

Singapore Study Tour on HVAC&R Technology 2010

Report



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Forewords

Message from the Advisor

It is my pleasure to introduce to you the successful outcomes of the Singapore Study Tour on Building Technology held on 23-29 August 2010. 24 students from five different universities/institutes in Hong Kong have carried out the study tour with the aim to develop knowledge in advanced building technology and to promote exchanges in Asian countries.

This year is the fifth time such a study tour is organized. The students from Hong Kong have demonstrated very good team work skills and enthusiasm when they were preparing for the study tour. To understand Singapore better, they have visited the major government departments and university including Urban Redevelopment Authority (URA), Housing Development Board (HDB), Land Transport Authority (LTA) and National University of Singapore (NUS). They have also visited some interesting projects such as National Library Building, Singapore District Cooling, BCA Academy Zero Energy Building, NEWater Visitor Centre and Marina Barrage. On the leisure side, they have attended the closing ceremony of the Singapore Youth Olympics Games 2010 and visited some tourist attractions in Singapore.

The students have attended the ASHRAE Region XIII Chapters Regional Conference and interacted with the student representatives and ASHRAE delegates from Thailand, Indonesia, Philippines, Malaysia, Singapore and Taiwan. They have also met the ASHRAE President (Ms. Lynn Bellenger) and other ASHRAE USA staff. The experience could expand their vision in regional and international affairs.

On behalf of the study tour participants, I would like to express sincere thanks to the ASHRAE Hong Kong Chapter, ASHRAE Singapore Chapter, the study tour sponsors and all related organizations and people for their kind support. I believe this study tour has created a big impact to encourage exchanges and cooperation among the students.

I hope that the spirit of the study tour will be continued and the participants will extend the findings and experience to benefit themselves, other students and our industry.

Dr. Sam C. M. Hui

Study Tour Advisor, ASHRAE Hong Kong Chapter



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Housing Development Board (HDB), Singapore

Urban Redevelopment Authority (URA), Singapore

Land Transport Authority (LTA), Singapore

National Library Board (NLB), Singapore

National University of Singapore (NUS)

Johnson Controls (Singapore) Pte Ltd

Singapore District Cooling

Building & Construction Authority (BCA), Singapore

Executive Summary



Compared with last year's study tour, we have doubled the number of participants to twenty-four students to participate in the 7-day Singapore Study Tour on HVAC&R Technology. It is hoped that we could increase the number of participants and provide more opportunities to the students who can benefit and learn from the study tour.

"Singapore is a very strong competitor. In terms of technology advancement & innovation, language diversity & ability and policy implementation efficiency, Hong Kong is much lagging behind." This is the deepest impression I had after visiting to Singapore.

This year, the students combining from five institutions including the University of Hong Kong, the City University of Hong Kong, the Hong Kong Polytechnic University, the Hong Kong University of Science and Technology and Hong Kong Institute of Vocational Education, joined for the study tour from 23th August to 29th August 2010 in this summer.

This seven-day visit is a very fruitful visit .It enhances students' interests in HVAC&R technologies by talks, seminars and visits. This seven-days visit comprising of joining ASHARE Regional XIII Chapters Regional Conference (CRC), visiting to different government bureaus such as the Housing and Development Board, Urban Redevelopment Authority, Land Transportation Authority, participating in the technical visits including the Singapore District Cooling, BCA Academy Zero Energy Building ,Marina Barrage and New Water Plant and also visiting to the Johnson Controls Singapore Company .

In spite of acquiring engineering knowledge, the visit to the National University of Singapore and the Banquet Dinner also provided us an occasional opportunity to have academic and cultural exchange with students from other countries.

Thank you for the arrangement of the ASHRAE Hong Kong Chapter, ASHRAE Singapore Chapter and all other organizations which give support to our study tour. In this year, some students said the tour in this year is tiring but the most rewarding tour which they learned the most.

Mr. Lam Cheuk Yin, Victor

Team Leader, Singapore Study Tour 2010

1. Introduction

Background

In August 2010, the ASHRAE Region XIII Chapters Regional Conference was held in Singapore. This study tour was arranged to allow the students in Hong Kong to attend the conference and to carry out technical and academic visits and exchanges. Successful study tours to Malaysia, Taiwan, the Philippines and Thailand were organized in 2006, 2007, 2008 and 2009 respectively.

Objectives

The objectives of this study tour are:

- To study the culture and social-economic development of Singapore
- To enable the students to develop knowledge and skills in advanced HVAC&R technology, building environmental design and creative thinking
- To promote international cooperation, cultural exchange and mutual understanding in Asia

The participants of the study tour come from five student branches including City University of Hong Kong, The University of Hong Kong, The Hong Kong Polytechnic University, The Hong Kong University of Science and Technology and Hong Kong Institute of Vocational Education. Before having the study tour, students had to attend meetings for the preparation works. Through the meetings, students from different institutions learnt the importance of teamwork and organization skills. During the study tours, attending professional engineering conferences, technical visits, company visits and sightseeing had broadened students' horizon. In addition, students were able to meet different engineering students from the Philippines, Taiwan, Thailand, Indonesia, Singapore and Malaysia. Cultural values could be exchanged with different student chapters and a better understanding of Asian countries would be developed.

