



AI-Enhanced Visualization for Early- Stage Residential Design

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Background and content

Background and need for research

- Early-stage design requires multiple options, but visualization is laborious and slow.
- Cost and schedule pressures emphasize the need to automate routine work.
- Visualizations are central to both designers' internal decision-making and regulatory processes.

Research objective

- To investigate how artificial intelligence can enhance early-stage visualization.
- Produce usable images faster and more cost-effectively than by traditionally methods.
- Enable better dialogue between stakeholders early in the design process.

Method

Qualitative approach

- Six workshops in 2025.
- Participants: 3 housing development professionals, 1 architect, 1 design software expert and 2 construction researchers

Evaluation criteria of visualization

- Technical feasibility with commonly used programs
- Practical usability of results in planning and decision-making

Tools

- Archicad and ChatGPT were selected based on security and usability.

Results

Key findings

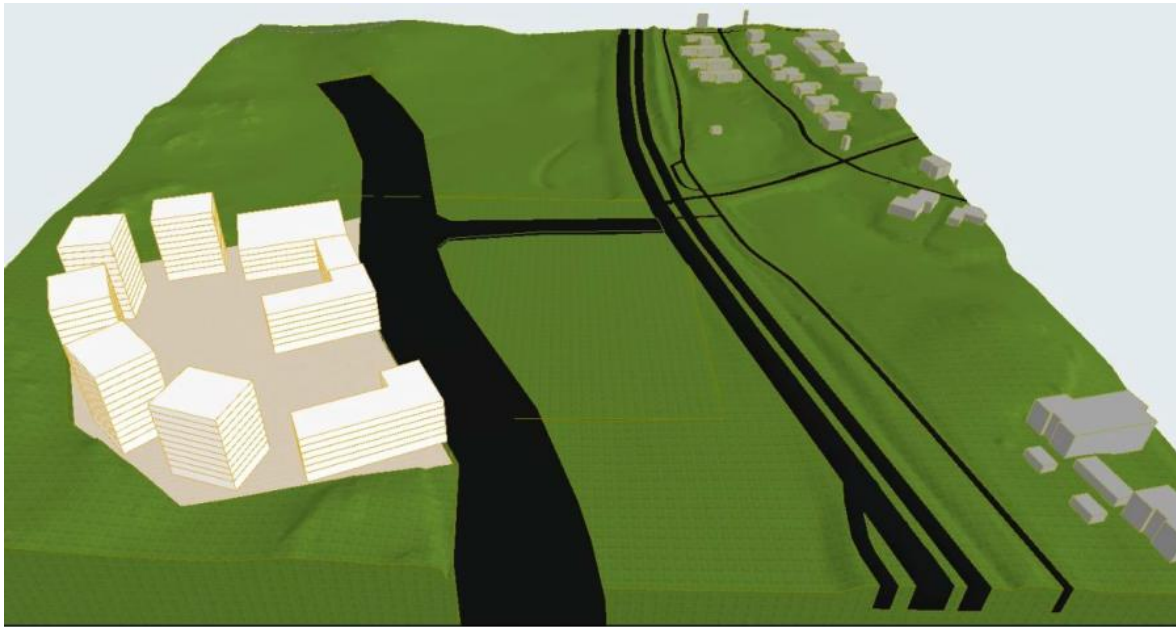
- Adding BIM-generated input data to the visualization workflow yielded better results than text-based AI steering alone.
- Although the quality of the visualizations produced with AI varied, each iteration brought new insights. In the beginning of the early-stage design, perfection is not a reasonable goal.
- AI enabled rapid and extensive alternative production, which enriched the design discussion.
- Visualizations supported discussions about economic feasibility, technical constraints and customer expectations
- Images may be possible to utilize in regulatory processes with authorities.

Conclusions

- The developed method enables the production of usable images.
- Artificial intelligence can significantly enhance the efficiency of early-stage architectural design.
- AI visualizations improve the speed, interaction and market orientation of the process.

