Capital Communiqué

2013-2014 October Edition

ASHRAE Ottawa Valley Chapter

DATE: **Tuesday October 15, 2013**
(Social: 17:30,Dinner:18:30,Program: 20:00)
Algonquin College Restaurant International
1385 Woodrofee Ave, Building H, Room H100

THEME: YEA (Young Engineers in ASHRAE)

PROGRAM: **Precision A/C design - Optimizing the reliability and efficiency of POD cooling**

SPEAKER BIO: **Mr. Jason Koo, P.Eng.**
Senior Technical Sales Engineer (Stulz Air Technology Inc.)

Jason Koo is the Senior Technical Sales Engineer of Stulz Air Technology, Inc., a manufacturer that is dedicated to providing innovative solutions to critical environmental control needs. Jason joined Stulz-ATS in September 2008, managing accounts throughout the United States and actively promoting greener solutions to our industries. As a 31-year veteran in the HVAC industry, Jason has spent the past decade focusing primarily on mission critical cooling applications. He holds a Bachelor Degree of Engineering Science from the University of Western Ontario in London, Ontario and is a member of ASHRAE and Chartered Institution of Building Services Engineers (CIBSE), UK.

OVERVIEW:

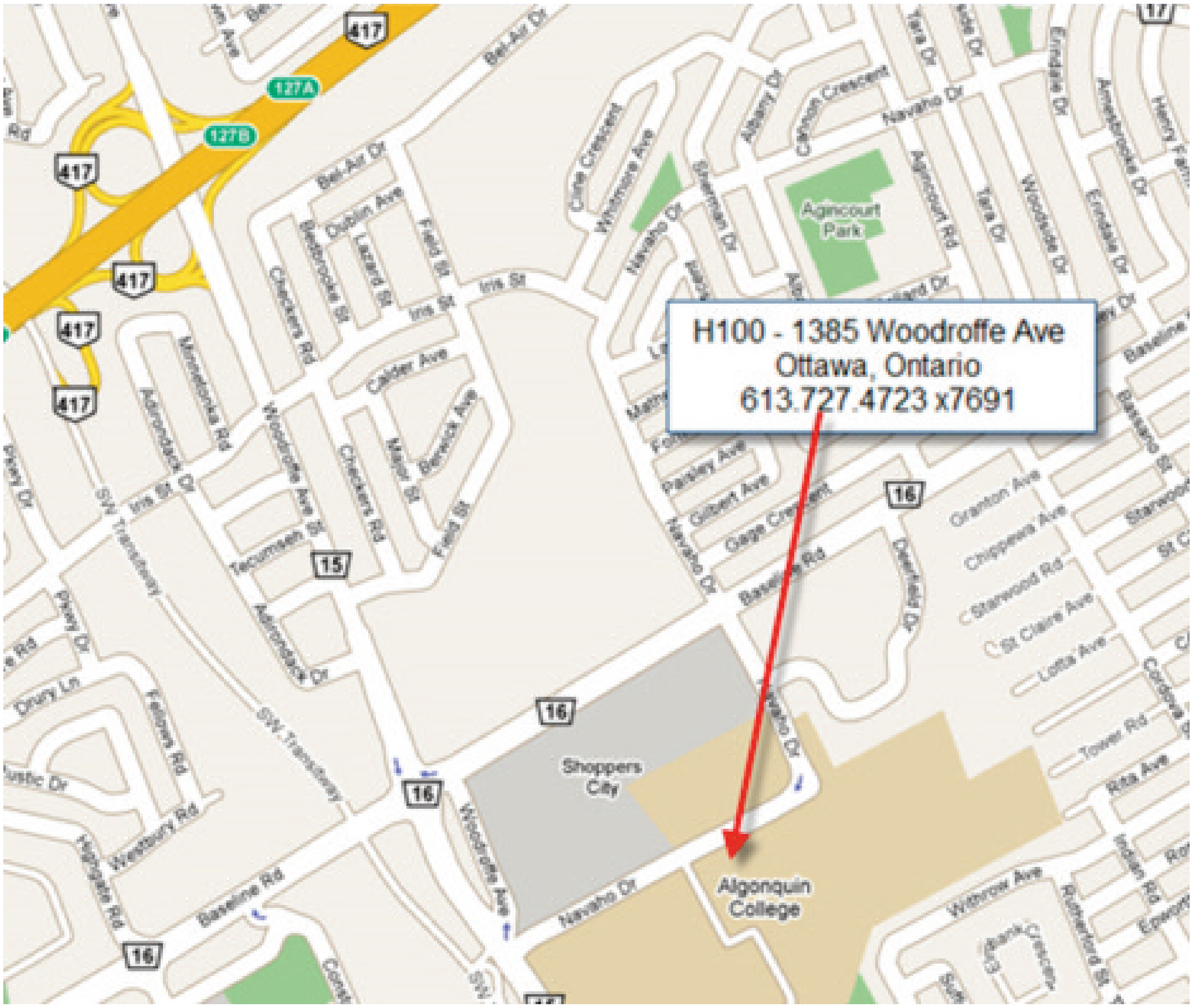
The speaker will discuss precision cooling equipment and design applications. Topics will include row and perimeter cooling equipment for POD applications and enhancing the reliability and efficiency of cooling equipment. Discussion to include the following relevant ASHRAE standards:
ASHRAE TC9.9: benefits of increased return air temperatures
ASHRAE 90.1: benefits of air and water side economizers; latest warm water cooling technologies

October Meeting Menu
Menu - To be Announced
Restaurant International is happy to accommodate ANY dietary needs with one week's notice.
Please get in touch with Sandy Taylor.
sandy@ashrae.ottawa.on.ca

Chapter Members: $40.00 Guests: $60.00
Student Members: $30.00 Life or Fellow: $40.00
Space is limited so please register online at:
https://ashraeottawa.simplesignup.ca/en/81/index.php?m=eventSummary

New Meeting Location

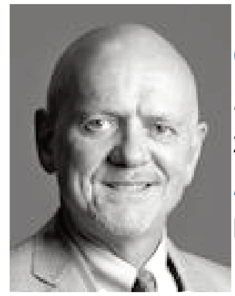
Restaurant International at Algonquin College, Woodroffe Campus



There are about 40 free parking spaces right outside the building, Pay and Display directly across the street, and free parking in Shoppers City on the north side of Navaho Drive.

We look forward to seeing you there!

President's Message



President & CRC Delegate

Roderic Potter

2013-2014 OVC President

Rodders CAS

E-mail: *rod@rodders.com*

My good friend Adam Moons is continuing this year as Membership Promotion Chair and as part of his duties, he plans to visit selected companies providing **ASHRAE** Lunch & Learn sessions. He has told me that one question he is often asked is *"Why would I get involved with ASHRAE Ottawa Valley Chapter?"* - a sort of *"What's in it for me?"* phrase. This of course is a very good question, particularly when it is tabled by new aspiring engineers who think they have enough on their plate already without thinking about **ASHRAE** meetings. *"I work seemingly all hours under the sun as it is and frankly at the end of the day I am just too tired to get involved"*.

I guess there are two things to discuss here: (a) simply attending the meetings; and (b) actually volunteering your time to help out the chapter. It is fairly obvious that you can benefit greatly from attending the meetings because they are (usually) very informative on a technical level, and the socializing/networking that ensues is always fun. Assuming that you don't stand at the back being shy. I can remember years ago when I first started taking an interest - somewhere in the mid 90's when Lan Chi was a greeter - there was sort of a cliquey atmosphere to meetings. This was probably because I did not know many of the attendees, and of course demonstrates the importance of friendly greeters at our meeting doors. Now I know most of the people who show up and they are a fine bunch I say!

One of my passions is watching movies and I usually watch them at home, on a vulgar big screen that dominates my living room wall. And they are usually accompanied by rock concert level audio spewing out of Tannoy speakers. Most of us seem to have a good life in this age of entitlement - we tend to have everything we need and most of what we want. I recognize that this is because Ottawa has given me a living; its relative opulence and high standard of living is something for all of us to hold dear (Google the economy of Detroit as a comparison). So why am I saying this? My lifestyle is not down to just hard work on my part - it is down to our local economy. Which brings me back to volunteering for **ASHRAE** OVC: it is the ideal portal for giving back to my community and hopefully helping out recent graduates and new members.

