WOULD UTILITY SURVEY RESULT TRUSTABLE?

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Abstract

For many years, utility survey results have been in doubt by many people. Some even think it is not necessary to carry out utility survey and digging trial pits will be the same. The reasons behind was that there are many "specialists" they claimed themselves "specialists" but they do not pose the necessary training, necessary tools, necessary experiences, nor do they have necessary ethical and logical mind set for a quality work that they priced below cost and hence cut corner for their own benefits. In such a manner, clients' benefits will be forfeited by the "specialists" and clients are the one eventually bear the risk, cost, delay to their contract, damage to their reputation, etc. This paper will look at how the situation is improved and that utility survey results will be trustable and to an acceptable level.

Hong Kong's Past Situation in Terms of Utility Survey

In Hong Kong, there are a lot of utilities laid underground. And there are thousands of slopes and many them are situation next to us, Hong Kong citizens. In the past, there had not been an industry-wide, standardized set of guidelines and requirements on utility survey, and therefore quite a number of underground utility incidents occurred. One of the deadliest incidents was the Kwun Lung Lau landslide in 1994, which killed 3 people.

Since then, more thorough guidelines and requirements were set up by the joint work of the government and the different parties in the utility surveying industry. So, there has been continuous improvement with new technological advancements in utility management, as well as the provision of continuous training to the professionals in the industry. When all these factors join hands, utility survey results can become more trustable.

Lacking on standard methods, standard requirements and standard performance checks on utility surveying in Hong Kong, in the past, not many operators were qualified, and not many clients' representatives fully understood the requirements used in other countries, as stated in their contracts. Different companies conducted surveys in different ways and many not in accordance with the contract requirements but no one cared as no one really understood what was happening. Few clients' representatives knew what was going on. They might not be able to identify the faults even though the surveying personnel did perform badly as they themselves have not been trained.

Changes for the Industry

In a bid to rectify these problems, standardization of work, institution and qualification, management training, safety training, equipment operation and survey reporting, public understanding and recognition of qualified companies are urged by the industry undertakers and clients.

One of the route to professionalism is training. There are courses (both introductory and qualifying) provided in Hong Kong meeting the international standards of the same. These courses aim to provide the industrial undertakers the up-to-date knowledge and skills development in the field as professionals. For those who take qualifying training courses, they need to attain competence levels for both written and practical examinations to be eligible for applying for professional qualifications in HKIUS. Such training courses can equip professionals to get along with the advances in the industry standards and issues, which helps in attaining trustable utility survey result.

Continuous Professional Development (CPD) courses are also becoming more and more prevalent among the industry for its practitioners to take part so as to maintain their professional standards. To equip practitioners with sufficient and updated knowledge, CPD courses are held from various qualified parties, the industry's research institutes and also with some universities. As one of the continuous professional development requirements, members of the Hong Kong Institute of Utility Specialists (HKIUS) are required to take part in a minimum of 35 hours of training per year or 70 hours of training every 2 years. It is hoped that, through these CPD trainings, professionals in the industry can get correct and updated knowledge in utility services when they work in this profession.

Contract requirements

There has been a higher set of requirements laid down on contracts. Consultants being appointed have been taken into considerations on the requirements of highly qualified

companies in terms of reputation, track records, tools equipment and with highly qualified staff in terms of training and experiences. There is a marking scheme with a formula to evaluate the competence of a company in terms of resources, staff qualifications, company experiences, etc. has been introduced since 1995. The new contract re-emphasized the importance of applying the standard/standard systems for the surveys with a lot of emphasis on digital data management. Moreover, there are a number of requirements for qualified operators to run underground utility survey. For example, he/she should have at least 2 years of experience, and be a holder of certificate from Hong Kong Polytechnic University, or be a degree holder of a recognized university. There may be more requirements now, such as the operator should be a member of Hong Kong Institute of Utility Specialists and/or Hong Kong Institution of Engineers, etc. These measures should be able to promote trustable utility survey result.

Guidelines and requirements

Guidelines and requirements in utility survey have been strengthened, such as in gas safety, electricity supply lines and excavation near water mains. Other types of strengthened guidelines and requirements include those for road opening for telecommunication/broadcasting operators.

