3	2	2	2.3	11.1	
	56	20		2	4	1	2.3	13.4	
	58	25		6	1	1	2.7	16.1	
	1:00	30		4	1	1	2	18.1	
<3>	1:04	30		0	0	0	0	18.1	(18)
	1:06	20		-2	0	0	-0.7	17.4	
	1:08	10		-4	-3	-2	-3	14.4	
	1:10	5		-3	-4	-2	-3	11.4	
	1:12	0		-4	-1	-2	-2.3	9.1	
	1:16	0		-1	0	0	-0.3	8.8	
	1:18	10		0	0	0	0	8.8	
	1:20	20		7	2	2	3.7	12.5	

PLATE BEARING TEST　　　　　　　　　　DATA SHEET (2)

Time	Time Elapsed	Stress (kgf/cm²)	Jack Pressure (kgf/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading ④	⑤	⑥	(④+⑤+⑥)/3	Σδ	Remarks
	1:22	30		2	2	4	2.7	15.2	
	1:24	35		4	2	4	3.3	18.5	
	1:26	40		7	3	5	5	23.5	
	1:28	45		8	3	6	5.7	29.2	
<4>	1:32	45		0	3	0	1	30.2	(30)
	1:34	40		0	0	0	0	30.2	
	1:36	30		-2	-4	-3	-3	27.2	
	1:38	20		-6	-4	-7	-5.7	21.5	
	1:40	10		-6	-5	-2	-4.3	17.2	
	1:42	5		-3	-2	-3	-2.7	14.5	
	1:44	0		-6	-1	-2	-3	11.5	
	1:48	0		0	0	-1	-0.3	11.2	
	1:50	10		0	0	0	0	11.2	
	1:52	20		1	3	0	1.3	12.5	
	1:54	30		8	3	5	5.3	17.8	
	1:56	40		5	4	7	5.3	23.1	
	1:58	45		6	4	8	6	29.1	
	2:00	50		3	5	6	4.7	33.8	
	2:02	55		5	4	8	5.7	39.5	
	2:04	60		7	2	9	6	45.5	
<5>	2:08	60		0	0	1	0.3	45.8	(46)
	2:10	50		0	0	-1	-0.3	45.5	
	2:12	40		0	0	-4	-1.3	44.2	
	2:14	30		-6	-2	-8	-5.3	38.9	
	2:16	20		-13	-4	-9	-8.7	30.2	
	2:18	10		-16	-5	-10	-10.3	19.9	
	2:20	5		-13	-7	-11	-10.3	9.6	
	2:22	0		0	0	0	0	9.6	
<6>	2:26	0		0	0	0	0	9.6	(10)
	2:28	10		3	0	0	1	10.6	
	2:30	20		3	0	3	2	12.6	
	2:32	30		15	4	6	8.3	20.9	
	2:34	40		11	6	13	10	30.9	
	2:36	50		10	9	12	10.3	41.2	
<7>	2:38	60		12	7	12	10.3	51.5	(52)
	2:40	60		0	0	1	0.3	51.8	
	2:43	60		1	1	0	0.7	52.5	
	2:48	60		0	0	1	0.3	52.8	
	2:53	60		1	1	0	0.7	53.5	
	2:58	60		1	1	1	1	54.5	
	3:03	60		1	0	1	0.7	55.2	
	3:08	60		1	1	0	0.7	55.9	
	3:18	60		2	1	1	1.3	57.2	
	3:28	60		2	1	1	1.3	58.5	
	3:38	60		2	1	1	1.3	59.8	

PLATE BEARING TEST

DATA SHEET (3)

Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading ①	②	③		(① + ② + ③)/3	Σ δ	Remarks
	4:08	60		3	2	2		2.3	62.1	
	4:38	60		2	2	2		2	64.1	
	5:08	60		2	1	2		1.7	65.8	
	5:38	60		1	0	2		1	66.8	
	6:08	60		1	1	2		1.3	68.1	
	6:38	60		1	0	1		0.7	68.8	
	7:08	60		0	1	1		0.7	69.5	
	7:38	60		1	0	1		0.7	70.2	
	8:08	60		0	1	1		0.7	70.9	
<8>	8:38	60		0	0	1		0.3	71.2	(71)
	8:40	50		0	0	−1		−0.3	70.9	
	8:42	40		−3	0	−4		−2.3	68.6	
	8:44	30		−7	−3	−15		−8.3	60.3	
	8:46	20		−15	−6	−15		−12	48.3	
	8:48	10		−22	−9	−22		−17.7	30.6	
	8:50	5		−18	−9	−7		−11.3	19.3	
	8:52	0		−7	−4	−2		−4.3	15.0	
<9>	8:56	0		−2	−2	−4		−2.7	12.3	(12)
	8:58	10		0	0	0		0	12.0	
<10>	9:00	20		8	3	4		5	17.3	(17)
	9:02	30		12	4	7		7.7	25	
<11>	9:04	40		11	7	12		10	35	(35)
	9:06	50		8	7	9		8	43	
<12>	9:08	60		5	5	6		5.3	48.3	(48)
	9:10	65		7	5	5		5.7	54	
<13>	9:14	65		1	1	1		1	55	(55)
	9:16	60		0	−1	−2		−1	54	
	9:18	50		−2	−2	−2		−2	52	
	9:20	40		−6	−3	−5		−4.7	47.3	
	9:22	30		−7	−4	−7		−6	41.3	
	9:24	20		−8	−5	−7		−6.7	34.6	
	9:26	10		−9	−6	−9		−8	26.6	
	9:28	5		−9	−5	−7		−7	19.6	
	9:30	0		−3	−3	−3		−3	16.6	
<14>	9:34	0		0	0	0		0	16.6	(17)
	9:36	10		0	0	1		0.3	16.9	
<15>	9:38	20		5	2	2		3	19.9	(20)
	9:40	30		10	3	6		6.3	26.2	
<16>	9:42	40		12	9	17		12.7	38.9	(39)
	9:44	50		19	9	10		12.7	51.6	
<17>	9:46	60		10	9	10		9.7	61.3	(61)
	9:48	65		4	1	2		2.3	63.6	
<18>	9:52	65		0	0	0		0	63.6	(64)
	9:54	60		0	0	0		0	63.6	
	9:56	50		0	0	0		0	63.6	

PLATE BEARING TEST

DATA SHEET (4)

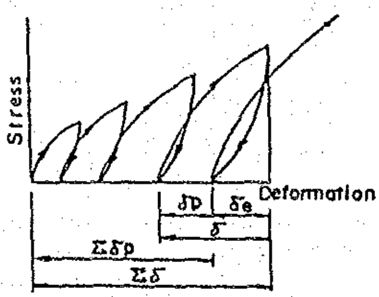
Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading				(④+⑤+⑥)/3	Σδ	Remarks
				④	⑦	⑤ ⑥	⑧			
	9:58	40		-2	-1	-5		-2.7	60.9	
	10:00	30		-5	-2	-6		-4.3	56.6	
	10:02	20		-12	-4	-14		-10	46.6	
	10:04	10		-15	-7	-16		-12.7	33.9	
	10:06	5		-10	-7	-6		-7.7	26.2	
	10:08	0		-8	-3	-3		-4.7	21.5	
<19>	10:12	0		0	-1	0		-0.3	21.2	(21)