2. Itinerary of Singapore Study Tour 2010 on HVAC&R Technology

Duration: 23 August 2010 – 29 August 2010

Flight: JetStar Asia (3K)

Hotel: Fragrance Hotel - Oasis

Day 1 23 Aug 2010 (Mon)

Depart Hong Kong to Singapore (3K692 1100/1450)

Day 2 24 Aug 2010 (Tue)

Morning: Housing Development Board Gallery (housing)
URA Centre's Singapore City Gallery

Afternoon: Chinatown (Chinese culture) + Lunch
LTA Land Transport Gallery (transport)
National Library Building (green building)

Day 3 25 Aug 2010 (Wed)

Sightseeing - Sentosa Resort World

Day 4 26 Aug 2010 (Thur)

Morning: Visit to National University of Singapore (NUS)

Afternoon: Visit to Johnson Controls Singapore
Technical Visit : Singapore District Cooling

Night: Youth Olympics Games Closing Ceremony

Day 5 27Aug 2010 (Fri)

Morning: CRC Technical seminars

Afternoon: Technical Visit -BCA Academy Zero Energy Building

Night: CRC banquet dinner

Day 6 28 Aug 2010 (Sat)

Morning: Technical Visit - NEWater Visitor Centre

Afternoon: Technical Visit - Marina Barrage

Night: Farewell dinner

Day 7 29 Aug 2010 (Sun)

Depart Singapore to Hong Kong (3K695 1545/1930)

3. ASHRAE Chapter Regional Conference (CRC)

Introduction

ASHRAE Region XIII Chapters Regional Conference (CRC) 2010 was held at the Holiday Inn Atrium Hotel from 27 to 28 August 2010. Our study tour members have joined the 27 August half-day technical seminar with the theme "**Green Buildings: Developments and Technologies**". The seminar is aiming to solve the issues originating from the climatic change which causes the most severe threat towards mankind. Moreover, the seminar will also act as a bridge to link the speakers and participants to share and transfer of the knowledge and information.

This year, three speakers have been invited to give presentations. The first speaker is **Dr Drury B. Crawley** who shares the topic on **Trends in Buildings and Energy Simulation**. The second speaker is **Prof Lee Siew Eang** who mentioned about **The Design, Development and Performance**



of a Retrofitted Solar- powered Zero Energy Building. The third speaker is **Mr. Vinod Kesava** who gave the talk about **CARE. The first CDM Program in Singapore for Energy Efficiency in Chiller Plants employing ASHRAE 14 guidelines**. A banquet dinner was held on that night to all the participants in the CRC.

Speech 1: Trends in Buildings and Energy Simulation (By Dr. Drury B. Crawley)

In today's world, we face energy shortage and scarce resource. Thinking of the future, sustainability is the key to protect our environment and ensure there is enough resource and energy in the future. In this talk, **Dr Drury B. Crawley** mentioned that we should adopt most energy-efficient or green measures to design and construct the buildings. In order to make the buildings to be green, energy stimulation is a must. In this presentation, Dr Drury elaborates on how the future of the trend of buildings will be , what are the key factors to push the wider usage of the Stimulation software and also introduction of different simulation tools.

Nowadays, among the transportation, industry and the buildings, the buildings consisting the residential and commercial buildings occupy the most primary energy consumptions end users.

Compared with 2008 and 2030 years, it is predicted that the projected increase in the carbon emission will be largest in the commercial buildings.

The existing technology used includes usage of the electro, photo-chromic, thermo-windows, super envelopes, moving from the incandescent fluorescent to LED and OLED lighting.

To get the net-zero energy building, it needs the lower the number of floors, the higher percentage the floor area to able to get zero energy. To obtain the zero energy consumption, the commercial buildings need to cut 60% to 70% energy consumption.

Then, Dr **Drury** demonstrates there exists some buildings in USA which shows negative value on the annual purchased energy .it means that the buildings generates and sells the remaining energy to the other parties

To be successful in improving the building energy efficiency, the stimulation needs to consider the following issues including the getting the building data maintenance and storage data throughout building cycle, training the users in the stimulation users and encourage the application of the new technologies.

“Every building is a forecast. Every forecast is wrong.” Stewart Brand said.

The problems of the stimulation exist. They consist of the real buildings using more energy, producing less energy, having more pollutants complaint and GIGO (**Garbage In, Garbage Out**).

Finally, Dr **Drury** suggests using the simulation software including the EnergyPlus, Open Studio, Energy10, ECOTECT, EFEN, EPQUICK, etc. He noted that stimulation is critical to support the decision-making to achieve the low and zero-energy buildings. But the good predicted result only comes from the good input data.

Speech 2: The Design, Development and Performance of a Retrofitted Solar- powered Zero Energy Building (By Prof Lee Siew Eang)

The Zero Energy Building at the Building and Construction Authority's Academy is a project supported by the Ministry of National Development. It is the first Zero Energy Building in Singapore to achieve the net zero consumption by cutting the energy consumption by 60% and generating its own electricity by the solar power. The Zero Energy Building is a project jointly coordinated by the Building and Construction Authority and the Centre for Total Building Performance of the National University of Singapore.

