Zeitschrift: IABSE congress report = Rapport du congrès AIPC = IVBH Kongressbericht

Band: 7 (1964)

Artikel: Structural analysis of space frames supporting solid parabolic reflectors

Autor: Best, K.H.

DOI: https://doi.org/10.5169/seals-7947

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. Mehr erfahren

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. En savoir plus

Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. Find out more

Download PDF: 22.02.2026

ETH-Bibliothek Zürich, E-Periodica, https://www.e-periodica.ch

Id2

Structural Analysis of Space Frames Supporting Solid Parabolic Reflectors

Le calcul des ossatures spatiales supportant des réflecteurs paraboliques pleins

Untersuchungen an räumlichen Tragkonstruktionen für Radioteleskope

K. H. BEST[1])

B. Eng., M.I.C.E., M.I. Struct. E., F. ASCE., M. Cons. E., London

Steerable aerials comprising solid steel parabolic reflectors supported and stiffened by complex frameworks are becoming more common throughout the world, and with the recent developments in satellite communications, for which an international agreement was concluded last year, there is greater interest in the techniques for analysing these types of structure.

The principal structural requirement for a steerable radio aerial involves the production of a solid parabolic reflecting surface which has to keep its shape within fine limits, whatever its position in azimuth or elevation, and in many cases under severe loading from high winds.

The precise operational conditions can vary according to the type of instrument, and the tolerances within which a reflector must keep its shape are dependent on the frequency of the radio waves to be either received or transmitted by the instrument.

An aerial used for radio astronomy at a research station can perhaps be put out of action during periods of high winds because it is not usually a vital matter if this type of research activity is interrupted, but on the other hand in the case of an instrument used for satellite communications, the ground station must be fully operational in all kinds of weather if it is to be of any use.

Thus, on the one hand a radio telescope might be designed to keep within the specified deflection limits in winds up to, say, 20 m. p. h., whereas an aerial for tracking satellites might be required to maintain its shape in 80 m. p. h. force winds.

For satellite communications high frequency transmissions are involved, and these require strict specifications for profile accuracy. The permissible tolerance in the shape of a reflector is a function of wavelength, and the shorter the wavelength, the more nearly must the reflecting surface approach the condition of an optical mirror.

The analysis of these structures is almost entirely concerned with calculating

---

[1]) Partner, Husband & Co., Consulting Engineers.

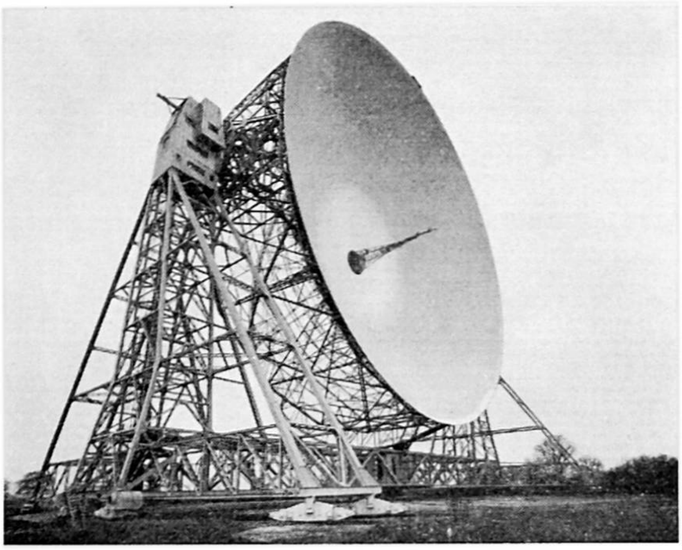

Fig. 1. 250-ft. diameter radio telescope at Jodrell Bank.

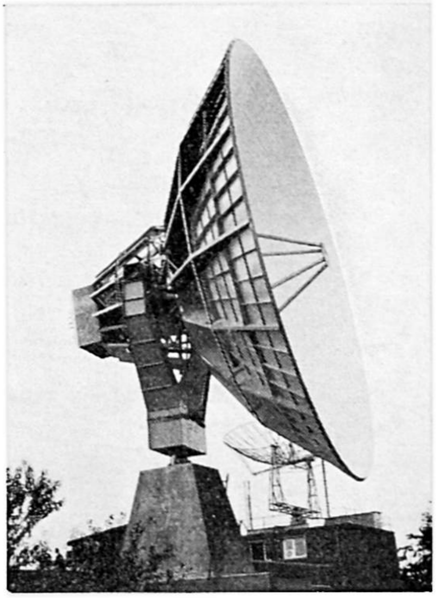

Fig. 2. 50-ft. diameter altazimuth instrument at Jodrell Bank.

