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Code for design of grain steel silos

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1 General

1.0.1 In order to sum up the experience in the construction of grain steel silos in my country and make the design of grain steel silos safe, reliable, advanced in technology and economically reasonable, this specification is formulated.

1.0.2 This specification is applicable to the design of grain steel silos with a circular plane shape and central loading and unloading.

1.0.3 The design service life of grain steel silos should not be less than 25 years.

1.0.4 The safety level of the grain steel silo structure shall be Class II, the seismic fortification category shall be Class C, and the fire resistance class may be Class II.

1.0.5 Grain steel plate silos shall be designed by units with relevant design qualifications.

1.0.6 The design of steel plate silos for grain shall not only comply with this code, but also comply with the current relevant national standards.

2.1.1 grain steel silo

Steel structure upright containers for storing grain bulk materials, the plane is mainly circular. The main forms are welded steel plate, spiral edged steel plate, bolted corrugated steel plate, bolted ribbed steel plate, bolted ribbed double wall and assembled steel structure frame, etc.

2.1.2 grain granular material

Wheat, corn, rice, beans and grain bulk materials with similar physical properties.

2.1.3 Bulk solids

The steel silo contains the bulk grain material.

2.1.4 top of silo

A structure that closes the top surface of the bin body.

2.1.5 building above top of silo

A building built on the roof of the warehouse according to the technical requirements.

2.1.6 Wall of silo

The vertical wall of the bin body that is in direct contact with the grain bulk material and bears the lateral pressure of the grain bulk material.

2.1.7 Supporting wall

Support the vertical wall of the warehouse body.

2.1.8 Supporting structure of silo bottom

The support structure above the foundation and below the warehouse body, including cylinder walls, columns, buttresses, etc.

2.1.9 Funnel hopper

The lower part of the silo is a structural container for unloading grain bulk materials.

2.1.10 Shencang deep bin

The silo whose ratio of the calculated height h_n of grain storage to the inner diameter d_n of the silo is greater than or equal to 1.5.

2.1.11 shallow bin

The silo whose ratio of calculated grain storage height h_n to silo inner diameter d_n is less than 1.5.

2.1.12 single warehouse single silo

A single silo that is not integrated with other buildings (structures).

2.1.13 warehouse group group silos

Multiple silos arranged in groups.

2.1.14 Filler

The bottom of the silo constitutes the filling material for unloading and filling slopes.

2.1.15 Overall flow mass flow

During the grain unloading process, the horizontal section of the grain bulk material in the warehouse flows downward in a plane state.

2.1.16 Tubular flow funnel flow

During the grain unloading process, the surface of the grain bulk material in the warehouse flows downward in a funnel shape.

2.1.17 Concentric discharge

During the grain unloading process, the bulk grain in the silo flows symmetrically downward along the geometric center of the silo.

2.1.18 Eccentric discharge

During the grain unloading process, the bulk grain in the silo flows asymmetrically downward along the geometric center of the silo.

2.1.19 work tower

The place where grain transportation, measurement, cleaning and other work are carried out.

2.1.20 tunnel underpass

The underground passage between the silo and the silo, and between the silo and the working tower.

2.2.1 Geometric parameters

h - the height from the ground to the top of the warehouse wall;

h_n - calculated height of grain storage;

h_h - the height from the top surface of the funnel to the calculation section;

S - Calculation depth, the distance from the center of gravity of the silo roof or grain storage cone to the calculation section;

d_n - the inner diameter of the silo;

R - the radius of the silo;

t - the thickness of the silo wall or the calculated thickness of the silo wall, and the thickness of the steel plate;

e - base of natural logarithm;

a - the angle between the wall of the funnel and the horizontal plane.

2.2.2 Calculation coefficients

k - the lateral pressure coefficient of grain storage;

k_p - the vertical compression stability coefficient of the silo wall;

ρ - the hydraulic radius of the horizontal net section of the silo;

Ch - Correction coefficient of dynamic horizontal pressure of grain stored in Shenzhen;

C_v - dynamic vertical pressure correction coefficient of deep storage grain;

C_f - Shenzhen stored grain dynamic friction correction coefficient.

2.2.3 Physical characteristic parameters of grain bulk materials

γ - gravity density;

ρ_0 - mass density of grain;

u - the friction coefficient of stored grain against the silo wall;

Φ - Internal friction angle of stored grain.

2.2.4 Properties and resistance of steel

E - elastic modulus of steel;

f - design value of steel tensile and compressive strength;

f_{tw} - design value of tensile strength of butt weld;