



ARTICLE

Research on Structural Design of Coal Crusher House in Thermal Power Plant

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ABSTRACT

This paper takes the specific characteristics of pulverized coal room in thermal power plant as the starting point, firstly, this paper analyzes the process layout and structure selection, and then the structural design and vibration design requirements of coal crusher house are introduced in this paper. Finally, based on the engineering example, a new structure form of vibration isolation design is creatively proposed, which provides a new design idea for the practical engineering design.

1. Introduction

In the field of industrial construction, power plants are an important branch with a complete and mature system. Power plants can be divided into thermal power generation, hydropower, nuclear power, wind power, geothermal power, tidal power, photovoltaic power, etc. Among them, the most traditional is thermal power generation, and thermal power stations can be divided into coal, gas, burning garbage combustion, biomass combustion and other types, and coal power generation is the most traditional. After decades of research and development, coal-fired thermal power generation has formed a very complete process system. As a fossil fuel for coal-fired power generation, raw coal must undergo a series of treatment in order to improve its combustion efficiency and reduce the generation standard coal as much as possible. The most common treatment steps are briefly described as follows: dry coal → pulverized coal →

grinding coal. This paper mainly discusses the important link of “pulverized coal”. Crushed coal the necessary equipment commonly known as required for coal pulverizer, and provide structure for normal operation of the coal pulverizer platform called coal crusher house^[1], the coal crusher house through constant development, according to the requirements of the process, in the coal conveying system, can rise to coal transport, raw coal screening, raw coal breakage and a series of functions in an organic whole, is an important part of the coal conveying system.

2. Overview of Coal Crusher House

2.1 Brief Introduction of Coal Crusher House Process System

In coal-fired power plants, raw coal is crushed by pulverizer to reach the particle size acceptable by pulverizer,

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which can be considered as coal grinding pretreatment. The Coal crusher house is normally arranged before the coal belt conveyor enters the main workshop or the coal storage silo, and its structural arrangement mainly includes the belt entrance layer connected with the coal conveying trestle [2], raw coal screen stratification, coal seam crushing and the coal belt outlet layer at the bottom, etc.

Under normal circumstances, in order to ensure the normal operation of the power plant, two coal crushers are generally installed, one is transported and one is prepared. The bottom plate and vibration isolation platform supporting rotor bearing are generally provided on both sides of the coal crusher, and the supporting platform of the equipment is connected with the structure through the embedded parts of the floor or the reserved anchor bolts [3].

2.2 Brief Introduction of Structure Selection of Coal Crusher House

The most common structural form of coal crusher room is the cast-in-place reinforced concrete frame structure [1], and steel frame structure can also be used under normal circumstances. When high seismic intensity zone is encountered, frame + shear wall or frame + support structure is selected. Due to the large vibration generated during the normal operation of the coal crusher, in order to reduce the adverse impact of equipment vibration on the structure, it is suggested to set up vibration isolation device on the coal crusher, that is, the vibration isolation device built by the coal crusher. In actual production, the dynamic disturbance force of coal crusher will vary with the different installed capacity, coal consumption and equipment, etc. When the disturbance force is large, extra measures must be taken to ensure the normal operation of the structure and equipment. When coal pulverizer dynamic disturbance force in more than 4.6 t, coal crusher equipment supporting structure system, should choose independent wall type, the overall frame type or the spring vibration isolation foundation [4], independent wall type, the foundation of the frame type and spring spring vibration isolation at the top of the table should be around with setting antivibration joint between the floor structure in order to separate, the seam width is 50 mm.

3. Key Points of Structural Design of Coal Crusher House

3.1 Calculation of Structural Dynamics and Bearing Capacity of Coal Crusher House

In the structural design of coal crusher house, the dynamic calculation and vibration isolation design of structure

and structural components are the key points. In the coal crusher house, the structural beam or the platform plate used to directly support the coal crusher equipment or the vibration isolation foundation must be calculated vertically according to the requirements. If the base form of equipment with spring isolation or other effective vibration isolation measures is adopted and the measured base vibration isolation efficiency is not less than 90%, the supporting structure below the vibration isolation device of coal crusher equipment can be exempted from dynamic calculation according to regulations [1].

In the coal crusher house, floor beams directly supporting the coal crusher are not subject to vertical vibration calculation when their high-span ratio meets the requirements of Table 1 [1].

