

ARCH 121 – INTRODUCTION TO ARCHITECTURE I

WEEK 7: Color and Sound (Acoustics) in Architecture

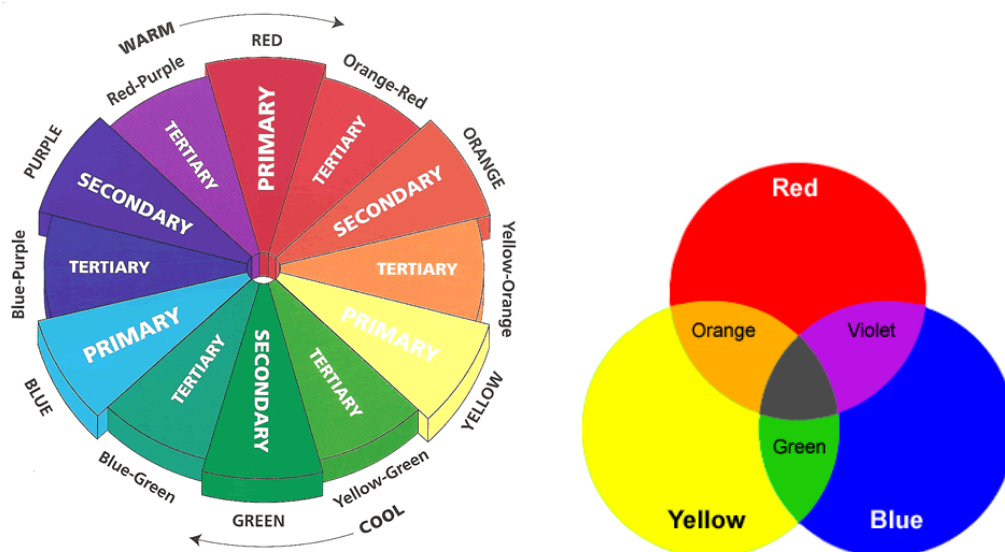
From: Roth, L.

Rasmussen, S. E.

1. Color in Architecture

a. Color Theory

Color wheel shows the principal colors divided in two major segments which are warm and cool colors. The area made up of red, red-orange and yellow-orange is said to consist of warm colors, while the areas made up of yellow-green, green, blue-green, blue and blue-violet is said to consist of cool colors. The **primary colors** are **red, yellow** and **blue**. Other (secondary and tertiary) colors are get from their combination.



There are some important terms about color:

Hue means the same as **color**. It is described with the words we normally think of as describing color: red, purple, blue, etc.

Value (also called brightness or luminosity) is a description of how light or dark a color is. By adding a relative amount of white or black in a hue can be achieved a variety of values.

Chroma (also called as **saturation**) is defined as the strength or dominance of the hue. It shows how pure (unmixed) the color is, compared to a color diluted with white, darkened by black or grey. High saturation colors look rich and full. Low saturation colors look dull and grayish.

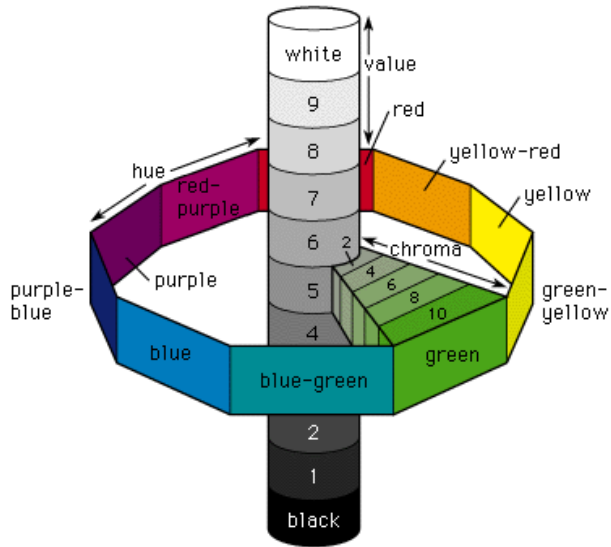
Tint is formed by the addition of white to a hue. This results in lighter values of the hue. Pink is a tint of red. Tinted colors are commonly called as pastel colors.

