CONDITION OF "ELASTIZELL"
LIGHTWEIGHT CONCRETE BACKFILLS
AFTER ONE YEAR IN PLACE

(First Progress Report)

MICHIGAN DEPARTMENT OF TRANSPORTATION

MATERIALS and TECHNOLOGY DIVISION

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T. M. Green
E. C. Novak, Jr.

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During 1976, the Pine River Bridge on M 29 and the Waiska River Bridge on M 28 were reconstructed using a lightweight fill, Elastizell concrete, for support of the bridge approaches. Use of this material, a cellular concrete having a design unit weight of 35 lb/cu ft, enabled the bridge approach grades to be raised without increasing pressures on the soft clay foundations. Construction details for these projects have been described in previous reports (1, 2). Because the use of Elastizell is experimental, its performance is being observed closely and periodic condition surveys will be made, particularly to monitor moisture content and density of the Elastizell fill, and to measure any settlement of the approaches or lateral movement of the abutments. This report describes the condition of the fills approximately one year after construction.

Movement of Bridge Abutments

Although reference bench marks were carefully established at the time of construction for measuring any lateral movements of the bridge abutments, first year measurements could not be made because the reference points at each bridge site had been removed either during construction activities or, subsequently, by vandals. In one case a power pole with reference points attached was removed and relocated by the utility company.

Due to the unstable soil conditions at each bridge site, considerable time and cost would be required to establish suitable permanent reference monuments. Instead, reference points have been established at the two corners of each facing abutment and the distances between them determined. Periodic measurements will indicate any movements of the abutments relative to each other but will not indicate the degree of movement contributed by each. If movement is indicated, it may then be worth the cost of placing permanent reference points for the more accurate measurement of the movement of each abutment. Absence of general settlement in the approach pavements, however, indicates that to date there has been no movement of the abutments.

Approach Elevation Measurements

Elevations of the approach to the bridges were obtained at 30-ft intervals along the centerline of the roadway over the Elastizell concrete fill and, in general, there is no indication of settlement in it. Localized settlements of from 1/2 to 3/4 in. were found adjoining the east approach abutment of the Waiska River bridge and at the north approach to the Pine River bridge, but these are believed to be in the sand fill covering the Elastizell. These areas will be checked closely during the next inspection in an effort to isolate the cause. Individual elevations for each job are given in Table 1.

TABLE 1

SUMMARY OF BRIDGE APPROACH ELEVATIONS FOR THE M 28 WAISKA RIVER BRIDGE AND THE M 29 PINE RIVER BRIDGE

Waiska River, M 28
East Approach Along Pavement Centerline

Location		Elevation, ft	
Number	Station	10-7-76	9-22-77
Pav't Seat At Abutment	73+05	621.42	621.38
1	73+08	621.43	621.35
2	73+38	621.56	621.51
3	73+68	621.91	621.87
4	73+98	622.12	622.08
5	74+28	622.46	622.42
6	74+58	622.78	622.75
7	74+88	623.08	623.06
8	75+18	623.42	623.39
9	75+48	623.70	623.69
10	75+78	623.99	623.98
11	76+08	624.34	624.31

Pine River, M 29
Elevations Taken at Edge of Pavement

	North Approach				South Approach	
	Station	Elevation, ft 6-9-77	9-7-77	1-5-78	Station	Elevation, ft 1-5-78
Northbound	82+87	590.87	590.86	590.90	80+87.7	590.78
	83+00	590.62	590.62	590.64	80+59	590.17
	83+31	589.84	589.87	589.85	80+29	589.41
	83+61	588.92	588.91	588.93	79+99	588.82
	83+91	587.97	587.97	587.96		
	84+21	587.19	587.20	587.17		
Southbound	82+87	590.88	590.87	590.89	80+87	590.78
	83+00	590.58	590.59	590.59	80+57	590.13
	83+31	589.78	589.81	589.78	80+27	589.35
	83+61	588.77	588.82	588.73	80+00	588.82
	83+91	587.84	587.92	587.79		
	84+21	587.43	587.49	587.36		

