



Materials for Design

DSGN3240

Lecture 1

Introduction to the course

WHY MATERIALS MATTER

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- Every material possesses an inherent poetry that is interconnected with human experience and engages both the mind and the body.
- The connections that materials have with human experience can, however, be highly subjective or have broad cultural associations.



- Our connotation of an object made out of wood may differ greatly from that of a similar object made out of metal or glass.
- The generally accepted notion is perhaps that glass is sleek, metal is cold, and wood is warm. However, it is not just the material of an object that imbues it with character. Rather, our perception of an object's materiality is influenced by the distinctions of its particular color, surface texture, thermal conductivity, density, and finish.



- It is possible for **wood** to be highly figured, carved, knotty, stained, unfinished, weathered, or have either open or closed grain.
- **Brickwork** can appear rough, smooth, flat, or shiny.
- **Glass** can appear clear, translucent, opaque, textured, colored, or be laminated to other materials.
- Similarly, **metals** can range in color and surface texture, be polished or brushed, have a patina, or be rusted through.

Therefore, objects made of the same material but with different finishes have their own unique character and sense of materiality.

- **New technologies** have expanded the range of materials and finishes available.
- The development of **new manufacturing techniques** has enhanced performance characteristics and broadened the spectrum of unique aesthetic properties.

These innovations make it necessary for designers to frequently revisit the palette of contemporary materials.

- **Aesthetics** can significantly influence one's sense of luxury and comfort, or the lack thereof. It has been said that 75 percent of an object's monetary value lies in its visual appeal. Polished marble, highly figured wood, and lustrous velvet invoke a sensorial response quite unlike that of natural concrete, unfinished knotty pine, and vinyl upholstery

- To articulate the range of associations that a particular material might invoke, we use descriptions such as **elegant, casual, sleek, rustic, traditional, trendy, and so on.**
- Just as there are no “ugly” colors, there are no “ugly” materials. Beauty, however, entails only one dimension of materiality.

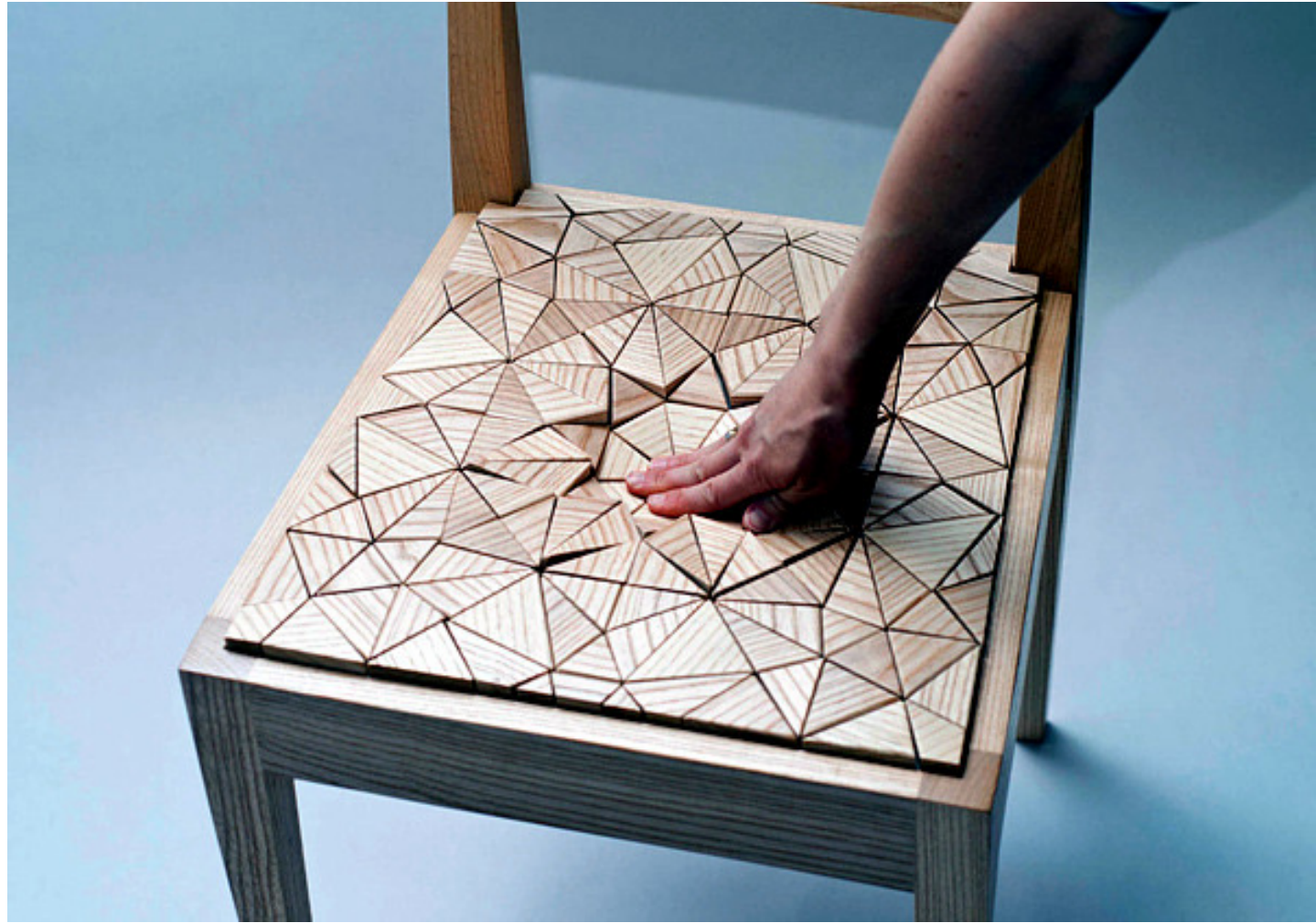
Environmental context and cultural bias collectively give materials their broader meaning,