Tone is formed by the addition of gray to a hue.

Shade is formed by the addition of black to a hue. It appears when the hue is produced by mixing an original hue with black or gray. The result is a darker value of the original hue and this is called as the shade of that original hue. For example, burgundy is a shade of red.



Hue Contrast - strikingly different hues



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High Chroma - very shiny, vivid



Low Chroma - achromatic, no hue



Constant Chroma - medium chroma



Chroma differences of same hue - various levels of fullness, same hue



These scales show red, magenta and blue hues in a range of saturations (chromas).



Tint

Shade



Tints (adding white to a pure hue)



Shades (adding black to a pure hue)



There are also some other terms that are important about color:

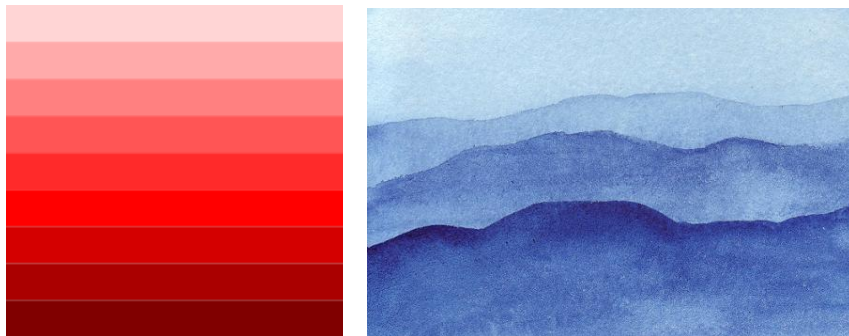
Monochromatic colors: A color scheme involving the use of only one hue that can vary in value or intensity. For example, a composition that uses just the different shades of red is monochromatic.

Achromatic colors (neutral colors): Designates color perceived to have zero hue, such as neutral grays, white, or black.

Neutral colors:

Complementary colors: are pairs of colors that are of “opposite” hue in color wheel. In color theory, two colors are called *complementary* if, when mixed in the proper proportion, they produce a neutral color (grey, white, or black). For example:

- red and green
- blue and orange
- yellow and violet



Monochromatic



Achromatic



Opposite colors are said to be complementary

b. Psychological effects of colors

It is well known that different colors have different psychological effects on us. Warm colors such as red or orange heighten body functions, while cool colors slightly reduce bodily functions. For example, when we see red, our muscular tension and heartbeat increases, we release adrenalin and our gastric activity is triggered. It is for this reason that restaurants use red or red-checked table covers inside. On the other hand, when we see green or blue, our muscular tension decreases, our heartbeat is slowed down, and our body temperature decreases. This is why summer clothing or summer houses are generally in pale blues or greens.



Moreover, our minds interpret warm and dark colors as being closer to eye and cool and light colors as slightly far away. For this reason, if a room is small, warm and dark colors might make it look smaller, whereas cool and light colors might make it larger than it already is.

Here are some of the effects of colors:

Red: is the color of energy, it's bold, powerful and vibrant. It has the longest wavelength. It's the color of effectiveness, excitement and liveliness. All over the world we follow red traffic light to stop, its visibility is the strongest amongst all other colors because of its highest wavelength. On the other hand its negative impacts can be aggression, visual disturbance and strain. If you live in a red room for a day and you could get disturbed, so it has to be complimented with other colors to make it subtle.

Yellow: is a very emotional color, it is the color of self-esteem, confidence and optimism. After red, yellow has the longest wave length, appearing to be strong from a distance. World over yellow cabs can easily be seen, sunflowers, daffodils appear to be friendly. Contrary to this it also communicates few negative values like depression, hatred and anxiety.

Blue: is the color of intelligence, vastness, royalty, serenity, coolness and tranquility. Sky appears blue and gives calm effect, water appears blue and gives peace of mind. Blue appears to be the favorite color of most of the people but on the other hand it is also a color of coldness and unfriendliness.

Green: is the most refreshing and cool color. Green is the color of nature, life, peace, harmony, balance. Green is soothing to our eyes. As for its negative traits, it is the color of boredom and stagnation.

