Sensor characteristics of geotechnical instruments

This paper is written to help the selection and understanding of the Geotechnical engineering measuring instrument of Geotechnical engineer in consideration of the output characteristics of each sensor applied to the civil engineering measuring instrument and the applicability of the civil engineering field. The expression is not absolute and may be somewhat subjective.

1. Electric resistance sensor

The electric resistance type sensor is used as a sensor element (thin plate resistance strain gauge, potentiometer, encoder, linear resistance sensor, resistance type angle sensor, etc.) in a general industrial field, and users can choose from a variety of shapes and applications, from ultra-low-priced products to ultra-high-quality products.

Geotechnical engineers need to know what kind of sensor they have adopted because it is not enough to mount a high-end sensor in the age of price competition.

Electric resistive sensors commonly used in industrial sites are not well used in geotechnical engineering sites for the following reasons.

As engineers know, most civil engineering sites have a lot of water, and electricity is actually supplied to structures such as strut due to air conditioning system operation, air compressor operation.

Even if electricity is not available, it is in the field of influence. If you connect the electric resistance sensor to the output device without additional reinforcement in this area, the data may not be readable or may be seriously shaken.

When installing on geotechnical engineering sites, you need to be very careful about electrical shielding.

Electric resistance type sensor is very sensitive to electric noise and humidity because the output signal is sent to mV, Ohm(resistance) as the basic principle of change of resistance, and the transmission distance is about 300~400m

Durability is short due to its short life span compared with vibrating gauges. The advantage of the Electric sensor is that dynamic measurement is possible, so if you need to measure dynamic conditions such as indoor model test or pile load test, you must use electric resistance sensor.

2. Vibrating wire sensor

In order to overcome the problem of operating the above-mentioned electric resistance type sensor, the vibration sensor is a mechanical sensor for outputting frequency, which is mainly used in the civil engineering field invented by civil engineers at the civil engineer's laboratory in Norway for the first time. It is possible to design all of the various civil engineering instruments with one vibration sensor element and the fact that only the manufacturing reliability is secured and the semi-permanent measurement can be done because the distance is long and the output device is simple and compatible with each other, Since it is very advantageous, about 7-8 civil engineering measuring equipment manufacturers have succeeded in industrialization worldwide and are widely used only in civil works.

However, one of the big weaknesses is that it is impossible to measure dynamically. Therefore, it is inevitable to use electric resistance type in the field where dynamic measurement is required.

3. mA (including 4-20mA) About output sensor

When engineers read the website of the civil engineering industry or the technical data, if you see the property comparison chart for each type of sensor, you can see many articles that output the mA as the best sensor compared to other types of sensor characteristics. But this is a sensor theory comparison, and one thing is overlooked.

Since the sensor of mA type requires high manufacturing technology, the price of sensor element is very high, and sensors capable of detecting pressure, displacement, and angle only have been developed, and there are weaknesses that can not be designed with various types of civil measuring instruments.

In addition, since the mA output sensor is sent in the form of constant current, theoretically, long-distance transmission is possible, but in reality, there are few sensors that transmit a constant current.

An output device or a data logger that acquires a signal to be transmitted can not directly receive mA but converts mA to mV and accepts it. Theoretically, the transmission distance is long and does not affect electrical noise.

However, in a realistic situation, there is almost no difference from an electric resistance sensor, so it is considered to be an overestimation, and it should be explained in consideration of the circumstances and circumstances of the civil engineering field

4. Semiconductor sensor

The sensor of semiconductor type has been mass-produced industrially for microscale measurement of automobile cylinder pressure for 20 years, and it must be very precise pressure sensor.

However, the diaphragm that confines the pressure is silicon, which is very cheap because it is injection molded, but one of the big weaknesses is that the diaphragm is a semiconductor, so when it encounters moisture or water, the sensor is dead.

A company that has developed a semiconductor sensor has purchased a semiconductor pressure gauge and made a secondary diaphragm with a rubber pad at the front of the diaphragm to seal it.

For this reason, groundwater in civil engineering sites is often contaminated with cement or chemicals, and semiconductor type pore pressure gauges protected by rubber pads do not have a long life span due to corrosion or oxidation of the rubber sheets in contaminated water.

It would be up to the honest company to describe the advantages and disadvantages as they are and to be evaluated.