

Thermal Comfort at Middlebury College

Submitted by the Air Conditioning Committee: February 10, 2003

The Committee:

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The Charge:

1. To review the College's current guidelines on air conditioning the campus (from May 2001).
2. To establish general principles and priorities for air conditioning spaces across campus.

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I. General Framework for Thinking About Thermal Comfort at Middlebury College:

Thermal comfort can be defined as the range of temperatures whereby an individual wearing a normal amount of clothing for the season feels neither too cold nor too warm. Air temperature, humidity level, air movement and mean radiant temperature each factor into comfortable thermal conditions that fall within a “comfort zone” rather than a specific temperature, humidity level or air movement velocity. Activity level, clothing choices, and cultural and social background also impact one’s ability to adapt or acclimatize to greater ranges of temperature and humidity.

Vermont’s climate is classified as Continental Moist¹ meaning that summers are usually mild with moderate precipitation. The vast majority of summer days have temperatures in the 70’s and 80’s. The few days reaching into the 90’s can be accompanied by high humidity. With the exception of a 10-20 day period in July and August, exterior temperature and humidity levels tend to be within acceptable thermal comfort ranges. While outside temperatures may rise into the eighties and low nineties, these hot days are normally accompanied by relatively cool nights that allow for the dissipation of heat into the atmosphere.

Middlebury’s Thermal Comfort Policy is designed to achieve a productive environment for learning and working, while responsibly addressing economic and environmental factors. The college’s priority for the cooling of spaces is to employ natural ventilation techniques and behavior changes whenever possible. Supplemental use of mechanical devices will be considered only when absolutely necessary. Through effective new building design and retrofits to existing structures - via building orientation, well-insulated envelopes, and devices to limit summer solar radiation intrusion (e.g. window shades) - the College is committed to minimizing the need for future mechanical cooling systems.

II. Middlebury College Thermal Comfort Policy:

A. Natural Cooling Measures:

1. General Guidelines:

Middlebury College recognizes that thermal comfort is important for both health and productivity of its students, faculty, and staff. During sustained period of high heat and humidity (defined here as two or more consecutive days of outside temperatures above 90° Fahrenheit and relative humidity of over 60 %) certain measures may have to be taken to protect the health of students, faculty, and staff as well as to create a minimum thermal comfort that enables the campus community to work effectively. Of these measures air conditioning is the most costly solution in terms of both real dollars and environmental impact.

¹ Cf. Kieran Timberlake Associates *Building Environmental Control Strategies*. Philadelphia, PA, 2000.
Vermont State Climatologist *Primer on Weather and Climate*
http://www.uvm.edu/~ldupigny/sc/climate_vermont.html
http://academics.smcvt.edu/vtgeographic/textbook/weather/weather_and_climate_of_vermont.htm

The College commits to retrofitting existing spaces with heat load reducing mechanisms prior to introducing mechanical cooling to a space. The College will use mechanical intervention for cooling and humidity control only when natural methods and retrofits to minimize solar radiation intrusions and other heat created by equipment, machinery and human activity are proven to be inadequate on an on-going basis.

Examples of natural methods and retrofits could include:

- Effective window shades
- Awnings (although this may not be aesthetically appropriate)
- Installed ceiling fans
- Improved cross ventilation
- Improving external fresh air flow into closed interior spaces

We recommend that any future construction as well as any building renovations be undertaken on the basis of the principles laid out in this document and that the feasibility of alternate cooling measures be considered in the planning and design stage. (Cf. *Designing the Future: A Framework for Implementation of Sustainable Design and Construction Standards for Middlebury College, 2002*).

2. Measures to Increase Thermal Comfort During Sustained Periods of Extreme Heat:

The College encourages supervisors to exercise flexibility in assisting employees in finding adequate working conditions during periods of extreme heat.

During such periods:

- A “relaxed dress code” will be in effect. All college staff, as well as faculty and students are encouraged to wear light, well-ventilated, appropriate attire.
- Wherever possible, flexible work schedules should be implemented, allowing employees to report to work 1-2 hours early² and leaving earlier to avoid the maximum heat period during the middle and late afternoon.
- Wherever it is not imperative that staff remain at their desks at all times, supervisors will permit them to take their work and move to a “cool area” - a naturally cooled or air conditioned space either in the same building or in a proximate one. Similar “cool areas” will be established in, or proximate to, student dormitories and classroom/office buildings.

² We recognize that faculty and staff with working spouses and small children may not always be able to take advantage of this policy. However, the committee felt that, the gain in flexibility for all (which might include this group as well if the necessary childcare arrangements can be made) outweighed the problem of inequity for some.

