Architectural Design and Drawing

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Abstract:

This paper focuses on the function of drawing in architectural design. It does so by taking an in-depth look at the drawing material produced for the design of the chapel at Ronchamp. Within architectural design there is more than one type of drawing. The objective therefore is to determine what exactly these different types of drawing are and furthermore what their function is for the architect. For we believe that questioning, at this basic level, the function of drawing within the design process provides the basis from which it is possible to go on to question the function of computer-based drawing within the design process, and consequently it's function in CAAD.
Introduction

Our aim is to examine architectural design-drawing, to ask how drawing and design relate. Our approach is to focus in on the particular: one architect, one building by that architect, one type of drawing from within the drawings produced for the design of the building. So starting with a macro-level interest in architectural design-drawing this study moves inward to consider the micro-level of the plans produced by Le Corbusier for the design of the chapel at Ronchamp.

We think it is necessary at the onset to justify both this approach and the particular choices made.

Ronchamp as example

The Ronchamp project is exceptional. It is not a 'bread and butter' job but rather the commission most architects would give dearly to have: a commission which gave the money, the time, the artistic liberty, to really produce 'architecture'. Corbusier testifies himself that it was an exceptional brief. '1950 - 1955. Liberty: Ronchamp a totally free architecture. No programme other than the celebration of the mass.' [1] Originally, Corbusier refused the commission to design Ronchamp on the grounds that he would not work for a 'dead institution' (the Catholic church), but it was Canon Ledeur who finally enticed him with the offer that in this project: 'he could go all the way' [2].

The Ronchamp commission occurred late in Corbusier's life. It began in 1950, when he was sixty three, and was completed in 1955 ten years before his death. The first step in this design therefore advanced upon a resource of forty realised projects and it is fair to assume that in terms of age, and experience, Corbusiers method of working had reached a well-honed and polished pattern. Corbusier himself seemed to think so since he chose his method of designing Ronchamp to illustrate his method of designing generally [3].

Corbusier was famous by the time of the Ronchamp project. Even while producing the study sketches for the design of Ronchamp he was at least partly conscious that they would be for others to see, and so in turn, was more self-conscious of his method of design. Soon after the completion of the project, Corbusier compiled and had published a selection of the drawings in a book on the design of Ronchamp [4]. Such self consciousness could be a disadvantage. However, we feel Corbusier is unlikely to have changed his (lifetime-evolved) pattern of designing in order to design Ronchamp, and that he wrote about Ronchamp as a statement of his design method generally (not as an exception) would tend to confirm this [5].

There is a good pragmatic reason for choosing the Ronchamp chapel to illustrate Corbusier's method of design rather than one of his other projects: it is one of the most complete in terms of surviving drawings. Pauly wrote 'Analysing the project for the chapel of Ronchamp proved particularly revealing; unlike most of Le

[1] Le Corbusier Textes et Dessins pour Ronchamps Forces Vives (1965)
[5] Le Corbusier, Les Carnets de la recherche patiente, notebook 2 Girsberger Zurich 1957
Corbusier's other projects, for which only a small number of preparatory drawings have been found, it was possible in this case to retrieve almost all of the study sketches, notebook sketches and studio drawings [1]

One further value in studying Ronchamp is the wealth and quality of information, both drawn and written, which is available. All of this was produced for real goals under real circumstances; it is almost experimental quality data without the drawbacks of having been obtained through experiment.

To acquire a wealth of drawings with accompanying depth of information, especially the dates, similar to that which exists for Ronchamp one would need to be present at and observe the design, such as Kraus and Myer (1968)[2] who recorded their own ideas and activities while designing a school. But we cannot see how doing so does not affect self-awareness and ultimately what is produced.

