In 1989, Sweden housed a cylindrical igloo made of ice to showcase a gallery of artwork. When visitors boldly spent the night in the igloo, the idea for an ice hotel was born. The following winter, an actual hotel was built in Jukkasjärvi, Sweden, based on this ice igloo, where guests could stay overnight in bedrooms constructed of ice and snow [3]. Since Quebec, Canada, is known as the snow capital of the world, it is only appropriate that for four months of the year, it houses an ice hotel as well. The Ice Hotel, modeled closely after the Swedish ice hotel, is constructed in November and December, once the temperatures and sun drop in intensity. 12,000 tons of snow and 400 tons of ice from nearby lakes are packed, shaped, and built into a hotel, featuring a chapel, nightclub, hotel rooms, and many other amenities [2]. Ice Hotel was designed as a predominantly social structure, though it is an engineering masterpiece and a piece of structural art in its planning and fabrication.

The Ice Hotel is a very structurally sound work during the four coldest months of the year it is open, January through April. There is a simple floor plan, with small rooms located alongside long corridors, while the walls and ceilings consist of gothic archways, peaking at 18 feet and enclosing 30,000 ft² of snowy ground. The walls of the hotel are four feet thick and are formed by tightly packing snow, then tunneling through to dig out the hallways. In addition to supporting the upper sections of the arched ceilings, the walls first must support their own weight of heavy snow [2]. They are slightly tapered outwards at the base to better distribute the vertical forces and avoid problems encountered when designing and constructing solid masonry columns such as the Washington Monument. These walls and arches must also be sturdy enough to resist horizontal wind forces, which is difficult because the broad outside walls have such great surface areas. During construction, workers check these walls and arches for cracks in the packed snow foundation, making repairs and packing additional snow onto the surfaces if necessary. Since the hotel is constructed solely of ice and snow, it must also resist melting from the inside and out. Though the interior of the hotel remains between -2°C and -5°C, the lack of wind inside
the corridors makes staying inside the hotel bearable since no internal heaters may be used [1]. It closes in April for this reason, as the sun begins to shine and gradually weakens and destroys the building.

To provide additional strength to the self-supporting vaulted ceilings, columns made of stacked ice blocks are positioned in interior hallways to prevent collapse and carry vertical loads [2] (see figs. 1, 2). Forces also travel along the arches and through the walls to the ground, but safety is important so extra support is sometimes necessary. Walls at the ends of halls are constructed of stacked ice blocks as well, so that light can illuminate the hallways without opening the corridor to the outside winds and weather (see figs. 3, 4). These ice walls also support the arches and resist wind with less material than if additional snow walls were constructed, making the structure more efficient.

The Ice Hotel is constructed each year to fulfill the social desires and curiosity of tourists and vacationers. It receives thousands of visitors each winter, some touring briefly, others spending the night, and other couples getting married in the hotel chapel. Visitors pay anywhere from $7 to $1,000 to visit the hotel, repaying the $2.4 million that is spent to design, build, and maintain the hotel [2]. To date, over 220,000 guests have visited Ice Hotel [1]. By visiting the hotel, guests truly experience the structure and are able to see common materials take on a form completely new to them. Though the guests cannot see through the solid snow walls or witness the hotel in the making to ensure that no hidden supports or reinforcements other than natural ice and snow are used, living in the snow for the duration of the visit allows guests to experience snow and ice in different ways than they have likely known before.

The designers of the Ice Hotel, in essence, bring the legendary igloo to life in a modern form. The igloo, which served as a wintertime house to the Inuit, was a small dome-shaped building built by stacking blocks of carved snow (see fig. 5). They could be erected within an hour and sometimes were reinforced with animal bones built into the walls. Only a few people could fit into each igloo, so igloo communities were arranged [5]. Igloos themselves were sound enough to last all winter, though the Inuit peoples frequently built fires inside to provide warmth. Since this caused melting, igloos were rebuilt many times during the winter. The Ice Hotel takes these concepts to the next level, creating a community within one building. Structurally, the igloo and Ice Hotel are quite different. Ice Hotel is a much more massive and permanent structure, incorporating solid ice blocks and walls thicker than those in an igloo.

The designers of Ice Hotel also chose to utilize gothic arches instead of domes, likely because they...
constructed one building with a large interior, as opposed to many small, disconnected rooms. Though traditional igloo-like domes could have been used for the bedrooms, it seems very sensible that the designers kept the building uniform. The aesthetics of Ice Hotel also help to distinguish the structure from an igloo. With elements such as chapels (see fig. 4), saunas (see fig. 6), and chandeliers made of shined ice chips, guests feel as though they are in ordinary buildings, simply a few degrees colder. Even though the arches themselves have an inherent elegance, architects and artists add additional sculptures and pieces of visual art to the structure. The interior of each bedroom is designed by an architect. Each room contains an ice block mattress and reindeer skins for warmth, though sculptures and other elements may be added at the architect’s will. Most of the wonder still remains in the structural art that is the physical construction and design. While the hotel itself is checked to ensure that cracks are sealed, artists use more natural looking pieces of ice to create sculptures that accentuate the cracks and supposed flaws of other ice forms. This juxtaposition of perfect snow and ice walls with marred ice sculptures adds to the experience, as visitors are constantly reminded of the materials from which their surroundings have been constructed.

Even though the physical Ice Hotel lacks permanence because it melts every spring and must be rebuilt, the notion is rather permanent and more or less an engineering experiment every year, as design and constructability develop. The hotel has never failed structurally and visitation grows every year, though hotel designers and engineers try to improve the structure and experience for future visitors. This does not detract from its ability to be structural art; it simply limits the period of time during which guests can experience the structure. Ice Hotel is an incredibly pure structure, built from natural materials and eventually melting back into nature, before it is reconstructed months later. The concept of a snow structure is definitely not a new one, but this structure combines an ancient idea with new engineering ideas and techniques as it displays winter during its finest moments. Despite its short life each year, the Ice Hotel will remain a wonder for years to come, in part because of its new features each time it opens. The Ice Hotel is a truly beautiful and aesthetic structural work, functioning well as a physical structure, tourist attraction, and engineering marvel.
Works Cited:


