

A Form Language's Regional Adaptation Index

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Discovering theory from measurements

While architecture's technical part consists of physical measurements, considering design qualities as inherently measurable is a novel step. The simple measurements and estimates performed as part of our projects turned out to contain the seeds of a new theory of architecture. In this way, the students were introduced not only to mathematical modeling of design, but also to the very process of model formation, something that was new for them. I believe this hands-on insight into how human beings understand the world through science is an invaluable lesson for young architects, who will determine our future built environment.

The process of developing a quantitative theory of architecture was tied essentially to the findings of other researchers who have undertaken to do precisely this. Students saw for themselves how some of this research was done. Therefore, they did not fall into the catastrophic relativist trap of thinking that our readings were just another opinion, by yet another group of thinkers: and thus according to the usual faulty logic, as no more or no less valid than anyone else's thinking about architecture. In the end, relativism accomplishes the opposite of what it sets out to do: it validates the ideas that are supported by the most powerful group, and not the ideas that correspond more closely to reality.

The complexity of a Form Language was measured by the Kolmogorov-Chaitin Complexity (using the separate Form Language Checklist to obtain a word count). We then used the online mathematical software engine *Wolfram Alpha* to plot the word count of each student's form language versus its Regional Adaptation Index R estimated as a percentage (see description given below). Each student entered one data point such as, for example, (*word count, regional adaptation*) = (336, 70). All the data points were plotted together using the function "Linear Fit". The result was that the points distributed themselves clustered around a straight line, which indicates a linear dependence of regionalism on complexity.

Perhaps the overriding lesson for the student was that a quantitative approach to analyzing design and its adaptation is indeed possible, and it can be done in class using very simple tools of estimation. This potential reverses the usual way of teaching architectural theory. We now possess proof and justifications that draw on arguments from within architecture and science. In the educational rubric firmly in place since the middle of the 20th Century, a student does not question design canon, even though he or she might disagree with it on an intuitive level.

While arguing and discussion are encouraged in architecture theory seminars, the debate feeds from sources in a way that no conclusion can ever be reached. Ultimately, the established viewpoint remains the unquestioned standard for guiding and evaluating a student's design. Nor is the student presented with actual tools that can be used to evaluate someone else's theoretical claims, or disprove them altogether. The quantitative approach to architectural theory developed in this class hopefully prepares the student to profit from a more independent way of thinking about architecture.

Measuring the regionalism of a Form Language: geographical and human adaptations

Please estimate, on a scale of three options from 0 to 2, the following qualities inherent in your form language. Give a score of 0 for each quality in the left-hand-side descriptor, and a score of 2 for each quality on the right-hand-side. If you cannot decide on either descriptor because you feel that the quality lies somewhere in-between, give a score of 1. Clearly, these coupled architectural qualities represent pairs of opposites.

The first group of measures adapt to geography, here called x -values:

x_1 : GLOBAL TYPOLOGY → REGIONAL TYPOLOGY

x_2 : USE OF IMPORTED MATERIALS → USE OF LOCAL MATERIALS

x_3 : INDEPENDENT OF LOCAL CLIMATE → ADAPTED TO LOCAL CLIMATE

x_4 : NOT ENERGY EFFICIENT → CONCERNED WITH ENERGY EFFICIENCY

x_5 : RELIES UPON GLOBAL INDUSTRY FOR ENERGY EFFICIENCY → USES LOW-TECH ENERGY SOLUTIONS

The second group of measures adapt to human beings, here called y -values:

