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The First Campaign of Construction, Summer-Fall 1833

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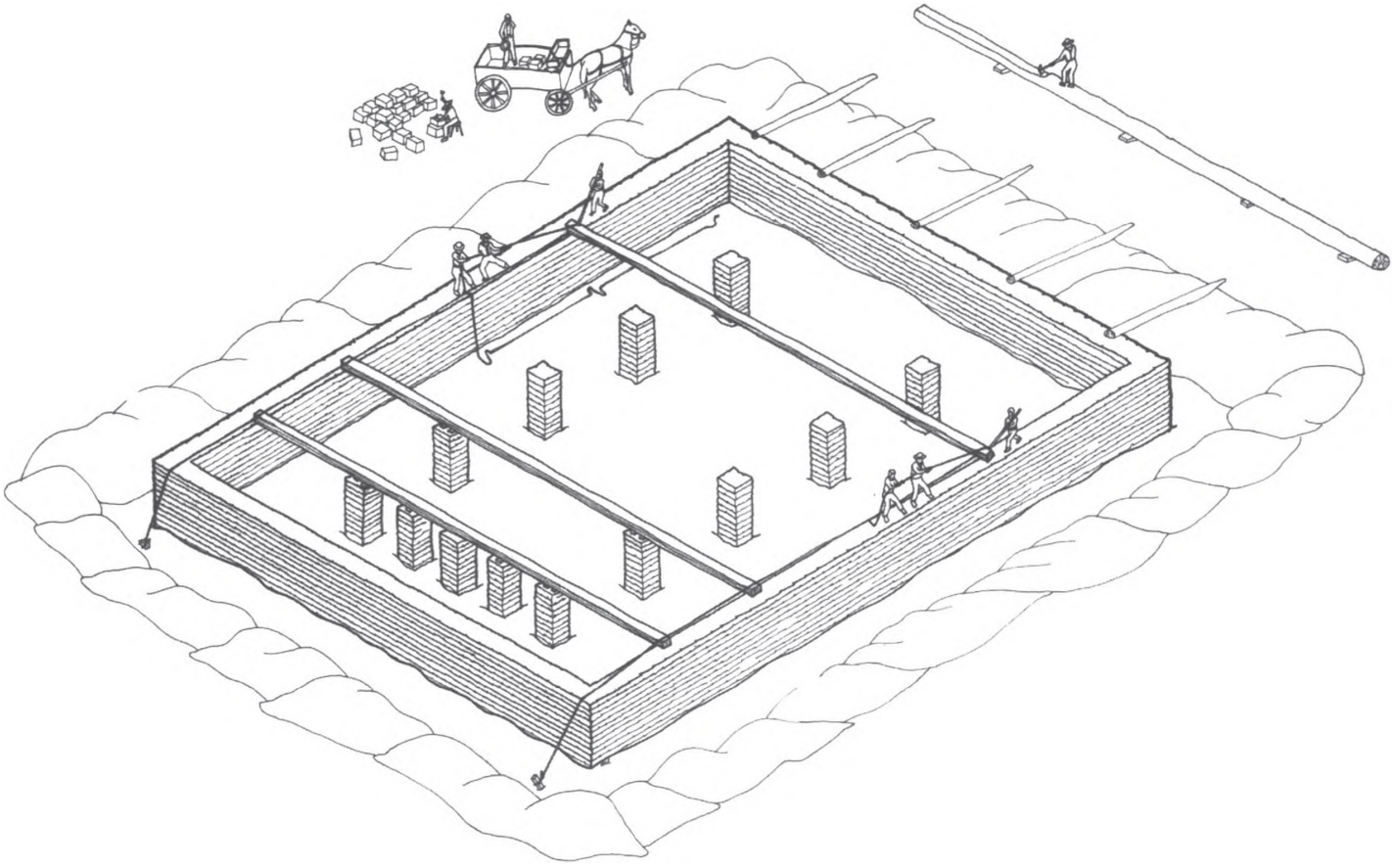

Fig 3-1. Axonometric view of building site circa early 1834. The representative construction phases illustrated here would probably not have occurred simultaneously as shown, but they have been included to show the range of tasks required in construction.

Chapter 3

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On June 1, 1833, Joseph received a revelation which caused a sudden flurry of temple-building activity during June 1833. In this revelation, the Lord "chasten[s]" the members of the Church, "for ye have sinned . . . a very grevious sin, in that ye have not considered the great commandment in all things, that I have given unto you concerning the building of mine house." Furthermore, in this revelation, the Lord gives specific instructions about the dimensions of the temple and promises to "show unto three of you" the manner in which it should be built (D&C 95:3, 14–15).

On the day Joseph Smith, Sidney Rigdon, and Frederick G. Williams saw the Kirtland Temple in a vision, Joseph Smith convened a council meeting and asked each participant to propose the type of structure for the temple. Lucy Mack Smith, Joseph Smith's mother, later recorded:

> Some thought that it would be better to build a frame others said that a frame was too costly kind of a house and the majority concluded upon the putting up a log house and made their calculations about what they could do towards it building it—Joseph rose and reminded them that they were not making a house for themselves or any other man but a house for God. ["]And shall we brethren build a house for Our God of logs. No brethren, I have a better plan than that I have the plan of the house of the Lord given by himself you will see by this the difference between our calculations and his Ideas[."] He then gave them the plan in full of the house of the Lord at Kirtland.[1]

Clearly, the concept of a substantial masonry structure was beyond the expectation of most in the group. But Joseph's proposal was enthusiastically embraced, and after the meeting's close, council members walked to the building site. Lucy Mack Smith recorded that, while the group viewed the site,

> Hyrum [Joseph's older brother] ~~came~~ ran to the house and caught the sythe and was about returning to the place without giving any explanation but I stopt him and asked him where he was going with the sythe he said we are preparing to build a house for the Lord and I am determined to be the first at the work In a few minutes the fence was removed the young wheat cut, and the ground in order for the foundation.[2]

Construction of the temple began in earnest the following Monday, June 5, 1833, with Hyrum Smith and Reynolds Cahoon digging the trench for the foundation and Harry Stanley and George A. Smith hauling the first load of stone.[3]

The scale of the intended building must have seemed ludicrous to those viewing the construction site, for Benjamin F. Johnson records, "Such was the poverty of the people at the time of breaking ground for its foundation, that there was not a scraper and hardly a plow that could be obtained among the Saints."[4] Without scrapers, effective use of draft animals in the excavation would have been difficult. Hyrum Smith's enthusiasm must have been vital to the completion of the project, for he and Reynolds Cahoon excavated the foundation by hand.