The Design Concept

- A strong design concept demands the integration of many considerations. Intradependent upon a working knowledge of design and construction, material selection is guided by the desire to actualize the design concept.
- A single material or finish can inspire a design concept or the development of a color scheme.
- Beyond the selection of materials lies an equally important consideration of use, application, and detail. The deliberative use, application, and detail of materials can reinforce design principles such as rhythm and repetition, scale and proportion, and unity and variety, thereby creating ideological links among material, spatial experience, and design intention.



- The inherent poetry of a material can imbue a strong design concept with the powerful sense of experience and meaning.



Human Factors

- Human factors is an area of study that involves scientific research on the interaction between the human body and the design form.
- A human factors specialist conducts user trials in order to evaluate the design of products, as well as their effect on the people who use them. The application of this combined research aims to improve the well-being and ensure the safety of the end user.

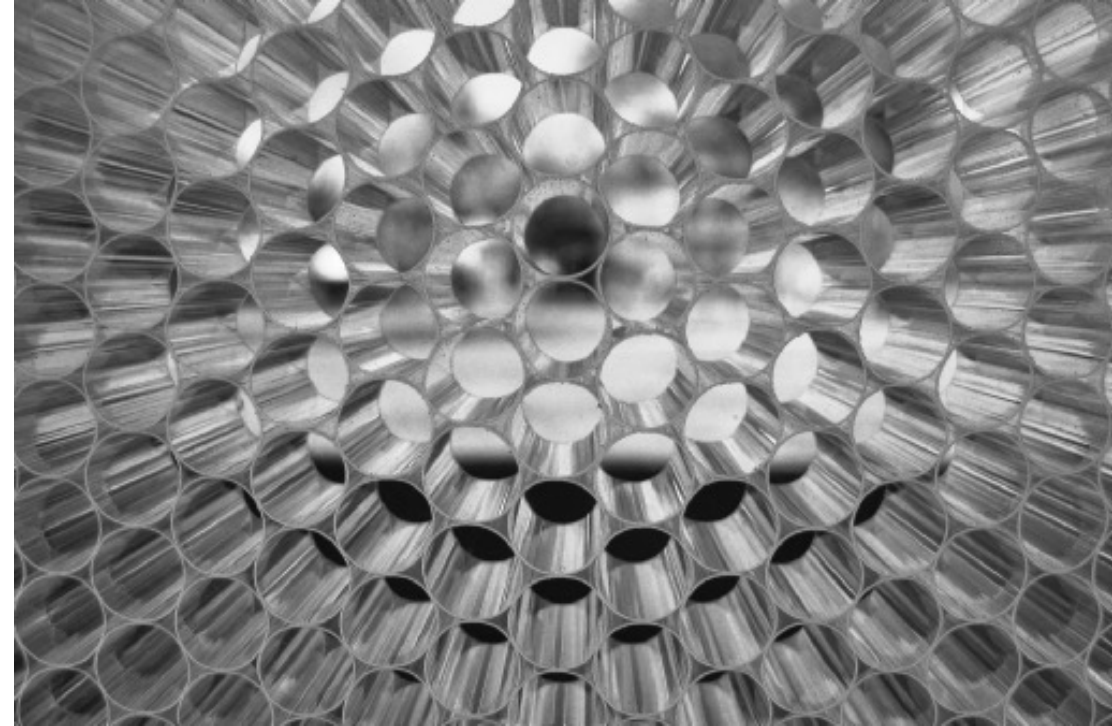


Perception

- Perception is an active process, which is both learned and innate. Through our senses, we develop an understanding of materials. Materials and the built environment, both directly and indirectly, stimulate
- the body's senses:
 - Visual sense = Sight
 - Tactile sense = Touch
 - Thermal sense = Environmental comfort
 - Auditory sense = Hearing
 - Olfactory sense = Smell
- Materials are a visceral encounter as well as a visual phenomenon. Some materials contribute to our sense of pleasure and touch, such as the experience of grasping a wooden, hand-formed handrail or walking on a resilient cork floor.
- Others negatively affect the experience of a space due to the concern that they might contribute to accidents. Walking on a wet, polished marble floor can lead to slips and falls, while the glare from a highly reflective floor or wall surface might create the unpleasant sensation of temporary blindness, depending on the location and source of light.