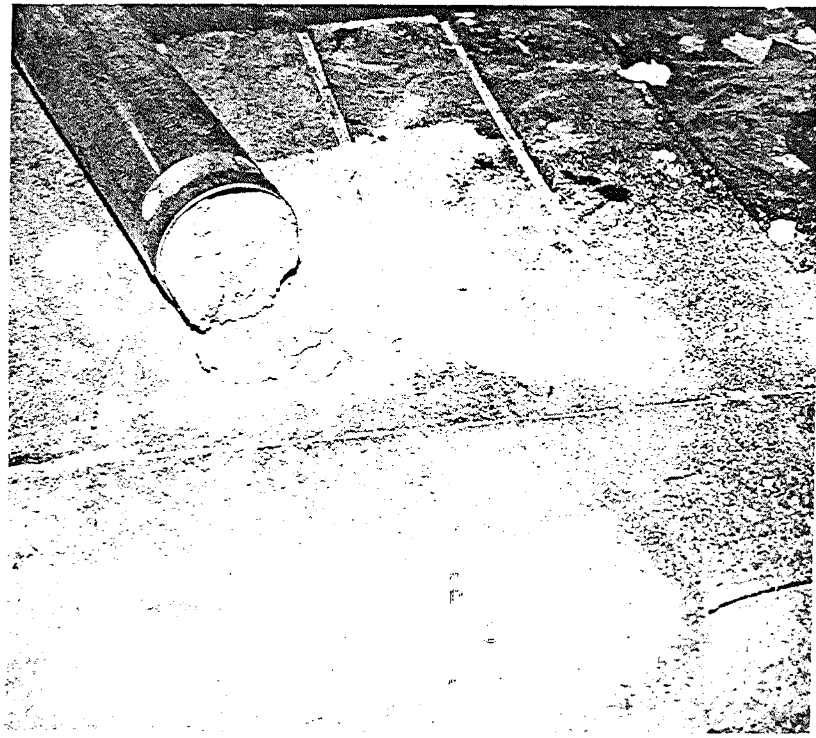
Properties of the Elastizell Fill

Various properties of the Elastizell fill were determined by testing the in-place material. Samples were obtained by driving 3-in. diameter Shelby tubes into the Elastizell at four test sites with a 140-lb hammer. Each tube contained about a 3-ft length of sample. Figure 1 shows an Elastizell sample in a section of tubing.

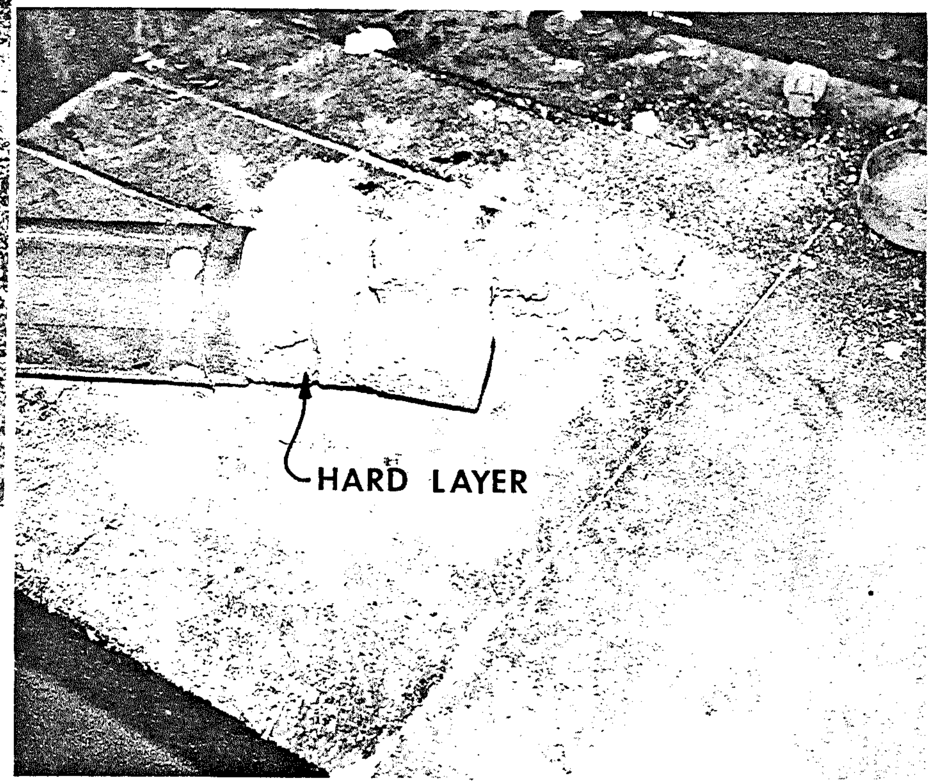
A large number of the sample cores were either cracked, so that compression strengths could not be determined, or were so weak and powdery that proper test samples could not be obtained. Generally, the soft material was associated with a thin, hard, dense layer of portland cement paste, as shown in Figure 1. The material above the hard layer was so weak it could not be handled without crumbling to a powder. This condition indicates that the portland cement had, in some cases, settled to the bottom of a pour leaving cell walls of the layer extremely thin and weak. Why this occurs in some cases and not in others is not known. Inadequate control of the quality and mixing of individual batches of Elastizell could be responsible for the lack of uniformity. Because of the overall structural integrity of the fill, it is assumed that the weak layers are localized and probably represent only a small percentage of the total pour.

