What Colour is the Red House?
Perceived colour of painted facades

Karin Fridell Anter

This article summarises the author's doctoral thesis[1], starting from an experience shared by many architects and others who have at some time chosen facade colours: *The house is not the colour I thought it would be!* It discusses the differences between facade colours perceived under different viewing conditions. It also demonstrates recurring tendencies in the relationship between the colour sample chosen for a facade, and the colour that can be seen on the finished facade.

The colours for painted facades are often chosen with the help of colour samples, selected and combined to give a basis for the purchase of materials and the painting work. But, once the facade has been finished, it is all too common that its colours do not look the same as the samples. May of us have shared the same experience: *The house is not the colour I thought it would be!*

Professional colour designers and others who work with exterior colours on a regular basis soon become aware of the difficulties, and by trial and error they can gradually find a way to master them. People who more seldom choose colours for houses run a great risk of unpleasant surprises, as they cannot foresee the difference between the colour of the sample and the final colour of the house.

The problem became obvious to me while working with a previous research project, a survey and analysis of the exterior colours of hundreds of buildings in Sweden and Norway.[2] In this work I and my colleague architect could notice considerable and perplexing differences between the colour we saw in "normal observation" of a facade and the colour that we could "measure" through comparison with colour samples directly towards the facade. This caused me to wonder whether these differences showed any recurring tendencies, and in that case, if these tendencies could be described in a way that could contribute to more successful colour design work.

The colour of a facade is not constant, however, but changes with the observation situation, the distance, the weather and the season. Therefore it is relevant to ask how large these variations are, and if they can be predicted. Is it at all possible to grasp how the perceived colour of a building varies between different observation situations? If these variations can be understood and predicted it could also be possible to find recurring variation tendencies between "the colour of the house" and "the colour of the sample". On the other hand, if the perceived colour of the facade varies much and unforeseeably, it is hardly meaningful to talk about "the colour of the house" and thereby impossible to find any variation tendencies or patterns.

The issue of perceived building colours has been poorly investigated in scientific contexts[3] , and there is no authorised method to find out what colours people see in the complex totality where buildings are placed. Thus an important part of my work has been to discuss the theoretical foundations of the planned surveys and to find, develop and evaluate methods for determining the perceived colours of facades.

Three main sets of questions were formulated:

- Is it possible to survey and map out what colours people perceive on facades observed under different conditions? If so, what methods can be used and to what extent it is possible to obtain results of wider application?
- How does the perceived colour of a facade vary with changing observation conditions? What is the impact of factors such as light conditions, viewing distance and surrounding colours?
- How does the perceived colour of the house, in different situations, differ from the colour corresponding to the specification of the sample used for selection? Are there any recurring tendencies or perhaps even consistent variation patterns that can be presented in a practically useful way?

Starting from these questions I have made a broad explorative survey of the colours of painted facades seen in daylight. I have tried to illustrate the complexity of the problem through studies of different aspects such as light, viewing distance and surrounding colours. As a first attempt at systematising and generalising, the different studies have been compared and combined, which has led to the formulation of some recurring variation patterns in the relationship between inherent and perceived colour of painted facades. These variation patterns will be presented in this article, together with a preliminary discussion on possible explanations.

The study was carried out in mid-Sweden and the conclusions cannot automatically be extended to other preconditions, regarding such as light conditions, vegetation colours, building tradition and the cultural references of the observers. After discussions on international conferences[4] I have, however, reason to believe that the results obtained at least in principle are valid even in situations that drastically differ from the surveyed.

Basic concepts and definitions

The main concepts and terminology of this work are connected to the Natural Colour System NCS. The term *colour* thus here is equal to *colour percept,* which means that *colour is that which is seen as colour.* The colour of a specific colour object – e.g. a facade – is not a constant quality belonging to the object but something that varies depending on the specific viewing situation. In everyday language there are also other meanings of the word *colour* (Swedish *färg*, which is used not only for colour, but also for paint and dye), and to avoid misunderstanding I have often used the concept *perceived colour* as synonymous to *colour* in the meaning *colour percept*.