Table 1. The high span ratio limit of structural beam supporting coal crusher can be calculated without vertical vibration

Dynamic disturbance force(P_0 ,kN) of coal crusher	Beam span (m) and the number of coal crusher							
	5<L≤6		6<L≤7		7<L≤8		8<L≤9	
	One set	Two sets	One set	Two sets	One set	Two sets	One set	Two sets
15< P_0 ≤25	1/6	1/5.5	1/5.5	1/5	1/5.5	1/5	1/5.5	1/5
25< P_0 ≤35	1/5.2	1/4.7	1/5	1/4.5	1/5	1/4.5	1/4.7	1/4.2
35< P_0 ≤46	1/4.8	1/4.5	1/4.7	1/4.2	1/4.7	1/4.2	1/4.5	1/4.1

The method of transforming dynamic load into static load can be used to calculate the bearing capacity of the structure directly bearing the dynamic load of coal crusher, the specific conversion method is shown in Formula 1:

In the formula: P-The equivalent static load (KN)
 -Power coefficient of coal crusher
 G-Total load of equipment (KN)

3.2 Structural Design and Construction Requirements of Coal Crusher House

When the coal crusher equipment is directly supported on the floor, the corresponding supporting beam must be set under the coal crusher equipment, and the dynamic disturbing force direction of the equipment should be consistent with the longitudinal axis direction of the beam. The arrangement of coal crusher floor should avoid overhanging arrangement.

In the cast-in-place reinforced concrete structure, the floor plate directly supporting the coal crusher shall have a thickness of at least 120mm.

According to relevant regulations, the minimum reinforcement ratio of longitudinal stressed bars at the top and bottom of concrete beams used for directly bearing dynamic loads should not be less than 0.2%. The stirrup of the beam should be enclosed. The diameter of the stir-

rup should not be less than 10mm. In special cases, it can be relaxed to 8mm. When the concrete beam is taller than 2m, the diameter of stirrup should not be less than 10mm - 12mm. The stirrup spacing shall conform to the current national standard “Code for Design of Concrete Structures” GB 50010 and shall not be greater than 300mm.

When the coal crusher is directly arranged on the concrete floor, corresponding measures can be taken for the seismic structure of the filled wall of the frame structure according to the requirements of Chapter 13 of the Chinese standard “Code for Seismic Design of Buildings” GB 50011-2010.

When arranging the frame structure of coal crusher house, the center line of frame beam or column and seismic wall (support) should be consistent, the distance between the beam center line and the line in the column should not be more than 1/4 of the column width, otherwise, the effect of eccentricity should be considered.

The columns of the frame structure of the coal crusher house should avoid the necessary channels, and the structural beam of the coal crusher house should be set to ensure the net height requirement between the coal crusher house and the coal trestle [5]. The net height should be determined by the coal transporting specialty, and the net height should be no less than 2.2 meters.

The single frame structure should be avoided in the coal crusher house, especially in the areas with high seismic fortification requirements.

3.3 Practical Engineering Example of Coal Crusher House Structure

In order to feel more intuitively the concept of structural design of coal crusher house, This article takes an actual engineering project as an example. The project is a coal-fired power plant, rated generating capacity is 350MW. The structural calculation model and main deformation results of this practical engineering case are shown in figure 1 to figure 4.

