Life as a site engineer in the United Kingdom

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Many surveyors from New Zealand travel overseas at some stage in their career. I was no different and early on in my career travelled to the United Kingdom in 1993 with the objective of a working holiday. I left the New Zealand economy in the middle of a recession and arrived in the United Kingdom in the middle of a recession with little survey work on offer. Fortunately a job offer came through, but in the Middle East. It took several months to arrange work permits. In the meantime I travelled around Europe on holiday which was much more fun.

After working in Bahrain and south east Asia for several years, I ended up back in the United Kingdom in 2004, eventually working as a site engineer on a variety of commercial construction projects. Land surveyors in the United Kingdom spend the majority of their time on topographical and measured building surveys. Measured building surveys to generate floor plans, elevations and cross sections of a building can be very challenging. The age of the buildings could be from tens of years to hundreds of years old.

The United Kingdom surveying scene

Many of the surveyors who are used to carry out the field work have little or no formal survey training from a tertiary institution. There is a heavy reliance on the use of the latest survey equipment, 3D laser scanning, robotics and GPS. Field surveyors are generally trained in house, starting off as a chainman, then if showing promise progressing to a technician level. Salaries for a typical field land surveyor range between £15,000 and £25,000 a year depending on experience.

Falling into the role of a site engineer offered many more challenges and a higher income. The following article reviews four years of experience in such a role in England, which I hope is of benefit for surveyors in the future who choose to head overseas in that direction.

Construction projects

Whether the project is a £1 million or a £10 billion project, the principle contractor manages it and the many sub-contractors who carry out the physical construction work on site. Even on small projects there are usually several sub-contractors to do earthworks, soil stabilisation, drainage and ducting, concrete foundations, joinery, steel fixing, steel framework erection, brick and block work, roofing and landscaping.

These smaller construction projects will only have one site engineer working for the principle contractor and setting out for all the subcontractors. Larger projects may have a site engineer for the principle contractor with each of the various sub-contractors also having their own engineers.

The overall design work and contract management including clerk of works is normally carried out by an architectural firm. This firm will sub-contract various the parts of the design outside of their in-house expertise to sub-contractors such as structural engineers and specialised glass designers. The senior management of the principle contractor normally consists of, in descending order of seniority, the directors, contracts manager, quantity surveyor, site manager, site agent followed by site engineer.

Any variations to original contracted work specifications will allow the sub-contractor to charge extra, adding to the original project budget. Budget blow-outs and extras regularly occur in the earthworks and foundations stage of a project.

Role of a site engineer

Setting out of construction works is usually completed by a site engineer. Most start off as a site engineer's assistant, similar to a chainman. If they show promise then they can quickly progress to a site engineer's position. Most will eventually do evening classes a couple of times a week over a few years to get formal training.

The site engineer is the agent's eyes and ears on the site. Being permanently outdoors in all weather, is the norm. If you do not like mud and rain then a career change might be in order. The site engineer must be familiar with all the construction drawings and ensure that the sub-contractors build in accordance with the drawings. Any shortcomings in the design drawings must be reported to the site agent for review by the designers. The sub-contractor carrying out the actual construction work will often point out the shortfalls in design to the site engineer.

Challenges

If any of the sub-contractors on the site have a question with the design drawings then they will first discuss with the site engineer for clarification. If they are not able to resolve the problem then the site engineer will refer it to the agent or site manager. The site engineer never undertakes any design work, and any design review must be performed by the original architectural firm who is contracted to do so.

Generally hard copies of all design drawings are worked from on site in A1 or A0 size. Digital copies of drawings are normally only provided by the designer in PDF format. Getting a DWG ?? drawing from the designer is nearly impossible. On larger projects a drawing register is maintained via a website portal with the status of each drawing indicated which minimises the chance of using a superseded drawing.

Most problems with setting out resulted from a drawing which was obsolete or a drawing with dimensional errors on it. Checking the dimensional accuracy of a drawing is critical before using it for setting out.

