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Standard for appraisal of reliability of industrial buildings and structures

工业建筑可靠性鉴定标准

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Standard for appraisal of reliability of industrial buildings and structures

1 General provisions

1.0.1 This Standard is formulated in order to standardize the appraisal of reliability of industrial buildings, ensure the quality of appraisal, and strengthen the safety management of industrial buildings.

1.0.2 This Standard applies to the reliability appraisal of the following existing industrial buildings and structures:

1. Industrial buildings such as single-story and multi-story factory buildings with concrete structures, steel structures, and masonry structures as load-bearing structures;

2. Industrial structures such as smoke, reinforced concrete cooling towers, storage bins, corridors, pipe supports, pools, boiler steel structure supports, dust collector structures, etc.

1.0.3 The appraisal of reliability of industrial buildings and structures shall not only implement this Standard, but also comply with the current relevant national standards.

2 Terms and symbols

2.1 Terms

2.1.1 existing industrial buildings and structures

Built buildings and structures that serve industrial production.

2.1.2 existing structure

Various types of members and their combinations that have been built.

2.1.3 appraisal of reliability

Technical activities such as investigation, inspection, analysis checking calculation and assessment of the safety and serviceability of existing industrial buildings and structures. Safety includes bearing capacity and overall stability, etc. Serviceability includes applicability and durability.

Appraisal units subdivided according to the different functions of the building structure in the appraisal unit. Generally, Generally, industrial buildings can be divided into three structure systems according to the basement foundation, upper load-bearing structure, and envelope structure. For industrial structures, it also includes their special functional structure systems.

2.1.14 member

A basic appraisal unit further subdivided in the structure system. It refers to a single structure member that bears various actions, or an integral part of a load-bearing structure.

2.1.15 member assemblage

A collection of homogeneous members. It is divided into important member assemblage and less important assemblage.

2.1.16 items of assessment

Items for assessing the reliability of buildings and structures as well as their components.

2.1.17 important member

A member whose failure will cause other members to fail and endanger the safety of the load-bearing structure system, or a member that directly affects the operation of production equipment.

2.1.18 less important member

A member that its own failure is an isolated event, which will not cause failure of other members and does not directly affect the operation of production equipment.

2.2 Symbols

2.2.1 Structural properties and effects

h - Height of the frame floor or the floor height of the multi-storey factory building.

H - Total height from the top of the foundation to the top of the column.

l_0 - Calculated span or calculated length of member.

R - Resistance of structures or members.

S - Effects of structures or members.

γ_0 - Structural importance coefficient.

2.2.2 Appraisal rating

a, b, c, d - assessment rating for member.

A, B, C, D - assessment rating for structure system.

I, II, III, IV - assessment rating for appraisal unit.

3 Basic requirements

3.1 General requirements

3.1.1 Appraisal of reliability shall be carried out for industrial buildings and structures under the following circumstances:

1. When the designed service life is reached and intended to continue to be used.
2. When the purpose of use or the environment changes.
3. When structural renovations or extensions are carried out.
4. After a disaster or accident.
5. When there are serious quality defects or serious corrosion, damage or deformation.

3.1.2 Appraisal of reliability shall be carried out for industrial buildings and structures under the following circumstances:

1. When routine inspection identification is required during use and maintenance.
2. When large-scale maintenance is required.
3. In other situations where the grade of structural reliability needs to be mastered.

3.1.3 Special appraisal can be carried out for industrial buildings and structures under the following circumstances:

1. When there are special requirements for structure maintenance and transformation.
2. When the structure has durability damage that affects its durability.
3. When the structure has fatigue problems that affect its fatigue life.
4. When there is obvious vibration effect on the structure.
5. When the structure requires long-term monitoring.

entrusting party and shall be determined after consultation with the appraisal party.

3.2.3 Preliminary investigation shall include the following work contents:

1. Consult the original design and construction materials, including engineering geological survey reports, design calculations, design and construction drawings, design change records, construction and construction negotiation records, completion materials, etc.

