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*Cover image of Peter Lax courtesy of the NYU Office of Public Relations.*

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# How to Design a Mathematics Building

*By Brian Birgen*

At Wartburg College, we recently underwent an expansion and renovation of our science building. The Becker Hall of Science was built in 1967 and housed the Biology, Chemistry, Physics, Computer Science, and Mathematics departments. Throughout the renovation process the faculty worked with the architects and consultants to help design optimal teaching and research space. However, when preparing for discussions with the architects, we found very little literature specifically addressing designing a mathematics building.

Often mathematics gets included in the science building, but the unique demands of a mathematics department are frequently overlooked by consultants. While many of the other sciences require expensive laboratory equipment, the mathematics department is cheap by comparison and gets less attention during the design phase. The purpose of this article is to address the characteristics of a well designed math building for faculty faced with this task in the future.

**Study Space**

Fundamental to a mathematics department is the existence of places for students to congregate and study. Mathematics thrives on an exchange of ideas, and there must be places available for students to meet and work. Furthermore, the lounge needs to be centrally located to increase the likelihood of random encounters. In this setting faculty are more likely to happen upon students working and offer a word or two of direction or encouragement. Students are more likely to recognize colleagues from class working on assignments and join in.

A well equipped lounge will have chalkboards or whiteboards on which students can do their work. This allows multiple students to work together and also encourages students to separate the process of solving a problem from that of writing up the solution. An open space will help bring more people into the lounge by removing barriers to entry. This also decreases the chance that the lounge will be converted into a classroom or office at some later date.

*The central study area at the Wartburg College Department of Mathematics*

*The classroom with a group work arrangement.*

In addition to a central lounge, having many other spots where small groups can gather for a quick discussion is beneficial. At Rockhurst University, for example, the hallways are lined with benches; students waiting for classes to start have a place to sit and read before class, and teachers have a place to continue a conversation with a student after class. During the design phase, keep in mind that to increase the amount of mathematics done, one must increase the amount of interaction among its practitioners.

**Office Space**

There are a variety of ways in which mathematicians use their offices, which results in a variety of opinions of how offices should be designed. For some the focus is to bring students into faculty offices, while for others the goal is to get professors out of their offices working together in a common area. Still others want their office to be a place of quiet repose where work can be done. One must try to find a design that can serve all of these needs.

Common to all is the need for offices to be centrally located, ideally around a common study lounge. When offices are close together, there is increased interaction among faculty and more mathematics is done. At institutions with a graduate program, graduate student offices should be mixed together with faculty offices. At the University of Michigan, offices are in clusters of five with faculty in three of the offices and graduate students filling the other two. This facilitates the finding of an advisor, increases the interaction between student and advisor, reminds advisors of the teaching demands on graduate students, and produces other beneficial side effects.

It is also important that future growth be taken into account when planning office space. If the offices are centrally located except for one or two which were added later, there is a danger of departmental fragmentation, isolating the faculty away from the central hub. (This is

particularly likely if those faculty members are shy or have the tendency to focus only on their own work.) For this reason it is a good idea to include a small classroom or seminar room among the offices which could be converted into an office in the future.

Ideally the offices should be places which enable both research and teaching. There should be space for individual academic advising and small group interaction, but there also needs to be room for faculty to work on their own research topics. At Kenyon College the offices were designed with a partition in the middle of the room, dividing the space into a research area and a teaching area. This enables faculty to have projects in various stages of completion and to meet with students in a separate area. No matter how it is accomplished there needs to be enough room in the office for advising students without first putting away existing research projects.

**Classrooms**

The most important factor to consider when designing a classroom is flexibility of the teaching environment. The same classroom should work equally well for a lecture as it does for working in small groups. Teaching techniques are continually being refined and revisited, so this flexibility is crucial. It is best accomplished through appropriate choice of furniture. At Wartburg College the classrooms are equipped with small two-person tables which can be moved to form squares for groups of four or can be placed in rows for a traditional lecture. This gives faculty much more control over the learning environment and the ability to adapt the room to the needs of the students.

Technology should be built into the room, yet unobtrusive. There should be a built-in projector and the ability to easily connect a laptop computer to the system. Technology can add a great deal to the teaching process, both for demonstration and as a computation tool. However, if the process for using the technology is unnecessarily complicated, faculty will be discouraged from trying new things. The computer system in a classroom should be quick and easy to start up and use. USB ports for easy plug-in and internet connectivity to appropriate websites are a must for classroom technology.

Perhaps the greatest source of controversy for mathematicians is the split over chalkboards and markerboards. Most math faculty are used to teaching with chalkboards and the cost of chalk is significantly less than the cost of markers. It is much easier to use color on a markerboard and the amount of dust produced is significantly less. At Wartburg, we decided to create rooms that have both: markerboards at each end and a chalkboard at the front. Due to the flexible seating, faculty can chose which they use by having the students turn their tables to face one wall or another.

There are other issues which one must attend to in order to effectively incorporate technology into the classroom. For example, rather than center the projector on the wall, it can be offset to one side, so there is room to use a chalkboard next to the projector screen. Even better, the projector can be aimed at a markerboard so that the instructor can draw on what is being projected — this is especially good for drawing flow lines on a vector field. This is an area where creativity and vision will continue to find new ideas for the classroom.

**Computer Labs**

Even with an increased emphasis on wireless technology and laptop computers, there continues to be a need for computer labs. They can serve as a place where students can access specialty software like Mathematica, Maple or Minitab or as a classroom where a professor will lead students through hands-on activities; either way, they are essential. These rooms will not have the same level of flexibility as a classroom — complete rearrangement of the tables is hard with all the computers and cables in the way — but should still be capable of supporting group work as well as lecture as needed. Group work can be facilitated by providing plentiful desk space for each computer and raising the computer monitor so that more students can view it at a time. Additional table space away from the computer is helpful for supporting lectures.

At Wartburg the computer labs are frequently used during only a portion of class time. An instructor might relocate all of the students into the computer lab for the second half of the class period. For this reason each of the computer labs has a classroom next to it, with the doors only a few feet apart. This allows for a quick move from one room to the other, without any students getting "lost" along the way.

**The WOW Factor**

Finally, a math building needs some identifying characteristic so that anyone entering will immediately know that this is not the English department. There are many examples of details that can be added to make for a special space that mathematicians can call home. Most mathematicians are familiar with the sculptures of Helaman Ferguson which display the inherent beauty of mathematics. At Meredith College the floor of the atrium has a Penrose tiling which was designed by two students and a faculty member. At Central College the floor has a large sine wave down the hallway. Carleton College boasts an outdoor chalkboard where professors can relocate class outside on especially nice days. There should be some way to identify your building where the mathematicians can be found.

In summary, when designing a math building the focus should be on enabling its inhabitants to interact more readily with each other. Learning space should be flexible and technology should fit in naturally. And finally, a math building should showcase the beauty and uniqueness of mathematics for the entire world to behold.

*Brian Birgen teaches at Wartburg College.* *He thanks Russell Goodman, Ruth Gornet, Jill Guerra, Jennifer Hontz, Thomas Hull, Sarah Merz, Gail Ratcliff, Carol Schumacher and others for their contributions.*