America's Courthouse: the History and Restoration of the Dome of the Old Nassau County Courthouse

Nancy A. Rankin

AIA, LEED AP, John G. Waite Associates, Architects PLLC, USA
E-mail: NRankin@JGWAarchitects.com

The Old Nassau County Courthouse was designed in 1899 by architect William B. Tubby and was built in Mineola, NY in 1901 to the engineering specifications of Ernest L. Ransome. The Courthouse is a handsome two-story building, with a front entrance portico and central sky-lit rotunda surmounted by a double-shell dome 30 feet in diameter. The building is a very early example of the use of reinforced concrete as an expressed architectural exterior feature, and despite significant deterioration the building was listed on the National Register of Historic Places in 1978. Starting in 2002, a comprehensive archival research and physical investigation process was undertaken for the entire building. The dome was identified early on as the most distinctive and character-defining element of the aesthetic design, as well as the technical achievement of the building, and its restoration became a visible symbol of pride for the entire county.

Keywords: *Dome, Concrete, Ernest L. Ransome.*

1. Introduction

The Old Nassau County Courthouse was designed in 1899 by architect William B. Tubby and was built in Mineola, NY in 1901 to the engineering specifications of Ernest L. Ransome. Ransome was a pioneer in the use of reinforced concrete technology in the United States, and the Old Nassau County Courthouse is today the only remaining example of his patented system of hollow wall construction and twisted steel reinforcement.

1.1. Design history

Nassau County, NY was founded in 1898; almost immediately, a design competition was announced for a new Courthouse, which was to be a symbol of the recently-established government in Mineola. The winning design by William B. Tubby was a handsome two-story building, with a front entrance portico and central sky-lit rotunda surmounted by a double-shell dome 30 feet in diameter. The dome of the reinforced-concrete Courthouse was intended to be visible for miles across the flat, agrarian landscape of Long Island as a symbol of the new County.

Bid documents were quickly prepared for two different methods of construction: one scheme proposed traditional construction techniques using brick, stone, and iron, while the other detailed a system of hollow-core reinforced concrete patented by Ernest L. Ransome. After much discussion once bids were received, and further consideration of cost and schedule, county officials selected a contractor and the Ransome system of concrete construction for the building, which was to have a stark white reinforced-concrete dome of unique detailing and construction.

1.2. Significance

The building as designed and constructed remains a very early example of the use of reinforced concrete as an expressed architectural exterior feature, with trap rock and marble aggregate walls that were bush-hammered and with decorative trim features such as corner quoins and cornice modillions.

A creative engineer who held many patents for reinforced concrete systems and methods, Ransome was among the first to exploit the aesthetic quality of concrete by patenting a method to imprint horizontal joints in the walls to simulate masonry coursing, to select aggregate for its visual qualities, and to hand-tool the finished concrete or use plaster molds applied to the

Fig. 1. Front façade of the Old Nassau County Courthouse, shortly after its completion in 1902. Photo courtesy of the Long Island Studies Institute.

formed surfaces to simulate the appearance of carved natural stone.

The Courthouse is a rare and unusually well-preserved application to civic architecture of Ransome's reinforced concrete technology. The system utilized iron bars that were cold twisted to create an irregular surface that would improve bond strength between the reinforcement bars and the concrete. Other merits of the Ransome system included ease and speed of construction, structural strength combined with an economic use of materials, and improved characteristics of fire resistance for the completed building. These qualities are especially apparent in the construction details of the building's central double-shell dome.

1.3. Construction of dome

The construction of the Courthouse was a proud event for the new county, and the cornerstone-laying ceremony was presided over by then-Governor and Vice-Presidential candidate Theodore Roosevelt, a Nassau County resident. More than 1,500 people attended the event in the middle of fields and farmland, which was held on July 13, 1900. Construction of the Courthouse was completed 18 months later, and the building was opened to the public for use on February 27, 1902.

The use of reinforced concrete was so unusual for a public building that "The Nassau County Steel-Concrete Court House" was extensively documented within several periodicals at the turn of the 20th century. The most complete and detailed diagrams were published in *Engineering Record* in 1901. They illustrate the wood and plaster formwork used during the placement of concrete, the size and location of cold-twisted steel reinforcement bars, and the concrete details of both the inner shell, which provides a decorative ceiling surface within the rotunda, and the outer dome, which extends another 20 feet above the inner dome.