Senior management on site

An accurate as-built record of the construction works must be maintained by the site engineer. Normally a hard copy of the design drawings is used for this with highlighting and marking with pen by hand indicating the areas of work completed on which date. A tabulated comparison is also maintained between the quantity of materials in design and the actual materials used. Reasons for any variations must be clearly explained and justified for the quantity surveyor to claim extras. The site engineer determines the quantities of materials to order for each day. These include concrete, stone and fill material as well as any others requested.

Concrete is available in trucks holding six or eight cubic metres. Based on the measure by the site engineer, the concrete is ordered and a part load is placed at the end of each pour after the last full truck arrives on site. The site engineer also takes sample cubes of each pour which are laboratory tested at seven, 14 and 28 days to prove the strength of the mix. On large pours three cubes are often taken at the beginning, middle and end of a pour, but are random. The truck from which the cube was taken be recorded.

Stone and fill is ordered by the truck, which is eight cubic metres or 20 tonnes. A typical ratio of 2.2 tonnes a cubic metre is used but it does vary a lot, depending upon material. The site engineer is considered part of senior management for the site and as such has an active part to play in enforcing any health and safety issues.

Setting out

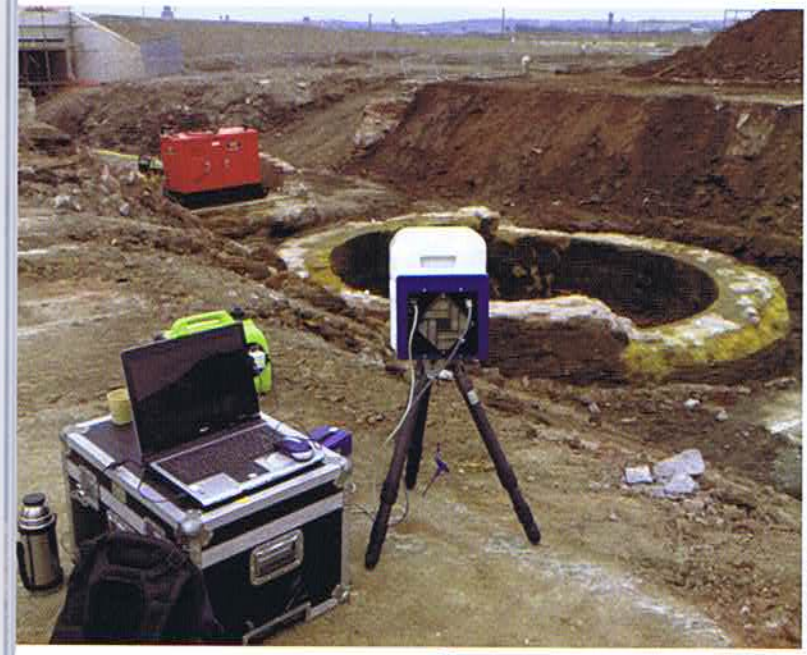
Setting out may be done by using a string line or dumpy level, steel tape or total station. Many site engineers take A3 laminated copies of drawings on site to use in set-out from. I always preferred to make detailed records in my field book instead. The one field book could always be relied on to be in your pocket, whereas lots of A3 sheets flapping in the wind were more difficult to control and were often left back in the site office. Any disputes or questions in the future could also be resolved by the field book records. Recording dates and times of events including setting out was critical in the case of any disputes.

Time is critical as even on small sites there will be several sub-contractors expecting setting out information from the site engineer. Having very efficient methods appropriate for the task at hand is important. Time should never be wasted setting out with a total station when the task could be achieved with a string line and tape measure.

