Quaking in the Boot:
Approaches to Seismic-Resistant Design in Historic Northern Italian Architecture

A non-degree-required thesis submitted to the
Master of Architecture Program
Department of Architecture

by

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Quaking in the Boot analyzes construction methods and materials from both historic vernacular Italian and modern contexts to develop a series of interventions aimed at preventing seismic-related damage. It challenges two assumptions or standard practices of architectural and structural design. First, that modern is always better—that newer materials and construction techniques are preferable and result in more force resistance and less damage. This can lead to forgetting historic methods that are effective and relate to local materials, craftsmanship, and history.

Second, this project challenges siloed approaches to design. Often architects, engineers, and historic preservationists work independently from, and linear to, each other. This thesis proposes a multilateral approach in which architecture, structure, historic preservation, and context are considered simultaneously during all phases of design.

Quaking in the Boot is based in Ferrara, Italy, because of two series of earthquakes—one in the 1570s, the other in 2012—that each resulted in multiple deaths and caused significant damage to the built environment. It uses the Palazzo di Renata di Francia as a case study to propose three distinct designs to enable the continued use of the building. All three respond to existing structural stabilization needs to both strengthen the structure and prevent damage from future earthquakes. The first maintains the existing elevations, as if the Palazzo has been frozen in time. The second allows for changes to the façades while ensuring coherence with the surroundings. The third proposal hypothesizes the building's eventual collapse; it uses more distinctive structural systems to enable the current walls to crumble while allowing for the continued use of the existing floor and roof.

Dedicated to

Mom, Dad, Carolyn, Will, Lauren,
Olivia, Madison, Hannah, and the
best friends anyone could ask for:

You have shown me more love and
supported me in more ways than
words can describe. I would not be
where I am today without you.
Thank you.

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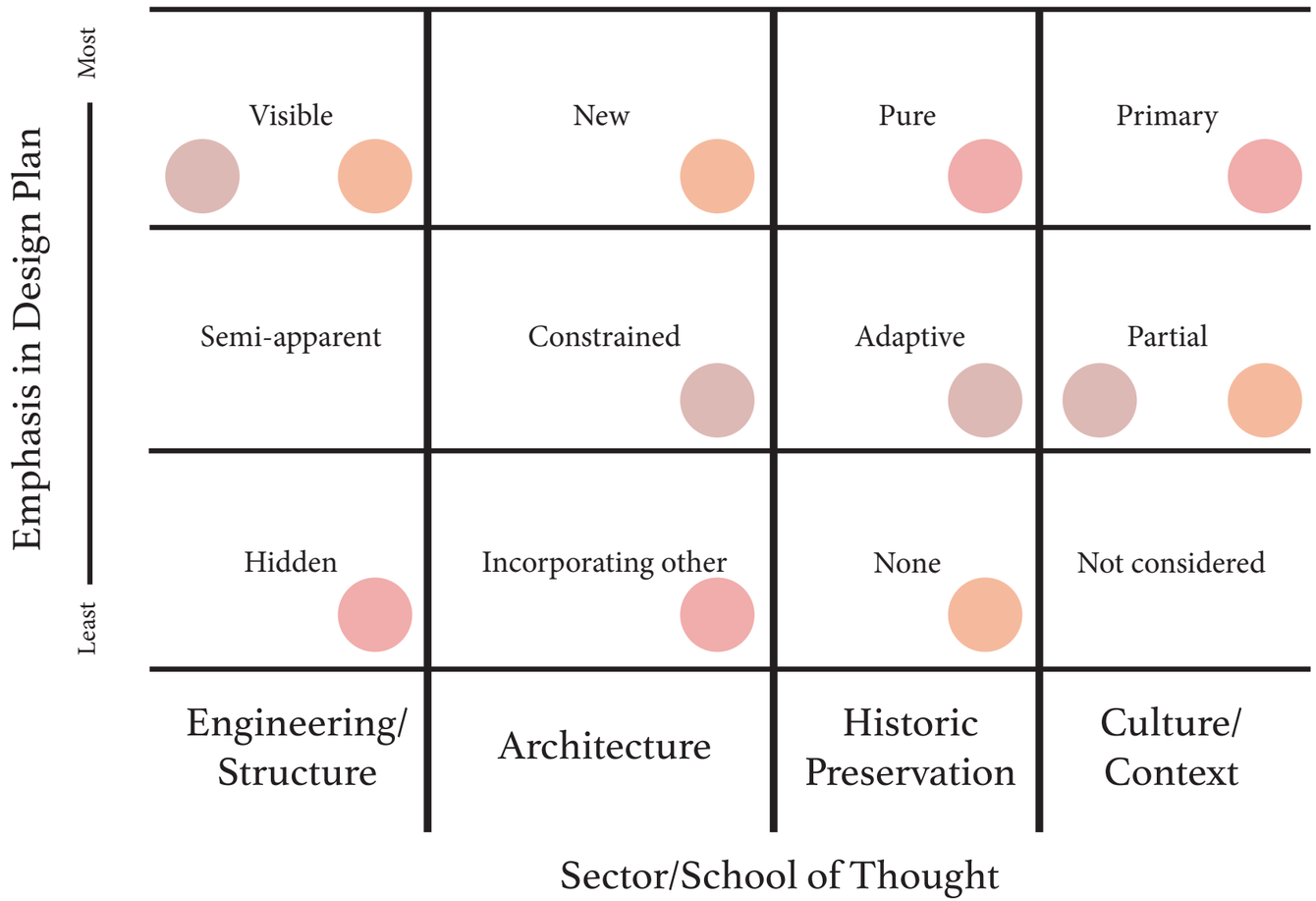
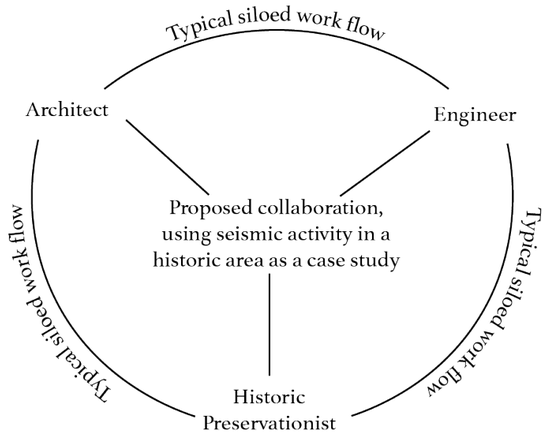
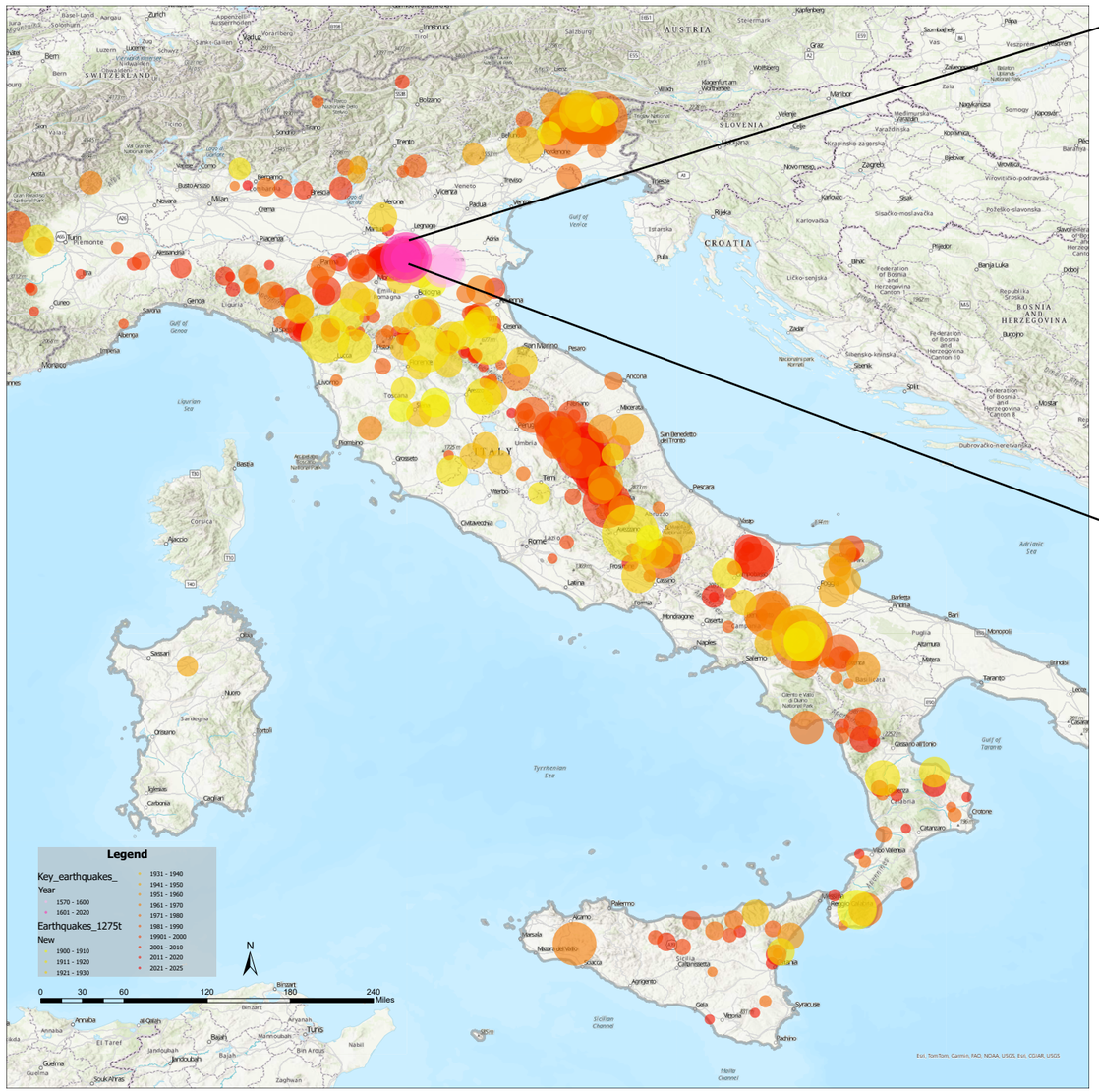
Pillar I: Collaborative approach to design

