World Plumbing Council Scholarship 2018

WORLD PLUMBING COUNCIL

A Comparative Education study of the Plumbing and Training in Japan and Ireland. Cites Visited Tokyo, Kyoto and Osaka.

Shay Shanahan, Plumbing Teacher.

About the World Plumbing Council

The World Plumbing Council (WPC) is an international organization that aims to develop and promote the image and standards of the plumbing industry worldwide.

"To promote the role of plumbing in improving public health and safeguarding the environment, by uniting the World Plumbing Industry, for the benefit of all.

The WPC's mission and objectives are:

To develop and promote the image and professional standards of plumbing to the world.

To encourage, participate in and facilitate the exchange of information, research and technology applicable to the world plumbing industry.

To promote plumbing education and training worldwide.

To promote the Plumbing Industry's role in improving public health through the provision and protection of safe water and sanitation.

To promote the Plumbing Industry's role in safeguarding the environment through proper management, care, reuse and conservation of natural resources.

To meet at a World Plumbing Conference at least every three years.

To increase membership of and participation in the WPC.

To enhance the status and influence of the WPC.

To ensure the integrity of the World Plumbing Council through good governance.

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About the WPC Representative

My name is Shay Shanahan. I am a 33-year-old Plumbing teacher from Dublin, Ireland. I have been working in the Plumbing Industry since I finished school at 18 years of age. You never forget your first day, it was January 7th 2004. Plumbing is like any job, you got to love it to do it every day. I loved it from the start. My apprenticeship lasted 48 months and in 2008 I was fully qualified. Since qualification I have completed several different gas, oil, & renewable energy courses, plus many more continuous professional development ones. My main area of expertise is in large residential houses and small commercial projects. In 2014, I began a BSc in Education and Training at Dublin City University. In May 2018, I began my full-time teaching career at the City of Dublin Education and Training Board as a Plumbing and Heating Teacher. My intentions going to Japan as a 'researcher' was to develop a full understanding of systems as culturally diverse as possible on opposite sides of the world in order to compare and contrast both educational training systems without proximal contamination, anthropologically speaking, in the expectation of a comprehensive understanding of the character of each model independently' (Thoma, 2016).

Since the inception of modern plumbing systems, new technologies, appliances and processes have emerged for plumbers to learn. This WPC Comparative study offers me a way of seeing things differently which is a catalyst for learning. Although this study will be qualitative and not suitable for making wider generalizations it is empirical nonetheless. The study will provide data from observations and from experiences with others in the field which will enhance my own teaching practice. In addition, the World Plumbing Council Scholarship has provided an opportunity for me to network and meet other plumbers and industry professionals from around the world.

Figure 1 (Inside Tokyo Metropolitan Flood Defence Centre)

Acknowledgements

To the World Plumbing Council for providing me with the opportunity to travel to Japan, to experience and compare at first hand their educational practices and cultural traditions.

To my fiancée Nikki for her invaluable guidance and unending support through the journey of research and implementation. Offering constructive suggestions, as well as motivating support at the correct dosage and at the right time. She also provided vital input, analytical questioning and professional reporting at a time where I was too busy trying to make stuff.

To Nishihara Engineering Ltd and their General Manager Mr Makoto Uto for his expert advice, direction, detailed itinerary, generosity and time. I was overwhelmed by it.

To Mr Hiroshi Akimoto a delegate of the Official World skills Japan team and the Japanese Vocational Ability Development Association. I thank you for your generous assistance in providing an essential link with Japan and for educating me about the World Skills and giving me a complete overview of the Japanese Vocational Education system.

To Hidemasa Kondo and Yuta Sugiura my two friends from Kyoto. It felt like we had known each other our whole lives. It was a joy to see and hear about the day to day operations of your company 'Mellow Plumbing'. I will always remember that sunny day driving around Kyoto.

To Mr Hiroki Iwai at Benkan Corporations. Your enthusiasm about our visit from the start really motivated me. Thank you for your presentation and the company tour.

To the three interpreters Stanislav, Fukuko Haniki, and Keiko Ishida. The professionalism and clear communication service you provided me with, gave great peace of mind when entering meetings.

Ga raibh mile maith agaibh / Arigatou gozaimasu / Thank you

Figure 2 (Outside Kinden Corporation)

Executive Summary

The World Plumbing Council Education and Training Scholarship Program objective is to promote and assist the Plumbing Industry and facilitate international recognition of competencies and standards.

The key comparative areas to emerge were:

Recognition of Education and Training practices that have cultivated from Japanese army style training. Students are not only immersed in the learning but are fostered into a healthy living mind set. A number of plumbing companies train and certify their students in their in house training facility. It raises the question does this system of Education and Training have reliability and validity, compared to Ireland's Standards Based Apprenticeship system.

Recognition of the importance of vocational education in society. Students are guided along either the vocational or academic route. The one size fits all route doesn't exist here.

Recognition of water quality, supply and demand that is imperative for human flourishing. The Japanese work aggressively to fix water distribution pipes. Their leakage rate is only 3.2% compared to Irelands 50%. Japan's potable water is clean and pure and free of harmful chemicals such as fluoride.

Recognition of sewerage treatment and raising awareness of the importance of an efficient treatment system.

Recognition from employers about the importance of continuous professional development for their employees.

Recognition from employers of employee hard work, commitment and dedication.

Recognition of the importance of product development for a sustainable future in the plumbing industry. Japan is one of the world's leaders in innovation. They are constantly working to achieve excellence across the plumbing industry. They innovate new products but they also look at making older products more efficient.

Recognition of the importance of hygiene and the continuum of the sanitary revolution. No country is doing more to combine electronics and sanitary ware than Japan. The development of their state of art facilities, prevent the transfer of infectious diseases and aid less mobile people to use wash room facilities.

Recognition of natural disasters and putting in place preventative measures to have the least amount of disruption to important services.

This report ties in nicely with World Plumbing Council Four Pillars of Plumbing Initiative. The World Plumbing Council (WPC) wants to build strong industry frameworks for the plumbing industry, and they think better frameworks will result from plumbing industries learning from each other. The frameworks of plumbing industries can be categorised into four dimensions:

- Participation: primarily the training requirements to work in the industry.
- Practices: standards and accountability in day-to-day work in the industry.
- Products: features and quality of the materials, fittings and appliances used in plumbing work.
- Protection: measures to minimise risks and provide redress when failures occur.

Figure 3 (Cliffs of Moher, Ireland)

Ireland at a Glance

The Republic of Ireland is a beautiful green country located in northwest Europe on the edge of the Atlantic Ocean. The island is considered the 20th largest island in the world and encompasses comprising 84,421 kilometres squared of land. It is home to 4.8 million people, and the capital city Dublin has a population of 1.273 million people. The island has a hilly geography with numerous plains and rivers cutting through the land. The island's lush vegetation, is a product of its mild climate and frequent rainfall, earning it the sobriquet the Emerald Isle. Overall, the climate is typically insular and is temperate, avoiding the extremes in temperature of many other areas in the world at similar latitudes e.g. Japan. The country's official language is both English and Irish. Most people speak a dialect of English, however many families who have lived in Ireland for generations understand and speak Irish. The national flag is green/white/orange as seen on the image below.

Figure 4 (Map of Ireland)

Figure 5 (Osaka castle)

Japan at a Glance

The Japanese name for Japan is "Nihon" or "Nippon" which means "sun origin". Japan belongs to the continent of Asia. It is an island nation surrounded by the Sea of Japan to the East and the Pacific Ocean to the West. Japan is made up of 6,852 islands. The highest point is Mount Fuji, which stands at 3,776m (12,388ft). As of July 2012, there are over 127 million people living in Japan (127,368,088), which is the tenth largest population in the world. Tokyo is the capital city and the largest. Other major cities include Osaka, Nagoya, and Sapporo. Japanese is the official language of Japan, but English is taught at school. Japan sits along the "Pacific Ring of Fire", so has many volcanoes and experiences earthquakes. In 2011, an earthquake of magnitude 9.0 hit Japan and created a tsunami which resulted in much devastation. Later in the report we will look at innovative technology that prevents minimum damage to water supply, sewerage and plumbing systems.

Figure 6 (View from Tokyo Skytree)

Getting acquainted with the Japanese food, culture and sightseeing

We arrived at our hotel in Japan at 9.30am on the 10th of May 2018. Mr Makoto Uto (Nishihara Ltd) and Mr Hiroshi Akimoto (World Skills) met us at the hotel at 10am to discuss the following week's itinerary. I contacted the Japanese World skills Organisation directly. Mr Hiroshi then contacted Mr Uto. The meeting lasted about thirty minutes. Together they had precisely planned four full days of our twelve-day trip.

Tokyo is a big, busy, bustling city. I must point out at this early stage, something you will not see in any other country in the world. Large groups of people moving from A to B in perfect harmony. Arrows guide pedestrians along footpaths and up/down stairs. When waiting for a train people stand in single file and wait until everyone has got off the train before they try to enter. If it wasn't like this, it would be utter chaos. But how do you get a society of 127 million to conform to simple guidelines that in turn make life easier for everyone.

We wanted to get used to the railway system as it would be our main mode of transport around the city. We arrived in Tokyo station. Just so readers can gauge the scale of the place, 2 million passengers pass through its doors every day. We got slightly lost and asked a young gentleman for assistance. He said 'its right this way let me show you'. I presumed he was going to walk us to the corner and point us in the right direction. He walked to the corner and said 'ok it's about ten minutes from here'. I said it's quite ok, but he insisted. He was only twenty-two years of age. He had just finished college and was attending interviews all day. This kind gesture to me, from a total stranger, had me speechless. When we got to the correct location, thanked him, gave him a business cards and told him if he ever came to Ireland we would be his tour guide for a day. He smiled and thanked us then walked back the way he just came. I've told so many people about this story, and other people have told me of similar situations.

We travelled a lot over the course of our trip and managed to fit in some tourist visits along the way. In Tokyo we visited Shinjuku, Harajuku, Imperial palace, Tokyo Sky Tree to name a few. The Shinjuku crossing is known as the scramble. It's called this because it's the busiest pedestrian crossing in the world. We walked to see Harajuku an area of Tokyo which is internationally famous for its shops, food and busy streets. There was a slight drizzle of rain that day, so it wasn't as busy as expected. The next stop was the Imperial Palace which is the primary residence of the Emperor of Japan. Japan has so many Palaces and Edu period style architecture is an impressive sight. The Tokyo sky line is dominated by sky scrapers, which you don't see in Ireland. Although our trip was mostly for research purposes it still required us to travel from location to location.

Figure 7 (Harajuku)

Figure 8 (Palace)

The pictures show the true scale of the buildings. We travelled on the Shinkansen or bullet train to Kyoto. It travels at up to speeds of 320kmph. We were travelling to meet a Plumber who I contacted via Instagram and spent a day in the life of Kyoto's number one Plumber!

Figure 9 (Shinkansen/Bullet train)

Kyoto is approximately 365km from Tokyo. It was once the capital during the Edu period. It's because of this, its rich in history, culture and charm. The countryside is green and beautiful. We managed to visit Fushimi Inari Taisha, Imperial Palace, Higashi Honganji. These are three must visit places if you ever travel to Kyoto, Japan. On your travels between each location you get to take in and be immersed in the Japanese cultures and traditions. Below is Higashi Honganji which is the largest wooden structure in the world. The area surrounding it is populated by dear which roam free. Tourists are able to buy crackers to feed them, but watch out they don't bite you on the behind. Walking up to gates you can't see the building, it's only upon entry you are met with this incredible sight.

Figure 10 (Tokyo Sky Tree)

Figure 11 (Higashi Honganji)

Throughout our visit to Japan, we honestly didn't receive a bad meal. We were brave and willing to try almost anything. I say almost because some foods I think we just needed more time to acquire the taste. Some foods we had already tried at home prior to going, and some are now our favourites.

Figure 12/13 (Fushimi Inari Taisha & Dotombori)

Figure 14 (Street food)

Figure 15/16 (Fried Eel & Sushi)

It took about an hour to travel to Osaka from Kyoto. Osaka is Japan's second largest city after Tokyo. Our hotel was centrally located in the city and stood small because it was beside the Umeda Sky Building. The Umeda is the 19th tallest building in the world, standing at 170metres tall. It was built in 1993 and has won a number of awards for its architecture. We also got to see Osaka castle, Ebisu Bashi-Suji (which is a market) plus many more. On our last day in Tokyo we managed to stop by the Major Shinto shrine festival. The Kanda Matsuri in Tokyo is held every two years in May. The festival features a parade with elaborately decorated floats and thousands of people. It's only held every two years so we were pretty lucky to see it. It made up for missing the cherry blossoms. The festival was full of life with people of all ages dancing, singing and jumping in their native dress. The atmosphere was electric and it was great to just stand and observe all the people.

Figure 17/18 (Kanda Matsuri festival Tokyo)

Figure 19 (Umeda Sky Building)

Figure 20 (Osaka Castle)

Figure 20/21/22/23 (Kanda Matsuri festival Tokyo)

Figure 21

Figure 22

Figure 23

Figure 24 (Sunny Tokyo)

Culturally and traditionally Japan was everything I expected and more. It's a place that has left fond memories in my heart. Every person we interacted with treated us with the upmost respect and integrity. Any people we chatted to in shops or on the street, were always so calm, polite and helpful. I urge people if you are ever lucky enough to travel to that side of the World, choose Japan. You won't be disappointed.

Education and Training in Ireland

The study of vocational education is not new and considerable research in this area has been done in many Western countries, although the study of learning in the workplace is a recent phenomenon with an increase of research in this area expanding from the 1990's (Tynjala, 2008). Many variations of apprenticeship have existed without a single agreed or accepted definition of what an apprenticeship is (Bridgford, 2013). The benefits of vocational education and, more specifically, the apprentice paradigm for the individual, the employer and for society. These benefits have been delivered through a structured apprenticeship which has persisted for centuries (Thoma, 2016). The following organisations oversee the running of the apprenticeship system in Ireland.

