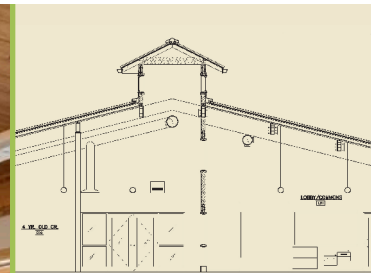


# Innovations in Wood: Duke Lower and Middle Schools


**PROJECT/OWNER:**

Duke School

**LOCATION:**

Durham, North Carolina

**COMPLETED:**

2009

**BUILDING AND OCCUPANCY:**

Type VB, Educational Occupancy

**DESIGN ARCHITECT:**

 Fielding Nair International /  
DTW Architects & Planners

**ARCHITECT:**

DTW Architects &amp; Planners

**STRUCTURAL ENGINEER:**

GKC Associates

**MEP ENGINEER:**

Edmondson Engineer

**BUILDER:**

CT Wilson Construction Company

**LANDSCAPE ARCHITECT:**

Coulter Jewell Thomas PA

**ACOUSTICS:**

Dewey Lawson

## An enriching space that balances cost, functionality and environmental objectives

When DTW Architects & Planners and Fielding Nair International signed on to design Duke School, they faced the same challenge school boards and design teams face across the country: how to balance cost, functionality and environmental objectives while creating an enriching space that inspires learning. The response from students, teachers and the community is a testament to their achievement.

“To create a positive learning environment, we used exposed wood as the main design element,” said DTW’s Robert Sotolongo, AIA, LEED AP. “The warm color palette of the natural wood structure and finishes complements the informal and open educational philosophy of the school, and the open floor plan allows the use of wood to unify the design. We’ve taken tours of people back to the school and the comments I get from students and teachers are always gratifying—everyone loves the exposed wood.”

Duke School is located adjacent to the Duke Forest, a 7,000-acre forest used for research and education by the Nicholas School of the Environment at Duke University, Duke School, and the Durham community. In addition to creating a sense of harmony with the outdoor environment, one of the design objectives was to expand the concept of learning to the school itself by exposing the structural and mechanical systems and making the solar hot water system, rain gardens with cisterns, and daylighting techniques all visible.





Photos: Jerry Markatos,  
courtesy DTW Architects & Planners

In the early design phase, several structural systems were analyzed and the combination of a glued laminated (glulam) timber structure and wood stud walls proved to be an economical option for most of the new construction. Overall, the project included three new wood-frame middle school buildings, two new wood-frame lower school buildings, the renovation of four existing lower school buildings and a new steel-frame gymnasium, for a total of 79,204 square feet.

Glulam columns, girders, purlins and arches comprise the main structural frames, while exposed tongue-and-groove wood roof decking is used as a design element. Other wood features include exterior walls comprised of wood studs with plywood sheathing, interior walls featuring wood studs with pressure-treated wood floor plates, and wood windows clad with aluminum.

### Cost and Constructability

Of the five new wood buildings, the two lower school buildings averaged \$130 per square foot while the three middle school buildings averaged \$112 per square foot.

Among its cost advantages, wood can be locally sourced and tends to be delivered quickly, and most communities have a large pool of qualified tradespeople, which minimizes construction delays and keeps labor costs competitive. Wood's ease of use also translates into faster construction schedules, while a smaller foundation may be needed because of its light weight.

Adaptability is also a consideration. For example, Duke School was designed with an area adjacent to the art room and covered in canopies for outdoor learning. However, a year after the school was completed, the owner decided that the indoor art room needed more capacity. It was a relatively easy fix to move the outside wall to the edge of the canopy.

At the same time, there are challenges in the design of any building. For Sotolongo and his team, the desire for large, open rooms dominated by exposed wood decking created an acoustical challenge. "At first we planned to use dropped acoustical ceilings in select areas, but the owner loved the wood so much we changed our minds. We put down carpet, which helped, but if you have reflective walls and your ceiling is also reflective, you need multiple ways to absorb sound. We ended up suspending ceiling baffles in select areas, which did double duty because both sides are exposed. We also constructed some wall panels, essentially wood framing with batt insulation covered with fabric, which turned out to be a cost-effective solution."

Although maintenance of the outside columns and canopies was an early concern, it proved not to be an issue. The glulam columns and beams were pretreated and a preservative was effectively applied a year after construction.

### Creating a Positive Learning Environment

Although budget was important, Sotolongo says the number one reason for using exposed wood was the aesthetic and, more specifically, how the warmth and beauty of wood could influence students.

The term biophilia describes the instinctive connection and attraction people have to natural materials, and Sotolongo is not the only designer to cite the warm and natural attributes of wood as a reason for its use. Evidence also suggests that the use of natural materials can contribute to an individual's sense of well-being.

For example, a study at the University of British Columbia and FPIInnovations found that the presence of visual wood surfaces in a room lowered activation of the sympathetic nervous system (SNS), which is responsible for physiological stress responses in humans. Study author David Fell says that research on schools is underway, but the results of the study apply to any interior environment. "The stress-reducing effects we found for wood in office environments are in theory transferable to any building type as these are innate reactions to natural materials."

### Environmental Performance

Although Duke School did not pursue green building certification, sustainability was a stated design objective that was met in part by the use of wood.

Wood is the only major building material that grows naturally and is renewable, and Duke School utilized Southern Yellow Pine from local, sustainably managed forests. Life cycle assessment (LCA) studies also show that wood has environmental advantages over other common building materials in terms of embodied energy, air pollution and water pollution.<sup>1</sup> In terms of operational energy, the wood building system also allowed for high insulation values in the exterior building envelope. According to Sotolongo, "the combination of a thermal building envelope, daylighting, occupancy sensors, solar hot water system, high 19 seer heat pumps, HVAC system and other elements allowed the facility to achieve a 25 percent reduction in energy use compared to typical schools."