Despite these difficulties, the excavation was ready for the cornerstones by July 23, following about six weeks of labor.[5] Just as the Saints had lacked sufficient tools for digging the foundation, they also lacked sufficient personnel for the cornerstone ceremony. Twenty-four Melchizedek Priesthood holders were needed (or desired) to officiate, but the group of Saints was so small that a sufficient number could not be assembled on the required day. Joseph C. Kingsbury and Don Carlos Smith, still in their teens, were quickly ordained to the proper priesthood office in order to expedite matters.[6] Despite this serious lack of both men and proper equipment, to say nothing of the staggering debt already incurred by Joseph Smith on behalf of the group,[7] construction moved ahead.

This dogged determination to complete the building in the face of continuous obstacles is a leitmotif in the history of the building. Whatever motives might be ascribed to Joseph Smith and his associates, the building history of the Kirtland Temple clearly underscores their vision of what the Mormon community was eventually to become. At the time construction began, only about 150 members of the faith lived in Kirtland.[8] Not until well after the Kirtland Temple was finished and most Saints had left Ohio did large numbers of English converts dramatically increase the size of the Church. Given these rather inauspicious beginnings—especially considering local opposition to the group—the faith in the future exhibited by Joseph Smith and his associates is all the more remarkable.

Construction of the Foundation Walls

From late July through October, construction on the foundation walls progressed under the direction of Reynolds Cahoon and Jacob Bump, a plasterer and carpenter from a Lake Erie harbor town in New York state.[9] Workers continued to haul sandstone from Stannard's Quarry, located about two

miles south of the building site. Though not deep, this quarry consists of a sandstone bed exposed by the small stream running over it (fig. 3-2). The neat, regular drilling holes still visible in the quarry probably do not date from the Mormon excavations, for the majority of the stone in the temple walls is far more irregular in shape. Workers most likely used wedges to split out irregular blocks of stone along natural fissures.

Typical residential foundations in the 1830s had cut-stone or rubblestone walls and extended into the soil below frost level—deeper if root cellars were to be located under the structure. In most soils, wood-framed houses do not require wide foundations to spread out their relatively modest weight, and such simple foundations perform satisfactorily.

Like these residential foundations, the Kirtland Temple foundation is formed of large cut-stone blocks to the outside, with rubblestone completing the thickness of the wall. However, the Kirtland Temple, more than ten times the volume of most residences and constructed of thick masonry walls, requires a far more substantial foundation than a residence. Though the temple's foundation walls are twenty-eight inches wide—approximately double the width of most residential foundations—they have no footing, or flared base, to spread out the weight on the soil. As none of the workers involved with the project up to this point had experience with such large-scale buildings, they did not sufficiently broaden the foundation. Consequently, the building has settled about two inches since its construction, causing the walls to crack visibly.[10]

Photo by author.

Fig 3-2. Stannard Quarry, Lake County Metroparks, Kirtland. The neat, regular excavation markings probably date from later quarrying activities.

Rough-Worked Girders

Bump and Cahoon likely supervised placing the girders that go on top of the foundation walls, for these girders exhibit characteristics typical of relatively unskilled craftsmen. The oak girders show a large number of knots; apparently no special effort was made to obtain timbers free from defects. The surface of the girders is roughly worked, showing a pockmarked pattern where chips of wood were crudely split off (fig. 3-3). Either the workers did not have an adze at their disposal, or they did not know how to wield one effectively.

The orientation of the girders also reveals the workers' lack of experience constructing large buildings. The girders have a scantling, or cross section, of about nine inches by twelve inches oriented flatwise—that is, with the twelve-inch dimension horizontal and the nine-inch dimension vertical. This orientation cuts the bending strength nearly in half compared to that of a vertically oriented girder.[11] This construction practice is typical of the eighteenth century, as builders preferred leaving substantial beam widths in order to accommodate mortises, or joist pockets, which were carved into the sides of the beam. This practice was also adequate for residences, which typically have smaller spans and floor loads than public assembly buildings. However, with the building designed to house large public assemblies and with the span between support piers close to twenty-five feet, the horizontal orientation of support girders is woefully inadequate.

Photo by author.

Fig 3-3. Detail of girder and pier supporting floor of lower court. Also visible are the masonry pier supporting the girder and joists framing into the girder. Modern additions include the insulated ductwork.

After its completion, the temple regularly hosted meetings with about one thousand people in attendance.[12] Given the weakness of the girders supporting the floor of the lower court, the floor must have creaked and groaned during the services. The girders possess only about one-sixth of the modern code-required strength. Of course, today's codes have a generous safety factor built in, and wood will safely carry moderate overstresses for

Foundations

Proper foundations are essential to the long-term stability of a building. If some sections of a building sink into the ground farther than others, walls can crack. These cracks may not themselves be dangerous, but they allow moisture to penetrate the walls, causing wooden elements to rot. In colder climates, cracks can cause freeze-thaw damage due to the expansion that occurs when water freezes. In more serious cases of settlement, walls can rotate or lean dangerously, threatening the stability of a structure.

The best foundation is one established directly on bedrock. In that instance, builders merely extend the walls down to the rock strata. However, bedrock is rarely found conveniently close to the surface, so to prevent the building from sinking into the soil, foundations must spread out their load much as one wears snowshoes to prevent floundering in deep snow. Techniques used in preindustrial America to build adequate foundations for larger structures included stepping out the foundation at each course, thereby widening the contact area between the foundation and the soil, and laying stout timbers crosswise underneath the wall to spread out the weight. However, the builders of the Kirtland Temple, who did not employ these techniques, did not fully appreciate the substantial weight of the structure, nor did they realize how poor the underlying soil is for building.

The soils under the Kirtland Temple are glacial deposits that vary a great deal at different depths. The foundation walls bear directly on reasonably firm soil. However, when the building is fully occupied, the relatively narrow width of the foundation walls stresses the soil to nearly three times the level recommended in modern engineering practice. Exacerbating this situation is a layer of loose sand and silt, which has a very low bearing capacity, about ten feet below the foundations. This soil profile presents some paradoxical problems.

