CONCEPTUAL COMPONENTS
AMIE’s final form—designed by SOM in collaboration with Rose and ORNL—echoes elements found in the student projects.

For instance, the shell group created a series of printed rings, representing walls, ceiling, and floor, which could be joined to form the structure’s open, unsupported interior. AMIE features ten of these interlocking rings, each formed from two C-shaped components joined top and bottom.

The origami group proposed a partially collapsible structure with louvered sides like the bellows of an accordion. AMIE’s louvered sides have inset windows that can be positioned to allow penetration of warming sunlight in colder climates. For warmer climates, the structure can be oriented to block sunlight. The origami group also conceived a central interior island with a sink, dishwasher, stove, microwave, refrigerator, and bed.

Although the work of the bone group does not apply directly to the final design, it may yet influence future 3-D-printed architecture. “Often, students haven’t learned yet that something is impossible,” Rose said. “And they go on to demonstrate a new way of looking at a problem.”

One of 3-D printing’s limitations is the inability to print unsupported horizontal structures because the thread of molten plastic will collapse before it can harden. The bone group solved the problem by printing a barrel arch that leveraged the print head’s ability to deposit material at a 40-degree angle. The structure’s walls incrementally gained thickness with each pass until they joined at the center of the interior space.

SOME ASSEMBLY REQUIRED
Parallel to the student work, architects from SOM completed the final design and delivered it to ORNL as a computer file. All of AMIE’s parts were formed by layering building material—a polymer blended with 20 percent carbon fiber—extruded from ORNL’s big area additive manufacturing printer’s print head.

The composite parts were then transported to Clayton Homes in Andersonville, Tennessee, for assembly by 3-D printing. The two C-shaped components joined top and bottom to form the structure’s open, unsupported interior. AMIE features ten of these interlocking rings, each formed from two C-shaped components joined top and bottom.

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WHAT’S NEXT?
Architecture is an iterative process, and successful practitioners look into the future even as they glance back at the past. Barrel arches, for example, trace back to the Roman Empire. But the students were able to use a novel building system to give the arch new expression.

Architecture is also an additive process—like 3-D printing itself—ever building on past innovations. Rose’s Governor’s Chair studio is already devising the next phase of AMIE’s evolution: individual 3-D-printed modular rooms that will snap together like Lego bricks and stack to create high-density housing. As for the configuration and features of the rooms themselves—including 3-D-printed fixtures and even furniture—the decisions would be left up to the occupants. From a design perspective, 3-D printing enables a shift from mass production to mass customization.

“With 3-D printing, there’s no penalty in cost or materials for printing every part differently,” Rose said. “And 3-D printing also liberates architects from the hard edges imposed by traditional building materials and allows them to create fluid lines.”

Granted, it’s a large leap from miniature snap-together rooms to a habitable apartment building. But even Christopher Wren began St. Paul’s Cathedral with a scale model and a vision.

For more information about AMIE, visit tiny.utk.edu/amie.