

Reconnecting...

Nick Safley
Kent State University

Reconceptualizing Details with 3D Scanning



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ABSTRACT

This design research reimagines the architectural detail in a postdigital framework and proposes digital methods to work upon discrete tectonics. Drawing upon Marco Frascari's writing "The Tell-the-Tale Detail" (Frascari 1996), the study aims to reimagine tectonic thinking for focused attention after the digital turn. Today, computational tools are powerful enough to perform operations more similar to physical tools than in the earlier digital era. These tools create a "digital materiality," where architects can manipulate digital information in parallel and overlapping ways to physical corollaries (Abrons and Fure 2018, 185-195). To date work in this area has focused on materiality specifically. This project reinterprets tectonics using texture map editing and point cloud information, particularly reconceptualizing jointing using images. Smartphone-based 3D digital scanning was used to capture details from a series of Carlo Scarpa's influential works, isolating these details from their physical sites and focusing attention upon individual tectonic moments. As digital scans, these details problematize the rhetoric of smoothness and seamlessness prevalent in digital architecture as they are discretely construed loci yet composed of digital meshes (Jones 2014, 29-42). Once removed from their contexts, reconnecting the digital scans into compositions of "compound details" necessitated a series of new mechanisms for constructing and construing not native to the material world. Using Photoshop editing of texture-mapped images, digital texturing of meshes, and interpretation of the initial material constructions, new joints within and between these the digital scanned details were created to reframe the original detail for the post-digital.

- 1 Point cloud scan of fountain detail at the Querini Stampalia
- 2 "Der Knoten" from Gottfried Semper, *Der Stil*, 1860

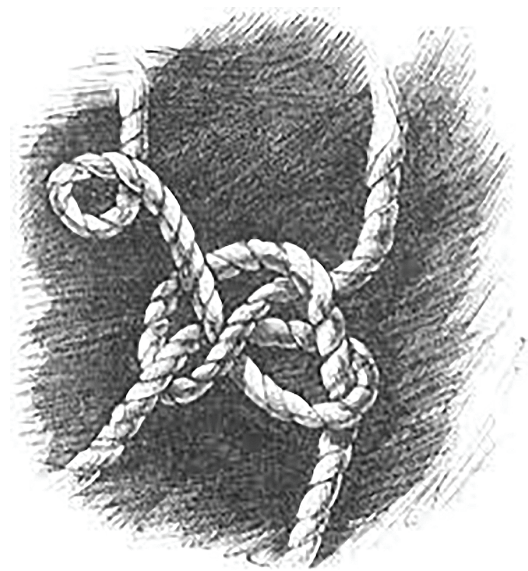
WHY STUDY DETAILS NOW?

Details occupy a murky territory between isolated cultural objects and the vast continuum of the material in the world. In the pioneering treatise, *The Four Elements of Architecture*, Gottfried Semper insisted that the threading, twisting, and knotting of linear fibers were among the most ancient of human arts, from which all else was derived, including both building and textiles. In Semper's work, the most fundamental element of both building and textiles was the knot (Ingold 2013). For Semper, a knot was both part of and separate from the world, existing as part of the chord (material world) but not simply due to the chord's materiality. Knots are neither autonomously authored nor a result of inherent material forces. In the postdigital era, architects question the networked continuity, smoothness, and focusless logic of much of the digital age and its practitioners, who found parallels to the knot and chord in Semper's writing. The renewed need for cultural expression and perceptual focus drives skepticism of the detail's demise at the hand of computational tools and data management via the computer. By reengaging the historic pre-digital notions of tectonic, we can situate details in ways which neither reject nor fetishize the material or digital realms.