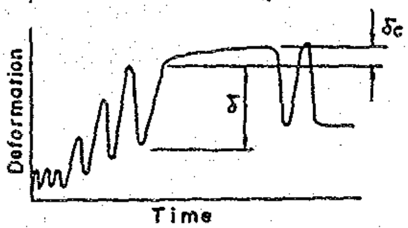
PLATE BEARING TEST RESULTS

Test Location: DA-1, P-1, TD 20.0m
Measuring Point: Crown
Loading Plate Radius: a = 15 cm
Date Measured: 24 Nov. 1988
Geological Classification: Ophiolite
Measured by:
Rock Grade: 2B III (b)

Deformation Measurement Results

Stress (kgf/cm²)	Deformation (x10⁻³ mm) δ	δe	δp	Σδ	Σδp	Remarks	
15	24	6	18	24	18		
15	9	5	4	27	22		
15	6	9	-3	28	19		
30	39	16	23	58	42		
45	49	33	16	91	58	Creep Deformation δc (x10⁻³ mm)	Creep Factor Cf (%)
60	64	49	15	122	73		
60	54 (64)	44 (54)	10 (10)	127 (137)	83	10	19
65	64	55	9	147	92	$Cf = \frac{\delta_c}{\delta} \times 100$	
65	59	57	2	151	94	$= \frac{10}{54} \times 100$	
						$= 19$	





δ : Total deformation
δe : Elastic deformation
δp : Plastic deformation
Σδ : Cumulative total deformation
Σδp : Cumulative plastic deformation
δc : Creep deformation

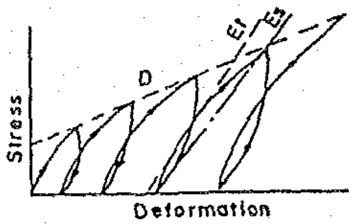
Coefficients Related to Deformation

Modulus of Deformation D (kgf/cm²)	Tangential Modulus of Elasticity Et (kgf/cm²)	Stress Level (kgf/cm²)	Secant Modulus of Elasticity Es (kgf/cm²)
107,700	189,200	20 ~ 65	239,500

Modulus of Deformation, Modulus of Elasticity Calculation Formula

$$D \text{ or } E = \frac{(1-\nu^2)}{2a} \cdot \frac{\Delta F}{\Delta W} = \frac{\pi a(1-\nu^2)}{2} \cdot \frac{\Delta\sigma}{\Delta\delta}$$

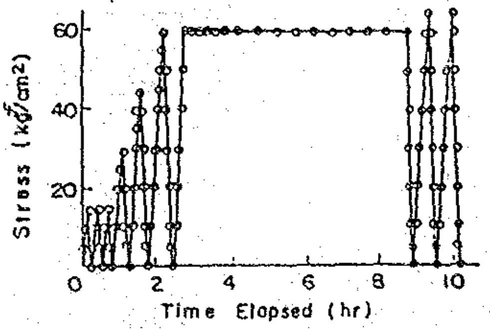
ν : Poisson's ratio (0.2~0.3) a : Plate radius (cm)
ΔF : Load increment (kgf) ΔW : Deformation increment due to ΔF
$\Delta\sigma$: Stress increment (kgf/cm²) $\Delta\delta$: Deformation increment due to $\Delta\sigma$



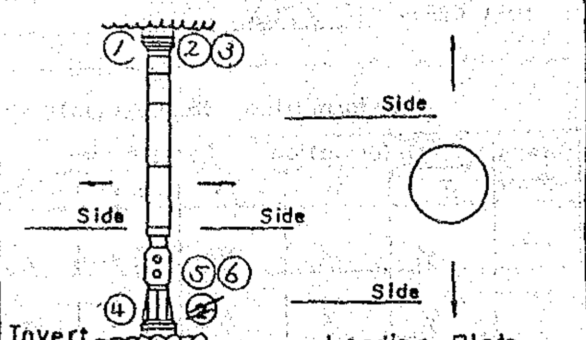
Remarks

PLATE BEARING TEST — DATA SHEET (1)

Test Location	DA-1, P-1, TD 20.0 m	Measuring Point	Crown
Loading Plate Radius	a = 15 cm	Date Measured	24. 11. 1988
Jack Capacity	200 ton	Max. Oil Pressure	1,100 kg/cm²
Ram Diameter	φ 15.24 cm	Measured by	
Geological Classification	Ophiolite	Rock Grade	2B III ; (b)



Loading Pattern (Example)



Loading Plate

Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge · Reading ①	②	③	(①+②+③)/3	Σ δ	Remarks
	0	0		0	0	0	0	0	
	2	5		-2	4	28	10	10	
	4	10		-1	10	3	4	14	
	6	15		5	13	9	9	23	
	10	15		0	2	2	1.3	24.3	
	12	5		0	-6	-5	-3.7	20.6	
	14	0		0	-3	-6	-3.0	17.6	
	18	0		0	0	0	0	17.6	
	20	10		0	2	5	2.3	19.9	
	22	15		2	8	8	6	25.9	
	26	15		0	2	1	1	26.9	
	28	5		0	-2	-2	-1.3	25.6	
	30	0		-1	-5	-5	-3.7	21.9	
<1>	34	0		0	-1	0	-0.3	21.6	(22)
	36	10		0	3	2	1.7	23.3	
	38	15		0	5	5	3.3	26.6	
<2>	42	15		0	2	1	1	27.6	(28)
	44	5		0	-2	-1	-1	26.6	
	46	0		0	-6	-6	-4	22.6	
	50	0		0	-10	0	-3.3	19.3	
	52	10		0	11	1	4	23.3	
	54	15		0	7	7	4.7	28	
	56	20		5	9	7	7	35	
	58	25		5	18	11	11.3	46.3	
	1:00	30		4	16	10	10	56.3	
<3>	1:04	30		0	2	3	1.7	58	(58)
	1:06	20		5	0	0	1.7	59.7	
	1:08	10		0	-2	-3	-1.7	58	
	1:10	5		-4	-17	-12	-11	47	
	1:12	0		-1	-8	-7	-5.3	41.7	
	1:16	0		0	0	0	0	41.7	
	1:18	10		-1	0	0	-0.3	41.4	
	1:20	20		0	14	9	7.7	49.1	

PLATE BEARING TEST

DATA SHEET (2)

Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation (x 10^{-3} mm) Displacement Gauge Reading ①	②	③	(①+②+③)/3	Σδ	Remarks
	1:22	30		8	14	15	12.3	61.4	
	1:24	35		3	15	5	7.6	69	
	1:26	40		6	16	10	10.6	79.6	
	1:28	45		7	15	10	10.6	90.2	
<4>	1:32	45		0	1	0	0.3	90.5	(91)
	1:34	40		0	0	0	0	90.5	
	1:36	30		0	0	0	0	90.5	
	1:38	20		0	-5	-3	-2.7	87.8	
	1:40	10		-4	-13	-12	-9.7	78.1	
	1:42	5		-8	-25	-13	-15.3	62.8	
	1:44	0		-1	-8	-7	-5.3	57.5	
	1:48	0		0	0	0	0	57.5	
	1:50	10		0	0	0	0	57.5	
	1:52	20		0	11	5	5.3	62.8	
	1:54	30		5	20	13	12.7	75.5	
	1:56	40		7	16	14	12.3	87.8	
	1:58	45		3	9	6	6	93.8	
	2:00	50		5	10	7	7.3	101.1	
	2:02	55		6	12	9	9	110.1	
	2:04	60		6	14	9	9.7	119.8	
<5>	2:08	60		1	3	1	1.7	121.5	(122)
	2:10	50		0	0	0	0	121.5	
	2:12	40		0	0	-2	-0.7	120.8	
	2:14	30		-2	-9	-8	-6.3	114.5	
	2:16	20		-3	-10	-11	-8	106.5	
	2:18	10		-8	-20	-9	-12.3	94.2	
	2:20	5		-9	-29	-16	-18	76.2	
	2:22	0		-1	-4	-4	-3	73.2	
<6>	2:26	0		0	0	0	0	73.2	(73)
	2:28	10		0	0	0	0	73.2	
	2:30	20		0	10	1	3.7	76.9	
	2:32	30		5	21	15	13.7	90.6	
	2:34	40		8	18	12	12.7	103.3	
	2:36	50		7	14	13	11.3	114.6	
<7>	2:38	60		8	17	12	12.3	126.9	(127)
	2:40	60		0	2	1	1	127.9	
	2:43	60		1	2	2	1.7	129.6	
	2:48	60		0	1	0	0.3	129.9	
	2:53	60		0	1	0	0.3	130.2	
	2:58	60		1	0	0	0.3	130.5	
	3:03	60		0	1	1	0.7	131.2	
	3:08	60		0	1	0	0.3	131.5	
	3:18	60		0	0	0	0	131.5	
	3:28	60		0	0	0	0	131.5	
	3:38	60		0	0	0	0	131.5	

PLATE BEARING TEST　　　　DATA SHEET (3)

Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading ①	②	③	(①+②+③)/3	Σδ	Remarks
	4:08	60		0	1	0	0.3	131.8	
	4:38	60		0	0	0	0	131.8	
	5:08	60		0	1	1	0.7	132.5	
	5:38	60		1	1	0	0.7	133.2	
	6:08	60		0	1	1	0.7	133.9	
	6:38	60		1	2	1	1.3	135.2	
	7:08	60		0	1	1	0.7	135.9	
	7:38	60		0	1	0	0.3	136.2	
	8:08	60		1	0	1	0.7	136.9	
<8>	8:38	60		0	0	0	0	136.9	(137)
	8:40	50		0	0	0	0	136.9	
	8:42	40		0	1	-1	0	136.9	
	8:44	30		-1	2	-9	-2.7	134.2	
	8:46	20		-4	-23	-10	-12.3	121.9	
	8:48	10		-8	-23	-13	-14.7	107.2	
	8:50	5		-10	-30	-20	-20	87.2	
	8:52	0		-1	-8	-3	-4	83.2	
<9>	8:56	0		0	0	0	0	83.2	(83)
	8:58	10		0	0	0	0	83.2	
<10>	9:00	20		0	17	8	8.3	91.5	(92)
	9:02	30		5	20	14	13	104.5	
<11>	9:04	40		7	18	13	12.7	117.2	(117)
	9:06	50		7	15	11	11	128.2	
<12>	9:08	60		7	16	11	11.3	139.5	(140)
	9:10	65		4	7	8	6.3	145.8	
<13>	9:14	65		0	2	0	0.7	146.5	(147)
	9:16	60		0	0	0	0	146.5	
	9:18	50		0	0	0	0	146.5	
	9:20	40		0	-4	-5	-3	143.5	
	9:22	30		-4	-9	-9	-7.3	136.2	
	9:24	20		-5	-17	-11	-11	125.2	
	9:26	10		-8	-22	-14	-14.7	110.5	
	9:28	5		-7	-20	-11	-12.7	97.8	
	9:30	0		-2	-10	-5	-5.7	92.1	
<14>	9:34	0		0	0	0	0	92.1	(92)
	9:36	10		0	0	0	0	92.1	
<15>	9:38	20		0	13	4	5.7	97.8	(98)
	9:40	30		4	20	14	12.7	110.5	
<16>	9:42	40		8	17	12	12.3	122.8	(123)
	9:44	50		7	15	13	11.7	134.5	
<17>	9:46	60		7	15	11	11	145.5	(146)
	9:48	65		3	6	6	5	150.5	
<18>	9:52	65		0	0	0	0	150.5	(151)
	9:54	60		0	0	0	0	150.5	
	9:56	50		0	0	0	0	150.5	

PLATE BEARING TEST										DATA SHEET (4)
Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation (x 10^{-3} mm) Displacement Gauge Reading ①	②	③		(① + ② + ③) / 3	Σδ	Remarks
	9:58	40		0	−1	−5		−2	148.5	
	10:00	30		−2	−10	−9		−7	141.5	
	10:02	20		−6	−15	−11		−10.7	130.8	
	10:04	10		−9	−27	−15		−17	113.8	
	10:06	5		−8	−23	−14		−15	98.8	
	10:08	0		−2	−9	−4		−5	93.8	
<19>	10:12	0		0	0	0		0	93.8	(94)

PLATE BEARING TEST RESULTS

Test Location: DA-1, P-2, TD40.5m — Measuring Point: Invert

Loading Plate Radius: a = 15 cm — Date Measured: 30 Aug. 1988

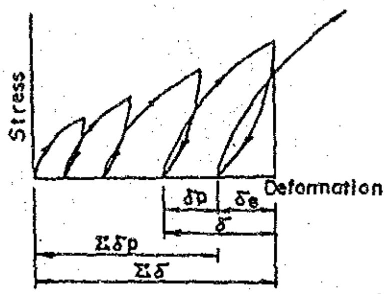
Geological Classification: Ophiolite — Measured by:

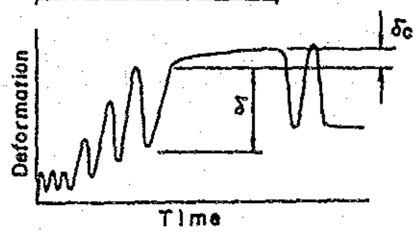
Rock Grade: ZB IV ©

Deformation Measurement Results

Stress (kg^f/cm^2)	Deformation ($\times 10^{-3}$ mm) δ	δ_e	δ_p	$\Sigma\delta$	$\Sigma\delta_p$	Remarks: Creep Deformation δ_c ($\times 10^{-3}$ mm)	Creep Factor Cf (%)
15	21	2	19	21	19		
15	11	1	10	30	29		
15	9	3	6	38	35		
30	39	21	18	74	53		
45	62	42	20	115	73		
60	90	67	23	163	96		
60	78 (84)	81 (87)	− 3 (− 3)	174 (180)	93	6	8
65	92	74	18	185	111		
65	88	79	9	199	120		

$Cf = \frac{\delta_c}{\delta} \times 100 = \frac{6}{78} \times 100 = 8$





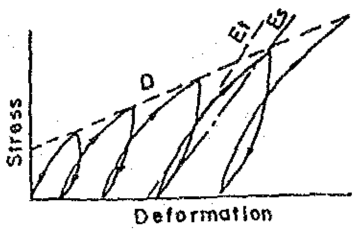
δ : Total deformation
δ_e : Elastic deformation
δ_p : Plastic deformation
$\Sigma\delta$: Cumulative total deformation
$\Sigma\delta_p$: Cumulative plastic deformation
δ_c : Creep deformation

Coefficients Related to Deformation

Modulus of Deformation D (kg^f/cm^2)	Tangential Modulus of Elasticity Et (kg^f/cm^2)	Stress Level (kg^f/cm^2)	Secant Modulus of Elasticity Es (kg^f/cm^2)
81,200	137,400	20 ~ 65	163,500

