

# Overlaps, Boundaries and Continuities: Transforming Sketch

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This essay focuses on the concept and implementation of the design sketch discussing its possible origins, changing definitions, and transposition of its traditional form into the digital environment against current research on perception, cognition, media, and human computer interaction. It seeks to bring together and confront the various positions represented in architecture, based on the premise that any form of representation that is not the material consummation of the final design is an analogue.

## INTRODUCTION

The sketch is a subject under continuous debate in architectural discourse, particularly regarding representation and the design process. Articles seem to appear in spurs every decade. At the turn of the 19<sup>th</sup> century discussion centered on challenges posed to traditional representation by film and photography. Now, digital media, informatics, GIS, and cyberspace have opened a new horizon. For the past two decades much controversy has surrounded the question of traditional drawing versus digital devices. Even when the debate appears to have been muted by the pervasiveness of digital media, it flares again. A symposium held in 2006 posing the questions: "Has computer-aided design rendered the pencil and pen obsolete? Is drawing by hand critical to certain ways of thinking, perceiving and understanding?"<sup>1</sup> is exemplary of the state of mind of the discipline.

Some would argue the challenge is theoretical, not centered on design process, construction tools, or representation devices, but on a different conception for architecture and dwelling.<sup>2</sup> Why spend so much time on the means of the discipline, as Vesely writes, rather than on "the

goals of architecture [...] human life."<sup>3</sup> Yet, this is the time when we need to be most reflective. We know that the means mirror the ideologies of the profession, thus affecting their products. The implication is clear, drawing – or sketching for that matter – plays an unquestionable role in shaping the character of our designs. The goal of this paper is to investigate what we know about why and how we sketch.

## BACKGROUND

A closer look at the role of drawing in architecture at key points throughout history reveals the significant impact it has had on not just the qualities of our designs, but the transformation of the cultural and social organization of architectural place and practice.<sup>4</sup> Such a discussion includes the evolving nature of representation and its relationship to the role of the architect, the practice of architecture, shifts in cultural climate, and developing technologies.

### *The Emergence of the Sketch*

Mark Hewitt marks the earliest appearance of the study sketch to have occurred during the *quattrocento*, when drawing became essential to architectural practice.<sup>5</sup> Subsequently during the period of the Italian High Renaissance the role of the architect as we know it was born.<sup>6</sup> Most agree that these two arrivals were formed of the same beginnings. Jonathan Hill interprets it as: "the architect and the architectural drawing are twins"<sup>7</sup> - a concept that implies interdependency and mirroring.

Important precipitating factors surround the emergence of the sketch. The introduction of papermills in Italy during the 13<sup>th</sup> century, and the

later invention of the printing press made paper more readily available thus providing a convenient medium for drawing to occur. Humanistic valuing of an individual point of view, as well as light and ocular studies characteristic of the Gothic period, encouraged the emergence and popularity of Brunelleschi's one-point-perspective. On the construction site, the appearance of an *appareilleur*, as seen in the Sansedoni project, allowed a second in command to begin releasing the ties of the lead master builder designer. In addition, the formation of highly skilled guilds in masonry and carpentry provided a stable foundation of tradespeople allowing the architect to act independently. Growing pools of secular patrons offering smaller jobs made providing only design services a viable source of income.<sup>8</sup> Additionally, Renaissance architects could easily produce iterations on paper when their designs were nothing more than compositional variations of conventional building elements, rather than complex structural and spatial advancements.<sup>9</sup>

The foundation for change was laid socially, professionally, culturally, economically, and technologically. It is in this context that the design sketch was born. Its advantage was to free the lead architect from the site of construction, thus allowing for multiple projects to be undertaken simultaneously. A varied body of work over a single lifetime, as opposed to decades, led to individualistic development. However, the design sketch of the Renaissance artist-architect remained primarily an analytic tool. It wasn't until the 19<sup>th</sup> and 20<sup>th</sup> centuries that the idea-sketch would take on its present identity and significance.<sup>10</sup>

The 19th century witnessed a period of great innovation. New inventions for architectural drawing were developed. These ranged from "accurate, sophisticated mathematical instruments such as the ellitograph, pantograph and scale rule, to the simpler tee square, drawing board and tracing paper."<sup>11</sup> The earlier reopening of the Academy of Architecture as the *École des Beaux Arts* reinforced the alignment of Architecture with the fine arts of sculpture and painting in academia. In the 20<sup>th</sup> century Constructivism, Futurism, and De Stijl movements and the Bauhaus International Style all proposed a level of synchronization of art and architecture. This expanded view of architectural creativity allowed for greater abstraction in archi-

tectural representation. The freehand sketch as a product of self-identity, and individualism was born.<sup>12</sup> Today it remains a primary mode of investigation, and expression in the architectural design process. So much so, with the onset of digital technologies, efforts have been made to explore design drawing within a digital environment.