Figures 2 and 3 show profiles of the Elastizell fills at both the Waiska River and the Pine River jobs as obtained from the sampling tubes. Moisture content, density, and compressive strength data for individual samples cut from the profile, are summarized in Tables 2 and 3. These data indicate that the in-place density of the Elastizell fill, as a whole, is below the 35 lb/cu ft design density. Neither the densities nor the moisture content values show that moisture is being absorbed by the fill. This important characteristic will be followed closely, however. In general, the moisture contents are fairly uniform throughout the fills with no consistent differential between the tops and bottoms. The Waiska River fill has a moisture content higher than that of the Pine River fill, the reason for which is unknown.

Compressive strengths of 32 samples which were firm enough to be tested, are all well above the minimum allowable 20 psi. In spite of the presence of locally weak areas, the overall strengths of the Elastizell fills appear to be satisfactory. It is felt that most of such weaker areas could be eliminated in future work by closer control by the contractor of the batch mixing.



Soft crumbled layer of lightweight concrete apparently caused by too much foam in the mix.



Hard white layer of portland cement paste with no foam cells as normally found below soft crumbled layers.

Figure 1. Shelby tube samples showing a soft Elastizell layer and the associated hard layer.

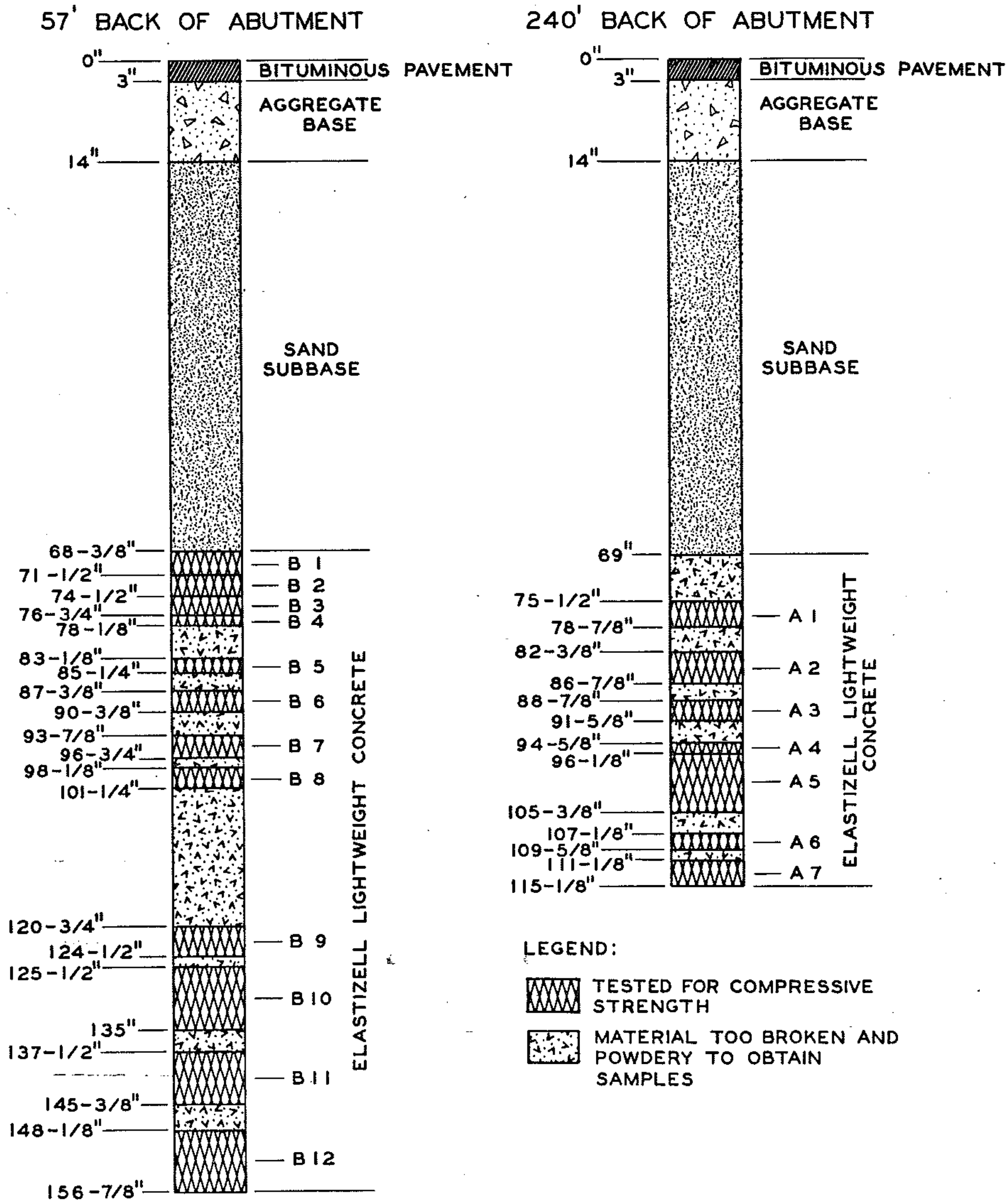


Figure 2. Profile of the east approach fill of the M 28 Waiska River bridge (not to scale).