Modulus of Deformation, Modulus of Elasticity Calculation Formula

$$D \text{ or } E = \frac{(1-\nu^2)}{2a} \cdot \frac{\Delta F}{\Delta W} = \frac{\pi a (1-\nu^2)}{2} \cdot \frac{\Delta\sigma}{\Delta\delta}$$



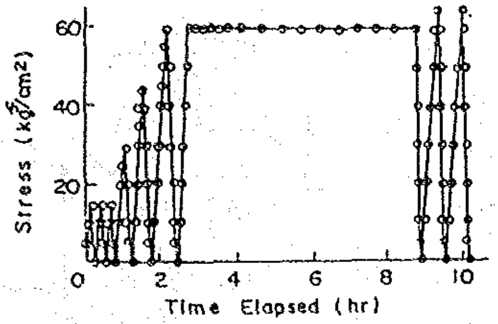
ν : Poisson's ratio (0.2~0.3)   a : Plate radius (cm)
ΔF : Load increment (kgf) ΔW : Deformation increment due to ΔF
$\Delta\sigma$: Stress increment (kg^f/cm^2) $\Delta\delta$: Deformation increment due to $\Delta\sigma$

Remarks

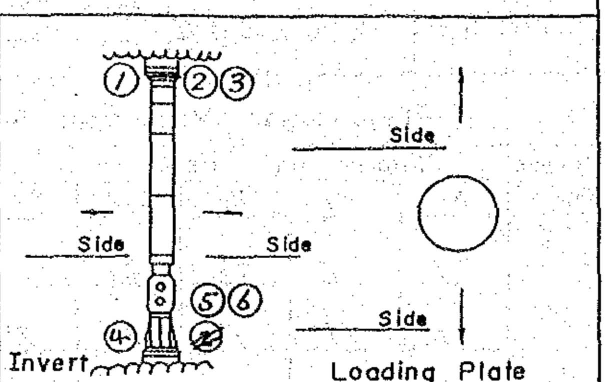
PLATE BEARING TEST

DATA SHEET (1)

Test Location	DA-1, P-2, TD405m	Measuring Point	Invert
Geological Classification	Ophiolite		
Loading Plate Radius	a = 15 cm	Date Measured	30 Aug. 1988
Rock Grade	2BIV ©		
Jack Capacity	200 ton	Max. Oil Pressure	1100 kg/cm²
Measured by			
Ram Diameter	ø 15.24 cm		



Loading Pattern (Example)



Loading Plate

Time	Time Elapsed	Stress (kgf/cm²)	Jack Pressure (kgf/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading ④	① ⑤	⑥	②	(④+⑤+⑥)/3	Σδ	Remarks
	0	0		0	0	0			0	
	2	5		0	5	0		1.7	1.7	
	4	10		3	12	0		5.0	6.7	
	6	15		8	10	+13		10.3	17.0	
	10	15		4	6	3		4.3	21.3	
	12	5		1	−1	−2		− 0.7	20.6	
	14	0		0	−3	−2		− 1.7	18.9	
	18	0		0	0	0		0	18.9	
	20	10		1	3	2		2	20.9	
	22	15		6	8	6		6.7	27.6	
	26	15		4	2	1		2.3	29.9	
	28	5		−1	0	−1		− 0.7	29.2	
	30	0		0	−1	0		− 0.3	28.9	
⟨1⟩	34	0		0	1	0		0.3	29.2	(29)
	36	10		1	1	0		0.7	29.9	
	38	15		6	4	4		4.7	34.6	
⟨2⟩	42	15		2	5	3		3.3	37.9	(38)
	44	5		0	−2	−2		− 1.3	36.6	
	46	0		−1	−2	−1		− 1.3	35.3	
	50	0		0	0	0		0	35.3	
	52	10		0	1	1		0.7	36.0	
	54	15		5	6	3		4.7	40.7	
	56	20		8	7	13		9.3	50.0	
	58	25		7	10	18		11.7	61.7	
	1:00	30		5	9	19		11.0	72.7	
⟨3⟩	1:04	30		1	1	2		1.3	74.0	(74)
	1:06	20		0	0	−1		− 0.3	73.7	
	1:08	10		−6	−5	−16		− 9.0	64.7	
	1:10	5		−5	−10	−13		− 9.3	55.4	
	1:12	0		−1	−3	−2		− 2.0	53.4	
	1:16	0		0	0	0		0	53.4	
	1:18	10		0	0	0		0	53.4	
	1:20	20		11	11	15		12.3	65.7	

PLATE BEARING TEST DATA SHEET (2)

Time	Time Elapsed	Stress (kgf/cm²)	Jack Pressure (kgf/cm²)	Deformation ($\times 10^{-3}$ mm) Displacement Gauge Reading (4)	(5)	(6)		(④+⑤+⑥)/3	$\Sigma\delta$	Remarks
	1:22	30		8	14	24		15.3	81.0	
	1:24	35		6	7	13		8.6	89.6	
	1:26	40		9	11	19		13.0	102.6	
	1:28	45		7	7	16		10.0	112.6	
<4>	1:32	45		2	2	4		2.7	115.3	(115)
	1:34	40		0	0	0		0	115.3	
	1:36	30		1	-1	-3		-1.0	114.3	
	1:38	20		-5	-6	-17		-9.3	105.0	
	1:40	10		-12	-13	-25		-16.7	88.3	
	1:42	5		-7	-11	-12		-10.0	78.3	
	1:44	0		-5	-6	-4		-5.0	73.3	
	1:48	0		1	0	-1		0	73.3	
	1:50	10		0	0	1		0.3	73.6	
	1:52	20		10	12	15		12.3	85.6	
	1:54	30		20	21	26		22.3	108.2	
	1:56	40		10	13	23		15.3	123.5	
	1:58	45		3	4	11		6.0	129.5	
	2:00	50		5	14	20		13.0	142.5	
	2:02	55		12	1	11		8.0	150.5	
	2:04	60		10	8	17		11.7	162.2	
<5>	2:08	60		0	0	3		1.0	163.2	(163)
	2:10	50		0	0	-1		-0.3	162.9	
	2:12	40		-5	0	-5		-3.3	159.6	
	2:14	30		-3	-8	-16		-9.0	150.6	
	2:16	20		-9	-5	-22		-12.0	138.6	
	2:18	10		-19	-19	-35		-24.3	114.3	
	2:20	5		-13	-14	-18		-11.7	102.6	
	2:22	0		-5	-7	-2		-4.7	97.9	
<6>	2:26	0		-1	-2	-2		-1.7	96.2	(96)
	2:28	10		0	0	0		0	96.2	
	2:30	20		8	+11	12		10.3	106.5	
	2:32	30		12	18	29		19.7	126.2	
	2:34	40		10	15	28		17.7	143.9	
	2:36	50		15	15	23		17.7	161.6	
<7>	2:38	60		10	8	20		12.7	174.3	(174)
	2:40	60		5	3	2		3.3	177.6	
	2:43	60		0	0	+1		0.3	177.9	
	2:48	60		0	0	0		0	177.9	
	2:53	60		0	0	1		0.3	178.2	
	2:58	60		0	0	0		0	178.2	
	3:03	60		0	0	0		0	178.2	
	3:08	60		1	0	1		0.7	178.9	
	3:18	60		0	1	0		0.3	179.2	
	3:28	60		0	0	0		0	179.2	
	3:38	60		0	0	0		0	179.2	