Violet: is the color of truth, luxury and spiritual awareness. It has the shortest wavelength therefore it is also considered to be weak. It is a color of introversion and suppression. It is associated with deep contemplation and royalty, meditation and quality.

Orange: gives warmth, comfort, security, passion, and fun. Due to the mixture of red and yellow it gives stimulation and sensuality.

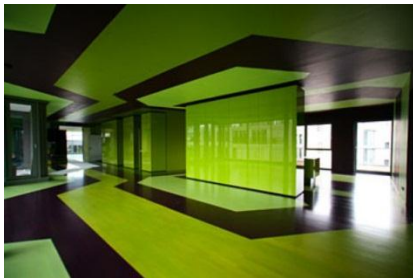
Pink: is the color of femininity, love and tranquility. Although pink is a tint of red, it still soothes rather than stimulates. It gives comfort and suggests grace and elegance.

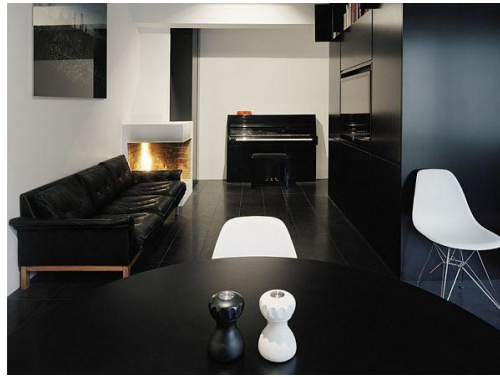
Grey: is a neutral color, not giving a direct psychological effect. It may represent emptiness and dullness.

Black: All colors are absorbed in black. Black is graceful, efficient and serious. Black is the color of mourning also. Too much black creates heaviness and scary look.

White: is pure, clean, hygienic, innocent and simple. All colors are reflected from white. It enhances the perception of space, therefore too much clutter in a design can be overcome by using spaces of white.

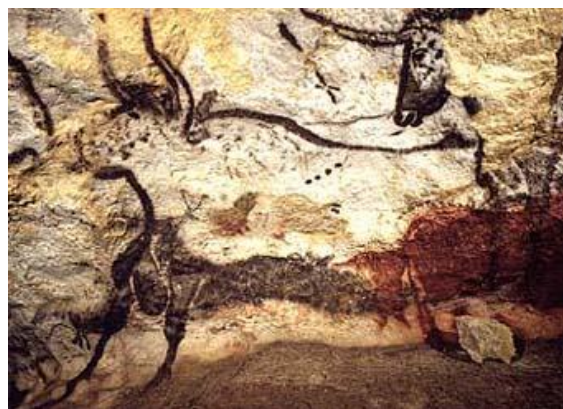
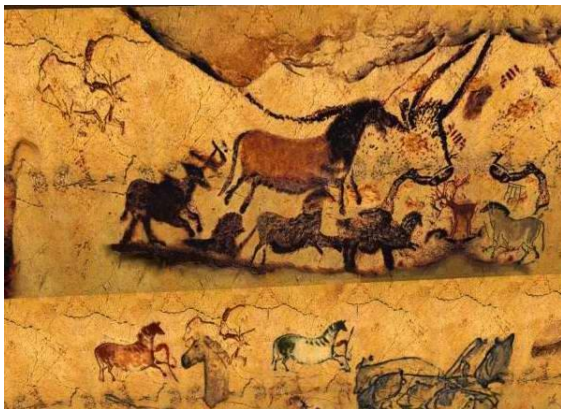
Brown: is the color of earth. It looks serious, old, and ancient. Since brown is the combination of red and yellow with much larger percentage of black, it also gives the same seriousness as black but in a warmer way. It is natural and supportive but at the same time it can be boring and heavy.





c. Colors in architecture

Color has been effectively used in architecture since ancient times, as the ancient Neolithic cave paintings (10000-4000 BC) or the colored walls and rooms of Crete dwellings (2000-1300 BC) show. We also know that Greek temples were originally colored, but they were bleached in time due to sun. The same was also true for Egyptian temples.