#### *The New Doodle: Digital Sketch*

The effort to make use of the skills and knowledge already at the disposal of the discipline via hand-sketching has pushed research into new computer systems. These initiatives can be organized into five sub-categories: sketch-based systems, sketch-mimicking tools, hybrid media or media switching (from 2D freehand sketch to 3D digital model, etc), inference-based software tools and knowledge-based tools.

The sketch-mimicking tools are the most pervasive, forming part of a host of other tools in 2D, 3D, and animation applications. The media switching systems (from 2D freehand sketch to 3D digital model, etc) are also readily available commercially. We found a prototypical version of such a system as far back as 1993.<sup>13</sup> Also belonging to this type are 3D scanner-based systems, and the immersive environments that allow the use of the body to draw, and in 'Sketch Furniture'<sup>14</sup> to transfer movement in space to physical object.

Sketch-based systems are inference-based software tools and knowledge-based tools such as the Cocktail Napkin (1996), RTRT(1998), and SketchREAD (2004). In all of these the physical interface (i.e. tablet, pen, pad, mouse, joystick, glove, sensing space) allows for hands, arms, body to draw with individually created sets of moves. Mark Gross et al 'Cocktail Napkin' uses sketches as quasi-calligraphic gestures allowing designers to register their own collection of marks and corresponding meanings. Ellen Do's 'Right Tool Right Time' (RTRT) is a freehand sketching system that can infer intentions from the designer's drawing-acts to activate different tools. In her research Do found "designers use symbols and configurations," and these depend on the context within which design thinking takes place. RTRT is based on the premise "it is possible to associate symbols and spatial arrangements in the drawing with the designer's intention, or task context." Another

entry into the collection of sketch-based systems is SketchREAD developed by Christine Alvarado. It interprets sketches generated by individuals in many disciplines, not only design. Alvarado describes complex freehand sketches as having "ambiguity and uncertainty" and explains their interpretation depends on context. Both Do and Alvarado's claims share this focus.

The quest to physically merge traditional hand-sketching with digital mediating technologies echoes the perceived importance of the role of sketching in architectural design. Current discourse seeks to examine this critical relationship by offering ideas as to why designers sketch, and what is actually taking place while sketching.

### CURRENT DISCOURSE ON SKETCHING

Discussion of the sketch can range in tone from romantic anecdote to empirical research findings. This section seeks to address both with an emphasis on scientific evidence. Research on the sketch and sketching comes from four main areas: systems development, design research, visual thinking and reasoning (neurophysiology, psychology), and technical application. Each of these areas pursues its own goals, but the results are not mutually exclusive since each field influences the others. We have organized the findings into the following themes: process and understanding, re-interpretation and emergence, externalization and memory, and the affective dimension. In practice they all tend to operate in concert.

#### *Process for Understanding*

A number of studies have sought to qualify the attributes of sketching as thinking medium. Wiggins found thinking drawing "depends on the relationship between drawing and understanding the structural relationships" of the object considered.<sup>15</sup> He called this process "*drawing-understanding-drawing*," where understanding is more than "seeing." For Wiggins this is a "productive," rather than formulaic process. Other descriptors used by Wiggins referring to the designers' processes in his study were: "iterative, a design act, and process of making." The results point to the strong ties between drawing and designing, and between designing and making. They also confirm the cyclical nature of thinking through drawing.