Yeomans (1974)[3] focuses attention on the difficulties that are involved in attempting to observe the design process. His research was based upon the different methods used by the Liverpool University School of Architecture teaching office to observe their own design schemes. The schemes were real, although students and staff and designers from outside the school were involved in the design. In a sense it offers a halfway house between the laboratory experiments of Eastman (1970)[4] and design in the real world. The paper looked closely at the techniques which may be used to explore different stages of the design process, and also weighed the difficulties posed by different experimental methods. Yeomans consider aspects such as self monitoring, the 'participant observer' and the independent observer, but at the end of the day concludes: 'The observation of live situations has its own special problems. Not only are the processes often very long and the data generated extensive but the observer may affect, or may be affected by, the process he is trying to record.'

To conclude, we do not believe Ronchamp's exceptionality to be that exceptional nor do we believe that what exceptionality does exist outweighs the virtues it affords as a source of study but a decision on that ultimately rests with the reader.

Corbusier as example

Corbusier is not an average architect. He belongs to those acclaimed geniuses' which are a very small minority within the wider body of architects. This begs the question: 'Is it possible to come to conclusions about the work of one man which bear any relevance to others who, are unlike?'

In one sense we think it is possible, and it is simply because architects, on the whole, seek to emulate famous architects. Famous architects are the exemplary models. This is not saying that all architects aspire to be famous, or considered great, but they do aspire to be creative: it is the famous, who are looked to as a source of creativity. The prevailing perceptions of who, or what,

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is particularly creative are open to debate but nonetheless it is undeniable that 'great' architects prevail and have their influence. Conclusions drawn from the work of a famous architect, such as Corbusier, have some validity in that how he designed is how many other architects would like to be able to design.

In questioning the validity of studying Corbusier it is assumed that the great architect works differently from the typical architect. But is that necessarily true? We do not know nor do we know if it is true to what extent it is true. However there is value in setting out how a great architect works as what emerges then exists to be compared with how a typical architect works, and maybe even to reveal why they are considered differently.

The plan as example

In the analysis that follows we concentrate on the development of the plan of Ronchamp. We do this partly because this constitutes the bulk of the drawings, but there is a sense in which the plan holds a special place in the development of design. The plan as a drawing-type, more than any other, embodies architecture. Indeed the word 'planning' has come to mean design generally. Oxman, Radford and Oxman felt also that there was something special about the plan:

"The representation of architecture by drawing requires multiple views, but among these standard views of buildings, the plan occupies a special status" Their recent ECAADE report [1] used the plan as the basis to teach more widely about architecture. This is because the plan is the leading generative drawing in design and so many aspects of a design are dealt with in the plan. Ronchamp itself confirms the central importance of the plan as there are more views of the building in plan than in any other view.

The analysis

Design drawing is made up of more than one type of drawing. Over the years there have been many attempts to distinguish between, and label, these different types. What seems to have emerged is the identification of dime distinct types. These are: sketch drawings, detail drawings, and working drawings (although they may be referred to by various other names such as concept drawings, preliminary working drawings and production drawings). These three drawing types also appear to describe stages in the design process. The aim of this study, therefore, is to ask: are there are distinctly different types of drawing? If there are three; and if there are three distinct drawing-types can they be considered stages in the design process?

In the following experiment three preparatory steps are taken in order to make it possible to arrive at a set of histograms which, as accurately as possible, show the plans for each of the drawing-types plotted against the time-span of the project. Firstly a detailed chronology of the Ronchamp plans is established. Then the drawing types are defined and the plans sorted into these types. Finally assumptions and decisions are made concerning the actual representation of the data.

The first step: establishing the chronology of the plans

The plans for Ronchamp derive from two comprehensive sources: *The Le Corbusier Sketchbooks, Volume 2, (1950-1954)* and the *Le Corbusier Archive, Volume 20, Ronchamp, maisons Jaoul, and other Buildings and Projects, (1951-1952)*. Together these two sources provide access to all of the drawings bequeathed by Le Corbusier to the Foundation Le Corbusier in Paris, and They probably contain nearly all of Corbusiers drawings: he was a notorious hoarder.