The colour of an object varies with the viewing situation, and strictly speaking there is no true colour that the object "really" has. To be able to describe how the perceived colour varies between different situations there is however a need for a fixed point of reference among all the possible colours that the object can assume. To define such a point of reference I use the concept *inherent colour.*

In this work the concept *inherent colour* is defined as the colour that the colour object would have, if it was observed under the standardised viewing conditions that are a prerequisite for the NCS colour samples to coincide with their specifications.[5] But to observe facades under such conditions is in practice impossible. One simply cannot place the house inside a lightbooth! Therefore the definition has been supplemented with a operational method of determination, in which the inherent colour is determined through visual comparison with NCS colour samples placed directly towards the facade surface. (Figure 1)

On colour perception

Each time we observe a house its perceived facade colour is influenced by a number of continuously changing factors. The colour that we see on the facade depends on the qualities of the facade surface, the viewing situation and factors that lie within ourselves. These factors interact in a complicated way, and in any single case it is virtually impossible to fully understand what makes us perceive the specific colour that we see.

As a first step towards clarity I want to dismiss a persistent misunderstanding, which is still taught in many schools and even at university level. According to this misunderstanding there are simple relationships between, on one hand, the wavelength composition of physical radiation energy reaching our eye and, on the other hand, the colours that we perceive. This is, however, not true, as has been shown by among others the American psychologist J.J. Gibson.

It is not the absolute wavelength composition and/or intensity of the radiation that conveys information, but rather the relationships in wavelength composition and intensity between different pencils of rays, the nature of the borders between these pencils of rays and the transformation over time of the pattern that they form. Our visual sense reacts to contrasts.

There are also several other factors that influence what colour we perceive. The effect of surrounding colours, called induction or simultaneous contrast, has since long been explored in both art, neural physiology and perception psychology.[6] Much of this research has so far been carried out in two dimensions, with flat colour samples or computer screens. Our visual sense is, however, developed to understand the three dimensional world that we are a part of. As has been described by Anders Liljefors, the visual experience describes space and space sequences connected in various ways:

> Our habit of perceiving spatiality in what we see is irresistible, a result of our vision's ability to interpret the two dimensional information of the retinal images into three dimensional space.[7]

The perceived colour is also influenced by the intentions, references, knowledge and expectations of the observer. One aspect of this is the difference between the *reflective observation attitude* and the *unreflective living perception*, as discussed by the phenomenologist philosopher Maurice Merleau-Ponty. A person moving around in a city or a landscape most often sees the houses as part of the environment, without specifically thinking about their colours. The visual sense is instead preoccupied with other things. But sometimes we more actively notice the colours of the houses, e.g. if we are to paint a picture, if we want to visit a friend in "the green house" or if we intend to chose a colour for repainting a house.

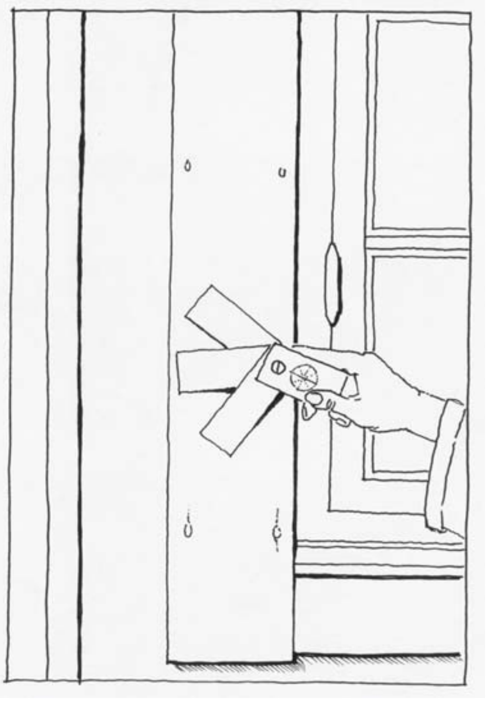

Figure 1. The method for determination of inherent colour.

