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A Monte Carlo Method for thermal building simulation

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Abstract

Title: A Monte Carlo Method for thermal building simulation

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Search terms: Monte Carlo model, stochastic model, deterministic model, building thermal simulation, temperature distribution, verification study, convolution, Chi-square test, constant weather, seasons.

A Monte Carlo method for finding an approximation of the building inside stochastic temperature distribution is given. Present simulation techniques are either over-simplified and uses only a deterministic method, or are highly complex stochastic models.

The development of a new method, easier to understand than a stochastic model, and at the same time giving a more general understanding of the problem than deterministic models is discussed. The method consists of a Monte Carlo approach, used in conjunction with a more traditional deterministic building thermal simulation model. Radiation and temperature data are simulated separately, then the combined effect is found with a numerical convolution integral.

Because the convolution integral is only strictly valid for independent variables, a verification study is also presented, using four different buildings and five different ventilation rates. Temperature and global radiation data measured at Irene over the five year period 1994 to 1998 was used. After analysis it was divided into four periods of constant weather, roughly coinciding with the seasons for this locale. Diffuse radiation was calculated from the global values since no measurements were available.

To measure the inside temperature distribution for five years, five different ventilation rates for the same four buildings was out of the timeframe of this study. Therefore the method was verified by comparison of results obtained with the new technique and results obtained by simulating every day for the same period.

Since the Chi-square test normally used to quantify the difference between distributions do not produce readily interpretable results in this instance, another test was developed and is described. From this it can be seen that the average predicted temperature error is 0.68°C, with a standard deviation of 1,37°C. The verification thus shows that by using the new Monte Carlo method a good approximation can be found for the inside temperature distribution by using only 4% of the days from the five year period.

Samevatting

Titel: A Monte Carlo Method for thermal building simulation

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Soek terme: Monte Carlo metode, stochastiese metode, deterministiese metode, gebou termiese simulasie, temperatuur verspreiding, verifikasie studie, konvolusie, Chi-kwadraat toets, konstante weer, seisoene.

'n Monte Carlo metode word gegee wat 'n benadering gee van die gebou binne stochastiese temperatuur verspreiding. Huidige metodes is òf oor-vereenvouding en gebruik net 'n deterministiese metode, òf is hoogs komplekse stochastiese metodes.

Die ontwikkeling van 'n nuwe metode wat is makliker om te verstaan as 'n stochastiese metode en tog 'n meer algemene begrip van die probleem gee word bespreek. Die metode gebruik 'n Monte Carlo benadering tesame met 'n meer traditionele deterministiese model. Radiasie en temperatuur data word afsonderlik gesimuleer, en dan word die gesamentlike effek gekry deur 'n numeriese konvolusie integraal te gebruik.

Omdat die konvolusie integraal slegs geldig is vir onafhanklike veranderlikes, word 'n verifikasie studie ook gegee. Die studie gebruik vier verskillende geboue en vyf ventilasie tempo's. Temperatuur en globale radiasie data gemeet by Irene oor die vyf-jaar periode van 1994 tot 1998 word gebruik. Na analiese word dit in vier periodes van konstante weer opgebreek, wat rofweg met die seisoene vir die meetstasie ooreenstem. Diffuse radiasie word uitgewerk van die globale waardes af aangesien geen metings beskikbaar was nie.

Dit sou buite die tydsbestek van die studie val om binne temperature te meet vir vyf jaar en vyf verskillende ventilasie tempo's vir dieselfde vier huise. Daarom is die metode geverifieer deur vergelyking van resultate soos deur die metode voorspel teen resultate verkry deur elke dag afsonderlik te simuleer vir dieselfde periode.

Aangesien die Chi-kwadraat toets wat gewoonlik gebruik word om die verskil tussen twee verspreidings weer te gee nie maklik interpreteerbare resultate vir die geval gegee het nie, is 'n ander toets ontwikkel en word ook hier beskryf. Hiervan kan gesien word dat die tempertuur met 'n gemiddelde fout van 0.68°C voorspel is, en die standaard afwyking van die fout 1,37°C is. Die verifikasie wys dus dat met die nuwe Monte Carlo metode 'n goeie benadering van die binne temperatuur verspreiding gekry kan word deur slegs 4% van die dae van die vyf jaar periode te gebruik.

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Chapter 1

Introduction to thermal building simulation

1.1 The objective of building thermal simulation

1.1.1 Optimal design

With the growing environmental consciousness the more efficient use of energy is a priority. International studies have show that 37% of world primary-energy-consumption is used for building operational costs. (Drozdov, V.A., Matrosov, Y.A. and Tabunschikov, Y.A.) Clearly any improvement in building energy usage will benefit overall energy consumption.

According to Hong and Jiang there are two reasons to calculate building HVAC system loads: 'one is to calculate the peak load for plant sizing, the other is to calculate the annual energy consumption for energy audit and design of energy efficient building HVAC systems'. (Hong, T. and Jiang, Y., 1995) (Yoshida, H. and Terai, T., 1990) They do not consider the calculation of passive building inside temperatures.

The idea of passive building design has been used for a long time. Examples are the pueblos of Southwestern United States and the igloos of the Eskimo people. (Meyer, W.T., 1983) (Eberhard, J.P., 1980) (Dumas, L.J., 1976) A passive building will be the best design of all, a building that uses no energy at all for climate control.

In many buildings HVAC systems will (and should) be used. The problem is that case studies, such as the six done by Piani (Piani, C.B., 1995), have shown HVAC systems over-designed by a factor of up to 1.8. This over sizing leads to systems being operated far from the optimal conditions for most of the time, as well as unnecessary initial costs. Furthermore, from the perspective of the building operators, more energy efficient buildings can lead to substantial savings on energy costs.

For this reason we need a tool that can not only calculate the peak load expected on a HVAC system and the annual energy consumption, but also the passive building's temperature to find out if the HVAC system is really needed. This tool can then be used by the engineer when designing a HVAC system, and also by the architect to optimize the building for smaller energy requirements or passive design.

1.1.2 The stochastic answer

It is unrealistic to expect to be able to predict building thermal performance with total accuracy. The weather, one of the most important influences on building thermal performance, behaves in a stochastical manner (Hong, T. and Jiang, Y., 1995). The best way to find the thermal performance would be to find the statistics of the building inside temperature. This brings us to stochastical modeling.

Stochastical modeling is a way to model the statistical parameters of the system rather than the actual response. Stochastic processes has been described thus: 'A stochastic process is one which cannot be modeled deterministically because there are unknown (or unpredictable) factors affecting the variable, which prevent the exact calculation of its future behavior. We can develop stochastic models for these processes which allow us to calculate the expected future value of the process and the probability that a future value will be between two specified limits.'(Hittle, D.C. and Pedersen, C.O., 1981)

Where deterministic methods will have a certain output for a certain input, stochastical methods will have output statistics for input statistics. The question we ask is 'will the HVAC plant be big enough', or for a passive building, 'will the building be comfortable'. Because of the stochastic nature of the problem, the ideal answer is not yes/no, but rather: "yes for 99% or 20% of the time", and we need to know the statistics of the unpredictable input variables, not a single value of the variable.

There is an easier way around the stochastic model, which is very difficult to solve. If we can generate a large set of input data, with the same statistics as the population, or real data, use all of the data with a deterministic method to generate output data and find the statistics of the output, we will have the same answer. This is known as a Monte Carlo method

With the generation of data lies a problem: In general, the input data will have cross-correlations between the various input components. Let S(x) donate the statistics of input x, and similar for y and z. If the effective input function consists of the sum x+y+z, then: S(x+y+z) = S(x) +S(y) +S(z) +S(xy) + S(xz) + S(yz) + S(xyz). Care will have to be taken that terms such as S(xy), donating the statistics of the cross-correlations between x and y, are not neglected. The generated data must have the correct statistics, i.e. reflects the real world. To achieve that the cross-correlations have to be determined.

1.2 Existing methods

We have seen that for optimal design the stochastic answer is needed. Before we reinvent the wheel, we must first study the existing methods, to try and find one that suits our needs. Only if we cannot find one should we develop a new method. Since the weather data format tend to be specific to the simulation model used, the model and the weather are discussed hand-in-hand in the following sections.

1.2.1 Deterministic methods

Because of the difficulty of the stochastic methods, deterministic methods were developed. Probably the most well known methods are those of ASHRAE. ASHRAE (ASHRAE Fundamentals, 1997) discusses two principle methods to calculate building heating or cooling peak-load: TFM and CLTD. The Transfer Function Method (TFM) (Mitalas, G.P. 1972) and the Cooling Load Temperature Differential method (CLTD) (Rudoy, W. and Duran, F., 1975) derived from it, use tabulated factors with equations to take into account the time-delay in the cooling load.

These methods either use a 24 hour weather cycle or, from the data as tabulated in ASHRAE Fundamentals, a daily range and a single design day temperature. Clearly they should be considered highly simplified, and are not to be used if a highly accurate answer is needed. They can also not calculate the passive temperatures inside a building. The heating load is calculated as a simple steady state problem.

Software exists to simulate the annual energy performance of buildings requiring a one-year (8760 h or 365 days) data set of weather conditions. The data represents a typical year from the viewpoint of weather-induced energy loads on a building. (ASHRAE Fundamentals, 1997) These sets of data are then also available from ASHRAE.

The days are simulated separately, and thus give 365 days of output data. No explicit effort was made to represent extreme conditions, so these files do not represent design conditions, and should not be used for HVAC systems sizing. (ASHRAE Fundamentals, 1997) This method was created to give as single output the amount of energy the building will use over the period of one year.

Britain's Chartered Institution of Building Services Engineers, CIBSE, (Chartered Institution of Building Services Engineers, 1986) gives weather data in several different formats. For heating load plant sizing a single temperature is given for different number of occurrences per heating season. Thus the designer is able to choose the extremeness of the weather he is designing for. A daily mean outdoor temperature is given to calculate heating load energy consumption over the heating season.

For the cooling season wet and dry bulb temperatures are given again for different amounts of occurrences per cooling season, both correlated to each other and separate. Wet and dry bulb temperatures are also given for 1% and 2.5% of hours of the cooling season, with correction factors for height above sea level.

Annual load data is given as banded weather data, where the proportion of the month is given that the average value falls within a certain range or band. Each band within each month is treated as a separate block of weather data when running an environmental computer program and the results obtained are weighted by the proportion of the month within each band. (CIBSE, 1986)

Load calculations can be done by CIBSE's admittance procedure (CIBSE, 1986), taking into account both radiant and air temperature. The modifying effect of the surfaces is taken into account, and the procedure is suitable for programming into a PC. Manual calculations can be done by a steady state method for heating load, and for cooling load a manual method with correction for time lag is given.

The South African CSIR (Wentzel, J.D. *et al*, 1985) provides weather data as 24-hour extreme days. Data is selected according to temperature, with the average of the days exceeding 10% of the values given as the 10% design day. The corresponding humidity, wind and radiation are calculated as the average of the days with a maximum within about 1degree of the average maximum of the 10% design day.

The South African data is suitable for the calculation methods of ASHRAE or CIBSE. Its higher accuracy, due to the 24-hour format, also makes it more appropriate for methods like the first-order thermal model of Mathews et al (Mathews et al, 1994). This model has been incorporated into the commercially available program QUICK (MCI(Pty) Ltd., 1998), and extended to the third-order thermal model of Van Heerden et al (Van Heerden, E, et al, 1996).

1.2.2 Stochastic and Monte Carlo methods

Recently, with advances in computers and the drive for more energy efficient buildings, several models to account for the random nature of weather have been put forward. These range from creating synthetical weather data that approximate the statistics of real weather over a long period of time, and using it similar to a Reference Year, to breaking the weather up into several components that can be used together to give a stochastic model with statistics similar to that of the real weather.

Van Paasen and De Jong created a method to obtain the 'Synthetical Reference Outdoor Climate'. The synthetical data are generated by a mathematical model of the outdoor climate, in which all the linear and nonlinear correlations between the weather variables and also their probabilities and auto correlations are formulated. (Van Paasen, A.H. and De Jong, A.G., 1979)

Later, Hittle and Pedersen expected that weather data could be modeled as the result of both deterministic and stochastic processes. They did a Fourier transform on several years of weather data, and found that 'true periodicity in the data exists only at the annual cycle and at the diurnal cycle plus its harmonics.'(Hittle, D.C. and Pedersen, C.O., 1981) This they used to model what they consider the deterministic part of the model. (There must be some deterministic part since we have night, day and seasons. This can be calculated from basic astronomy.) They then used an Auto Regressive Moving Average (ARMA) model to account for the stochastic part. The final model is then the sum of the two parts.

They concluded: 'Generally, the combined model is more satisfactory than ARMA-only models for characterizing weather data time series, since the deterministic periodic behavior of the data is separated from the stochastic auto regressive behavior.'(Hittle, D.C. and Pedersen, C.O., 1981)

Hokoi et al used ARMA models for solar radiation, and ARMAX models for air temperature. (Hokoi, S. *et al*, 1990) Yoshida and Terai proposes a method divided into three components: A Trend component expressing climatic change with time, a deterministic component accounting for the annual and diurnal components modeled by Fourier series, and a stochastic component that they again break up into three components, namely a gradual, a moderate and rapid change random component, with some further refinements.(Yoshida, H. and Terai, T., 1992)

The stochastic weather model (Hong, T. and Jiang, Y., 1995) (Jiang, Y. 1981, J. Sino Refrigeration) (Jiang, Y. 1981, ASHRAE) and building simulation model (Jiang, Y. and Hong, T., 1993) used by Hong and Jiang will now be given, in order that the reader can get a clearer picture of the mathematics involved in stochastic processes.

Hong and Jiang proposed a Vector Auto-Regressive (VAR) time series weather model. They give this as:

$$W_\tau = M_\tau + DX_\tau \qquad \text{Eq 1.2.2-1}$$

where τ indicates the day number, W_τ is a column vector with daily mean and range of the outdoor temperature, daily solar radiation coefficient *Kt*, daily mean and range of the outdoor air humidity respectively. M_τ stands for the deterministic part of W_τ and DX_τ for the random part. With the matrix *D*, X_τ becomes a five-dimensional stochastic process and can be modeled by:

$$X_\tau = \Phi X_{\tau-1} + \Theta A_\tau \qquad \text{Eq 1.2.2- 2}$$

where Φ and Θ describe the auto and cross correlation between each variable. A_τ becomes five-dimensional independent random process with standard normal distribution.

They consider the detailed hourly weather data not as important as the daily data because of the significant thermal mass of buildings, and give the following interpolation model to transfer the daily data into hourly data:

$$U_\tau = (u_{1\tau}, u_{2\tau}, u_{3\tau}, \ldots u_{24\tau})^T = S(W\tau, Q_\tau) \qquad \text{Eq 1.2.2-3}$$

Where Q_τ is the internal casual gain on the τth day, $u_{j,\tau}$ includes temperature, direct and diffuse solar radiation and casual gain at the *j*th hour on the τth day, U_τ stands here for 24 groups of hourly external and internal disturbance data for the whole day, *S* is a shape matrix that transfers each variable from daily data into hourly data.

They arrive at the building model by stating that according to the State Space method the thermal processes within a building can be described by

$$\frac{dT}{d\tau} = KT + PU(\tau) \qquad \text{Eq 1.2.2-4}$$

where *T* is a vector consisting of all the node temperatures within the building, *U* is a vector consisting of all the external and internal disturbances such as the outdoor air temperature, the solar radiation and the casual gains, matrix *K* and *P* depend upon the construction of the building and the thermal properties of the building materials and the convective and radiative surface coefficients at each surface.

The zone temperature t_z in the building is obtained from the state variable T:

$$t_z = VT \qquad \text{Eq 1.2.2-5}$$

where V is a vector. They give the solution of this equation in the form of

$$t_{z\tau j} = \sum_{i=0}^{\infty} Z_{ij} u_{\tau-i} \qquad \text{Eq 1.2.2-6}$$

where Z_{ij} are calculated from K, P and V in Eg 4 and 5, i indicates different coefficients and j indicates different hourly values of the zone temperature. The 24 hourly values of t_z can be writen as $T_{z\tau}$, a vector of the dialy zone temperature:

$$T_{z\tau} = (t_{z1}, t_{z2}, ..., t_{z24})_{\tau}^{T} = \sum_{i=0}^{\infty} Z_i U_{\tau-i} \qquad \text{Eq 1.2.2-7}$$

where Z_i consists of Z_{ij} in equation 6. By substituting Eq 3 into 7, the zone temperature can be obtained as:

$$T_{z\tau} = \sum_{i=0}^{\infty} (H_{1i} W_{\tau-i} + H_{2i} Q_{\tau-i}) \qquad \text{Eq 1.2.2-8}$$

where H_{1i} and H_{2i} are calculated by matrix Z_i and S. To simplify the rest of the analysis the influence of the casual gain, Q_r is left out at this stage. As the disturbances W_τ consist of the deterministic part and the random part, $T_{z\tau}$, the zone temperature can be written as

$$T_{z\tau} = \sum_{i=0}^{\infty} H_i M_{\tau-1} + \sum_{i=0}^{\infty} H_i DX_{\tau-i} \qquad \text{Eq 1.2.2-9}$$

They then divide the zone temperature two parts, the deterministic part $T_{d\tau}$ and the random part $T_{r\tau}$:

$$T_{z\tau} = T_{d\tau} + T_{r\tau} \qquad \text{Eq 1.2.2-10}$$

$$T_{d\tau} = \sum_{i=0}^{\infty} H_i M_{\tau-i} \qquad \text{Eq 1.2.2-11}$$

$$T_{r\tau} = \sum_{i=0}^{\infty} H_i DX_{\tau-i} \qquad \text{Eq 1.2.2-12}$$

From equation 2, the stochastic process X_τ can then be expressed as

$$X_\tau = \sum_{i=0}^{\infty} \Psi_i A_{\tau-i} \qquad \text{Eq 1.2.2-13}$$

where

$$\Psi_i = \Phi^i \Theta$$

Then the stochastic model of the zone temperature can be obtained as

$$T_{r\tau} = \sum_{i=0}^{\infty} \sum_{j=0}^{\infty} H_i D \Psi_j A_{\tau-i-j} = \sum_{i=0}^{\infty} \Omega_i A_{\tau-i} \qquad \text{Eq 1.2.2-14}$$

where

$$\Omega_i = \sum_{j=0}^{i} H_j D \Psi_{i-j}$$

As A_τ are standard normal white noise, $T_{r\tau}$ is also a normally distributed multi-dimensional stochastic process of which the expectation value is zero. As the deterministic part of the zone temperature $T_{d\tau}$ varies with time, $T_{z\tau}$ is a non-stationary process. However, as the probability distribution of the $T_{z\tau}$ at every profile is a normal one, it can be described clearly with its first-order correlation matrix $R(T_{z\tau}, T_{z\tau+k})$ that can be calculated from equation 14 as

$$R(T_{z\tau}, T_{z\tau+k}) = R(T_{r\tau}, T_{r\tau+k}) = R_{Tr}(k) = \sum_{i=0}^{\infty} \Omega_i \Omega_{i+k}^T \qquad \text{Eq 1.2.2-15}$$

For $K = 0$, the $R_{T_r}(0)$ is

$$R_{T_r}(0) = \sum_{i=0}^{\infty} \Omega_i \Omega_i^T \qquad \text{Eq 1.2.2-16}$$

the main diagonal elements in $R_{T_r}(0)$ will be the devaitions of the zone temperature at each hour during a day and the other elements show the relations of the zone temperature between different times within a day. The expected process $T_{d\tau}$ and the first-order correlation matrix $R_{T_r}(k)$ give the whole characteristics of the zone temperature process.

1.3 Shortcomings of present methods

1.3.1 Deterministic methods

The stochastical problem is very difficult to solve. Not only does it require stochastic models for both buildings and weather, but also the computing power required is often not available to practicing architects and engineers. Since stochastic models were not available, deterministic models were developed to be used in the design of buildings and the sizing of HVAC systems. These deterministic models were not as accurate or complete as the stochastic models would have been, but for lack of better techniques the approximations they supplied help considerably.

These methods were created by organizations such as ASHRAE and CIBSE for use by their members. The problem was approached deterministically from the other angle - the question was if the building would be comfortable with the weather occurring only 1 or 2% of the time, and the answer was a simple yes/no. No or little computing power was required.

Input weather data was chosen as either a mean value or a 24 hour cycle, and well known heat transfer principles was used to calculate the deterministic HVAC load, or inside temperatures.

For the drive to improve the energy efficiency of buildings and their HVAC systems, we need much more sophisticated design measures. The common measures have already been applied. (Yoshida, H. and Terai, T., 1992) The first deterministic methods were developed when no or little computers were available to assist people. Those that were powerful enough were prohibitively expensive. Now everybody has a computer on her or his desk. This lead to the development of stochastic methods.

1.3.2 Stochastic and Monte Carlo methods

The Synthetical Reference Outdoor Climate as developed by Van Päasen and De Jong is method independent, as it is used to generate a large number of days for an outdoor climate that will conform to the real weather statistics. Although care is taken to account for all auto and cross correlations, it still uses generated data.

Any deterministic simulation method can be used to simulate all of the weather days generated. It can thus be used to generate data for a Monte Carlo method. It would, however, result in a large amount of simulations, which would still be time-consuming.

Hittle and Pedersen use their FFT plus ARMA model to be able to generate large amounts of weather data that was then simulated with Building Loads Analysis and System Thermodynamics (Blast) (Hittle, D.C., 1979). No attempt is made to reduce the amount of data needed. Also cross correlations are not considered. (Hokoi, S. and Matsumoto, M 1993)

Others, such as Hokoi et al and Yoshida et al, give stochastic building simulation models with their stochastical weather models. They base their weather models on the work of Hittle and Pedersen, with certain improvements. Most notably of these are the cross-correlation between Dry-bulb temperature and global radiation.

As can be seen from the discussion on the methods of Jiang and Hong given, these methods are either quite complex, or require simulations to be done for a large number of days. They are not accessible to most people who design buildings and install HVAC systems. This is a serious drawback.

1.4 Overview of Quick

1.4.1 Introduction

As an example of a deterministic model, Quick will be discussed in more detail. Van Heerden (Van Heerden, E et al, 1996) (Van Heerden, E 1997) used the first-order building model of Mathews, Richards and Lombard (Mathews, E.H. et al 1994) (Richards, P.G. 1992) as a point of departure, and continued with a similar philosophy.

The first order model was adequate for passive buildings, but not for buildings with HVAC systems installed. (Van Heerden, E et al, 1996) For this reason Van Heerden created a third order model. One of the very important philosophical ideas behind the first model was to obtain a physically interpretable thermal model. This was continued with the work of Van Heerden (Van Heerden, E. 1997).

Quick uses four climatic variables. Firstly outside dry-bulb temperature, measured in degrees Celsius. Secondly, global radiation on a horizontal surface, measured in kW/m^2. Global radiation is made up of beam, or direct radiation (i.e. direct sunlight) and diffuse radiation (the radiation that falls on surfaces in the shadow). The third variable is the diffuse radiation on a horizontal surface. Lastly is Relative Humidity, RH. This is the ratio between the mass of moisture in the air and the mass of moisture the air can absorb. (Van Heerden, E. 1997)

Van Heerden recommends the following procedure:

- The air node is treated as a separate node; its capacitance is simply $C_i = Volc_p$
- The ventilation, infiltration and environmental control are treated separately, i.e. the resistance is given as 1/air changes per second.

- Any internal masses are combined and treated as one capacitor.
- Provision is made for two structural heat flow paths:
    1. Glass, fenestration in general, and other low mass structures (low mass path, single node)
    2. A heavy mass path (triple node).
- The heat gains through the floor are treated separately, or incorporated into the internal mass.
- Convective heat gains act directly on the air node.
- Radiative heat gains are weighed according to surface area and act directly on the surface.

1.4.2 The Electrical analogy

The building model can be visualized by the electrical analogy given in Figure 1.4.2-1

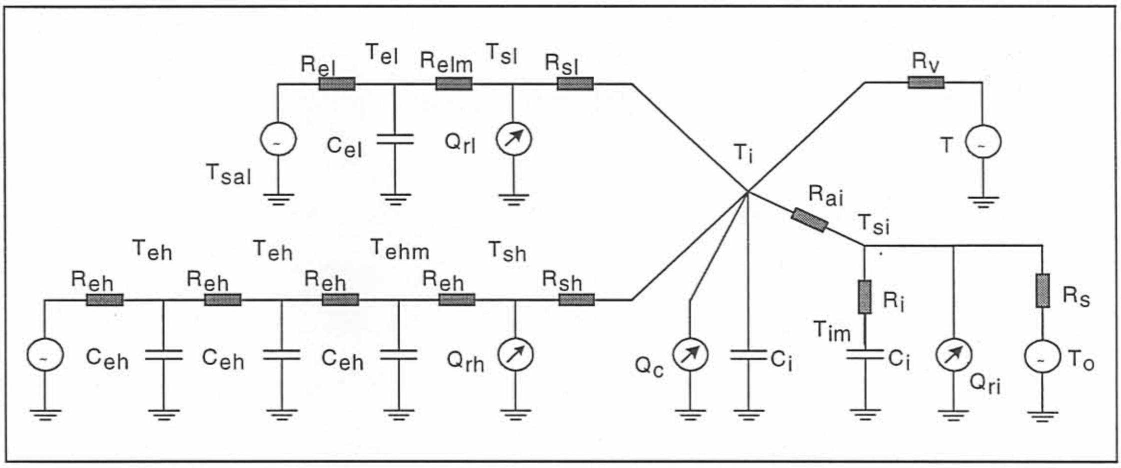

Figure 1.4.2-1

Physical restrictions on Ci and Ri are that the steady state thermal resistance used in the model must be equal to the total thermal resistance of the building, and the total capacity used in the model must be equal to the thermal capacity of the building.

The final model makes provision for all structural heat flow paths, i.e. a high mass flow path, a low mass flow path, internal mass, floors in ground contact, and convective heat flow by ventilation. It is solved using a forward-in-time differencing scheme.

1.5 Objective of this study

1.5.1 Why not implement an available method?

Since there are stochastic methods available, we have to ask why do we not simply use one of them? The reason is that the stochastic methods available up to now are complex. The weather normally has to be modeled by at least an FFT plus ARMA model, and cross correlations between temperature and radiation have to be considered. As can be seen from the methods of Jiang and Hong given, a complex simulation model must be set up. It is no wonder they are not freely available to people in the building industry.

The fact that an easy to use, physically interpretable method, such as the one used by Quick is available leads to the question: What if, by simply using a deterministic method together with a Monte Carlo method, an approximation of the stochastical answer could be found? This answer would greatly increase the information available, and assist in the process of design as well as the sizing of HVAC equipment.

Furthermore it would be far easier to implement. It would be less trouble than to develop a stochastic method or implement one of the highly complex methods already available. This way it will have an impact long before other methods, and it will move from the domain of the academic to be a practical tool.

1.5.2 Closure

The main aim of this study is to develop a Monte Carlo method to calculate the inside temperature statistics of the building heat transfer problem. This must be practical, available immediately and easy to use. It was decided to stick to the passive problem for now, so that all effort could be put into the ideas behind the method. Once the method is developed, and all the problems are better understood, it can easily be expanded to include all stochastic aspects.

For the same reasons the input variables was restricted to the weather. Apart from the building envelope, the weather has the most influence on the inside temperatures, more specifically dry-bulb temperature and radiation. (Hittle, D.C. and Pedersen, C.O., 1981)(Hong, T. and Jiang, Y., 1995) Relative humidity will for this reason not be considered a stochastic variable.

Since Quick uses global radiation, made up of diffuse radiation and direct radiation, global radiation cannot be considered apart from diffuse radiation. They will be considered as a single variable for the purpose of the Monte Carlo simulation. Temperature and radiation (combining the input global and diffuse radiation) are thus the chosen stochastic variables.

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Chapter 2

A new Monte Carlo method

2.1 Explanation of statistical concepts

2.1.1 Statistical Probability Density Functions and their application to the problem.

At this time a few statistical concepts should be explained. The standard way to present data about the probability of a certain variable having a given value is with a Probability Density Function, or PDF. A PDF is a function with a variable, such as temperature, on the horizontal and the expected probability of that variable for a specific differential interval on the vertical. The most well known of these is the Gaussian or Normal probability distribution.

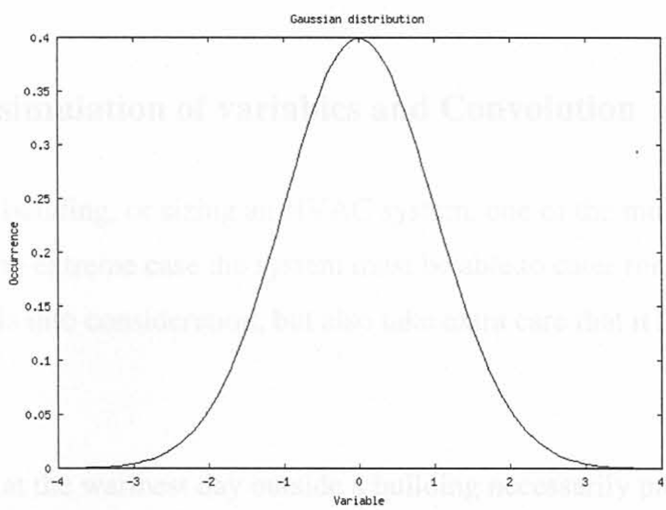

Figure 2.1.1-1

Figure 2.1.1-1 shows a Gaussian distribution, with a mean at 0, and a standard deviation of 1. If we want to find out the probability that an event might occur between two values of the variable, we find the area under the curve between those two values of the variable.

The weather data we have is in the form of hourly values. To generate PDF's from such data the following procedure was followed.

Bins were created for each hour, starting at -5 °C for temperature, with a one degree interval up to 45°C. For radiation bins started at -0.05kW/m^2 with a 0.05kW/m^2 interval, up to 2.45kW/m^2. Should a reading then be greater than the lower value of the bin, or smaller or equal to the higher value, that bin is incremented by one. A radiation reading of 0kW/m^2 would therefore be placed in the bin -0.05 to 0kW/m^2. This will ensure that any non-zero reading of radiation, no matter how small, will not be taken as zero.

As is the standard practice, the PDF's are then normalized by dividing each value with the area under the curve for that hour. The result is then written out a file that contains not only a PDF for each of the twenty-four hours per day, but also the bin information. This eases later use of the file.

2.1.2 Separate simulation of variables and Convolution

When designing a building, or sizing an HVAC system, one of the most important considerations is the extreme case the system must be able to cater for. We therefore need not only to take this into consideration, but also take extra care that it is adequately described.

We cannot state that the warmest day outside a building necessarily produce the warmest inside climate. "Almost invariably the hottest days are not those with the greatest amounts of solar radiation."(Chartered Institution of Building Services Engineers, 1986) This brings us to a problem, what days should we select for the extreme case? Should we base it on the outside temperature or radiation? We cannot base it on the sol-air temperature at this stage, that requires information on the color of the building, and we do not have that information beforehand.

We also cannot simply use the extreme temperature together with the extreme radiation, since this is not a realistic or possible weather day. The only output variable we are interested in at the moment is the statistics of the inside temperature. If we can see the effect of each variable on its own, and then find the combined effect, this would be perfect. But the combined effect cannot be found by normal addition.

This brings us the process of convolution. To quote "If two quantities can assume values of x describable by frequency distributions $P_1(x)$ and $P_2(x)$, respectively, then their sum is described by a frequency distribution P(x) given by $P(x) = P_1(x) * P_2(x)$", where * indicates the standard convolution integral. (Bracewell, R.N., 1978) This is true if the two distributions are independent from one another.

The convolution integral is given by Numerical Recipes in C (Press, W.H. *et al*, 1992) for functions g and h:

$$g * h \equiv \int_{-\infty}^{+\infty} g(\tau)h(t-\tau)d\tau \qquad \text{Eq 2.1.2-1}$$

Since we will work with discrete distributions, we will use the discrete form, again from Numerical Recipes in C:

$$(r * s)_j \equiv \sum_{k=-M/2+1}^{M/2} s_{j-k} r_k \qquad \text{Eq 2.1.2-2}$$

By using the convolution integral we can combine the output statistics of both input variables. The problem is that the weather variables we are working with have cross-correlation's, as explained earlier. For the time being we will assume that they can be neglected, and later test the results to find the error made.

2.2 Development of a new Monte Carlo technique

2.2.1 Introduction to Monte Carlo techniques

The simplest way to compute any problem with random input will be to have simulations for all possible inputs. Computationally, this would be prohibitively expensive. The other option is to randomly select possible values for the input variables. If we assume that the output we get from this is a representative sample from the whole population, we can calculate the statistics of the output with much less effort. This is known as a Monte Carlo method.

A True Monte Carlo Method would entail full random selection, out of all possible values. It was quickly realized that by being selective about the selection of data, the amount of simulations could be reduced even further. Care must be taken, however, not to influence the outcome too much. At the end, the results will have to be tested to prove that the selection process did not bias the result.

While trying to find a Monte Carlo method we must always remember the 3D nature of our input. We have two input PDF's for each hour, one for outside temperature and one for outside radiation, or assembled for a day as in Figure 2.2.1-1.

What we are looking for is a method to map these distributions of the outside variables to the inside temperature distribution. For this we need to select a number of days of 24 hour outside data so that a deterministic program can be used to simulate them. From the output an approximation must then be found of the distribution of the output variable.

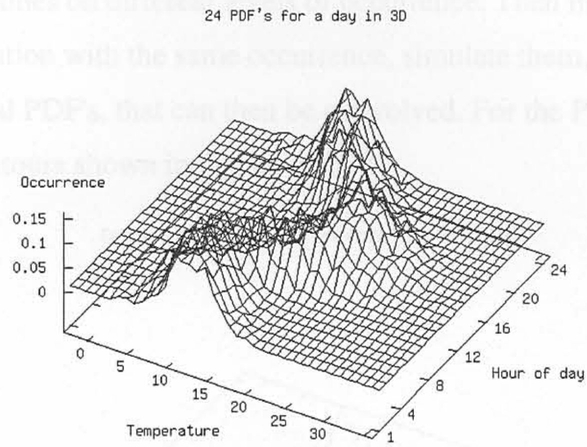

Figure 2.2.1-1

2.2.2 Method of Contour lines

The first possible method comes from data as supplied by CIBSE (CIBSE, 1986). They give banded weather data for different locations. This data is set up by taking the range of radiation data, dividing it by ten, and then giving the proportion of the month that falls within each of the 10 bands. The coincident max, mean and min temperatures are then given for each band. Data is also available where the banding was done with the temperature data, and coincident radiation is given.

Clearly this is a start, but fundamental problems arise if the data must be used for a statistical method. First, we will have to decide on a set, either banded according to radiation or to temperature. This then may not include that day that the building under consideration will be at its most extreme internal climate. Also the data is given on a daily value, with little possibility for accurate hourly predictions. This is because the data is primarily for the calculation of simplified monthly energy usage.

With the theory of convolution as discussed earlier this idea can be adjusted slightly: Use the PDF's as we have it for the external weather, considering radiation and temperature apart. Draw contour lines on different levels of occurrence. Then make up days of hourly temperatures or radiation with the same occurrence, simulate them, and assemble the results for the internal PDF's, that can then be convolved. For the PDF's of Figure 2.2.1-1 this will give the contours shown in Figure 2.2.2-1:

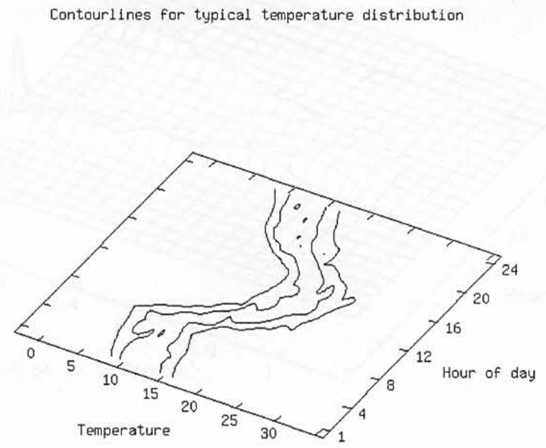

Figure 2.2.2-1

Problems arise here because of the fact that the distributions during the night, because of a smaller range, normally have a higher maximum occurrence. If a contour line is set on one of these values of maximum occurrence, there is no corresponding value during the daytime. If all contour lines are chosen to ensure they fall below this point, the maximum occurrence values of the night time is not accounted for.

This problem is most noticeable with radiation. There all the nighttime values are 0, giving an impulse function for a PDF. Even if only hours with radiation are considered, there are still major problems with the differences in range and maximum value of occurrence. Figure 2.2.1-1 and Figure 2.2.2-1 represent typical temperature data. Figure 2.2.2-2 shows typical radiation data, and figure 2.2.2-3 show the contours of such data.

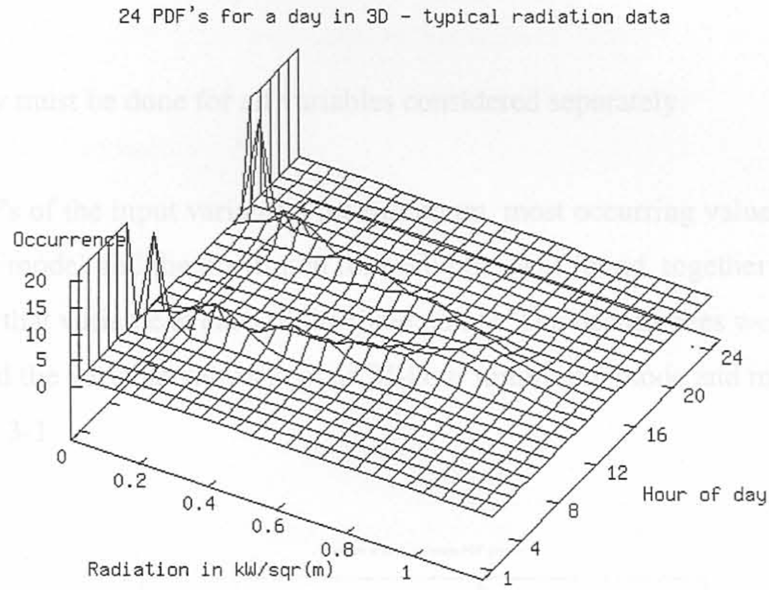

Figure 2.2.2-2

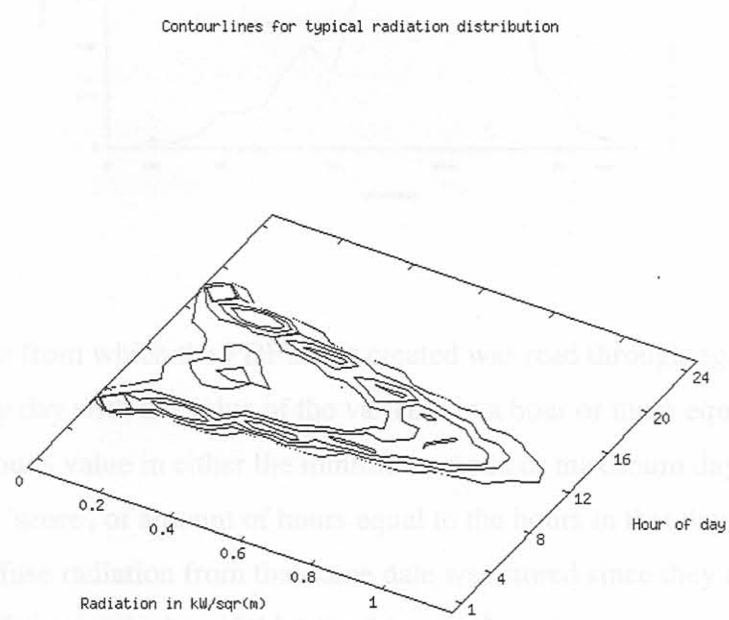

Figure 2.2.2-3

Clearly this will not work.

2.2.3 Method of minimum, mode and maximum

All that follow must be done for all variables considered separately.