The downward pressure of foundations can cause sandy soils such as those under the temple to flow upward and away from the bottom of the foundation, much like what happens when one steps in firm mud and it oozes up around the foot. This problem is avoided in modern practice by burying foundations deep enough that the weight of the soil above holds the lower soil in place.

The foundations of the temple have almost no embedment in the soil. The dirt floor of the basement is just inches above the bottom of the foundation, so excessive weight on the foundations could cause an uplift of soil in the basement floor. However, if builders had tried to solve this problem by burying the foundations deeper, the area affected by the foundation's pressure would have come dangerously close to the loose stratum of soil lying about ten feet below.

As it currently stands, the Kirtland Temple is delicately balanced on insufficiently wide and insufficiently embedded foundations perched above a loose layer of soil. The west wall has rotated outward slightly, probably because of the foundations' settlement. Some joist ends have nearly pulled out of their pockets in the wall, and one of the piers under the vestibule wall has rotated a significant amount. However, the foundation wall is so thick that the current amount of rotation is not a cause for concern. Recent stabilization of the soil by pressure grouting will hopefully secure the structure for its long-term preservation.

shorter duration loads (such as three- or four-hour meetings). However, the stresses in the girders underscore the extreme good fortune that the floor of the lower court did not collapse during the temple's dedicatory services.

Later occupants were not so lucky. The westernmost girder supporting the lower court floor has a large defect in the wood that eventually caused it to split and fail. Luckily, the floor did not completely collapse. It probably gave a loud crack and dropped a few inches in midspan. Total collapse of the girder likely was prevented by both the quick reaction of people standing above the failure and the thick floorboards, which spread the load over to sound structural members.[13]

Timber props to support the girders at their midspans and reduce the tremendous overstresses present in the original design were placed in the basement in about 1883 (fig. 3-4).[14] These provisional supports have adequately supported the floor of the lower court over the years, and it is fortunate that these girders, oriented in their weaker flatwise position, were placed where they could be easily supported on the basement floor. Had such girders been used in the structure of one of the upper floors, propping them up without ruining the space below would have been extremely difficult.

Photo by author.

Fig 3-4. Timber prop supporting the lower-court floor girders at midspan. Note that the foundation of the timber prop is merely a block set on the dirt floor. In addition to the piping, wiring, and conduit visible in the photograph, a paint spot on the wooden girder identifies a surveying point which is checked periodically to ensure that these provisional repairs are not settling on the dirt floor.

Walls of Rubble: The Arrival of Artemus Millett

The settlement and subsequent cracking of the temple's walls might have been reduced if the temple had been built of brick as originally intended.[15] Common brick weighs about 15 percent less than most stone, and less weight would have resulted in a smaller degree of settling. On April 2, 1833, Frederick G. Williams was placed in charge of a brickyard located on the recently purchased Peter French farm. Although the stated justification in the *History of the Church* for

the brick kiln was merely that it "was essential to the building up of the city," workers in the brickyard recorded in their journals that they were "making brick for the House of the Lord then about to be built in that place." Workers labored through the summer until September 25, 1833, when brickmaking was abandoned, apparently because workers were unable to produce a sufficient quantity of usable bricks.[16] As a consequence, when the stone foundation was completed in October, no materials were available to continue work, and the building site was abandoned until spring.[17]

The failure in brickmaking must have been a severe blow to the community. Not only had construction on the temple halted, but the fruitless expenditure of time and effort in a community handicapped by limited resources must have created great discouragement for both Church leaders and members. Of course, beginning in late 1832, brick was locally available for purchase in sufficient quantity to build the temple, but the impoverished Mormon community likely could not bear the expense of such a large purchase.[18]

This materials crisis was most likely solved by Artemus Millett, a builder of mills, chimneys, and foundations from Ontario, Canada. Apparently on the recommendation of Brigham Young, who had converted Millett in January 1833, Joseph Smith requested that Millett come to Kirtland to work on the temple.[19] Fortunately for the Saints, Millett had large-scale building experience: he had built a brewery in New York state around 1825 and two three-story flour mills in Canada in 1830.[20] Since brickmaking attempts were abandoned in September, Millett must have observed considerable anxiety over prospects for completing the temple when he arrived in Kirtland later that fall. His contribution during his short stay was the suggestion to use rubblestone walls covered with a stucco finish in place of brick.

Because of Millett's building experience in Canada, he was familiar with the rubblework-and-stucco building technique common in the provinces of Ontario and Quebec. During the early nineteenth century, buildings of rubble construction in the United States were quite rare, primarily because wood framing was so inexpensive in contrast with solid masonry walls. When a masonry building was desired, it was almost always constructed of brick. However, in Ontario and Quebec, rubblework construction was very popular, especially for public buildings. This popularity is probably due to Canada's closer ties with England and France, where stucco-covered, rubble-walled buildings are common. The northern shore of Lake Ontario, where Millett had worked, still has many examples of churches built using rubblework construction techniques during the late eighteenth and early nineteenth centuries.[21]

Millett was also familiar with American variations on traditional masonry. During the War of 1812, he worked as a "huckster," hauling supplies

Photo by author.

Fig 3-5. Russell Quarry in Kirtland. The regular bedding planes and exposed sandstone bed would have enabled roughly rectangular stones to be quarried with a minimum amount of effort. This site is one of several on the Russell property.

for the army at the Sackets Harbor, New York, army post.[22] The buildings in this military installation are some of the few examples of stone construction in this region of the United States. The Madison Barracks (1816–1819), constructed just after the war in the area where Millett worked as a mason, have narrow decorative stones at the corners. These quoins are unusually long and narrow and are similar to those found on the Kirtland Temple.[23] Millett may have picked up this local variation on quoin design and used it in Kirtland.

