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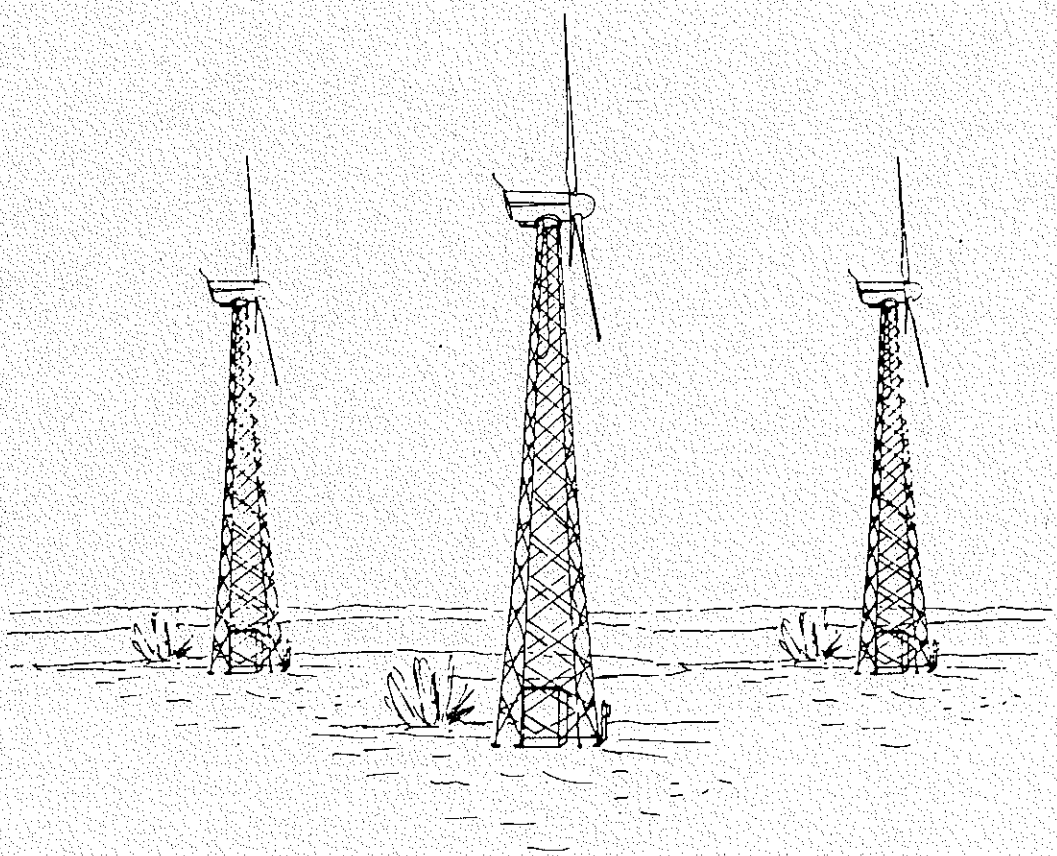
FC

WINDMILL REGULATIONS



VOLUME I

REGULATION ON THE SAFETY OF WINDMILLS

1988

JACOB BUGGE

THE DANISH CENTRE FOR RENEWABLE ENERGY. INT. TEL.: 45 79 56 55 55. INT. FAX: 45 79 56 56 65

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REVIEW OF FC WINDMILL REGULATIONS

The following FC Windmill Regulations have been reviewed by Lloyd's Register of Shipping and are considered to be suitable as a design guide for the construction of Windmills.

In following these Regulations, the manufacturer should demonstrate the integrity of the construction to satisfy certification and local authority requirements.

The responsibility for the contents of the Regulations rested with the Folkecenter for Renewable Energy.

26th June 1989

H. Chan
(Specialist Engineer)

W.J. Winkworth
(Principal Surveyor,
Ocean Engineering Dep

1. Lloyd's Register was requested to determine the appraisal requirements of Windmills designed to Folkecenter Windmill Regulations. These Regulations have been prepared and published with financial support from the Danish Council of Technology by its steering Committee for Renewable Energy.

Documents received are:-

FC Windmill Regulations

Volume I Regulation on the safety of Windmills, Feb 88.

Volume II Regulation on the determination of loads on Windmills, Feb 88.

Volume III Regulation on the application of timber to Windmills, Feb 89.

Volume IV Regulation on the application of steel to Windmills, Feb 89.

Volume V Regulation on the application of fibreglass to Windmills, Feb 88.

Volume VI Supplement, Feb 88.

2. The Regulations have been written as a set of guidelines for the design and construction of Windmills of various types. They stipulate specific rules for design and construction and do not rely on other codes. However exemptions are allowed in vol VI for using other valid bases of calculation and construction.

3. It is also stated that the Regulations will be withdrawn concurrently with the emanation of adequate national or international codes of practice, (P. 4-5, vol. II).

4. For design appraisal, Lloyd's Register will perform a review of the designer's calculations with independent checks if necessary. This checking process may rely on general engineering practice as to the choices of load data, material and manufacturing requirements. The Society also offers on site inspection and surveying. Independent assessments to comply with local authority requirements may also be required.