What colour we see is also influenced by our knowledge – or assumed knowledge – of the specific situation, and of background knowledge of such as pigments or other material colours. This means that two people may very well see different colours, even if the external circumstances are identical. It also means that one person may see alternative colours by changing his or her observation attitude.

Thus, a facade has no "true" colour even if the viewing situation – light, distance and other external factors – can be totally controlled. This means that it is theoretically impossible to determine the precise perceived colour of a facade in a specific instance. It can, however, be possible to "encircle" a colour area within which the perceived colour varies, and to use statistical methods to determine an "approximate perceived colour".

As has been discussed above, the assumed correlation between measurable physical stimuli and perceived colour is a blind alley for those who want to understand colour in real life. Thus measuring radiation would be of no use for determining the perceived colour of a house. The only way to know what people see would be to ask them, and I have therefore chosen to use psychometric methods. The thesis work has included development and evaluation of methods for determining what colour a single observer perceives on a specific facade in a specific situation, and methods for using many such observations to determine the approximate perceived colour of a facade.

Survey of the perceived colour of facades

My thesis work included about 3600 observations of houses in their already existing surroundings. The observations objects were 125 painted timber and rendered facades in the surroundings of Uppsala in mid-Sweden. The houses were observed at approximately right angles to the facade, most often from a distance of about 50 metres. The colour determinations were made both by skilled colour observers and by groups of naïve observers, and several facades were subjects for repeated observations under varying viewing conditions.

Six psychometric methods were tested. The simplest ones were based on everyday language: The observers were asked to describe the colour they saw on the house, either in their own words or by choosing among given alternatives. These methods proved to have high validity, as they enabled people to express their colour perceptions in a direct and clearly understandable way. They did not, however, allow for much preciseness as there are not enough words to differentiate between all perceivable colours. Thus these methods could be used for detecting a certain colour property, such as blueness in a predominantly greyish colour, but they could not be used for measuring the size of the detected property ("how much blueness?").

In another method the perceived facade colours were determined through comparison with NCS samples, seen against the white background pages of NCS colour atlas (Figure 2). To be reliable this method demands observers with a rather thorough understanding of NCS and its categories. Comparisons between light situations must be interpreted carefully, but for other comparisons the method gives reliable results. As perceived colours can be given numerical values this method allows for statistical processing of data.

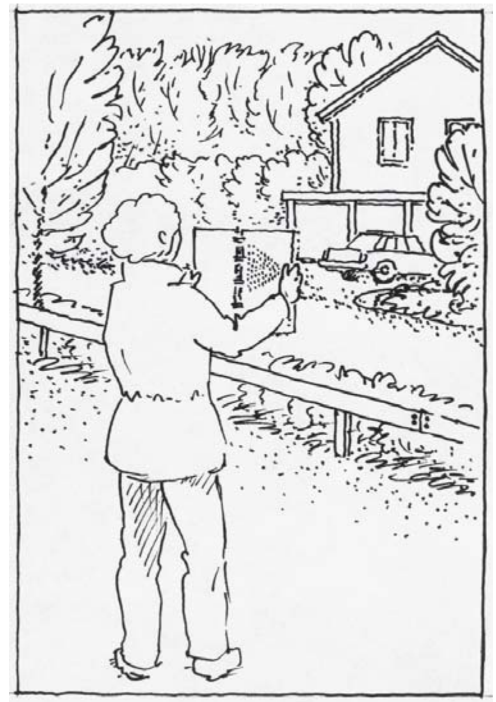

Figure 2. Determination of perceived facade colour through comparison with the NCS colour atlas.

The last two methods were based on different types of magnitude estimation scales. The evaluation of methods showed, that none of the methods alone could give reliable results for all observed colour areas and all the questions posed. Therefore their results were taken together to give a more profound understanding.

