An Architect's Toolkit for Color Theory
There's a trend for American architects to wear all black, build all white models, and design buildings all in shades of gray and beige. Why?
One of many reasons is that in American architectural education, color theory is not a required aspect of design curriculum. In response, this thesis proposes a toolkit for architects with the intent to:

1. Shed light on biases against color within the discipline.
2. Educate designers on color theory and application.
3. Provide frameworks to encourage more intentional use of color throughout a contemporary design process.
The toolkit consists of:

A Glossary
A Model
A Catalog
A Library
An Algorithm
A Case Study
A Schedule
For clarity throughout this work, the following is how I specifically define the qualities and perceptions of color.
Value
(noun) val-yü

How light or dark a color is.
Saturation
(noun) sa-chə-rā-shən

How vibrant a color is.
Hue
(noun) hyü

Where the color falls on the visible spectrum of light. What "color" it is.
Our perception of color is impacted equally by both the qualities of an individual color AND the colors of its context.
The relativity of color indicates that we all perceive color from different points of view. The way we communicate color can also be relative, hence this glossary.
If my blue is not the same as your blue, and everyone experiences color uniquely...
... then when common biases against or toward certain colors emerge, it is a result of culture and experience, not a fact of nature.
Polychrome:
(noun) pä-lē-krōm

Greek for "many colors."

Traditionally, the practice of decorating architectural elements, sculpture, etc., in a variety of colors.

or

The color scheme of a built environment or design in contemporary practice.
Chromophobia:
(noun) krō-mə-fō-bē-ə

A bias towards highly saturated colors and specific hues,
caused implicitly by cultural ideals,
and
the explicit (and unfounded) notions that certain colors can be too feminine, too exotic, too queer, too childlike, or too otherly.
The specific colors that symbolically or literally represent a person, place, or culture.

This toolkit suggests designers stray from trends and biases of color. One method is to lean into color theory to respond to a design’s context, another is to lean into the specific culture or color identity a design is intended for.
Place's Palette
2020 Design Research Lab with I/Thee Studio and Roundhouse Platform
The Catalogue: A Collection of Architectural Colors

16 Colors examined through cultural anecdotes, physical swatches, common names, and architectural examples.
The Farnsworth House isn't green, but its beauty comes from the surrounding view of nature provided by the curtain wall exterior. Literally green buildings aren't common, and green buildings in a sustainable sense aren't common enough.

Green is easy to find in architecture visualization however. If we had enough trees in the Lumion render will people think the project is sustainable? The growing green urbanism movement has contributed to this. High rises that are designed to be vertical forests are being constructed around the world, some more successful than others however. Qiyi City Forest Garden in China is a large housing project that has been mostly vacant since it opened. There was a lack of consideration for the maintenance required of the multitudes of plantings; mosquitos have infested the site making it mostly unlivable.
The Guthrie Theater isn't just a space for performances, it is a performer in and of itself. A visitor experiences phenomenon of light and saturated color throughout the building. A viewing platform is encapsuled in yellow polycarbonate which displays the city through a whimsical new lense. Elsewhere a blue polycarbonate curtain wall fills a gathering space with a cyan glow that invites visitors to step outside to a bridge that leads straight into the sky.

To complete the primary color scheme, the chairs within the main auditorium are in varying shades of red. Even without special stage lighting, the audience appears to be in an atmosphere of dappled light. The subtle changes in color are yet another example of how color acts as spectacle in this theater. Of course a theater is expected to be a place of excitement and wonder. These colorful design choices aren't welcome in many other programs.

Yellow
Ardyle Yellow Oil Paint

- Gold
- Sunflower
- Blonde
- Amber
- Maize

A vibrant yellow isn't especially common in the built environment outside of traffic signs. However, dark yellow is relatively common place, we just don't call it yellow. Many olive greens or browns are actually a dark yellow. The color most vibrantly resonates at a light value, but appears muddy and muted when at a darker value.