The first step was to establish the chronology of the Ronchamp plans. There were 72 design plans for Ronchamp, but of the 72 there were 27 which had no date and so could not immediately be incorporated in a chronology. Considerable time [1] was spent establishing the chronological order of some of the early plans, and in the end it was possible to ascribe dates to 12 of the 27 undated plans. (It was only necessary that the dates be accurate to within a month though wherever possible we aimed for greater accuracy). The 12 remaining plans without dates were left aside, leaving a total of 60 dated plans.

The second step: defining each of these drawing-types

The second step was to define the different drawing-types. The decision was made to was made to take on board the drawing/design guide-lines devised by different bodies such as the RIBA and DOE etc which are illustrated in Table 1.

[1] The development of the method used to analyse the drawings themselves is an extensive piece of work in its own right and is dealt with in full in the M.Phil thesis to be submitted by Lee Jenkinson.
The stages of Architectural design

Table 1. Traditional stages of Architectural design

<table>
<thead>
<tr>
<th>RIBA plan of work</th>
<th>D.O.E</th>
<th>D.H.S.</th>
<th>Large London Practice</th>
<th>Small London Practice</th>
<th>A broad summary</th>
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<tr>
<td>A Inception</td>
<td>1. Pre Design</td>
<td>1) Outline Project Intensions</td>
<td>Outline Scheme</td>
<td>Feasibility Studies</td>
<td>Feasibility / Outline</td>
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<td>B Feasibility</td>
<td>2. Design</td>
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<tr>
<td>C Outline Proposals</td>
<td>2.1 Outline Design</td>
<td>2) Planning Project &amp; Feasibility</td>
<td>Sketch Design</td>
<td>Sketch Design</td>
<td>Sketch Design</td>
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<td>D Scheme Design</td>
<td>2.2 Final Sketch Design</td>
<td>3) Design &amp; Cost Planning</td>
<td>Sketch Design</td>
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<tr>
<td>E Detail Design</td>
<td>2.3 Detailed Design</td>
<td>Preliminary Working Drawings</td>
<td>Detail Design</td>
<td>Detail Design</td>
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<td>F Production Information</td>
<td>Production Material Bills of Quantities Pre-Tender Estimate</td>
<td>Final Working Drawings</td>
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<td>G Bills Of Quantity</td>
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<td>H Tender Action</td>
<td>2.4 Contract Preparation</td>
<td>4) Contract &amp; Construction</td>
<td>Contract Supervision</td>
<td>Revision</td>
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<td>J Project Planning</td>
<td>3. Construction</td>
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<td>K Site Operations</td>
<td>3.1 Pre-planning</td>
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<td>L Completion</td>
<td>3.2 Construction Control</td>
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<td>3.3 Construction Completion</td>
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<td>4 Post Construction</td>
<td>5) Commissioning &amp; Evaluation</td>
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The guide-lines shown above conform to the idea that there are different types of drawing, and even to some extent upon what these types should be called. Regrettably they give no detailed explanation of what is really meant by each drawing-type. This is left conveniently vague and when trying to pin down accurate definitions we could see why: it is very difficult.

However we believe it is possible to define different types of drawing since they must result from the different functions which drawing is required to perform in the design process. Table 2 summarises the attempt which was made to establish what exactly these different functions of drawing were and to see how they grouped together.

Table 2. characteristics used to distinguish between the three types of design

One difficulty which arose while trying to define types was that many of the characteristics though most often true are not invariably true. Notable are the possible distinctions listed in the third section, each of which would demand a lot of individual research in order to be sustained. However those points about which we could be more definite constitute the following definitions which were used to categorise the drawings.

The sketch:

The job of a sketch is primarily personal: it may be used to convey an idea to another, but this is secondary to helping communication with oneself. Invariably the sketch is drawn freehand and drawn not-exactly to scale. If it is to be compared with other types of drawing produced by the same person, then it appears to be drawn more free, loose, quick, and altogether more rough. It is not so easy to compare one persons sketching with another as such qualities vary with each person's standard of drawing or style of drawing.

Any medium can be used for sketching; although, in general, that which least inhibits the flow is preferred, such as: charcoal, felt pen, marker, soft pencil.