The number of observers in every observation situation varied between 2 and 30, where the few observers were skilled ones using the NCS atlas and the large groups consisted of high school students answering verbal questions or putting crosses on preformulated scales. The observations showed that there were some systematic differences between individual observers' colour assessments, but these differences were so small that they could not be established by the available methods and thereby could be assumed not to influence the result of a statistical analysis. Thus the average of assessments in each type of situation was interpreted as the "approximate perceived colour" under this specific light, distance and other viewing conditions.

Five special studies were made to explore the facade colour's variation with external viewing conditions. In these studies I used different groupings of the total 3600 colour observations, analysing one influential factor at a time and for the moment disregarding the variation of other influential factors. As suggested by previous research three of these studies were concerned with the light situation, the viewing distance and the surrounding colours in the visual field. The studies showed that all these factors may cause variations of perceived facade colour, which is discussed later in this article. The variations between different situations were small, however, in comparison to the difference between inherent and perceived colour of the same facade, a difference that remained relatively unaltered irrespective of viewing situation.

I therefore propose that every facade can be said to have an "approximate perceived colour" that certainly can vary depending on observer, light situation, viewing distance and seasonal surround colours, but where the variation area always falls within the accuracy limits of the determination methods. This was, however, only demonstrated for the following circumstances: Painted timber cladding facades without directly adjacent neighbours of different colours, light that can be called full daylight and a viewing distance up to a couple of hundred metres.

One of the special studies included rendered facades, and the results from that study indicate that my discussions and conclusions about the perceived colour on painted timber facades would be valid also for facades with painted rendering other single-colour materials.

Conclusion: the relationship between inherent and perceived facade colour

The comparison between the "approximate perceived colours" and the inherent colours of the observed facades showed consistent variation patterns for differences in both hue and nuance. The most obvious and consistent tendency was that the perceived facade colour always had less blackness than the inherent colour. This was true for all observed facades with inherent colours from a large part of the colour world.

The decrease of blackness corresponded to an increase of whiteness and/or chromaticness. It here seems as if inherent colours with much whiteness would give perceived colours with even more whiteness and unchanged chromaticness. When the inherent colour has only a little whiteness it would, on the contrary, be the chromaticness that increased the most, whereas the whiteness of inherent and perceived colour would be approximately the same.

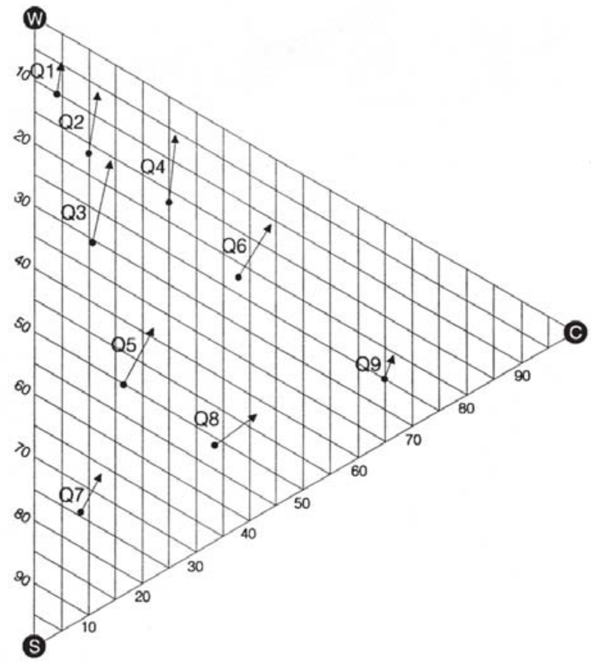

Figure 3. The nuance difference between inherent and perceived colour for timber facades within different colour areas.
• *= inherent colour* 5 *= perceived colour*

In the graphic symbol – NCS colour triangle – this can be shown as a swarm of arrows, all of the pointing from S (black) but gradually changing their direction so that they point towards W (white) in the upper part of the triangle and towards C (the pure chromatic colour) in its lower part. See Figure 3.

