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Open ground cracks occurred at Oya and its adjacent area, Ebina Town, Kanagawa Prefecture

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海老名町大谷及び隣接地域に生じた地割れ群について

著者らは，海老町大谷を中心にして生じた多数の地割れについて，地質学的な立場から検討を加えた。

その結果，地割れは，図2に示されているように，相模川沖積低地の後背湿地と，いわゆる相模野台地の境界線上に生じた一つのわれ目帯（fissure zone）に沿って，ほぼ南北方向に発生していることがわかった。

横づれを示す地割れはみとめられない。割れ口の西側が数cmから，10数cm下方に垂直移動しているものが，数ケ所で観察された。これらの事実その他から，この地域の地割れは，後背湿地の沈下によって引き越された西下方への張力によって生じたものであると推定される。（見上敬三・今永　勇）

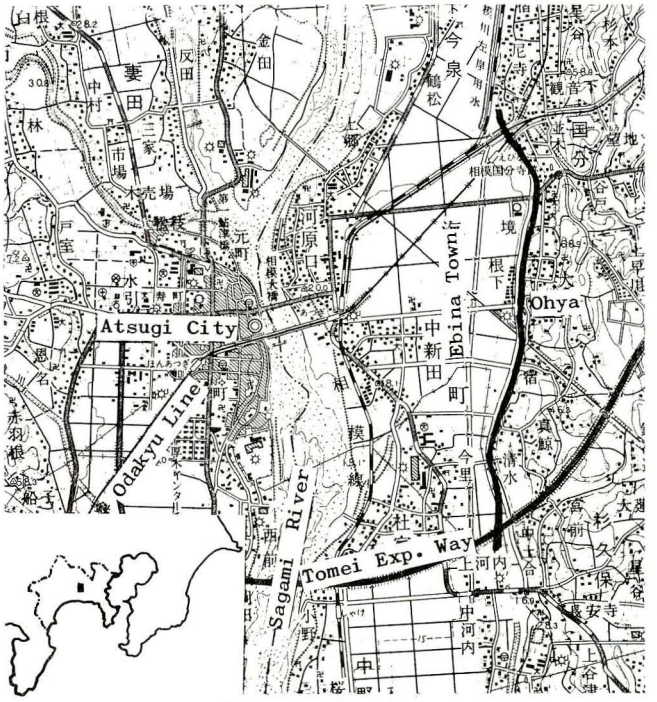

Fig. 1. Location map

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Preface

For several years, the village of Oya and its adjacent area situated in the central part of Ebina Town, Kanagawa Prefecture have suffered from the damages due to successive occurrences of many open ground cracks.

According to the residents, their occurrences became evident in 1967 with the gradual decrease in the amount of underground water, and culminated in 1969. Kanagawa Prefecture started in 1969 hydrogeological examination of Oya Village, and is still continuing now.

The writers observed these cracks from the geological view-point in the biginning of July, 1969. Additional ovservations were carried out at the end of the same year and in August, 1970. In this paper are given the geological feature of these cracks and some consideration on their origin.

Geological Setting

The studied area where the cracks occur lies along the northeastern margin of the Sagami alluvial plain 2.5 km east of Atsugi City. On the eastern side of this area are steep cliffs bordering the southwestern part of the Pleistocene Sagamino upland, over which the hill of Zama spreads out northeast, while, on the other hand, the western side faces a back swamp extending from north to south along the margin of this plain, the surface of which is used as paddy-fields. And also the present area is between the Odakyu Railway Line in the north and the Tomei Express Way in the south.

The upland is covered widely with the Kanto loam which well exposes on the face of these cliffs as a somewhat thick accumulation of volcanic ash and lapilli intercalated occasionally with two thin layers of pumice. Terrace gravels expose at the foot of the cliffs near the village of Shimizu, and are overlain by this accumulation.

Besides, the boring data at the Ebina Junior High School located on the same upland confirm an occurrence of gravels which are underlain by the loam, but their stratigraphic relation to the above mentioned gravels is uncertain.

The back swamp consists mainly of humic soils and soft, unconsolidated muddy sediments overlying a gravel bed more than 30 m thick (Fig. 3).