Practically, when we can effortlessly create and manage vast amounts of data outside of our mind via the computer, we must curate, organize, and then reconnect isolated chunks if we aim to focus our limited attention. Today, ubiquitous digitality makes this necessary for both the discipline of architecture and, more importantly, for larger cultural practices. What would otherwise be an ocean of information, overwhelming in volume and too big for comprehension, needs to be isolated for discussion and practice. By creating working methods to focus attention and relate areas of concentration, one can strategically bound information to solicit new meaning. Contrary to early postmodern narratives of meaning, this method of reconnecting asks for attention as cognitive participatory labor, not stable embodiment or a prescribed narrative.

BACKGROUND

As within Semper's illustrations of knotted chords shown in Figure 2, details can be isolated moments. In both—the illustrations of knots and mundane technical drawings of details—only parts of the material world are shown, removed via convention or technique from their surroundings. In technical drawings, notation and graphic location relate details to one another, but creating such isolation requires different tools and techniques in physical reality. The questions of how to isolate and focus attention were at the heart of Marco Frascari's "The Tell-the-Tale Detail,"



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where the locus of detailing was in material jointing (Frascari 1996, 498-513). In his historical description of this process, candles and flashlights were the tools used to focus a sensing subject who visited the building site in the darkness of night. While Scarpa's designs were holistic pieces of architecture, he found it necessary to study, during design and construction, the details in isolation from the larger work. Details viewed in perceptual isolation function much more like miniature worlds and stand in stark contrast to arrays of parametric connections standard in digital design work. For Frascari—in a process he terms "the mind's eye"—each detail required a suspension of contextual continuity and asked for the observer's mental participation relating an individual detail to the details and organization of the same built work.

While this analysis will focus on how we can adapt Frascari's thinking to a postdigital context, it is worth outlining other interpretations of details. Edward Ford is one of the only scholars writing upon this topic, and in his work *The Architectural Detail*, he outlines four types, or ways, of thinking about details to which we will add two terms. Ford categorizes details as either *motific*, a representation of construction and an expression of material joints, or as *autonomous* from the larger work as a whole (Ford 2011). To this list, architect Nader Tehrani adds *grain* or the directional organization of a surface to address materiality in computational terms. Tehrani's addition moves away from the discrete detail, opening the tectonic to progressive geometric shifts and gradients required in field conditions (Tehrani 2017). Grain defines details through geometric variation and not typology. His definition is the legacy of the digital project in material fabrication



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and furthers Ford's analysis to conceptualize the computational surface itself.

At the time of Frascari's writing, in the early 1980s, he sought to frame the detail as the generator of design, yet he also identified the detail as ill-defined. He proposed the definition of details to be the union of construction and construing. Construction, in this definition, results from the *logos of techne* or thoughts of making. Construing, on the other hand, results from the *techne of logos* or the making of thoughts. Through his definition, the detail could become the vehicle for communication and narrative. Today, we remain rightfully skeptical of the detail's capacity to signify direct meaning. Yet, the relationship between construction, as an act of material organization, and construing, as the appearance of the material once organized, remains a helpful structure. In light of evolving digital culture, the proliferation of images, and easy movement of visual information between the digital and physical world, one new detail type needs to be added to Frascari's list. This detail type directly addresses the space between our updated version of constructing and construing. Details in the work that follows address digital tools, techniques, and construction in an effort to find places to create joints in the digital substrate—what contemporary thinkers Adam Fure and Ellie Abrons term "postdigital materiality" (Abrons and Fure 2018, 185-195). This detail type could be referred to as the *image detail*, which exists not purely as a material joint, organization of a surface condition, or *grain*, but uses image-based digital information and high-fidelity geometric approximations of material to construe the qualities of physical material unrelated to the underlying construction. To politely borrow Frascari's term, the construction

and construing do not have the same "logos" (reason), instead privileging the autonomous image as that which is construed, with material construction purely in its service.

METHODS

Scarpa made a practice of visiting the building site during the night for verification with a flashlight. He thereby controlled the execution and the expression of the individual details. In normal daylight, it would indeed be impossible to focus on details in such a selective manner. It is also a procedure whereby the indirect vision becomes a critical process in design decisions.

