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AN EVALUATION OF HINGED WIRE MESH REINFORCEMENT FOR CONCRETE PAVEMENT

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In connection with discussions of hinged wire mesh reinforcement for concrete pavements by the Committee for Investigation of New Materials, in January 1960 and at subsequent meetings, the Research Laboratory Division was requested to compare certain properties of hinged and standard reinforcement.

The hinged reinforcement under investigation was manufactured by the Pittsburgh Steel Company, Pittsburgh, Pennsylvania. The hinges consisted of one and one-half turns of each transverse wire on a standard 12-ft mat width, wound around the center longitudinal wire. Thus, a hinge occurred every 12 in. along the center longitudinal reinforcing wire.

The purpose of this investigation was to evaluate the effect of such a hinge on performance of the wire mesh as concrete pavement reinforcement. Two series of tests were conducted to compare the load deformation characteristics of the hinged material with standard welded reinforcement fabricated by the same manufacturer. Series 1 was a pilot series to determine probable failure loads and failure types. Series 2 incorporated modifications of instrumentation and specimen preparation. The specimens used in both test series were identical in size and shape, cut from samples obtained from the manufacturer. These specimens were of four types:

1. Longitudinal wire with standard welded joints
2. Longitudinal wire with hinged joints
3. Transverse wire with standard welded joints
4. Transverse wire with hinged joints.

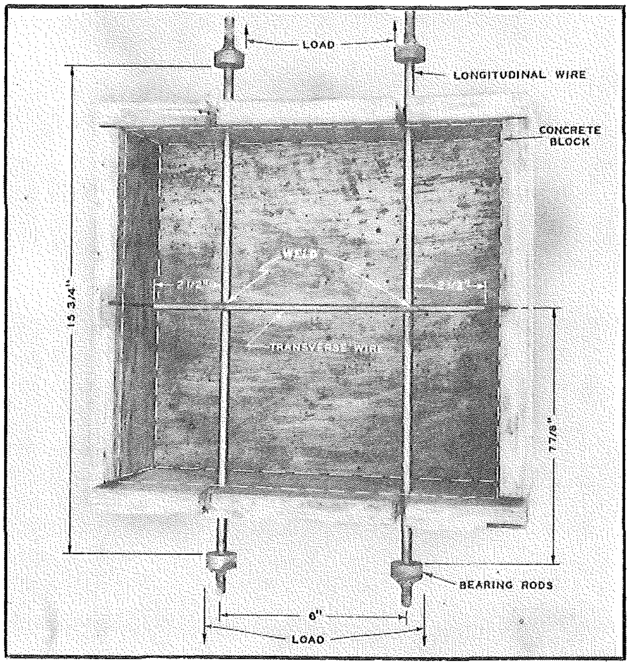
Five test specimens were prepared for each of these four types. Each longitudinal specimen had two longitudinal wires attached to a crosswire, and each transverse specimen consisted of a single transverse wire attached to a crosswire (Fig. 1).

<u>Test Procedure</u>

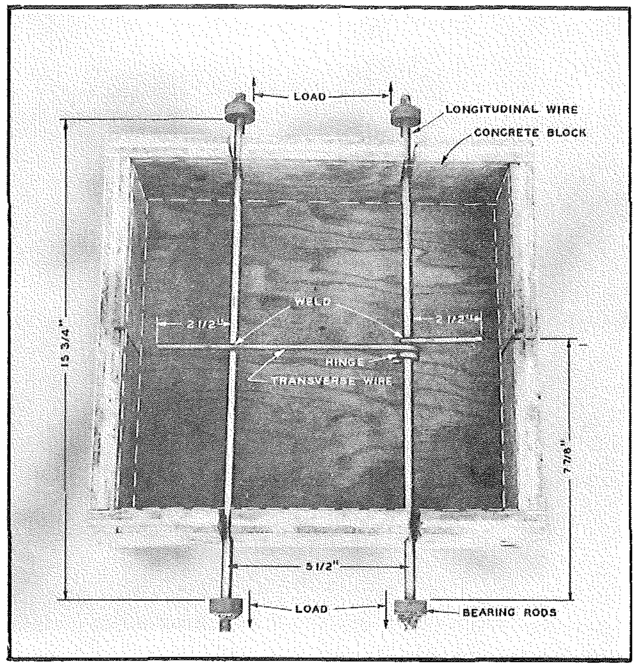
Each wire specimen was placed in a wooden form box and cast in concrete for the deformation tests. The concrete blocks were partially sawed and then precracked at the crosswire. Tensile loads were applied through a jig on each longitudinal wire, and directly to each transverse wire; typical set-ups are shown in Fig. 2. Deformations across the preformed crack were measured on all four faces of the block. Mechanical strain gages with specially designed adapters were attached to embedded metal plugs, 2-in. apart and centered on the crack. All four gages were read simultaneously and recorded along with the load. The average of the four gages was considered the average crack opening.