Gold is one of few examples of an abiotic natural material. The more pure gold is, the more vividly yellow is. Thailand is known for very pure, high-quality gold. However, westerners might see Thai gold jewelry and assume it is fake because of how yellow it is, when in reality the high saturation is a mark of purity. Being a soft metal, gold is often mixed with other metals for durability, which creates a more muted shade of yellow that Americans are used to.
Poetry Foundation
John Ronan Architects - Chicago, IL - 2006

The Poetry Foundation is a pocket of respite amidst a bustling city. A black perforated shell vails a courtyard that seemlessly flows into the bright interior. The main hall is comprised of warm and cool neutrals in very light values. The color palette provides little distraction in the spaces for reading, thinking, and writing. In contrast, the enclosed space for performance is covered by a low, black ceiling that enforces a more serious mood. This project carefully uses black across surfaces to denote the intention of thresholds and spaces.

Architects are known to love the color black; especially for clothing. It hides shadows which is supposedly slimming. However, a true black is used more sparingly in design for the same reason. The trend of black clothing isn't ill intentioned, but contributes to the discipline's cultural identity and aids the biases against saturated colors.

**Black**

*Black 3.0 Paint*

| Onyx | Ebony | Sable | Raven | Soot |

Black is the darkest possible color, technically it is the absence of light. A black surface is one that reflects very little light. Lamp black is one of the oldest pigments humans have used, created by burning a carbon based material.  

Today there are many different black pigments available, but none as infamous as Vantablack. Created by Surrey NanoSystems, Vantablack pigment is made of carbon nano-tubes and is so matte it absorbs 99.965% of all light. It appears so dark it makes three-dimensional objects appear as flat, black voids. Artist Anish Kapoor bought the exclusive rights to Vantablack’s use as an art material. In response to Kapoor’s hoarding of the incredible material, another artist Stuart Semple has released other extreme pigments, such as the Pinkest Pink, Black 2.0, and Black 3.0. Anyone can buy them at an affordable price, except for Anish Kapoor.
The United States Capitol is a prime example of Neo-Classical architecture. Using Greco-Roman forms of columns, domes, arches, and triangular pediments it references the aesthetics of the first democratic states. But unlike Greco-Roman architecture, it is entirely white.

Greek and Roman art and architecture was often painted in vibrant shades of primary colors; an applied polychrome was a significant aspect of the design aesthetic. However, many nineteenth century scholars argued that Greek and Roman artists had left their buildings and sculptures bare. It both confirmed their superior rationality and distinguished their aesthetic from non-Western art. Johann Winckelmann, coined the father of art history, never visited Greece and in reference to classical sculpture contended "the whiter the body is, the more beautiful it is."

If neo-classical buildings used classical polychrome, the cannon of modern architecture might have been influenced to look less white.

In western culture, white is often a symbol of purity, cleanliness, and innocence. The tradition of white wedding dresses started as symbol of virginity, the Christian Bible speaks of forgiven sins made "white as snow."

At the turn of the 20th century, it was learned that paint made with slaked lime, called white-wash, had anti-bacterial properties. Because of this and his aesthetic ideals, Le Corbusier was a proponent of requiring this white-wash used in all buildings, as "a necessity both moral and material. It is necessary to establish the law of whitening. This cleanliness makes one see the objects in their sincere truth: hence in perfect purity."

The frequency of white walls in design today is not necessarily a result of the use of gypsum board. Dry wall needs a finish coat of latex paint, which someone somewhere chooses to be white.
The Sheldon Museum of art was the most expensive building in the US per square foot at the time of its construction. The steel frame building is entirely clad in Italian travertine marble and features solid bronze stairs and fixtures while the main hall's ceiling is adorned with gold leaf. The exterior appears as a monolithic white, while the interior reflects warm shades of off-white.

The materials ostentatiously flaunt wealth though remain in a monochrome color pallette. The only allowance of saturated color is the oppulent gold leaf. The limited use of color here is in association with the ideals of refinement and affluence. While this post-modern design has clear influences from Greco-Roman architecture, the aesthetic is perhaps more inspired by Johnson's admiration of the neoclassicism of nineteenth-century architects.