From the PDF's of the input variables, the minimum, most occurring value of the variable (known as the mode) and the maximum for each hour was found, together with the occurrence of that variable at each of the three points. The occurrences were stored separately, and the variable values kept as 24-hour minimum, mode and maximum days. See figure 2.2.3-1

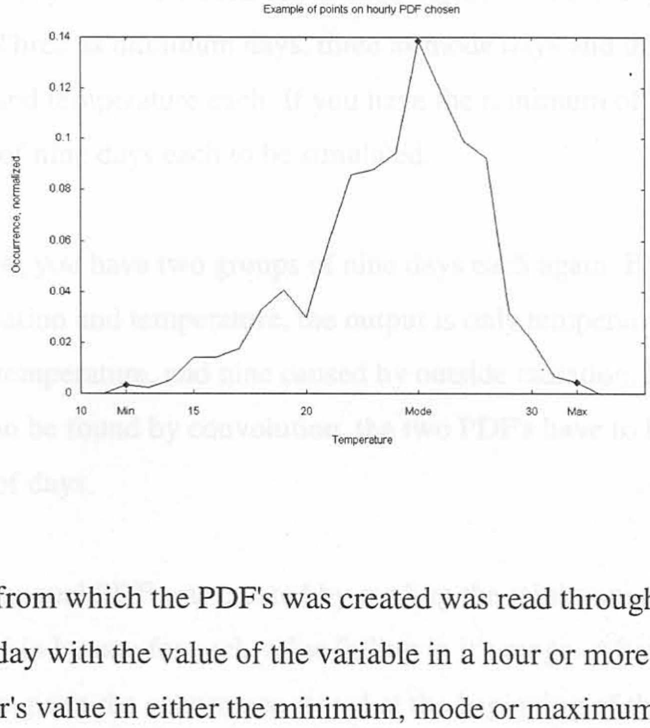

Figure 2.2.3-1

Now the raw data from which the PDF's was created was read through again. This time the data from any day with the value of the variable in a hour or more equal to the corresponding hour's value in either the minimum, mode or maximum day was stored, together with it's 'score', or amount of hours equal to the hours in that day. With global radiation, the diffuse radiation from that same date was stored since they are considered fully dependent (i.e. as a single variable) for this exercise.

Next the top three scores were found from the stored data, together with the amount of times they occurred. In other words, lets say that the top three scores found was 15, 13 and 10, then the amount of days those scores occurred will be counted. From this the best three days must be chosen. If the top score, in this case 15, occurred 3 times, or the top 2 scores together occurred 3 times, or the top 3 scores together occurred 3 times, then no random selection is necessary.

However, if the top score occurred more than three times, three days with that score was randomly chosen. If the top score occurred two times and the second one more than one time, one day of the second score was randomly chosen. The rest of the logic is self-evident.

In this manner nine days were selected out of each variable. These days are real, made up of measured data. Three as minimum days, three as mode days and three as maximum days for radiation and temperature each. If you have the minimum of two variables, this leaves two groups of nine days each to be simulated.

After the simulation, you have two groups of nine days each again. But where the input variables were radiation and temperature, the output is only temperature, nine days caused by outside temperature, and nine caused by outside radiation. Before the combined effect can be found by convolution, the two PDF's have to be reconstructed out of the two groups of days.

First a three dimensional PDF was created by reading the minimum days and incrementing each bin by one for each value falling in it's range. After that the value occurring most was given the occurrence stored at the beginning of the exercise. The same was done for the mode and maximum days.

The PDF was completed by calculating the values of the empty bins by assuming a straight line from the first value in the PDF to the highest occurrence, and another line down from the highest occurrence to the last value of the PDF. The shape of the PDF is thus a simple triangle.

Because the output variable values was given the same occurrence as the input value, it was in effect assumed that the effect of the process on a single variable would be to stretch the PDF by lengthening or shortening the x-axis, but not changing the shape in the y direction. The y values would only be influenced by the re-normalization necessary. This assumption can alternatively be stated that if the input variable is changed in a certain way, the way the output variable change would be constant, no matter where in the range of the input variable the change occurred.

At this stage you are left with two PDF's for the inside variable as result of the each of the input variables. After convolution the result is then again a single PDF, the combined effect.

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Chapter 3

Case studies

3.1 Case descriptions

The method described in the previous chapter for estimating the inside temperature statistics was based on a well-verified deterministic method. It should therefore be applicable to all problems the deterministic method can be used for, provided the input data set is available. Still, different cases are needed to verify the Monte Carlo method.

For this reason the building selection was not considered critical. Input Data for several buildings used by Van Heerden (Van Heerden, E., 1997) and Ellis (Ellis, M.W., 1999) for verification studies was available. From this four buildings were chosen to test the method developed.

This ensures that the buildings used will be realistic. The details of the buildings are from the study of Ellis. To ease comparison with the work of Van Heerden and Ellis the designations they used for the buildings was kept. Detailed descriptions can be found in Appendix C.

Deciding on a ventilation rate to use for the building can also be tricky. Van Heerden gives values for the number of Air Changes per Hour (ACH) for a tight building as 0.5 ACH and for a very leaky building as 2 ACH. This can be taken to be a building with closed windows. When a building with open windows is considered, the ACH rates can be a lot higher. For this reason it was decided to use ventilation rates of 0, 1, 5, 10 and 50 ACH (Air Changes per Hour).

3.2 Input data

3.2.1 Time span and location

In order to find the statistics of the input variables, measured input data will have to be used. For the statistics to be reliable, this data will have to span some years. This must be the same type of data as used by Quick. Furthermore weather data is highly dependent on the site, as thus data from only one site is acceptable.

For the true nature of weather data to be clear, as much weather data as possible is needed. The South African Weather Bureau was able to supply data collected at the Irene weather station near Pretoria, since hourly data for temperature, humidity and global radiation was available for this site. (SAWB, 1999)

Although data for many of the months of 1993 were available, the data did not span the whole of that year. It was decided to stick to whole annual cycles, as this is one of the main periods of the data. (Hittle, D.C. and Pederson, C.O., 1981) Thus the five years of 1994-1998 was used. This data was made available in electronic format, making the subsequent analyzing and processing easier. Data files were of global radiation in mega joules, temperature in degrees Celsius and relative humidity as the fraction of the mass of water in the air divided by the mass the air can hold, expressed as a %. (SAWB, 1999)

Unfortunately diffuse radiation data are not measured at most weather stations, including Irene. For these locations ways have to be found to calculate the diffuse from the global values.

3.2.2 Calculation of Diffuse radiation

Several formulas exist for the calculation of diffuse radiation from the Global. Kimura (Kimura, K., 1977) gives an equation of Liu and Jordan (Liu, B.Y.H., and Jordan, R.C., 1960), Eq. 3.2.2-1. According to Lunde (Lunde, J.L., 1980) this is based too heavily on data from Blue Hill, Massachusetts. He then goes on to give a formula by Page, Eq 3.2.2-2 (Page, J.K., 1961)

$$\frac{I_{SH}}{I_O} = \sin\beta(0.2710 - 0.2913\frac{I_{DN}}{I_O}) \qquad \text{Eq. 3.2.2-1}$$

Where

I_{SH} = Diffuse solar radiation

I_O = Solar constant

β = The angle between the sun and the earth

I_{DN} = Direct normal solar radiation

$$\left(\frac{\overline{H_{Td}}}{\overline{H_T}}\right) = 1.00 - 1.13\overline{K_T} \qquad \text{Eq 3.2.2-2}$$

Where

$\overline{H_{Td}}$ = Monthly daily-average diffuse radiation on a horizontal surface

$\overline{H_T}$ = Monthly daily-average total global radiation on a horizontal surface

$\overline{K_T}$ = Clearness index, defined by $\overline{H_T}/\overline{H_{OT}}$, where

$\overline{H_{OT}}$ = Monthly daily-average extraterrestrial radiation on a horizontal surface

As with most methods, Page calculates the monthly Clearness Index, an indication of the fraction of extra terrestrial radiation that reaches the earth. This is then used in an linear relationship with the global radiation to give the diffuse.

It was decided to use the method of Page. According to Lunde it correlates well with Choudhury, (Choudhury, N.K.O., 1963) Stanhill (Stanhill, G., 1966) and Norris (Norris, D.J., 1966). It would be advisable to obtain new recent constants for South Africa, but none was available.

All these methods were set up to give the total amount of diffuse radiation per day, and use a clearness index to give it as a fraction of the global radiation for the entire day. But Quick uses hourly values of all its variables.

The problem is that although the total diffuse radiation for the day will still be correct, if the hourly value of global radiation is used to calculate the diffuse part, then the ratio of diffuse/global will stay constant during the day. It is well known that this is not the case, and that when the sun rises and sets the ratio is much larger than during the middle of the day, when it will be at a minimum.

At the moment this remains the best method available. It should be remembered that the global radiation would always be a lot more than the diffuse. Therefore this approach can be used for the moment. If and when a better method does come to the fore, or preferably measures values of diffuse radiation becomes available, it should be implemented without delay.

3.2.3 The reasoning behind and selection of periods of similar weather.

The reason to change to Monte Carlo simulations is to have available the statistics of the output variable of the problem. The simulation must calculate these statistics as completely as possible. Software should then interpret it in such a way that the user can extract all useable information without being confused.

The most comprehensive solution suitable for our needs will be where the full internal temperature PDF for any time is known for each and every day of the year. In this way it would be easy to find out exactly for what days cooling might be necessary, when it should heated, and for what times in the year there will be heating and cooling days. The maximum heating/cooling load will also be clear, as well as total power consumption.

From a full and true stochastic answer this can be found. However, for reasons as explained, we decided on a Monte Carlo method. To get this type of detail from a Monte Carlo method would entail a huge amount of data and very long simulation times. Weather data for many years will be needed in order to have a high enough certainty for the data of each day.

Being engineers, we have to make a working compromise between the limited data available, the amount of computing time necessary, and the extra accuracy obtained for the effort. It was thus decided to make a study to see in how many discrete periods of assumed constant weather the year can be divided.

The monthly average was calculated for temperature and radiation over the time period chosen. After this was presented graphically it was decided that for Irene four periods would define the problem sufficiently. See figure 3.2.3-1. These roughly concur with the seasons. Summer for Oct, Nov, Des, Jan, Feb and March. April and May for fall, June and July for winter, August and September for spring.

It must be made clear that this part of the analysis must be done for each new location. Hokoi et al divided the weather of Tokyo into winter and summer, although no indication is given of the reasoning behind this. (Hokoi, S. *et al*, 1990) Locations on the equator, for example, will have marked different periods of constant weather.

These weather data periods can now be treated as times of constant weather, and input statistics calculated for each of them. This would mean that with two variables chosen as stochastical, the whole Monte Carlo method would use 72 days to describe the weather statistics of 1826 days, 4% of the total.

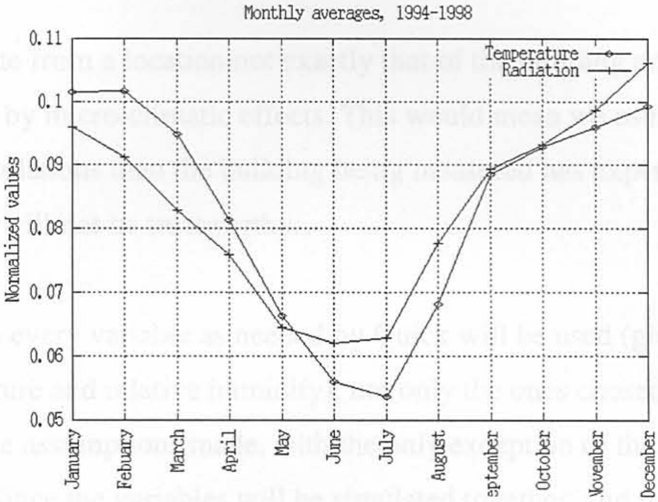

Figure 3.2.3-1

3.2.4 Data simulations for testing purposes.

As previously said, the reasoning behind this study is to develop a Monte Carlo method to give estimates of the output statistics with minimal effort. For this a deterministic tool will be utilized. Quick was chosen, in part because of its extensive verification. (Van Heerden, E., 1997)

In the end, the results as obtained by the Monte Carlo method developed in this study will have to be tested against measurements. However, since measurements are not available it was decided that it would be better to test against the results as obtained by simulating each day with QUICK. This would be taken as equivalent to a full 5 years of measured building internal temperatures.

Because of the verification done on the program, the results can be trusted. Furthermore, a full 5 years of real weather data will be used. It would be out of the time frame available for this study to measure a full 5 years of indoor temperature for a building. We will then also know that we have the exact corresponding external climate, and not the external climate for a location some distance away.

The external climate from a location not exactly that of the building under consideration may be influenced by micro-climatic effects. This would mean we use a different external climate for the simulations than the building being measured has experienced. In the end our measurements will not be trustworthy.

For this simulation every variable as needed by Quick will be used (global and diffuse radiation, temperature and relative humidity), not only the ones chosen as stochastical. This will test all the assumptions made, with the only exception of the calculation of the diffuse radiation. Since the variables will be simulated together, and no convolution will be done, cross-correlation's between different variables are inherently considered.

These simulations were done for the same ACH rates and houses used for the Monte Carlo simulations. After the simulations was done the PDF's for the inside temperature was obtained from the raw data, one for each hour of each of the periods of constant weather. These full simulations represent the true inside temperature statistics.

At the same time, the effect of the convolution done must be tested as well. Not only do we know there are cross-correlation's between the variables, but also we know for the convolution process to be correct the variables have to be independent. For this reason a second full simulation was done, this time simulating the temperature and radiation parts of the input as separate variables. The most important reason for this simulation is to see how big an error is made by assuming the variables are independent from one another, and if the error is acceptable. This was also done for the four houses, as well as the different ACH rates decided upon.

After simulating the separate variables, the PDF's was created for each season for each hour for each output variable. The output variables are inside temperature caused by outside temperature, and inside temperature caused by outside radiation. The combined effect was then found by convolving the PDF's, to obtain the statistics of the single output variable, inside temperature caused by outside weather.

These full convolutions represent the best possible result. They will be compared to the full simulations to see if the assumption that radiation and temperature can be taken as independent creates unacceptable errors.

3.3 Results

Input files were created with the method of minimum, mode and maximum. They are for the different seasons, for temperature with radiation, global and diffuse, and relative humidity taken as zero and for radiation, both global and diffuse, with temperature and relative humidity taken as zero. Simulations were then run for the four houses, for the different ACH rates, and from this PDF's were created with the method discussed.

Statistically the accepted way to test the result would be to use a Chi-square test. This would give an answer as the percentage chance that the two distributions were drawn from the same population. Lets look at Figure 3.3-1. The smooth curve is a PDF result from the Monte Carlo method, and the jagged curve a PDF from the full simulation.

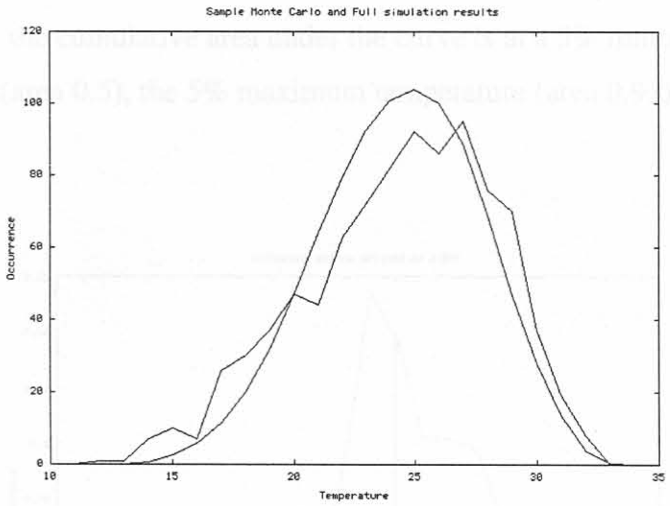

Figure 3.3-1

If we look at the distributions, we can see that they are not too different. The Chi-square statistic for two binned data sets is given by: $X^2 = \sum_i \frac{(R_i - S_i)^2}{R_i + S_i}$ (Press, W.H. et al, 1992). If this is calculated for these two curves, with the full simulation curve not normalized, and the area under the Monte Carlo curve made to be equal to that of the full simulation curve, we have a chi-square statistic value of 40. 53, and 22 degrees of freedom. See Appendix D for more detail.

We use the incomplete gamma function to find the percentage chance that the two distributions are from the same population (Press, W.H. et al, 1992) and we get an answer of 0.937%. From this we will decide that the distributions are not from the same population, and that the Monte Carlo method did fail. At the same time, we do not know far will the answer be out. The Chi-square does not give an indication of this. We knew we were not going to be 100% accurate. Therefore it was decided to find another way of presenting the results.

The most important question will be: if the Monte Carlo method predicts a temperature of 29 and higher for 5% of the time, how far will it be out? To answer these types of questions, five points on the PDF was defined, the minimum temperature expected, the temperature where the cumulative area under the curve is at a 5% minimum or 0.05, the mean temperature (area 0.5), the 5% maximum temperature (area 0.95) and the maximum temperature.

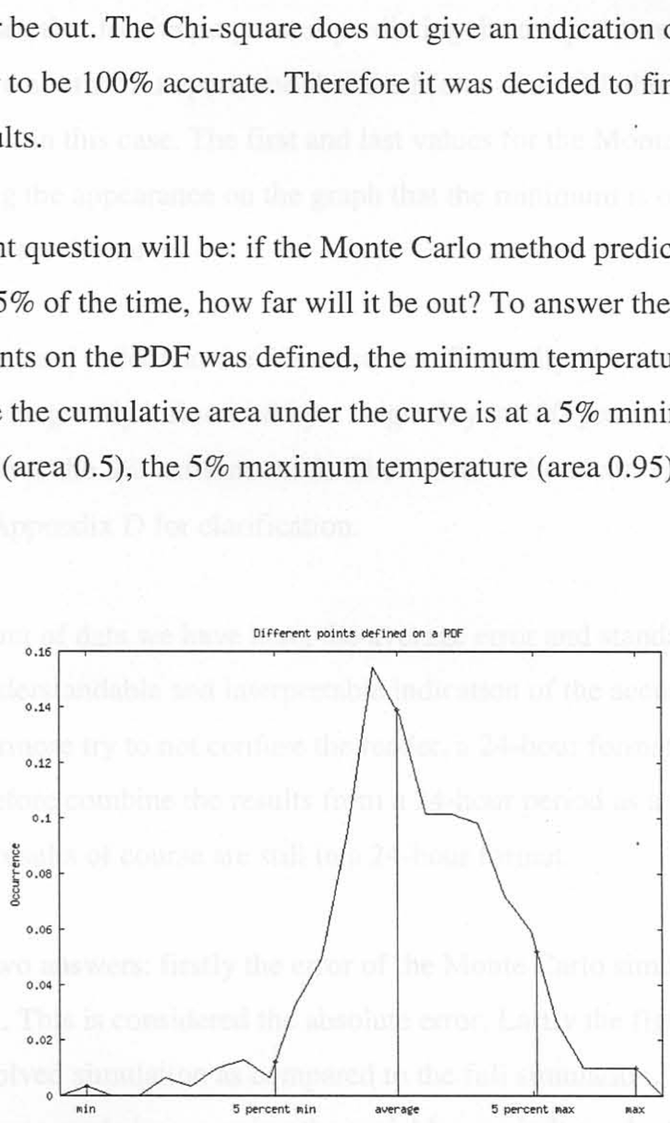

Figure 3.3-2

By then deducting the temperature predicted by the full simulations from that predicted by the Monte Carlo method at these points, the error made by the Monte Carlo method can be found. If we find these errors for the same PDF's in figure 3.3-1, we find that both show the minimum temperature as 12 degrees. The 5% minimum of the Monte Carlo is out by 1.4 degrees, the average by 0.31, the 5% maximum by 0.5 and the maximum by 2 degrees.

From this we can see that for the purpose of predicting the temperatures inside a building, these two PDF's are not that far apart, and that the Monte Carlo Method produced quite a good approximation in this case. The first and last values for the Monte Carlo method are very small, creating the appearance on the graph that the minimum is out by 2 degrees, and the maximums are the same.

This underlines the need to look at the 5% extremes. Generally, the maximum and minimum can also be greatly influenced by a single day in 100 years, but the effect will not be as noticeable at the 5% extreme mark. The values of both curves are given in tabular format in Appendix D for clarification.

For the large amount of data we have here, the average error and standard deviation of the error give a understandable and interpretable indication of the accuracy of the method. To furthermore try to not confuse the reader, a 24-hour format was not used. All figures given therefore combine the results from a 24-hour period as a single number. The Monte Carlo results of course are still in a 24-hour format.

The figures give two answers: firstly the error of the Monte Carlo simulation compared to the full simulation. This is considered the absolute error. Lastly the figures give the error made by the convolved simulation as compared to the full simulation. This will give an indication of the error made by assuming the variables are independent.

The first figure gives these two answers if all the data points are considered, i.e. all ACH's, houses, seasons and positions on the PDF are used. The rest of the graphs give the two answers split up according to the different variables, i.e. ACH's, houses, seasons and positions on the PDF used. In Appendix A the information of the figures are given in tabular format, and Appendix B gives the detailed results.

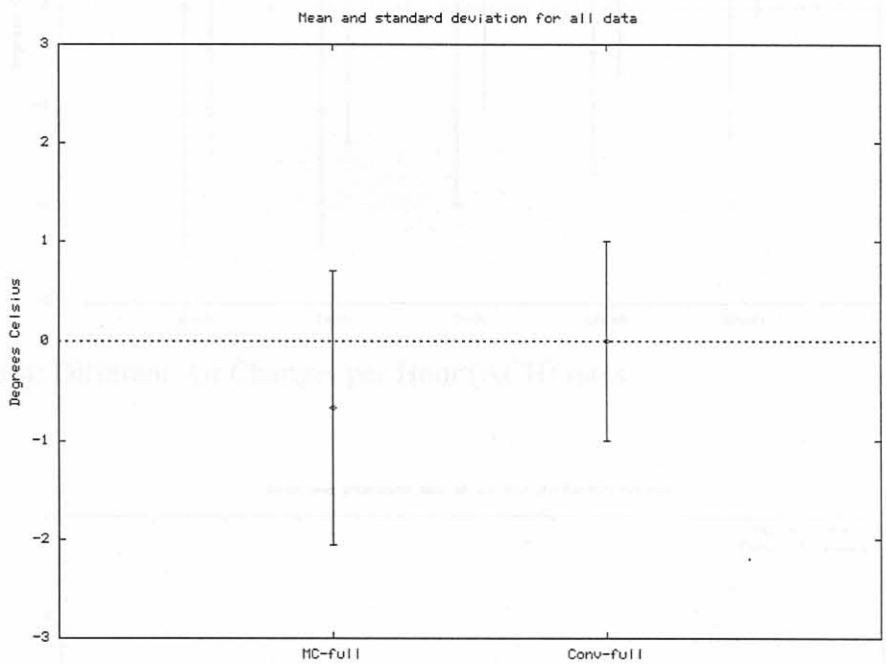

Figure 3.3-3 All data points

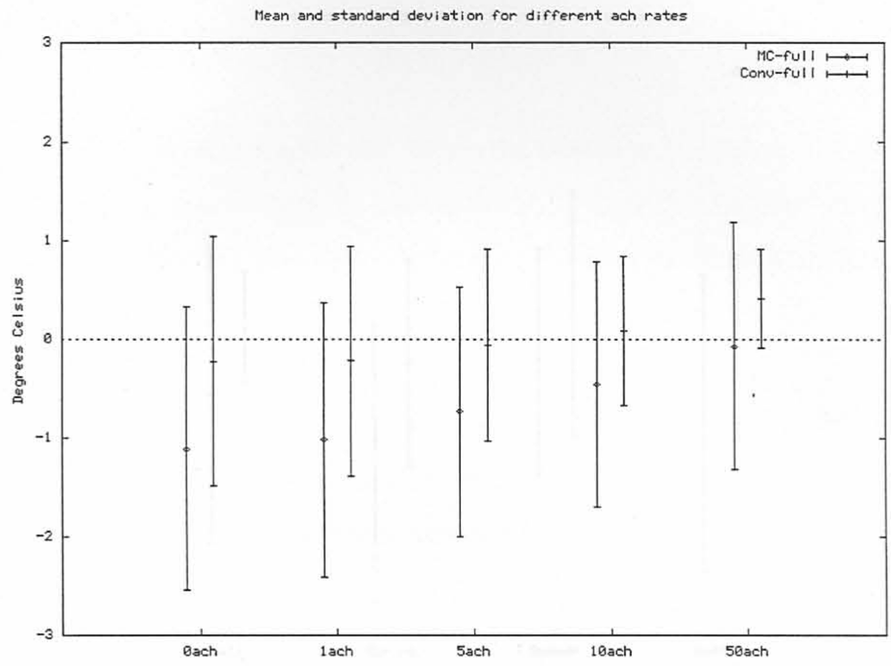

Figure 3.3-4: Different Air Changes per Hour (ACH) rates

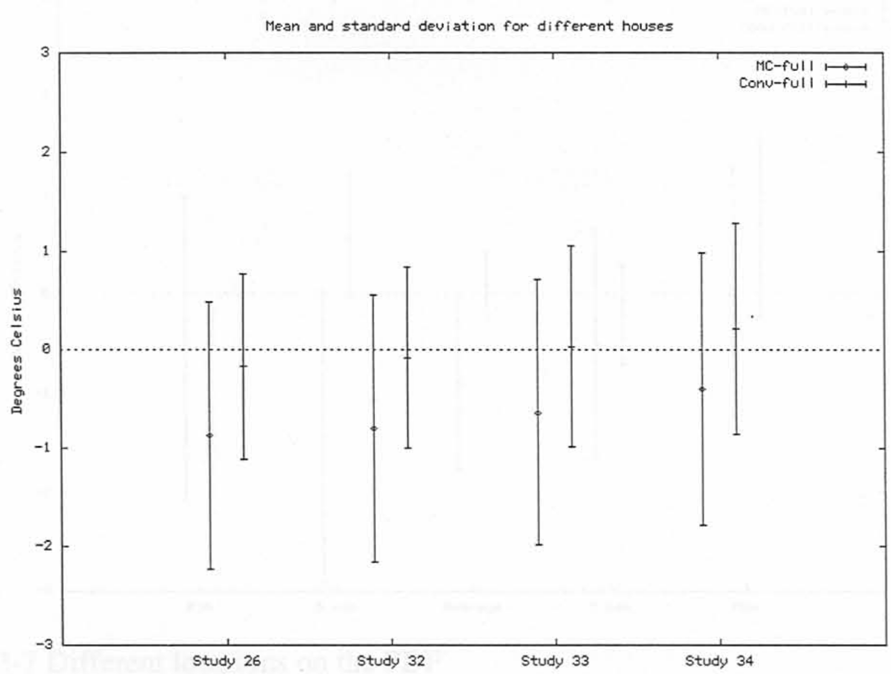

Figure 3.3-5 Different houses

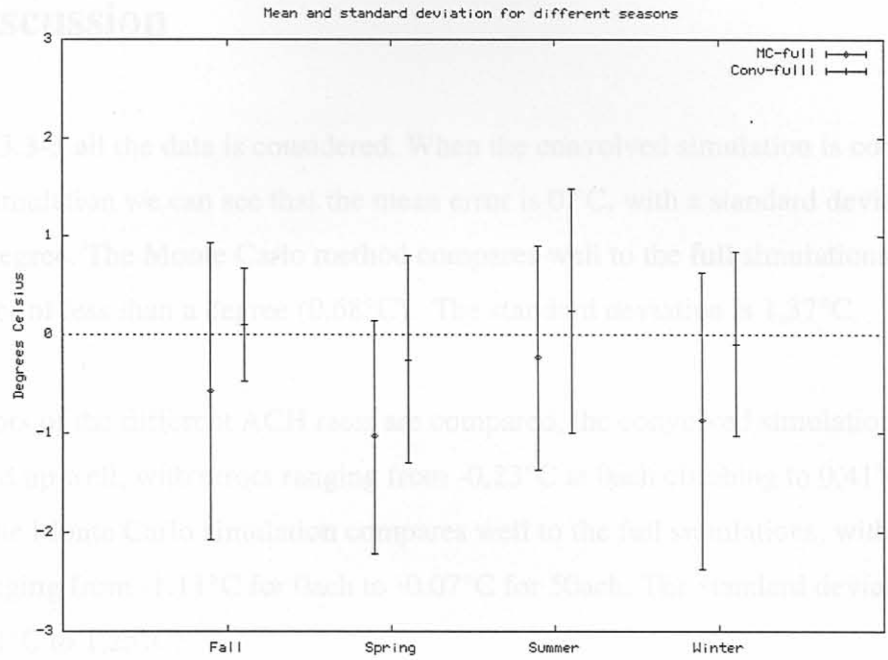

Figure 3.3-6 Different seasons

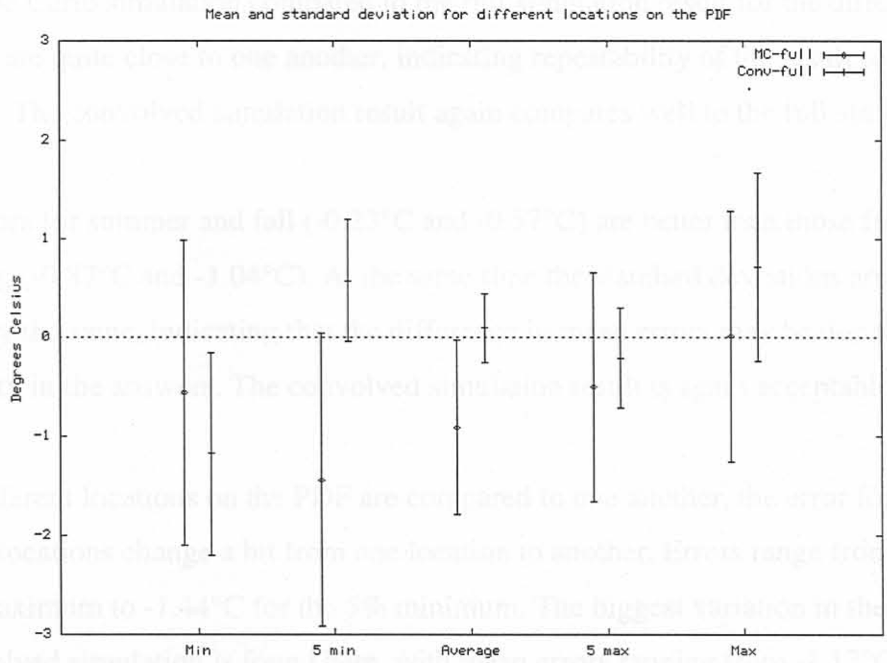

Figure 3.3-7 Different locations on the PDF

3.4 Discussion

In figure 3.3-3 all the data is considered. When the convolved simulation is compared to the full simulation we can see that the mean error is 0 °C, with a standard deviation of about 1 degree. The Monte Carlo method compares well to the full simulations, with a mean error of less than a degree (0.68°C). The standard deviation is 1,37°C.

If the errors of the different ACH rates are compared, the convolved simulation result again hold up well, with errors ranging from -0,23°C at 0ach climbing to 0,41°C at 50ach. The Monte Carlo simulation compares well to the full simulations, with mean errors ranging from -1.11°C for 0ach to -0.07°C for 50ach. The standard deviations range from 1,44°C to 1,25°C.

The Monte Carlo simulation compared to the full simulation result for the different buildings are quite close to one another, indicating repeatability of the result for different buildings. The convolved simulation result again compares well to the full simulation.

Mean errors for summer and fall (-0.23°C and -0.57°C) are better than those from winter and spring (-0.87°C and -1.04°C). At the same time the standard deviations are practically the same, indicating that the difference in mean errors may be due to the uncertainty in the answers. The convolved simulation result is again acceptable.

When different locations on the PDF are compared to one another, the error for the different locations change a bit from one location to another. Errors range from -0.02°C for the maximum to -1.44°C for the 5% minimum. The biggest variation in the result for the convolved simulation is found here, with mean errors ranging from -1.17°C to 0.71°C.

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Chapter 4

Conclusion

4.1 Validity of Assumptions made

Before we can judge the success of the Monte Carlo Method, we first need to look at the assumptions made. Some of them can be justified in the end by the comparing the results of the full simulations with the results of the Monte Carlo method, some, however, may not be justified in this manner. They will have to be re-evaluated at this time.

1) The use of Quick will not invalidate the results.

Since the method needs a deterministic method, one had to be chosen. Because of the extensive verification done on Quick, we can accept the method. (Van Heerden, E., 1997)

2) Five years of data is enough for the statistics to be accurate.

There is no way of knowing this for sure, and the only way to test it would be to test it against a larger period of weather. If we had such a period, we would have used that from the start. We should therefore state our answer in the form: "During the years 1994-1998, the building would have performed in the following manner..." This is a case of doing the best with what is available, and is enough to test the method.

3) The calculation of diffuse radiation is accurate enough.

The lack of measured diffuse radiation data is a difficulty for all simulation techniques, and the best method available for finding the diffuse radiation was used. The global radiation is far more important, and therefore the effect of diffuse radiation should be minimal.

4) The method will be valid for different houses and cases from that used for the simulations.

Because the method makes no assumptions about the building itself or variables other than climatic variables, it should be valid for all buildings and variables other than climatic variables.

5) No unacceptable errors were introduced by assuming that the temperature and radiation can be considered independent.

The most important question we have to ask ourselves is how large an error did we introduce by assuming that temperature and radiation can be taken as independent variables. If all the data is considered, there is a mean error of 0°C and a standard deviation of 1 degree. This result is better than expected, and within the range of errors we can expect from any thermal simulation.

When the data is split up into different categories, the assumption of independent variables again did not introduce any large errors. We can therefore conclude that assuming that temperature and radiation are independent variables did not introduce unreasonable errors, and we can safely continue with the method.

4.2 Success of the Monte Carlo method

The Monte Carlo method produced good results for the case studies. If the results from the method are compared with the results of the full simulations, we see that if all the data is considered, the mean error is -0.68°C, with a standard deviation of 1.37°C. When the different categories are considered, again the result is acceptable. The main aim of this study was to develop such a Monte Carlo method to calculate the inside temperature statistics of the building heat transfer problem.

It was shown that the method developed successfully approximated the inside temperature statistics for a five-year period by using only 72 (18 days per period of constant weather, with four such periods for this location) days, instead of the 1826 for a full five years. This means by using only 4% of the total data, a good approximation of the output statistics could be found. If a longer period of weather is used as input, there would still be only 18 days needed per period of constant weather.

The method is very practical and easy to understand, and can be used together with any deterministic method. It is open to include more variables, by simply setting up the statistical distribution of the input variable, choosing the nine days to simulate, and convoluting the end distributions.

4.3 Possible improvements

From what was discussed the first improvement suggested is to change the shape of the PDF's created by the Monte Carlo method. At the moment they are simple triangles. If one considers that the area's are normalized, i.e. made equal to one, then the occurrence values of the input distributions used does not make that much of a difference.

To explain: the values of the input occurrence values used were that at the first non-negative occurrence value, the most occurring value and the last non-negative value. The first and the last values are obviously small compared to the middle value. Then a simple triangle is constructed, and the area normalized. From this we can take the base length, the difference between the first and last non-negative value, as a known quantity.

Then the height of the triangle can be found from the formula for the area of a triangle: area = 1/2 x height x base, or in terms of the height: height = (area x 2) / base. With area = 1, the only variable remaining is where the highest part of the triangle lies.

Furthermore, the real distributions are not very triangular in shape. It is therefore suggested that the complete shape of the input PDF is used to build a PDF from the three data points found by the Monte Carlo method. In figure 4.2-1 a typical temperature output PDF for the convolution process is show, together with the triangular PDF created for the same case by the Monte Carlo method.

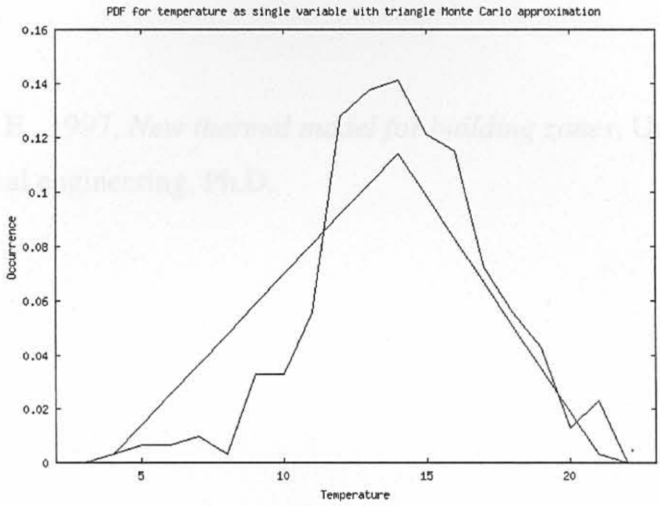

Figure 4.2-1

The next area open for improvement is the diffuse radiation used at the moment. Measured data is most definitely the desired option. If that cannot be found then a method will have to be found that can include parameters such as overcast days, where the diffuse radiation will differ considerably from that found by a clearness index method. With a clearness index method the diffuse radiation is considered in a fixed relation to the global radiation for a certain month.

The last improvement is the time-span for the raw weather data used. For this exercise only five years worth of data was used. The more data is used, the more accurate the input distributions will be. Also there may be unknown weather cycles spanning more than five years.

References:

VAN HEERDEN, E., 1997, *New thermal model for building zones*, University of Pretoria, Mechanical engineering, Ph.D.