The arrow Q2 here represents facades with light inherent colours with relatively little chromaticness, such as light yellow or pink. Such facades get perceived colours that are even lighter than the inherent colour and also somewhat more chromatic – facade colours that can sometimes be experienced as almost luminant.

The arrow Q8 represents facades with dark and rather strongly chromatic inherent colours, such as the traditional Swedish Falun red. Such houses get perceived colours that are less blackish and more chromatic than the inherent colour, but with approximately unchanged whiteness.

Also the hue differences between inherent and perceived colour showed a consistent variation pattern. See Figure 4. Using the NCS colour circle the recurring tendencies can be described as follows:

- Inherent colours in the reddish yellow octant, the green/yellow quadrant and the blue/green quadrant would tend to give perceived colours which shifted anticlockwise in the circle, aiming towards a breaking point where inherent and perceived colour would seem to coincide, near the hue of the blue elementary colour.
- Inherent colours in the yellowish red octant and most of the red/blue quadrant on the contrary would tend to shift clockwise aiming towards the same breaking point.
- The breaking point between reddish yellow colours that were shifted anticlockwise and yellowish red colours that were shifted clockwise has not been identified, owing to too few observations in this area. It appeared to lie somewhere between the hues Y35R and Y60R.
- Neutral grey inherent colours would tend to get an added chromaticness and hue near blue.
- The majority of the observations implied that a breaking point that is common for all the shifts would exist somewhere between the hues B and R70B. For blue inherent colours with only a little whiteness, some of the observations instead pointed towards a breaking point with a hue of a somewhat greenish blue.

After a grouping in hue and nuance areas the following can be said about hues difference between inherent and perceived colour. Illustrative examples are shown on page 35.

Inherent colours with reddish yellow hue (Y-Y35R) appear to give perceived colours near the inherent hue, but with a little tendency of shifting in the direction from red towards yellow, that is anticlockwise in the colour circle. The hue difference between inherent and perceived colour was clear for "pale" nuances with much whiteness and little chromaticness. Here it would even be possible that the perceived colour would become greenish yellow instead of reddish yellow. For darker and more chromatic nuances in this hue area the hue shift tendency was weaker, but its direction was totally clear: If there was a difference in hue, the perceived colour was always less red/more yellow then the inherent colour.

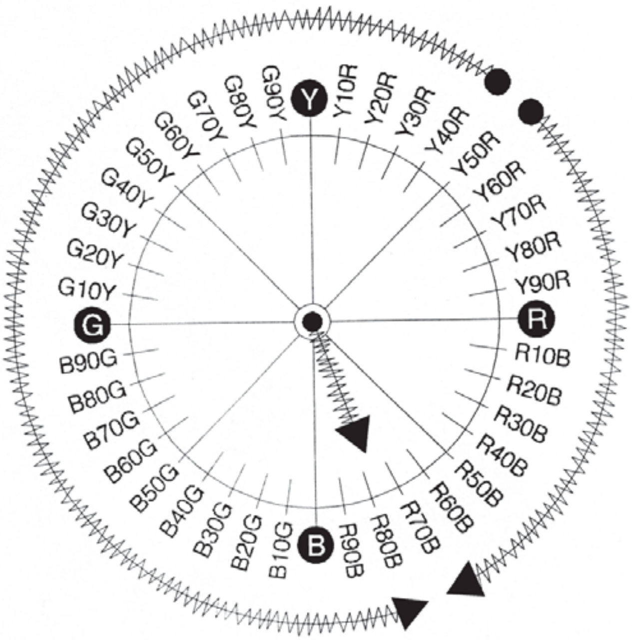

Figure 4. Recurring tendencies for hue shifts from inherent to perceived colour. Arrows indicate directions, not sizes, of shifts.