The outer dome consists of a solid concrete shell only 3" thick, and is reinforced by ¼-inch radial and circular horizontal twisted steel rods. Both the vertical and horizontal bars are spaced 12" apart, are lapped 18", and are set only ¾-inch below the outside surface of concrete. Wood formwork was braced on the interior above the second floor of the central rotunda, and steel tie rods were placed at intervals to attach the exterior formwork of the outer dome. Plaster molds were

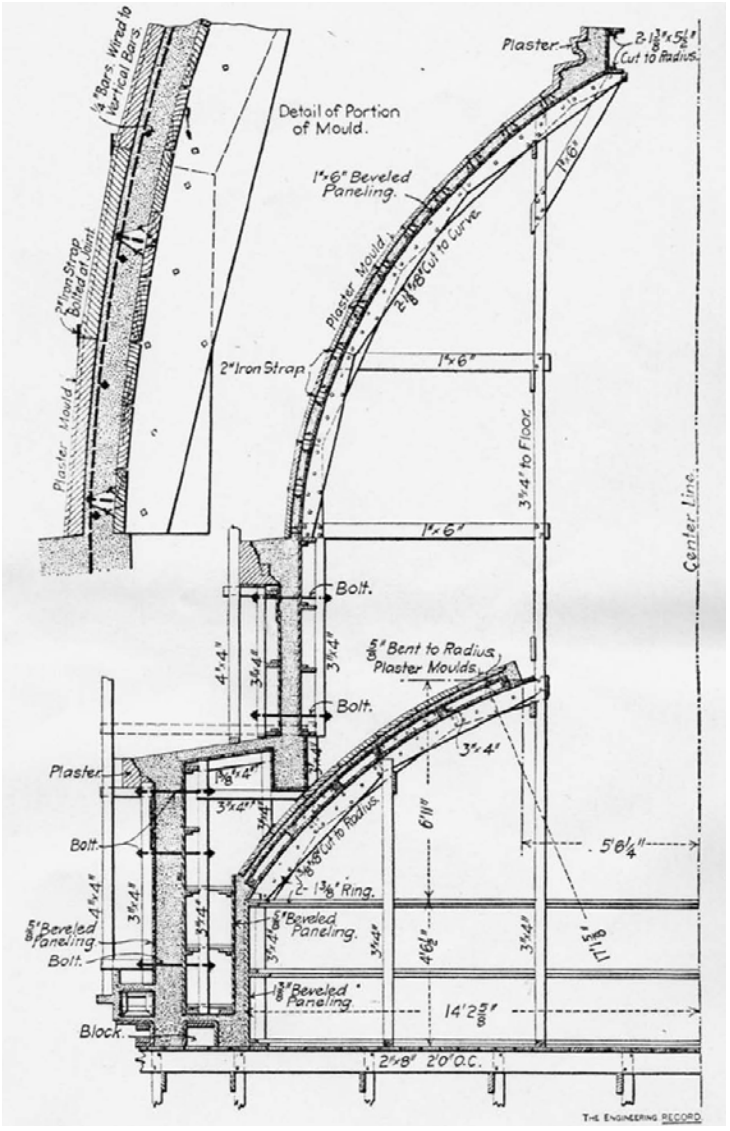

Fig. 2. This diagram, and the following diagram, illustrate the construction of the double-shell dome of the Nassau County Courthouse published in Engineering Record on December 7, 1901.

used at the exterior along with the wood formwork to get the correct shape and curvature of the double-shell dome's interior and exterior surfaces, to provide an exceptionally smooth and uniform finished surface for the exterior of the outer dome, and to achieve detailed decorative cornice profiles at the base and top of the outer dome. White Portland cement with crushed white marble aggregate was mixed very wet on site, and was hoisted and placed into the dome's formwork by one-yard buckets.

