In search of new computer tools:  
what does Bovill really measure in architecture?

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Research is carried out concerning the use of computer programming techniques for architectural urban design. This research concerns a wide spectrum of tools involving all stages of the design process.

Bovill claims that the progression of the perception of detail can be expressed by the use of Box-Counting Dimension. The lack of the needed progression of detail would be expressed by the decrease in the value of the dimension measured. However, doubts appear already at the stage of choosing the objects to be measured, as they are likely to be selected in an arbitrary way. Thus chances are increased for the easy confirmation of the correctness of the results obtained. It remains doubtful, however, whether in the case of a different selection of components measured the results would have been confirmed.

The measurements are carried out on the drawings of the facades, or on details. Bovill left unanswered the issue of the “importance” of lines on drawings, i.e. which might, or even should be, left out. He also claims that the siding should not be taken into account during the measurements. This, however, brings the question of which elements of the drawing constitute siding, and which details. Therefore, would the drawings made by two people look identical and yield the same results of the Box-Counting Dimension measurements? By demonstrating diverse examples this paper discusses the possibilities of using Box-Counting Dimension (one of the fractal dimension of Mandelbrot) in design.

Keywords: Fractal; Box-Counting Dimension; indigenous architecture.

A book by Carl Bovill “Fractal Geometry in Architecture and Design” was published in 1996. There, in a very convincing manner, the author proves that a Box-Counting Dimension can be also useful for the architectural criticism. It would constitute a tool to evaluate architectural projects. Bovill explains that for an object to be evaluated positively it should show progression of architectural detail in subsequent scales of viewing, namely as the viewer approaches the object. Bovill suggests that indigenous architecture shows natural detail progression from a large to a small scale and that is why it can be examined through the method of the Box-Counting Dimension.

The rule of the Box-Counting Dimension (used also by Bovill) is shown by Peitgen and his co-
workers (Peitgen and others, 1992). Broadly speaking, the method involves counting the taken meshes of the net put on the drawing.

Bovill’s hypothesis was verified by conducting the measurements on the drawings of houses from the region of North-Eastern Poland. Examples discussed below concern the use of the program for automatic count through the Box-Counting Dimension, and are illustrated by figures and tables.

According to Bovill’s suggestion facades of houses with regional features (indigenous architecture) were examined. Drawings of facades were used in this research. In the process of preparation first doubts appeared. Bovill requires that the siding should not be taken into consideration while counting. Therefore, one must make a decision if a decorated top roof boarding is still a siding or a detail. (Figure 1) Should this decision depend on the width of the planks being used in boarding? Eventually, this element was treated as the surface quality, meaning that it was not considered in counting. (Figure 2) The results achieved for regional architecture objects were satisfactory and according to expectation. (Table 1)

It remains doubtful, however, whether such supporting results are always to be expected.

Modernisation of the existing houses can be made according to the rules of shaping the objects of regional architecture. A test was applied to use the method of the Box-Counting Dimension to evaluate the quality of such modernisation changes. Counting was made on the inventory facade drawings before modernisation and on the modernisation project drawing of the same facade. (Zarnowiecka, 2000) The results showed the growth of the Box-Counting Dimension. (Table 2) According to assumptions

![Figure 1. Elevation of a traditional house (F. Piasek) Detail or siding.](image)

![Figure 2. Box counting grids placed over the traditional House Elevation.](image)
taken after Bovill, this would confirm a positive effect of the modernisation.

Therefore, can it be stated, that the method may be useful to evaluate modernisation changes as far as the present shaping of indigenous architecture is concerned?

The experiments conducted lead to a general question whether “all possible cases” were examined so that the method can be successfully applied in the study of features of indigenous architecture.

One can imagine that the growth of the dimension may be achieved by a free concentration of the lines on the facade. In extreme case this means that drawing sections in windows or a sign of a house number becomes equally important for the counting. (Figure 3) These “bar codes” change the results of the measurement, even though aesthetically they are quite meaningless. (Table 3)

Drawings of the same elevation prepared by two people differ, even though both drawings were done in the scale 1:200 and for the same purpose. (Figure 4) The measurements based on these drawings yielded diverse results. (Table 4)

On the basis of the conducted experiments

<table>
<thead>
<tr>
<th>scale range</th>
<th>Box-Counting Dimension</th>
<th>Box-Counting Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,2 – 1,6 m</td>
<td>1,364</td>
<td>1,604</td>
</tr>
<tr>
<td>1,6 – 0,8 m</td>
<td>1,408</td>
<td>1,468</td>
</tr>
</tbody>
</table>

Table 1. Box Count for the Traditional House Elevation

<table>
<thead>
<tr>
<th>scale range</th>
<th>Box-Counting Dimension before modernisation</th>
<th>Box-Counting Dimension after modernisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,2 – 1,6 m</td>
<td>1,364</td>
<td>1,604</td>
</tr>
<tr>
<td>1,6 – 0,8 m</td>
<td>1,408</td>
<td>1,468</td>
</tr>
</tbody>
</table>

Table 2. The modernisation of a house in Narewka, Box-Counting Dimension

<table>
<thead>
<tr>
<th>scale range</th>
<th>Box-Counting Dimension (left)</th>
<th>Box-Counting Dimension (center)</th>
<th>Box-Counting Dimension (right)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,2 – 1,6 m</td>
<td>1,695</td>
<td>1,524</td>
<td>1,524</td>
</tr>
<tr>
<td>1,6 – 0,8 m</td>
<td>1,413</td>
<td>1,771</td>
<td>1,656</td>
</tr>
<tr>
<td>0,8 – 0,4 m</td>
<td>1,392</td>
<td>1,526</td>
<td>1,427</td>
</tr>
<tr>
<td>0,4 – 0,2 m</td>
<td>1,445</td>
<td>1,486</td>
<td>1,374</td>
</tr>
</tbody>
</table>

Table 3. The impact of “siding” and “bar codes” on the measurement of fractal elevation of the house in Sejny

Table 4. Comparison of fractural dimensions of the elevations of a house in Sejny based on drawings by two people.
the question formulated in the topic of this paper may be answered. Many promising examples presented by Bovill encourage using fractal geometry in design. Even though the scale of the conducted experiments does not allow drawing far-reaching conclusions, it appears that Box-Counting Dimension can be used for descriptions, to show the degree of the complexity of the object, to prove that a change has taken place. It does not seem possible, however, to agree entirely with Bovill’s suggestion to use the method as an objective, calibrated tool of esthetic evaluation (Bovill 1996: 6). Nevertheless, the alluring and enticing beauty of fractals remains a source of inspiration and search for potential usage of fractal geometry in architectural design.

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References

Book:

Chapter or other contribution to a book: