Colour design effects on the visibility of shape: Exploring shape defining design concepts in architectural theory and practice

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ABSTRACT
This paper explores the relevance of three concepts for shape defining colour design, developed from camouflage theory. The visual distinction between colour patterns as defining either colour or shape allows colour design to interfere with shape defining patterns given by any specific light situation. The concepts counter-/co-shading, disruption and constructive shading are applied in descriptions and analysis of colour design effects, on both a selection of painted geometrical reliefs and existing buildings. Analysing colour design as interacting with shape defining patterns allows an explanation of how colour design affect the visibility of shape and may produce a more complex visual situation. Inconsistencies result in ambivalent visibility of shape, affecting the impression of the light situation and atmosphere. In conclusion the three developed concepts clearly contribute to a more precise understanding of colour design effects on the visibility of shape in an architectural context.

Keywords: Architecture, Camouflage, Colour Design, Visibility

1. INTRODUCTION
This paper explores the relevance of the camouflage concepts counter-/co-shading, disruption and constructive shading first identified by Hugh B. Cott [1] which have been developed for describing, analyzing and understanding colour design effects on buildings. It is suggested that using these concepts will bring about a more precise understanding of how colour design affect the visibility of buildings and in some cases also the visual impression of light and atmosphere.

Our visual distinction between colour patterns as defining either colour or shape allows colour design to interfere with the shape defining patterns given by any specific light situation [2].

The camouflaging effects are in different ways the result of interference with the shape defining patterns of light and shadows given by a specific light situation (from here on simply called “shape defining pattern”). This interference has previously been studied on painted geometrical reliefs [2], some of which are used here to introduce each concept. Each concept is thereafter applied in analysis of one or two existing buildings. Counter- and co-shading is what most clearly reveals the principals at work, and is therefore chosen as the first concept to explore. Constructive shading seems to combine counter-shading and disruption and is therefore the last applied concept in this paper.
In spite of the limited scope of this paper the analysis clearly demonstrate the relevance of the three concepts in an architectural context.

2. ANALYSIS

2.1 Counter- and co-shading

The camouflage concept *counter shading* represent an effect produced by a surface colour pattern that counter-acts the visual appearance that normally would be given by the shape-defining pattern [1, 2]. When the surface colour pattern counterworks a light coming from above, it is in nature’s fauna a quite robust camouflage – until the animal is turned upside down and then instead becomes extra visible. This opposed effect is what is called co-shading. In relief studies as well as in full scale rooms by Billger [3] it has been observed that, as long as the painted pattern follow or contradict the shape defining pattern, surprisingly large differences in colour hue and nuance can be painted without being possible to visually identify. Compared to a neutrally painted relief the counter- and co-shaded relief instead appear to be displayed in another light situation, and the same effect has also been observed in experimental painting of full scale rooms [3].

In a counter-/co-shaded relief the fine painted colour differences are not so easy to visually identify (Fig. 1a). When rotated it rather seems as if the quality of the light is changing. When the sides painted with lighter colour are turned towards the source of light and the ones darkest painted are in deepest shadow the light appear stronger and brighter, and the shape becomes visually sharper. When turned the opposite way the light instead appear weaker and duller and the shape appears blurry or even flattened.
Also when the painted differences are so large that you can visually perceive that the differences are painted they still seem to have an enhancing or flattening effect on the shape (Fig. 1b), and the degree of painted difference is then according to experience regularly underestimated: when a surface colour becomes engaged in visual shape defining it looses some of its colour-quality and appears to be more neutrally grey, while a shadow freed from its shape-defining function and instead perceived as a surface colour may gain chromaticity – as on Hurvich' folded paper viewed through a tube [4], Logvinenko's manipulations with our stereoscopic vision of a cast shadow [5] and also a previously presented relief combining counter- and co-shading in constructive colour design [6]. Also perceivable surface colour differences affect the visibility of shape by co- or counter-acting with shape defining patterns.

The simple “colour-clock” relief [7] clearly demonstrate that also large differences in surface colour may affect the impression of the light situation and/or visibility of shape, as long as the surface colour pattern coincide with the shape defining pattern. On this relief the surfaces facing different directions have different lightness depending on the use of different rather chromatic hues distributed according to the order of a colour circle (that is: yellowish facing opposite to bluish and greenish facing opposite to reddish, and the in between hues facing opposites in between). While rotated the main colour impression changes, but also the quality of light seems to change. In the counter shaded position we can again see the darker dullness and in the co-shaded the brilliant sharp light enhancing the visibility of shape.

