It is the actual drawing that forces the artist to look at the object in front of him, to dissect it in his mind’s eye and put it together again.
—John Berger, “Drawing”

For artists and architects, drawing is a vehicle of discovery through iteration, not simply one of translation. In architectural practice and the teaching studio, the skill of designing depends on repeated drawing and the way the drawing is made, for example, as a plan or an isometric projection. This affects how a design arises, enabling the design process, and training the architect how to look. Preliminary architectural studies in which ideas are processed contribute significantly to final designs and their drawings. They are equivalent to John Berger’s distinction in art between a “working drawing and a ‘finished’ work,” but in architecture, they can be indistinguishable. This paper looks at how three different types of drawing have been used, initially in my own architectural practice, and then in my studio teaching in Degree Unit 3A at the University of Nottingham School of Architecture, to reveal ways in which the process of making these drawings affect how different kinds of configurational decisions of architectural form are made. In my architectural practice, the process of design involves investigative research, ranging from spatial morphology to detailed construction, in which drawing is used as an analytical methodology. Three recurring types used in this research – the Nolli figure-ground plan, the axonometric projection, and the developed surface drawing – have evolved into teaching instruments to study underlying architectural strategies. As the teaching focus of Unit 3A is on the physical and material reality of architecture, drawing plays an essential role in the critical development of student projects.

Treating the drawing type as its own precedent study, this paper discusses each in relation to its original form and the students’ interpretations. The
mechanism of redrawing that they were asked to undertake revealed underlying methods in the case studies, resulting in a potential reciprocity in students’ designs. A question arises as to whether certain drawing types are applicable to specific kinds of projects; for example, in my practice research, I used redrawing to understand the spatial effects of architectural interventions on the same plan form in the Louvre Museum or making dynamic plans and sections of Eileen Gray’s moveable fixed furniture to understand the effects of her mechanical fixing techniques on her spatial design. Less familiar drawing types, such as the ones proposed here, are useful when they disrupt conventional ways of looking at projects and challenge preconceptions about the purpose of different drawing systems.

In tasks associated with urban propositions, individual building designs, and their inhabitable spaces, the students of Unit 3A, and Nick Haynes’s and Laura Hanks’s mArch Studio 4 students, recorded the contemporary city by applying Nolli’s urban plan type; my students used James Stirling’s and Rafael Moneo’s versions of the sectioned axonometric to draw existing conditions or parts of their projects, and they referenced Eileen Gray’s version of the developed surface interior drawing to explore interior spaces. Initially, the types were chosen because of their respective associations with context, tectonic form, and inhabitation, yet each contains parts of the others. We found that by using three drawing types disconnected from a linear working method that moves from large to small scale, we could disrupt the preconception about working from overall form to detailed design.

**Type 1: Giambattista Nolli’s Map of Rome (1748)**

For the architect, recording context is a primary design action that is difficult to effect in a single drawing. The interplay of topography, time, personal experience, access, and the conditions of the existing fabric requires multiple representations. To a certain extent, this issue of overlaying multiple data in one drawing is overcome, or at least acknowledged, in Giambattista Nolli’s 1748 map of Rome (the Nolli plan), which is based on a drawing system used to investigate ground-level urban activity while acknowledging built form. (fig. 8.1) For some teaching studios in the United Kingdom and the United States, this representational method became the eponymous recording technique of the postmodern era, but applying it to the post-industrial contemporary city is complicated, since it is fractured by disruptive infrastructures and strategic ideological interventions. This year, Unit 3A’s design brief was sited in Nottingham’s city centre, which is currently undergoing radical changes. The Nolli plan type was used to investigate and analyse Nottingham’s public space, identify potential sites and interstitial gaps, and specifically engender discussion around the redevelopment of a large, derelict 1970s shopping mall.
Distinct from the drawing system of depicting building blocks as black figures on white ground representing exterior space, Nolli’s map depicts external and internal open space as an urban continuity. Generated from a meticulous survey of Rome, it records a city centre whose form has changed little in the subsequent 270 years. The accuracy of the plan is such that it continued to be used as the basis for Rome’s maps until the 1970s, when most of the public spaces depicted remained open. Derived from Leonardo Bufalini’s 1551 printed map of Rome, it was one of the first ichnographic city maps (previously, cities had been depicted using bird’s-eye perspective). Whereas Bufalini’s city is a line-drawn network of spaces and built fabric, the Nolli plan records building blocks as solids, with a consistent morphology of internal public spaces carved from them and depicted as white, equalising them with the surrounding urban network of streets and public squares. Almost for the first time, it presented building interiors as part of a continuous network of accessible urban space.