- In addition, many adhesives and sealers selected to enhance technical performance are known to contain carcinogens and emit harmful volatile organic compounds.

Visual Characteristics

- People rely primarily upon their sense of sight when describing materials. Generally, a material is conveyed first through optical perception, followed closely by the other senses. A key part of visual perception is the manner and effect in which light strikes a material's surface.



Close-up view of Panelite IB TO4 partition at McCormick Tribune Campus Center, Illinois Institute of Technology, Chicago, Illinois, designed by Rem Koolhaas, OMA (2003). Photography by Mandy Hamberg.

- **Visual characteristics can be described using the following specific terms:**
 - **Color / hue:** The visual property that depends on the light reflected by a surface, which is generally perceived as red, blue, green, and everything in between. The perception of color is influenced by the surface conditions of the material and the surrounding environment.
 - **Depth:** The visual or perceived depth of a material's surface
 - **Light transmission:** The property of a material or substance to permit the passage of light, with little or none of the incident light absorbed in the process.
 - **Luster:** A visual quality caused by the refraction and reflection of light off a finished surface.
 - **Reflection:** The change in direction of a wavelength at the interface of two different media so that the wavelength returns to the medium from which it originated.
 - **Shade / tone:** The presence of black in a color or hue.



- Sheen: The appearance of gloss on a surface.
- Texture: The tactile appearance of a surface.
- Tint: The presence of white in a color or hue.
- Value: The overall degree of lightness and darkness of a hue.



- In addition to sight, people rely on a synthesis of their senses of sound, **smell**, and **touch** to inform their perception and experience of objects.
- Thermal, visual, acoustic, and haptic sensations are experienced phenomena.
- **Perception is an active phenomenon and is dependent on the selection, finish, and detail of materials.**
- Human perception and behavioral response to material is critically important to consider in the broadest sense.