Appendix A

Abbreviated results in tabular format

All Data:	Mean error	Standard deviation of error
MC-Full	-0.68	1.37
MC-conv	-0.68	1.33
Conv-full	0.00	1

Different ACH						
ACH Rate	MC-full		MC-conv		Conv-full	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
0ach	-1.11	1.44	-0.88	1.34	-0.23	1.26
1ach	-1.02	1.39	-0.80	1.33	-0.22	1.16
5ach	-0.73	1.26	-0.68	1.30	-0.05	0.97
10ach	-0.46	1.25	0.54	1.32	0.09	0.76
50ach	-0.07	1.25	-0.48	1.31	0.41	0.50

Different houses						
Study	MC-full		MC-conv		Conv-full	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
26	-0.87	1.36	-0.70	1.29	-0.17	0.95
32	-0.80	1.36	-0.72	1.33	-0.08	0.92
33	-0.64	1.35	-0.67	1.33	0.04	1.02
34	-0.40	1.38	0.62	1.36	0.21	1.07

Different seasons						
Season	MC-full		MC-conv		Conv-full	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Fall	-0.57	1.50	-0.67	1.64	0.10	0.57
Spring	-1.04	1.17	-0.78	1.14	-0.25	1.05
Summer	-0.23	1.14	-0.47	1.10	0.24	1.25
Winter	-0.87	1.50	-0.77	1.34	-0.10	0.94

Different positions on the PDF						
Position	MC-full		MC-conv		Conv-full	
	Mean	Standard Deviation	Mean	Standard deviation	Mean	Standard deviation
Min	-0.55	1.55	0.63	1.14	-1.17	1.02
5 % min	-1.44	1.47	-2.01	1.24	0.58	0.62
Average	-0.91	0.87	-1.00	0.69	0.09	0.35
5 % max	-0.49	1.16	-0.29	0.88	-0.21	0.51
Max	-0.02	1.27	-0.69	1.01	0.71	0.96

Appendix B

Detailed results

0 ACH

Study 26 Fall	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	4	11.22	15.92	21.22	25	4	10.82	15.79	20.96	25	7	10.46	15.46	20.42	25
2	4	11.08	15.73	20.98	25	4	10.53	15.59	20.73	25	4	8.01	14.56	20.13	25
3	4	10.81	15.58	20.65	24	4	10.34	15.36	20.53	24	6	9.5	14.62	18.83	23
4	4	10.56	15.36	20.48	24	4	10.22	15.1	20.18	24	6	9.2	14.54	19.17	23
5	4	10.28	15.04	19.93	24	4	10.13	14.89	19.82	23	4	7.78	14.05	18.98	23
6	4	10.11	14.89	19.85	23	4	9.98	14.69	19.51	23	4	7.87	14.09	19.03	23
7	4	10.02	14.81	19.76	23	4	9.76	14.55	19.52	23	4	7.73	13.67	18.87	23
8	5	10.32	15.46	20.65	25	4	10.28	15.22	20.14	24	4	8.11	14.37	19.46	24
9	5	11.56	16.76	22.31	26	4	11.23	16.59	21.86	26	6	10.29	15.63	20.45	25
10	5	12.62	18.34	23.92	28	4	12.48	18.08	23.53	28	5	9.98	16.65	22.53	28
11	5	13.08	19.7	25.61	30	4	13.5	19.42	25	30	4	10.47	17.76	24.03	30
12	5	13.56	20.78	26.65	31	4	14.27	20.49	26.12	31	4	10.82	18.34	24.88	31
13	5	13.85	21.38	27.39	32	4	14.85	21.08	26.8	33	9	14.32	19.85	25.29	31
14	5	14.12	21.48	27.58	32	4	15.02	21.14	26.89	33	4	11.17	18.81	25.07	31
15	6	14.12	21.14	26.98	32	4	14.8	20.78	26.51	32	4	11.26	19.09	25.72	32
16	5	13.81	20.51	26.38	31	4	14.39	20.19	25.87	31	4	10.79	18.58	25.2	31
17	5	13.56	19.5	25.31	30	4	13.58	19.21	24.79	30	4	10.16	17.75	23.99	30
18	5	13.02	18.41	23.99	29	4	12.89	18.17	23.64	29	4	9.36	16.7	23.2	29
19	4	12.42	17.79	23.52	28	4	12.31	17.53	22.83	27	4	9.13	16.13	21.99	27
20	4	12.16	17.41	22.91	27	3	11.94	17.08	22.47	27	3	8.24	15.78	21.84	27
21	4	12.1	16.99	22.48	27	3	11.61	16.78	22.14	26	3	7.72	15.42	21.62	26
22	4	11.65	16.78	22.18	26	3	11.36	16.45	21.74	26	3	7.84	14.98	20.18	24
23	4	11.32	16.54	21.7	26	3	11.13	16.2	21.39	26	3	7.86	15	21.19	26
24	4	11.32	16.25	21.52	26	3	10.98	15.93	21	25	3	7.32	13.85	18.66	23

Study 26 Spring	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	11.22	17.24	24.52	28	6	11.2	17.26	23.39	27	8	11.79	16.8	21.75	26
2	8	11.17	16.92	23.77	28	6	11.08	16.9	23.05	27	8	11.61	16.73	21.72	26
3	8	10.71	16.65	23.65	28	5	10.84	16.64	22.77	27	8	11.68	16.61	22.37	27
4	8	10.32	16.29	23.48	27	5	10.51	16.46	22.5	27	5	9.25	15.73	22.1	27
5	8	10.16	16.1	22.85	27	5	10.11	16.19	22.24	26	5	9.32	15.51	21.35	26
6	8	9.92	15.8	22.73	26	5	9.88	15.86	21.78	26	5	9.04	14.96	20.31	25
7	8	9.82	15.77	22.81	27	5	9.87	15.74	21.88	26	5	9.02	14.94	20.26	25
8	8	10.53	16.51	23.9	28	5	10.43	16.59	22.85	28	5	9.71	16.14	22.53	28
9	8	11.47	17.89	25.61	30	5	11.83	17.93	24.32	29	8	12.46	17.44	22.87	28
10	8	12.47	19.54	27.42	32	5	12.98	19.53	25.99	32	8	13.2	19.08	25.41	31
11	9	13.41	21.02	28.98	34	6	14.24	21.01	27.64	33	6	12.53	19.3	25.78	32
12	9	14.04	22.2	30.25	36	6	15.27	22.2	28.81	35	6	12.62	19.56	26.13	32
13	9	14.88	22.98	31.22	36	6	15.82	22.82	29.44	36	6	13.27	20.6	27.37	34
14	9	15.04	23.14	31.29	37	6	16.05	23.09	29.8	36	6	13.31	20.67	27.52	34
15	9	14.85	22.92	31.11	36	6	15.95	22.82	29.46	35	6	13.11	20.3	26.94	33
16	9	14.37	22.23	30.25	35	6	15.3	22.13	28.69	35	6	12.89	20.12	26.92	33
17	9	13.89	21.18	29.22	34	6	14.52	21.13	27.73	34	6	12.07	18.94	25.27	31
18	9	12.82	20.07	27.77	33	6	13.44	19.98	26.52	32	6	11.42	18.3	24.63	30
19	8	12.52	19.29	26.84	31	6	12.94	19.23	25.69	31	6	11.27	18.01	24.2	29
20	8	12.03	18.84	26.48	31	5	12.5	18.72	25.18	29	5	10.04	17.06	22.9	28
21	8	11.81	18.49	25.81	30	5	12.27	18.4	24.77	29	5	9.67	16.62	22.95	28
22	8	11.75	18.21	25.58	30	5	12.03	18.06	24.45	29	5	9.99	16.77	23.08	28
23	8	11.31	17.93	25.09	29	5	11.64	17.71	24.05	29	5	9.7	16.54	23	28
24	8	11.18	17.59	24.78	29	5	11.38	17.41	23.75	28	5	9.68	16.3	22.29	27

0 ACH

Study 26	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	16.11	22.42	26.84	29	10	16.8	22.12	25.88	30	10	14.87	21.04	25.8	30
2	11	16.01	22.15	26.49	29	10	16.6	21.86	25.61	30	10	14.37	20.63	25.42	30
3	11	15.97	21.83	26.06	29	10	16.39	21.58	25.2	30	11	14.96	20.27	24.8	29
4	11	15.66	21.58	25.84	28	9	16.17	21.31	24.89	30	11	14.8	20.23	24.81	29
5	11	15.45	21.32	25.5	28	9	15.97	21.07	24.66	30	11	14.84	19.98	24.08	28
6	11	15.42	21.17	25.28	28	9	15.81	20.87	24.44	29	11	14.93	20.01	24.13	28
7	11	15.48	21.55	25.86	28	10	16.11	21.23	24.91	30	11	15.11	20.31	24.62	29
8	11	15.93	22.52	27.35	30	10	16.75	22.19	26.19	32	11	16.09	21.93	26.96	32
9	12	16.35	23.94	29.02	32	10	17.62	23.55	27.9	33	12	17.41	23.34	28.28	33
10	12	16.71	25.55	30.89	34	10	18.48	25.07	29.83	36	12	17.77	24.28	29.83	35
11	12	17.21	27.24	32.61	35	10	19.32	26.56	31.53	38	12	18.47	25.39	31.12	36
12	13	17.75	28.41	33.9	37	10	20.14	27.71	32.79	38	11	18.06	25.66	31.9	37
13	13	18.13	29.14	34.64	37	10	20.63	28.35	33.53	39	11	18.58	26.39	32.65	38
14	13	18.3	29.17	34.88	38	10	20.77	28.43	33.66	40	11	18.61	26.44	32.73	38
15	12	18.39	28.78	34.53	37	10	20.54	27.99	33.24	40	11	18.25	25.73	31.77	37
16	12	18.25	27.91	33.74	36	10	20.21	27.22	32.39	39	11	18.09	25.49	31.73	37
17	12	18.02	26.75	32.57	35	10	19.56	26.23	31.28	37	11	17.6	24.68	30.59	36
18	12	17.4	25.67	31.06	34	10	18.89	25.18	29.88	36	10	16.27	23.4	29.01	34
19	12	17.09	24.67	29.84	33	10	18.27	24.21	28.68	33	10	15.97	22.8	28.19	33
20	11	16.84	24.11	29.02	32	10	17.88	23.64	27.93	33	10	15.46	22.03	27.39	32
21	11	16.55	23.68	28.54	31	10	17.53	23.23	27.44	32	10	15.04	21.68	27.14	32
22	11	16.35	23.38	28.05	31	10	17.31	22.89	26.94	32	10	15.08	21.49	26.76	31
23	11	16.25	23.09	27.72	30	10	17.09	22.58	26.67	32	10	15.04	21.37	26.5	31
24	11	16.07	22.72	27.39	30	10	16.9	22.31	26.27	30	10	15.01	21.09	25.82	30

Study 26	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	8.01	12.53	15.88	18	1	7.11	11.68	15.32	19	1	4.01	9.8	14.75	19
2	3	7.53	12.29	15.7	18	1	7	11.46	15.08	19	1	4.29	9.97	14.33	18
3	3	7.2	12.01	15.45	18	1	6.75	11.27	14.9	19	1	4.53	10.31	15.06	18
4	2	7.16	11.78	14.99	18	0	6.48	11.05	14.76	18	0	3.59	9.98	14.98	18
5	2	7.01	11.51	14.92	18	0	6.29	10.88	14.55	18	0	3.78	10.04	14.98	18
6	2	6.53	11.32	14.72	17	1	6.11	10.67	14.3	17	1	4.52	10.07	14.39	17
7	2	6.41	11.1	14.49	17	1	5.99	10.55	13.96	17	1	4.51	10.06	14.36	17
8	2	6.75	11.57	14.93	17	0	6.2	10.75	14.37	18	0	3.71	9.77	14.3	18
9	3	8.02	12.88	16.28	19	1	7.49	12.15	15.82	20	1	5.26	11.03	15.88	19
10	4	9.37	14.45	17.85	20	1	8.65	13.62	17.48	22	1	5.91	12.34	17.67	22
11	5	10.58	15.83	19.46	22	1	10.08	14.95	18.83	23	1	6.63	13.08	18.51	23
12	5	11.36	16.85	20.46	23	1	10.86	15.91	19.86	25	1	5.55	12.5	18.62	23
13	5	11.46	17.45	21.05	24	2	11.35	16.58	20.52	25	2	8.06	14.38	19.52	24
14	5	11.54	17.57	21.23	24	2	11.5	16.72	20.84	25	2	8.18	14.73	20.32	25
15	5	11.37	17.38	21.06	24	2	11.41	16.5	20.58	25	2	7.09	14.1	20.44	25
16	5	11.21	16.95	20.61	23	2	11.01	15.89	19.87	25	2	7.66	14.16	19.69	24
17	5	10.37	15.91	19.62	22	2	10.13	14.95	18.93	23	2	7.07	13.38	18.6	23
18	5	9.54	14.9	18.49	21	2	9.14	13.98	17.75	22	2	6.3	12.44	17.15	21
19	4	9.04	14.28	17.76	20	2	8.57	13.51	17.3	21	2	6.38	12.47	17.13	20
20	4	8.81	13.89	17.48	20	1	8.21	13.13	16.93	20	1	5.4	11.71	16.81	20
21	4	8.54	13.52	16.99	20	1	7.97	12.63	16.56	20	1	4.27	10.63	15.67	19
22	4	8.32	13.32	16.8	19	1	7.46	12.34	15.99	20	1	5	11.17	16.03	19
23	3	7.81	12.96	16.49	19	1	7.15	12.02	15.83	20	1	4.21	10.33	15.03	19
24	3	7.65	12.69	16.13	19	1	6.98	11.76	15.61	19	1	4.5	10.2	14.93	19

0 ACH

Study 32 Fall	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	10.85	15.68	20.75	24	4	10.64	15.57	20.74	25	4	7.9	14.32	19.77	24
2	5	10.65	15.54	20.61	24	4	10.37	15.39	20.44	23	6	9.19	14.52	19.12	23
3	4	10.37	15.19	20.19	23	4	10.2	15.13	20.33	23	6	9.24	14.31	18.44	22
4	4	10.16	14.97	19.86	23	4	10.09	14.93	19.79	23	4	7.6	13.99	18.99	23
5	4	9.87	14.82	19.52	23	4	10.02	14.66	19.46	23	4	7.78	14.05	18.98	23
6	4	9.71	14.55	19.22	23	4	9.6	14.44	19.21	23	5	8.53	14.08	18.4	22
7	4	9.47	14.51	19.19	23	4	9.41	14.32	19.18	23	5	8.48	13.92	18.92	23
8	5	10.2	15.2	19.99	24	4	10.19	15.09	19.97	24	4	8.11	14.37	19.46	24
9	5	11.46	16.61	21.88	26	4	11.25	16.56	21.72	26	6	10.38	15.92	21.16	26
10	5	12.75	18.23	23.81	28	4	12.59	18.12	23.54	28	8	12.23	17.88	23.23	28
11	5	13.08	19.73	25.63	30	4	13.71	19.62	25.19	31	4	10.25	17.43	23.6	29
12	6	13.75	20.9	26.75	31	4	14.69	20.7	26.32	32	4	10.68	18.31	25.12	31
13	5	14.08	21.64	27.58	32	4	15.11	21.41	27.08	33	5	11.7	19.4	25.82	32
14	5	14.12	21.6	27.61	32	4	15.34	21.42	27.2	33	5	11.74	19.47	25.94	32
15	6	14.42	21.35	27.11	32	4	15.17	21.06	26.75	32	4	10.73	18.44	24.88	31
16	6	14.25	20.57	26.48	31	4	14.66	20.31	25.97	32	4	10.63	18.55	25.5	31
17	5	13.75	19.5	25.09	30	4	13.86	19.24	24.81	30	4	10.01	17.72	24.32	30
18	5	13.02	18.3	23.76	28	4	12.81	18.12	23.59	28	4	9.23	16.8	22.92	28
19	4	12.18	17.68	23.09	27	4	12.31	17.43	22.83	28	4	8.94	16.08	22.39	27
20	4	12.03	17.27	22.65	27	3	12	17.03	22.32	27	3	8.07	15.73	22.18	27
21	4	11.65	16.86	22.18	26	3	11.63	16.75	21.97	26	3	7.42	15.13	21.31	26
22	4	11.36	16.59	21.73	26	4	11.32	16.43	21.68	26	4	8.31	14.96	19.92	24
23	4	11.22	16.28	21.48	26	3	11.06	16.04	21.27	26	3	7.52	14.67	20.85	26
24	4	11.02	15.95	20.99	25	3	10.69	15.76	20.77	25	3	7.06	13.52	18.23	22

Study 32 Spring	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	10.91	16.82	23.7	28	6	11.01	16.98	23.07	27	8	11.79	16.8	21.75	26
2	8	10.41	16.5	23.52	27	6	10.75	16.5	22.65	27	8	11.19	15.95	21.23	26
3	8	10.16	16.16	22.9	27	5	10.42	16.22	22.28	27	8	11.13	15.92	21.64	26
4	8	10.03	15.87	22.7	27	5	10.12	15.98	21.97	26	5	8.57	14.81	20.64	25
5	8	9.66	15.68	22.34	26	5	9.79	15.65	21.65	26	5	8.64	14.59	19.84	24
6	7	9.48	15.38	21.91	26	5	9.51	15.32	21.22	25	5	8.57	14.17	19.75	24
7	7	9.33	15.28	22.25	26	5	9.48	15.36	21.34	26	5	8.7	14.61	19.85	24
8	8	9.93	16.05	23.52	28	5	10.22	16.32	22.61	28	5	9.35	15.53	21.37	26
9	8	11.16	17.62	25.12	30	5	11.62	17.75	24.11	29	8	12.26	17.09	22.47	27
10	9	12.39	19.35	26.92	32	6	12.87	19.41	25.86	31	8	13.12	18.79	24.66	30
11	9	13.36	20.92	28.84	34	6	14.29	21.05	27.58	34	6	12.52	19.54	26.79	33
12	9	14.08	22.28	30.25	36	6	15.38	22.31	28.89	35	6	12.94	20.27	27.02	33
13	9	14.89	23.08	31.11	37	6	16.04	23.11	29.71	36	6	13.09	20.27	26.88	33
14	9	15.04	23.19	31.47	37	7	16.32	23.27	29.83	36	7	14.05	21.22	28.6	35
15	9	14.85	22.87	30.84	36	7	15.96	22.93	29.53	36	7	13.83	20.97	27.61	34
16	9	14.41	22.22	30.13	35	7	15.32	22.23	28.74	35	7	13.64	20.77	27.47	33
17	9	13.72	21.09	28.98	34	7	14.5	21.15	27.69	33	7	13.07	19.94	26.27	32
18	9	12.66	19.98	27.61	32	6	13.46	19.88	26.39	32	6	11.42	18.3	24.63	30
19	9	12.48	19.1	26.6	31	6	12.77	19.07	25.49	30	6	11	17.68	23.86	29
20	8	11.91	18.6	25.8	30	5	12.35	18.57	25.04	30	5	9.83	17.01	23.27	28
21	8	11.75	18.19	25.58	30	5	12.16	18.21	24.53	29	5	9.5	16.71	22.7	27
22	8	11.45	17.98	25.09	29	5	11.89	17.83	24.1	29	5	9.67	16.42	22.68	27
23	8	11.05	17.55	24.61	29	5	11.43	17.53	23.81	28	5	9.7	16.54	23	28
24	8	10.91	17.26	24.48	28	5	11.17	17.22	23.47	27	5	9.68	16.3	22.29	27

0 ACH

Study 32	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.98	22.03	26.35	29	10	16.64	21.82	25.51	30	10	14.77	20.74	25.09	29
2	11	15.93	21.68	25.95	28	10	16.37	21.53	25.06	30	11	15.32	20.94	25.15	29
3	11	15.7	21.37	25.61	28	10	16.18	21.26	24.78	29	11	15.36	20.6	24.94	29
4	11	15.5	21.06	25.22	28	10	16	20.95	24.46	29	11	15.22	20.54	24.95	29
5	11	15.36	20.84	24.85	27	9	15.71	20.65	24	28	11	15.28	20.31	24.28	28
6	11	15.29	20.69	24.68	27	9	15.6	20.51	23.86	28	9	13.85	19.78	24.14	28
7	11	15.39	21.13	25.47	28	10	15.98	20.94	24.59	30	11	15.33	20.33	24.29	28
8	11	15.85	22.2	26.85	29	10	16.62	22.01	25.9	31	10	15.4	21.3	26.18	31
9	12	16.31	23.77	28.72	31	10	17.52	23.41	27.75	34	12	17.98	23.65	28.58	33
10	12	16.82	25.37	30.67	33	10	18.44	24.95	29.66	36	11	17.44	23.93	29.37	34
11	12	17.38	27.21	32.55	35	10	19.41	26.61	31.5	38	13	19.52	25.68	30.94	36
12	13	17.9	28.53	34.05	37	10	20.19	27.87	32.93	40	13	19.94	26.64	32.09	37
13	13	18.31	29.32	34.83	38	10	20.72	28.56	33.74	40	12	19.65	26.69	32.33	37
14	13	18.56	29.33	34.94	38	10	20.86	28.59	33.84	40	11	19.21	26.73	32.91	38
15	12	18.47	28.93	34.54	37	10	20.67	28.14	33.39	39	11	19.03	26.38	32.51	38
16	12	18.45	27.93	33.69	36	10	20.29	27.32	32.48	38	11	18.64	25.81	31.83	37
17	12	18.15	26.64	32.35	35	10	19.64	26.26	31.21	36	11	17.91	24.74	30.07	35
18	12	17.4	25.51	30.89	34	10	18.92	25.1	29.78	35	11	17.17	23.7	29.03	34
19	12	17.11	24.41	29.5	32	10	18.14	24.03	28.44	34	11	16.78	23.11	28.25	33
20	11	16.75	23.79	28.7	31	10	17.79	23.43	27.74	32	10	15.56	22.12	26.91	31
21	11	16.48	23.39	28.08	31	10	17.39	23.04	27.15	32	10	15.2	21.66	26.82	31
22	11	16.34	23.06	27.71	30	10	17.19	22.67	26.68	31	10	15.49	21.82	26.91	31
23	11	16.14	22.63	27.21	30	10	16.99	22.33	26.27	31	10	15.18	21.38	26.29	31
24	11	16.06	22.38	26.82	29	10	16.69	22.05	25.84	31	10	15.02	21.1	25.84	30

Study 32	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	7.32	12.01	15.65	18	1	7.09	11.64	15.25	18	1	4	9.68	14.4	18
2	3	7.17	11.69	15.3	18	1	6.84	11.44	15.04	18	1	3.72	9.35	13.63	17
3	2	7.07	11.47	14.99	18	1	6.64	11.22	14.97	18	2	4.96	10.66	15.38	18
4	2	6.85	11.18	14.75	17	0	6.45	10.98	14.66	18	1	4.02	10.33	15.32	18
5	2	6.41	10.97	14.49	17	0	6.13	10.75	14.46	17	0	3.68	9.75	14.28	17
6	2	6.17	10.75	14.06	17	1	5.88	10.51	14.15	17	1	4.52	10.07	14.39	17
7	2	5.88	10.48	13.96	16	1	5.68	10.23	13.85	17	1	4.29	9.33	13.44	16
8	2	6.53	10.97	14.68	17	1	6.1	10.7	14.31	17	1	4.48	10.05	14.37	17
9	3	7.85	12.48	15.94	18	1	7.43	12.26	15.87	19	1	5.26	11.03	15.88	19
10	4	9.05	14.11	17.78	20	1	8.72	13.72	17.63	21	1	5.89	12.32	17.64	21
11	5	10.66	15.62	19.51	22	1	10.11	15.13	19.08	23	1	6.14	13.19	19.01	23
12	5	11.47	16.72	20.62	23	2	11.15	16.22	20.13	24	2	6.55	13.5	19.62	24
13	6	11.58	17.41	21.38	24	3	11.81	16.88	20.97	26	3	8.71	15.32	21.08	26
14	5	11.65	17.54	21.53	24	2	11.8	17.03	21.02	26	2	7.23	14.05	19.91	24
15	5	11.46	17.32	21.06	24	2	11.76	16.88	20.82	25	2	7.62	14.06	19.45	24
16	5	11.18	16.57	20.64	23	3	11.18	16.16	20.15	24	3	8.04	14.2	19.1	23
17	5	10.41	15.5	19.62	22	2	10.2	15.1	19.08	23	4	7.25	13.43	18.36	22
18	5	9.54	14.45	18.36	21	2	9.38	14.17	18.08	21	2	6.37	12.72	17.87	21
19	4	8.81	13.83	17.64	20	2	8.52	13.41	17.26	21	2	5.92	12.05	16.87	20
20	4	8.81	13.47	17.36	20	2	8.07	13.01	16.86	21	2	5.43	11.19	15.97	20
21	4	8.32	13.15	16.88	19	1	7.73	12.58	16.42	20	1	4.36	10.94	16.41	20
22	4	8.04	12.8	16.6	19	1	7.29	12.32	15.9	20	1	5	11.17	16.03	19
23	3	7.65	12.45	16.2	19	1	7.1	12.01	15.74	20	1	4.15	10.14	14.58	18
24	3	7.37	12.16	15.84	18	1	6.93	11.74	15.65	18	1	4.08	9.71	14.41	18

0 ACH

Study 33 Fall	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	11.54	16.52	21.7	26	4	11.65	16.7	21.87	26	4	8.51	15.12	19.93	24
2	5	11.46	16.33	21.48	25	4	11.48	16.48	21.55	25	7	10.65	15.89	20.13	24
3	5	11.28	15.95	21.09	25	4	11.32	16.23	21.22	25	4	8.49	15.05	20.56	25
4	5	11.14	15.85	20.86	25	4	11.14	16	20.96	25	4	8.02	14.58	20.18	25
5	5	11.02	15.68	20.6	24	4	11.03	15.81	20.84	24	6	9.6	14.91	19.59	24
6	5	10.81	15.49	20.48	24	4	10.66	15.64	20.72	24	6	9.68	14.96	19.64	24
7	5	10.75	15.41	20.38	24	4	10.5	15.54	20.64	24	4	8.14	14.38	19.45	24
8	5	11.11	15.83	20.99	25	4	11.02	16.12	21.23	26	6	10.21	15.58	20.38	25
9	5	12.02	16.84	22.38	26	4	12.02	17.07	22.2	27	5	9.2	15.43	20.52	25
10	5	12.75	17.93	23.65	28	4	12.77	18.18	23.56	29	8	12.15	17.59	22.5	27
11	5	13.06	18.91	24.75	29	4	13.65	19.15	24.62	29	4	10.25	17.43	23.6	29
12	5	13.42	19.92	25.67	30	4	14.35	20.1	25.62	30	4	10.3	17.69	24.04	30
13	5	13.56	20.5	26.48	31	4	14.62	20.59	26.16	32	5	11.36	18.79	24.68	30
14	5	13.71	20.64	26.67	31	4	14.94	20.78	26.49	32	5	11.39	18.84	24.78	30
15	6	14.12	20.64	26.47	31	4	15.02	20.81	26.43	32	5	11.18	18.79	25.07	31
16	6	14.12	20.33	25.98	31	4	14.69	20.43	25.99	31	9	14.39	20.02	25.68	31
17	5	13.75	19.7	25.48	31	4	14.21	19.8	25.37	30	9	13.86	19.17	24.49	30
18	5	13.21	18.74	24.43	29	4	13.42	18.83	24.4	30	4	9.81	17.45	23.71	29
19	5	13.11	18.05	23.63	28	4	13.05	18.23	23.78	29	4	9.46	16.74	23.22	29
20	5	12.62	17.74	23.4	28	4	12.69	17.78	23.07	28	4	9.12	16.34	22.68	28
21	5	12.21	17.46	22.8	27	4	12.45	17.58	22.76	27	8	11.94	17.19	22.48	27
22	5	12.16	17.2	22.55	27	4	12.24	17.31	22.6	27	4	9.11	16.2	22.24	27
23	5	12.04	16.84	22.28	27	4	11.92	17.07	22.37	27	4	8.86	15.46	20.42	25
24	5	11.54	16.65	21.87	26	4	11.73	16.78	21.99	27	4	8.64	15.17	19.95	24

Study 33 Spring	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	11.71	17.71	24.7	28	6	12.22	18.09	24.27	29	6	10.51	16.57	21.96	27
2	9	11.32	17.43	24.48	27	6	11.9	17.95	24.02	28	6	10.33	16.49	21.94	27
3	9	11.25	17.1	24.34	27	6	11.59	17.63	23.68	28	8	12.06	17.13	22.16	27
4	9	11.02	16.88	23.73	27	6	11.36	17.39	23.28	28	8	11.92	17.08	22.18	27
5	8	10.62	16.66	23.6	26	6	11.23	17.01	23.01	28	8	11.6	16.34	21.61	26
6	8	10.57	16.42	23.34	26	5	11.05	16.8	22.73	27	8	11.67	16.38	21.66	26
7	8	10.52	16.36	23.48	26	5	10.84	16.8	22.84	28	8	12.03	16.97	22.77	28
8	8	10.79	16.92	24.44	28	5	11.41	17.41	23.59	29	8	11.92	16.7	21.99	27
9	9	11.63	17.93	25.52	29	5	12.2	18.48	24.77	30	8	12.77	18.15	23.79	29
10	9	12.47	19.1	26.84	30	6	13.17	19.62	25.92	32	6	11.63	18.2	24.47	30
11	9	13.3	20.3	28.09	32	6	14.12	20.65	26.99	32	6	12.07	18.62	24.94	31
12	9	14.02	21.29	29.19	33	6	14.97	21.64	28.08	34	6	12.76	20.24	27.44	34
13	9	14.28	21.93	29.9	34	6	15.45	22.28	28.78	35	6	12.8	19.93	26.54	33
14	9	14.56	22.23	30.12	34	6	15.8	22.61	29.09	35	6	13.12	20.34	27	33
15	9	14.62	22.31	30.22	34	7	15.87	22.58	29.09	35	7	13.52	20.26	26.7	33
16	9	14.21	21.93	29.9	34	7	15.6	22.3	28.86	35	7	13.58	20.41	27.01	33
17	9	14.14	21.29	29.31	33	7	15.1	21.68	28.24	35	7	13.04	19.55	25.81	32
18	9	13.44	20.28	28.31	32	6	14.36	20.76	27.2	33	6	12.01	18.96	25.41	31
19	9	12.72	19.62	27.34	31	6	13.59	19.97	26.42	32	6	11.53	18.35	24.64	30
20	9	12.62	19.17	26.62	30	6	13.2	19.53	25.93	31	6	11.43	18.27	24.53	30
21	9	12.42	18.79	26.34	30	5	12.98	19.18	25.53	31	5	10.36	17.68	23.87	29
22	8	11.81	18.55	25.84	29	5	12.69	18.89	25.15	30	5	10.38	17.5	23.58	28
23	8	11.78	18.29	25.56	29	5	12.44	18.54	24.89	30	5	9.91	16.59	22.68	28
24	8	11.75	17.99	25.34	29	5	12.2	18.26	24.52	29	5	9.99	16.62	22.69	28

0 ACH

Study 33	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	12	16.7	23.26	27.9	30	10	17.81	23.33	27.3	33	10	15.53	21.69	26.44	31
2	12	16.53	22.97	27.64	30	10	17.66	23.04	26.89	33	10	15.31	21.59	26.41	31
3	12	16.39	22.66	27.32	30	10	17.46	22.76	26.59	31	10	15.5	21.68	26.44	31
4	12	16.29	22.46	26.91	29	10	17.27	22.53	26.28	31	10	15.32	21.61	26.45	31
5	11	16.18	22.2	26.71	29	10	17.1	22.3	25.94	31	11	16.13	21.58	26.27	31
6	11	16.14	22.08	26.6	29	10	17.01	22.2	25.88	31	11	16.2	21.63	26.32	31
7	11	16.22	22.5	27.26	30	10	17.21	22.55	26.49	32	11	16.36	21.93	26.78	32
8	12	16.45	23.27	28.28	31	10	17.69	23.32	27.5	34	12	17.46	22.94	27.49	32
9	12	16.75	24.3	29.5	32	10	18.27	24.24	28.7	35	12	18.15	23.99	29	34
10	12	17.08	25.4	30.81	33	10	18.96	25.29	29.9	36	12	18.31	24.58	29.92	35
11	13	17.57	26.62	31.97	35	10	19.59	26.41	31.16	37	13	19.52	25.68	30.94	36
12	13	17.79	27.61	33.06	36	11	20.16	27.34	32.24	39	11	18.63	25.98	31.9	37
13	13	18.13	28.24	33.81	37	11	20.59	27.95	32.93	40	11	19.01	26.35	32.46	38
14	13	18.44	28.51	34.2	37	10	20.76	28.18	33.23	39	11	19.19	26.74	33.04	39
15	13	18.44	28.39	34.13	37	10	20.74	28.04	33.15	40	11	19.03	26.38	32.51	38
16	13	18.5	27.97	33.87	37	10	20.6	27.66	32.79	39	11	18.85	26.16	32.39	38
17	13	18.31	27.29	33.23	36	10	20.27	27.1	32.26	38	11	18.76	26	32.05	38
18	12	18.16	26.56	32.52	35	10	19.82	26.39	31.51	38	11	18.36	25.5	31.49	37
19	12	17.45	25.44	30.88	34	10	19.13	25.31	29.93	36	11	17.75	24.41	29.92	35
20	12	17.23	24.89	30.06	33	10	18.76	24.74	29.25	35	11	17.38	24.01	29.52	35
21	12	17.13	24.47	29.61	32	10	18.49	24.35	28.69	34	11	16.82	23.31	28.48	33
22	12	17.04	24.19	29.19	32	10	18.27	24.06	28.3	33	11	17.01	23.11	28.35	33
23	12	16.97	23.82	28.75	31	10	18.07	23.73	27.86	33	11	16.96	22.97	27.99	33
24	12	16.74	23.54	28.45	31	10	17.89	23.48	27.61	33	10	15.79	22.06	27.09	32
Study 33	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	8.12	12.82	16.38	19	1	7.92	12.44	16.23	20	1	4.13	10.24	14.92	19
2	3	8.08	12.6	15.96	19	1	7.61	12.21	15.98	20	1	4.02	10.4	15.55	20
3	3	8.01	12.37	15.86	18	1	7.46	12.01	15.69	20	1	4.08	10.08	15.5	20
4	3	7.61	12.2	15.64	18	1	7.23	11.77	15.39	19	1	3.74	9.48	13.99	18
5	3	7.41	12.06	15.34	18	1	7.07	11.56	15.07	19	1	4.01	9.8	14.75	19
6	3	7.11	11.79	14.99	18	1	6.88	11.32	14.86	19	1	4.37	9.92	14.23	18
7	3	7.02	11.51	14.92	17	1	6.55	11.17	14.76	19	1	4.01	9.61	14.13	18
8	3	7.32	12.04	15.36	18	1	7	11.55	15.19	19	1	3.99	9.6	14.14	18
9	3	8.21	12.97	16.49	19	1	8.02	12.64	16.17	20	1	5.39	11.45	16.05	19
10	4	9.18	14.19	17.62	20	1	9	13.71	17.52	21	1	5.89	12.32	17.64	21
11	5	10.04	15.18	18.72	21	2	9.93	14.73	18.64	23	2	6.69	13.07	18.92	23
12	5	10.66	16.06	19.58	22	2	10.5	15.61	19.49	24	2	7.35	13.71	18.77	23
13	6	10.78	16.54	20.23	23	3	11.1	16.12	19.93	24	3	8.08	14.38	19.59	24
14	5	11.06	16.76	20.51	23	2	11.45	16.39	20.4	24	2	7.23	14.05	19.91	24
15	5	11.25	16.81	20.56	23	3	11.45	16.44	20.44	25	3	8.1	14.4	19.64	24
16	6	11.04	16.48	20.13	23	3	11.16	16.12	19.98	25	3	8.1	14.47	19.82	23
17	6	10.46	15.83	19.62	22	2	10.57	15.5	19.38	24	2	7.07	13.38	18.6	23
18	5	9.81	14.99	18.61	21	2	9.84	14.52	18.4	22	4	7.19	13.45	18.47	22
19	5	9.54	14.41	17.92	21	2	9.15	14.05	17.73	22	2	6.4	12.49	17.16	21
20	4	9.04	14.08	17.67	20	2	8.91	13.81	17.55	21	2	6.3	12.41	17.04	20
21	4	8.81	13.78	17.38	20	2	8.53	13.58	17.35	20	2	6	11.95	16.99	20
22	4	8.54	13.5	16.93	19	2	8.37	13.28	17.01	20	2	6.22	12.08	17.1	20
23	4	8.32	13.26	16.78	19	2	8.17	12.96	16.72	20	2	6.13	11.69	16.08	19
24	4	8.05	12.99	16.54	19	1	7.84	12.59	16.31	20	1	4.64	10.64	15.12	19

0 ACH

Study 34	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	11.46	16.41	21.65	25	4	11.83	16.74	21.89	26	5	8.58	15.15	19.87	24
2	5	11.36	16.02	21.34	25	4	11.54	16.52	21.65	25	8	10.78	15.94	20.03	24
3	5	11.1	15.84	20.92	24	4	11.38	16.23	21.12	25	8	10.95	16	20.06	24
4	5	10.85	15.65	20.67	24	4	11.2	16.02	20.82	25	5	8.38	14.96	20.49	25
5	5	10.56	15.36	20.42	24	4	10.89	15.75	20.65	25	5	8.25	14.67	20.04	24
6	5	10.28	15.13	19.99	23	4	10.7	15.48	20.46	24	7	9.8	14.99	19.51	23
7	5	10.11	14.96	19.99	24	4	10.59	15.5	20.35	25	5	8.5	14.74	19.71	24
8	5	11.19	15.97	21.52	26	4	11.49	16.53	21.6	26	7	10.72	16.2	21.36	26
9	6	12.28	17.45	23.11	27	5	12.58	17.89	23.01	27	6	10.63	16.64	22.06	27
10	6	13.12	18.59	24.56	29	4	13.65	19.04	24.42	29	4	9.73	17.01	23.21	29
11	5	13.31	19.5	25.52	30	4	14.22	19.82	25.33	31	4	10.34	17.72	24.33	30
12	6	13.56	19.93	25.77	30	4	14.68	20.35	25.86	31	4	10.3	18.08	24.53	30
13	6	13.81	20.46	26.34	31	5	14.94	20.73	26.38	31	5	11.44	18.69	24.9	31
14	6	13.85	20.53	26.48	31	6	15.29	20.9	26.55	33	10	15.09	20.57	26.09	32
15	6	14.12	20.62	26.39	31	6	15.35	20.85	26.45	32	6	11.68	18.74	24.73	30
16	6	14.42	20.42	26.11	31	6	15.14	20.64	26.15	32	6	12	19.59	25.92	31
17	6	14.11	19.79	25.58	31	6	14.65	20.06	25.66	31	6	11.42	18.67	25.03	31
18	5	13.21	18.82	24.56	29	4	13.99	19.15	24.6	30	5	10.03	17.77	24.39	30
19	5	13.02	18.12	23.85	28	4	13.42	18.53	23.88	28	5	9.74	17.21	23.21	28
20	5	12.75	17.77	23.48	28	4	13.01	18.15	23.63	28	5	9.64	17.14	23.08	28
21	5	12.28	17.51	22.85	27	4	12.67	17.85	23.17	28	5	9.13	16.12	21.62	26
22	5	12.16	17.26	22.58	27	4	12.41	17.54	22.66	28	5	9.29	16.5	22.86	27
23	5	11.65	16.85	22.34	26	4	12.22	17.24	22.42	26	9	12.25	17.15	21.98	26
24	5	11.41	16.6	21.88	26	4	11.87	16.93	22.14	26	9	11.81	16.3	20.17	24

Study 34	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	9	11.36	17.54	24.72	29	6	12.31	18.09	24.35	29	9	12.9	17.69	22.97	28
2	9	11.25	17.17	24.52	29	6	12.05	17.83	23.99	29	9	12.54	17.55	23.33	28
3	9	11.03	16.89	23.83	28	6	11.56	17.5	23.65	29	6	10.39	16.78	23.08	28
4	8	10.66	16.55	23.7	28	6	11.32	17.16	23.27	29	6	10.25	16.73	23.1	28
5	8	10.52	16.22	23.42	27	6	11.13	16.82	22.83	27	6	10.11	15.79	21.43	26
6	8	10.25	15.96	22.84	27	5	10.91	16.5	22.45	27	5	9.11	15.23	21.03	26
7	8	10.23	15.99	23.52	28	5	10.82	16.73	22.81	28	5	9.65	15.87	21.76	27
8	9	11.02	17.16	25.28	30	5	11.98	17.86	24.29	30	5	10.36	17.08	23.99	30
9	9	12.15	18.63	26.58	31	6	12.89	19.19	25.74	32	7	12.01	18.25	24.28	30
10	9	13.02	19.82	27.84	33	7	14.04	20.41	26.86	33	10	14.72	20.33	26.9	33
11	9	13.41	20.72	28.83	34	7	14.67	21.29	27.88	34	10	15.27	20.86	26.7	32
12	9	14.02	21.29	29.39	35	7	15.22	21.83	28.35	35	7	12.94	19.95	26.44	32
13	9	14.3	21.67	29.84	35	8	15.66	22.26	28.85	35	8	14.01	20.79	27.82	34
14	9	14.56	21.98	29.91	35	8	15.93	22.51	29.02	35	8	14.11	21.01	27.42	33
15	9	14.42	22.08	29.98	35	8	15.9	22.6	29.18	36	8	14.1	20.97	27.34	33
16	9	14.41	21.95	29.91	35	8	15.81	22.45	28.96	36	8	13.84	20.79	27.34	33
17	9	14.22	21.34	29.56	35	8	15.37	22.02	28.54	35	8	13.75	20.6	26.9	33
18	9	13.52	20.31	28.56	34	7	14.52	20.92	27.57	34	7	12.67	19.63	26.04	32
19	9	12.91	19.72	27.61	32	6	14.09	20.17	26.68	32	6	11.62	18.63	25.4	31
20	9	12.78	19.15	26.78	31	6	13.6	19.68	26.13	32	6	11.18	17.94	24.07	29
21	9	12.53	18.87	26.64	31	6	13.26	19.3	25.73	31	6	10.67	17.62	23.95	29
22	9	11.92	18.54	26.09	31	6	13.03	19	25.44	31	6	10.99	17.77	24.08	29
23	8	11.91	18.24	25.67	30	6	12.63	18.69	25.01	30	6	11.01	17.87	24.43	30
24	8	11.75	17.84	25.48	29	5	12.41	18.4	24.69	29	5	10.21	17.35	23.62	29