PLATE BEARING TEST　　　　　　　　　　DATA SHEET (3)

Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation Displacement Gauge Reading (×10⁻³ mm) ④	⑤	⑥	(④+⑤+⑥)/3	Σδ	Remarks
	4:08	60		0	0	0	0	179.2	
	4:38	60		0	0	0	0	179.2	
	5:08	60		0	0	0	0	179.2	
	5:38	60		0	1	1	0.7	179.9	
	6:08	60		-1	0	0	-0.3	179.6	
	6:38	60		0	0	0	0	179.6	
	7:08	60		0	1	0	0.3	179.9	
	7:38	60		0	0	0	0	179.9	
	8:08	60		0	0	0	0	179.9	
<8>	8:38	60		0	0	0	0	179.9	(180)
	8:40	50		-3	0	-2	-1.7	178.2	
	8:42	40		-8	-4	-9	-7.0	171.2	
	8:44	30		-1	-15	-18	-11.3	159.9	
	8:46	20		-14	-12	-26	-17.3	142.6	
	8:48	10		-17	-19	-34	-23.3	119.3	
	8:50	5		-20	-23	-17	-20.0	99.3	
	8:52	0		-5	-7	-6	-6.0	93.3	
<9>	8:56	0		0	0	0	0	93.3	(93)
	8:58	10		0	0	0	0	93.3	
<10>	9:00	20		10	15	14	13.0	106.3	(106)
	9:02	30		16	20	30	22.0	128.3	
<11>	9:04	40		12	15	28	18.3	146.6	(147)
	9:06	50		10	11	21	14.0	160.6	
<12>	9:08	60		15	11	17	14.3	174.9	(175)
	9:10	65		5	6	9	6.7	181.6	
<13>	9:14	65		6	2	1	3.0	184.6	(185)
	9:16	60		0	1	-1	0	184.6	
	9:18	50		0	1	-1	0	184.6	
	9:20	40		-5	-1	-6	-4.0	180.6	
	9:22	30		-6	-6	-16	-9.3	171.3	
	9:24	20		-5	-14	-24	-14.3	157.0	
	9:26	10		-20	-21	-38	-26.3	130.7	
	9:28	5		-10	-13	-17	-13.3	117.4	
	9:30	0		-5	-6	-5	-5.3	112.1	
<14>	9:34	0		0	-2	-2	-1.3	110.8	(111)
	9:36	10		0	0	0	0	110.8	
<15>	9:38	20		13	16	18	15.7	126.5	(127)
	9:40	30		12	17	31	20.0	146.5	
<16>	9:42	40		10	17	27	18.0	164.5	(165)
	9:44	50		10	11	19	13.3	177.8	
<17>	9:46	60		12	8	17	12.3	190.1	(190)
	9:48	65		7	6	9	7.3	197.4	
<18>	9:52	65		1	1	2	1.3	198.7	(199)
	9:54	60		0	-2	-1	-1.0	197.7	
	9:56	50		-1	1	-1	-0.3	197.4	

PLATE BEARING TEST

DATA SHEET (4)

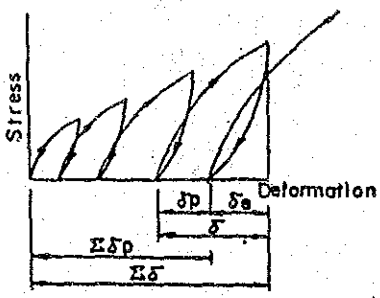
Time	Time Elapsed	Stress (kgf/cm^2)	Jack Pressure (kgf/cm^2)	Deformation ($\times 10^{-3}$ mm) Displacement Gauge Reading ④	⑤	⑥		(④+⑤+⑥)/3	Σδ	Remarks
	9:58	40		-7	-2	-9		-6.0	191.4	
	10:00	30		-11	-10	-21		-14.0	177.4	
	10:02	20		-6	-12	-23		-13.7	163.7	
	10:04	10		-14	-20	-33		-19.0	144.7	
	10:06	5		-11	-14	-20		-15.0	129.7	
	10:08	0		-7	-10	-6		-7.7	122.0	
<19>	10:12	0		-1	-2	-2		-1.7	120.3	(120)

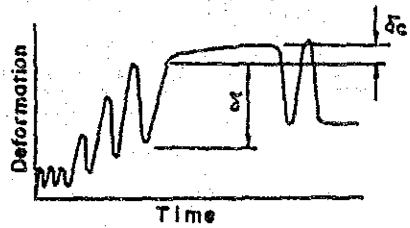
PLATE BEARING TEST RESULTS

Test Location: DA-1, P-2, TD 40.5m
Measuring Point: Crown
Loading Plate Radius: a = 15 cm
Date Measured: 30 Aug. 1988
Geological Classification: Ophiolite
Measured by:
Rock Grade: 2B IV ©

Deformation Measurement Results

Stress (kgf/cm²)	Deformation (x10⁻³ mm) δ	δ_e	δ_p	$\Sigma\delta$	$\Sigma\delta_p$	Remarks: Creep Deformation δ_c (x10⁻³ mm)	Creep Factor Cf (%)
15	2	0	2	2	2		
15	2	0	2	4	4		
15	1	0	1	5	5		
30	7	2	5	12	10		
45	12	2	10	22	20		
60	12	5	7	32	27		
60	5 (9)	3 (7)	2 (2)	32 (36)	29	4	80
65	15	15	0	44	29	$Cf = \frac{\delta_c}{\delta} \times 100 = \frac{4}{5} \times 100 = 80$	
65	23	18	5	52	36		





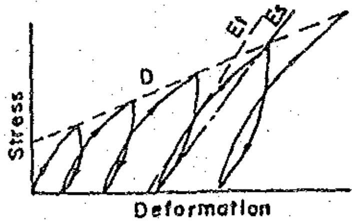
δ : Total deformation
δ_e : Elastic deformation
δ_p : Plastic deformation
$\Sigma\delta$: Cumulative total deformation
$\Sigma\delta_p$: Cumulative plastic deformation
δ_c : Creep deformation

Coefficients Related to Deformation

Modulus of Deformation D (kgf/cm²)	Tangential Modulus of Elasticity Et (kgf/cm²)	Stress Level (kgf/cm²)	Secant Modulus of Elasticity Es (kgf/cm²)
370,400	856,000	20 ~ 65	809,700

Modulus of Deformation, Modulus of Elasticity Calculation Formula

$$D \text{ or } E = \frac{(1-\nu^2)}{2a} \cdot \frac{\Delta F}{\Delta W} = \frac{\pi a(1-\nu^2)}{2} \cdot \frac{\Delta\sigma}{\Delta\delta}$$

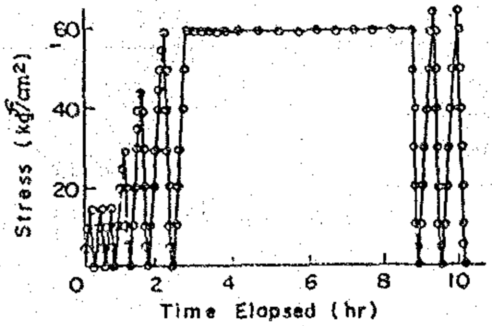


ν : Poisson's ratio (0.2~0.3)
a : Plate radius (cm)
ΔF : Load increment (kgf)
ΔW : Deformation increment due to ΔF
$\Delta\sigma$: Stress increment (kgf/cm²)
$\Delta\delta$: Deformation increment due to $\Delta\sigma$