The flashlight is a tool by which is achieved an analog of both the process of vision and the eye's movement in its perception field (with only one spot in focus and the eye darting around).

—Marco Frascari, "The Tell-the-Tale Detail"

Today, isolation of details from architectural works is possible in a similar way using digital 3D scanning. This process mimics the use of light in a dark environment to control the extents of individual vision. Dense scans comprised of captured color data points are organized in Cartesian space, closely matching the geometric extents of the original detail. The data that comprises the scans constitute information curated not just by the human eye, but in collaboration with the digital scanning technology. Further, the connecting of details does not simply need to rely upon indirect vision, the spatial and mental connection of details experience individually, to find connections. The collections of details can be shared readily with others in geographically distant locations and viewed collaboratively.

Lastly, the flattening of Scarpa's initial details into a common "digital material" comprised of mesh point locations and color information can be used to speculate upon new means of connecting detail previously distinct from one another.

Scanning

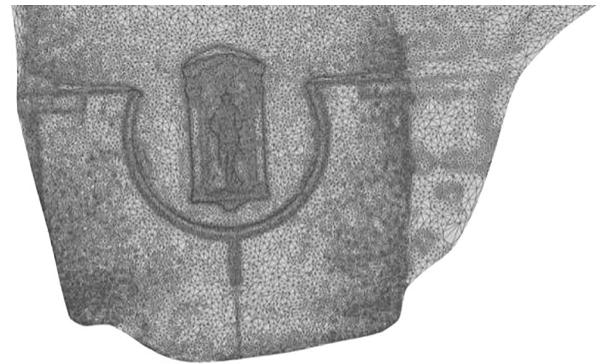
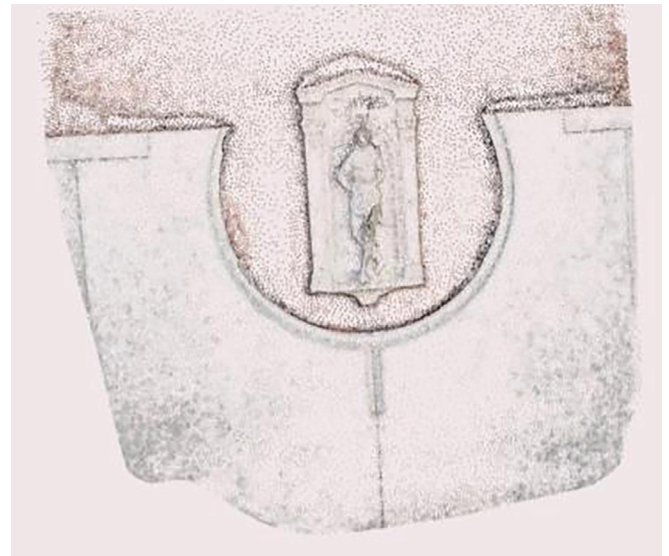
Digital scanning, in this project, utilizes inexpensive photogrammetry via the iPhone app Capture (Standard Cyborg 2019) to create isolated details from built projects by Carlo Scarpa. The scanning process is analogous to the flashlight-based methods that Scarpa used in his construction verification visits. The small phone-based scanner allowed the capture of projects that would have otherwise required a special permit or occurred only within institutions that allow photography. This lack of access does not affect the rhetoric of the project, but it is worth mentioning as an influence on the details curated. Scans of the details were created by slowly moving the phone's camera over and around the area of interest while watching the phone screen to check the fidelity of the scan. The Capture app generates point clouds, each with a Cartesian location in model space that has a central $0,0,0$ origin. This technical fact has ideological implications as the detail, once scanned, is quite literally the center of its universe. Color information is encoded into the point cloud also and is later used to generate a texture-mapped mesh.