Pillar II: Combining modern and historic methods and materials

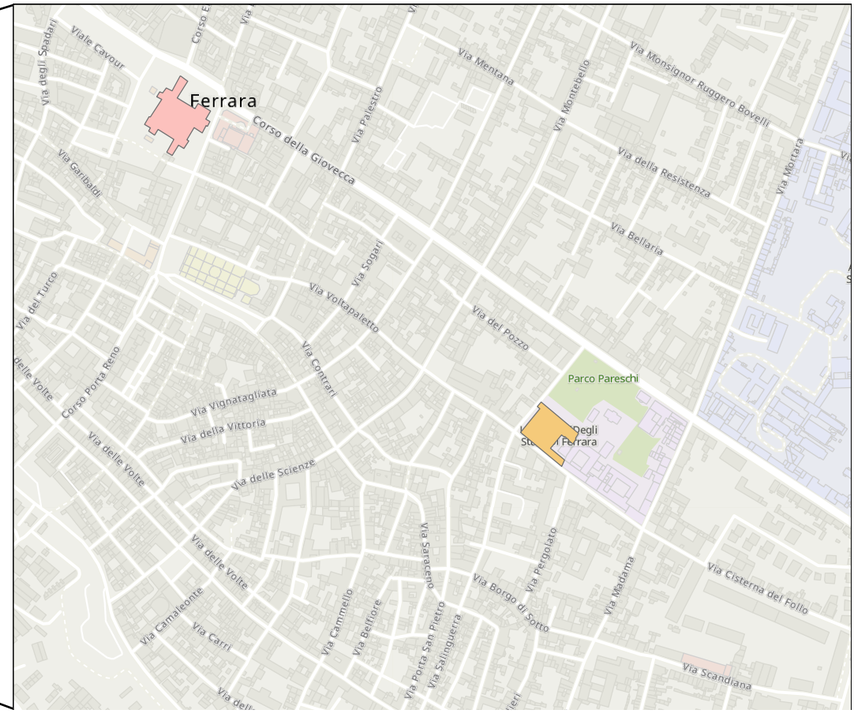




Thought matrix with design-specific orientations and proposed, multilateral approach



Map of earthquakes in Italy

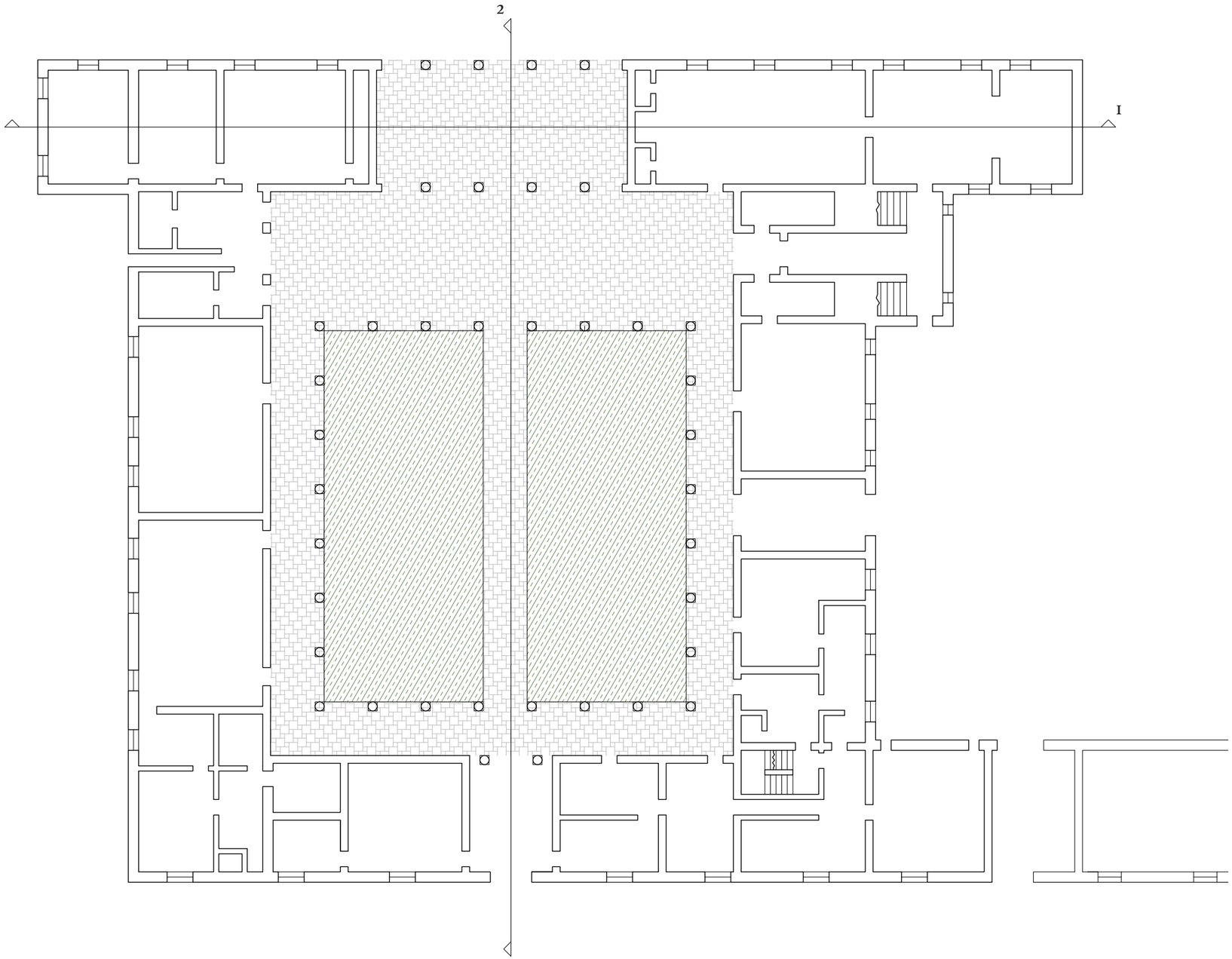


Pillar III: Seismic activity in Italy, specifically Ferrara

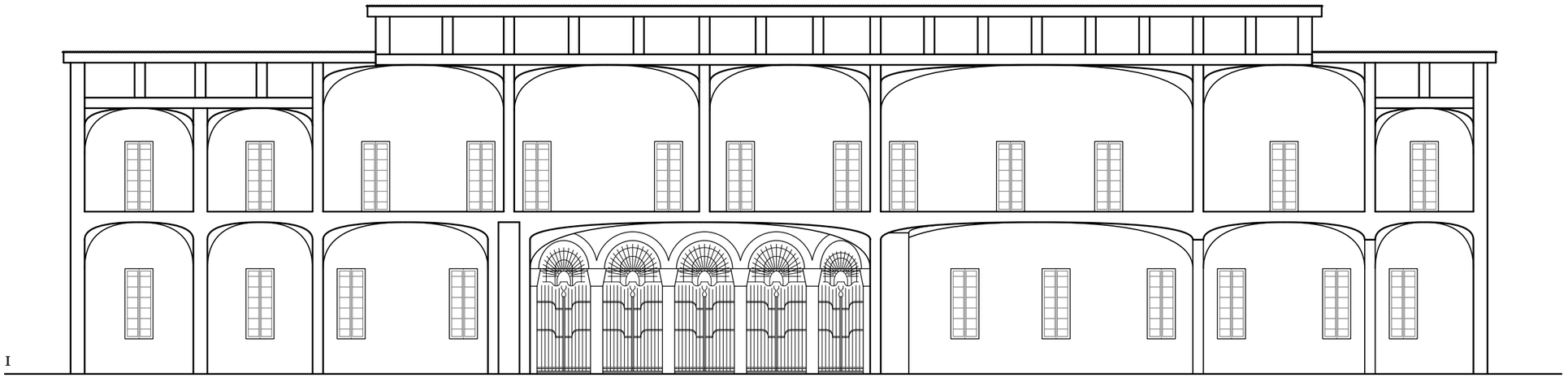
Map of Ferrara highlighting Castello Estense di Ferrara, top left in the town center, and the Palazzo di Renata di Francia, right

