Different Monitoring Methods for Building Deformation of Practical Exploration

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Abstract. During the whole life of the building, the common inclination and displacement of the buildings affect the use and safety of the buildings. These problems must be observed by tilt and displacement observation. This paper mainly introduces the building slant measurement method, and the measurement data is prepared to deal with the measurement data in order to obtain the correct data performance of the construction and the stability of the construction and use.

1. Introduction
Today, building, due to the survey, design, construction, operation and maintenance management and the causes of natural disasters arising tilt, uneven settlement in especially in high-rise building, the inclination deformation of content than the subsidence deformation, even a slight tilt will also affect the structure of the beautiful and normal use, but excessive tilt lowers build, safety, and even collapse. Therefore, the construction of this kind of construction is the main content of oblique deformation observation. When a building is seriously deformed, effective engineering must be carried out, such as the high rise of the high rise due to uneven subsidence, must be correct, before it can be used. With the rapid development of social economy, engineering survey services become more and more wide, the structure of the deformation measurement is one of the, deformation measurement, the observation object and object in addition to the building itself, it is including construction sites, the base field, top and bottom structures and internal, etc. And the means of observation are not limited to conventional plane coordinates, elevation and variation, but also modern means, such as close-up photography, non-visible light perspective and so on. In addition to the amount of deformation directly provided by the external observation, the deformation law can be found through data processing and geometric analysis. The corresponding relationship can be analyzed by means of the measurement of the slant volume and the settlement amount of the high-rises, and the whole process of rectifying work is provided.

2. Monitoring purpose
As the basic building of daily life work, the stability and security of people are always concerned. In recent years, due to a variety of reasons, some buildings have been inclined, severely affected normal use, and even endanger user safety. In accordance with relevant regulations, when the subject tilts value above a certain number, the building is considered unsafe. When the inclination of the building has reached or even exceeded the allowable inclination value (1/20), the building has the proper use and economic value, and the proper corrective measures are adopted to support the building. Therefore, accurately grasp the structure of the actual situation is particularly important, the measurement accuracy, building tilt data for relevant units to provide real and effective results of the measurement data needs to be correct. The measures include the settlement observation of the building and the...
oblique monitoring of the inner and outer tilt of the building. Through data analysis, judgment and foundation settlement calculation of building tilting tilt consistency, subsidence and tilt rate exceed the national standard requirements, for the relevant departments or units of experts and scholars on the deformation structures provide powerful basis rectifying make decisions.

3. Monitoring programmer

The tilt of buildings is calculated by measuring the horizontal displacement of the top of the building relative to the bottom or the upper layer of the building relative to the lower layer. The common methods of measuring building slanting have the instrument observation method, the observation method of the lead hammer, the measurement method of the inclinometer, the basic subsidence observation method, and the near sighting photogrammetry. The overall tilt of the rigid building can be determined by measuring the relative subsidence of the top or base. Tilt was measured, generally using the direct projection method, is the extension of vertical intersection of two sides wall line, measuring 1.5 times to 1.5 times the height of building in the distance, with two precision theodolite or total station set up line in the north and south direction of the point will be projected onto the ground, corner sometimes when leave the building a close observation location and bend at the eyepiece end ocular observation and measuring its tilt. External observation is something near perpendicular to the settlement of a contour line on the direction of the precision theodolite, total station or obtain houses near that point contour line on what direction with the highest position of the top floor at the bottom of the slope displacement; The north and south direction at the same time in close to a settlement observation point perpendicular to the line set up total station or precision theodolite observation, get that point line near the building periphery upstairs in the north-south direction base slope displacement and the roof of their building. According to the height of the building, calculate the inclination rate of buildings in the direction of north and south. This is the most common observation of the sloping value of the building in the construction, but due to the uneven formation of the building in the process of masonry painting. The direct projection method need to be in vertical intersection of two side’s wall, on the extension of 1.5 - 2.0 times the height of high-rise buildings in the distance, the corner with two precision theodolites is projected onto the ground, and then take its tilt amount. However, in high-density buildings, it is difficult to implement the gap between them. Therefore, this method cannot be implemented in big cities.

Besides external observation and internal observation method, it is inside the building floors, in close to a settlement observation point perpendicular to the corresponding contour direction with total station or precision theodolite observation, get the settlement points corresponds to the layer to its highest position at the bottom of the slope displacement; At the same time, in the south and north of this layer, which is perpendicular to a settlement point, the sloping displacement of the contour line of the house near the point in the south and north of the site is higher than that of the highest position. Four observation points are taken on each floor, the lowest point is the base of the lowest point, the floor surface is selected 0.5 m high, and the height of the second point is 1m; To the third point height of 1.5 m, the fourth height is 2 m, according to the result of measurement can also calculate the tilt rate of the house, calculating formula for the parties to the upward sloping rate: \[ \Sigma \text{(each layer between the north and the south (something) in the direction of the average tilt rate)} / 4 \]