This argument is more relevant to members of my age because I have had a successful career here since 1987 when I started out (in Canada) with Goodkey Weedmark & Associates. I cannot think of anyone who has given more in the past to **ASHRAE OVC** than **George Carscallen** (now retired) - because his attitude emulated John F. Kennedy's inaugural speech: *"Ask not what ASHRAE can do for me; ask what I can do for ASHRAE OVC"*.

This is why I make the effort - and we all hope you will try to do the same.

What You Missed September Meeting

Secretary

Abbey Saunders

2013-2014 OVC Secretary

NRC-CNRC

E-mail: *abbey.saunders@nrc-cnrc.gc.ca*

The September meeting took place at the Mill Street Brew Pub. The meeting was called to order by **President Rod Potter** at 6:30pm and attendees were seated for dinner.

The business session commenced with **President Rod Potter** introducing the Board of Governors and Executive followed by **Georges Maamari** introducing the evening guests. **Chris Fudge** briefly discussed the earlier technical session which was well attended. Next **Adam Moons** introduced new members who recently joined the chapter:

- **Mr. Alexandre Gaboury**
- **Mr. Mark Pasini**
- **Mr. Les Mack**
- **Mr. Brendan Myers**
- **Mr. Ben Griffin**
- **Mr. Alan Wylie Jr**
- **Mr. Scott Macdonald**
- **Mr. Michel Larouche**
- **Mr. Christopher Kirney**
- **Mr. Jean-Pierre Tardiff**
- **Mr. Danial O'Connor**

Steve Moons then informed everyone the **ASHRAE** Stroke Play Golf Tournament was postpone due to poor weather conditions, but participants should hear in the near future about rescheduling.

Don Weekes then introduced the members of the Research Promotion Committee and dedicated this year's Research Promotion Campaign in Memory of Paul Baker. During social hour the research committee ran beer pong and an **ASHRAE** Research 50/50 Draw. All who participated enjoyed the beer pong, and **Colin Berry** was the winner of the ASHRAE Research 50/50 Draw, winning $125.

Following the business session, attendees made dinner selections from a 3-course à la carte menu which featured a main entrée of either chicken, beef or fish and a house specialty dessert. Dinner was served in a timely manner and well received by attendees.

After dinner, the main program event took place, speaker **Guy Newsham's** presentation topic was an NRC (National Research Council) study about occupant's experience of green buildings. The NRC conducted a post-occupancy evaluation of 12 green and 12 conventional office buildings scattered throughout Canada and the northern US. Occupants completed a detailed online questionnaire, the research group conducted on-site physical measurements, interviewed building personnel and reviewed existing literature as part of the study. The results of the study, along with a re-analysis of energy usage data for 100 LEED-certified commercial and industrial facilities were presented. The general goal of the study was to determine if green buildings are as green as we think they are. The simple answer is yes, but…

The literature review portion of the study found that in general green buildings are perceived to have improved indoor air quality, similar lighting characteristics and worse acoustics than conventional buildings.

For the online questionnaire component of the study, in addition to the previously identified parameters from the literature review, namely indoor air quality, lighting and acoustics, the following parameters were part of the occupant questionnaire: job satisfaction, health, organizational productivity, thermal comfort, sleep at night, and environmental attitudes.

Using the Wilcoxon Method to analyze the data obtained from the questionnaires it became apparent that for overall environmental satisfaction the green buildings outperformed the conventional buildings. The overall parameter analysis resulted in green buildings scoring more highly than conventional buildings in the following categories: overall environmental satisfaction, satisfaction with ventilation and temperature, noise from HVAC equipment, workplace image, positive mood, visual and physical discomfort and sleep quality at night.

On-site measurements conducted at the facilities included measurements of temperature, humidity, air speed, airborne particular matter, VOCs and noise at both seated and standing heights. Very few differences in the measurement data obtained for the green and conventional buildings were established. Green buildings performed slightly better with lower air speeds and fewer airborne particular matter present. However, the green building performed worse for acoustics, in particular speech privacy.

Based on the findings of the NRC study it become apparent to the researchers that there are certain parameters that lead to good buildings, in terms of occupant comfort, regardless of whether they are green or not. The study identified these parameters as: improved speech privacy, higher lighting levels, more access to windows, lower number of airborne particulate matter and better thermal comfort.

The re-analysis of previously LEED-certified buildings results indicated on average the LEED-certified buildings used 25% less energy than their conventional counterparts. However, about 1/3 of the buildings used more energy. The analysis also revealed that there was no strong correlation between obtaining higher energy credits from the ranking system (LEED in this case) and the actual energy savings realized.

To summarize the study results indicated on average green buildings have superior performance over conventional buildings, as well as lower energy use. In addition, the study also allowed researchers to acquire more knowledge about key physical features of green buildings that affect the occupants.

Following the presentation, **President Rod Potter** thanks **Mr. Guy Newsham** for his presentation, and the meeting was adjourned at approximately 8:50pm.

News Update

Governor

Daniel Redmond

2013-2014 Chapter Technology Transfer Chair

MMM Group

E-mail:

RedmondDan@mmm.ca

ASHRAE/IES PUBLISH FIRST STANDARD FOCUSED ON COMMISSIONING PROCESS

ATLANTA – A newly published standard focused on the commissioning process will help ensure a fully functional, fine-tuned facility.

ANSI/ASHRAE/IES Standard 202, Commissioning Process for Buildings and Systems, identifies the minimum acceptable commissioning process for buildings and systems as described in **ASHRAE**'s Guideline 0-2005, The Commissioning Process. Standard 202 is **ASHRAE**'s first standard focused on the commissioning process. The commissioning process as detailed in Standard 202 applies to all construction projects and systems and is an industry consensus document.

"*Given the integration and interdependency of facility systems, a performance deficiency in one system can result in less than optimal performance by other systems*" Gerald Kettler, P.E., chair of the committee that wrote the standard, said. "*Implementing the Commissioning Process is intended to reduce the project capital cost through the warranty period and also reduce the life-cycle cost of the facility. Using this integrated process results in a fully functional, fine-tuned facility, with complete documentation of its systems and assemblies and trained operations and maintenance personnel.*"

The commissioning process assumes that owners, programmers, designers, contractors and operations and maintenance entities are fully accountable for the quality of their work. The process begins at project inception and continues for the life of a facility.

The process includes specific tasks to be conducted to verify that design, construction, verification, testing, documentation and training meet the owner's project requirements, according to Kettler.

The standard defines the commissioning process through 13 functional steps; each of which contains deliverables. The commissioning activities and deliverable are as follows:

- Initiate the Commissioning Process, including defining roles and responsibilities
- Define the project requirements, which results in the Owner's Project Requirements (OPR) doc ument
- Develop commissioning plan – produces a written Commission ing Process Plan
- Plan design approach to Owners Project Requirements – defines the basis of design
- Set contractor commissioning re quirement, which are included in the commissioning specifications
- Design review by the commission ing authority provides feedback and a design review report
- Submittals review verifies compli ance with the OPR in a submittal review report
- Observation & Testing verifies system performance with results documented in construction checklists and reports
- Issues resolution coordination is done with an issues and resolu tion log
- Systems manual assembly results in a systems manual for building operation
- Conduct training for building op erations with training plans and records
- Post occupancy operation com missioning provides an end of warranty commissioning report
- Assembly of a commissioning re port captures all the project com missioning documentation

Other commissioning guidance from ASHRAE includes Guideline 0-2005, The Commissioning Process; Guideline 1.1-2007, HVAC&R Technical Requirements for the Commissioning Process; and Guideline 1.5-2012, The Commissioning Process for Smoke Control Systems.

ASHRAE also is working on several other guidelines related to commissioning: Guideline 0.2P, The Commissioning Process for Existing Systems and Assemblies; Guideline 1.2P, The Commissioning Process for Existing HVAC&R Systems; Guideline 1.3P, Building Operation and Maintenance Training for the HVAC&R Commissioning Process; and Guideline 1.4P, Procedures for Preparing Facility Systems Manuals.

The cost of ANSI/ASHRAE/IES Standard 202-2013, Commissioning Process for Buildings and Systems, is $72 ($61, **ASHRAE** members). To order, contact **ASHRAE** Customer Contact Center at 1-800-527-4723 (United States and Canada) or 404-636-8400 (worldwide), fax 678-539-2129, or visit www.ashrae.org/bookstore.

ASHRAE/IBPSA-USA BUILDING SIMULATION CONFERENCE ANNOUNCED

ATLANTA – **ASHRAE** and IBPSA-USA have announced a joint conference that merges the IBPSA-USA SimBuild and **ASHRAE** Energy Modeling Conferences.