1.4. Building use

Later additions in 1916, extensions of the rear wings constructed in 1925, and further additions in 1939 diminished the clarity of the building's original design and internal configuration. In the 1940s, the building was extensively altered for general county administrative office uses as the local population expanded dramatically during the post-WWII period, and was thereafter minimally maintained and modified only when necessary and in an ad-hoc manner. However, throughout the 20th century, the dome continued to remain the focus of the front entrance to the building and as the symbol of county government. In 1978, despite its marginal use and condition, the Old Courthouse was noted for its historic significance as the first building built by and for the new county, and it was listed in the National Register of Historic Places.

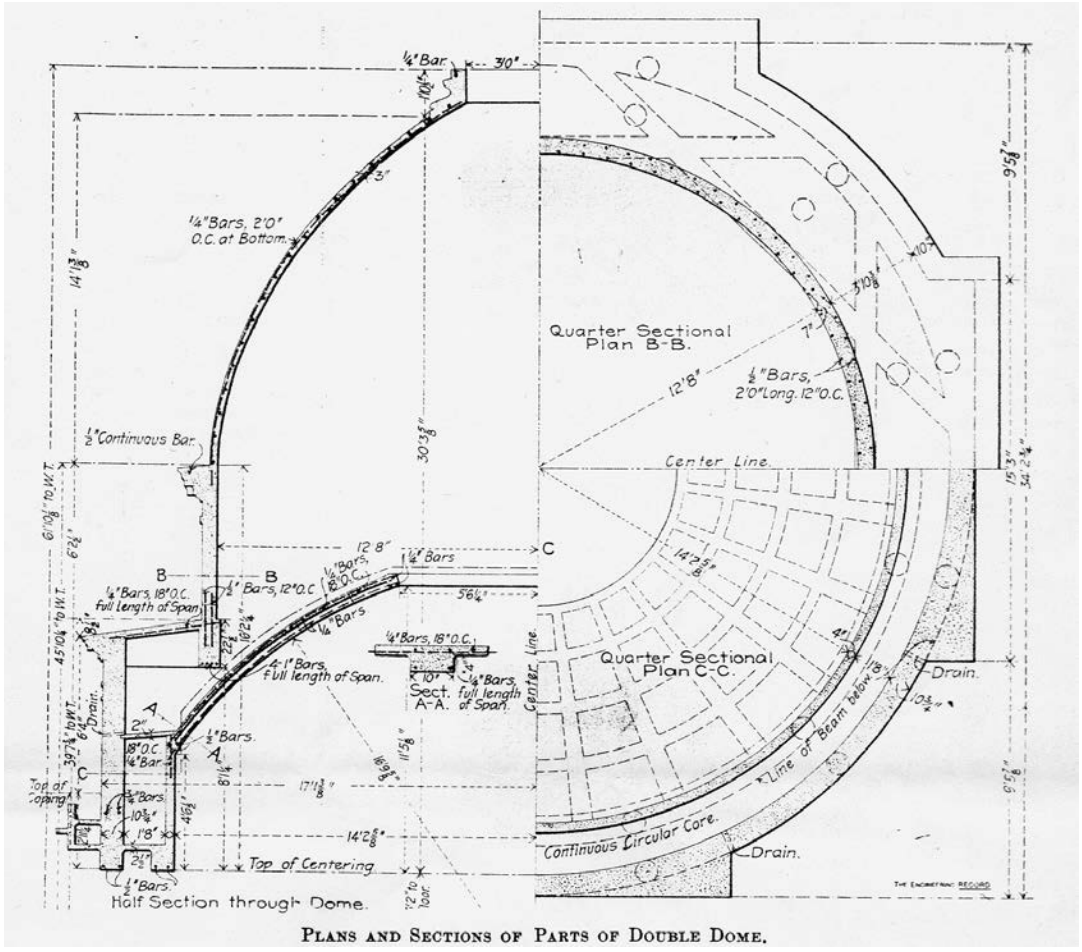

Fig. 3. "Plans and Sections of Parts of Double Dome" published in Engineering Record on December 7, 1901.

2. Documentation and analysis

2.1. Documentation

After more than 100 years, the building known as "America's Courthouse" was in serious disrepair, and a comprehensive restoration of the concrete structure was begun, starting with the building's dome. In 2002, measured drawings and a Historic Structure Report were completed that comprehensively recorded, documented, and evaluated the historical evolution of the entire building and its existing condition, and provided a framework to guide restoration efforts.