- Employees working in spaces that cannot be cooled by using natural cooling methods and fans (e.g. because they have no windows or no or inadequate cross-ventilation) and where installing air conditioning units is not a reasonable option will be permitted to take an extra morning and afternoon break in a “cool area”. On rare and extreme occasions, should the temperature in such a space rise to a point where productive work is no longer possible, and the worker(s) impacted cannot move to cooler work areas, supervisors should dismiss affected employee(s) after midday under these extreme conditions and report this occurrence to Human Resources. Human Resources will then bring this to the attention of Facilities Management. In these cases employees will not be required to use CTO time. The committee acknowledges that there will be certain exceptions to this recommendation, due to the critical nature of particular employees’ job functions which does not allow them to leave their post.
- All offices that are not air conditioned will be supplied **efficient** floor, window, oscillating, and/or ceiling fans, as well as blinds or shades upon request. Facilities Management will determine which cooling method is most efficient for each space.
- The designated sections of the air conditioned dining areas should be made available all throughout the day for studying, if needed.

B. Air Conditioned Spaces:³

1. General Guidelines:

³ Currently, there are no laws or regulations specifying thermal comfort temperature or humidity set points in Vermont. Instead, there are guidance documents for energy efficient commercial construction and for spaces with inoperable windows. Middlebury College follows these reference guidelines for all any new construction project that requires air conditioning pursuant to the stipulations established in this policy.

In addition to meeting the minimum energy performance standards detailed in Vermont’s current commercial building energy standards, this Thermal Comfort policy also references guidelines provided by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). Standard 55-1992, Thermal Environmental Conditions for Human Occupancy specifies conditions in which 80% or more of the occupants of a building will find the environment thermally acceptable. Table 1 shows the suggested ranges of temperature and relative humidity during the summer within the thermal comfort zone. For those spaces on campus cooled by mechanical air conditioning units, the cooling temperature will be maintained within the range of 73°F - 80°F, based on this ASHRAE standard.

Relative Humidity	Summer Temperature
30%	74.0° F- 80.0° F
40%	73.5° F- 80.0° F
50%	73.0° F – 79.0° F
60%	73.0° F – 78.5° F

The College will use mechanical cooling for cooling and humidity control only when natural methods and fans are proven to be inadequate.

The air conditioning set-point will be 78° Fahrenheit.

As of January 2003, Middlebury College uses mechanical means to fully air condition eight buildings and partially air condition approximately thirty other buildings. In recognition of the historical infrastructure of the campus and that many of these buildings are poorly oriented to benefit from prevailing winds, and are not designed to maximize thermal comfort, some additional mechanical cooling may be necessary as the College continues to develop its summer schools.

Mechanical cooling (air conditioning) in existing structures as well as renovations to or construction of future buildings is restricted to the following categories:

- Laboratories or parts thereof that cannot function without a controlled environment (including animal labs).
- Large scale computer, printing, radio and other electronic equipment rooms. These kinds of rooms may need cooling both to enable people to work in an area where excess heat is generated by multiple pieces of equipment and to ensure that the operation of the equipment itself is not negatively impacted by excess heat.
- Special collections of books, films, photographs and art as well as musical instruments sensitive to changes in humidity or temperature.
- Certain academic, social, and dining spaces (including Ross, Atwater, and FIC) used regularly by the College during the summer, where function and equipment makes natural ventilation techniques impractical.
- Prime summer study locations capable of comfortably accommodating a large number of students, faculty and staff (BIH, The Grille, Library), once it has been established that other measures are not sufficient in cooling down the room to a reasonable temperature.
- Classrooms, study lounges, and work spaces where the thermal comfort zone is exceeded on an ongoing basis.
- Spaces where natural ventilation is impacted by construction noise and dust, or exaggerated and on-going external noise clearly impacts occupant productivity. (Such spaces will be considered as requiring temporary mechanical cooling, which will be discontinued with the cessation of the external impact)

2. Policy on Air Conditioning College Spaces:

2.1. Residential Spaces:

Residential space will not be air conditioned except for those accommodations approved by the American with Disabilities Act (ADA) Committee and/or the standing Air Conditioning Committee.

Students or faculty of the Summer Language Schools, as well as their family or guests may not bring and install their own window units except for units installed for health reasons as

certified by the ADA Committee or the standing Air Conditioning Committee based on consultation with the college physician where necessary.⁴ This restriction is necessary since the purchase of the unit does not pay for either the operating costs or the environmental damage caused by it. Most importantly, the existing electrical wiring in some of Middlebury's older buildings may not support the load increase caused by large numbers of window units. Window units installed without permission will be removed by Facilities Management.

In the event that nearby construction or noise makes it unsuitable to open windows in the summer months, window air conditioning units will be considered. Permission to use these units is restricted to the time construction is ongoing and does not extend beyond this period or into any of the following summers.

2.2. Classrooms and Lecture Halls:

The College is committed to providing a thermal controlled learning environment. Classrooms and lecture halls that cannot be sufficiently cooled down by means of natural ventilation and fans will be air conditioned as deemed necessary by Facilities Management and the Dean of the Language Schools. In addition, the College provides "cool areas" for study and recreational purposes.

Currently, approximately 75 percent of the of classrooms used by the Summer Language Schools are air-conditioned. The vast majority of summer classes meet during the coolest times of the day (i.e., before noon). As such, the afternoon demand for cooled spaces is diminished, and an abundance of academic space is therefore available for independent study. These spaces include Bicentennial Hall, Twilight Hall, Ross and Atwater (upon completion) Commons dining halls, libraries, lounges, and seminar rooms, the new Library (upon completion), Sunderland, the CFA, Johnson, and Starr Library, as well as those classrooms that are equipped with summer window units as identified by the Dean of the Language Schools.

2.3. Staff and Academic Offices:

In general, office spaces will not be air conditioned. The exceptions to this are those offices that are in a building with central air conditioning, or those offices that meet the specific criteria (i.e., equipment, construction, etc.) identified above. Offices that are not currently air conditioned will be surveyed by Facilities Management over the next 12 months to assess what additional non-air conditioning measures could be added to these spaces (i.e., improved shades, ceiling fans, etc.) to improve thermal comfort. Spaces that have been air conditioned with window units in past summers will be reassessed to ascertain if air conditioning is absolutely necessary or if other means of cooling may be sufficient.

⁴ The ADA Office currently owns three air conditioning (A/C) units that are provided to students on a first come/first served basis after the certification process has been met. These units, as well as any additional units purchased by students based on ADA certification will have to be installed by Facilities Management to adhere to College policy and must meet the standards for energy efficiency set by the College.

Academic and office spaces with central air conditioning will be enabled to operate only during the summer language school months of June, July, and August (except for spaces with inoperable windows, such as Bi Hall). The cooling temperature will be maintained at a range between 75° F and 80° F with a target cooling temperature of 78° F. Exceptions will be made only for the purpose of using central air conditioning to protect equipment and collections, as outlined above.

Faculty or staff of the Summer Language Schools, may not bring and install their own window air conditioning units except for units installed for health reasons as certified by the ADA Committee or the standing Air Conditioning Committee based on consultation with the college physician where necessary⁵ This restriction is necessary since the purchase of the unit does not pay for either the operating costs or the environmental damage caused by it. Most importantly, the existing electrical wiring in some of Middlebury's older buildings may not support the load increase caused by large numbers of window units.

2.4. Social and Recreational Spaces

Many of the social and recreational spaces on campus do not need to meet the same comfort criteria as academic and office spaces since the use of such space is voluntary. Those social and recreational spaces equipped with central air conditioning will be enabled to operate only during the summer language school months of June, July, and August (except for spaces with inoperable windows, as well as some dining halls where air conditioning may be needed for very hot days in September). The cooling temperature will be maintained at a range between 75° F and 80° F with a target cooling temperature of 78° F. If social and recreational spaces are centrally air conditioned due to unacceptable heat loads from building machinery, the chillers will operate based on outside temperature. A temporary air conditioning unit will only be considered to cool social and recreational spaces if nearby dust or noise from construction makes it unreasonable to open windows during the summer months.

III. Policy Implementation

Facilities Management will oversee the implementation of Middlebury College's Thermal Comfort policy. Facilities Management and the Office of Environmental Affairs will maintain a web page on strategies for keeping oneself and one's workspace or residential space cool during summer's hottest days. For areas that are currently not air conditioned, Facilities Management will seek to employ measures to minimize the solar and mechanical heat load of the building as discussed above. Mechanical cooling will be considered only after room and ceiling fans, insulation, shades, awnings, and security measures for nighttime air flushing prove ineffective in lowering the temperature to the thermal comfort zone defined by ASHRAE. It is the responsibility of those impacted by unreasonable thermal conditions to report such situations to Facilities Management either directly or through one's supervisor, faculty or language school coordinator.