Le Corbusier defined a set of 61 colors for architects to use, it includes multiple shades of light yellow. While this kit of colors includes very saturated colors, the polychrome has a heirarchy that leans towards warmer, lighter, and less saturated colors. While Corbusier did say that "colour was as powerful as the plan and section," he also described his most saturated colors as "disturbing," and simply "not of construction" or the "architectual aesthetic." To him, color was a problem that had to be controlled, it was a "perilous agent," a "formidable fatality," and destroys and disorganises the "elevated faculties of the mind."
Wells Fargot Bank
I. M. Pei - Lincoln, NE - 1972

This tower is a brutalist concrete structure. It was likely more gray and less of a warm tone when constructed, however the original photos are in black and white. Modernist projects were photographed in black and white because that was just the technology of the time. The high contrast and lack of any saturation emphasized the whiteness of famous works.

Later brutalist works like this are often seen as ugly to the general public. Though the origin of "brutalist" is the french word for concrete, in english the name enforces the notion of this construction style being brutal. Today concrete is made to look lighter and with no saturation; even white concrete now exists. Concrete in general has unintentionally contributed to a duller built environment due to its wide use and structural capabilities.

Beige
Wood Veneer

Beige is everywhere. Beige, split-face CMU are the standard facade material for Target, Walgreens, Home Depot, and countless more national brands. The standardized architecture of these national stores has contributed to placelessness; a trend of cities starting to appear the same no matter where in the country they exist. The color identities of these corporate giants is slowly eating at the color identity of our cities.

I will note that not all beige is the same. A lot of wood could be described as beige, but any wood material will include much more variance than a CMU or painted dry wall. This means that throughout the material there is variation of the beige: light, dark, dull, bright, yellowish, orangish, or redish. Along with the organic textures of wood grain the beige of wood might have more aesthetic value than the beige of concrete.
Red
Cotton Fabric

Vermillion  Scarlet  Carmine  Ruby  Crimson

Red is almost always the third color to have a name in the many languages of the world, the first two being black and white. One hypothesis to explain this is that red is the easiest color for a human to create; the color of blood is hard to ignore or forget for any human. Purple is often the last color to be named in a language; it is much more difficult to find in nature then say the color green.

These findings from The World Color Survey in 1973 sparked the notion that one's understanding of color is dependent on the language one speaks. Language is yet another variable in the relativity of color perception. Without ever having the words to distinguish between two colors, a person might actually perceive those two different colors as the same.

Sperone Westwater Gallery
Foster + Partners - NYC -2010

The Sperone Westwater Gallery uses an entirely neutral color palette except for the exterior of the incredibly large elevator. The lift functions as a gallery of its own that can move between levels. From the street, the location of the saturated red box hints at what's happening inside and signifies the rotations of new exhibits. This is a very graphic use of the color; it's meant to be viewed from afar. From the interior of the elevator the red isn't visible.

Red has very specific uses for architectural conventions in drawings, but a red pen is most used for marking mistakes in the discipline. It stands out from our black and white prints. Because our drawings are so often black and white, does that process make colors like red seem more stark or foreign than it might in context? Red appears incredibly bold against black and white, but if we printed brown colored plans on orange paper, red wouldn't have so much power.
Orange
*Copper Plate*

Burnt Sienna    Ginger    Copper    Tawny    Rust

Orange is the underlying hue of most earthy tones. Any shade of brown or tan could be described as an unsaturated orange. Sometimes these colors are described as "warm neutrals," but perhaps neutral orange is a better description.

Orange is also the central hue in the range of warm colors. Humans have an inherent visual instinct of associating hues with temperatures. This most likely is related to way we experience natural light. The brightest high noon sun is just slightly blue, while the morning or evening light is tinted with orange. The evolutionary need to tell time contributed to this division in the way we see color.

