



Castillo de San Marcos, St. Augustine, Florida

CASTILLO de SAN MARCOS

Castillo de San Marcos is the oldest masonry fort in the continental United States. Only the forts in San Juan, Puerto Rico are older: Castillo de San Felipe del Morro and Castillo de San Cristobal. Castillo de San Marcos guards the Matanzas Bay of the City of St. Augustine, FL. It was begun by the Spanish founders of the city in 1762, almost two hundred years after the city's founding in 1565 to better protect it from raids by the English and from pirates and to preserve the city as part of the Spanish empire. Sir Francis Drake had attacked the city in 1568, and Robert Searle, an English pirate had attacked it in 1668. The initial forts were built of wood and were not much of a defense against these types of marauders.

The design of the Castillo adheres to the theories of the French engineer Vauban regarding the design of masonry forts to protect against pedestrian, cavalry and seaborne attacks and cannon ball projectiles. Vauban's theories were valid until about 1880 when the technology of cannons markedly improved by rifling and use of aerodynamic projectiles to the point that masonry forts were obsolete. The final military invalidation of these types of forts was the inventions of the hot air

balloon and the airplane, both of which could be used to bomb from above.

Castillo de San Marcos was designed by the Spanish engineer, Ignacio Daza under the direction of Francisco de la Guerra y de la Vega, Comman-dant. It is constructed of a unique stone called *coquina*, mined from the

neighboring island of Anastasia from the 'King's Quarry', and ferried to the construction site. The *coquina* consists of sea creature shells accumulated over multiple millennia similar to limestone. However, this material is initially soft when quarried because there typically isn't an overburden to compress and densify it like with limestone. It was quarried from the ground with hand tools, but after drying when exposed to air it hardens considerably. After hardening, it retains its porous composition that functions very much like a shock absorber when impacted by cannon balls, as was experienced later when the fort saw action in 1702 when the S. Carolina Colony attacked it, and again in 1740 when the Georgia Colony attacked it.

The plan of the fort is a masonry star, with a square Plaza de Armas (parade ground) in the center, surrounded by very thick masonry walls and buildings, which walls are protected on the corners by projecting bastions

that are solid masonry with earthen fill, to absorb the brunt of any cannon fire, and shaped in plan to preserve lines angles of fire against any attacker. The Spanish named each of the bastions and the view in this issue's limited edition print of a sketch by Ladd P. Ehlinger is of the San Pedro Bastion, to the left of the entry bridge as one enters the fort. The other three bastions in clockwise order are, San Pablo, San Carlos, and San Agustin. This surrounding masonry wall is composed of casemate masonry vaults, the deck on top of which were mounted cannon in addition to the cannon within each vault. Other functions were also contained in these vaults, such as kitchen, dining, offices, men's quarters, powder magazines, etc.

The fort is surrounded by a moat, kept dry by the Spanish until an attack, during which sluice gates were opened to fill it with sea water. On the other side of the moat were various constructions of retaining walls to make it more difficult for attackers to even get to the moat, all typical of a Vauban type design.



After the Treaty of Paris in 1763, the British gained control of St. Augustine as the capital of British East Florida, and the fort was renamed Fort St. Mark until the Peace of Paris in 1783 when Florida was transferred back to Spain. In 1821, Spain ceded Florida to the United States, and we renamed it Fort Marion in honor of Francis Marion, the Revolutionary War hero. The fort was deactivated in 1933 and given to the National Park Service where it remains today as a major tourist attraction and historical monument worth seeing

Robotics in Construction

Robotic construction has rarely ventured outside of controlled manufacturing facilities into building construction, due to the unique conditions at each site, weather considerations, and the difficulty of integrating multiple activities where it doesn't interfere with automation. It has been applied, but only in the largest construction projects where the costs justify. Advances in sensors, stabilization, miniaturization, and computer processing are looking to change that, rapidly.

One such machine, by Construction Robotics, is the SAM, which stands for Semi-Automated Mason. It's a brick-laying robot that operates on a slide track and is placed on elevator scaffolding. Feed it dimensions, bricks, mortar mix and water, and it will place over 200 bricks / hour, compared to a typical mason's laying of about 400 bricks / day.

Sensors allow it to compensate for wind and scaffolding motion, so each brick placement is accurate. A human mason still needs to strike the mortar joints (wipe the excess mortar), but without the tiring, repetitive task of placing the bricks, the mason can focus on keeping the cavity clean, smoothly trowelling joints, and placing reinforcing and brick-ties.

While the photos from Construction Robotics are of rather boring straight walls, the SAM is capable of handling a range of brick sizes, laying different brick bond patterns, as well as corbelling. This particular robot is aimed for commercialization sometime this year, with an initial price tag of \$650,000, limiting it initially to larger construction firms and equipment leasing companies.

Another, more specialized robot, is called the Robo Surf, which is a concrete floor finishing robot. What separates it from simply an oversized tool are sensors and programming which allow it to recognize and adjust to varying conditions of the concrete during the curing process.



Takenaka Corp.'s Robo Surf

The same company which makes Robo Surf (Takenaka, Japan) also makes a steel frame field-welding robot, capable of being taught by instruction how to properly weld varying steel connections.

For demolition and recycling, there's the ERO, a robot which will dissolve concrete walls with powerful water jets, leaving behind only the reinforcing. The concrete can be reused as gravel, and the reinforcing can be recycled.



The ERO demolishes a section of reinforced concrete wall.

While no company has yet mastered automating some of the more generalized construction professions, many are racing to do so. Proposals and studies for interior wall painting robots, tile laying machines, plaster/stucco machines all abound in internet searches. In the next couple of years, it will result in a very different world for the construction industry.

R. Perrin Ehlinger

Historic Wedding Receptions

With the popularity of wedding websites on the rise touting destination weddings, New Orleans has become a premier venue selected by brides all over the country. Although many of the wedding venues focus on having the wedding and the reception at the same location, the beautiful churches in New Orleans appeal to many couples. Along with the famous St. Louis Cathedral on Jackson Square in the French Quarter, many other historic churches are seeing an increase in wedding bookings by out of town couples seeking a romantic, New Orleans themed wedding.

The Immaculate Conception Church, locally known as Jesuit's on Baronne, is right across the street from the historic Roosevelt Hotel in the Central Business District. The original Roman Catholic church built on this site was completed in 1857 in the Neo-Venetian Gothic style of Gothic Revival architecture, with Moorish Revival and Byzantine Revival elements but had to be dismantled due to foundation damage in 1928 when the floor split in half. The church was rebuilt on the same site in 1929 using most of the original fixtures. The enormous height of the nave, the bronze chandeliers and the 24 karat gold plated altar handmade in Lyon, France offer a stunning backdrop to wedding ceremonies and photographs.

Also popular is the National Historic Landmark and Home of the Shrine Of Blessed Francis Seelos is St Mary's Assumption Church located in the Lower Garden District. Originally built in 1858, the Church's heavily ornamented interior and exterior make it a striking example the American expression of German Baroque architecture. The Historic Sites Survey report touts "The altar itself, building upward to a climax of the Coronation of the Virgin, is a real "tour de force" and forms a dramatic focal point in this truly remarkable Baroque church." The altar, built in Bavaria by the Institute of Mayrs, together with the rich golds and jewel tones of the columns, vaulting and stained glass windows offer a very dramatic wedding ceremony setting.

These are only two examples out of the many churches in New Orleans that are being chosen for their variety of architectural styles and interior ornamentation by brides all over the United States looking for the perfect church to have their dream wedding.

- Karen Ehlinger



The SAM, on elevator scaffolding, completing a stretch of wall.