<u>Test Results</u>

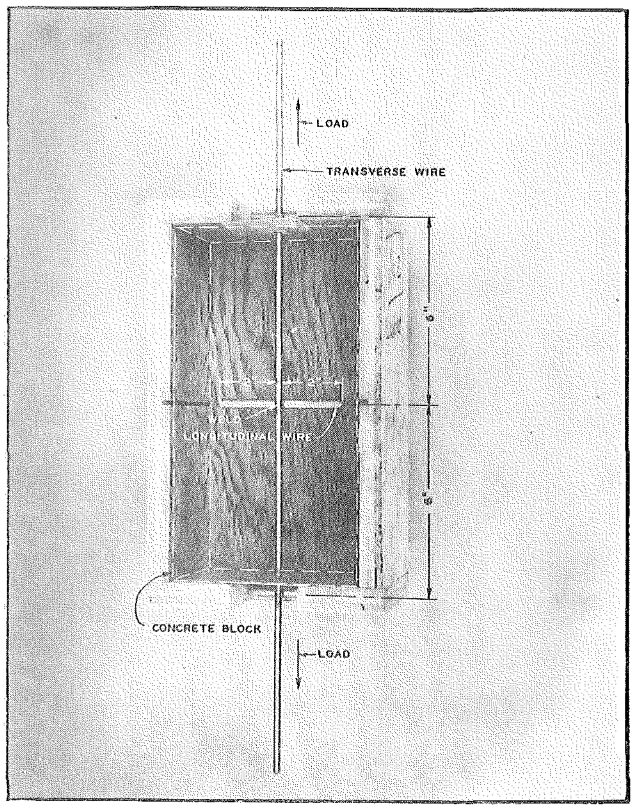
Ultimate loads and methods of failure in the transverse and longitudinal wire tests for five specimens each of the hinged and standard



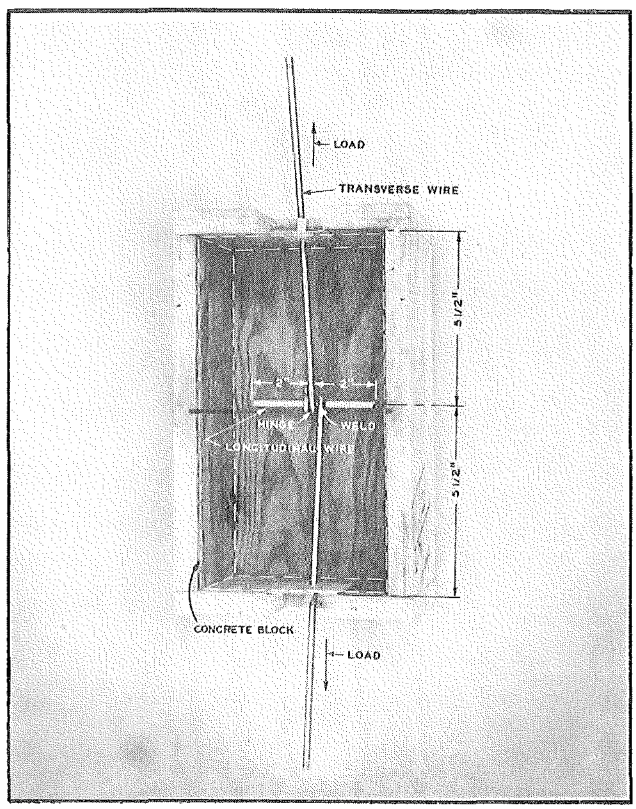
Specimen 1. Standard Longitudinal



Specimen 2. Hinged Longitudinal



Specimen 3. Standard Transverse



Specimen 4. Hinged Transverse

Figure 1. Views of specimens mounted in form boxes for concrete test blocks.