Case study: Palazzo di Renata di Francia

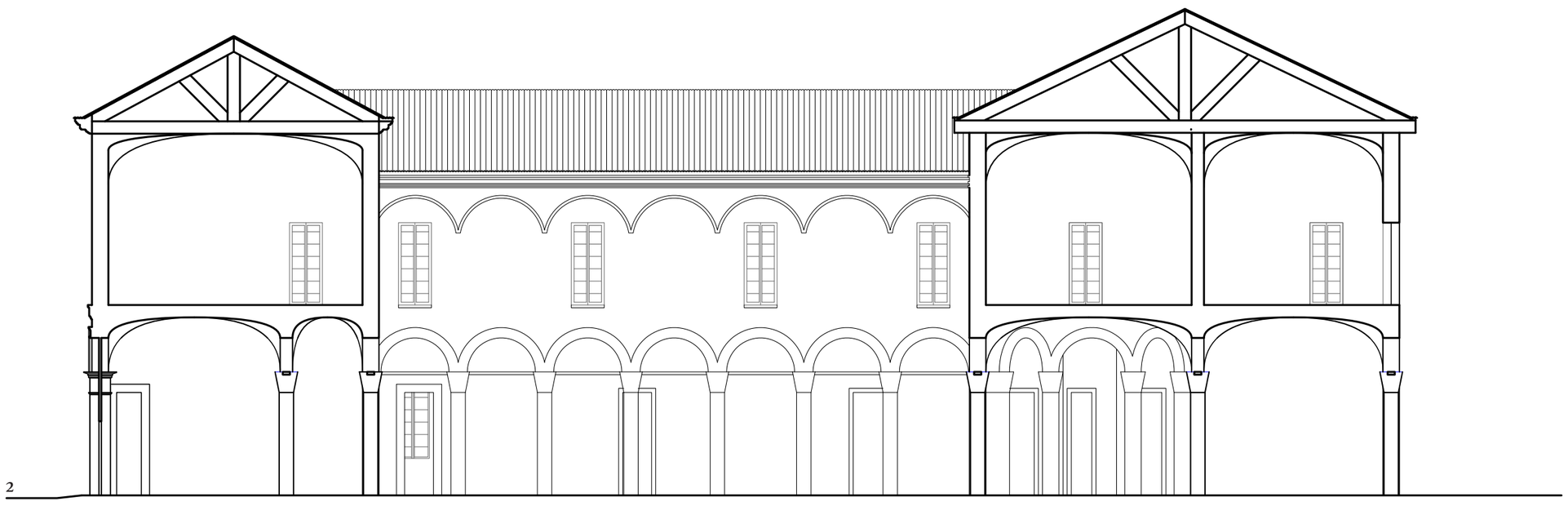
Street context



Existing conditions: ground-floor plan



1



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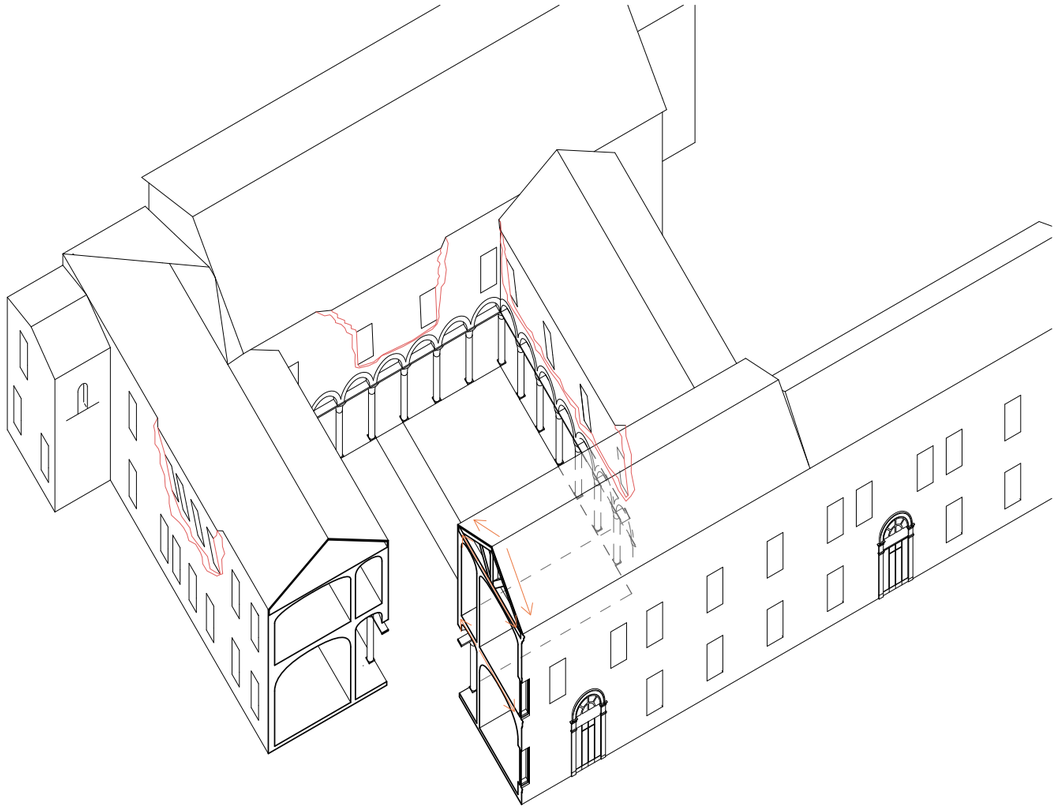
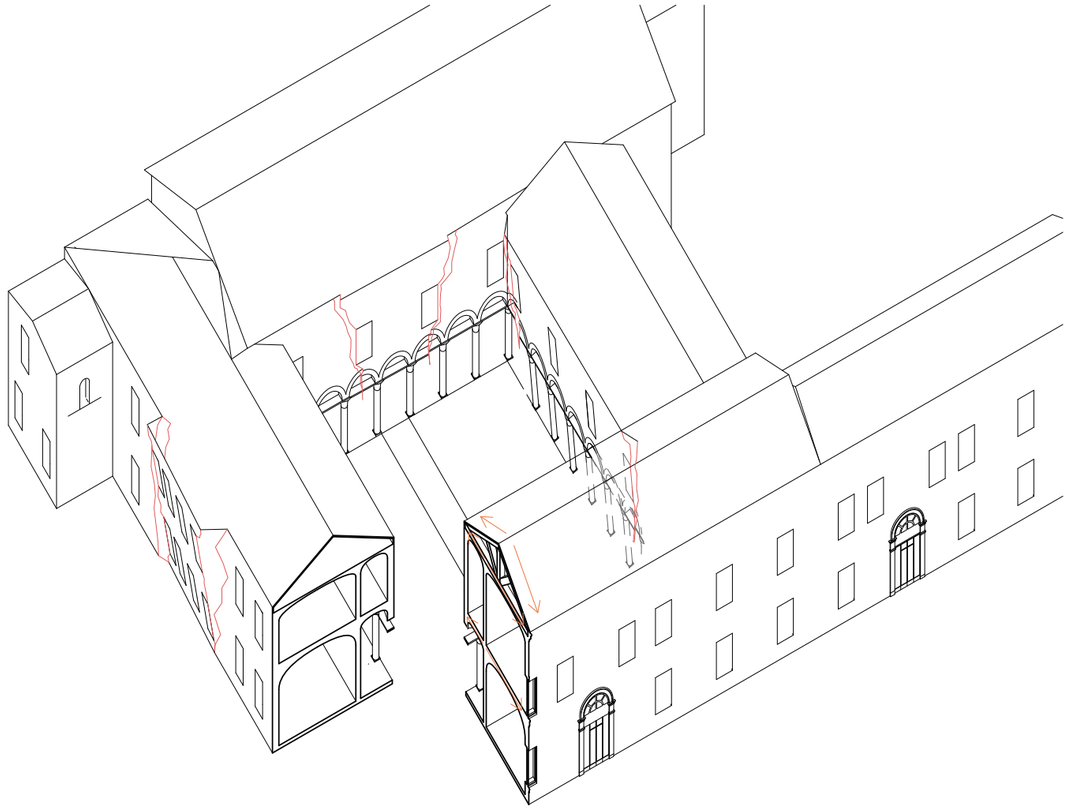
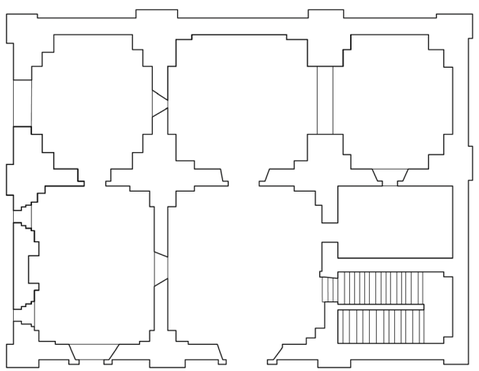
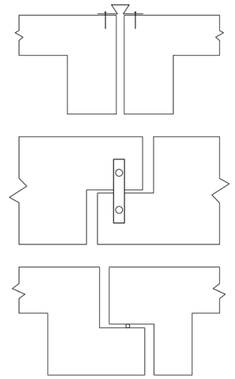
Existing conditions: sections