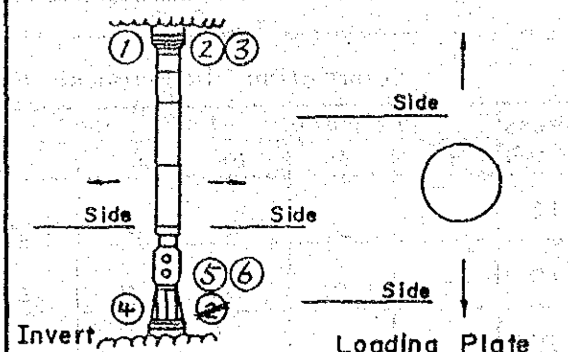
Remarks

PLATE BEARING TEST — DATA SHEET (1)

Test Location	DA-1 P-2, TD40.5m	Measuring Point	Crown	Geological Classification	Ophiolite
Loading Plate Radius	a = 15 cm	Date Measured	30 Aug. 1988	Rock Grade	2BN ©
Jack Capacity	200 ton	Max. Oil Pressure	1100 kgf/cm²	Measured by	
Ram Diameter	ø 15.2 cm				



Loading Pattern (Example)



Loading Plate

Time	Time Elapsed	Stress (kgf/cm²)	Jack Pressure (kgf/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading ①	②	③		(① + ② + ③) / 3	Σ δ	Remarks
	0	0		0	0	0		0	0	
	2	5		0	0	0		0	0	
	4	10		0	0	1		0.3	0.3	
	6	15		1	4	0		1.7	2.0	
	10	15		0	1	0		0.3	2.3	
	12	5		0	0	0		0	2.3	
	14	0		−1	0	0		−0.3	2.0	
	18	0		0	0	0		0	2.0	
	20	10		0	0	0		0	2.0	
	22	15		0	1	4		1.7	3.7	
	26	15		0	0	0		0	3.7	
	28	5		0	0	0		0	3.7	
	30	0		0	0	0		0	3.7	
<1>	34	0		0	0	0		0	3.7	(4)
	36	10		1	0	0		0.3	4.0	
	38	15		0	1	0		0.3	4.3	
<2>	42	15		0	1	0		0.4	4.7	(5)
	44	5		0	0	0		0	4.7	
	46	0		0	0	0		0	4.7	
	50	0		0	0	0		0	4.7	
	52	10		0	0	0		0	4.7	
	54	15		0	1	1		0.7	5.4	
	56	20		0	4	2		2.0	7.4	
	58	25		1	3	3		2.3	9.7	
	1:00	30		1	0	1		1.7	11.4	
<3>	1:04	30		1	0	0		0.3	11.7	(12)
	1:06	20		0	0	0		0	11.7	
	1:08	10		0	0	0		0	11.7	
	1:10	5		0	−2	0		−0.7	11.0	
	1:12	0		−1	−1	0		−0.7	10.3	
	1:16	0		0	0	0		0	10.3	
	1:18	10		0	0	0		0	10.3	
	1:20	20		1	3	0		1.4	11.7	

PLATE BEARING TEST　　　　　　　　　　　　DATA SHEET (2)

Time	Time Elapsed	Stress (kg^f/cm^2)	Jack Pressure (kg^f/cm^2)	Deformation ($\times 10^{-3}$ mm) Displacement Gauge Reading ①	②	③	(①+②+③)/3	Σδ	Remarks
	1:22	30		2	3	1	2.0	13.7	
	1:24	35		0	2	2	1.3	15.0	
	1:26	40		2	4	3	3.0	18.0	
	1:28	45		2	4	2	2.7	20.7	
<4>	1:32	45		1	2	2	1.6	22.3	(22)
	1:34	40		0	0	0	0	22.3	
	1:36	30		0	0	0	0	22.3	
	1:38	20		0	0	0	0	22.3	
	1:40	10		0	-1	0	-0.3	22.0	
	1:42	5		0	-3	0	-1.0	21.0	
	1:44	0		0	-2	0	-0.7	20.3	
	1:48	0		0	0	0	0	20.3	
	1:50	10		0	0	0	0	20.3	
	1:52	20		0	2	0	0.7	21.0	
	1:54	30		0	4	0	1.3	22.3	
	1:56	40		0	2	0	0.7	23.0	
	1:58	45		1	2	0	1.7	24.7	
	2:00	50		2	0	1	1.0	25.7	
	2:02	55		2	2	3	2.3	28.0	
	2:04	60		2	4	2	2.7	30.7	
<5>	2:08	60		2	1	0	1.0	31.7	(32)
	2:10	50		-1	1	0	0	31.7	
	2:12	40		0	0	0	0	31.7	
	2:14	30		0	0	0	0	31.7	
	2:16	20		0	0	-1	-0.3	31.4	
	2:18	10		0	-6	0	-2.0	29.4	
	2:20	5		0	-5	0	-1.7	27.7	
	2:22	0		0	-2	-1	-1.0	26.7	
<6>	2:26	0		0	0	0	0	26.7	(27)
	2:28	10		1	0	0	0.3	27.0	
	2:30	20		0	1	0	0.3	27.3	
	2:32	30		0	5	0	1.7	29.0	
	2:34	40		0	4	0	1.3	30.3	
	2:36	50		0	1	0	0.3	30.6	
<7>	2:38	60		0	3	2	1.7	32.3	(32)
	2:40	60		0	0	0	0	32.3	
	2:43	60		0	0	0	0	32.3	
	2:48	60		1	1	1	1.0	33.3	
	2:53	60		0	0	2	0.7	34.0	
	2:58	60		0	0	0	0	34.0	
	3:03	60		0	0	0	0	34.0	
	3:08	60		0	0	0	0	34.0	
	3:18	60		0	0	0	0	34.0	
	3:28	60		0	0	0	0	34.0	
	3:38	60		0	0	0	0	34.0	

PLATE BEARING TEST DATA SHEET (3)

Time	Time Elapsed	Stress (kgf/cm²)	Jack Pressure (kgf/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading ①	②	③		(① + ② + ③)/3	Σδ	Remarks
	4:08	60		0	0	0		0	34.0	
	4:38	60		0	0	0		0	34.0	
	5:08	60		1	0	0		0.3	34.3	
	5:38	60		1	0	0		0.3	34.6	
	6:08	60		1	0	0		0.4	35.0	
	6:38	60		2	1	1		1.3	36.3	
	7:08	60		0	0	0		0	36.3	
	7:38	60		0	0	0		0	36.3	
	8:08	60		0	0	0		0	36.3	
<8>	8:38	60		0	0	0		0	36.3	(36)
	8:40	50		0	0	0		0	36.3	
	8:42	40		0	0	0		0	36.3	
	8:44	30		0	1	-1		0	36.3	
	8:46	20		0	0	-1		-0.3	36.0	
	8:48	10		0	-5	-1		-2.0	34.0	
	8:50	5		0	-7	-3		-3.3	30.7	
	8:52	0		-1	0	-3		-1.3	29.4	
<9>	8:56	0		0	-2	0		-0.7	28.7	(29)
	8:58	10		0	2	0		0.7	29.4	
<10>	9:00	20		0	14	-1		4.3	33.7	(34)
	9:02	30		0	-3	4		0.3	34.0	
<11>	9:04	40		0	5	4		3.0	37.0	(37)
	9:06	50		0	3	3		2.0	39.0	
<12>	9:08	60		1	2	6		3.0	42.0	(42)
	9:10	65		0	4	2		2.0	44.0	
<13>	9:14	65		0	0	0		0	44.0	(44)
	9:16	60		0	-1	0		-0.3	43.7	
	9:18	50		0	0	0		0	43.7	
	9:20	40		0	0	0		0	43.7	
	9:22	30		0	-1	-2		-1.0	42.7	
	9:24	20		0	-1	-1		-0.7	42.0	
	9:26	10		0	-5	0		-1.7	40.3	
	9:28	5		0	-14	-4		-6.0	34.3	
	9:30	0		0	-8	-5		-4.3	30.0	
<14>	9:34	0		0	-1	-1		-0.6	29.3	(29)
	9:36	10		0	4	1		1.7	31.0	
<15>	9:38	20		0	15	2		5.7	36.7	(37)
	9:40	30		0	10	6		5.3	42.0	
<16>	9:42	40		0	5	4		3.0	45.0	(45)
	9:44	50		0	2	3		1.7	46.7	
<17>	9:46	60		0	2	5		2.3	49.0	(49)
	9:48	65		1	2	2		1.6	50.6	
<18>	9:52	65		1	2	2		1.7	52.3	(52)
	9:54	60		0	0	0		0	52.3	
	9:56	50		0	0	0		0	52.3	