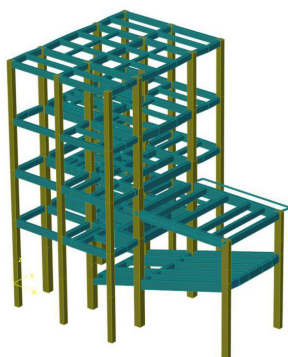


Figure 1. Three-dimensional view of the structure of this Coal crusher house

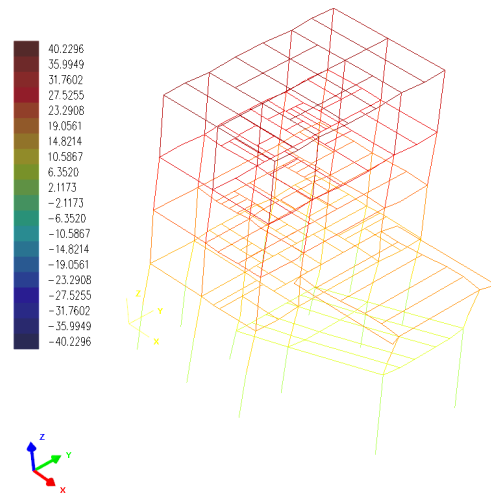


Figure 2. Deformation of this Coal crusher house structure in the X direction

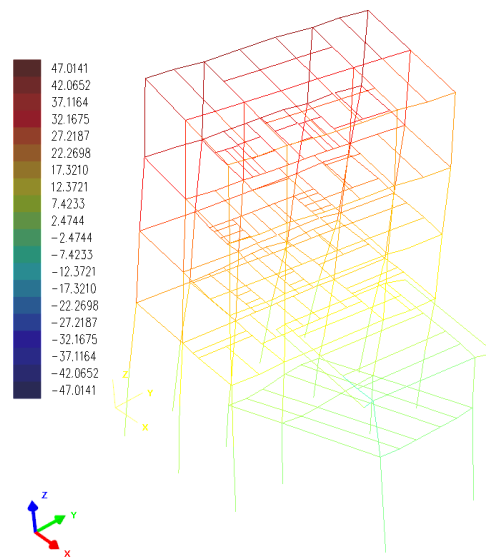


Figure 3. Deformation of this Coal crusher house structure in the Y direction

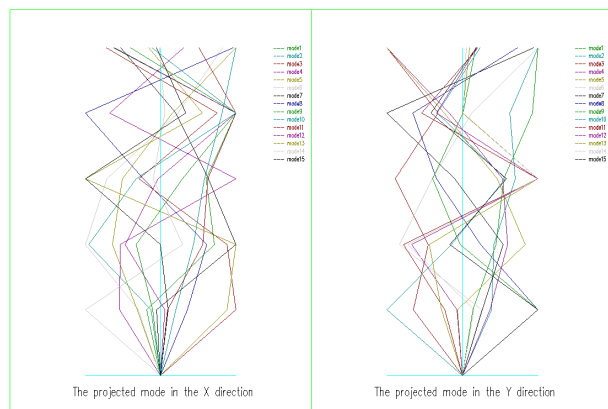


Figure 4. The vibration mode of this Coal crusher house structure

4. Exploration and Research on Structural Design of Coal Crusher House

In the structural design of coal crusher house, it is not difficult to find that the vibration isolation and reduction design of coal crusher equipment is the key content. The structural components of the direct support equipment and the main structural load are controlled by the vibration, dead weight and disturbing force of the equipment. If the vibration can be further reduced, it is very beneficial to the overall structure. Normal circumstances, the coal crusher equipment vibration isolation bearing itself bring, is now considering to form an independent whole concrete supporting structure, and coal pulverizer layer main structure release to decorate, this method can be directly partition coal crusher equipment vibration on the adverse impact of the main structure, if considering the earthquake under the action of equipment independent supporting system there may be a large horizontal deformation, may be considered in a separate supporting platform and device layer separation seam set in the buffer between the main structure components, the components in the device when can have the effect of vibration isolation, vibration in the earthquake, can have the effect of seismic energy dissipation. Concrete idea is shown in the figure 5.

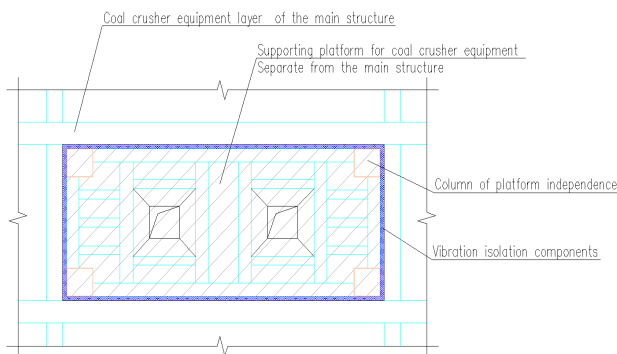


Figure 5. A vibration isolation structure of coal crusher house

5. Brief summary

Coal crusher house structure design of concrete design, needs from the craft, construction, structure, and even have electrical, hvac, hydraulic and so on many specialized consideration, this article mainly aimed at the key points of the design and construction requirements, makes a brief analysis on the basis of engineering examples, highlights the importance of structure design of vibration isolation, and power plant steam turbine generator base isolation design principle, in view of the coal crusher equipment put forward a new design of vibration isolation structure can be realized, this kind of structure design idea, the principle of simple, clear structure and force, and can effectively solve the equipment vibration on the negative impact of the main structure in the engineering practice, This design method has high practical value.

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