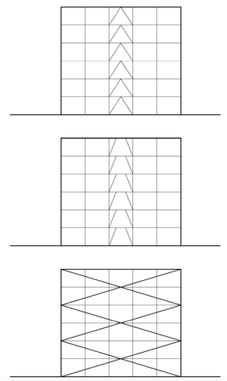




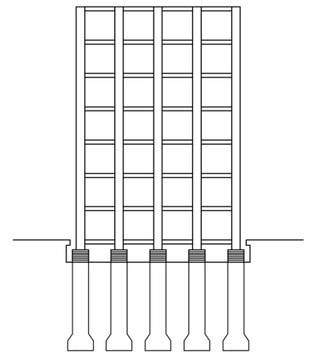
Thickened walls



Separation joints



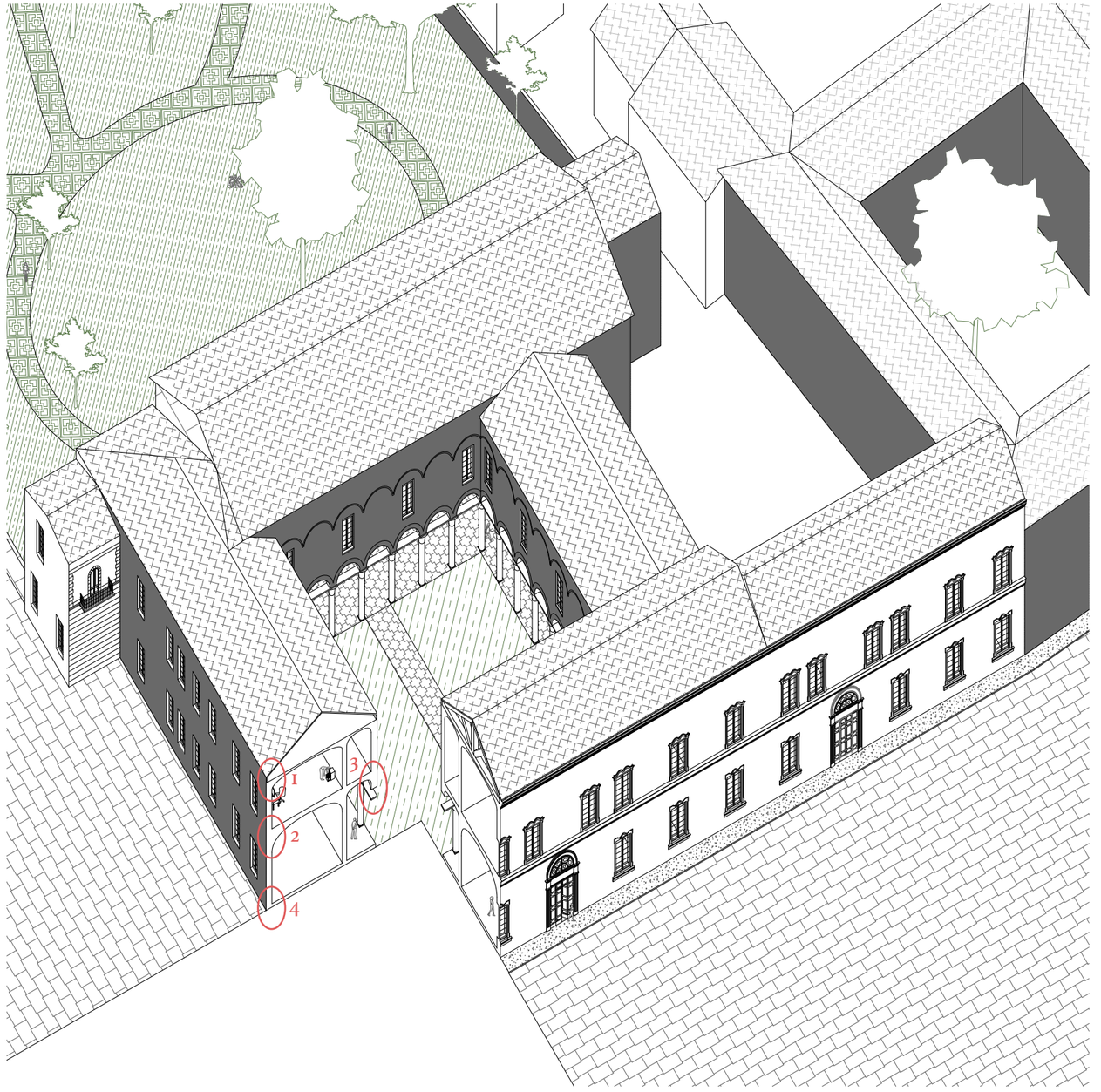
Bracing



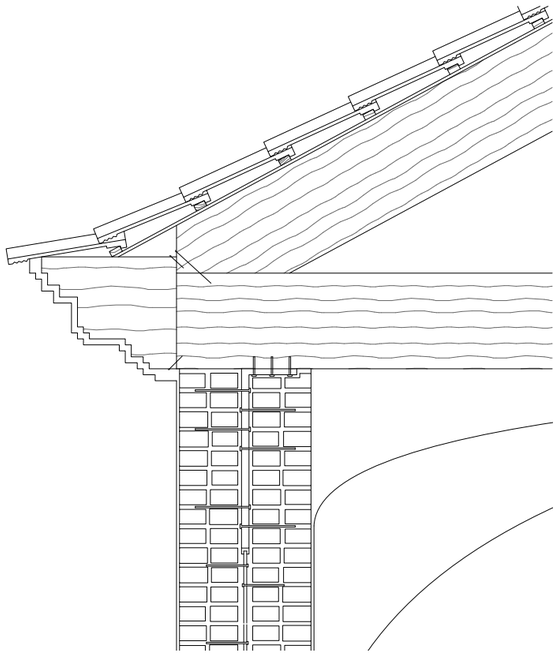
Base isolators

Likely failures and possible solutions

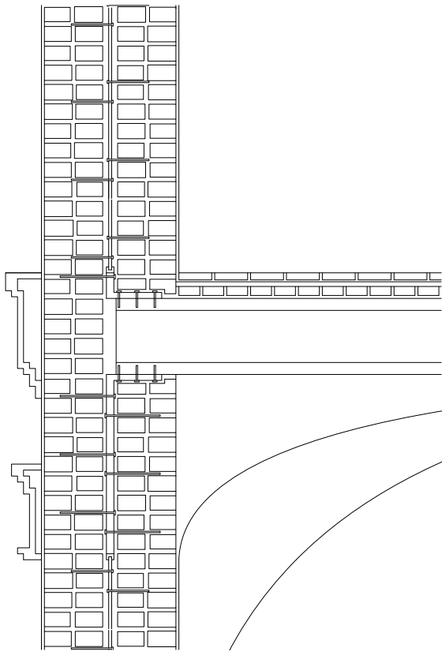
Structure: Hidden
Architecture: Incorporating Other
Historic Preservation: Pure
Culture and Context: Primary