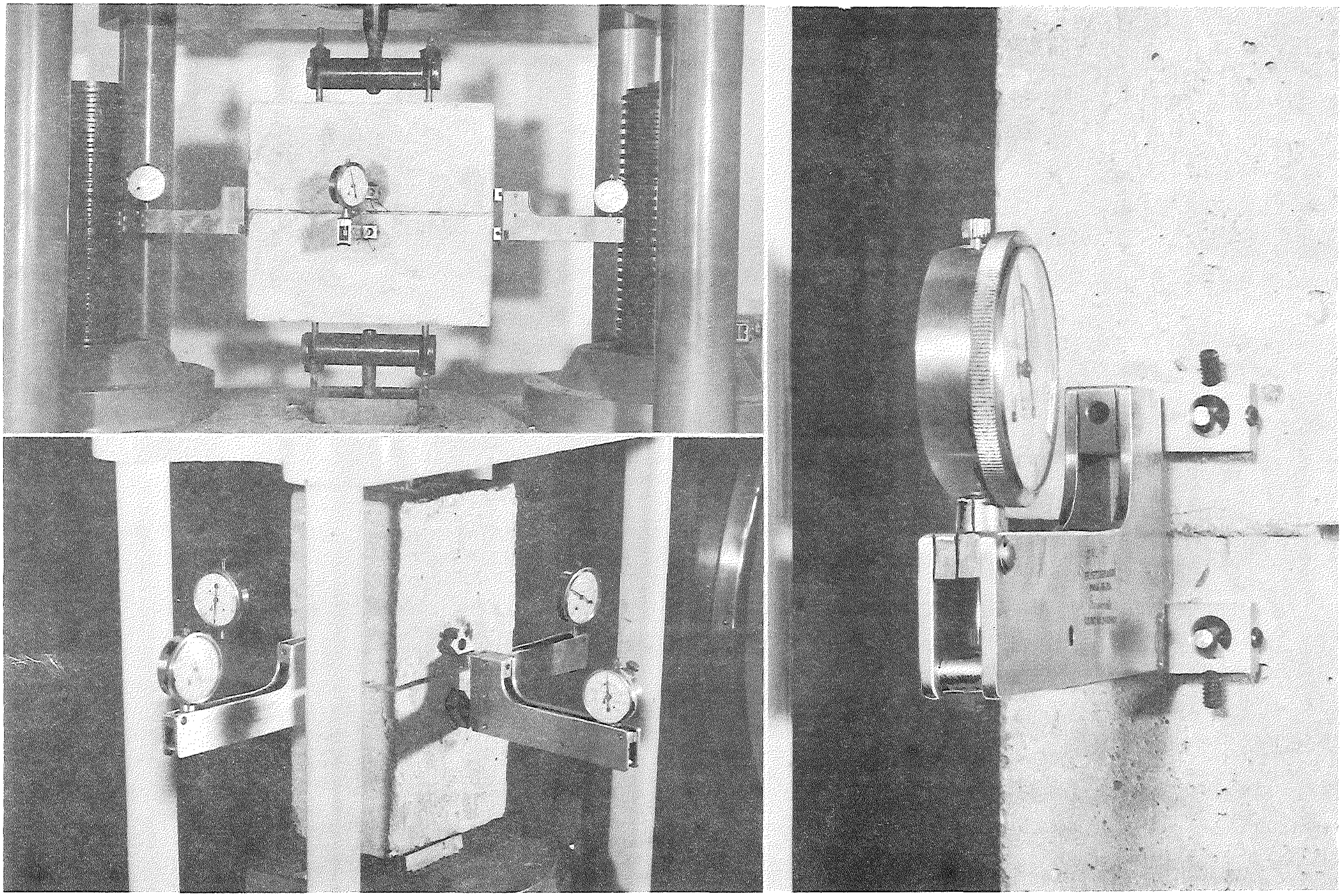


Figure 2. Typical test setups for specimens of longitudinal wire (upper left) and transverse wire (lower left) mounted in sawed and precracked concrete blocks. Typical strain gage instrumentation on a longitudinal specimen is shown at right.