The objectives of the buildings are to demonstrate that an existing building is able to achieve net zero energy, to serve as a test-bed for integration of Green Building technologies in existing buildings and to be a hub for practitioners and students in the study of energy efficiency and green buildings.

What is a Zero Energy Building?

Net Zero Energy Building is defined as the building, after a year's operation, has all its consumed energy for by a system of renewable energy source. It has net zero consumption from the grid. The building is grid tied. It is using the grid as battery which stores its surplus generated green energy into the grid and draw down from its reserve on the grid when renewable energy generation is low such as on a raining day. A Net Zero Energy Building consumes 100% green energy.



The design of the Net Zero Energy Building consists of different aspects. System Technologies factors include the application of the single coil twin fan, personalized ventilation, energy ventilation, energy efficiency, lighting, PV, BIPV, etc. Climate factors consist of the urban heat island study, roof gardens and vertical greening. Design factors combine of the total building performances, design process and new technology. Management factors consist of lighting management, user tracking, environment reporting and energy balance. People factors include the personal feedback and control, personal energy account, awareness and training.

Analyzing the energy distribution, HVAC consumption (chiller plant, AHUs, FCUs, etc.) occupies the most energy which is about 56% of the total electricity consumption. Out of HVAC consumption, chillers are the biggest consumers which occupy 36% of the total energy consumption.

The Zero Energy Building at the Building and Construction Authority is operating purely on 100% clean renewable energy. Surplus energy generated was used on other facilities on the campus. Passive and active design is the key to success of the project.

Speech 3: CARE . The first CDM Program in Singapore for Energy Efficiency in Chiller Plants employing ASHRAE 14 guidelines. (By Mr Vinod Kesava)

The presentation investigates the first time CDM (Clean Development Mechanism) POA (Program of Activities) implemented in Singapore for the Energy Efficiency in Chiller Plants of commercial and industrial buildings, which is known CARE, Climate Action Response Enterprise. The POA is based on aggregating projects which replace the chiller plants to reach a minimum energy efficiency coefficient of 0.65kW/TR and that must be measured and verified in accordance with ASHRAE guideline 14 annually, over 10 years to benefit from the Certified Emission Reductions or carbon credits.

The chiller plant occupies a large part of the power consumed in buildings; hence, improvement in chiller plant efficiency contributes to reduction in energy consumption greatly. Moreover, the reduction in energy consumption also reduces in the CO₂ emission if the project is registered with the UNFCCC (United Nations Framework Convention on Climate Change).

This is the first time the Chiller Replacement Program takes place in Singapore under the Clean Development Mechanism (CDM). It aims to increase the chiller plant efficiency to at least 0.65 kW/TR or better and monitored at 1-minute intervals employing ASHRAE 14 Guidelines. Also, it targets at reducing the energy consumption and hence the usage of the fossil fuels and the total CO₂ emissions in Singapore.

To facilitate the monitoring process, the temperature for chilled water supply and return (delta degrees Celsius), rate of Flow of chilled water (litres/second) and Electrical Energy Demand for each and every equipment within the chiller plant (KW) are needed to be measured. Moreover, the measurement of data shall be at 1 (one) minute intervals.

After the data is gathered using a suitable Energy Management Software (EMS), this data is computed to account for

- (1) chiller plant loading (in TR – tons of refrigeration) over a time series to obtain: TR-H and
- (2) Electrical Energy Consumption in KW – Kilowatts) over a time series to derive : KW-H.

Finally, the speaker mentioned that through the long-term measures, we could reduce the emissions of CO₂ in mitigating catastrophic climate change consequences.

Moreover, we should further plan to implement solutions for energy efficiency in lighting and other refrigeration applications in the near future.

4. University Visit - National University of Singapore



In the National University of Singapore, we were first introduced to the Engineering Faculty. The structure of faculty and number of staff of student were shown. The subjects are similar to those in Hong Kong but the great difference is the programmes are 4 years instead of 3. For project, students are given a design and build project on a group basis in the fifth and sixth semesters. The students are also required to undertake a research based project leading to a B.Eng. Dissertation in the last two semesters.

The NUS Libraries comprises seven libraries. We also visited the central library which is a multi-disciplinary collection. It includes the collection of Faculty of Engineering and their Graduate Divisions. Some special features are as follows:

Chat Point for mobile phones

is available for you to answer or make calls on your mobile phone.



The New Books Displays showcase recently catalogued books which may be checked out immediately.



The Microform collection comprising microfilm, microfiche and microcard, issued by the Loans Desk can be viewed in the Microform Viewing Room.



Due to the tight schedule, we just had a little time to share and exchange our experience in study. It would be a great opportunity for us to know more about the study in Singapore if we had more time.

5. Company Visit – Johnson Controls (Singapore)

We are very pleased to visit to **Johnson Controls** on the fourth day on Singapore. Johnson Controls is a global diversified company in building and automotive industries serving customers in over 150 countries. 130,000 employees create quality products, services and solutions to optimize energy and operational efficiencies of buildings; lead-acid automotive batteries and advanced batteries for hybrid and electric vehicles; and interior systems for automobiles. Johnson Controls provided an opportunity for us to know more about their markets and businesses. Also, we have lunch together, although time is limited, it is worth a visit in order to communicate.