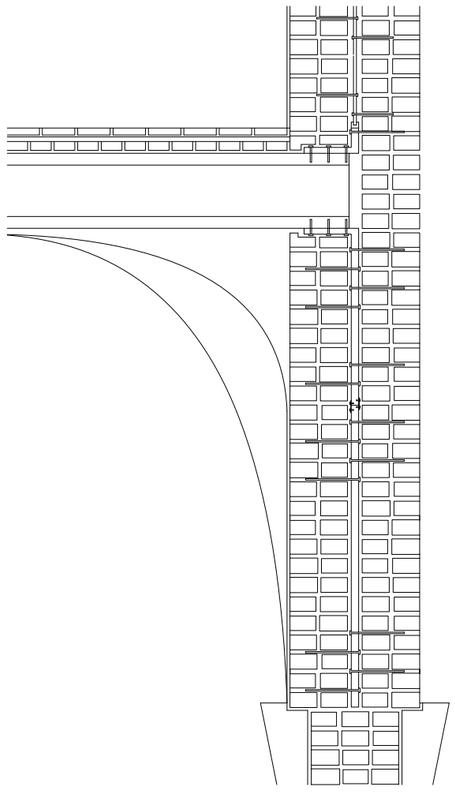
Design 1: In-wall preservation



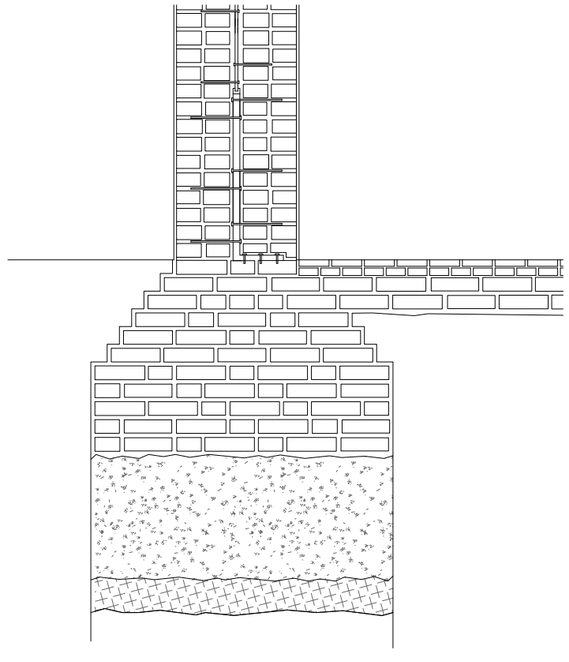
Detail 1: Roof-to-wall connection



Detail 2: Floor-to-wall connection

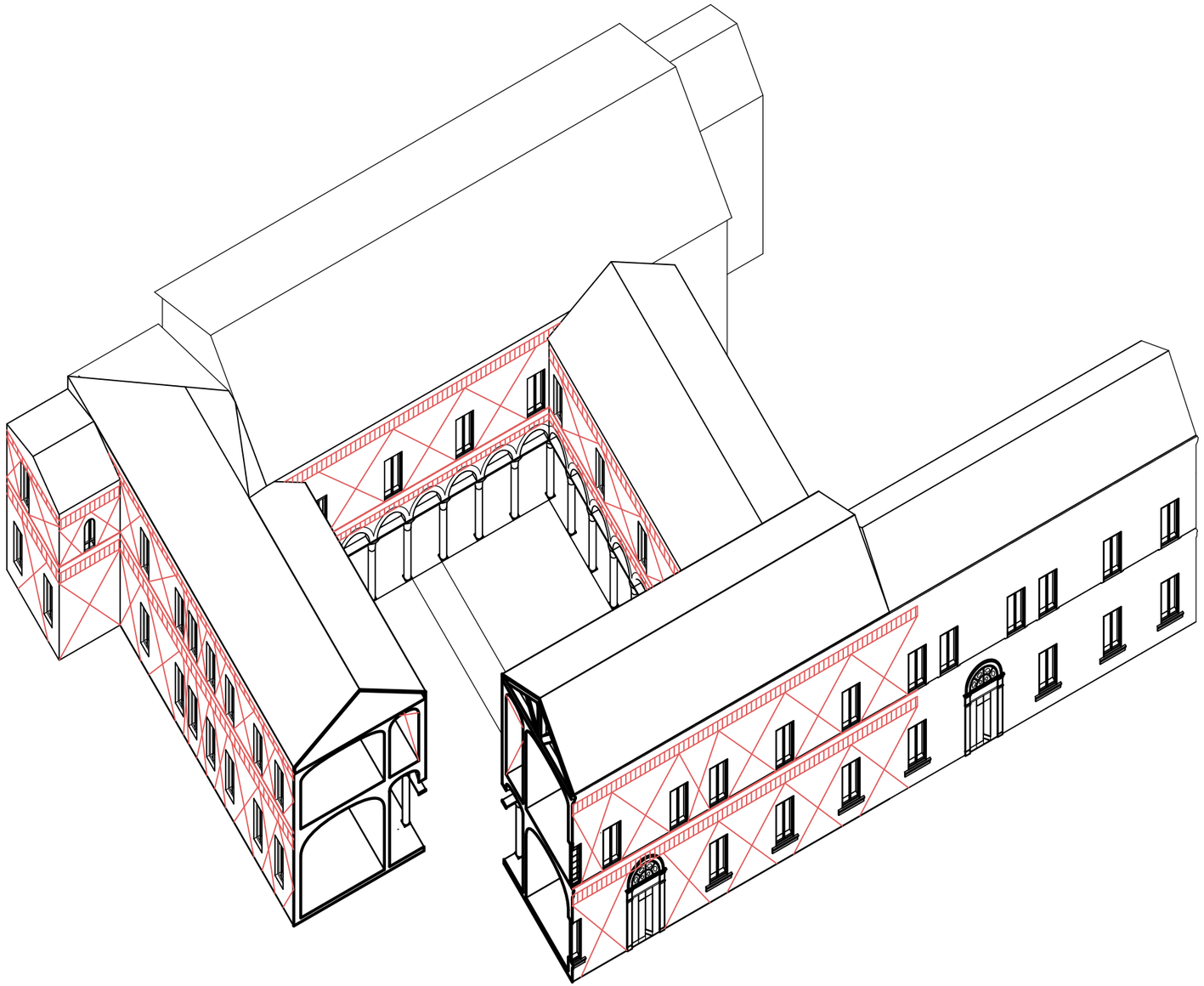


Detail 3: Column, wall, and floor connection



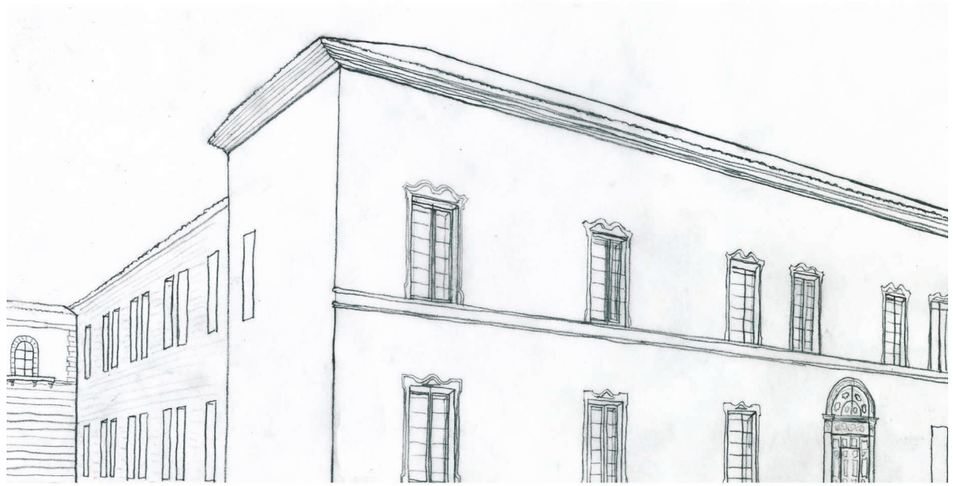
Detail 4: Foundation

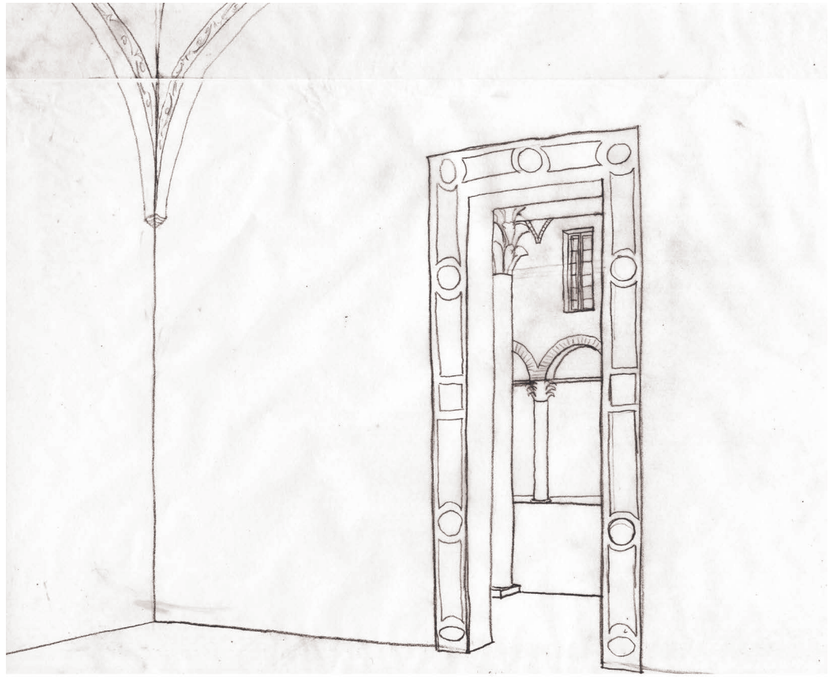
Design 1: In-wall preservation



Design 1 location diagram

Design 1: In-wall preservation



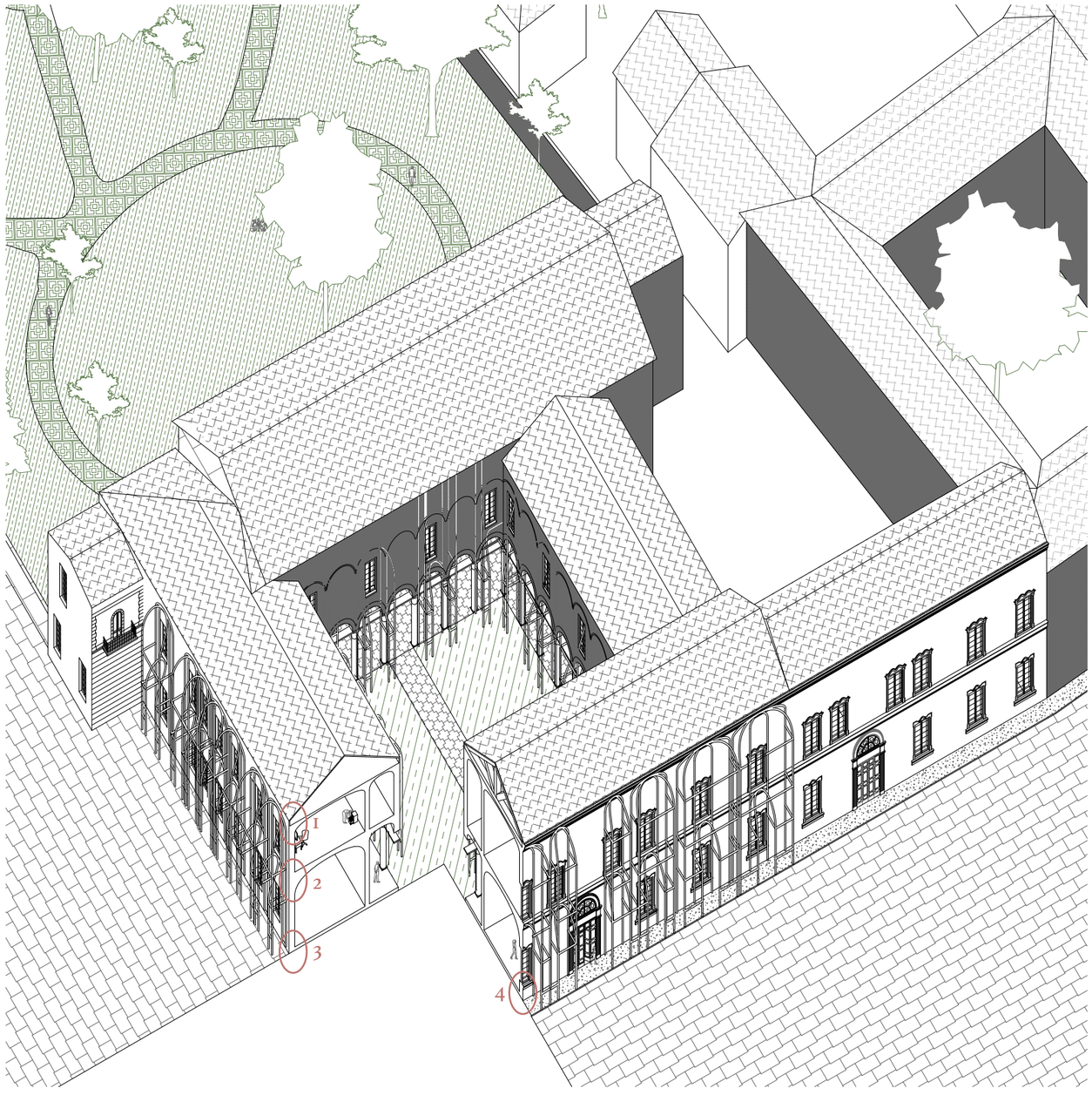


Design 1: In-wall preservation

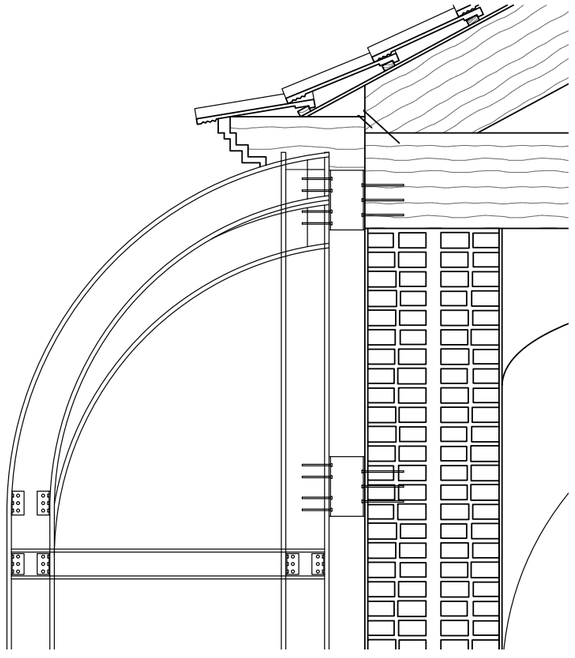
Design 1: In-wall preservation

Wall construction with Design 1 inserted into existing gap between brick wythes.

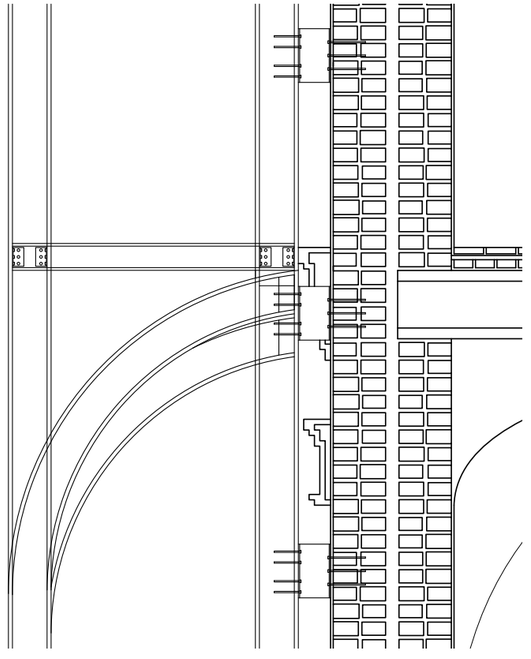
Structure: Visible
Architecture: Constrained
Historic Preservation: Adaptive
Culture and Context: Partial