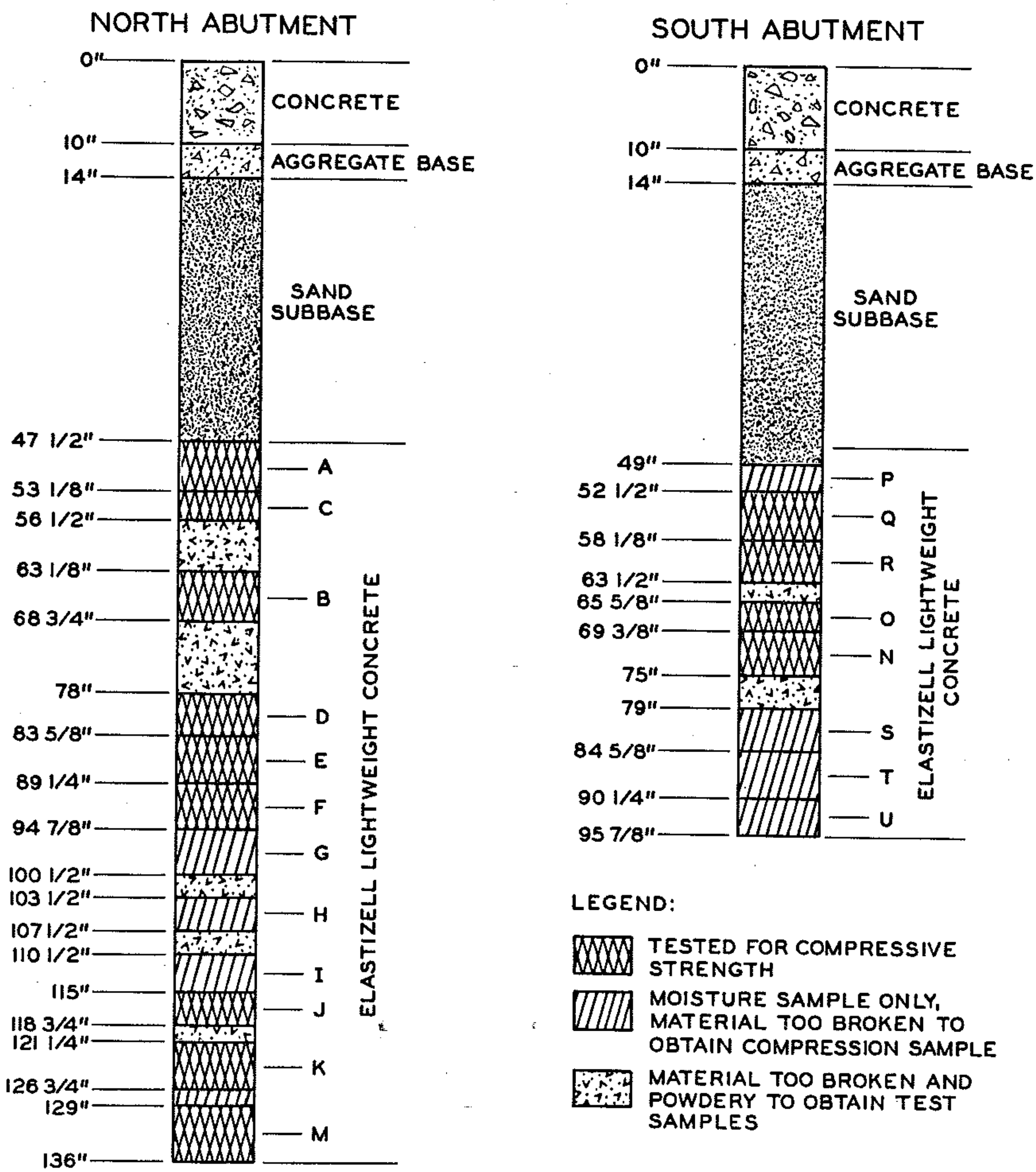


Figure 3. Profile of the north and south approach abutments of the M 29 Pine River bridge (not to scale).

TABLE 2
TEST RESULTS OF SAMPLES TAKEN FROM EAST APPROACH OF M 28, WAISKA RIVER BRIDGE

	Sample No.	Depth, in.	Water, percent	In-Place Density, lb/cu ft	Dry Density, lb/cu ft	Compressive Strength, psi	Failure Type
North Side, 57 ft From Abutment	B1	68-3/8 - 71-1/8	48.0	28.7	19.3	31	Crushing
	B2	71-1/2 - 74-1/8	43.9	28.7	19.9	75	Crushing
	B3	74-1/2 - 76-1/2	35.2	27.9	20.7	64	Crushing
	B4	76-3/4 - 78-1/8	53.2	28.8	18.8	71	Crushing
	B5	83-1/8 - 85-1/4	57.1	28.9	18.4	44	Crushing
	B6	87-3/8 - 90-3/8	42.2	33.7	23.6	132	Crushing
	B7	93-7/8 - 96-3/4	46.2	33.3	22.8	67	Shear
	B8	98-1/8 - 101-1/4	39.1	24.6	17.8	79	Crushing
	B9	120-3/4 - 124-1/2	42.0	31.3	22.0	113	Crushing
	B10	125-1/2 - 135	40.3	25.1	17.9	78	Crushing
	B11	137-1/2 - 145-3/8	35.5	33.0	24.3	192	Crushing
	B12	148-1/8 - 156-7/8	46.7	32.2	22.0	160	Shear
North Side, 240 ft From Abutment	A1	75-1/2 - 78-7/8	50.4	32.0	21.2	100	Crushing
	A2	82-3/8 - 86-7/8	51.0	28.7	18.9	127	Crushing
	A3	88-7/8 - 91-5/8	47.2	28.0	19.0	112	Crushing
	A4	94-5/8 - 96-1/8	41.8	36.2	25.7	118	Crushing
	A5	97-1/8 - 105-3/8	59.3	35.5	22.2	142	Shear
	A6	107-1/8 - 109-5/8	66.6	38.2	23.0	130	Crushing
	A7	111-1/8 - 115-1/8	70.2	39.4	23.1	93	Crushing