Cave Paintings



Cave Paintings



Palace in Knossos, Crete, Mediterranean (2000-1300 BC)



Palace in Knossos, Crete, by Minoans (2000-1300 BC)

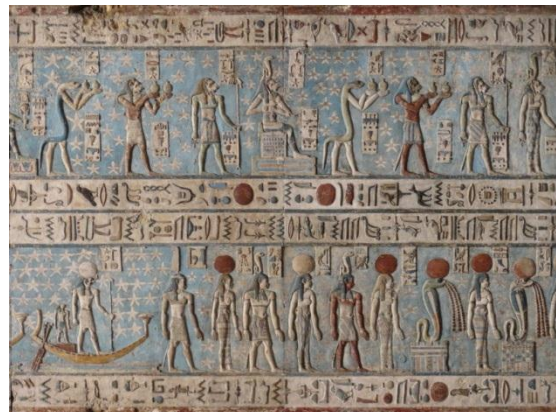


Parthenon as it looked originally, Athens, Greece, c. 400 B.C.

Originally colored Greek temples (Parthenon on the left)



© Mark E Tisdale



Color in Egyptian temples

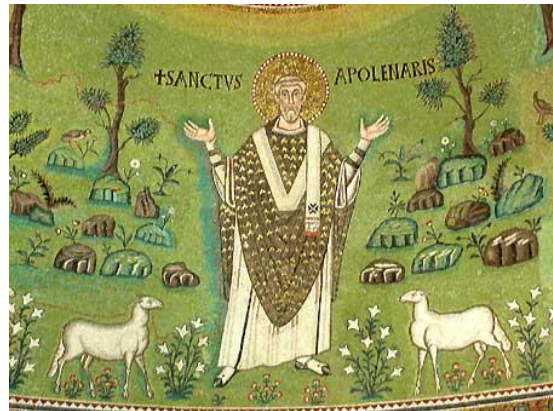
Early Christian churches (around 450-500 AD) were very plain outside but they were covered with colored mosaics inside that showed biblical figures. Gothic churches were also alive with color, by way of paintings and stained glass windows.

But perhaps the most colorful buildings of all were those built by Muslims, especially in Iran and in Spain, which were colored mostly by ceramic glazed tiles (cini).

Renaissance architects (15th century) were not much interested in colors, since they were more interested in the composition of forms and volumes. But in Baroque (17th century) and Rococo periods (early 18th century) we see the rise of color again.



Color in Early Christian Churches: San Appollinare in Classe, Italy (532-49 AD)



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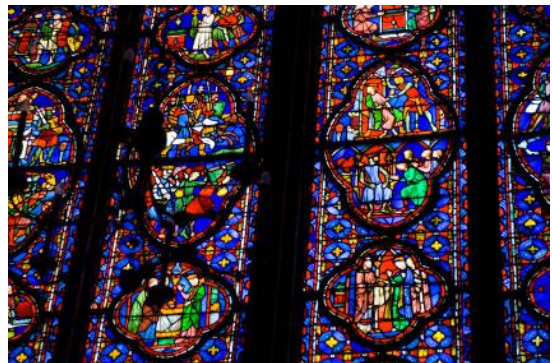
San Vitale Church in Ravenna, Italy (532-48 AD)



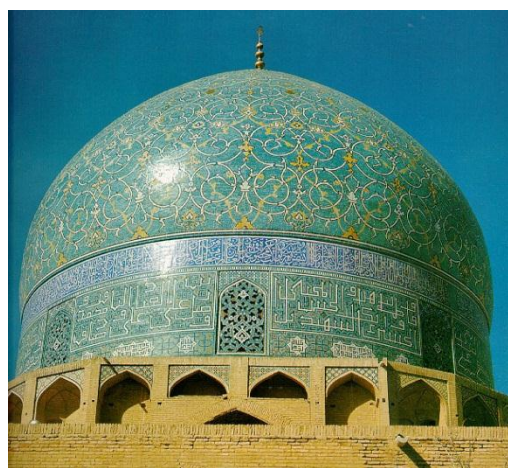
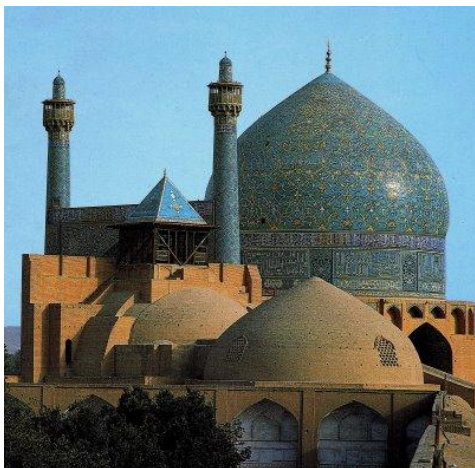
Color in Early Christian Churches: San Vitale Church in Ravenna, Italy (532-48 AD)