Conceptually, each scan's creation parallels Scarpa's projects. Each of his details and each of the scans function alone as discrete information and also in conjunction with other details to create the larger whole of the project. Marco Frascari describes the part to the whole relation in Scarpa's work:

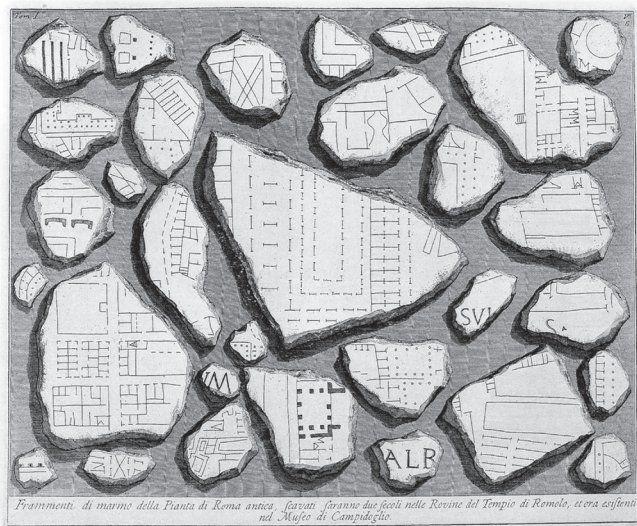
While it is whole, Scarpa's architecture cannot be characterized as complete. An architectural whole is seen as a phenomenon composed of details unified by a structuring 'device,' a structuring principle.

—Marco Frascari, "The Tell-the-Tale Detail"

In digital scans, discrete parts, themselves composed of points, work in the service of a larger image of the scanned detail. This process is nearly identical to the way Frascari posits that details work in relation to the built whole in Scarpa's work. This conception of the part to whole relationships does not neatly fit neatly within the either Ford's or Tehrani's expanded list of detail categories. Here details are semi-autonomous, working discreetly to construe an image without specific meaning themselves. The computational modeling software used to collect and combine the scans functions as a new platform, whereby the scanned



- 3 Scanning Process using smart phone at Carlo Scarpa's San Sebastiano Gate
- 4 Enlarged cut stone stepped detail of San Sebastiano Gate
- 5 Top to Bottom: Point Cloud, Digital Mesh Geometry, and Mesh Scan with Color Information as Texture Map

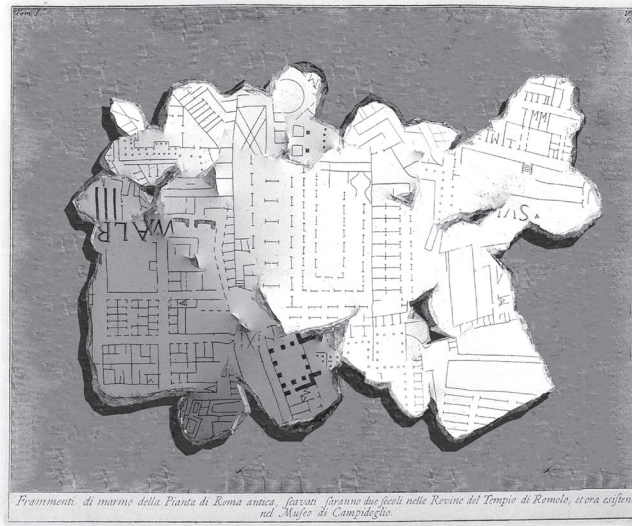


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details are combined independent of the human body or the physical the built environment. Using the computer to act upon scanned details allows architects to work collectively and collaboratively with other human and nonhuman subjects to create architectural wholes.