TABLE 3
TEST RESULTS OF SAMPLES TAKEN FROM THE NORTH AND SOUTH APPROACHES OF THE M 29, PINE RIVER BRIDGE

	Sample No.	Depth, in.	Water, percent	In-Place Density, lb/cu ft	Dry Density, lb/cu ft	Compressive Strength, psi	Failure Type
North Abutment (East Side)	A	47-1/2 - 53-1/8	31.7	27.5	20.9	159	Shear
	B	63-1/8 - 68-3/4	33.4	27.5	20.6	118	Crushing
	C	53-1/8 - 56-1/2	33.8	27.4	20.5	106	Crushing
	D	78 - 83-5/8	30.5	26.3	20.2	128	Crushing
	E	83-5/8 - 89-1/4	29.7	32.4	25.1	141	Shear
	F	89-1/4 - 94-7/8	29.6	29.4	22.7	111	Crushing
	G	94-7/8 - 100-1/2	29.9	--	--	---	*
	H	103-1/2 - 107-1/2	28.8	--	--	---	*
	I	110-1/2 - 115	30.0	--	--	---	*
	J	115 - 118-3/4	33.9	27.4	20.4	66	Crushing
	K	121-1/4 - 126-3/4	40.3	27.4	19.5	92	Crushing
	L	127 - 129	42.4	--	--	---	*
	M	130-1/2 - 136	39.9	37.6	26.9	190	Shear
South Abutment (East Side)	P	49 - 52	44.0	--	--	---	*
	Q	52-1/2 - 58-1/8	34.2	27.4	20.4	92	Crushing
	R	58-1/8 - 63-1/2	37.4	28.1	20.4	71	Crushing
	O	65-5/8 - 69-3/8	33.9	25.3	18.9	148	Shear
	N	69-3/8 - 75	40.4	29.3	20.8	81	Crushing
	S	79 - 84-5/8	36.7	--	--	---	*
	T	84-5/8 - 90-1/4	36.9	--	--	---	*
	U	90-1/4 - 95-7/8	32.7	--	--	---	*

* Unable to test.

Conclusions

The Pine River and Waiska River Elastizell lightweight fill projects were inspected and tested after one year in place. The following conclusions and comments appear warranted at this time:

1) In general, Elastizell concrete appears to be a satisfactory lightweight fill material. The fills are of adequate strength, remain lighter than the design unit weight, are not absorbing water and no serious settlements have been noted.

2) Although structurally sound, the Elastizell fills contain a large number of soft, powdery areas having little or no support value. To date, these have not appeared to be damaging, but they should certainly be eliminated, or minimized, by closer batch mixing control on future jobs.

3) No conclusions concerning the long-term performance of Elastizell can be made at this time. Sampling and testing of the fills will continue in order to monitor any changes in settlement, in-place density, or moisture content that may take place with continued exposure.

REFERENCES

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3. Mainfort, R. C., "Laboratory Evaluation of 'Elastizell' as a Lightweight Fill," Michigan Department of State Highways and Transportation, Research Report No. R-956, January 1975.