Cap. 51B Gas Safety (Gas Supply) Regulations Section 23A enacted in 1997 state that “No person shall carry out, or permit to be carried out, any works in the vicinity of a gas pipe unless he or the person carrying out the works has, before commencing the works, taken all reasonable steps to ascertain the location and position of the gas pipe.” Also, the guidelines state that “A person who carries out, or permits to be carried out, any works in the vicinity of a gas pipe shall ensure that all reasonable measures are taken to protect the gas pipe from damage arising out of the works that would be likely to prejudice safety”.

Cap. 406H Electricity Supply Lines (Protection) Regulation enacted in April 2001 states that works in the vicinity of electricity supply lines require that “reasonable steps shall not be regarded as having been taken unless a Competent Person has undertaken an investigation for the purpose of ascertaining the existence within the proposed works site and its vicinity of any such underground electricity cable and its alignment and depth and has provided a written report of his findings as to those matters”.

For guidelines for excavation near water mains, it is stated that professionals should “make use of suitable pipe detector to ascertain as accurately as possible the alignment and depth of buried water mains near the work, before digging trial holes”. And for the Guidelines for Road Opening for Telecommunication/Broadcasting Operators, relevant guidelines state

that “ when a telecommunication/broadcasting network operator prepares any road opening plan, it should check with the other operators regarding the availability of capacity on existing ducts along the planned route or any alternative route to meet its requirement”.

Practitioners in the industry should follow the mentioned enacted guidelines and requirements. Standardization of work could be attained and utility survey result should become more trustable.

Technological Advancement

There are some technological advancements in recent years, including GIS Database Concept, Integrated Data Management System (IDMS), Ground-penetrating radar (GPR), etc. which help to attain trustable utility survey result.

GIS Database Concept

Geographical Information System (GIS) is a system of computer software, hardware and data, and personnel to help manipulate, analyze and present information that is tied to a spatial location. At the core of this database, it enables users to obtain the relevant data through the Internet. Users can select a location by coordinates, slope number on the map displayed and the categories of data that they want on the browser, the web-based GIS will retrieve the required information and display on users’ browser. It also allows the users to pay and download the softcopy of the data.

GIS is used because it helps us in a number of ways. We have to handle a lot of data which might have come to us in different types and time. To some professionals, the operations on site are mainly manual type. This can create a lot of discrepancies and inconsistencies. With GIS, we can find ways to fill in correct information on underground public utilities, so that we can save cost when we dig up the road to search for relevant underground utilities. To this extent, GIS is trusted to produce utility survey result in a reasonable manner. However, there is still room for improvement for training of GIS personnel for utility surveys.

Integrated Data Management System (IDMS)

In many cases, there are various kinds of utility breakage. Built according to HKCCEC-200d and other related regulations, GIS based Integrated Data Management System (IDMS) can digitally record all kinds of breakage or destruction. It is a database containing various sorts of information: Project Information, manhole internal condition

survey results, CCTV survey results including movie recording pipe condition, GPR survey, WLD survey, topographic survey, and other surveys.

The drainage condition will be graded according to the codes. The best will be “1” while the worst will be “5”. The drains whose grade is “5” represents that it needs to be repaired immediately.

With such a system, we can be assured that the problematic breakage or destruction can be dealt with quickly, so that more serious events can be prevented in future.

There are a number of advantages brought by IDMS. Practitioners in the profession can have a complete, seamless and eventually shared utility information coverage to support safer, more effective road opening. Also, from the established database, there is a lot of application potential, such as dynamic map/report generation, online query, spatial analysis, network tracing, 3D modeling and schematics production. On the service level, there will be more standardized and correct information to be saved and dispatched at the same time to both clients and competent persons. The time cost to deal with excavation and all other related works can be lowered with a higher degree of accuracy.

With the help of latest technology, the position and level of locatable services, at the recorded points and intervals defined above, shall be recorded points and intervals defined, shall be related to grid control points and bench marks to better than $\pm$100mm root mean square error on the ground. 90% of a representative sample of points on locatable services shall be within $\pm$165mm or 10% of the buried depth (0.1d).