6. Government Department/ Building Visits

6.1 Housing Development Board (HDB) Gallery

Singapore HDB Gallery is located in its Housing Department. This gallery shows the development of Singapore public housing over the years. In fact, there is nearly 80% of the Singapore residents are living in the public estate. The Housing Department also planned the besides facilities which are convenient to the users.



For the difference period of the indoor decoration, three models representing different periods are shown. They shows the normal flats of “Before 1960s”, “1960s-1970s”, “1980s-1990s” as the time flies. It is really a good witness to show the improvement made by the housing department. At the same time, the design of the entire estate has changed.



Furthermore, demonstrations of the flats, which are with 2, 3, 4 and 5 rooms, are displayed in an area of Habitat Forum. They are decorated with difference styles, such as: Pastel charm, Spring greens, Modernistic harmony and Auric glam. Moreover, all of the flats are built up with a civil defence shelter. It can used to protect the residents when there is any accident or attack to the buildings.

Last but not the least, the gallery is equipped with high technology, such as 3D projector and a circular 360 degree theatre. It can help us to understand their daily life more.



6.2 Land Transport Authority - Land Transport Gallery



The Land Transport Authority (LTA) is a statutory board under the Ministry of Transport that spearheads land transport developments in Singapore. LTA plans the long-term transport needs of Singapore, taking care of those who drive as well as those who take public transport. The ultimate goal is to access a smooth and seamless journey for all. Their mission is to provide an efficient and cost-effective land transport system for different needs.



The Land Transport Gallery explains in a fun and interactive way, the developments of land transport over time and how improvements have been made possible. In the Land Transport Gallery, we went through a journey; from the past, to the present, then into the future. There are six zones during the one hour walkthrough.

1. **Journeys** - Catch a glimpse of land transport systems in the world major cities as well as Singapore's own mode of transportations.
2. **Memories** - Travel to the nostalgic past and experienced the mode of transports during the pre-independence.

3. **Formative Years** - Learn about the key milestones in Singapore's land transport development and the challenges faced during the nation's formative years.
4. **Land Transport Today** - Learn how the LTA faced with the challenges such as meeting diverse needs and managing road usage.
5. **Challenge Theatre** - Be a transport planner in an interactive multi-player game!
6. **Vision & Aspirations** - Enter the future and get a peek of what the transportation landscape might be like in 2030.

After the one-hour walkthrough, we learnt about Singapore's different modes of transportation and a lot of live-size exhibits showcase the modes of transport available. We knew how to deliver a land transport network that is integrated, efficient, cost-effective and sustainable to meet the nation's needs, to plan, develop and manage Singapore's land transport system to support a quality environment while making optimal use of our transport measures and safeguarding the well-being of the travelling public and to develop and implement policies to encourage commuters to choose the most appropriate transportation mode.



6.3 National Library, Singapore



National Library, Singapore

The National Library in Singapore is located on an 11,304-square metre site between Bugis Junction and the Bras Basah Complex at 100, Victoria Street. The building is a 16-storey with three basements, two-block development situated in the city's Civic District.

The library replaces the old National Library at Stamford Road, which closed on 31 March 2004 and moved to its new home on 22 July 2005. It houses two libraries, Central Lending Library at B1 and Lee Kong Chian Reference Library at Level 7 - 13. It also houses Drama Centre at Level 3 - 5.

The total collection of the library is over 200,000 books, 726 magazines, 74 newspaper as well as audiobooks on CDs. Moreover, it has a full range of facilities such as access to electronic databases; document delivery service, microfilm, reprography and audio-visual are available.

The National Library is not only a place provided knowledge and entertainment to visitors, but also a green building using bioclimatic design techniques.

Key Green Features:

- Building is oriented away from the east-west sun, combined with sun shading features on the west face of the building as an additional shield against solar heat gain and glare.
- Energy efficient features include daylight sensors that are used together with automatic blinds at the building facades, motion sensors and energy efficient lightings.
- An open plaza area between the two blocks, which allows natural ventilation and daylighting.



Adoption of daylighting

- Extensive landscaping, sky terraces and roof gardens are utilized to lower local ambient temperature.
- Use of rain sensors as part of the automatic irrigation system for rooftop gardens. Water efficient taps and cisterns also used to conserve water.



Daytime and Night time of Green Garden at Level 10, The Retreat

7. Technical Visits

7.1 Singapore District Cooling

Background

District cooling is an innovative urban utility service involving the centralized production of chilled water that is piped to commercial buildings for air-conditioning.

Singapore District Cooling Pte Ltd (SDC) provides district cooling services to developments at the Marina Bay New Business District. It is a joint-venture between Singapore Power and Dalkia, a French energy company.



SDC commenced commercial operation in May 2006 with One Raffles Quay as the first development receiving chilled water supplies from the district cooling system. One Raffles Quay is the host development for the first district cooling plant. In May 2010, SDC commissioned its second district cooling plant at Marina Bay Sands. Developments currently served by the district cooling system include One Raffles Quay, Marina Bay Sands, The Sail @ Marina Bay and Marina Bay Financial Centre. Supplies will be extended to Asia Square, Ocean Financial Centre, Gardens by the Bay, MRT stations and other new developments as they are completed in the years ahead.