y_1 : CONCERNED WITH GLOBAL STYLE → TRIES TO REINFORCE HISTORICAL TRADITIONS CONNECTED WITH LOCAL CULTURE

y_2 : ADAPTED TO ABSTRACT FORMAL RULES → ADAPTED TO HUMAN PHYSIOLOGY

y_3 : SPACES AND SURFACES DEFINED BY PHILOSOPHICAL CONCERNS → SPACES AND SURFACES ADAPTED TO HUMAN PSYCHOLOGY

y_4 : CHILDREN'S NEEDS ARE NOT AN OBVIOUS CONCERN → ADAPTED SPECIFICALLY TO CHILDREN

y_5 : BASED UPON THE INTELLECTUAL CHOICES OF AN ELITE → GEARED TOWARDS GIVING EMOTIONAL PLEASURE TO ALL PEOPLE

Compute a total score by adding up all the variables in each group separately. The score is recorded as the pair $x = \text{geographical adaptation}$ and $y = \text{human adaptation}$, and each measure will range from values of 0 to 10.

For an overall measure of regional adaptability, we define a percentage measure as the product $R = xy$. Since x and y take values from 0 to 10, R will be a number from 0 to 100. This numerical percentage measure is defined here for the first time. The index R is a combined measure of the regional and human adaptability of the form language. Cutting through the stylistic prejudices of the past several decades, these measures provide a first approximation to actually *measuring* adaptability.

Documenting a form language and estimating its complexity

Each student will choose and document one particular form language from one or a group of chosen buildings; or will design a new building using an invented form language, and will present it in class. Please use the “Form Language Checklist” as a guide. The class will be exposed to and learn from many different form languages. An in-depth study and analysis of your form language prepares you to use it as a design tool by understanding how a design arises from the combinatoric “linguistic” structure of forms. This method is not the same as merely copying superficial images from someone else’s work.

Please use the same headings in the form language checklist and just fill out the details for your own form language as succinctly as possible. The entries include lists of materials, forms, sizes, etc. For some entries, a simple yes or no indicates whether something (a structural element, or property of that element) is present or not. It will be necessary to estimate both actual sizes of components, and relative ratios of sizes among different components. In listing the connections, an unusual element of interest (at least for today’s design thinking) is to look for and document an intermediate piece that connects two other components. In many contemporary buildings, this intermediate connection is missing for stylistic reasons, so to perform this exercise, students will have to change the way they look at structures.

I want students to use the understanding obtained from their chosen form language to create a very simple design of a building. The function of the building and overall brief is up to them to choose. The aim here is to realize what it means to become proficient in “speaking” that form language (going only as far as the first few design steps). Students will present their form language and its characteristics, and their building roughly designed using it, in class.

Please compute the Kolmogorov-Chaitin complexity of your form language by using the word count of your completed checklist. The more “wordy” your checklist, the more complex is the form language. An “International Style” building will necessarily rank very low. What is remarkable is that we are able to measure the complexity of a form language at all, and by a simple means such as the word count by a word processor. The mathematical background for this model was covered in class. We will go further and correlate this complexity with adaptability and regionalism.

Here are some guidelines for students to help in choosing their Form Language for this project.

1. I know that you are all eager to document a famous building, either from the 20th Century, or by some contemporary architect. But all of those are accessible only through photographs. Consider rather that the most useful evaluation of a form language (for your education) comes from any building that you can physically enter and study. So, think of choosing an accessible building of any age.

2. Architecture students are enthralled by the signature work of famous name architects, yet the majority of humanity lives and works in modest buildings. Consider studying a local building — house, office, bank, commercial building, government building — that is not particularly distinctive, but is typical of our living and working environment. Your analysis will be important.

3. One aim of this course is to validate historical form languages for use today. With this in mind, why not choose a local building that comes from an older architectural tradition? That will offer a wonderful opportunity for you to document its form language (usually a far richer

language), and to analyze how you would adapt that form language to build a similar building today.

4. Some of you are working already part-time in an architecture office. The best candidate for your form language might be a building project that you have access to through your employer. Choose one that is either finished or almost ready, so you don't work only from drawings and renderings. That's important because you will need to judge the overall spaces and components on site.