2. Investigate the historical situation of industrial buildings and structures, including previous inspection and observation records, previous maintenance and reinforcement or transformation data, changes in use, changes in use conditions, accident handling and disasters, etc.

3. Visit and inspect the site. The status quo, conditions of use, internal and external environment, and existing problems of industrial buildings shall be investigated.

3.2.4 The appraisal plan shall be formulated according to the purpose, scope, content and preliminary investigation results of the appraisal. It shall include appraisal basis, detailed investigation and inspection content, inspection method, work schedule and preparation and cooperation work to be completed by the entrusting party, etc.

3.2.5 Detailed investigation and inspection shall include the followings:

1. Investigate structural roles and disadvantages in the environment.

2. Check structural arrangement and construction, bracing systems, structural members and connections.

3. Inspect the actual performance of structural materials and geometric parameters of members. The actual performance of structures or members can also be verified through load tests.

4. Investigate or measure the deformation of the foundation. Check the influence of foundation deformation on the upper load-bearing structure, envelope structure system and crane operation, etc. Excavation foundation inspection, supplementary survey or on-site foundation bearing capacity test can also be carried out.

5. Inspect the defects and damages, cracks, deformation or deviation, corrosion, aging, etc. in the upper load-bearing structure or members, supporting rods and their connections.

6. Check the safety condition and function of the building envelope system.

7. Check the safety status and function of the special functional structure system of the structure.

"Technical standard for inspection of building structure" and the relevant provisions of Chapter 6 and Chapter 7 of this Standard.

5. The defects and damage of the members and their nodes shall be conducted in appearance. The location, scope, degree and form of defects and damages shall be recorded in detail.

6. The performance of structure members, structural dynamic characteristics and dynamic response can be tested through field tests according to the current national standard GB/T 50344 "Technical standard for inspection of building structure".

4.2.6 When it is necessary to carry out material performance and durability testing on concrete structure members, in addition to implementing the provisions in Article 4.2.5 of this Standard, the following provisions shall also be complied with:

1. The inspection of concrete strength shall be comprehensively determined by coring, rebound, ultrasonic rebound and other methods.

2. The aging of concrete members can be determined through visual inspection, concrete neutralization test, steel corrosion detection, degraded concrete petrographic and chemical analysis, concrete surface permeability measurement, etc.

3. For the inspection of steel bars in concrete, steel bars can be cut from concrete members for mechanical performance and chemical composition inspection.

4.2.7 When it is necessary to perform steel performance inspection on steel structure members, steel mechanical performance tests and main chemical composition analysis shall be carried out. Steel products of the same specification for similar structure members shall be inspected as a batch.

4.2.8 When there is a large area of corrosion on the steel structure members and the cross-section is obviously weakened, it can be inspected according to the method in Annex C of this Standard. The inspection contents for fatigue damage of steel crane girders can be carried out according to the provisions in Annex D of this Standard.

4.2.9 When it is necessary to test the masonry quality and masonry strength of masonry structure members, in addition to the provisions of Article 4.2.5 of this standard, the following provisions shall also be met:

1. For masonry strength testing, an appropriate testing method shall be selected according to the current national standard GB/T 50315 "Technical standard for site testing of masonry engineering".

2. For structural members whose masonry quality least meets the requirements of the current national standard GB 50203 "Code for acceptance of constructional

quality of masonry structures", the number of samples shall be increased.

4.2.10 For the investigation of the envelop structure, the relevant drawings and materials shall be consulted. Carry out on-site verification of the layout of the envelope structure system. Investigate the actual conditions of various envelop members and their structural connections, as well as the use function, aging damage, failure and failure of the envelop system.

5 Structural analysis and check

5.0.1 Structural or member analysis and check shall be carried out according to the limit state of bearing capacity and the limit state of normal service. Structural or member analysis and verification methods shall comply with the provisions of the current national standards GB 50010 "Code for design of concrete structures", GB 50017 "Code for Design of Steel Structure" and GB 50003 "Code for design of masonry structures".