Wiggins observes sketching is utilized in "typically unformed and uncertain [design context], the final results of which cannot be predicted." This is consistent with studies conducted by McGown and Green locating the sketch at the beginning of the design process, where there is "indeterminate and evolving priorities."<sup>16</sup> However, these findings resulted from a very limited study involving four design students in a conventional studio setting. Nevertheless, the notions of the *unformed*, *indeterminate* and *evolving* are consistent with neurological studies that have found the brain has "multiple ways of transmitting information [that are not] hierarchical, as would be if the flow were straightforwardly linear, but involves connections which are parallel, recursive, feed forward, and feedback."<sup>17</sup> Thinking operates as if it were an adaptive system. If sketching is a way of thinking, then it also possesses such attributes.

A view often expressed in professional publications is that sketching has the capacity to provide "a better visual understanding of the whole," where "hand-eye relationship and coordination"<sup>18</sup> are keys to seeing and understanding. When drawing from the mind, the eyes follow the hand's movement. Working on the computer the eyes follow the cursor or pointer on the screen. Research on the function of the brain shows that it is not just a 'hand-eye' combination that explains what we do, for example when sketching, but rather a 'hand-eye-brain' collaboration. As Wilson states "the hand affords the brain new ways of approaching old tasks and the possibility of undertaking and mastering new tasks. That means, the brain for its part, can acquire new ways of representing and defining the world."<sup>19</sup> We also know that the act of seeing is not executed solely by the eyes.<sup>20</sup> The input is processed by different parts of the brain, which puts it all together, making vision an "active process."<sup>21</sup> This is consistent with Cohen's study of adults revealing that a misperception of the object viewed is one of the primary conditions for drawing errors, "not motor coordination, a misperception of the work, or the decision-making process."<sup>22</sup>

We have the mental capacity to transform 2D images into 3D equivalents on the go.<sup>23</sup> But we must have a previous understanding of what we are looking at, what we are looking for, where it is found, and how it is put together. If one says

- *think about a sphere* - one person may visualize the formula, another sees a circle or a round volume with shadows, another a ball, and the last one draws a blank either because they don't know what a sphere is, or because they don't speak the same language, and 'sphere' is just a sound. Recognition plays an important role both when referring to an existing or non-existing object. But what if the object is to be conceived, to be made? Designers think about what they are to make and record their thoughts, as well as tweak their thoughts through representations, just as one writes and rewrites a sentence. We don't behave as a pantograph that follows the path of the tracing. As demonstrated by empirical research we look at an object, recognize it, and draw it. We can imagine while drawing, as one technique proposes, our eyes are touching the surface of the object as if it were our own hands. This approach requires looking at the object drawn, rather than the hand drawing.

In architecture understanding the object requires direct understanding of spatial conditions, relationships and activities, building systems and materials which are at the core of the discipline's knowledge domain. Sheil refers to this knowledge when arguing "the making of buildings demands an expertise that is familiar with the tactile and the physical [...] that goes beyond the production of information."<sup>24</sup>

#### *Re-interpretation and Emergence*

Among the categories, this is the most widely researched.<sup>25</sup> Schön and Wiggins explain the sketch is a 'visual display' that can be reinterpreted. Goldschmidt suggests sketches have 'figural properties' that are reinterpreted. Radford and Coyne describe hand sketches as "explorations of alternatives through interpretations of flexible abstractions." Their observation confirms the findings of van der Lugt and others. For Purcell and Gero the sketch is a "relatively unstructured form of pictorial representation,"<sup>26</sup> in the context of the design process applied when investigating "a possible form and a way of developing that form."<sup>27</sup> Therefore, they suggest it is important to investigate "how to facilitate emergence and reinterpretation."<sup>28</sup> Here emergence refers to a "new way of seeing," possibly beyond the sketch as an artifact, but as a thinking medium. Sheil

proposes the design process is "a discipline that instigates, rather than solves ideas."<sup>29</sup> Reinterpretation requires *projecting* one's thoughts into marks registered on the paper, or the screen, or into other tactile objects, reforming them into the object of our thinking. In the early 90's when computer graphics systems were still slow in calculating hidden line removal, some were convinced that the shifting areas of color on the screen as the image was formed, allowed discovering new configurations. Unfortunately, the temporary images could not be printed, and they transformed too fast to sketch.

Results on the interpretive aspect of sketching are not conclusive. Purcell and Gero have found not all drawings are reinterpreted.<sup>30</sup> Van der Lugt's experimental research on design collaboration confirmed sketching allows for a "re-interpretation cycle," and "enhances access to earlier ideas," but provided few insights into the reinterpretation of "other's ideas" when working in a group. This suggests the sketch is essentially a personal device occupying a space that cannot be intruded upon without expressed permission. It could also reflect the fact that some drawings are discarded anyway without further elucidation.