Most of the sediments seem to become coarser towards the north, and are partly replaced by gravels under the town office of Ebina.

Geological Feature of Cracks

The distribution of ground cracks observed by the junior writer up to August 1970 is shown in Fig. 2. The information on individual cracks, such as their

Fig. 2. Map showing the distribution of ground cracks.
The mark•indicates the crack, the mark•indicates the crack and its direction.

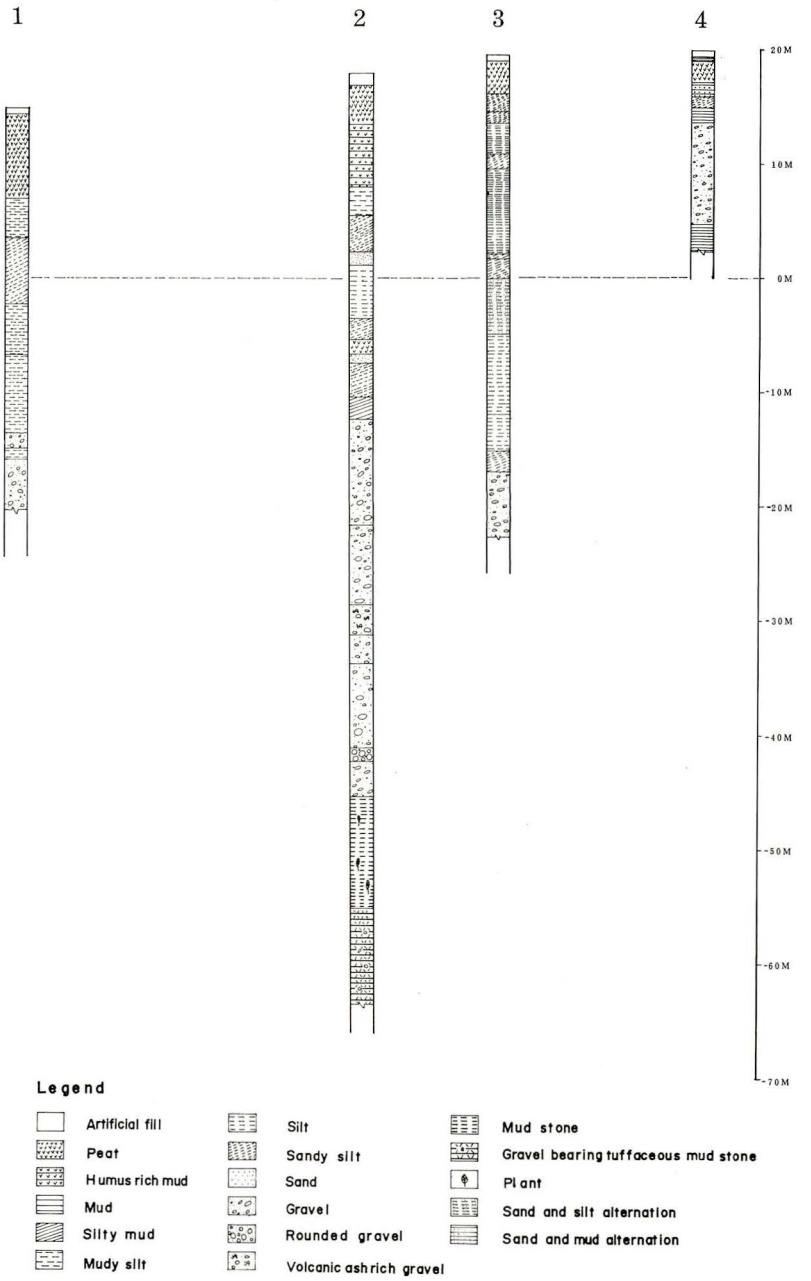

Fig. 3. Columner section of the back swamp.
1. Tomei Exp. Way (about 50 m from the foot of cliff)
2. Test Bore Point 3. Atsugi Nylon Co., LTD.
4. Ebina Town Office