Examples: The visualization of town plan

Steering data to ChatGPT: Image of geometry model and simplified town planning regulation



Archicad model



In the end result, the shape of the terrain behind the buildings follows reality.

Examples: The visualization of town plan

Town planning regulation that have been used as a steering data to ChatGPT with BIM images

Generate a photorealistic visualization of the Kaupinlaakso residential area in Tampere, Finland.  Use the actual site layout from the zoning map: buildings located in their correct positions, oriented as shown, forming semi-closed courtyard blocks.  The environment includes natural forested terrain in the background and accessible inner courtyards in the blocks.  No fences between plots; instead, shared playgrounds, green areas, pedestrian paths, and one large bicycle shelter with a green roof (for 100 bicycles).  Buildings are 5–8 stories tall, residential blocks (white volumes in reference model)  and one parking building (blue volume in reference model).  Roofs are single-slope, 15° pitch, oriented sideways towards the neighboring buildings,  covered with matte red-brown clay tiles  or equivalent metal roofing. Technical spaces are hidden under the roof volume. Balconies are recessed; balcony glazing only in the top floors for weather protection.  Facades are made of brick masonry in different shades of red brick with varied mortar colors (light grey, dark grey, natural white).  Each building has its own individual tone, but the overall style is harmonious. Avoid large continuous glass facades  if glass is used, apply textured glass to prevent bird collisions. Courtyards and pedestrian areas are structured with paving (stone, gravel), planting beds, trees, benches  and lighting  Green areas merge naturally into the surrounding forest landscape. The style should be highly photorealistic: realistic sunlight, shadows, material textures (brick bonds visible), detailed vegetation  and natural human scale elements (people walking, children playing, cyclists). 



Examples: The visualization of town plan

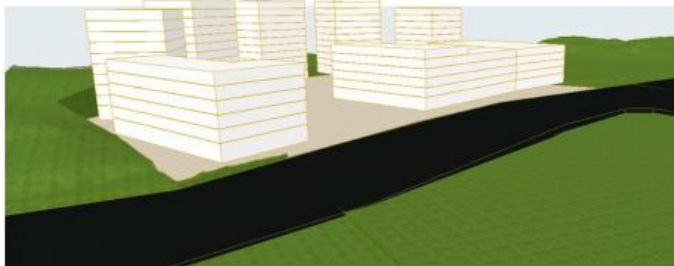
Town planning regulation that have been used as a steering data to ChatGPT without BIM images

-  • Location: Residential apartment blocks between Kaupinlaakso boulevard and Teiskontie in Tampere
-  • 8-storey laminated apartment buildings
-  • The street level floor must be lively and open towards the street and square, equipped with large windows.
-  • The floor height of the street level floor must be at least 4.2 meters
-  • The stairwells of residential buildings that border a tram line must be passable.
-  • The building area boundary and the street area or square must be built at the same height and quality level as the part of the street area or square bordering it.
-  • Areas that are not marked for planting must function as part of the pedestrian area.
-  • The exterior doors of stairwells and commercial premises that open directly onto the street area must be designed to be at least 1.2 m deep.
-  • On facades bordering the tram line, balconies must be retracted.
-  • Balconies must be located inside the building areas. Balcony railings are made of glass. Balconies must be glazed. 
-  • On plots whose yard areas border each other, play and recreation areas must be built as common areas for the plots.
-  • The boundaries between plots must not be fenced.
-  • Yards must be structured into comfortable play and outdoor recreation spaces with surface materials, planting, furniture and lighting.
-  • Outbuildings in yards must be built with green roofs as part of the stormwater system.



Examples: The visualization of town plan

Steering data to ChatGPT: BIM images and town planning regulation with many degrees of freedom



Examples: Editing of image

Steering data to ChatGPT: Add a wintery, snowy atmosphere to the image. Make a visualization image.