Collecting

Collecting requires the capability to remove something from its context. Historically architects have used collections to frame theoretical arguments and expose those unable to travel far distances to seminal works of architecture. During the nineteenth century, drawings and plaster casting were a relatively expedient means for circulating works of architecture to those who could not physically inhabit or experience it firsthand. At the end of the nineteenth century, photography began to replace drawings, but the three-dimensional quality of plaster castings, albeit free of color, contained information not compressible or transferable in two-dimensional media (Lending 2017). As such, the plaster cast occupies a unique position in architectural history and discipline. One to one in scale, plaster casts of entire projects were not practical or technically possible due to the realities of transportation and physical access to built works. Details sized so they could be placed in crates, handled, and shipped made their way from the world's far corners into the collections of museums located in European centers of colonial power and the United States. Collecting these details involved complex political, economic, and ethical relationships, which have generated a body of scholarship and may inform this project in the future. For this research, we will narrowly view this casting practice as the collection of detail fragments and purely as a technical process of curation. Once collected, many of these casts found themselves on display in spatial proximity unimaginable in situ, and their intention as pedagogical



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tools aside, the capriccio-like collections were immersive material compositions. The current practice of handheld 3D scanning addressed in this research has given the collection process an ease similar to that of photography, and one might imagine the educational intent of earlier plaster casting taking place not in physical galleries but in an online viewable database or search engine.

This project uses a method of pulling apart and collecting built work by its details, like detail casts in the Carnegie Gallery at the Pittsburgh Museum of Art, or other architectural plaster galleries. New negotiations between the individual fragments replace polite voids in the museum. Figure 7 expresses this, conceptually joining with the work of another Venetian, Piranesi, who interestingly also explored details, as fragments of larger works, in darkness by candlelight. The curatorial display of the scans also finds a counterpoint to plaster casts. Historically, casting was a way to appropriate distant history and cultures from which one created rooms to display the power of the collecting nation. As a method to be updated via new technology and worldviews, collecting details in a digital format can be a means of reimagining the material world through an expanded conception of tectonics and not simply as a colonial endeavor.

Reconnecting

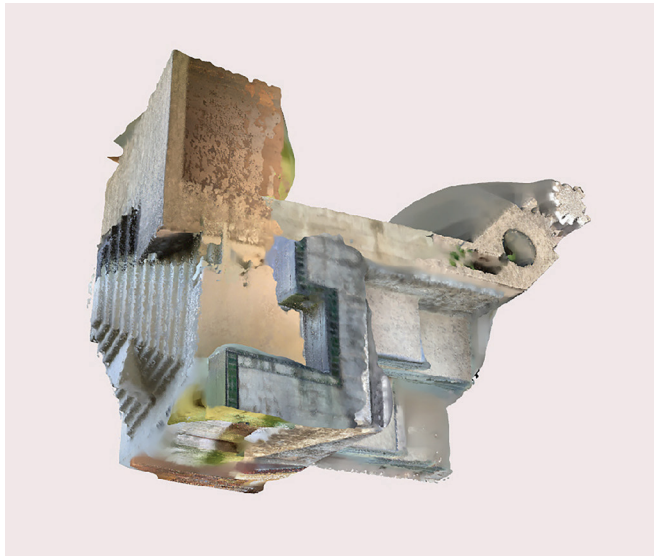
The projects whose details were collected come from recent history and belong to a single architect's body of work. Counter to museums' historical collections, the collected details are not displayed as detail fragments encrusting a preexisting room, which serves as a container, frame, and method of unification. Instead, the scanned details—a digital parallel to portable plaster castings—are combined into compound detail objects without an accessible interior.



In this way, the newly designed compound details are their own context, and each collection of details from Scarpa's work are only reconnected with scans from the same initial project.

More specifically, collections of scanned details are composed and organized into new architectural wholes utilizing qualities found in the digital point cloud scan. Qualities—such as similar color, point cloud shape, point cloud density, mesh direction, and fidelity of the 3D scan—organize the new objects as compound details. Once located, the scanned details were collapsed into one dataset and the resulting point cloud was meshed via the open-source software MeshLab (Cignoni 2009). Automatically created meshes and numerically averaged color information fill in the gaps between what began as separate scans. The spaces between scans are exemplary of the image detail discussed earlier, connecting the digital construction of the mesh into a seamless object. What differentiates the image detail from surface-based connections is that the new object is construed as a collection of materials from the initial material details but without clear edges or physical joints.