Haptic Sensation

- Haptic sensations are physical and phenomenological experiences of touching and interacting with materials, particularly experienced through the hands and feet.
- Environmental conditions that influence the sense of touch include air movement, air temperature, and air humidity.



Leather wrapped door handle at Säynätsalo Town Hall, Säynätsalo, Finland, designed by Alvar Aalto (1949-1952). Photography by Jim Postell.

- **Metals often feel cool to the touch**, especially in temperate or thermally controlled environments.
- **Glass can feel cool to the touch because it draws heat away from our bodies into the glass.** When exposed to direct sunlight, however, glass can feel exceptionally warm.
- A material's thermal sense is influenced by its **emissivity, conductivity, and radiant potential, all of which are influencing factors regarding the perception of touch.**
- **Emissivity** is the degree of light reflectivity from the surface of a material. Highly reflective materials have a low emissivity rating (near 0). Highly absorptive or black surfaced materials have a higher emissivity rating (up to 1).
- A material's **conductivity** indicates the rate of transfer of heat energy through the material. A material's radiant potential is its capacity to release heat into the surrounding ambient environment.



- Natural oils in the hands and fingers can leave marks on glass if the glass is not properly treated.
- Vinyl does not absorb moisture, and, as a result, condensation can form when direct contact is made with exposed skin.
- In response to these conditions and characteristics, designers and architects have sought to work with new materials and have used existing materials in unconventional ways.
- For example, hard surfaces can be treated and finished to create a range of visual and visceral effects. Granite, for example, can be hammered, flamed, honed, or polished. Polished granite feels and looks much different from flamed granite.
- Glass can be annealed, cast, distressed, floated, blown, or tempered. For nearly every material, there is more than one option to consider regarding the characteristics and quality of its surface and finish. Different material finishes will result in unique sensory experiences.



Vinyl Fabric

Health, Safety, and Welfare

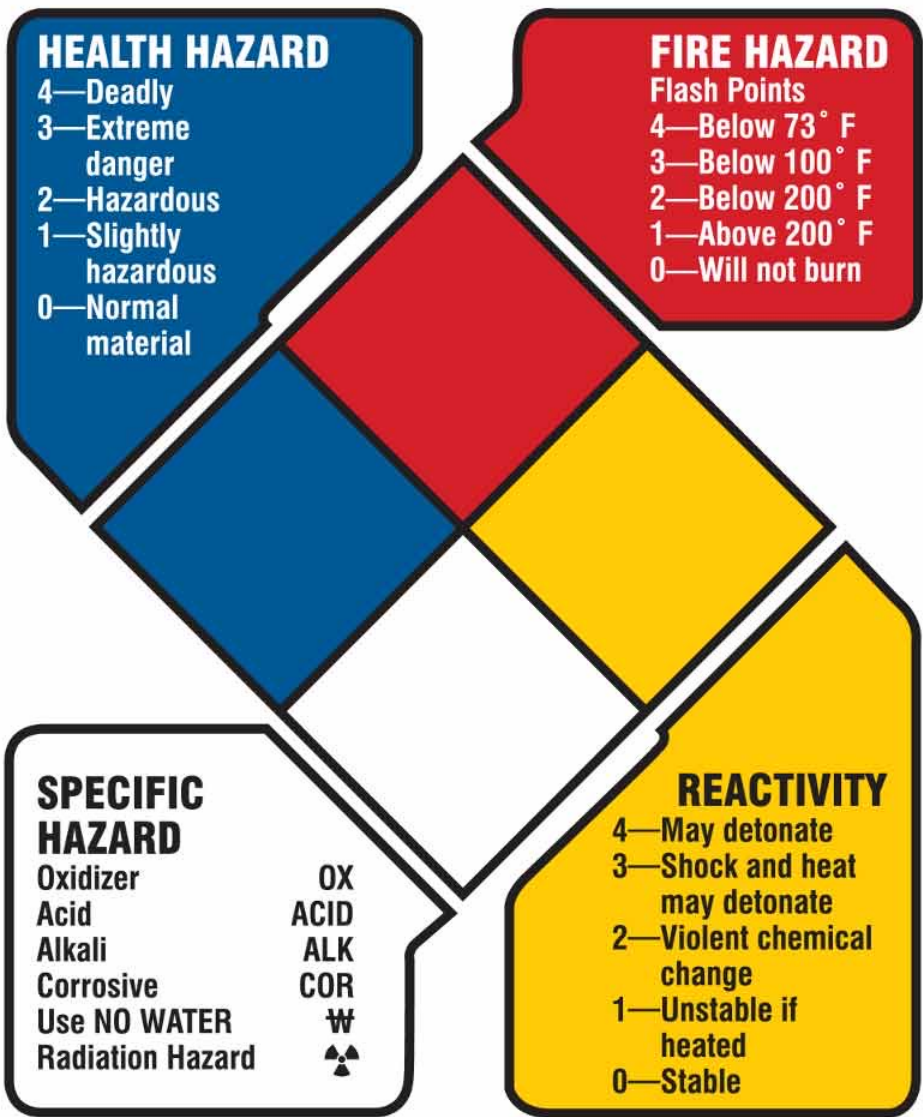
- The specification of materials and finishes contributes to the health, safety, and welfare of their users.
- The designer's challenge is to select appropriate materials while considering the limits of the human body, functional needs, and ambience relative to use and experience.