Millett's suggestion to use the sandstone readily available from local quarries must have brought tremendous relief to Joseph and members of the building committee, who were trying to raise the necessary funds to build the structure. For the stone of the upper walls, Millett selected a nearby quarry whose sandstone was reportedly soft when quarried and later hardened when exposed. This was probably the Russell Quarry, located south of the temple site (fig. 3-5). Like the Stannard Quarry, the Russell Quarry is a ravine where the streambed has exposed a stratum of sandstone that can therefore be easily removed.[24]

Spacing of Piers and Windows

In addition to solving the materials problem in Kirtland, Millett superintended the construction site. What Millett saw in October 1833 was an

excavation four to five feet deep, with the stone foundation wall completed and probably at least some of the floor girders in place. This situation would have presented a number of difficulties for Millett. First, Millett had no way to provide for quality control on the foundations, which had been built by workers who lacked large-scale building experience. If Millett was concerned about the narrowness of the foundations and the weight of the walls bearing on them, one wonders if he would have been able to order substantial changes as a newcomer to the building. It would have been very awkward for him to walk onto the site and criticize the work, and in fact no record mentions any such discussions. Of course, spotting building problems after damage has occurred is much easier than anticipating their occurrence, and Millett may not have had the necessary expertise to recognize the inadequacy of the foundations.

The second challenge facing Millett was the spacing of piers and windows. Once foundations are built, they are not easily moved. Unless workers had been willing to go to great labor and expense in dismantling and moving the foundations (an unlikely step for the financially strapped Saints), no changes could have been made in the size of the building. Of course, since the dimensions of the structure were determined by revelation, the foundation walls could not be moved for theological reasons either. Most critical for Millett, the foundation walls and masonry piers determined the location of the interior columns and girders. Interior columns should be located between the windows so the girders (the main horizontal supports) that run between the columns and outside walls are supported on the exterior by solid masonry and are not immediately above a window. However, when Hyrum Smith and Reynolds Cahoon started digging the foundation trenches—and, consequently, determining the size of the building and the location of columns—details such as window placement were not fully worked out.[25]

The difficulty for Millett, who eventually built the masonry walls, was to create a regular exterior shell around an irregular internal structure. The plan by Joseph Smith, Sidney Rigdon, and Frederick G. Williams specified a ten-foot-wide vestibule (fig. 3-6). Since the vestibule wall (and tower above) determined the location of the easternmost line of masonry piers, the remaining lines of piers would logically continue at even, ten-foot intervals. However, the revelation also determined the length of the courts as sixty-five feet—a number not evenly divided by ten—making a series of ten-foot intervals between windows on the exterior impossible.

Rather than building the piers at five even intervals of thirteen feet, builders varied bay spacing across the building. This irregular spacing is visible in the longitudinal section of the temple as built (fig. 3-7; transverse section shown in fig. 3-8). Starting at the east end, bay spacings begin with the required ten feet in the vestibule, then jump up to just over twelve feet

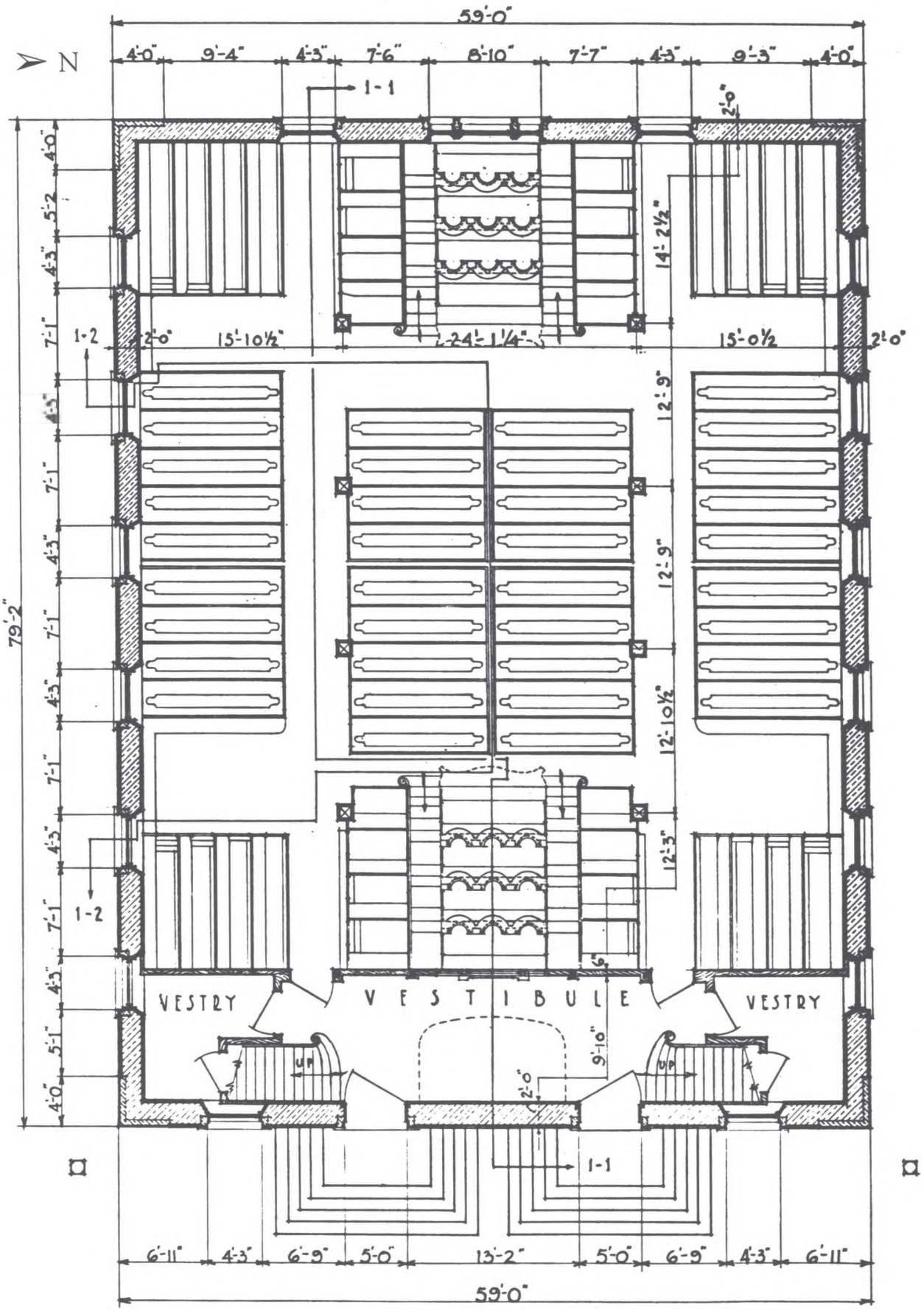

Fig 3-6a. Plan of the lower court, Kirtland Temple, drawn March 1934 by Veredon W. Upham. Courtesy Library of Congress.