The joint conference, entitled **2014 ASHRAE/IBPSA-USA Building Simulation Conference**, Sept. 10-12, 2014, Atlanta, Ga., currently has a call for papers.

"*This conference is a first for the industry, and we're excited about the benefits it can bring to the building energy analysis and performance simulation community*" Dennis Knight, Conference chair, said. The conference seeks to improve the industry's ability to accurately model building performance.

Modelers, software developers, owners and researchers will address the practices of energy modeling and building performance simulation using existing simulation tools, software development, and future simulation research and applications.

The conference is focusing on "*BIM, BEM and SIM – Integrated Building Design and Modeling*" addressing building information modeling, building energy modeling and building simulation.

"*The most pressing need facing modelers is transferring data between tools, and this conference seeks to provide answers through the conference content and by bringing together practitioners, software developers and the research community*" Knight said.

Currently, organizers are seeking papers on topics addressing the integration and interoperability of analytic modeling tools (BEM and SIM) with physical modeling tools (BIM). In addition, papers are sought describing workarounds, case studies, how to's, challenges, barriers and cloud based solutions.

Topics include:

- Energy efficiency
- HVAC component modeling
- Urban scale modeling
- HVAC load analysis
- Lighting and daylighting
- Computational fluid dynamics
- Data exchange and interoperability
- Energy auditing
- Life cycle cost and economic analysis
- Model calibration and validation
- Combined use of multiple tools
- Co-simulation
- Optimization
- Model and algorithm advances
- Moisture
- Weather data

Abstracts (400 or less words in length) are due Nov. 4, 2013. If accepted, papers are due March 3, 2014. The conference papers will be a maximum of 8 pages in length.

To submit an abstract or for more information, visit www.ashrae.org/simulation2014.

A call for presenters will be announced after the call for papers closes. Invited speakers and keynote speakers will be announced.

The conference will cover two-and-a half days and will be preceded by two days of training seminars and short courses.

"*The goal of the conference is help make better decisions through the application of simulation and modeling over the entire building life cycle from the earliest concept through operation and maintenance*" Knight said.

ASHRAE, founded in 1894, is a building technology society with more than **50,000** members worldwide. The Society and its members focus on building systems, energy efficiency, indoor air quality, refrigeration and sustainability. Through research, standards writing, publishing, certification and continuing education, **ASHRAE** shapes tomorrow's built environment today. More information can be found at www.ashrae.org/news.

IBPSA-USA is the United States regional affiliate of the International Building Performance Simulation Association (IBPSA). The mission of IBPSA-USA is to advance and promote the science of building simulation in order to improve the design, construction, operation, and maintenance of new and existing buildings in the United States.

Research Promotion

Past President

Donald Weekes

2013-2014 Chapter Research Promotion Chair

InAIR Environmental Ltd.

E-mail: *don.weekes@inairenvironmental.ca*

Hi, Everyone!

It was great to see everyone at the September chapter meeting, especially those of you who participated in the beer glass pong for **ASHRAE** research promotion. We raised **$125.00 for RP!** Thanks to **Cathy Godin** and **Christine Kemp** for organizing the game, and for collecting the money. Also thanks to our Chapter President, **Rod Potter**, who bought three of the 60th anniversary glasses and donated the money to **ASHRAE** RP. Thanks, Rod!

At the September, 2013 Chapter meeting at the Mill Street Pub, the theme was research, and I discussed briefly the events that the RP team (**Steve Moons**, **Cathy Godin**, **Christine Kemp**, **Bob Kilpatrick** and **Mike Swayne**) are planning for this year. First we are looking for donations of hockey tickets for the monthly raffles starting in October. Please contact myself or one of the RP Team members if you are able to donate a pair of hockey tickets.

On September 20th and 21st, **Steve Moons** (Vice Chair of RP) and I attended the centralized training for research promotion in Chicago. We both learned a lot about **ASHRAE** resource promotion, the 'new' name for RP. There are five funds that the monies we raise support: Research; Education (**ASHRAE** Learning Institute; **ASHRAE** Foundation (research endowed funds); the General Fund; and **ASHRAE** Scholarships. Each of these funds play a vital role in our society, and our funds help to advance the funds for the future of our members. Also, please remember that the monies we raise go to **ASHRAE** Research Canada, so that all of the money will be spent here in Canada.

We will be planning other fun events, such as a scotch tasting, a wine tasting and a night at a pub with a live band. Please check out our monthly blog on the **ASHRAE OVC** website as well as the monthly articles in the Communique.

ASHRAE OVC Online Biography Update

President-Elect

Steve Moons

2013-2014 President-Elect & PAOE Committee Chair

Total HVAC

E-mail: *Stevem@totalhvac.com*

One of the roles of the executive is to review our local members and nominate those that are qualified for certain chapter, regional and society awards. Many of these are reflective of the years of dedicated service that many of you have given to our chapter and **ASHRAE** as a whole. However, we are unable to nominate people if we cannot provide the documentation showing what they have done for **ASHRAE** throughout their career.

To that end, I'm putting out a call for all of you to sign on at the main **ASHRAE** society web page and update your member biography and profile. It is this information that will assist us in ensuring we can give you the recognition you deserve for your efforts in making **ASHRAE** a success. Please take a few minutes in the next week to sign on and update your profile. If anyone has any questions about this process, they are welcome to contact me. Thanks very much.

ASHRAE OVC 2013-2014 Financial Update

We have finished reviewing the 2012-13 financial year. A basic P&L below for the various areas of the chapter will follow in the next communiqué. We had a successful year, surpassing our profit goal, thanks in large part to a very successful CRC in the summer of 2012. If you have any questions about what you see here, please don't hesitate to contact me directly. Thanks very much.

President-Elect

Steve Moons

2013-2014 President-Elect & PAOE Committee Chair

Total HVAC

E-mail: *Stevem@totalhvac.com*

Student Activities

Plans for October include visits to students at Algonquin College, Carleton Univeristy and Ottawa University to promote attendance at chapter meetings and to get the student chapters up and running for the new school year.

Also the week of October 18 to 27th is National Science and Technology Week. There are a number of different science and engineering activities happening at the Science and Technology Museum and NRC.

If you have any questions, or would like to help in any of this year's activities please don't hesitate to contact us.

Check This Out:

ASHRAE Student Zone: Scholarships and Grants to Careers and Internships...
http://www.ashrae.org/students/

ASHRAE Scholarship Program
http://www.ashrae.org/students/page/1271

ASHRAE Smart Start Program (20-50-50) – Student members can pay student prices after graduating!
http://www.ashrae.org/students/page/703

Committee Co-Chair

Adrianne Mitani

2013-2014 Student Activities Committee Co-Chair

Smith + Anderson

E-mail:*Adrianne.Mitani@smithandandersen.com*

Committee Co-Chair

Richard Cameron

2013-2014 Student Activities Committee Co-Chair & Publications Committee Chair

Goodkey Weedmark

E-mail: *r.cameron@gwal.com*

Green Job Fair - Carleton University

Robin McLaughlin, Events Coordinator at Co-op and Career Services at Carleton University is currently working on a Green Jobs Fair to take place on October 24, 2013 on campus. He and his group are very excited about this new initiative, and plan to have it take place in the Minto Centre (Engineering Building). He is currently working on finding employers to participate in the event.

There is a fee to participate, but it is small and if it becomes a barrier he would be happy to discuss that with the employer. Carleton has launched its official strategic plan "Sustainable Communities, Global Prosperity" and has added a number of degree programs that specifically prepare students for careers in environmentally sustainable areas.

President & CRC Delegate

Roderic Potter

2013-2014 OVC President

Rodders CAS

E-mail: *rod@rodders.com*

You can learn more about the fair here -
http://www5.carleton.ca/cc/green-jobs-fair/

ASHRAE Special Events

ASHRAE OVC Stroke Play Tournament Wrap-up

The **ASHRAE OVC** stroke play golf tournament was held again this year at The Canadian Golf & Country Club. The original date of the tournament was rained out, so the tournament proceeded on the make-up date of Sept. 30th. Congratulations again go to Marc Parent with Longhill Energy, who repeated as champion with the same score as last year, shooting a 78 on recently punched greens. The tournament will go ahead next year, with an eye towards a Friday date to facilitate participation. See you all next year.