Material Safety Data Sheets

In an effort to manage product stewardship and workplace safety, manufacturers of building materials and components are required to supply Material Safety Data Sheets (MSDS)

- Substance identity and company contact information
- Chemical composition and data on components
- Hazards identification
- First-aid measures
- Firefighting measures
- Accidental-release measures
- Handling and storage
- Exposure controls and personal protection
- Physical and chemical properties
- Stability and reactivity
- Toxicological information
- Ecological information
- Disposal considerations
- Transport information
- Regulations

HAZARDOUS MATERIALS CLASSIFICATION



HISTORICAL OVERVIEW

- The discovery, extraction, manufacturing, installation, maintenance, and reuse of materials are important to understand within a chronological and geographical context.
- Knowing when and where a specific material or fabrication technology was first used can foster connections among materials, fabrication, users, and place.
- This can provide a better understanding of social and cultural connotations inherent in the use of specific materials.

Milestones in Materials



Pottery
c. 10,000 BC



Glass
c. 1500 BC



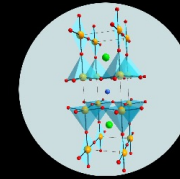
Porcelain
c. 600



Gold ruby glass
c. 1600



Borosilicate glass
1893



High-temperature
superconductors, 1986



Copper
c. 5000 BC



Iron
c. 1500 BC



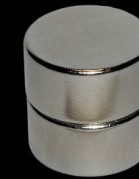
Damascus
steel, c. 500



Type metal
c. 1450



Stainless steel
1915



Neodymium
magnets, 1982

10,000 BC

4000 BC

1000 BC

400

1200

1600

1800

1900

2000



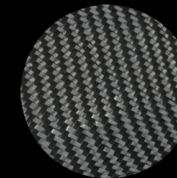
Bronze (copper / tin)
c. 3300 BC



Concrete
c. 50 BC



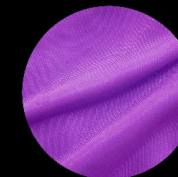
Aluminium
1825



Carbon fibre
composites, c. 1960



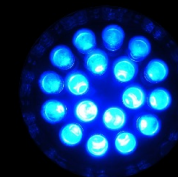
Leather
c. 3500 BC



Mauve dye
1856



Polyethylene
1935



Gallium nitride
LED, 1992

- Initially, human beings began exploring and developing natural materials that were on hand and abundantly available to construct dwellings that provided shelter from the elements.
- Availability and functionality influence the selection and use of materials.

<https://www.youtube.com/watch?v=cUEjPtVIIM>

https://www.youtube.com/watch?v=qb5w_LD1ifY&list=RDLV7SVybnfUkbo&index=4

<https://www.youtube.com/watch?v=mCj5XwaDpjM&list=RDLV7SVybnfUkbo&index=3>