Table 1. Information on Indibidual Cracks

Noumber of site	Occurrence	Distance from the road (r) or the foot of the hill (h)	Trend	Width	Depth (d) Length (l)	Displacement
1	terrace	11.5 m (h)	N 20° E	1 cm		
2	plinth	12 m (h)		0.2 cm		
3	plinth	13.5 m (h)	N 30° E	0.2 cm		
4	plinth	12 m (h)		1 cm		
5	concrete block wall	14 m (h)		2.5 cm		
6	ditch	6.3 m (r)		2 cm		
7	concrete blok wall			0.6 cm		
8	concrete stoop					a little bit down in the west side
9	concrete floor					7cm declining at the south end
10	concrete block wall			1.5 cm		
11	ditch	3.6 m (r)		1 cm		
	//	8.1 m (r)		6 cm		
	//	14.3 m (r)		3.2 cm		
12	concrete block wall	5 m (r)		0.1 cm		
13	concrete block wall	5 m (r)		0.5 cm		
14	stone wall	3 m (r)		3 cm		
15	concrete block wall	20 m (r)		0.7 cm		1cm down in the west side
16	concrete paving	21 m (r)	N-S	1.8 cm		
	//	26 m (r)	N 35° w	1.5 cm		
	//	30 m (r)	N 10° E	0.5 cm		
17	concrete paving	16.8 m (r)	N 10° E	0.5 cm		
18	ditch	9.4 m (r)		1 cm		
	//	18.4 m (r)		3 cm		
19	earth of dwelling site	16 m (r)				
20	plinth	12 m (r)	N 20° E	0.3 cm		
21	earth of dwelling site	15 m (r)				
22	plinth	10 m (r)		2 cm		a little bit down in the west side
	//	11.5 m (r)		2 cm		a little bit down in the west side
23	town road	1 m (r)	N 10° E			
24	earth of dwelling site	22 m (r)	N-S			
	//	24 m (r)	N 10° E	7 cm	65 cm (d)	3cm down in the west side
	//	25 m (r)	N 35° E	8 cm		
25	plinth		N-S	4.5 cm		
	low concrete block retaining wall	10 m (r)	N-S	4 cm		3.5cm down in the west side
	//	12 m (r)	N-S	2 cm		0.5cm down in the west side
26	yard	13 m (r)	N20°w~N30°E	30 cm	30 cm (d) 6 m (l)	3cm down in the west side
	//	15 m (r)	N10°w~N45°E		37 cm (d) 8 m (l)	
27	site of store house		N 50° E			
28	water way	10 m (r)		4 cm		
	//	15 m (r)		3.5 cm		
29	yard	12 m (r)	N 10° E	16 cm	3 m (d) 3.7 m (l)	
30	earth of dwelling site	10 m (r)				
31	concrete stoop	10 m (r)				
32	pass	5 m (r)	N 20° E	30 cm		
33	earth of dwelling site	10 m (r)	N 20° E	3 cm	5 m (l)	
	earth of dwelling site	10.8 m (r)	N 25° E			
34	joint of concrete slab	16.6 m (r)		2.2 cm		
35	//	13.8 m (r)		4.5 cm		
	concrete slab of doorway	10.7 m (r)	N 35° E	4 cm	2 m (l) 1 m (d)	
	concrete plinth	7.5 m (r)	N 30° E	1.7 cm		
36	//	6.5 m (r)		11.2 cm		
	//	9 m (r)		0.8 cm		
	concrete block wall	3 m (r)		5 cm		15cm down in the west side 7cm to the left
37	concrete block wall	2 m (r)		6 cm		
	//	4 m (r)	N 30° E	5 cm		
38	concrete block wall	1 m (r)	N 20° E	5 cm		20cm down in the west side a little bit to the right
39	earth of dwelling site	15 m (r)	N 20°W	0.2 cm	60 cm (l)	
	garrage	8 m (r)				
40	concrete pavement of doorway	6 m (r)		2.5 cm		
41	concrete pavement of doorway	13 m (r)		1.5 cm		
42	earth of dwelling site	8.5 m (r)		2.5 cm		a little bit subsided
43	yard					50cm to 1 m subsided
44	earth under the bridge of Tomei Exp. Way	7 m (r)	N 10° E	2 cm	2 cm (d) 30 m (l)	
	//	19 m (r)	N 20° E	13 cm	3 cm (d) 12 m (l)	
	//	24 m (r)	N 10° E	13 cm	3 cm (d) 30 cm (l)	
	//	47 m (r)	N 20° E	5 cm	20 cm (d) 30 m (l)	
	//	55 m (r)	N 10° E	5 cm	30 cm (d) 30 m (l)	
	//	60 m (r)	N 10° E	8 cm	50 cm (d) 30 m (l)	
	//	75 m (r)	N 10° E	5 cm	10 cm (d) 30 m (l)	
	//	90 m (r)	N 50° E	5 cm	15 cm (d) 25 m (l)	
	//	105 m (r)	N 15° E	2.5 cm	20 cm (d) 30 m (l)	
	//	111 m (r)	N 20°W	1 cm	16 cm (d) 7.4 m (l)	
	//	124 m (r)	N 15°W	1.5 cm	30 cm (d) 10 m (l)	
	//	127 m (r)	N 10° E	1 cm	4 cm (d) 1 m (l)	
	//	127 m (r)	N 10° E	2 cm	3 cm (d) 2 m (l)	
	//	141 m (r)	N 10° E	1 cm	16 cm (d) 11.3 m (l)	