ASHRAE OVC 2013 Bowling Social

Ladies and Gentlemen,

You are cordially invited to participate in the 2013 **ASHRAE** Bowling Social, to be held on Tuesday, November 12th, 2013 at the Merivale Bowling Center (1916 Merivale Rd., Ottawa, www.merivalebowlingcentre.com). The format will be three games with 4 people per lane. 7:00 pm start. Please show up at 6:30 to register. The entry fee is $175 per foursome, or $50 per individual. The entry fee includes warm-up, 3 games, shoe rental and plenty of nachos/wings/pizza. Individual participants will be assigned into groups of four.

President-Elect

Steve Moons

2013-2014 President-Elect & PAOE Committee Chair

Total HVAC

E-mail: *Stevem@totalhvac.com*

This is intended to be a social event to promote the camaraderie and fellowship of **ASHRAE**, please consider attending. Numbers need to be finalized by the first week of November, so please register early. Registration can be done on-line via the link below. Registrations will be confirmed via email receipt. If you have any questions, or need more information, please don't hesitate to contact me.

Payment can be made during the online registration.

Registration Link:
https://ashraeottawa.simplesignup.ca/en/148/index.php?m=eventSummary

Canadian Fire Alarm Association 2013 National Capital Region Technical Seminar

The Canadian Fire Alarm Association is pleased to announce their 2013 National Capital Region Technical Seminar. Plan to attend the conference and increase your knowledge through presentations on technical topics, codes and practices in Ontario.

Topics include:
- Intelligibility and what we have Learned in the Field
- Mobile Applications for Life Safety
- Integrated Systems Testing of Fire Protection and Life Safety Systems and Fire Protection System Commissioning
- Nuisance Alarm History and the Ottawa Fire Services' Requirements when an Order is Issued.
- Ancillary Devices and Connections to Fire Alarm Systems
- When a Building Permit is and is not required for Life Safety Projects
- Fault Isolators and Strobe Design for Compliance with ULC-S524
- Electrified Hardware, Magnetic Locks and Other Controlled Exit Devices.

The speakers are leaders in the fire alarm industry. Their backgrounds include fire alarm system manufacturers, consultants specializing in fire protection and life safety systems and inspecting authorities. Several are also members of many of the committees responsible for standards that govern the design, installation and testing of Fire Alarm and other Life Safety Systems.

The Seminar takes place Wednesday, October 30, 2013, 8:00am to 4:30 pm at Carleton University. For more information please contact the CFAA 1-800-529-0552 or email admin@cfaa.ca.

Online registration and more information, including session details and speaker biographies, is available at www.cfaa.ca/EducationSeminars.aspx.

Don't miss out, register today!

President-Elect
Steve Moons
2013-2014 President-Elect & PAOE Committee Chair
Total HVAC

Advertising

Advertising career opportunities on the **ASHRAE** Ottawa Valley website makes good business sense. We offer a unique way to reach technical professionals and make your ad dollars work hard for you.

E-mail: *Stevem@totalhvac.com*

To discuss your needs, contact one of our chapter officers, via our "This Year" page. Increase the impact of your advertising through the **ASHRAE** Ottawa Valley website today.

Rates for career opportunities ads are as follows:
Chapter Member: $50/month
Non-member: $250/month

Placement of an Ad

We suggest that you complete and submit our advertisement form to speed up the processing of your request. If you have provided your e-mail address, a confirmation receipt e-mail will be sent to you for reference.

Please note that ads require prepayment made to the treasurer. For payment and other information contact **Steve Moons** at stevem@totalhvac.com.

The ads will appear on the website until the end date for publication provided in the submitted form. To extend the ad, please resubmit the form with the new publication dates and the required prepayment amounts.

Rod Lancefield
2013-2014 Publicity Committee Co-Chair
HTS Engineering Ltd.
E-mail: *rodl@htseng.com*

Business Card Ads

You can support your chapter and promote your business by placing your business card in the Capital Communiqué. It will also appear on the chapter website.

The cost is $225.00 for the year. Please contact Rod Lancefield at rodl@htseng.com for more details.

The following is a supplemental article provided by John Hammond PE. The views expressed in this article are entirely those of John Hammond and do not represent the views of ASHRAE Ottawa Valley Chapter or Society. John lives in Laguna Hills, California, and he has over 40 years of experience in the mechanical engineering field.

Prepared by John Hammond PE, MCIBSE & C Eng.

Sizing Heating systems for early morning Pickup capacity and Night Setback

This article hopes to assist HVAC Designers by providing them with more information regarding sizing the heat exchangers or furnaces for the Pickup load and Setback within different types of buildings and different areas of the same building (cool perimeter and warmer central core areas).

Arguably the most important calculation on any HVAC (Heating, Ventilation and Air Conditioning) design is the Winter **Heating** system capability and in particular the **Extra heat** required for the **early morning Pickup capacity** after a night or weekend Setback of at least 8.3C (15F), which is now required by many USA City Codes. The United Kingdom=s CIBSE (Chartered Institution of Building Service Engineers) shows, using a formula in their 2005 Guide AA@, that a well insulated 450 sm single floor building requires **79% <u>Extra</u> Pickup load** (instead of the typical 10% often allowed) based on a three hour Pickup time, 8 hours occupied and 7 day week usage period. The reason this is a larger number than most expect is that over the last fifty years AR@ (resistance) values have increased four to eightfold and the converse with the AU@ (transmission), reducing the total heat loss to between a **quarter** to **eighth**. Therefore, fifty year old Pickup allowances of 10% to 20% should increase accordingly to between about 40% and 150%, which makes the 79% Extra **percentage** Pickup load seem more reasonable.

Equally important is that many heating coils (for instance in air handling units) may be undersized. This is possibly due to it being sized for the AMixed Air@ A**On**@ temperature of perhaps 12.5^{oC} and warmed to an AOff@ temperature of perhaps 29.5^{oC}. Instead it should be sized for the **Pickup load condition**, (outdoor forced air damper closed) which would eventually (as the building temperature recovers) have a supply air AOn@ temperature of **21^{oC} and AOff temperature of 38^{oC}**. The higher Supply Air temperature of 38^{oC} includes the <u>Extra</u> 79% (29.5^{oC} to 38^{oC}) Pickup heating load required to warm the building structure. While **the AActual heat Quantity@ of these two heating loads,** in this example, **may be the same**, the **heat transfer Surface AREA** of the Coils is NOT. The **Mixed Air temperature conditions** produce a heater with **much less Surface Area** than that required for the **Pickup heating** condition, due to the difference in **LMTD** (log mean temperature difference) between the hot Water and Air for the two conditions**.** Consequently, the smaller surface area of the AMixed Air@ heating coil will NOT be able to warm the building sufficiently during the Pickup period. This under-sizing of the heating coils makes it seem that the boiler is too large, because it is not being fully used. The problem however is likely to be the **undersized heating coil** and not the over-sizing of the boiler, which is usually correctly sized but cannot be fully utilized.

Another problem sometimes encountered is too low a **Winter air flow** on VAV (variable air volume) systems derating the heat output from the heating coil. The derating may occur due to the high limit safety thermostat or high limit control in the control valve loop) in many coils switching the heater off when the temperature exceeds the setting of only $46^{oC.}$ This cycles the coil heating on and off, often reducing the heat output to less than half. Another problem encountered at low air flow is that the air rises to a higher temperature, reducing the heat output due to a much smaller LMTD. Therefore, the VAV unit and its controls must be designed and then operated to maintain **sufficient Air Flow** during this Pickup period so that the leaving air temperature is **not allowed above 38^{oC}** by increasing air flow until that temperature is reached**.** This is best achieved by installing a temperature sensor in the VAV unit and increasing the air flow until the supply air temperature reaches a maximum of 38^{oC}. Alternatively, the flow sensors in the VAV units can stop the Air Flow going below approximately **10** lps/m^2 for the perimeter building area and about **5** lps/m^2 in the warmer central areas during the heating Pickup period but this requires programming of floor areas into the control systems related to each area served. Note a typical classroom standalone roof mounted AHU has a flow rate of 12 lps/m^2. The above figures are good rule of thumb numbers but the temperature sensor method is a more practical and fool proof approach. This lack of Air Flow and derating of the heating coils again makes the boiler plant seem oversized, because it is not being fully utilized, whereas the lack of Air flow is often the problem and needs reprogramming correctly to keep the air flow high enough during the Pickup times. Pickup and warming of the building structure continues even after the building is occupied and maintaining minimum heating mode air flows should continue for at least three hours after occupancy begins.