2.2. Physical investigation and analysis

In addition to extensive archival research, detailed physical investigations were undertaken on areas of the original concrete structure of the Courthouse. The testing included petrographic analysis of 2" diameter concrete core samples taken from the dome, as well as a non-destructive evaluation (NDE) to locate the approximate size and spacing of steel reinforcement using techniques such as magnetic detection, impulse radar, and pulse velocity methods of measurement and documentation.

2.2.1. Original concrete mix

Two core samples of the concrete dome were taken for laboratory and petrographic analysis, in order to determine the composition of the original concrete mix design so that it could be replicated for restoration efforts. The samples were also tested for concrete strength and extent of potential carbonation.

Several aspects of the original concrete mix that differ substantially from contemporary concrete construction materials and practices were identified. For example, both the fine and coarse aggregate was all from one source, identified as a compact crystalline marble with a

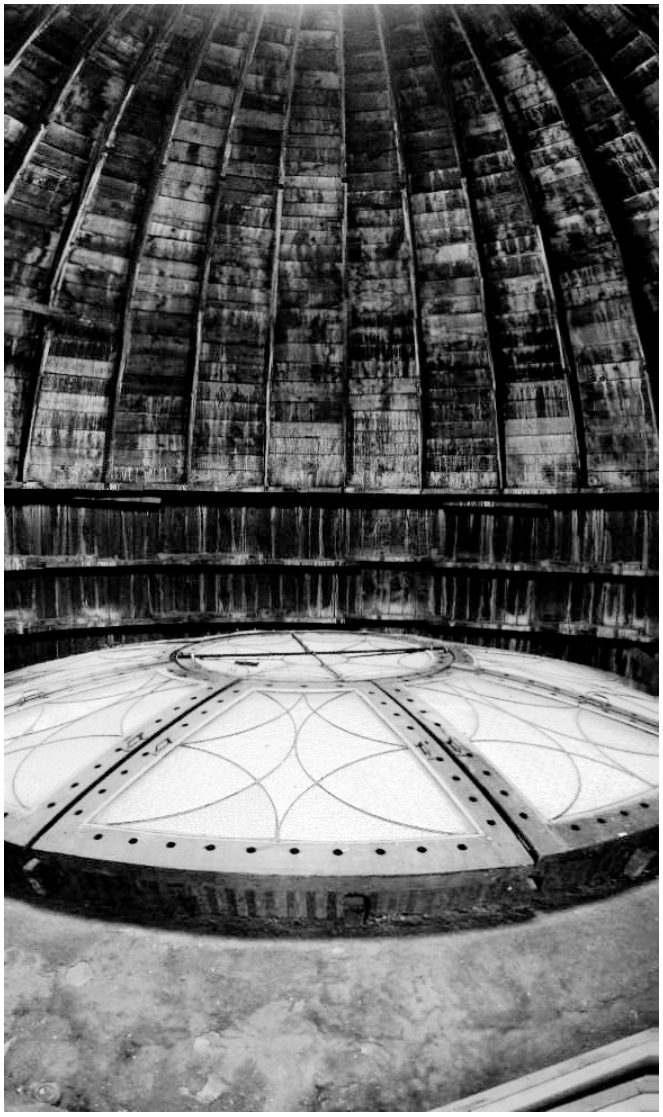

Fig. 4. Existing conditions of the space between the double dome, with original wood board formwork remaining in place at the interior surface of the outer dome. The segmented Rotunda laylight at the oculus of the inner dome is in the foreground. Photo courtesy of JGWA.

high percentage of magnesium carbonate, which is classified as dolomite. Today, a silica-based sand would likely be used as a fine aggregate; sand was not present within the tested samples of the original concrete mix. Regarding aggregate, the maximum size of the coarse aggregate within the tested samples was only 3/8"; today, the typical minimum size for coarse aggregate is 3/4".

The original mix included a significant amount of "rock flour", indicating that the aggregate was not as thoroughly washed as it would be today. In addition, the cement content of the mix was very low, and the water-cement ratio was determined to be higher than what is commonly specified today. It is not clear what measurable effect the rock flour, the limited quantity of cementitious materials, and the higher water-cement ratio may have had on the structural performance of the concrete mix.