Plant Room Visit

First of all, SDC provided a technical talk for us. They described the overall background of the operating principal of the district cooling system in



Marina Bay.

We can know the overall picture of the district cooling and technical constrain for the design and installation. After the presentation, they lead us to see the plant rooms. For example, Chiller plant room, ice storage plant room, and cooling tower plant room.



District cooling is an essential energy saving method in large commercial area. There always 7 days and 24 hours operation during a week. There is a system will optimize the chiller operate in 100% full load. To avoid wasting energy in light load, extra load will store in ice storage tank for later use.

It really gave a good opportunity for us to see the district cooling plant room because district cooling is a trend in future development to HVAC industry. It can not only be energy saving, but also can providing more room. But we still need to consider many issues before installing this large plant. It is because it may not save energy if the cooling load demand is low at normal time. It will consume more energy that we need. So, we have to think a optimize method to fully utilize the District Cooling System.



7.2 BCA Academy Zero Energy Building

Zero Energy Building is a building of Building and Construction Authority (BCA) in Singapore which adopted green building technologies. The technologies help to reduce the energy consumption without affecting the comfort and environmental qualities. The building is 60% more energy efficient than conventional buildings. The key energy efficient features include:

1. Energy Efficient Envelop

- Use of low-e glass and shading devices to reduce the thermal loading.

2. Lighting System

- Use of artificial lighting, energy efficient lamps and automatic switching via photo-sensors to reduce the electricity consumption.



3. Active Control and Management

- An advanced BMS is used to control, monitor and manage the equipments in the building. There is fast and flexible responses to the changing sociological environment, diverse and complex working demands.

4. Air-Conditioning System

- Advanced chillers, variable speed drives and personalized ventilation systems are used to reduce the power consumption.



5. Fully Powered by the Sun

- Photovoltaic system is used to convert solar energy to electricity and power for the appliances in the building.

In this visit we see lots of energy efficient technologies and application, our engineering fundamentals have further been developed.



7.3 Marina Barrage

Marina Barrage, a green icon in Singapore, has contemplated damming the mouth of the Marina Channel to create a freshwater reservoir since nearly two decades ago. The Marina Barrage was conferred the Superior Achievement Award : the highest honour of the competition for the best project entry at the [American Academy of Environmental Engineers](#) (AAEE) Annual Awards Luncheon held in Washington, DC, USA on 6 May 2009.

This S\$226 million project turns the Marina Bay and Kallang Basin into a new downtown freshwater marina reservoir. Role as Singapore's first reservoir in the city and 15th reservoir, it offers several benefits, including the water supply, flood control and lifestyle attractions for the whole Singapore.



For the prospective of water supply, Marina Reservoir will boost Singapore's water catchment from half to two-thirds of the country's land area by combining with new Punggol and Serangoon reservoirs. Besides imported water, NEWater and desalinated water, local catchment water is one of the Four National Taps. Therefore, Marina Reservoir will occupy more than 10% of Singapore's current water demand.



By the use of crest gates at the dam, the barrage can alleviate flooding in the low lying areas in the city, including Chinatown and Geylang during heavy rain. Moreover, it will not be influenced by tides, thus it is desirable to launch various types of recreational activities such as windsurfing, dragonboating etc.



7.4 New Water Plant

We had the golden opportunity to visit the NEWater Plant at the sixth day of our study tour. Singapore's first water masterplan was drawn up in 1972. However, the idea was shelved to await further technological advancement because of high cost and unreliability. In 1998, the necessary technology had matured and driven production costs down. In May 2000, the first NEWater plant was completed.

Nowadays, NEWater is used as a source of raw water to supplement Singapore's water supply. NEWater could be mixed and blended with reservoir water and then undergo conventional water treatment to produce drinking water. NEWater is currently being supplied to our industrial and commercial customers for use in manufacturing process, air-con cooling, process cooling, boilers etc in the 4 clusters.



8. CRC banquet dinner

After the ASHRAE Chapter Regional Conference and technical visit, there was a CRC banquet dinner. At that night, students from different chapters performed their own shows for entertainment after the greetings were introduced. In



the performance, Girls and Guys from Hong Kong chapter danced with pop songs and two students from Thailand chapter taught us how to perform their traditional dance and custom for good luck. Each Chapter had also prepared their traditional and wonderful performances. It was a great opportunity for us to exchange different cultures with each other. For the meal, different chapters had different cuisines in order to suit the appetite and taste of each person from different countries. After that, there was an exchange of souvenirs between each chapter. All Chapters also prepared some special, representative souvenirs. At last, group photos were taken for memorial.



9. Words from Delegates



“It is my first time to visit Singapore through this study tour. I have a good impression of Singapore. It is because I visited a lot of galleries such as HDB gallery, local transport gallery, and Singapore city gallery. I think Singapore city gallery is the best as it shows the whole Singapore with a big model. In addition, I have a good chance to meet lots of new friends especially the CRC banquet dinner. Some Malaysia and Taiwan students can become my friends. I think this study tour is a good experience.”

Chu Kin San (CityU)

“By joining the ASHRAE study tour, I visited the country which is similar to Hong Kong--Singapore. We had travelled several galleries which let me get the well known to Singapore and its culture. Besides, the technical visit had introduced the district cooling and the technology of renew water. For the district cooling, there were large chillers plants and the five stories height cooling towers. It really widens my horizons. Also, I am glad to meet students from other countries students by the CRC seminar and banquet dinner. And I am pleased to have the great time with my friends.”