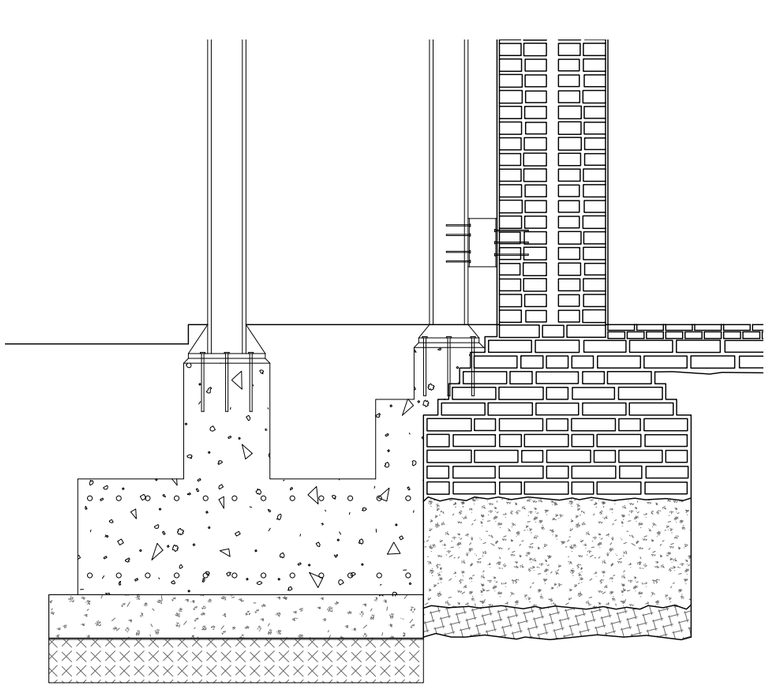
Design 1: Modern Buttressing



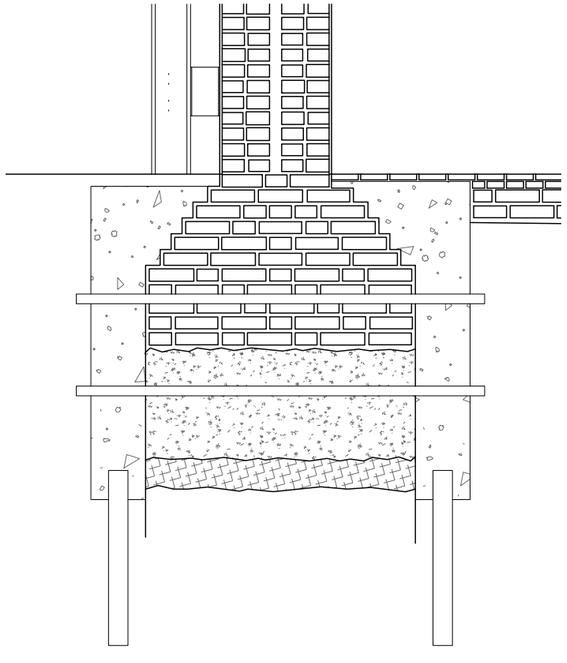
Detail 1: Roof-to-wall connection



Detail 2: Floor-to-wall connection



Detail 3: New foundation



Detail 4: Improved existing foundation

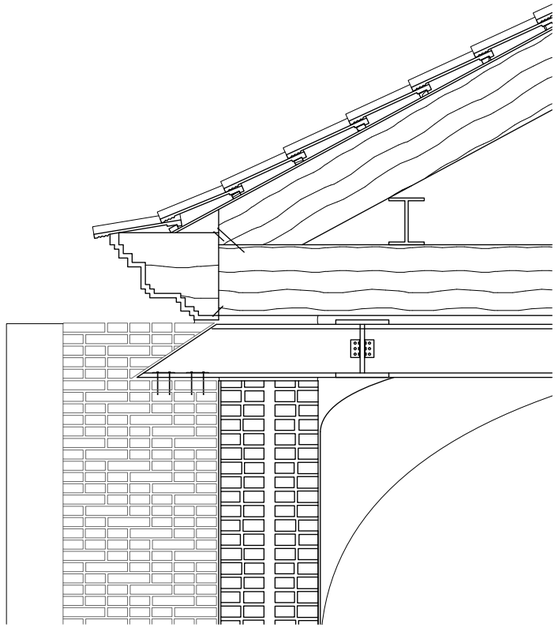
Design 1: Modern Buttressing

Design 1: Modern Buttressing

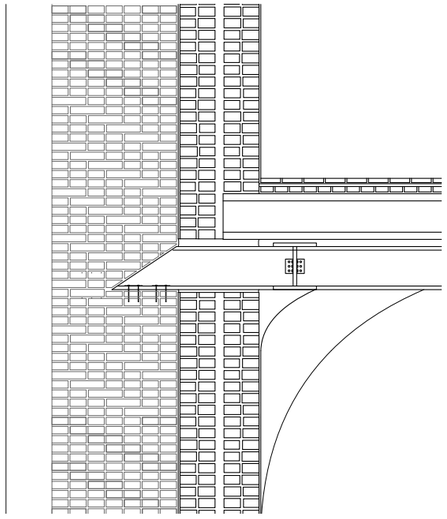
Design 1: Modern Buttressing

Structure: Visible
Architecture: New
Historic Preservation: None
Culture and Context: Partial

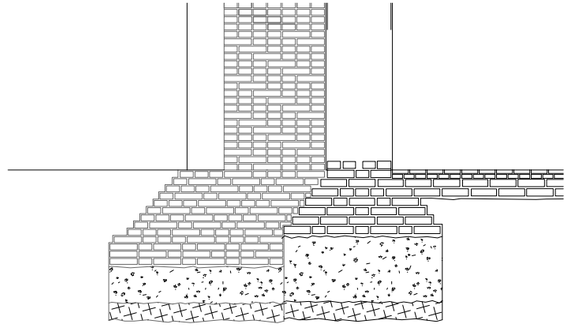
Design 1: Curated Deterioration



Detail 1: Roof-to-wall connection, new brick wall

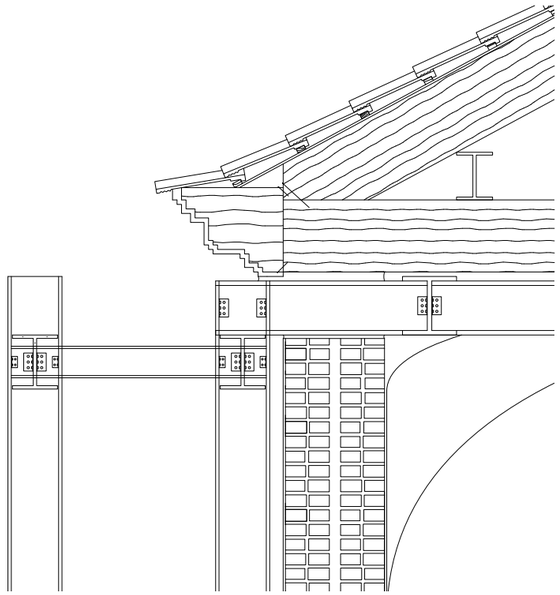


Detail 2: Floor-to-wall connection, new brick wall

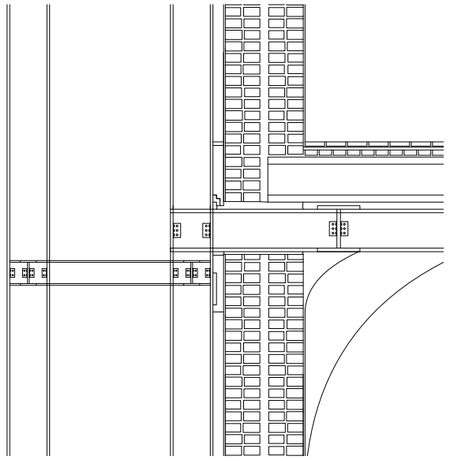


Detail 4: New brick wall foundation

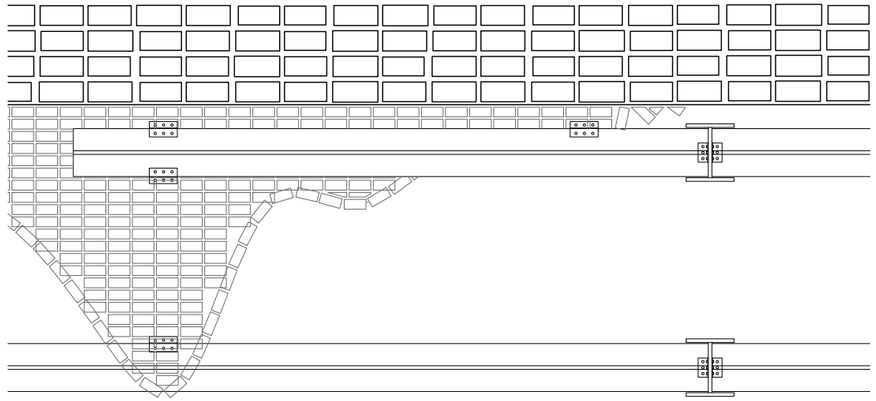
Design 1: Curated Deterioration



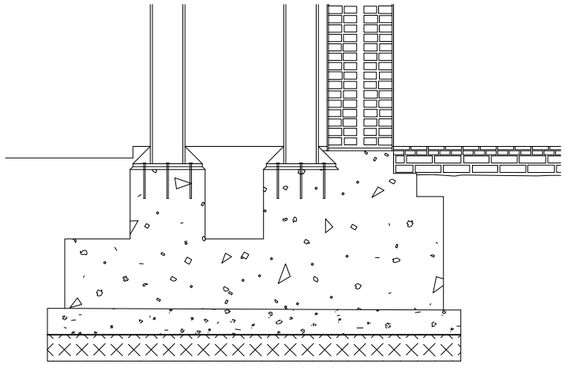
Detail 4: Roof-to-wall connection, steel scaffolding



Detail 5: Floor-to-wall connection, steel scaffolding

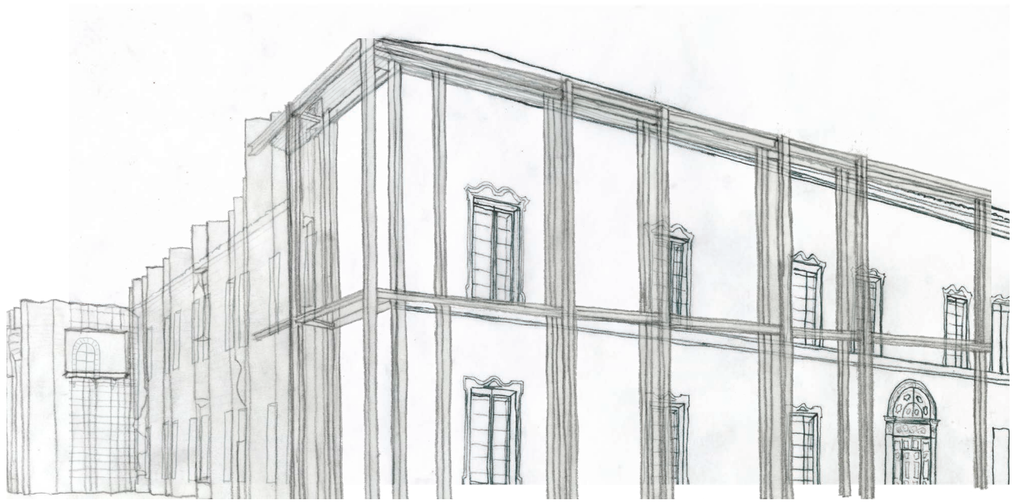


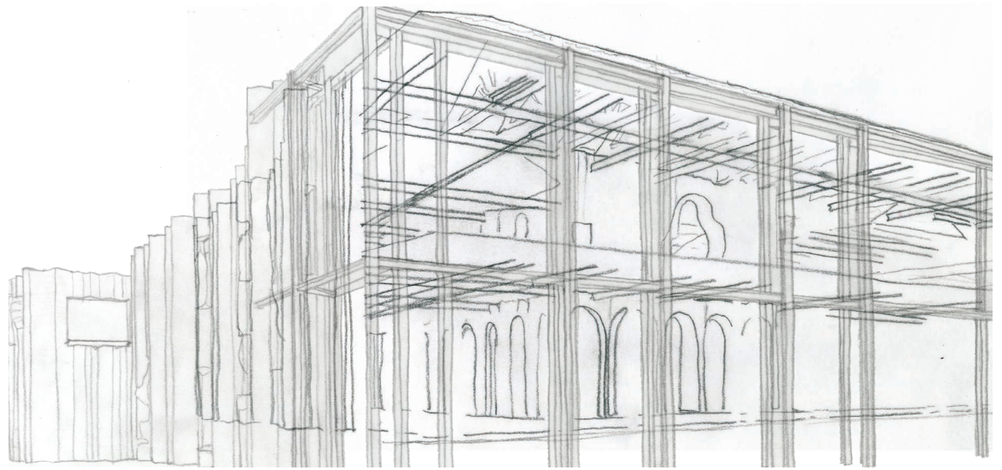
Detail 7: New brick wall and steel scaffolding connection, plan view



Detail 6: Foundation, steel scaffolding

Design 1: Curated Deterioration





After collapse of the walls, at which point the roof and floor systems are “caught” by the intervention.

Design 1: Curated Deterioration

Design 1: Curated Deterioration

Bibliography

Acito, Maurizio, Massimiliano Bocciarelli, Claudio Chesi, and Gabriele Milani. "Collapse of the clock tower in Finale Emilia after the May 2012 Emilia Romagna earthquake sequence: Numerical insight". *Engineering Structures* 72, no. 1 (August 2014): 70–91. https://doi.org/10.1016/j.engstruct.2014.04.026.