location, length, width, trend, mode of displacement, and distance from the road, Kokubu-Sugikubo Highway, running along the cliffs, have been measured at forty-four stations (Sites 1 to 44, Fig. 2), the results of which are listed in Table 1. Below is given some additional descriptions of them.

The crack at Site 9 is opened on a concrete floor extruding from the Ebina Nokyo Building situated on the soil-covered back swamp, and the result of measurment shows this floor declining 7 cm at its end, without any appreciable lateral displacement (Pl. 22, Fig. 2).

The three cracks at Site 24 are observed under a veranda of a house, and arranged in parallel at the intervals of several meters. And they are also associated with several small cracks trending in the almost same direction. Of these cracks, the middle one is opened 7 cm in maximum separation, and its west side is vertically downthrown, the amount of which attains to 3 cm (Pl. 22, Figs. 5, 7 and 8).

One of the three cracks at Site 25 is seen traversing a concrete base of a wooden house, and is estimated 4.5 cm in maximum separation. The other two are observed on a concrete block wall several meters to the south of the house. Both trending in a N-S direction reveal clearly vertical displacement amounting to 3.5 cm and 0.5 cm respectively, and their downthrown sides are in the west (Pl. 23, Figs. 1 and 2).

The crack at the station, Site 29, is in some house-lawn and 3.7 m in length. It occurs in a lenticular form extremely elongated to the direction of N 10° E, the center of which is estimated 16 cm in maximum separation and 3 m in depth, without the vertical or lateral displacement.

One of the three cracks at Site 37 is of special interest in its mode of displacement. This crack runs across the north side of a concrete block-wall trending in a E-W direction, and its west side is downthrown by about 15 cm and displaced laterally by 7 cm to the north.

From the above data and descriptions, the following are given as geological features common to these cracks.

1) The cracks are limited in distribution to a narrow area between the back swamp and the foot of the cliff, and arranged intermittently in a fissure zone extending from north to south along the foot. And also they are concentrated in the middle and the southern parts of this zone where the villages of Oya and Shimizu are located.

2) Some of the cracks show apparently vertical displacement, though small in amount. In this case, the downthrown side is always in the west. Moreover any appreciable lateral displacement is not observed among the cracks, except for one crack at Site 37.

Conclusive Remark

The occurrence of cracks along the very junction of the back swamp and the Sagamino upland seems to be controled strongly by surface geology. Compared with the upland, the back swamp predominated with humic soils and soft muddy sediments is more favorable for the ground subsidence due to extreme deficiency of underground water. In fact, the vertical displacement is observed among the cracks, though small in amount, and its downthrown side is always in the west. The subsidence of the concrete floor at Site 9 indicates the subsidence of back swamp, Thus, these cracks are interpreted as resulting from an west-downward tension which took place with the advance of gradual subsidence of the back swamp. This interpretation is strongly supported by the following observations by the residents: 1) the underground water outflowed from the gravels exposed near the village of Shimizu was completely drained in 1967 when the occurrence of the cracks became noticeable, and 2) at the village of Oya, the gradual decrease in the amount of well water took place during the period from 1967 to 1969.