5.0.2 The calculation model adopted in the structural analysis shall conform to the actual stress, structural condition and boundary conditions of the structure.

5.0.3 The standard value of the effect on the structure shall be taken according to the provisions of Article 4.1.3 of this Standard. The sub-item coefficients and combination coefficients of action effects shall be determined according to the provisions of the current national standard GB 50009 "Load code for the design of building structures". According to the principle of having the same exceeding probability in different periods, the sub-item coefficients of wind load and snow load can be appropriately reduced according to the target working life.

5.0.4 When structural members are subject to non-negligible effects of temperature, foundation deformation, etc., additional effects shall be considered.

5.0.5 The standard value of material strength shall be selected according to the following principles according to the actual condition of the structure member and the obtained test data:

1. When the type and performance of the material meet the original design requirements, the value can be taken according to the original design.

2. When the type and performance of the material are inconsistent with the original design, or the performance of the material has been significantly degraded, it shall be determined according to the current national standard GB/T 50344 "Technical standard for inspection of building structure" and other provisions based on the measured data.

5.0.6 The geometric parameters of structures or members shall be measured values. The actual deformation, deviation, cracks, defects, damage, corrosion, aging and other effects of the structure shall be considered.

specified in Article 6.1.4 of this Standard, the serviceability level of the member can be assessed according to the provisions of Article 6.1.4 of this Standard.

3. The safety grade and serviceability grade of members can also be assessed through load tests according to the provisions of Article 6.1.3 of this Standard.

4. When the deformation of the member is too large, the crack is too wide, the corrosion, the defect and the damage are serious, the influence of the unfavorable situation on the safety rating of the member shall be considered. Its serviceability grade shall be rated as grade c.

6.1.3 When the structural load test is used to assess the safety and serviceability of members, it shall be based on the test purpose and inspection results, the actual condition and service conditions of the members. Assess according to the provisions of the current national standard GB/T 50344 "Technical standard for inspection of building structure".

6.1.4 When the following conditions are met at the same time, the serviceability grade of the member can be rated as grade a or grade b according to the actual service situation:

1. After detailed inspection, no obvious deformation, defect, damage, corrosion, crack, aging, and cumulative damage are found in the members, and the members are in good or basically good condition.

2. During the target working life, the function and environmental conditions on the member will not change significantly compared with the past; the member has sufficient durability and can meet the requirements of normal use.

6.1.5 When assessing the remaining life of the durability of concrete structures in industrial atmospheric environments, the provisions of Annex B of this Standard can be followed.

6.1.6 The fatigue performance assessment of steel crane girders for heavy-duty work and steel crane cabinets for middle-class work can be carried out in accordance with the provisions of Annex D of this Standard. The evaluation of its remaining fatigue life can be carried out according to the provisions of Annex E of this Standard.

6.2 Concrete structure members

6.2.1 The safety grade of concrete members shall be assessed according to the two items: bearing capacity, structure and connection. The lower grade shall be taken as the safety grade of the member.

6.2.2 The bearing capacity items of concrete members shall be graded according to the provisions in Table 6.2.2. When compression and baroclinic cracks appear in the member, the bearing capacity item is directly rated as grade c or d depending on its

life is an estimated value.

9.4.10 The auxiliary facilities of the silo shall include the inlet and outlet and connections, ladders, lightning protection devices, etc. The appraisal rating shall be carried out according to the provisions of 9.1.6 of this Standard.

9.4.11 The rating for appraisal of reliability of the silo appraisal unit shall be determined according to the lower reliability grade of the two main structure systems: foundation, silo body and support structure.

9.4.12 For ancillary buildings such as the distribution corridor built on the top of the silo and the discharge corridor at the lower part of the silo, appraisal rating shall be carried out respectively in accordance with the relevant provisions of this Standard.