5. The Society has no objection if the FC Regulations were followed by the designers and manufacturers. However since the Regulations are not yet fully comprehensive, it is the designer's duty to demonstrate the integrity of the construction. They should show that the design is "appropriate" in the sense of the Regulations. Special effects such as extreme local environmental conditions (icing, temperature, wind, flood, earthquake, collision etc), noise disturbance, resonances, environmental interferences, unbalance, dynamic compling etc have already been taken into consideration.

6. The Regulations have specified construction details safeguarding the integrity of different components. These are useful guides to the designers. Design values are used throughout the Regulations with various safety factors for loads, materials and sectional properties. While this format may simplify the task of design, it is not directly comparable with other codes. The assessment of fatigue loads is of specific concern. The Society would prefer to use site specific wind regimes and design S-N curves for design appraisal.

7. During the course of this review, several versions of the Regulations have been commented upon and revisions have been submitted. The responsibility for the Regulations rested with the Folkecenter for Renewable Energy.

CONTENTS:

0. PREFACE:

The present set of FC windmill regulations forms a revised English edition of the NIVE windmill regulations published by FC in 1984, when FC assumed most of the activities of NIVE.

The FC windmill regulations comprise six volumes:

Volume I : Regulation on the safety of windmills.

Volume II : Regulation on the determination of loads on windmills.

Volume III : Regulation on the application of timber to windmills.

Volume IV : Regulation on the application of steel to windmills.

Volume V : Regulation on the application of fibreglass to windmills

Volume VI : Supplement.

When the NIVE Windmill Regulations were published in 1984, the purpose was to replace the rather simplistic and incoherent rules of thumb then in use as official guidelines with a flexible, coherent and comprehensive set of regulations, which might develop, through further considerations and exchange of experience, into a code of practice prepared for immediate use covering the various kinds and modes of operations of windmills.

Unfortunately the past years have brought no such development.

Thus the NIVE/FC Windmill Regulations still form the only complete set of guidelines and the only one considering a windmill a composition of a building and a machine and dealing with solidity and mode of operation, not to mention other kinds of windmills than the modern fast running horizontal axis windmill.

To avoid errors, safety factors are included in all final values throughout the regulations. Thus all values of loads, of strength and of stiffness rendered throughout the regulations are design values.

The values of loads, the values of strength and stiffness and the rules of construction form a whole specifically adapted to the conditions of windmills. Thus individual values are generally not comparable with analogous values rendered elsewhere.

Owing to the rather strict rules of construction, some of the strength values are somewhat higher than those laid down in national codes of practice, as those allow for a certain amount of strength reduction and stress intensification due to inconvenient constructions. Where the rules are not met, additional factors are used.

Units are left out in all expressions and tables throughout the regulations, as these are adapted to the units rendered in the relevant lists of symbols.

In order to complete and maintain the FC windmill regulations, the supplement comprising exemption clauses, additions and corrections will be issued according to need, thus forming the sixth volume of the regulations.

Except for specific exemptions, the FC regulations are indispensible.

Exemptions implying constant supervision or periodical inspection of load bearing members are ruled out.

Exemptions imply verification through measurement, through testing or through reference to a substitute regulation.

Measurement and testing may be performed according to the FC regulation in question or according to a substitute regulation.

An alternative regulation may only be regarded as substitute when recognized by FC and only to the extent that it covers windmills or has a similar field of application.

Generally, national and international codes of practise and the like are not recognized as substitute regulations, as they deal with installations either without movable parts, of a rigid construction, protected from the weather or subject to frequent inspection, whereas windmills are installations with unprotected, flexible and movable parts operating lengthily without inspection.

The purpose of the NIVE/FC windmill regulations being to meet an immediate want and to prepare the ground for a comprehensive set of codes of practice, the FC regulations will be withdrawn concurrently with the emanation of adequate national or international codes of practice.

Thus the present edition of the regulation on the application of fibreglass to windmills has been reduced to a supplement to Dansk Ingeniørforenings Code of Practice for the Structural Use of Glas Fibre Reinforced Unsaturated Polyester, DS 456.

The present set of regulations is prepared and published with financial support from the Council of Technology by its Steering Committee for Renewable Energy.

1. INTRODUCTION:

This volume deals with third party safety and principles of safety in general. Accordingly, three safety classes with corresponding safety distances and safety rules are laid down.

In safety class 0 with a large safety distance, a low degree of safety is allowed within an area closed to the public.

In safety class 1 with a normal safety distance, a normal degree of safety is implied.

In safety class 2 with a small safety distance, a high degree of safety is implied.

The calculation of safety distances is stated in volume II.

2. SAFETY CLASSES:

In the following subsections 2.1 to 2.3, the three safety classes are defined by the siting with regard to probability of third party injury in case of breakdown.

2.1. SAFETY CLASS 0:

This class covers windmills sited so as to obtain a very low probability of third party injury in case of breakdown.

2.2. SAFETY CLASS 1:

This class covers windmills sited so as to obtain a low probability of third party injury in case of breakdown.

2.3. SAFETY CLASS 2:

This class covers windmills sited so as to obtain a moderate probability of third party injury in case of breakdown.