Lai Sheung Yu, Moka (CityU)



“It is my first time to been Singapore and I never think I can get such a lot of precious moment during the 7-day trip. Time in Singapore is memorable and valuable. I have been many galleries, such as HDB, URA Centre’s Singapore City and LTA Land Transport. After visiting those galleries, I learned much about Singaporean culture and City’s life. Singapore is not only a modern and cosmopolitan city, but also a “Green” city. Environmental protection is always at high priority in urban planning. It is really appreciated.

Moreover, I made a lot of friends during the tour. In CRC Banquet Dinner, a number of 145 numbers of students from the Philippines, Malaysia, Taiwan, Thailand, Indonesia and Singapore join the dinner. They are very nice and friendly. I would like to express my sincere thanks to ASHRAE Singapore Chapter for their enthusiastic reception.

Hey friends, see you in Hong Kong next year! ”

Wong Sze Man, Mandy (CityU)

“It was my first time to join ASHRAE study tour; I learnt a lot of different kinds of building technology during the tour. All these knowledge will be useful in my future career. This study tour is a memorable journey in my life and I met a lot of people from different countries in the banquet dinner. It not only expands my social network, but also knows more about the cultures of different countries. Finally, I am happy that I can join this study tour and I really enjoy it. I would like to thank all the people to organize this study tour. See you all next year.”

Law Cheuk Hei, Terry (CityU)



“This is the first time that I joined the study tour held by ASHRAE. I am very happy that I can have a chance to join this tour as I can broaden my horizon. Singapore is really a well-developed country which included many good conditions for living.

I visited three Singapore’s government departments in this tour and attend the seminar about energy efficiency. Also, I went to Net Zero energy building and visit the Singapore District Cooling (SDC) Plant. I think it is a good experience to visit these places, because I can know more building services in different country.”

Mak Hoi Kit, Matthew (CityU)

“As a building engineering student, i noticed that energy saving is becoming much and much important in future building aspect. After this study tour, i saw a lot of technology, and energy efficient management which are improving the energy efficiency. Such as the visit to “Zero Energy Building”, where has lots of design and technology that inspire me a lot. I am sure the things that i saw there will help me to my finial year research project, and see whether those technology or management method is suitable in Hong Kong or not.

For improvement, i think that if those technical visits provide us a deeper view to those system or mechanism ,it could be better, because I think some visits only allow me to see things as same as other tourist can see in Singapore.”

Wong Chi Ho, Tommy (CityU)





“This study tour was an incredible and unforgettable tour for me. Through this seven-day tour, not only can I have fun in Singapore, but also gain lots of knowledge from the technical visit, especially the zero energy building, green building and district cooling technique. Moreover, I can have further understanding about the development of housing policy and water supply of Singapore in this study tour. This study tour not only can gain my knowledge, but also can broaden my horizon because I have made friends with those from Malaysia, Thailand, and Taiwan chapter and among our tour mates. We had a wonderful moment in the banquet dinner,

we performed our dance together which we had practiced for a long time. That was a fantastic tour that I ever had been. Last but not least, I would like to thank ASHRAE Hong Kong chapter for providing this valuable and worthy chance for us.”

Wong Chun Lam, Rick (CityU)

“I was so glad to go to this tour in this year. It is my first time to go to foreign country. I have learned that everything should be well prepared before any trip. One of the important parts is transportation. Especially for this tour, we had to travel by MRT and public bus. You will waste lot of time and money, if you don't prepare your transportation schedule. Moreover, it is the time management. Everyone have to follow the schedule set up before and do remember “everything should be on time”. Otherwise, it will bring a lot of trouble to others. Also, in this tour, I have met a lot of friends from other countries. They are so nice and active. We played games together and shared both cultures. Even though some of time, we have communication problem,

Wong Chung Yin, Eddie (CityU)



“This is the first time for me to take part in the Study Tour organized by ASHRAE. It is a valuable chance for a student like me to visit and learn about the culture and technology in Singapore. During the tour, I found that Singapore is quite similar to Hong Kong but with more regulations when compared to our city. The new water in Singapore impresses me a lot and it plays an important role as one-third of the land is for reserving water. It is excited for me to attend the conference, visit the large cooling tower and the ice storage system. I am glad to have this opportunity and hope other students would join us next year.”

Lam Ming Yan, Ceila (CityU)





“This was my second time to join ASHRAE study tour, I learned a lots and it was beyond my expectation. In this tour, I participated in technical seminar, company visit and building visits, and gained a lot of knowledge about HVAC design, Singapore infrastructure and also green building development.

Apart from gaining engineering knowledge, I also enjoyed this tour a lot. The most memorable part was the banquet dinner as all of us put the greatest effort in preparing our dancing performance and guests enjoyed

our show a lot. And I met many new friends from different chapters such as Malaysia, Singapore, Thailand and Philippines.

Before we went to Singapore, we co-operated and did a lot of preparation work, for example, booklet preparation, banner & T-shirt design. I had chances to communicate and co-operate with other buddies and I learnt a lot through the preparation work.