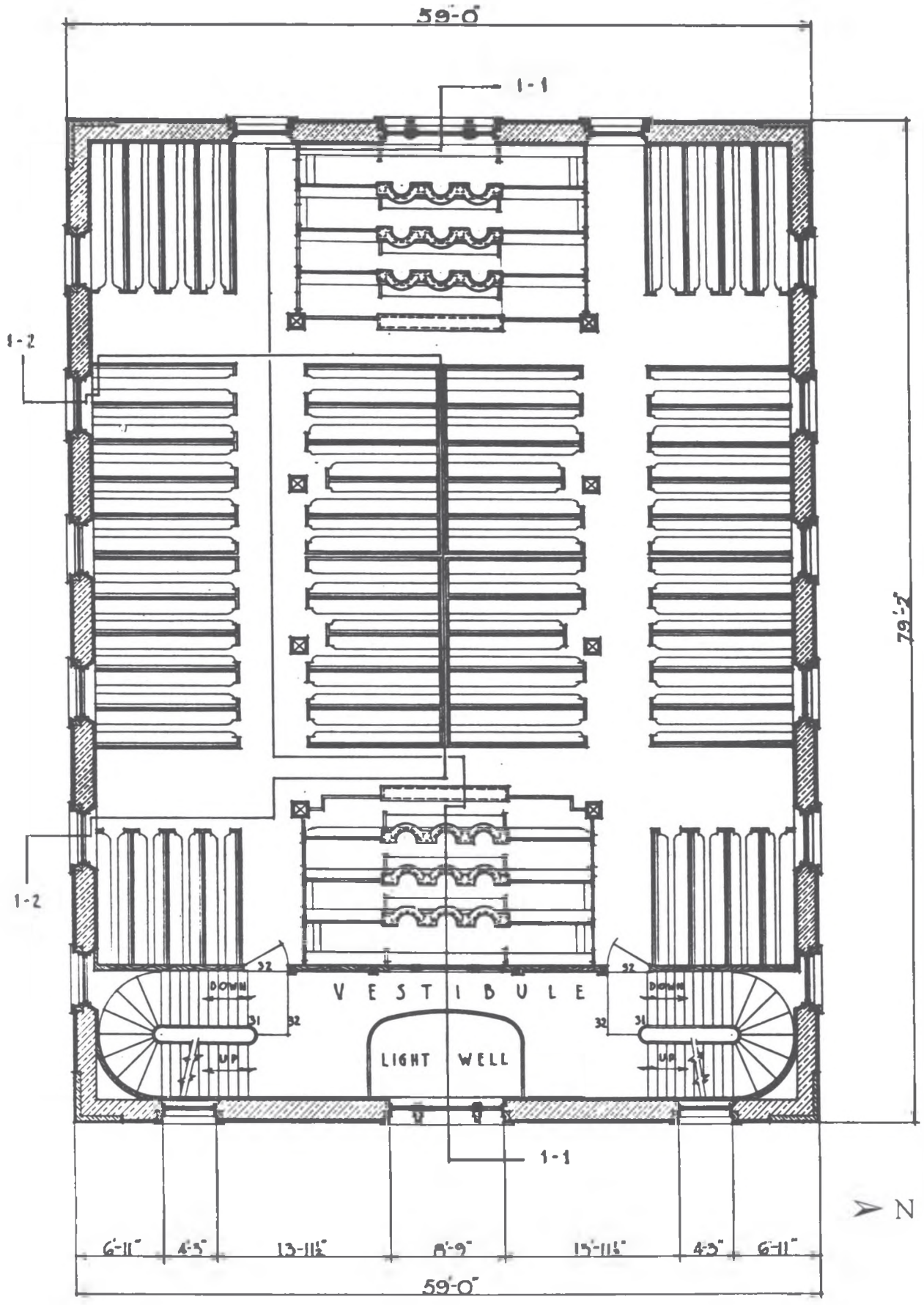

Fig 3-6b. Plan of the upper court, Kirtland Temple, drawn March 1934 by Veredon W. Upham. Courtesy Library of Congress.