The testing of the core samples also confirmed that the white concrete mix for the dome had included a significant amount of crushed glass, an unusual additive that would have contributed a distinctive "sparkle" to the original exterior surface of the dome. This had been documented in the county's archival records, but was no longer apparent on the existing bronze-coated surface of the dome.

The samples also indicated a moderate level of carbonation, which results when carbon dioxide from the atmosphere has penetrated below the surface of the concrete and combined with water to form a weak acid within the concrete. This chemical reaction changes the pH value of the alkaline concrete, and often leads to rapid onset of steel reinforcement corrosion. The depth of carbonation was not able to be established from the limited number of core samples taken at the dome.

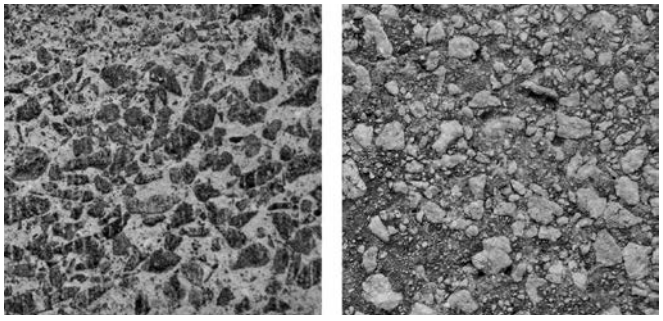

Fig. 5. Detailed photographs illustrating the two different types of aggregate (trap rock and marble) used within the same cement binder to provide aesthetic character to the exterior walls and trim of the reinforced-concrete structure. The dome material was similar to the sample at right, but with a finer marble aggregate, rock flour, and crushed glass that provided a smoother, uniform finish with sparkle. Photo courtesy of JGWA.

Fig. 6. Front façade of the Old Nassau County Courthouse in 2002, with bronze coating applied to dome. Photo courtesy of JGWA.

2.2.2. Physical investigation of the dome

Visual inspection of the interior and exterior of the inner and outer dome surfaces revealed that they were structurally sound without any deficiencies to the concrete material or the internal reinforcement, and adjacent finish materials showed limited areas of deterioration related primarily to water infiltration. Details of the dome's construction were compared to the 1901 *Engineering Record* diagrams, which had very accurately recorded the as-built conditions in great detail.

No control or expansion joints appear to have been provided within the original concrete construction of the dome or other structural elements of the building. Despite the inclusion of a very frequent and regular pattern of 1¼" diameter twisted steel rods within the thin 3" shell of the exterior dome structure, minor hairline cracking was observed on the original exterior surface of the outer dome.

Likely causes of the surface cracking condition are both seasonal and diurnal temperature changes, which create thermally-induced tensile and compressive stresses within the concrete that manifest in cracks through the thickness of the concrete. Despite the quantity and locations of these hairline cracks at the dome surface, almost no evidence of steel reinforcement corrosion, such as rust stain seepage or large areas of concrete spalling due to expanding oxide products of erosion, was observed.

The pervasive cracking condition was more visually apparent when the bronze coating applied in the 1970s was removed from the exterior surface of the outer dome: this was accomplished using an environmentally safe paste-consistency coating remover that did not contain methylene chloride or methanol, followed by a low-pressure water cleaning with an angled fan-tip nozzle. This allowed an examination of the entire exterior outer dome surface so that specific concrete deterioration problems could be addressed during the dome's restoration.

3. Restoration

3.1. Sequence of exterior work

Following the cleaning and detailed physical investigations of the outer dome, construction drawings and specifications were prepared for bidding, and a qualified restoration contractor was selected to perform the work. A pre-restoration conference was held on site to discuss logistics, specific concrete repair details, materials requirements, and quality control. Material submittals and mock-ups illustrating the methods, materials, and finished color and texture appearance of the concrete patching repair mortar were prepared for review and approval prior to full-scale application across the entire exterior surface of the outer dome. Scaffolding accommodating the geometry of the dome was installed, allowing full access to the entire exterior surface.

