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Solar Design Tools – Practical examples of visible and colored photovoltaics in architecture

HSLU – DFK
Research Group Products & Textiles

Prof. Tina Moor
Prof. Brigitt Egloff

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Changes in the landscape and cityscape

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Visualisation HSLU

Meggerhorn barn; Swiss Solar prize 2014
<https://www.benetz.ch/referenzen>

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Customised solutions for a wide range of requirements

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Visible PV systems

- technically sophisticated and proven
- uniform and technoid appearance
- Aesthetically unsatisfactory

Case Study PEG52

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Customised solutions for a wide range of requirements

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One possible solution

- Colour-matched ceramic printing
- More efficient design processes with SDT
- Precise predictions of aesthetics and energy yield
- repeatable surface concepts
- Visual integration into the built environment thanks to flexible color matching

Case Study PEG52

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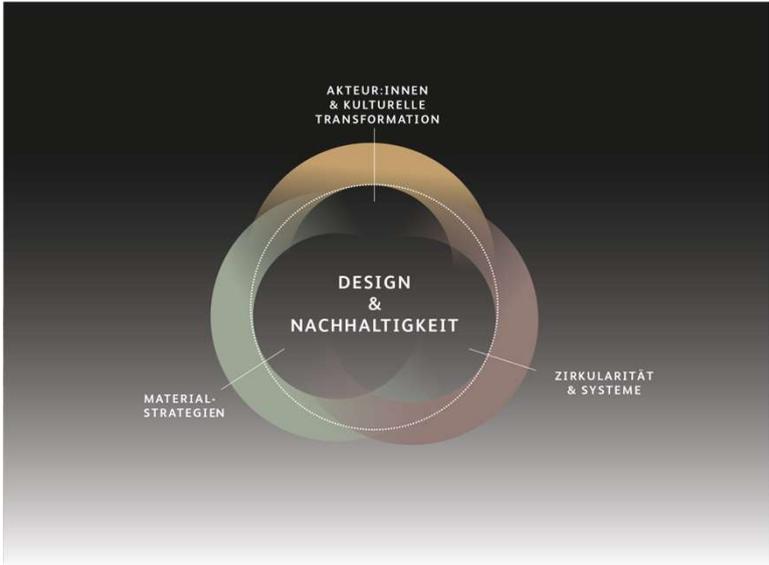


Foto: EM2N

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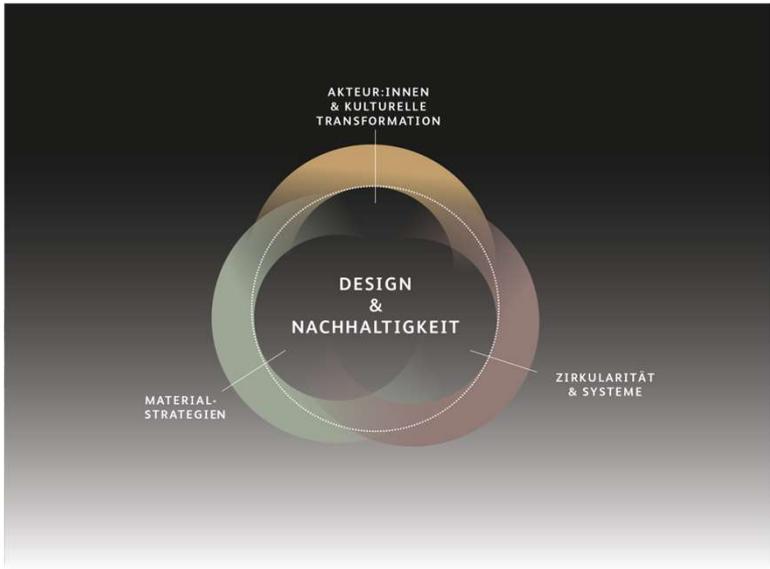
Applied design research in the fields of textiles, products and materials



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Strategy



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- Material strategy**
- Positioning PV as a new building material that is included in the planning at an early stage

- Stakeholders and cultural transformation**
- Promoting acceptance through good case studies and dissemination



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INNOSUISSE PROJECT

Solar Design Tools

Limited color chart

Efficiency – 32%

Efficiency – 20%

Efficiency – 10%

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Expansion of the color chart

Bauhuisches Bauernhaus, Johan Joseph Aarts (1895)

Atelier Object Project, Cenk Kivrikoglu, Brüssel

Bauhaus spintop, optical color mixing, Design Ludwig Hirschfeld-Mack

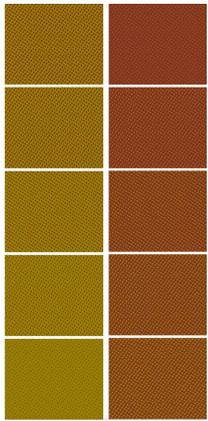
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Focus «material colors»