PLATE BEARING TEST

DATA SHEET (4)

Time	Time Elapsed	Stress (kg_f/cm^2)	Jack Pressure (kg_f/cm^2)	Deformation (x 10^{-3} mm) Displacement Gauge Reading ①	②	③		(① + ② + ③) / 3	Σδ	Remarks
	9:58	40		0	0	−1		−0.3	52.0	
	10:00	30		0	0	−2		−0.7	51.3	
	10:02	20		0	−1	−1		−0.6	50.7	
	10:04	10		0	−8	−3		−3.7	47.0	
	10:06	5		0	−6	−4		−3.3	43.7	
	10:08	0		−1	−10	−10		−7.0	36.7	
⟨19⟩	10:12	0		−1	−1	0		−0.7	36.0	(36)

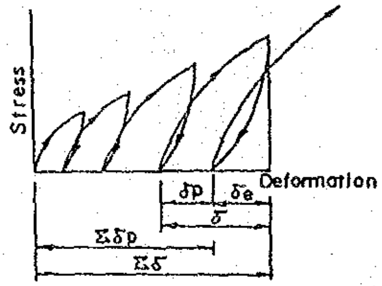
PLATE BEARING TEST RESULTS

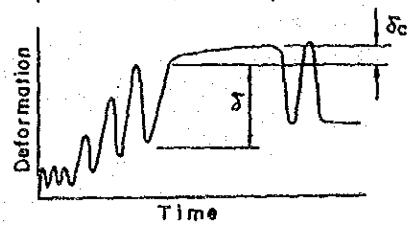
Test Location	DA-1, P-3, TD(B)2.1m	Measuring Point	Left wall
Loading Plate Radius	a = 15 cm	Date Measured	26 Aug. 1988
Geological Classification	Ophiolite	Measured by	
Rock Grade	2BIII ⓑ		

Deformation Measurement Results

Stress (kgf/cm²)	Deformation ($\times 10^{-3}$ mm) δ	δ_e	δ_p	$\Sigma\delta$	$\Sigma\delta_p$	Remarks: Creep Deformation δ_c ($\times 10^{-3}$ mm)	Creep Factor Cf (%)
15	85	7	78	85	78		
15	11	6	5	89	83		
15	6	8	-2	89	81		
30	35	20	15	116	96		
45	49	35	14	145	110		
60	61	50	11	171	121		
60	61 (72)	52 (63)	9 (9)	182 (193)	130	11	18
65	74	50	24	204	154		
65	68	58	10	222	164		

$$Cf = \frac{\delta_c}{\delta} \times 100 = \frac{11}{61} \times 100 = 18$$





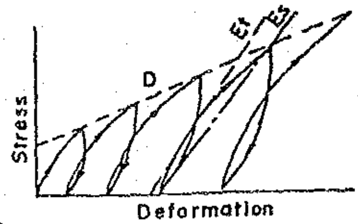
δ : Total deformation
δ_e : Elastic deformation
δ_p : Plastic deformation
$\Sigma\delta$: Cumulative total deformation
$\Sigma\delta_p$: Cumulative plastic deformation
δ_c : Creep deformation

Coefficients Related to Deformation

Modulus of Deformation D (kgf/cm²)	Tangential Modulus of Elasticity Et (kgf/cm²)	Stress Level (kgf/cm²)	Secant Modulus of Elasticity Es (kgf/cm²)
123,000	192,000	20 ~ 65	207,000

Modulus of Deformation, Modulus of Elasticity Calculation Formula

$$D \text{ or } E = \frac{(1-\nu^2)}{2a} \cdot \frac{\Delta F}{\Delta W} = \frac{\pi a (1-\nu^2)}{2} \cdot \frac{\Delta\sigma}{\Delta\delta}$$

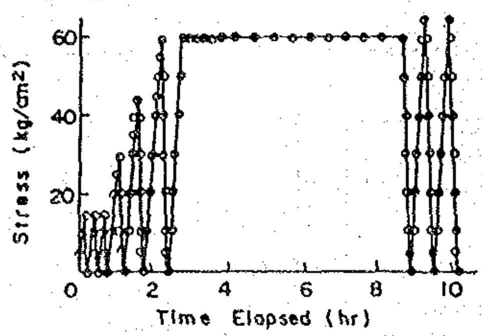


ν : Poisson's ratio (0.2~0.3) a : Plate radius (cm)
ΔF : Load increment (kgf) ΔW : Deformation increment due to ΔF
*$\Delta\sigma$: Stress increment (kgf/cm²) $\Delta\delta$: Deformation increment due to $\Delta\sigma$

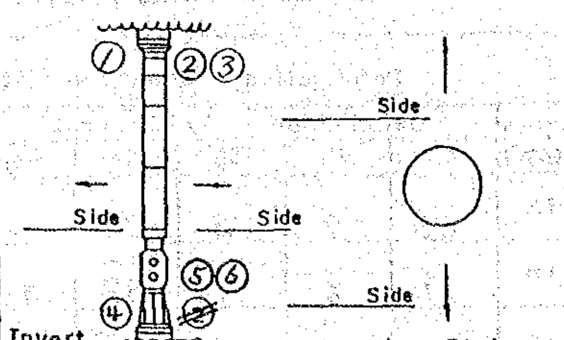
Remarks

PLATE BEARING TEST DATA SHEET (1)

Test Location	DA - 1, P-3, TD(B) 2.1m	Measuring Point	Left wall	Geological Classification	Ophiolite
Loading Plate Radius	a = 15 cm	Date Measured	26 Aug. 1988	Rock Grade	2 BIII ⑥
Jack Capacity	200 ton	Max. Oil Pressure	1,100 kg/cm^2	Measured by	
Ram Diameter	ϕ 15.24cm				



Loading Pattern (Example)