Color in Gothic Churches: Sainte-Chapelle, Paris (1242-48)



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Color in Islamic Architecture: Masjed-I Shah Mosque in Isfahan, Iran (1611-1638)



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Color in Islamic Architecture: Cordoba Mosque in Spain (784 AD)



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Color in Baroque-Rococo Architecture: The Basilica of the Fourteen Holy Helpers (also Basilika Vierzehnheiligen) (1743-1772 AD)

Color continued to be an important element in 19th century European and American architecture, but in accordance with the view held then, which stated that architecture should be real and truthful, building materials were used to exploit their inherent color – the red of brick, the white of marble, or grey of concrete. An excellent example to the use of the original colors of building materials is Mies van der Rohe’s Barcelona Pavillion.

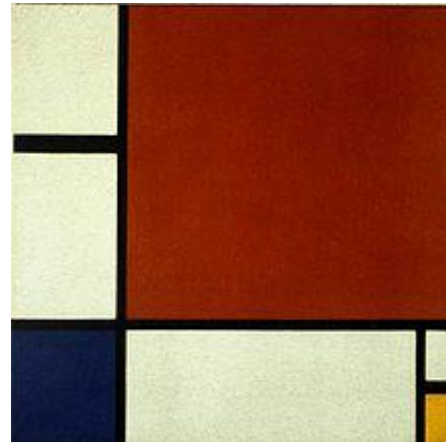
The color scheme of International Modernist architecture, which was formed by the designers of Bauhaus, Germany in 1920’s, was inspired by De Stijl architects. De Stijl architects used saturated primary colors (red, blue, yellow) for painting the walls of the space, and used black for the structural elements such as columns or beams. The most famous example to the use of colors as such is Schroder House by the architect Gerrit Rietveld. Another example to how effective the primary colors can be in architecture is Le Corbusier’s La Tourette Monastery in France.



Color in Modern Architecture: Mies van der Rohe, Barcelona Pavillion, the use of onyx marble



Color in Modern Architecture: Mies van der Rohe, Barcelona Pavillion, the use of onyx marble



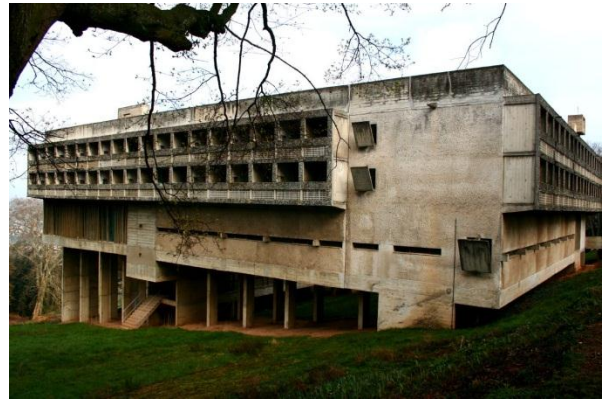
Color in Modern Architecture: Drawing by De Stijl artists Theo van Doesburg and Cornelis van Eesteren (left); painting by De Stijl artist Piet Mondrian