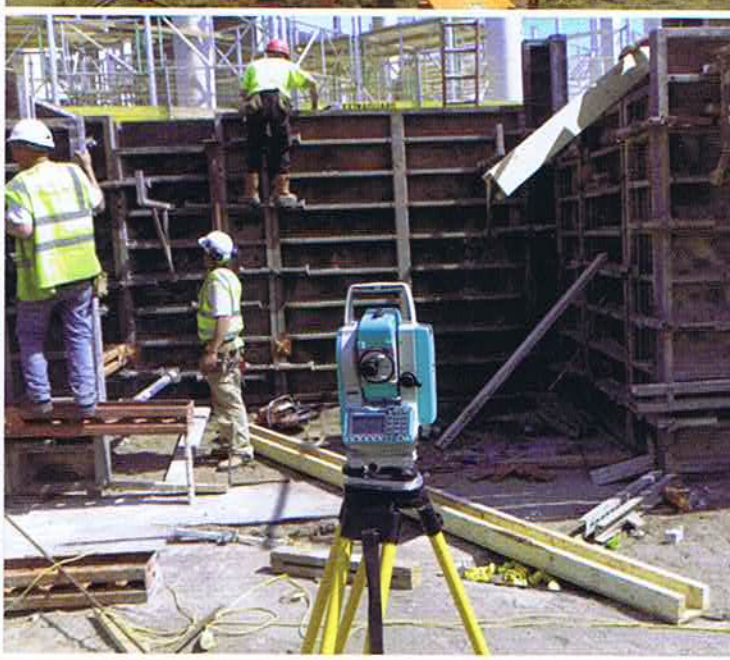
The majority of projects are for commercial buildings and usually require setting out to a tolerance of five millimetres both horizontal and vertical. The preference is for a reflectorless total station, and free stationing or resection within 10 metres of the points to be set out. Having very accurate control to free station is critical.

Critical checks

Setting out information is usually provided by the designer as 2D dimensioned drawings. Site engineers are expected to spend the majority of their time on site in the mud and rain ensuring all construction work is carried out by the sub-contractor in the correct position and to the specified standards. There is little time available to spend in an office calculating setting out information. Therefore it is common for critical





points on site, such as construction grid intersections, to be coordinated for setting out. Having a total station with a two point reference line programme to set out offsets is critical to avoid having to do lots of calculations in the field.

During the ground breaking stage of a project, there is normally ample time for the site engineer to become familiar with all the drawings, to check the dimensional accuracy of the drawings and raise any queries before work commences. Rotating and pipe lasers are extensively used. The site engineer is normally expected to set up all the lasers on site each day and to check them on a weekly basis to ensure they are functioning within the accuracy tolerances.

Existing services

The site engineer is also expected to locate all existing services on site before ground works begin, working jointly with the sub-contractor. All electricity, gas, fibre optic cables and existing underground pipe work must all be located by trial holes to confirm their location and depth to avoid any damage during construction. As-built drawings of the existing services are provided by various agencies. Keep in mind some of the services such as water pipes may have been installed in the 1800s so they are often never where you expect them. Being familiar with a CAT scan is essential.

The site engineer also prepares the permits to work for the sub-contractors. For example, a permit to dig must be prepared for the ground works contractor before starting work on a section of the site. The site engineer must complete the permit, clearly stating all underground services records have been reviewed and any services in the work area have been located by trial hole to prove their location. The permit must also state that a CAT scan has been used by the site engineer over the area to detect any additional services not shown on the records. Often, as part of the topographical survey, the survey, contractor may have been requested to do a GPRS survey to locate underground services, is a valuable guide to service locations.

Weather

Work on the site including any setting out is seldom weather dependant. In the United Kingdom you can be sure of one thing, rain and mud. The construction work and phases are planned to minimise any delays from weather. Rain and mud is no excuse for a site engineer to not be setting out. In four years the site I was on was only stopped once by inclement weather. It was a Siberian weather pattern which lasted for two weeks, with temperatures of minus 10°C to minus 15°C. The country ran out of grit for the roads so the trucks could not drive up to access the site.

Road chalk and building pencils are ideal for marking out in wet weather on concrete and formwork. Due to the wet weather earthworks are normally budgeted for lime and cement stabilisation. The roof of a building is often constructed early on in the project. This allows the brick layers and concrete floor sub-contractors to work in all weather.

Health and safety

Every year in the United Kingdom several hundred people go to work and never return. They are a statistic of the many fatalities which occur annually, even with a very strict health and safety environment.

Around the year 2006 the laws in England were changed to allow for corporate manslaughter. This meant that the directors of a company could be prosecuted and sent to jail for fatalities on site. A strong health and safety policy from the top down exists. Everyone on site must have attended a construction skills certification scheme. It is a simple multi-choice exam which takes 45 minutes, but study for it is essential. Suitable books are available from most bookshops.