The hot supply air ducts, when new, leak 6% (Code tested to achieve 6%) and degrade to more than10% leaks with time plus the hot air ducts lose at least 2% heat which just warms the structure area above the false ceilings. All this is wasted heat but is accommodated in the calculations for determining the Pickup load and shown later in this article. However, we suggest **adding 8%** to the theoretical cool air **fan volume** to allow the calculated right amount of cool air to reach the required conditioned areas. Unfortunately, the extra 8% is required, but cools the false ceiling areas and that may help the conditioned rooms a little.

ASHRAE admits they have little information for establishing the Pickup load required to match an individual building construction, although they recommended 40% Extra Pickup load for Residential property about fifteen years ago. With increases in Code AR@ values and probably halving of heat losses during the last fifteen years, this recommendation should likely increase this Pickup load to 80%. The building Operators often manage to cover up Designer=s poor HVAC Pickup designs by reducing the Setback setting to 3^{oC} or 4^{oC} instead of the often USA Code required minimum of 8^{oC}. This wastes energy, as well as increasing environmental greenhouse gases.

Information on CIBSE sizing heating systems for the Extra Pickup Load

The CIBSE in their 2005 Guide A (Environmental Design) (some info. available free on line), chapter 5, shows a **Formula** for calculating the Extra Pickup Load (above hourly 99.6% conventional heat loss design condition) required to warm a building structure after a nights shut down of often 12 or 13 hours. It should not be surprising that 79% Pickup load is required to put back heat lost from the building over 12/13 hours. A weekend shut down of 60 hours is addressed later in this article, often with a little higher percentage required depending on the Setback temperature, which limits the cooling of the building. The CIBSE Formula is based on the ratio of the total AY@ A**Admittance**@ values for **All** the **Surface areas** of a building including internal walls and furnishings, divided by the Transmission **AU@** values for **All the external building surfaces**. This **Formula** uses a seven day week operation of the HVAC system and a 24 hour daily heating Cycle time period. The CIBSE Formula does **Not** include a night **Setback temperature** and is shown below.

$$F = \frac{24 . QA_r}{(T_{op.} QA_r) + (24 - T_{op})}$$

Where F = Thermal response factor based on Total Cycle time of 24 hours and a 7 day week operation.

$$QA_r = \text{Heat flow ratio } \frac{\text{AY@ (Admittance value Btu/sf.h.F:or W/sm.K) x area each surface + Infil air load}}{\text{AU@(Transmission Btu/sf.h.F:or W/sm,K) x area of each surface + Infiltration air load}}$$

$T_{op.}$ = Total heating Operating period including Pickup time (like 8 hours + 3 hours Pickup = 11 Hours)

CIBSE shows the values of AY@ for varius multilayered constructions in chapter 3 of their 2005 Guide A (Environmental Design). These listed values are useful because the AAdmittance@ AY@ values use the complicated heat transfer formula involving Asine ($\frac{L \sinh(\rho + i\rho)}{(\lambda(\rho + i\rho))}$) and assumes cosine heat variations, etc.@.

Example: Y x Area & Totals and U x Area & Totals (note: All the same AY@ values and AU@ values and are used for the **same Floor Area 11,148 sm** but with different Totals of A (area) x Y and A x U for the two different shaped buildings (one floor verses 5 floors).

Component	Area	Y	A x Y	U	A x U
Grd Floor	11148.00	5.20	57970.00	0.22	2453.00
[Grd Floor 5 Floor Building]	[2230.00]	[5.20]	[11596.00]	[0.22]	[491.00]
[Intermediate Flrs top & bottom]	[17840.00]	[5.20]	[92768.00]	[0.00]	[0.00]
Outdoor Walls	1498.00	0.75	1124.00	0.30	449.00
Internal Partitions/walls both sides	6420.00	1.92	12326.00	0.00	0.00
Windows	167.00	1.92	321.00	3.12	521.00
Roof, Insulated Metal Panels	11150.00	0.28	3122.00	0.19	2085.00
[Roof, Insulated Metal Panels 5 flr]	[2230.00]	[0.28]	[624.00]	[0.19]	[417.00]
Metal Filing Cabinets	33.40	3.00	100.00	0.00	0.00
Wood Shelves and Files	258.00	2.00	516.00	0.00	0.00

Total **Single Floor** Metal Panel Roof Total A x Y = 75,479 Total A x U = 5,508

Total **5 Floor** Building Concrete Fls., Roof metal panels Total A x Y=122,497 Total A x U = 1,875

Infiltration air load for 0.25 air change/hour : Volume 25,484 x 0.333 x 0.25(air change) = 2,123

QA_r Total Single Floor Metal Panel Roof $= \frac{75{,}479 + 2{,}123}{5{,}508 + 2{,}123} = \frac{77{,}602}{7{,}631} = 10.17$

QA_r Total 5 Floor Concrete Flrs & Roof $= \frac{122{,}497 + 2{,}123}{1{,}875 + 2{,}123} = \frac{124{,}620}{3{,}998} = 31.17$

Using CIBSE Basic Formula Pickup time $F = \frac{24.\, QA_r}{(T_{op.}\, QA_r) + (24 - T_{op})}$

Single Floor Bldg.

USA Pickup time for **Single Flr Bldg:** $F = \frac{24\text{hrs} \times 10.17 \text{ (Single Floor Bldg.)}}{(9\text{hrs} + 3\text{hrs}) \times 10.17) + (24\text{hrs} - (9\text{ hrs} + 3\text{ hrs})}$

Pickup time AF@ for **USA operating times** in **Single Floor bldg** = 1.82

Therefore, Extra Pickup time for **Single Flr Bldg** = 1.82 -1 = 0.82 = **82% Extra Pickup Htg. required** above Structural & Infiltration hourly heating load for 7 day week operation no Setback.

Relating Setback Temperatures to Pickup times

Unfortunately, the CIBSE Formula does NOT relate the Pickup load to the Setback temperature, which is required in most current USA Building Codes. The object of this section is to show the effect of Setback and how to calculate the heater sizes with satisfactory Pickup capacity in an acceptable time period to suit the Setback temperature required.

It is worth restating, traditionally (fifty years ago) the Pickup values were typically 10% to 20%. Yet, AR@ values have increased four to eightfold since then, doing the converse with the AU@ transmission. Therefore, the Pickup values should increase to perhaps between 40% to 150% in comparison with the new much smaller total hourly heat losses. In addition, Setback values have increased from 3^{oC} or 4^{oC} to 8^{oC} or 10^{oC} and this increases the Pickup load proportionally (double/triple these percentages).

A problem that can occur in old property with poor AU@ values is condensation and therefore it is better in this type of property to first remove any mold (any vinegar often kills mold), then keep the property warm like 22^{oC} to 24^{oC} during the occupied period and then perhaps not Setback more than 6^{oC}.

The **heat (required)** in a building components for Setback is given by the following Formula:

Q = Total A.Y x Setback temperature x Temp hourly Pickup Derating Factor

where Q = Total Heat Load (W or Btu/h)

A.Y = Area x AY@ **A**Admittance**@** value for each building component

Hrly Pickup Derating Factor = **1^{st} hr=80%, 2^{nd} hr=70%, 3^{rd} hr=60%, 4^{th} hr=51%, 5^{th} hr=43%, 6^{th} hr = 35%.** Note: Derating occurs each hour over the Pickup period because the surface of the building component warms with increase of Pickup time. Hence the Setback temperature reduces by this Derating Factor each hour and in turn the heat flow reduces each hour accordingly. The Derating Factor is derived from plotting the heat flow through walls, floors etc. and determining the average hourly heat flow, then placing the results into the CIBSE basic Formula for each hour and noting the average derating each hour. These results are shown above and below.

Normal Setback temps. are 3^{oC}, or 6^{oC}, or 8^{oC}, or 10^{oC}. More than 10^{oC} Setback is difficult to achieve in office property even over a weekend and probably is not advisable in humid environments like Ottawa, due to potential condensation occurring and causing mold, particularly in poorly insulated properties.

Calculations to determine heat load at four Setback temperatures in two different building types both With and Without Forced Ventilation

Using formula **Q = A x Y x Setback Temp** (and No Derating Factor) the following two Tables summarize the heat required for the two types of buildings, at four Setback temperatures, both **With Forced Ventilation** (189kW Ottawa at 99.6% winter design condition) and **Without**.