Lastly, I would like to express my sincere thanks to ASHRAE Hong Kong Chapter, ASHRAE Singapore Chapter, Dr. Sam Hui and all the delegates for giving me this unforgettable tour!”

Chan So Chun, Sue (HKU)

“This was my second time to participate in the ASHRAE study tour. It was valuable for me to visit a lot of places in Singapore that I may not have a chance to visit there if I just have a summer trip in Singapore, such as some galleries, the district cooling system in one building. The gallery can let me know more about the culture of Singapore. And the district cooling system is very powerful and I can learn more about the HVAC system. I also enjoy the Youth Olympics Games Closing Ceremony very much because their shows are very attractive and the atmosphere in there was extremely good.



Another important thing for me in this study tour is that I can meet more friends. There are different students coming from different Universities. Through this study tour, we can visit, play together and communicate with the students from other countries. Therefore, we can be very friendly in this tour. And I also enjoy and proud of ourselves about the performance in the banquet dinner although technical problem occurred. But we still had team spirit!

The free time of the study tour was also very good because we tried a lot of special food in Singapore. And the quality of the food and souvenir were high. And Singapore was very safe. I think that Singapore is similar to Hong Kong. To conclude, I like Singapore's environment and culture after this study tour. "

Chan Yuk Ting, LorLor (HKU)



"It is my first time to join ASHRAE study tour and visit to Singapore. This study tour is a memorable journey in my life. I learnt a lot from the technical visits and University visit. I made many new friends with students in other chapters. The academic and cultural exchange really widened my horizons. I would like to thanks Dr Sam Hui and trip members for the trip arrangement."

Wu Cheuk Bun, Benny (HKU)

"How time flies! 7 days tour had already passed away. But my soul still cannot leave Singapore. I miss the culture, people and food of Singapore.

This is already the third time for me to join the ASHRAE Study Tour. I keep on joining the ASHRAE Study Tour because I can really get a lot from the tour. Before the tour, we need to have a lot of preparation. I need to prepare for the booklet, souvenirs, performance, etc, therefore I can know more about Hong Kong during the preparation. It is also a training for me to learn how to coordinate and cooperate with each other.



One of the distinguishing features of our tour is the Chapter Regional Conference. This is also one of the factors which attract me to join the ASHRAE Study Tour. In the Conference, I can know more developments and technologies of my discipline. It is also a rare opportunity for me to join such grand conference. At night, we had a banquet dinner, the students of each Chapters had a performance to show their country's cultures to the others. All of them really got a great show. I saw the traditional, special performance of each country.

In this trip, I can make many new friends, not only from the other institutes but also from the other countries. It is a rare opportunity for me to know so many friends from different countries.

This is entirely a memorable study tour for me. In the trip, I gained lots of knowledge from the university visits, technical visits, etc. It provided many special experiences for us. I am glad that I have the chance to join this study tour. Finally, I would like to thanks ASHRAE Singapore Chapter, ASHRAE Hong Kong Chapter and Dr. Sam Hui to organize a great study tour for us.”

Li Shuk Wan, Iris (HKU)



“This study tour gave me an unforgettable experience and it was my first time to visit Singapore. Each chapter had to perform in the banquet dinner. Although there was a technical problem during our performance, most of the audiences enjoyed our show.

In this tour, I learnt technical knowledge from different technical visits such as the new water technique. Moreover, I realized more about the local culture from sightseeing and visiting different galleries and National University of Singapore (NUS). Furthermore, I was glad that I have met new friends from different southeast countries. They taught me some of their languages. It was a good chance for me to communicate with them.

Finally, I would like to thank ASHRAE Hong Kong Chapter, Dr. Sam Hui and all tour buddies involved to organize this valuable and memorable tour. ”

Ho Sze Wing, Cici (HKU)

“Thanks’ ASHRAE Hong Kong chapter.

Thanks Dr Hui .

First, I appreciated and glad to have a chance to join 2010 Singapore study tour.

I learnt a lot from this trip. As a freshman in the industry, this trip can explore the knowledge in HVAC. During this study week, the system and operation of BCA Academy Zero Energy Building gave me a deep impression.

However, it is not only to have the knowledge, but also I am more familiar with using different language in the same occasion.

I believe that learn from experience is always true.

And I found that Singapore is a green city. So maybe Hong Kong should make a big effort in this area such as plant more trees.”

Ho Hiu Ka, Natalie (IVE)



“Singapore ... My first time impression is basic on my textbook. When I am still primary student, I was told that Singapore is one of The Four Asia Tigers. After this study tour, I understand more than what textbook told me.

In fact, Singapore is quite a similar with Hong Kong. To history, both of them have been a The Britain colony before. To geographical environment, they lack of natural resource and land limited. On the other hand, Singapore has well greening on the city, unique transport system, and remarkable hygiene environment, which I hard to find in Hong Kong.

During these days in Singapore, we were not only taking coach for visiting, but also using their public transport (Buses, Taxi and MRT). These are good experience for all of us to understand more Singapore. Besides, we have visited different government department and companied, which can let us more realize what Building Services engineering is.