Another facet of reinterpretation is reflection. Reflection is a proper term in this context because it refers both to the 'projective' capabilities of the sketch, as well as the contemplative and deliberative. An architect's explanation "sketching gives me a distance,"<sup>31</sup> suggests it allows the designer to be positioned outside the design. This is consistent with Schön and Wiggins "freehand sketches are an essential medium" for introspection, a way of talking to oneself, of talking aloud;<sup>32</sup> and, as Fish and Scrivener described it an "on going dialectic."<sup>33</sup> This observation has been noted in the work of designers, not just architects.<sup>34</sup> Although explanations abound on this subject, as Suwa et al caution, there is not sufficient empirical data to confirm it.

Suwa et al have found studies on sketching and the design process coincide on two points: sketches allow for "re-interpretation" and for "unexpected discoveries," which is a significant offshoot asset. They have found freehand sketches play three main roles:

- Serve as repositories of ideas for future inspection.
- Provide cues associating visual and non-visual functional issues.
- Offer a physical setting, a physical field of action or physical context, "in which design thoughts are constructed on the fly in a situated way."<sup>35</sup>

The association of the visual and non-visual through sketching is clearly apparent in Carlos Jimenez's explanation: "Sketches help me keep track of the placement of trees, or potential views of the landscape inside the house, and to arrive at my own understanding of the problem."<sup>36</sup> Bahamón elaborates "[sketching] reveals details that cannot be reflected in the construction itself [such as] the history of the place, mechanism used to approach the design or structural solutions."

#### *Externalization and Memory*

Sketches facilitate three actions: bringing ideas to the fore, backtracking to access ideas later in the process, and refining ideas. Fish and Scrivener link sketching to "image externalization processes."<sup>37</sup> Referring to "the externalization and concretizing" of the painting process Zeki refers us to Hegel's concept 'disgorging.'<sup>38</sup> Picasso's bull drawing series immediately comes to mind here, also in relation to lateral transformation, discussed later. Externalizing as *disgorging* sets a vivid picture of the materialization of energy in a brainstorming session, very different from the concept of distillation implying a more carefully considered and slower process. In architecture Sommerhoff suggests sketching "facilitates the creative process and distillation of ideas."

McLeod contends sketching allows to "externalize ideas," by providing a "representation of an intangible mental visualization." Kavakli suggests *idea sketch* is the externalization of "envisioned or partially envisioned entities."<sup>39</sup> Kalay has written about how through sketching "configurational knowledge, structures the explorations of variations and moves within the design."<sup>40</sup> This knowledge, intricately related to sketching as memory, must exist in the designer's mind for sketching to happen. Form finding and form making are not automatic processes, intentionality and purpose drive the effort.

Why do we need transitional artifacts before we move on to engaging the thing itself? Can we not simply conceive in the mind, then build? Is the transitional object's only purpose to keep track of the mind, or to explain that which words cannot hold? Externalization seems not to be always essential. Finke et al found that creativity appears not to be always enhanced by the capacity to sketch or doodle.<sup>41</sup> Consistent with this finding Verstijnen's experimental research indicates "creative discovery does not require externalization in synthesis tasks."<sup>42</sup> But, when it involves analysis "it benefits from externalization through sketching."<sup>43</sup> Although these results are far from conclusive because of limited empirical evidence<sup>44</sup> to verify their accuracy, it is conceivable that as buildings gain in complexity, we are less able to project solely in the mind. Still, some have argued sketching is less an act of necessity - an instrument - than it is an act of pleasure offering emotional dimension to the creative experience.