This research project combines scans from three projects into a series of objects, though scans from a much larger body of Scarpa's work exist for future research. The Castelvechio in Verona, Scarpa's largest work, is included as it has the most range of detail scale, bridging spatial or formal joints like stairs, with overtly material joints like doorknobs. The Querini Stampalia is quite different from Castelvechio and is primarily composed of surface linings of an existing building. The scans here were much smaller, more discrete, and composed of surfaces, putting more pressure upon the composition and adjacency between them to define an enclosed volume. The last project used for this research is the Brion Tomb, whose archipelago of small pavilions juxtaposes the myriad of stepped concrete motific details. From all the projects scanned, these three



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6 Fragments of the Marble Plan of Ancient Rome, Giovanni Battista Piranesi, *Le antichità romane* (*The Roman Antiquities*), 1756

7 Digital image (created using the photomerge command in Photoshop) shows seamlessly joining fragments

8 Compound detail created from scans of the Castelvechio

9 Compound detail created from scans of the Brion Tomb

10 Compound detail created from scans of the Querini Stampalia

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- 11 Stepped motif in the endwall of the Brion Tomb; material layers are implied in the plastic material
- 12 Texture map of digital mesh detail scan in Figure 13
- 13 Combined mesh detail of two fountains at the Querini Stampalia, with edited texture map applied and joints created around color areas

most exemplify the narrative of Frascati. Once the sites are visited and scanned, his narrative and rhetoric are problematized by the reality of the material construction. In many cases that which is being construed places material in the complete service of form, something Edward Ford explains:

...the reality of Scarpa's work is that if it lacks a conceptual structure, it has no shortage of formal unity; the excess of typical Scarpa motifs is, if anything, oppressive in its unity in works such as the Bank of Verona in Verona Italy (1973), or the Brion Cemetery. It cannot be said that there is no system to the use of these motifs. The step-like echelon motif at Brion is used at the ends of all planes of concrete and stone. It is not the absence of a system that is problematic here; it is that the system is primarily a decorative one indifferent to material and function, and used to excess.

—Edward R. Ford, *The Architectural Detail*, 124

While Ford seems to be ethically chastising Scarpa, his comment is a possible direction for contemporary work to operate. Scarpa's motifs presuppose collections of things that simply look alike, and the image as a formal architectural device.

Material joints in both the Brion Tomb and the 3D scans of material details unify the appearance of multiple materials negotiated using physical joints into single plastic material, either concrete or the "digital material" of the scans. Now that 3D printing in various materials and with integral color allows for the recreation of the digital scans in physical reality, the space between Scarpa and contemporary digital techniques nearly collapses. Today, architects can operate on the gaps and joints construed between isolated materials themselves, as these materials do not necessarily need to match the construction. Images transgress the boundaries of detail fragments; joints become expanded in their scope and can become objects or areas that negotiate between parts through image yet continuous as material. We can organize details loosely and create negotiated material compositions in what otherwise has remained a gap or joint.

Despite the motific character of the Scarpa building(s) the details take on an autonomous character. They are autonomous narratives of construction in buildings otherwise unconcerned with construction.

—Edward R. Ford, *The Architectural Detail*, 255

A second design exercise of this research explores a more traditional notion of jointing as the discontinuous negotiation between material parts. As seen in Figure 13, a single

scanned detail is broken into parts unrelated to its initial material configuration. The texture map of the digital mesh, which contains the color information related to the material in the initial detail scanned, is overlaid with a simple tile pattern. This subdivision of the image into four parts maps to the 3D scan in unpredictable ways due to the automated methods the meshing software used to texture map. These areas, shown as brightly colored patches, are then treated as differing materials and joints created between the color patches. In both example processes, the texture map as an image is the site of tectonic operation. In the color jointing example, an autonomous narrative of detail construction is used in the scanned detail, which is unconcerned with construction.