⁵ Units purchased by faculty or staff based on ADA certification will have to be installed by Facilities Management to adhere to College policy and must meet the standards for energy efficiency set by the College.

Air conditioning will be considered only after room and ceiling fans, insulation, shades, awnings, and security measures for nighttime air flushing prove ineffective. Special consideration should be given to those employees who cannot leave their post even during periods of extreme heat because their job function is critical to the operation of the college.

For spaces that are centrally air-conditioned, the temperature and humidity in the space will be controlled by Facilities Management. For spaces with manually controlled window air-conditioners, occupants will be requested to comply with set-point limits identified by Facilities Management (78° F) as well as good practices (i.e., when the unit is on, other windows are shut and window shades drawn). In special cases, window units may be hooked up to the central control system and regulated directly by Facilities Management.

Requests for accommodation from students based on a qualifying disability should be submitted to the ADA Coordinator and should be in accordance with the ADA Policy at Middlebury College. All requests of this nature will be reviewed by the ADA Committee who shall determine the student's eligibility for accommodations under the ADA. Permission to operate a window air conditioning unit based on a qualifying disability will require the support of the ADA Committee which may require a medical consultation between the student's health care professional and the college physician. If both requirements are met, the ADA Coordinator, in consultation with an appointed member of the standing Air Conditioning Committee, will determine and facilitate with the appropriate accommodation.

Requests for accommodation from students based on a medical need that does not fall under the ADA guidelines should be submitted solely to the standing Air Conditioning Committee. These requests must be accompanied by a letter from a qualified physician documenting 1. the special medical condition requiring constant air conditioning in a climate like Vermont's (with a typical maximum of no more than 5 consecutive days of extreme heat each summer), 2. an explanation of the medical need for constant air conditioning along with an explanation of the medical dangers incurred if air conditioning is not provided, 3. the expected duration of the medical condition, and 4. plans for reassessment of the medical condition at a future date (if the student is returning to campus for more than one summer). The standing Air Conditioning Committee, or an appointed member of the committee, in consultation with the College Physician, will then determine if there is a documented medical need, and, if there is, facilitate with the appropriate accommodation.

The standing Air Conditioning Committee reserves the right to ask the person making the request to obtain a second medical opinion from another qualifying physician at the requestor's expense.

Requests from faculty and staff should be submitted to the Associate Director of HR for Employee Relations and Development. The Associate Director of HR, in consultation with an appointed member of the standing Air Conditioning Committee, will determine the appropriate accommodation.

All requests for air conditioning based on these or any other contingencies not covered in this report will be adjudicated on a case-by-case basis by the standing Air Conditioning Committee consisting of one of the Associate Deans of the Faculty, the Director of Facilities Management and the Operations Manager of the Language Schools, who will make their decisions in

consultation with the College Physician (as needed), the Director of Environmental Affairs and the Director of the Budget Office.

IV. References:

Canadian Centre for Occupational Health and Safety *Thermal Comfort for Office Work*
http://www.ccohs.ca/oshanswers/phys_agents/thermal_comfort.html

Kieran Timberlake Associates *Building Environmental Control Strategies*. Philadelphia, PA, 2000.

The University of New South Wales *Administration Manual-Air Conditioning* Sydney, Australia, July 2001. <http://www.infonet.unsw.edu.au/poldoc/admax/aircop20.htm>

The University of Sydney Air Conditioning Policy, 1 July 1999.

V. Appendices:

Map of air conditioned spaces

List of air conditioned spaces

Appendix I: List of Buildings with Air Conditioning Summer 2002

Fully Air Conditioned

Atwater Dining (planned)
Bicentennial Hall
Center for Educational Technology
Center for the Arts
Fletcher Bubble (planned)
Kirk Alumni Center
Library (planned)
Ross Dining

Partially Air Conditioned Spaces*

Adirondack House	Mead Chapel
Allen Hall	Munroe
Battell Halls	Old Chapel
Carr Hall	Painter House
Chateau	Pearsons
Emma Willard	Proctor
Freeman International Ctr	Robert A. Jones House
Forest	Service Building
Hadley House	Starr Library
Hepburn Hall	Stewart
Hillcrest	Sunderland
Johnson Memorial Building	Twilight
Kenyon Arena	Voter
LaForce	Warner
McCullough	Wright Theater

* The Language School has approximately 50 window air conditioning units that they use in classrooms and study lounges across the campus during the summer. From year to year, depending on need, the units are located in different rooms and buildings. In addition to this use, small air conditioning systems are present in specific buildings across the campus to protect collections and equipment, or to provide “cool areas” for the college community.