Loading Plate

Time	Time Elapsed	Stress (kg^f/cm^2)	Jack Pressure (kg^f/cm^2)	Deformation (x 10^{-3} mm) Displacement Gauge Reading ①	②	③	(① + ② + ③) / 3	Σ δ	Remarks
	0	0		0	0	0	0	0	
	2	5		27	125	2	51.3	51.3	
	4	10		27	27	12	22.0	73.3	
	6	15		11	4	8	7.7	81.0	
	10	15		4	5	3	4.0	85.0	
	12	5		-6	0	-2	- 2.7	82.3	
	14	0		-9	0	-4	- 4.3	78.0	
	18	0		0	0	0	0	78.0	
	20	10		7	0	1	2.7	80.7	
	22	15		11	7	7	8.3	89.0	
	26	15		0	0	0	0	89.0	
	28	5		-6	-1	0	- 2.3	86.7	
	30	0		-6	0	-5	- 3.7	83.0	
<1>	34	0		1	0	0	0.3	83.3	(83)
	36	10		3	0	0	1.0	84.3	
	38	15		8	0	5	4.3	88.6	
<2>	42	15		0	0	0	0	88.6	(89)
	44	5		-6	0	-2	- 2.7	85.9	
	46	0		-8	-1	-5	- 4.7	81.2	
	50	0		0	0	0	0	81.2	
	52	10		6	0	1	2.3	83.5	
	54	15		9	4	6	6.3	89.8	
	56	20		7	6	8	7.0	96.8	
	58	25		11	6	8	8.3	105.1	
	1:00	30		10	8	8	8.7	113.8	
<3>	1:04	30		2	2	1	1.7	115.5	(116)
	1:06	20		0	0	0	0	115.5	
	1:08	10		-5	0	0	- 1.7	113.8	
	1:10	5		-9	-6	10	- 8.3	105.5	
	1:12	0		-10	-8	9	- 9.0	96.5	
	1:16	0		-1	0	-1	- 0.7	95.8	
	1:18	10		6	0	0	2.0	97.8	
	1:20	20		18	8	12	12.7	110.5	

PLATE BEARING TEST

DATA SHEET (2)

Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation (x 10⁻³ mm) Displacement Gauge Reading ① ~~④~~	②	③	~~②~~	(①+②+③)/3	Σδ	Remarks
	1:22	30		13	8	10		10.3	120.8	
	1:24	35		8	4	6		6.0	126.8	
	1:26	40		11	7	8		8.7	135.5	
	1:28	45		10	7	8		8.3	143.8	
<4>	1:32	45		2	0	2		1.3	145.1	(145)
	1:34	40		0	0	0		0	145.1	
	1:36	30		0	0	2		0.7	145.8	
	1:38	20		-4	0	0		-1.3	144.5	
	1:40	10		-19	-9	-10		-12.7	131.8	
	1:42	5		-22	-11	-16		-16.3	115.5	
	1:44	0		-12	-3	0		-5.0	110.5	
	1:48	0		-1	0	0		-0.3	110.2	
	1:50	10		8	0	0		2.7	112.9	
	1:52	20		16	1	11		9.3	122.2	
	1:54	30		16	8	14		12.7	134.9	
	1:56	40		12	7	9		9.3	144.2	
	1:58	45		8	5	3		5.3	149.5	
	2:00	50		8	5	3		5.3	154.8	
	2:02	55		9	7	5		7.0	161.8	
	2:04	60		10	9	4		7.7	169.5	
<5>	2:08	60		3	0	2		1.7	171.2	(171)
	2:10	50		0	0	0		0	171.2	
	2:12	40		0	0	0		0	171.2	
	2:14	30		-5	0	0		-1.7	169.5	
	2:16	20		-2	-6	4		-1.3	168.2	
	2:18	10		-33	-18	-19		-23.3	144.9	
	2:20	5		-20	-15	-19		-18.0	126.9	
	2:22	0		-15	0	-3		-6.0	120.9	
<6>	2:26	0		0	0	0		0	120.9	(121)
	2:28	10		5	0	0		1.7	122.6	
	2:30	20		20	8	10		12.7	135.3	
	2:32	30		15	10	16		13.7	149.0	
	2:34	40		15	9	10		11.3	160.3	
	2:36	50		15	12	7		11.3	171.6	
<7>	2:38	60		14	11	5		10.0	181.6	(182)
	2:40	60		0	0	1		0.3	181.9	
	2:43	60		2	1	1		1.3	183.2	
	2:48	60		0	0	0		0	183.2	
	2:53	60		0	0	0		0	183.2	
	2:58	60		1	0	0		0.3	183.5	
	3:03	60		1	0	0		0.3	183.8	
	3:08	60		2	3	0		1.7	185.5	
	3:18	60		3	4	0		2.3	187.8	
	3:28	60		2	2	6		3.3	191.1	
	3:38	60		1	3	1		1.7	192.8	

PLATE BEARING TEST   DATA SHEET (3)

Time	Time Elapsed	Stress (kg/cm²)	Jack Pressure (kg/cm²)	Deformation (×10⁻³ mm) Displacement Gauge Reading ①	②	③		(①+②+③)/3	Σδ	Remarks
	4:08	60		0	0	0		0	192.8	
	4:38	60		0	0	0		0	192.8	
	5:08	60		0	0	0		0	192.8	
	5:38	60		0	0	0		0	192.8	
	6:08	60		0	0	0		0	192.8	
	6:38	60		0	0	0		0	192.8	
	7:08	60		0	0	0		0	192.8	
	7:38	60		0	0	0		0	192.8	
	8:08	60		0	0	0		0	192.8	
<8>	8:38	60		0	0	0		0	192.8	(193)
	8:40	50		-1	-5	0		-2.0	190.8	
	8:42	40		-9	-8	-1		-6.0	184.8	
	8:44	30		-8	-10	0		-6.0	178.8	
	8:46	20		-10	-3	0		-4.3	174.5	
	8:48	10		-20	-17	-13		-16.7	157.8	
	8:50	5		-23	-11	-19		-17.7	140.1	
	8:52	0		-22	-1	-8		-10.3	129.8	
<9>	8:56	0		0	0	0		0	129.8	(130)
	8:58	10		6	0	1		2.3	132.1	
<10>	9:00	20		21	11	15		15.7	147.8	(148)
	9:02	30		20	11	15		15.3	163.1	
<11>	9:04	40		11	12	12		11.7	174.8	(175)
	9:06	50		15	14	6		11.7	186.5	
<12>	9:08	60		14	13	4		10.3	196.8	(197)
	9:10	65		6	5	2		4.3	201.1	
<13>	9:14	65		3	4	3		3.3	204.4	(204)
	9:16	60		1	0	1		0.7	205.1	
	9:18	50		-2	0	2		0	205.1	
	9:20	40		-2	0	2		0	205.1	
	9:22	30		-7	0	1		-2.0	203.1	
	9:24	20		-12	-7	-1		-6.7	196.4	
	9:26	10		-19	-16	-13		-18.0	178.4	
	9:28	5		-26	-13	-20		-19.7	158.7	
	9:30	0		-9	-1	-5		-5.0	153.7	
<14>	9:34	0		0	0	1		0.3	154.0	(154)
	9:36	10		3	0	0		1.0	155.0	
<15>	9:38	20		21	10	14		15.0	170.0	(170)
	9:40	30		13	3	17		16.3	186.3	
<16>	9:42	40		14	9	11		11.3	197.6	(198)
	9:44	50		14	8	5		9.0	206.6	
<17>	9:46	60		12	10	3		8.3	214.9	(215)
	9:48	65		5	5	1		3.7	218.6	
<18>	9:52	65		4	2	3		3.0	221.6	(222)
	9:54	60		0	0	1		0.3	221.9	
	9:56	50		0	0	3		1.0	222.9	