PROPOSED STANDARD METHOD FOR DYNAMIC TESTING OF REINFORCED CONCRETE MEMBERS AND FOR PRESENTATION OF TEST RESULTS

by

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SYNOPSIS

Dynamic testing of reinforced concrete structural components is time consuming and expensive. Comparative study and evaluation of the numerous dynamic test results reported by various investigators throughout the world is difficult, because their applied loadings vary, and their test results are often shown as dimensionalized force-displacement hysterisis curves. To facilitate the dissemination of the knowledge gained from testing, the loading pattern and methods of presentation of test results should be standardized for universal use in a similar fashion as the column curves or S-N curve in fatigue testing are standardized. In this paper for displacement-controlled dynamic component testing, a standard applied displacement sequence is proposed. Also, two non-dimensional curves and three non-dimensional scalar indices are suggested for standard presentation of test results.

THE METHOD OF LOADING AND PRESENTATION OF TEST RESULTS

The proposed symmetrical displacement sequence shown in Fig. 1 is found to be suitable to be used as a standard loading pattern in displacement-controlled testing of reinforced concrete structural components with brittle or ductile failure-modes. The magnitude of the successive imposed displacements in the proposed sequence follows the following Fibonaci-type series:

d ⟶ 0.5, 1, 1.5, 2.5, 4, 6.5, 10.5, 17, 27.5, 44.5, 72 . . .

where d=D/Dy is the displacement index. D and Dy are defined in Fig. 1. At each displacement level of the sequence four load cycles are carried out.

It is proposed that the test results should be presented by means of a force-displacement hysterisis curve (S-d), a strength degradation versus number of cycles curve (S-N), and the three indices e, d_u, and d_n representing the energy absorbing capacity, the failure displacement index, and the nominal ductility, respectively. Two idealized samples of proposed (S-d) hysterisis curves are shown in Fig. 2-a and 2-b. On the abscissa displacement index d= D/Dy, and on the ordinate, force index S=F/Fy are shown. F and Fy are defined in Fig. 2. The displacement sequence of Fig. 1 is used for the generation of these hysterisis curves. Two samples of proposed (S-N) curves for presentation of strength degradation are shown in Fig. 3. On the abscissa the number of cycles and on the ordinate the strength index, S, obtained from Fig. 2 are shown. The energy absorbing capacity or toughness index, e, is defined as the cumulative sum of the areas contained by the non-dimensional hysterisis loops, shown in Fig. 2 up to and including the Nth cycle at which the test specimen fails. The failure is defined as when the maximum strength of the member, in a cycle in any direction, becomes less than ten percent of its yield strength. The ultimate displacement index d_u is defined as the displacement index at which the failure occurs. The nominal ductility factor $d_n=1+(e/2N)$ is defined as the maximum displacement index of a hysterisis loop, constructed of an elastic-perfectly plastic material on the basis of Clough's hysterisis rules, which absorbs an equivalent amount of energy e, during N cycles of oscillation. The significance of these factors and discussion of other relevant curves and indices will be given in a more detailed paper.

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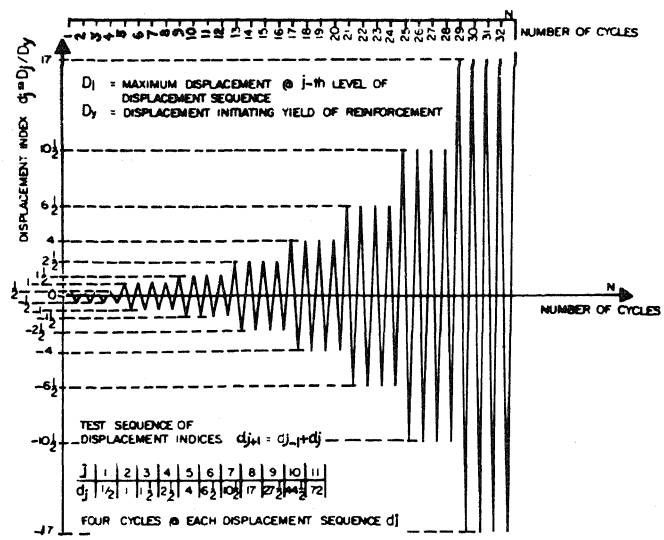