Solas is the State Organisation with responsibility for funding, planning and co-ordinating Further Education and Training (FET) in Ireland. It was established in 2013 under the Further Education and Training Act. It is part of the Department of Education and Skills and is governed by a Board. The organisation is responsible for building the identity and values of a world-class, integrated FET sector that is responsive to the needs of learners and the requirements of a changed and changing economy. Their mission is to fund, co-ordinate and monitor a range of FET provisions to ensure economic and social wellbeing and to play our part in progressing, influencing and supporting the development of a FET sector that is more responsive to the needs of learners and employers, is innovative, flexible and demand-led (Solas, 2013). The plumbing apprenticeship is also under the watch full eye of Solas.

Plumbing qualifications are accredited by the **Quality and Qualifications Ireland** (QQI). It is an independent State agency responsible for promoting quality and accountability in education and training services in Ireland. It was established in 2012 by the Qualifications and Quality Assurance (Education and Training) Act 2012. They approve programmes offered at a variety of schools, colleges and further and higher education and training institutions. These programmes lead to qualifications (QQI awards) listed in the NFQ, which are recognised internationally. They also promote, maintain and develop the Irish National Framework of Qualifications (NFQ), a 10-level framework for the development, recognition and awarding of qualifications in Ireland (QQI, 2012).

SOLAS
An tSeirbhís Oideachais Leanúnaigh agus Scileanna
Further Education and Training Authority

Figure 25 (Solas Logo)

QQI
Quality and Qualifications Ireland
Dearbhú Cáilíochta agus Cáilíochtaí Éireann

Figure 26 (QQI Logo)

On successful completion of the apprenticeship programme, apprentices are qualified to work within the recognised trade or profession. Where apprentices and craftspeople have the necessary ability, initiative and qualifications, opportunities are available for advancement. These include advanced technology courses and management courses which are available in Institutes of Technology, Schools of Management and Professional Institutes. Many apprentices use their apprenticeship qualification as a platform to launch careers such as engineers, managers, owners of businesses, teachers and instructors amongst others (Solas, 2013).

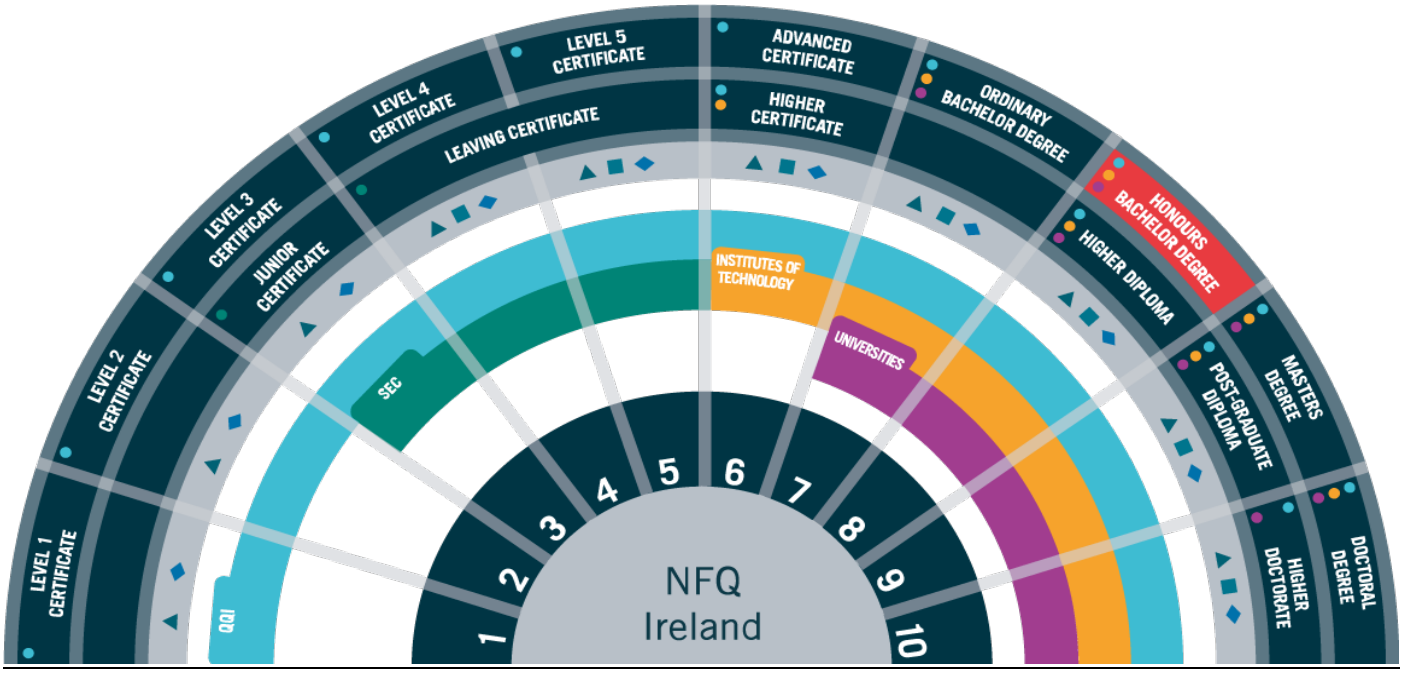


Figure 27 (NFQ)

The above chart is the National Framework of Qualifications in Ireland. It represents the different levels of Educational Development. The highest is Level 10 which a Doctoral degree. On successful completion of a plumbing apprenticeship students will hold a Level 6, which is over half way around the semi-circle. As mentioned above students can use their apprenticeship to advance onto third level education. For example, a qualified plumber can apply for a Level 7 or Level 8 3-4-year degree in their chosen progression course, and their qualification allows them to jump onto the 2nd year of some courses because of their previous experience. Students can work full time and study at night two evenings per week.

The plumbing apprenticeship in Ireland is standards based. Which means the programme is in partnership with a number of different stakeholders. These are the apprentice, employer, Solas, trade unions, Higher Education Authority, Education and Training Boards like the CDETB and also the Department of Education and Skills. It's driven by the economic and social changes. This is an important point which we will look at below. It takes a total of 48 months to complete all seven phases of a plumbing apprenticeship.

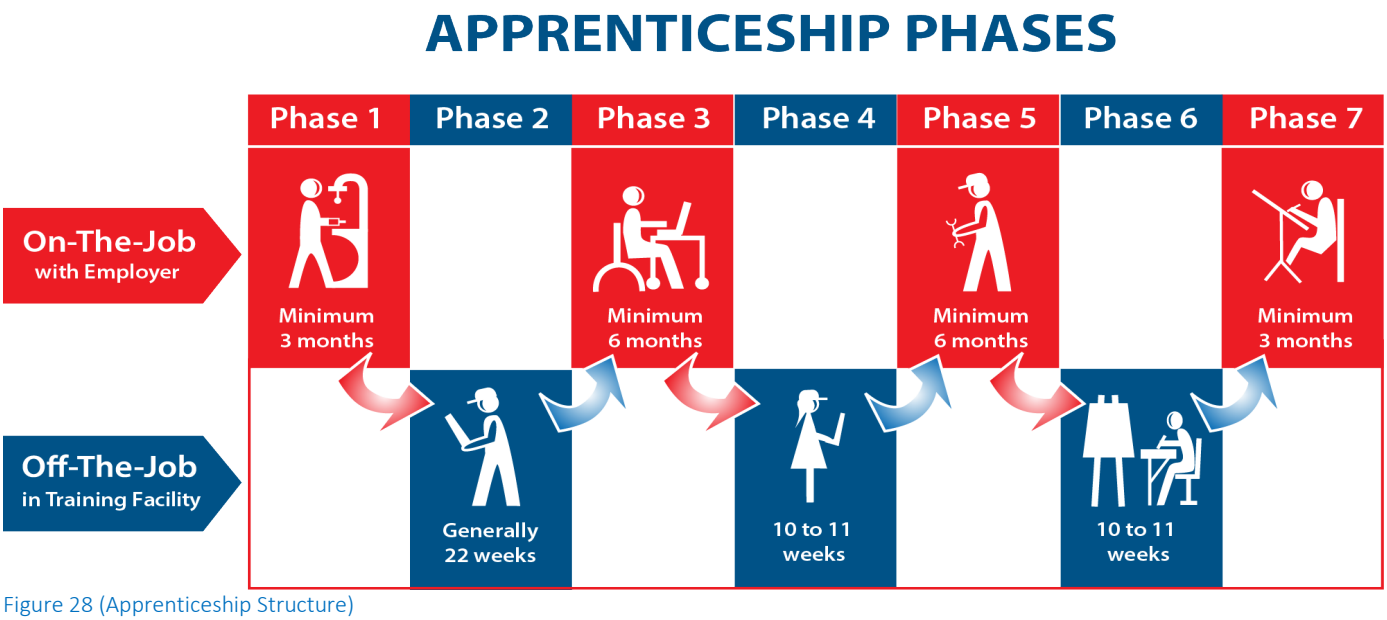


Figure 28 (Apprenticeship Structure)

An apprenticeship is: "A method by which a person works for an employer in a chosen occupation and learns the necessary skills, knowledge and attitudes to become a qualified craftsperson." (Bates, 2011) However, an apprenticeship from all aspects, revealed that it is a much more complex and fragile interplay of characters and contexts that coalesce to form that learning experience of skills, knowledge and attitudes defined by Bates (2011). In Ireland, you can't become a plumber without first being taken on as an employee by an employer who must be registered to employ apprentices with Solas. The economy drives the apprenticeship system along. When the construction industry is thriving, companies will require eager tradespeople, so they have the resources to complete jobs efficiently. It's a win/win for both the employer and the apprentice. The employers train their apprentices in the on the job phases of the apprenticeship. For the first 12 months apprentices are paid a lower rate than the average wage. The reason for this is because firstly, apprentices are undertaking a trade which they have no prior experience, but also it's an incentive for companies to take on apprentices. The apprentices in return receive a perfect combination of theory and practice in their on and off the job training. Apprentices also receive the equivalent wages as they would on the job, as they do for their off the job phase. They earn as they learn. It's important to point out the success of the apprentice is down to three areas their eagerness to learn, their employer and their Plumbing teacher.

For phases 1-3-5-7 while working for their companies, students will get that valuable real-life experiences. Bruner (1960) advocated meaningful curricula, asserting that if prior learning was going to make subsequent learning easier, then it had to provide students with a general picture of the ways in which different subject matter relate to one another and unless detail is placed into a structured pattern, it is rapidly forgotten.

Figure 29 (CDETB Logo)

For phase 2 students attend a training centre. For phases 4 and 6 students attend an Institute of Technology. Phase 2 is where I enter the picture for these young aspiring apprentices. I work for the **City of Dublin Education and Training Board (CDETB).** The general functions of CDETB are set in the Education & Training Boards Act 2014. They include that it should 'plan, provide, coordinate and review the provision of education and training, in its functional area' (CDETB, 2013). Part of this area is the apprenticeship system. This also includes electrical, carpentry, mechanic to name a few. You may wonder why the phase 2 stage is 22weeks but phase 4-6 are only 11weeks long. Phase 2 is where students first enter a training college. It is within this timeframe the foundation and scaffolding of their knowledge and skills start to develop and begin to make sense of the industry. They are giving 22weeks to fully immerse themselves in both theoretical and practical aspects of their profession.

Figure 30 (CDETB classroom Finglas)

The subjects for each off the job college phases are:

Phase 2: Delivered at a training college (22week duration)
Thermal Processes and Mild Steel Pipework
Domestic Hot and Cold Water Services
Central Heating
Team leadership
Communications
Portfolio

Phase 4: Delivered at Technology Colleges (11week duration)
Thermal Processes and Piping Systems
Cold Water and Water Treatment Systems
Oil and Central Heating Systems
Hot Water Systems
Gas Installation Safety
Team Leadership
Communications

Phase 6: Delivered at Technology Colleges (11week duration)
Thermal Processes and Piping Systems
Renewable Energy
Heating and Air Conditioning
Gas Installer Domestic
Plant and Process Systems
Team Leadership
Communications

Students are assessed throughout their apprenticeship by a range of assessment instruments. These include theory, practical, portfolio and coursework assessments. (Brown et al, 1989) believed that when educators act as practitioners to tease out key concepts to solve real world problems, the process may seem informal but is an authentic process that can be deeply informative for the learner (Brown et al, 1989) these 'authentic activities' were exercised in the off-the-job phases of the Irish apprenticeship system, where apprentices are tasked with making a model piece of a real world item or installing some piece of equipment or infrastructure that required numerous opportunities of problem solving with the support of educators and peers while in a training centre or college. Thus the problem, the solution and the cognition were combined and embedded within the mind of the learner with the successful completion of each task (Brown et al, 1989).

Research Comparison

In Japan, the apprenticeship model has no formal structure, demonstrated by aspects such as the undetermined length of time potentially served by an apprentice under a single Master. An additional year or two was required to be served by an apprentice to repay the benevolence of that Master and the deciding authority of the Master on the qualification of an apprentice. The Japanese apprentice was presented with a much more difficult negotiation, with little participation or time given to reification within the traditional Japanese apprenticeship experience. It lacked the scaffolding of a nationally agreed structure such as the Standards based apprenticeship system but was perfect example of what Lave and Wenger (1991) described as a fundamental contradiction where the newcomer was being trained to replace the old-timer, setting up an inherent conflict within a narrow community of practice (Lave & Wenger, 1991). (Okamoto,2011) outlined the difficult methodologies of the traditional apprenticeship for an apprentice in Japan under the tutelage of a Master, he pointed out that, to become an expert the student, had to watch and learn from the master, not asking questions but watching and learning in silence (Okamoto, 2011). This mind set would have typically have been part of the culture and traditions in Japan. However, as we progress further into the 21st century, older less communicative pedagogical strategies start to be replaced with new and efficient ways of educating and training the next generations of plumbers, which we will examine below. An aspect of apprenticeship that was unexpectedly revealed was the unofficial trial period of a potential apprentice by employers prior to registering the apprentice with the relevant state body in Ireland.