TABLE 1
LONGITUDINAL WIRE TEST

Specimen No.	Type	Test Series	Ultimate Load, pounds	Type of Failure
1	Hinged	2	10,800	1 in. from weld junction inside concrete block
2	Hinged	2	12,500	At weld junction outside concrete block
3	Hinged	2	12,900	
4	Hinged	1	10,900	
5	Hinged	1	12,450	At weld junction inside concrete block
			11,910	Average (Hinged)
6	Standard	2	11,500	At weld junction outside concrete block
7	Standard	2	11,900	
8	Standard	2	12,700	
9	Standard	1	14,200	
10	Standard	1	13,400	
			12,740	Average (Standard)

TABLE 2
TRANSVERSE WIRE TEST

Specimen No.	Type	Test Series	Ultimate Load, pounds	Type of Failure
1	Hinged	2	2060	At weld junction inside concrete block, hinge unwould one turn
2	Hinged	2	1940	At weld junction inside concrete block
3	Hinged	2	2350	
4	Hinged	1	1280	Hinge unwound
5	Hinged	1	1680	
			1860	Average (Hinged)
6	Standard	2	2950	At weld junction inside concrete block
7	Standard	2	3050	At weld junction outside concrete block
8	Standard	2	3080	
9	Standard	1	3080	
10	Standard	1	3140	
			3060	Average (Standard)

mesh sections are tabulated in Tables 1 and 2. The results of the load-deformation tests are plotted in Figs. 3 and 4 for the longitudinal and transverse wire specimens, respectively.

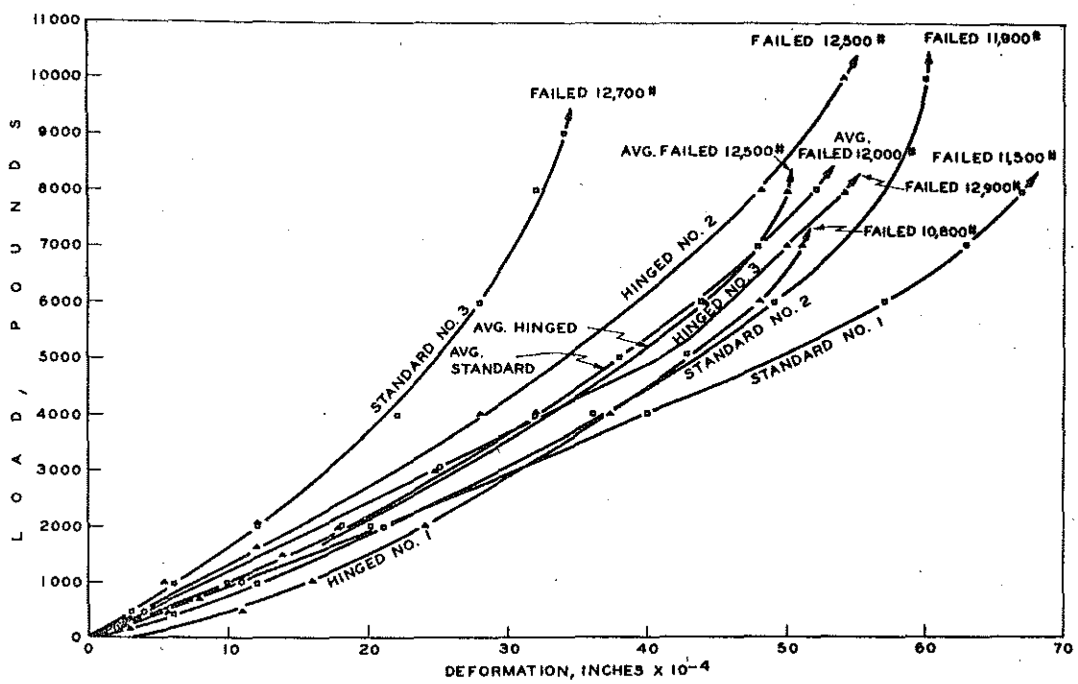


Figure 3. Results of load deformation tests of longitudinal wires, Series 2.

The average deformation across the crack per unit load for both the hinged and standard longitudinal wire specimens was essentially the same (Fig. 3). Table 1 shows that average ultimate load resistance of the hinged longitudinal wire was 11,910 lb, or 93 percent of the average ultimate load resistance of 12,740 lb for the standard mesh specimens.