Ground-penetrating radar (GPR)

Ground-penetrating radar (GPR) is a geophysical method that uses radar pulses to image the subsurface. This non-destructive method uses electromagnetic radiation in the microwave band (UHF/VHF frequencies) of the radio spectrum, and detects the reflected signals from subsurface structures. GPR can be used in a variety of media, including rock, soil, ice, fresh water, pavements and structures. It can detect objects, changes in material, and voids and cracks provided that sufficient transverse, suitable frequency and qualified personnel are employed..

GPR uses transmitting and receiving antennas. The transmitting antenna radiates short pulses of the high-frequency (usually polarized) radio waves into the ground. When the wave hits a buried object or a boundary with different dielectric constants, the receiving antenna records variations in the reflected return signal. The principles involved are similar

to reflection seismology, except that electromagnetic energy is used instead of acoustic energy, and reflections appear at boundaries with different dielectric constants instead of acoustic impedances.

The depth range of GPR is limited by the electrical conductivity of the ground, and the transmitting frequency. As conductivity increases, the penetration depth decreases. This is because the electromagnetic energy is more quickly dissipated into heat energy, causing a loss in signal strength at depth. Higher frequencies do not penetrate as far as lower frequencies, but give better resolution. Optical depth penetration is achieved in dry sandy soils or massive dry materials such as granite, limestone, and concentrate where the depth of penetration is up to 15m. In moist and/or clay laden soils and soils with high electrical conductivity, penetration is sometimes only a few centimetres.

Ground-penetrating radar antennas are generally in contact with the ground for the strongest signal strengths; however, GPR horn antennas can be used 0.3 to 0.6m above the ground.

Engineering applications include nondestructive testing (NDT) of structures and pavements, locating buried structures and utility lines, and studying soils and bedrock.

When we use the GPR as an instrument on sub-surface characterization, usually utility surveyors need not dig holes on the ground to see if the underground utilities are working fine or not. In other words, manpower to dig the holes, locate faulty utility service as well as obstruction to road users are kept low. This can save operating cost, and improve safety.

Global Positioning System (GPS)

GPS is gaining increasing importance for public utility resource management because of its capability to support accurate and cost-effective mapping of field facilities. A GPS receiver detects signals from orbiting satellites and uses triangulation to calculate the latitude and longitude of individual locations. Precise GPS mapping can replace traditional schematic maps that may be incomplete, inaccurate, and difficult to maintain. This effort can be done efficiently in conjunction with utility construction and maintenance activities, and the resulting data supports the preparation and continuous upgrading of infrastructure records. With correct information from GPS data will also be valuable for computer-aided drafting system operations for facilities drawings. Recorded marker coordinates can be used to auto-create points for the CAD system, resulting in precise and complete as-built drawings. This paperless, electronic approach to field records will reduce he possibility of error and speed the process of creating and updating

CAD records. With more accurate information, it can help produce more trustable utility survey result.

Conduit Condition Evaluation (CCTV Survey)

CCTV starts from the 60s in the last century. Its main function is to check the inside condition of pipes/ducts, and record it for following up purpose. CCTV can be divided into three parts, which are main controller, lens, driving device (can view 80mm and diameter 2.1 meters with length 250 meters and common recording function).

For common practice, lens can be controlled from driving device, and the image is transmitted to video recorder. Then, professionals can analyze and evaluate the situation of utility with the help of recording video and recognized conduit condition evaluation codes.

CCTV is one of the effective ways to check and improve slope condition and internal conditions of buried water-carrying service with video records. Also, with a set of standardized specifications adopted by Hong Kong Institute of Utility Specialists (HKIUS), CCTV method was officially confirmed for slope investigations. With the improvement of CCTV technology, slope failures start to decrease in number and this provided room for improvements of buried water-carrying services since then.

Conclusion

There are sufficient requirements and standards nowadays to regulate the survey results by utility survey specialists.

To improve the accuracy of the utility survey results, it is important that clients' representatives understand the pros and cons of utility survey and the need of qualified personnel for quality works.

Taken into account the advances in latest technology in utility survey, and the continuous increase in personnel training and their strive in excelling themselves, it is optimistic that utility survey result will become more and more trustable.

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