When the hue of the inherent colour lay *approximately in the middle between yellow and red* (Y45R-Y50R) the perceived colour on average had the same hue as the inherent colour. However, the analysed material in this area was very small.

For inherent colours within the *yellowish red octant of the colour circle* the perceived colour would tend to shift in the direction from yellow towards red. The hue shift was most obvious for the more whitish (pink) nuances, where the perceived colours even could achieve some blueness instead of the inherent colour's yellowness. Also for the brown and brownish pink nuances there was a little tendency for shift from yellow towards red, and on facades with brown inherent colours it was sometimes possible to perceive a certain blueness.

Evidently, somewhere between the hues Y35R and Y60R there would seem to be a *breaking point* or a hue area were the inherent and the perceived hues coincide. Facades with more yellowish inherent colours would tend to shift from red towards yellow, whereas facades with more reddish inherent hues would tend to shift from yellow towards red.

The survey did not allow for a more precise specification of this breaking point or this stable area.

When the inherent colour was found within the *red/blue quadrant* and had relatively much whiteness, the perceived colour shifted in the direction towards a breaking point somewhere between R70B and B. Blue inherent colours with only little redness thus tended to give perceived colours with increased redness, whereas bluish red inherent colours gave perceived colours with increased blueness. A more precise specification of the breaking point was not possible on the basis of this survey.

Blue inherent colours with only a little whiteness were very sparsely represented in the material. Those that were found showed a slight tendency for the perceived hue to shift, not towards the already established red-blue breaking point but instead in the direction towards greenish blue. This might indicate that the breaking point for the hue shift is situated at different hues depending on the inherent colour's nuance.

Inherent colours in the *blue-green* quadrant were hardly represented in this survey. However, the three observed facades all showed a hue shift where the perceived colour was bluer and less green than the inherent colour.

For inherent colours in the *green-yellow quadrant* there seems to be a pervading hue shift, meaning that the perceived colour would have less yellowness than the inherent colour and sometimes even an added blueness. This shift was clear for yellow-green facades irrespective of nuance.

For *neutral grey inherent colours* my observations gave the following results: Relatively light grey inherent colours tended to give perceived colours with some blueness, perhaps also redness. For really light grey inherent colours (blackness ca. 07) I have, however not found this tendency, nor for dark grey inherent colours (blackness ca. 85). This makes it reasonable to presume that the tendency of "shift towards blue" exists for grey inherent colours with a blackness over ca. 10 and up to a limit, situated somewhere between blackness=35 and blackness=85. The observation material did not allow for a further specification of this limit.

Light, viewing distance and surrounding colours and their impact on perceived facade colour

The variation patterns shown in Figures 3 and 4 were established for the totality of observations, irrespective of viewing conditions. They were also established in each of the special studies on light, viewing distance and surrounding seasonal colours, as well a in the study on rendered facades. This means that the overall variation patterns appears to be valid in most situations where houses are normally viewed. Within this pervading pattern there where, however, differences appearing in each of the special studies.

One of the special studies concerned the influence of light on the perceived facade colour. Here all observations were divided into four categories regarding the light situation. Two of them included observations made in direct sunlight, either at a full or an oblique angle to the facade. The third light category was for observations made in diffuse light from a cloudy, hazy or fully overcast sky, and the fourth category was for facades that were shaded and thus lit only by light from a blue or mainly blue sky.

Comparisons between facades observed in the different light situations indicated a consistent difference between on one hand, direct sunlight (straight or oblique angle) and on the other hand, diffuse light from an overcast or blue sky. The diffuse light from an overcast or blue sky gave greater perceived blackness and less perceived whiteness than the direct sunlight. There was also a tendency for diffuse light from overcast or blue sky to give less yellowness and/or greater blueness, which could show both in hue and chromaticness.