Today, the color temperature of artificial lights can have dramatic impacts on the visual comfort of spaces as well as the hormones that regulate the human circadian rhythm.¹⁴

Harm A. Weber Academic Center
*Burnidge Cassell Associates - Elgin, IL -2007*

The Harm A. Weber Academic Center at Judson University is a stark contrast to the adjacent brick buildings that border the campus green. The saturated orange is the exact compliment to the blue sky behind the building’s silhouette, this contrast emphasizes the unique roofline to produce an iconic face to the campus that’s visible from the major interstate a few blocks away.

Yellow accent walls everywhere. Actually pleasant when paired with good lighting.

Easy to find vibrant colors in educational spaces and spaces for children in general. Major difference in healthcare spaces, kind of sucks for adults.
Dark Gray
Graphite
Charcoal Slate Graphite Iron Gun-Metal

Most black is dark gray. A true black is a complete absence of light. James Turrell art. Understands color and light, the technical lighting skills is what makes the art. Experienced complete black, eyes still searched for some amount of dark gray.

Yale Health Center
Mack Scogin Merrill Elam Architects- New Haven, CT - 2010

Custom dark gray bricks. Very neutral but really uses materiality to engage the form.
Public response was negative as it seemed dark and not meshing well with historic Yale architecture.
Issue of white box modeling and renders.

These early whitebox renders were what was most widely disseminated to the public, so when it was built in a dark gray brick the campus was surprised in a less than positive way. This is one example of an unintended consequence of white box renders and massing studies. Using just white to study form is a legacy modernists have had on architectural pedagogy.
Light blue is commonly found in modern architecture, but not always intentionally used. Glass can reflect the changing colors of the sky, though window glass isn't often considered colorful. The Spertus Institute very intentionally uses the reflective properties of the glass curtain wall however. Each plain is angled to reflect a different shade of sky, which is enhanced by each facet having a different density of frit, the dots that stop birds from flying into glass. Architects are trained to understand value and contemplate light and shadow, but the other components of color are often brushed aside.

The many angles of the facade intentionally symbolize the multi-faceted complexity of Jewish philosophy. The interior of the building is entirely achromatic except for the yellow velvet chairs in the auditorium. The intent was to reclaim a color that had once been a symbol of persecution as a symbol of community and identity.

Light Blue
Dyed Vinyl Spackle

Azure    Sky    Cerulean    Lazuline    Saxe

What we culturally consider "blue" takes up the largest portion of the spectrum of visible light. Of course, we could more academically dissect blue into cyan and indigo, but we often don't. This is perhaps because of how well any shade of blue coordinates with another. Different shades of yellow often seem to clash and red with pink is considered a fashion faux-pas, but navy blue is fine with any other shade of blue.

Blue is almost seen as a neutral as far as clothing goes. Blue jeans are great example; you can wear any color of shirt with blue jeans. Originally, jeans were invented as heavy duty canvas pants for miners to wear during the gold rush. The indigo root made an affordable dye that was dark enough to cover stains and dirt; it just so happened to be a pleasant shade of blue aswell.15
Magenta
*Acrylic Paint*

**Fuscia  Hot-Pink  Orchid  Red-Violet  Cerise**

Red violet/pink. More accurate primary color than red. Included by Newton. Some cultures see pink as different than red.

Cmyk printing, rby based on goethe and pigments available. Not on visible light spectrum, but exact compliment of green

**Museum of Pop Culture**
*Frank Gehry - Seattle, WA - 2000*

Inspired by smashed jimmy hendrix guitar, psychedelic. Vibrant colors are often seen as intoxicating or like a drug. Include example quote here from chromophobia. Color is less serious. Uses duochrome/analagous scheme in section.
**Joslyn Art Museum**
*John and Alan McDonald - Omaha, NE - 1931*

Pinkish building, but taken seriously because of it’s materiality. addition by foster + partners, uses same material, more neutral interior.

Snowhetta addition, breaks form, all white. All white trend of starchitects currently.