The writers are grateful to the public officials of Kanagawa Prefecture and Ebina Town for giving many facilities to their geological survey, and also indebted to the residents of Oya village for their information regarding the ground cracks.

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Plate 22

Fig. 1 A crack occurred on a concrete base, looking northward at Site 1.

Fig. 2 A crack opend on a concrete floor of Ebina Nokyo Bldg., looking westward at Site 9. Relative subsidence of the floor amounts to 7 cm.

Fig. 3 A crack seen on a concrete paving of Atsugi Nylon Co., looking northward at Site 16.

Fig. 4 Crack traversing a concrete base, looking northward at Site 23. The base is cracked at three points and downthrown in the west.

Fig. 5 Three ground cracks-A, B and C-under a veranda of a wooden house, looking westward at Site 24. Note that western harf of the house is subsided and bent.

Fig. 6 Enlarged photograph of the cracks A and B in Fig. 5 looking northward. They are arranged in echelon.

Fig. 7 Enlarged photograph of the crack C in Fig. 5 looking northward. West side of the crack is downthrown vertically.

Fig. 8 Ditto.

Plate 23

Fig. 1 A crack crossing a concrete base, looking northward at Site 25. The separation amounts to 4.5 cm.

Fig. 2 A crack running across a concrete block wall, looking northward at Site 25. This shows clearly vertical displacement.

Fig. 3 A crack traversing a water-way made of concrete, looking southward at Site 28.

Fig. 4 A crack traversing a water-way made of concrete, looking southward at Site 28. 5 meter east of the crack in Fig. 3.

Fig. 5 A stoop downthrown on the west, looking northward at Site 35.

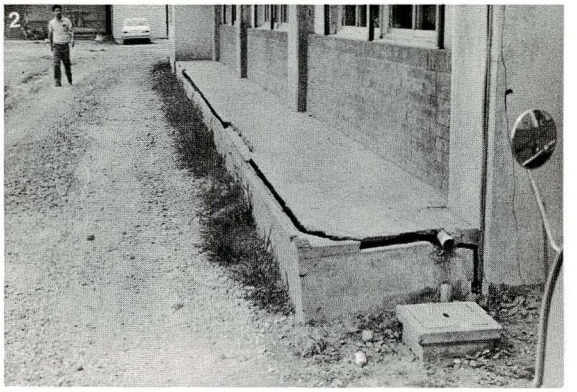
Fig. 6 A foundation of subsided poach at Site 35. Note that stones are inserted for sustaining the flame wood.

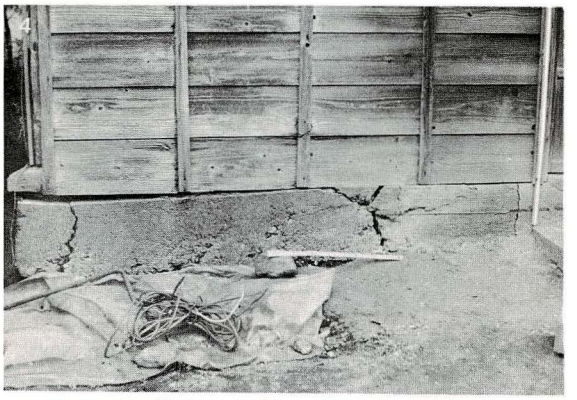
Fig. 7 Photograph showing a concrete floor separated from a concrete base, looking northward at Site 31. Note that the floor tilted westward.