'Although there was an inbuilt period to accept or reject an apprentice within the Standards Based Apprenticeship model as outlined by one interviewee, employers still adopted their own trial period. This was explained by one employer who described this filtering process, where the potential apprentice was assessed over an undetermined trial period to see if that potential candidate has an interest in that craft and to assess if they would be suitable and productive employees, only then would that person be offered an apprenticeship contract' (Thoma, 2016). Breaches or reinterpretation of the apprenticeship terms and conditions occurred in the Guild system as well with one in ten contracts being cancelled according to Minns and Wallis (2013), a trend that occurred throughout Europe up to recent times as stated by Steedman (2012).

It was clear that while the Irish apprenticeship system developed and became more regulated with the changing needs of industry to build and enhance the apprenticeship model, the Japanese model was left untended by Government according to Kito (2014) and it was only due to the craft areas being shored up by tradition that ensured the formality of an apprenticeship, in the Japanese sense, all be it unregulated and left to the discretion of the Master, a system that has become brittle and vulnerable to the unrelenting advance of technology in challenging economic times.

Figure 31 (JAVADA Logo)

Vocational Education in Japan

On my visit to Japan I had the pleasure of meeting Mr Hiroshi Akimoto a delegate of the Official World skills Japan team and the Japanese Vocational Ability Development Association (JAVADA). Mr Akimoto studied Japanese literature at University. He speaks English and Chinese. JAVADA have been engaged in efforts to firmly respond to changing times and needs of society ever since it was established in 1979. It has created a fair and impartial abilities evaluation system, in close cooperation with industry and with the national and prefectural governments and as a comprehensive public institution for vocational abilities development nationwide (JAVADA). By implementing proper evaluation of an individual's vocational abilities allows them to market their skills and provides a guide to set goals for future career development. For companies, it serves as a guideline for proper personal evaluation criteria and appropriate human resource allocation.

The national trade skill and certification (NTSTC) is national testing system certified by the Japanese Government. It tests workers knowledge and skills according to uniform standards. The content of NTSTC has been steadily expanded since its establishment in 1959, and as of April 2017, it has been implemented for 111 trades. Those who pass the NTSTC are awarded a certificate of passing bearing the name of the Minister of Health, Labour and Welfare (Advanced Grade, Grade 1 and Non-classified Grade) or the prefectural governor (Grade 2 and Grade 3) and are given the title of 'Certified Skilled Worker'. As of 2012, more than 4.10 million people have successfully passed NTSTC, an achievement that has been highly lauded in the workplace as a sure Certification of skill.

Advanced: Level of skill that should normally be held by a manager or supervisor.
Grade 1 and Non-Classified Grade Level: skill that should normally be held by a senior-level skilled worker.
Grade 2: Level of skill that should normally be held by mid-level skilled worker
Grade 3: Level of skill that should normally be held by starting-level skilled workers.

Figure 31 (Mr Hiroshi and I, outside Nishihara Engineering training centre)

Industry Vocational High School

On my trip, I visited one of nine Public Industry Vocational High School in Osaka. Students attending are boys and girls aged between 15-18 years of age. The students in this school even at this young age have chosen the vocational study and career route. Students receive a broad and wide-ranging curriculum to provide them with a complete overview of the vocational education system. The subjects include plumbing, electrical, science, metal fabrication, facilities and English to name a few. I had the pleasure of chatting with two students about why they like this school and why they chose the vocational route. One student said his father was in the electrical industry and he wanted to follow in his footsteps. The other said he wanted to become a plumber because he fascinated by how water moves, and he sees it as an important job. Most the lessons are theoretical in a classroom setting. Students also get some hands-on experience in the workshops. Teachers aren't qualified tradespeople. However, they are licenced to teach the curriculum subject content. Teachers go out into industry to learn the skills from qualified tradespeople to bring the knowledge back to the school.

Figure 32/39 (Industry Vocational High School)

Figure 33

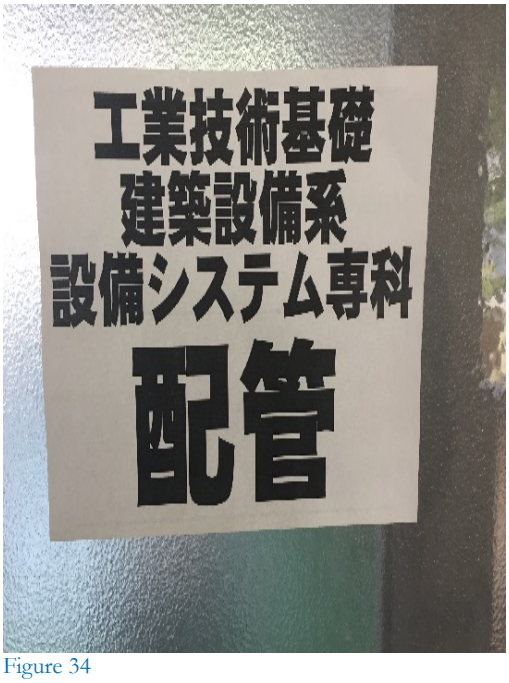


Figure 34

Figure 35

Figure 36

Figure 37

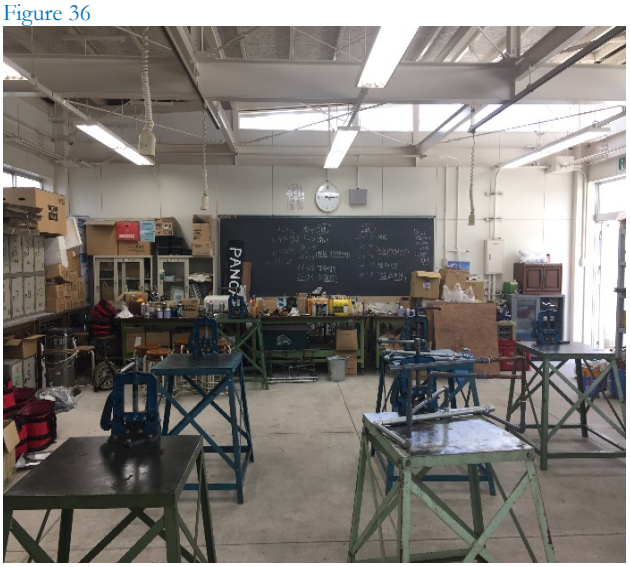


Figure 38

Figure 39

Kinden Corporation

We visited Kinden Gauken Technical Training Center, and what a warm welcome we received. Kinden were established in 1944. The company business activities include: Plumbing, Sanitation, Civil Engineering, Instrumentation, Information and Communication's, Electrical power lines plus many more. They work hard to meet their customers' increasingly diversifying needs in technology to support their daily lives. They do this with a workforce of 7,482, across 101 domestic and 5 oversees locations.

Education and Training

They train all their employees in-house, in an environment which can only be described as a combination of both the boarding school and army style training approach. The basic principles of their Trinitarian Education system is to: "Nurture the mind, Improve skill and Train the body. By nurturing a well-rounded person, through dormitory life, who does not cause trouble to others, does not do things offensive to others, and who is equipped with the common sense and knowledge required to be a member of society. By improving skill, a professional engineer needs to master the foundation of techniques and skills through basic practices, and further acquiring advanced skills and abilities to apply such skills through on site, on the job training. By training the body it will help develop physical strength and strong mind through dormitory life to handle life's responsibilities and mission.

Figure 40/51 (Kinden Corporation Training Centre)

Figure 41

In return students are asked to do only three things, as the educational philosophy sign says below…

Be… Confident Energetic Articulate

Students daily routine Monday-Friday (342 students)
6.30: Awakening
6.45-7.00: Roll call and exercise. Students must be physically fit to do their job.
7.00-8.15: All students eat breakfast then clean the entire training facility together.
8.30-12.10: Start work.
12.10-13.10: Lunch
13.10-17.30: Work
17.30: Dinner, shower etc
20.30: Curfew
22.00: Lights out

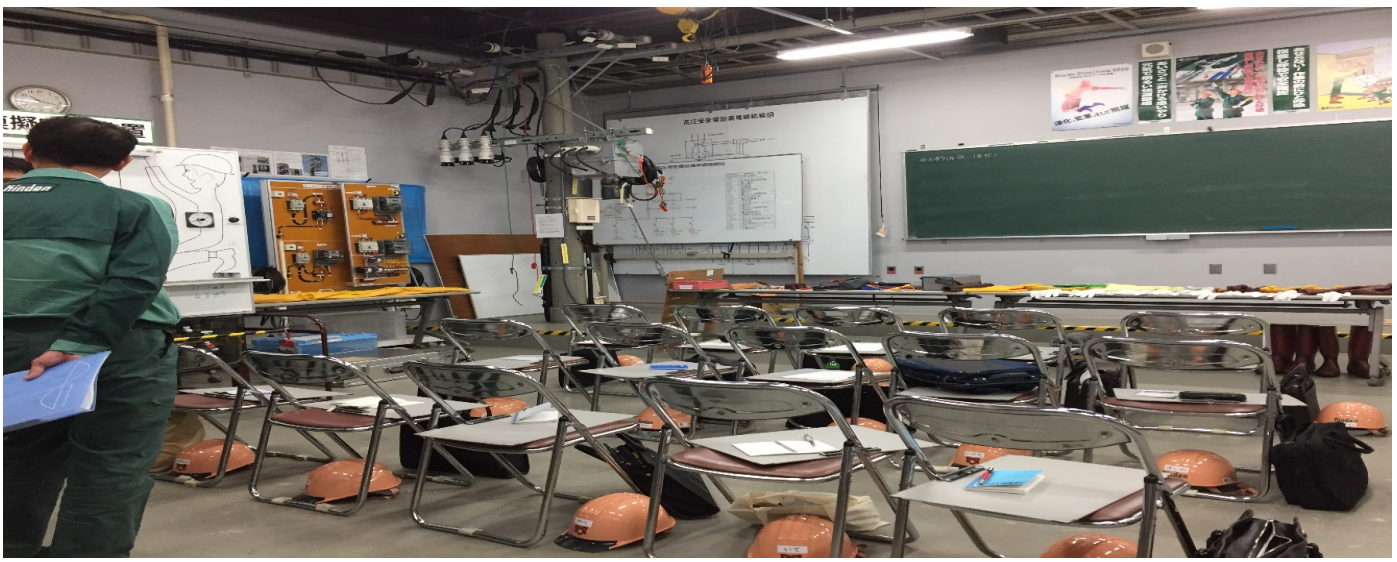


Figure 44

The students are generally high school graduates (aged 18), some may have even passed through the Industry Vocational School we visited in Osaka. Their training duration lasts for a total of 18 months. One year at the training college and 6 months on site. At the end of their first year of training students must complete an

assessment called the Class 1. After three more years, students complete a final assessment called the Class 2. However, if a student has a university qualification prior to joining Kinden, their training will be structured differently because they already have built up a strong educational foundation. This training only takes one year to complete. The University graduate will generally undertake a different role within the company, depending on their qualification. Qualifications obtained would only be recognised nationally.

Figure 45

Figure 46

Teacher Training

This style on training (Boarding style) is rare in Japan so I was informed by Kinden. At Kinden teachers/instructors have all come up through the ranks of the Kinden training school. There are two requirements to become a teacher: Teachers must have at least 10 years' experience then they must complete a seven-day teaching course, which is called a 'Vocational technical training licence'. It is similar to the 'Train the Trainer course in Ireland. There are numerous public vocational qualifications in many industry and business sectors, though they are not immediately intended for the evaluation of vocational capabilities. Meanwhile, private-sector companies have their own ability-based grade system and in-house certification for use in their own evaluation activities, and a lot of private-sector qualifications are available as well." (Japanese Government White Paper, 2004). To teach a trade skill in Ireland, the requirement is 2 years post apprenticeship experience, which is a total of 6 years' experience. A teaching qualification and experience is desirable but not applicable. As I already stated above, in my opinion the three most important parts of the success of apprentice is the apprentice's willingness to learn, the employer and the teacher. This question of quality control by those responsible for the implementation was cited as a concern in a 2010 report by the Organisation for Economic Co-Operation and Development (OECD) who recommended that all VET trainers, teachers and instructors should have had some pedagogical training (EU Commission, 2014:3, EU Commission, 2012:11, ReferNet, 2013:31, Unwin, 2014:17, Tierney & Clarke, 2007:138). The lack of empirical evidence regarding vocational training in Japan suggests that similar issues may exist (Kito, 2014:64).

Future proof

The term duo professional should be widely used. If a person is going to teach their craft in any chosen subject, firstly, they should be a subject matter expert (SME), they should have also a proven record of continuous professional development. Having some pedagogical training isn't acceptable. Teachers should also have

completed a recognised teaching qualification. Allowing SME to teach without any prior training puts the learner at a huge disadvantage. There are so many more complex areas that go into teaching than just the direct delivery of the subject matter. Areas such as assessment, evaluation, classroom management, teaching mythologies plus many more are all equally important areas of the process. Teachers should also be critically assessed through a number of teaching episodes and receive constructive feedback, which they can reflect on and use to improve their own teaching practice. This feedback helps the teacher to see what does and what doesn't work. This is the system I have been through on my journey to my teaching role. So how did it help me? After a teaching episode I was giving feedback that when asking a low/higher order question, I should allow more time for the students to answer. Don't be afraid of silence. I took this valuable feedback on board. I then reflected on it and in my next lesson focused on this area. This is just one example. Without this critical analysis of my teaching how was I to ever know if I was teaching effectively? The answer is I wouldn't have been aware. As I have said already the three most important parts of the success of the apprentice is down to three areas their eagerness to learn, their employer and their Plumbing teacher.