0 ACH

Study 34	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	12	16.67	23.32	27.9	30	10	18.19	23.49	27.5	33	11	16.38	22.29	27.16	32
2	12	16.52	22.89	27.53	30	10	17.91	23.19	27.15	32	12	16.96	22.49	27.23	32
3	12	16.38	22.6	27.02	30	10	17.67	22.88	26.84	32	12	16.91	22.25	26.8	31
4	12	16.25	22.32	26.66	29	10	17.42	22.55	26.44	32	12	16.71	22.19	26.8	31
5	12	16.11	21.96	26.37	29	10	17.22	22.26	25.93	32	10	15.16	20.97	25.72	30
6	11	16.13	22.05	26.55	29	10	17.23	22.32	26.24	33	10	15.59	21.49	26.42	31
7	12	16.31	22.89	27.96	31	10	17.76	23.17	27.62	34	10	16.37	22.62	27.88	33
8	12	16.71	24.18	29.82	32	10	18.46	24.43	29.25	36	12	18.58	24.92	30.39	36
9	13	17.05	25.56	31.28	34	11	19.17	25.64	30.72	38	11	18.58	25.66	31.85	38
10	13	17.41	26.62	32.4	35	11	19.79	26.66	31.84	39	13	20	26.92	32.97	39
11	13	17.79	27.57	33.24	36	11	20.36	27.5	32.71	40	13	20.39	27.28	32.98	38
12	13	18.03	28.04	33.64	36	11	20.72	27.93	33.11	40	13	20.09	26.96	32.75	38
13	13	18.34	28.44	33.97	37	11	21.11	28.29	33.52	41	12	19.61	26.66	32.56	38
14	13	18.53	28.6	34.2	37	11	21.3	28.44	33.69	41	12	20.01	27.39	33.74	40
15	14	18.53	28.55	34.34	37	11	21.29	28.4	33.69	41	12	20.13	27.68	34.26	41
16	13	18.69	28.22	34.3	37	11	21.18	28.16	33.51	41	11	19.52	27.52	34.46	41
17	13	18.55	27.67	33.83	37	11	20.92	27.71	33.07	39	11	19.07	26.59	32.75	38
18	13	18.27	27.02	33.21	36	11	20.51	27.11	32.47	39	11	18.55	26.04	32.21	38
19	13	17.76	25.77	31.29	34	10	19.74	25.88	30.74	37	11	17.75	24.41	29.92	35
20	12	17.33	25.21	30.42	33	10	19.3	25.25	29.88	35	11	17.38	24.01	29.52	35
21	12	17.16	24.7	29.86	32	10	19.05	24.8	29.32	35	11	16.97	23.64	29.12	34
22	12	17.02	24.34	29.42	32	10	18.76	24.46	28.92	35	11	17.46	24.15	29.78	35
23	12	16.97	24	28.89	32	10	18.45	24.1	28.44	34	11	17.02	23.35	28.5	33
24	12	16.82	23.67	28.55	31	10	18.21	23.75	27.94	34	11	17.09	23.39	28.51	33

Study 34	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	8.1	12.62	15.93	18	2	8.13	12.57	16.04	20	2	4.91	10.52	14.97	19
2	3	8.01	12.34	15.85	18	1	7.78	12.29	15.84	20	1	4.02	10.4	15.55	20
3	3	7.61	12.11	15.65	18	1	7.46	12.02	15.72	20	1	4.2	10.52	15.68	20
4	3	7.22	11.76	15.12	18	1	7.31	11.83	15.37	19	1	4.05	10.36	15.35	19
5	3	7.16	11.53	14.93	18	1	7.22	11.66	15.15	18	1	3.99	9.68	14.4	18
6	3	6.85	11.32	14.83	17	1	7.03	11.42	14.86	18	2	5.04	10.7	15.43	18
7	3	6.47	11.14	14.59	17	1	6.55	11.27	14.76	18	2	5.02	10.68	15.39	18
8	3	7.32	11.85	15.23	18	1	7.31	12	15.58	19	1	4.07	9.89	14.86	19
9	4	8.61	13.29	16.84	19	2	8.46	13.19	16.95	21	2	5.93	12.12	17.07	21
10	5	9.65	14.55	17.99	21	3	9.63	14.58	18.26	22	3	7.11	12.99	17.93	22
11	5	10.37	15.44	18.92	22	3	10.37	15.33	19.07	23	3	7.4	13.49	18.16	22
12	5	11.09	15.84	19.54	22	3	11.01	15.84	19.74	23	3	7.34	13.72	18.91	23
13	6	10.78	16.33	19.92	23	3	11.32	16.34	20.19	24	3	7.26	13.69	19.2	24
14	6	11.06	16.48	20.18	23	3	11.45	16.52	20.36	24	2	7.33	14.14	19.52	23
15	6	11.25	16.55	20.34	23	4	11.58	16.56	20.47	24	3	7.8	14.4	20.01	24
16	6	11.04	16.38	19.99	23	4	11.62	16.39	20.32	24	4	8.53	14.86	20.09	24
17	6	10.65	15.76	19.62	22	4	11.07	15.91	19.7	24	5	8.88	15.08	20.01	23
18	5	10.02	14.85	18.57	21	4	10.06	14.85	18.66	23	4	7.57	13.37	18.24	22
19	5	9.65	14.34	17.89	20	3	9.59	14.45	18.16	21	3	6.9	13.12	18.14	21
20	4	9.04	14.08	17.64	20	2	9.29	14.22	17.86	21	2	6.4	12.71	17.81	21
21	4	8.81	13.7	17.29	20	2	8.93	13.81	17.61	21	2	6.1	12.36	17.17	20
22	4	8.65	13.4	16.96	19	2	8.53	13.4	17.24	21	2	5.84	11.75	16.89	20
23	4	8.32	13.09	16.72	19	2	8.16	13.08	16.77	20	2	5.09	10.9	15.86	20
24	3	8.04	12.83	16.36	19	2	8.02	12.73	16.52	20	2	5.41	10.93	15.2	19

1 ACH

Study 26	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	4	10.81	15.65	20.65	24	4	10.57	15.46	20.61	24	4	7.9	14.32	19.77	24
2	4	10.65	15.46	20.58	24	4	10.35	15.25	20.29	24	6	9.19	14.52	19.12	23
3	4	10.32	15.18	19.99	23	4	10.09	15.03	20.14	23	6	9.24	14.31	18.44	22
4	4	10.12	14.94	19.85	23	4	10.01	14.77	19.68	23	6	9.2	14.54	19.17	23
5	4	9.75	14.75	19.56	23	4	9.85	14.56	19.26	23	4	7.78	14.05	18.98	23
6	4	9.71	14.55	19.19	23	4	9.45	14.3	19.02	23	5	8.63	14.36	19.12	23
7	4	9.42	14.5	19.19	23	4	9.27	14.17	18.99	23	5	8.48	13.92	18.92	23
8	5	10.1	15.02	19.99	24	4	10.1	14.94	19.81	24	4	7.81	14.06	19	23
9	5	11.16	16.44	21.71	26	4	11.11	16.33	21.53	26	6	10.38	15.92	21.16	26
10	5	12.25	18.05	23.65	28	4	12.37	17.85	23.23	28	5	9.94	17.04	22.95	28
11	5	13.05	19.4	25.31	30	4	13.39	19.11	24.6	29	4	10.25	17.43	23.6	29
12	5	13.31	20.53	26.43	31	4	14.28	20.29	25.89	32	4	10.68	18.31	25.12	31
13	5	13.65	21.15	26.86	32	4	14.7	20.75	26.43	32	5	11.36	18.79	24.68	30
14	5	14.12	21.2	27.38	32	4	14.94	20.95	26.67	32	4	11.06	18.8	25.32	31
15	6	14.12	20.96	26.7	32	4	14.84	20.69	26.31	31	9	14.34	19.88	25.37	31
16	6	14.05	20.32	25.98	31	4	14.39	19.98	25.63	31	4	10.63	18.55	25.5	31
17	5	13.21	19.31	24.86	30	4	13.56	19	24.55	30	9	13.73	19.12	24.75	30
18	5	12.62	18.17	23.69	28	4	12.61	17.91	23.42	28	4	9.23	16.8	22.92	28
19	4	12.14	17.52	23.09	27	4	12.1	17.23	22.59	27	4	8.94	16.08	22.39	27
20	4	11.81	17.11	22.55	27	4	11.81	16.88	22.11	27	8	11.92	17.11	22.61	27
21	4	11.65	16.78	22.18	26	3	11.55	16.59	21.84	26	3	7.42	15.13	21.31	26
22	4	11.36	16.54	21.63	26	4	11.15	16.21	21.47	26	4	8.31	14.96	19.92	24
23	4	11.22	16.18	21.4	25	4	10.89	15.88	21.08	26	4	8.04	14.61	20.56	25
24	4	11.02	15.86	20.99	25	4	10.55	15.62	20.62	24	4	7.82	13.81	18.31	22

Study 26	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	11.02	16.82	23.67	28	6	10.83	16.82	22.92	27	8	11.46	16.46	21.42	26
2	8	10.32	16.5	23.56	27	6	10.64	16.38	22.58	27	8	10.95	15.61	20.82	25
3	8	10.25	16.18	22.78	27	5	10.32	16.06	22.16	27	8	11.13	15.92	21.64	26
4	8	10.03	15.89	22.7	27	5	10.12	15.85	21.88	26	5	8.65	15.08	21.4	26
5	8	9.66	15.71	22.34	26	5	9.64	15.57	21.64	25	5	8.73	14.86	20.62	25
6	7	9.56	15.45	21.98	26	5	9.47	15.25	21.24	25	5	8.57	14.17	19.75	24
7	7	9.38	15.28	22.11	26	5	9.44	15.23	21.33	25	5	8.7	14.61	19.85	24
8	8	9.92	16.04	23.34	28	5	10.07	16.15	22.42	27	5	9.35	15.53	21.37	26
9	8	11.04	17.59	24.98	30	5	11.44	17.5	23.84	28	8	12.01	16.75	22.08	27
10	9	12.11	19.23	26.75	32	6	12.64	19.19	25.66	31	8	13.12	18.79	24.66	30
11	9	13.27	20.77	28.53	34	6	13.94	20.62	27.07	33	6	12.33	18.96	25.31	31
12	9	13.89	22.07	29.78	35	6	15.02	21.85	28.38	34	6	12.76	20.24	27.44	34
13	9	14.65	22.67	30.61	36	6	15.7	22.59	29.17	35	6	13.09	20.27	26.88	33
14	9	15.03	22.93	30.81	36	6	15.92	22.75	29.38	36	6	13.12	20.34	27	33
15	9	14.85	22.63	30.48	36	7	15.66	22.52	29.04	35	7	13.52	20.26	26.7	33
16	9	14.14	21.99	29.75	35	7	15.06	21.82	28.39	34	7	13.2	20.04	26.96	33
17	9	13.48	20.96	28.7	34	7	14.29	20.89	27.44	33	7	12.9	19.51	26.07	32
18	9	12.6	19.84	27.43	32	6	13.29	19.71	26.18	32	6	11.42	18.3	24.63	30
19	9	12.14	19.07	26.48	31	6	12.63	18.92	25.39	30	6	11	17.68	23.86	29
20	8	11.89	18.49	25.7	30	5	12.22	18.4	24.88	30	5	9.83	17.01	23.27	28
21	8	11.75	18.18	25.58	30	5	12.02	18.04	24.36	28	5	9.5	16.71	22.7	27
22	8	11.37	17.93	24.89	29	5	11.73	17.72	23.97	28	5	9.67	16.42	22.68	27
23	8	11.05	17.5	24.58	29	5	11.38	17.41	23.73	28	5	9.61	16.27	22.27	27
24	8	10.91	17.15	24.43	28	5	11.14	17.02	23.28	27	5	9.36	15.97	21.92	27

1 ACH

Study 26	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.93	21.81	26.05	29	10	16.37	21.54	25.16	29	10	14.77	20.74	25.09	29
2	11	15.88	21.53	25.77	28	10	16.16	21.29	24.83	29	11	15.32	20.94	25.15	29
3	11	15.55	21.21	25.47	28	10	15.98	21.01	24.54	29	11	15.36	20.6	24.94	29
4	11	15.4	20.95	24.99	27	10	15.72	20.72	24.16	29	11	15.21	20.53	24.94	28
5	11	15.28	20.7	24.74	27	9	15.49	20.48	23.88	29	11	14.73	19.66	23.48	27
6	11	15.18	20.56	24.59	27	9	15.41	20.31	23.7	29	9	13.27	19.15	23.37	27
7	11	15.32	20.97	25.12	28	10	15.72	20.68	24.25	29	11	15.33	20.33	24.29	28
8	11	15.74	21.99	26.65	29	10	16.36	21.66	25.56	30	10	15.19	20.99	25.74	30
9	12	16.05	23.43	28.47	31	10	17.23	23.03	27.32	33	12	17.7	23.32	28.18	33
10	12	16.63	25.02	30.25	33	10	18.17	24.49	29.07	35	12	18.14	24.24	29.47	34
11	12	17.1	26.68	31.94	35	10	19.04	26.01	30.81	37	11	18.1	24.7	30.27	35
12	12	17.58	27.82	33.22	36	10	19.81	27.12	32.04	38	13	19.74	26.29	31.61	36
13	13	18.03	28.5	33.95	37	10	20.29	27.77	32.76	39	11	18.84	26.03	31.83	37
14	13	18.17	28.66	34.22	37	10	20.4	27.86	32.91	39	11	19.04	26.4	32.56	38
15	12	18.29	28.25	33.86	36	10	20.22	27.45	32.59	38	11	18.6	25.7	31.63	37
16	12	18.22	27.38	33.09	36	10	19.89	26.71	31.77	37	11	18.23	25.15	30.94	36
17	12	17.79	26.33	31.95	35	10	19.29	25.76	30.67	36	11	17.91	24.74	30.07	35
18	12	17.31	25.18	30.57	33	10	18.54	24.71	29.33	34	11	17.17	23.7	29.03	34
19	11	16.97	24.18	29.21	32	10	17.88	23.69	28.03	33	11	16.78	23.11	28.25	33
20	11	16.52	23.57	28.45	31	10	17.5	23.11	27.34	32	10	15.56	22.12	26.91	31
21	11	16.38	23.18	27.89	30	10	17.17	22.71	26.79	31	10	15.2	21.66	26.82	31
22	11	16.14	22.8	27.49	30	10	17	22.39	26.36	31	10	14.99	21.18	26.09	30
23	11	16.06	22.48	26.97	29	10	16.71	22.08	25.95	31	10	14.94	21.07	25.83	30
24	11	16.01	22.18	26.64	29	10	16.45	21.77	25.59	30	10	15.02	21.1	25.84	30

Study 26	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	7.16	11.95	15.64	18	1	7.08	11.66	15.33	18	2	4.98	10.67	15.38	18
2	3	7.14	11.71	15.36	18	1	6.77	11.42	15.01	18	1	4.29	9.97	14.32	17
3	2	7.01	11.51	14.99	18	1	6.55	11.2	14.93	18	1	4.53	10.31	15.06	18
4	2	6.71	11.22	14.78	17	0	6.33	10.87	14.6	18	0	3.59	9.98	14.98	18
5	2	6.36	10.97	14.57	17	0	5.99	10.6	14.3	18	0	3.78	10.04	14.98	18
6	2	6.17	10.78	14.06	17	1	5.62	10.32	13.95	17	1	4.52	10.07	14.39	17
7	2	5.87	10.5	13.96	17	1	5.39	10.02	13.66	17	1	3.68	8.69	12.71	16
8	2	6.41	10.97	14.64	17	1	6.06	10.69	14.28	17	1	4.48	10.05	14.37	17
9	3	7.85	12.44	15.94	18	1	7.22	12.01	15.72	19	1	4.67	10.38	15.16	19
10	4	9.04	13.99	17.75	20	1	8.56	13.43	17.39	21	1	5.22	11.4	16.12	20
11	5	10.28	15.4	19.3	22	1	9.98	14.82	18.77	23	1	6.01	12.78	18.84	23
12	5	11.16	16.44	20.34	23	2	10.88	15.87	19.73	24	2	6.42	13.18	18.92	23
13	6	11.46	16.97	20.92	24	3	11.32	16.43	20.58	24	3	7.58	13.89	19.02	24
14	5	11.45	17.23	21.23	24	2	11.57	16.62	20.72	25	2	7.23	14.05	19.91	24
15	5	11.25	17.04	20.92	24	2	11.33	16.51	20.57	25	2	7.62	14.06	19.45	24
16	5	11.04	16.48	20.54	23	2	10.99	15.91	19.83	24	2	7.13	13.51	18.87	23
17	5	10.32	15.5	19.51	22	2	9.91	14.87	18.86	23	2	6.46	12.73	17.8	22
18	5	9.54	14.43	18.25	21	2	9.27	13.98	17.78	21	2	6.28	12.42	17.11	20
19	4	8.81	13.78	17.61	20	2	8.31	13.21	16.99	21	2	5.92	12.05	16.87	20
20	4	8.81	13.49	17.27	20	1	7.99	12.82	16.7	20	1	4.65	10.92	15.91	20
21	3	8.21	13.11	16.81	19	1	7.63	12.49	16.21	20	1	4.36	10.94	16.41	20
22	3	7.81	12.72	16.6	19	1	7.34	12.26	15.87	19	1	4.16	10.22	14.8	18
23	3	7.54	12.45	16.23	19	1	7.09	12.01	15.73	19	1	4.15	10.14	14.58	18
24	3	7.37	12.09	15.85	18	1	6.91	11.72	15.65	18	1	4.66	10.36	15.08	18

1 ACH

Study 32 Fall	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	4	10.65	15.45	20.53	24	4	10.49	15.29	20.38	24	4	7.9	14.32	19.77	24
2	5	10.16	15.14	20.17	23	4	10.18	15.14	20.04	23	6	9.19	14.52	19.12	23
3	4	9.87	14.85	19.8	23	4	10.06	14.82	19.86	23	6	9.24	14.31	18.44	22
4	4	9.66	14.73	19.43	23	4	9.71	14.54	19.32	23	4	7.6	13.99	18.99	23
5	4	9.47	14.49	18.99	22	4	9.45	14.33	18.95	23	4	7.78	14.04	18.98	22
6	4	9.3	14.18	18.9	22	4	9.19	14.04	18.81	22	5	7.8	12.99	17.51	21
7	4	9.19	14.04	18.86	22	4	9.05	13.96	18.77	23	4	7.1	12.97	18.14	22
8	5	9.89	14.82	19.81	23	4	10.03	14.84	19.69	23	4	7.81	14.06	19	23
9	5	11.17	16.36	21.67	26	4	11.1	16.29	21.41	26	4	8.59	15.05	20.61	25
10	5	12.37	18.08	23.63	28	4	12.42	17.91	23.32	28	5	9.94	17.04	22.95	28
11	5	13.06	19.5	25.31	29	4	13.7	19.4	24.86	30	4	10.25	17.43	23.6	29
12	5	13.31	20.8	26.65	31	4	14.66	20.5	26.12	32	4	10.54	18.4	24.96	31
13	5	13.87	21.43	27.25	32	4	15.07	21.14	26.82	32	5	11.45	19.09	25.38	31
14	5	14.12	21.53	27.58	32	4	15.32	21.21	26.91	33	5	11.2	18.82	25.16	31
15	6	14.42	21.17	26.7	32	4	15.13	20.88	26.54	32	4	10.57	18.41	25.15	31
16	6	14.21	20.43	25.98	31	4	14.57	20.21	25.88	31	4	10.47	18.65	25.34	31
17	5	13.32	19.33	24.92	30	4	13.77	19.12	24.73	30	4	9.39	17.08	23.57	29
18	5	12.42	18.07	23.56	28	4	12.64	17.92	23.27	28	9	12.81	17.86	22.9	27
19	4	12.14	17.39	22.84	27	4	12.13	17.22	22.7	27	4	8.6	15.76	22.02	27
20	4	11.65	16.92	22.34	27	4	11.78	16.76	22.04	27	4	8.5	15.69	21.92	27
21	4	11.36	16.69	21.85	26	4	11.34	16.44	21.62	25	8	11.1	16.18	21.29	25
22	4	11.25	16.38	21.44	25	4	11.11	16.18	21.32	25	4	8.04	14.61	19.53	23
23	4	10.85	16.01	21.08	25	4	10.85	15.78	20.89	25	4	8.04	14.61	20.56	25
24	4	10.46	15.63	20.71	25	4	10.43	15.47	20.48	24	4	7.82	13.81	18.31	22

Study 32 Spring	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	10.53	16.52	23.38	27	6	10.66	16.53	22.66	27	8	11.21	16.13	20.97	25
2	8	10.22	16.13	22.73	27	5	10.37	16.09	22.09	26	8	11.03	15.87	21.61	26
3	8	9.72	15.8	22.56	27	5	10.05	15.79	21.89	26	6	9.57	15.39	21.47	26
4	8	9.57	15.53	21.91	26	5	9.79	15.49	21.62	25	5	8.57	14.81	20.64	25
5	7	9.48	15.25	21.67	26	5	9.43	15.22	21.09	25	5	8.64	14.59	19.84	24
6	7	9.22	14.91	21.47	25	5	9.17	14.93	20.8	25	5	8.57	14.17	19.75	24
7	7	9.1	14.91	21.57	26	5	9.07	14.89	20.86	25	5	8.55	14.15	19.71	24
8	7	9.72	15.81	22.98	27	5	9.88	15.88	22.19	27	5	9.07	15.2	20.99	26
9	8	10.92	17.3	24.61	29	5	11.27	17.36	23.78	29	8	12.14	17.31	23.64	29
10	9	12.17	19.07	26.67	32	6	12.57	19.05	25.53	32	6	11.12	17.54	23.68	29
11	9	13.2	20.72	28.53	34	6	14.06	20.71	27.15	33	6	12.04	18.86	25.97	32
12	9	14.03	22.14	29.83	35	6	15.18	22.02	28.56	35	6	12.42	19.6	26.23	32
13	9	14.87	22.81	30.73	36	7	15.98	22.76	29.41	36	7	13.71	20.8	28.04	35
14	9	15.03	23.08	30.83	36	7	16.07	22.95	29.5	36	7	13.6	20.67	27.21	33
15	9	14.85	22.77	30.65	36	7	15.92	22.75	29.29	35	7	13.59	20.64	27.12	33
16	9	14.14	22.04	29.7	35	7	15.28	22	28.46	34	7	13.14	20.11	26.66	32
17	9	13.48	20.96	28.63	34	7	14.41	20.96	27.45	33	7	12.49	19.28	25.49	31
18	9	12.66	19.76	27.09	32	6	13.28	19.63	26.09	31	6	10.98	17.93	24.63	30
19	9	12.03	18.96	25.86	30	6	12.57	18.75	25.15	30	6	10.68	17.35	23.47	28
20	8	11.89	18.32	25.58	30	5	12.17	18.28	24.72	29	5	9.83	17.01	23.27	28
21	8	11.54	17.93	24.91	29	5	11.83	17.88	24.23	29	5	9.69	17.28	24.25	29
22	8	11.05	17.61	24.48	29	5	11.41	17.44	23.69	28	5	9.21	16.21	22.05	26
23	7	10.91	17.25	24.22	28	5	11.18	17.15	23.52	28	5	9.04	15.61	21.56	26
24	7	10.71	16.83	23.84	27	5	11.05	16.77	23.03	27	5	9.1	15.64	21.57	26

1 ACH

Study 32	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.93	21.45	25.67	28	10	16.34	21.36	24.86	29	10	14.76	20.73	25.08	28
2	11	15.62	21.16	25.3	28	10	16.15	21.09	24.58	29	10	14.41	20.23	24.85	28
3	11	15.45	20.84	24.84	28	10	15.83	20.76	24.2	29	11	14.83	19.96	24.17	28
4	11	15.31	20.57	24.58	27	10	15.59	20.44	23.83	28	11	14.66	19.9	24.18	28
5	11	15.18	20.29	24.33	27	9	15.37	20.18	23.51	27	11	14.73	19.66	23.48	27
6	11	15.05	20.15	23.91	27	9	15.22	20.03	23.27	27	9	13.27	19.15	23.37	27
7	11	15.2	20.62	24.79	27	10	15.57	20.47	23.91	29	11	15.33	20.33	24.29	28
8	11	15.53	21.75	26.32	29	10	16.31	21.58	25.37	30	10	15.19	20.99	25.74	30
9	12	16.06	23.3	27.98	31	10	17.3	23	27.17	33	12	17.48	22.99	27.72	32
10	12	16.7	24.99	29.98	33	10	18.28	24.5	28.98	35	11	17.42	23.94	29.52	35
11	12	17.19	26.73	31.86	35	10	19.29	26.17	30.91	38	13	19.49	25.65	31.13	36
12	13	17.78	28.02	33.32	36	11	20.11	27.39	32.35	38	13	19.92	26.61	32.24	37
13	13	18.25	28.73	34.09	37	11	20.65	28.12	33.09	39	12	19.43	26.33	32.02	37
14	13	18.42	28.85	34.37	37	10	20.81	28.19	33.3	39	11	18.83	26.06	32.01	37
15	12	18.39	28.39	33.89	37	10	20.58	27.72	32.82	39	11	18.96	26.4	32.54	38
16	12	18.33	27.41	33.02	36	10	20.12	26.9	31.9	38	11	18.39	25.51	31.21	36
17	12	18.02	26.26	31.88	35	10	19.47	25.87	30.74	36	11	17.91	24.74	30.07	35
18	12	17.33	25.05	30.37	33	10	18.68	24.7	29.32	34	10	16.07	23.16	28.41	33
19	11	16.92	23.94	28.9	32	10	17.9	23.63	27.91	33	10	15.78	22.49	27.71	32
20	11	16.54	23.34	28.08	31	10	17.47	23.03	27.17	32	10	15.05	21.48	26.07	30
21	11	16.35	22.9	27.58	30	10	17.17	22.61	26.68	31	10	14.66	21.04	25.98	30
22	11	16.09	22.52	27.02	29	10	16.92	22.22	26.16	31	10	14.99	21.18	26.09	30
23	11	16.04	22.19	26.64	29	10	16.69	21.89	25.74	30	10	14.94	21.07	25.83	30
24	11	15.8	21.83	26.08	29	10	16.39	21.59	25.32	30	10	15.02	21.1	25.84	30

Study 32	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	7.1	11.61	15.26	18	1	7.01	11.57	15.05	18	2	4.98	10.67	15.38	18
2	2	6.85	11.32	14.96	18	1	6.54	11.23	14.88	18	2	4.78	10.59	15.36	18
3	2	6.71	11.05	14.81	17	1	6.24	10.83	14.57	18	2	4.96	10.66	15.38	18
4	2	6.25	10.72	14.44	17	0	5.9	10.4	14.12	18	1	3.24	9.6	14.64	18
5	2	6.09	10.46	14.12	17	0	5.47	10.08	13.71	17	0	3.09	9.11	13.57	17
6	2	5.61	10.24	13.89	17	1	5.26	9.71	13.37	17	1	3.8	8.99	13.51	17
7	2	5.47	10.07	13.73	16	1	4.76	9.5	13.03	17	1	3.68	8.69	12.71	16
8	2	6.12	10.65	14.25	17	1	6	10.52	14.13	17	1	4.35	9.59	14.17	17
9	3	7.65	12.07	15.88	18	1	7.08	11.81	15.51	19	1	4.67	10.38	15.16	19
10	4	9.05	13.84	17.72	20	1	8.54	13.42	17.32	21	1	5.31	11.7	16.87	21
11	5	10.28	15.38	19.38	22	2	9.96	14.95	18.82	23	2	6.75	13.17	18.45	22
12	5	11.41	16.5	20.51	23	2	11.09	16.14	20.21	24	2	7.45	14.02	19.51	24
13	6	11.46	17.2	21.25	24	3	11.7	16.73	20.77	25	3	7.58	13.89	19.02	24
14	5	11.54	17.32	21.39	24	2	11.79	16.95	20.94	25	2	7.23	14.05	19.91	24
15	5	11.37	17.13	20.99	24	3	11.61	16.74	20.75	25	3	8.61	15.05	20.43	24
16	6	11.04	16.44	20.59	23	3	11.15	16.15	20.11	24	3	8.13	14.51	19.87	24
17	5	10.41	15.37	19.56	22	3	10.2	15.08	18.88	23	5	8.05	13.71	18.43	22
18	5	9.54	14.29	18.2	21	2	9.03	13.8	17.84	21	2	5.62	12.06	17.41	21
19	4	8.81	13.6	17.54	20	2	8.29	13.19	16.89	21	2	5.92	12.05	16.87	20
20	4	8.46	13.21	16.9	20	2	7.92	12.83	16.65	21	2	5.02	10.71	15.46	19
21	3	7.81	12.83	16.68	19	1	7.62	12.54	16.24	19	1	4.04	10.42	15.54	19
22	3	7.65	12.5	16.34	19	2	7.26	12.29	15.95	19	3	5.94	11.48	15.85	18
23	3	7.25	12.13	15.86	18	1	7.06	11.97	15.72	19	2	5.13	11.13	15.57	18
24	3	7.05	11.81	15.64	18	1	6.81	11.67	15.55	18	2	5.07	10.71	15.4	18

1 ACH

Study 33	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	11.22	16.05	21.19	25	4	11.36	16.36	21.45	25	7	10.52	15.63	19.83	24
2	5	11.15	15.87	20.91	25	4	11.19	16.07	20.94	25	7	10.44	15.85	20.57	25
3	5	11.1	15.7	20.67	24	4	11.02	15.83	20.73	25	4	8.19	14.72	20.2	25
4	5	10.65	15.5	20.48	24	4	10.61	15.59	20.55	25	6	9.28	14.81	19.92	24
5	5	10.37	15.24	19.99	24	4	10.47	15.38	20.45	23	6	9.33	14.59	19.16	23
6	5	10.22	15.06	19.91	23	4	10.29	15.2	20.2	23	6	9.4	14.63	19.21	23
7	5	10.11	14.91	19.86	23	4	10.25	15.14	19.88	23	4	7.85	14.07	18.99	23
8	5	10.75	15.54	20.65	25	4	10.53	15.76	20.76	25	6	9.63	14.93	19.61	24
9	5	11.81	16.58	21.75	26	4	11.78	16.81	21.83	26	5	9.31	15.79	21.29	26
10	5	12.45	17.68	23.11	27	4	12.56	17.87	23.29	28	5	9.94	17.04	22.95	28
11	5	13.04	18.71	24.48	29	4	13.49	19.01	24.41	29	4	9.69	16.77	22.79	28
12	5	13.12	19.64	25.48	30	4	14.11	19.72	25.21	31	4	10.3	18.08	24.53	30
13	5	13.56	20.31	25.85	31	4	14.56	20.36	25.89	31	5	11.07	18.46	24.33	30
14	5	13.65	20.5	26.52	31	4	14.79	20.59	26.17	31	5	11.2	18.82	25.16	31
15	6	13.81	20.45	26.11	31	4	14.76	20.45	26	31	10	14.65	19.87	25.03	30
16	6	14.05	20.16	25.75	31	4	14.67	20.19	25.74	31	4	10.63	18.55	25.5	31
17	5	13.62	19.47	24.93	30	4	14.11	19.48	24.99	31	4	10.01	17.72	24.32	30
18	5	13.1	18.4	23.88	29	4	13.2	18.57	24.01	29	4	9.49	17.13	23.39	29
19	5	12.62	17.82	23.48	28	4	12.71	17.88	23.43	28	4	9.34	16.85	22.93	28
20	5	12.18	17.44	22.78	27	4	12.41	17.51	22.84	28	4	8.83	16.01	22.27	27
21	5	12.11	17.05	22.48	27	4	12.17	17.25	22.37	26	8	11.64	16.84	21.98	26
22	5	12.02	16.84	22.18	26	4	12	16.95	22.14	26	8	11.9	16.96	22.12	26
23	5	11.46	16.57	21.73	26	4	11.55	16.69	21.87	26	4	8.25	14.82	19.65	24
24	5	11.36	16.37	21.55	26	4	11.45	16.49	21.61	26	4	8.5	15.42	21.1	26

Study 33	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	10.53	16.52	23.38	27	6	10.66	16.53	22.66	27	8	11.21	16.13	20.97	25
2	8	10.22	16.13	22.73	27	5	10.37	16.09	22.09	26	8	11.03	15.87	21.61	26
3	8	9.72	15.8	22.56	27	5	10.05	15.79	21.89	26	6	9.57	15.39	21.47	26
4	8	9.57	15.53	21.91	26	5	9.79	15.49	21.62	25	5	8.57	14.81	20.64	25
5	7	9.48	15.25	21.67	26	5	9.43	15.22	21.09	25	5	8.64	14.59	19.84	24
6	7	9.22	14.91	21.47	25	5	9.17	14.93	20.8	25	5	8.57	14.17	19.75	24
7	7	9.1	14.91	21.57	26	5	9.07	14.89	20.86	25	5	8.55	14.15	19.71	24
8	7	9.72	15.81	22.98	27	5	9.88	15.88	22.19	27	5	9.07	15.2	20.99	26
9	8	10.92	17.3	24.61	29	5	11.27	17.36	23.78	29	8	12.14	17.31	23.64	29
10	9	12.17	19.07	26.67	32	6	12.57	19.05	25.53	32	6	11.12	17.54	23.68	29
11	9	13.2	20.72	28.53	34	6	14.06	20.71	27.15	33	6	12.04	18.86	25.97	32
12	9	14.03	22.14	29.83	35	6	15.18	22.02	28.56	35	6	12.42	19.6	26.23	32
13	9	14.87	22.81	30.73	36	7	15.98	22.76	29.41	36	7	13.71	20.8	28.04	35
14	9	15.03	23.08	30.83	36	7	16.07	22.95	29.5	36	7	13.6	20.67	27.21	33
15	9	14.85	22.77	30.65	36	7	15.92	22.75	29.29	35	7	13.59	20.64	27.12	33
16	9	14.14	22.04	29.7	35	7	15.28	22	28.46	34	7	13.14	20.11	26.66	32
17	9	13.48	20.96	28.63	34	7	14.41	20.96	27.45	33	7	12.49	19.28	25.49	31
18	9	12.66	19.76	27.09	32	6	13.28	19.63	26.09	31	6	10.98	17.93	24.63	30
19	9	12.03	18.96	25.86	30	6	12.57	18.75	25.15	30	6	10.68	17.35	23.47	28
20	8	11.89	18.32	25.58	30	5	12.17	18.28	24.72	29	5	9.83	17.01	23.27	28
21	8	11.54	17.93	24.91	29	5	11.83	17.88	24.23	29	5	9.69	17.28	24.25	29
22	8	11.05	17.61	24.48	29	5	11.41	17.44	23.69	28	5	9.21	16.21	22.05	26
23	7	10.91	17.25	24.22	28	5	11.18	17.15	23.52	28	5	9.04	15.61	21.56	26
24	7	10.71	16.83	23.84	27	5	11.05	16.77	23.03	27	5	9.1	15.64	21.57	26

1 ACH

Study 33	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.93	21.45	25.67	28	10	16.34	21.36	24.86	29	10	14.76	20.73	25.08	28
2	11	15.62	21.16	25.3	28	10	16.15	21.09	24.58	29	10	14.41	20.23	24.85	28
3	11	15.45	20.84	24.84	28	10	15.83	20.76	24.2	29	11	14.83	19.96	24.17	28
4	11	15.31	20.57	24.58	27	10	15.59	20.44	23.83	28	11	14.66	19.9	24.18	28
5	11	15.18	20.29	24.33	27	9	15.37	20.18	23.51	27	11	14.73	19.66	23.48	27
6	11	15.05	20.15	23.91	27	9	15.22	20.03	23.27	27	9	13.27	19.15	23.37	27
7	11	15.2	20.62	24.79	27	10	15.57	20.47	23.91	29	11	15.33	20.33	24.29	28
8	11	15.53	21.75	26.32	29	10	16.31	21.58	25.37	30	10	15.19	20.99	25.74	30
9	12	16.06	23.3	27.98	31	10	17.3	23	27.17	33	12	17.48	22.99	27.72	32
10	12	16.7	24.99	29.98	33	10	18.28	24.5	28.98	35	11	17.42	23.94	29.52	35
11	12	17.19	26.73	31.86	35	10	19.29	26.17	30.91	38	13	19.49	25.65	31.13	36
12	13	17.78	28.02	33.32	36	11	20.11	27.39	32.35	38	13	19.92	26.61	32.24	37
13	13	18.25	28.73	34.09	37	11	20.65	28.12	33.09	39	12	19.43	26.33	32.02	37
14	13	18.42	28.85	34.37	37	10	20.81	28.19	33.3	39	11	18.83	26.06	32.01	37
15	12	18.39	28.39	33.89	37	10	20.58	27.72	32.82	39	11	18.96	26.4	32.54	38
16	12	18.33	27.41	33.02	36	10	20.12	26.9	31.9	38	11	18.39	25.51	31.21	36
17	12	18.02	26.26	31.88	35	10	19.47	25.87	30.74	36	11	17.91	24.74	30.07	35
18	12	17.33	25.05	30.37	33	10	18.68	24.7	29.32	34	10	16.07	23.16	28.41	33
19	11	16.92	23.94	28.9	32	10	17.9	23.63	27.91	33	10	15.78	22.49	27.71	32
20	11	16.54	23.34	28.08	31	10	17.47	23.03	27.17	32	10	15.05	21.48	26.07	30
21	11	16.35	22.9	27.58	30	10	17.17	22.61	26.68	31	10	14.66	21.04	25.98	30
22	11	16.09	22.52	27.02	29	10	16.92	22.22	26.16	31	10	14.99	21.18	26.09	30
23	11	16.04	22.19	26.64	29	10	16.69	21.89	25.74	30	10	14.94	21.07	25.83	30
24	11	15.8	21.83	26.08	29	10	16.39	21.59	25.32	30	10	15.02	21.1	25.84	30

Study 33	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	8.01	12.51	15.9	18	1	7.59	12.02	15.8	20	1	4.21	10.53	15.68	20
2	3	7.61	12.21	15.76	18	1	7.35	11.86	15.69	20	1	4.04	10.35	15.31	19
3	3	7.32	12.04	15.56	18	1	7.26	11.73	15.41	18	1	3.98	9.68	14.4	18
4	3	7.17	11.78	15.17	18	1	6.91	11.56	15.24	18	1	3.73	9.36	13.66	17
5	2	7.07	11.56	14.96	18	1	6.88	11.3	14.99	18	2	4.86	10.38	14.63	17
6	3	6.53	11.4	14.8	17	1	6.68	11.14	14.82	18	2	5.04	10.7	15.43	18
7	3	6.41	11.21	14.55	17	1	6.45	10.94	14.69	18	2	5.02	10.68	15.39	18
8	3	6.75	11.57	14.93	17	1	6.75	11.12	14.81	19	2	5	10.67	15.4	18
9	3	8.02	12.64	15.97	19	1	7.79	12.46	16.21	19	1	5.39	11.45	16.05	19
10	4	9.02	13.94	17.44	20	1	8.86	13.43	17.24	21	1	5.06	11.39	16.55	21
11	5	9.87	15.03	18.6	21	2	9.69	14.61	18.42	23	2	7.1	13.43	18.7	23
12	5	10.46	15.95	19.54	22	2	10.52	15.37	19.28	23	2	6.25	13	18.83	23
13	6	10.75	16.36	19.99	23	3	11.15	16.02	20.01	25	3	8.16	14.66	20.31	24
14	5	11.06	16.74	20.42	23	3	11.32	16.34	20.3	25	3	8.09	14.41	19.67	23
15	6	11.25	16.73	20.46	23	3	11.19	16.3	20.23	24	3	8.09	14.39	19.63	23
16	6	10.81	16.38	19.96	23	4	11.08	16.04	19.87	24	4	8.3	14.14	19.18	23
17	5	10.41	15.9	19.56	22	2	10.31	15.28	19.28	23	4	7.88	14.08	19.01	22
18	5	9.54	14.91	18.49	21	2	9.59	14.42	18.35	22	2	6.39	12.74	17.89	22
19	4	9.28	14.18	17.77	20	2	9.22	13.97	17.82	21	2	6.47	12.76	17.88	21
20	4	8.81	13.84	17.51	20	2	8.67	13.48	17.35	21	2	6.3	12.41	17.04	20
21	4	8.46	13.54	17.06	19	2	8.17	13.12	16.91	20	2	5.16	11.22	16.5	20
22	4	8.21	13.22	16.81	19	2	8.06	12.8	16.66	20	2	5.84	11.75	16.89	20
23	4	8.04	12.99	16.54	19	2	7.66	12.5	16.16	20	2	5.01	10.61	15.13	19
24	3	7.65	12.72	16.21	19	1	7.42	12.23	15.87	20	1	4.64	10.64	15.12	19