#### *The Affective Dimension*

Radford and Coyne have compared "the restricted language of a CAD system," with the "feel of a brush in hand and the quality of a stroke" full of expressivity, in apparent agreement with Bahamón who proposes: "drawings can reflect the author's character, points of reference, personality and mood." Others have described drawing by hand with pen on paper in a similar fashion: "I rejoice in the pen's ability to transfer feeling from my brain to the paper. I can express hatred, sweetness, infuriation or confidence as I scar the surface or stroke ink on to the paper with loving care."<sup>45</sup> The affective projections may be related to entering a state of concentration, of well-being, what Csikszentmihaly calls *flow*, to be creatively immersed in the design process. It is not about technique, but about being in the proper state of mind to perform the operations required when sketching. An example of *flow* is Hill's explanation for accepting his way of dealing with drawing: "particular pleasure and creative tension exists when drawing the building and building the drawing feed each other." A human desire to make (*homo faber*), to leave a mark in the material world could also explain this attitude. More than two decades ago Zuboff found the handwritten text allows the writer to identify with the thing written. After all, the digital is a less tangible way of making, except when directly tied

to automated fabrication. On this respect it is an issue of control as suggested by Hill's statement: "the conjunction of computer-aided design and computer aided manufacturing [...] aligns thinking, drawing, and making so that the architect can more accurately claim to be in command of drawing is to be in command of building."<sup>46</sup>

Anecdotal evidence found in professional publications renders additional insights into the findings of empirical research especially regarding the affective dimension. The hand-drawn sketch is described as endowing "practical ability to express concept quickly, fluidly [...] in a variety of locations."<sup>47</sup> What can compete with the immediacy and mobility of the stick, the hand, and the scratching surface? As compared with the digital, it is an undoubtedly simple and proven way to think without formidable infrastructure. Perhaps that is why some in architecture decry "the subordination of pencil and paper to fancy computer software."<sup>48</sup>

Both the empirical and anecdotal examination of the sketch provides valuable insight into the function and qualities of sketching. Upon this survey of viewpoints we offer a framework for considering the sketch redefined.

### ...CONCLUSION: REDEFINING "SKETCH".....

...The dissection of the sketch begins with the premise that sketching is a medium, an agent of transfer, simultaneously material and immaterial. Sketch is both a thing and a process. Differences arise when defining what sketching is a medium for, or plainly put, what is its purpose. This paper supposes that a comprehensive understanding of sketch can occur when it is considered as both a medium of drawing, and a medium of thought. One is not exclusive of the other. Both modes are intentional, and result with the designer gaining new awareness, yet they differ in structure and place of emphasis. As a drawing medium, sketching underscores product as the starting point of analysis, and as a design medium it highlights process as the site of investigation.

#### *Sketching: A Drawing Medium*

To draw means to produce a likeness, or representation of, by making lines on a surface. Sketching falls within the domain of rough, gestural, quick

drawing. It provides for describing, documenting, and archiving. When it is primarily a drawing medium, the process of conception is linear: ideas are internally conceived and birthed externally through graphic processes of line work. Thus sketching mechanisms by this description are only outputting devices. The act of sketching simply becomes a means to an end – to generate the likeness of, with the sketch behaving as a representation of mental imagery. It is literally an "image externalization process" in which the value of the process is revealed in the product, and all of its corresponding attributes. The collection of sketches mirrors the formal evolution of the designed object.

When sketching becomes just a way of making drawings the investigation of its various forms is satisfied by defining its taxonomy. An attempt to establish the role of sketching analyzes and identifies the types of output i.e. types of sketches produced based on **media** and **mode**.

The **modes** of sketch fall under three general categories:

- Referential: sketches used to record/document some existing condition of the physical environment. Sometimes these are made in the absence of a design task, and are referred to as travel or field sketches.
- Experimental: sketches used to capture or generate the non-existent. More often than not these are associated with a specific design task or inducement, real or self-imposed.
- Analytical: methodical sketches that use fixed-ordering systems such as codes, grids, or geometry, to calculate and create the non-existent, or decode and explain some aspect of the existing physical environment.

The content of the sketch is formed and framed by the technology or **media** that produces it, when sketching is considered *only* as a medium for drawing. This understanding of sketches makes the media choice used to create them undoubtedly significant. The current juxtaposition of the sketch in the preemptive debate of analog versus digital rests upon this dependency. In this debate the tried and true art of sketching is endangered



Figure 1. Diagram of sketching as a drawing medium.

by the perceived threat of a growing shift towards digital media choices during design. If the value of sketching is primarily identified by the resultant drawing's attributes (media and mode), then sketching is truly at risk. However, an expanded view of sketching as a process of thought may dissipate the risk associated with non-traditional drawing media.