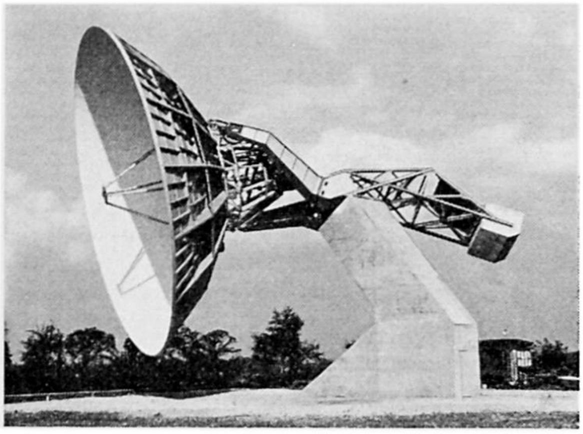

Fig. 3. 50-ft. polar axis instrument at Jodrell Bank.

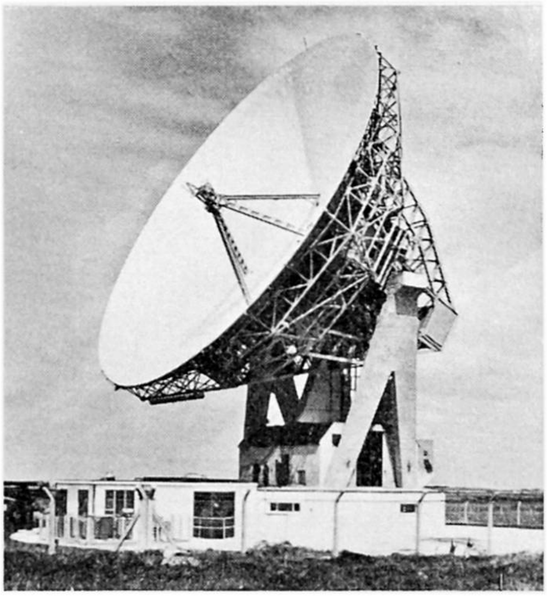

Fig. 4. 85-ft. diameter satellite communications aerial at Goonhilly Downs, Cornwall.

theoretical deflections. The final design must also take account of the best possible constructional accuracy which can be obtained — in other words, part of the shape tolerance is always taken up by fabrication errors.

Fig. 1 to 5 illustrate a few examples of recently completed large steerable aerials in Britain, all designed by Dr. H. C. Husband[2]), from which it will be seen that these structures can be highly complex, with many degrees of redundancy.

---

[2]) Senior Partner, Husband & Co., Consulting Engineers.

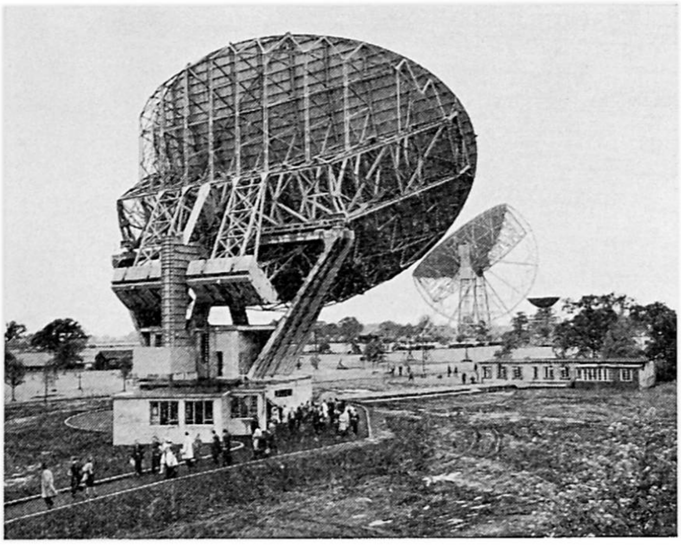

Fig. 5. 125-ft. radio telescope at Jodrell Bank.

These redundancies are of great advantage in limiting deflections, but complicate the deflection calculations. In addition to calculating the stiffness of a system of space frames supporting the reflector and connecting to a counterweighting system, consideration has also to be given to the stiffening effect of the continuous steel membrane.

A further factor which might increase the calculation problem is that sometimes these aerials have to be designed and constructed in an abnormally short time, perhaps to meet the date for a satellite launching. This applied in the case of the British ground station at Goonhilly Downs, which had to be built very quickly in order to be ready to receive the first transmission from Telstar.

These are obviously cases where an electronic computer becomes a useful if not essential tool at the design stage, but there are no available programmes capable of dealing with the comprehensive solution of interconnecting space frames combined with solid membranes of this type.

However, by adopting standard frame programmes which are readily available, the relative stiffnesses of the various components of the structure can be rapidly assessed, and alternative arrangements compared.

This method has the advantage of requiring the designer to exercise proper engineering judgment at all stages of the design process, and this is very useful because there is often a tendency for younger designers to become blinded by the rolls of figures which the machine turns out, and sometimes to treat them as if they were the Word of God.

Summary

This contribution deals with some practical considerations during the structural analysis of particular types of interconnected space frames.

Résumé

Cette contribution traite de quelques problèmes pratiques qui se posent dans le calcul de certains types particuliers de charpentes spatiales solidaires entre elles.

Zusammenfassung

Der Beitrag gibt einige praktische Überlegungen zur baulichen Ausbildung spezieller räumlicher Tragwerke.