FIG. 1 PROPOSED SEQUENCE OF IMPOSED DISPLACEMENTS FOR TESTING R.C. SPECIMEN IN DISPLACEMENT- CONTROLLED DYNAMIC TESTING

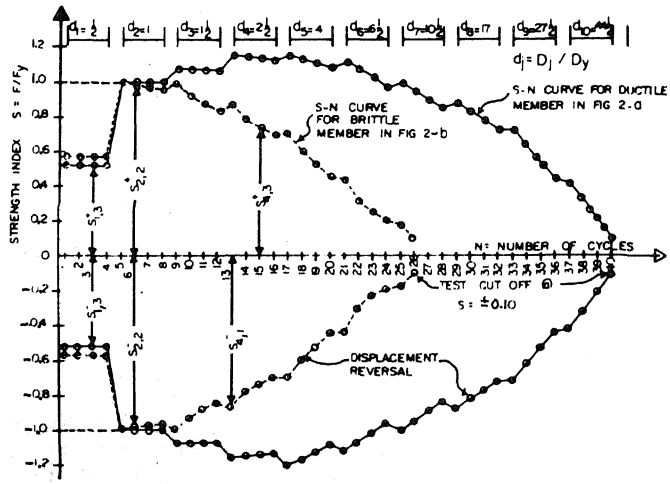

FIG. 3 TYPICAL CURVES FOR PRESENTATION OF STRENGTH DEGRADATION VERSUS NUMBER OF CYCLES (S-N CURVE)

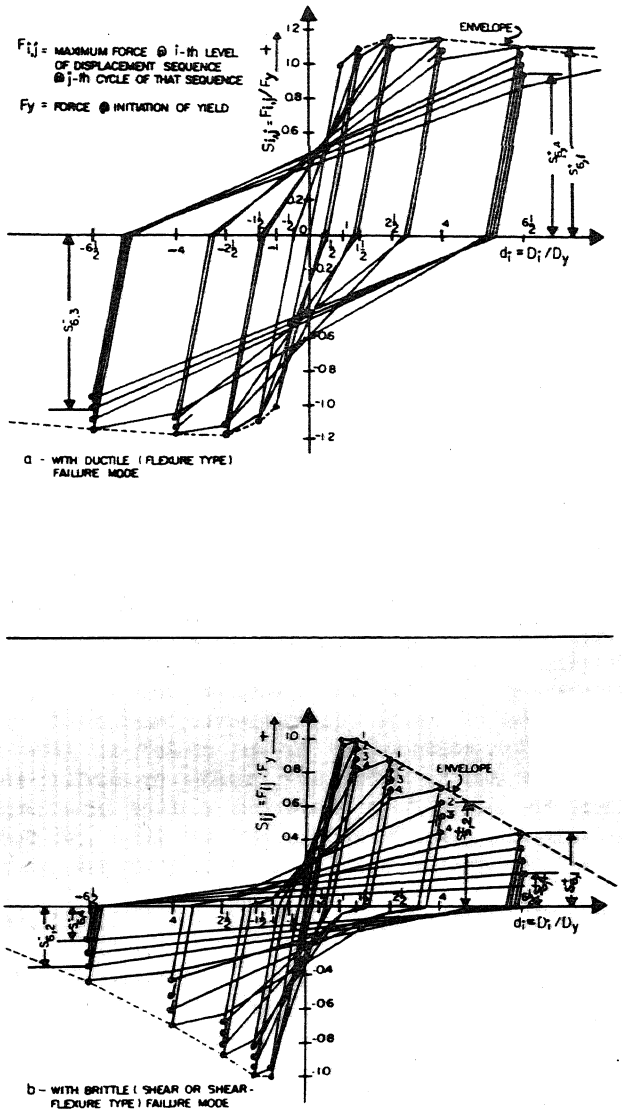

FIG. 2 IDEALIZED FORCE-DISPLACEMENT (S-d) OR HYSTERISIS CURVES FOR TYPICAL REINFORCED CONCRETE MEMBERS