Figure 47

Figure 48

Figure 49

Figure 50

Figure 51

Nishihara Engineering Ltd

We also visited Nishihara Engineering Ltd. Nishihara are one of Japan's most respected mechanical engineering companies. They have a one hundred and one-year history and have worked on projects such as the Tokyo national airport. They have 564 direct employees and 1000 sub contracted by them. The company's head office is in Tokyo which we visited and they have offices across seven major cities in Japan. They cover all aspects of the mechanical engineering from the design, install and maintenance phases. The company founder chose the Kingfisher bird as the symbol of the company because of its fierce hunting style around water and it's aggressive and brave character. This philosophy has stayed with them for their hundred and one year history and will continue with them for generations to come.

Figure 52 (Nishihara Founder)


Figure 53 (Kingfisher bird)

One of those employees which this part of the trip would not be possible without was their General Manager Mr Makoto Uto. Mr Uto started working for Nishihara twenty-five years ago as a trainee. Since then he has worked hard and been dedicated to the company. His loyalty and respect hasn't gone unnoticed, which in turn opened doors so he could progress and grow his career within the company.


Figure 54/55 (Mr Uto and I)

Figure 56 (Nishihara Plumbing Students)

Mr Uto began his career at the Nishihara training centre which we had the pleasure of visiting. Nishihara like Kinden train, deliver and certify all their students in their own training facility. Nishihara training school were established in 1966. In this training facility there was 45 students and three teachers. The students spend one-year training. They must complete an exam called the 2nd Grade. They must also develop their skills and knowledge for three years with an exam at the end called a 1st Grade. Students are aged between 18-23years. As there were six women present, we asked do they get many women trainees as this was an area Apprenticeship Ireland was trying to remedy. We were told they were clerical workers, and were only there on work experience to give them a complete overview of all the work the company does.

On one side of the facility students were fitting sanitary ware and pipework. On the other side students were welding and treading pipe. The classroom was upstairs, but we never had an opportunity to see any theoretical practice.

Figure 57

Figure 58

Figure 59

There was also another workshop with three advanced students practicing for the World Skills Competition. They buy copper specially to practice for this competition. In Japan, they haven't used copper on site for over twenty years for the reasons of sustainability and that it isn't as durable in relation to earthquakes. We will examine this further into the report about the products they use in our manufacturing segment.

Figure 60

The students on the far left and far right are have completed their 2nd grade and are on their 2nd year of training. The student in the middle is a 4th year student working his way towards his 1st grade qualification. He is also a silver medal holder at the World Skills competition and hopes to bring home the gold medal in November this year.

Figure 61 (World Skills Training Station)

World Skills Organisation

WorldSkills is the global hub for skills excellence and development. Through international cooperation and development between industry, government, organizations, and institutions, they promote the benefits of and the need for skilled professionals through grass-roots community projects, skill competitions, and knowledge exchange. They show how important skills education and training is for youth, industries and society by challenging young professionals around the world to become the best in the skill of their choice (WorldSkills, 2016).

WorldSkills is the collective voice for skills excellence and development in vocational, technological and service oriented careers around the globe. Since 1950 we have raised the awareness among youth, as well as their parents, teachers and employers, that our future depends on an effective skills training system. Today WorldSkills represents more than 45 skills in over 75 member countries and regions, all working together with youth, educators and industries to help prepare the workforce and talent of today for the jobs of the future (WorldSkills, 2016).

WorldSkills is not just a Competition though, it is a movement. By working within the six key areas comprising: of Research, Promoting Skills, Career Building, Education and Training, International Cooperation and Develop ment, and Skills Competitions. WorldSkills will be the global hub for skills excellence and development with ongoing activities nationally, regionally and globally. The WorldSkills Foundation contributes with projects and initiatives that demonstrate the capacity for innovation and collaboration with partners, in order to leverage and build self-sustaining activities (WorldSkills, 2016).

History of the WorldSkills

It was 1946 and there was a great need for skilled workers in Spain. Mr José Antonio Elola Olaso, who was General Director of OJE (Spanish Youth Organization), had an insight: it was necessary to convince youth, as well as their parents, teachers and prospective employers, that their future depended on an effective vocational training system.

Mr Olaso chose Francisco Albert-Vidal to further develop this idea together with Antonio Almagro Diaz and Faustino Ramos Diaz, who were on different occasion's directors of the Work Centres. Dr Diómedes Palencia Albert, Director at that time of "Virgen de la Paloma" (the most important Spanish Training Centre), was appointed as technical adviser for the whole project. For this challenge the most suitable solution was apparently to promote a competition. So, young people's competing spirit would be aroused, adults would discuss the competition results and visitors would be able to see a great variety of trades being demonstrated. Right from the start, State agencies, enterprises and religious vocational training schools were interested in the idea.This simple yet brilliant idea of watching people from different trades at their workstations proved to be a great success. So, in 1947, with the participation of around 4,000 apprentices from a dozen mechanical trades, the first National Competition took place in Spain.The World Skills Competition has a 60 year history and is the biggest vocational education and skills event in the world. The competitors represent the best of their peers in almost 50 different skills and are selected from skills competition in over 71 WorldSkills' Member Countries and Regions. For more see www.worldskills.org

In Ireland

The Department of Education introduced national and international skills competitions to Ireland in 1957 and Ireland has participated in all Competitions since. Ireland has won 59 gold medals, 53 silver medals, 79 bronze medals and 152 diploma/medallions. In the last competition in Leipzig, Germany, Ireland achieved 11th place out of 53 countries. This continues the trend of Irish craft people consistently achieving outstanding results at the World Skills Competition.

In Japan

Japan also has a rich history in the WorldSkills competitions. Since the foundation of the competition Japan has won a number of medals in many disciplines. As we have already seen above Kinden corporation and Nishihara Engineering take the Education and Training of their employees very seriously. If they see potential they nurture and help develop the skills of their student and employee. When we visited Kinden Corporation I have the pleasure of meeting Ryuji Shimase. Ryuji Shimase was the Network Cabling 2015 Gold medal winner at the World Skills. He is now 25 years of age and is too old to compete. His job now to help train, develop, teach the next generation of Network cabling champions. We met Ryuji Shimase in his workshop and got to see the first hand the training that these students do. Although not plumbing related is it WorldSkills and training related. The picture below is of Ryuji Shimase and me. I should also point out that slippers must be worn at all times inside the building. This prevents bringing the dirt from the outside in. My shoes size is a 10/44. These slippers were about a 7, so my feet were hanging off the other side.

Figure 62 (Ryuji Shimase and I)

A day in a life of Kyoto's Number 1 Plumber

On our visit to Kyoto we spent a day in a life of a Japanese plumber. I contacted Hidemasa Kondo of Mellow Plumbing via Instagram. He was the only plumber on it, so I was lucky he said yes. He explained from the start that he had little or no English but would ask his friend Sugiura Yuta to assist him with the translation on the day. He picked us up at our hotel at 10.30am. The moment we all got into the car it was as if we had known each other our whole lives.

Figure 63 (Hideamasa and Yuta)

Hidemasa is 32 years old family man with 3 children. He has been in the plumbing industry for the past 12 years. When he finished high school, he went straight into working as a plumber. For the first few years he worked in drain/sewer cleaning, which he didn't like. He then completed a three-year apprenticeship with an employer. The apprenticeship training, he received was all on the job training with no college phases. It was after that he went to work for the maintenance division in TOTO. TOTO are Japans leading sanitary ware manufacturer.

Now self-employed Hidemasa works for himself and like all great tradespeople, he is in high demand. He works 9-5 and at night sometimes he might have to respond to emergency call outs. In Ireland, tradespeople generally start at 7.30 and finish at 4.00. The reason for this is to avoid traffic congestion. The pay scale in Kyoto is approx 180-250 euro a day. Hidemasa is also part of the Kyoto Young Entrepreneurs Group. They meet once a week to discuss business, which helps them build strong network, with other like-minded people. 'A community of Practice'. As the saying goes do a job you love, and you'll never work a day in your life. Hidemsa loves his job and this was evident in the enthusiasm and expressions he showed when demonstrating products to us.

They brought us to the Panasonic bathroom showroom. Yes Panasonic. In Ireland they only make electronics. Panasonic are competing with TOTO to be new innovators of bathroom technology. The bathroom technology and innovation can only be described as something from the future.

Figure 64/7 (Toilet & Wash Basin inside Panasonic showroom)

Figure 65 (Bath & Shower Enclosure)

Figure 66 (Inside Panasonic Showroom)

Figure 67 (Kitchen sink with rotating waste outlet)

We then visited a plumbing supplier and a tool shop. I've never seen such a wide variety of tools.

Figure 68/72 (Daiwa House tool shop)

Figure 69 (Soil fittings and Pipe)

Figure 70

Figure 71

Figure 72

Hidemasa then brought us to his home to see his van and all the tools and fittings he carries and uses daily. It was at this point where we met his family apart from one, who was fast asleep. The van he uses is the compact Nissan NV100. As you can see below, it's a little beauty. I must point out that Hidemasa came in his full work attire, to give us the full Kyoto plumbing experience. I couldn't travel all the way to Kyoto, Japan without going for a spin myself, although unfortunately there were no emergency call outs to attend to.

Figure 73 (Hideamasa & his Nissan Nv100)

Figure 74 (Me going off work)

The language barrier was never an issue. Plumbers are Plumbers no matter if it's Ireland or Japan. We have our own lingo (language). The tools I wasn't familiar with, Hidemasa demonstrated their use. I understood then I showed him the way I do it, with either hand gestures, interpretation or through pictures. Here are some of the tools below.

Figure 75 (To prevent the wall burning when soldering)

Figure 76 (To cut soil or waste pipe internally)

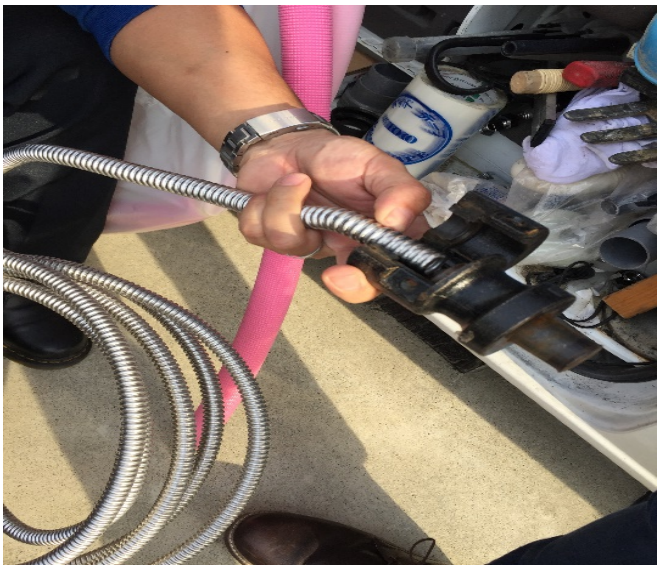


Figure 77 (Stainless pipe flair tool)

Figure 78 (Short adjustable spanner)

So now we had to confirm if Hidemasa was really Kyoto's number one plumber or was it all self-proclaimed. We visited a recent job he had completed. The job was a full house plumbing renovation. The plumbing included all hot and cold-water installations. A full pod style bathroom with toilet installed in a separate room which is quite common in Japan. The hot water used to be heated by gas, but part of the renovation was to change it over to a cheaper more sustainable option of an air to water heat pump that also does the air conditioning. Photovoltaic was also used to aid the heat pumps power usage.

A heat pump is an electrical device that extracts heat from one place and transfers it to another. Heat pumps transfer heat by circulating a substance called a refrigerant through a cycle of evaporation and condensation. A compressor pumps the refrigerant between two heat exchanger coils. In one coil, the refrigerant is evaporated at low pressure and absorbs heat from its surroundings. The refrigerant is then compressed en route to the other coil, where it condenses at high pressure. At this point, it releases the heat it absorbed earlier in the cycle.

Refrigerators and air conditioners are both examples of heat pumps operating only in the cooling mode. A refrigerator is essentially an insulated box with a heat pump system connected to it. The evaporator coil is located inside the box, usually in the freezer compartment. Heat is absorbed from this location and transferred

outside, usually behind or underneath the unit where the condenser coil is located. Similarly, an air conditioner transfers heat from inside a house to the outdoors (NRAN, 2017)

Figure 79 (Panasonic air to water heat pump)

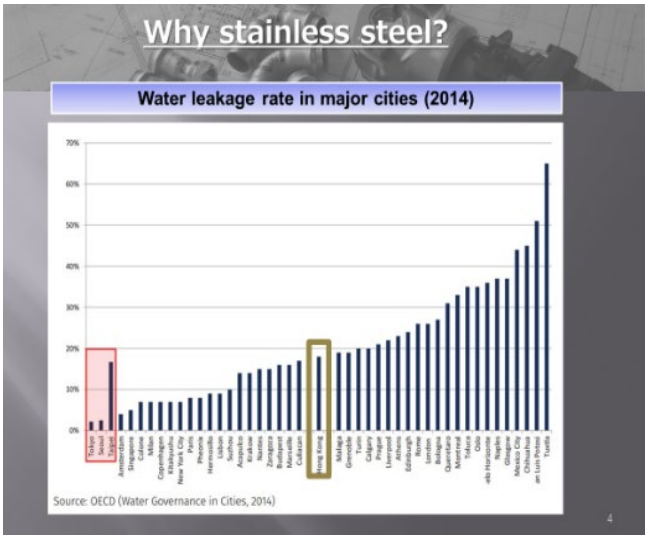
Figure 80 (Utility room)

Figure 81 (Bath and shower pod)

It's safe to say after meeting Hidemasa and spending a day in a life with him, meeting his family, observing the high-quality work he does, seeing his passion and love for the industry, I can now confirm Hidemasa Kondo is Kyoto's number one plumber, and an overall nice guy too.