Table 2 reveals a considerable difference in the average ultimate load resistances of the hinged and standard transverse wire specimens. Ultimate load resistance of the hinged transverse wire was 1860 lb, or 64

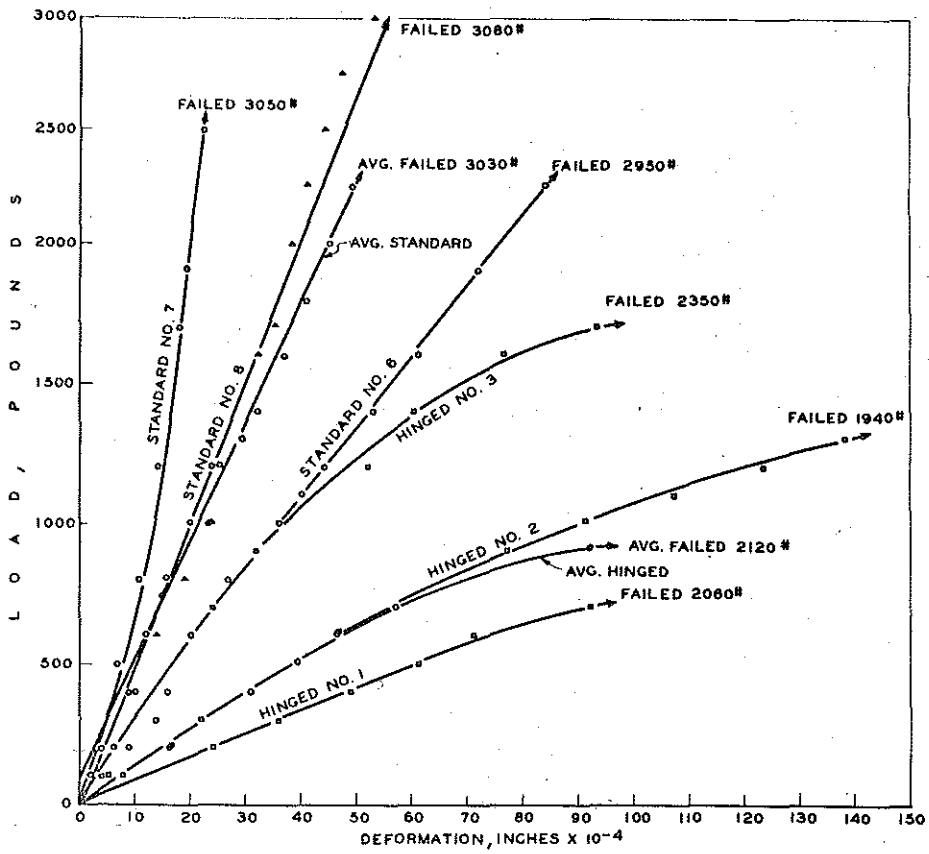


Figure 4. Results of load deformation tests of transverse wires, Series 2.

percent of the average ultimate load resistance of 3060 lb for the standard mesh.

The load-deformation characteristics of the hinged and standard transverse specimens also differed considerably (Fig. 4). Average deformation across the crack per unit load for the hinged transverse wire was 3.7 times greater than for standard transverse wire.

Conclusions

In a properly designed reinforced concrete pavement, the steel holds cracks tightly closed. Therefore, if hinged mesh is to perform effectively in reducing crack width opening, it must have the equivalent load-deformation characteristics of the standard wire mesh.

Both the standard and hinged mesh were assumed to be composed of a series of repeatable sections. The specimens chosen for investigation are repeatable and it was assumed that each specimen would act as any other specimen in the mat.

The tests show that the effect of the crosswire hinge on deformation and ultimate load resistance of the longitudinal wire is negligible (Fig. 3). The presence of the hinge would have no adverse effect on deformations across a transverse pavement crack, and in this respect hinged mesh would be equivalent to the standard mesh reinforcement.

The effect of the hinge on deformation and ultimate load resistance of the transverse wire, however, is significant. Depending on the location of the crack with respect to the hinge, it is possible that the hinge will unwind (Table 1). Unwinding of the hinge occurred at a relatively low load and with a great deal more deformation. Typical failures by unwinding of the transverse wire hinge are shown in Fig. 5. Note the extreme deformations that occurred at the relatively low loads of 1280 and 1680 lb. Deformation across the crack with the hinged wire was more than three and one-half times greater than crack deformation with standard mesh (Fig. 4).

