Int. J. Solids Structures Vol. 20, No. 4, pp. 415 416, 1984
Printed in Great Britain.

0020-7683/84 $3.00 + .00
Pergamon Press Ltd.

REPLY TO DISCUSSION

AUTHOR'S REPLY TO O. VILNAY'S DISCUSSION OF "MODAL STIFFNESSES OF A PRETENSIONED CABLE NET", BY C. R. CALLADINE. *INT. J. SOLIDS STRUCTURES* 18, 829–846 (1982)

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(*Received* 31 *March* 1983)

Vilnay's remarks have so little bearing on the substance of my paper that I find it difficult to frame a reply to them. I give comments below on various of his paragraphs, in order.

Paragraphs 1–3. I am well aware that cable nets do not fall within the scope of the term "tensegrity" as defined by R. B. Fuller in his Patent application; which is why I did not use this term in the present paper. But, as Dr. Vilnay acknowledges, in terms of the underlying *mechanics*, cable-nets and "tensegrity" structures are closely related.

Paragraph 4. I do give a reason, at the bottom of p. 831, for my statement $s = 1$. In "ordinary" mechanisms, with which we are all familiar, $s = 0$: it is only in *special cases* of a kind first foreseen by Maxwell (see my Ref. [5]) that $s \neq 0$. There is nothing particularly noteworthy or difficult about the observation that $s = 0$ in a "loose" mechanism.

Paragraphs 5–10. Here Vilnay gives a short account of his work (adequately described in his Refs. [6, 7]), interspersed with various remarks about mine.

Paragraph 5. A central idea in Vilnay's work is that an assembly is "stable' (i.e. has a unique geometrical configuration when under zero external load) when it satisfies the two conditions listed. It is not clear what forms the basis of this assertion. That the two conditions are *insufficient* to guarantee "stability" may be seen from the example shown in Fig. 1, which was suggested by Tarnai (Ref. [A]): although it satisfies both (1) and (2) it can distort freely in a "large-displacement mechanism" in which F and H move closer together while E and G move further apart.

Paragraph 7. In his various papers Vilnay consistently uses the term "statically determinate" to mean "number of unknown bar tensions = number of equilibrium equations", i.e. "Maxwell's rule is satisfied". One of the main points of my Ref. [5] was to show that an assembly which satisfies Maxwell's rule is not necessarily statically determinate: it can be simultaneously both "statically indeterminate" and also a "mechanism".

Paragraph 9. Vilnay does not seem to grasp the distinction which I make between the cases when the final bar is (i) too short, or (ii) too long. As I explain in the paper, the assembly (of inextensional bars) cannot be joined up at all in case (i), whereas it becomes a "loose", "ordinary" mechanism in case (ii). All of this can be seen clearly in a simple example such as that given at Fig. 3(a) in my paper, or at Fig. 6 in my Ref. [5].

Paragraph 10. Vilnay goes over ground which I covered in my Ref. [5], and which is epitomised in eqn (2) of my paper. He seems to cavil at my use of the word "mechanism" or "degree of freedom" to describe an "incipient" mechanism. My eqn (2)—which was, I believe, first described in my Ref. [1]—comes directly from the linear algebra of small-displacement analysis. One simply cannot tell without further analysis whether any given mechanism is "incipient" (as in a tight cable net) or "free" (as in the example of Fig. 1).

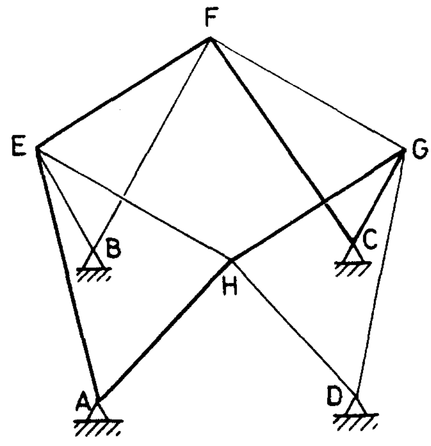

Fig. 1. All members are of equal length. ABCD is a rigid, square base. Members represented by thick lines are rods; members represented by thin lines are strings. The state of prestress has all rods in compression and all strings in tension.

Finally a remark on Vilnay's Ref. [6]. In my view even the title "Determinate tensegric shells" is misleading, since the word "determinate" here means precisely "satisfying Maxwell's rule".

REFERENCE

A. T. Tarnai, Simultaneous static and kinematic indeterminacy of space trusses with cyclic symmetry. *Int. J. Solids Structures*, **16**, 347–359 (1980).