Figure 82 (Saying Goodbye)

We visited Benkan Corporation's office and factory in Osaka. This was all organised by their overseas sales representative Mr Hiroki Iwai. Mr Hiroki was the first person to respond to me when I sent out all those emails at the start of the year. He was positive, good humoured and motivating from the start. Benkan are one of Japan's leading manufacturer of stainless steel mechanical fittings and welding joints. Benkan was established as Nihon Benkan Kogyo in 1947. In 1973, it started a project team to specialize in stainless steel fitting. They have four factories across Japan. The pictures below are from some of the presentation that was professionally delivered by Mr Hiroki.



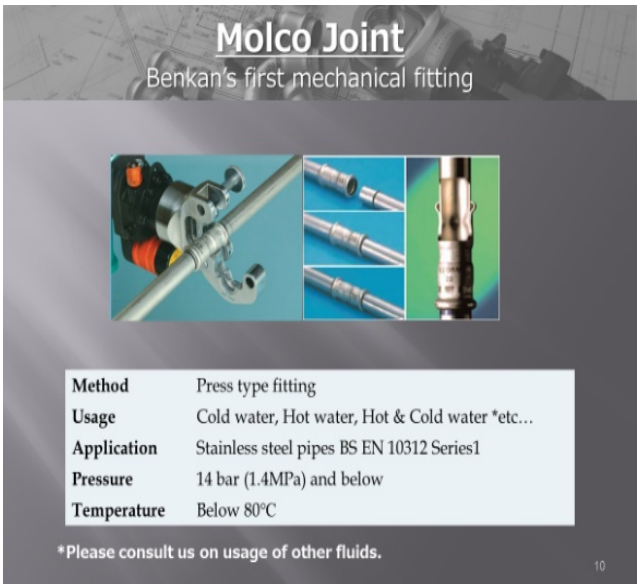


Figure 83 (Stainless steel press tool)

Figure 84 (Benkan range of press fittings)

The slides speak for themelves. Stainless steel is becomimg more popular and widely used across the plumbing industry. Press fit stainless steel is primarily used within commercial and industrial installations in Ireland but never for underground incoming mains supply.
Thank you Benkan for the informative company tour and the souvenirs.

Figure 85 (Saying Goodbye to Benkan)

Kanzai

Kanzai are Japan's biggest logistical distributer of plumbing fittings. The visit was again organised by Mr Makoto Uto of Nishihara Engineering Ltd and Mr Yusuke Fujiwara of Kanzai. Kanzai source and distribute a range of plumbing material and deliver it to sites or to whole sale agents directly. The vast range of fittings was staggering. Mr Uto explained that in Japan the one pipe fits all method doesn't apply. In Japan, they concentrate on what liquid is inside the pipe then make a pipe to suit its application. In Japan, they haven't used copper in twenty years for sustainability, earthquake damage reasons and its ability to resist corrosion.

So, as we have seen above they use stainless steel for some water main and plumbing installations. They also use a range of high-pressure glued plastic fittings, galvanised steel with a plastic inner lining, internally insulted pipes plus many more.

Figure 86/93 (Kanzai range of fittings)

Figure 87

Different coloured plastics and their use:

Black- used outside of the building or underground.
Brown- Hot waste water.
Yellow- Observation of waste water. Can also be used outside.
Dark green- It has a black lining that expands and seals the void it's going through in a fire.
White fitting- drainage for air conditioning
Light grey- cold water installation inside a building. Made from 100% recycled materials.
Red- used for hot water installations.

For each fitting and pipe different glue is used. The next part is clever. The glued is applied and has an ultraviolet paint inside it. A flash light is then used to check that an even application of glued has been applied. They also stock a pipe that has an insulated layer built inside it. They use this for air conditioning units. This is a Japanese invention.

Figure 88 (Fitting with ultraviolet glue)

Figure 89 (Internally Insulated pipe)

Figure 90 (Galvanised steel with inner plastic lining)

In Ireland, we have a different climate to Japan. Most houses would have some form of central heating system. In recent years with the introduction of condensing boilers, there has been an issue with condense pipes freezing during the winter months. The hot gases produced in the combustion process is water vapour (steam), which arises from burning the hydrogen content of the fuel. A condensing boiler extracts additional heat from the waste gases by condensing this water vapour to liquid water, thus recovering its latent heat of vaporization. The condensate produced is slightly acidic (3-5 pH), so suitable materials must be used in areas where liquid is present. The production of condensate also requires the installation of a heat exchanger Condensate drainage system. It's at this point the issue with pipe freezing becomes a problem. When the pipe freezes the condense pipe back fills into the boiler and causes the boiler to lock out. The consumer will then have to call a professional plumber to fix the problem or sometimes the plumber can advise the consumer on how to fix the issue. Understandably, pipes could be insulated on the outside, however over time the insulation can become worn or the pipe had no insulation since the installation.

Figure 91 (Different types of pipe)

Mr Uto told me, in his word that 'the Japanese generally like to keep busy, so they keep looking for and inventing new products. They do this because they are passionate about the plumbing industry and want to move the technology forward.

Figure 92 (Double sided soil tee piece that prevents cross flow)

Figure 93 (Soil pipe noise prevention jacket)

Figure 94

Thank you Kanzai. Pictured here Mr Uto, Fukuko Hanaki, Nikki Curran & Yusuke Fujiwara. We've seen all the products now it was time to visit a real site that Nishihara where working on.

Shibuya Stream Site Visit

So, we have seen how Nishihara Engineering Ltd train their employees and the many products Kanzai distribute. Now it's time to see and experience the different products used for real and observe the methods of plumbing installation. Again, Mr Makoto Uto organised this visit. The building we visited was a 35story sky scrapper called Shibuya Stream. It would be partly the home of Google's new offices in Tokyo. 21 floors would be Google's new offices. The rest would consist of a hotel and designer shops. Nishihara are the mechanical engineers contracted to design, install and maintain all plumbing installations.

We were welcomed to the site by the site foreman. He was 28 years old and oversaw the entire plumbing operations. The job is valued at one billion yen. Nishihara have about 30 plumbers working on the site, of which we met of the top floor. He explained the design process to us in detail, prior to the tour. The building has four floors underneath the ground. It's at this level where part of the magic happens. Water from below ground level is stored in large tanks and pumped up to each floor as far as number 14. It's at this level a break tank is located and second pumping station is used.

The water is then pumped onto the roof which consists of three floors above the 35th, which is open to the atmosphere. The water is stored in the tanks and used to feed cold water into each floor down as far floor 14. Floors 35-14 are feed using a gravity cold feed. The height of the building and the installation of a gravity cold feed means, there would be an issue with over pressurising each floor. They overcome this by installing a 2bar pressure reducing valve (PRV) as the cold feed enters each floor. This allows them to reduce and control the water pressure on each floor.

Within the office block instantaneous electric water heaters are used to heat the water for bathrooms, staff kitchens and shops. However, within the hotel section of the building four large gas calorifiers are used to meet the high volume of hot water storage required to meet the demands of the hotel.

Figure 95 (Pumping Station inside building)


Figure 96 (Water Heater)


Figure 97 (Blow off trap)


Figure 98 (Water Heater)


Figure 99 (Basins)


Figure 100 (Gas meters)


Figure 101 (One of Four calorifiers)

Figure 102 (Internal Pipework)

Figure 103


Figure 104

The roof space is over three floors all open to the atmosphere with a helicopter pad on top. The pictures below show the water storage tanks, pipework and irrigation system. That's us on the helicopter pad with Mr Uto and the Nishihara employees.

Figure 105 (Water storage on the roof)

Figure 106 (Water storage and irrigation system)

Figure 106 (Picture from the Helicopter pad with Ms Curran, Mr Uto and the Nishihara employees)

Figure 106 (View from helicopter pad of the Plumbing and electrical components)

Japanese people and especially Nishihara Engineering Ltd hate waste. They take sustainability very seriously and try to reuse all materials as much as possible. Tokyo has over 13 million people so that amount of people requires a lot of fresh drinking water and in turn the waste water must be also treated. We will look at both in depth further into the report. Nishihara have an onsite solution to water wastage and sewerage output. Toilets or foul water is piped independently from the building via soil pipes into the sewerage system to be treated. The basins, sinks are piped through their own piping system into the waste water treatment plant located within one of the four floors below the ground. The water is treated then reused for toilets, janitor sinks or watering plants. The excess water is stored then released into the sewerage system at night. They release it at night when the sewerage system isn't running at full capacity, which helps ease the pressure while benefitting the environment. Unfortunately, I don't have any pictures as it was still under construction.

Sewerage Museum Visit Tokyo

Sewerage plays a vital role in ensuring a safe and pleasant living environment, and in the makeup of a healthy water circulation system. In addition to cleaning water that is dirtied by use in the daily lives and activities of the citizens of Tokyo and returning that water to rivers and the sea, the system also speedily removes storm water from land surface of cities.

The sewerage is principally made up of 3 facilities sewers, pumping stations and water reclamation centres. **Sewers** transport sewage to water reclamation centres. Sewers weave their way through Tokyo like veins in a leaf, and the total length of pipes is approximately 16,000km in the 23 Wards area. Sewers are constructed of concrete, polyvinyl chloride (PVC), and tiled pipes. The internal diameter ranges from 25cm to 8.5metres. Big difference in diameter sizes of the sewer pipes.

Pumping stations- sewers had gentle slopes so that the sewerage flows naturally (gravity flow). Therefore, sewers gradually get deeper in the ground. When it gets too deep to build sewers, sewage is pumped and carried to the near surface and gravity flow starts again. Pumping stations have a role of keeping the sewerage moving to the reclamation centres. They also provide vital protection in times of heavy rainfall by promptly discharging storm water.

Water reclamation centres- have two major functions. The treatment of sewage and sludge generated as a result of the treatment of sewage**.** Sewage is treated with a system of tanks. The Bureau of Sewerage, Tokyo Metropolitan Government manages 20 centres that treat around 5.50 million cubic metres per day. Treating such large volumes of sewerage requires quite a lot of space for the water reclamation centres.

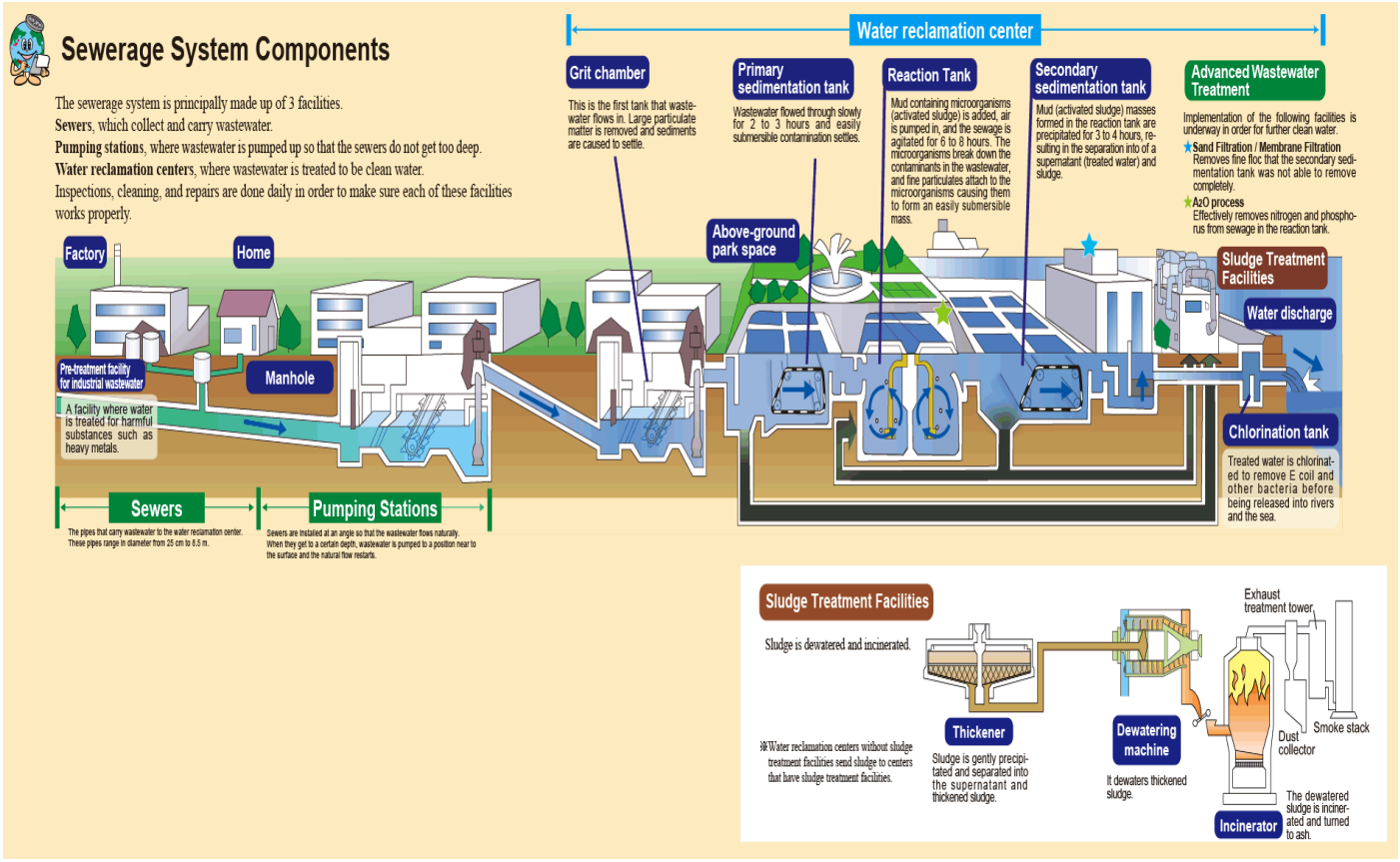


Figure 107 (Diagram of Sewerage system)

Entrance to the sewers

The sewer is either a combined sewer system or a separate sewer system. Sewage consists of both sanitary sewage from households, factories and storm water. In the combined system, sanitary sewage and storm water are collected in the same sewers and transported to a water reclamation centre. On the other hand, in a separate system sanitary sewage and storm water are collected separately. Sanitary sewage is sent to the water reclamation centre and storm water is discharged directly into seas and rivers.