1 ACH

Study 34	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	11.36	16.08	21.34	25	4	11.56	16.51	21.6	26	5	8.58	15.15	19.87	24
2	5	11.02	15.76	20.81	24	4	11.4	16.26	21.31	25	8	10.78	15.94	20.03	24
3	5	10.85	15.6	20.67	24	4	11.23	15.95	20.83	25	8	10.59	15.47	20.3	24
4	5	10.61	15.32	20.34	24	4	11.03	15.72	20.58	25	5	8.1	14.62	20.06	24
5	5	10.14	15.01	19.99	23	4	10.69	15.48	20.46	24	7	9.73	14.95	19.47	23
6	5	10.02	14.84	19.7	23	4	10.49	15.21	20.05	23	7	9.8	14.99	19.51	23
7	5	9.89	14.86	19.81	23	4	10.4	15.26	19.93	24	5	8.22	14.41	19.33	23
8	5	11.02	15.69	20.94	25	4	11.27	16.31	21.32	26	7	10.72	16.2	21.36	26
9	6	12.1	17.21	22.75	27	5	12.4	17.7	22.89	27	6	10.63	16.64	22.06	27
10	6	13.11	18.45	24.22	28	4	13.48	18.84	24.12	29	4	9.47	16.68	22.76	28
11	5	13.31	19.38	24.92	29	5	14.16	19.71	25.15	31	9	13.62	19.28	24.73	30
12	6	13.56	19.87	25.75	30	5	14.59	20.16	25.69	31	5	10.75	18.43	24.73	30
13	6	13.56	20.33	25.91	30	6	14.88	20.55	26.09	31	6	11.65	18.71	24.67	30
14	6	13.85	20.45	26.42	31	6	15.19	20.71	26.27	32	6	11.69	18.77	24.79	30
15	6	14.08	20.49	26.12	31	6	15.21	20.75	26.32	31	6	11.6	19.14	25.32	31
16	6	14.25	20.24	25.92	31	6	15.12	20.55	26.11	31	6	11.66	19.28	25.64	31
17	6	14.1	19.64	25.42	30	6	14.48	19.87	25.52	31	6	11.17	18.35	24.64	30
18	5	13.12	18.68	24.28	29	4	13.83	18.94	24.37	30	5	9.72	17.44	23.94	29
19	5	12.75	18.02	23.6	28	4	13.26	18.32	23.67	28	10	13.56	18.56	23.62	28
20	5	12.37	17.63	23.18	28	4	12.89	17.94	23.41	28	5	9.34	16.81	22.71	27
21	5	12.16	17.33	22.67	27	4	12.45	17.62	22.87	27	5	9.03	16.36	22.75	27
22	5	11.65	16.94	22.28	26	4	12.18	17.27	22.38	27	5	9.01	16.19	22.58	27
23	5	11.41	16.64	21.87	26	4	12.01	16.97	22.02	26	9	11.75	16.28	20.16	24
24	5	11.28	16.4	21.63	26	4	11.58	16.68	21.88	26	9	11.81	16.3	20.17	24

Study 34	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	9	11.25	17.16	24.56	28	6	12.09	17.78	23.97	29	9	12.61	17.35	22.61	27
2	9	11.2	16.83	23.84	28	6	11.74	17.51	23.63	28	9	12.54	17.55	23.33	28
3	8	10.6	16.54	23.7	28	6	11.27	17.2	23.33	28	6	10.39	16.78	23.08	28
4	8	10.44	16.18	23.34	27	6	11.08	16.83	22.84	27	6	9.78	15.87	21.27	26
5	8	10.3	15.96	22.81	27	6	10.87	16.52	22.49	27	6	9.79	15.46	21.06	26
6	7	9.81	15.67	22.64	26	5	10.39	16.21	22.16	27	5	9.11	15.23	21.03	26
7	7	10.02	15.8	23.11	27	5	10.42	16.33	22.46	28	5	9.09	15.21	20.98	26
8	8	10.79	16.93	24.65	29	5	11.57	17.51	23.91	30	6	10.47	17.07	23.93	30
9	9	11.81	18.34	26.34	31	6	12.69	18.97	25.48	31	7	12.01	18.25	24.28	30
10	9	12.58	19.58	27.58	33	7	13.83	20.15	26.64	33	10	14.5	19.97	26.49	32
11	9	13.3	20.53	28.53	34	7	14.47	21.05	27.65	34	7	12.79	19.67	26.05	32
12	9	13.62	21.08	28.91	34	8	15.1	21.61	28.16	35	8	13.37	19.91	26.18	32
13	9	14.25	21.51	29.67	35	8	15.49	22.03	28.64	35	8	13.58	20.17	26.74	33
14	9	14.22	21.82	29.85	35	8	15.63	22.34	28.9	36	8	13.79	20.67	27.04	33
15	9	14.21	21.95	29.85	35	8	15.77	22.41	28.93	36	8	13.78	20.64	26.96	33
16	9	14.22	21.73	29.77	35	8	15.69	22.23	28.78	35	8	13.57	20.45	26.86	32
17	9	14.22	21.16	29.42	34	8	15.24	21.8	28.43	35	8	13.49	20.28	26.49	32
18	9	13.39	20.11	28.42	33	7	14.4	20.77	27.35	34	7	12.42	19.3	25.63	31
19	9	12.81	19.41	27.09	32	6	13.79	19.92	26.38	32	6	11.21	18.41	24.78	30
20	9	12.53	18.99	26.7	31	6	13.4	19.4	25.89	32	6	10.89	17.61	23.75	29
21	9	12.04	18.65	26.25	31	6	13.22	19.1	25.56	30	6	10.67	17.62	23.95	29
22	8	11.78	18.3	25.64	30	6	12.77	18.79	25.21	30	6	10.99	17.77	24.08	29
23	8	11.75	18.02	25.43	30	5	12.42	18.43	24.7	30	5	9.96	17.27	23.93	29
24	8	11.65	17.64	24.97	29	5	12.2	18.05	24.31	29	5	9.94	17.03	23.2	28

1 ACH

Study 34	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	12	16.48	22.79	27.43	30	11	17.89	23.07	26.92	32	11	16.17	21.97	26.72	31
2	12	16.37	22.49	26.93	29	10	17.61	22.78	26.75	32	12	16.7	22.17	26.77	31
3	12	16.2	22.21	26.55	29	10	17.36	22.46	26.37	31	12	16.91	22.25	26.8	31
4	12	16.13	21.87	26.15	29	10	17.14	22.14	25.85	31	12	16.44	21.87	26.46	31
5	12	16.03	21.56	25.69	28	10	16.95	21.85	25.46	31	10	14.61	20.32	24.88	29
6	11	15.84	21.64	25.92	29	10	16.97	21.91	25.75	32	10	15.24	21.02	25.76	30
7	11	16.15	22.46	27.57	30	10	17.45	22.75	27.06	33	10	15.96	21.97	26.99	32
8	12	16.6	23.73	29.18	32	10	18.21	24.01	28.77	35	12	18.21	24.24	29.52	35
9	12	16.93	25.13	30.79	33	11	18.97	25.21	30.17	37	11	18.2	24.99	30.96	37
10	13	17.31	26.26	31.81	34	11	19.58	26.27	31.35	38	13	19.62	26.24	32.1	38
11	13	17.66	27.16	32.7	36	11	20.16	27.1	32.28	39	13	20.12	26.7	32.25	37
12	13	17.97	27.71	33.16	36	11	20.55	27.55	32.71	40	13	20.07	26.93	32.9	38
13	13	18.29	28.14	33.47	36	11	20.97	27.98	33.04	40	12	19.43	26.33	32.02	37
14	13	18.39	28.2	33.75	36	11	21.13	28.12	33.3	40	12	19.61	26.69	32.81	38
15	14	18.5	28.26	33.77	37	11	21.14	28.09	33.3	40	12	19.6	26.7	32.63	38
16	13	18.63	27.87	33.75	36	11	21.03	27.8	33	40	11	19.12	26.85	33.58	40
17	13	18.45	27.34	33.34	36	11	20.7	27.37	32.68	38	11	18.66	26.04	32.09	38
18	13	18.19	26.68	32.65	35	11	20.3	26.74	31.97	38	11	18.31	25.7	31.87	38
19	13	17.61	25.42	30.81	34	11	19.47	25.49	30.33	36	11	17.6	24.4	30.28	36
20	12	17.18	24.75	29.94	33	10	19.09	24.87	29.45	35	11	17.38	24.01	29.52	35
21	12	17.08	24.33	29.35	32	10	18.75	24.42	28.85	34	11	16.7	23.3	28.66	33
22	12	16.93	24.02	28.86	31	10	18.46	24.07	28.53	34	11	16.76	23.16	28.43	33
23	12	16.86	23.56	28.4	31	10	18.17	23.65	27.87	34	11	16.7	23.03	28.08	33
24	12	16.63	23.24	27.84	30	10	17.94	23.34	27.5	33	11	16.79	23.06	28.09	33

Study 34	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	8.06	12.32	15.82	18	2	7.9	12.35	15.87	20	2	4.91	10.52	14.97	19
2	3	7.61	12.08	15.67	18	1	7.59	12.13	15.72	19	1	4.04	10.35	15.31	19
3	3	7.25	11.84	15.3	18	1	7.42	11.92	15.61	19	2	5.16	11.38	16.31	19
4	2	7.02	11.49	14.92	18	1	7.14	11.73	15.19	18	2	4.8	10.74	14.8	17
5	2	6.85	11.25	14.75	17	1	7.03	11.49	14.99	18	2	4.86	10.38	14.63	17
6	3	6.36	11.06	14.46	17	1	6.69	11.3	14.83	18	2	5.04	10.7	15.43	18
7	2	6.3	10.8	14.25	17	1	6.4	11.06	14.66	18	2	5.02	10.68	15.39	18
8	3	7.09	11.58	15.05	17	1	7.02	11.59	15.2	19	1	4.07	9.89	14.86	19
9	3	8.45	12.96	16.65	19	2	8.29	12.97	16.75	21	2	5.93	12.12	17.07	21
10	4	9.46	14.35	17.92	20	3	9.49	14.52	18.2	22	3	7.1	12.97	17.91	21
11	5	10.28	15.26	18.84	22	3	10.34	15.2	18.88	23	3	7.49	13.78	18.9	23
12	6	11.01	15.73	19.49	22	3	11.01	15.69	19.57	24	3	7.43	14.02	19.7	24
13	6	10.75	16.25	19.79	23	4	11.15	16.13	19.92	24	4	7.97	13.68	18.55	23
14	6	11.06	16.39	20.18	23	4	11.35	16.36	20.29	24	3	8.2	14.74	20.3	24
15	6	11.05	16.41	20.2	23	4	11.56	16.49	20.45	25	4	8.58	15.05	20.62	25
16	6	11.04	16.37	19.9	23	4	11.55	16.34	20.23	25	4	8.53	14.86	20.09	24
17	6	10.46	15.66	19.61	22	4	10.93	15.63	19.62	23	5	8.25	14.43	19.36	23
18	5	9.81	14.64	18.48	21	4	10.08	14.81	18.59	23	4	7.55	13.35	18.21	21
19	5	9.54	14.27	17.77	20	3	9.47	14.39	18.12	21	3	6.9	13.12	18.14	21
20	4	8.81	13.81	17.51	20	3	9.06	13.85	17.67	21	3	6.2	12.43	17.39	21
21	4	8.81	13.48	17.06	20	2	8.48	13.42	17.15	21	2	5.27	11.63	16.67	20
22	4	8.37	13.22	16.83	19	2	8.23	13.09	16.88	20	2	5.84	11.75	16.89	20
23	4	8.04	12.93	16.51	19	2	7.99	12.82	16.48	20	2	5.09	10.9	15.86	20
24	3	7.81	12.53	16.07	19	2	7.86	12.5	15.99	20	2	5.41	10.93	15.2	19

5 ACH

Study 26	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	4	9.85	14.75	19.67	23	4	9.78	14.51	19.54	23	4	7.18	13.39	18.32	22
2	4	9.47	14.44	19.25	22	4	9.47	14.28	19.3	22	6	8.48	13.6	17.68	21
3	4	9.28	14.1	18.98	22	4	9.28	13.88	18.85	22	6	8.72	13.95	18.47	22
4	4	9.02	13.89	18.68	22	4	8.98	13.67	18.25	22	5	7.8	13.62	18.41	22
5	4	8.69	13.76	18.11	21	4	8.7	13.43	18.14	22	5	7.73	12.95	17.47	21
6	4	8.44	13.46	18.08	21	4	8.51	13.16	17.82	22	4	7.05	12.71	17.44	21
7	4	8.39	13.36	17.82	21	4	8.32	13.15	17.71	22	4	7.03	12.69	17.4	21
8	5	9.25	14.15	18.94	23	4	9.26	14.11	18.89	22	5	7.88	13.26	18.24	22
9	5	10.54	15.75	20.92	25	4	10.73	15.64	20.66	24	4	8.02	14.39	19.85	24
10	5	12.03	17.46	22.91	27	4	12.25	17.32	22.6	28	5	9.05	16.07	21.83	26
11	5	13.02	18.9	24.43	29	4	13.38	18.64	24.1	30	5	10.16	17.81	24.3	29
12	5	13.08	20.08	25.65	30	4	14.24	19.78	25.34	31	4	9.85	17.72	24.48	30
13	5	13.45	20.7	26.25	31	4	14.71	20.34	25.87	31	5	10.92	18.43	24.59	30
14	5	13.87	20.76	26.81	31	4	14.94	20.55	26.24	31	5	10.9	18.89	25.2	30
15	6	13.85	20.47	25.98	31	5	14.84	20.29	25.86	31	5	10.94	18.46	24.65	30
16	6	14.02	20.04	25.65	30	5	14.3	19.64	25.19	30	5	10.78	18.55	25.27	30
17	5	13.12	18.84	24.56	29	4	13.46	18.64	24.13	29	4	9.34	17.47	24.06	29
18	5	12.12	17.6	22.93	27	4	12.44	17.4	22.8	27	4	8.42	16.12	22.57	27
19	4	11.65	16.87	22.38	26	4	11.94	16.65	22.09	26	4	8.44	15.88	21.8	26
20	4	11.28	16.4	21.67	26	4	11.24	16.12	21.41	26	4	8.21	15.35	21.54	25
21	4	11.02	16.01	21.18	25	4	11.07	15.9	20.93	24	8	11.08	16.14	21.23	24
22	4	10.47	15.67	20.72	25	4	10.78	15.6	20.68	24	4	7.58	14.56	20.39	24
23	4	10.21	15.32	20.31	24	4	10.22	15.12	20.13	24	4	7.14	13.13	17.58	21
24	4	9.75	14.99	19.86	24	4	9.82	14.71	19.7	23	4	7.2	13.16	17.59	21

Study 26	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	9.78	15.75	22.19	26	6	10.02	15.72	21.82	25	8	10.44	14.97	20.13	24
2	7	9.48	15.45	21.65	25	5	9.65	15.33	21.35	25	8	10.39	15.2	20.88	25
3	7	9.27	14.97	21.38	25	5	9.2	14.9	20.96	25	6	9	14.71	20.75	25
4	7	9.02	14.67	20.78	25	5	8.9	14.56	20.49	24	6	8.76	14.43	19.98	24
5	6	8.57	14.43	20.58	24	5	8.37	14.19	20.04	24	5	7.92	13.46	18.96	23
6	6	8.22	14.01	20.31	23	5	8.15	14.02	19.83	23	5	8	13.5	19	23
7	6	8.16	14.01	20.53	24	4	8.1	14.01	19.99	24	5	7.97	13.48	18.96	23
8	7	9.1	15.04	21.9	26	5	9.23	15.14	21.53	26	5	8.76	14.87	20.64	25
9	8	10.32	16.71	23.75	28	5	10.69	16.69	23.15	28	8	11.8	16.68	22.47	27
10	9	11.53	18.47	25.72	31	6	12.19	18.35	24.78	30	6	10.73	17.44	24.45	30
11	9	12.62	20.07	27.47	32	6	13.46	19.94	26.48	32	6	11.53	18.34	24.63	30
12	9	13.47	21.43	28.67	34	7	14.68	21.23	27.65	33	7	12.87	19.81	26.99	33
13	9	14.2	22.09	29.53	34	7	15.17	21.87	28.5	35	7	13.08	19.94	26.26	32
14	9	14.22	22.36	29.77	35	7	15.53	22.21	28.71	34	7	13.28	20.58	27.89	34
15	9	14.28	22.24	29.53	34	7	15.36	21.99	28.46	34	7	12.94	19.92	26.65	32
16	9	13.81	21.6	28.83	34	7	14.82	21.4	27.92	33	7	12.67	19.74	26.65	32
17	9	13.3	20.62	27.77	32	7	14.02	20.45	26.94	32	7	12.04	18.9	25.48	31
18	9	12.41	19.22	26.38	31	6	13	19.17	25.7	31	6	10.49	17.72	24	29
19	8	11.88	18.3	25.4	29	6	12.2	18.2	24.56	29	6	10.25	17.24	24.29	29
20	8	11.25	17.84	24.61	28	5	11.9	17.67	24.08	28	5	9.22	16.36	22.55	27
21	7	11.14	17.39	24.31	28	5	11.34	17.31	23.72	28	5	9.03	16.36	22.75	27
22	7	10.65	17.08	23.55	28	5	11.15	16.94	23.22	28	5	9.34	16.73	23.62	27
23	7	10.41	16.58	23.28	27	5	10.72	16.52	22.89	27	5	9.11	15.87	22.3	26
24	6	10.2	16.21	22.75	26	4	10.31	16.09	22.37	25	4	8.3	15.37	21.49	25

5 ACH

Study 26	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.25	20.32	24.06	27	10	15.57	20.32	23.74	28	12	15.26	20.31	24.44	28
2	11	15.06	20.03	23.75	27	10	15.25	20.01	23.31	28	10	13.29	18.97	23.33	27
3	11	14.82	19.68	23.39	26	10	15.01	19.68	22.9	27	10	13.45	19.04	23.36	27
4	10	14.64	19.44	22.96	26	9	14.76	19.43	22.69	27	9	12.5	18.69	23.29	27
5	10	14.41	19.16	22.72	25	9	14.57	19.17	22.28	27	9	12.58	18.45	22.57	26
6	10	14.34	19.02	22.56	25	9	14.42	19.02	21.98	27	9	12.53	18.08	22.4	26
7	11	14.55	19.5	23.32	26	10	14.81	19.49	22.83	27	10	13.51	19.07	23.37	27
8	11	15.14	20.67	24.85	28	10	15.58	20.61	24.22	29	10	14.19	19.98	24.84	29
9	12	15.63	22.2	26.73	29	11	16.58	21.97	25.91	31	11	16.38	22.34	27.52	32
10	12	16.39	23.78	28.62	31	11	17.63	23.44	27.75	33	13	18.14	23.53	28.56	33
11	12	16.73	25.38	30.15	33	11	18.66	24.91	29.39	35	12	18.24	24.37	29.55	34
12	12	17.22	26.54	31.55	34	11	19.41	25.97	30.61	36	13	19	24.94	30.1	35
13	13	17.68	27.27	32.02	35	11	20.01	26.69	31.33	37	12	18.65	24.99	30.31	35
14	12	18.06	27.42	32.57	35	11	20.1	26.8	31.6	37	11	18.29	25.44	31.21	36
15	12	18.08	27.13	32.21	35	10	19.88	26.45	31.18	36	11	17.82	24.76	30.32	35
16	12	17.91	26.27	31.57	34	10	19.43	25.81	30.55	36	11	17.58	24.54	30.16	35
17	11	17.57	25.19	30.45	33	10	18.79	24.89	29.56	35	11	17.03	23.76	29.01	34
18	11	17.09	24.03	28.99	32	10	18.03	23.78	28.18	33	11	16.12	22.8	27.86	32
19	11	16.44	22.98	27.59	30	10	17.24	22.73	26.91	32	11	15.49	21.78	26.9	31
20	11	16.15	22.28	26.82	29	10	16.74	22.05	26.03	30	11	15.31	21.43	26.06	30
21	11	15.74	21.89	26.14	29	10	16.37	21.61	25.56	30	11	15.02	20.99	26.04	30
22	11	15.6	21.4	25.69	28	10	16.11	21.26	25.03	30	10	14.34	20.49	25.28	28
23	10	15.38	21.08	25.2	28	10	15.93	20.92	24.67	28	10	14.33	20.41	24.99	28
24	11	15.24	20.77	24.76	28	10	15.63	20.58	24.14	28	10	13.82	19.81	24.31	28

Study 26	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	2	6.47	10.87	14.65	17	1	6.12	10.64	13.95	17	1	3.98	9.67	14.38	17
2	2	6.11	10.53	14.26	17	1	5.83	10.34	13.89	17	1	3.78	9.59	14.36	17
3	1	5.85	10.25	14.05	17	1	5.61	10.16	13.72	17	1	3.96	9.66	14.38	17
4	1	5.47	9.93	13.7	16	0	5.29	9.87	13.39	17	0	2.8	8.74	12.8	15
5	1	5.19	9.66	13.36	16	0	5.15	9.65	13.1	16	0	3.08	9.11	13.57	16
6	1	4.75	9.38	12.99	16	0	4.61	9.36	12.9	16	0	2.88	7.99	13.09	16
7	1	4.58	9.19	12.81	15	1	4.48	9.16	12.67	16	1	3.77	8.97	13.47	16
8	1	5.41	9.8	13.57	16	1	5	9.61	12.99	16	1	3.75	8.96	13.47	16
9	2	7.02	11.57	15.38	18	1	6.8	11.6	14.98	18	1	4.66	10.37	15.14	18
10	4	8.81	13.35	17.32	20	1	8.45	13.39	17.05	21	1	5.39	11.97	17.63	21
11	5	10.02	14.81	18.75	22	2	9.67	14.57	18.51	23	2	6.54	13.21	19.06	23
12	5	10.85	15.86	19.88	23	2	10.84	15.65	19.51	24	2	6.25	13	18.83	23
13	6	11.06	16.54	20.67	24	4	11.23	16.3	20.28	25	4	8.56	15.02	20.56	25
14	5	11.06	16.82	20.88	24	3	11.58	16.58	20.54	25	3	7.88	14.47	20.12	24
15	6	11.21	16.68	20.79	24	3	11.33	16.54	20.42	24	3	8.09	14.39	19.63	23
16	6	10.85	16.14	20.21	23	3	11	15.9	19.8	24	5	8.32	14.57	19.67	23
17	5	10.28	15.13	18.99	22	3	9.93	14.8	18.72	23	3	6.71	12.93	17.88	22
18	4	9.12	13.76	17.81	20	3	9.07	13.77	17.59	21	4	6.98	12.7	17.51	20
19	4	8.45	13.16	16.99	20	2	8.13	13.12	16.9	20	3	6.26	12.46	17.45	20
20	3	7.81	12.63	16.6	19	2	7.47	12.46	16.15	20	3	5.56	11.63	16.17	19
21	3	7.37	12.25	16.07	19	2	7.06	11.98	15.63	19	2	4.84	10.8	15.87	19
22	3	7.28	11.86	15.85	18	2	6.56	11.51	15.02	19	2	4.99	10.53	14.91	18
23	3	6.65	11.5	15.34	18	1	6.34	11.16	14.8	18	1	4.18	10.27	14.65	17
24	2	6.37	11.15	14.84	18	1	6.11	10.78	14.56	17	1	4.07	9.71	14.4	17

5 ACH

Study 32 Fall	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	9.54	14.57	19.48	23	4	9.66	14.41	19.39	23	4	7.18	13.39	18.32	22
2	5	9.32	14.25	18.98	22	4	9.34	14.13	18.95	22	6	8.57	13.89	18.44	22
3	4	9.1	13.91	18.89	21	4	9.17	13.77	18.55	22	5	7.86	13.38	17.64	21
4	4	8.69	13.78	18.09	21	4	8.8	13.55	18.03	22	5	7.67	13.17	18.24	22
5	4	8.58	13.48	18.08	21	4	8.58	13.25	17.98	22	5	7.73	12.95	17.47	21
6	4	8.39	13.27	17.65	21	4	8.33	13.05	17.71	21	4	7.04	12.7	17.43	20
7	4	8.2	13.15	17.61	21	4	8.27	13.05	17.54	22	4	7.03	12.69	17.4	21
8	5	9.15	13.97	18.88	23	4	9.23	14.06	18.88	22	5	7.88	13.26	18.24	22
9	5	10.61	15.78	20.87	25	5	10.79	15.75	20.79	24	5	8.77	14.65	19.91	24
10	5	12.03	17.55	22.98	27	4	12.35	17.5	22.73	28	5	9.05	16.07	21.83	26
11	5	13.02	19.05	24.6	29	4	13.54	18.87	24.46	30	4	9.65	17.17	23.29	28
12	5	13.31	20.35	25.92	31	4	14.43	20.08	25.65	32	4	9.96	18.02	25.23	31
13	5	13.65	20.96	26.73	31	4	14.97	20.7	26.37	31	5	10.4	18.08	24.56	30
14	5	13.89	21.08	27.08	31	5	15.26	20.79	26.53	32	6	11.34	18.85	24.92	30
15	6	14.05	20.72	26.59	31	5	15.1	20.5	26.08	31	5	11.04	18.76	25.39	31
16	6	14.02	20.16	25.75	30	5	14.47	19.75	25.45	30	11	15.04	19.89	25.48	30
17	5	13.12	18.91	24.65	29	4	13.58	18.82	24.4	29	4	9.04	17.15	23.75	29
18	5	12.14	17.56	22.93	27	4	12.35	17.39	22.88	27	4	8.42	16.12	22.57	27
19	4	11.54	16.8	21.99	26	4	11.81	16.66	22.04	26	4	8.44	15.88	21.8	26
20	4	11.28	16.3	21.6	26	4	11.24	16.16	21.49	25	4	7.58	14.71	20.83	25
21	4	10.71	16.01	20.99	25	4	11.03	15.89	20.89	24	8	10.48	15.52	20.59	24
22	4	10.41	15.57	20.55	24	4	10.5	15.47	20.54	24	4	7.58	14.56	20.39	24
23	4	9.75	15.2	20.25	24	4	10.16	15.01	20.04	24	4	7.14	13.13	17.58	21
24	4	9.53	14.78	19.7	23	4	9.57	14.66	19.62	23	4	7.36	13.72	19.06	23

Study 32 Spring	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	7	9.78	15.52	21.85	26	6	9.96	15.58	21.63	25	6	8.93	14.46	19.95	24
2	7	9.3	15.18	21.52	25	5	9.51	15.13	21.17	25	6	8.83	14.66	20.73	25
3	7	9.08	14.77	21.11	25	5	9.14	14.68	20.72	25	6	9	14.71	20.75	25
4	6	8.62	14.47	20.61	24	5	8.64	14.33	20.12	24	6	8.67	14.17	19.24	23
5	6	8.23	14.01	20.42	24	5	8.24	14.05	19.87	24	5	8.01	13.71	19.75	24
6	6	8.02	13.82	19.81	23	5	8.05	13.85	19.64	23	5	8	13.5	19	23
7	6	7.72	13.81	20.22	24	4	7.86	13.77	19.8	24	5	7.97	13.48	18.96	23
8	6	8.89	14.98	21.75	26	5	9.16	15.08	21.41	26	5	8.76	14.87	20.64	25
9	8	10.2	16.59	23.65	28	5	10.63	16.72	23.2	28	8	11.47	16.35	22.11	27
10	9	11.41	18.46	25.69	31	6	12.24	18.4	24.87	30	9	13.03	18.29	24.72	30
11	9	12.66	20.09	27.42	33	7	13.47	20.06	26.62	32	7	12.46	19.19	26.23	32
12	9	13.52	21.55	28.74	34	7	14.92	21.43	27.94	34	7	12.76	19.52	26.27	32
13	9	14.25	22.28	29.75	35	7	15.51	22.27	28.8	35	7	13.08	19.94	26.26	32
14	9	14.32	22.51	29.8	35	7	15.7	22.52	28.9	34	7	13.34	20.72	27.33	33
15	9	14.28	22.31	29.73	35	8	15.42	22.33	28.76	35	8	13.83	20.64	26.88	32
16	9	14.03	21.72	28.77	34	8	14.95	21.69	27.98	34	8	13.3	20.1	26.44	31
17	9	13.44	20.66	27.67	33	7	14.09	20.57	27.08	32	7	11.74	18.56	25.04	30
18	9	12.41	19.18	26.34	31	7	12.99	19.15	25.63	31	7	11.01	17.65	23.72	28
19	8	12.02	18.24	25.09	29	6	12.3	18.25	24.69	29	6	10.31	17.43	23.66	28
20	7	11.25	17.67	24.61	28	5	12.04	17.69	24.17	28	5	9.22	16.36	22.55	27
21	7	11.03	17.26	23.9	28	5	11.38	17.37	23.71	28	5	9	16.32	22.7	26
22	7	10.54	16.83	23.48	27	5	11.03	16.88	23.26	28	5	9.34	16.73	23.62	27
23	6	10.25	16.4	23.09	27	5	10.47	16.36	22.73	26	5	8.46	15.22	21.61	26
24	6	10.17	16.01	22.65	25	4	10.22	15.89	22.17	25	4	7.68	14.72	20.77	25

5 ACH

Study 32	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.2	20.16	23.79	27	10	15.53	20.25	23.66	28	12	15.26	20.31	24.44	28
2	11	15.03	19.8	23.34	26	10	15.21	19.9	23.18	28	10	13.29	18.97	23.33	27
3	11	14.71	19.52	22.93	26	10	14.95	19.55	22.81	27	10	13.45	19.04	23.36	27
4	10	14.5	19.24	22.71	25	9	14.66	19.28	22.51	27	9	12.49	18.68	23.28	26
5	10	14.32	18.95	22.29	25	9	14.44	19.02	21.98	27	9	12.45	18.04	22.35	25
6	10	14.19	18.83	22.02	25	9	14.35	18.9	21.86	27	9	12.62	18.35	23.11	26
7	10	14.5	19.37	22.95	26	9	14.79	19.45	22.76	27	9	12.74	18.78	23.3	27
8	11	15.11	20.58	24.76	28	10	15.67	20.64	24.28	30	10	14.19	19.98	24.84	29
9	12	15.69	22.2	26.68	29	11	16.67	22.04	25.95	32	11	16.37	22.33	27.5	31
10	12	16.4	23.84	28.58	31	11	17.77	23.57	27.84	33	11	16.68	22.93	28.37	33
11	12	16.85	25.52	30.27	33	11	18.81	25.12	29.67	36	12	18.36	24.68	30.23	35
12	13	17.42	26.81	31.75	35	11	19.71	26.3	30.92	37	14	20	25.9	31.29	36
13	13	17.89	27.56	32.59	35	11	20.25	27.07	31.81	37	12	19	25.69	31.21	36
14	12	18.21	27.64	32.79	35	11	20.36	27.17	31.96	38	11	18.29	25.44	31.21	36
15	12	18.24	27.26	32.51	35	10	20.11	26.78	31.62	38	11	17.96	25.08	30.97	36
16	11	18.02	26.41	31.72	35	10	19.6	26.06	30.84	36	11	17.34	24.21	29.69	34
17	11	17.58	25.27	30.59	33	10	18.92	25.05	29.77	35	11	16.9	23.85	28.83	33
18	11	17.09	24.02	28.98	32	10	18.05	23.88	28.31	34	10	15.32	22.51	27.8	32
19	11	16.4	22.89	27.5	30	10	17.27	22.76	26.98	31	10	14.73	21.5	26.84	31
20	11	16.07	22.18	26.64	29	10	16.77	22.03	26.01	30	10	14.53	21.15	25.98	30
21	11	15.78	21.76	25.92	28	10	16.4	21.59	25.57	30	10	14.28	21.08	26.08	29
22	11	15.53	21.29	25.48	28	10	16.1	21.22	24.99	30	10	14.34	20.49	25.28	28
23	10	15.35	20.94	24.86	28	10	15.88	20.89	24.65	29	10	14.33	20.41	24.99	28
24	11	15.13	20.6	24.48	27	10	15.61	20.51	24.06	28	10	13.82	19.81	24.31	28

Study 32	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	2	6.28	10.66	14.2	17	1	6.11	10.55	13.91	17	1	3.98	9.67	14.38	17
2	2	5.89	10.32	13.99	17	1	5.84	10.27	13.83	17	1	3.78	9.59	14.36	17
3	1	5.71	10.06	13.76	17	0	5.61	10.07	13.65	17	0	3.16	9.38	14.31	17
4	1	5.2	9.66	13.39	16	0	5.26	9.71	13.21	16	0	2.91	9.05	13.57	16
5	1	4.89	9.36	13.12	16	0	5.07	9.43	12.97	16	0	2.97	8.66	13.38	16
6	1	4.58	9.16	12.78	16	0	4.54	9.26	12.73	16	0	2.88	7.99	13.09	16
7	1	4.41	8.93	12.59	15	0	4.42	9.01	12.54	15	0	0.88	6.03	15.23	19
8	1	5.19	9.65	13.34	16	1	5	9.53	12.98	16	1	3.75	8.96	13.47	16
9	2	7.02	11.5	15.23	18	1	6.83	11.63	15.04	18	1	4.66	10.37	15.14	18
10	4	8.81	13.39	17.32	20	2	8.48	13.44	17.13	21	2	6.21	12.38	17.08	20
11	5	10.02	14.89	18.88	22	2	10.05	14.73	18.64	23	2	6.44	12.91	18.37	22
12	5	11.02	16.11	20.18	23	2	11.1	15.93	19.78	24	2	6.5	13.7	19.75	24
13	6	11.37	16.79	20.83	24	4	11.71	16.59	20.53	25	4	8.47	14.73	19.8	24
14	6	11.37	17.06	20.99	24	3	11.86	16.86	20.82	25	3	8.01	14.78	20.84	25
15	6	11.25	16.82	20.85	24	3	11.78	16.78	20.75	25	3	8.3	15.12	20.55	24
16	6	10.85	16.3	20.46	23	3	11.35	16.12	19.98	25	5	8.53	15.29	20.6	24
17	5	10.36	15.13	19.21	22	3	10.16	14.91	18.86	23	3	6.71	12.93	17.88	22
18	4	9.12	13.73	17.72	20	3	9.12	13.97	17.73	21	4	7.09	13.14	17.67	20
19	4	8.45	13.07	16.95	20	2	8.06	12.97	16.82	20	3	6.02	12.21	17.24	20
20	3	7.81	12.57	16.57	19	2	7.54	12.34	15.95	20	3	5.56	11.63	16.17	19
21	3	7.37	12.15	16.07	18	2	7.02	11.88	15.54	19	2	4.84	10.8	15.87	19
22	3	6.75	11.79	15.72	18	2	6.53	11.5	14.98	18	2	4.94	10.48	14.85	17
23	2	6.37	11.28	14.99	18	1	6.22	11.12	14.76	18	1	4.18	10.27	14.65	17
24	2	6.32	10.95	14.76	17	1	6.11	10.73	14.53	17	1	4.07	9.71	14.4	17

5 ACH

Study 33 Fall	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	10.2	15.09	19.92	23	4	10.54	15.31	20.26	23	7	10.34	15.58	20.15	23
2	5	10.02	14.82	19.7	23	4	10.27	15	19.9	23	6	8.57	13.89	18.44	22
3	5	9.69	14.65	19.31	22	4	10.05	14.82	19.75	22	6	8.62	13.66	17.7	21
4	5	9.47	14.36	19.08	22	4	9.8	14.53	19.38	22	4	7.02	13.34	18.33	22
5	5	9.27	14.12	18.84	22	4	9.47	14.25	18.88	22	4	7.17	13.39	18.32	22
6	5	9.16	13.94	18.38	22	4	9.31	13.96	18.69	22	5	7.96	13.42	17.67	21
7	4	9.09	13.87	18.43	22	4	9.24	13.86	18.52	22	4	7.13	13.03	18.16	22
8	5	9.52	14.64	19.43	23	4	9.79	14.79	19.56	24	4	7.81	14.06	19	23
9	5	10.65	15.78	20.82	25	5	11.11	15.96	20.92	24	6	9.18	15.07	20.24	24
10	5	11.65	17.18	22.43	26	4	12.24	17.23	22.37	27	5	9.05	16.07	21.83	26
11	5	12.75	18.22	23.6	28	4	13.17	18.25	23.64	28	5	9.75	17.2	23.2	28
12	5	12.85	19.35	24.73	29	4	13.97	19.29	24.76	30	4	9.55	17.39	24.02	29
13	5	13.45	19.9	25.34	30	5	14.43	19.83	25.23	30	6	11.1	18.07	23.87	29
14	5	13.65	20.19	25.83	30	5	14.69	20.15	25.71	30	6	11.34	18.85	24.92	30
15	6	13.75	20.21	25.68	30	5	14.65	20.08	25.62	30	11	15.15	20.2	25.28	30
16	6	14.02	19.71	25.31	30	5	14.46	19.74	25.25	30	5	10.78	18.55	25.27	30
17	5	13.16	18.99	24.65	29	5	13.88	19.08	24.57	30	5	10.39	18.08	24.57	30
18	5	12.31	17.85	23.34	28	4	12.84	17.89	23.33	28	4	8.72	16.44	22.94	28
19	5	11.81	17.15	22.6	27	4	12.25	17.24	22.56	26	9	12.3	17.22	22.18	26
20	4	11.54	16.72	21.92	26	4	11.94	16.73	22.1	26	4	8.22	15.36	21.55	26
21	4	11.22	16.36	21.48	25	4	11.44	16.4	21.47	26	8	11.18	16.46	22.05	26
22	4	11.02	16.01	21.08	25	4	11.21	16.11	21.14	25	4	8.21	15.21	21.05	25
23	4	10.53	15.68	20.67	25	4	10.83	15.76	20.79	25	4	8.16	15.08	20.72	25
24	4	10.28	15.37	20.38	24	4	10.52	15.48	20.4	25	4	7.81	13.8	18.3	21