God make world in seven day and we also know more our strength and weakness in seven days. ”

Ng Hon Sum, Samuel (IVE)

“In the study tour of Singapore, I have learnt and widen my horizon on Building Services Engineering especially on the HVAC system. This is the first time for me to visit a district cooling system and it is a magnificent system that I have never expected. Besides, I am interested in the zero energy building in Singapore. The displacement system is used and each working space is supplied by fresh air individually. They seem to be a new trend for our future design and I am appreciated that I have gained such knowledge in this study tour.



Lam Kin Wai, Ray (PolyU)



“I am honor to join this study tour. I can meet people from other countries and communicate with them, so this trip broadened my view. Not only had I learned more local culture, but I was also cheerful to visit different characteristic of city. Singapore is a funny and charming place. I felt enjoyable in the atmosphere in Singapore.”

Lei Siu Man, Florence (PolyU)

“This is the second time that I joined ASHRAE study tour. I am very happy that I can join this tour because I know that the places are limited. It is good chance for me to broaden my horizon because Singapore is one of the “four little dragons” in Asia.

I visited three Singapore’s government departments in this tour. It can let us know more about the policy and the future development in Singapore.

For the CRC activities, we attend the seminar about energy efficiency. After the seminar, we went to Net Zero energy building. “Net Zero” is a hot topic in our industry nowadays. At first, I can’t believe that “net zero” can work in reality. After visiting this building, I think it is work if we have a good design and sufficient money.



I am interested in District cooling. So, It is a good chance for me to visit the Singapore District Cooling (SDC) Plant. For this Design, the designer have to make sure the chiller are operate in 100% full load. Also, they installed a thermal storage plant for storing excess cooling energy. I really hope that I can see the big district cooling plant in Hong Kong in the future.

Last but not least, I really want to thank ASHRAE, ASHRAE-Hong Kong Chapter, ASHRAE-Singapore Chapter and all sponsors from different organizations from the bottom of my heart. I can't join this wonderful study tour without your help. "

Chow Chi Fung, Taylor (PolyU)

"I am pleased that I can join the ASHRAE study tour 2010. It really expands my horizon & knowledge in building services. Singapore is a city which is similar to Hong Kong. It is just like a mixture of Hong Kong and China. We can find people who can speak Putonghua everywhere!

As Singapore is a competitor of Hong Kong in many aspects, this is a good chance for us to know more about this city. In this seven days tour, we've visit several Singapore government departments and buildings which adopted new building technology. One of those is the Zero Energy Building, it adopted the green building technologies. The technologies help to reduce the energy consumption without affecting the comfort and environmental qualities. Energy saving is the main trend in engineering design, I hope that in my future career I can make use of what I learn in this trip."

Tong Ho Yin, Donald (PolyU)





“In this summer, it is a pleasure for me to join this 7-Day study tour with 23 colleagues from different universities and institute. This tour widens my scope on the building technology to the world, also to understand why people always compare Singapore and Hong Kong.

Regard as a competitor of Hong Kong, Singapore government’ policies are not only economic orientated, but also maintain a good living environment to citizens.

Through several visits including NEWater Housing & Development Board (HDB) gallery, Land Transport Authority (LTA) gallery Visitor Centre and Marina Barrage etc., I discover her strategy on the future development of housing and transport are more mature and well planed than Hong Kong, especially the protection of their environment and heritage. I think Hong Kong government should pay more efforts and consult more.

On the whole, I gain valuable experience and make friends from different universities and countries. I hope to visit Singapore in the future.”

Wong Yee Ting, Bonnie (PolyU)

“Singapore, a nation that I have never paid a visit to till this summer, inspires me a lot.” I can say this without hesitation after the 7-day trip. Looking back to the first day of the study tour, I think this former British colony is nothing more than another Hong Kong, not only because of her history, culture, but also her city view, as well as way of living. I could not convince myself that I am not in Hong Kong until the third day of the trip. After visiting HDB, the housing department of Singapore, on the second day, it gave me a clear view on her housing policy that over 80% of its citizens consider public housing as their home. On the following day, when I took a bus within the boundary, I found that the public housing is much better than those in Hong Kong, ranging from its facilities, to the environment.



Apart from that, we also made some technical visit to the city cooling system, and New Water Plant, that are able to widen my horizons, as these are systems that are hardly found in my home of Hong Kong.

Additionally, there was a banquet dinner during the tour, providing me with a rare opportunity to befriend with those from overseas, and I have taken advantage of the study tour to reinforce my knowledge. Finally, I would like to express my thankfulness to ASHRAE Singapore and Hong Kong Chapter, and others that have made contributions to the tour.”

Ho TszHo, Willy (UST)

“This study tour was a special and valuable lecture for us to have a look on Singapore’s technologies on HVAC&R technologies. In this 7-day-tour, we visited lots of government departments and buildings like Housing & Development Board, Land Transport Authority and Building & Construction Authority. The most impressed event was the visit to Zero Energy Building of BCA. It taught us how to make good use of renewable energy and increase the efficiency of energy saving. They also introduced the design of systems in the building, which made us know more about the working principle of this green building and the importance of energy saving. I believe that we all have gained lots of experience after the study tour.

Finally, I would like to have a special thanks to our advisor Dr. Sam Hui for offering us this valuable and unforgettable study tour.”

So Pak Hei, Billy (UST)



7. Photo Gallery









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