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**Light Red**
*Folded Colored Paper*

- Pink
- Salmon
- Coral
- Rose
- Blush

At one point seen as masculine, blood stained shirts. Color as feminine. Warm shades of pink better than pink’s closer to purple. Rebranded as Salmon or Rose gold.
Blue
Latex Interior Paint

Cobalt  Indigo  Saphire  Ultramarine  Navy

used in branding currently, r. Seen as color of trust, social media and banks use blue.

Blue light is bad for the eyes though. Do phone apps use more blue to keep people up later, spending more time on line?

High Trestle Bridge
R.D.G. - Des Moines, IA

Bright blue light. Light entirely changes the other colors of the bridge. Changes with sunset. Most of this Potential for light to change color of buildings, what is the potential of recoloring buildings?
Purple

Eye Shadow in Matte Medium

Purple is the most difficult color for the eye to distinguish. Once associated with nobility, phoenician snails produced expensive pigment. Symbolizes LGBTQ community.

The Sherbet House

Venice Beach, California

Impossible to find purple buildings, no natural purple materials. Purple is a feminine color. For the longest time, color itself was seen as feminine. Weird line drawn in the discipline, especially in school. When interior architecture is what most lay persons connect to within a building. Also more holistic approach to architecture and the life time of a building. Paint colors change.
The Broad Museum
*Diller Scofidio + Renfro - Los Angeles, CA - 2015*

The Broad Museum is conceptually formed as a light-filtering veil surrounding a monolithic vault. Visitors travel through apertures in the vault to reach the gallery spaces that are white and full of diffused natural light. The architecture for galleries needs to be functional and adaptable for displaying art of any shape, size, or color. Most often, galleries will use plain white walls for this purpose, including the Broad. White is the default wall color in the discipline. However, a mid-toned gray might better provide contrast for both dark and light values in an art piece. A toned substrate is a common concept in the making of fine art. The first step taught in a RISD oil painting class is to tone the canvas. That is, to remove the white and start with a mid-value. This can aid in better understanding of value, saturation, and temperature during the process of painting a composition. Following this line of thought, I chose gray as the substrate for all the color swatches in this catalog.

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**Light Gray**
*Metallic Craft Paint*  
Pewter Fog Cloudy Zinc Silver

Gray has been one of the trendiest color for interiors in the past decade. The dozen student apartments I’ve toured or lived in have all had faux-wood gray tile as flooring. This trend is so common it has become a social media meme known as the "souless millenial gray."  

The popularity of gray has come at the fall of other colors. An experiment carried out by the British Science Museum concluded that designed objects in the past century have become increasingly square and less colorful. The most popular car colors today are black and white. Do people like vibrant color less, or are the mass produced items we consume come with less colorful options in effort to appeal to wider audiences? The rampant gray in our built environment seems at odds with the fact I have never met anyone who’s favorite color is gray.
Red clay bricks have contributed a lot of saturation to the canon of American architecture. For a few centuries they were an effective, modular building material. The Monadnock is a unique high-rise in that its structure isn't steel and concrete, but brick. With innovation in steel and concrete, brick has become more of a specialty material. Today it is an expensive choice and used only as a veneer of an interior structure.

The structural capabilities of concrete and steel are the reason for its popularity as a building material. However, recent innovation in engineered lumber has created a more sustainable choice for high efficiency structures. Along with a decreased carbon footprint, cross-laminated timber has aesthetic benefits. It isn't a particularly colorful material like brick, but perhaps it's a good step away from the current state of grayness in our cities.
Endnotes
1 yellow gold
2 guthrie theater
3 harvard color books
4 vanta black
5 bible
7 myth of whiteness new yorker
8 benjamin more
9 joanna day
10 chromophobia
11 purism corbusier
12 James Carder
13 world color survey
14 color temperature
15 harvard color book
16 millenial gray
17 less colorful survey
The Model: Spatialization of Color Relationships
The Algorithm: Creating Polychromes from Photos

This tool temporarily moves color to the beginning of the design process by using color as a method of site analysis.
Coordinating Polychrome Algorithm

200 colors are sampled from the input photos, and then reorganized by value, hue, and saturation to create a color scheme. This includes three pairs of swatches that change in size based on the ratio of value within each pair.
For Example...
Let's design an installation at La Muralla Roja, designed by Ricardo Bofill in 1968
The intention of the contrast polychromes is to be distinct from the context, but still complement and harmonize with the surroundings. They are derived through various combinations of inverting the hue, value, and saturation of the harmonious polychrome.