Most sites require supervisors and site engineers to have attended a first aid course for emergency first aid at work which takes two to three days to complete. Any near miss or incident must be reported to senior management, which is the site engineer or higher. I have seen several near misses and it is scary how quickly it can happen, even with the strictest health and safety policies in place.

Hazard identification

Tool box talks are held on a regular basis, usually once a week for 15 minutes or more at beginning of day. These are to remind workers of any problems and hazards which could occur in the course of their work over the coming days and to remind them of safe working practises.

Enforcing health and safety is an important part of the job of a site engineer. Not just the usual such as hard hat, steel cap boots, high viz, safety glasses and gloves but also safe working practices. Excavations of any trench deeper than 1.2 metres requires benching or a trench box.

Fall from height hazards means the use of ladders of any length are banned. Mobile scaffold towers, permanent scaffold, cherry pickers and cranes are the usual acceptable means to access heights. Jumping on to the back of a flat deck truck to unload or sling a load is not acceptable. Either dedicated loading bays or a fall arrest system from a crane is used. There is a zero tolerance for drugs and alcohol with random drugs tests regularly carried out.

Security

The sites, no matter how small or large, are always a target of criminals. They are normally interested in stealing diesel, equipment, tools and machinery.

Sometimes it can be just mindless vandalism.

Diesel on construction sites is cheaper than the normal consumer diesel and is a different colour with red dye in it. It is illegal to use the red diesel on roads outside the construction sites and the difference in colour is easily seen in the fuel bowl of the engine.

The high commodity prices mean that copper cables are a favourite for theft. Cables above and below ground are often stolen if the security is not good. To combat criminals security guards are employed to patrol the site after work hours. On some sites in very rough areas we have had to employ security guards during work hours as well.

Machines always have shutters locked on to each window at the end of each day to stop windows being broken by vandals and the immobiliser switch removed at end of each day. All sites are fenced off to stop any chance of the public accessing the site. On larger sites access is via a turn-style gate where an eye retina scan or palm scan is required to get through the gate. These types of gates can make it very challenging when carrying survey gear.

Carbon footprint

Environmental awareness and recycling is an important part of construction projects now. A wash-out pit for concrete trucks is regularly monitored by the site agent. The site engineer will be held accountable for an unusually large amount of wasted concrete in the pit.

All machines have spill trays under them at the end of each day to catch any oil or fuel leaks. Materials and contractors closest to the construction site are selected, with a preference for local labour. For workers there is a shorter daily commute and reduced carbon footprint. Waste skips are available on site to recycle wood, cardboard, paper, metal and cans.

Projects

The range of projects possible to get involved in is large and challenging. During my four years in England I was a site engineer on the following major projects –

- Athletics track and field to international Olympic standards at St Pauls School, Widnes.
- Retail park to construct a Morrisons supermarket, retail outlets and service station.
- Park refurbishment including construction of new playground at Otterspool Park, Liverpool.
- Events centre for conference and exhibition Echo Arena, Liverpool.
- Canal project to extend the Liverpool to Leeds canal through the centre of Liverpool.
- New schools in Everton and Wallasey.
- Several lime and cement stabilisation projects requiring for earthworks, with the largest involving 850,000 cubic metres of stabilised material for Eddie Stobbart, Runcorn.
- Precision roller alignment of hundreds of rolls in Pilkingtons Glass factory, St Helens.
- Streetscape refurbishment with new lanes, traffic lights, footpaths and underground services.

Conclusion

The New Zealand trained surveyor is ideally suited for the role of site engineer in the United Kingdom. Our broad range of training ensures this.

It is very satisfying to be part of a project team who successfully build something on time, on budget and with no injuries incurred.

One of the biggest issues I had to deal with was the different construction techniques used and the associated terminologies. Honesty was always the best option and I found the English always keen to educate the man from down under. I gave up trying to explain I was not from Australia.

Allan Hosking obtained a BSurv from Otago University, graduating in 1989. A further three years work experience with RPC Ltd in Whakatane led to registration as a professional surveyor in 1993. After work overseas Allan relocated to Tauranga in 2010 where today he operates his business Survey Solutions and is a supplier of the Chinese manufactured South brand of survey equipment.