The existing building chosen as the main case here is quite extraordinary in its consistency, and a more normal case will also be discussed below. Jantar Mantar (Fig, 2) is an astrological observatory built in the beginning of 18th century (1710-24) in a tradition assuming that the use of larger measuring instruments would result in more precise values. Its colour design is a clear case of co-shading where the painted colour pattern coincides with the shape defining pattern, assuming
Fig. 4: 
a) Unpainted relief. b) The same shape painted with a disruptive pattern.  
NB: Illumination coming from slightly different directions!

Fig. 5: 
a) The Gothenburg Opera entrance (Picture from Lund & Valentin architects),  
b) Weak dividing and strong disruptive pattern, on a cloudy day

light coming from the sky. The reading surfaces of these instruments are turned upwards and painted white to catch the faint light from distant stars. The contrast between light grey walking surfaces – also turned upwards – and red vertical surfaces could also be explained practically: the red turns even darker at night and thus the light grey walking
paths will be easier to distinguish in the dark. All surfaces turned towards the sky are lighter than all vertical surfaces. The colour design co-works, more or less, with the shape-defining pattern at any hour of the day – and night (!): Only artificial illumination may turn this effect into counter shading. The aesthetic function of this colour design is that it brings about an impression of clear vision: The heavy and dense atmosphere in the middle of New Delhi, where it is now situated, seems here locally rinsed and brightened. The air appears clearer and when walking in to this park you may feel as if your very mind is lifted from blurry confusion to sharpened attention.

The probably most common cases of counter and co-shading are buildings with different materials on different sides, like the example above. The differences in colour may result in counter- as well as co-shading on different hours of the day. When the pattern of surfaces colour differences work in relation to daylight coming from the side (that is, not from above), then what is co-shaded in the morning naturally becomes countershaded in the evening, and the reversed. The example above (Fig. 3) however is situated so that it is co-shaded most of the day, and in the evening – when it should have been countershaded – the sun is low and the house next to it casts a shadow on the darker side walls which otherwise would have been in full sunshine. Therefore this house never gets countershaded. Though the contrast between side and front walls is not very strong, the difference in hue helps to define the shape also on a cloudy day, while a sunnier day make the shape almost surrealistic in clarity and also seemingly reflecting a special quality of the light (which you can see is not present at the parking in front).

2. 2 Disruption

Disruption refers to the function of a surface colour pattern that merely by strong enough contrasts breaks down the real shape visibility. Above (Fig. 4), the right hand relief shape is efficiently broken down by the simple contrasting pattern which does not coincide with the real shape, creating a visual disruption without any counter- or co-shading in relation to the real shape. This function depends on that the surface colour differences visually dominate over the more discrete nuances showing the real shape [7]. That is: the continuity of the shape defining pattern is broken by the stronger contrasts of the surface colour pattern. The disruptive function of strong contrast is commonly used to visually break down large building blocks into visually smaller parts. A typically modern way of using this is to visually divide a large building into smaller buildings seemingly put together to a complex rather than making up one solid unit, as in the new Opera building in Gothenburg (Fig. 5a). In this case also differences in shape and structural character contribute to create separate bodies, but strong contrasts in both lightness and hue between the visually separated volumes also break up the continuity of the pattern that otherwise would define the shape of the building as one unit. The dividing effect here is also depending on that the colour differences partly coincide with the real shape: Seen from here and at this moment the darker blue wall is actually in the shadow while the protruding white part and the red arcade to the right are displayed in full sunshine. On the shadowed blue facade a disruptive pattern (white and blue not coinciding with real shape) breaks up the wall as a whole and contribute to visual ambiguity. The circumstance that the blue wall is in the shadow however weakens the contrast effects and therefore also the disruptive effect, in relation to the whole. The protruding white part and the
red arcade to the right are instead, in this light, both brightly lit and mainly co-shaded and thus visually enhanced in shape.

