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Headquarters
National Aeronautics and
Space Administration
1520 H. Street, N. W.
Washington 25, D. C.

Attention: Mr. Norman J. Mayer

Subject: NASA Contract No. NASr-65(04)
Fifth Quarterly Status Report
IITRI Project M 6046
"Applications of Prestressed Segmented
Brittle Materials in Aerospace Structures".

Gentlemen:

With the extension contract in effect as of June, our initial efforts have been directed towards resolving the segment interface problem. We consider this to be the central problem in quantitatively prediciting the behavior of simple prestressed members. The problem is being attacked from two points of view: (1) Attempting to achieve perfect contact between segments; (2) Determining methods to predict equivalent contact areas and their subsequent equivalent moments of inertia for imperfect contact between segments.

In our investigation of methods of producing "perfect interface match up", we have been unable to locate a source of glass segments with the required flatness and efforts to slice up glass blocks into matching segments have not produced satisfactory surfaces. We have decided to go to TiC precision gage blocks which can be readily obtained with a flatness of one-half light band on the 1" x 2" surfaces of the 1" x 2" x. 25" size. These gage blocks will be combined to form a beam approximately 20" long.

When imperfect contact exists between segments, it becomes necessary to modify the theory. The easiest way of incorporating the effects of imperfect contact is by utilizing effective properties such as an effective

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cross sectional area and its effective moment of inertia. These effective properties may be determined experimentally. The effective cross sectional area may be deduced from the load-deflection curves of a segmented column using the monolithic value of the modulus of elasticity. Similarly the effective moment of inertia can be deduced from a terminal couple-end rotation curve of a segmented beam.

Research under the original contract indicated that the ultimate stress obtainable in a segmented column was dependent upon the size of the segments - smaller size corresponding to larger stress. Consequently it is anticipated that the effective area-effective moment of inertia problem will also exhibit size dependence. Experiments on various size columns are being designed to measure the size effect. Also it may be possible to use extreme value statistics to analyze perhaps both the size effect and the relationship between the effective moment of inertia and the effective cross sectional area.

In another area, work is currently in progress to design tests to compare with the theory of prestressed monolithic brittle members. As currently envisioned, 100 to 200 nominally identical plaster beams will be prestressed and loaded to failure.

Respectfully submitted,

IIT RESEARCH INSTITUTE

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