#### *Sketching: A Design-Thinking Medium*

Digital technologies (any type of computer system used to present, record, manipulate or generate visual data) may challenge sketching as a drawing medium, but not necessarily sketching as a design-thinking medium. When sketching is seen as a medium for design-thinking, the process becomes cyclical. Conception leads to the act of sketching, encouraging perception, which in turn fuels further conception. Sketching acts like a bridge that connects what is just beneath the surface with the immediate reality of the perceived "now".

It must be noted that perception refers to a rather

low level of consciousness in which only awareness of immediate experience is achieved, not complete self-consciousness.<sup>49</sup> In fact, the lack of self-consciousness is a hallmark of the sketching process.

The sketch itself, the graphic artifact, is the continuous cognitive loop. By this scenario the residual graphic build up over time from a continuous cognitive loop. By this scenario the act of sketching is an emergent device, in which the value of the product can not be determined by its attributes. The value of the product can only be considered in the context of its parent process. Thus the sketch itself is an event. It is constituted of moving fields of data that continually reconstitute themselves. Once the process of sketching has concluded the remaining drawings become repositories for the experience.

Sketching as thinking medium resists specific forms and broad classifications. An attempt to understand sketching as a medium of thought can be described by conditions, types of activities, or participants' capabilities in the environment where sketching occurs:

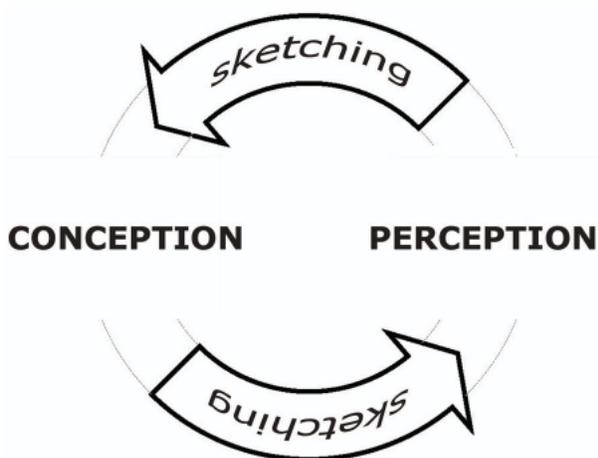


Figure 2. Diagram of Sketching as a thinking medium. Inspired by Charles Rusch diagram.

- Searching
- Re-interpretation
- Kinesthetic movement
- Incompleteness, continuously in-the-making
- Unstructured and unformed
- Ambiguity
- Unpredictability
- Lateral transformations<sup>50</sup>
- Abstraction
- Uncertainty
- Memory
- Emergence
- Cues
- Skill/expertise
- Canonical schema

### Uncovering More Questions

We found no evidence sketching as a drawing or design-thinking medium is disappearing, but rather 'sketching as thinking' is *transforming* as the nature of the discipline is changing. We conclude from anecdotal evidence sketching as drawing medium is being transformed by mode and media. However, we contend sketching can happen without drawing. We are unable to conclusively or tentatively establish if sketching is the best or the only thinking medium for design. Nor, if the traditional hand drawn sketch is the best thinking medium to enable understanding. Finally, we could not find empirical evidence demonstrating sketching results in a better design.

How does knowing that "the physiological and psychological aspects of perception cannot be separated" from each other, and that "all perception is extrasensory,"<sup>51</sup> change this discussion? How has our perspective about designing, drawing and thinking altered considering the hemispheres of the brain complement each other, but when the physical connection is cut, a person may be able to write but not draw? What happens when we use quasi automated processes to 'sketch,' where details are added not resulting from intentional acts? Are these useful as provocations? Are we recognizing them as such?

As we investigated sources for this essay we came about some predictions of the future, which did not seem to us to be extraordinarily visionary. One proposes "the future of architectural sketching may well be in the ability to quickly and easily create and manipulate design elements in 3D,"<sup>52</sup> implying sketching occurs in a digital environment. The other proposes "the future of hand rendering in design school may be about teaching future practitioners where, when, and how to use this skill as a complement to computer technology,"<sup>53</sup> suggesting traditional skills and media are here to stay. In both cases the emphasis is on sketching as drawing medium.

We reiterate sketching as a design-thinking medium is liberated from the constraints of media. As a personal device it allows a designer to think aloud. The process is fed by the designer's direct physical and intellectual experience.

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