Study 33 Spring	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	10.33	16.19	22.77	26	6	10.79	16.49	22.61	27	9	12.02	16.4	21.06	25
2	8	10.14	15.8	22.48	26	6	10.49	16.11	22.13	26	6	9.47	15.52	20.81	25
3	7	9.69	15.49	21.9	26	6	10.14	15.75	21.69	26	6	9.56	15.38	21.46	25
4	7	9.39	15.15	21.64	25	5	9.91	15.47	21.46	26	6	9.43	15.34	21.48	25
5	7	9.02	14.86	21.29	25	5	9.47	15.2	21.23	24	6	9.49	15.12	20.69	24
6	7	8.81	14.7	20.88	24	5	9.13	14.76	20.6	24	5	8.56	14.16	19.73	23
7	6	8.69	14.65	21.22	25	5	9.1	14.87	20.9	26	5	8.69	14.6	19.84	23
8	7	9.47	15.46	22.42	27	5	9.72	15.77	21.9	26	5	8.76	14.87	20.64	25
9	8	10.48	16.75	23.81	28	6	10.99	16.99	23.4	28	8	12.01	17.13	22.61	27
10	9	11.28	18.16	25.25	30	6	12.23	18.3	24.66	30	9	13.03	18.29	24.72	30
11	9	12.18	19.45	26.65	32	6	13.17	19.5	25.88	32	6	11.27	18.01	24.19	29
12	9	13.03	20.47	27.72	33	7	14.19	20.61	26.96	32	7	12.31	19.14	26.25	32
13	9	13.69	21.17	28.61	33	7	14.73	21.31	27.74	34	7	12.81	19.61	25.83	31
14	9	14.03	21.53	28.8	34	7	15.17	21.65	28.11	34	7	12.45	19.66	26.36	31
15	9	14.16	21.66	28.81	34	7	15.12	21.72	28.13	34	7	12.52	19.31	25.56	31
16	9	13.66	21.26	28.72	33	8	14.89	21.42	27.87	33	8	13.41	20.02	26.74	32
17	9	13.52	20.68	27.98	33	7	14.26	20.78	27.27	33	7	12.32	19.23	25.81	31
18	9	12.78	19.46	26.78	32	7	13.41	19.67	26.17	32	7	11.88	18.64	24.84	30
19	9	12.03	18.63	25.67	30	6	12.71	18.78	25.19	30	6	10.6	17.76	24.02	29
20	8	12.02	18.08	25.22	29	6	12.34	18.2	24.59	29	6	10.02	16.63	22.63	27
21	7	11.31	17.7	24.61	29	5	12.07	17.77	24.12	28	5	9.03	16.36	22.75	27
22	7	11.03	17.34	24.42	28	5	11.62	17.4	23.73	28	5	9.38	16.78	23.67	28
23	7	10.66	16.98	23.67	27	5	11.22	16.99	23.28	27	5	9.11	15.88	22.31	27
24	7	10.41	16.54	23.52	27	5	11.05	16.71	23.03	27	5	9.17	15.91	22.32	27

5 ACH

Study 33 Summer	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.8	20.96	24.93	28	10	16.35	21.09	24.58	29	12	15.86	20.97	25.17	29
2	11	15.5	20.67	24.55	27	10	16.04	20.79	24.06	29	12	15.55	20.59	24.45	28
3	11	15.33	20.36	24.11	27	10	15.88	20.54	23.8	28	10	14.07	19.66	24.06	27
4	11	15.17	20.02	23.81	26	10	15.58	20.28	23.55	28	10	13.9	19.6	24.06	27
5	11	15.05	19.8	23.52	26	10	15.35	20.02	23.19	28	10	13.46	19.04	23.36	27
6	10	14.79	19.77	23.48	26	10	15.28	19.92	23.01	28	10	14.14	19.71	24.11	27
7	11	15.15	20.23	24.02	27	10	15.62	20.35	23.74	28	10	14.13	19.7	24.09	28
8	11	15.47	21.15	25.54	28	10	16.27	21.29	24.87	30	10	14.75	20.62	25.65	30
9	12	15.98	22.28	26.81	29	11	17.04	22.31	26.16	32	11	16.38	22.34	27.52	32
10	12	16.43	23.53	28.09	31	11	17.87	23.43	27.57	33	13	17.92	23.2	28.17	33
11	12	16.93	24.69	29.54	32	11	18.59	24.52	28.78	34	12	17.79	23.71	28.7	33
12	12	17.19	25.73	30.59	33	11	19.31	25.47	29.84	36	12	18.08	24.3	29.55	34
13	13	17.59	26.43	31.1	34	11	19.81	26.14	30.57	36	12	18.33	24.63	30.1	35
14	13	17.96	26.71	31.77	34	11	20.04	26.38	30.86	36	11	17.83	24.78	30.38	35
15	12	18.03	26.66	31.78	34	11	20.01	26.32	30.86	36	11	17.82	24.76	30.32	35
16	12	18.06	26.24	31.53	34	10	19.74	26.03	30.7	37	11	17.58	24.54	30.16	35
17	12	18.01	25.56	30.95	34	10	19.34	25.44	30.11	36	11	17.03	23.76	29.01	34
18	12	17.39	24.73	29.94	33	10	18.77	24.64	29.18	34	11	16.94	23.77	29.13	34
19	12	16.93	23.51	28.39	31	10	17.98	23.48	27.74	33	11	16.1	22.43	27.71	32
20	11	16.6	22.9	27.51	30	10	17.49	22.84	26.86	31	11	15.91	22.07	26.87	31
21	11	16.28	22.4	26.92	29	10	17.16	22.38	26.34	31	11	15.12	21.39	26.23	30
22	11	16.11	22.08	26.47	29	10	16.84	22.06	25.88	31	11	15.38	21.53	26.35	30
23	11	15.98	21.69	25.86	29	10	16.58	21.68	25.44	30	11	15.13	20.7	25.09	29
24	11	15.63	21.35	25.55	28	10	16.36	21.36	24.93	29	10	14.4	20.45	25.01	29

Study 33 Winter	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	2	6.87	11.21	14.87	18	1	6.72	11.3	14.87	19	2	4.4	10.65	15.62	19
2	2	6.71	10.95	14.8	17	1	6.15	10.94	14.51	18	2	3.86	9.48	13.79	17
3	2	6.25	10.67	14.42	17	1	5.94	10.6	14.21	18	2	4.18	9.93	14.69	18
4	2	6.02	10.41	13.96	17	1	5.74	10.28	13.77	18	2	4.06	9.89	14.71	18
5	2	5.85	10.17	13.81	17	1	5.57	10.09	13.58	17	2	4	9.68	14.4	17
6	2	5.36	9.91	13.64	16	1	5.24	9.87	13.2	16	2	3.96	9.43	13.67	16
7	2	5.22	9.68	13.32	16	1	5.2	9.69	12.96	16	2	3.69	8.69	12.71	15
8	2	5.75	10.27	13.89	16	1	5.57	10.25	13.81	17	2	4.19	9.73	13.99	17
9	3	7.1	11.65	15.41	18	1	6.92	11.75	15.37	18	2	5.19	11.16	15.62	18
10	3	8.42	13.03	16.85	20	2	8.17	13.17	16.83	21	2	5.57	11.91	16.95	21
11	4	9.65	14.23	18.2	21	2	9.35	14.26	17.96	23	2	5.83	12.24	17.76	22
12	5	10.25	15.2	19.18	22	2	10.23	15.22	18.97	23	2	5.94	12.49	18.06	22
13	6	10.71	15.79	19.84	23	4	10.99	15.99	19.9	24	4	8.55	15.01	20.55	24
14	6	10.87	16.2	20.23	23	4	11.28	16.29	20.1	24	4	8.48	14.76	19.87	23
15	6	10.85	16.25	20.3	23	4	11.2	16.31	20.17	24	4	8.48	14.74	19.83	23
16	6	10.65	16.01	19.89	23	4	11.03	15.96	19.79	24	5	8.32	14.57	19.67	23
17	5	10.32	15.16	19.15	22	4	10.28	15.24	19.13	23	5	8.24	14.42	19.35	22
18	4	9.25	13.99	17.92	21	3	9.16	14.04	17.68	22	3	6.52	12.75	17.68	21
19	4	8.81	13.39	17.38	20	2	8.64	13.62	17.3	20	3	6.26	12.46	17.45	20
20	3	8.06	12.93	16.78	19	2	8.33	13.27	16.83	20	3	6.11	12.13	16.61	19
21	3	7.81	12.46	16.37	19	2	7.94	12.9	16.64	20	3	5.9	12.09	16.72	19
22	3	7.37	12.18	15.92	18	2	7.41	12.46	16.25	19	3	6.04	11.78	16.67	19
23	3	7.25	11.85	15.67	18	2	6.97	11.91	15.61	19	3	5.26	10.87	15.06	18
24	2	7.02	11.47	15.15	18	1	6.64	11.46	15.02	19	2	4.74	10.93	15.87	19

5 ACH

Study 34	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	10.37	15.3	20.48	24	5	10.9	15.77	20.66	24	8	10.64	15.67	19.7	23
2	5	10.03	14.99	19.98	23	5	10.78	15.45	20.34	24	6	9.01	15.32	20.29	24
3	5	9.91	14.79	19.81	23	4	10.38	15.2	19.99	24	7	9.76	15.02	19.5	23
4	5	9.66	14.53	19.25	23	4	10.23	15	19.78	24	7	9.57	14.89	19.47	22
5	5	9.39	14.2	18.99	22	4	10.02	14.69	19.29	22	5	8.16	14.38	19.31	22
6	5	9.2	13.99	18.67	22	4	9.71	14.42	19.05	22	6	8.46	14.2	18.95	22
7	5	9.17	13.96	18.74	22	4	9.66	14.45	19.04	23	5	8.07	14.36	19.57	24
8	5	9.87	15.02	20.19	24	5	10.4	15.56	20.55	25	6	9.26	15.02	19.78	24
9	6	11.32	16.6	21.93	26	5	12.03	17.09	22.15	26	6	10.07	15.99	21.35	26
10	5	12.28	17.99	23.58	28	6	13.12	18.37	23.63	29	6	10.4	16.99	22.65	27
11	5	13.11	18.82	24.58	29	5	13.86	19.16	24.64	30	5	10.34	17.85	23.92	29
12	6	13.31	19.47	25.11	29	6	14.31	19.81	25.31	30	6	11.06	18.36	24.79	30
13	6	13.56	19.98	25.65	30	6	14.69	20.19	25.75	31	6	11.18	18.35	24.64	30
14	6	13.81	20.06	25.98	30	6	15.02	20.49	25.98	32	11	15.16	20.23	25.36	30
15	6	14.04	20.29	25.73	30	6	15.08	20.48	25.94	31	6	11.33	18.82	24.86	30
16	6	14.03	19.98	25.67	30	6	14.86	20.21	25.84	31	6	11.19	18.9	25.54	30
17	6	13.45	19.31	24.89	30	6	14.29	19.57	25.08	30	6	10.8	18.42	24.81	30
18	5	12.81	18.11	23.72	28	4	13.3	18.48	23.85	29	5	9.42	17.12	23.57	28
19	5	11.85	17.49	22.91	27	4	12.89	17.83	23.09	28	5	9.22	16.84	23.26	28
20	5	11.65	16.99	22.57	27	4	12.32	17.38	22.66	28	5	8.82	16.44	22.76	27
21	5	11.32	16.69	21.93	26	4	11.89	17.01	22.27	26	5	8.5	16.15	22.19	26
22	5	11.16	16.38	21.55	25	4	11.53	16.62	21.68	26	5	8.67	15.86	22.16	26
23	5	10.71	16.02	21.08	25	4	11.25	16.32	21.33	25	9	11.63	16.48	21.31	25
24	5	10.46	15.66	20.74	25	4	10.98	15.94	20.85	25	9	11.42	15.7	18.97	22

Study 34	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	10.52	16.39	23.31	27	6	11.16	16.92	23.13	27	9	12.15	16.92	22.64	27
2	8	10.35	15.99	22.8	27	6	10.78	16.59	22.61	27	6	9.64	16.06	22.35	27
3	7	9.91	15.66	22.58	26	6	10.36	16.2	22.19	27	6	9.63	15.58	20.84	25
4	7	9.58	15.35	21.83	26	6	10.14	15.92	21.88	26	6	9.36	15.08	20.71	25
5	7	9.32	14.96	21.64	25	5	9.96	15.6	21.61	26	6	9.58	15.39	21.47	26
6	7	8.91	14.73	21.37	25	5	9.52	15.3	21.26	25	5	8.72	14.63	19.88	24
7	6	9.03	14.81	21.86	26	5	9.58	15.44	21.47	26	5	8.7	14.61	19.85	24
8	7	10.02	16.02	23.61	28	5	10.56	16.69	22.99	28	6	10.07	16.2	21.99	27
9	9	11.14	17.58	25.34	30	6	12.04	18.21	24.59	30	7	11.72	17.92	23.83	29
10	9	12.02	19.01	26.67	32	7	13.2	19.55	26	31	10	13.95	19	24.92	30
11	9	12.69	19.93	27.65	33	8	13.93	20.39	26.87	33	8	12.92	19.51	26.49	32
12	9	13.37	20.61	28.34	33	8	14.57	21.08	27.58	34	8	12.67	19.19	25.73	31
13	9	13.81	21.13	28.84	34	8	15.04	21.66	28.16	34	8	13.24	19.95	26.02	31
14	9	14.12	21.51	28.98	34	8	15.32	21.93	28.42	34	8	13.36	20.29	26.93	32
15	9	14.04	21.61	29.19	34	9	15.36	22.11	28.54	34	9	13.81	20.2	26.63	32
16	10	14.03	21.44	28.9	34	9	15.21	21.97	28.36	35	9	14.04	20.79	27.09	32
17	9	13.62	20.92	28.7	34	9	14.78	21.37	27.97	33	9	13.78	20.17	26.56	32
18	9	12.89	19.91	27.61	32	7	14.04	20.28	26.78	32	7	11.88	18.64	24.84	30
19	9	12.06	18.95	26.48	31	6	13.31	19.38	25.94	31	6	10.94	18.08	24.39	29
20	8	12.03	18.4	25.7	30	6	12.83	18.88	25.27	30	6	10.83	18.01	24.27	29
21	8	11.56	18.02	25.29	29	6	12.56	18.38	24.76	30	6	10.12	16.98	23.24	28
22	7	11.37	17.66	24.64	29	6	12.08	18.06	24.38	29	6	10.09	16.77	22.93	27
23	7	11.04	17.26	24.42	28	5	11.66	17.6	23.81	29	5	9.32	16.61	23.23	28
24	7	10.88	16.84	23.98	27	5	11.31	17.21	23.47	27	5	9.31	16.37	22.49	27

5 ACH

Study 34	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	16.06	21.6	25.72	28	10	17.02	21.85	25.53	30	12	16.38	21.61	25.94	30
2	11	15.93	21.2	25.34	28	10	16.7	21.47	24.97	30	12	15.65	20.89	25.13	29
3	11	15.56	20.86	24.85	28	10	16.44	21.19	24.67	30	10	14.27	20.39	24.99	29
4	11	15.39	20.61	24.49	27	10	16.2	20.88	24.3	29	10	13.91	19.61	24.08	28
5	11	15.22	20.27	23.97	27	10	15.93	20.56	23.9	29	10	14.08	19.67	24.07	28
6	11	15.17	20.32	24.14	27	10	15.96	20.59	24.02	30	10	14.39	20.05	24.6	29
7	11	15.47	21.2	25.82	28	10	16.54	21.49	25.38	32	10	15.43	21.31	26.18	31
8	11	16.08	22.57	27.64	30	10	17.43	22.8	27.04	33	10	16.18	22.66	27.92	33
9	12	16.5	23.95	29.15	32	11	18.23	24.01	28.57	35	11	17.57	24	29.65	35
10	13	16.82	25.12	30.36	33	11	19.04	25.1	29.77	36	11	17.55	24.25	30.16	36
11	13	17.25	26.1	31.19	34	11	19.61	25.97	30.7	38	12	18.82	25.35	31.06	36
12	13	17.65	26.63	31.74	34	11	20.09	26.49	31.22	38	14	20	25.9	31.29	36
13	13	18.07	27.16	32.17	35	11	20.41	26.9	31.67	38	12	19	25.69	31.21	36
14	13	18.13	27.3	32.5	35	11	20.56	27.12	31.9	39	11	18.29	25.44	31.21	36
15	13	18.29	27.32	32.6	35	11	20.58	27.12	31.93	39	11	18.06	25.09	30.79	36
16	13	18.33	27.03	32.52	35	11	20.46	26.89	31.81	39	11	18.29	25.53	31.56	37
17	13	18.2	26.4	32.02	35	11	20.13	26.42	31.41	37	11	17.66	24.81	30.14	35
18	12	17.97	25.64	31.37	34	11	19.6	25.73	30.61	37	11	17.15	24.09	29.66	35
19	12	17.13	24.36	29.49	32	11	18.76	24.42	28.89	34	11	16.78	23.49	28.71	33
20	12	16.84	23.68	28.56	31	10	18.28	23.76	28.05	34	11	16.16	22.39	27.35	32
21	12	16.63	23.22	27.88	30	10	17.99	23.28	27.52	32	11	15.96	22.36	27.51	32
22	11	16.34	22.82	27.46	30	10	17.67	22.89	26.93	32	11	15.99	22.18	27.09	31
23	11	16.19	22.35	26.79	30	10	17.34	22.47	26.5	32	11	15.94	22.07	26.83	31
24	11	16.01	22.01	26.45	29	10	17.13	22.17	25.97	32	10	15.11	21.39	26.58	31

Study 34	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	3	7.15	11.52	14.93	18	1	7.41	11.89	15.65	19	2	5.18	11.39	16.31	19
2	2	6.85	11.23	14.85	18	1	7.13	11.66	15.41	19	2	5.01	11.31	16.28	19
3	2	6.41	10.97	14.56	17	1	6.86	11.34	14.93	18	2	4.96	10.66	15.38	18
4	2	6.02	10.55	13.99	17	1	6.34	10.78	14.57	18	2	4.06	9.89	14.71	18
5	2	5.85	10.28	13.84	17	1	6.01	10.41	13.99	18	2	4.18	9.93	14.69	18
6	2	5.41	10.13	13.62	16	1	5.5	10.05	13.67	17	2	4.37	9.92	14.22	17
7	2	5.22	9.85	13.32	16	1	5.36	9.88	13.42	17	2	4.09	9.29	13.84	17
8	2	6.11	10.72	14.23	17	1	6.44	10.93	14.54	17	2	4.89	10.39	14.64	17
9	3	7.85	12.39	15.93	19	2	7.93	12.67	16.51	19	2	5.81	11.81	16.34	19
10	4	9.02	13.81	17.61	20	3	9.09	13.93	17.71	22	3	6.72	13.07	18.13	22
11	5	10.02	14.8	18.64	22	3	10.22	15.08	18.96	23	3	7.02	13.42	18.92	23
12	5	10.54	15.45	19.25	22	3	10.9	15.66	19.55	23	3	7.53	14.42	19.81	23
13	6	10.71	15.96	19.75	23	4	11.34	16.12	20.09	24	4	8.55	15.01	20.55	24
14	6	10.75	16.26	19.96	23	4	11.47	16.43	20.41	24	4	8.48	14.76	19.87	23
15	6	11.04	16.36	20.06	23	4	11.55	16.49	20.53	24	3	7.53	14.19	19.99	24
16	6	11.04	16.21	19.86	23	4	11.42	16.2	20.25	24	5	8.4	14.86	20.47	24
17	5	10.41	15.42	19.49	22	4	10.9	15.62	19.6	23	5	8.24	14.42	19.35	22
18	5	9.81	14.32	18.06	21	4	9.74	14.37	18.22	22	4	7.11	13.16	17.7	21
19	4	8.81	13.7	17.55	20	4	9.08	13.79	17.45	22	4	7.18	13.18	17.68	20
20	4	8.45	13.27	16.95	20	2	8.67	13.46	17.17	20	3	6.19	12.41	17.37	20
21	3	8.03	12.99	16.64	19	2	8.24	13.13	16.92	20	3	5.9	12.09	16.72	19
22	3	7.56	12.52	16.29	19	2	8.08	12.82	16.69	19	3	6.04	11.78	16.67	19
23	3	7.37	12.16	15.85	18	2	7.57	12.54	16.03	19	3	6.02	11.68	16.39	19
24	3	7.04	11.8	15.58	18	2	7.15	12.14	15.8	19	3	6	11.42	15.65	18

10 ACH

Study 26	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	9.02	13.92	18.83	22	4	9.31	14.03	18.89	22	6	8.73	13.95	18.46	21
2	5	8.91	13.72	18.42	21	4	9.18	13.86	18.69	21	4	7.01	13.31	18.28	21
3	4	8.58	13.45	18.09	21	4	8.76	13.55	18.04	21	5	7.85	13.38	17.63	20
4	4	8.32	13.14	17.75	21	4	8.56	13.36	17.89	21	5	7.62	12.98	17.5	20
5	4	8.12	12.93	17.42	20	4	8.32	13.12	17.66	20	4	6.97	12.66	17.38	20
6	4	7.87	12.64	17.11	20	4	8.11	12.93	17.16	20	4	7.04	12.7	17.43	20
7	4	7.47	12.6	16.88	20	3	8.04	12.8	17.44	20	4	7.02	12.68	17.39	20
8	5	8.57	13.64	18.48	22	4	9	13.74	18.43	23	4	7.11	13.03	18.17	22
9	5	10.12	15.3	20.56	24	5	10.57	15.58	20.6	25	5	8.79	14.71	19.92	24
10	5	11.47	17.08	22.65	27	5	12.11	17.22	22.52	28	6	9.67	16.57	23.13	28
11	5	12.81	18.61	24.38	29	4	13.27	18.63	23.96	30	5	9.62	17.43	24.35	29
12	5	13.37	19.76	25.42	30	5	14.23	19.64	25.25	31	5	10.46	18.1	24.3	29
13	5	13.31	20.38	25.98	30	5	14.73	20.36	25.97	31	6	11.13	18.75	25.14	30
14	5	13.87	20.58	26.53	31	5	15.01	20.52	26.28	31	6	11.16	18.81	25.29	30
15	6	14.04	20.29	26.11	30	5	14.87	20.34	25.96	31	5	10.66	18.83	25.56	31
16	6	13.75	19.82	25.52	30	5	14.33	19.72	25.29	30	5	10.41	18.63	25.46	30
17	5	13.12	18.63	24.48	29	5	13.41	18.62	24.27	29	11	14.2	18.96	24.68	29
18	4	11.85	17.16	22.73	27	4	12.04	17.33	22.68	26	10	13.08	17.7	22.98	26
19	4	11.18	16.5	21.87	26	4	11.43	16.47	21.81	26	4	7.93	15.51	21.86	26
20	4	10.81	16.04	21.27	25	4	10.93	15.8	21.08	25	4	7.58	14.71	20.83	25
21	4	10.41	15.54	20.65	24	4	10.52	15.45	20.3	24	8	10.48	15.52	20.59	24
22	4	10.04	15.09	19.94	24	4	10.12	15.11	19.89	24	4	7.58	14.56	20.39	24
23	4	9.46	14.7	19.62	23	4	9.64	14.72	19.61	23	4	7.38	13.96	19.82	23
24	4	9.05	14.29	19.08	23	4	9.01	14.34	19.11	22	4	7.11	12.86	16.81	19

Study 26	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	7	9.25	15.04	20.98	25	6	9.45	15.13	21.15	25	7	9.75	14.97	20.82	24
2	6	9.07	14.66	20.6	24	5	9.1	14.69	20.7	24	6	8.83	14.65	20.72	24
3	6	8.42	14.14	20.31	24	5	8.67	14.28	20.14	24	6	8.99	14.71	20.75	24
4	6	8.1	13.82	19.67	23	5	8.16	14.02	19.84	23	6	8.75	14.41	19.96	23
5	5	7.66	13.48	19.52	23	5	8.02	13.68	19.54	22	5	7.91	13.46	18.95	22
6	5	7.16	13.13	19.16	22	4	7.43	13.42	19.23	22	5	7.89	13.24	18.25	21
7	5	7.14	13.16	19.43	23	4	7.3	13.36	19.39	23	4	7.1	12.96	18.13	21
8	6	8.3	14.33	21.08	25	5	8.36	14.51	20.94	25	5	8.03	13.73	19.77	24
9	7	9.81	16.22	22.98	27	5	10.31	16.38	22.73	27	8	11.37	16.46	21.85	26
10	9	10.85	18.11	24.92	30	6	12.01	18.2	24.63	30	9	12.65	17.65	23.54	28
11	9	12.12	19.66	26.67	32	7	13.14	19.8	26.29	32	7	12.28	19.12	26.6	32
12	9	13.2	20.98	27.8	33	7	14.29	21.01	27.52	33	7	12.28	19.51	26.75	32
13	9	14.02	21.76	28.73	34	7	15.05	21.82	28.24	34	7	12.75	20.01	26.4	32
14	9	14.2	22.14	29.34	34	8	15.24	22.16	28.62	34	8	13.72	20.91	28.12	34
15	9	14.16	21.99	29.09	34	8	15.17	22.03	28.46	33	8	13.26	19.98	26.1	31
16	9	13.6	21.36	28.52	33	8	14.65	21.44	27.88	33	8	12.82	19.72	26.48	31
17	9	12.92	20.35	27.6	32	8	13.78	20.48	26.96	32	8	12.5	19.5	26.5	32
18	8	12.18	19.06	25.7	30	7	12.7	19.09	25.58	30	7	11.09	17.93	24.5	29
19	7	11.31	17.94	24.67	28	6	12.05	18.1	24.6	28	6	10.29	17.4	23.63	27
20	7	11.03	17.33	24.11	27	5	11.42	17.36	23.81	27	5	8.72	16.16	21.97	26
21	6	10.71	16.78	23.43	27	5	11.11	16.85	23.14	27	5	8.39	15.72	22.02	26
22	6	10.32	16.42	22.78	27	5	10.41	16.34	22.62	27	5	8.76	16.13	22.95	27
23	6	9.88	15.95	22.31	26	5	10.16	15.94	22.21	26	5	8.46	15.22	21.61	26
24	5	9.61	15.41	21.9	25	4	9.76	15.44	21.7	25	4	7.67	14.71	20.77	24

10 ACH

Study 26	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	10	14.86	19.42	22.88	26	10	15.08	19.58	22.89	27	12	15.26	20.31	24.43	27
2	10	14.48	19.13	22.46	26	10	14.71	19.24	22.56	27	10	13.38	19.24	24.02	27
3	10	14.16	18.79	21.97	25	9	14.34	18.9	22.01	26	9	12.08	18.11	22.57	26
4	10	13.97	18.51	21.81	25	9	14.01	18.58	21.71	26	9	11.93	18.06	22.58	26
5	9	13.66	18.24	21.44	24	9	13.82	18.3	21.22	25	9	11.94	17.52	21.7	25
6	9	13.44	18.15	21.17	24	9	13.72	18.2	20.96	26	9	12.05	17.71	22.44	26
7	10	13.88	18.67	22.11	25	9	14.26	18.85	21.94	26	9	12.51	18.06	22.36	25
8	11	14.63	19.91	23.84	27	10	15.2	20.06	23.6	28	10	14.18	19.98	24.84	28
9	11	15.4	21.46	25.79	29	11	16.23	21.46	25.25	30	11	15.85	21.67	26.69	30
10	12	16.04	23.06	27.67	30	11	17.3	22.9	26.96	32	12	17.1	22.96	27.79	31
11	12	16.57	24.64	29.2	32	11	18.31	24.3	28.66	34	14	18.87	23.94	28.76	33
12	12	17.08	25.82	30.55	34	11	19.11	25.35	29.76	36	14	19.43	25.25	30.51	35
13	13	17.5	26.52	31.2	34	11	19.65	26.09	30.58	36	12	18.06	24.38	29.52	34
14	12	17.83	26.71	31.66	34	11	19.81	26.29	30.82	36	11	17.56	24.85	30.46	35
15	11	17.81	26.39	31.47	34	10	19.59	26	30.6	35	11	17.04	24.19	29.58	34
16	11	17.66	25.64	30.79	34	10	19.16	25.43	29.96	35	11	17.07	24.28	29.78	34
17	11	17.3	24.68	29.79	33	10	18.5	24.53	29.08	33	11	16.41	23.52	28.72	33
18	11	16.68	23.47	28.27	31	10	17.64	23.41	27.82	32	10	14.74	21.88	26.98	31
19	11	16.09	22.26	26.86	29	10	16.85	22.23	26.43	30	10	14.14	20.87	26.09	30
20	11	15.74	21.54	25.91	29	10	16.28	21.48	25.56	30	10	13.97	20.5	25.28	29
21	11	15.38	21.06	25.18	28	10	16.03	21.05	24.93	29	10	13.69	20.43	25.38	28
22	10	15.14	20.64	24.67	27	10	15.59	20.67	24.52	28	10	13.86	20.15	25.31	28
23	10	14.98	20.23	23.97	27	10	15.32	20.25	23.91	28	10	13.74	19.77	24.29	27
24	10	14.69	19.91	23.66	27	10	15.12	19.91	23.48	27	10	13.81	19.8	24.3	27

Study 26	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	2	5.87	10.18	13.8	16	1	5.89	10.36	13.86	17	1	3.98	9.67	14.38	17
2	1	5.02	9.84	13.55	16	1	5.53	10.11	13.8	17	1	3.78	9.59	14.36	17
3	1	4.92	9.45	13.12	16	0	5.17	9.86	13.46	17	0	0.88	6.17	15.64	20
4	1	4.52	9.25	12.77	16	0	4.98	9.42	12.91	16	0	2.79	8.61	13.39	16
5	1	4.25	8.92	12.51	15	0	4.82	9.13	12.72	16	0	2.97	8.66	13.38	16
6	1	3.92	8.6	12.13	15	0	4.22	8.97	12.54	15	0	2.71	7.49	12.27	15
7	1	3.72	8.4	11.85	14	0	4.13	8.68	12.11	15	0	2.77	7.97	12.47	15
8	1	4.62	9.17	12.76	16	1	4.69	9.28	12.83	16	1	3.75	8.96	13.47	16
9	2	6.42	11.14	14.94	18	1	6.46	11.4	15	18	1	4.2	10.18	14.64	18
10	3	8.25	13.11	17.18	20	2	8.1	13.01	16.77	21	2	5.72	12.07	17.13	21
11	5	10.01	14.69	18.67	22	2	9.88	14.7	18.62	22	2	5.98	12.68	17.9	22
12	5	10.87	15.73	19.77	23	3	10.87	15.57	19.67	24	3	6.94	13.49	19.06	23
13	6	11.25	16.49	20.61	24	4	11.57	16.46	20.64	25	4	8.07	14.63	20.58	25
14	6	11.05	16.84	20.84	24	3	11.72	16.66	20.76	25	3	7.7	14.62	20.28	24
15	6	11.05	16.68	20.79	24	5	11.57	16.58	20.52	25	4	8.43	14.89	20.32	24
16	6	10.75	16.2	20.16	23	4	11.17	16.15	20.18	24	6	9.27	15.52	20.61	23
17	5	10.18	15.08	18.99	22	4	10.36	15.21	19.14	22	5	8.24	14.42	19.35	22
18	4	9.02	13.58	17.6	20	3	8.7	13.48	17.33	21	3	6.41	12.75	17.88	21
19	3	8.28	12.85	16.67	19	2	8.11	12.74	16.48	19	3	5.39	11.91	16.62	19
20	3	7.45	12.35	15.99	19	2	7.53	12.32	15.87	19	3	5.13	11.15	15.63	18
21	2	6.75	11.92	15.75	18	2	7.12	11.93	15.7	18	2	4.78	10.66	15.59	18
22	3	6.37	11.4	15.15	17	2	6.52	11.5	15.15	18	2	4.94	10.48	14.85	17
23	2	6.18	10.96	14.73	17	1	6.17	11.1	14.77	17	1	4.18	10.27	14.65	17
24	2	5.45	10.48	14.23	17	1	5.98	10.64	14.45	17	1	4	9.42	13.65	16

10 ACH

Study 32	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	9.02	13.86	18.75	22	4	9.29	14.03	18.78	22	6	8.73	13.95	18.46	21
2	5	8.61	13.52	18.31	21	4	9.13	13.88	18.54	21	5	7.68	13.31	17.61	20
3	4	8.53	13.23	17.87	20	4	8.76	13.52	18.04	21	5	7.75	13.02	17.49	20
4	4	8.11	12.96	17.64	20	4	8.44	13.3	17.87	21	4	6.86	12.71	17.43	20
5	4	7.75	12.8	17.38	20	4	8.18	13.07	17.42	20	4	6.97	12.66	17.38	20
6	4	7.58	12.53	16.81	19	4	8.04	12.81	17.16	20	4	7.04	12.7	17.43	20
7	3	7.32	12.41	16.78	20	3	7.87	12.73	17.25	20	4	7.02	12.68	17.39	20
8	5	8.39	13.63	18.44	21	4	8.78	13.72	18.37	23	5	7.88	13.26	18.24	22
9	5	10.16	15.35	20.63	24	5	10.56	15.65	20.62	25	5	8.88	14.96	20.71	25
10	5	11.53	17.15	22.73	28	5	12.13	17.3	22.67	29	6	9.4	16.42	22.12	26
11	5	12.85	18.82	24.43	29	4	13.49	18.79	24.22	30	5	9.53	17.16	23.58	28
12	5	13.37	20.02	25.7	31	5	14.54	19.93	25.55	32	5	10.65	18.68	25.81	31
13	5	13.56	20.78	26.34	31	5	14.95	20.7	26.29	31	6	11.13	18.75	25.14	30
14	6	13.89	20.82	26.9	31	5	15.21	20.79	26.56	32	12	15.91	20.89	25.9	30
15	6	14.04	20.49	26.13	31	5	14.91	20.53	26.1	31	5	10.66	18.83	25.56	31
16	6	13.81	20.01	25.73	30	5	14.36	19.86	25.57	30	5	10.41	18.63	25.46	30
17	5	13.14	18.77	24.52	29	5	13.58	18.77	24.37	29	5	9.58	17.37	24.18	29
18	4	11.85	17.13	22.72	27	4	12.1	17.41	22.75	27	10	12.53	17.33	23.11	27
19	4	11.18	16.45	21.86	25	4	11.39	16.48	21.85	26	4	7.93	15.51	21.86	26
20	4	10.65	15.99	21.18	25	4	10.76	15.96	21.11	25	4	7.67	14.99	21.62	26
21	4	10.32	15.47	20.6	24	4	10.44	15.46	20.33	24	8	10.51	15.52	20.55	24
22	4	9.89	15.04	19.83	24	4	10.12	15.11	19.88	24	4	7.53	14.51	20.32	23
23	4	9.41	14.55	19.55	23	4	9.66	14.64	19.58	23	4	7.38	13.96	19.82	23
24	4	9.05	14.18	18.87	22	4	9.01	14.29	19.02	22	4	7.11	12.86	16.81	19

Study 32	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	7	9.2	14.87	20.9	24	6	9.33	15	21.12	25	7	9.75	14.97	20.82	24
2	6	9.01	14.42	20.58	24	5	9.1	14.58	20.63	23	6	8.74	14.4	19.93	23
3	6	8.3	13.94	19.98	24	5	8.38	14.11	20.11	24	6	8.99	14.71	20.75	24
4	6	8.02	13.59	19.67	23	5	8.14	13.84	19.76	23	6	8.61	13.93	19.84	23
5	5	7.47	13.18	19.11	22	4	7.81	13.58	19.54	22	5	7.91	13.46	18.95	22
6	5	7.03	12.94	18.86	22	4	7.34	13.23	19.02	21	4	7.11	12.98	18.17	21
7	5	6.92	13.01	19.34	23	4	7.17	13.22	19.34	23	4	7.1	12.96	18.13	21
8	6	8.22	14.22	20.91	25	5	8.33	14.49	20.88	25	5	8.03	13.73	19.77	24
9	7	9.78	16.2	22.9	27	6	10.35	16.39	22.75	27	6	9.86	15.93	21.71	26
10	9	10.85	18.12	24.92	30	6	12.02	18.25	24.74	30	9	13.02	18.65	25.21	30
11	9	12.3	19.71	26.84	32	7	13.18	19.88	26.45	32	7	11.82	18.24	24.71	30
12	9	13.32	21.27	28.53	34	7	14.48	21.29	27.71	34	7	12.36	19.79	27.53	33
13	9	14.12	21.93	29.15	34	8	15.25	22.11	28.65	34	8	13.5	20.28	26.49	32
14	9	14.22	22.31	29.58	35	8	15.56	22.39	28.79	34	8	13.43	20.55	27.71	33
15	9	14.16	22.21	29.34	34	8	15.3	22.29	28.69	34	8	13.34	20.26	26.87	32
16	10	13.72	21.55	28.65	33	8	14.64	21.65	27.98	33	8	12.82	19.72	26.48	31
17	9	13.04	20.47	27.67	32	8	13.77	20.59	27.02	32	8	12.14	18.9	25.35	30
18	8	12.16	19.01	25.81	30	7	12.78	19.13	25.71	30	7	11.24	18.45	24.65	29
19	7	11.42	17.9	24.8	28	6	12.01	18.08	24.53	28	6	9.68	16.78	22.93	27
20	6	11.03	17.29	24.11	27	5	11.43	17.35	23.77	27	5	8.82	16.44	22.76	27
21	6	10.61	16.74	23.47	27	5	11.14	16.8	23.04	27	5	8.39	15.72	22.02	26
22	6	10.28	16.33	22.8	26	5	10.4	16.32	22.62	27	5	8.76	16.13	22.95	27
23	5	9.75	15.91	22.34	26	4	10.08	15.87	22.17	26	4	7.69	14.96	21.53	25
24	5	9.36	15.31	21.81	24	4	9.75	15.38	21.63	25	4	7.7	14.79	20.79	24

10 ACH

Study 32 Summer	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	10	14.73	19.3	22.77	26	10	15.02	19.48	22.79	27	12	15.26	20.31	24.43	27
2	10	14.34	19.02	22.41	26	10	14.6	19.15	22.42	26	10	12.69	18.32	22.61	26
3	10	14.05	18.66	21.91	25	9	14.26	18.8	21.86	26	9	12.08	18.11	22.57	26
4	10	13.69	18.35	21.69	25	9	13.97	18.48	21.56	26	9	11.7	17.34	21.65	25
5	9	13.39	18.1	21.23	24	9	13.75	18.18	21.02	25	9	11.87	17.39	21.64	25
6	9	13.28	18.07	20.97	24	9	13.64	18.13	20.91	26	9	11.85	17.14	20.89	24
7	10	13.83	18.59	21.97	25	9	14.23	18.77	21.9	26	9	12.51	18.06	22.36	25
8	11	14.6	19.91	23.85	27	10	15.25	20.09	23.61	28	10	14.18	19.98	24.84	28
9	12	15.45	21.52	25.81	29	11	16.3	21.53	25.42	31	11	15.27	21.04	25.9	30
10	12	16.1	23.18	27.75	31	11	17.35	23.02	27.13	33	12	17.19	23.26	28.53	32
11	12	16.65	24.82	29.49	32	11	18.48	24.54	28.87	34	12	17.38	23.36	28.59	33
12	12	17.18	26.07	30.83	34	11	19.28	25.68	30.11	36	14	19.43	25.25	30.51	35
13	13	17.73	26.8	31.71	35	11	19.91	26.44	30.94	36	12	18.06	24.38	29.52	34
14	12	17.91	27.05	31.89	35	11	20.03	26.56	31.17	36	11	17.56	24.85	30.46	35
15	11	18.02	26.68	31.68	34	10	19.82	26.29	30.89	36	11	17.04	24.19	29.58	34
16	11	17.74	25.83	30.97	34	10	19.27	25.63	30.3	36	10	16.29	24	29.72	34
17	11	17.37	24.8	29.89	33	10	18.54	24.66	29.3	34	10	15.65	23.24	28.66	33
18	11	16.66	23.51	28.38	31	10	17.69	23.46	27.85	32	10	14.87	22.28	27.23	31
19	11	16.07	22.24	26.86	30	10	16.84	22.25	26.47	30	10	14.26	21.28	26.3	30
20	10	15.69	21.48	25.92	29	10	16.29	21.5	25.58	30	10	13.96	20.49	25.26	28
21	10	15.37	21.03	25.13	28	10	16.03	21.03	24.94	29	10	13.69	20.43	25.38	28
22	10	15.14	20.57	24.64	27	10	15.59	20.64	24.52	28	10	13.86	20.15	25.31	28
23	10	14.88	20.14	23.95	27	10	15.31	20.21	23.85	28	10	13.84	20.07	24.99	28
24	10	14.65	19.76	23.52	27	10	15.11	19.83	23.43	27	10	13.81	19.8	24.3	27