Example 1 Extra Pickup: **Single floor** building: based on Ottawa 99.6% = minus 24.5^{oC} giving a **45.5^{oC} indoor/outdoor temp differential** the heat loss is 356kW & AY = 75,479. Plus 10% to 13% duct and duct heat losses within false ceiling and 5% outdoor air damper leakage when closed.
Single floor building heat in Structural (**No Hourly Derating**) **Single Flr** Heat Loses

Bldg type	3C Setback	6C Setback	8C Setback	10C Setback	Ht Loss at -24.5C
Setback Temp x 75,479 =	226kW	453kW	604kW	755kW	356kW Ht loss:Vent loss 189kW
% No Forced Vent	63.5%	127.0%	170.0%	212.0%	356kW (No Forced Vent)
% With Forced Vent	41.5%	83.0%	111.0%	139.0%	356 + 189 = 545kW (With Vent)

Example 2 Extra Pickup: **Five floor** building heat loss at 99.6% condition is 191kW & AY = 122,479.
5 Floor building heat stored in Structure (**No Hourly Derating**) **5 Flr Bldg** Ht Loses

Bldg type	3C Setback	6C Setback	8C Setback	10C Setback	Ht Loss at -24.5C
Setback temp x 122,479 =	367kW	735kW	980kW	1,225kW	191kW Ht loss:Vent loss 189kW
% No Forced Vent	192.0%	384.0%	513.0%	641.0%	191kW (No Forced Vent)
% With Forced Vent	96.6%	193.0%	258.0%	322.0%	191 + 189 = 380kW (With Vent)

Calculations to establish Actual heater load related to Pickup time period and Setback temperature in a Five floor building both With and Without Forced Ventilation

Example 3 Typical calculation to determine percentage in Table below. In this example it determines the percentage for **3 hour Pickup** (with **60% Derating** Factor: see previous page) and at **8^{oC} Setback.** From the Table above (5 floor bldg) select 8^{oC} Setback and No Forced Ventilation and it gives 980kW :
Therefore the **Extra Pickup load** for 3hrs Pickup = **980kW** x **60%** (3 hr Derating factor = **588kW**.
However, the **ACTUAL heater** must be **Sized** to include both the **Extra Pickup** load **(588kW) Plus** the **Normal 99.6% hourly heat** loss (**191kW**).
Therefore **Actual** heating coil size = 588kW + 191kW = 779kW instead of conventional 191kW.
This is 408% larger than the **conventional heater size** (191kW)**: 779kW/191kW=408%)** but is less

than the 513% (non derated figure) shown in example 2 above for No forced ventilation. Also note the **EXTRA Pickup load** is **308%** = 408% -(100% the conventional heat loss figure).
The Watts/m^2 is a more useful figure to use and is calculated by multiplying the Actual percentage by the conventional hourly heat loss (191kW or 17.1W/m^2). So 408% (4.08) x 191 / 11,148 (area) = **69.9**W/m^2. For design purposes should use 10^C Setback and 3 hour Pickup, which gives the client/ building owner options to save even more energy than Code requirements and also provides an allowance for some minor faults with the building construction or HVAC system.

Percent ACTUAL Heater Loads, with Pickup=s & Setback=s loads Ottawa Five Floor No Forced Vent

5 Floor Setback Temps	3C Setback	6C Setback	8C Setback	10C Setback	Ht Loss at -24.5C
Percent at 2 hr Pickup	235.0%	369.0%	459.0%	549.0%	191kW Hrly Ht Loss
Percent at 3 hr Pickup	215.0%	331.0%	408.0%	485.0%	191kW Hrly Ht Loss
Htr W/m2 3 hr Pickup	36.8W/m2	56.7W/m2	69.9W/m2	83.1W/m2	191kW Hrly Ht Loss
Percent at 4 hr Pickup	198.0%	296.0%	362.0%	427.0%	191kW Hrly Ht Loss
Htr W/m2 3 hr Pickup	33.9W/m2	50.7W/m2	62.0W/m2	73.2W/m2	191kW Hrly Ht Loss
Percent at 5 hr Pickup	183.0%	266.0%	321.0%	376.0%	191kW Hrly Ht Loss

Calculation Actual Load and Extra Pickup Load in Five floor building With Forced ventilation

Most larger buildings require Forced Ventilation by Code and the following example addresses that.

Example 4 For this calculation for a five floor building with Force ventilation and for the **3 hours of Pickup** the next hour (4th hour) needs to be used with a Derating factor of 51% (see Table two pages earlier) and 8C Setback.
3 hrs Pickup & 8C Setback load is 980kW (see table ex. # 2) x 51% (use 3 + 1 = 4th hr Derating factor) = 499.8kW = 500kW plus 380kW (189kW Forced Vent + 191kW Struct ht. loss) = 880kW Pickup load.

During the 3 hours of Pickup the actual Pickup load is 880kW - (189kW + damper leakage 10kW: which is 5% outdoor damper leakage) = 681kW. This is 93kW more than the 588kW in example 2 above and warms the building structure in 2 hours instead of 3 hrs. Therefore, the building components warmer quicker during the 2 to 3 hour Pickup period and makes the 4th hour lower Derated figure able to cope. At the 4th hour the outdoor air damper opens and now the reduced Pickup load of 500kW (880kW - (380kW : (189 + 191) can cope because of the extra warming in the 2 to 3 hour time period. Therefore the **generic formula** for buildings with **Forced Ventilation** is **(Pickup time) + 1 (one) hour** when doing the calculation shown above; and must be used when sizing the heaters for buildings with Force Ventilation.
This **3 hrs Pickup load & 8C Setback** as a percentage of the normal (conventional) hourly heating load is 880kW/380kW = **232%** and the **Extra Pickup** percentage is 232% -100% = **132%**

The following Table summarizes this for various Setbacks and Pickup times for where **Forced Ventilation** is used in a **Five floor building**.

Percent ACTUAL Heater Loads, Pickup=s & Setback=s for Ottawa Five Floor With Forced Vent

5 Floor Setback Temps	3C Setback	6C Setback	8C Setback	10C Setback	Ht Loss at -24.5C
Percent at 2 hr Pickup	158.0%	216.0%	255.0%	293.0%	191kW Ht Loss & 189kW Vent
Percent at 3 hr Pickup	149.0%	199.0%	232.0%	264.0%	380kW Hr Ht Loss & Forced Vent
Htr W/m2 3 hr Pickup	50.8W/m2	67.8W/m2	79.1W/m2	90.0W/m2	380kW Hr Ht Loss & Forced Vent
Percent at 4 hr Pickup	142.0%	183.0%	211.0%	239.0%	191kW Ht Loss & 189kW Vent
Htr W/m2 4 hr Pickup	48.4W/m2	62.4W/m2	71.9W/m2	81.5W/m2	191kW Ht Loss & 189kW Vent
Percent at 5 hr Pickup	134.0%	168.0%	190.0%	213.0%	380kW Hr Ht Loss & Forced Vent

Percent ACTUAL Heater Loads, Pickup=s & Setback=s for Ottawa One Floor No Forced Vent

1 Floor Setback Temps	3C Setback	6C Setback	8C Setback	10C Setback	Ht Loss at -24.5C
Percent at 2 hr Pickup	145.0%	189.0%	219.0%	249.0%	356kW Hrly Ht Loss
Percent at 3 hr Pickup	138.0%	176.0%	202.0%	227.0%	356kW Hrly Ht Loss
Htr W/m2 3 hr Pickup	44.1W/m2	56.2W/m2	64.5W/m2	72.5W/m2	356kW Hrly Ht Loss
Percent at 4 hr Pickup	132.0%	165.0%	187.0%	208.0%	356kW Hrly Ht Loss
Percent at 5 hr Pickup	127.0%	155.0%	173.0%	191.0%	356kW Hrly Ht Loss

Percent ACTUAL Heater Loads, Pickup=s & Setback=s for Ottawa One Floor With Forced Vent

1 Floor Setback Temps	3C Setback	6C Setback	8C Setback	10C Setback	Ht Loss at -24.5C
Percent at 2 hr Pickup	125.0%	150.0%	167.0%	183.0%	356kW Ht Loss & 189kW Vent
Percent at 3 hr Pickup	121.0%	143.0%	157.0%	171.0%	545kW Hrly Ht Loss
Htr W/m2 3 hr Pickup	59.2W/m2	69.9W/m2	76.8W/m2	83.6W/m2	545kW Hrly Ht Loss
Percent at 4 hr Pickup	118.0%	138.0%	148.0%	160.0%	356kW Ht Loss & 189kW Vent
Htr W/m2 4 hr Pickup	57.7W/m2	67.7W/m2	72.4W/m2	78.2W/m2	356kW Ht Loss & 189kW Vent
Percent at 5 hr Pickup	115.0%	129.0%	139.0%	149.0%	545kW Hrly Ht Loss

The above Tables show the Actual Heater load including Pickup. The **Extra Pickup** load is the actual heater load, shown immediately above, minus (100% the occupied conventional heating load).