Allen, Edward and Joseph Iano. *Fundamentals of Building Construction: Materials and Methods*. Seventh ed. Hoboken, New Jersey: Wiley, 2019.

Allen, Katherine. "Lacaton & Vassal's FRAC Dunkerque is an Architectural Echo Both in Form and in Concept". ArchDaily, February 26, 2019. https://www.archdaily.com/911719/lacaton-and-vassals-frac-dunkerque-is-an-architectural-echo-both-in-form-and-in-concept.

Ambrose, James E. and Dimitry Vergun. *Design for Lateral Forces*. New York: Wiley, 1987.

Antoniades, Anthony C. *Architecture and Allied Design: An Environmental Design Perspective*. Dubuque, Iowa: Kendall/Hunt Pub. Co, 1980.

Ascher, Kate. *The Heights: Anatomy of a Skyscraper*. Penguin Books, 2011.

Balboni, Veronica. "Architectural language in urban vernacular architecture: An example about building traditions and distinctive features of historical architecture in Ferrara". *SFERA*, 2015. https://sfera.unife.it/handle/11392/2329349.

Bonasera, Francesco. *La Casa Rurale Nell'Umbria*. Rist. ed. L.S. Olschki, 1999.

Bordoni, P. "Vernacular architecture and seismic risk: The case of Mugello in Tuscany". In *Proceedings HERITAGE 2022 - International Conference on Vernacular Heritage: Culture, People and Sustainability*, edited by Universitat Politècnica de València (2022): 773–780. https://doi.org/10.4995/HERITAGE2022.2022.14369

Bouras, Dr. Effie, and Ghyslaine McClure. "Considering the Quake | Seismic Design on the Edge". 2012. Design Exchange, Toronto, Canada.

Branco, J. M., H. Varum, Vitor Ramisote, and A. Costa. Load-carrying capacity test of a long-span timber truss. In *Proceedings of the Institution of Civil Engineers – Structures and Buildings* 169, no. 5 (December 2015): 373 – 387. DOI:10.1680/jstbu.15.00006.

"Brick Size Standards Around the World". Civil Technologist (2025). https://civiltechnologist.com/brick-size-standards-around-the-world/.

"Bricks – Roman". Dimensions.com (2024). https://www.dimensions.com/element/brick-roman#:~:text=The%20actual%20dimensions%20of%20Roman,cultures%20throughout%20the%20Mediterranean%20region.

Caglioti, Benedetta. "Costabili Palace and the Architecture 'All'Antica' in Ferrara at the End of the XV Century". *Athens Journal of Architecture* 7 (March 2021): 173 – 198. https://doi.org/10.30958/aja.7-0-3.

Calzolari, Marta. "Numerical evaluation of environmental performance of a renaissance building to address a comprehensive retrofit strategy: the case of Palazzo Tassoni Estense in Ferrara (Italy)". *SFERA*, 2020. https://sfera.unife.it/handle/11392/2473703.

"Carlo Scarpa, Mario Botta, Valeriano Pastor: Fondazione Querini Stampalia". *Divisare*. Accessed December 1, 2024. https://divisare.com/projects/318723-carlo-scarpa-mario-botta-valeriano-pastor-riccardo-de-cal-francesco-castagna-fondazione-querini-stampalia.

Carocci, C. F., V. Macca, and C. Tocci. "The roots of the 18th century turning point in earthquake-resistant building". *History of Construction Cultures* 2 (2021): 623 – 630.

Carter, Thomas and Elizabeth Collins Cromley. *Invitation to Vernacular Architecture: A Guide to the Study of Ordinary Buildings and Landscapes*. University of Tennessee Press, 2005.

"Cathedral". Opera di Santa Maria del Fiore: Firenze 1296. Accessed December 1, 2024. https://duomo.firenze.it/en/discover/cathedral.

"Cathedral of Syracuse". *Wikipedia*, December 15, 2023. https://en.wikipedia.org/wiki/Cathedral_of_Syracuse.

Cattari, Serena, Stefania Degli Abbati, Daniele Ferretti, and Sergio Lagomarsino. "The seismic behaviour of ancient masonry buildings after the earthquake in Emilia (Italy) on May 20th and 29th, 2012". *Ingegneria Sismica* 29, no. 2 (July 2012): 87 – 119. https://www.researchgate.net/publication/262376542.

Cheloni, D., R. Giuliani, N. D'Agostino, M. Mattone, M. Bonano, G. Fornaro, R. Lanari, D. Reale, and S. Atzori. "New insights into fault activation and stress transfer between en echelon thrusts: The 2012 Emilia, Northern Italy, earthquake sequence". *Journal of Geophysical Research: Solid Earth* 121 (June 2016): 4742–4766. https://doi.org/10.1002/2016JB012823.

Civil Protection Department. "Seismic Classification". Accessed February 20, 2024. https://rischi.protezionecivile.it/en/seismic/activities/emergency-planning-and-damage-scenarios/seismic-classification/.

"City Hall Restoration Project". City and County of San Francisco. Accessed December 1, 2024. https://www.sfgov.org/cityhall/city-hall-restoration-project.

Clemente, Paolo, and Alessandro Martelli. "Seismically isolated buildings in Italy: State-of-the-art review and applications". *Soil Dynamics and Earthquake Engineering* 119 (April 2019): 471 – 487. https://www.sciencedirect.com/science/article/abs/pii/S0267726117308898.

CNN Wire Staff. "Another deadly earthquake shakes northern Italy". *CNN*, May 29, 2012. https://www.cnn.com/2012/05/29/world/europe/italy-earthquake/index.html.

Cosenza, Edoardo, Ciro Del Vecchio, M. Di Ludovico, M. Dolce, Claudio Moroni, Andrea Prota, and Emanuele Renzi. "The Italian guidelines for seismic risk classification of constructions: technical principles and validation". *Bulletin of Earthquake Engineering* 16, no. 1 (December 2018). DOI:10.1007/s10518-018-0431-8.

"Deadly earthquake rocks northern Italy". *Al Jazeera*, May 20, 2012. https://www.aljazeera.com/news/2012/5/20/deadly-earthquake-rocks-northern-italy.

"Deadly northern Italy earthquake hits heritage sites". *BBC*, May 20, 2012. https://www.bbc.com/news/world-europe-18135898.

"Deadly quake shakes Italy". *Reuters*, May 29, 2012. https://www.reuters.com/news/picture/deadly-quake-shakes-italy-idINRTR32SQM/.

"Ferrara, City of the Renaissance, and its Po Delta". UNESCO, 2024. https://whc.unesco.org/en/list/733/.

Fischer, Scott. "Rod-to-Steel-Beam Connections for Anchor Tiedown Systems: Rod Welding, Brittle Failure, and Alternative Connections". Structural Engineering Blog. Simpson Strong-Tie (2025). https://seblog.strongtie.com/2018/09/rod-steel-beam-connections-anchor-tiedown-systems-rod-welding-brittle-failure-alternative-connections/.

"Florence Cathedral". *Wikipedia*, November 12, 2024. https://en.wikipedia.org/wiki/Florence_Cathedral.

"FRAC Dunkerque / Lacaton & Vassal". ArchDaily, February 12, 2014. https://www.archdaily.com/475507/frac-of-the-north-region-lacaton-and-vassal.

"Galleria Vittorio Emanuele II". *Wikipedia*, November 1, 2024. https://en.wikipedia.org/wiki/Galleria_Vittorio_Emanuele_II.

González, María Francisca. "LocHal Library / CIVIC architects + Braaksma & Roos architectenbureau + Inside Outside + Mecanoo". ArchDaily, January 16, 2019. https://www.archdaily.com/909540/lochal-library-mecanoo-plus-civic-architects-plus-braaksma-and-roos-architectenbureau.

Groth, Paul Erling and Todd W. Bressi. *Understanding Ordinary Landscapes*. Yale University Press, 1997.

Guidoboni, Emanuela. "Riti di Calamità: Terremoti a Ferrara Nel 1570-74." *Quaderni Storici* 19, no. 55 (1) (1984): 107–35. http://www.jstor.org/stable/43777225.

—. "Terremoti e Storia Trenta Anni Dopo." *Quaderni Storici* 50, no. 150 (3) (2015): 753–84. http://www.jstor.org/stable/43780308.

—. "When Towns Collapse: Images of Earthquakes, Floods, and Eruptions in Italy in the Fifteenth to Nineteenth Centuries". In *Wounded Cities: The Representation of Urban Disasters in European Art (14th-20th Centuries)*, edited by Marco Folin and Monica Preti, 33 – 57. Brill, 2015. https://doi.org/10.1163/9789004300682_003.

Guidoboni, Emanuela, and Marco Folin. "Terremoti a Ferrara e nel suo territorio: un rischio sottovalutato". *Ferrara: Voci di una Città*, 2010. https://rivista.fondazioneestense.it/it/2010/item/735-terremoti-a-ferrara-e-nel-suo-territorio-un-rischio-sottovalutato.

"Il Terremoto dell'Emilia del 2012". *ISAAC*, 2024. https://isaacantisismica.com/terremoto-emilia-2012/.

ISAAC. "The 2012 Emilia Earthquake". Accessed February 20, 2024. https://isaacantisismica.com/en/2012-emilia-earthquake/.

Jackson, Patrick. "Italy earthquake: Why so many houses collapsed". *BBC*, October 2, 2016. https://www.bbc.com/news/world-europe-37522660.

Lagomarsino, Sergio, Serena Cattari, Daria Ottonelli, and Sonia Giovinazzi. "Earthquake damage assessment of masonry churches: proposal for rapid and detailed forms and derivation of empirical vulnerability curves". *Bulletin of Earthquake Engineering* 17 (2019): 3327 – 3364. https://doi.org/10.1007/s10518-018-00542-8.

Levy, Matthys and Mario Salvadori. *Why Buildings Fall Down: How Structures Fail*. New York: W.W. Norton, 1992.

—. *Why the Earth Quakes*. New York: W.W. Norton & Company, 1995.

Ligorio, Pirro. *Libro di Diversi Terremoti*. 1571. In "Edizione Nazionale delle Opere di Pirro Ligorio", Torino: Volume 28, edited by Emanuela Guidoboni. De Luca Editori d'Arte, 2016. https://www.delucaeditori.com/prodotto/opere-di-pirro-ligoriolibro-di-diversi-terremotitorino-volume-28/.

Lindeburg, Michael R. *Seismic Design of Building Structures: A Professional's Introduction to Earthquake Forces and Design Details*. 6th ed. Belmont, CA: Professional Publications, 1994.