9.5 Gallery

9.5.1 The appraisal of reliability of gallery shall be assessed in three structure systems: foundation, gallery load-bearing structure and envelop structure.

9.5.2 The safety grade and serviceability grade of the foundation shall be assessed according to the relevant provisions of section 7.2 of this Standard. Its reliability grade can be determined according to the lower grade of safety grade and serviceability grade.

9.5.3 The safety grade of the load-bearing structure of the gallery shall be assessed based on the provisions of 7.3.4 of this Standard according to the bearing capacity items. Take the assessment grade of the grade function item as its safety grade. Serviceability grade shall be assessed based on the provisions of 7.3.7 of this Standard according to the items of use status. Take the assessment grade of the use status item as its serviceability grade. When there is serious deformation and cracking at the main connecting parts of the gallery structure or slippage occurs at the connecting parts at both ends of the elevated inclined gallery, it shall be rated as grade C or D according to the potential hazard degree. The reliability grade shall be determined according to the principle stipulated in Clause 1 of 7.1.2 of this Standard.

9.5.4 The envelope structure of gallery shall be assessed for safety grade and serviceability grade according to the provisions of 7.4.1 and 7.4.2 of this Standard. The reliability grade shall be determined according to the principle stipulated in Clause 1 of 7.1.2 of this Standard.

9.5.5 The load-bearing structure members of gallery shall be assessed for safety grade and serviceability grade according to the relevant provisions of 6.2 to 6.4 of this Standard according to the type of structure.

9.5.6 The rating for appraisal of reliability of the gallery appraisal unit shall be determined according to the lower reliability grade of the two structure systems: the foundation and the corridor load-bearing structure. When the assessment grade of the

enclosure structure is two grades or more lower than the lower grade of the foundation and corridor load-bearing structures, the reliability grade of the gallery appraisal unit can be determined by lowering the lower grade of the foundation and the gallery load-bearing structure by one grade.

9.5.7 When there is obvious vibration deformation reaction in the gallery structure, or vibration deformation obviously affects the normal operation of the belt conveyor, it shall be appraised according to Annex F of this Standard.

9.5.8 When the end of the gallery is supported by other buildings, the appraisal scope of the gallery shall include the supporting members and connections.

9.6 Pipe support

9.6.1 The appraisal of reliability of the pipe support shall be divided into two structure systems, the foundation and the load-bearing structure of the pipe support, for assessment.

9.6.2 The safety grade and serviceability grade of the foundation shall be assessed according to the relevant provisions of 7.2 of this Standard. Its reliability grade can be determined according to the lower grade of safety grade and serviceability grade.

9.6.3 The safety grade of the load-bearing structure of the pipe support shall be assessed according to the load-bearing function items in accordance with 7.3.4 of this Standard. Take the assessment grade of the carrying function item as its safety grade. Serviceability grade shall be assessed according to item 7.3.7 of this Standard. Take the assessment grade of the use status item as its serviceability grade. When there is serious deformation and cracking in the main connection part of the pipe support structure or slippage and dislocation in the connection parts at both ends of the elevated inclined pipe support, it shall be rated as grade C or D according to the potential hazard degree. The reliability grade shall be determined according to the principle stipulated in Clause 1 of 7.1.2 of this Standard.

9.6.4 The structure members of the pipe support shall be assessed for safety grade and serviceability grade according to the relevant provisions of 6.2 to 6.3 of this Standard according to the type of structure.

9.6.5 The ancillary facilities of the pipe support shall include maintenance ladders, walkways, etc. Its appraisal rating shall comply with the provisions of 9.1.6 of this Standard.

9.6.6 The rating for appraisal of reliability of the pipe support appraisal unit shall be determined according to the lower reliability grade of the two structure systems: the foundation and the pipe support load-bearing structure.

9.6.7 When the end of the pipe support is supported by other buildings, the appraisal

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