How Nolli came to do this remains unexplained. His map of Rome demonstrates how a plan can convey ideology by graphic means. In Bufalini’s map, the topography and large structures of the ancient city are dominant features. Topography and the presence of ancient Rome are integrated into Nolli’s
representational system, in which he portrays the extant ancient city within the contemporary form. Ancient Rome’s structures are shown as discrete elements, fragments in the surrounding vineyards, or integrated into city centre blocks, with a sense of their spatial inhabitation. The idea that the city’s mapping could include its fabric’s historic vestiges may have led Nolli to choose to depict public internal spaces with their enclosing structures as a way of describing the fusion of the old and contemporary cities in one period. In the network of space Nolli represents, his attachment of building structure to the principal spaces of churches, scholastic orders, hospices, and palazzi interweaves Rome’s social order into his contemporary city. His portrayal equalises exterior and interior public spaces, irrespective of their relationships to the block, presenting to us the idea that a city could be a continuously inhabited organism. Nevertheless, while Rome was ordered by its institutions, many of these, as the map shows, were ecclesiastical and would have had controlled access. Nolli’s graphic method of using dots through the middle of streets to define Rome’s governing structure of rioni or districts, for which the map was commissioned, does not interrupt its concept of inhabitable physical space transcending civic structures. Unlike this paper’s other drawing types, it was made as a statutory document for dissemination. Composed of twelve engravings, its indisputable accuracy and printed form gave it authority.

In distinguishing between built form and external or internal public space, the Nolli plan presents a useful way of observing urban morphology as a ground-level phenomenon. In Unit 3A, the type has been used to discuss notions of civic space and relationships to building form, ownership, and public access, questioning whether Nolli’s method is applicable to the contemporary city. What appeared to be a clear system for denoting all public space is complicated, because as public access changes, single mappings do not present a definitive record. Trials carried out by Unit 3A, and mArch Studio 4A, adapted Nolli’s graphic methodology to the contemporary city by making mappings at different times of all public interior spaces. As a preliminary experiment, Unit 3A students speculatively mapped part of the Via de Condotti, Rome, and part of Nottingham’s Low Pavement, extending Nolli’s mapping of interior public space to include shops, bars, and restaurants as interior public space. mArch Studio 4 mapped three main Nottingham city centre squares – Market Square, St Peter’s Square, and Nottingham Contemporary (fig. 8.2) – investigating whether their public spaces are extended by the surrounding public interiors. Publicly accessible space appears to have grown in the daytime, but as a phenomenon detached from architectural form. Both question the relationship of public space to land ownership. Redrawings of Nolli’s Rome map for different times would distinguish the spaces of institutions that would have had controlled access. The contemporary history of interior public spaces in the United Kingdom is one attempt to manipulate them for private commercial gain at the expense of their democratisation and coherent urban form.
Fig. 8.2: Nolli plans of squares daytime Nottingham city centre, from top Market Square, St Peter’s Square, Nottingham Contemporary. © School of Architecture M Arch Studio 4 Group 2 students Bethan Crouch, Brady Hill, Georgina Ley, 2020. The mappings have indeterminate outcomes and some intriguing findings in relation to Nolli’s plan of Rome. While a typology of spaces equated to inhabitable building volumes is discernible in Nolli’s map, the public spaces drawn in these three Nottingham mappings are generally detached from architectural form and without hierarchy, apart from the churches and the exchange building. Large shop interiors appear spatially endless without the ordering structures of their buildings. The difference between the contemporary public city and its Roman predecessor also appears to be the condition of continuous public frontages on block exteriors. The perimeter shops convey more about a commercially driven market than a spatially ordered urban structure.
Type 2: The Axonometric Projection

The axonometric projection type conjoins two and three dimensions, making it a critical design and representational tool within Unit 3A, alongside physical model making. Oblique projection can simultaneously represent a building and its construction, applying figuration in the depiction of built form, as a complete or partial portrayal. The axonometric, including the bird’s-eye or worm’s-eye view as whole or cutaway views, is capable of conveying spatial volume grounded in context or as an abstraction. Using as precedents hand-drawn versions by Auguste Choisy, James Stirling, and Raphael Moneo, these variants of the type have been used in Unit 3A to describe composition, tectonics, and inhabitable space, focusing on one while investigating its interaction with the others.