Architectural regionalism correlates with design complexity

Each student is asked to estimate their building's Regional Adaptation Index R on a scale from 0 to 100, with 0 being the least adaptive to locality, building culture, and specific user needs tied to local culture. Students are guided in this estimation by our class discussion of what regionalism means in the context of using local materials, employing traditional typologies, low-cost methods of energy use and optimization, historical continuity of design typologies and the use of traditional ornamentation, etc. Students should read the more detailed criteria for regionalism.

The Regional Adaptation Index R of your form language is the simplest possible estimate of regional adaptivity of your building. A high value of R represents the opposite of any abstract, formal, or "universal" design method. Our class data will generate a graph of Regional Adaptation Index R (vertical axis) versus Complexity of a Form Language as measured by the word count of its verbal description (horizontal axis). The class will then plot these values for (*word count*, *regional adaptation*) together in a scatter plot to look for any correlation.

A previous class generated a plot with a linear relationship, which indicates that the regional adaptation correlates with the complexity of a form language. This result was all the more striking because the students' projects varied as to the analysis of the chosen buildings, and even with the specific writing style of each student. Obviously, a measure of form language complexity that depends on the word count is also dependent upon the verbosity of each individual student! Despite the evident inaccuracies of the method, these results open a very promising topic for more detailed investigation.

It is fair to say that after seeing the graph as it was produced in the previous class, some students experienced a drastic change in their architectural preferences. This was a surprise. During our discussion evaluating each building in the context of all the results brought together, several students said that their choice of building "turned out not to be a good example after all". Pressed to explain this, they stated that they were originally attracted to their building because of the usual architectural design criteria, but our analysis showed them that more important qualities facilitating human use and simple economics were lacking. As a result, they would never use that form language to build a building nowadays, but would adopt a far more adaptive form language. And that now, they understood how to judge whether a form language was adaptive or not.

Evaluation of the fitness of a Form Language

Based on this analysis, do you judge your form language more or less fit for building in contemporary society? Again, the form language is validated because it has been used successfully by many people over a long period of time. Or is it an unproven experimental form language? It

could be the latter, especially when used over and over to create a “look”, but every time failing to provide a genuinely comfortable living and working environment. It is now possible, with the tools of this course, to make a judgment largely free of prejudice. This is especially so if a form language looks “old-fashioned”, ruled out of current practice by ideology for the past several decades. In the usual contexts where only “contemporary” form languages are allowed, we would lose all of this extremely useful information.

Are there any modifications that you suggest to your form language that would make it more fit for building in contemporary society? A form language is not rigidly set in time, and any improvement is welcome as long as it leads to better adaptation for the user and the natural environment. Undertake the “genetic evolution” of your form language by making some changes. Then check its fitness by re-computing the measures for architectural regionalism (x, y). If these fall as a result of the changes made to the form language, then something is not right! Natural selection would allow only changes that raise both these values.

Are there other factors that have guaranteed the success of your form language, as seen in the number of built examples, and which are independent of the analysis undertaken here? Discuss how those factors can override the model of fitness computed as outlined above. Namely, are there unnatural selection rules in place that in fact contribute to the success of your form language despite it violating the regional, adaptive, and human factors? This in itself is a form of evolution: it’s just not acting according to natural criteria. Ideology, vested interests, and bureaucratic inertia could all be driving the use of a particular non-adaptive form language.

The central question of architecture is — and has been for over one century — the appropriate form language to use in building for contemporary society. In this course, we have developed analytical methods for evaluating form languages studying both their evolution through time, and through deliberate changes made by an architect. Hopefully, this rubric will help young architects to achieve adaptation and individual expression together in their own designs. The end of our course is only the beginning of an architect’s quest for design solutions. The student is directed to the discussion of form languages in “Form Language and Style”, Chapter 16 of Christopher Alexander’s Book 2 of *The Nature of Order: The Process of Creating Life* (Center for Environmental Structure, Berkeley, California, 2002), pages 431-460.