The detail drawing:

The detail-drawing lies somewhere between sketch and working drawing in both appearance and function. The detail-drawing performs a dual task: it helps communication with oneself and it helps communication, usually informally, with others; these are most often other members of staff or specialist consultants rather than 'outside' contractors or statutory bodies.

In appearance, the detail-drawing distinguishes itself from the sketch by being drawn with ruled lines and by being drawn to scale. The distinction between the detail-drawing and the working-drawing is less obvious, although, almost always it looks to be drawn in less detail and with less control or deliberateness.

The working drawing:
The working drawing has a unique job of communicating information between architect and site. Working drawings therefore have a drawing label: this contains information such as the name of the draughtsman, the date on which the drawing was issued to site, the scale of the drawing, the title of the project, and the number of the drawing; all of which serves to order the exchange of drawn-information between architect and contractor. If a drawing is a 'revision'; that is, if it is the re-working of a drawing which has been previously been issued to site, then this is a clear indication that the drawing is a working drawing.

A working drawing appears as if it has been drawn with the aid of a straight edge. Most usually, it is drawn to scale, drawn in ink, and drawn in a highly controlled manner: all of which combined, give it a neat, finished appearance. Where there is great detail and/or, many layers of information then again it is most likely that the drawing is a working drawing.

A visual image of what we felt each of these definitions to amount to is reproduced below. This represents the yardstick used to categorise the plans.

![Sketch Drawing](image1)
![Detail Drawing](image2)
![Working Drawing](image3)

**The third step: ironing out problems in representing the data**

Analysing the archive in this way requires that the 60 plans were studied in chronological order and each of these plans categorised as a distinct drawing type, but what was necessary was a way of making visible the variations in drawing output over time. We needed a unit of time that would enable us to show how many plans were produced within that given unit of time. The unit chosen was the month, half yearly being too crude and anything smaller than a month being more accurate than the data itself. [1]

Considering each plan as a date, and forgetting for the moment the distinction between the different drawing types the result is the total output as shown in figure 1.

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[1] For instance, the date on the drawings is taken to be the date on which the drawings were produced yet, except for sketches, few architectural drawings are produced in a single day.
Figure 1. showing all the drawings

The plans cluster in two periods of time: an early part ending in March 1951 and a later part beginning in October 1952.

However this picture is not altogether accurate: The second grouping consists largely of 'working drawings' and working drawings are not single drawings but series of drawings, or revisions, over time. This analysis conceals the multiple drawing nature of working drawings. Steps had to be taken to represent, fairly, the nature of the working drawing.

It was possible to return to the archives and find out the number of revisions for each working drawing. However, where these revisions simply added to the drawings of which they were a revision, a distortion would occur. The amount of drawings at certain dates would be exaggerated. This would create an illusion of some overly intense periods of working-drawing production. This distortion is illustrated in figure 2.
Therefore, in order to show accurately the spread of drawing activity over time it is necessary to consider each revision of a drawing as equivalent to separate drawing. This has two effects. It produces a much more even spread over time of the working drawings and also it changes the balance in output intensity between working drawings and sketch drawings, both are shown clearly in the final graphs: figures 3, 4 and 5.

Figure 3. Occurrence of sketch drawings.

Figure 4. Occurrence of detail drawings.
Figure 5. Occurrence of working drawings

What do the histograms show?

We expected the different types of drawing produced for the design of Ronchamp to conform to the four 'stages of drawing' outlined in the guidelines produced by the DOE, DHSS and RIBA etc. (Table 1): feasibility/outline - sketch design - detail design - working drawings, and it appears that they do.

A period of no drawing stretches from the inception of the project in January 1950 until the early site visits around the beginning of June; this corresponds to the feasibility/outline stage. The next recognisable stage is the sketch design stage. Most of the sketch drawings cluster between June 1950 and May of the following year. The detail-drawings predominantly cluster around the same time period but the peaks in drawing output for the two drawings-types are at different times: the peak in drawing output for detail-drawings is five months after that of sketch drawings. So the detail design stage does appear to follow the sketch design stage. The working drawings form the last major group (as expected) and are spread over the last three years of the project.

Sketch-drawings

However, within that general order of things there are exceptions and one, not entirely unexpected, is sketch-drawing. As expected it occurs most at the beginning (after, of course, the period of no drawing), but it also transcends the idea of distinct drawing/design stages. Sketching does this in two ways: it occurs initially in two distinctly separate phases rather than just one and it is not confined to the beginning of the project but recurs briefly throughout the design process. So although Ronchamp demonstrates very definitely the initial period of
intense sketching, it displays a process which is more than a simple progression from one drawing type to the next.

We also didn't expect the particular spread of sketching activity which was revealed by the sketching histogram. About seven months after the first concentration of sketch-drawings, there is a second concentration. The first is where one would expect to find it: in the initial 'sketch design stage'. The second is a shock. The temptation was to dismiss it: to say that it was an eccentricity, a 'second sketch-design period' peculiar to either Ronchamp or Corbusier. [1]

But on reflection it is not such an anomaly but really a rather common occurrence in design. The best name we can think of to describe it is 'the real design'; it is the design period which occurs when suddenly 'it's all really going to happen', the project is to go ahead and there is the need to make changes because it is going to be built.

The timing of this second peak of sketch design activity is immediately after a full presentation of the scheme to the client, the Commission for Holy Art. The period of re-design is often like this, coming after the major presentation to the client, or maybe more often, after the first stage when planning permission is granted. It is often only then that the money is made available, often only then that the brief is rigourously determined and so, only then that the design begins in earnest. Up until that point most design jobs carry with them a reluctance to commit too much in terms of time or resources: enough, of course, to secure the job, but not too much in case the project is destined to become just another of the many in the the drawing files which never got any further than this along the road towards becoming a real building.

There were not only these first and second sketch design phases, but there is the matter of Corbusier sketching a little throughout the design of Ronchamp. If a graph of all the drawings, plan or not, were plotted, it would show lots of little peaks of sketch activity throughout the project, not just two big ones.

We feel it is important to stress this because it is not visible in the histogram. It is due more to the particular choice of 'the plan' to illustrate everything rather than an accurate depiction of the truth. The plan has advantages as a means of illustrating general points from the drawings, but this case highlights one of the drawbacks: the plan is of central importance in the process of design and therefore will early on in the project have had to become fixed. This means that after a certain time, the plan as a complete drawing (which is how we have been dealing with it) will not alter radically again. To do so would mean everything changing. So parts of it will change but the changes will not show up as complete new sketched plans, but rather as individual sketches like those below of a doorway or a stair:

[1] The abrupt cessation in sketch activity can be attributed to Corbusier having to leave for Chandigar after the 9th of June but this does nothing to explain re-commencing being as late as 7 months after the initial period, especially when Corbusier had returned by the end of the summer. Had the sketch activity really constituted one period, but which was interrupted, then one would expect it to have carried on immediately upon Corbusiers return to France - which it didn't.
We have not chosen to plot *all* the drawings to show that sketching does occur throughout the design process but the point can be made by indicating and illustrating one or two of situations spread throughout the design where there is a recurrent use of sketching. For Corbusier it is primarily where particular elements of the design need resolved, such as the bell-towers or the main ceremonial entrance through the south elevation.

There follows a sample of some of the sketches produced over a wide spread of time for main south entrance.
Reasons which concern the nature of the design process itself must be turned to in order to explain the continuous recurrence of sketching on a smaller scale throughout the design process. As a process, design has been likened to a 'wicked problem' [1] but we believe that within that overall problem there are problems which are more wicked. These can be big or small, but often they demand an inordinate amount of time to be resolved.

Corbusier doesn't only wrestle with the fundamental design problems at the beginning: the wrestling with design goes on deep into the project. There are lulls, but then in the middle of detailed planning, or surrounded by working drawings, there is a need to resolve the gargoyle detail or the deep windows in the South wall, and here Corbusier needs to think, to design, and most of all to sketch. For him the means of resolving these wicked problems is by sketching.