4. Monitoring content

Deformation of the building has two kinds of static deformation and dynamic deformation, the static deformation is usually refers to the deformation observation results only show how without under the action of external force during a certain period of deformation value, the deformation value function only change over time. Refers to the external forces under the influence of dynamic deformation and the deformation, dynamic system represented by outside force function for the change of time, the observation is the result of the said buildings at some point of the instantaneous deformation. The slope observation of the observation of deformation observation of buildings, crack observation of buildings and deflection observation of buildings.
4.1. Settlement observation
The settlement of buildings is the result of the combination of foundation and superstructure. This is to use level, according to the standard, regular observation of building settlement observation point elevation difference between each point and level, and calculate the observation point of elevation and subsidence and calculate according to the historical data analysis of subsidence, subsidence of buildings is the difference between observation points and leveling point’s deformation values. As a result, the stability of the leveling points determine the reliability of the observed values, standard points should be not less than three basis points, the stationing position is not affected by the surrounding environment, leave the building proper distance, but also about observation condition requirement. The number and location of observation point, should according to the structure of the covering surface size, importance, basic form, form, load distribution and geological conditions, can reflect the status of building settlement. The settlement observation technology and data are the basis of the research to solve the settlement of complex foundation, and help to improve the foundation design. At the same time, the relative settlement difference of the settlement observation point is analyzed, and the security condition of the building is monitored.

4.2. Displacement observation
The displacement observation of a building refers to its horizontal displacement observation, which mainly measures the movement of the overall plane position of buildings over time. The foundation is affected by horizontal stress, which makes the plane of the building move, such as the foundation is in the landslide zone or affected by the earthquake. Displacement observation is the measurement of the displacement of the building in the plane position with time. Due to different building structures, different horizontal displacement observation requirements are required. Different methods are needed. The commonly used displacement observation method is base line method, traverse measurement method, triangulation method, and forward intersection method.

4.3. Oblique observation
The oblique observation of buildings, because the upper structure of high-rise buildings and the overall stiffness of the base area, the inclination of the foundation, such as uneven settlement, reflects the tilt of the upper main body. The tilt observation of buildings is the unevenness of the foundation settlement, and the safety of buildings is monitored by oblique observation.

4.4. Fracture observation
Fracture observation, when the foundation of the building is caused by uneven settlement, the walls appear in different sizes of cracks, and the external erosion media infiltrates the buildings and destroys the buildings. Fracture observation can be informed of the status quo and development trend of crack, so that according to the observation data analysis of the causes of cracks, measure the influence degree of the safety of the building, in order to take effective measures to deal with. According to fracture observation and settlement observation, the laws, characteristics and causes of deformation are analyzed to take measures to ensure the safety of buildings. According to the specific situation of the building, the crack observation means, the plaster mark, the thin iron mark or the metal bar sign.

4.5. The deflection observation
Deflection observation, the structure member of the building will generate the deflection with the increase of the load; the size of the flexure will have a great influence on the stress state of the structural member of the building. Therefore, the flexure deformation of building structural components must not exceed a certain value; otherwise the building will be endangered. The common building foundation deflection observation, the deflection observation of the building truss, the deflection observation of the bridge cantilever beam, the deflection observation of the building main body. The deflection observation of the building is the degree of deflection of the building member. For vertical high-rise buildings, three displacement observation points should be set up, medium and lower, and displacement observation: the deflection of the component can be calculated by using the displacement of three points.
4.6. The method of building deformation observation

In the observation of deformation of buildings, besides the above five deformation observations, there is also torsional observation, vibration observation, bending observation, offset observation, etc. The above five kinds of deformation observation of buildings, and not every building, must be applied to the different USES of buildings, the above five kinds of deformation observation of buildings, and not every building, must be applied to the different USES of buildings, the deformation observation point is also different. The method of building deformation observation should be determined according to the nature of the building, the size of the building, the use function, the observation precision and the surrounding environment. In the general case, the settlement deformation of buildings is measured by precision level measurement, liquid static level measurement or micro level measurement. For horizontal displacement, if it is a straight line building, it is usually observed by reference line method. If it is a curved structure, it is usually observed by traverse method. For the deformation of cracks or expansion joints of buildings, special instruments or other methods for measuring gap can be used to observe.

5. Observational data analysis

To deformation observation data monitoring buildings safe use and develop its project benefit, in the engineering field observation data, the exact analysis, still need to do to deformation observation data to make the right process. It should be careful, comprehensive and scientific to deal with deformation observation data and conform to the principle of experimental data processing. The deformation observation data of the actual project is processed and sorted into a diagram for practical application. To discuss the reason of building deformation, the value function of the relationship between load and deformation are given, so as to make the right judgment for building operation state and deformations forecast, and provide the basis for modifying design parameters. The content of the deformation observation data analysis is the geometric analysis of the deformation of the building, which is the geometric description of the spatial change of the building. The second is the physical explanation of the deformation of the building, which explains the deformation of the building.

6. Conclusion

The practice shows that the measurement of the inclination of buildings is one of the important means to provide scientific basis for the safe and effective means of building emergency. Only by building subsidence observation, oblique observation, such as scientific observations, a combination of observation data, can grasp the building safety, which will provide a scientific basis for experts to make scientific decision.

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8. References

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