Figure 108 (Demonstration of inside sewer line)

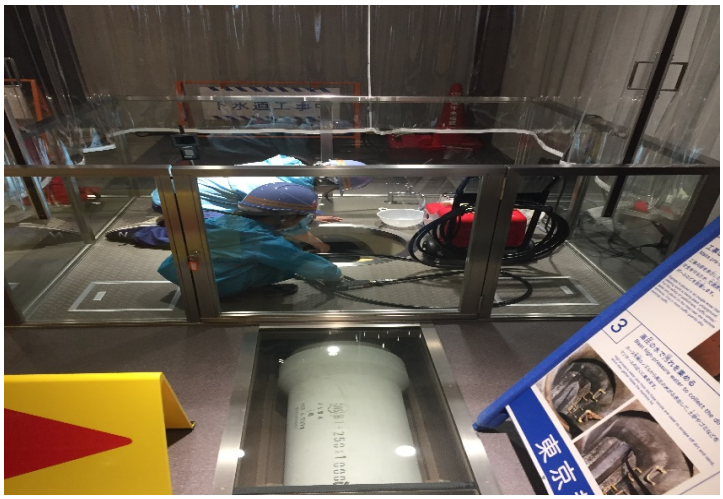


Figure 109 (Demonstration on sewer cleaning)

The sewerage museum in Tokyo was an interactive centre for (Big) children. The aim of the centre is to promote awareness about the importance of the sewerage system within society. Without an efficient sewerage system humanity would not flourish. By educating the next generation of its importance, they protect the sewers from unwanted products been sent into them.

Figure 110 (Toilet and pipework demo)

Figure 111 (Different types of pipe)

Figure 112

The manhole covers on the footpaths around Tokyo are numbered and coloured for easy identification for service engineers to inspect and maintain if required. It was only on the last day that I noticed them after the Sewerage Museum because when you are in Tokyo you spend all of your time looking up at the sky scrapper.

The most important function of the raised design on manhole covers is not to look good, but to provide traction for the traffic moving over it. This is particularly important in wet weather, when manhole covers can be treacherously slippery, especially for two-wheeled conveyances such as motorcycles, scooters and bicycles. A good design, in terms of preventing slippage, will have multidirectional lines for better grip. Designs should also be recognizable no matter which direction they are viewed from, and have lasting appeal, since manhole covers last for decades at least, and often much longer.

Japan is a country full of amazing art. Some of it is housed within museums and galleries while others are right underneath our feet. I'm talking, of course, about Japan's peculiar obsession with manhole covers. Just about anywhere in the country you can find stylized manhole covers, each more beautiful and intricate than the next. As to why this phenomenon developed, signs point to a high-ranking bureaucrat in the construction ministry who, in 1985, came up with the idea of allowing municipalities to design their own manhole covers. His objective was to raise awareness for costly sewage projects and make them more palatable for taxpayers.

Thanks to a few design contests and subsequent publications, the manhole craze took off and municipalities were soon competing with each other to see who could come up with the best designs. According to the Japan Society of Manhole Covers (yes, that's a thing) today there are almost 6000 artistic manhole covers throughout Japan. And according to their latest findings, the largest single category are trees, followed by landscapes, floral designs and birds – all symbols that could, and surely did, boost local appeal (Collosal, 2018)

Figures 113 (Manhole art)

Waste water treatment in Ireland

The EPA is the environmental regulator responsible for the authorisation and enforcement of urban waste water discharges, in accordance with the Waste Water Discharge (Authorisation) Regulations, 2007 as amended. Irish Water is responsible for the collection, treatment and discharge of urban waste water in compliance with the requirements of EPA waste water discharge authorisations. The EPA publishes annual reports on the quality of effluent discharged from urban waste water treatment works throughout the country (EPA,). Waste water goes through eight stages of treatment at the reclamation centre to ensure quality control (Irish Water, 2015).

Preliminary treatment- This stage removes materials from the raw wastewater that could damage our equipment. This screening involves removing: paper and plastics; grit removal; flow balancing; fat and grease removal.

Primary treatment- In this stage wastewater flows through large primary sedimentation tanks with mechanical scrapers. These tanks use gravity to settle the solids. The solids are then transferred to sludge treatment facilities.

Secondary treatment- This stage adds large amounts of air to degrade the biological content of the wastewater. Most wastewater treatment plants treat the settled wastewater liquor using aerobic processes.

Floc formation- We use bacteria and protozoa to consume soluble contaminants like sugars, fats and organic short-chain carbon molecules. A lot of the less soluble fractions are bound into clumps of fine particles that we call floc.

Final settlement- The wastewater is now passed through final settlement tanks. These tanks use gravity settlement and mechanical scrapers to remove the floc.

Tertiary treatment- Some wastewater treatment plants improve the wastewater quality further using tertiary treatment.

Nutrient removal- To meet discharge licence conditions we reduce the levels of nutrients, such as nitrate and phosphorus. We do this through biological processes and chemical addition in the secondary and final settlement stages.

Quality control- Our quality control measures include regular laboratory testing of the final treated wastewater. This is to ensure the cleaned water has no detrimental effects on aquatic life or other water users.

Figure 114 (EPA logo)

In Ireland the sewerage system is also separate or combined the same as Japan. Some of the content below is taken from the experts at Municipal Sewer and Water by (West, 2104). We will now look at the different materials used in the construction of sewerage pipes.

Why PVC?

PVC pipe is a low initial cost option and provides long-term savings because of its superior pumping efficiency, corrosion resistance and longevity. Ductile iron pipe produces up to nine times more carbon emissions during raw materials processing, manufacturing, transportation and installation than equivalent PVC pipe. The energy required to pump water through PVC pipe over a 100-year design life remains constant because its smooth walls do not roughen over time. This generates overall life cycle cost savings compared to ductile iron and concrete pipes that require more pumping energy over time due to corrosion, leaks and internal degradation. Of the competing pipe materials, including iron, concrete, and HDPE pipes, PVC pipe is the most favourable alternative when considering the products' energy consumption and carbon footprint from cradle-to-grave in a public water system.

Recycled material is only a single attribute of a pipe's life cycle environmental impacts. For example, more energy is required to process the recycled metals to manufacture ductile iron pipe than in PVC pipe production. As well, producing iron pipe with recycled scrap iron emits more toxins than pipe made from virgin iron ore.

Why Concrete?

Concrete, which is one of the world's most common building materials, is used in both gravity flow and pressure pipe. Precast gravity-flow pipe is manufactured in several shapes, including round, elliptical, arched and box, and is used in sanitary sewers, storm drains and culverts. Concrete pressure pipe, which is a separate classification, is primarily used for potable water. "Concrete pipe is pretty simple, "You've got a big, strong, heavy pipe, and as long as you don't mess it up, it's going to be there for a really long time. We've got pipe that's been in the ground for 150 years. This rigid pipe system is 85 percent dependent on pipe strength and only 15 percent dependent on the soil envelope for underlying support, which makes it a good candidate for low-lying or marshy environments. Our biggest advantage is durability, strength and longevity. We also have very good flow characteristics because we have a smooth surface. Despite its durability, concrete is susceptible to H2S attacks, and in extremely acidic soil, it can corrode. To combat these problems, concrete pipe can be coated with a plastic liner, and special measures can be used to prevent corrosion in acidic soils (Matt Childs, president of the American Concrete Pipe Association).

Figure 116 (Concrete Pipe)

Why Steel?

Steel pipe, which was first introduced in the early 1800s, has a long history and has been recognized for its excellent resistance to high internal pressures and pressure surges. Large-diameter steel piping is most often used in pressure pipes for water and wastewater applications. It can be made using three methods: seamless, welded and casting mould. Like other metal pipes, steel is prone to corrosion, so it is lined with an asphalt coating when used in water mains to protect against acidic water. This also retains its good flow characteristics. The drawback to the various coatings and linings is that they can be damaged during installation. Steel's primary benefit is brute strength. Cracking typically doesn't occur, and under abnormal loads, the material bends rather than breaking (West, 2014).

Figure 117 (Cast Steel Pipe)

Why Clay?

Clay pipe has been used for millennia, with the earliest examples dating to 4000 B.C. The material was used in Mesopotamia, the Minoan civilization and the Roman Empire, and has a long pedigree of city sewer system applications. But today's clay pipe is nothing like those early examples. Nor is it anything like what was prominently used in the 1950s and '60s. Most people who aren't familiar with modern clay pipe associate it with something that's been in their system for more than 100 years, and they're different. Their opinion of the product is based off of something that isn't made anymore. Primarily used in gravity-flow sanitary sewer systems, vitrified clay pipe has improved greatly in this age of technology. Computer-controlled kiln firing means the final product is uniform and meets quality standards. Gone are the laminations in the pipe body thanks to a high densification extruding process (West, 2014).

Figure 118 (Clay Pipe)

Going Forward

Pipe material selection can be a complex process, filled with politics, preconceived ideas and budget parameters. And to complicate the matter, municipal leaders must now navigate through marketing hype as manufacturers fight for a piece of the infrastructure pie. What it boils down to is considering uses, soil conditions and reasons for previous failures, and then making a well-informed materials decision. After all, if all goes well, a pipe replacement decision should only come around once every hundred years (West, 2014).

Bureau of Waterworks/ Tokyo Metropolitan Government

Figure 119/120 (Outside the Tokyo Waterworks Historical Museum)

Introduction

Since the waterworks in Tokyo started to supply water from the Yodabashi purification plant in 1898, as a modern waterworks, they have been implementing measures to secure water resources to improve and expand their facilities to provide a consistent, stable supply of clean water. As a result, the Tokyo Waterworks has evolved today into one of the largest facilities in the world, with the highest level of technology. On another front one that which the World Plumbing Council is passionate about, is the promotion of the Plumbing Industry's role in improving public health through the provision and protection of safe water and sanitation. The securement of safe drinking water is still an important issue in developing countries, with 660million people with no daily access to drinking water. The water issue is expected to escalate quickly due to the prospective increase in demand for water from population growth and economic development. Furthermore, issues such as climate change are also factors associated with water shortages.

History

The history of Tokyo waterworks can be traced back to Edo Era (1603). The waterworks in the Edo period was called "Josui" which in Japanese means clean water. The water was guided through water pipes made of wood or stone (Sekihi/Mokuhi) to clean wells, where people used it for daily life.

Figure 121 (Wooden Water Pipe)

Figure 122

One of the busiest men in Edo is the ***mizu-bugyo*** (the water "mayor") -- the man in charge of Edo's water supply. It is a huge job to keep the water system in Edo working properly. Even back some 400years ago Japanese paid for their water usage. As the centre of politics and culture in Japan, Edo grew into a huge city with a population of over a million by the mid-eighteenth century. Throughout this time, the Emperor resided in Kyoto, which was the formal capital of the nation. The Edo Period lasted for nearly 260 years until the Meiji Restoration in 1868, when the Tokugawa Shogunate ended and imperial rule was restored. The Emperor moved to Edo, which was renamed Tokyo. Thus, Tokyo became the capital of Japan (Metro Government). As the picture shows above they used wooden pipes to transport their water. This of course had its problems. It caused contamination of the channels occurred from rotting pipes but also tapping connections, where firefighting connections were made. Furthermore, the pandemic of cholera in 1886 accelerated the movement to start the modern-day water works. In 1888, concrete research was started, and the Japanese done what they do best. Think of new ideas, innovate new products and productively get things done.

Figure 125

Figure 126

The waterworks was to guide the water of the Tamagawa River to the Yodobashi Purification Plant using the Tamagawa channel to perform sedimentation and filtration at the plant, and then distribute the water across the city through pressurising iron pipes. The expansion of the waterworks continued throughout this period. After the World War 2, Japan concentrated its efforts on the restoration works such as repair of leakages, but also the expansion project which was suspended due to the war. As we seen at the beginning of the report, water is as a necessity for human flourishing. With this, Tokyo developed rapidly and the demand for water became more stringent. For this reason, a new expansion project to utilise the tone river as a water source was started. This project also saw the expansion of four other purification plants and the construction of two new ones. Additionally, the distribution line network was developed. Today these purification plants have a total capacity

of 6.86million m3 per day of water. Moreover, palatability of water supplied to the customers is currently improved at a steady pace, to meet the needs of potable delicious water. Such measures include the introduction of the advanced water treatment system to all purification plants which use raw water from the Toneagazwa River system. Tokyo has reached the world's highest level in terms of quality and amount. The Tokyo Waterworks goal is to make continuous steps to reduce its environmental burden, assure stable water resources, and strengthen their earthquake defence system.