Coordinating Polychrome
The intention of the contrast polychromes is to be distinct from the context, but still complement and harmonize with the surroundings. They are derived through various combinations on inverting the hue, value, and saturation of the harmonious polychrome.
Including color in site analysis brings color to the beginning of a design process. This creates more opportunities to iterate contextually and integrate materiality with form.
The Library: A Color-Coded Material Archive
Polished Concrete
The Case Study: A Design Charette Utilizing the Toolkit
Addition to the Sheldon Art Museum
Addition to the Sheldon Art Museum

Requirements:

3,000 - 5,000 sqft
An accessible entry
A student gallery
A classroom
A study space
The Site
The sculpture garden to the South of the Sheldon is mostly hardscape and void of visitors, except for a few weeks in the spring when the trees bloom in a dazzling pink.
Input Photos

I was intrigued how this natural pop of color created engagement with the site, and decided to use these site photos to input into the algorithm.
I decided to use the contrasting polychrome that included the most pink since that was the color that stood out the most from the existing site.
I tried to recreate the polychrome on my own without printing, using colored paper, colored pencils, and chalk pastels. This was helpful in understanding the physicality of each color and understanding how the polychrome reacted to light, shadow, and small adjustments of hue.
I then made a site model that included the more colorful sculptures. I found it difficult to find the right shade of green to represent the campus lawn. If I were to spend more time developing this charrette I would like to consider how the change of seasons and loss of green would interact with the polychrome.
By physically modeling with colored paper I quickly found that the visual weight of a form depended on its color, and that color and material choice had a relationship with perceived scale.
I moved to modeling in Rhino to more accurately represent the polychrome; the algorithm automatically creates a render material with each color that allows for quick iterations. Eventually I found a stopping point and pushed on to studying the process of representation with this charrette.
Elevation
Entry
Student Gallery
The Schedule: A Set of Conventions for Architectural Representation with Color
### Convention Schedule

<table>
<thead>
<tr>
<th>Object</th>
<th>Graphic Standard</th>
<th>Additional Graphic Layers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut line</td>
<td>Colored Line x2 LW</td>
<td>Black line layered above</td>
</tr>
<tr>
<td>*Line Color Value &lt; 20%</td>
<td>Colored Line x2 LW</td>
<td>40% Value Gray line layered above</td>
</tr>
<tr>
<td>*Line Color Value &gt; 80%</td>
<td>Colored Line</td>
<td>Colored Line at 50% Value layered below x2 LW</td>
</tr>
<tr>
<td>Cut Object Fill</td>
<td>Hatch in color of visible surface</td>
<td></td>
</tr>
<tr>
<td>Surface Fills of Cut objects</td>
<td>Color at 75% Opacity</td>
<td></td>
</tr>
<tr>
<td>Surface Fills of Proposed Design</td>
<td>Color at 50% Opacity</td>
<td></td>
</tr>
<tr>
<td>Surface Fills Design Context</td>
<td>Color at 25% Opacity</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>Color with 25% Value</td>
<td></td>
</tr>
</tbody>
</table>

Each drawing shall include a key of colors present on page which must respond to a project master key.

#C denotes a proposed color which shall be numbered, #CE denotes an existing color of the site

"Cut" refers to the cross section of a form that is split by a section view.

A line shall be the color of the surface edge it represents

*If a drawing is only linework these colors shall be tagged, along with colors of lesser variance
Elevation with Color Conventions
Elevation Detail

#C1

#C5
Section Render
These light shelves aren't white. However, these two colors are complimentary, and when combined produce a white light.
The color conventions communicate how the surfaces of the light shelves are different colors, and don't require extra time in Photoshop.