3.2. Dome preparation and resurfacing

3.2.1. Steel reinforcement

Minor repairs to exposed reinforcement bars were required prior to any concrete surface repair procedures. Small lengths of deformed or severely corroded bars were cut out, and exposed steel reinforcement to remain was coated with two applications of an epoxy-modified, cementitious bonding and anticorrosion agent. Once inappropriate prior repairs had been removed and other areas of spalled concrete surface had been addressed and the entire exterior surface of the outer dome was sound and smooth, a water-based alkaline solution of corrosion-inhibiting chemicals that penetrate concrete by diffusion to form a protective barrier on unexposed steel reinforcement was applied.

Fig. 7. Construction scaffolding surrounding the concrete dome of the Old Nassau County Courthouse, following removal of the non-original bronze coating and prior to concrete repairs. Repair mortar mock-up samples are visible on the right side of the dome, above the first stage of scaffolding. Photo courtesy of JGWA.

3.2.2. Dome resurfacing

Several larger cracks within the dome were routed out with hand-tools and repaired with structural repair mortar; similar work was also done at the upper and lower profiled cornices, which had a rough aggregate surface that was replicated by pressing matching aggregate into the still-damp surface of the crack repair mortar. Prior to the resurfacing of the dome, an epoxy bonding agent was applied over the entire repaired concrete surface. While the bonding agent remained tacky, the job-mixed custom patching repair mortar matching the original concrete mix in composition, texture, and color was troweled over the exterior surface of the outer dome and worked into a smooth polished finish. The dome surface was then wet-cured for 7 days using damp burlap.

3.3. Other elements

In addition to the extensive efforts to restore the concrete surface and decorative cornice profiles of the dome structure, other elements of the dome's finished exterior appearance were repaired or replicated. The upper and lower metal balustrades that encircle the dome were

Fig. 8. Interior view of the Rotunda looking up at the restored segmented zinc-camed decorative glass laylight at the oculus of the inner dome. The original decorative paint scheme highlights the restored plaster coffered ceiling. Photo courtesy of JGWA.

Fig. 9. The front façade of the Old Nassau County Courthouse, following a comprehensive rehabilitation of the entire building that began with the restoration of the central dome. Photo courtesy of JGWA.

stripped to bare metal, repaired and welded where required, and repainted. Paint seriation of the existing coatings was undertaken beforehand to determine the original colors of the first layers of paint, which were matched and used on the finished railings.

The exterior oculus at the top of the dome was reglazed using the original 1/2" thick glass lites and the original radial pyramid steel frame; the glass was removed, cleaned, and reset into the primed and painted frame. Corroded anchors cast into the top decorative concrete profile for both the oculus and the metal railing were also cleaned, primed, and repainted. The wood door and frame providing access to the space between the two domes from the roof was reproduced to match original details.

3.4. Interior work

Within the Rotunda, the plaster-and-canvas coffered ceiling suspended below the concrete frame of the inner dome was restored. Again, paint analysis of the original colors enabled the restoration of the original decorative paint scheme of the interior of the space, and the original gold-leaf two-arm bracket light fixtures around the base of the inner dome were restored, re-wired, and reinstalled. In later phases of the building's restoration, the entire Rotunda including the ceremonial staircases, the terrazzo floor finishes, and the four Works Progress Administration murals were also restored.

Conclusions

Following completion of the dome restoration, which was accomplished with private funds, Nassau County was awarded state grant funding to continue the concrete preservation efforts of the original portions of the Courthouse. Completed in 2008 after a seven-year restoration process that incorporated new functional office space for county officials within the original building, the restored Old Nassau County Courthouse, and especially its unique, double-shell reinforced concrete dome, has regained its original beauty and stature as a symbol of good government in New York.

Acknowledgements — The author would like to acknowledge the contributions of her colleagues at John G. Waite Associates, Architects PLLC, as well as the Executive Architect for the project, HLW International. Sub-consultants contributing to the project include Mount Ida Press for historical research, Robert Silman Associates PC for structural engineering, Atkinson-Noland & Associates, Inc. for non-destructive testing and evaluation, and Testwell Laboratories, Inc. for petrographic analysis services.

References

—, "The Nassau County Steel-Concrete Court House", *Engineering Record* 44 (7 Dec. 1901), 541-544.

John G. Waite Associates, Architects PLLC (JGWA), *Old Nassau County Courthouse: Historic Structure Report*, March 2003.