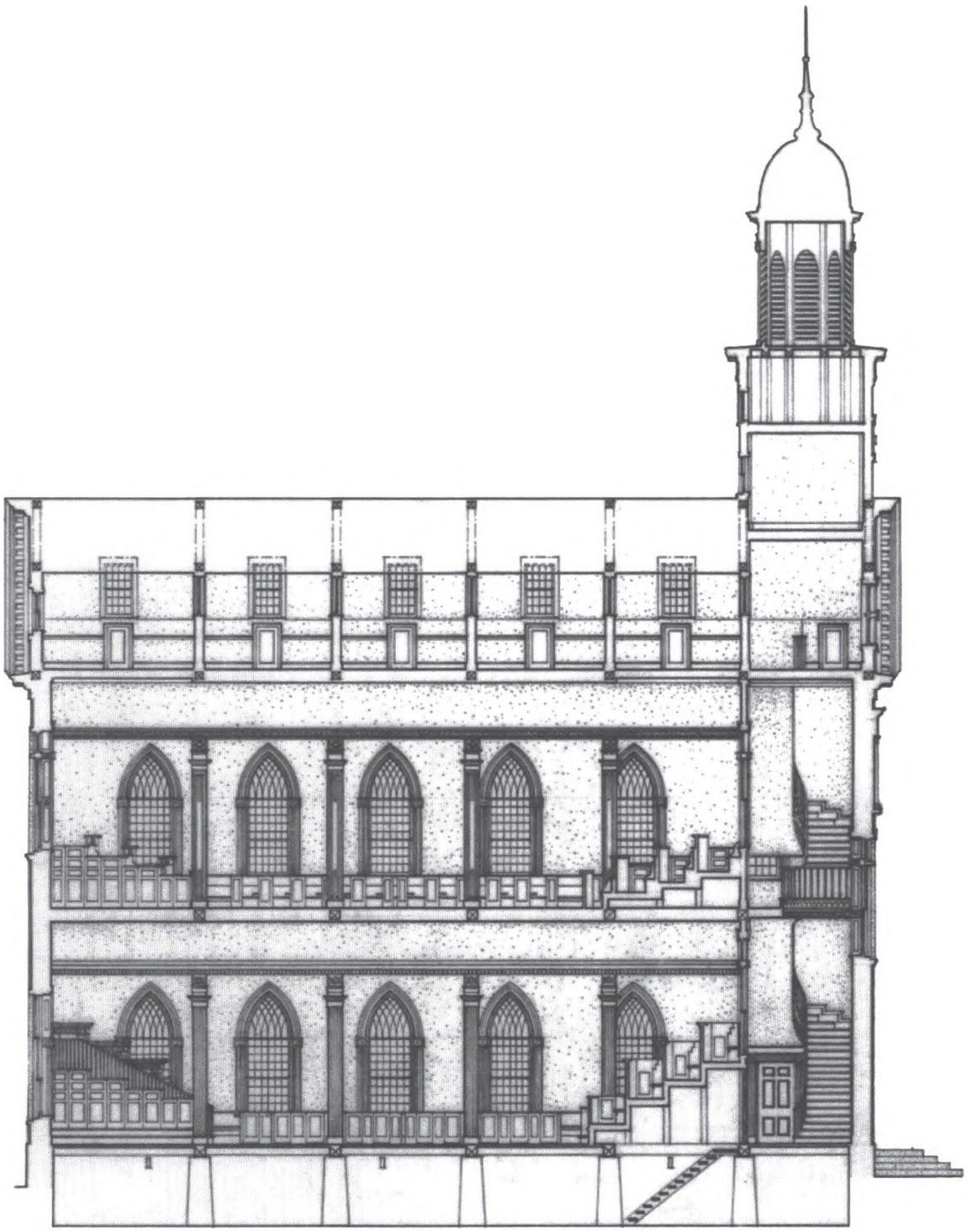

Fig 3-7. Longitudinal section, Kirtland Temple, drawn March 1934 by Verdon W. Upham. Courtesy Library of Congress.

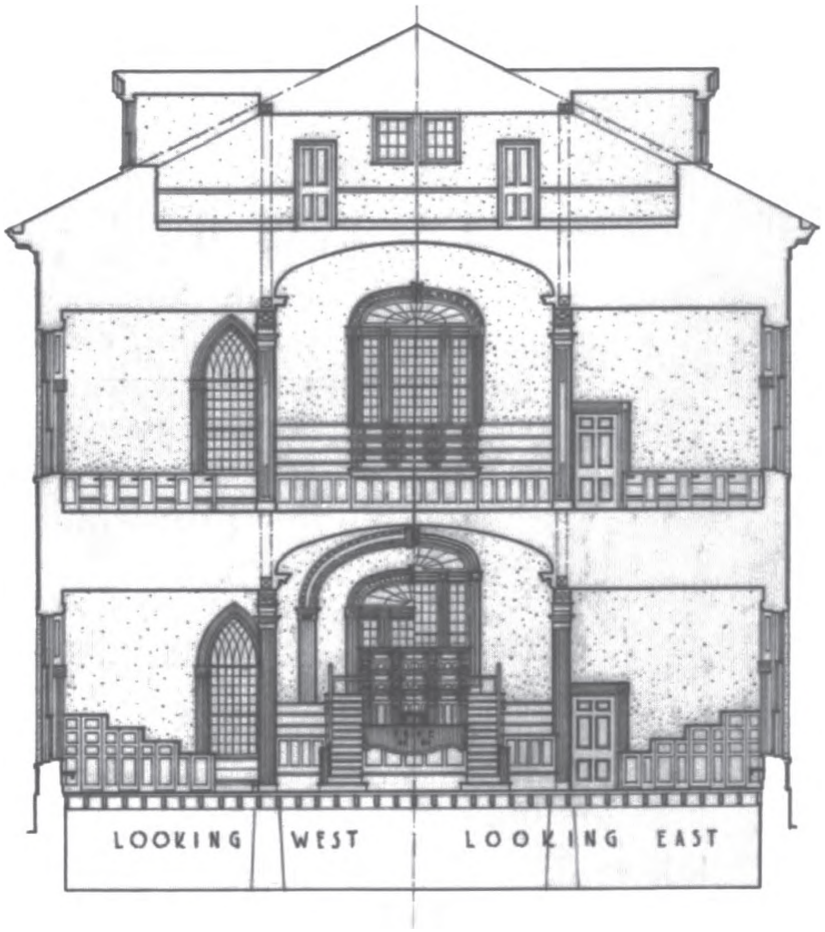

Fig 3-8. Transverse section, Kirtland Temple, drawn March 1934 by Verdon W. Upham. Courtesy Library of Congress.

in the courts and gradually lengthen as they approach the westernmost bay, with a maximum spacing of about fourteen feet, measured center to center. This irregular spacing creates a variety of problems, indicating that the builders who determined the bay spacing were unaware of its effect on the upper wall.

Columns and girders manage to miss the windows on the western half of the building, but unfortunately, the narrower bay spacing causes the easternmost girders (set into the vestibule wall) to frame into the masonry directly above a window. Although about eight feet of masonry separates the girder and the window opening (allowing the pressure of the girder load to spread out along the wall), stacking the girder and window puts unnecessary stress on the arch above the window.

In addition to adding structural stress, this uneven bay spacing causes the vestibule wall that separates the stairs from the lower and upper courts to cut awkwardly through a window opening (fig. 3-9). On the lower floor, raised choir seats in the corner would have further interfered with the window opening in the eastern corners. Later restorers simply chose to cover the window, boxing it in so it lights only the vestries (the small rooms located under the stairs). However, early descriptions indicate that

Photo by author.

Fig 3-9. Interior detail, upper court, showing the vestibule wall intersecting a window.

the lower-court window was originally treated like that in the upper court, with an awkwardly shaped portion of the window peering into the corner of the room.[26]

Since the joists have the same cross section throughout the lower-court floor, the variation in spans in the joists—from twelve feet, center to center, at the east end of the court to fourteen feet, center to center, at the west—supporting the lower-court floor results in a 20 percent difference in bending stresses.[27] Even with the specified ten-foot bay under the vestibule, dividing the remaining sixty-five-foot court into even thirteen-foot intervals would have stressed the joists more uniformly and safely and would have avoided a girder framed above a window.