Clearly it is 'the sketch' which is the visible and discernible tool which Corbusier resorts to when in these difficult times of design. Two of the best examples are: the main South entrance, which he laboured over a lot; and the towers. One further illustration of the point which we find particularly telling is that even two years after the building was dedicated we find Corbusier struggling to resolve 'the essential elements of worship' which had persistently annoyed him throughout the project, and the tool which he uses to tackle them is the sketch. In his own book published in the same year Corbusier wrote: The positioning of the essential elements of worship in the chapel of Notre-Dame-du-Haut was temporarily settled for the dedication ceremony on the 25th of June 1955. Since then the great wooden cross fixed at the back of the altar has appeared awkward to me. I felt an increasing uneasiness about it, I concentrated on it and today, two years later, I began to draw; I made these five sketches; they are dated 25th June (just a coincidence) [2]

So it would seem that as and when these tough design periods occur so to do sketches.

The histograms of the detail drawings and working drawings

This paper is concerned principally with the role of sketch design but it is worth mentioning here something about the patterns of detail drawing and working drawing. The most intense period of detail drawing lies between the two periods of sketch-design. This affirms the overall order of the drawing/design guidelines where the major detail-design stage should follow the major sketch design stage.

More interesting though is that two smaller peaks of detail-drawing activity coincide with the two peaks of sketch-drawing activity. In the first, sketching is very much dominant but in the second, both appear to be of approximately equal importance. Detail-drawing, like sketching, also recurs spasmodically throughout the design of Ronchamp.

The working-drawings form very definitely one large group. The group is not uniform in the sense of being represented in the histogram as one large peak: it is a grouping of many peaks and troughs in activity.

Discussion

This study of Ronchamp emphasises the important role that drawing plays in design. In Corbusier's work sketching and reworking sketches continues throughout the preconstruction phase of designing (and even surprisingly after the building is finished). There are clear peaks in this activity - one occurring at the earliest conceptual stage another as the project is firmed up - but they are peaks within a continuous purposeful sketching programme. Clearly for this architect this kind of drawing is an important design aid and the drawings are used as a continuing reminder of the development of design.

We cannot over-extrapolate from such a limited study but the findings reported confirm a commonly held view of design, a view enshrined in the curriculum of many schools of architecture and in Negroponte's early ideas [1]. This view is that the human activity of designing cannot (or even should not be divorced from 'drawing'. In the CAAD context this raises questions about how this activity can be integrated or incorporated into the man-machine complex. Many of the existing CAD packages assume that designing is basically a cerebral event, think then draw; and are dedicated to making the production of drawings easier on the grounds that what is being done is expensive craft work. The designer is helped to be more productive to leave him free to get on with the 'real' work. This study suggests (no more than that is claimed) that this is a limited view of design. We suggest that the process of designing needs more investigation and the role of drawing be made clearer.

No more firm conclusions can be reached after what is merely a pilot study. More constructively we could point to the way that this work is being developed. As one building is a limited study; the intention is to extend the study to include other buildings by other architects. As far as possible, this will be a study of buildings and architects that are comparative with Le Corbusier and Ronchamp.

We considered balancing the exceptional nature of both architect and project by studying the opposite extreme: a very typical building produced by an unacclaimed architectural practice. But, besides whether it is fair to make comparison with other than like with like, there is a practical difficulty: drawing collections of less famous architects do not exist. It is only the drawing collections of 'big names' like Mies Van der Rohe, Louis Kahn or Louis Sullivan which can be sure of securing a readership, profit, and therefore publishers interest.

A second way in which the work is being developed is a closer examination of what is involved in drawing. This has developed in to a video-tape study of what people do when they draw. Different types of drawers: designers, artists and non-drawers have been observed while they produce still-life drawings, imaginative drawings and design drawings.

This work continues and will be reported later: in the manner of our favourite machine (the Macintosh) we can truly end with 3 dots that signify that there is more to come ...

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