Malvezzi, Roberto and Vincenzo Mallardo. "On the seismic vulnerability of a Renaissance 'palace with loggia': a limit analysis approach". Paper presented at the 2nd International Congress on Construction History, Cambridge, January 2006: 2055 – 2075. https://www.researchgate.net/publication/356716932.

Mark, Robert, ed. *Architectural Technology up to the Scientific Revolution: The Art and Structure of Large-Scale Buildings*. Cambridge, Mass: MIT Press, 1994.

Mascarenhas-Mateus, João and Ana Paula Pires, eds. *History of Construction Cultures*. Proceedings of the 7th International Congress on Construction History, Lisbon, Portugal, July 2021. Taylor & Francis. DOI: 10.1201/9781003173359.

Maybank, Geoff. "Traditional Brickwork". Cathedral Communications Limited (2019). https://www.buildingconservation.com/articles/traditional-brickwork/traditional-brickwork.htm#:~:text=Medieval%20brick%20sizes%20generally%20ranged,width%20being%20twice%20the%20height.

Meinig, D. W. (Donald William) and John Brinckerhoff Jackson. *The Interpretation of Ordinary Landscapes: Geographical Essays*. Oxford University Press, 1979.

Meroni, Fabrizio, Thea Squarcina, Vera Pessina, Mario Locati, Marco Modica, and Roberto Zoboli. "A Damage Scenario for the 2012 Northern Italy Earthquakes and Estimation of the Economic Losses to Residential Buildings". *International Journal of Disaster Risk Science* 8 (2017): 326 – 341. https://doi.org/10.1007/s13753-017-0142-9.

Nadeau, Barbie. "New quake rattles Italy after earlier tremor kills 7". *CNN*, May 21, 2012. https://www.cnn.com/2012/05/21/world/europe/italy-earthquake/index.html.

Nash, Art. "Foundation Retrofit and Rehabilitation". Trans. Nils Johanson and Richard D. Seifert. University of Alaska Fairbanks (1989; reviewed September 2021). https://www.uaf.edu/ces/publications/database/housing/foundation-retrofit.php.

Pagano, Giuseppe and Guarniero Daniel. *Architettura Rurale Italiana*. Ulrico Hoepli Editore, 1936. https://digit.biblio.polito it/4236/15/Architettura_rurale_italiana_G.Pagano_e_G.Daniel_compressed.pdf.

Pappas, Stephanie. "Medieval Earthquake Moved Italian River 12 Miles". *NBC News*, August 17, 2015. https://www.nbcnews.com/science/science-news/medieval-earthquake-moved-italian-river-12-miles-n411101.

Pezzella, Frances. "Who designed the first anti-seismic house? A lesson from history". Istituto Nazionale di Geoficisa e Vulcanologia, February 2021. https://www.ingv.it/en/newsletter-ingv-n-2-febbraio-2021-anno-xv/chi-ha-ideato-la-prima-casa-antisismica-una-lezione-dalla-storia.

Pianigiani, Gaia, and Elisabetta Povoledo. "Quake Exposes Italy's Challenge to Retrofit Its Architecture". *The New York Times*, August 26, 2016. https://www.nytimes.com/2016/08/27/world/europe/quake-italy-architecture.html.

"Preserving the Past while Shaping the Future". Turner Construction Company, 2024. https://www.turnerconstruction.com/projects/san-francisco-city-hall-seismic-renovation.

Przewłócki, I., I. Dardzińska, and J. Świniański. "Review of historical buildings' foundations". *Géotechnique* 55, no. 5 (June 2005): 363 – 372. https://www.icevirtuallibrary.com/doi/abs/10.1680/geot.2005.55.5.363?journalCode=jgeot.

Rudofsky, Bernard. *Architecture Without Architects: An Introduction to Non-pedigreed Architecture*. Museum of Modern Art, 1965.

Saggio, Antonino. *L'Opera Di Giuseppe Pagano Tra Politica e Architettura*. Dedalo, 1984.

Salinger, Joshua. "Detailing a Wall-to-Roof Truss Transition". Green Building Advisor (2025). https://www.greenbuildingadvisor.com/article/detailing-a-wall-to-roof-truss-transition.

Salvadori, Mario, Saralinda Hooker and Christopher Ragus. *Why Buildings Stand Up: The Strength of Architecture*. New York: Norton, 1980.

Sambin, Maria Teresa, ed. "Palace of Renata of France (Palazzo di Renata di Francia)". Ducato Estense (2022). https://ducatoestense.com/en/estensi/palace-of-renata-of-france-palazzo-di-renata-di-francia/.

"San Francisco City Hall". City and County of San Francisco. Accessed December 1, 2024. https://www.sf.gov/location/san-francisco-city-hall.

"San Francisco City Hall Seismic Upgrade". San Francisco Public Works. Accessed December 1, 2024. https://www.sfpublicworks.org/cityhall.

Sarkisian, Mark P. *Designing Tall Buildings: Structure As Architecture*. New York: Routledge, 2012.

"Scagliola". *Wikipedia*, July 17, 2024. https://en.wikipedia.org/wiki/Scagliola.

Scibilia, Federica. "Earthquake-Resistant Construction Techniques in Italy between 1880 and 1910: Alternatives to Reinforced Concrete." *Construction History* 32, no. 1 (2017): 63 – 82. https://www.jstor.org/stable/26489039.

Scopinaro, Eleonora. "Building techniques with limestone wall facing in the Umbrian-Marques area". PhD diss., University of Rome, 2018. https://iris.uniroma1.it/handle/11573/1109741.

"Seismic base isolation". *Wikipedia*, November 11, 2024. https://en.wikipedia.org/wiki/Seismic_base_isolation.

"Simple Connections". SteelConstruction.info. Accessed April 26, 2025. https://steelconstruction.info/Simple_connections.

Sirovich, L., and F. Pettenati. "Source inversion of the 1570 Ferrara earthquake and definitive diversion of the Po River (Italy)". *Journal of Geophysical Research: Solid Earth* 120, No. 8 (August 2015): 5747 – 5763. First published July 20, 2015. https://doi.org/10.1002/2015JB012340.

Sorrentino, Luigi, Laura Liberatore, Domenico Liberatore, and Renato Masiani. "The behaviour of vernacular buildings in the 2012 Emilia earthquakes". *Bulletin of Earthquake Engineering* 12 (2014): 2367–2382. https://link.springer.com/article/10.1007/s10518-013-9455-2.

"Steel Beam Connection Detail on top of Masonry Stone or Brick Load Bearing Wall". Structural Details (2025). https://structuraldetails.com/products/steel-beam-connection-detail-on-top-of-masonry-stone-or-brick-load-bearing-wall.

"Steel Column Footing Foundation Detail". Structural Details (2025). https://structuraldetails.com/products/steel-column-footing-foundation-detail.

"Street View". Google Maps (2025). https://www.google.com/maps/@44.8338699,11.6267614,15z?entry=ttu&g_ep=EgoyMDI1MDUwNy4wIKXMDSoASAFQAw%3D%3D.

Symonds, Richard. "Bricks Through History". Sussex Archaeological Society (November 2013). https://www.brocross.com/Bricks/Penmorfa/Bricks/Bits/BRICKS%20THROUGH%20HISTORY.pdf.

Taylor, Alan. "Earthquake in Northern Italy". *The Atlantic*, May 22, 2012. https://www.theatlantic.com/photo/2012/05/earthquake-in-northern-italy/100302/.

"The Cathedral". Siena Opera della Metropolitana. Accessed December 1, 2024. https://operaduomo.siena.it/en/the-cathedral/.

"The renovation of the Fondazione Querini Stampalia by Carlo Scarpa." ARCHIVIBE, 2021. https://www.archivibe.com/the-renovation-of-the-fondazione-querini-stampalia-by-carlo-scarpa/.

"Timber Roof with Clay Tiles Ridge Connection Detail". Structural Details (2025). https://structuraldetails.com/products/timber-roof-with-clay-tiles-ridge-connection-detail.

"Timeline of Italian architecture". *Wikipedia*, November 23, 2024. https://en.wikipedia.org/wiki/Timeline_of_Italian_architecture.

Tobriner, Stephen. "Building the Cathedral of Noto: earthquakes, reconstruction and building practice in 18th-century Sicily". *Construction and Building Materials* 17, no. 8 (December 2003): 521–532. https://doi.org/10.1016/S0950-0618(03)00051-5.

—. "Earthquakes and Planning in the 17th and 18th Centuries". *Journal of Architectural Education* 33, no. 4 (April 2015): 11–15. https://doi.org/10.1080/10464883.1980.11102616.

—. *The Genesis of Noto: An Eighteenth-century Sicilian City*. University of California Press, 1982.

—. "A History of Reinforced Masonry Construction Designed to Resist Earthquakes: 1755 – 1907". *Earthquake Spectra* 1, no. 1 (1984). https://doi.org/10.1193/1.1585260.

—. "La Casa Baraccata: Earthquake-Resistant Construction in 18th-Century Calabria". *Journal of the Society of Architectural Historians* 42, no. 2 (1983): 131–138. https://doi.org/10.2307/989827.

—. "Safety and Reconstruction of Noto after the Sicilian Earthquake of 1693—The Eighteenth-Century Context 1". In *Dreadful Visitations: Confronting Natural Catastrophe in the Age of Enlightenment*, edited by Alessa Johns. Routledge, 2013.

"Two-Piece Mission: 2000 Series". Redland Clay Tile. Accessed April 28, 2025. https://www.redlandclaytile.com/movil/eng/rooftile-two-piece-mission.html.

"United Nations". Integrated Conservation Resources, Inc. Accessed December 1, 2024. https://www.icr-icc.com/united-nations.

Upton, Dell and John Michael Vlach. *Common Places: Readings In American Vernacular Architecture*. University of Georgia Press, 1986.

Vogt, Andrea, and Tom Kington. "Italy earthquake kills six and razes centuries of history". *The Guardian*, May 20, 2012. https://www.theguardian.com/world/2012/may/20/italy-earthquake-kills-five-history.

Webb, Patrick. "Plaster in Architecture During the Renaissance and Baroque". Walls & Ceilings, August 1, 2013. https://www.wconline.com/articles/88501-the-history-of-plaster-in-architecture-the-renaissance-and-baroque.

Weinberg, Joanna. "The Voice of God: Jewish and Christian Responses to the Ferrara Earthquake of November 1570". *Italian Studies* 46 (1991): 69-81. https://www.academia.edu/37546937/Joanna_Weinberg_The_Voice_of_God_Jewish_and_Christian_Responses_to_the_Ferrara_Earthquake_of_November_1570_Italian_Studies_vol_46_1991_69_81.

"Wood Truss Roof Design & Solarcrete Wall". Solarcrete International, LLC (2014). https://www.solarcrete.com/roof-attachment-design-detail.php.

Yanev, Peter I. *Peace of Mind in Earthquake Country*. Chronicle Books, 1991.