In the second example above (Fig. 5b) different volumes of the building are separated from the wall by a weaker disruptive pattern which could also work as partly counter-/co-shading: The slightly drawn back dark column of windows at the right side clearly breaks the continuity of the plane wall, and could work as a co-shading pattern assuming light coming from the side. The protruding window sections and balconies are in both material and colour separated from the plane wall. On the left shadowed sides of these volumes the difference in lightness compared to the wall, in this light, results in weak co-shading. However, each vertical protruding or withdrawn part is broken up in horizontal divisions by stronger contrasts and clear differences in hue, that is: disruptive patterns. Thus the finer shape defin-
ing differences are out-ruled and the volume shape of each part camouflaged. While the surface colour differences coinciding with the real shape are weaker than the disruptive pattern on each part volume, this colour design does not result in the clear dividing into separate volumes as on the opera house above. The shape of the building as a whole is instead blurred and flattened by the disruptive patterns breaking up each part volume of this façade – which in real shape is quite articulated.

2.3 Constructive shading
Constructive shading in camouflage theory refers to patterns that give the visual impression of shape where there is no real shape, that is like Trompe l’oeil creating the impression of volumes on flat surfaces – though the surfaces don’t have to be flat. A constructive pattern that visually reshapes volumes seems to combine effects from counter-/co-shading and disruption. On the relief above (Fig. 6b) each really flat side of the relief is effectively divided into parts belonging to different volumes by strong contrast, while parts of planes, which are really juxtaposed, are visually leveled by counter shading and united by similarities in hue.

A traditional use of constructive patterns implies contrast-marking some kind of grid over the facade. The example above (Fig. 7) shows a dark red brick grid strongly contrasting to the plaster wall making up a pale background. The real shape is discretely articulated with window sections slightly withdrawn and the windows drawn back even a bit further, but the strong contrasts of the dark brick grid make this articulation hard to perceive. Where the contrasting brick-lines almost follow the real shape they cover both sides of corners and their contrast to the wall dominate over the finer shape defining differences between planes in angle, so by disruption the dark lines camouflage the real shape. Simultaneously the dark brick-grid seems to suggest a shape that is not there, and even though this shaping is not visually compelling, the dark lines work as if they where dark shadows and contribute to an impression of a brighter light.

In the example below (Fig. 8) the darker grid has a similar function, and here we can compare directly. The contrasting grid clearly creates an impression of more articulated shape, as if the dark lines where shadows. In this picture the sides to the left are in pale sunshine while the sides turned towards us are in shadow. We can directly compare the grid-painted gable and the left side of the “tower”, which is also in sunshine but all white, to see the degree of increased brightness created by the grid. We can also see how differences in hue here produces a kind of co-shading: even though the white sides are lighter they get clearly bluer than the slightly darker and warmer gable: this enhances the difference in hue between light and shadow. Still, because of the reversed relation in lightness, the building, as a whole, simultaneously gets counter-shaded, and the impression of pale, less sharp sunshine is enhanced.

3. RESULTS AND CONCLUSION

The limited scope of this paper allows only a very brief analyses of the selected examples. To fully grasp the colour design’s effects on the visibility of any building, a deeper and more complete analysis is required, including observations carried through at different times of the day, sunny, cloudy, dry and rainy days, and at different times of the year (in northern countries also in snow!) – and also with artificial illumination. Still, the brief exploration in this paper clearly
shows the relevance of these concepts applied in an architectural context.

As can be seen in the analyses above the concepts disruption, counter-/ co-shading and constructive shading allow identification and explanation of how surface colour patterns coincide or not with shape defining patterns, and thus affect the visibility of architectural shape.

From this simple theoretical base one can predict that whether a surface colour pattern, not coinciding with the shape defining pattern, gets disruptive or constructive depends on the degree of colour differences compared to the shape defining pattern, and of the shape defining logic of the pattern. When strong contrasts and/or large differences in hue neither coincide with nor simulate a shape defining pattern then they work as a disruptive pattern, camouflaging the real shape.

On the experimental reliefs, designed particularly to explore the effects of extreme colour design, perfectly camouflaging patterns are rarely achieved, and even less so in existing built environments. Still it is clear that the same visual rules are at work and any colour design that interferes with shape defining patterns also affect the visibility of shape. Even though such interfering colour design does not completely replace or take the role of real differences in light and shadow, they produce a more complex visual situation. Inconsistencies result in ambivalent visibility of shape, it may appear as affecting the light situation, but can also add other more subtle aesthetic qualities, like a special atmosphere, to the visual appearance of a building.

In conclusion the three developed concepts clearly contribute to a more precise understanding of colour design effects on the visibility of shape in an architectural context.

REFERENCES