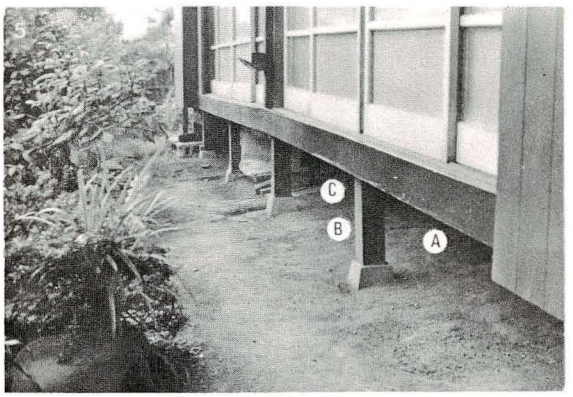
Fig. 8 A crack crossing obliquely a concrete block wall, looking north-east ward at Site 37.

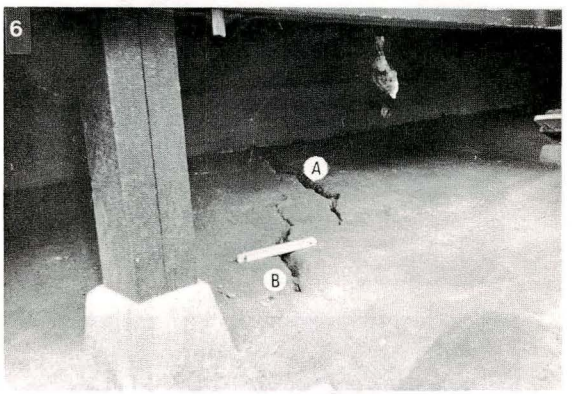
Fig. 9 A crack at the northern corner of concrete block wall which surrounds the dwelling, looking southward at Site 38. The amount of vertical displacement attains to 20 cm.