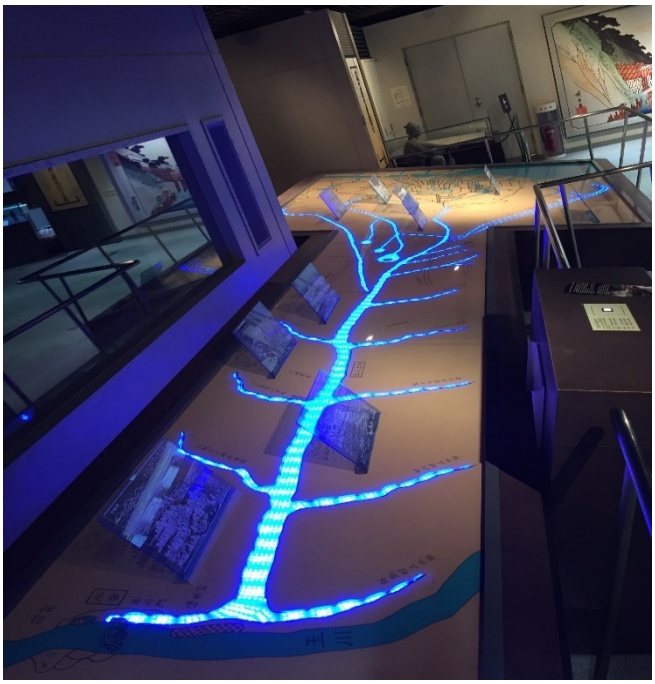


Figure 127 (Tokyo Water Channels)

Figure 128 (Tokyo Bottled Water)

Leakage Prevention Measures

Tokyo network of water distribution pipes is a total length of 26,915km. These pipes are constantly exposed to earthquake tremors, road construction, corrosive soil etc. Leakage not only loses valuable water resources but also may cause damage to buildings. For this reason, the Bureau of Waterworks aggressively work to implement leakage prevention measures. For surface leaks they provide 24hour alerts and generally repairs take place within a day. 8,315 leaks were repaired in 2015. As for underground leakage, they detect and repair leakages using electronic leakage, detectors and correlative leakage detectors. In 2015, they examined a total of 2,152km of pipe and repaired 434 cases. Additionally, we are promoting the replacement of old distribution with ductile cast iron pipes and conducting maintenance on the service in areas where leakages tend to occur. The pipes that branch off the distribution pipe to the meters are replaced with stainless steel (Benkan Corporation) or hard PVC (Kanzai) pipes. Due to the promotion of these leakage prevention measures, the leakage rate for 2015 was improved to 3.2%. Staggering low figure compared to Ireland.

The Japanese have been paying for their water since the Edu period. Running a service that provides safe, delicious and efficient water services, costs money to develop and maintain. The water charges consist of minimum usage and commodity charges. It adopts a water rate system based on the diameter bore of the pipe. This ensures fairness in the cost and clarity in the system rate. I must also point out that the Bureau of Waterworks Tokyo Metropolitan Government takes the upmost care and consideration for duty of care to the environment and the sustainability of their country. This theme is apparent across their business outline manual for 2016.

Irish Water

How relevant it is that I am writing this as Ireland is going through a water shortage because we are having our hottest summer in 40Years. The government has also brought in a national hose pipe ban, which states that for the month of July 2018 anyone caught or reported using a hose pipe to water their garden will be giving a 125euro fine. But how did it get to this? Here's a brief overview….

In 2009, a Minister announces that preparations for water charges are underway and, when introduced, they will be based on consumption above a free allocation.

In 2010, introduce an interim flat rate of residential water tax pending the installation of meters in 1.2 million homes connected to the public water mains supply.

In late 2010, €85 billion EU-IMF bailout which says water charges will be introduced in 2012 or 2013, by which time metering is to have been installed across the State. Irish water Authority is set up.

In 2011, work begins on the installation of water meters. Protests begin by some members of parliament and citizens.

In 2014, details of water charges which indicate that the average cost for a household of two adults and two children will come in at €278. Metered rates are set at €4.88 for 1,000 litres of water for properties.

In 2014, citizens are required to register for water. Only half of the citizens do so.

Late 2014, 130,000 people march throughout the city of Dublin, the largest protest since the inception of the state in 1922.

In 2017, the government plans to reimburse citizens who paid for water under the scheme, water charges are no more.

It's like a game of chess. Every time the government gets chance it calls a water shortage state of emergency to shock to Irish people. We are an Island that gets a lot of rainfall and our rivers are mostly rich and uncontaminated. So how have we a water shortage? After additional research which was hard to find, I found that:

Old distribution pipes are made from either cast iron pipes or asbestos. New ones are made from PVC. Old service pipe feeding the consumers are made from copper or lead. New pipe are made from PVC also. The distribution pipes have a life expectancy of 80-100 years. These pipes are up to 140 years old and it's because of this very reason that 50% of the water pumped through the distribution pipe is lost to leakage. Yes 50% compared to Japans 3.2%. Japans has 26,915km of distribution pipework. I was unable to find out the exact amount of kilometres of Irish distribution pipe. Irish water are working to replace pipes, but it is a complex issue with pipes running through land owner's property. However, why weren't these issues red flagged back in the consultancy stages in 2008? The Japanese plan for distant future, not just the foreseeable one. Installing metres before the system supplying them isn't fit for purpose, is downright incompetent. Is that not one of the first rules in a supply and demand business model, build up a quality, affordable, efficient distribution network? Water is no different. The water quality varies across the island. The image below gives an overview of the system in place. If you mention it in a document the product meets EU standards, everyone turns their head and says ok. But what does that mean for Irish people. What are the standards? Is meeting the minimum standard enough. The Japanese don't just meet the standards, they surpass them.

Figure 129 (Picture from EPA website)

Key Findings for 2017
Quality of public Water Supplies

- The quality of drinking water in public supplies remains high
- Microbiological compliance is better than 99.9%
- Chemical compliance is 99.6%
- Half of boil water notices issued in 2017 were short-term notices, in place for less than 30 days.

Main issues affecting water quality

- High levels of disinfection by-products
- Persistent pesticide failures in some supplies
- Large numbers of lead pipe connections in properties.

Progress in 2017

- EPA Remedial Action List down from 99 supplies in 2016 to 77 supplies during 2017
- Disinfection upgrades were completed at 81 drinking water treatment plants
- Irish Water completed almost 25,000 Drinking Water Safety Plan hazard assessments in 2017

Action Required

- Continue to upgrade disinfection treatment under the National Disinfection Strategy
- Replace lead pipework in public buildings and private homes
- Put Drinking Water Safety Plans in place to protect supplies into the future

There is no mention of Fluoride being added to the water supply. The image above also suggests the onus is on the consumer to replace any lead pipes inside their home. Irish water also states that the consumer is responsible for the incoming mains water pipe from the water meter where the boundary wall of the property is into the home. Houses built before 1990 would have had either lead or copper with soldered capillary joints installed as brass reacts with the soil. To read more about the effects lead has on the human body, I suggest you read Dr Simon Reddy's report from his 2015 World Plumbing Council trip to Hong Kong. Simon is a master plumber who is leading the way in this area with his findings.

The EPA's Remedial Action List (RAL) is a register of public water supplies with the most serious deficiencies and known to be most at risk, where the EPA is requiring Irish Water to take corrective action to ensure the safety and security of the supplies. The EPA has instructed Irish Water to submit an action programme for the improvement of each of these water supplies and has initiated enforcement action where action programmes have not been prepared or implemented to the satisfaction of the EPA. This includes issuing legally binding directions requiring specific work to be carried out to ensure the safety and security of a water supply.
Since the original RAL was published in 2008, 87% (295) of supplies have been removed from the original list because the necessary remedial actions have been completed. The primary issues addressed to-date include disinfection of E. coli, barriers to Cryptosporidium, adequate treatment for trihalomethanes and operational controls for managing aluminium and turbidity levels. The EPA updates and publishes the RAL on a quarterly basis. 72 supplies remain on the RAL at the end of April 2018 which collectively supply water to 632,452 consumers.

The water in Ireland although mostly uncontaminated and free of bacteria, I don't drink it. This is generally the opinion of 7/10 people who drink a lot of water. The reason for this is there is a smell of chlorine and fluoride from it. Anyone who has smelled it before, knows it's quite a strong odour, not to mention the health hazards. The table below shows countries in Europe who either do or don't add fluoride into their drinking water. If you add the number above 632,452+ the one below 3, 250, 00 + the consumers who collect their own water through wells etc. That's the entire Island of Ireland which is serviced with inadequate water supply. No wonder there was such an overwhelming rejection to the proposed water charges. The table below shows the Water Fluoridation Status of Western Europe.

Water Fluoridation Status of Western Europe
(BFS 2012)

Country	Population Size*	No. of People w/ Fluoridated Water**	% w/ Fluoridated Water**
Austria	8,452,835	0	0%
Belgium	10,951,266	0	0%
Denmark	5,584,758	0	0%
Finland	5,413,830	0	0%
France	65,350,000	0	0%
Germany	81,859,000	0	0%
Greece	10,787,690	0	0%
Iceland	320,060	0	0%
Irish Republic	4,588,252	3,250,000	73%
Italy	60,820,787	0	0%
Luxembourg	511,800	0	0%

Netherlands	16,738,836	0	0%
Norway	5,027,800	0	0%
Portugal	10,561,614	0	0%
Spain	46,163,116	4,250,000	11%
Sweden	9,495,113	0	0%
Switzerland	7,952,600	0	0%
United Kingdom	62,262,000	5,797,000	11%
TOTAL	412,841,357	13,297,000	3%

Table 1 (Water Fluoride Table)

The classification of fluoride as a pollutant rather than as a nutrient or medicine is a useful starting point for analysing the adverse effect of fluoride. No fluoride deficiency disease has ever been documented for humans. Indeed, the basis for setting an "adequate intake" of fluoride rests on the alleged ability of ingested fluoride to prevent tooth decay. However, since it is now known that the effect of fluoride is topical, the notion of an "adequate daily intake" is flawed. (NCBI,)

Fluoride has modest benefit in terms of reduction of dental caries but significant costs in relation to cognitive impairment, hypothyroidism, dental and skeletal fluorosis, enzyme and electrolyte derangement, and uterine cancer. Given that most of the toxic effects of fluoride are due to ingestion, whereas its predominant beneficial effect is obtained via topical application, ingestion or inhalation of fluoride predominantly in any form constitutes an unacceptable risk with virtually no proven benefit. Improvements in occupational health and safety practices and safer disposal of fluoride waste would help to reduce occupational and environmental exposures to fluoride. Artificial or natural fluoridation of water represents a public health hazard—significantly damaging health where fluoride levels are high but are clearly demonstrated as having harmful effects at lower levels found where water has been artificially fluoridated. In addition, ingested water is a very inefficient way of delivering fluoride to teeth given its topical effect but is an important cause of fluoride's adverse effects on human health. Of all sources of fluoride, artificially fluoridated water is the most practical source to eliminate in order to reduce its human hazards at population levels (NRC, 2006)

Currently, only about 5% of the world's population—350 million people (including 200 million Americans) consume artificially fluoridated water globally. Only eight countries—Malaysia, Australia, USA, New Zealand, Singapore, and Ireland, more than 50% of the water supply artificially fluoridate. In a major review of the topic published in 1987, the International Agency for Research on Cancer labelled fluorides as "non-classifiable as to their ability to cause cancer in humans and that the studies reviewed have shown no consistent tendency for people living in areas with high concentrations of fluoride in the water to have higher cancer rates than those living in areas with low concentrations (IRC, 1987).

Moreover, in a 2005 study, it was found at 47% of children living in a New Delhi neighbourhood with average water fluoride level of 4.37 ppm have evidence of clinical hypothyroidism attributable to fluoride. They found borderline low FT_3 levels among all children exposed to fluoridated water (Susheela et al, 2005). The mechanisms through which fluoride exacerbates hypothyroidism include competitive binding with iodine, as well as synthesis obstruction of T_3 and T_4. These mechanisms explain the use of fluoride at doses above 5 mg/day in the treatment of hyperthyroidism (Idris & Wiharddza, 2005). Skeletal fluorosis is a chronic metabolic bone disease caused by ingestion or inhalation of large amounts of fluoride. In regions with water fluoride concentrations over 2 ppm, or among workers constantly exposed to fluoride in aluminium or fertilizer industries, skeletal fluorosis is common (>20% prevalence) and manifested as joint pain in both upper and lower limbs, numbing and tingling of the extremities, back pains, and knock-knees. Vertebral osteosclerosis may result in spinal cord compression (Fisher & Medcaf, 1989).

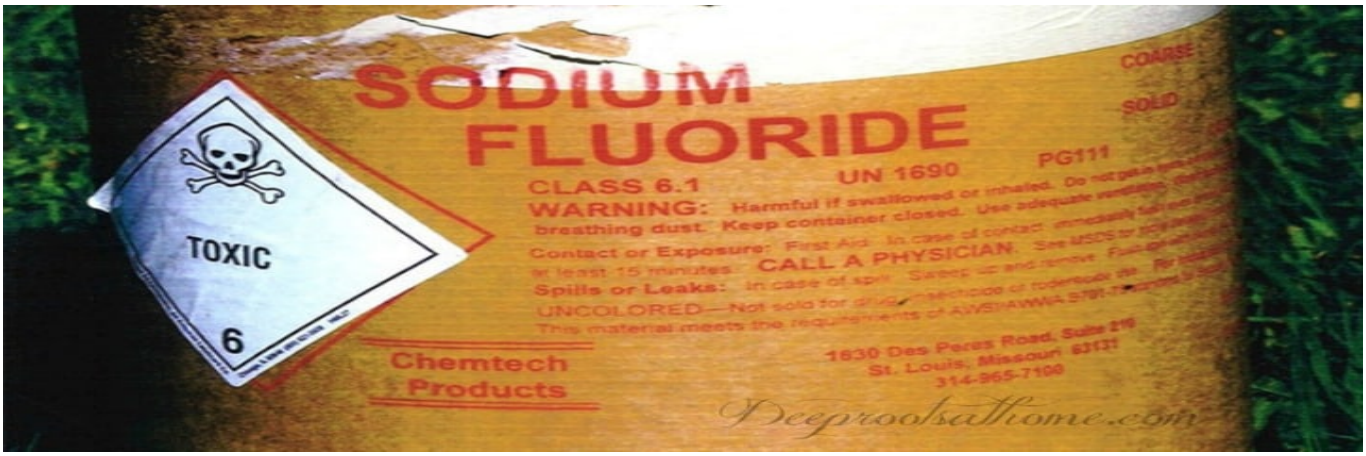


Figure 130 (Sodium Fluoride)

Urgent Action Required

All nutrient values for fluoride need to be withdrawn, not least because it is irrational to have daily nutrient intakes for a hazardous substance whose mode of action is topical on teeth enamel. A coordinated global effort to reduce adverse human health effects on fluoride need to start with ensuring that its introduction into water supplies is prohibited, occupational and industrial fluoride exposures and injuries are reduced to the minimum possible, and natural water systems with high fluoride content are DE fluorinated prior to being endorsed as "potable." Finally, given that dental caries is the most common disease globally arising from bacterial infection (Tanzer, 1995). Adding fluoride to the water system in the 1950s was probably ground-breaking and the effect fluoride has on tooth decay is evident. However, 70years into the future the effect that fluoride has to the human body in protuberant. The onus should be on the individual to look after and keep their own teeth healthy. The countries and governments in question need to look to their neighbouring countries, and observe how wholesome, odourless, no toxic water is delivered to billions of people every day.