The versions of the projection type derived from Choisy, which became synonymous with Stirling’s practice, could impart the interdependency of form and construction. As Chris Dyson, who worked in Stirling’s office, has observed,

The plan was the originator – initially quite diagrammatic, it was then fleshed out using the axonometric, the worm’s eye, the split up view and the single-point perspective. [...] The axonometric [...] enabled measured massing and form to be tested in contextual drawings. The split up view [...] enabled the viewer to understand the hierarchy of spaces within the building.\(^8\)

In using axonometric techniques, which were relatively new at the time, to describe ancient construction, Choisy understood how worm’s-eye-view drawings were simultaneously capable of conveying construction and spatial character.\(^9\) His worm’s-eye oblique partial projections showing interior volumes resulting from a building’s ordering system are equivalent to placing oneself inside a physical model. The worm’s-eye view effectively represents inhabitable architectural space perceived while floating in space. In Stirling’s projects, axonometric representations, showing buildings without context, privilege their formal concepts. In the studio, this has become a means to discuss a project’s abstract intention, temporarily suppressing context in favour of the figure. In Stirling’s designs, such as the Staatsgalerie Stuttgart and the unbuilt North Rhine–Westphalia Art Collection Dusseldorf, the worm’s-eye projection (fig. 8.3), in which volumes and elements are drawn floating without context or registering their actual scale, convey form and route, simultaneously enabling the viewer to envisage themselves standing in the spaces of the building and moving through them while reading the architecture as an abstract concept.
Fig. 8.3: James Stirling Northrhine-Westphalia Art Collection Dusseldorf worm’s-eye axonometric, 1980. James Stirling/Michael Wilford fonds Canadian Centre for Architecture © CCA.
A preliminary Unit 3A study of some of Nottingham’s urban elements, such as arcades and canopies, appropriated the axonometric type to reinterpret their definitions in the fractured contemporary city. A survey of the canopy generated its redefinition on a route starting in front of the Nottingham Contemporary Gallery and extending the canopy’s description to the tramline undercroft (fig. 8.4). Similar to some of Stirling’s drawings, the canopy study connects spaces defined by a load-bearing structure, floor surface, and the art gallery’s canopy, a cantilevered volume hovering like an exterior baldachin.

Fig. 8.4: Nottingham city canopy worms-eye view Nottingham School of Architecture B Arch Unit 3A Group 2, 2019. © Oliver Skelton. The worm’s-eye axonometric described the possibility of inhabiting spaces so that the fragmented components would reassemble themselves into a discernible urban route. It draws the potential for infrastructural elements superimposed on the city’s steep topography to be recomposed into a more coherent urban form. Nottingham School of Architecture B Arch Unit 3A Group 2 Oliver Skelton (drawing), Imogen Clark, Nida Hannan, Jessica Hollis, 2019.
Moneo uses another type of cutaway axonometric projection, notably on the National Museum of Roman Art Mérida, 1980–1986, in which the building is shown partially, with its ground floor and the street context. The expressive drawing technique, used to impart the construction with the overall spatial concept, conveys the building’s atmosphere.\(^\text{10}\) (fig. 8.5) It imparts the idea of the brick arched form overlain on the museum’s archaeological level like an ancient construction while simultaneously showing slim walkways taken through the walls and the contemporary, linear roof lights.\(^\text{11}\) In its portrayal of the building system, and the black drawn-cut sections, it recalls Nolli’s spatial representation integrating the ancient city into his contemporary plan of Rome. The cutaway axonometric offers Unit 3A a more legible drawing type to describe structural form and construction detail than the standardised large section and dismantles distinctions between working and finished drawings.

**Fig. 8.5:** Raphael Moneo, National Museum of Roman Art Mérida axonometric, Enrique de Teresa 1980. © Rafael Moneo arquitecto Madrid.
Type 3: The Developed Surface Drawing, Eileen Gray

If the axonometric can be characterised as a drawing capable of conveying inhabitation, the type of orthographic projection used by the designer and architect Eileen Gray to depict interior space, by projecting elevations around a floor plan, can be seen as the most complex to read spatially. She applied her unique version of an eighteenth-century drawing type to the design of buildings, notably the two houses E.1027 and Tempe á Pailla, which were her most realised works and for which she made multiple projection drawings. The two houses, which are works of total design, are the result of her multifaceted skills and the way she was able to fuse them through a consistency of spatial concepts, applied to each component, including their purpose-designed fixed and loose furniture, carpets, and lighting. At the same time as she started designing buildings, she was working on interior commissions. Gray worked almost entirely alone, making all her own drawings. They were working examples of her parallel design practices of architecture, furnishings, graphics, collage, and sculpture.