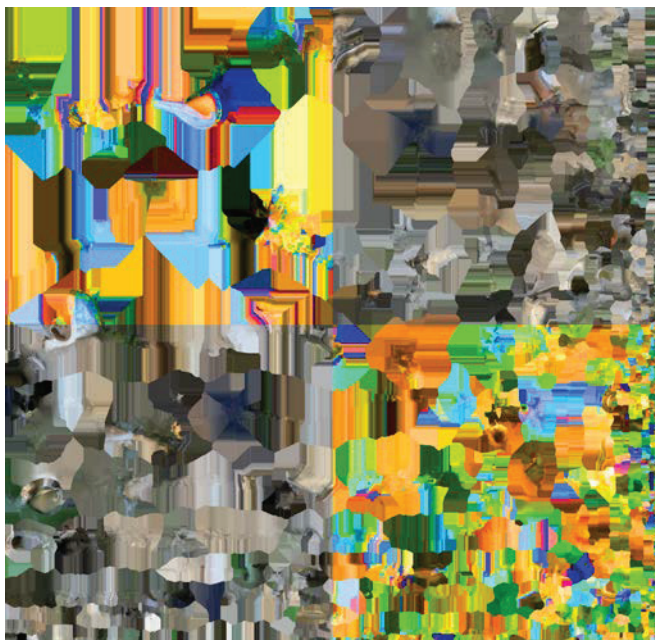
RESULTS AND REFLECTION

Scanning Scarpa's works, removing, isolating, and collecting details is a colonial endeavor to find an optimistic outlook for digital technologies. Like plaster casting, 3D scanning as technology and technique envelopes and approximates material joints from the initial material construction as an image joint with no material necessity and pure expression. The scan is not a copy but an approximation with image qualities consistent enough to allow correlation. Material joints from the initial detail are only approximated and sometimes captured in the texture-mapped image. In the texture mapping of detail scans, we find the most significant difference between plaster casting and scanning. While both techniques create forms in media with a high degree of granularity, for plaster, the granules are actual plaster granules, and for scans, it is the digital

mesh resolution. Color information can only be hand-painted onto plaster casts, while 3D scans work more like photographs displayed on the 3D mesh surface. In the .jpeg file, tools within Adobe Photoshop (Adobe 2019) operate upon the texture map, and the results suggest material tectonics, joints, and organizations not native to traditional tools and their related materials.

Interestingly, the automated 3D scan process generates seams between the image fragments accessible in the mesh texture map. Gradient fills that negotiate pixel information, surface texture joints that do not cohere to the initial material logic, and finishes created via visual pixel manipulation challenge traditional jointing tectonics. With these and other tools, new tectonic thinking can connect or reconnect anything once digitized.

Once details are scanned or more generally isolated from their context, we can create a blueprint for new architecture. This process is familiar to the discipline of analytique drawings, where details were collected onto a single drawing as delineations by the architect to be interpreted and executed by skilled craftsmen. Further, the spaces between the details are omitted, to be either collaborated upon during construction or interpreted, truly making the architect the team leader of a skilled collective. The real and virtual categories are much more overlapping in the postdigital computational environment, if not a false binary. Details can be collaboratively joined in a similar process to that of a knowledgeable craftsman as an automatic or inferred process originating in the computer program code.



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14 Mesh connection joining a series of scanned details from the Querini Stampalia

Craft in construction stands in contrast to the drawing or mediated construction documentation, which assumes little, or at least less, knowledge of the person constructing the detail. A shared commonality, or culture, is assumed between architect and craftsman. A similar relationship with the person or people who developed the computer code can be considered in the latter, as both utilize an assumption of a known but collaborative outcome. Encoded software operations can here function more like motifs or images, placing them in closer parallel to the knowledge of the preindustrial craftsman than of draftsman.

