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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Cranes -- Stiffness -- Bridge and gantry cranes
(English Translation)**

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Foreword

This Standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This Standard uses redrafting method to adopt and modify ISO 22986.2007 "Cranes -- Stiffness -- Bridge and gantry cranes" (English version).

The technical differences between this Standard and ISO 22986.2007, and the reasons therefor, are as follows.

- Regarding normative references, this Standard has made adjustments with technical differences to adapt to Chinese technical conditions. These adjustments are mainly reflected in Chapter 2 "Normative references." Specific adjustments are as follows.

- Replace ISO 4306-1 with GB/T 6974.1, which is equivalent to ISO 4306-1;

- Replace ISO 4306-5 with GB/T 6974.5, which is equivalent to ISO 4306-5.

- Annex A includes a stiffness index formula (A.2) for the trolley located at the effective cantilever length;

- In Annex A, Table A.1, it adds "Scope of application" and "Trolley position" to the header, and adds "Mid-span" and "Effective cantilever length" to the "Trolley position";

- Annex A includes Figure A.1, which shows the stiffness index of the main beam at different positions of the crane trolley;

- In Annex B, the coefficient "0.4857" in the formula is changed to "0.492";
- An informative Annex C "Guidance values for minimum vertical natural frequencies of bridge and gantry cranes" has been added. The dynamic vibration of the entire crane, in addition to the main beam, shall also include the fully loaded trolley, hoisting wire rope pulley blocks, lifting equipment, and hoisting load.

Annex B of ISO 22986:2007 only provides guidance values for minimum natural frequencies for beams with free supports at both ends, and does not provide guidance values for the minimum natural frequencies of the entire bridge and gantry crane.

To facilitate use, the following editorial modifications have been made to this Standard.

- The description of δ_1 in Figure 1 shall be changed to "the static deflection caused by the self-weight load of the main beam minus the preset camber";
- Figure 1 is supplemented with illustrations to show the cases where the trolley is located at the positions of maximum and minimum slope of the main beam,

Cranes -- Stiffness -- Bridge and gantry cranes

1 Scope

This Standard provides recommended values and requirements for the stiffness characteristics of bridge and gantry cranes (hereinafter referred to as "cranes") structures -- deflection and natural frequency.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 6974.1, Cranes -- Vocabulary -- Part 1.General (GB/T 6974.1-2008, ISO 4306-1:2007, IDT)

GB/T 6974.5, Cranes -- Vocabulary -- Part 5.Bridge and gantry cranes (GB/T 6974.5-2008, ISO 4306-5:2005, IDT)

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 6974.1 and GB/T 6974.5 apply.

4.1 General

The effects of flexibility manifest as elastic deformation under load and vibration caused by motion or instantaneous force.

Excessive flexibility in crane structures and mechanical components can affect their safe operation. Elastic deformation and vibration must be controlled to prevent dangerous situations that could disrupt normal crane use. The requirements for elastic deformation and vibration depend on the crane's construction, the positioning accuracy of the load, the type and performance of the control system, and the location of the control console. Increasing stiffness means higher investment costs and may require more space, which is not worthwhile for all applications. Furthermore, the possibility of offsetting flexibility largely depends on the type and construction of the crane, making it difficult to provide precise limits for deflection or vibration.

4.2 Basic requirements for elastic deformation

The elastic deformation of the crane structure shall not.

- a) cause the crane or trolley to collide with surrounding objects and structures;
- b) prevent the trolley from being started and braked using the designed starting/braking system when carrying any load not exceeding that of the dynamic load test;
- c) prevent the trolley from safely remaining in a certain position when carrying any load not exceeding that of the static load test;
- d) result in excessive lateral forces on the crane and trolley rails or hinder crane operation;
- e) lead to premature component life, excessive vibration, premature wear, or brake failure due to misalignment of the mechanical transmission device.

The recommended maximum deflection (stiffness index) of the main beam is given in Annex A.

5 Preset camber of main beam

The preset camber has no effect on the strength of the main beam and no specific requirements need to be made.

To help meet the requirements of 4.2b), the slope range of the crane main beam (the difference between the maximum and minimum slopes) can be divided into two parts with approximately equal positive and negative values, or a preset camber method can be adopted to reduce the maximum slope value (see Figure 1).

The slope of the main beam shall take into account the position of the unloaded trolley that gives it the maximum slope. It shall take into account other possible unloaded trolleys and their own weight loads.

Other possible reasons for the pre-set camber are the appearance requirements of the crane or to compensate for certain permanent deformations of the welded main beam after load testing.

6.1 Impact on operators

To avoid discomfort for operators in the cab due to vibration, the natural frequency of vertical vibration of the structure including the cab shall not be less than 2 Hz. For large-span cranes, if the stiffness cannot meet this limit, a lower natural frequency is permissible. However, measures such as stepless speed control and smooth transition shall be taken to minimize the amplitude and duration of vibration.

During gantry crane operations, the natural frequency of horizontal vibration caused by the crane's main operating motion shall not be less than 0.5 Hz (e.g., the trolley running direction of ship unloaders and quay container cranes).

6.2 Impact on structure and operation

The impact of vibration on the crane structure and operation can be reduced by controlling the stiffness of the main beam.