![Diagram](image)

Fig. 8.6: Eileen Gray E.1027 plan and internal elevations of salon c. 1929. © National Museum of Ireland. Gray appears to use the same line weight as she constructs layers of spaces from the assemblages of parts and imagines their inhabitation, equivalently indicating building elements such as her unique folding terrace doors, screens, day-beds, rugs, and adjustable furniture, such as pivoting bedside tables.
Gray’s drawing technique is a version of an eighteenth-century type referred to by Robin Evans as “the developed surface interior,” used to represent room interiors, as “a way of turning architecture inside-out.” A technique used by Robert Adam to individualise rooms by showing their figured and embellished walls was adopted by Gray to represent interconnected interior space. Gray had also seen how members of the De Stijl group, for example, Theo Von Doesburg, described their spatial ideas in wall patterns. Gray’s versions are complicated by the interaction of the building envelope, exterior space, interior partitions, and furnishing elements. She treated space in the configuration of her houses, and their tectonic forms, in the way she had in the evolution of her furniture. From the mid-1920s, at a time when she was also starting to design buildings, her loose furniture transformed: tables and chairs were conceived as free-standing pieces with less predetermined uses, and the tables were accessible and useable from all sides. They supported the idea of the informal occupation of rooms.

Gray’s development of adjustable fixed furniture coincided with her adaptation of her adjustable block screen into a wall lining and the idea that both could construct or moderate space. This starts to explain why the technique of the developed surface drawing, in which she could integrate building elements and furniture, suited her design methods. The interior and spatial compositions imagine inhabitation intimately. Her drawing of the salon in E.1027 (fig. 8.6), in which fixed and loose furniture and fittings are flattened onto line-drawn elevations, visually equalising all the elements, suits the equivalence with which she constructed space in her buildings and furniture. The elevations can appear as abstract compositions, yet simultaneously, layers of space are implied by the overlaying of the parts. More than recalling their eighteenth-century predecessors, these drawings reference cubist space, with its repetition of objects viewed from different angles, and particularly Marcel Duchamp’s version, “elementary parallelism.” It is hard to know the extent to which the drawing type assisted Gray’s approach, but the complex assemblies almost describe her thought processes. She had evolved a way of treating space in the configuration of her houses and their tectonic forms, in the way she had in the evolution of her furniture, from recognisable forms to adaptable, free-standing pieces.

In Unit 3A, the brief for the first student project asked groups to imagine how actions of inhabitation could create atmosphere by designing rooms using the developed surface drawing, first in order to unpack room precedents. By using the unfamiliar drawing type, the intention was to disrupt preconceptions associated with plan and elevation drawings, and a conventional architectural hierarchy leading from building tectonics and the enclosure, to its fitting. Groups used the drawing type together with developmental models to test composition, the design of fittings, and changing atmospheres generated in their interior spaces resulting from occupation. A group designing a space for the actions of cooking and eating (fig. 8.7) investigated spatial characteristics
Fig. 8.7: Nottingham School of Architecture B Arch Unit 3A Group 2
“A Room of One’s Own, cooking and eating,” 2020. © Tonia Constantinou, Dona De Vas Gunasekera, Rhys Jamieson-Prince, Oliver Skelton. The group experimented with moving screens and space dividers to create and hide alcoves and subsidiary spaces. Yet tectonic and material qualities enhanced by light and the extruded rooflights visible in photographs of their 1:20 scale model were not translated into the drawings.
generated by volumetric forms and daylight control, approaching the room interior as they would a building design. However, the drawings tended to privilege surface and furniture over spatial experiment. While the model conveys the room's changing atmosphere, the drawing portrays the room as static. In Gray's projection drawings, spaces of modestly sized rooms, unconfined by conventionally structured enclosure, extend to balconies and exterior terraces, implying atmospheric differences from changes in daylight. What we should have done was to try to understand her methods by redrawing, using multiple plans and elevations to interrogate the layers.