Study 32 Winter	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	2	5.66	10.12	13.73	16	1	5.99	10.3	13.86	17	1	3.98	9.67	14.38	17
2	1	5.02	9.66	13.39	16	1	5.32	10.04	13.71	17	1	3.58	9.03	12.83	15
3	1	4.91	9.3	12.96	16	0	5.09	9.71	13.24	16	0	2.96	8.66	13.38	16
4	1	4.32	9.05	12.61	15	0	4.86	9.34	12.81	16	0	2.79	8.61	13.39	16
5	1	4.1	8.77	12.38	15	0	4.57	9.03	12.63	16	0	2.97	8.66	13.38	16
6	0	3.82	8.47	11.93	15	0	4.05	8.81	12.42	15	0	2.71	7.49	12.27	15
7	1	3.42	8.14	11.69	14	0	3.86	8.55	11.92	15	0	2.68	7.68	11.7	14
8	1	4.58	9.07	12.67	15	1	4.67	9.2	12.82	16	1	3.75	8.96	13.47	16
9	2	6.56	11.14	14.9	18	1	6.38	11.36	15.06	18	1	4.2	10.18	14.64	18
10	3	8.25	13.18	17.28	20	2	8.09	13.03	16.93	21	2	5.72	12.07	17.13	21
11	5	10.01	14.84	18.75	22	2	9.96	14.9	18.82	23	2	6.07	12.98	18.7	23
12	5	10.87	15.99	19.9	23	4	11.12	15.86	19.81	24	4	7.86	14.37	19.93	24
13	6	11.25	16.82	20.79	24	4	11.84	16.73	20.8	25	5	8.9	15.09	20.02	24
14	6	11.25	17.09	21.12	24	4	11.79	16.86	20.91	25	3	8.09	14.94	20.49	24
15	6	11.21	16.89	20.92	24	5	11.96	16.89	20.89	26	5	8.35	14.73	20.14	24
16	6	10.75	16.34	20.38	23	5	11.4	16.3	20.44	24	6	9.22	15.67	21.29	24
17	5	10.18	15.17	19.08	22	4	10.39	15.32	19.27	23	5	8.24	14.42	19.35	22
18	4	9.02	13.59	17.55	20	3	8.58	13.44	17.23	21	3	6.41	12.75	17.88	21
19	3	8.25	12.8	16.65	19	3	8.21	12.78	16.51	19	4	6.19	12.19	16.68	19
20	3	7.45	12.3	15.99	19	2	7.53	12.36	15.95	19	3	5.21	11.43	16.38	19
21	2	6.75	11.84	15.67	18	2	7.01	11.93	15.7	18	2	4.78	10.66	15.59	18
22	3	6.37	11.28	14.95	17	2	6.52	11.51	15.06	17	2	4.94	10.48	14.85	17
23	2	5.85	10.86	14.63	17	1	6.17	11.04	14.7	17	1	4.02	9.68	14.39	17
24	2	5.45	10.37	13.96	17	1	5.8	10.55	14.31	17	1	4.07	9.71	14.4	17

10 ACH

Study 33	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	9.32	14.34	19.22	22	5	9.67	14.44	19.54	23	5	7.99	13.67	18.39	22
2	5	9.11	14.01	18.98	22	4	9.38	14.24	19.04	22	6	8.57	13.89	18.44	22
3	5	8.89	13.81	18.31	21	4	9.27	13.88	18.75	22	6	8.72	13.95	18.47	22
4	5	8.66	13.53	17.99	21	4	8.84	13.7	18.1	22	5	7.8	13.62	18.41	22
5	5	8.42	13.29	17.81	21	4	8.62	13.45	17.97	21	5	7.72	12.95	17.46	20
6	5	8.2	13.05	17.43	20	4	8.43	13.2	17.74	20	4	7.04	12.7	17.43	20
7	4	8.1	13.04	17.52	21	4	8.3	13.23	17.56	22	4	7.1	12.97	18.14	22
8	5	9.08	13.9	18.78	22	4	9.22	14.2	18.88	23	5	8.01	13.68	18.41	22
9	5	10.16	15.34	20.52	24	5	10.6	15.59	20.63	25	6	9.18	15.07	20.24	24
10	5	11.53	16.92	22.31	27	5	11.92	17.01	22.25	27	6	9.37	16.24	22.76	27
11	5	12.28	18.04	23.43	28	4	13.01	18.22	23.58	29	5	9.62	17.43	24.35	29
12	5	13.02	18.99	24.68	29	5	14.05	19.09	24.63	30	5	9.89	17.46	23.55	28
13	5	13.21	19.73	24.98	29	5	14.3	19.75	25.21	30	6	10.71	18.15	24.03	29
14	6	13.54	20.07	25.9	30	5	14.64	20.03	25.72	30	6	10.85	18.48	24.94	30
15	6	13.75	20.01	25.68	30	5	14.59	20.05	25.72	30	12	15.29	20.2	25.08	29
16	6	14.02	19.56	25.31	30	5	14.38	19.76	25.31	30	5	10.41	18.63	25.46	30
17	5	13.16	18.82	24.48	29	5	13.66	18.9	24.53	29	11	14.37	19.04	24.31	29
18	5	11.85	17.55	22.88	27	4	12.47	17.63	22.97	27	10	13.1	17.73	23.01	27
19	4	11.41	16.68	21.98	26	4	12	16.91	22.2	26	4	7.93	15.51	21.86	26
20	4	11.14	16.2	21.52	26	4	11.38	16.4	21.71	26	4	7.67	14.99	21.62	26
21	4	10.53	15.93	20.92	24	4	10.87	15.96	21.08	25	4	7.39	14.72	21.02	25
22	4	10.21	15.39	20.44	24	4	10.55	15.5	20.52	24	4	7.58	14.56	20.39	24
23	4	9.75	15.06	19.85	24	4	10.17	15.12	19.93	24	4	7.25	13.54	17.76	21
24	4	9.46	14.69	19.54	23	4	9.77	14.76	19.53	24	4	7.44	14	19.84	24

Study 33	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	7	9.53	15.38	21.65	25	6	10.04	15.7	21.7	25	7	9.83	15.21	20.21	24
2	7	9.25	14.91	21.11	25	6	9.45	15.2	21.14	25	7	9.75	15.41	20.93	25
3	6	8.89	14.59	20.65	25	5	9.15	14.76	20.7	25	6	9	14.71	20.75	25
4	6	8.44	14.26	20.38	24	5	8.68	14.42	20.2	24	6	8.76	14.43	19.98	24
5	6	8.1	13.91	19.81	23	5	8.29	14.08	19.93	24	6	8.66	13.72	19.03	23
6	6	7.75	13.72	19.52	23	5	8.04	13.85	19.61	23	5	8	13.5	19	23
7	5	7.62	13.58	19.89	24	4	7.88	13.84	19.9	24	5	7.97	13.48	18.96	23
8	6	8.58	14.64	21.48	26	5	9.13	15.16	21.34	25	5	8.75	14.87	20.63	24
9	7	9.91	16.2	22.85	27	6	10.51	16.52	22.83	27	6	9.86	15.93	21.71	26
10	9	10.82	17.66	24.65	30	6	11.92	18.07	24.42	30	9	12.83	18.1	23.67	28
11	9	11.92	19.02	25.87	31	7	12.73	19.33	25.74	32	7	11.7	18.44	25.85	31
12	9	12.81	20.26	27.12	32	7	13.88	20.47	26.91	32	7	11.46	18.61	25.26	30
13	9	13.52	20.93	27.75	33	8	14.62	21.27	27.55	33	8	13.24	19.95	26.02	31
14	9	13.62	21.38	28.57	33	8	14.95	21.66	28.12	33	8	13.09	20.08	26.59	31
15	9	13.69	21.5	28.56	33	8	15.11	21.76	28.07	33	8	13.26	19.98	26.1	31
16	10	13.57	21.19	28.22	33	8	14.75	21.39	27.8	33	8	13.2	20.36	27.69	33
17	9	13.25	20.52	27.65	32	8	14.04	20.77	27.23	32	8	12.83	19.83	26.82	32
18	9	12.54	19.15	26.22	31	7	13.14	19.45	25.85	31	7	11.21	18.39	24.64	29
19	8	12.02	18.18	24.98	29	6	12.42	18.51	24.95	29	6	10.31	17.43	23.66	28
20	7	11.21	17.57	24.42	28	6	12.11	18.01	24.33	28	6	10.21	17.35	23.54	27
21	6	11.1	17.13	23.73	28	5	11.52	17.45	23.8	27	5	9.1	16.75	22.83	26
22	6	10.47	16.69	23.31	27	5	11.08	16.96	23.34	27	5	8.76	16.13	22.95	27
23	6	10.2	16.28	22.78	26	5	10.52	16.44	22.71	26	5	8.6	15.69	21.76	26
24	6	9.88	15.79	22.34	25	5	10.26	16.03	22.27	25	5	8.44	15	20.84	25

10 ACH

Study 33	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.12	19.95	23.64	26	10	15.69	20.25	23.56	28	12	15.26	20.31	24.44	28
2	11	15.01	19.55	23.15	26	10	15.36	19.93	23.08	28	10	13.29	18.97	23.32	26
3	10	14.6	19.3	22.75	26	10	15.09	19.65	22.79	27	10	13.44	19.03	23.35	26
4	10	14.39	18.99	22.46	25	9	14.78	19.37	22.56	26	9	12.49	18.68	23.28	26
5	10	14.12	18.74	21.98	25	9	14.5	19.12	22.08	26	9	12.45	18.04	22.35	25
6	10	14.1	18.64	21.88	25	9	14.48	19	21.94	27	9	12.52	18.07	22.39	25
7	10	14.43	19.21	22.87	26	10	14.98	19.53	22.78	27	10	13.51	19.07	23.37	27
8	11	15.04	20.24	24.26	28	10	15.67	20.55	23.95	29	10	14.19	19.98	24.84	29
9	12	15.52	21.5	25.81	29	11	16.49	21.64	25.44	31	11	15.85	21.67	26.69	30
10	12	16.08	22.76	27.02	30	11	17.29	22.8	26.82	31	12	16.55	22.33	26.96	31
11	12	16.63	24.02	28.6	31	11	18.16	23.95	28.01	33	14	18.87	23.94	28.76	33
12	12	17.07	25.05	29.7	33	11	18.87	24.89	29.07	35	14	19.01	24.59	29.68	34
13	13	17.38	25.78	30.32	33	11	19.39	25.6	29.91	35	12	18.06	24.37	29.51	33
14	12	17.82	26.08	30.84	33	11	19.62	25.91	30.29	35	11	17.55	24.83	30.43	34
15	12	17.79	26.03	30.9	34	11	19.65	25.88	30.33	35	11	17.04	24.19	29.58	34
16	11	17.84	25.56	30.72	34	11	19.4	25.56	30.05	35	11	17.07	24.28	29.78	34
17	11	17.53	24.9	30.17	33	10	19.01	24.96	29.57	34	11	16.69	23.84	29.14	34
18	11	17.16	23.96	29.08	32	10	18.32	24.11	28.65	34	11	15.81	22.49	27.55	32
19	11	16.44	22.72	27.34	30	10	17.38	22.81	26.98	31	11	15.63	22.21	27.08	31
20	11	16.1	22.02	26.5	29	10	16.93	22.15	26.17	31	11	15.3	21.41	26.04	29
21	11	15.81	21.53	25.85	28	10	16.5	21.64	25.56	29	11	14.51	20.76	25.5	29
22	11	15.47	21.12	25.3	28	10	16.26	21.24	25.02	29	10	14.04	20.61	25.53	29
23	10	15.29	20.71	24.69	28	10	15.98	20.87	24.52	29	10	13.75	19.78	24.3	28
24	11	15.11	20.33	24.27	27	10	15.64	20.55	23.97	28	10	13.82	19.81	24.31	28
Study 33	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	2	6.02	10.49	14.06	17	1	6.28	10.67	14.07	17	2	4.01	9.68	14.4	17
2	2	5.75	10.16	13.9	17	1	6.02	10.37	13.94	17	2	3.83	9.63	14.39	17
3	1	5.3	9.92	13.65	16	1	5.68	10.15	13.75	17	2	3.99	9.68	14.4	17
4	1	4.92	9.5	13.12	16	0	5.28	9.81	13.37	16	1	2.96	9.08	13.59	16
5	1	4.89	9.2	12.86	16	0	5.09	9.54	13.17	16	1	0.9	5.77	14.47	18
6	1	4.27	9.03	12.64	15	0	4.81	9.28	12.9	16	1	2.9	8	13.1	16
7	1	4.17	8.76	12.34	15	1	4.56	9.05	12.65	15	2	3.69	8.69	12.71	15
8	1	4.81	9.49	13.13	16	1	5.15	9.62	13.19	16	2	3.77	8.98	13.49	16
9	2	6.56	11.11	14.95	18	1	6.53	11.37	15.08	18	2	4.82	10.82	15.35	18
10	3	8.09	12.84	16.7	20	2	8.06	12.94	16.67	20	2	5.13	11.42	16.44	20
11	4	9.16	14.06	17.99	21	2	9.27	14.17	18.02	22	2	6.23	13.07	18.55	22
12	5	10.16	15.03	19.12	22	4	10.72	15.24	19.26	23	4	7.73	14.07	19.14	22
13	6	10.46	15.74	19.8	23	4	11.17	15.84	19.8	25	4	8.07	14.63	20.58	24
14	6	10.71	16.18	20.23	23	4	11.35	16.26	20.17	25	4	7.49	14.2	19.38	23
15	6	11.04	16.28	20.36	24	5	11.4	16.43	20.39	24	6	9.26	15.44	20.39	23
16	6	10.61	16.01	20.06	23	5	11.17	16.11	19.98	24	6	9.27	15.52	20.61	23
17	5	10.18	15.11	19.07	22	5	10.42	15.25	19.02	23	5	8.25	14.43	19.36	23
18	4	9.14	13.65	17.7	20	3	9.14	14.08	17.87	21	4	7.17	13.42	18.44	21
19	4	8.45	13.01	16.9	20	3	8.25	12.99	16.69	21	4	6.92	12.93	17.49	20
20	3	7.56	12.51	16.55	19	2	7.56	12.47	16.09	20	3	5.65	11.92	16.91	20
21	3	7.32	12.03	15.95	18	2	7.28	12.05	15.85	18	3	4.83	10.7	15.61	18
22	3	6.56	11.66	15.48	18	2	6.56	11.73	15.44	18	3	4.96	10.49	14.86	17
23	2	6.37	11.17	14.92	17	2	6.44	11.27	14.91	18	3	5	10.54	14.7	17
24	2	6.16	10.73	14.63	17	1	6.27	10.95	14.63	17	2	4.2	10.16	14.59	17

10 ACH

Study 34	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	10.02	14.71	19.8	23	5	10.29	15.14	19.99	23	8	10	15.2	19.75	23
2	5	9.46	14.35	19.27	22	5	9.86	14.75	19.68	23	7	8.79	14.13	18.66	22
3	5	9.16	13.99	18.92	22	4	9.58	14.48	19.25	22	7	8.98	14.19	18.76	22
4	5	8.89	13.8	18.53	22	4	9.21	14.14	18.68	22	6	8.06	13.89	18.71	22
5	5	8.75	13.55	18.11	21	4	8.92	13.89	18.54	22	6	8.18	13.93	18.69	22
6	5	8.47	13.32	17.7	21	4	8.84	13.57	18.12	22	5	7.46	13.2	17.95	21
7	4	8.36	13.21	17.8	21	4	8.71	13.59	18.2	22	5	7.38	13.29	18.55	22
8	5	9.32	14.5	19.65	23	4	9.96	15.03	19.67	24	6	9.01	14.68	19.41	23
9	6	10.85	16.13	21.63	25	5	11.45	16.6	21.72	26	6	9.86	15.93	21.71	26
10	5	12.16	17.54	23.22	28	6	12.64	17.93	23.36	29	6	10.13	17.35	23.61	28
11	5	13.02	18.58	24.37	29	5	13.52	18.93	24.31	30	5	9.95	17.77	24.73	30
12	6	13.25	19.3	24.9	30	6	14.29	19.49	24.93	30	6	10.57	18.15	24.21	29
13	5	13.45	19.84	25.52	29	6	14.45	20.01	25.5	31	11	14.53	19.5	24.47	29
14	6	13.65	20.05	25.8	30	6	14.86	20.26	25.86	31	6	10.85	18.48	24.94	30
15	6	13.75	20.15	25.68	30	6	14.89	20.36	25.94	30	12	15.55	20.53	25.53	30
16	6	14.03	19.98	25.61	30	6	14.76	20.13	25.62	31	6	10.81	18.99	25.73	30
17	5	13.32	19.12	24.77	30	6	14.05	19.34	24.89	30	12	14.88	19.64	25.36	30
18	5	12.32	17.79	23.43	28	4	12.84	18.14	23.53	29	11	13.53	18.33	24.11	28
19	5	12.02	16.97	22.7	26	4	12.42	17.38	22.77	27	5	8.93	16.51	22.86	27
20	4	11.32	16.59	21.93	26	4	12.04	16.92	22.09	27	5	8.82	16.44	22.76	27
21	4	11.14	16.19	21.4	25	4	11.37	16.6	21.72	26	5	8.46	16.11	22.13	25
22	4	10.54	15.8	20.83	25	4	11.08	16.08	21.12	25	5	8.41	15.61	21.93	25
23	4	10.18	15.35	20.45	24	4	10.64	15.74	20.75	24	9	10.96	15.81	20.7	24
24	4	9.71	15.04	19.89	24	4	10.49	15.37	20.3	24	5	7.64	13.64	18.12	21

Study 34	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	8	10.03	15.71	22.31	26	6	10.4	16.31	22.21	26	7	10.42	15.86	20.9	24
2	7	9.71	15.32	21.77	25	6	10.16	15.79	21.79	25	7	10.34	16.06	21.66	25
3	7	9.2	14.82	21.53	25	5	9.45	15.32	21.38	25	6	9	14.71	20.75	25
4	6	8.91	14.56	20.8	25	5	9.25	14.97	20.98	25	6	8.85	14.68	20.78	25
5	6	8.47	14.14	20.64	24	5	8.68	14.57	20.43	24	6	8.82	14.21	19.21	23
6	6	8.02	13.84	20.07	23	5	8.26	14.22	20.12	23	5	8	13.5	19	23
7	6	8.03	13.96	20.86	25	4	8.5	14.39	20.49	25	5	8.23	13.81	19.39	24
8	7	9.22	15.31	22.68	27	5	9.83	15.94	22.26	27	6	9.43	15.54	21.31	26
9	8	10.66	17.07	24.34	29	7	11.39	17.52	23.97	29	7	11.15	17.26	23.08	28
10	9	11.69	18.49	25.86	31	7	12.64	18.99	25.44	31	10	13.51	18.77	24.34	29
11	9	12.32	19.61	26.93	32	8	13.48	20.07	26.54	33	8	12.53	18.89	25.3	30
12	9	13.11	20.44	27.77	33	8	14.23	20.78	27.31	33	8	12.7	19.85	26.99	32
13	9	13.66	20.96	28.58	33	9	14.91	21.43	27.77	34	9	13.65	20.29	26.31	31
14	9	13.78	21.31	28.72	34	9	15.1	21.76	28.34	34	9	13.68	20.35	26.45	31
15	9	13.89	21.48	28.8	34	9	15.23	21.88	28.3	34	9	13.67	20.32	26.38	31
16	10	13.69	21.29	28.72	34	9	15.09	21.66	28.22	33	9	13.5	20.41	27.15	32
17	10	13.58	20.74	28.43	33	9	14.56	21.2	27.74	33	9	13.5	20.5	27.5	33
18	9	12.88	19.39	26.78	32	8	13.51	19.85	26.41	32	8	11.9	19.08	25.33	30
19	8	12.04	18.47	25.67	30	6	12.76	18.87	25.37	30	6	10.31	17.43	23.66	28
20	7	11.75	17.96	24.98	29	6	12.35	18.37	24.7	29	6	10.22	17.36	23.55	28
21	7	11.25	17.57	24.57	28	5	12.15	17.89	24.26	29	5	9.19	16.91	22.89	27
22	7	10.75	17.16	24.11	28	5	11.65	17.53	23.87	28	5	9.29	16.5	22.86	27
23	6	10.53	16.61	23.42	27	5	11.22	17.12	23.34	28	5	9.32	16.61	23.22	27
24	6	10.22	16.22	23.08	26	5	10.86	16.64	22.86	26	5	9.22	16.1	21.72	25

10 ACH

Study 34	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	11	15.46	20.6	24.51	27	10	16.29	20.9	24.38	29	12	15.85	20.96	25.16	28
2	11	15.25	20.21	24.15	27	10	16	20.55	23.9	29	10	14.02	20.02	24.29	27
3	11	15.08	19.89	23.63	27	10	15.63	20.22	23.55	27	10	13.45	19.04	23.36	27
4	11	14.69	19.57	23.21	26	10	15.35	19.9	23.14	27	10	13.3	18.99	23.37	27
5	10	14.44	19.26	22.8	26	9	15.08	19.61	22.81	27	9	12.68	18.75	23.28	27
6	10	14.47	19.32	22.89	26	9	15.09	19.66	22.85	29	9	13.15	18.72	23.13	27
7	11	15.01	20.2	24.62	27	10	15.79	20.55	24.18	29	10	14.67	20.34	24.89	29
8	11	15.56	21.66	26.51	29	10	16.83	21.93	25.94	31	10	15.42	21.69	26.66	31
9	12	16.06	23.11	27.91	31	11	17.65	23.17	27.51	33	11	16.93	23	28.33	33
10	12	16.56	24.26	29.23	32	11	18.44	24.26	28.7	35	12	17.68	23.93	29.37	34
11	12	16.93	25.29	30.09	33	11	19.11	25.16	29.72	36	14	19.69	25.29	30.58	36
12	13	17.28	25.87	30.84	34	11	19.49	25.71	30.23	37	14	19.65	25.59	30.94	36
13	13	17.62	26.37	31.2	34	11	19.93	26.24	30.77	37	12	18.06	24.38	29.52	34
14	13	18.06	26.58	31.75	34	11	20.13	26.48	30.99	37	11	17.56	24.85	30.46	35
15	12	18.15	26.66	31.79	34	11	20.16	26.49	31.13	37	11	17.55	24.83	30.41	35
16	12	18.03	26.34	31.79	35	11	20.04	26.28	30.97	37	11	17.59	24.93	30.62	35
17	12	17.97	25.78	31.2	34	11	19.63	25.8	30.62	35	11	17.25	24.48	29.95	35
18	12	17.44	24.88	30.51	33	11	19.11	25.01	29.78	35	11	16.72	23.76	29.54	35
19	12	16.85	23.58	28.51	31	11	18.16	23.63	27.97	32	11	16.22	22.85	27.87	32
20	11	16.5	22.85	27.59	30	10	17.69	23.01	27.22	32	11	15.4	21.72	26.83	31
21	11	16.13	22.32	26.84	29	10	17.28	22.46	26.61	32	11	15.12	21.39	26.23	30
22	11	15.93	21.91	26.38	29	10	16.98	22.04	25.97	30	11	15.38	21.53	26.35	30
23	11	15.71	21.45	25.68	29	10	16.61	21.57	25.46	30	11	15.25	21.13	25.34	29
24	11	15.5	21.11	25.25	28	10	16.34	21.22	24.91	30	10	14.5	20.74	25.79	30

Study 34	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	2	6.32	10.92	14.36	17	1	6.4	10.88	14.48	17	2	4.11	10.13	14.58	17
2	2	5.91	10.54	13.99	17	1	6.02	10.53	14.19	17	2	3.83	9.63	14.39	17
3	1	5.71	10.21	13.82	17	1	5.78	10.25	13.91	17	2	3.99	9.68	14.4	17
4	1	5.22	9.87	13.41	16	1	5.36	9.99	13.64	17	1	2.85	8.78	12.82	15
5	1	5.02	9.59	13.12	16	1	5.18	9.76	13.29	16	2	3.89	9.4	13.64	16
6	1	4.58	9.26	12.73	16	1	4.91	9.49	12.96	16	2	3.81	8.99	13.51	16
7	1	4.41	9.06	12.59	15	1	4.62	9.22	12.76	16	2	3.79	8.98	13.48	16
8	2	5.58	9.99	13.61	16	1	5.86	10.46	14.03	17	2	4.75	9.96	14.47	17
9	3	7.12	11.82	15.61	18	2	7.04	11.88	15.65	19	2	5.2	11.18	15.64	19
10	4	8.81	13.59	17.41	20	3	8.95	13.88	17.76	21	3	6.7	13.05	18.09	21
11	5	10.01	14.59	18.51	22	3	9.98	14.74	18.6	23	3	7.13	13.84	19.05	22
12	5	10.32	15.31	19.18	22	4	10.89	15.3	19.31	24	4	7.75	14.09	19.18	23
13	6	10.65	15.91	19.74	23	4	11.22	15.95	19.89	24	4	7.9	14.09	19.02	23
14	6	10.71	16.23	19.93	23	4	11.32	16.27	20.19	25	3	8.09	14.94	20.49	24
15	6	11.04	16.37	20.32	23	5	11.48	16.46	20.42	24	6	9.26	15.44	20.39	23
16	6	10.87	16.17	19.96	23	5	11.45	16.46	20.38	24	6	9.27	15.52	20.61	23
17	5	10.41	15.36	19.36	22	5	10.68	15.47	19.43	23	5	8.25	14.43	19.36	23
18	4	9.42	14.11	17.81	21	4	9.64	14.4	18.17	21	4	7.17	13.42	18.44	21
19	4	8.56	13.38	17.16	20	4	9.1	13.8	17.6	21	4	7.18	13.18	17.68	20
20	3	8.04	12.94	16.62	19	2	8.17	13.31	17.13	20	3	6.19	12.41	17.37	20
21	3	7.45	12.43	16.08	19	2	7.57	12.57	16.55	20	2	4.97	11.22	16	19
22	3	7.18	12.03	15.85	18	2	7.11	12.08	15.92	19	3	5.8	11.58	16.53	19
23	3	6.56	11.62	15.29	18	2	6.63	11.58	15.18	19	3	5.26	10.87	15.06	18
24	2	6.37	11.17	14.8	17	1	6.37	11.19	14.75	19	2	4.28	10.44	15.34	18

50 ACH

Study 26	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	4	7.52	12.46	17.38	20	4	8.15	12.99	17.75	21	5	7.98	13.67	18.38	21
2	3	6.82	12.15	16.75	19	3	7.23	12.46	17.26	20	3	5.15	11.48	16.49	20
3	3	6.66	11.6	16.17	19	3	6.81	11.89	16.55	20	3	5.29	11.35	15.85	19
4	3	6.19	11.43	15.9	19	2	6.18	11.46	15.89	20	2	4.31	10.73	15.69	19
5	2	5.91	11.18	15.59	19	2	5.81	11.15	15.47	19	2	4.38	10.64	15.62	19
6	2	5.85	10.87	14.94	19	2	5.61	10.79	14.91	18	2	4.24	10.43	15.36	18
7	1	5.81	10.95	15.48	20	1	6.02	11.01	15.62	21	1	3.72	10.32	16.88	21
8	4	7.41	12.71	17.56	21	3	8.11	13.35	18.13	22	3	6.35	12.95	18.83	22
9	6	9.66	15.01	20.34	25	6	10.02	15.39	20.72	25	6	9.09	14.76	20.83	24
10	5	11.41	17.14	22.8	30	5	11.93	17.34	22.94	31	6	9.08	16.46	23.21	27
11	4	12.85	18.56	24.58	31	4	13.39	18.96	24.64	31	5	9.33	17.94	24.7	28
12	5	13.31	19.7	25.86	32	5	14.42	19.83	25.91	33	6	10.15	18.87	25.71	29
13	5	13.45	20.39	26.39	30	5	14.6	20.63	26.57	31	6	10.4	19.17	26.34	30
14	6	14.16	20.7	26.89	31	5	15.05	21.09	26.99	32	6	10.55	19.65	26.63	30
15	6	14.28	20.55	26.47	31	6	14.99	20.86	26.7	31	6	11.07	19.85	27.07	31
16	6	14.1	19.93	25.98	30	6	14.6	20.09	25.87	31	6	10.48	19.35	26.75	31
17	5	12.87	18.56	24.6	29	5	13.45	19	24.9	29	5	9.39	18.17	25.34	29
18	4	11.21	16.69	22.19	26	4	12.12	17.33	22.97	27	4	8.09	16.45	23.54	27
19	4	10.56	15.67	21.11	25	4	11.2	16.34	21.94	25	4	7.9	15.48	21.84	25
20	3	9.87	15.06	20.28	24	3	10.72	15.74	20.98	25	3	6.9	14.7	21.53	25
21	3	9.46	14.5	19.56	23	3	10.07	15.09	20.26	24	8	10.44	15.48	20.54	23
22	4	8.87	13.8	18.83	22	4	9.4	14.37	19.34	23	4	7.2	13.88	19.99	23
23	4	8.25	13.24	18.25	22	4	8.45	13.7	18.59	23	7	8.56	12.71	15.7	18
24	4	7.81	12.85	17.65	21	4	7.9	13	17.86	22	4	6.23	11.32	14.75	17

Study 26	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	7.61	13.21	19.19	22	5	8.3	13.88	19.91	23	6	8.75	13.97	19.82	23
2	5	6.69	12.65	18.42	22	4	7.33	13.3	19.17	22	6	8.52	13.66	19	22
3	4	6.16	11.95	18.06	22	4	6.5	12.46	18.38	23	4	6.41	12.71	18.94	23
4	4	5.75	11.65	17.34	20	4	6.01	11.87	17.62	21	4	6.03	11.69	17.31	21
5	4	5.2	11.27	17.08	20	3	5.25	11.3	17.16	21	4	6.01	11.25	17.11	21
6	3	4.81	10.96	16.84	19	3	4.83	10.96	16.79	20	3	5.33	10.73	15.81	19
7	3	5.02	11.19	17.55	21	3	5.3	11.59	17.8	22	3	5.24	10.81	16.38	20
8	5	7.02	13.01	20.09	24	4	7.74	13.63	20.47	24	5	8.09	13.97	20.55	24
9	7	9.27	15.47	22.48	27	6	9.55	15.71	22.56	26	6	9.37	15.77	22.54	26
10	8	10.58	17.56	24.48	30	7	11.29	17.97	24.72	30	7	10.39	17.3	25.19	30
11	9	11.92	19.34	26.34	31	8	12.73	19.73	26.33	31	8	12.16	18.94	25.48	29
12	9	13.1	20.8	27.7	33	8	14.01	20.95	27.59	33	8	11.64	19.05	25.72	30
13	9	13.75	21.67	28.59	33	9	14.65	21.85	28.48	34	9	13.36	20.64	27.26	32
14	10	14.2	22.06	28.9	33	9	14.87	22.41	29.03	34	9	12.76	20.04	26.7	31
15	10	14.25	22.06	28.89	33	10	15.15	22.54	29.1	33	10	14.16	20.92	27.4	31
16	10	13.84	21.7	28.42	33	10	14.38	21.97	28.53	33	10	13.75	20.94	28.67	33
17	10	13.2	20.67	27.58	32	9	13.56	20.94	27.6	31	9	12.81	20.24	27.33	31
18	7	12.02	18.56	25.39	30	7	12.77	19.19	25.84	30	7	10.82	18.53	24.84	28
19	6	10.91	17.19	23.83	27	6	11.83	17.9	24.58	27	6	9.94	17.56	23.85	27
20	5	10.3	16.49	23.22	26	5	11.14	17.17	23.75	26	5	8.8	16.42	22.75	26
21	4	9.88	15.73	22.47	25	4	10.55	16.49	22.99	26	4	7.74	15.95	22.08	25
22	4	9.11	15.23	21.67	25	4	9.77	15.82	22.41	25	4	7.86	15.53	22.01	25
23	4	8.41	14.46	20.7	24	4	8.82	15	21.46	25	4	7.69	14.96	21.53	25
24	3	7.91	13.91	20.27	22	3	8.25	14.09	20.64	23	3	6.2	13.37	18.75	22

50 ACH

Study 26	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	9	13.18	17.68	20.83	24	9	13.85	18.34	21.63	25	9	12.1	18.11	22.57	25
2	9	12.75	17.29	20.45	24	9	13.42	17.95	21.12	25	9	11.78	17.59	22.36	25
3	9	12.4	16.95	19.93	24	9	12.95	17.56	20.69	25	9	11.85	17.38	21.63	24
4	8	12.15	16.63	19.69	23	8	12.5	17.2	20.32	24	8	10.86	16.71	21.43	24
5	8	11.76	16.33	19.28	23	8	12.13	16.82	19.85	23	8	10.93	16.51	20.69	23
6	8	11.86	16.33	19.08	23	8	12.24	16.78	19.76	24	8	10.84	16.13	19.88	22
7	9	12.54	17.23	20.58	25	9	13.27	17.87	20.98	25	9	12.02	17.68	22.39	25
8	10	13.62	18.79	22.64	27	10	14.15	19.18	22.73	27	11	14	19.67	24.4	27
9	11	14.59	20.49	24.62	29	11	15.25	20.8	24.76	30	12	15.66	21.37	26.14	29
10	12	15.44	22.1	26.37	30	11	16.36	22.23	26.26	31	13	16.48	22.32	27.18	30
11	12	16.22	23.41	27.77	31	11	17.29	23.58	27.81	32	14	17.67	23.41	28.25	32
12	12	16.79	24.56	28.9	33	12	18.06	24.68	28.93	33	16	19.9	25.26	30.01	33
13	12	17.14	25.29	29.86	33	11	18.44	25.47	29.79	33	11	16.16	23.89	29.6	33
14	10	17.48	25.62	30.31	33	10	18.78	25.73	30.32	34	10	15.62	24.36	30.56	34
15	10	17.54	25.57	30.27	33	10	18.61	25.68	30.1	34	10	15.03	23.71	29.78	34
16	10	17.18	25.05	29.97	33	10	18.2	25.32	30	33	10	14.81	23.13	28.47	31
17	10	16.73	24.17	29.35	32	10	17.49	24.41	29.34	33	10	14.16	22.41	27.58	31
18	10	16.15	22.74	27.62	31	10	16.73	23.11	27.77	31	10	13.94	22	27.42	30
19	10	15.35	21.11	25.79	29	10	15.98	21.67	26.21	30	10	13.7	20.91	26.31	29
20	10	14.71	20.16	24.53	28	10	15.43	20.83	25.1	28	10	13.39	20.14	25.3	28
21	10	14.31	19.58	23.75	27	10	15.09	20.21	24.35	28	10	13.01	19.38	24.51	27
22	9	14.09	19.1	22.97	26	9	14.61	19.69	23.74	27	10	13.23	19.5	24.6	27
23	9	13.69	18.58	22.25	26	9	14.35	19.12	22.85	27	9	12.42	19.13	24.24	27
24	9	13.33	18.17	21.68	25	9	13.94	18.7	22.31	26	9	12.27	18.43	23.33	26

Study 26	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	0	4.16	8.55	11.93	15	0	4.18	8.65	12.25	15	0	2.11	7.64	11.9	15
2	0	3.39	8.09	11.75	15	0	3.33	8.03	11.62	16	0	1.69	7.18	12.21	15
3	-1	3.19	7.66	11.42	14	0	3.26	7.61	11.32	14	0	1.04	6.69	11.4	14
4	-1	2.6	7.29	10.78	14	0	2.7	7.25	10.73	14	0	0.97	6.66	11.43	14
5	-1	2.3	6.96	10.65	13	1	2.51	6.95	10.6	13	0	0.96	6.41	10.64	13
6	-1	1.91	6.6	10.42	13	0	2.02	6.57	10.36	13	0	0.85	6	10.51	13
7	-1	1.66	6.36	9.96	13	0	1.72	6.29	9.95	13	0	0.74	5.7	9.71	12
8	0	3.28	7.92	11.41	15	0	4.05	8.64	12.14	15	0	2.75	7.96	12.47	15
9	2	6.02	10.75	14.63	18	1	6.43	11.26	14.98	18	1	4.31	10.55	15.42	18
10	3	8.2	13.39	17.41	21	2	8.27	13.49	17.49	21	2	5.38	12.4	18.08	21
11	4	10.08	14.86	19.06	23	4	10.24	15.39	19.54	24	4	7.52	14.96	20.85	24
12	5	10.85	16.14	20.25	24	5	11.59	16.66	20.83	25	5	8.41	15.42	21.13	24
13	6	11.32	16.95	21.16	25	6	12.28	17.52	21.69	26	6	9.46	16.15	21.27	24
14	6	11.54	17.43	21.62	25	6	12.58	17.97	21.99	26	6	9.71	16.91	22.3	25
15	6	11.65	17.46	21.52	25	7	12.18	17.58	21.63	26	7	10.13	16.84	21.99	25
16	6	11.42	16.93	20.99	25	6	12.02	17.18	21.19	25	8	10.16	16.09	21.49	24
17	5	10.37	15.51	19.67	23	5	11.28	16.03	19.99	23	7	9.13	14.99	20.17	23
18	4	8.75	13.35	17.08	20	4	9.5	14.12	17.89	21	5	7.11	13.16	17.68	20
19	3	7.56	12.34	16.17	19	3	8.1	13.15	16.89	20	3	6.26	12.46	17.45	20
20	2	6.45	11.62	15.58	18	2	7.24	12.35	16.24	19	4	6.79	12.04	16.54	19
21	1	6.03	10.94	14.78	17	1	6.28	11.46	15.27	18	1	3.9	10.09	14.72	17
22	2	5.18	10.26	13.95	16	2	5.31	10.35	14.04	17	2	4.47	9.56	13.79	16
23	1	4.69	9.64	13.42	16	1	4.61	9.47	13	16	2	4.06	9.12	13.13	16
24	1	4.18	9.01	12.71	15	0	4.03	8.82	12.61	15	2	3.75	8.71	12.71	15

50 ACH

Study 32	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	4	7.48	12.42	17.31	20	4	8.13	13.05	17.82	21	5	7.98	13.67	18.38	21
2	3	6.69	12.06	16.72	19	3	7.27	12.45	17.29	20	3	5.15	11.48	16.49	20
3	3	6.61	11.59	16.16	19	3	6.86	12	16.63	20	3	5.29	11.35	15.85	19
4	2	6.1	11.38	15.9	19	2	6.27	11.55	16.01	20	2	4.31	10.73	15.69	19
5	2	5.89	11.17	15.59	19	2	5.85	11.18	15.53	19	2	4.38	10.64	15.62	19
6	2	5.71	10.81	14.93	19	2	5.54	10.79	14.93	19	2	4.24	10.43	15.36	18
7	1	5.81	10.88	15.42	20	1	5.97	11.01	15.68	21	1	3.72	10.32	16.88	21
8	4	7.41	12.71	17.56	21	3	8.12	13.36	18.14	22	3	6.35	12.95	18.83	22
9	6	9.66	15.12	20.34	25	6	10.15	15.43	20.81	25	6	9.15	15.02	21.62	25
10	5	11.41	17.15	22.98	30	5	11.99	17.41	23.03	31	6	9.08	16.46	23.21	27
11	4	12.85	18.62	24.68	31	4	13.47	19.06	24.97	32	5	9.33	17.94	24.7	28
12	5	13.42	19.86	26.07	32	5	14.43	19.98	25.92	33	6	10.4	19.71	28.02	32
13	5	13.56	20.53	26.59	30	5	14.8	20.73	26.67	31	6	10.53	19.61	26.52	30
14	6	14.16	20.81	26.9	31	6	15.15	21.17	27.23	32	15	17.51	22.04	27.31	30
15	6	14.28	20.68	26.59	31	6	15.04	20.94	26.82	31	6	11.07	19.85	27.07	31
16	6	14.11	20.01	25.98	30	6	14.6	20.16	26.11	31	6	10.48	19.35	26.75	31
17	5	12.87	18.64	24.65	29	5	13.45	19.02	24.97	29	5	9.39	18.17	25.34	29
18	4	11.18	16.69	22.18	26	4	12.12	17.35	22.97	27	4	8.09	16.45	23.54	27
19	4	10.45	15.64	21.11	25	4	11.21	16.35	21.94	25	4	7.9	15.48	21.84	25
20	3	9.87	15.01	20.19	24	3	10.74	15.74	20.99	25	3	6.9	14.7	21.53	25
21	3	9.41	14.48	19.48	23	3	10.07	15.12	20.26	24	8	10.44	15.48	20.54	23
22	4	8.87	13.8	18.8	22	4	9.44	14.41	19.35	23	4	7.2	13.88	19.99	23
23	4	8.25	13.24	17.99	22	4	8.47	13.74	18.62	23	7	8.56	12.71	15.7	18
24	4	7.56	12.76	17.6	21	4	7.94	13.11	17.97	22	4	6.23	11.32	14.75	17