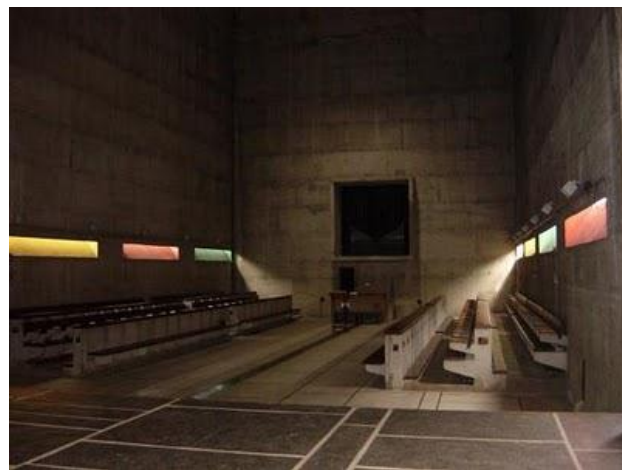
Color in Modern Architecture: Schroder House by Gerrit Rietveld



Color in Modern Architecture: Schroder House by Gerrit Rietveld



Color in Modern Architecture: La Tourette Monastery by Le Corbusier





Color in Modern Architecture: La Tourette Monastery by Le Corbusier



Color in Modern Architecture: Unite d'Habitation by Le Corbusier



Color in Modern Architecture: Unite d'Habitation by Le Corbusier

2. Sound (Acoustics) in Architecture

Every space has an acoustical quality. Acoustics is basically defined as the science of sound. Architectural acoustics deals with the quality of sound within buildings. It concentrates on either the control and suppression of noise in the environment, or the enhancement of sounds in the space. The acoustical quality of a library or office could be given as an example to the first one and the acoustical quality of a concert or music hall could be given as an example to the second one.

There are several factors that affect the acoustical quality of spaces, such as the materials or the shape of buildings. It is known that reflective and hard surfaces, such as marble or ceramic floors, reflect sounds and increase reverberation (reflection of sounds by surfaces such as floors or walls) of sound. These materials are not used when we want the environment quite as in a library or office. However they could be used in environments when we want the sound level and quality to increase, such as concert halls. Soft surfaces on the other hand, such as draperies or carpets, absorb the sound and decrease reverberation. In quiet spaces, such as libraries we tend to use these materials, such as carpets or draperies, because of that.



Hard surfaces are sound reflectors (left); soft surfaces are sound absorbers (right)



Library-noise control: carpets on the floor and acoustic fabric panels on the walls



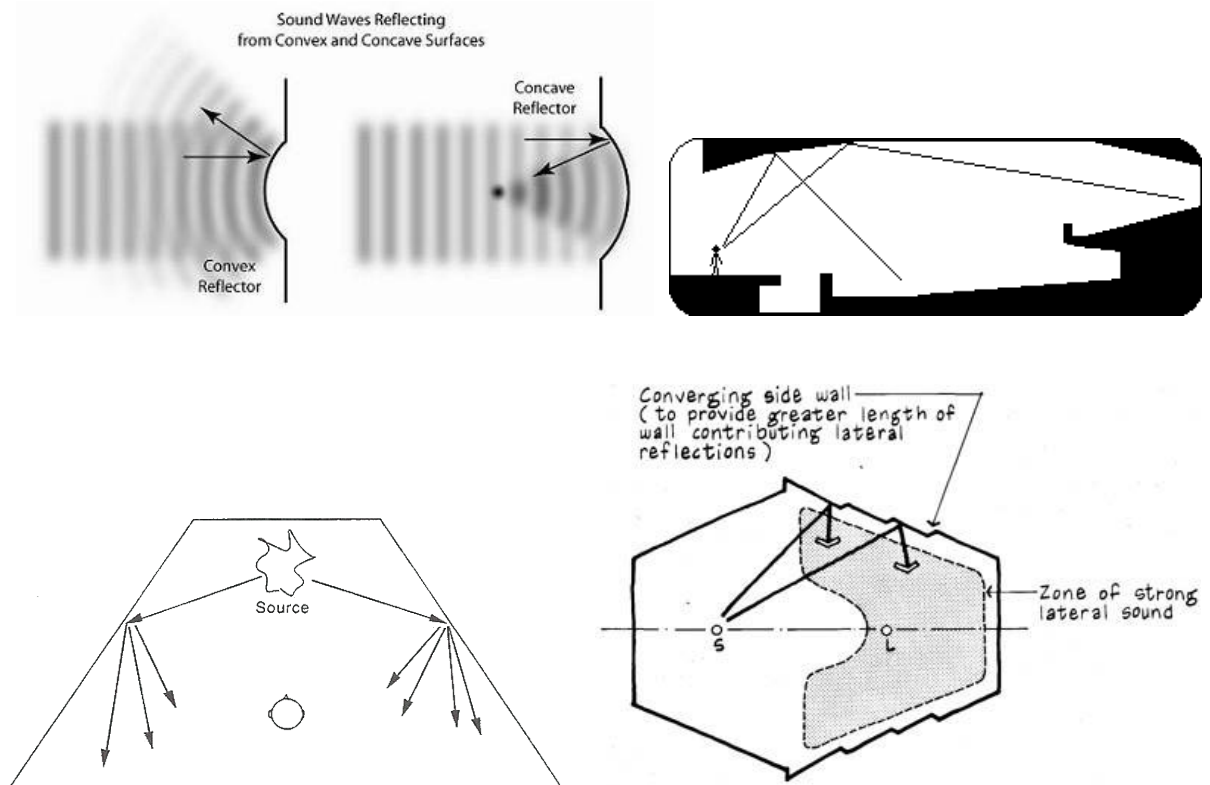
Office-noise control: carpets on the floor and acoustic panels on the sides of tables