**Conclusion**

Architectural design depends on drawing to activate ideas from which concepts develop, and then drawing conveys them as physical entities and inhabitable space, as John Berger points out: “A line, an area of tone, is not really important because it records what you have seen, but because of what it will lead you on to see.” The purpose of architectural drawing often proceeds unquestioned in practice and the school design studio, where it can relate to the need for production but not necessarily investigation.

In investigating how abstract concepts can prevail, as detailed projects are developed in the teaching studio, three kinds of drawing, treated as types and associated with specific tasks, were used as methods to disaggregate parts of a linear design approach in which drawing scales are often equated with particular stages of a design's development. Our strategy was to ask students to work simultaneously and equally on interior inhabitation, tectonics, and contextualised form. The developed surface interior drawing was used with versions of the axonometric to develop interior spaces and atmospheres, while at the same time, other versions of axonometrics were used to depict tectonic form or networks of interior volumes. In Nolli plan drawing exercises, projects were superimposed on their contexts as public ground-floor interventions and constructional forms. The purpose of using the three types of drawing as investigative tools was also not to distinguish between making drawings to present designs or to construct.

By superimposing tectonic form on an urban figure ground, the Nolli plan led the students to represent their building designs in an urban context, in which the city is not defined at ground level by individual building form but as a continuous network of public access. By conjoining the section and the elevation, projected from the oblique plan, which conveys space from a standing viewpoint, the axonometric of a building whole or a fragment enabled students to materialise their formal ideas, simultaneously observing relationships of the individual to the city. Using the drawing technique of the developed surface interior, spaces were investigated as dynamic entities, their atmospheres altered by changes of light and their occupation. While not completely resolved,
the students’ examples demonstrated how the drawing types could be used to integrate design concepts into developed projects, overcoming tendencies to separate drawings made to represent ideas from construction descriptions. While the studio drawing experiments, in cases such as the Nolli plan, have not led directly to design answers, they have shown their value as provisional tools, exposing some of the uncertainties accompanying the design process.

In practice and teaching, a common assumption exists that distinguishes between what are characterised as working and presentation drawings: if both are concerned with description, it should be possible to convey construction and its appearance simultaneously. A floor plan may seem the obvious drawing to describe an entire complex, and a section the drawing to describe construction, but more is required of a drawing to comprehend meaning or even to understand how to construct something. What might be needed to conflate ideas and fabrication are drawings that combine more than one kind of geometrical projection. Nolli’s plan of Rome, Stirling’s and Moneo’s axonometrics of parts of their designs, and Gray’s developed surface interior drawings of her houses are exemplars in which their architects have simultaneously conveyed formal concepts, fabrication, and inhabitation in a single drawing. The problem of the neorealist render, now such a familiar school of drawing, and one also used in our teaching studio, is its focus on surface, which fixes a proposition on one view and one moment in time. By dissecting the drawing as an integral device of research and approach in my architectural practice and in the teaching studio, it has again become central to design. It makes us and our students conscious that the way we draw affects how we design.
Notes

3. The Broadmarsh shopping centre, which covers a 2.5 ha site in Nottingham’s city centre.
4. Giambattista Nolli Nuova pianta di Roma, 176 x 208cm, consisting of twelve copper-plate engravings, 1748. The survey was started in 1736. It was made in response to Pope Benedict XIV’s commission to demarcate fourteen rioni, or districts, of Rome.
5. Its accuracy is confirmed by overlays of Rome’s contemporary satellite image. This is demonstrated in the digital remastering of interactive maps by the University of Oregon, presented on its Nolli Map website, http://nolli.uoregon.edu/.
6. Nolli acknowledged the importance of his predecessor Leonardo Bufalini’s printed map of Rome of 1551 by including it with his 1748 map. Bufalini’s was the first ichnographic (orthogonal) map. Nolli’s map is also differentiated by its north–south reorientation.
7. Unit 3A students Yasmine Dahim, Felix King, and Chloe Marples, MArch Studio 4 “Territories of Transformation,” students Bethan Crouch, Brady Hill and Georgina Ley, tutors Nick Haynes and Laura Hanks.
10. Drawing made by Enrique de Teresa September 1980. A second, worm’s-eye version was made by Stan Allen May 1984, after the building’s completion.
12. Apart from some collaboration with Jean Badovici, the architect and editor of l’Architecture Vivante.

Bibliography