So, what then is the architect's position and role in this sort of design practice? Firstly, automation of connections still requires collaboration, not necessarily the type of craftsman Scarpa notoriously collaborated with, but instead their contemporary corollaries, programmers writing code and fabricators controlling digital making processes. Second, in controlling the desired perception of the design, the architect is still responsible for its organization. In the postdigital era, the perception of the designed object is also not limited to that of the human body directly experiencing the physical material world. Instead, at stake is the entirety of the mediation of the designed object. The variety and scope of this meditation form the new responsibility of the architect, no matter the sort of collaboration, craftsman or digital code. The location and organization of the constituent parts in this proposal closely parallel that of Frascari's phenomenological discussion of Scarpa.

Collocation is the composing by place, that is, the functional placement of the details. The function in this case not only is limited to the practical and structural dimensions but it embodies, as well, historical and aesthetic dimensions. The placing of details, then, is deeply related to the other two requirements: numbers and analogies. The detail in this manner is not defined by scale, but, rather, the scale is the tool for controlling it. The geometrical and mathematical construction of the architectural detail is in no sense a technical question. The matter should be regarded as falling within the philosophical problem of the foundation of architecture or geometry, and ultimately within the theories of perception.

—Marco Frascari, *The Tell-the-Tale Detail*

Curation, location, and organization then become the design choices of the postdigital architect. Proposed is not a totalizing or total design process desired in some early modern practices and reappeared in a high degree of digital customization fabrication enabled in the early 2000s. We do not design to produce totalizing environments but instead discrete objects that solicit collaboration during construction and during their mediation. There is no desire to recreate the overwhelming conditions Adolf Loos outlined for his "poor little rich man," who had no space to imagine. Our task is to create a collaborative relationship in which the designed object solicits interaction with the viewing subject. Objects made for this project reframe the title of Frascari's essay. Here tale might better be spelled tail. The narrative character of the detail is superseded by the detail as a character, as a thing with an agency in and of itself. This definition wags the agency of the detail from being a repository of human speech, embodied or otherwise, to functioning as a quasi-subject, authored by the architect, but needing the viewer's consistent labor in trying to make an array of narrative tales. This process imbues the object with life, or something like it, as the viewing subject's attention literally places it there. This process is further pushed with the automated connections between details found in the compound detail objects. Each is created, not by the architect, but by the relationships the architect places the details in that allow for collaboration. These designed objects are composites of vital moments, both in their scanned details, those of the computer's labor, and from the meaning creating subject.

CONCLUSION

While the research for this grant was conducted in the summer of 2019, its fruition took much longer. The global Covid-19 pandemic placed this research on the back burner as teaching and navigating social isolation dominated. Strangely, there could have been no better time to

focus upon topics of isolation and how computational tools can—and do—allow for created connections. Details have a life of their own when removed from their in situ location but cannot construe in isolation. Reconnecting and refiguring the material world as a social one via digital tools means that we can use the past to imagine an optimistic future with the material world. A postdigital tectonic hopes that we find a social relationship with one another and social relationship in equal part with the material in which work. Like knots, details as material constructions exist within the larger ecology of the planet, and at the same time, a locus of attention for tectonic thinking. A postdigital flattening of the hierarchy between the material world and the digital realm expands our focus further. Colloquially, this gives us more rope to hang ourselves as we are able to manage large sums of information without specific locations of commonality. The postdigital detail uses our perception in conjunction with technical devices to remove areas of focus from the larger world to construe digital constructions of a common world.

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Nick Safley is a designer whose work focuses on architectural character, materiality, and methods of fabrication. His work takes place at the intersection of form, material, and the technologies used to negotiate between these categories. At Kent State he teaches courses on construction and coordinates the fourth year Integrated Design Studio. Prior to teaching, Safley worked professionally for the LADG, Utile, and NADAAA.