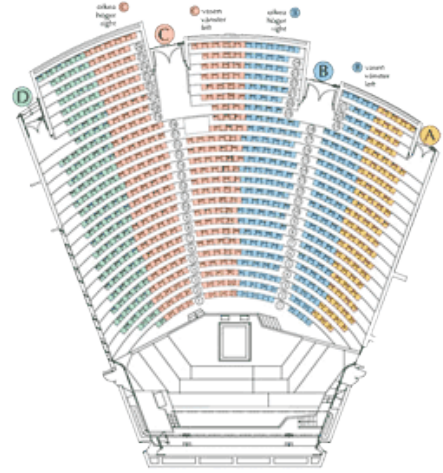


Anechoic chamber: no reverberation of sound is permitted. There are sound absorbing walls everywhere. Ideal for sound recording music studios.

Acoustics is especially important for music and concert halls where the sound quality has utmost importance. In those spaces architecture should enhance the sound quality of the music or performance, and work as a fundamental part of the show, almost as one of the instruments that are played. Such buildings work as instruments that control the level and quality of sound in the environment. Architects design those spaces specifically to enhance the sound level.

Every surface reflects sounds and it is good (to a certain extent) to have sound reflection in music and concert halls. Convex surfaces especially reflect and distribute sound, while concave surfaces form sound focusing zones that we don't want in a concert hall. The shape of the hall is crucial for reflection. Fan shaped spaces are especially preferred for this reason as they reflect and distribute the sound.





Fan shaped concert hall: Finland Hall by Alvar Aalto, Helsinki



Fan shaped concert hall: Finland Hall by Alvar Aalto, Helsinki



Fan shaped concert hall: Kulttuuritalo Concert Hall Helsinki by Alvar Aalto



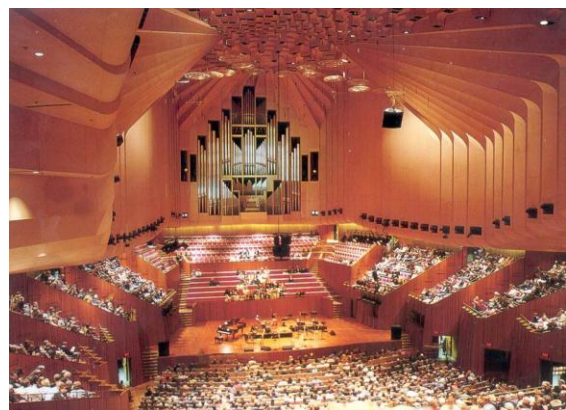
Fan shaped concert hall: Kulttuuritalo Concert Hall Helsinki by Alvar Aalto



Berlin Philharmonic Hall by Hans Scharoun: designed totally with acoustics in mind. It is an example of organic architecture.



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Sydney Opera House by Jorn Utzon