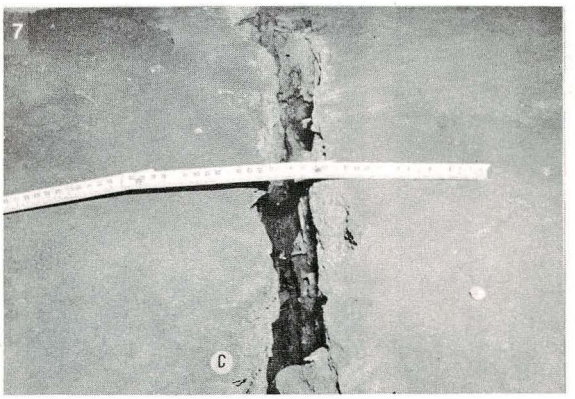
Pl. 22

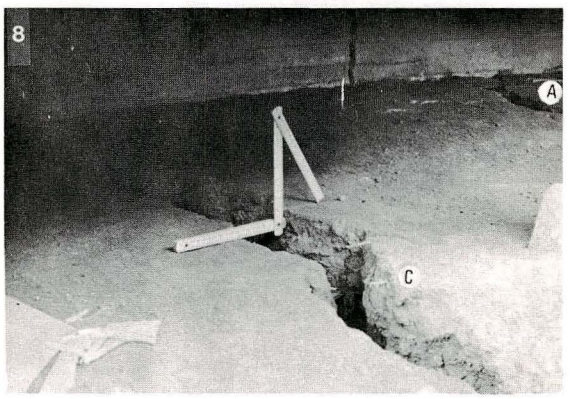




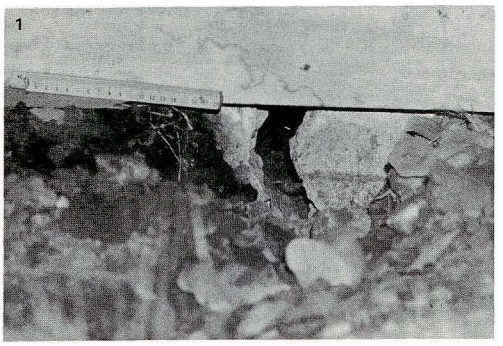








Pl. 23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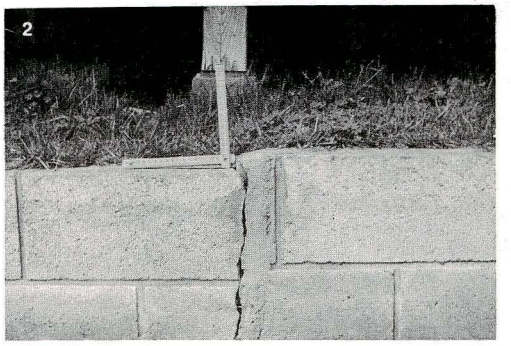
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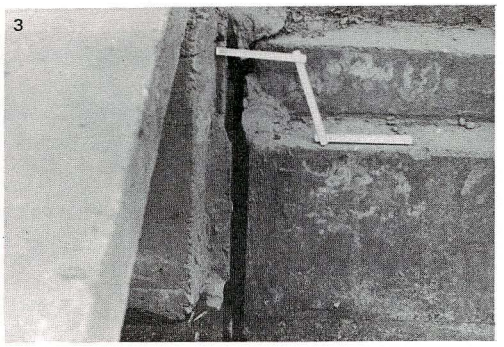
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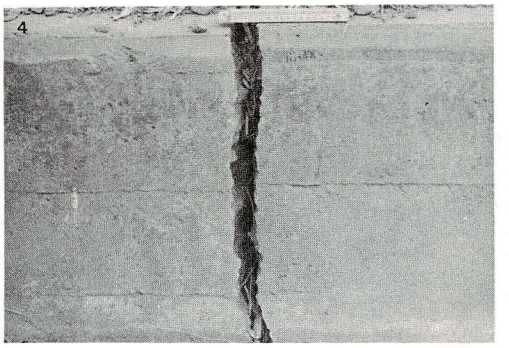
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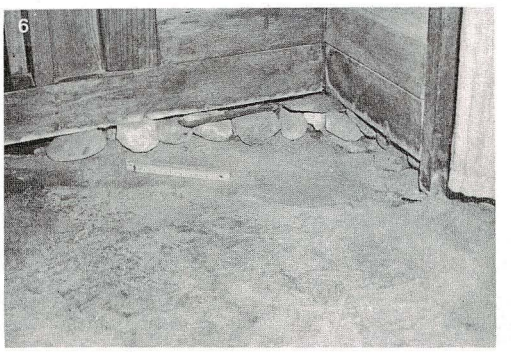
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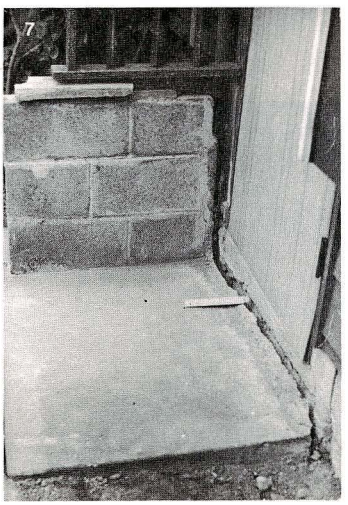
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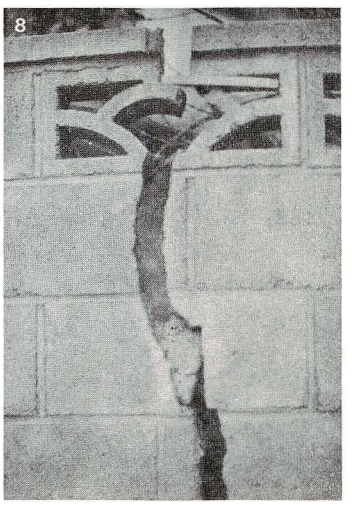
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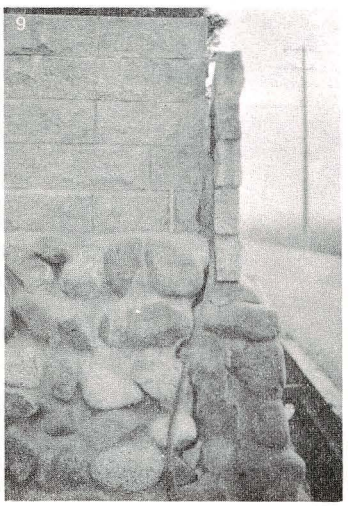
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