The special study on viewing distance included observations from approximately 4m and 50m and longer distances up to 1300m. The results were uncertain due to the small number of observations, but there were indications for some consistent tendencies that were also supported by the sparse earlier research in this field.[8]

A distance increase from 4m to 50m did not appear to give any pervading differences in perceived facade colour. For some colour areas there was, however, a tendency for the perceived colour to be closer to the inherent colour when distance was only 4m. There was, for instance, a tendency for light and weakly chromatic houses with somewhat reddish hue to get an added whiteness when seen from 50m. There was also a tendency for pink houses to get an added blueness when seen from 50m as compared to a close-up view.

Clear tendencies of distance dependent colour differences could be discerned only when distance increased over 600m. It appeared as if pink, red and green houses would have a tendency of hue shift from yellow towards blue with increasing distance. Whiteness would appear to increase with increasing distance for most colour areas, and chromaticness would appear to decrease at least for blue and green houses.[9] These changes most certainly depend highly on the weather and the amount of air pollution, factors that have so far not been studied systematically.

In the special study on surrounding colours the observations were divided according to the seasonal colours of ground and vegetation. The categories used were *winter brown*, *spring green, summer green*, *autumn green* and *winter white*. No observations were made against a background of dazzling red and yellow autumn colours.

The analysis showed no systematic differences between the facade colours perceived in the different seasonal situations, from 50 metres distance. The chosen determination methods unanimously showed, that the facades had the same perceived colours against backgrounds as different as luxuriant summer greenery, brownish bare winter and snow covering both ground and vegetation. This finding might be a bit surprising, as one might assume that simultaneous contrast against the surroundings would change the perceived colour of the facades. I myself expected to find such effects at least for green houses, where the facade colour is seen together with similar vegetation colours during some of the seasons. The observations showed, however, that also the green houses kept their approximate perceived colour irrespective of season.

Giving these findings a second thought they do, however, point in the same direction as previous research. Billger's experiments in multicoloured interior rooms lead to the conclusion that simultaneous contrast in spatial situations would occur only when different colour surfaces meet in the same plane.[10] A house seen from 50m is clearly a separate object, which does not belong to the same plane as its background. Seen from this distance the house distinguishes itself from both ground and surrounding vegetation, and there is no need for our visual sense to exaggerate the differences through enhanced colour contrasts.

Possible explanations of the variation patterns found

The aim of my work has been primarily to *survey* and *describe* rather than *explain* the differences between inherent colour and perceived colour on facades. I have, however, included some speculation on possible explanations for the consistent variation patterns found. I consider there is not *one* explanation but a number of interacting explanations that may have different relative importance in each individual case. Most of the issues involved are far from fully explored, which means that the following discussion on possible explanations also raises questions for further research.

One important set of probable explanations start from the differences between the light in the NCS standard situation, in which the inherent colour is defined, and the daylight in which facades usually exist. These differences involve both intensity, radiation composition and the distribution between direct and diffuse light. The impact of each of these differences has not been fully explored, but colour science is full of examples where perceived colour changes when light is changed.[11] To me this suggests that both nuance and hue differences between inherent and perceived facade colour can be explained by the differences between standard light and daylight. An important issue for further research would be to systematically compare colour perception in the "daylight simulating" standard light with that in real daylight.

Another set of explanations start from the background and context in which the colour is seen. Once more, we have to consider the standard situation in which the inherent colour of every sample is defined. In this situation the sample is seen against a white background paper, and through simultaneous contrast this makes the sample's perceived colour less whitish than it would be against other background. The fact that the perceived colour of the facades always was less blackish than the inherent colour may thus partially be explained by the fact that the colour sample but not the house was affected by simultaneous contrast from a white paper. Further understanding here demands more thorough investigations on contrast effects in three dimensions.

As a further explanation for the found hue differences (shift from yellow towards blue) I suggest the hypothesis of *acquired successive contrast.* It starts from the fact that practically all inherent colours of nature have some yellowness, as do building materials and surface materials like bricks, concrete and most paints for external use. Blueness, on the other hand, is rare and special in the natural environment.[12] The hypothesis about *acquired successive contrast* implies that we adapt or calibrate our vision to disregard the overall yellowness in the outdoor environment, and when we meet surfaces or objects lacking this yellowness, we perceive them with an added blueness. This hypothesis needs to be further discussed with researchers on context effects and adaptation.