Further evidence of this lack of coordination between foundation construction and the design of upper sections of the temple is found in the three masonry piers built under the vestibule wall to carry columns supporting the belfry (figs. 3-10 and 3-11). The central pier is unused because the windows in the interior vestibule wall are directly above it. The column would run right through the center of the window, obviously an unsatisfactory arrangement. Remember that this window arrangement was clearly described in the specifications for the Independence Temple. However, just as Joseph Smith, Sidney Rigdon, and Frederick G. Williams were unable to anticipate the effect elliptical vaults in the ceiling would have on the total height of the structure, the builders who placed the foundations either did not understand the interrelationship between the foundation and the supporting walls and columns or, more likely, did not have the design explained to them in sufficient detail to avoid such errors.

Conclusion

After his brief consulting visit in the fall of 1833, Millett returned to Canada to close his business and sell his holdings (on credit—he was never

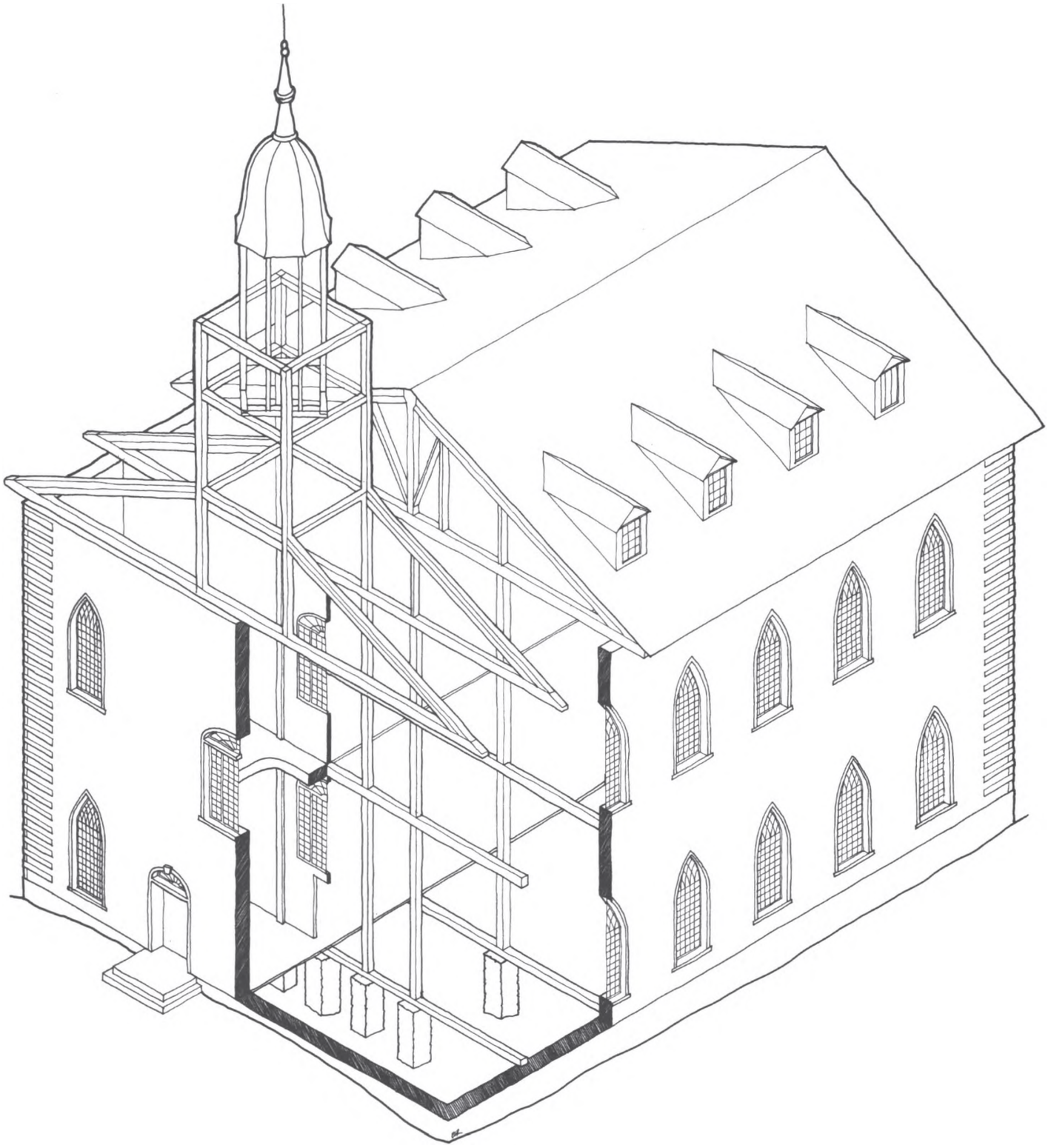

Fig 3-10. Cutaway axonometric showing the masonry piers, vestibule wall, and major framing timbers of the roof and tower.

fully paid).[28] Millett's journal does not state how long his initial visit to Kirtland lasted, but it probably was not long. Millett's son reported that Millett was sustained by vote as superintendent of the construction site, but that he left Jacob Bump and Reynolds Cahoon in charge while he returned to Canada. Since he arrived after the closing of the work site in October and would have returned to Canada before the icing over of the Lake Erie and Lake Ontario ports by late December, his visit could have lasted at most two months.[29] However, since he had over thirty masons working for him in Ontario,[30] he had to hurry back to supervise work in Canada and probably left in a matter of weeks. Except for workers stockpiling stone and seasoning timbers to be used the next year,[31] the work site was largely inactive until Millett's return the following spring.

Photo by author.

Fig 3-11. Detail of unused masonry pier directly under the window in the center of the vestibule wall. There is no physical connection between the pier and the girder above. Also visible are the large cast-iron pipe of the sprinkler system and smaller conduit carrying electric wiring.

Notes

[1]Lucy Mack Smith, "History of Lucy Smith," 189. This written history was later edited and published as the *History of Joseph Smith by His Mother* with the corresponding passages found on p. 230 of the 1979 edition.

[2]Lucy Mack Smith, "History of Lucy Smith," 189–90. The edited version reads as follows: "In a few minutes the fence was removed, and the standing grain was levelled, in order to prepare a place for the building and Hyrum commenced digging a trench for the wall, he having declared that he would strike the first blow upon the house." Lucy Mack Smith, *History of Joseph Smith*, 231.

[3]*History of the Church*, 1:353: "Hyrum Smith and Reynolds Cahoon commenced digging the trench for the walls of the Lord's house, and finished the same with their own hands." See also George Smith, "Memoirs," 8.

[4]Benjamin Johnson, *Life Review*, 11.

[5]*History of the Church*, 1:400.