If heat recovery is used from exhaust air at room temperature to warm the cold outdoor air then the figures need adjusting to accommodate these recovery amounts.

Some of the percentages above may seem large, like 549% in the five floor building with no forced ventilation and 10^{oC} Setback. However, using CIBSE basic formula and changing the operating cycle from 24 hours to 72 hours for a weekend operating period, 2 hour Pickup and 9 hour work period we get 5.558 = 555.8%. This makes the 549% in the Table for 10^{oC} Setback, 2 hour Pickup and 9 hour work period above seem reasonable and accurate. However, longer

Pickup times and lower percentages should be used. The 2 hour Pickup and 549% should be to 376% for a 5 hour Pickup time and 10^{oC} Setback. The 376% seems logical and reasonable and far better than the poor information currently available.

In other locations like Los Angles California or London UK where the heat loss of the building is about half that of the Ottawa Canada the **Extra Pickup** shown in the tables above will increase in inverse proportion and therefore halving the heat loss doubles the Pickup load. Note the Pickup load (ie heat size) is constant and same in both locations.

We hope this article shows that all designers should make calculations to establish the Pickup load for each building and each area (zone) within the building. The above Tables give a quick reference guide to the **Pickup percentage values** for different types of building that should be applied when a quick estimate has to be made. It also gives a reference for determining the number of hours of Pickup the designer should apply to a particular building; such as more for a multi floor building (4 or 5 hours Pickup) and less to a single floor building (2 or 3 hours Pickup) with no forced ventilation and what approximate amount of extra Pickup load is required.

Actual Zone Heater Coils with Extra Pickup Load in Five floor building With Forced ventilation

A better way of calculating the Actual individual Heater Zone loads is to do it on a Watt/square meter basis rather than as percentage of the conventional hourly static heat loss. This is because each heating zone heater coil, like the perimeter or interior area loads can be easily seen and calculated from the AAY@ summarizing Table on the third page. It is interesting to note that many roof top stand alone AH units, for say a classroom, have a heating capacity of 200 W/M^2 giving relatively short (less than 2 hours) Pickup time from a 10^{oC} Setback. This (200 W/m^2) capacity provides the classroom with about 200% to 250% Actual heat capacity, or **100% to 150% Extra Pickup capacity**, which is more than the 79% Extra capacity that CIBSE calculated for their exampled 450 m^2 building and much more Extra capacity than many designers use for heating coils within a multi-floor building. The following examples 5 through 8 and Tables show the type of calculation required and the typical results for a five floor building. Recommend the heaters be designed capable of a 3 hour Pickup with 10^{oC} Setback. This provides some allowance for errors in building construction and for extra duct leakage and damage after testing by reducing to 8.3^{oC} (15^{oF}) Setback and still meeting Build Code requirements, also providing even more extra Pickup capacity by extending to a 4 hour Pickup, which is acceptable to most maintenance staff.

Example 5 for Five Floor Building Three Intermediate floors **Perimeter Area (2625 m²)/Zone**
Assume the **Perimeter** Zone extends 5 meters in from **all** the outdoor walls on **3 Intermediate floors**

Component	Area	Y	A x Y	U	A x U
3 Interm Perimeter Flrs top/bottom	2 x 2625.00	5.20	27300.00	0.00	0.00
Outdoor Walls on 3 floors	1300.00	0.75	975.00	0.30	390.00
Internal Partn/walls both sides (3 flrs)	1512.00	1.92	2903.00	0.00	0.00
Windows on 3 floors	100.00	1.92	100.00	3.12	312.00
Furniture/Shelves/Books/Etc.	68.60	2.25	154.00	0.00	0.00
			31432.00		702.00

Infiltration air load for 0.25 air change/hour : 3 flr Volume (60%) x 25,484 x 0.333 x 0.25(air change) = 1,274

Perimeter AAU@ Load = (702 + Infil (1,274)) x Design Temp (21.1^{oC} + 24.4^{oC} = 45.5^{oC}) = 89,908Watts
Therefore normal Perimeter Zone Heat Loss load W/M^2 = 89,908/Area (2,625) = 34.3W/m^2
To this needs to be added at least 12% (8% air duct leakage & 4% air duct heat loss) that never reaches the room. = 34.4 x 1.12 = 38.528 W/m^2

Perimeter 3 flr 8% outside Damper leak = 8% x (10 lps/m^2/1000) x 1.2 x Design Temp (21.1^{oC} + 24.4^{oC} = 45.5^{oC}) = 0.0436 W/m^2

Total of Design Hourly Heat Loss + Outdoor (Shut) Damper Leakage = 38.528 + 0.022 = 38.6 W/m^2

Perimeter Zone PICKUP=s Load Watts/m² for various SETBACK=s in Ottawa and Three intermediate Floors Zones (Area 2,625 m²) within Five Floor Building

5 Floor Setback Temps	3C Setback	6C Setback	8C Setback	10C Setback
Setback Temp x AAY@(31,422) =	94.3kW	188.5kW	251.4kW	314.2kW
Ht 100% : W/m2 (Watts/area)	35.9W/m2	71.9W/m2	95.8W/m2	119.8W/m2
2 hr Pickup w/60% Derating	21.5W/m2	43.1W/m2	57.5W/m2	71.9W/m2
2 hr Dertd Pickup+Hourly Ht Loss+OutdrDamperLeak	60.1W/m2	81.7W/m2	96.1W/m2	110.5W/m2
3 hr Pickup w/51% Derating	18.3W/m2	36.6W/m2	48.8W/m2	61.0W/m2
3 hr Dertd Pickup+Hourly Ht Loss+OutdrDamperLeak	56.9W/m2	75.2W/m2	87.4W/m2	99.6W/m2
4 hr Pickup w/43% Derating	15.4W/m2	30.9W/m2	41.2W/m2	51.5W/m2
4 hr Dertd Pickup+Hourly Ht Loss+OutdrDamperLeak	54.0W/m2	69.5W/m2	79.8W/m2	90.1W/m2
5 hr Pickup w/35% Derating	12.6W/m2	25.1W/m2	33.1W/m2	41.9W/m2
5 hr Dertd Pickup+Hourly Ht Loss+OutdrDamperLeak	51.2W/m2	63.7W/m2	71.7W/m2	80.5W/m2

Example 6 for Five Floor Building Three Intermediate floors Internal area (4,063 m^2)
Assume the **perimeter** zone extends 5 meters in from all the outdoor walls and **3 intermediate floors Zones**

Component	Area	Y	A x Y	U	A x U
3 Intermdt Interior Flrs top/bottom	2 x 4,063.00	5.20	42255.00	0.00	0.00
Outdoor Walls on 3 floors	0.00	0.75	0.00	0.00	0.00
Intrnl Partitns/walls both sides (3 flrs)	2340.00	1.92	4493.00	0.00	0.00
Windows on 3 floors	0.00	1.92	0.00	0.00	0.00
Furniture/Shelves/Books/Etc.	106.20	2.25	239.00	0.00	0.00
			46987.00		0.00

Infiltration air load for 0.25 air change/hour : 3 flr Volume 0% x 25,484 x 0.333 x 0.25(air change) = 0.0 (Zero)

Internal Ht Loss AAU@ Load = (0.0 + Infil (0.0)) x Design Temp (21.1^{oC} + 24.4^{oC} = 45.5^{oC}) = 0.00Watts
Therefore normal Perimeter Zone load W/m^2 = 0.00/Area () = 0.00 W/m^2

Intrnl 3 flr 8% Damper leak = 8% x (5 lps/m^2/1000) x 1.2 x Design Temp (21.1^{oC} + 24.4^{oC} = 45.5^{oC}) = 0.02184 W/m^2

Total of Design Hourly Heat Loss + Outdoor (Shut) Damper Leakage = 0.0 + 0.02184 = 0.02184 W/m^2

The heating coil needs to have added about 12% (8% air duct leakage & 4% air duct heat loss) for duct leakage and duct heat loss that never reaches the room and a safety factor.