The Metropolitan Area Outer Underground Discharge Channel

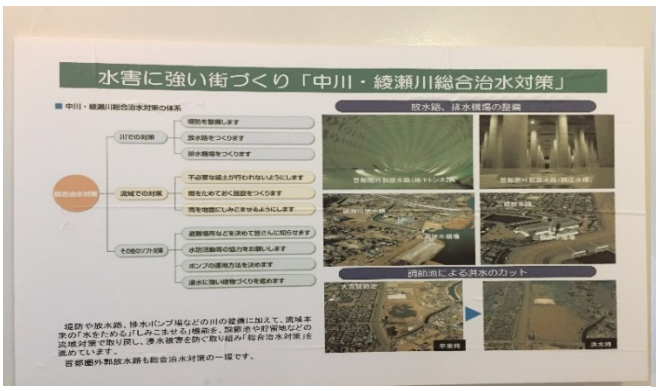
The Metropolitan Area Outer Underground Discharge Channel is one of the world's largest underground discharge channels, which takes water overflow underground from the rivers Naka, Kuramatsu and the Oootoshifurutone and directs it into the Edo River through a 6.3kilometre long tunnel that runs 50 metres below the ground. Construction was started in March 1993. They utilized their world class Japanese civil engineering technologies. After a construction period of 13years, in June 2006 it became possible to direct water from the rivers into the Edo River.

Figure 131 (Metropolitan Area Outer Underground Discharge Channel)

Figure 132

The Naka river drainage basin had been devastated since earlier times due to its changed flow channel caused by flooding of the tone and Ara Rivers. Being surrounded by large rivers this area was susceptible to flooding. Since the water level inclines gradually, the area remains in a dangerous state long after. Water will always find its own level and with this area in a bowl like shape the water will always collect in the low lying areas.

Figure 133/136 (Pictures illustrating the gradient in the surface)



Major facilities of the Metropolitan Area Outer Underground Discharge Channel

It consists of the inflow facilities, banks, tunnel, pressure adjusting water tank, draining pump station and the drainage sluiceway.

The **bank** maintains and controls inflow flooding and the discharge channel. The five banks from no1 to no 5 are interconnected to each other through the underground tunnel and used for taking in the flood water from the rivers. They also play an important role in the maintenance and management of the outer underground discharge channel. These are gigantic cylindrical facilities. They measure 70 metres in height with an inner diameter of 30metres. To put it into perspective the NASA space shuttle is 55 metres in height.

The **inflow facility** takes in the water from the overflow levee during flooding. If the water level surpasses the height of the overflow levee, flood water will go into the inflow facility. The over flow levee is the same height as the lowest nearby ground to cope with even the smallest of floods.

The **tunnel** runs a total of 6.3km, 50 metres below the earth's surface. It is a manmade Underground River constructed to lead flood water flowing in from the rivers. The tunnel connects to five banks is connected along the route. The tunnel has an inner diameter of 10metres and can drain flood water of a speed of up to 200m3 per second.

The drainage facility is the heart for controlling this gigantic system. The Showa Drainage Pump Station has two jobs. One job is to drain the flood water that runs down from the underground tunnels, from the pressure adjusting water tank through the giant pump and drainage sluiceway into the Edo River. The other job is to operate and centrally monitor each inflow facility.

Figure 137 (Control Room in the Showa Facility)

The **drain pump** facility is another important part of the system. It moves the large body of water from the tunnels and the pressure adjusting water tank. It consists of four gigantic pumps, the largest of their kind in Japan. They have a 50m3 per second discharge capacity. To give you a sense of the power of these pumps that's a pumping capacity of a full 25metres swimming pool per second. It operates by using the power of a gas turbine which rotate bladed wheels called an impeller at a high speed to give energy (lifting and centrifugal forces) to water and generate flow. The gas turbines used is a modified version of the one designed for aircraft. Its key characteristics are its compact size, reduced noise and vibrations.

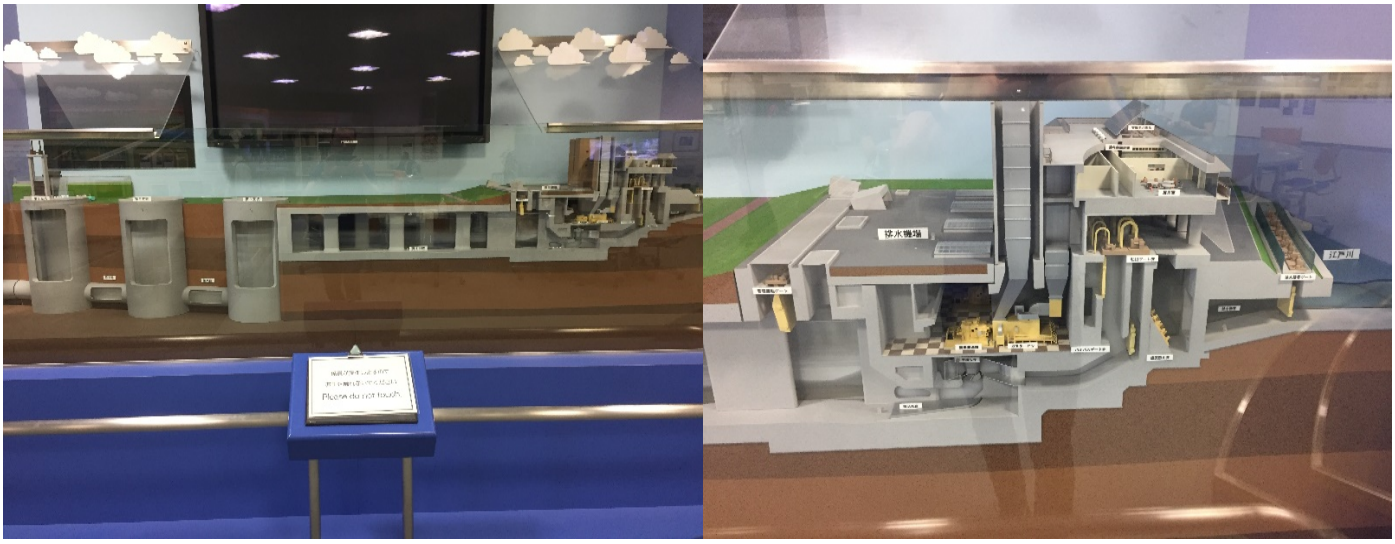


Figure 138/139(Models of Underground Discharge Channel)

The **pressure adjusting** water tank is an enormous built at a position approximately 22metres below the surface. It reduces the flow of water and is then drained smoothly into the Edo River. It is 177metres long by 78metres by 18metres high. How about some maths for the readers?

To find the volume and capacity of this enormous tank. Multiply the Length x width x height = the volume which is in m3. To find the capacity multiply your answer by 1000 and the answer in in litres. Inside the tank there are fifty-nine pillars 7metres long, 2metres wide by 18metres high and each weighs a cool 500 tons. You enter the tank through what is like a small shed at the end of a football pitch. There are 116 steps you must go down to get to the base of the tank. Photos are prohibited on the stairs in case of accidents as all the group can only walk down in single file. Inside the tank the temperature is 12degrees Celsius. Inside the tank can only be described as an underground engineering temple. Truly incredible.

Figure 140 (Above the pressure adjusting water tank)

Figure 141 (Stanilav and myself at entrance to tank)

Figure 142 (Inside the pressure adjusting water tank)

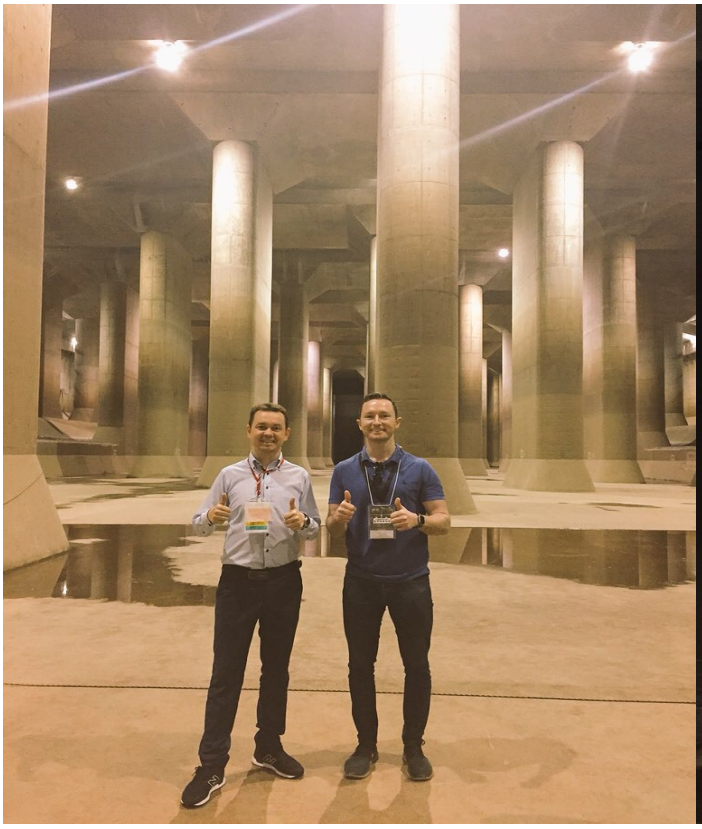


Figure 143 (Stanislav and I)

Figure 144

The drainage sluiceway is the facility used for draining the flood water from the system. The flood water sucked up by the pump at the drainage pump station is drained in the Edo River through six drainage sluiceways, each 5.4metres by 4.2metres. It also prevents back water from back water from the Edu River. The metropolitan Area Outer Underground Discharge Channel was such a success it won the 2002 OCEA award from the Japans Society of Civil Engineers. The OCE award is presented to an epochal project that has achieved distinguished contribution to civil engineering development.

Conclusion

Putting pen to paper and weaving all this research together over the past two months, while working full time was not without its challenges or its rewards. The research showed the diversity in the methods, aims and experiences in the Plumbing Industry. This was best demonstrated by an examination of the outlier examples of Irish and Japanese Vocational models and plumbing industry visits. Initial investigations of Japan suggested that a weak or poorly enforced quality assurance system was the singular cause of decline, however the Japanese model demonstrated that the underlying cause was broader than one single element. What was revealed through the process of reading, reviewing and reflection was that it had suffered a decline of status in society throughout the centuries. This negative trend was set to continue particularly in Japan as companies are the employer and training provider. The main difference between the Irish and Japanese approaches was that the Irish apprenticeship system had evolved a rigid structure with the involvement of the various stakeholders such as Solas, who are the State Organisation with responsibility for funding, planning and co-ordinating Further Education and Training and QQI who are a state agency responsible for promoting quality and accountability in education and training services in Ireland. 'The Japanese apprenticeship on the other had rigidly and ruthlessly adopted a high standard of the apprentice, where even the act of learning the craft was a test of endurance and patience, resulting in the highest of standards, without any real structure, curriculum or recognisable pedagogical methodology' (Thoma, 2016). The question you have to ask yourself is the system working for the countries in question. The answer is yes. Could it be more efficient? definitely!! If you ask me would it be easier for a Japanese or Irish plumber to transition to each country. My answer would be in would be easier for an Irish plumber. The Irish Plumbing curriculum is broad ranging and covers all areas of the industry. This happens regardless of the apprentice is working for a company specialising in one particular area. The apprentice will learn the knowledge and skills in the off the job phases. In Japan, if a plumber is working for a company and they train and certify the trainees themselves, that trainee will only learn that area of skills. This can limit the plumber's ability to travel and move to different areas of the industry. Another issue would be the knowledge of wet heating systems in Ireland as all Japanese heating system are convector or air conditioning. The Irish Standards based system is recognised internationally, where the Japanese model is only recognised nationally.

The goal as my going over to a researcher was to conduct a comparative Education and Training study. Although this study was qualitative and not suitable for making wider generalizations it has been empirical nonetheless. The study has provided data from observations, meetings, presentations, sites visits, training centre tours and dialogue with others in the field. Going forward this will enhance my own teaching practice and professional development. In addition, the World Plumbing Council Scholarship has provided an opportunity to network, meet new friends in the industry and highlight the apprenticeship structure in Ireland.

Keep an eye of for the development of the Four Pillars of Plumbing in the coming years. Also don't forget to the celebrate World Plumbing day which is the 11th of March every year.

Thanks for reading and I hope you enjoyed.

Shay Shanahan

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