Study 32	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	5	7.61	13.19	19.19	22	5	8.35	13.87	19.94	23	6	8.75	13.97	19.82	23
2	5	6.66	12.58	18.42	22	4	7.41	13.32	19.24	22	6	8.52	13.66	19	22
3	4	6.11	11.93	17.98	22	4	6.56	12.55	18.46	23	4	7.19	13.45	19.67	23
4	4	5.69	11.6	17.34	20	4	6.1	11.92	17.69	21	4	6.03	11.69	17.31	21
5	4	5.17	11.18	17.08	20	3	5.32	11.38	17.18	21	4	6.01	11.25	17.11	21
6	3	4.75	10.91	16.72	19	3	4.85	10.93	16.65	20	3	5.33	10.73	15.81	19
7	3	4.82	11.16	17.44	21	3	5.21	11.55	17.65	22	3	5.24	10.81	16.38	20
8	5	6.89	13.04	20.09	24	4	7.76	13.65	20.54	24	5	7.93	13.53	20.41	24
9	7	9.27	15.47	22.59	27	6	9.66	15.77	22.62	26	9	11.66	16.58	22.78	26
10	8	10.63	17.6	24.61	30	7	11.31	17.96	24.74	30	7	10.39	17.3	25.19	30
11	9	12.02	19.46	26.38	32	8	12.74	19.82	26.52	32	8	11.77	19.07	27.12	32
12	10	13.16	20.89	27.83	33	9	14.09	21.1	27.79	33	9	12.51	19.57	25.86	30
13	10	14.03	21.81	28.78	33	9	14.67	21.95	28.67	34	9	13.36	20.64	27.26	32
14	10	14.2	22.18	28.98	34	10	15.01	22.51	29.23	34	10	13.67	20.76	26.9	31
15	10	14.25	22.27	28.97	33	10	15.24	22.59	29.19	33	11	14.51	21.26	27.69	31
16	10	14.11	21.75	28.56	33	10	14.48	22.01	28.57	33	10	13.75	20.94	28.67	33
17	10	13.2	20.67	27.61	32	9	13.56	20.94	27.64	31	9	12.81	20.24	27.33	31
18	7	12.03	18.56	25.39	30	7	12.78	19.2	25.97	30	7	10.82	18.53	24.84	28
19	6	10.91	17.19	23.9	27	6	11.83	17.9	24.58	27	6	9.94	17.56	23.85	27
20	5	10.3	16.41	23.11	26	5	11.15	17.17	23.75	26	5	8.8	16.42	22.75	26
21	4	9.88	15.73	22.39	25	4	10.56	16.47	22.91	26	4	7.83	16.22	22.86	26
22	4	9.11	15.17	21.67	25	4	9.8	15.78	22.38	25	4	7.86	15.53	22.01	25
23	4	8.32	14.38	20.78	24	4	8.84	15.02	21.45	25	4	7.69	14.96	21.53	25
24	3	7.89	13.82	20.21	22	3	8.32	14.14	20.69	23	3	6.82	14.17	19.92	23

50 ACH

Study 32	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	9	13.12	17.64	20.8	24	9	13.85	18.31	21.63	25	9	12.1	18.11	22.57	25
2	9	12.77	17.24	20.41	24	9	13.41	17.92	20.99	25	9	11.78	17.59	22.36	25
3	9	12.35	16.89	19.88	24	9	13.01	17.58	20.71	25	9	11.85	17.38	21.63	24
4	8	12.04	16.58	19.63	23	8	12.57	17.22	20.32	24	8	10.86	16.71	21.43	24
5	8	11.69	16.3	19.13	22	8	12.17	16.87	19.87	23	8	10.86	16.38	20.63	23
6	8	11.86	16.28	19	23	7	12.24	16.83	19.8	24	8	11.04	16.7	21.43	24
7	9	12.53	17.23	20.58	25	9	13.28	17.88	20.99	25	9	12.02	17.68	22.39	25
8	10	13.67	18.81	22.66	27	10	14.16	19.2	22.76	27	11	14	19.67	24.4	27
9	11	14.58	20.55	24.69	29	11	15.28	20.87	24.83	30	12	15.66	21.37	26.14	29
10	12	15.44	22.15	26.45	30	11	16.39	22.3	26.36	31	13	16.48	22.32	27.18	30
11	12	16.26	23.53	27.89	31	11	17.37	23.73	27.94	32	14	18.26	24.04	28.94	32
12	12	16.85	24.75	28.99	33	12	18.14	24.85	29.11	33	16	19.9	25.26	30.01	33
13	11	17.21	25.47	29.93	33	11	18.59	25.62	29.94	34	11	16.16	23.89	29.6	33
14	10	17.48	25.8	30.52	33	10	18.93	25.91	30.49	34	10	15.62	24.36	30.56	34
15	10	17.66	25.68	30.47	34	10	18.68	25.81	30.3	34	10	15.03	23.71	29.78	34
16	10	17.18	25.13	30.15	33	10	18.21	25.43	30.19	34	10	15.03	23.77	29.95	33
17	10	16.76	24.21	29.35	32	10	17.48	24.45	29.46	33	10	14.16	22.41	27.58	31
18	10	16.12	22.77	27.65	31	10	16.73	23.17	27.82	31	10	13.94	22	27.42	30
19	10	15.34	21.11	25.79	29	10	15.99	21.7	26.25	30	10	13.7	20.91	26.31	29
20	10	14.69	20.16	24.54	28	10	15.42	20.82	25.08	28	10	13.39	20.14	25.3	28
21	10	14.31	19.55	23.73	27	10	15.09	20.21	24.33	28	10	13.01	19.38	24.51	27
22	9	14.09	19.08	22.96	26	9	14.64	19.67	23.72	27	10	13.14	19.2	23.79	26
23	9	13.65	18.54	22.15	26	9	14.36	19.11	22.83	27	9	12.42	19.13	24.24	27
24	9	13.33	18.13	21.63	25	9	13.98	18.68	22.3	26	9	12.27	18.43	23.33	26
Study 32	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	0	4.1	8.51	11.92	15	0	4.32	8.84	12.54	15	0	2.11	7.64	11.9	15
2	0	3.33	8.05	11.72	15	0	3.34	8.08	11.72	16	0	1.83	7.31	12.39	16
3	-1	3.1	7.62	11.36	14	0	3.26	7.58	11.3	14	0	1.04	6.69	11.4	14
4	-1	2.6	7.23	10.78	14	0	2.65	7.17	10.7	14	0	0.97	6.66	11.43	14
5	-1	2.27	6.91	10.65	13	1	2.47	6.92	10.52	13	0	0.96	6.41	10.64	13
6	-1	1.81	6.56	10.4	13	0	1.91	6.51	10.14	13	0	0.85	6	10.51	13
7	-1	1.62	6.29	9.95	13	0	1.62	6.26	9.94	13	0	0.74	5.7	9.71	12
8	0	3.27	7.86	11.41	15	0	4.02	8.6	12.16	15	0	2.75	7.96	12.47	15
9	2	6.02	10.83	14.67	18	1	6.43	11.3	15.05	18	1	4.31	10.55	15.42	18
10	3	8.22	13.43	17.46	21	2	8.31	13.57	17.63	21	2	5.38	12.4	18.08	21
11	4	10.09	15.01	19.13	23	4	10.29	15.43	19.65	24	4	7.43	14.66	20.07	23
12	5	11.03	16.26	20.43	24	5	11.6	16.75	20.91	25	5	8.41	15.42	21.13	24
13	6	11.46	17.1	21.23	25	6	12.46	17.61	21.78	26	6	9.46	16.15	21.27	24
14	6	11.65	17.48	21.72	25	6	12.61	18.15	22.15	26	6	9.71	16.91	22.3	25
15	6	11.65	17.55	21.7	25	7	12.15	17.62	21.75	26	7	10.22	17.12	22.79	26
16	6	11.56	16.99	21.09	25	7	12.03	17.28	21.34	25	8	10.16	16.09	21.49	24
17	5	10.37	15.54	19.72	23	5	11.32	16.09	20.08	23	7	9.25	15.43	20.35	23
18	4	8.75	13.33	17.08	20	4	9.5	14.12	17.89	21	5	7.11	13.16	17.68	20
19	3	7.56	12.33	16.17	19	3	8.1	13.15	16.85	20	3	6.26	12.46	17.45	20
20	2	6.45	11.6	15.55	18	2	7.26	12.36	16.25	19	4	6.79	12.04	16.54	19
21	1	6.03	10.92	14.75	17	1	6.32	11.53	15.4	18	1	3.9	10.09	14.72	17
22	2	5.18	10.2	13.95	16	2	5.4	10.41	14.16	17	2	4.47	9.56	13.79	16
23	1	4.69	9.58	13.38	15	1	4.55	9.51	13.21	16	2	4.06	9.12	13.13	16
24	1	4.18	8.9	12.65	15	0	4.02	8.77	12.58	15	0	2.2	8.16	12.59	15

50 ACH

Study 33	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	4	7.69	12.62	17.48	21	4	8.67	13.46	18.29	21	5	7.98	13.67	18.38	21
2	3	7.16	12.28	16.9	19	3	8	13.13	17.73	20	4	6.78	12.59	17.36	20
3	3	6.89	11.83	16.34	19	3	7.79	12.62	17.15	20	3	6.08	12.1	16.57	19
4	3	6.36	11.69	16.08	19	3	7.24	12.43	16.88	20	3	5.86	11.71	16.43	19
5	3	6.28	11.4	15.82	19	3	7.08	12.22	16.6	20	2	5.24	11.66	17.03	20
6	2	6.09	11.12	15.25	19	2	6.84	11.81	16.04	20	2	5.31	11.7	17.08	20
7	1	6.09	11.05	15.52	20	1	6.81	11.89	16.36	21	1	4.48	11.25	17.61	21
8	4	7.46	12.85	17.56	21	4	8.24	13.48	18.18	22	4	7.15	13.21	18.9	22
9	6	9.62	14.94	20.31	25	5	10.03	15.41	20.64	25	7	9.16	15.03	21.63	25
10	5	11.28	16.77	22.47	29	5	11.69	17.05	22.46	30	6	9.08	16.46	23.21	27
11	4	12.46	18.26	23.9	30	4	13.05	18.55	24.19	31	5	9.08	17.68	24.49	28
12	5	13.21	19.25	25.08	31	5	14.22	19.66	25.67	32	6	10.15	18.87	25.71	29
13	5	13.25	19.99	25.88	30	6	14.53	20.47	26.23	30	6	10.4	19.17	26.34	30
14	6	14.03	20.34	26.4	30	6	14.89	20.78	26.67	30	6	10.55	19.65	26.63	30
15	6	14.28	20.27	26.22	30	6	14.92	20.68	26.57	31	7	11.08	19.86	27.08	31
16	6	14.1	19.93	25.83	30	6	14.68	20.1	25.97	31	7	11.29	20.16	27.58	31
17	5	12.87	18.76	24.67	29	5	13.54	18.99	24.89	30	5	9.39	18.17	25.34	29
18	4	11.32	16.82	22.48	27	4	12.27	17.38	22.98	27	4	8.09	16.45	23.54	27
19	4	10.71	15.8	21.31	25	4	11.36	16.47	21.98	25	4	7.9	15.48	21.84	25
20	4	10.21	15.15	20.4	24	4	10.85	15.96	21.17	25	4	7.66	14.97	21.6	25
21	4	9.46	14.74	19.65	23	4	10.36	15.31	20.45	24	8	10.44	15.48	20.54	23
22	4	9.16	14.04	18.98	22	4	9.82	14.78	19.76	23	4	7.4	14.07	20.18	23
23	4	8.42	13.38	18.48	22	4	9.22	14.2	19.03	23	7	9.28	13.38	16.26	18
24	4	7.87	13.01	17.74	21	4	8.74	13.78	18.59	22	4	7.22	13.24	18.9	22
Study 33	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	6	7.91	13.46	19.34	22	5	8.73	14.19	20.17	23	6	8.75	13.97	19.82	23
2	5	6.82	12.8	18.81	22	5	7.72	13.68	19.61	23	6	8.6	13.91	19.8	23
3	4	6.75	12.32	18.08	22	4	7.44	12.99	19.05	23	5	7.99	13.71	19.75	23
4	4	6.02	11.77	17.8	21	4	6.86	12.65	18.49	21	4	6.75	12.41	17.96	21
5	4	5.47	11.54	17.34	20	4	6.34	12.35	18.12	21	4	6.91	12.46	17.95	21
6	3	5.25	11.18	16.86	19	3	6.03	11.99	17.79	20	3	5.99	11.49	16.99	20
7	3	5.2	11.36	17.68	21	3	6.07	12.19	18.4	22	3	5.97	11.47	16.96	20
8	5	7.03	13.13	19.97	24	4	7.85	13.74	20.57	24	5	8.09	13.97	20.55	24
9	6	9.27	15.34	22.34	26	6	9.56	15.73	22.56	26	6	9.29	15.51	21.75	25
10	8	10.52	17.28	24.19	30	7	10.98	17.56	24.42	30	8	10.87	17.8	25.73	30
11	9	11.72	19.01	25.89	31	9	12.5	19.39	26.02	31	9	12.52	19.33	27.2	31
12	9	12.82	20.27	27.19	32	8	13.89	20.81	27.4	32	8	11.64	19.05	25.72	30
13	9	13.58	21.06	28.09	33	9	14.52	21.68	28.21	32	9	12.74	19.99	26.57	31
14	10	14.03	21.69	28.61	33	10	14.75	22.15	28.72	33	10	13.75	21.03	27.69	31
15	10	14.2	21.82	28.65	33	10	15.1	22.4	28.9	33	11	14.51	21.26	27.69	31
16	10	13.77	21.6	28.31	32	10	14.49	21.97	28.51	33	11	14.55	21.76	29.5	33
17	10	13.27	20.67	27.65	32	9	13.65	20.99	27.72	32	9	12.82	20.25	27.34	32
18	7	12.03	18.68	25.7	30	7	12.83	19.21	25.85	30	7	10.82	18.53	24.84	28
19	6	10.92	17.37	23.91	27	6	11.88	17.96	24.66	27	6	9.9	17.48	23.84	27
20	5	10.47	16.59	23.25	26	5	11.27	17.28	23.96	26	5	8.8	16.42	22.75	26
21	4	10.1	15.87	22.61	26	4	10.82	16.64	23.17	26	4	7.74	15.95	22.08	25
22	4	9.28	15.31	21.73	25	4	10.1	16.08	22.57	25	4	7.86	15.53	22.01	25
23	4	8.87	14.7	21.2	24	4	9.36	15.35	21.9	25	4	7.69	14.96	21.53	25
24	4	7.91	14.01	20.44	22	3	8.86	14.77	21.09	23	3	6.72	13.88	19.18	22

50 ACH

Study 33	Full					Conv					MC				
Summer	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	9	13.37	17.91	20.94	25	9	14.1	18.63	21.78	25	9	12.1	18.11	22.57	25
2	9	13.05	17.53	20.64	24	9	13.74	18.23	21.33	25	9	11.78	17.59	22.36	25
3	9	12.57	17.14	20.05	24	9	13.36	17.87	20.88	25	9	11.85	17.38	21.63	24
4	8	12.31	16.85	19.84	23	8	13.11	17.61	20.66	24	8	10.91	17.05	21.57	24
5	8	12.09	16.55	19.51	23	8	12.74	17.32	20.18	24	8	11.02	16.76	21.43	24
6	8	12.01	16.52	19.41	23	8	12.77	17.3	19.99	24	8	10.84	16.13	19.88	22
7	9	12.65	17.4	20.73	25	9	13.44	18.07	21.12	25	9	12.02	17.68	22.39	25
8	10	13.76	18.88	22.69	27	10	14.28	19.24	22.77	28	11	14.01	19.68	24.41	28
9	12	14.56	20.41	24.49	29	11	15.25	20.76	24.67	30	12	15.66	21.37	26.14	29
10	12	15.43	21.72	25.96	29	11	16.32	22.14	26	30	13	16.48	22.32	27.18	30
11	12	16.16	23.09	27.3	31	11	17.06	23.28	27.28	32	14	17.65	23.38	28.22	31
12	12	16.72	24.19	28.51	32	12	17.75	24.31	28.43	33	16	19.15	24.07	27.8	31
13	12	17.08	24.92	29.29	32	11	18.23	25.1	29.35	33	11	15.44	22.96	28.1	32
14	10	17.43	25.3	29.86	33	10	18.59	25.43	29.88	34	10	15.04	23.73	29.83	34
15	11	17.54	25.38	29.95	33	10	18.54	25.51	29.95	34	10	15.03	23.71	29.78	34
16	10	17.28	25.02	29.95	33	10	18.29	25.33	29.96	34	10	14.9	23.34	28.59	31
17	10	16.92	24.3	29.39	32	10	17.89	24.58	29.48	33	10	14.78	23.06	28.28	31
18	10	16.29	23.09	27.89	31	10	17.08	23.34	28	32	10	13.97	22.02	27.45	31
19	10	15.44	21.34	25.93	29	10	16.19	21.78	26.26	30	10	13.7	20.91	26.31	29
20	10	15.05	20.39	24.85	28	10	15.55	21.03	25.17	29	10	13.48	20.42	26.02	29
21	10	14.54	19.81	23.94	27	10	15.28	20.37	24.62	28	10	13.01	19.38	24.51	27
22	10	14.21	19.31	23.26	26	9	15.02	19.94	23.85	27	10	13.23	19.5	24.6	27
23	9	13.94	18.82	22.57	26	9	14.64	19.38	22.99	27	10	13.22	19.41	24.32	27
24	9	13.54	18.32	21.85	25	9	14.28	19.04	22.59	26	9	12.27	18.43	23.33	26

Study 33	Full					Conv					MC				
Winter	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	0	4.22	8.69	11.99	15	0	5.16	9.64	12.95	16	1	3.01	8.68	13.4	16
2	0	3.57	8.31	11.89	15	0	4.4	9.13	12.75	16	1	2.83	8.63	13.39	16
3	0	3.35	7.96	11.54	15	0	4.26	8.82	12.44	16	0	2.1	7.95	13.12	16
4	-1	3.09	7.47	10.96	14	1	3.95	8.35	11.83	15	0	1.92	7.63	12.4	15
5	-1	2.62	7.14	10.78	14	0	3.41	8.03	11.66	14	0	1.94	7.39	11.63	14
6	-1	2.09	6.87	10.61	14	0	3.02	7.63	11.54	14	0	1.83	6.99	11.5	14
7	-1	1.81	6.56	10.34	13	0	2.71	7.43	10.94	14	0	1.72	6.69	10.7	13
8	1	3.4	7.99	11.55	15	0	4.13	8.79	12.2	15	0	2.75	7.96	12.47	15
9	2	6.02	10.69	14.48	18	1	6.37	11.27	14.95	18	1	4.31	10.55	15.42	18
10	3	8.11	13.12	17.12	20	2	8.22	13.39	17.39	21	3	5.32	12.14	17.36	20
11	4	9.31	14.61	18.77	23	4	9.65	14.68	18.81	23	4	6.67	13.76	19.9	23
12	5	10.65	15.71	19.88	23	5	11.08	16.01	20.19	24	4	7.56	14.64	20.52	24
13	6	11.28	16.65	20.77	25	6	12.05	17.06	21.39	26	6	9.46	16.15	21.27	24
14	6	11.54	17.13	21.15	25	6	12.12	17.46	21.7	26	6	9.3	16.22	21.91	25
15	6	11.56	17.25	21.15	25	7	12.07	17.35	21.41	26	7	10.13	16.84	21.99	25
16	6	11.12	16.82	20.94	24	7	11.81	17.06	20.99	25	8	10.16	16.09	21.49	24
17	5	10.37	15.54	19.7	23	6	11.28	16.03	19.95	23	7	9.13	14.99	20.17	23
18	4	8.75	13.44	17.19	20	4	9.55	14.16	17.94	21	5	7.19	13.44	18.45	21
19	3	8.02	12.46	16.17	19	3	8.3	13.24	16.95	20	4	6.27	12.47	17.46	20
20	2	6.75	11.74	15.65	18	2	7.35	12.55	16.46	19	5	6.81	12.05	16.55	19
21	2	6.16	11.04	14.87	17	1	7	11.88	15.73	18	1	3.9	10.09	14.72	17
22	2	5.37	10.43	14.16	16	2	6.17	11.21	14.93	17	2	4.79	10.05	14.74	17
23	1	4.89	9.85	13.6	16	1	5.64	10.6	14.26	17	2	4.73	9.79	13.75	16
24	1	4.21	9.18	12.79	15	1	5.12	10.01	13.68	16	2	4.74	9.7	13.71	16

50 ACH

Study 34	Full					Conv					MC				
Fall	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	4	8.1	12.81	17.7	21	4	8.78	13.61	18.52	22	6	8.01	13.68	18.4	21
2	4	7.52	12.45	17.31	20	3	8.32	13.33	17.9	20	5	7.62	12.97	17.47	20
3	3	7.12	12.17	16.77	19	3	7.9	12.89	17.34	20	4	6.85	12.38	16.63	19
4	3	6.71	11.88	16.34	19	3	7.52	12.7	17.17	20	3	5.91	12.05	16.57	19
5	3	6.47	11.55	16.19	19	3	7.27	12.41	17.06	20	3	6.03	11.75	17.04	20
6	2	6.23	11.35	15.72	19	2	7.14	12.19	16.38	20	2	5.31	11.7	17.08	20
7	2	6.16	11.37	15.73	20	1	7.09	12.05	16.59	21	1	4.6	11.69	17.76	21
8	4	7.89	13.01	17.93	22	4	8.31	13.57	18.35	23	5	7.38	13.32	19.22	23
9	6	9.89	15.31	20.75	25	6	10.42	15.77	20.95	26	6	9.04	15.45	22.24	26
10	5	11.53	17.2	22.98	30	6	12.34	17.56	23.1	30	6	9.82	17.73	25.98	30
11	5	12.71	18.46	24.25	30	5	13.42	18.87	24.46	31	5	9.33	17.94	24.7	28
12	5	13.21	19.29	25.09	31	6	14.31	19.64	25.36	32	6	10.15	18.87	25.71	29
13	5	13.25	19.96	25.75	30	6	14.51	20.26	25.98	30	6	10.31	18.89	25.58	29
14	6	14.03	20.22	26.16	30	6	14.96	20.63	26.68	31	6	10.42	19.22	26.47	30
15	6	14.28	20.22	26.19	30	7	15.12	20.66	26.66	31	15	17.57	22.3	27.99	31
16	6	14.1	19.99	25.84	30	7	14.8	20.36	26.33	30	15	17.36	21.98	27.42	30
17	5	13.18	18.86	24.73	29	6	13.81	19.14	25.06	30	6	9.89	18.67	25.87	30
18	4	11.54	17.12	22.89	27	4	12.28	17.39	22.99	28	5	8.11	16.46	23.56	27
19	4	11.04	16.11	21.64	25	4	11.6	16.55	21.98	25	5	7.91	15.49	21.84	25
20	4	10.45	15.32	20.7	25	4	10.89	16.08	21.27	25	4	7.66	14.97	21.6	25
21	4	9.65	14.99	19.85	23	4	10.46	15.54	20.56	24	8	10.47	15.48	20.5	23
22	4	9.28	14.27	19.19	23	4	10.02	14.92	19.86	23	4	7.4	14.07	20.18	23
23	4	8.65	13.69	18.69	23	4	9.39	14.4	19.36	23	7	9.28	13.38	16.26	18
24	4	8.06	13.25	17.94	21	4	8.86	13.98	18.68	22	4	7.03	12.54	16.04	18

Study 34	Full					Conv					MC				
Spring	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	6	8.14	13.78	19.98	23	5	8.89	14.46	20.37	23	7	9.67	14.71	20.02	23
2	5	7.47	13.17	19.38	22	5	8.03	13.84	19.96	23	6	8.74	14.4	19.93	23
3	5	6.89	12.62	18.61	23	4	7.86	13.35	19.17	23	5	7.99	13.71	19.75	23
4	4	6.48	12.24	18.08	21	4	7.01	12.87	18.87	22	4	6.84	12.67	18.77	22
5	4	6.12	11.73	17.73	20	4	6.66	12.61	18.51	21	4	6.91	12.46	17.95	21
6	4	5.44	11.5	17.34	20	3	6.35	12.27	17.84	20	4	6.72	11.74	17.08	20
7	3	5.44	11.69	18.08	22	3	6.19	12.37	18.73	22	4	6.87	12.26	18.62	22
8	5	7.54	13.6	20.68	25	4	8.04	14.03	20.82	25	6	8.37	14.34	20.9	25
9	7	9.58	15.84	22.88	27	7	10.27	16.38	23.12	27	7	10.29	16.51	22.75	26
10	8	10.72	17.76	24.85	30	8	11.73	18.15	25.07	31	8	11.36	18.2	26.12	30
11	9	11.84	19.17	26.19	31	9	12.63	19.6	26.18	32	9	12.54	19.36	27.23	32
12	10	12.82	20.26	27.19	32	9	13.93	20.62	27.22	33	9	12.61	20.02	28.14	32
13	10	13.58	20.96	28.09	33	10	14.42	21.52	28.09	33	10	13.64	20.71	26.78	30
14	10	14.03	21.58	28.6	33	10	14.74	21.9	28.45	34	10	13.75	21.03	27.69	31
15	10	14.22	21.78	28.8	33	11	14.94	22.26	28.76	34	11	14.51	21.26	27.69	31
16	10	13.77	21.61	28.56	33	11	14.72	21.97	28.62	33	11	14.53	21.36	27.97	31
17	10	13.33	20.72	27.75	32	10	14.11	21.22	27.86	32	10	13.29	20.76	27.86	32
18	8	12.16	18.95	25.91	30	7	12.93	19.3	25.88	31	7	10.85	18.55	24.87	29
19	6	11.31	17.61	24.52	27	6	11.9	17.98	24.73	27	6	9.9	17.48	23.84	27
20	5	10.66	16.79	23.61	26	5	11.38	17.39	23.97	26	5	8.8	16.42	22.75	26
21	5	10.27	16.22	22.83	26	4	10.86	16.7	23.28	26	4	7.74	15.95	22.08	25
22	5	9.41	15.64	22.37	25	4	10.27	16.25	22.62	26	4	7.96	15.82	22.83	26
23	4	8.89	15.03	21.48	25	4	9.84	15.56	21.95	25	4	7.69	14.96	21.53	25
24	4	8.61	14.27	20.8	23	4	8.89	14.99	21.37	24	4	7.67	14.71	20.77	24

50 ACH

Study 34 Summer	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	10	13.8	18.27	21.56	25	9	14.28	18.8	21.89	26	9	12.18	18.39	23.31	26
2	9	13.33	17.91	21.02	25	9	14.01	18.44	21.62	25	9	11.8	17.73	21.78	24
3	9	13.04	17.59	20.69	24	9	13.53	18.09	20.98	25	9	11.85	17.38	21.63	24
4	9	12.58	17.18	20.28	23	9	13.28	17.83	20.82	24	9	11.69	17.33	21.63	24
5	8	12.38	16.94	19.86	23	8	13.12	17.54	20.49	24	8	11.02	16.76	21.43	24
6	8	12.37	17.05	19.86	24	8	12.96	17.46	20.29	26	8	11.04	16.7	21.43	24
7	10	13.2	18.04	21.66	25	9	13.79	18.45	21.75	26	9	12.51	18.06	22.36	25
8	11	14.21	19.61	23.75	28	10	15.02	19.99	23.67	29	11	14.58	20.33	25.09	29
9	12	15.02	21.23	25.61	29	11	16	21.47	25.44	30	11	15.49	21.74	26.82	30
10	12	15.66	22.5	26.9	30	11	16.9	22.72	26.81	32	13	17.1	22.97	27.91	31
11	12	16.35	23.61	27.98	31	11	17.59	23.81	27.93	33	14	18.26	24.04	28.94	32
12	12	16.78	24.45	28.87	32	12	18.16	24.63	28.78	34	15	18.79	23.98	28.3	31
13	12	17.18	25.15	29.61	32	11	18.51	25.25	29.57	34	11	16.16	23.89	29.6	33
14	11	17.58	25.52	30.11	33	10	18.91	25.66	29.98	34	10	15.52	24.06	29.81	33
15	11	17.61	25.62	30.31	33	10	18.91	25.73	30.28	35	10	15.62	24.34	30.51	34
16	10	17.4	25.24	30.46	33	10	18.64	25.53	30.23	35	10	14.94	23.38	28.65	32
17	11	17.15	24.6	29.75	33	10	18.23	24.9	29.71	33	10	14.79	23.07	28.3	32
18	10	16.53	23.47	28.63	32	10	17.53	23.76	28.5	33	10	14.46	22.34	27.43	31
19	10	15.71	21.74	26.52	30	10	16.43	22.05	26.58	30	10	13.72	20.94	26.34	30
20	10	15.24	20.87	25.29	28	10	15.85	21.14	25.35	30	10	13.5	20.43	26.04	30
21	10	15.01	20.27	24.59	27	10	15.39	20.51	24.69	29	10	13.01	19.38	24.51	27
22	10	14.52	19.71	23.85	27	10	15.15	20.11	23.91	27	10	13.23	19.5	24.6	27
23	9	14.22	19.17	22.98	27	9	14.91	19.6	23.24	27	10	13.22	19.41	24.32	27
24	9	13.93	18.75	22.51	26	9	14.44	19.2	22.74	26	9	12.27	18.43	23.33	26

Study 34 Winter	Full					Conv					MC				
	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max	Min	5%min	Aver.	5%max	Max
1	1	4.39	9.03	12.61	15	0	5.32	9.78	13.05	16	1	3.01	8.68	13.4	16
2	0	3.92	8.59	12.23	15	0	4.55	9.38	12.9	16	1	2.83	8.63	13.39	16
3	0	3.52	8.16	11.81	15	0	4.38	9.04	12.54	16	1	2.99	8.68	13.4	16
4	0	3.3	7.73	11.34	14	1	4.34	8.56	12.07	15	1	1.97	7.66	12.43	15
5	-1	2.75	7.39	10.92	14	0	3.82	8.26	11.81	15	1	2.05	7.69	12.4	15
6	0	2.31	7.14	10.72	14	0	3.21	8.05	11.63	15	1	2.08	7.72	12.44	15
7	0	2.13	6.89	10.56	13	0	2.9	7.66	11.42	14	0	2.45	6.97	10.76	13
8	1	3.69	8.29	11.93	15	0	4.25	8.89	12.34	15	1	2.91	8.41	12.65	15
9	2	6.03	11.05	14.83	18	2	6.37	11.21	14.91	18	2	4.31	10.56	15.43	18
10	3	8.22	13.36	17.36	21	3	8.68	13.83	17.9	21	3	5.79	12.62	17.89	21
11	4	10.01	14.72	18.81	23	4	10.09	15.26	19.45	24	4	7.66	14.75	20.89	24
12	5	10.54	15.65	19.75	23	5	11.23	16.27	20.33	24	5	8.41	15.42	21.13	24
13	6	11.28	16.37	20.58	24	6	12.07	16.99	21.12	25	6	9.33	15.71	21.07	24
14	6	11.32	16.99	20.95	24	6	12.17	17.5	21.75	25	6	9.57	16.47	22.11	25
15	6	11.65	17.17	20.99	25	7	12.1	17.49	21.62	26	7	10.02	16.39	21.85	25
16	6	11.08	16.79	20.87	24	6	11.88	16.86	20.99	25	8	11.02	16.94	22.37	25
17	5	10.45	15.56	19.7	23	6	11.16	15.91	19.85	23	7	9.13	14.99	20.17	23
18	4	9.03	13.54	17.43	20	5	9.31	14.16	17.94	21	5	7.19	13.44	18.45	21
19	3	8.02	12.63	16.41	19	3	8.37	13.28	17.08	20	4	6.27	12.47	17.46	20
20	2	7.14	12.03	15.79	18	2	7.45	12.62	16.55	19	5	6.81	12.05	16.55	19
21	2	6.18	11.34	15.08	17	2	7.14	11.99	15.81	18	4	5.61	10.99	15.68	18
22	2	5.56	10.63	14.44	16	2	6.32	11.41	15.07	17	3	4.81	10.07	14.75	17
23	2	4.91	10.09	13.75	16	1	5.89	10.85	14.56	17	3	4.96	10.37	14.63	17
24	1	4.58	9.41	13.08	16	1	5.32	10.23	13.8	16	3	4.75	9.71	13.71	16

Appendix C

Building input data as used by Quick

Study 26

Roof	
Area	11 m^2
Absorptance	75 %
Emissivity	90 %
Tilt Angle	0°
Type:	External
Bright:	No
Layers:	
Mild Steel	2 mm
Airspace ceiling	300 mm
Gypsum Plaster Board	20 mm

Surface 0	
Area	7.60 m^2
Absorptance	40 %
Transmittance	0 %
Orientation	0°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 1	
Area	8.64 m^2
Absorptance	40 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 2	
Area	9.63 m^2
Absorptance	40 %
Transmittance	0 %
Orientation	45°
Tilt angle	. 90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 3	
Area	8.64 m^2
Absorptance	40 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 4	
Area	2.02 m^2
Absorptance	17 %
Transmittance	64 %
Orientation	0°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Glass	3 mm

Floor	
Area	11.00 m^2
Exp Perimeter	13.3 m
Type	Ground contact
Layers:	
Carpet	5 mm
Cast concrete (l.w.)	150 mm

Study 32

Roof	
Area	10.9 m^2
Absorptance	75 %
Emissivity	90 %
Tilt Angle	0°
Type:	External
Bright:	No
Layers:	
Mild Steel	2 mm
Airspace ceiling	300 mm
Gypsum Plaster Board	20 mm

Surface 0	
Area	5.17 m^2
Absorptance	40 %
Transmittance	0 %
Orientation	0°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 1	
Area	9.08 m^2
Absorptance	40 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 2	
Area	9.07 m^2
Absorptance	40 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 3	
Area	9.08 m^2
Absorptance	40 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 4	
Area	3.90 m^2
Absorptance	17 %
Transmittance	64 %
Orientation	0°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Glass	3 mm

Floor	
Area	10.90 m^2
Exp Perimeter	13.2 m
Type	Ground contact
Layers:	
Carpet	5 mm
Cast concrete (l.w.)	150 mm

Study 33

Roof	
Area	8.40 m^2
Absorptance	75 %
Emissivity	80 %
Tilt Angle	0°
Type:	External
Bright:	No
Layers:	
Asphalt	10 mm
Airspace ceiling	300 mm
Gypsum Plaster Board	20 mm

Surface 0	
Area	8.25 m^2
Absorptance	75 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 1	
Area	7.70 m^2
Absorptance	75 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 2	
Area	6.35 m^2
Absorptance	75 %
Transmittance	0 %
Orientation	180°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 3	
Area	7.70 m^2
Absorptance	75 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 4	
Area	1.90 m^2
Absorptance	17 %
Transmittance	64 %
Orientation	180°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Glass	3 mm

Floor	
Area	8.40 m^2
Exp Perimeter	11.6 m
Type	Ground contact
Layers:	
Carpet	5 mm
Cast concrete (l.w.)	150 mm

Study 34

Roof	
Area	4.40 m^2
Absorptance	75 %
Emissivity	80 %
Tilt Angle	0°
Type:	External
Bright:	No
Layers:	
Asphalt	10 mm
Airspace ceiling	300 mm
Gypsum Plaster Board	20 mm

Surface 0	
Area	6.32 m^2
Absorptance	75 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 1	
Area	4.21 m^2
Absorptance	75 %
Transmittance	0 %
Orientation	90°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 2	
Area	4.43 m^2
Absorptance	75 %
Transmittance	0 %
Orientation	180°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 3	
Area	5.26 m^2
Absorptance	75 %
Transmittance	0 %
Orientation	45°
Tilt angle	90°
Bright	No
Shading	Specify
Type	Internal
Layers:	
Brickwork	110 mm
Air space resistance	50 mm
Brickwork	110 mm
Plaster	13 mm

Surface 4	
Area	1.05 m^2
Absorptance	17 %
Transmittance	64 %
Orientation	90°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Glass	3 mm

Surface 5	
Area	1.90 m^2
Absorptance	17 %
Transmittance	64 %
Orientation	180°
Tilt angle	90°
Bright	No
Shading	Specify
Type	External
Layers:	
Glass	3 mm

Floor	
Area	4.40 m^2
Exp Perimeter	8.4 m
Type	Ground contact
Layers:	
Carpet	5 mm
Cast concrete (l.w.)	150 mm

Appendix D

Chi-square test of two distributions

The two distributions compared here with the Chi-square statistic is given in the second and third column of the table. The first column give the temperature for which the occurrence is given. In the fourth column, the area under the distribution obtained by the Monte Carlo method was forced equal to the distribution obtained by the full simulation. This results in the number of degrees of freedom being one less than the total number of bins, or with 23 bins, the number of degrees of freedom is 22. The area of the full simulation curve is 910, or the total number of events. The second and fourth column was used to calculate the Chi-square statistic for each bin. The sum of this give the statistic for the two distributions, given by $X^2 = \sum_i \frac{(R_i - S_i)^2}{R_i + S_i}$ (Press, W.H., et al, 1992)

The value of the Chi-square statistic came to 40.53136. The incomplete gamma function for 22 degrees of freedom give the chance that the two distributions are from the same population as 0.00937, or 0,937 percent.

Temperature	Full	MC	MC, Area = Area Full	Chi-square
11	0	0	0	0
12	1	1.8E-06	0.001638	0.995097
13	1	6.94E-05	0.063154	0.825544
14	7	0.000791	0.719355	5.110077
15	10	0.002752	2.504684	4.492697
16	7	0.006543	5.95413	0.08444
17	26	0.01275	11.602318	5.512778
18	30	0.02196	19.983964	2.007063
19	37	0.034762	31.633784	0.419564
20	47	0.051587	46.943715	3.37E-05
21	44	0.070312	63.983829	3.698271
22	63	0.087495	79.620268	1.936845
23	72	0.101557	92.416688	2.535273
24	82	0.110977	100.98907	1.970526
25	92	0.114235	103.953668	0.729204
26	86	0.109855	99.967595	1.049074
27	95	0.097182	88.435529	0.234918
28	76	0.075629	68.822754	0.355696
29	70	0.051413	46.785921	4.61437
30	37	0.030749	27.981772	1.251558
31	19	0.01473	13.403845	0.966458
32	8	0.004287	3.901534	1.411366
33	0	0.000356	0.323869	0.323869
34	0	7.3E-06	0.006643	0.006643
35	0	0	0	0
			Total :	40.53136

Reference

PRESS, W.H., TEUKOLSKY, S.A., VETTERLING, W.T. AND FLANNERY, B.P., 1992, *Numerical Recipes in C*, Cambridge university press, Cambridge, 0-521-43108-5.