At the weld junction adjacent to the hinge, the hinged specimens failed at two-thirds the failure load of standard specimens. Bending of

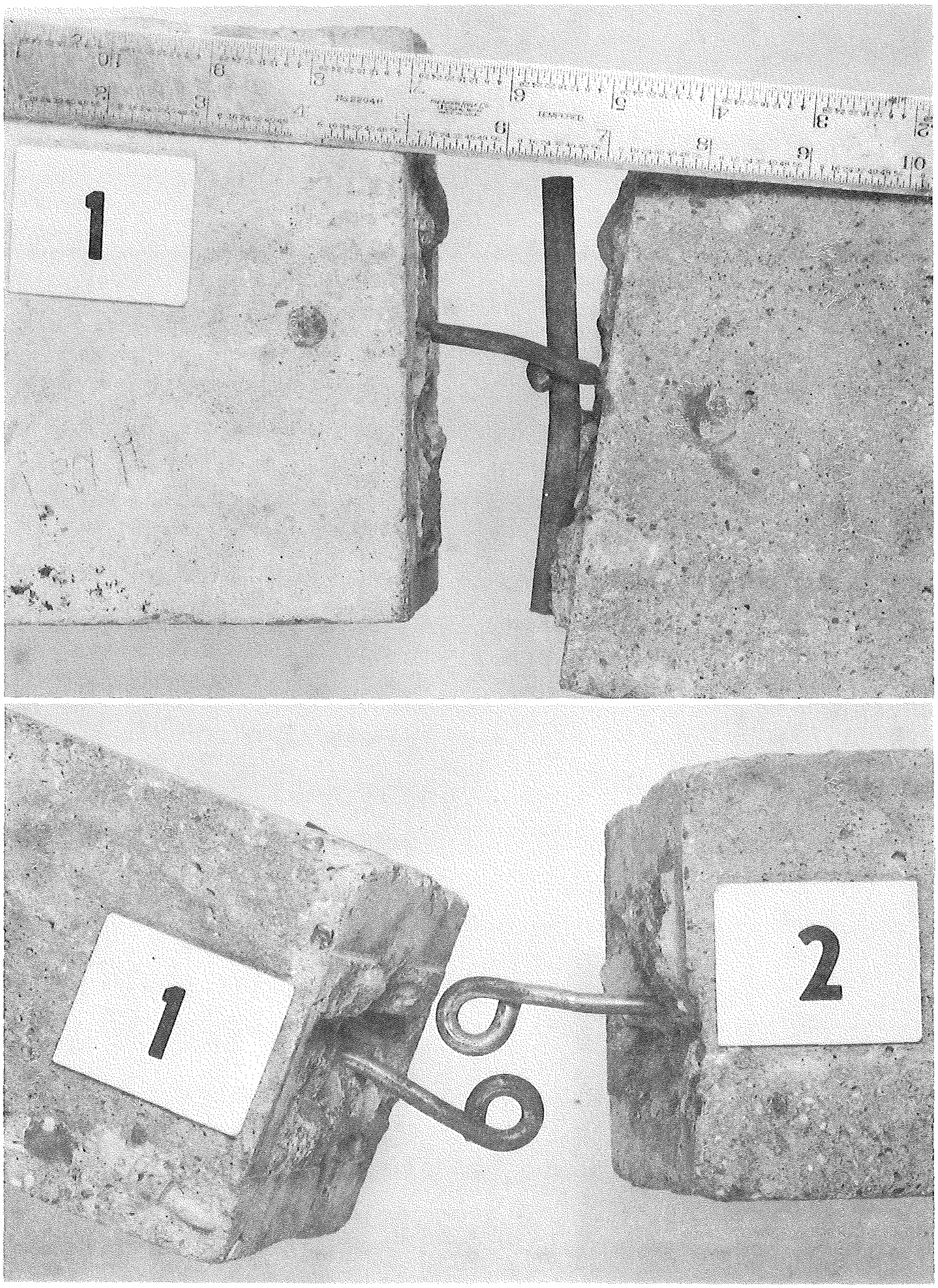


Figure 5. Typical failures of transverse wire specimens. Specimen 1 (above and left below) unwound at a load of 1280 lb and Specimen 2 (right, below) at 1680 lb.

the transverse wire as the hinge rotated about the longitudinal wire produced greater stress at this point.

On the basis of these tests it is concluded that the hinged wire mesh is not equivalent to standard wire mesh reinforcement. Should a longitudinal crack occur at the hinge, the reinforcement would offer little resistance to crack opening.