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Stakeholder-Workshop



Color shades yellow/red



«material color» Rust

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Expansion of the color chart

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Combinations of colors, 75 RE



Color chart, 75RE

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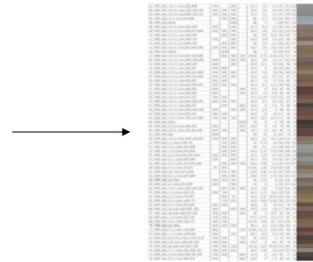
Comparison with NCS colors



Demowall Proof-of-Concept



Visual comparison with colors NCS



Mathematical comparison with NCS colors



Summary

The SDT color chart offers

- Colours that are reminiscent of material colors
- Many "warm" color nuances
- Predictable energy performance

Strengths

- All colors of a defined efficiency can be mixed together

Challenges

- Only a few light and pastel ochre, pink, and orange shades are available



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Case study PEG52 - Petersgraben

- Historic building in the old town center
- Complete refurbishment
- High demands on visual integration
- Pilot project for the client of the city of Basel

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Initial situation

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Plain-colored PV modules after color matching with the roof and tiles



Different stages of the patterned PV modules

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Choice of colors

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Color matching with historic tiles



First color selection

Mock-up PEG52

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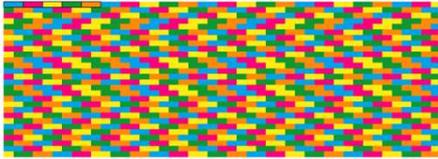
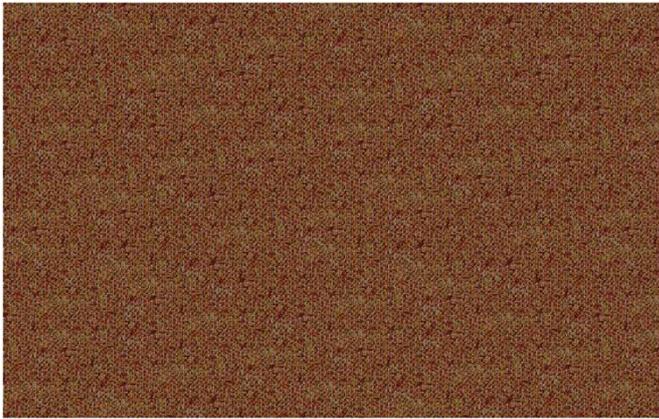


Designs as mock-ups with functioning PV modules



Long-distance effect

Final Design



Final realisation with 5 module types and corresponding installation strategy

Visualization



Finale Visualisation PEG52



Hotel Drei Könige: View from Klosterstrasse, top view of the roof

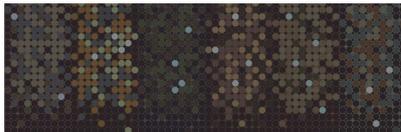
Case study Hotel Drei Könige

- Building worthy of protection in the center of Lucerne
- High demands on visual integration
- The owner wants renewable energy production

Design for the roof of Hotel Drei Könige



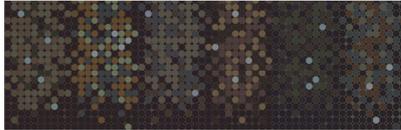
Module E1.1



Adjusted module E1.1



Module E1.2



Variation E1.2



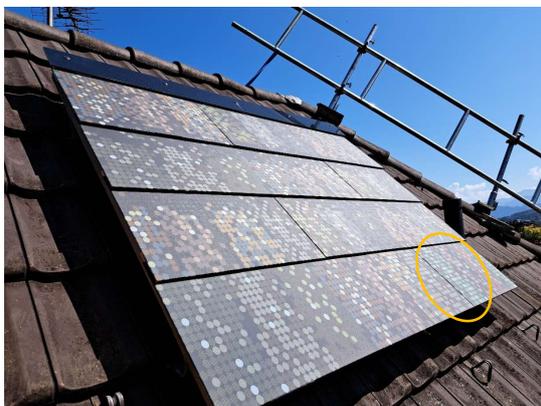
Module E1.3



Variation E1.3



Installation



Mock-up H3K



Visualisation HK3

Summary

- Roof design with only three modules
- Energy loss -10%
- Involvement of monument preservation in the design process
- Building application in progress



Outlook

Follow-up project Innosuisse

- Establishing colored PV as a common building material
- Refining (textile) design methods and processes
- Expansion of the color palettes
- Optimised processes for higher energy efficiency and minimized costs

Design services

- Patent application for solar color system
- Establishment of a spin-off for design services
- «à la carte» design solutions



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Survey on the „Solar Design Tools“ project



Presentation and exhibition at HSLU in Emmenbrücke on 28 May 2025 at 3.15pm

Thank you very much for your attention!



University of Applied Sciences and Arts of Southern Switzerland



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