[6]"When the corner stones were laid in Kirtland, they had to pick up boys of fifteen and sixteen years of age, and ordain them Elders, to get officers enough to lay the Corner Stones." Brigham Young, in *Journal of Discourses*, 1:133, April 6, 1853. In November 1859, George A. Smith listed from memory the twenty-four elders who participated in the ceremony: Jacob Bump, Reynolds Cahoon, Gideon H. Carter, Jared Carter, Joseph Coe, Edmund Durfee, David Elliot, Levi W. Hancock, Solomon

Humphreys, Orson Hyde, Joel H. Johnson, Joseph C. Kingsbury, Sidney Rigdon, Harpin Riggs, Don Carlos Smith, Hyrum Smith, John Smith, Joseph Smith Jr., Joseph Smith Sr., Samuel H. Smith, Sylvester Smith, William Smith, Newel K. Whitney, and Frederick G. Williams. Jenson, Journal History, July 23, 1833, 1–2. (6a)

[7]The total debts incurred in 1836–37 by Joseph Smith and cosigners may have exceeded $100,000.00. Hill, Rooker, and Wimmer, "Kirtland Economy Revisited," 24–29. However, it should be noted that these authors concluded that if financial conditions had not changed in 1837 that Joseph Smith would have been able to pay his obligations.

[8]*History of the Church*, 1:366.

[9]"While the basement was going up Jacob Bump and Reynolds Cahhoon were left in charge of the work while Artimus Millett went back, finished his contract in Canada then returned bringing his family to kirtland." Joseph Millet, "Millet on C B Island," 92. Note that Artemus Millett's own account indicates that the foundation was finished before his arrival in Kirtland. Artemus Millett, Reminiscences.

[10]Petraus and Triggs, "Report of Subsurface Investigation."

[11]The strength of a beam in bending is proportional to its second moment of inertia, which for a beam of rectangular section is given by $I = bh^3/12$, where I = the second moment of inertia, b = the width of the beam, and h = the depth of the beam. For a vertically oriented girder with a 9" by 12" cross section, $I = (9)(12^3)/12 = 1296$ in^4. For the horizontally oriented girder, $I = (12)(9^3)/12 = 729$ in^4.

The Historic American Building Survey drawings prepared under the WPA program show slightly larger dimensions for the girders, but as with most long timbers, the dimensions vary along their length. Actual widths vary from 11 1/2" to 14", and depths vary from 7" to 9 3/4". However, the median measurements are approximately 9" by 12".

[12]*History of the Church*, 2:410.

[13]Graffiti on the prop supporting this failed girder dates from 1918, which serves as a post rem date. Repairs to the joists at the point of breakage use crudely cut plate steel with well-oxidized surfaces consistent with the 1918 date.

[14]Kelley and Blakesee, "Report of Committee on Kirtland Temple," 560.

[15]The specifications for the Independence Temple called for brick walls, and the same material was originally intended for Kirtland. Independence Temple drawings, signed set. See also *History of the Church*, 1:361.

[16]*History of the Church*, 1:336; Joel Johnson, "Journal or Sketch," 8. See also Benjamin Johnson, *Life Review*, 10.

[17]Ames, Autobiography and Journal; Williams to Saints in Missouri. Peter French, who sold the farm and kiln to the Saints, had previously built himself a two-story brick home. Holzapfel and Cottle, *Old Mormon Kirtland and Missouri*, 59, 60. Just what the problem with the brick manufacture was is not stated, but a likely possibility is that insufficient sand was mixed in with the clay, which results in excess shrinkage after firing causing crumbling, fractured bricks.

[18]*Painesville Telegraph*, May 1, 1832, 3. *Painesville Telegraph*, December 7, 1832, 4. A rough estimate of the number of bricks required to build the temple with twenty-four-inch-thick walls is thirty-five thousand.

[19]"In January 1833 I was baptized by Brigham Young in Loughborough—U.[pper] C.[anada] in the Summer Br. Hyrum Smith wrote to me that it was the will of the Lord that I should go and work on the Temple in Kirtland when I went the work was suspended, and I returned sold out on credit and took my family in April 1834 to Kirtland." Artemus Millett, Reminiscences.

[20]Artemus Millett, Reminiscences.

[21]One example among many such churches is the St. James Episcopal Church in Maitland, Ontario, built in 1826.

[22]Artemus Millett, Reminiscences.

[23]I am grateful to Priscilla Graham of Hudson, Ohio, for this observation.

[24]Joseph Millet, "Millet on C B Island," 92. See also Lumbard, "Family Chronicle," 9.

[25]The first set of drawings for the Independence Temple shows a side elevation (fig. 2-2) with five Gothic windows on each floor, while the revised set (fig. 2-6) has nine windows. Neither of these two plans was followed in the Kirtland Temple, which has six windows to each floor. However, both sets of

drawings show a regular spacing of the windows, clearly showing the intent of the designers to have as symmetrical a building as possible no matter how many windows were eventually placed on the structure.

[26]"The auditorium occupies all the rest of the first story, but one could wish that the wall which divided it from the vestibule need not have spoiled one of the beautiful windows at either end, thus leaving an ungainly half window in the auditorium." Mather, "Early Days of Mormonism," 209.

[27]The clear span of the joists in the vestibule is about 9 1/2' as opposed to 13 1/2' in the west bay, with corresponding center-to-center bay sizes of about 10' to 14'. Clear spans of the joists supporting the interior bays going from east to west increase from 12' 2 1/2" to 13' 6" along the south wall. Clear spans along the north wall are not as uniform because the central girder supporting the lower court is not parallel with the other girders, its north end being located approximately eight inches too far to the east.

[28]Artemus Millett, Reminiscences.

[29]Other trips made by Millett between Kirtland and Canada were taken by boat, see Millett, Reminiscences. Even when he had a wagon at his disposal, Millett only drove to the first port on Lake Ontario, avoiding the long journey around the lake. It was possible to walk across the ice, but Brigham Young's account of a six mile crossing across frozen Lake Ontario suggests that it was a risky proposition, see "History of Brigham Young," *Deseret News*.

[30]Joseph Millet, Record Book: "He had made lots of property there, in Earnesttown Upper Canada, Took contracts on Government roads, and Stone bridges, and building Stone houses, had employed over 30 Scotch masons."

[31]*History of the Church*, 1:353–54.