Finally I consider perception of facade colours to be at least partially cultural dependent. We know how houses usually look and tend to notice and exaggerate the differences from this acquired reference. The traditional hue scale of Swedish houses is mainly yellow-red, whereas bluish facade colours hardly exist at all. When we see houses that differ from this scale we might tend to enlarge the difference – which for houses with some tinge of blue would make us perceive a larger blueness than there is in the inherent colour. For a further understanding of this issue it would be very interesting to make similar investigations in other countries, where the colour tradition gives a different frame of reference.[13]

Practical application of results

The starting point of this research project was a practical colour design problem, and the results obtained have immediate applicability in the practice of exterior colour design. It would therefore be fruitful to publish a shortened and more easily read presentation of the variation patterns found, with suitable illustrations and efficient channels of distribution to reach those people who actually do colour design. Such a publication project is already planned, and I hope it will come to reality.

Notes

1. Doctoral thesis *What colour is the red house? Perceived colour of painted facades* presented Nov. 2000 at the Royal Institute of Technology, Department of Architecture. Principal supervisor was Prof. Jadwiga Krupinska. The research work was financed by the Swedish Council for Building Research (Byggforskningsrådet), the Swedish Federation of Painting Contractors (Målaremästarnas Riksförening) and the Swedish Painters' Union (Måleareförbundet). A copy can be ordered from karinfa@arch.kth.se.
2. The work was carried out together with architect Kristina Enberg and published in the book *Utvändig färgsättning – förutsättningar, arbetssätt, exempel.*
3. The question *what colour do you see on the building?* has, to my knowledge, not been posed in precious scientific work. Research on similar questions is cited in the article and presented in the reference list.
4. *Colour Interaction*, Sydney 1999, *Color in its Surround*, Savannah 2000.
5. The standardised viewing conditions include:
   - lightbooth with specified measurements and grey walls
   - simulated daylight, 6x20 watt Luma Colorette fluorescent tubes, approximately 5400K, diffused through opaline plastic sheet which gives approximately 1000 lux.
   - the colour sample to be observed measures 6x9cm, it is placed on a white panel and tilted about 45°.
   - the sample is viewed from about 40cm at approximately right angle.

   See further Hård, Sivik & Tonnquist 1996 pp.189–190.
6. The conference *Color in its Surround*, Savannah Feb. 2000, included several presentations from leading researchers. There was a broad agreement around two facts: The colour that we perceive is influenced by surroundings colours, and the mechanisms behind this phenomenon are still not fully known.
7. Liljefors 1997 p.12, translation and revision by Liljefors to be published in English. Anders Liljefors is professor in Lighting for Architects at the Royal Institute of Technology, Stockholm.
8. Sivik & Hård 1979, Hård & Hård 1991, Minah 1996 and 1997, Mahadev & Henry 1999.
9. Similar effects have been analysed in 1810 by J.W. von Goethe and centuries before described and used in the form of "airial perspective" by artists such as Leonardo da Vinci.
10. Billger 1999 p.29.
11. Examples of this are the so called Bezold-Brücke phenomenon and the first and second Hunt effects. All of these have been shown for colour samples observed under controlled laboratory conditions, which means that their relevance for houses can not be taken for granted. They do, however, show that light intensity and composition do influence the colours that we perceive.
12. Fridell Anter 1996b on ground and vegetation, Fridell Anter & Svedmyr 1996a on traditional pigments, Fridell Anter & Enberg 1997 on concrete and bricks.
13. The author welcomes suggestions on co-operation with other researchers throughout the world. Please send an e-mail message to karinfa@arch.kth.se.

Karin Fridell Anter, architect, techn.dr.
The department of Architectural Forms,
Royal Institute of Tecnology, Stockholm
karinfa@arch.kth.se

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