<u>Internal Zone</u> PICKUP=s Load Watts/m^2 for various SETBACK=s in Ottawa and <u>Three Intermediate Floors Zones (Area 4,063 m^2</u>) within <u>Five</u> Floor Building

5 Floor Setback Temps	3C Setback	6C Setback	8C Setback	10C Setback
Setback Temp x AAY@(46,987) =	141.0kW	281.9kW	375.9kW	469.9kW
Ht 100% : W/m2 (Watts/area)	20.8W/m2	41.6W/m2	55.5W/m2	69.4W/m2
2 hr Pickup w/60% Derating	12.5W/m2	25.0W/m2	33.3W/m2	41.6W/m2
2 hr Dertd Pickup+DamprLeak+12%Losses	14.0W/m2	28.0W/m2	37.3W/m2	46.6W/m2
3 hr Pickup w/51% Derating	10.6W/m2	21.2W/m2	28.3W/m2	35.4W/m2
3 hr Dertd Pickup+DamprLeak+12%Losses	11.9W/m2	23.7W/m2	31.7W/m2	39.7W/m2
4 hr Pickup w/43% Derating	8.9W/m2	17.9W/m2	23.9W/m2	29.8W/m2
4 hr Dertd Pickup+DamprLeak+12%Losses	10.0W/m2	20.0W/m2	25.8W/m2	33.4W/m2
5 hr Pickup w/35% Derating	7.3W/m2	14.6W/m2	19.4W/m2	24.3W/m2
5 hr Dertd Pickup+DamprLeak+12%Losses	8.2W/m2	16.4W/m2	21.7W/m2	27.2W/m2

Example 7 for Five Floor Building **Ground Floor Perimeter Area (875 m²)/Zone**
Assume the **Perimeter** Zone extends 5 meters in from **all** the outdoor walls on **Grd Floor**

Component	Area	Y	A x Y	U	A x U
Grd Flr Perimeter Floor top/bottom	2 x 875.00	5.20	9100.00	0.35	306.30
Outdoor Walls on 1 floor	433.00	0.75	325.00	0.30	130.00
Internal Partn/walls both sides (1 flr)	504.00	1.92	968.00	0.00	0.00
Windowson 1 floor	30.00	1.92	58.00	3.12	94.00
Furniture/Shelves/Books/Etc.	22.90	2.25	52.00	0.00	0.00
			10503.00		530.30

Infiltration air load for 0.25 air change/hour : Grd Flr Volume 60% x 25,484 x 0.333 x 0.25(air change) = 425

Perimeter AAU@ Load = (530.3 + Infil (425)) x Design Temp (21.1^{oC} + 24.4^{oC} = 45.5^{oC}) = 43,466Watts
Therefore normal Perimeter Zone Heat Loss load W/M² = 43,466/Area (875) = 49.7W/m²
To this needs to be added about 12% (8% air duct leakage & 4% air duct heat loss) that never reaches the room. = 49.7 x 1.12 = 55.64 W/m²

Perimeter 3 flr 8% outside Damper leak = 8% x (10 lps/m²/1000) x 1.2 x Design Temp (21.1^{oC} + 24.4^{oC} = 45.5^{oC}) = 0.0436 W/m²

Total of Design Hourly Heat Loss + Outdoor (Shut) Damper Leakage = 55.64 + 0.044 = 55.7 W/m²

Perimeter Zone PICKUP=s Load Watts/m² for various SETBACK=s in Ottawa and Grd Floor Zones (Area 875 m²) within Five Floor Building

5 Floor Setback Temps	3C Setback	6C Setback	8C Setback	10C Setback
Setback Temp x AAY@(10,503) =	31.5kW	63.0kW	84.0kW	105.0kW
Ht 100% : W/m2 (Watts/area)	36.0W/m2	72.0W/m2	96.0W/m2	120.0W/m2
2 hr Pickup w/60% Derating	21.6W/m2	43.2W/m2	57.6W/m2	72.0W/m2
2 hr Dertd Pickup+Hourly Ht Loss+OutdrDamperLeak	77.3W/m2	98.9W/m2	113.3W/m2	127.7W/m2
3 hr Pickup w/51% Derating	18.4W/m2	36.7W/m2	48.8W/m2	61.2W/m2
3 hr Dertd Pickup+Hourly Ht Loss+OutdrDamperLeak	74.1W/m2	92.4W/m2	104.5W/m2	116.9W/m2
4 hr Pickup w/43% Derating	15.5W/m2	31.0W/m2	41.3W/m2	51.6W/m2
4 hr Dertd Pickup+Hourly Ht Loss+OutdrDamperLeak	71.1W/m2	86.7W/m2	97.0W/m2	107.3W/m2
5 hr Pickup w/35% Derating	12.6W/m2	25.2W/m2	33.6W/m2	42.0W/m2
5 hr Dertd Pickup+Hourly Ht Loss+OutdrDamperLeak	68.3W/m2	80.9W/m2	89.3W/m2	97.7W/m2

Example 8 for Five Floor Building **Ground Floor Internal** area (1,354 m^2)
Assume the **perimeter** zone extends 5 meters in from all the outdoor walls and **Grd Floor Zones**

Component	Area	Y	A x Y	U	A x U
Grd Flr Interior area top/bottom	2 x 1,354	5.20	14082.00	0.15	203.10
Outdoor Walls on 3 floors	0.00	0.75	0.00	0.00	0.00
Intrnl Partitns/walls both sides (1 flr)	780.00	1.92	1498.00	0.00	0.00
Windows on 1 floor	0.00	1.92	0.00	0.00	0.00
Furniture/Shelves/Books/Etc.	35.40	2.25	80.00	0.00	0.00
			15660.00		203.10

Infiltration air load for 0.25 air change/hour:Grd Flr Volume 0% x 25,484 x 0.333 x 0.25(air change) = 0.0 (Zero)

Internal Ht Loss AAU@ Load = (203.1 + Infil (0.0)) x Design Temp (21.1^{oC} + 24.4^{oC} = 45.5^{oC}) = 9,241Watts
Therefore normal Grd Flr Internal Zone load W/m^2 = 9,241/Area (1,354) = 6.83 W/m^2

Grd Flr 8% Damper leak = 8% x (5 lps/m^2/1000) x 1.2 x Design Temp (21.1^{oC} + 24.4^{oC} = 45.5^{oC}) = 0.02184 W/m^2

Total of Design Hourly Heat Loss +Outdoor (Shut) Damper Leakage = 6.83 + 0.0218= 6.9W/m^2

To the heat supplied needs to be added at least 12% (8% air duct leakage & 4% air duct heat loss) that never reaches the room and safety factor 6.9 x 1.12 = 7.7 W/m^2.

<u>Internal Zone</u> PICKUP=s Load Watts/m^2 for various SETBACK=s in Ottawa and <u>Three</u> <u>Intermediate Floors Zones (Area 1,354 m^2)</u> within <u>Five</u> Floor Building

5 Floor Setback Temps	3C Setback	6C Setback	8C Setback	10C Setback
Setback Temp x AAY@(15,660) =	34.7kW	69.4kW	92.5kW	115.7kW
Ht 100% : W/m2 (Watts/area)	25.6W/m2	51.3W/m2	68.3W/m2	85.4W/m2
2 hr Pickup w/60% Derating	15.4W/m2	30.7W/m2	41.0W/m2	51.2W/m2
2 hr Dertd Pickup+DamprLeak+12%Losses	23.1W/m2	38.4W/m2	48.7W/m2	58.9W/m2
3 hr Pickup w/51% Derating	13.1W/m2	26.1W/m2	34.8W/m2	43.5W/m2
3 hr Dertd Pickup+DamprLeak+12%Losses	20.7W/m2	33.8W/m2	42.5W/m2	51.2W/m2
4 hr Pickup w/43% Derating	11.0W/m2	22.0W/m2	29.4W/m2	36.7W/m2
4 hr Dertd Pickup+DamprLeak+12%Losses	18.7W/m2	27.7W/m2	37.1W/m2	44.4W/m2
5 hr Pickup w/35% Derating	9.0W/m2	17.9W/m2	23.9W/m2	29.9W/m2
5 hr Dertd Pickup+DamprLeak+12%Losses	16.7W/m2	25.6W/m2	31.6W/m2	37.6W/m2

The calculations for top floor and all corner zones follow the same format as examples 5 through 8. These are just guide figures and each designer must calculate his own figure to suit his parameters.

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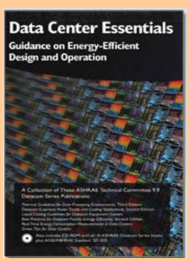

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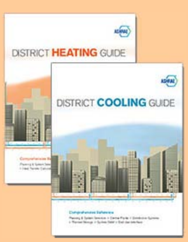

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